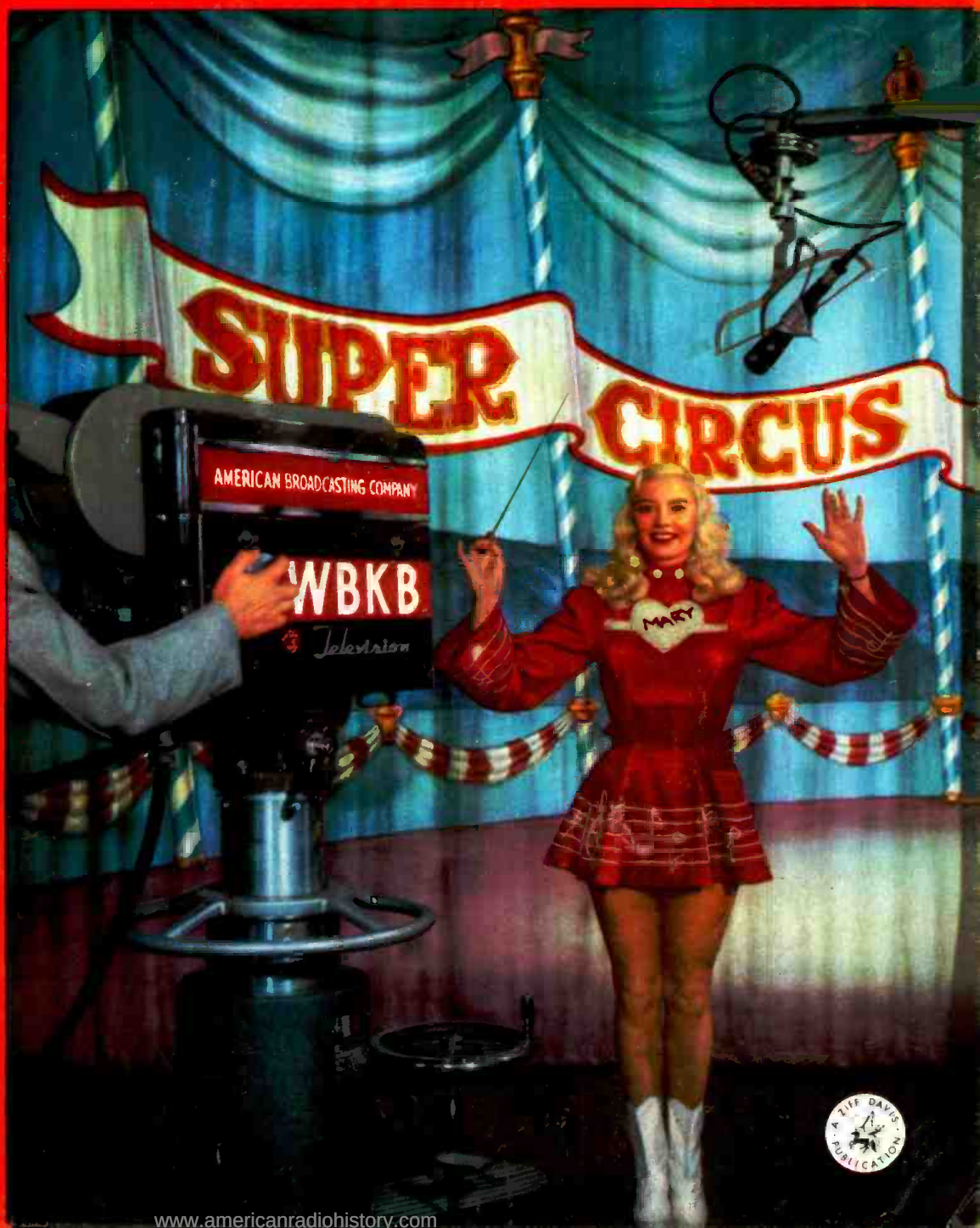
SPECIAL SERVICE FEATURE ISSUE

RADIO & TELEVISION NEWS

MARCH
1954
35 CENTS
In Canada 40¢

IN THIS ISSUE



SERVICE DEALERS!

RAYTHEON

Ask your TUBE DISTRIBUTOR how you can get the

time and money saving new RAYTHEON BROW-LITE

Here's another sensational *Raytheon first.* It's a different kind of flashlight that sheds a new light on Radio-TV servicing — makes it faster, easier, more profitable.

RAYTHEON BROW-LITES *are available through your Raytheon Tube Distributor. Ask him how to get a supply for you and your men.*

Here's why Service Dealers from coast to coast are hailing the RAYTHEON BROW-LITE:

- **FREES BOTH HANDS** — work is easier, faster
- **DIRECTS LIGHT AUTOMATICALLY**—you see what you look at in a clear, bright light
- **USES STANDARD PARTS** — 1½ volt penlite batteries and 3 volt penlite bulb
- **ANYONE CAN USE IT** — fits easily above glasses
- **EASY TO CARRY** — folds compactly to pocket size
- **REPLACES FLASHLIGHTS** — easier, safer to use
- **DURABLE** — made of rugged plastic

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Training plus opportunity is the *perfect combination* for job security, good pay, advancement. A Federal Communications Commission Commercial Operator's License puts you in line for a good job in Radio or Television Broadcasting, Police, Marine, Aviation, Mobile or Micro-Wave Relay Radio. Mail Coupon for 64-page book *free*. It will give complete facts about my Communications Course.

You Build This Transmitter

with parts I send. Use it to get practical experience. Put this station "on the air." Perform procedures required of broadcasting station operators, conduct many experiments, make practical tests.

LEARN BROADCASTING by PRACTICING at Home in Spare Time

J. E. SMITH, President
National Radio Institute
Washington, D. C.
has trained more men for Radio-Television than any other man.
OUR 40TH YEAR.

YOU BUILD this Transmitter Power Supply used in the basic experiments in RF and AF amplifiers, frequency multipliers, buffers, etc.

YOU MEASURE current, voltage (AC, DC and RF), resistance and impedance in circuits with Electronic Multitester you build. Shows how basic transmitter circuits behave; needed to maintain station operation.

YOU PRACTICE setting up code, amplitude and frequency modulation circuits (put voice, music, etc., on "carrier signals" you produce). You learn how to get best performance.

YOU BUILD this Wavemeter and use it to determine frequency of operation, make other tests on transmitter currents.

Get Practical Experience on Circuits Common to Radio & TV

Ever think HOW FAST Radio-Television Communications is changing, developing, growing? Have you considered what this amazing progress can mean to you?

Even without Television the industry is bigger than ever before. Over 115 million home and auto radios, 3000 radio stations, about 200 TV stations with hundreds more being built. Expanding use of Aviation and Police Radio, Micro-Wave Relay, Two-Way Radio for buses, taxis, etc. makes opportunities for Communications Technicians and FCC licensed operators. New jobs, more jobs for beginners! Better jobs, better pay for experienced men!

Television Is Today's Good Job Maker

Over 25 million television sets are in use. Thousands more being sold every week. Good TV jobs opening for Technicians, Operators everywhere. The time to act is NOW! Start learning Radio-TV communications. America's fast growing industry offers good pay, a bright future, security. If you are a beginner, my course can help you get FCC License, prepare for the job you want. If you've had some training in Radio or Radar, or as a Licensed Operator, my course modernizes—increases the value of your knowledge.

MY COURSE INCLUDES TELEVISION

Includes New Developments

Mail coupon now for facts about my practical course in Radio-Television Communications. Let me send you my FREE book. See the nine big Kits of Parts I send that "bring to life" theory you learn. You get practical experience by working on circuits common to both Radio and Television; also lessons on TV principles. Read about the Transmitter you build and operate, about the Electronic Multitester you get. All equipment is yours to keep.

My graduates are filling jobs, making good money in both Radio and Television. Remember, the way to a successful career in Television is through experience in Radio.

SERVICING TRAINING ALSO AVAILABLE

If you prefer a good-pay job in Radio-Television Servicing . . . or your own money-making Radio-Television Sales and Service Shop, I'll train you at home. My famous Servicing Course also includes many Kits of Parts. You use them to get PRACTICAL EXPERIENCE with circuits common to Radio and Television. I also show you how to make $10, $15 a week or more EXTRA MONEY fixing neighbors' Radios while training. Full information in my 64-page book . . . Mail coupon.

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Send today! See what my Communications course is like. Find out how I get you ready for a brighter future, better earnings, more security in Radio-Television. Send coupon now in envelope or paste on postal. NO OBLIGATION. NO SALESMAN WILL CALL! My book sent to you FREE, tells the full story. J. E. SMITH, President, Dept. 4CE, National Radio Institute, Washington 9, D. C. Our 40th year.

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Chief Technician
Chief Operator
Power Monitor
Recording Operator
Remote Control Operator

SHIP AND HARBOR RADIO
Chief Operator
Assistant Operator
Radiotelephone Operator

GOVERNMENT RADIO
Operator in Army, Navy, Marine Corps, Coast Guard
Forestry Service
Dispatcher
Airways Radio Operator

POLICE RADIO
Transmitter Operator
Service Technician

AVIATION RADIO
Plane Radio Operator
Airport Transmitter Operator

TELEVISION
Pick-Up Operator
Voice Transmitter Operator
TV Technician
Remote Control Operator

I TRAINED THESE MEN

"My position with WNBT is video control engineer on the RCA color project. I owe a lot of my success to your textbooks."—Warren Deem, Malverne, N. Y.

"I am a technician at WTOP in Washington and I like it very much. Most of my radio knowledge was from N.R.I."—John Britto, Hyattsville, Md.

AVAILABLE TO VETERANS UNDER G.I. BILLS

"A former employer recommended N.R.I. training. Now employed as transmitter operator at WKBO."—Albert Herr, New Cumberland, Pa.

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National Radio Institute, Washington 9, D. C.
Mail me your 64-page Book, FREE. (No salesman will call. Please write plainly.)

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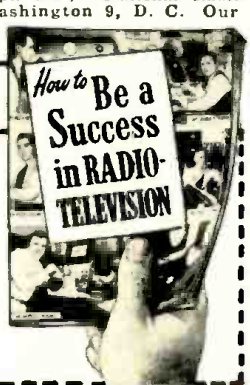
Address.....

City..... Zone..... State.....

VETS write in date of discharge .....



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RADIO & TELEVISION NEWS

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COVER PHOTO: Mary Hartline, lovely queen of ABC's "Super Circus" as she would look on color television. The microphone visible at the top right is an Electro-Voice Model 666. For details on this unit, see page 63. (Ektachrome by Mickey Pallas)

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MARCH, 1954

DEPARTMENTS

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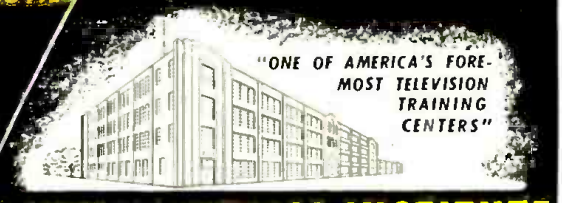
If you're subject to military service, the information we have for you should prove very helpful. Mail coupon today.



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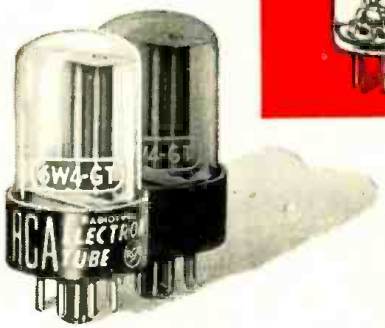
CHICAGO 41 ILLINOIS

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.

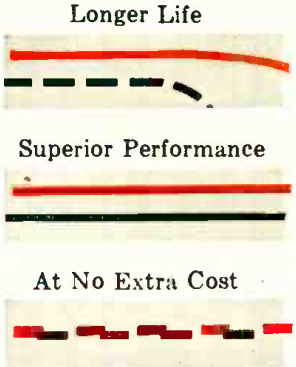
The RCA-6AL5 now utilizes double helical heaters to insure low hum and pinched cathodes to minimize cathode shift within the mount. These features make possible greatly reduced microphonics.

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.



RADIO CORPORATION of AMERICA

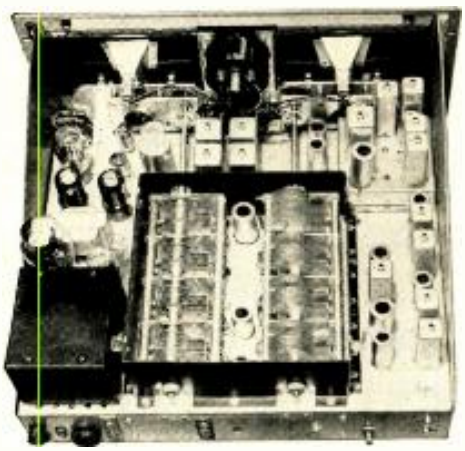
ELECTRON TUBES — HARRISON, N.J.

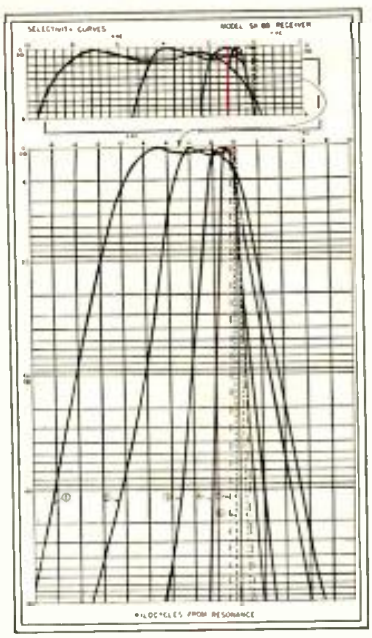
HERE ARE 31 REASONS WHY THE hallicrafters SX-88

is the hottest ham news in years!

SX-88

SELECTIVITY—
For the first time, selectivity from 10 kc to 250 cycles in six steps. Compare with ANY other receiver!





1. Heavy gauge steel welded chassis for mechanical stability.
2. Full precision gear drive for main and band spread tuning.
3. Six position Band Width Control (selectivity) from 250 cycles to 10 kc.
4. 10 watt inverse feed back and push-pull audio output.
5. Exhalted B.F.O. for tops in single side band reception.
6. Buffer amplifier in B.F.O. circuit.
7. Antenna trimmer.
8. Amplified and delayed A.V.C.
9. Built-in 100 kc calibration crystal.
10. Second conversion oscillators crystal controlled.
11. Inertia tuning (fly wheels both dials).
12. Full frequency coverage from 535 kc. to 33 mc.
13. Calibrated electrical band spread 160, 80, 40, 20, 15, 11, and 10 meters.
14. Logging scales on each tuning shaft.
15. Dial locks on each tuning shaft.
16. Tuning dial indicators resetable from front panel for maximum calibration accuracy.
17. Auxiliary A.C. socket on rear of chassis.
18. Illuminated band-in-use indicator.
19. Illuminated S meter.
20. Dual S meter calibration S units and microvolts.
21. Auxiliary power socket plus .6 amps at 6.3 volts and 10 ma at 150 volts for accessories.
22. Standard 8¾" by 19" panel for rack mounting if desired.
23. 50 kc i.f. output jack via cathode follower for teletype converter, etc.
24. Five position response control (tone control).
25. Two r.f. stages (Bands II to VI).
26. 17 tubes plus voltage regulator, ballast tube and rectifier.
27. Automatic noise limiter circuit.
28. Phono Jack.
29. Audio output transformer for 3.2, 8, 500/600 ohm loads.
30. Fuse for overload protection.
31. Auxiliary sensitivity control permits monitoring of local transmissions in standby position.

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For the RECORD

BY THE EDITOR

TALKIES, TELEVISION, AND TAPE

THE history of our industry will some day record the year 1954 as one of the most competitive periods of tremendous technical achievements in the field of electronics. The past year concluded with many developments still in the experimental stage. One, well-known to millions of moviegoers, was the mad race to win public acceptance of a particular 3-D system. All in all, we've witnessed many showings on all shapes and sizes of screens and have listened intently to an even greater number of sound systems. Some of these have provided a spatial effect—depending on the individual seating location. Others have simulated, to some degree, a stereophonic effect by employing multitrack audio channels into widely separated loudspeakers.

We've drawn some conclusions and perhaps the most definite is that stereosound techniques have reached only the half-way mark on the road to binaural reproduction or its effect.

The peculiar and unfortunate technical requirements for true 3-D motion pictures with binaural sound are well-known to the physicist and the audio engineer. But the public simply will not accept the fact that it must be encased in a network of earphones and polaroid glasses to watch 3-D and listen to binaural sound for any length of time, with the attendant discomfort and fatigue that results.

The public has accepted the new screen techniques as providing realism and perspective for the picture. Audio systems used with *Cinemascope* and *Cinerama* have done wonders to educate the public to the need for better sound. These recordings have about twice the frequency response of conventional theater sound and a wider dynamic range of musical scores greatly enhances the action. We feel that the public will support any screen technique that provides the ingredients of high-fidelity *sound* and wide-screen optical *effects*. Of the two—audio needs the most attention. It will be interesting to see which system wins greatest public favor. The small movie houses simply do not lend themselves, acoustically, to the requirements of wide range audio at high volume levels. This is just one of many obstacles that must be met in the ensuing year.

And, this is the year when color television emerges from the laboratory as a full-fledged giant in our industry. Hand-in-hand with live telecasts in color will be rapid development of electronic photography. Certainly one cannot overlook the tremendous contributions of *Crosby Enterprises* and *RCA* engineers in making such rapid progress in video recording on magnetic tape. Those of us who witnessed the first *RCA* demonstration of "recorded color TV" will, in years to come, remember the occasion as representing a new era of photography for industry, the theater, and the home.

We've been in on many "firsts" in reporting technical achievements of our electronics industry. But, we don't recall any "preview" that represented a development that was so highly refined and one that was capable of rousing such great enthusiasm as the one at Princeton. There's little doubt that our future home movies will be photographed on magnetic tape and that the visual and audio information will be "played back" through our television sets for the entire family to see and hear.

Another important use for magnetic tape is the control device developed by *G-E*'s engineers. This machine is a tape record-playback device that directs a machine operation on a process cycle from information recorded on the magnetic tape. A machinist, skilled in an operation, performs the functions of operation on the original piece of work.

Each motion of this correctly executed operation is recorded on the tape as a result of translation to electrical signals *via* selsyns. Playback of the tape then duplicates the operation of the machine and an identical part is thus produced. The tape can be stored until needed to re-fill an order. In its present stage of development any control or motion that can be operated from electrical signals can be done with this tape playback control device.

There is an almost unlimited horizon for applications of magnetic tape in fields of sound and signals. Any device that can be controlled by electrical signals in conjunction with selsyn motors can be controlled *via* signals recorded on magnetic tape.

The year 1954 certainly will see rapid progress made in each of the three T's—talkies, television, and tape. O.R.

Quality is an elusive thing. Engineers measure it . . . copywriters glorify it . . . salesmen describe it. But the final test is actual performance. If a product is the best in its field, those who know quality will accept no other.

That is the story of Pickering's new 260 Turnover Cartridge.

Introduced only months ago, it is already a leader among magnetic cartridges. It has won that position because it is the nearest thing to perfection yet produced. Here are the combined advantages it offers:

The nearest Thing to Perfection

A simple flip of the handy lever and you're ready to play any favorite that fits your mood—whether it's standard or microgroove.

1. HIGHER OUTPUT—*Better overall signal-to-noise ratio.*
2. LOWER OVERALL DISTORTION —*Less intermodulation distortion with wider frequency response.*
3. MINIMUM TRACKING FORCE —*Lowest practical tracking force for both microgroove and standard recordings.*
4. HIGHER COMPLIANCE—*Compliance of moving elements is the highest practical, consistent with best-quality transcription arms and changers.*
5. LOWER MOVING MASS —*Lowest of any comparable magnetic cartridge.*
6. TWO DIAMOND STYLI—*For longer record and stylus life and greatest economy.*

These design features have real meaning to those who understand that quality reproduction depends on components which meet professional standards. If you want the best that high fidelity can offer, ask your dealer to demonstrate the new 260 Turnover Cartridge. You, too, will hear the difference!

PICKERING ***and company incorporated • Oceanside, L.I., New York***

PICKERING PROFESSIONAL AUDIO COMPONENTS

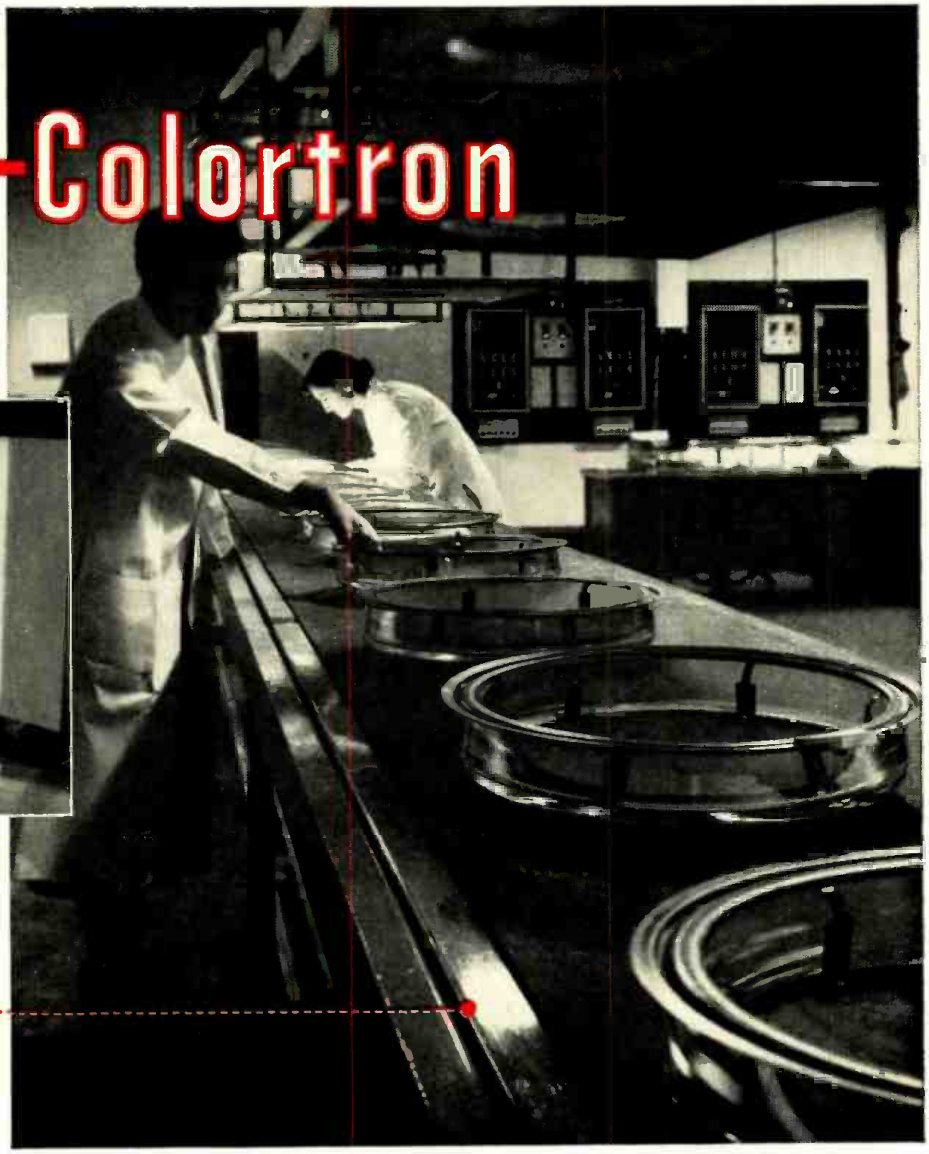
"For those who can hear the difference"

. . . Demonstrated and sold by Leading Radio Parts Distributors everywhere. For the one nearest you and for detailed literature; write Dept. C-4

New CBS-Colortron

NOW IN MASS PRODUCTION

Unique photographic process, like photoengraving, uses aperture masks as negatives to print consecutively the red, green, and blue phosphor dots (250,000 of each) on CBS-Colortron screens.



After tri-color screens are printed, aperture masks are temporarily removed and face plates move on to critical inspection for screen imperfections.

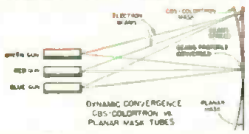
COLOR TV IS COMING . . . faster than you think. The revolutionary new CBS-Colortron . . . a practical color picture tube . . . hastens the day. Already it is in lower-cost, mass production . . . made possible by its simplified, advanced design.

As in black-and-white tubes, the CBS-Colortron's screen is deposited directly onto the inside of its face plate. A unique photographic technique makes this possible. Because each aperture mask serves as a negative to print its tri-color screen, perfect register of mask and screen is automatically achieved and maintained. The rugged, simple, light-weight mask sharply reduces assembly and exhaust problems. And the spherical design of mask and screen simplifies convergence circuitry and adjustment.

The CBS-Colortron is now a 15-inch, round tube. But, as soon as tooling is completed, it will be made in larger sizes. Watch for the new CBS-Colortrons. You'll see plenty of them soon. And you'll be sold on sight by their logical simplicity . . . their superior performance . . . their many advantages.

CBS-Colortron OFFERS MANY ADVANTAGES

Cross-section (face plate, aperture mask, funnel, tri-color electron gun) shows simplicity of CBS-Colortron and its adaptability to low-cost, mass production.



Spherical screen and aperture mask of CBS-Colortron simplify convergence and focus. Electron beams remain in focus over entire surface of screen.

Light-weight (6 oz.), rugged, simple aperture mask of CBS-Colortron minimizes problems of exhaust, handling, and assembly.

COMPLETE CBS-Colortron DATA *FREE!*

Take a look into the future. Write today for complete information on CBS-Colortron 15HP22: Construction . . . operation . . . application . . . installation and adjustment . . . electrical and mechanical data. Four packed pages . . . free!

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CBS-HYTRON, Main Office: Danvers, Massachusetts

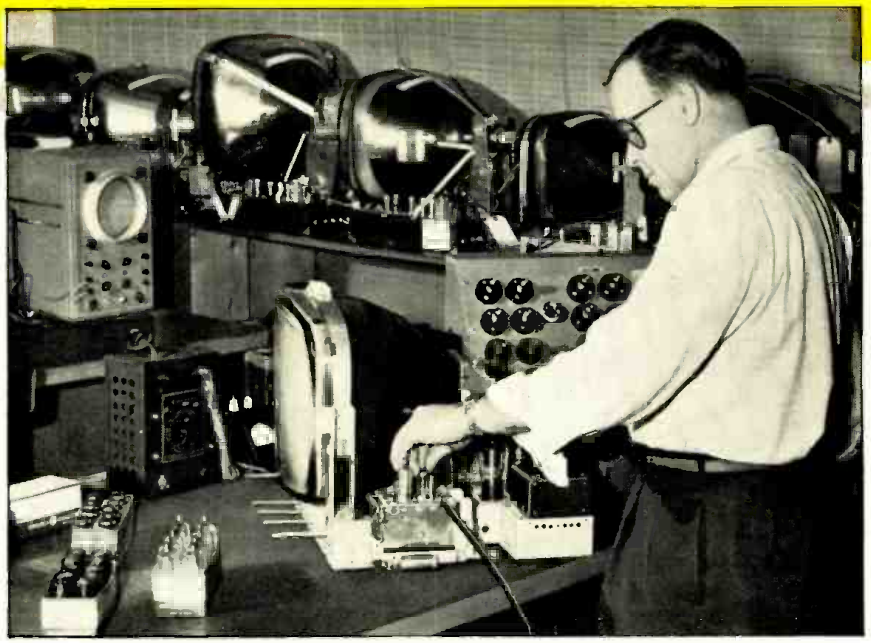
A Division of Columbia Broadcasting System, Inc.

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

Now G-E TUBES ARE SERVICE-TESTED

IN INDIANAPOLIS: Howard W. Sams & Co., Inc. regularly checks the performance of current-production G-E tubes in all popular TV chassis, at various line voltages.



A Howard Sams staff member tests General Electric tubes in one of a series of TV chassis of different makes. The preheating panel at right makes it possible to have up to 30 tubes ready at one time for substitution and test.

Electronic TUBES

Simplify your tube requirements, reduce service call-backs, with G-E interchangeable tubes!

SINCE September, 1953, the nationally-known Howard Sams TV-radio technical organization has checked G-E receiving tubes for servicing interchangeability.

A number of tubes of each type are selected periodically for test. The tubes are fully representative of normal production—their performance ranges all the way between top and bottom limits of the permissible variation in tube characteristics. The tubes are all tested at various line voltages in TV chassis of different makes. Their performance is accurately checked by instruments. When a tube fails to operate satisfactorily in any chassis, that fact is noted in the detailed report sent by Howard Sams to General Electric.

Based on these reports, G.E.—as described at right—takes prompt corrective steps that help give you tubes you can install successfully in every make receiver!

FOR TV-SET INTERCHANGEABILITY!

AT GENERAL ELECTRIC: the Howard Sams reports are carefully studied for ways in which G-E tubes may be improved for wider usefulness in servicing.

A General Electric tube engineer—with a Howard Sams analysis before him—re-checks tube performance in the same make of chassis where difficulties were reported.

A General Electric executive micro-inspects a tube structure, to determine whether or not manufacturing or test requirements need to be changed.

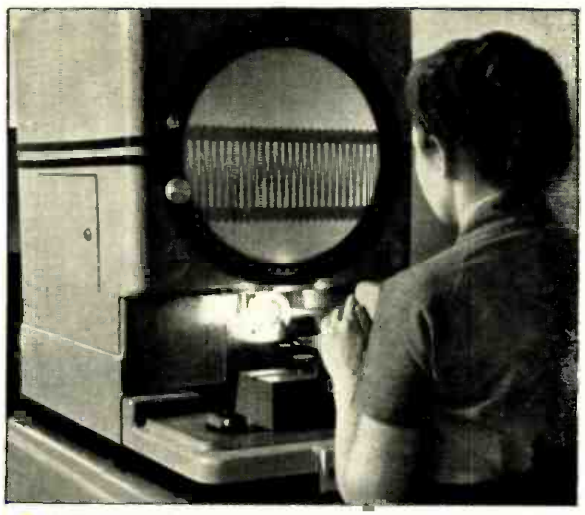
Ever-better quality is the aim of G-E tube manufacture and testing!

So that G-E tubes will give superior service in *all* receivers, G.E. exhaustively studies each case of unsatisfactory performance reported by Howard Sams.

First, a cross-section of General Electric tubes of that type is tested in the same make TV chassis where trouble was encountered. Afterwards, tubes other than G-E are substituted and checked.

By comparison and analysis, any G-E tube performance fault is established and isolated. The cause then is determined by laboratory investigation, and corrective steps follow immediately. These may take the form of an improvement in manufacture or inspection, or revised tube test specifications.

Result: you are always installing *better G-E tubes.* Your General Electric tube distributor is your source for a product that is constantly being improved in quality and interchangeability. *General Electric Co., Tube Department, Schenectady 5, New York.*



A General Electric plant employee checks a tube grid, using a comparator that greatly magnifies the component which is to receive special attention.

GENERAL ELECTRIC

161-1A1

Spot Radio News

★ **Presenting latest information on the Radio Industry.**

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

COMPATIBLE COLOR TV, now blessed with the official seal of Uncle Sam, found itself steeped in affectionate phrases of approval as the public announcement of the historic decision appeared. Said the Commission: "The accomplishment of a compatible color television system that can operate within a 6-megacycle bandwidth is a tribute to the skill and ingenuity of the electronics industry."

In supporting industry through its approval, the FCC declared that it had decided to adopt the new system because there is . . . "virtual unanimity" that the proposed standards are . . . "fundamentally capable of producing satisfactory color television pictures . . ." and in addition there is . . . "also substantial agreement" . . . that they . . . "have a potential for growth."

The Commissioners also declared that the system will . . . "furnish incentive and stimulus to manufacturing and research organizations to devote their efforts to the quipment problems . . ." and that history . . . "has demonstrated that American industry is capable of devising practical and economical equipment on a mass production basis . . ." which would eventually reduce the price of receivers and other equipment. The new approach would also afford the consumer, the Commissioners added, a . . . "greater degree of freedom than would an incompatible system in choosing whether or not to purchase a color receiver . . . since the public will, in any event, continue to receive program material in monochrome."

In a concurring statement, Commissioner Robert Lee said that he would like to consider the decision . . . "a milestone in the fast-moving electronics industry." In his opinion, the . . . "defects and shortcomings that may now exist will evaporate in the coming months as industry takes on mass production." Continuing, he declared: "The first automobile had many defects. An airplane going on the assembly line immediately takes on some aspects of being outmoded as experience teaches us new improvements and better methods of production. We would never learn the new short-cuts if we kept the basic idea on the drawing board." Our economy, he felt, will . . . "get a tremendous boost from this development.

"I am delighted at long last to have had a small part in putting the show on the road," he concluded.

In another concurring view, Commissioner George Sterling noted that he was certain that both larger and cheaper color receivers . . . "with controls having the ease of adjustments of current monochrome receivers will be made available to the public within the next two to three years; the time necessary to establish a color television broadcasting service of any consequence."

Commander E. M. Webster also applauded the decision, but issued a stern warning to industry, noting that the adoption of the standards creates ". . . certain receiver problems which must be recognized . . ." Receiver manufacturers, he went on to say . . . "are obligated to the public to incorporate . . . refinements beyond those in monochrome receivers necessary to suppress adequately aggravated receiver radiation and overcome the greater susceptibility to interference, particularly in the region of the color subcarrier."

The report and order, a 22-page affair supplemented by a comprehensive review of the system's operation, presented some intriguing facts, heretofore not too well known. In a commentary on station costs, the Commission said that color broadcasters will have to spend over $187,000 for equipment that will permit them to network color programs, and colorcast slides, color films, and live color. To transmit color film, stations will require a 16-mm film chain and miscellaneous gear. For live pickup, at least one three-tube color camera will be needed, and the price offered covers but one unit; it was noted, generally two or more cameras are required for live telecasts. In addition, stations will also require remote equipment, which will add many thousands of dollars to the cost.

The controversial subject of convertibility also received a frank explanation in the report. The Commission declared that . . . "No practical converter has been demonstrated, nor does it appear that proponents of the proposed signal specifications have any current plans for the production of converters."

Describing receivers and their costs, the Commission reported that they were well aware of the fact that the new sets would be high priced and fall

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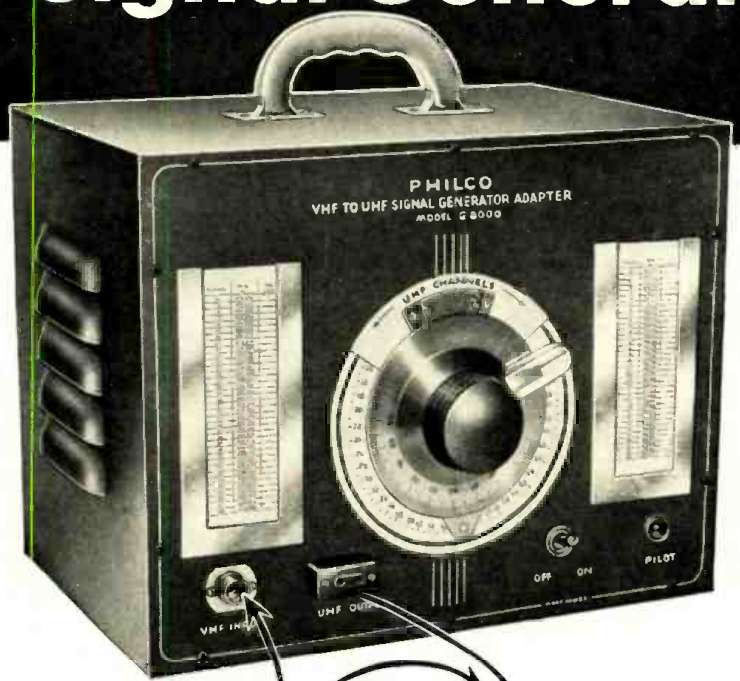

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in the luxury-price brackets of from $800 to $1000. Unfortunately, they added, the high cost is caused by the complex three-gun tube, which presently is valued at from $175 to $200 at the set-makers' level; this tube, a 15-inch model, provides an 11½-inch picture.

Since the Commission released its statement, several very significant tube cost and size developments have appeared on the scene. It has been reported that it has now become possible to produce a 19-inch tri-color, 3-gun tube, which can provide a 15- to 16-inch picture. A nationally-known laboratory has also demonstrated the practicability of a single-gun tube that can produce a 17-inch picture, and be sold at a substantially lower price that the 3-gun smaller-face model. Commenting on this tube, the lab officials declared that it has good light efficiency, assures automatic registration due to color switching near the phosphor screen and minimizes the problem of convergence. Model shown was a 22-inch round type; it was explained that a 21-inch rectangular version will be available soon, and this will probably be followed by a 24-inch model, which will provide 18- and 21- to 22-inch pictures, respectively.

THE ANNUAL REPORT of the Commission, always bulging with valuable information, was equally complete in its '53 version, replete with vital data and statistics. Noting that as the nineteenth year of the Commission closed (June, '53), there were nearly 1,100,000 radio authorizations on its books, the report said that over 235,000 of these were for safety and communications purposes on land, sea, and air, and almost 5500 were for broadcast. Radio station authorizations covered the use of about 600,000 transmitters, of which more than 430,000 were for mobile purposes.

The growing utilization of radio by industry was reflected by nine types of services now operating, for which there are nearly 17,000 authorizations, involving the use of over 127,000 transmitters. These services concern power, petroleum, forest products, relay press, motion picture, agriculture, radio-location/land, and special industrial.

Authorized ham stations were said to number over 112,000. It was noted that the popularity of the new Novice class operator license prompted the issuance of nearly 10,000 licenses during the fiscal-year period ending June 30, '53.

The field engineering and monitoring division of the Commission revealed that they had received over 20,000 complaints on interference; almost twice as many as in '52. Most of the broadcast-interference complaints were due to increased TV operation and the high susceptibility of its reception to interference. Other complaints involved interference from industrial, scientific and medical equipment, and even community antenna systems. Many odd cases of interference were also reported. To illustrate, in the

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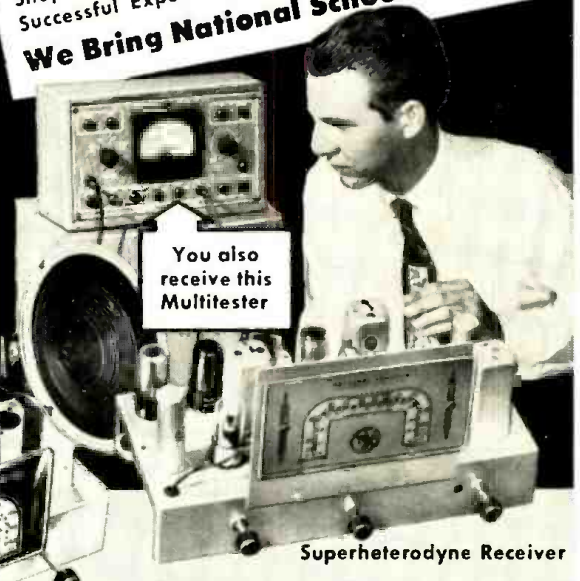
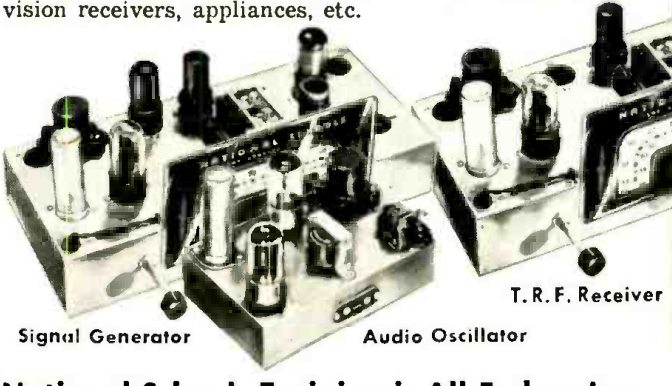


Superheterodyne Receiver



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spring of '53, interference caused to the International Airport, in East Boston, was traced to a partly broken 4400-volt power cable inside a metal conduit on a high-line pole 2½ miles from the airport.

Reviewing the uses of radio by police, the Commission pointed out that as of June 30, over 8000 police stations held licenses to operate. A normal police radio station, it was noted, consists of a base station, usually located at police headquarters, and a group of radio-equipped cars. These cars may include not only official police cars, but also ambulances and emergency vehicles used to clear highways of obstructions.

The ever-increasing demand for two-way communications, taxing the capacity of the spectrum, also received a thorough analysis in the yearly report. A development that was said to offer considerable promise in alleviating some of the congestion was channel-splitting. The net result of such splitting would be to provide more channels in the same amount of space. It is hoped that during '54 it might be possible to introduce this new technique. The great problem that faces the Commission in introducing the new approach, however, is how such a change-over can be made, especially in the more crowded parts of the spectrum, without too rapid obsolescense of equipment already in use. Supplementing its channel-splitting study, the Commission has initiated a frequency utilization investigation looking toward a revaluation of the frequency requirements of communication services.*

Citizens radio service has also begun to show signs of real life, the annual review revealed. Due to the absence of equipment, the service had been stalemated. In the past year, however, this service has experienced a boom due in part to the availability of commercial gear, and also to the widespread acceptance and use of the recently added 27.255-megacycle frequency, which is available, among other things, for the control of objects such as model airplanes. To encourage further the development and manufacture of low-cost transmitters for this service, the Commission has proposed to relax technical standards applicable to low-powered equipment of the walkie-talkie type.

As of June 30, close to 4000 authorizations had been issued for the Citizens radio service band.

AS A MEANS of helping FM broadcasters improve their financial situations, and at the same time make further use of the FM broadcast band, the Commission has issued a proposal to

(*Continued on page* 165)

* Since the above report was prepared, the Commission has issued a new allocation plan for the 450-460 mc. band. Under the revised program, industrial services were assigned frequencies from 451.05 mc. at 100 kc. intervals to 451.95 and from 456.05 to 456.95 mc.; land transportation services received 452.05 to 452.95 mc. and 457.05 to 457.95 mc. ranges; public safety services were given 453.05 to 453.95 and 458.05 to 458.95 mc. bands; and domestic public services were placed in the 454.05 to 454.95 and 459.05 to 459.95 mc. area.

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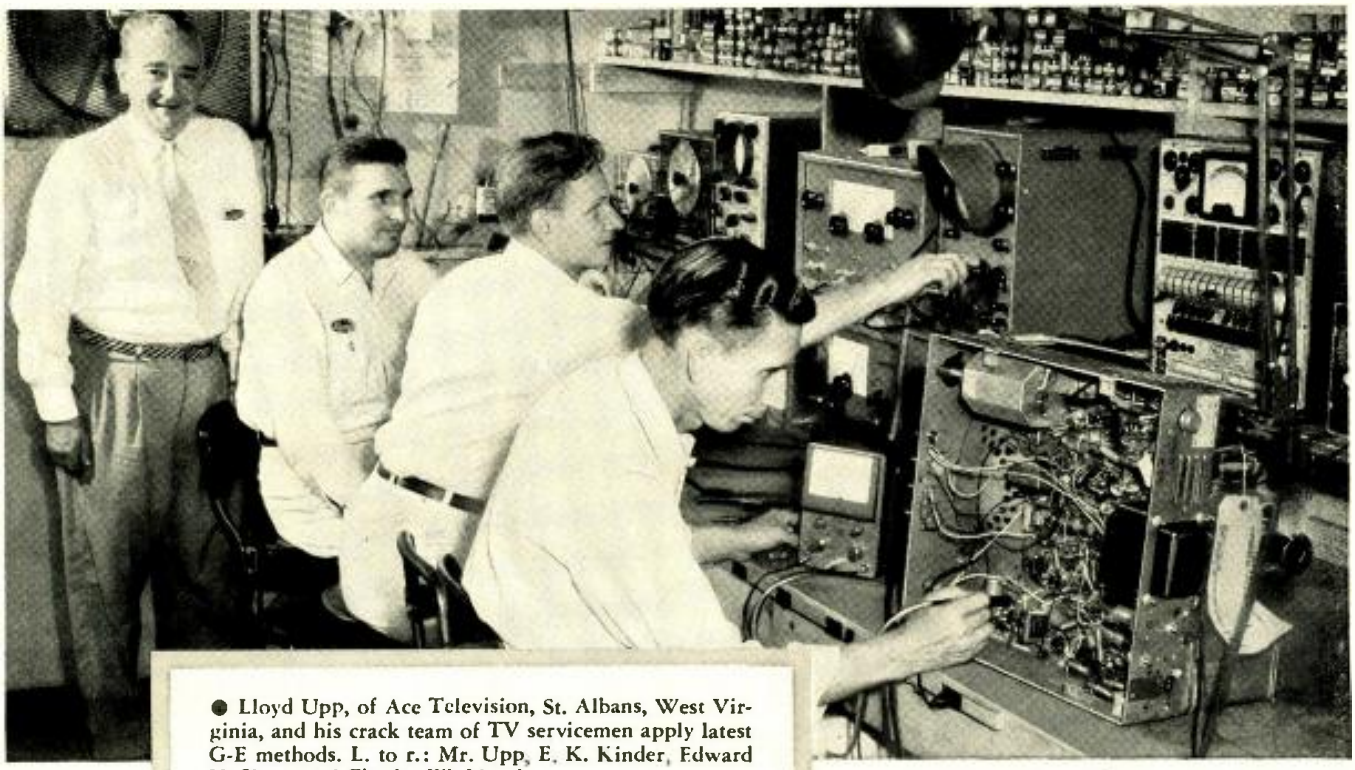

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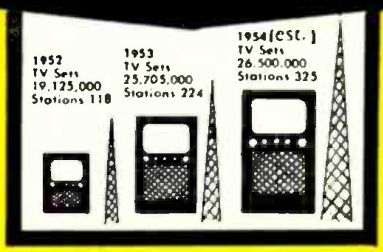

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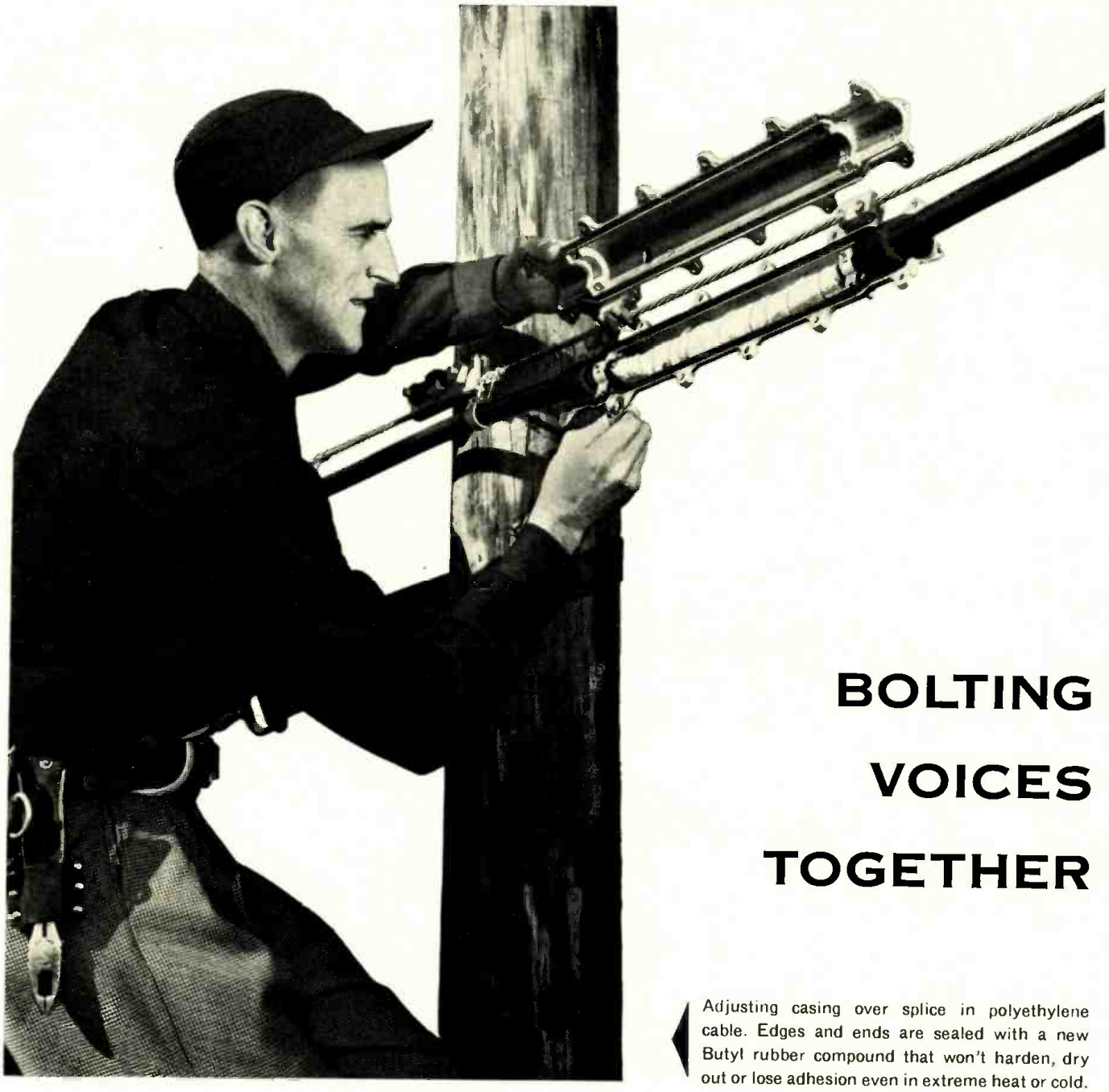

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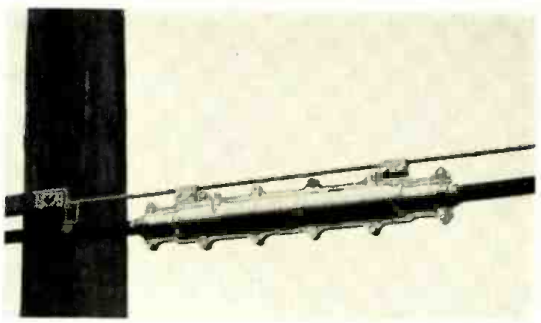

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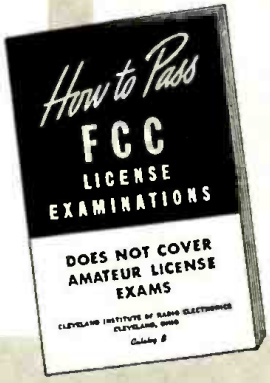

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TELLS HOW

HERE IS YOUR GUARANTEE

If you fail to pass your Commercial License exam after completing our course, we guarantee to continue your training without additional cost of any kind, until you successfully obtain your Commercial license, provided you first sit for this examination within 90 days after completing our course.

WE GUARANTEE

TO TRAIN AND COACH YOU AT HOME IN SPARE TIME UNTIL YOU GET

YOUR FCC LICENSE

If you have had any practical experience—Amateur, Army, Navy, radio repair, or experimenting

TELLS HOW

Employers make

JOB OFFERS Like These to Our Graduates Every Month

Letter from nationally-known Airlines. "We would also appreciate if you would place the following additional advertisement in your bulletin—Wanted—Superintendent of Communications . . . Salary $666.66 per month."

Letter from nationally-known airplane manufacturer. "We need men with electronic training or experience in radar maintenance to perform operational check-out of radar and other electronics systems . . . starting salary . . . amounting to $329.33 per month."

These are just a few examples of the job offers that come to our office periodically. Some licensed radiomen filled each of these jobs . . . it might have been you!

HERE'S PROOF FCC LICENSES Are OFTEN SECURED IN A FEW HOURS OF STUDY WITH OUR COACHING at HOME in SPARE TIME

Name and Address	License	Lessons
Lee Worthy 2210½ Wilshire St., Bakersfield, Calif.	2nd Phone	16
Clifford E. Vogt Box 1016, Dania, Fla.	1st Phone	20
Francis X. Foerch 38 Beucler Pl., Bergenfield, N. J.	1st Phone	38
S/Sgt. Ben H. Davis 317 North Roosevelt, Lebanon, Ill.	1st Phone	28
Albert Schoell 110 West 11th St., Escondido, Calif.	2nd Phone	23

CLEVELAND INSTITUTE OF RADIO ELECTRONICS
CARL E. SMITH, E. E., Consulting Engineer, President
Desk RN-62 — 4900 Euclid Bldg., Cleveland 3, Ohio

TELLS HOW

Our Amazingly Effective JOB-FINDING SERVICE Helps CIRE Students Get Better Jobs

Here are a few recent examples of Job-Finding results

GETS FIVE JOB-OFFERS FROM BROADCAST STATIONS

"Your 'Chief Engineer's Bulletin' is a grand way of obtaining employment for your graduates who have obtained their 1st class license. Since my name has been on the list I have received calls or letters from five stations in the southern states, and am now employed as Transmitting Engineer at WMMT."

Elmer Powell, Box 274, Sparta, Tenn.

GETS CIVIL SERVICE JOB

"I have obtained a position at Wright-Patterson Air Force Base, Dayton, Ohio, as Junior Electronic Equipment Repairman. The Employment Application you prepared for me had a lot to do with my landing this desirable position."

Charles E. Loomis, 4516 Genessee Ave., Dayton 6, Ohio.

GETS AIRLINES JOB

"Due to your Job-Finding Service, I have been getting many offers from all over the country, and have taken a job with Capital Airlines in Chicago, as Radio Mechanic."

Harry Clare, 4537 S. Drexel Blvd., Chicago, Ill.

OURS IS THE ONLY HOME STUDY COURSE WHICH SUPPLIES FCC-TYPE EXAMINATIONS WITH ALL LESSONS AND FINAL TESTS.

Your FCC Ticket is recognized in all radio fields as proof of your technical ability.

Get All 3 FREE

MAIL COUPON NOW

CLEVELAND INSTITUTE OF RADIO ELECTRONICS
Desk RN-62
4900 Euclid Bldg., Cleveland 3, Ohio
(Address to Desk No. to avoid delay)

B

I want to know how I can get my FCC ticket in a minimum of time. Send me your FREE booklet, "How to Pass FCC License Examinations" (does not cover exams for Amateur License), as well as a Sample FCC-type exam and the amazing new booklet, "Money-Making FCC License Information."

☐ Tell me how I can get a TV Engineering Course without additional charge.

NAME .....

ADDRESS .....

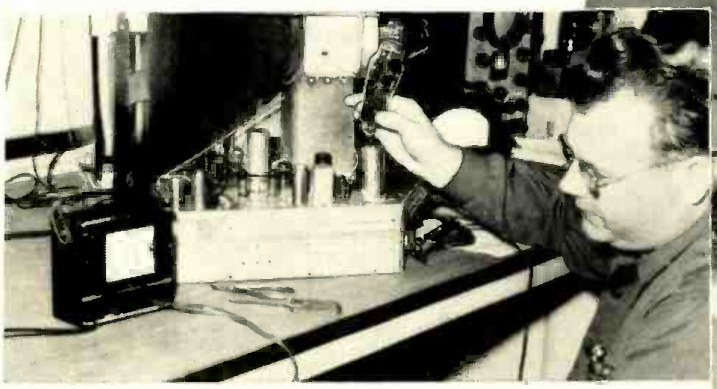
CITY ..... ZONE ... STATE .....

Paste on 2-cent post card or send air mail

Bill Clemens says—

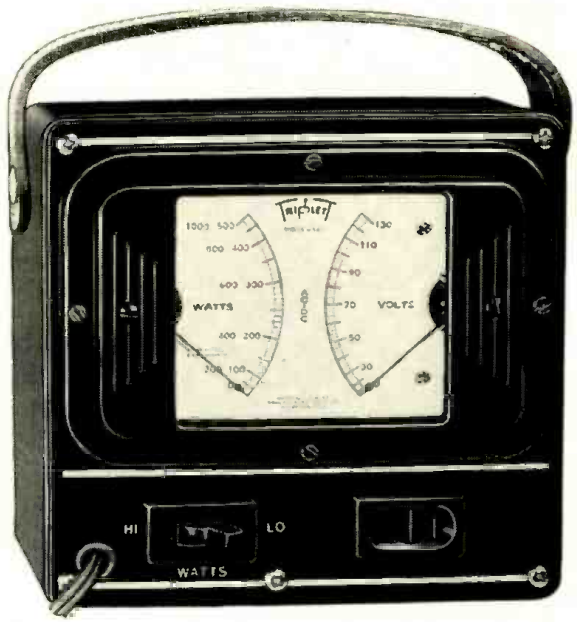
Midget Radio Service (a 3-Man Shop)
129 S. Elizabeth St.,Lima, Ohio

"TRIPLETT 660 saves us 50 to 100 man hours per month."



1. ISOLATING THE TROUBLE—Plug the power cord of the chassis into LOADCHEK and note the reading. With your eye on the large meter remove the rectifier tube and you can tell immediately which side of the tube the trouble is on. You have already eliminated 50% of your probing time.

2. LOCATING THE SHORT—With Loadchek you can quickly check the shorted side, part by part, without laying down tools or picking up test leads. Here, the trouble was a short in the transformer, spotted without having to warm up set. Overloads are found the same way.



Locates trouble in a hurry

The above pictures illustrate but one of the many time-saving uses of Triplett 660 Loadchek. This versatile instrument accurately measures power consumption, enables you to see instantly any deviation from normal load, without disconnecting a single part . . . finds trouble in a hurry.

For Radio and TV servicing—for almost any kind of electrical trouble-shooting—LOADCHEK saves hours of painstaking work every day. At its moderate cost no service technician can afford to be without it. Try one today—and see! Write for free booklet.

TRIPLETT ELECTRICAL INSTRUMENT CO., BLUFFTON, OHIO, U.S.A.

Suggested U. S. A. DEALER NET $29.50

Price subject to change without notice.

Triplett

TRAIN *FASTER* — TRAIN *BETTER* — TRAIN *EASIER*
IN 10 MONTHS — OR LESS — FOR
RADIO-TELEVISION

Our 21st Year Training Men for Greater Incomes and Security in Radio-Television

I SEND YOU 18 BIG KITS

of Radio Television parts and equipment. Much of your training will be actual construction and experimentation . . . the kind of truly PRACTICAL instruction that prepares you for your Radio-Television career.

Frank L. Sprayberry
President
Sprayberry Academy of Radio

NEW! NO OBLIGATION PLAN

You Have No Monthly Payment Contract to Sign
Pay For Your Training as You Earn and Learn

You can get into Radio-Television, today's fastest growing big money opportunity field, in *months* instead of years! My completely new "package unit" training plan prepares you in as little as 10 months or even less! *No monthly payment contract to sign—thus NO PISK to you!* This is America's finest, most complete, practical training—gets you ready to handle any practical job in the booming Radio-Television industry. Start your own profitable Radio-Television shop . . . or accept a good paying job. I have trained hundreds of successful Radio-Television technicians during the past 21 years—and stand ready to train you, even if you have no previous experience! Mail coupon and get all the facts—FREE!

Valuable Equipment Included With Training

The new Sprayberry "package" plan includes many big kits of genuine, professional Radio-Television equipment. You perform over 300 demonstrations, experiments and construction projects. You build a powerful 6-tube 2-band radio set, multi-range test meter, signal generator, signal tracer, many other projects. All equipment and lessons are *yours to keep* . . . you have practically everything you need to set up your own profitable Radio-Television service shop.

Earn Extra Money While You Learn!

All your 10 months of training is IN YOUR HOME in spare hours. Keep on with your present job and income while learning. With each training "package" unit, you receive extra plans and "Business Builder" ideas for spare time Radio-Television jobs. New television stations everywhere, open vast new opportunities for trained Radio-Television Technicians—and those in training. If you expect to be in the armed forces later, there is no better preparation than practical Sprayberry Radio-Television training.

YOU BUILD the Television set and the powerful superhet radio receiver shown above. IN ADDITION to the other test units shown here (many are not shown because of lack of space). All equipment I send you is YOURS TO KEEP.

SPRAYBERRY ACADEMY OF RADIO
111 NORTH CANAL ST.
Dept. 25-G, Chicago 6, Ill.

MAIL COUPON TODAY! NO OBLIGATION

Approved for Veterans under the G.I. Bill

I invite you to get all the facts—

FREE TO YOU 3 BIG RADIO-TELEVISION BOOKS

I want you to have ALL the facts about my new 10-MONTH Radio-Television Training—without cost! Rush coupon for my three big Radio-Television books: "How to Make Money in Radio-Television." PLUS my new illustrated Television Bulletin PLUS an actual sample Sprayberry Lesson—ALL FREE. No obligation and no salesman will call. Mail coupon NOW!

SPRAYBERRY ACADEMY OF RADIO, Dept. 25-G
111 North Canal St., Chicago 6, Ill.

Please rush to me all information on your 10-MONTH Radio-Television Training Plan. I understand this does not obligate me and that no salesman will call upon me. Be sure to include 3 books FREE.

Name..... Age.....

Address.....

City..... Zone..... State.....

Within the INDUSTRY

LOUIS DE LA FLEUR of the Federal Communications Commission staff has joined RETMA as manager of the newly-established international department of the Association.

He has been with the FCC since 1940 when he began as an assistant monitoring officer in Baltimore, later becoming chief of the investigating section of the Commission's Radio Intelligence Division in 1946. He subsequently served as chief of the frequency utilization and requirements branch and since 1947 has been assistant chief of that division.

He has served as a member of various U. S. delegations at international conferences. In his new post he will assist RETMA members engaged in export trade.

* * *

D. W. GUNN has been appointed general sales manager of electronic products for *Sylvania Electric Products Inc.*, succeeding Harold P. Gilpin who has retired.

In his new post Mr. Gunn will be responsible for the sales of products of the radio and television tube divisions and the electronics division.

He joined the company in 1931 as a factory engineer at the Salem plant, became a sales engineer for the firm in Chicago in 1936, and since that date has worked successively as a quality engineer, supervisor of quality control, eastern district sales engineer, east central district engineer, and assistant to the general sales manager. Until his new appointment he has been assistant general sales manager of the electronic products sales division.

* * *

THE VICTOR DIVISION of **RADIO CORPORATION OF AMERICA** has started construction on a group of ultra-modern buildings which will serve as administration and laboratory headquarters for its home instrument and service company activities. The project will be located on a 58-acre tract in the Cherry Hill section of Camden, N. J. . . . **HELIPOT CORPORATION,** California manufacturer of precision potentiometers, has opened a new eastern plant in Mountainside, N. J. The 20,000 square foot plant will house manufacturing, showroom, and regional office activities . . . **JAMES B. LANSING SOUND, INC.** has moved into a new building adjoining its main building which will be retained for production facilities. The mail address will continue to be 2439 Fletcher Drive, Los Angeles 39, Calif. . . . **SHALLCROSS MANUFACTURING CO.** of Collingdale, Pa. has recently completed a building program which provides for completely modernized and larger offices as well as increased production and engineering facilities . . . **G. C. WILSON & CO.,** designer and manufacturer of electronic timers, has moved its offices and plant from Chatham, N. J. to 1950 Eighth Ave. in Huntington. W. Va. . . . **CHANNEL MASTER CORPORATION** of Ellenville, N. Y. recently opened a $1,500,000 TV antenna plant with a production potential of over four times its present factory. The new plant has 115.000 square feet of floor space and has six separate assembly lines to supplement the two assembly lines in the old plant, which will remain in operation . . . **DAVIS ELECTRONICS** of Burbank, California, has established two new regional plants to provide faster antenna deliveries. The plant at 8933 Brookville Rd., Silver Spring, Maryland will supply the eastern seaboard while a plant at 5725 N. Central Ave. in Chicago will supply the midwest market . . . **MAJESTIC RADIO & TELEVISION DIVISION** has acquired an additional manufacturing plant at 41 Water Street near its main Brooklyn plant. The new structure adds 50,000 square feet of production and warehousing space . . . **ROHN MANUFACTURING COMPANY** has added a 5000 square foot addition to its plant in Peoria, Ill. This is the third addition to the original plant and gives the firm approximately 24,000 square feet of floor space for the manufacture of TV and communication towers.

* * *

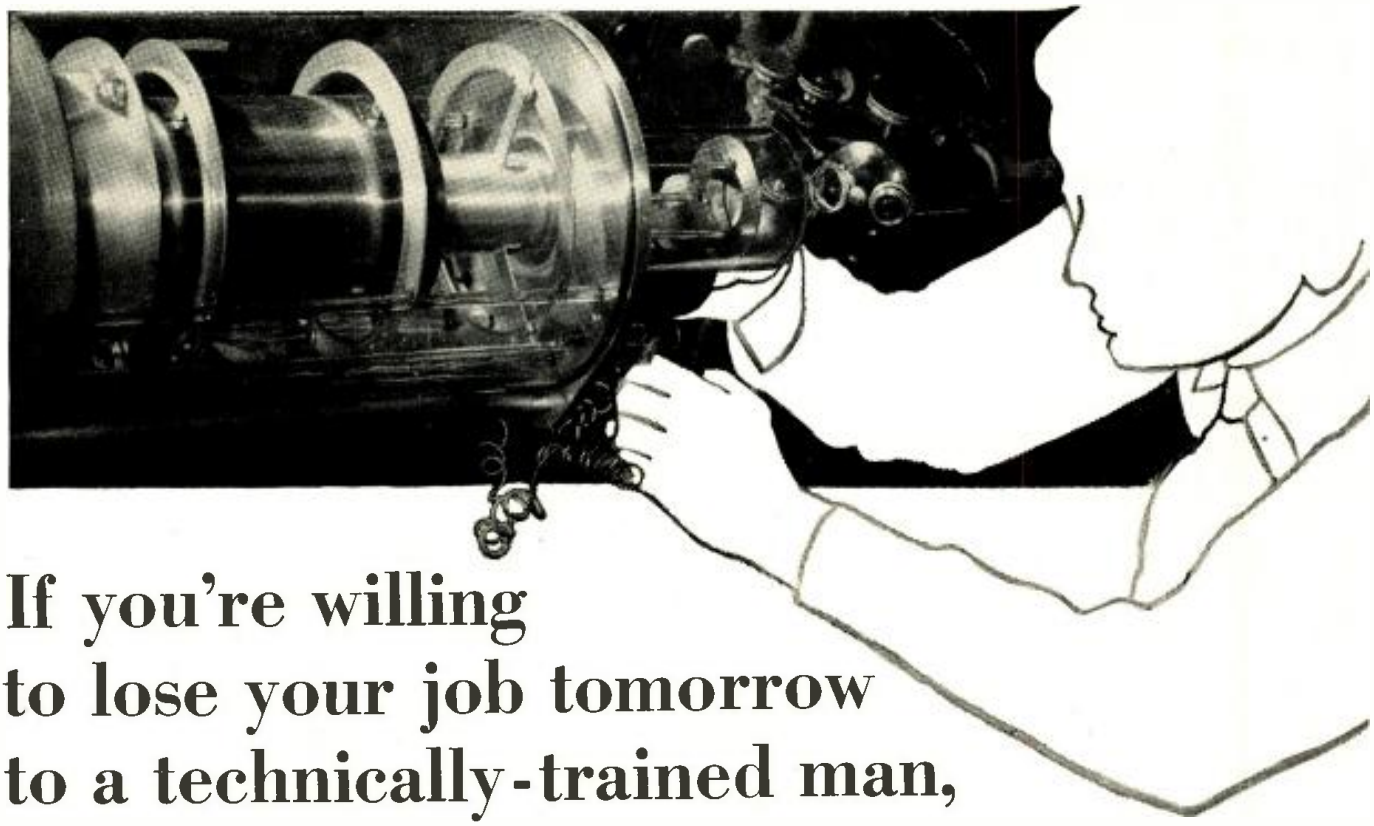
LEO HAHN has been promoted to the post of national radio sales manager of *Emerson Radio and Phonograph Corporation.*

He has been in charge of sales in the Central Atlantic states and will now head the radio department in the company's sales division. He will coordinate all radio sales and merchandising by working in close association with the company's regional sales managers, district salesmen, and distributors' sales personnel.

* * *

RCA SERVICE COMPANY has developed a comprehensive color training and educational program which will be made available to the entire TV service industry.

The program will provide complete information on the theory and practice of installation and service for color television receiving equipment to the serv-



If you're willing to lose your job tomorrow to a technically-trained man,

turn the page, Mister

But, if you're interested in an honest-to-goodness career in the vigorous young electronics industry, here's how you can step ahead of competition, move up to a better job, earn more money, and be sure of holding your technical job even if the brass is firing instead of hiring.

The "how" is CREI training in radio-television-electronics.

You don't have to be a college graduate. You *do* have to be willing to study—at home. You can do it while holding down a full-time job. Thousands have. Since 1927 CREI has provided alert young men with the technical knowledge that leads to more responsibility, more job security, more money. More than a quarter century of experience qualifies CREI to train you.

What qualifies *you* for CREI? If you have a high school education, you're off to a good start. If you have a knack for math, so much the better. If you are currently working in some phase of the electronics industry, you'll get going faster. But remember this: CREI starts with fundamentals and takes you along at your own speed. You are not held back by a class, not pushed to keep up with others who have more experience or education. You set your own pace. Your CREI instructors guide you through the lesson material and *grade* your written work personally. You master the fundamentals, then get into more advanced phases of electronics engineering principles and practice. Finally you may elect training at career level in highly specialized applications of radio or television engineering or aeronautical radio.

How good is CREI training? Here are a few ways to judge. Ask an electronics engineer if you know one. Ask a high-school or college physics teacher. Ask a radio station engineer. Check up on our professional reputation: CREI home study courses are accredited by the Engineers' Council for Professional Development; CREI is an approved member of the National Council of Technical Schools. Ask personnel managers how they regard a man with a CREI "ticket." Look at this partial listing of organizations *that pay CREI* to train their own personnel: All American Cables & Radio, Inc., Canadian Aviation Electronics, Ltd., Canadian Broadcasting Corporation, Columbia Broadcasting System, Hoffman Radio Corp., Machlett Labs., Glenn L. Martin Co., Magnavox Co., Pan American Airways, Atlantic Division, RCA Victor Division, United Air Lines. Finally, ask a CREI graduate to tell you about our Placement Bureau, which currently has on file more requests for trained men than we can fill.

What's the next step? The logical one is to get more information than we can cram into one page. The coupon below, properly filled out, will bring you a fact-packed booklet called "Your Future in the New World of Electronics." It includes outlines of courses offered, a resume of career opportunities, full details about the school, and tuition details. It's free.

Note: CREI also offers Resident School instruction, day or evening, in Washington, D.C. New classes start once a month. If you are a veteran discharged after June 27, 1950, let the new GI Bill help you obtain resident instruction. Check the coupon for more data.

CAPITOL RADIO ENGINEERING INSTITUTE

An Accredited Technical Institute • Founded in 1927

3224 16th Street, N. W. Dept. 113A Washington 10, D. C.

Send booklet "Your Future in the New World of Electronics" and course outline.

CHECK FIELD OF GREATEST INTEREST

- ☐ Practical Radio Engineering
- ☐ Broadcast Radio Engineering (AM, FM, TV)
- ☐ Practical Television Engineering
- ☐ Aeronautical Radio Engineering
- ☐ TV, FM & Advanced AM Servicing

Name.....

Street.....

City.....Zone.....State .....

Check— ☐ Residence School ☐ Veteran

ice industry even before the first commercial color sets reach the public. The program is divided into four major elements.

One is a series of two-day technical clinics to be held in 65 key cities. The clinics will be conducted by technical specialists of the company, using textbooks, test equipment, and other instructional materials developed especially for these clinics. Service dealers and technicians in each city will be invited to attend.

The second phase is a comprehensive textbook "Practical Color Television for the Service Industry." The third area of assistance will be a home-study course, while the fourth aid is a series of test equipment designed for use with color sets.

* * *

DAVID J. HOPKINS has been named director of sales for *CBS-Columbia,* the manufacturing division of *CBS.*

Mr. Hopkins resigned his position as director of sales and advertising for *Emerson Radio and Phonograph Corporation* to take his new post. During World War II, he served for three and a half years with the Naval Air Arm in the Pacific Theater, attaining the rank of Lieutenant Commander.

* * *

CLIFFORD SHEARER has been named advertising manager of *Radio Merchandise Sales, Inc.* His duties will include handling all advertising and sales promotion material . . . *CBS-Hytron* has promoted **CHARLES F. STROMEYER** to the position of executive vice-president. He was formerly chief engineer and assistant to the president and later vice-president in charge of manufacturing and engineering . . . **COLE H. PILCHER** has been named director of industrial relations of *Sylvania Electric Products Inc.* He succeeds **HOWARD L. RICHARDSON** who was recently named vice-president in charge of engineering operation . . . **A. MELVIN SKELLETT,** vice-president in charge of manufacturing and engineering for *National Union Radio Corporation,* has been elected to the board of directors of the firm . . . *Emerson Radio and Phonograph Corporation* has appointed **M. F. BLAKESLEE** to the post of director of distributor relations, a newly-created post with the company . . . **DONALD H. ROGERS** has been appointed chief engineer of *Blonder-Tongue Laboratories* of Westfield, N. J. He was formerly associated with *Western Electric* and *Utility Electronics* . . . **JOHN A. CURTIS** has been appointed general sales manager of the *Westinghouse* Electronic Tube Division . . . **ALBERT J. FRANKEL** has been promoted to the post of purchasing agent for *CBS-Columbia.* He was formerly chief buyer . . . **RALPH R. STUBBE** is the new chief engineer of *General Instrument Corporation.* He will make his headquarters at the company's Elizabeth, N. J. plant . . . **JE-**

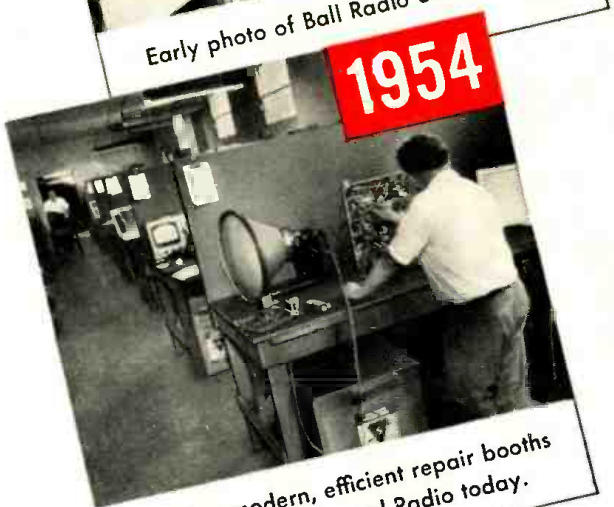
Another Outstanding Service Success Story...

with SYLVANIA!

From Basement Repair Shop to prosperous Service Business... featuring Sylvania Tubes, Parts and Promotion Programs!

The steady and substantial growth of the Ball Television and Radio Service, from basement shop to the large handsome brick building, shown below, is a tribute to the fair practices and alert policies of the owner, Mr. Ted Ball.

Early photo of Ball Radio Service Shop.



Showing modern, efficient repair booths in Ball Television and Radio today.

Says Mr. Ball: *"My men are as skilled and experienced as any you'll find anywhere, and each is instructed to do the best job possible with the best of parts... and that, of course, includes Sylvania Tubes."*

Ted Ball is another important Radio-TV Service Manager that appreciates the quality performance, dependability, and the nation-wide high reputation of Sylvania products.

Mr. Ball also knows about the business-boosting power of Sylvania's promotion and display offers. Find out how Sylvania can step up *your* business. Your friendly Sylvania Distributor is ready and anxious to give you full cooperation. Call him today.

SYLVANIA

Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y.

In Canada: Sylvania Electric (Canada) Ltd., University Tower Bldg. St. Catherine St., Montreal, P. Q.

LIGHTING · RADIO · ELECTRONICS · TELEVISION

ROME V. DEEVY has been appointed director of industrial relations for *National Union Radio Corp.* . . . **BRUCE K. ARNOLD** has been appointed engineer for the eastern division of *Cannon Electric Company* after twenty-years' experience in production and engineering at the company's Los Angeles factory . . . **BOB MIDDLETON,** formerly with *RCA* and *Precision Apparatus,* has joined the sales-engineering division of *Simpson Electric Company* of Chicago. He will conduct a series of lectures for technicians throughout the country . . . **JOHN P. TANSEY** has been appointed national service manager of *Motorola's* communications and electronic division . . . **SAM GROSSMAN,** associated with *Wholesale Radio Parts. Inc.,* Baltimore distributing firm, died suddenly at his home at the age of 50. He had been in the electronics field for 30 years and was an active ham with the call W3FT . . . **DAVID C. McNEELY** has been named sales manager of *Helipot Corporation.* He will make his headquarters at the company's South Pasadena, California plant . . . **P. R. DAWSON** has retired from *Tung-Sol Electric. Inc.* after 34 years with the firm. He plans to make his home in Florida. At the time of his retirement, he was staff assistant to the general sales manager of the company . . . **JOHN R. HUTSELL** has been appointed general sales manager of *The Sealtron Corporation* of Cincinnati . . . **STANLEY ADAMS** has been named general manager of the Chicago plants of *Standard Coil Products Co. Inc.* He was formerly manager of the company's plant at Bangor, Michigan . . . **C. H. FRITZ** is the new assistant sales manager of *Shallcross Manufacturing Company* of Collingdale, Pa. For the past seven years he was with the company's engineering and sales departments . . . **GEORGE R. LOUX** is the new vice-president in charge of manufacturing for the *National Company, Inc.* He was formerly with *Federal Telephone and Radio Company, General Instrument Company, Sylvania,* and *RCA* . . . **HAROLD P. GILPIN,** general manager of the electronic sales division of *Sylvania Electric Products Inc.* has retired after 21 years of service with the company . . . **CHARLES G. SHERWOOD,** director of purchases for *Federal Telephone and Radio Company* has been named a vice-president of the company . . . **MAURICE SCHOENBRUN** has been promoted to the post of director of cabinet engineering for *CBS-Columbia* . . . **ERNEST B. LOVEMAN,** for many years vice-president and general manager of *Philco* Television Broadcasting Division, died recently in the reception room of the firm's headquarters plant in Philadelphia. He was 58 . . . **OTTO C. BIXLER,** director of engineering and research for *Magnecord. Inc.,* has been elected vice-president of the firm. He joined the company in 1951 as chief engineer . . . *Schwab Brothers Corporation* of New York City has announced the appointment of **JOSEPH K. NOLL** as vice-president in charge of the firm's mica division . . . *Phen-O-Tron, Inc.* has named **RICHARD D. SCHOTTER** vice-president and **JACK BAYHA** chief engineer of the company's new printed circuit plant in New Rochelle, N. Y. . . . **VERNE ROBERTS** has been named distributor sales manager of *I.D.E.A.* of Indianapolis.

* * *

JOHN C. MARSHALL has been elected a vice-president of *Arvin Industries, Inc.* and appointed director of sales for the firm's radio-television sales division.

Joining the company in 1928 soon after his graduation from DePauw University, Mr. Marshall has spent his entire business life in sales work. For the past several years he has been director of sales of the company's special products division. He has also served as a member of the firm's board of directors since 1947.

* * *

WORKSHOP ASSOCIATES DIVISION of Norwood, Mass. has changed its name to the **GABRIEL ELECTRONICS DIVISION** of **THE GABRIEL COMPANY.** The change was required to reflect the broadened scope of the division's operation . . . John R. Wells, formerly a partner of **WELLS & WINEGARD,** television accessory manufacturer, has established a new television antenna manufacturing firm in Burlington, Iowa, **WELCO MANUFACTURING COMPANY** . . . **COLLINS RADIO COMPANY** of Cedar Rapids, Iowa has organized a wholly-owned Canadian subsidiary, **COLLINS RADIO COMPANY OF CANADA, LTD.** with offices at 74 Sparks St. in Ottawa, Ontario . . . **SIGHTMASTER CORP.** has acquired the complete fuse operation of **GENERAL FUSE CO.** of South River, N. J. . . . **RADIO MERCHANDISE SALES, INC.** has acquired the controlling interest in **AMES MFG. CORP.,** manufacturers of a complete line of wire products, and in **JEB SALES CORPORATION,** producers of a television rotator . . . **CHESAPEAKE INDUSTRIES, INC.** of New York has purchased the **ALLEN D. CARDWELL MFG. CORP.,** electronics firm with plants in Plainville, N. Y. and Stamford, Conn.

* * *

E. P. GERTSCH has been elected chairman of the West Coast Electronic Manufacturers' Association's Los Angeles Council for 1954.

Serving with Mr. Gertsch are R. G. Leitner of *Packard-Bell* as vice-chairman and Gramer Yarbrough of *American Microphone Company* as secretary-treasurer.

New directors include Ed Grigsby, *Altec-Lansing Corp.;* Don Duncan, *Helipot Corp.;* W. V. Phillips, *Hoffman Radio Corp.;* and Thomas J. Walker, *Triad Transformer Mfg. Co.*

* * *

GENERAL ELECTRIC COMPANY'S Tube Department has received its fifth award for its public relations program on behalf of the service industry.

Here's the Most Compatible Line of Matched Hi-Fi Components

in the industry today!

Custom Music Ensemble

Dual Coaxial Speaker A1-400

Preamplifier-Control Unit A1-200

Power Amplifier A1-300

Baton Tone Arms:
A1-500 (12")
A1-501 (16")

Speaker Enclosure (Blond, Mahogany or Unfinished Veneers) A1-406

From stylus to speaker General Electric designs... engineers... and manufactures more of its own components than any other company. The result: matched equipment worthy of the name! Forget about stocking many different brands and offer customers *one integrated sound system* that minimizes distortion.

Remember, you are already a sales step ahead with the famous General Electric cartridge. No other high quality line is as complete ...as preferred...as outstanding in performance and price as G-E! And, people everywhere who listen once to the complete Custom Music Ensemble then look at its low price tag, sell themselves. To go places in the Hi-Fi business... go all the way with G.E.! For complete information, mail the coupon below, today.

G-E VARIABLE RELUCTANCE CARTRIDGES

New Stylus

Worn Stylus

Why you should use a G-E *Diamond* Stylus Cartridge.
All records cause stylus wear. The result: reduced record life and performance. Tests conducted on diamond styli have run hundreds of hours with no audible distortion and only highlights on the styli to indicate visible wear.

General Electric Company, Section R934
Electronics Park, Syracuse, New York.
Send me information on all units in the G-E high-fidelity equipment line.

NAME _____

ADDRESS _____

CITY _____ STATE _____

GENERAL ELECTRIC

The National Alliance of Television and Electronic Service Associations presented its award to the firm for the second straight year, citing the Tube Department "for outstanding service to television service management in creating better customer relations."

Previous awards include those from NATESA, Associated Radio and Television Service Dealers, Inc. of Columbus, Ohio, The Federation of Radio Servicemen's Associations of Philadelphia, and RTG of Boston.

* * *

JOHN N. PHILLIPS has been named manager of color television products engineering for *General Electric Company's* radio and television department while Carroll R. Miner has been appointed to a similar post for monochrome products.

The two new appointments are part of the firm's reorganization plan to gear the television product engineering department for the mass production of color television receivers.

Mr. Phillips graduated from Union College in 1940 and joined the company immediately following his graduation.

Mr. Miner has been with *G-E* for 25 years and was a member of the original engineering group at Schenectady in 1934. Until recently he was manager of TV product engineering.

* * *

DeVRY TECHNICAL INSTITUTE is the new name for the television, radio, electronics school formerly known as *DeForest's Training, Inc.*

The renamed school will occupy new quarters at 4141 W. Belmont Ave. in Chicago.

* * *

WORLD RADIO LABORATORIES, Council Bluffs, Iowa distributor, suffered a disastrous fire on January 3rd which completely destroyed its store.

According to Leo Meyerson, head of the firm, plans have now been completed for moving into a new ultra-modern fireproof plant at 3415-27 W. Broadway, Council Bluffs. The new building contains 30,000 square feet of floor space plus an additional 30,000 square feet of customer parking area.

Mr. Meyerson also announced that no attempt would be made to salvage equipment from the burned out building and that all equipment would be new, as will be all components used in reconditioning ham gear in the Used Amateur Equipment Division.

Copies of the company's 1954 catalogue are available from the company at its new address.

* * *

DALMO VICTOR COMPANY, San Carlos, California electronics firm, has been sold to *Textron Incorporated,* a textile firm.

Dalmo Victor has become a subsidiary of the parent company but will continue under present management.

—30—

$5,000
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

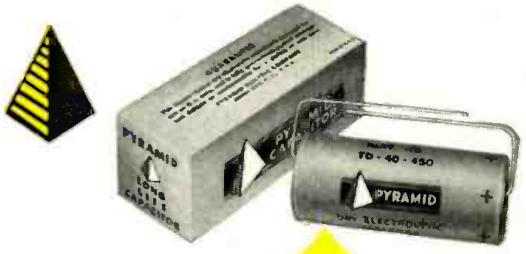
To win one of these 503 prizes all you have to do is complete in 25 words or less "I like Pyramid capacitors because_____" You fill in this statement on a Pyramid contest entry blank which can be obtained from any electronic parts jobber selling Pyramid capacitors. You have this entry blank countersigned 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 they always check out perfectly and don't deteriorate and so I know I won't have to call back at my expense."

"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."

PYRAMID



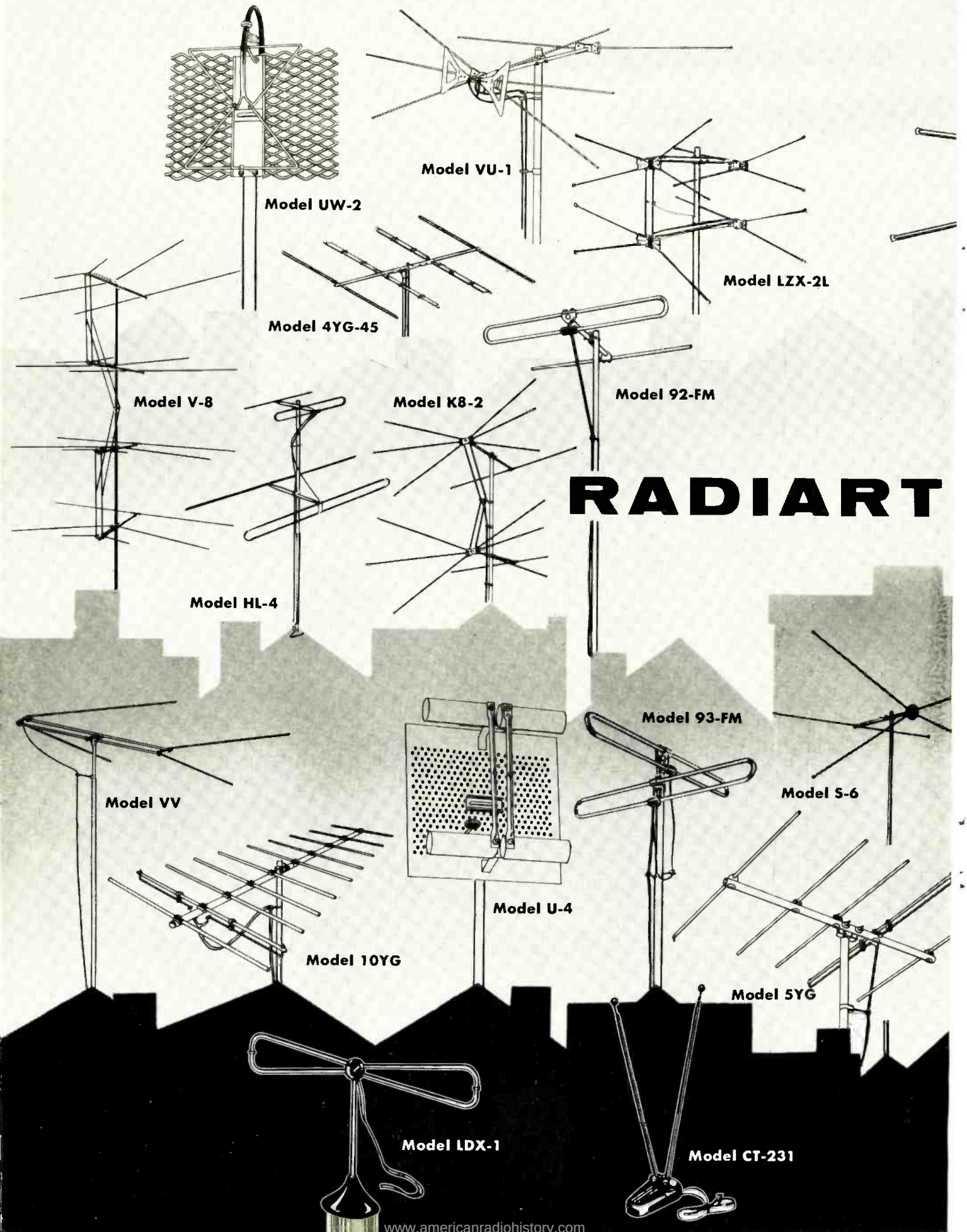
PYRAMID FEATURES:

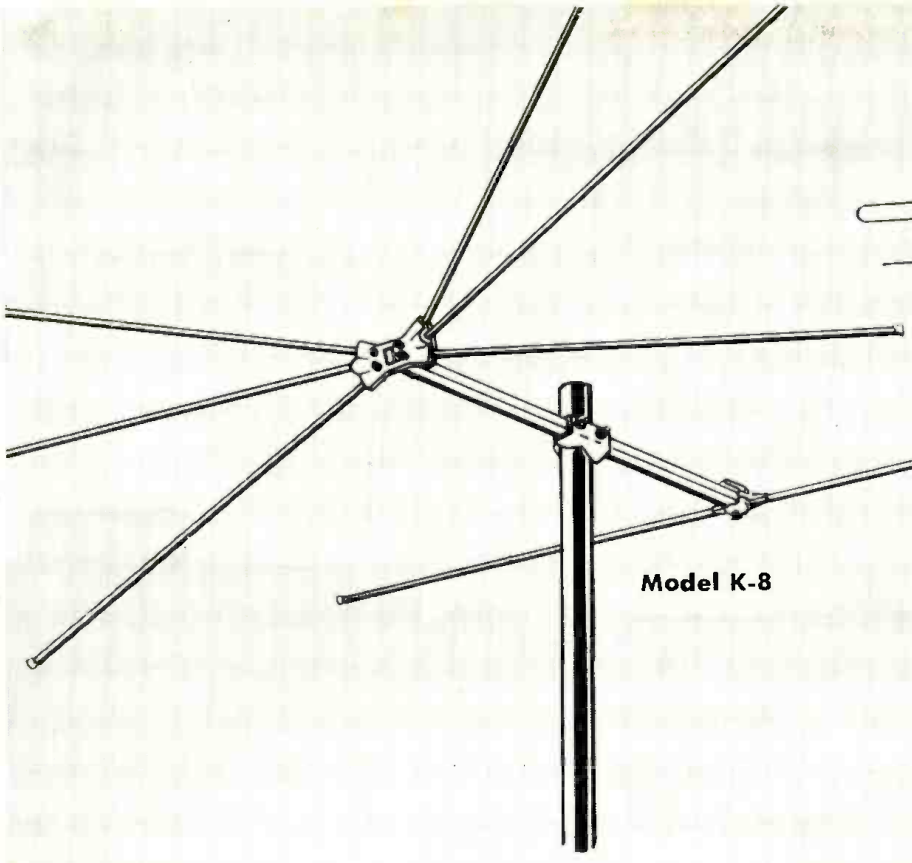
1. Only one quality—the best at no premium. All Pyramid capacitors are made of materials commanded by rigid military specifications.
2. All Pyramid capacitors are non-hygroscopic.
3. Highest quality insulator material used in all production results in low leakage factor.
4. Exclusive non-contamination 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.

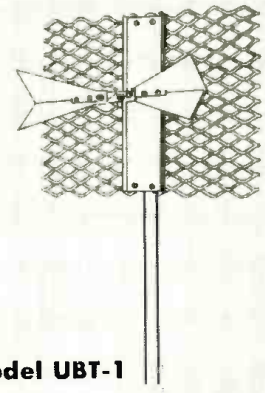
PYRAMID ELECTRIC COMPANY
1445 HUDSON BOULEVARD
NORTH BERGEN, N. J.

Burton browne advertising



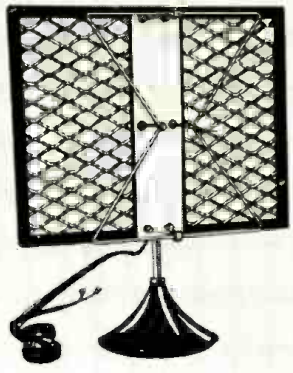


Model SL



Model UBT-1

Model K-8

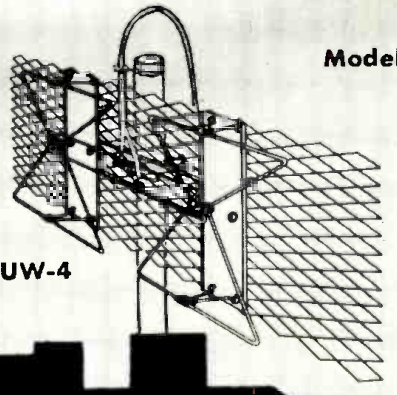


Model UW-1-2

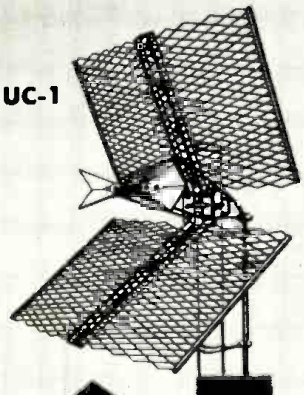
has a type for every need . . .
a design for every application

UHF and VHF ANTENNAS

Ready For Immediate Delivery



Model UW-4



Model UC-1

THE **RADIART** CORPORATION
CLEVELAND 13, OHIO

TV ANTENNAS * AUTO AERIALS * VIBRATORS * ROTORS * POWER SUPPLIES

The New SYLVANIA SERVICE POLYMETER

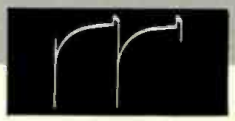
TYPE 301

REDUCE SERVICE TIME
READ DIRECT PEAK TO PEAK VOLTAGES

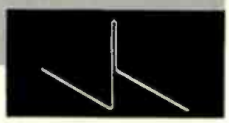
The new AC input circuit provides for full wave rectification to give you direct "P-P" readings of symmetrical and asymmetrical waveforms. This feature has been included in the new Polymeter to aid in measuring signals of a complex nature. A point to point search quickly localizes circuit failures and minimizes service time.

QUICK, ACCURATE MEASUREMENT OF COMPLEX WAVEFORMS

COMPOSITE VIDEO SIGNAL
Plate of video amplifier
(75 volts P-P)



COMPLEX WAVE FOR TRIGGERING
Grid of vertical oscillator
(180 volts P-P)



COMPLEX WAVE FOR DEFLECTION
Plate of vertical output tube
(700 volts P-P)

ENGINEERED BY SYLVANIA ... world famous in electronics
STYLED BY SUNDBERG & FERAR .... leaders in industrial design

LABORATORY PRECISION ACCURACY FOR DIRECT MEASUREMENT OF...

- ✓ P-P voltages from .2v to 2800v.
- ✓ DC voltages of plus or minus polarity from .05v to 1000v.
- ✓ AC voltages from .05v to 1000v.
- ✓ DC current from 50 Microamps to 10 amps.
- ✓ Resistance from .5 ohm to 1000 megohms.
- ✓ Decibels from −20 db to +61.4 db.

COMPARE THESE DELUXE FEATURES

- ✓ Peak to Peak Scale.
- ✓ New Sylvania 7" Meter Movement.
- ✓ Lighted Scale.
- ✓ Sylvania Patented Linearity Circuit.
- ✓ 17 Megohm Input Impedance.
- ✓ Shielded AC Lead.
- ✓ Screw-on Connectors.

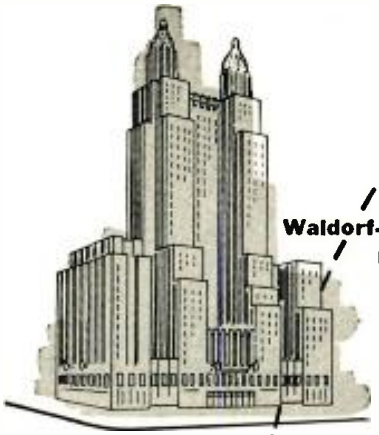
AVAILABLE THROUGH YOUR

SYLVANIA RADIO TUBE DISTRIBUTOR

Sylvania Electric Products Inc., Radio and Television Division

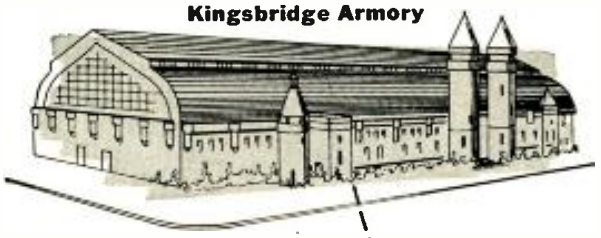
WILLIAMSPORT, PENNSYLVANIA

The eye-opening event of the radio-electronic new year!



Waldorf-Astoria Hotel

Kingsbridge Armory



For the past 12 months the vast, fast-growing radio-electronic industry has been preparing for 4 great days — March 22-25. This is when the IRE National Convention and Radio Engineering Show — the biggest and best ever — will take place in New York City. Be sure to join the other radio-electronic men — nearly 40,000 are expected — who will come, see and appraise the show at which all that is new will be unveiled.

A practical summary of radio-electronic progress will be unfolded at 54 technical sessions during the four-day period. 243 scientific and engineering papers, grouped by related interests, will be presented during these sessions, more than half of which are organized by IRE professional groups. Actually, you will be attending 21 conventions fused into one. New York's finest meeting facilities are provided — the Waldorf-Astoria Hotel plus 3 huge halls in Kingsbridge Armory. Transportation between the two locations is quick, easy — by subway and bus service.

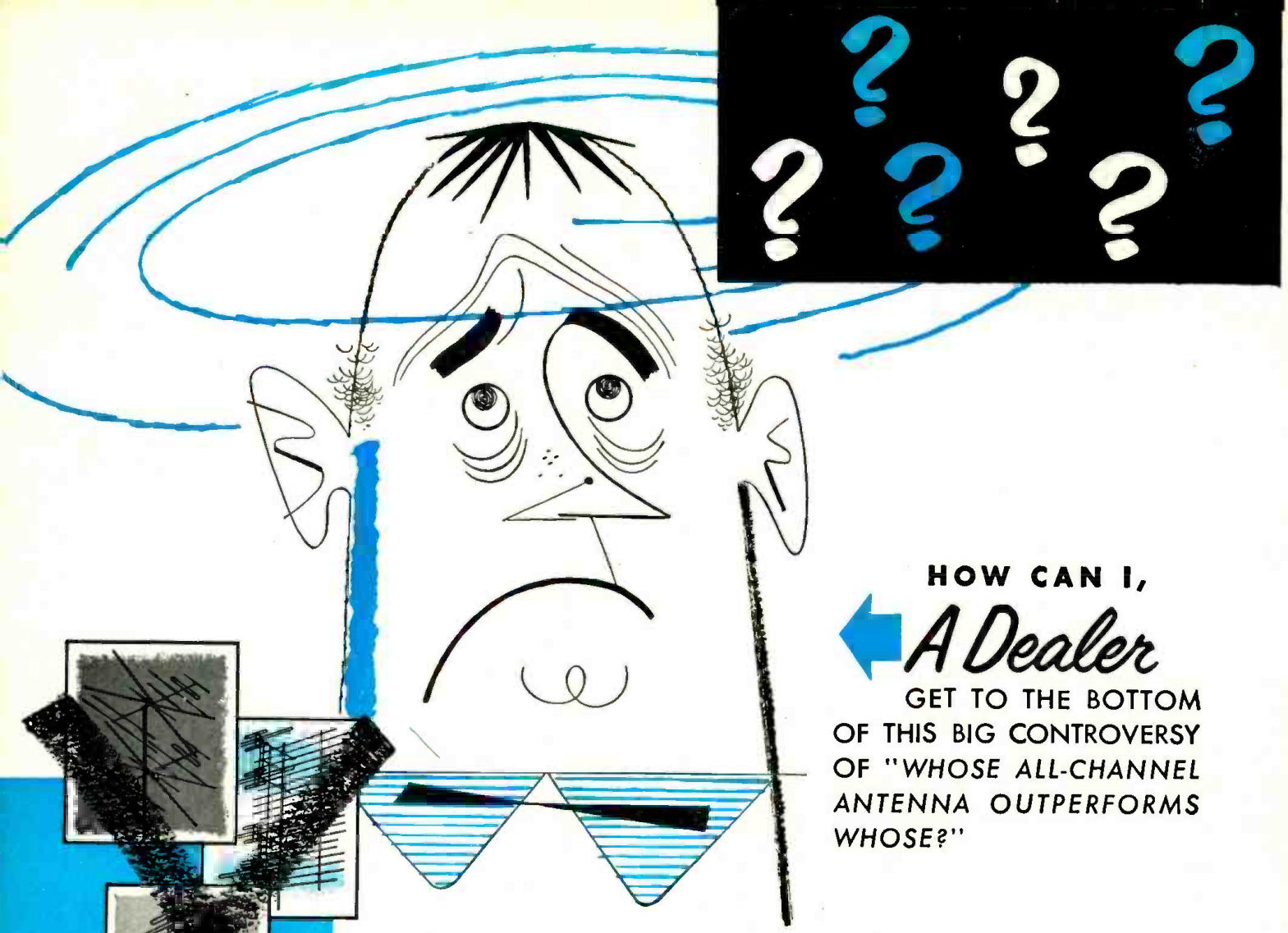
At the show you will find over 600 firms **"spotlighting the new"** in their high-interest product exhibits. These will extend over a mile and a half along avenues appropriately named for radio elements: "Instruments," "Components," "Airborne," "Radar," "Transistor," "Audio," "Microwave," etc. These exhibits, an education and revelation in themselves, fill the four-acre space of the great Kingsbridge Armory ... and can be viewed throughout any one or all of the four days.

Admission is by registration only, and serves for the four-day period. For IRE members the cost is only $1.00. For non-members it is a low $3.00, covering sessions and exhibits. Social events have been carefully planned. These are priced separately.

March 22-25, 1954

is the date! New York is the city where the radio-electronic event of the year will take place. Come! See! Enjoy!

THE 1954
IRE NATIONAL CONVENTION
AND
RADIO ENGINEERING SHOW
THE INSTITUTE
OF RADIO ENGINEERS
1 EAST 79th STREET, NEW YORK CITY



HOW CAN I,

A Dealer

GET TO THE BOTTOM OF THIS BIG CONTROVERSY OF "*WHOSE ALL-CHANNEL ANTENNA OUTPERFORMS WHOSE?*"

DO AS THOUSANDS OF OTHER DEALERS ARE DOING...

Test the super "KATYS" Yourself!

Find out for yourself, in your own area, why KAY-TOWNES can honestly guarantee that a super "KATY" will outperform any other all-channel TV antenna on the market today!

If we were in your shoes, with a local Dealer-Service reputation to protect . . . *and add to* . . . we would do exactly as you *should do!* WE WOULD RUN OUR OWN PERFORMANCE TESTS ON THE SUPER "KATYS"!

In the next few months, many of our competitors are going to attempt to copy the "KATYS" . . . just as they did our "BIG JACK". We have already taken the necessary steps to stop them . . . *and to protect our dealers.* This is the price forced upon us, because of our recognized leadership in the field of "fringe area" antenna design.

When you stop to think, it is easy to understand why KAY-TOWNES is so far ahead of the pack. While the others have been busy "commercializing" strictly on production to satisfy the huge demand, KAY-TOWNES has been working toward the "*reception perfection*" demanded by today's more cautious buyers of Television!

4½ YEARS OF DEVELOPMENT, with our resources and energies trained upon the objective of designing and engineering the world's finest TV antenna, has produced the SUPER "KATYS". What the SUPER "KATYS" will do toward the betterment of Television enjoyment is a foregone conclusion.

Look for KAY-TOWNES' big consumer ads appearing in *Life Magazine* . . . *Country Gentleman* . . . *Progressive Farmer* . . . and many other of the leading home publications!

The combined readership of all these publications will add up to more than 30,000,000 individual readers in the most productive "fringe areas" in America! *Think what this means in terms of selling help for you!*

It's a fact...

The amazing, "long-distance", photo-clear reception performance of the KAY-TOWNES SUPER "KATYS" makes all other all-channel antenna designs as obsolete as the 7-inch screen!

THE SUPER "KATYS" WILL PROVE . . . THE BEST SET IS ONLY AS GOOD AS ITS ANTENNA!

WHO CAN I BELIEVE

Who IS TELLING THE TRUTH ABOUT TV ANTENNA PERFORMANCE... *and who isn't!*

WE CAN ONLY ANSWER FOR OUR OWN ANTENNAS . . . *AND THEN LEAVE THE ENTIRE QUESTION UP TO YOUR OWN GOOD, QUALIFIED JUDGMENT!*

***THE NEW,* KAY-TOWNES SUPER "KATYS" ARE *POSITIVELY GUARANTEED* TO OUTPERFORM ANY OTHER ALL-CHANNEL ANTENNA ON THE MARKET TODAY!**

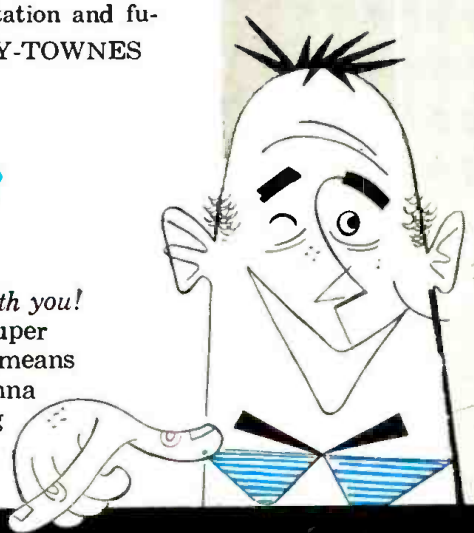
This is an absolute fact, and not simply an advertising statement! In our search for a perfect All-Channel Antenna design we have, in the past 4½ years, developed countless arrays *with ability to perform as well and often better* than any competitive design available. We didn't stop there!

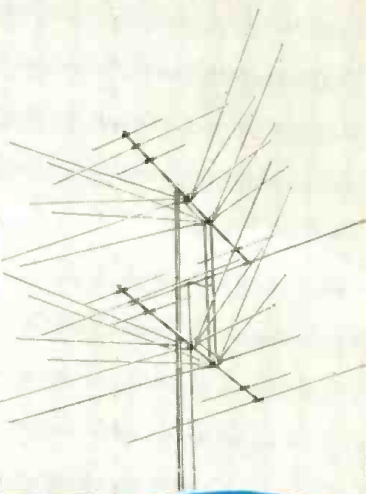
The more we probed into the secrets of TV reception, the more convinced we became that with the *right research and study*, the *right engineering and experimentation* we could finally develop a truly amazing and outstanding TV Antenna. We didn't stop until we did just that!

We've crossed and recrossed our engineering trails many times. We've made every test and check possible. We stake our reputation and future on the positive GUARANTEE we make for the KAY-TOWNES SUPER "KATYS"!

What does this Guarantee mean to You...a Dealer?

First of all, it means that we are absolutely sincere with you! It means that we are willing to stand behind the Super "KATYS" with all the resources at our command. It means that you can finally SELL an All-Channel TV Antenna you can depend on to do the best possible receiving job for any installation!





KAY-TOWNES
ANTENNA COMPANY
ROME, GEORGIA

Recognized leaders in the field of fringe area antenna design

NOW . . . 2 SENSATIONAL EICO SCOPE VALUES!

NEW AMAZING FEATURE PACKED

7" PUSH-PULL OSCILLOSCOPE

Only EICO Has All These Features

- VERTICAL FREQ. RESPONSE: flat ± 2 db 10 cps — 1 mc
- VERTICAL SENS.: .01 volts rms/inch
- HOR. FREQ. RESP.: flat ± 0 db 10 cps — 200 kc, —4 db at 500 kc
- HOR. SENS.: .3 volts rms/inch
- SWEEP RANGE: 15 cps-100 kc
- 3-STEP FREQ.-COMPENSATED ATTENUATOR eliminates freq. distortion, overloading.
- CATHODE FOLLOWER inputs to both amplifiers
- PUSH-PULL outputs in both amplifiers
- RETURN TRACE BLANKING
- INT. VOLTAGE CALIBRATOR
- V & H TRACE EXPANSION & CENTERING: 1.5X full screen without distortion.
- DIRECT CONNECTION to vert. CRT plates.
- PHASING CONTROL of internal 60 cps sine wave sweep.
- AT FRONT PANEL: intensity mod. input; 60 cps, sawtooth outputs.

MODEL 470K
KIT $79.95. WIRED $129.50.

EICO EXCLUSIVE! 5" PUSH-PULL SCOPE, 425K, Amazing feature-packed economy-priced Wired, $79.95. KIT, $44.95.

- PUSH-PULL V & H amplifiers. Sens: 0.5-.1 rms v/in. Useful to 2.5 mc.
- SWEEP: 15 cps-76 kc. Z-axis intensity modulation. Dual trace positioning controls.

SCOPE VOLTAGE CALIBRATOR KIT 495K KIT $12.95. WIRED $17.95.
- Sq. wave output at power-line freq. with full-scale readings of .1, 1, 10 or 100 V. peak-to-peak.
- Accuracy ± 5% of full-scale on each range.

6V & 12V BATTERY ELIMINATOR KIT 1050K KIT $29.95. WIRED $38.95.

- DC output: 0-8 V or 0-16 V.
- Continuous current rating: 10 A at 6 V, 6 A at 12 V.
- Intermittent current rating: 20 A at 6 V, 12 A at 12 V.
- Separate voltmeter & Ammeter.

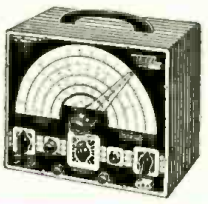
NOW! ONLY EICO KITS & WIRED INSTRUMENTS Gives You LIFETIME SERVICE & CALIBRATION GUARANTEE*

*at less than our cost of handling (See EICO Guarantee Card enclosed with each Kit & Instrument).

221K VTVM KIT $25.95. WIRED $49.95.

- AC & DC volts: 0-5, 10, 100, 500, 1000 V (30 KV with HVP-1 probe).
- 5 ohm ranges from .2 ohm to 1000 megs.
- DC input Z 26 megs.
- 4½" meter movement in can't-burn-out circuit.
- 1% mult. resistors.

360K SWEEP GEN. KIT $34.95. WIRED $49.95.



- Continuous coverage of all TV & FM freqs. from 500 kc to 228 mc.
- Sweep width variable 0-30 mc.
- Crystal marker oscillator, variable amplitude.

HIGH VOLTAGE PROBE $6.95
- Extends range of VTVMs & voltmeters to 30 KV.

PIX TUBE ADAPTER for Tube Testers $4.50. Checks TV picture tubes while in set.

214K VTVM KIT $34.95. WIRED $54.95.

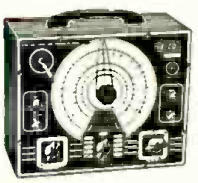
- Large 7½" meter, can't-burn-out circuit.
- AC/DC volts: 0-5, 10, 100, 500, 1000 (30 KV with HV Probe).
- 5 ohms ranges from .2 ohm to 1000 megs.
- DC input Z 26 megs.
- 1% mult. resistors.

625K TUBE TESTER KIT $34.95. WIRED $49.95.

- Illum. gear-driven "Speed Rollchart."
- New lever-action switches for individual testing of every element.
- Tests all conventional & TV tubes.

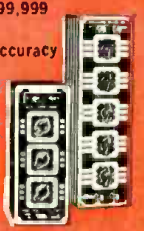
COUNTER CABINET for above: add $10.00 to Kit or Wired Prices.

950A-K R-C BRIDGE & R-C-L COMP. KIT $19.95. WIRED $29.95.



- Measures & tests all resistors; .5 ohm to 500 megohms.
- Every type condenser, 10 mmf to 5000 mfd.
- 0-500 DC voltage source for capacitor leakage testing.

1171K RES. DECADE BOX KIT $19.95. WIRED $24.95.
- Resistance values from 0 to 99,999 ohms with 0.5% precision.
- All resistors have 0.5% accuracy



DECADE CONDENSER BOX KIT 1180K KIT $14.95. WIRED $19.95.
- All capacitors precision silver mica, accuracy ± 1%.
- Range from 100 mmf — 0.111 mfd in steps of 100 mmf.
- Smooth-action positive detent ceramic switches.

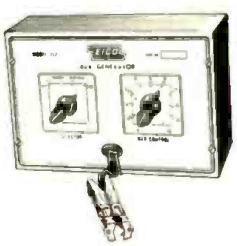
Prices 5% higher on West Coast. Specifications and prices subject to change without notice.

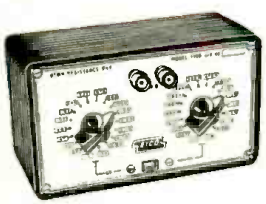
New! EICO SCOOPS!

CATHODE RAY TUBE CHECKER 630K, WIRED $24.95 KIT, $17.95.

- Checks all types of TV picture and C.R. tubes in the set or carton. Bridge measurement of peak beam current (proportional to screen brightness).
- Detects shorted & open elements.

BAR GENERATOR 352K, WIRED $19.95 KIT, $14.95
- Enabels rapid adjustment of TV picture V & H linearity without hard-to-find station-transmitted test pattern.
- Produces 16 V or 12 H bars. Operates on TV channels 3, 4, or 5.





RTMA RESISTANCE SUBSTITUTION BOX 1100K WIRED $9.95 KIT, $5.50.
- Enables rapid substitution of resistances from 15 ohms to 10 megs in decade multiples of 15, 22, 33, 47, 68, 100 ohms.
- Uses 36 standard 1 watt, ± 10% RTMA resistors.

315K DELUXE SIG. GEN. KIT $39.95. WIRED $59.95.

- Covers range of 75 kc to 150 mc.
- 7 calibrated scales: accuracy better than 1%.
- Bandspread vernier tuning.
- 4-step RF shielded output multiplier: constant output Z.

565K MULTIMETER KIT $24.95 WIRED $29.95.

555K MULTIMETER KIT $29.95 WIRED $34.95. (1% precision resistors)

- 20,000 Ω/V; 31 ranges.
- DC/AC/Output volts: 0-2.5, 10, 50, 250, 1000, 5000.
- DC Current: 0-100 ua; 10, 100, 500 ma; 10 A.
- Ohms: 0-2K, 200K, 20 meg.

377K SINE & SQUARE WAVE AUDIO GEN. KIT $31.95. WIRED $49.95.

- Complete sine wave coverage, 20-200,000 cps in 4 direct-reading ranges.
- Complete square wave coverage, 60-50,000 cps.
- Cathode follower output circuit.

145K SIG. TRACER KIT $19.95. WIRED $28.95.

- Audibly signal traces all IF, RF, Video & Audio circuits from ANT to SPKR or CRT in all TV, FM, AM, etc. without switching.
- Germanium crystal diode probe responsive to over 200 mc.
- Integral test speaker.

536K MULTIMETER KIT $12.90. WIRED $14.90.
526K MULTIMETER KIT $13.90. WIRED $16.90.

- 1000 Ω/V; 31 ranges
- DC/AC volts: Zero to 1, 5, 10, 50, 100, 500, 5000.
- DC/AC Current: 0-1, 10 ma; 0.1, 1 A.
- Ohms: 0-500, 100 K, 1 meg.

320K SIG. GEN. KIT $19.95. WIRED $29.95.
322K SIG. GEN. KIT $23.95. WIRED $34.95.

- Fundamentals 150 kc to 34 mc, harmonics to 102 mc.
- 5-step band switching.
- Colpitts audio oscillator generates 400 cps pure sine wave voltage.
- Permits pure RF, modulated RF, or pure AF.

Write NOW for FREE latest Catalog R-3

See our I.R.E. Booth No. 209—211. Ask your jobber for FREE EICO business building decals.

EICO

Seperate Assembly & Operating Manuals supplied with each EICO KIT!

You build EICO Kits in one evening, but . . . they last a lifetime!

SAVE OVER 50%! See the famous EICO line TODAY, at your local jobber.

ELECTRONIC INSTRUMENT CO., Inc., 84 Withers Street, Brooklyn 11, N. Y.

LOOKING AHEAD

By **HAROLD J. SCHULMAN**
Chairman, Service Committee, RETMA

An appraisal of the status of servicing today, and of the new opportunities for service technicians in u.h.f. and color TV, hi-fi, and tape recording.

RIGHT at this moment more than thirty million television receivers are plugged into handy wall sockets. A simple "twist of the wrist" and a "window on the world" is brought into being in thirty million homes.

Ten years ago, you could have been a millionaire and still not have been able to enjoy the magic of big screen television that we take for granted today. This modern miracle was made possible by teamwork such as exists in no other industry. Receiver manufacturers conceived and produced this wonder-child. The broadcasters give it its daily sustenance. And service technicians keep it alive. Without the combined efforts of these main segments of our industry, television as we know it today could not come to pass. The service technician is not just a repairman, installer, or tinkerer. He is a most important member of the team helping to make electronic developments enrich the lives of all of us.

What can we look forward to in television service? With the FCC approval of compatible color, this question almost answers itself. But let's for the moment look back a bit to see where we are today.

Television service has passed through several distinct stages. The first, or introductory stage, featured factory sponsored or controlled one-year service contracts. Many manufacturers, either through their own organizations or their distributors, encouraged the sale of factory service contracts. This led to the build-up of giant service companies, some good—some bad.

Changing times brought the decline of the large service company. A number of factors helped this along. Receiver prices came down. The cost of a service contract thus looked high in relation to the cost of the set. Design improvements and competitive conditions also combined to encourage the consumer to risk owning a set without service contract coverage. Also, too many service companies were closing their doors, leaving angry contract owners with nothing more than worthless pieces of paper to show for their money.

All this led to a trend away from the service contract. Independent service technicians, some of them former employees of the larger companies, started taking over more of the available service work on a charge-per-call basis. Moderate-size service companies and dealer service organizations completed the group then handling the country's service requirements. This is mostly on a charge-per-call basis.

Of course, there are occasional exceptions where a large well-managed service organization survived and thrived. But the trend is definitely to smaller organizations and independent service technicians. It is interesting to note that even a major factory service organization is pulling in its large-scale horns. A trade report says that it is selling or closing its service company branches in cities with less than 100,000 population.

While the consolidation of this trend was going on, u.h.f. bounced on the scene. The educational process started all over again. Experienced service technicians had to learn new techniques. Newcomers in newly opened areas really had to scratch around a bit to get things rolling right.

H. J. SCHULMAN—studied electronics at Syracuse University and business administration at N. Y. U. During the war, served in the Air Force doing radar maintenance and teaching radar. After the war, had a retail radio and TV sales and service business in New York. Was TV service manager for Admiral distributor in New York City, and has been Director of Service at Allen B. Du Mont Labs. for past three years. Co-authored a TV troubleshooting course for a correspondence school, and assisted in the preparation of a TV booklet for the New York City Better Business Bureau, subsequently adopted by the Radio-Electronics Television Manufacturers Association.

New u.h.f. antennas had to be put up. The tricks played by different transmission lines had to be mastered. The "why's" and "wherefore's" of strips, converters, and all-channel tuners had to be learned.

To add to the national work load, some v.h.f. stations switched channels in line with FCC recommendations. Set owners in these areas usually found some change in their reception. Sometimes it was better, sometimes worse. Where it was worse, the service technician heard about it.

That the service technician has been able to keep up with the changing scene—and for the most part, very admirably—is attested again by the latest Elmo Roper survey. Again Roper concluded that the overwhelming majority of television set owners was pleased with the service they received when they needed it.

This is a great tribute to the men in the service field. Thirty million television receivers—600 million television sockets with tubes that can, and often do, go bad, all in operation today, give us a feeling of confidence that the service industry will be able to meet new challenges with flying colors.

The service technician can be expected to take on increasing work on hi-fi equipment and tape recorders. But the main problem will still be black-and-white television in existing and ever increasing markets. Much emphasis will be in u.h.f. as more and more u.h.f. transmitters hit the air.

The main challenge, of course, will be color. This year can be called the "Year of Preparation" for color TV service technicians. The main emphasis at this point should be towards acquiring a good theoretical understanding of the NTSC signal.

At this writing there are no production line color sets available. This means that no one has reliable statistics or experience on color sets as they will roll out of the factories this fall.

Early indications show that for the most part the same broadband antennas used in black and white will be suitable for color. Narrowband antennas. or those with sharp dips at the color subcarrier frequency, may cause some trouble and will have to be watched carefully.

The installer will have to learn how to insert the color tube in the cabinet. According to current information, color picture tubes will most likely be shipped out of the cabinet. The installer will also have to set up a new series of color adjustments as well as spend more time teaching the customer how to tune in (*Continued on page* 143)

NEW TV

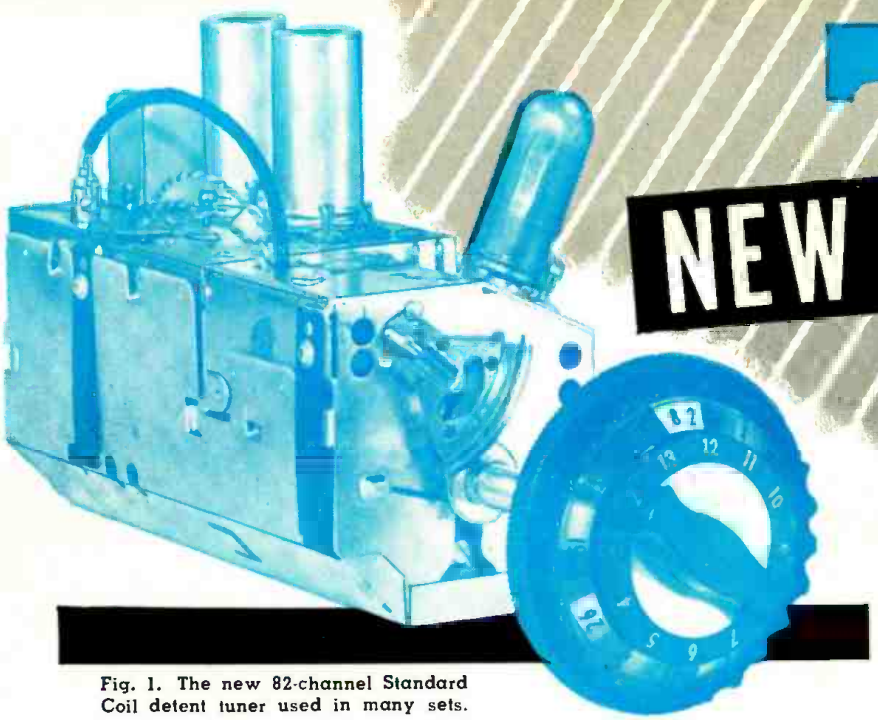


Fig. 1. The new 82-channel Standard Coil detent tuner used in many sets.

WITH the somewhat confused and uncertain market conditions caused partly by the advent of color TV and partly by the general slack in business, the television industry has prepared its 1954 models with great care. Shying away from radical innovations, most manufacturers have emphasized price, quality, and ease of servicing in their new designs. Most models feature time-tested electronic circuits, with improved mechanical design, and better layout for easier servicing and simpler assembly methods. Two new electrical features appear in almost every major TV line; high-fidelity sound, and a full u.h.f.-v.h.f. band tuner.

High fidelity has proven to be such good business that many TV manufacturers have diverted some of their facilities to radio-phonograph combinations, while others offer TV receivers with greatly improved sound quality, phono attachments, AM-FM combinations, etc. There are even TV sets on the market using two speakers, push-pull output amplifiers, and connections for tape recorders and record players.

The second feature, an 82-channel tuner, is incorporated in most of the better lines. The September 1953 issue of RADIO & TELEVISION NEWS described the *Standard Coil Products* 82-channel detent tuner which is used in TV sets made by *Admiral, Emerson, Hoffman, CBS-Columbia, Majestic, Olympic, Packard-Bell, Stewart-Warner,* and several others. The outstanding features of this tuner are the fact that it is a single conversion system, uses straight detent turret switching, and permits selection of each of the 82 channels simply by setting the two concentric dials until the desired channel number appears. This tuner is shown in Fig. 1.

Most of the other 82-channel tuners consist of a detent-type v.h.f. tuner, and a continuous-type u.h.f. tuner. These, however, were fairly common in 1953 models.

Before discussing individual new designs, the subject of color receivers deserves some mention. At the time of publication color TV sets are still as scarce as solid gold *Cadillacs*. During the second half of 1954, however, some color receivers will appear at the dealers. From current engineering plans it appears that practically all major manufacturers will use basically the same circuit, a type of "630" of the color variety. In a subsequent issue a detailed description of this first color receiver will appear, but for the present only some of its features can be mentioned.

The first color receivers will use a shadow mask tube, either the *RCA* tri-color tube, which is being produced by other manufacturers as well, or the *CBS-Hytron* "Colortron" which is a simplified version of the *RCA* tube. Most color receivers will use 82-channel tuners. It is expected that the color decoder section will be a separate sub-chassis, probably identical in all sets, and eventually as standardized as TV tuners. The i.f. section of all color sets will use the 41 mc. band and feature "bridged-T" rejection filters of great efficiency. The i.f. response curve must be flat to 4 mc. from the video carrier while the sound i.f., 4.5 mc. from the video carrier, must be at least 60 db down to avoid sound interference. These requirements will focus special attention on i.f. alignment both at the factory and by the service technician. Practically all aspects of the color sets will be new, but space does not permit a detailed discussion here.

New Electronic Designs

Instead of producing different TV receiver models for normal reception areas and for fringe areas, most manufacturers incorporate some type of adjustment for sensitivity in a single model. Two major systems are used to get better fringe area performance. One system makes use of a switch or potentiometer to set the level for the a.g.c., the other system concentrates on improving the sync action in the presence of noise or weak sync pulses.

In Fig. 2 are shown two versions of the *Admiral* "DX Range Finder." The a.g.c. system in Fig. 2A is a simple diode type and the "DX Range Finder" control sets the d.c. level of the bias voltage. The cathode of the a.g.c. diode is biased positively by the action of the voltage divider R_{322} and R_{321}, the contrast control. When maximum contrast is desired, the cathode of the video amplifier is grounded, putting the entire 1000 ohms of R_{321} in series with the a.g.c. diode and making the a.g.c. cathode quite positive. In addition to this variable voltage divider, a fixed network R_{314} and R_{338} also has control over the d.c. level at the a.g.c. diode cathode. The total effect of these two voltage dividers is to allow an increase in positive delay voltage, and therefore a decrease in a.g.c. bias when the contrast control is turned up. The potentiometer R_{315} together with R_{316}, C_{309}, and C_{310} form the time constant of the charging network for the a.g.c. diode. When R_{315} is set for maximum resistance, the developed a.g.c. bias will correspond to the peak sync pulse level of the video carrier, a condition desired in strong signal areas. As R_{315} is reduced, the time constant becomes shorter until the developed bias corresponds only to the average video carrier voltage. The reduced bias will provide more i.f. gain; at the same time, the short time constant does not allow the a.g.c. to be affected by strong noise pulses. The result is that both sensitivity and noise immunity are adjustable for each location.

In Fig. 2B is shown the a.g.c. circuit for the *Admiral* 22F series. In this chassis a keyed a.g.c. system is used and the "DX Range Finder" control sets the grid bias level of the a.g.c. tube. The grid bias of this tube controls the final a.g.c. voltage, but is determined itself by the amplitude of the horizontal sync pulses applied to the grid. Resistors R_{331} and R_{342} form a voltage divider controlling the d.c. bias on the a.g.c. tube. By adjusting R_{342} the final a.g.c. level is set, just as in the circuit of Fig. 2A.

In many other receivers, such as the 1954 *Majestic,* the fringe control simply consists of an additional resistor in the a.g.c. bias network which is switched in or out to reduce or increase the total bias. A variation of

DESIGNS FOR 1954

By

ROBERT B. GARY

A few new circuits and improved mechanical layout for better serviceability are the highlights of 1954 sets.

the fringe switch is found in the new *Westinghouse* V2240 chassis which uses a triode in a keyed a.g.c. circuit. In this unit the a.g.c. cathode is at 140 volts positive for local stations, allowing a certain a.g.c. voltage as determined by the flyback pulse and the composite video signal amplitude. For fringe operation a resistor in series with the cathode is shorted out by the fringe switch and the cathode potential is increased to 150 volts. This reduces the tube current and therefore the a.g.c. bias.

A second type of fringe area improvement is illustrated in Fig. 3, the sync pulse clipper used in the 1954 *Raytheon* models. The 6BE6 pentagrid tube receives two different video signals, one from the 2nd detector and the other from the video amplifier. The signal from the detector is applied to the control grid and is positive in polarity. The gating grid receives a much stronger negative signal from the video amplifier. By setting the d.c. voltage on the control grid, the level of clipping is set so that only the top of the sync pulse is passed by this tube. Since the tube can conduct only during the sync pulse period, noise pulses occurring during the video portion of the signal cannot pass the tube. Resistor R_{401}, called the "sync stabilizer" permits adjusting the operating level for the sync clipper tube for optimum performance in a particular area.

The new *Emerson* receivers feature a very effective sync stabilizing system which actually amplifies and inverts noise pulses so that cancellation of noise pulses is possible. When a noise pulse is greater in amplitude than the horizontal synchronizing pulse, it is amplified in a triode section and then fed back, in opposite polarity and slightly stronger than the original signal. The cancellation of strong noise pulses results in more stable sync action. For fringe area operation a potentiometer and "on-off" switch permit both a fine and rough level setting to determine at just what amplitude the noise inverter tube should function. This tube's bias level is set by the fringe compensator so that the tube is cut off for sync pulses, but any pulse higher than the sync level will set off the cancellation scheme. A similar noise cancellation system, but without the adjustable features, is found in the new *Philco* TV models.

Another new feature in many 1954 models is the higher i.f. of 41 to 45 mc. Although a few of the 1953 TV sets used these new frequencies, practically all manufacturers have switched to the higher i.f. for 1954. An increasing number of TV manufacturers use the new *RCA* printed circuit i.f. strip. For the service technician the higher i.f. range means a whole new set of interference problems, mostly due to local police broadcasts which are often in the 40 mc. band. (See article on TV interference in the July 1953 issue of RADIO & TELEVISION NEWS).

Concerning the printed circuit i.f. section, good grounding is essential in all alignment and troubleshooting because the entire i.f. assembly is subject to regeneration and oscillation.

In tune with the economy and power conservation policy followed in most late models, most manufacturers have arranged the d.c. power distribution for maximum efficiency and minimum losses in bleeder resistors. A typical example of this is shown in Fig. 4, the "B+" circuit of the *Admiral* 19B1 receiver series. In this system there is a total of five different branches for the d.c. power. The fuse is used to protect the high voltage flyback and "B+" boost voltage, isolating any breakdown in this section.

Mechanical Features

The 1954 *Zenith* models have two rather unique features as shown in Fig. 5. The speaker is retractable and can be pushed out of sight when the set is not in use. One advantage of this design is the compact cabinet size and the fact that the impression is given that the sound originates directly from the screen. This is some improvement

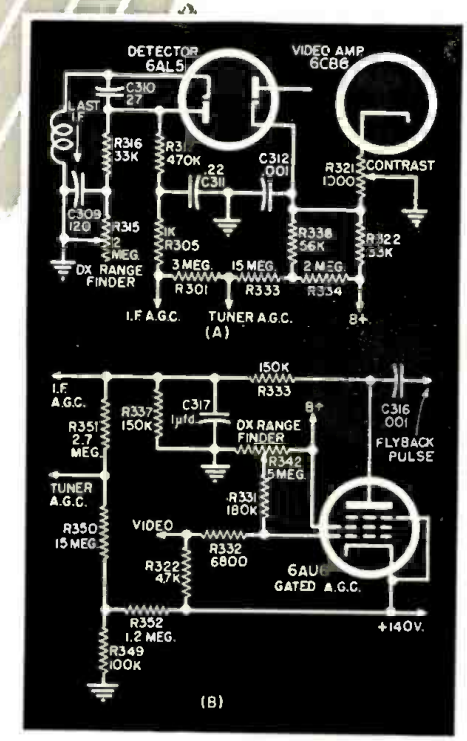


Fig. 2. Admiral, among others, uses a potentiometer to regulate the sensitivity of the receiver for fringe and normal viewing. The circuit in (A) is from the 19B1 series, the circuit in (B) is from the 22F chassis.

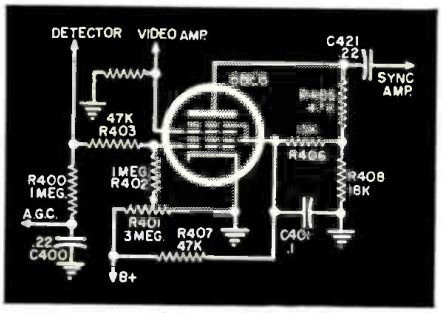
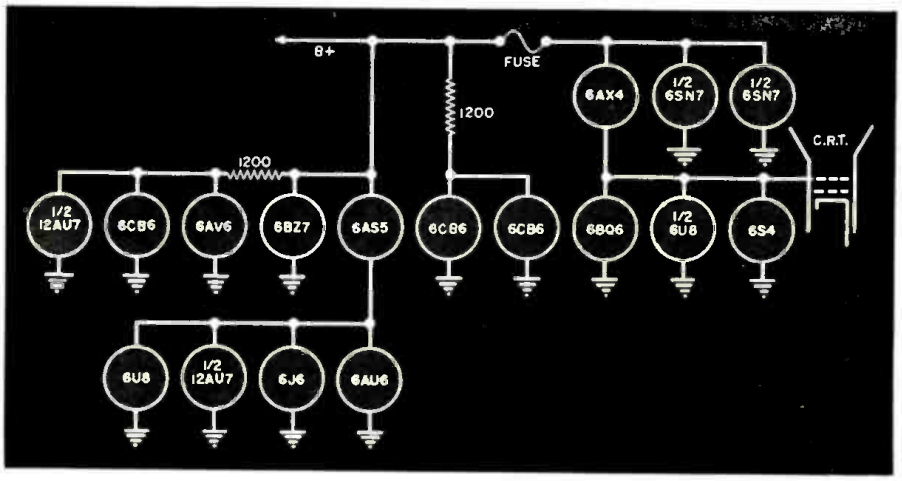


Fig. 3. Circuit of sync clipper used in Raytheon's 1954 TV receiver line.

Fig. 4. The "B+" distribution diagram for the Admiral 19B1 series chassis.



over the usual practice of mounting the speaker on the side, at the rear. A drawback is the fact that the mechanical arrangement for the retracting of the speaker is subject to various defects and although good sound is claimed by the manufacturer, the lack of any sort of baffle is hardly an improvement.

The second unique feature of the *Zenith* line is the channel selector. As seen in the illustration of Fig. 5, the selected channel lights up in large numbers at the center of the dial. This is a good sales feature since it makes it possible to see the operating channel number in the dark and at a distance. For the service technician this presents another possible mechanical troublespot for, in addition to burned out pilot lights, the switching arrangement is subject to friction and wear.

As mentioned in the beginning of this article, most manufacturers have also made some efforts to include features in their 1954 models which will appeal to the service technician since it is now understood that many sales are the result of the service technician's recommendation.

Among the "service engineered" new 1954 models is the *Stewart-Warner* "Thunderbolt" line as shown in Figs. 6 and 7. Fig. 6 shows a cleverly designed U-bracket which supports the deflection yoke assembly and at the same time permits the service technician to turn the chassis upside down for easier servicing. This bracket can also be used as a handle for pulling the chassis from the cabinet, carrying it, resting the chassis on either side, and rolling it over as might be needed. In addition, the U-bracket eliminates the customary center bracket which usually makes some of the tubes hard to reach. The circuit layout of this chassis is designed for greatest accessibility, all tubes can be reached with the receiver in the cabinet, and high-voltage fuse replacement can be effected from the rear without soldering or removing the chassis.

A further boon to the technician is the fact that both deflection yoke and high-voltage transformer can be replaced from the rear of the receiver, without soldering connections. Fig. 7 shows how to disconnect and remove the flyback transformer. All connector plugs are color coded to avoid errors.

Many other TV manufacturers use plug-in arrangements for the focus coil and deflection yoke to allow for easier replacement, and accessible fuses are also found frequently. The new *Majestic* receivers even use two separate fuses in snap-on holders. One fuse, a 3 amp. type, protects the entire receiver, while a regular ¼ amp. fuse is used for the high-voltage section.

Since many TV sets sold in 1954 will have u.h.f. channels added or may require changing of tuner coil plates, several leading TV manufacturers provide access doors underneath the tuner assembly. *Majestic* and *Packard-Bell* receivers, as well as other popular brands, have a small trap door, set into the cabinet bottom of the table models for this purpose. It will usually be necessary to remove the tuning knobs and adjust the oscillator frequency with a tuning rod from the front panel. In many cases where the tuning slug has been pushed in too far during adjustment it will no longer be necessary to remove the entire chassis for correction.

Another good idea in TV design is the use of a removable safety glass on the front of the cabinet. While many manufacturers have used this in the past, it is only now gaining widespread acceptance. Some receivers, like the new *Packard-Bell* models, use a tilted safety glass, mounted on soft rubber, which is easily removable and can be cleaned and replaced without affecting any other part of the television receiver.

Surveying the innovations for 1954 we find that they include many welcome features which are expected to ease the burden of the service technician. A number of manufacturers have obviously consulted their service departments before settling on any new design and the result will be felt by both manufacturer and customer. Other features are based on economy, such as the fairly widespread use of selenium rectifier supplies instead of the more expensive power transformer and tube combination.

Most components and circuits have already become standardized and apparently few actual improvements are possible at this time. It is more economical to use a proven system for which all parts are readily available than embark on new developments which usually require special components and a lot of expensive engineering, field testing, and modifying afterwards.

The trend in TV picture tubes is definitely towards the 21, 24, and 27 inch sizes. The new popular screen will be at least 21 inches. A good quantity of 27-inch tubes in economy style cabinets is also expected to be marketed.

—30—

Fig. 5. Shown here are an ingenious speaker arrangement and channel dial.

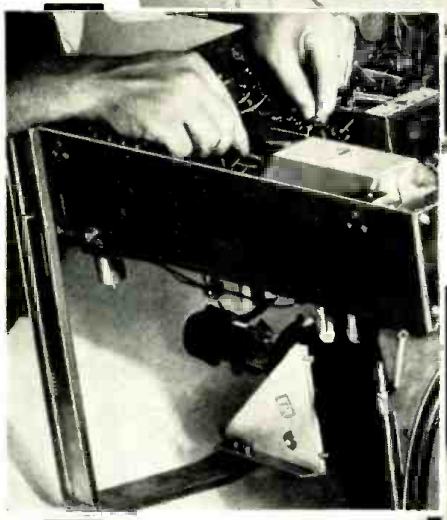
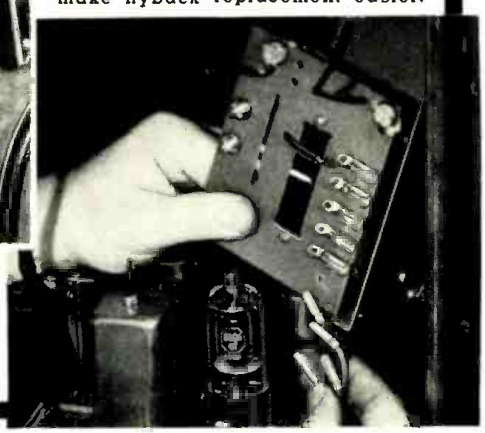


Fig. 6. The new Stewart-Warner sets include bracket on which to rest set when it is turned over for troubleshooting and repair.

Fig. 7. The plugs used in this receiver make flyback replacement easier.



CRYSTAL SUBSTITUTE

By
J. G. DONALD

Fig. 1. The v.f.o. and transmitter set-up. The author uses his unit with a Heath Model AT-1 transmitter kit, but it will work with other transmitters.

Build this compact v.f.o. for your crystal-controlled transmitter. The unit uses standard parts throughout.

WHILE crystal-controlled transmitters are usually the most economical to build or buy, they are not always desirable for use in crowded areas of the amateur bands. A simple v.f.o. is just the thing to avoid interference, especially when applied to low-powered transmitters and limited antenna space. Since a v.f.o. can be a tremendous help, it is worth the time spent in constructing one.

A typical v.f.o. and transmitter setup is shown in Fig. 1.

The *Heath* Model AT-1 transmitter kit was chosen because of its economy and bandswitching facilities. Power for the v.f.o. is supplied by the transmitter through an octal socket mounted on the rear of the chassis.

A series-tuned Colpitts oscillator circuit is used as shown in Fig. 2. The grid coupling condenser which is usually used in this type of circuit has been omitted because the circuit will work with or without it. The 6AQ5 miniature tube, mounted to the right of the 0A2 regulator, uses less space in the 3"x4"x5" aluminum box than the equivalent 6V6.

Oscillations are prevented by operating the v.f.o. on 160 meters and its output on 80 meters. The oscillator coil is a standard *Bud* OCL-160 which fits a five-prong socket. The oscillator plate coil is resonant about the middle of the 80-meter band and requires no tuning.

Instead of mounting the series resistor inside the v.f.o. box, it was mounted between pins four and five of the v.f.o. power output socket on the transmitter chassis. This eliminates heat accumulation in the v.f.o. box. The plate voltage for the v.f.o. is obtained from pin 5 on the socket instead of pin 4. In case this particular transmitter is not used, provisions should be made to mount the resistor outside the box, preferably inside the transmitter chassis.

The key jack on the front of the oscillator unit is not used. Originally, the oscillator was to be keyed for break-in operation. But since the

(*Continued on page* 122)

R_1—*100,000 ohm, ½ w. res.*
R_2—*12,000 ohm, 10 w. wirewound res. (see text)*
C_1—*50 μμfd. var. cond.*
C_2—*100 μμfd. var. cond.*
C_3, C_4—*.001 μfd., 600 v. cond.*
C_5—*.01 μfd., 600 v. cond.*
C_6—*100 μμfd. mica cond.*
L_1—*160 m. osc. coil (Bud OCL-160)*
L_2—*#30 en., 7/8" long, closewound on ½" form*
RFC_1—*2.5 mhy. r.f. choke*
P_1—*Octal plug*
P_2—*2-circuit plug, to fit crystal socket*
SO_1—*Octal socket*
V_1—*6AQ5 tube*
V_2—*0A2 tube*

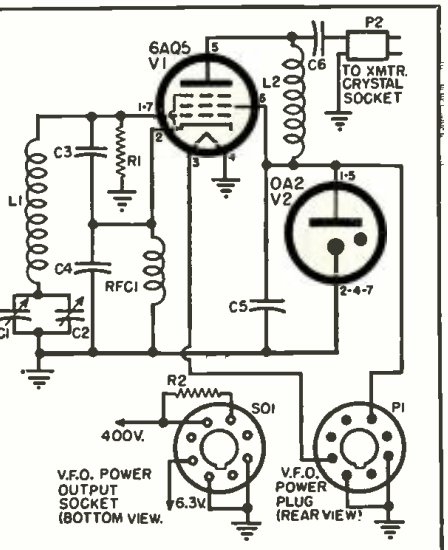
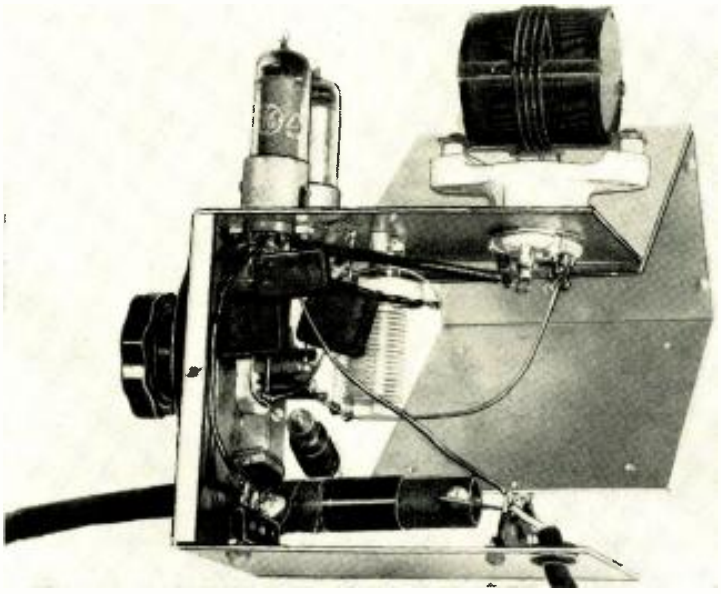


Fig. 2. Schematic of the "crystal substitute," a series-tuned Colpitts oscillator.

Fig. 3. Interior view of the v.f.o. box shows component layout. Placement of the parts is not too critical and almost any component arrangement can be used. Condenser adjustments are made from top of box.



TV TEST EQUIPMENT

By

ROBERT G. MIDDLETON
Author, "TV Troubleshooting Guide"

PERHAPS less than in any other trade do the five senses of the TV technician directly serve their possessor. Occasionally an overloaded resistor, arced transformer, or shorted condenser may make itself evident to the sense of smell; some faults announce themselves to the sense of hearing as noisy, distorted, or weak sound; other faults display their character in the form of picture distortions; overheated transformers, tubes, and resistors are evident to the sense of touch; and some gross mechanical failures, such as broken leads, may be directly visible. In the main, however, the majority of faults which occur in a TV chassis can be revealed only by means of suitable test equipment. The components of a TV chassis appear quiescent and uninformative to the unaided eye, but when investigated with suitable instruments exhibit myriads of rapid electrical actions. Oscilloscopes, vacuum tube voltmeters, and similar instruments are extensions of sense, particularly the sense of sight, which enable the operator to peer into the innermost activities of electrical circuits.

Sweep Generators

Among the major circuits of a TV receiver are the tuned signal circuits, comprising the r.f. mixer and i.f. amplifiers. Practically all receiver service data provides average response curves of voltage *vs* frequency for these circuits, and responses of the type shown in Fig. 1 are quite familiar to most TV technicians. Less well known, perhaps, are the requirements for suitable sweep generators for such applications. In general, the r.f. circuits of the receiver impose the severest demands upon a sweep generator and the user of the instrument is concerned with the following performance factors:

1. Is the sweep generator a true r.f. sweeper, or is it primarily an i.f. sweeper, relying upon harmonic output for high-band coverage?
2. Does the sweep generator have sufficient output on the high channels to obtain satisfactory scope deflection?
3. Is the attenuator satisfactory for r.f. sweeping, providing control of the output voltage without distorting the response curve at various settings?
4. Most important of all, is the output voltage from the sweep generator flat within plus-or-minus 10% over the swept band?

The output from an r.f. sweep generator should be at least 0.1 volt on channel 13. The gain of a front end is usually least on the high channels, but if the stated amount of output is available, a reasonable amount of scope deflection can be obtained, even if the front end is not in peak alignment at the outset. The gain on channel 2 is usually about double the gain of the front end on channel 13, hence, the full output of the generator is not required for low-band alignment.

The attenuators should be of low-impedance construction, to avoid resonances and partial resonances which cause lack of flatness in the output at various operating frequencies. The flatness of a sweep generator is easily tested with the aid of a crystal demodulator probe and scope, as shown in Fig. 7A. The pattern which is obtained on the scope screen will be quite flat over the swept trace as in Fig. 7B, if the output voltage from the sweep generator is uniform over the swept band. However, the swept trace will be uneven, or wavy as in Fig. 7C, if the output voltage from the sweep generator is not uniform. The extent of nonuniformity is usually observed with respect to a zero-volt reference line; there are various methods of obtaining zero-volt reference lines, but the usual method is to use the retrace-blanking function provided by many sweep generators.

Some caution should be observed, however, when checking the output from very simple types of beat-frequency sweep generators, since the output is often a mixed output, comprising feedthrough frequencies from the beating oscillators, sum and difference beat frequencies, and harmonics of these frequencies. In consequence, the flatness check is not necessarily valid unless the operator utilizes suitable output filters to remove the unwanted frequencies. It is quite possible, for example, for the fundamental output from a sweep generator to be quite flat, while the second-harmonic output may be far from flat, due to partial resonances in the output system. For this reason, the operator should be certain to study the circuit diagram of the sweep generator before tests are made, and to provide suitable filters, if required. Sometimes low-pass filters are built into the generator, and sometimes they are provided as accessory units. In other cases, the technician will have to make use of 75-ohm filters which have been designed primarily for other applications.

Oscilloscopes

A common misconception concerning scopes for use in alignment work is that 4 mc. bandwidth is believed to be required. Nothing could be farther from the facts of the matter, and no other application of the scope requires less bandwidth than does visual alignment. The chief point to keep in mind is that a visual response curve, as shown in Fig. 2, for example, is a *demodulated* response, and belongs to the same general class of waveforms characterized by a 60-cycle square wave. Such waveforms are properly

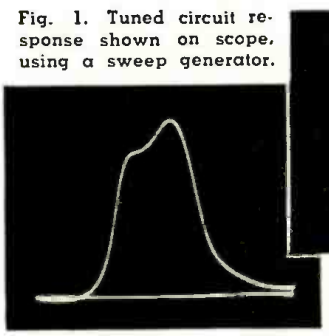


Fig. 1. Tuned circuit response shown on scope, using a sweep generator.

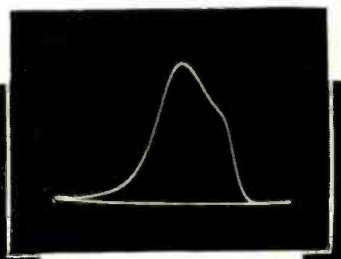


Fig. 2. A demodulated h.f. response curve for a tuned circuit.

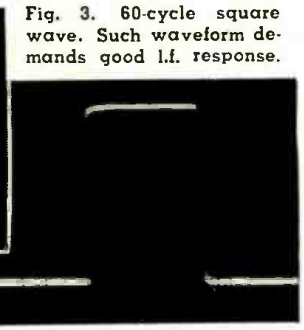


Fig. 3. 60-cycle square wave. Such waveform demands good l.f. response.

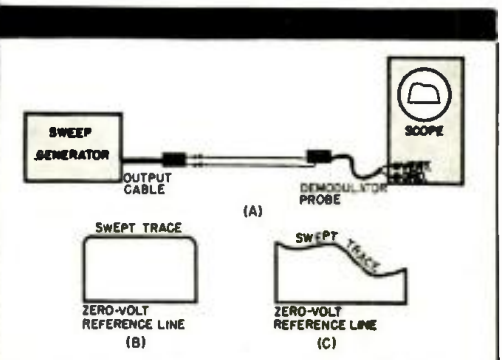


Fig. 7. (A) Test set-up used to check flatness of output from sweep generator. (B) Flat output. (C) Poor output, varying 2:1.

Since test gear represents a major investment for the technician, its selection requires careful planning.

displayed by scopes having vertical amplifier response down to 20 cycles per second. The upper frequency limit need not be more than 1 kc. In fact, when the upper frequency limit is high, such as 2, 3, or 4 mc., the marker indication will be very poor. This matter is reserved for later discussion.

It is sometimes asked why the low-frequency response of a scope must extend down to 20 cycles per second to properly reproduce a 60-cycle square wave. The reason for this requirement is that the phase characteristic of the vertical amplifier is just as important as the frequency characteristic. Unless the phase characteristic is linear, the reproduced square wave will exhibit tilt, and the phase characteristic cannot remain linear at 60 cycles unless the frequency response is sustained to 20 cycles, or lower.

The sensitivity of a scope used in visual-alignment work should be relatively high, in order to obtain satisfactory pattern displays in r.f. alignment work. It has been seen that a sweep generator may have limited output on the high band, and this deficiency can be compensated, to some extent, by using a high-gain scope. Many present-day service scopes provide a sensitivity of 10 millivolts per inch, which is ample for alignment work.

Marker Generators

Practical considerations limit the accuracy of frequency indication which can be obtained from sweep generators, and limit the extent of horizontal linearity which can be realized, as well as the accuracy of the sweep-width calibration. If these three functions could be maintained to a high degree of accuracy, a marker generator would not be required. However, a marker generator is almost always utilized in practical work.

A typical beat marker, or birdie, is shown in Fig. 4. The marker is obtained by mixing the output from a signal generator, termed a marker generator, with the FM sweep signal. A beat occurs in the circuits under test, and the zero-beat point, or maximum marker excursion, corresponds to the dial indication of the marker generator. Unless the bandwidth of the scope is restricted, the marker will appear very broad and fuzzy on the response curve. Sharp markers, such as seen in Fig. 4, can be obtained when using wideband scopes by shunting a fixed condenser of suitable value across the vertical input terminals of the scope.

The accuracy of the marker depends upon the type of circuit which is under test. For general i.f. alignment work, a generator which is accurate within ± 2% is usually satisfactory. However, the accuracy required for sound i.f. and ratio detector work, as illustrated in Fig. 5, is very strict, and very few marker generators can meet the requirements. The majority of test equipment manufacturers recommend that the technician utilize a 4.5 mc. marking crystal, instead of a generator, for this application. Many marker generators and sweep generators contain 4.5 mc. crystal oscillators to meet this requirement. However, if the marker generator provides for calibration checks, it is often possible to use the generator output for sound i.f. work. The accuracy of calibration should be within ± 1 kc.

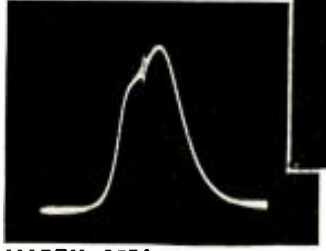
One of the difficulties encountered in ratio detector marking is the AM rejection of the circuit, which wipes out the marker from the center of the "S" curve, as seen in Fig. 5. The visibility of the marker can be improved in double-ended ratio detector circuits by opening the stabilizing condenser during the alignment. In the case of single-ended ratio detector circuits, the most practical method of marking is provided by a bypass marker injector which develops the beat marker independently of the tuned circuits in the receiver.

Spurious markers, shown in Fig. 6, often arise to plague the user of sweep and marker generators. In most cases, the spurious markers are caused by beating of spurious outputs from the generators, although improper test conditions can also give rise to spurious markers. For example, if the local oscillator is not disabled during i.f. alignment, harmonics of the local oscillator frequency will almost certainly cross beat with harmonics of the sweep and marker generators to produce spurious markers and spurious sweeps which distort the shape of the i.f. response curve.

When running r.f. response curves, the local oscillator must be kept in operation to avoid distortion of the response curve as a result of improper mixer bias. Hence, the operator is sometimes troubled with cross beats of oscillator output with sweep and marker voltages and their harmonics. However, these sources of difficulty are much less frequent than in i.f. work. Unless the sweep generator has a very

(*Continued on page* 144)

Fig. 4. The appearance of a beat marker or "birdie" on an i.f. response curve.



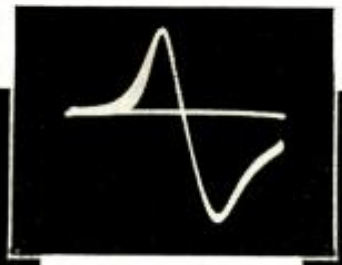
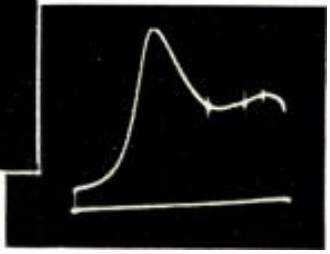


Fig. 5. An FM ratio detector "S" curve. See text for explanation.

Fig. 6. Curve with spurious markers caused by faulty set and/or test equipment.



LATEST TRENDS IN

By M. S. KAY

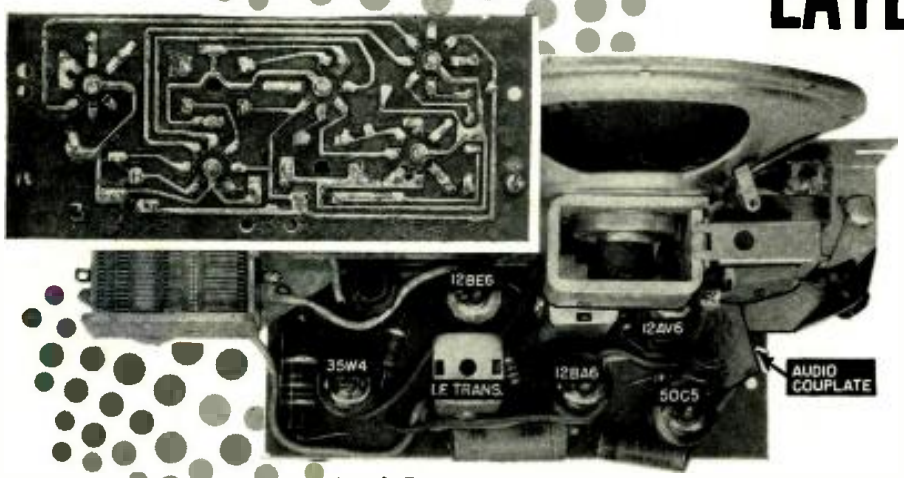


Fig. 1. Top and bottom views of an AM receiver which uses printed circuitry. Note that in this chassis all components are on one side and the wiring on the other.

The "new look" in radio sets with ferrite antennas and printed circuitry requires some new service techniques.

EVERYONE has been so preoccupied with television these last few years that not much attention, editorial or otherwise, has been given to radio. Yet it takes but a glance at current statistics to reveal that radio production is greater than ever, more numerous by far than television.

What has happened to radio since it was so abruptly shunted aside by the onslaught of television back in 1946? Basically, as far as circuitry is concerned, very little. However, there have been some significant changes made in components and it may not be amiss at this time to examine these in some detail.

The first item to strike you upon examination of current sets is the change in tube types. Thus, where we used to find such tubes as a 12SA7 (converter), 12SK7 (r.f. and i.f.), 12SQ7 (detector, a.v.c., and 1st audio), 50L6 (output), and 35Z5 (power supply), we now find such miniature replacements as a 12BE6 (converter), 12BA6 (r.f. and i.f.), 12AT6 (detector, a.v.c., and 1st audio), 50C5 (output), and 35W4 (power supply). The miniature tubes are more compact and generally possess slightly lower ratings than their predecessors; otherwise they are comparable to the tubes they have replaced.

Alternate tubes for some of those just mentioned include a 12BD6 for the i.f., and a 35C5 for the power output. The choice of the latter tube is frequently governed by what tubes have been used in the prior stages and what total voltage is required by their heaters in series. Thus, if we have a 12BE6, 12BA6, 12AT6, and 35W4, then the 50C5 will round out the combination with a total series heater requirement of 121 volts. On the other hand, if we desire to add a 12BA6 r.f. amplifier, then the total required heater voltage rises to 133 volts, which is far in excess of what is commercially available. Under these conditions, it is wiser to substitute a 35C5 for the 50C5.

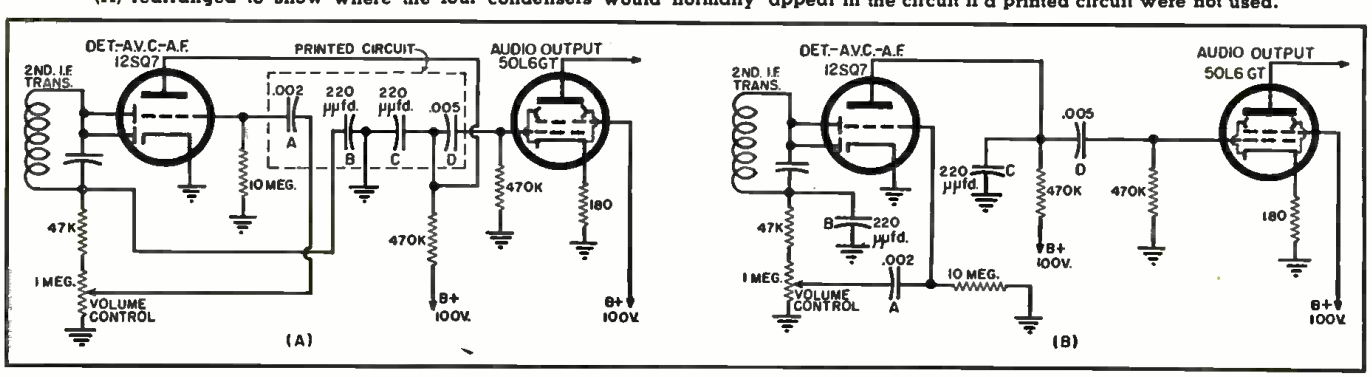
In battery receivers, the current tube line-up is as follows: 1U4 (r.f. and i.f. amplifiers), 1R5 (converter), 1U5 (detector, a.v.c., and 1st audio), and 3V4 (audio output). There are, of course, other tubes which can be and occasionally are used, such as the 1V6 (mixer and oscillator), 1AH4 (i.f.), 1AJ5 (detector, a.v.c., and 1st audio) and 3S4 (output). However, most battery receivers utilize the first set of tubes noted.

A second important change in recent years has been the substitution of ferrite-rod antennas for the flat air-core loop antenna. This change, while principally made in portable and table-model sets has, to a limited extent, also been made in console receivers. The principal advantages of the ferrite-rod antennas stem from their reduced size (important primarily in portable sets) and their greater operating efficiency, the latter arising from the higher "*Q*" of these units.

The flat air-core loop antenna has a fairly large area (approximately 20 square inches) and for optimum reception it must be oriented so that the ends are pointing toward the received signal. The most common position of this antenna in a portable receiver is within a hinged lid and when the set is to be operated, the lid is swung into an upright position away from the receiver cabinet.

When a ferrite-rod antenna, Fig. 6, is employed, it is generally mounted near the top of the receiver and does not have to be oriented for the best signal reception. Another feature of the ferrite-rod antenna is its ease of adjustment to obtain the correct inductance. This might be required in the manufacture of the set or when a ferrite-rod antenna is either being used to replace an air-core loop or simply another, defective ferrite unit. The adjustment is carried out by varying the position of the coil along the ferrite rod. A 10 per-cent change in inductance will be obtained by varying the coil position over the range of

Fig. 2. (A) Printed circuit consisting of four condensers, as used in an AM receiver. (B) Same circuit as shown in (A) rearranged to show where the four condensers would normally appear in the circuit if a printed circuit were not used.



AM RECEIVERS

plus or minus one-quarter inch on the rod.

Incidentally, every one of the radio receivers now using an air-core loop can be converted to a ferrite-rod antenna. In many instances the greater "*Q*" of this unit will revitalize the set remarkably, improving not only the set sensitivity, but also its signal-to-noise ratio. Commercial units are available for less than a dollar at any parts jobber, and come complete with a mounting bracket having a predrilled hole for single fastener mounting. To obtain best results with these antennas, mount them as far as possible from any metallic surfaces or components. Ferrous metals will introduce more loss than nonferrous metals (such as aluminum, copper, and brass). After the unit is mounted in the set, the ferrite rod is moved back and forth until the best signal is obtained.

Printed Circuits

One of the major electronic developments of World War II was the miniaturization of condensers and resistors through the use of printed circuits. Since printed circuit manufacturing techniques have been discussed in past issues of RADIO & TELEVISION NEWS, no explanation will be given here except to state that through the use of these circuits, it has been possible to simplify the manufacture of radio receivers.

The chief application of printed circuit components in radio sets has been in the network between the diode detector and the grid of the audio amplifier. See Figs. 3 and 5. The circuits are available with a variety of condenser and resistor values and with a number of components. For example, one of the simplest printed circuits in use replaces the two bypass condensers and series resistor in the load circuit of the diode detector. See Fig. 4. The printed circuit has three wires: one goes to ground while the other two are connected between the volume control and the bottom of the secondary winding of the output i.f. transformer. The circuit is symmetrical, and once the ground wire is established, either one of the two remaining wires may be connected to the volume control. The remaining wire is then attached to the i.f. transformer.

There is, of course, no limit to the complexity of these printed circuits and they may contain as many condensers and/or resistors as any particular application requires. Thus, in Fig. 2A, the printed circuit unit contains four condensers ranging in value from 220 $\mu\mu$fd. to .005 μfd. The first condenser, .002 μfd., serves to couple the volume control to the grid of the 1st audio amplifier. The second condenser, 220 $\mu\mu$fd., bypasses the i.f. voltage around the detector load resistors. The third condenser, another 220 $\mu\mu$fd. unit, serves in a similar capacity at the plate of the audio amplifier. The fourth and final condenser, .005 μfd., couples the audio signal from the plate of the 12SQ7 to the grid of the 50L6.

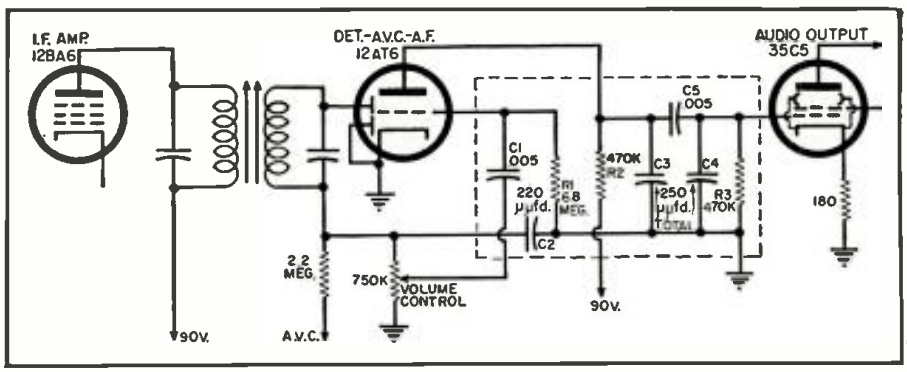


Fig. 3. In this partial schematic, a single printed circuit unit replaces five condensers and three resistors in the audio amplifier stages of set.

When the condensers are arranged as shown in Fig. 2A (in order to bring out the fact that they are all contained within the same printed circuit), their position in the receiver tends to be obscured. A rearrangement of the circuit to the form shown in Fig. 2B makes their individual purposes more evident.

A printed circuit containing five condensers and three resistors is illustrated in Fig. 3. C_1 couples the volume control to the audio amplifier; C_2 is an i.f. bypass for the diode load circuit; C_3 and C_4 are similar i.f. bypass units for the plate circuit of the audio amplifier and the grid circuit of the audio output stage; C_5 couples the audio voltage from the audio amplifier to the audio output. In the resistor section there is R_1, the grid resistor for the audio amplifier, R_2, the plate resistor of this stage, and R_3, the grid resistor of the following audio output stage. For what would be eight parts requiring sixteen leads to be soldered, we now have only one small component with seven leads. The savings under such an arrangement are obvious, and all this without any impairment of operation.

There are many other configurations that these printed circuits can take,

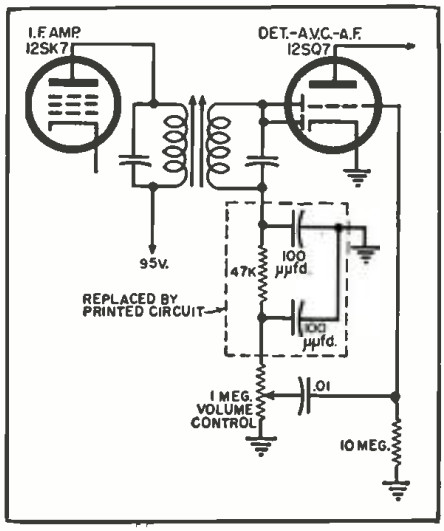


Fig. 4. Partial diagram of an AM receiver showing the components that can be replaced by a printed circuit.

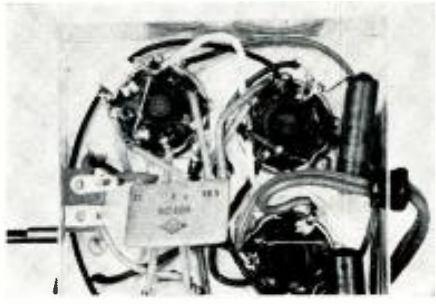


Fig. 5. The printed circuit used here has several resistors and condensers.

but those discussed are representative.

Printed Wiring

Another form of printed circuitry is the printed wiring which has recently been adapted to midget AM receivers.

(*Continued on page* 181)

Fig. 6. A ferrite-rod antenna as installed on a midget radio receiver chassis.

THE CHROMATIC

By WALTER H. BUCHSBAUM
Television Consultant
RADIO & TELEVISION NEWS

Report on the construction, operation, and progress of the "Chromatron," a single-gun picture tube for color TV

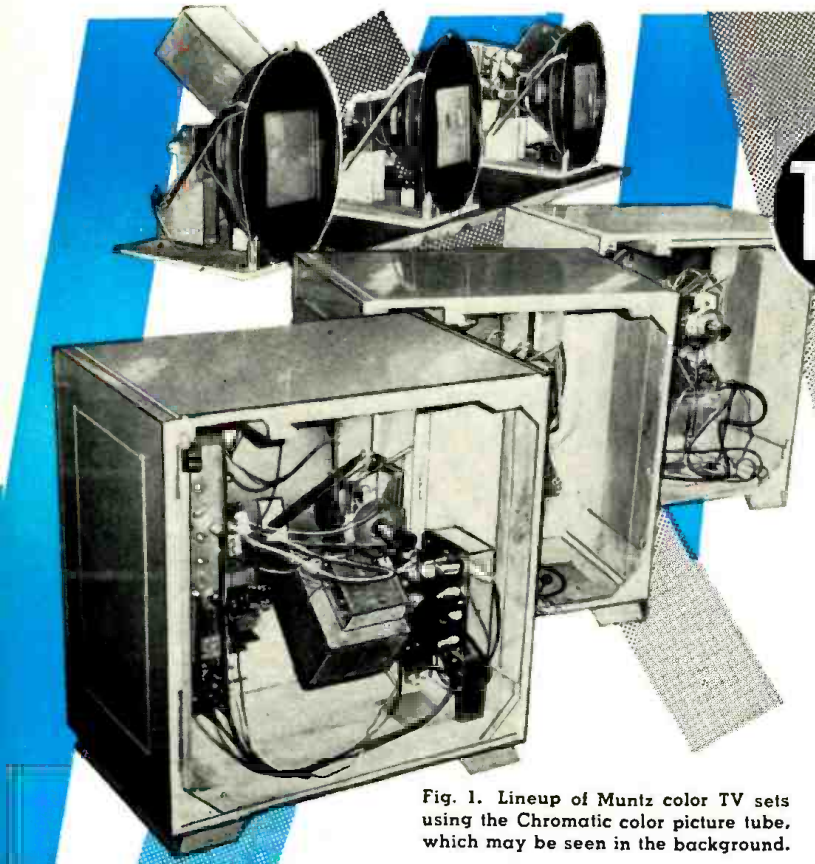


Fig. 1. Lineup of Muntz color TV sets using the Chromatic color picture tube, which may be seen in the background.

With the inauguration of color TV receiver manufacturing, the problem of color picture tubes is again receiving much attention. Radio & Television News reported some time ago on the tri-color tube both as developed by *RCA* and as simplified by *CBS-Hytron*. Now it is possible to give some of the details concerning another type of color picture tube. This latter type, based on the ideas of Dr. E. O. Lawrence of the University of California, was publicized as being a "simple" and inexpensive rival of the *RCA* tri-color tube. The actual development work on the tube and associated circuits was taken over by *Chromatic Television Laboratories, Inc.*, a subsidiary of *Paramount Inc.* The tube described here is not necessarily the final design. Further improvements and changes are currently under development.

The current model of this color picture tube has been named the "Chromatron" and a complete 22-inch unit is shown in Fig. 1. The neck and flared portion of the tube are essentially the same as for other metal envelope picture tubes, but the cone is made in two parts to permit separate assembly of the color screen. Although the "Chromatron" is a round picture tube, the color structure is rectangular and occupies less than the full screen space. Picture width of the tube shown is 16 inches; the remaining screen space is taken up by the frame and mounting flanges required for the color structure. Fig. 2 shows the color structure in its frame before being assembled into the complete "Chromatron." In the manner of assembly this is very similar to the *RCA* tri-color tube which also contains a separate color structure, frame, and flanges. While the *RCA* system employs three electron guns, the "Chromatron" uses only a single gun, but it would be possible to use three guns.

The deflection components used for the "Chromatron" are essentially the same as used for black-and-white picture tubes. This is a considerable advantage over the *RCA* design which requires complex deflection yokes, a purity coil, and convergence and centering adjustments. The simplification at the neck of the tube is possible in the "Chromatron" because the complete color switching section is part of the color screen structure.

The *RCA* tri-color tube has a screen consisting of small dots of colored phosphors each of which lights up either in red, green, or blue. These color dots are arranged in the correct sequence and the colored picture is the composite of the amount of light coming from a large number of dots.

The "Chromatron" uses lines of colored phosphor instead of dots and a special wire screen behind the phosphor strips makes the electron beam dance back and forth between the color strips to produce, effectively, a series of color dots. Fig. 4 shows the principle of the "Chromatron" color structure. A number of vertical strips are laid out, each containing a colored phosphor. The color sequence is arranged so that a green strip falls between each red and blue one. Behind the phosphor is a fine wire grid, so spaced that an electron beam passing between two wires will hit the green phosphor if there is no voltage between the wires.

The phosphor screen is aluminum backed, just as in some types of black-and-white picture tubes, and the aluminum backing is connected to a terminal outside the tube. If a voltage is applied between the two wire grids and the aluminum backing, a series of electron lenses will be set up between the wires and the screen. These lenses help to focus the electron beam so that a sharp spot is obtained on the screen. Although the focusing produced by these lenses is not as effective as the focusing coil or electrostatic focus element back in the electron gun, this "post deflection focus" (PDF) system has a considerable effect on the size of the spot. Because the acceleration of the electrons in the beam is so high near the screen, the focusing potential required is much greater than at the electron gun.

Editor's Note: *Although, to date, most manufacturers of color TV receivers have designed their color TV sets for use with the 3-gun color tube, as produced by RCA, CBS-Hytron, and others, a large segment of the industry is investigating the possibility of using a single-gun tube such as described in this article. This tube is based upon the invention of Dr. E. O. Lawrence, and the development work of the Chromatic Television Laboratories. Engineers, manufacturers, and all others concerned in the color television industry are divided on which type of tube will predominate in the future. Each has its advantages and disadvantages.*

Which tube will be more popular? This depends upon which tube will result in a more simplified circuit, lower over-all set production cost, lower picture tube cost, and which tube will give the better picture. Although there is no reason why both the 3-gun tube and the single-gun tube cannot live side-by-side, in the final analysis, the public will decide as to which will be more popular.

COLOR PICTURE TUBE

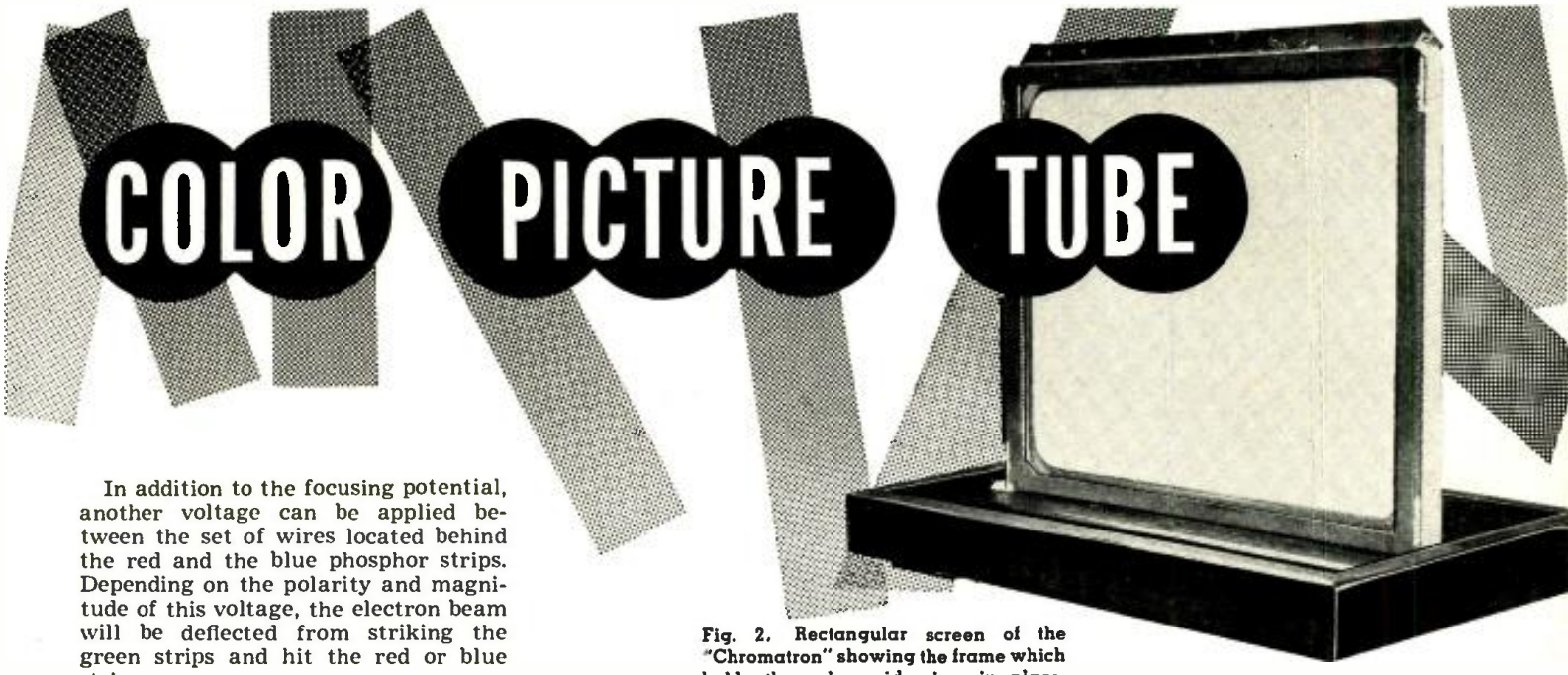


Fig. 2. Rectangular screen of the "Chromatron" showing the frame which holds the color grid wires in place.

In addition to the focusing potential, another voltage can be applied between the set of wires located behind the red and the blue phosphor strips. Depending on the polarity and magnitude of this voltage, the electron beam will be deflected from striking the green strips and hit the red or blue strips.

The color of the spot is therefore determined by the instantaneous voltage between the two sets of wire grids, while the size of the spot is determined by the d.c. voltage between the aluminum backing and the electrical center of the two wire grids. This is similar to the application of centering voltage in an electrostatic deflection cathode-ray tube. In the simplified sketch of Fig. 5, the condition is illustrated where the electron beam hits a green strip because no potential exists between the red and blue wire grids. If a positive voltage is applied to the red wire grid, for example, the electron beam would be deflected slightly more to the left and hit a red phosphor strip.

In addition to the deflecting action of the two wire grids, the electron beam is also moved by the vertical and horizontal deflection coils located around the neck of the tube. It should be understood that the action of the two wire grids is on the order of a minute jiggling motion, superimposed on the horizontal and vertical sweep movement of the electron beam. The colored phosphor strips, the wires, and the spacing between the wires are all so small that from the standard viewing distance individual colors are not discernible.

For operation under the NTSC standards for all electronic color TV, the color switching rate for the wire grids is 3.58 mc., the frequency of the color subcarrier. Rigid standards are needed to maintain the phase relationship between the three color components since it is this relationship which delivers the color or chromaticity information.

To switch at this rate raises some problems when we consider that the wire grids contain considerable capacity and require quite some power to move the electron beam sufficiently. The d.c. voltage on the wires for focusing is on the order of 5000 volts and the a.c. switching signal must, accordingly, be strong, usually about 500 volts. In one practical demonstration the driving power was about 25 watts. To increase the efficiency of the system somewhat an external inductance was used to resonate the approximately 1200 $\mu\mu$fd. capacity due to the wire grids.

The problem of driving the wire grids, however, is being solved by new driving methods and a modification in the design of the "Chromatron." One approach is to move the grid wires further away from the screen and, thus, reduce the capacity. This would help to reduce the required driving power considerably. In addition to the switching circuits it is also necessary to key the cathode or control grid of the electron gun so that only the red picture information or brightness level exists during the instant that the electron beam hits the red phosphor, and so on for the other colors. To accomplish this, the output of the three video amplifiers are switched, each delivering its signal, in turn, to the picture tube.

A block diagram of the circuitry needed to utilize the "Chromatron"

(*Continued on page* 156)

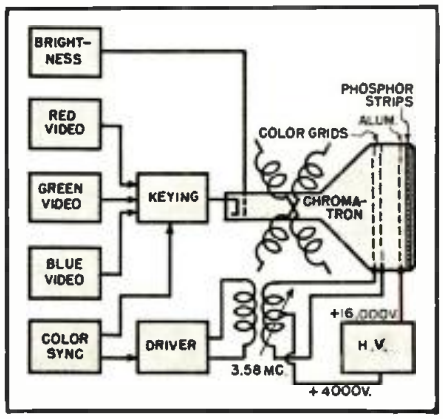


Fig. 3. Simplified block diagram of the circuits required with the "Chromatron."

Fig. 4. Representation of the "Chromatron" phosphor screen showing the grid arrangement behind the color strips.

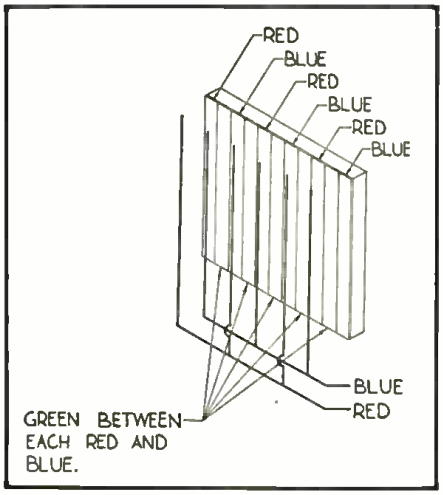
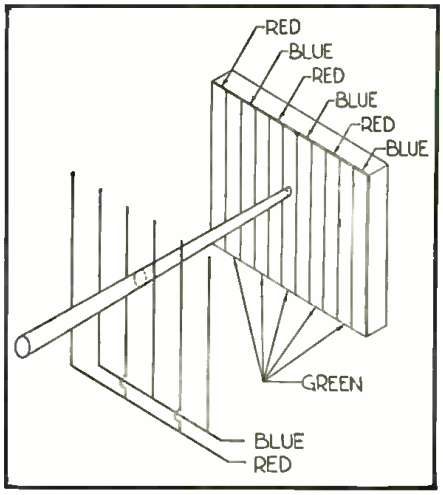


Fig. 5. Electron beam excites green phosphor strip when no deflecting voltage is fed to the blue and red grid wires.



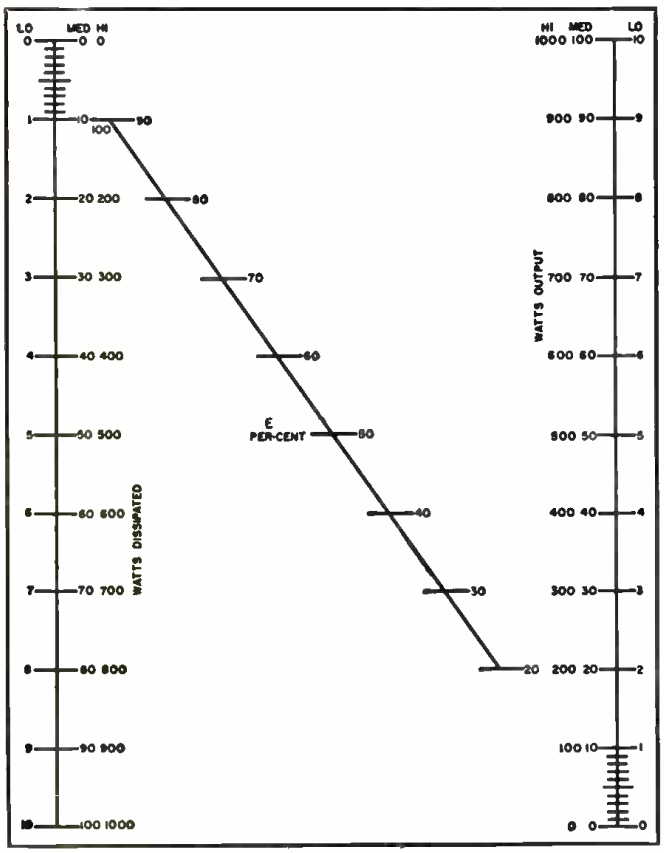
POWER AMPLIFIER OUTPUT

By JOSEPH F. SODARO, W6ZRT

Simple nomograph for determining power output versus efficiency for tubes of a specified plate dissipation rating.

POWER amplifier tubes are rated by maximum allowable plate dissipation. By this system of rating, the 100 watter is a tube which will dissipate 100 watts at the plate. However, this tube may generate from 25 to 500 watts in the circuit. This power output difference depends upon the circuit efficiency. Efficiency, in turn, depends upon the amplifier class and operation. For example, the class C amplifier is more efficient than the class A amplifier. Also, a class C amplifier with adequate excitation and plate voltage has higher efficiency and output than one with inadequate excitation or plate voltage. "Watts output" is an important figure to the amateur. It is the purpose of this article to present a simple, rapid method of estimating output in terms of allowable plate dissipation. Such an estimate is made possible by the calculator shown in Fig. 1.

Fig. 1. Dissipation vs output calculator. See text on its use.



The dissipation-output calculator of Fig. 1 is used by simply placing a straightedge across the scales through an anticipated or known amplifier class or efficiency. The class C amplifier is at the top of the group with an efficiency range of 60 to 80 per-cent. Sometimes 85 to 90 per-cent is given as an upper limit. Class B amplifiers have efficiencies from 50 to 60, class AB from 40 to 50, and class A from 20 to 35 per-cent. The class B linear amplifier has an average efficiency of about 30 per-cent, reaching 50 to 65 per-cent at full output. The high-efficiency Doherty amplifier has an average figure of 60 per-cent.

The power output calculator has been designed for estimating maximum output when maximum allowable plate dissipation and efficiency are known. This calculator can be used during transmitter planning to determine the power output to be expected when a certain tube is operated in a certain class of amplifier. The chart can also be used to estimate dissipation power for values of efficiency and output. Another application of this graph is the determination of circuit efficiency when input and dissipation powers are known. In general the nomograph can be entered on any two scales and an answer read on the third scale.

On the left side are the power dissipation scales. On the right side are the power output scales. In order to meet all amateur transmitter power requirements, these scales have several ranges. Thus the low power range (LO) runs from zero to 10 watts, medium (MED) to 100 watts, and high (HI) to 1000 watts. It is only necessary to remember to read both dissipation and output on scales of the same range. Thus, use LO with LO, MED with MED, and HI with HI.

All scales are linear. Thus, the midpoint between two scale values is the midscale value. Notice that while the power dissipation scale increases downward, both the power output and efficiency scales increase upward. The first major division on both outer scales is subdivided into ten smaller divisions. Each of these is one unit. Thus, the fourth division from zero is 0.4 on "LO," 4 on "MED," and 40 on "HI."

Using the Calculator

To use the calculator simply locate values on two scales, place a straightedge such as a plastic rule through these values, and read the answer where the rule intersects the other scale. A straight line can be drawn through the three points if desired. A piece of black thread is an excellent nomograph indicator.

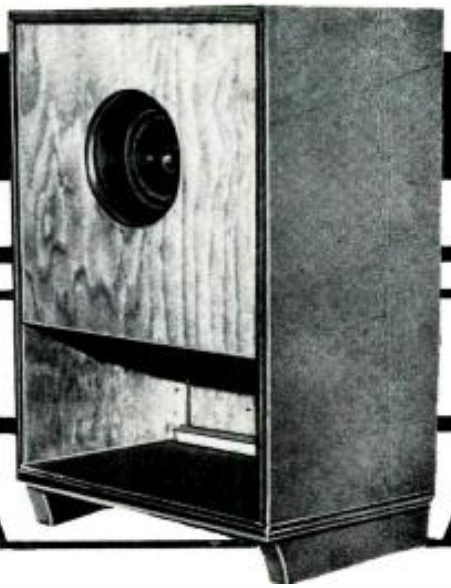
As an example, assume that a tube capable of dissipating 20 watts is on hand and we wish to know what outputs can be expected from this tube when used in a radio-frequency power amplifier. Since this would be a class C amplifier we place the straightedge indicator across 20 on the "MED" dissipation scale and 60 per-cent on the "E" scale and read an output (*Continued on page* 121)

Table 1. Dissipation multiplying factors for rapidly estimating the power output of a given tube. Their use is covered in text.

EFFICIENCY		MULTIPLYING
FRACTION	PER-CENT	FACTOR
¼	25	⅓
⅓	33.3	½
½	50	1
⅔	66.6	2
¾	75	3
⅘	80	4
⅚	83.4	5
6/7	85.7	6
⅞	87.5	7
8/9	88.9	8
9/10	90	9

The "DIFFUSICONE - 8" ENCLOSURE

By
ABRAHAM B. COHEN
University Loudspeakers, Inc.



Over-all view of enclosure for the University "Diffusicone-8", shown without finish.

Designed for an 8-inch speaker, this cabinet received considerable attention at last year's N.Y. Audic Fair.

OPTIMUM performance of a loudspeaker is obtained when it is mounted in the proper enclosure. The enclosure and the loudspeaker must be matched to each other. A 6-inch speaker doesn't require a seven cubic foot cabinet, nor will a two cubic foot cabinet suffice for a 15-inch woofer. The *University* cabinet for the "Diffusicone-8" was designed to provide the proper load match for this speaker. Since this speaker is a high-efficiency, extended-range radiator, it requires a cabinet that will:

(*a*) allow its extended high frequencies to spread into the room without obstructions due to bends or folds in the cabinet;
(*b*) do justice to the high-level, low-frequency output of which the speaker is capable; and
(*c*) be modest in size compatible with the performance requirements of the "Diffusicone-8"

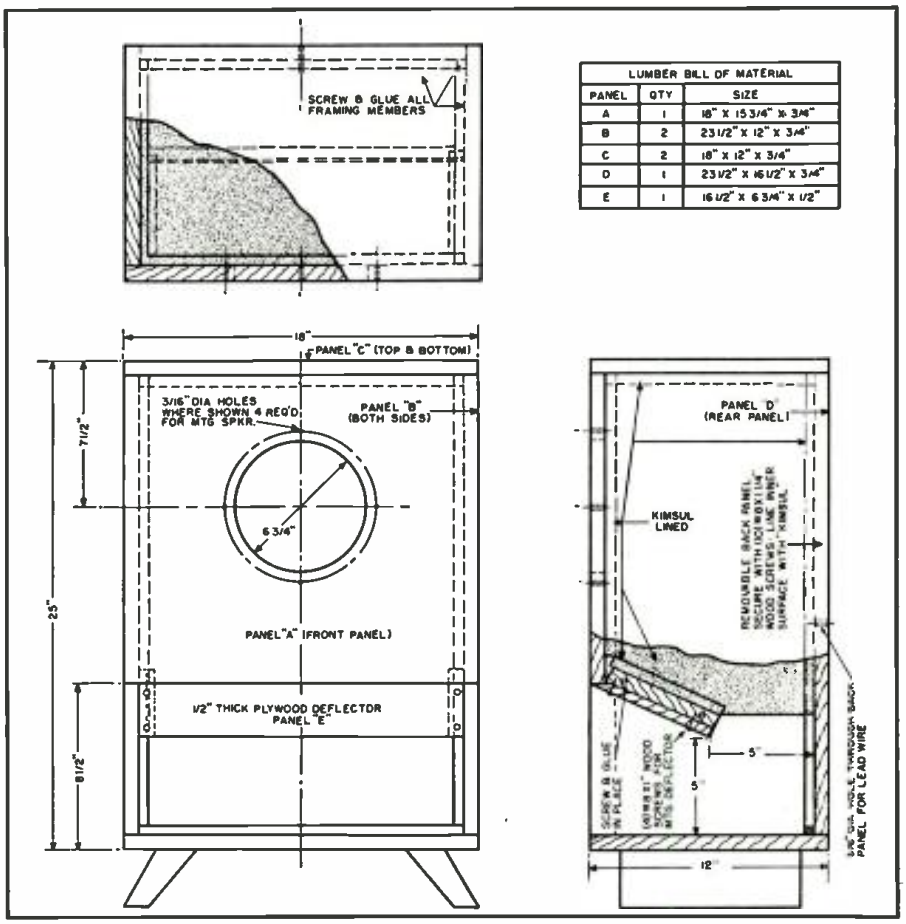
Requirement (*a*), calling for an unobstructed path for the high frequencies, makes it mandatory that the enclosure and the speaker constitute a "direct radiator" combination, rather than a horn type. The final design of this enclosure resulted in essentially a bass reflex type of cabinet with the important addition of a horn load applied to the port of the enclosure. Thus, what looks like an exceptionally large port for a bass-reflex cabinet of this size is actually the mouth of the horn which feeds from the proper size port located at the rear bottom of the enclosure. The addition of the horn to the port permits smoother low frequency radiation than is possible from a simple port aperture. This condition holds because the efficiency of radiation of low frequencies rises as the size of the radiating opening becomes larger. Thus, since the mouth of the horn is more compatible, dimensionally, with the wave length of the low frequencies than is the smaller sized port, the horn adds a considerable measure of improvement to the performance of the bass reflex cabinet.

Inasmuch as this horn mouth lies at the bottom of the cabinet structure, the floor of the room acts as a natural extension of the horn walls which effect still further aids the low-frequency efficiency. The relatively small size of the enclosure allows it to lie flat against a room wall or in the corner.

Due to the high efficiency of the "Diffusicone-8," the sound pressures developed within the enclosure for the lower frequencies require that the cabinet be constructed of heavy rigid

(*Continued on page* 150)

Mechanical details of cabinet construction. Although any 8-inch speaker can be used, its design and performance characteristics are based on the use of the University "Diffusicone-8" speaker. The cabinet is simple to build and is, fundamentally, a bass reflex cabinet with a horn flare. The entire upper section of the cabinet should be Kimsul lined. All inside corners are re-inforced by using ½" square wood strips glued and screwed to the sides of the cabinet. Dimensions for the legs are not given and can be designed to suit the builder or omitted.



LUMBER BILL OF MATERIAL		
PANEL	QTY	SIZE
A	1	18" X 15 3/4" X 3/4"
B	2	23 1/2" X 12" X 3/4"
C	2	18" X 12" X 3/4"
D	1	23 1/2" X 16 1/2" X 3/4"
E	1	16 1/2" X 6 3/4" X 1/2"

A profitable scource of service income is available to the service technician with some mechanical aptitude.

THE versatility and popularity of record changers presents a challenge and a new responsibility to the electronic service technician. In addition to thinking in electronic terms, he must think in terms of gears, cams, motors, and mechanical devices, so he can meet successfully the service requirements for a television-radio-phonograph combination.

Fortunately, to master the servicing of record changers does not call for learning the theory of mechanics. If the service technician can learn to focus his attention on the particular section that is giving trouble, refrain from trying to make a diagnosis by observing the mechanism as a whole, and exercise patience, he will be able to solve most of the problems that face him.

To most people, most record changers look alike, and so there is a natural assumption that they are alike and operate the same way. This is an erroneous impression. Every record changer has a motor, a tone arm, a spindle, and its function is to play records. However, in spite of all this apparent similarity, the working parts are different and each record changer has its own particular set of problems.

Many record changers, although made by the same company, appear under different brand names, so the ones discussed here have been selected because they represent different types of units.

For a record changer to accomplish its task it must have the following sections:

1. An indexing or tone arm set-down assembly
2. A motor and speed reduction system
3. A trip and reject system to start the change cycle.
4. A record drop mechanism to furnish a new record.

Regardless of the brand of record changer, it will have to index (set the tone arm to the proper start position) correctly for 7", 10", and 12" records. How is this accomplished? The *Admiral* RC600 uses a set-down index assembly, shown in Fig. 1, containing slots for each size record.

The tone arm mechanism is made to fall into the proper slot by a control finger extending above the changer base which feels the edge of the record played. Failure to index correctly must be attributed to one of these two parts. For instance, the control finger may be bent so that it does not feel the edge of the record, or there may be an obstruction in the slot in which the tone arm shaft rides as it lets the tone arm down to the record.

The *V-M* 950 record changer also uses a control finger rising above the changer pan to feel the size of the record to be played. See Fig. 3. The finger does not control the set-down index assembly by feeling the edge of a record, but rather by the height to which it travels. Twelve inch records have a separate selector to control the index assembly. The actual setting down of the tone arm on the record is accomplished by the tone arm shaft sliding down the inclined angle of a cam. If index trouble in this record changer is not solved by the adjustment screw under the tone arm, it may be because the control finger is bent so that it rises too high above the changer base.

In the *Motorola* RC36 record changer the location of the index position is determined by the manual movement of the record support shelf. The record support shelf (see Fig. 2) is geared to the index set-down cam. This set-down cam is positioned correctly so that when the tone arm assembly is moved inward, it will stop at the proper record size. The actual setting down of the tone arm on the record is accomplished by the tone arm shaft riding down the inclined section of the cam assembly.

Failure to index correctly, if only by a narrow margin, may be corrected by the index adjustment screw located at the inside rear of the tone arm. More complex servicing information on this problem will be given in a future article.

Motor and Speed System

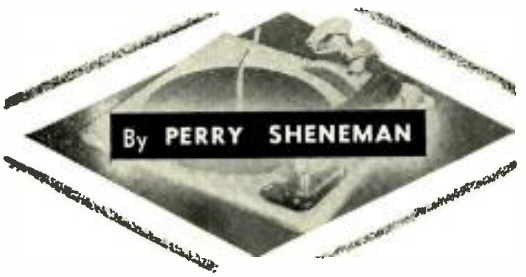
The modern motor is electronically balanced, has powdered metal bearings, requires very little service, and is a mighty sturdy and reliable piece of equipment. When the record changer is ready to be discarded because it is obsolete or worn out, the motor is still going strong.

The need for service arises in the linkage between the motor and the turntable, where the 1750 rpm of the motor is reduced to 78, 33⅓, and 45 rpm for the turntable. The turntable not only must rotate accurately, but must also supply power to the rest of the mechanism. Different methods are used.

For example, the *Zenith* S14028 record changer has the motor shaft contacting a drive wheel lying horizontally that furnishes the power (see Fig. 4). An idler wheel riding vertically between the turntable bottom and the drive wheel provides the friction necessary to turn the turntable. The speed of the turntable is controlled by changing the position of the idler wheel on the drive wheel. When the idler wheel is moved inward, it will rotate more slowly. This is because the inside of the drive wheel moves more slowly than the outer edge.

In the *RCA* 960282 series, only one wheel between the motor shaft and turntable rim provides the friction to turn the turntable. Speed is controlled for the different rpm records by the motor shaft itself. The motor shaft is different from the ordinary pencil-like variety in that it has enlarged sections, similar to the shaft used by *Philco* and shown in Fig. 5. Moving the idler wheel to different places on the shaft controls the speed by the principle that the outside of the larger shaft moves more rapidly than the outside of the narrower shaft.

The method used in the *Webcor* 106



changer is that of an idler wheel furnishing the friction, but the turntable speed is changed by placing a pulley between the idler wheel and the motor shaft. The circumference of the pulley placed between the idler wheel and the motor shaft determines the turntable speed. Another type of speed reduction system using pulleys and a belt drive is shown in Fig. 6.

Service requirements differ with the type of speed reduction used. One principle, common to all, is that the turntable speed and power depend upon friction coupling between the motor shaft and the turntable. Naturally, any loss of friction means incorrect turntable speed and loss of power to pull the mechanism through its change cycle. This loss of friction can be due to oil or grease on the idler wheel, pulleys, or turntable rim. The spring that holds the idler wheel to the motor shaft, or, in the case of *Webcor* type units, the idler wheel to the pulley, may be weak. A worn idler wheel or pulley, or any binding of a pulley or idler wheel on the shaft on which it turns, also are possible causes of trouble. A small thing like removing the gloss from an idler wheel or pulley may solve the problem.

The most important single service on any type of speed reduction system is a good cleaning, preferably with alcohol.

Reject and Trip Section

In any automatic device, every part is essential. It is true that the smallest washer or nut can cause even a well designed machine to fail. The trip and reject system is the very heart of the record changer. Because it is so important to the operation of a record changer, it stands to reason that its function must be perfect. There is no room for error here, and here lies the greatest single cause for complaint.

The reject system performs two important jobs. The most important is the control of the playing cycle; *i.e.*, the reject system must allow the record player to play through an entire record before beginning the change cycle. The second job of the reject system is to release power from the turntable to the main cam which, in turn, operates the change cycle. These two operations work together, and one is dependent upon the other.

The most important service for the trip and reject system is a good cleaning, just as in the speed reduction system, for dirt and grease will cause malfunction.

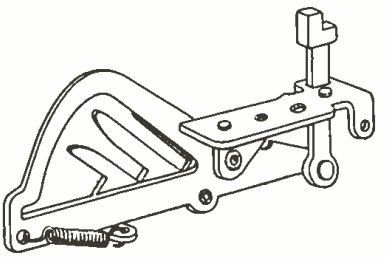


Fig. 1. Index assembly used in the Admiral RC600 automatic record changer.

Fig. 2. The indexing for different record sizes is controlled manually in Motorola record changer shown here.

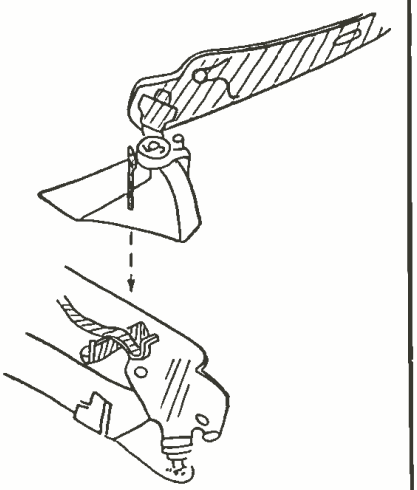


Fig. 3. Indexing system used in the V-M automatic record changer. The vertical finger on the tone arm support sets the slider on the indexing assembly below the turntable so that the tone arm moves to the proper start position for different record sizes.

Practically all changers use a velocity trip method which means that they take full advantage of the oscillating grooves in the center of the record. The reason this method is popular is because the trip and reject can be controlled irrespective of the type of record played, whether it has more or less than normal playing time.

Although the velocity trip and reject is common to all record changers, the principle and method vary with each manufacturer.

One *RCA* record changer has spiral grooves on the turntable to operate the change cycle. Here, the trip causes a plunger to jump into the spiral and start the change cycle. A *Zenith* changer uses a solenoid that becomes activated by the trip and permits the change cycle to begin. A weighted cam in a *Philco* model is released by the trip action and permits the record changing mechanism to operate.

Obviously, the repair required is dependent upon the type of reject mechanism. For instance, in the *Zenith*, first determine if the solenoid is being activated by the trip finger. If it is

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Fig. 4. A vertical idler wheel (not shown) rides on the upper face of the horizontal drive wheel in the Zenith speed system. The position of the idler wheel on the drive wheel determines final speed. →

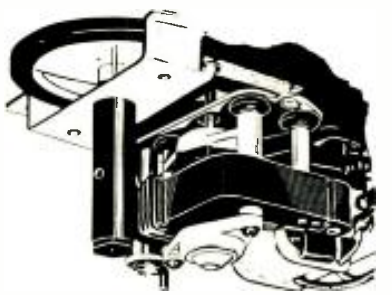
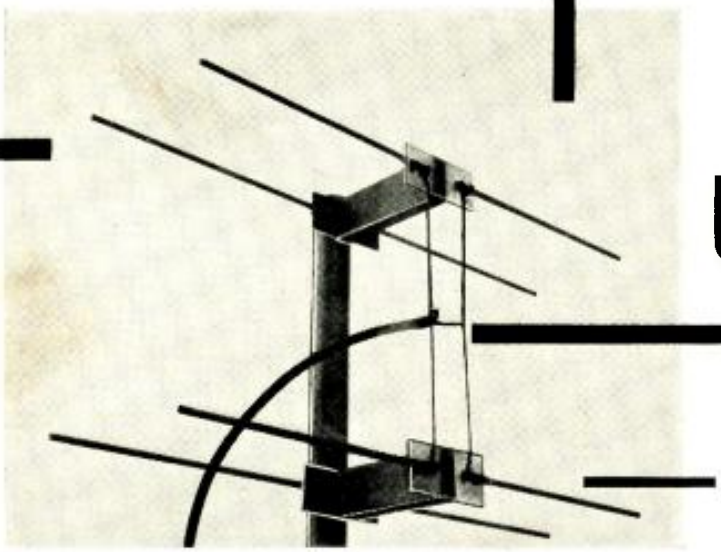


Fig. 5. The Philco motor and speed reduction system uses a single drive shaft working against another shaft with three different size pulleys for various speeds.

Fig. 6. Admiral and V-M speed reduction system using a set of pulleys with a belt drive from the motor armature shaft. →

HOME-BUILT U.H.F. ANTENNAS



The author's antenna for u.h.f. reception on channel 43.

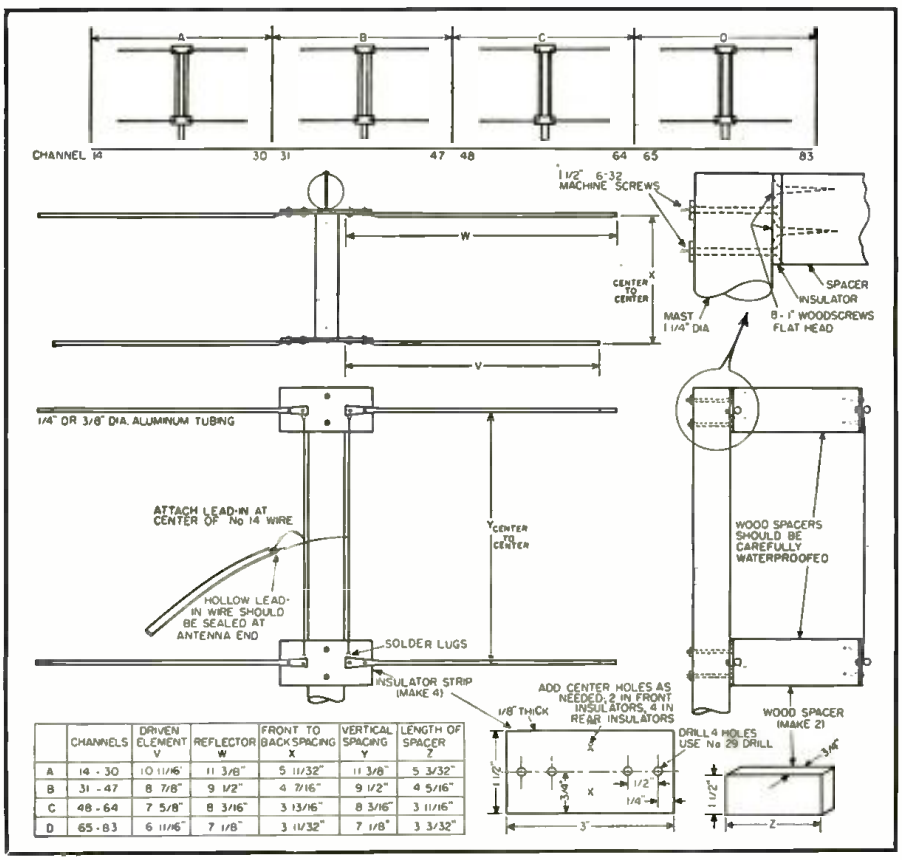
By **ROBERT H. HAWKINS**

Details on four collinear arrays for channels 14-30, 31-47, 48-64 and 65-83. Antennas may be built in an evening.

THE licensing of many new TV stations in the u.h.f. range has brought with it many "growing pains" for the TV set owner. Some antennas work well in one area, others work better for another location. Should we use round lead-in wire or wire of the oval cross section? Many such questions arise as a community learns to live with its new u.h.f. station.

This article covers an easily-built antenna that has helped improve reception for TV set owners who were about to conclude that their sets or converters just didn't work for u.h.f. reception. There is nothing new or original about the basic design used. It's a collinear array, the same design as used by amateur radio operators for many years. The only things that have been done to adapt this simple design for u.h.f. television use is to determine the proper element lengths and spacings and mount the antenna for horizontal polarization.

Mechanical details for building receiving antenna for the u.h.f. television bands.



	CHANNELS	DRIVEN ELEMENT V	REFLECTOR W	FRONT TO BACK SPACING X	VERTICAL SPACING Y	LENGTH OF SPACER Z
A	14 - 30	10 11/16"	11 3/8"	5 11/32"	11 3/8"	5 3/32"
B	31 - 47	8 7/8"	9 1/2"	4 7/16"	9 1/2"	4 5/16"
C	48 - 64	7 5/8"	8 3/16"	3 13/16"	8 3/16"	3 11/16"
D	65 - 83	6 11/16"	7 1/8"	3 11/32"	7 1/8"	3 3/32"

To build the antenna shown in the photograph is specially cut for channel 43, but, using the dimensions shown in the chart, antennas can be constructed which will cover the u.h.f. channels as indicated. Four antennas are listed and they are so spaced throughout the u.h.f. television spectrum that they will give adequate coverage for the entire band. The antennas are broadbanded enough to cover more than the seventeen channels assigned to each of the antennas *A, B, C,* and *D*. Choose the one which comes closest to the channel of the u.h.f. station in your area and it should help you achieve reception equal to or better than that obtained by your neighbors. It's always a source of pride to say, "I built it myself," so here is how you can build yourself a good u.h.f. antenna in a single evening.

Constructing the antenna requires few tools, a small amount of material, and not much time. The elements can be made from ¼" aluminum welding rod or ⅜" diameter aluminum tubing. (Either size seems to work equally well; the larger diameter makes the antenna a little more broadbanded.) Cut them to length as shown in the diagram, four driven elements and four reflectors. Flatten one end of each element about 1" in from the end and drill two holes as shown, using a #29 drill. Make four insulator strips from fiber, or preferably polystyrene, as shown. Two wooden spacers are required to separate the driven elements from the reflectors. After two assemblies consisting of two driven elements and two reflectors each are

(*Continued on page* 143)

KNOW YOUR 1954 STEWART-WARNER TV RECEIVERS

Fig. 1. Rear view of the Stewart-Warner 9340 series TV chassis.

By
H. B. MASSIE
Field Engr., Stewart-Warner Electric

Another complete analysis of a popular 1954 TV set including the schematic diagram and alignment data.

ALL THE 1954 *Stewart-Warner* television receivers incorporate the "Thunderbolt" chassis that will be used with 21-inch, 24-inch, and 27-inch picture tubes. There are two basic chassis: one incorporates a turret-type v.h.f. tuner which can be adapted to u.h.f. by inserting a set of strips in the tuner for the particular u.h.f. channel involved, the other utilizes an all-channel turret-type tuner and additional new circuitry. The latter chassis, the 9340 series, containing a 21-inch picture tube, will be discussed.

All the "Thunderbolt" chassis incorporate many new features which simplify servicing, such as the positioning of receiving tubes on the chassis to allow for easy replacement. (See Fig. 1.) Also, plug-type connections are used for the flyback transformer and deflection yoke so that they can be replaced without the use of a soldering iron or removing the chassis from the cabinet. A special-type chassis bracket is used which allows for easy removal of the chassis from the cabinet as well as allowing the chassis to be turned upside down for servicing. (See Fig. 2.)

Tuner

The all-channel turret-type tuner furnished with the 9340 series sets is of the latest design, and is capable of tuning all standard television channels in the v.h.f. and u.h.f. range from channels 2 to 83. It consists of two separate chassis joined together as a unit. The front section tunes the u.h.f. stations, channels 14 to 83, and incorporates two preselector stages, a 6AF4 or 6T4 tube as the oscillator, and a 1N82 crystal as the mixer. The rear section performs a dual function in that it tunes all the v.h.f. stations, and operates as a 41-mc. i.f. amplifier when the receiver is tuned to any u.h.f. channel. It incorporates a 6BZ7 or 6BQ7A tube as a cascoded r.f. amplifier for v.h.f. operation and as a 41-mc. i.f. amplifier for u.h.f., and a 6U8 as the oscillator-mixer. In the u.h.f. position, the oscillator section of the 6U8 tube is rendered inoperative.

Fine tuning of both the v.h.f. and u.h.f. channels is performed by the same control. The shaft of the fine tuning control rotates two separate pieces of dielectric material simultaneously between two separate sets of condenser plates, one set connected to the u.h.f. and the other to the v.h.f. oscillator tank circuits. The front-panel oscillator adjustment is merely a screw adjustment similar to that used in many v.h.f. turret-type tuners. The adjustment tool should be a non-metallic screwdriver at least 9 inches long, so it can make contact with the v.h.f. oscillator slug which is located in back of the u.h.f. section.

Fig. 2. The special chassis bracket on Stewart-Warner's TV sets makes removal from the cabinet very simple.

The selection of a u.h.f. channel is accomplished in a dual manner. Rotation of the u.h.f. turret, which is accomplished by turning the middle knob, sets into position a coil assembly that can be tuned through a range of 10 channels with the front knob. Eight different coil assemblies are used and they are easily removed for replacement. There are nine settings of the u.h.f. turret, one of which is blank, containing no coil assembly. For v.h.f. operation, the u.h.f. turret is placed in the blank position.

The u.h.f. signal entering the tuner is first fed through a high-pass filter, consisting of condensers 402A and 402B and inductances 403 and 404, which attenuates all frequencies below 470 mc. See Fig. 4. It is then coupled to the first preselector circuit, which consists of a coil connected between terminal "F" and a condenser plate.

From here the signal is coupled through condenser 406 to the second preselector stage which consists of a coil connected between terminal "H" and a condenser plate. One condenser plate is common to both preselector stages and is grounded through terminal "G." These preselector coils and

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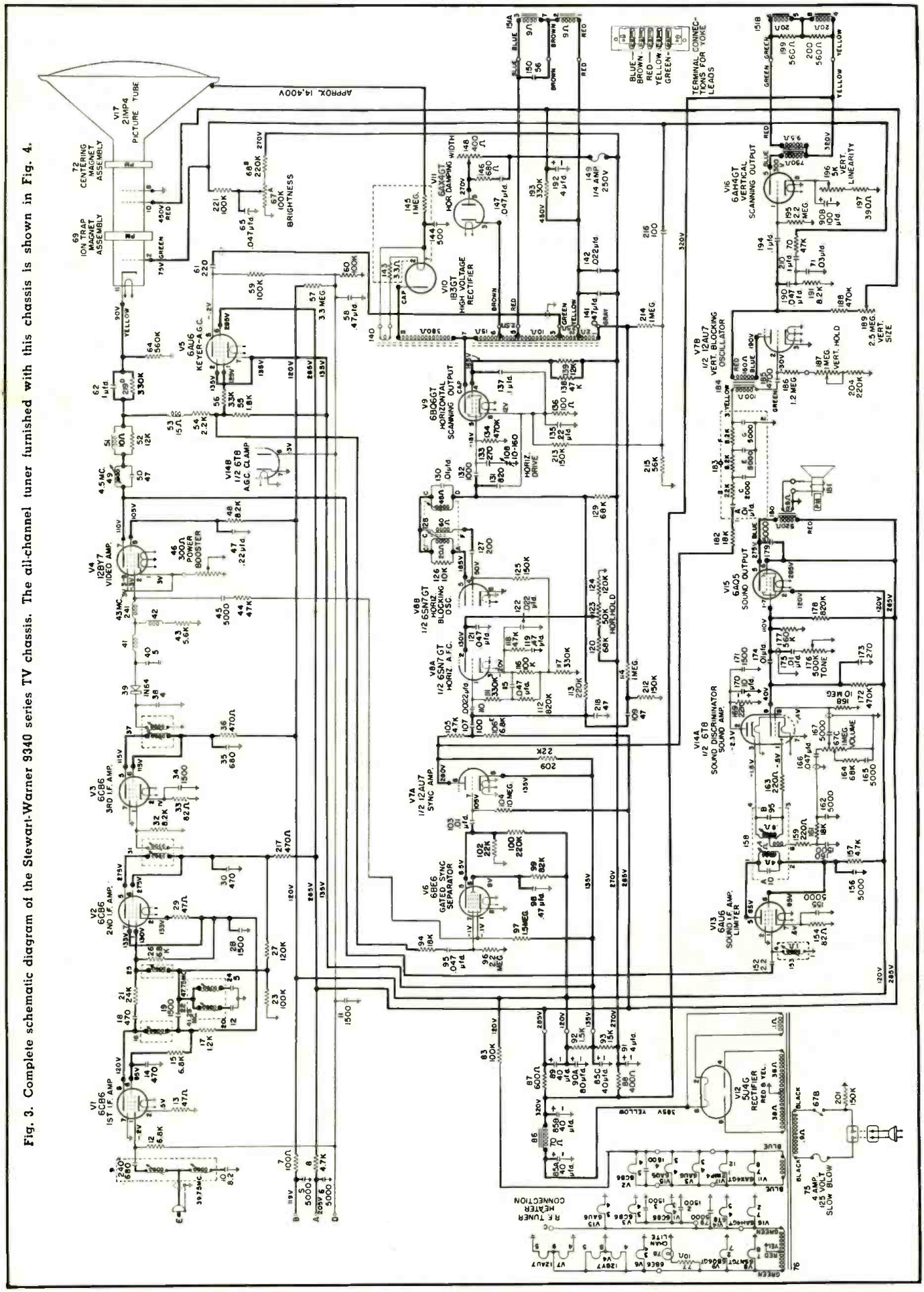
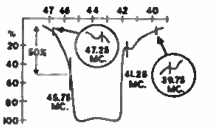


Fig. 3. Complete schematic diagram of the Stewart-Warner 9340 series TV chassis. The all-channel tuner furnished with this chassis is shown in Fig. 4.

VIDEO I. F. ALIGNMENT

STEP	SIGNAL GENERATOR FREQUENCY	SIGNAL GENERATOR CONNECT TO	OUTPUT INDICATOR	CONNECT TO	ADJUST	REMARKS
1	45 mc., 10 mc. sweep. 42 mc. and 45 mc. markers	Pin 1 of V_3 Output of sweep generator (loosely coupled)	Oscilloscope or/and a V.T.V.M. through a 10,000-ohm resistor	Pin 2 of V_4	Primary and secondary of 3rd i.f. transformer for maximum, with even plateau between markers. Connect a detuning clip to pin 5 of V_2	Short antenna terminals together. Sweep generator output at detector should be 1 volt maximum. Place 1000 $\mu\mu$fd. condenser across oscilloscope terminals.
2	45 mc., 10 mc. sweep. 42 mc., 43.5 mc., and 44.9 mc. markers.	Pin 1 of V_2 through a 100-$\mu\mu$fd. condenser. Output of sweep generator (loosely coupled)	Same as above	Same as above	Primary and secondary of 2nd i.f. transformer for maximum—with even plateau between markers. 43.5 mc. marker in center.	Remove detuning clip. Connect negative terminal of 3-volt bias battery to a.g.c. line at point "D" (Fig. 3) on i.f. strip, positive side. to chassis.
3	41.25 mc. unmodulated	Pin 1 of V_1	Same as above	Same as above	Sound i.f. trap for minimum	Disconnect a.g.c. bias battery.
4	47.75 mc. unmodulated	Pin 1 of V_1	Same as above	Same as above	Adjacent sound i.f. trap for minimum	
5	45 mc., 10 mc. sweep. 42.5 mc. and 44.5 mc. markers	Pin 1 of V_1 Output of sweep generator (loosely coupled)	Same as above	Same as above	2nd i.f. grid coil and 1st i.f. plate coil for maximum with even plateau between markers	Reconnect a.g.c. bias battery as in step 2.
6	39.75 mc. unmodulated	Top of raised tube shield on V_{19}	Same as above	Same as above	Adjacent picture i.f. trap for minimum	Disconnect a.g.c. bias battery.
7	45 mc., 10 mc. sweep	Top of raised tube shield on V_{19}	Same as above	Same as above	1st i.f. grid coil and converter plate coil (458, see Fig. 5) for curve below: 	Reconnect a.g.c. bias battery as in step 2.

SOUND ALIGNMENT

8	4.5 mc. unmodulated	Pin 2 of V_4 through a 1000-$\mu\mu$fd. condenser	V.T.V.M.	Pin 11 of picture tube through high-frequency probe or detector network shown in Fig. 8	Sound trap, coil 49, for minimum	Set contrast control to maximum counter-clockwise. Remove one of 6CB6 i.f. tubes.
9	Same as above	Same as above	Same as above	Pin 2 of V_{14A} through a 10,000-ohm resistor, using negative meter lead. Positive lead to ground	Top of transformer 158 for maximum	Reinsert 6CB6 tube.
10	Same as above	Same as above	Same as above	Same as above	Bottom of transformer 158 for maximum	
11	Same as above	Same as above	Same as above	Same as above	Transformer 153 for maximum	
12	Same as above	Same as above	Same as above	Junction of two series 68,000-ohm resistors from pin 2 of V_{14A} to ground. Positive meter lead to junction of resistor 161 and condenser 162	Top of transformer 158 for zero between a positive and a negative peak	68,000 ohm resistors are added to V_{14A} circuit for alignment only.

Table 1. Condensed alignment procedure for the Stewart-Warner 9340 TV chassis. Before alignment, cut out the r.f. oscillator by setting the tuner to an inoperative channel and placing a piece of tape over the first two tuner drum contacts.

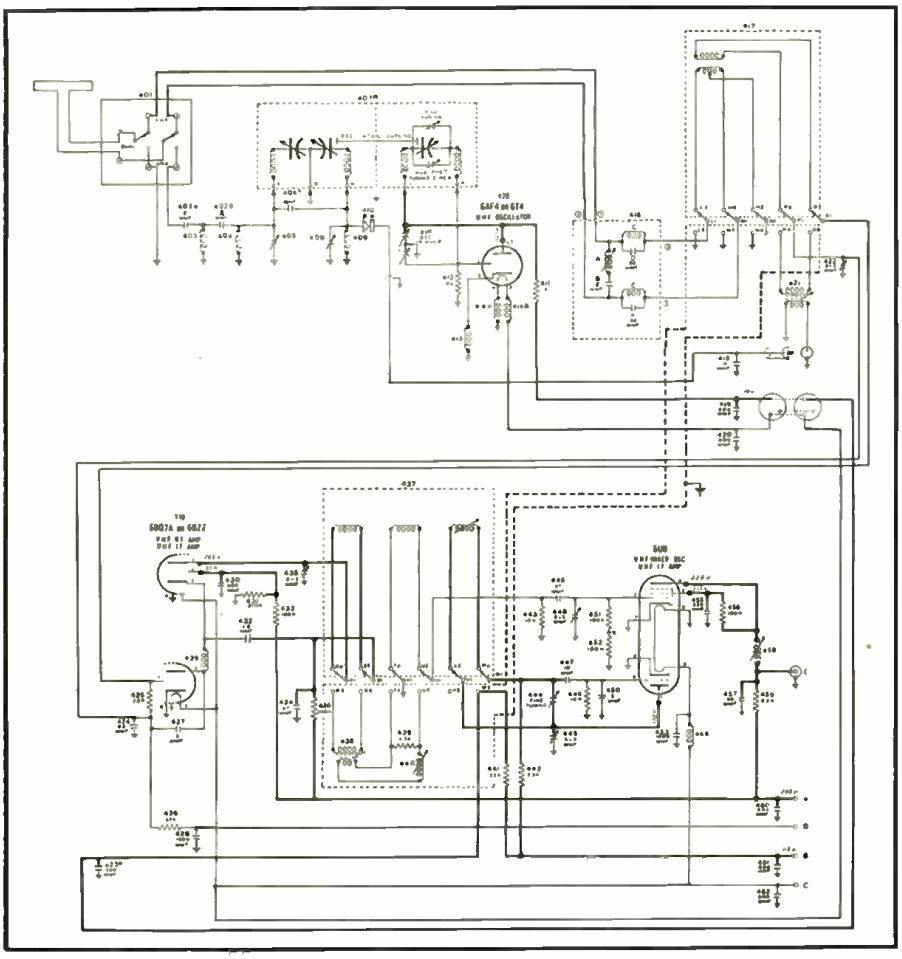


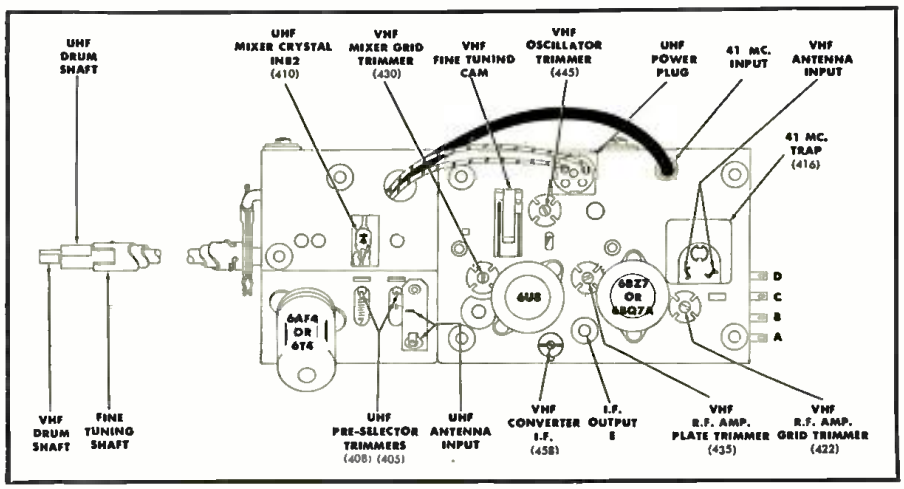
Fig. 4. Schematic diagram of the 82-channel turret tuner, furnished with the 9340 series Stewart-Warner TV chassis, shown set on a v.h.f. channel.

condenser plates are mounted on a single form and are tunable through a range of 10 channels. Selection of any one channel is effected by varying the amount of dielectric between the condenser plates. Additional tuning for alignment purposes is accomplished by adjusting condensers 405 and 408, and by either compressing or expanding the preselector coils.

A 6AF4 tube is operated as the u.h.f. oscillator, and its tank circuit consists of two condenser plates and a coil connected to each plate. These are mounted on the same form as the preselector coils and form a complete coil assembly which is tunable through a range of 10 channels in the same way as the oscillator. In addition, the frequency range of fine tuning on all u.h.f. channels is approximately 2 to 3 mc.

Auxiliary fine tuning is accomplished by adjusting a metal slug between the oscillator-condenser plates on the coil form. On some tuners, auxiliary fine tuning is performed by a screw mounted on the face of the u.h.f. drum, which varies the capacity between the oscillator plate and ground. On other tuners this auxiliary fine tuning screw is mounted on the coil form. Adjustment of this screw changes the capacity between the oscillator condenser plates. As before, additional tuning, for alignment purposes only, can be accomplished by either compressing or expanding the oscillator coils.

Fig. 5. Top view of the 82-channel turret tuner showing the major parts.



The output of the oscillator is capacitively coupled to the second preselector coil. The coupling is in the form of a short piece of wire, one end of which is close to one of the oscillator condenser plates while the other end is close to the second preselector plate. Note that no physical contact is made with either plate.

The oscillator frequency and u.h.f. signal are then fed to a 1N82 crystal, 410, operating as a u.h.f. mixer. This action produces the desired i.f. frequency of 41 mc. which is fed through a coaxial cable to the primary of transformer 421 which is mounted on a 41-mc. contact board. This board maintains electrical contact in the circuit of the 6BZ7 and 6U8 only when the tuner is set for u.h.f. operation, and is switched in by a cam action on the rear of the u.h.f. drum which, at the same time, breaks contact between the v.h.f. drum and its associated circuit. The secondary of transformer 421 is connected to the input circuit of the 6BZ7 tube, which is now operating as a 41-mc. amplifier. The 6BZ7 tube is a dual triode, and is connected in the circuit as a direct-coupled, grounded-grid amplifier. Transformer 438 couples the output from the plate (pin 1) of the 6BZ7 to the grid input of the pentode section of the 6U8 tube, which operates as a 41-mc. amplifier during u.h.f. operation. Transformers 421 and 438 and coil 440 are all mounted on the 41-mc. contact board. Note that in u.h.f. operation, terminal V3 on the 41-mc. contact board is left open, removing plate voltage from the triode section of the 6U8 tube, which makes this section of the tube inoperative. Signal output from the 6U8 is coupled through the plate coil, 458, to a coaxial socket on the tuner and then fed to the receiver's i.f. amplifiers.

For v.h.f. channel selection, the u.h.f. turret must be rotated until the blank setting is detented into position. This occurs when the middle knob shows the letters "v.h.f." in an upright position or when the flat of the middle shaft is in its uppermost position. With the drum in this position, there is no connection to the u.h.f. drum, which makes the u.h.f. oscillator inoperative. At this time the 41-mc. contact board is switched out of the circuit, and the v.h.f. drum is placed into operation. The desired v.h.f. channel selection is now brought about by turning the front knob which rotates the v.h.f. drum. This drum contains two sets of easily removable coil assemblies for each v.h.f. channel.

In v.h.f. operation, the antenna signal is first fed to a 41-mc. trap network, 416, which is tunable from the

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E·V MODEL 666

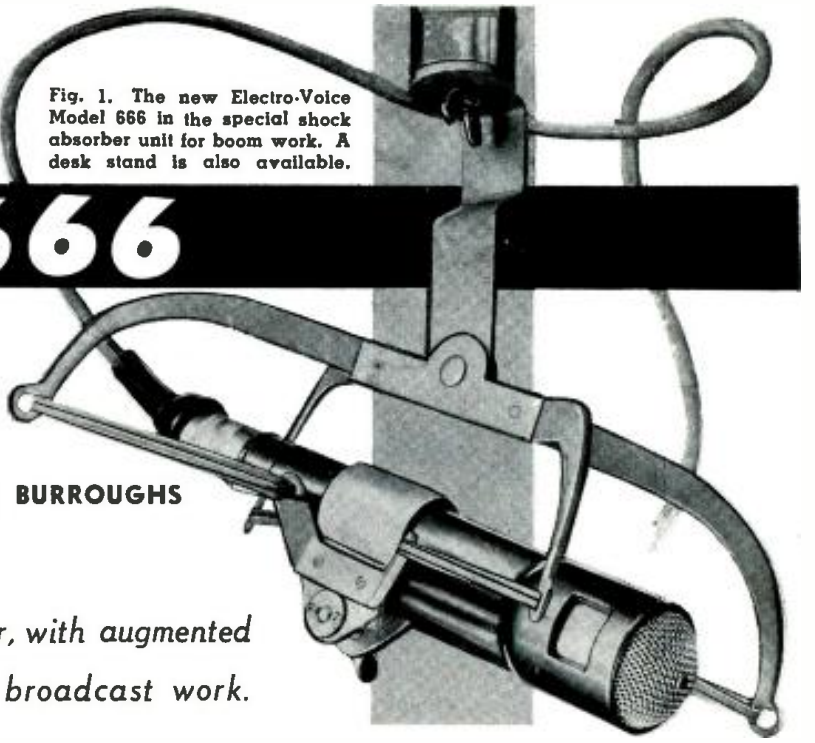


Fig. 1. The new Electro-Voice Model 666 in the special shock absorber unit for boom work. A desk stand is also available.

By
HOWARD SOUTHER & LOUIS R. BURROUGHS
Electro-Voice, Inc.

Details on a new wide-range transducer, with augmented cardioid characteristics, for use in broadcast work.

NOW, all the advantages of a pressure-operated type dynamic microphone, *i.e.,* wider range response, greater sensitivity, and extreme ruggedness, are available in a cardioid microphone—the new *Electro-Voice* Model 666.*

Despite the overwhelming superiority of the dynamic type in all of the aforementioned categories, in the important field of unidirectional design, up to now engineers have not been able to use it for wide-range applications. This new development in the unidirectional field extends the high-frequency response, permits elimination of ribbons, and does not have a characteristic boominess in the high bass region, caused by the proximity effect, when used close to the sound source. In the field of microphone design, the successful application of the dynamic principle to a microphone of outstanding characteristics is a truly major advance.

It is highly advantageous to have a unidirectional or cardioid pickup pattern in a microphone. In broadcast work it is generally desirable to exclude audience sounds and other noise not originating from the performers. It is also helpful if vocalists, with their respective microphones, can be placed near or in front of the orchestra with minimum orchestral pickup to confuse balance and sometimes override the singer. A directional microphone also prevents undue reverberation caused by reflected sound impinging from walls and reflective surfaces not a part of the performing area.

It is also necessary, in telecasting, to exclude the sounds caused by the movements of camera crews and noisy equipment. The preservation of an intimate quality in speech despite a fairly distant microphone position, out of the camera's range, can be achieved only by a directional microphone. Further, rapid movement of a ribbon microphone can cause deformation or failure of the fragile ribbon. Increased ribbon sag can, in some cases, decrease the response resulting in non-uniform operation between microphones of the same model. Most essential, the development described herein presents adequate and uniform cardioid action throughout the entire range. In the region below 150 cps and above 4 kc., the improvement in the Model 666 is particularly noticeable and important because unwanted noise exists in the extreme bass region. Also, the ear is sensitive to the higher frequencies in speech, dolly squeaks, audience movements, and other extraneous noise to be found in the last two octaves.

Because of these new and stringent demands on microphone performance, it was obvious that the industry needed a lightweight, rugged microphone which could provide high and uniform front-to-back discrimination. Simplicity of design was also required to provide stable operation. Susceptibility to shock and wind noise had to be reduced and the size had to be small to eliminate shadows and make the microphone as unobtrusive as possible. A microphone which meets these requirements will be described.

* Patent Pending

Design and Operation

The Model 666 is 7½" long, 1⅝" at its largest diameter and 1" at its smallest diameter. The microphone is supplied with an integrated blast filter and magnetic shield and weighs only 11 ounces. Accessories for use with this model include a small, heavy cast stand and an inconspicuous shock mount for boom work.

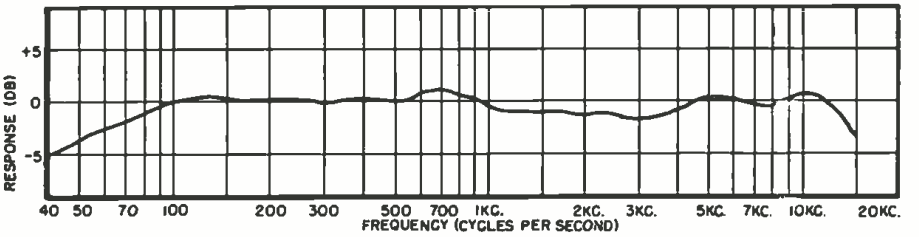
The output level of the microphone is —57 db below 1 milliwatt operating in a sound field of 10 dynes/ cm.². Output impedances are available at 50, 150, and 250 ohms with a matching strap provided internally in the barrel of the unit.

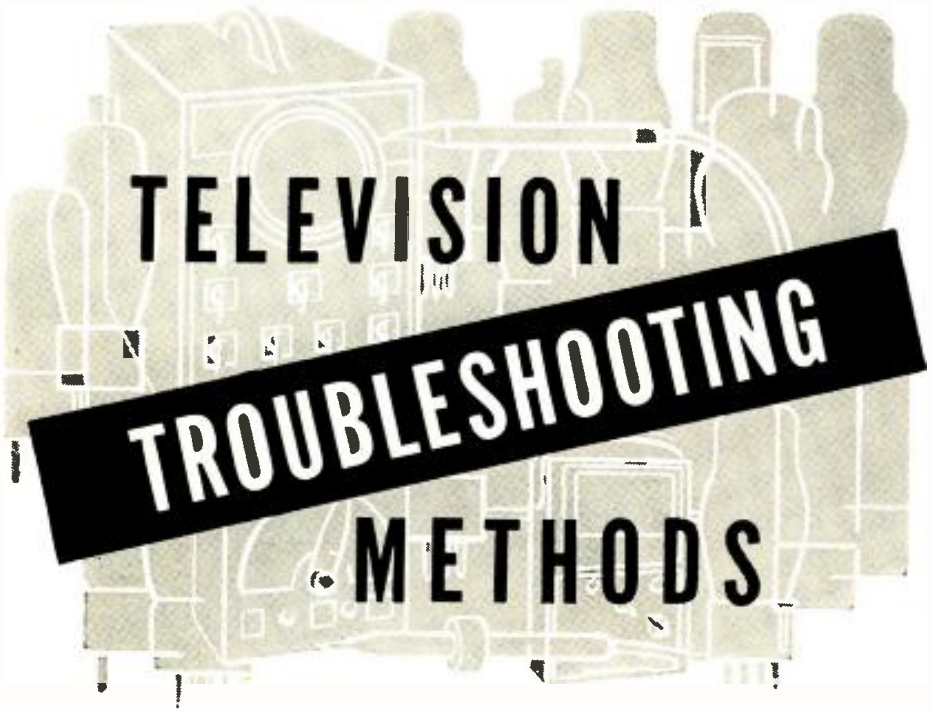
The frequency response range, Fig. 2, is substantially uniform throughout the entire spectrum. The front-to-back signal discrimination is no less than 14 db at any frequency and averages 25 db throughout the spectrum in the back hemisphere.

The shape of the microphone, Fig. 1, is the result of fundamental functionality. The two tubes extending from the rear of the head cavity include sound entrances. These sound entrances, in combination with the openings directly behind the diaphragm, form part of three separate acoustic paths, all of different lengths. Each path is carefully calculated to pass sound over only that part of the spec-

(*Continued on page* 150)

Fig. 2. Frequency response of the Model 666. See text for discussion of response.





By **JOHN K. FRIEBORN**

How systematic is your troubleshooting? Review the techniques described here for better TV servicing.

"IS THE television receiver you are trying to outthink an *Ultravision* Model 2020 with a purple shamrock on the rear chassis apron and does it show people with short legs and long heads? Replace the vertical amplifier tube and/or C_{3D}."

This service hint may be valuable to you unless the only *Ultravision* Model 2020 that ever tried to get the best of you had a *green* shamrock and showed people with long legs and flat heads.

You say you want something that you can use a bit more often? How about this? "If the sound produced by a given receiver is all right, but there is something wrong with the picture, then the trouble is in one of the parts of the receiver which affect the picture but not the sound."

Too general, you say, and it doesn't tell you what to do? That isn't the half of it; sometimes such "obvious" statements are, from a practical point of view, not even true and television receiver troubles are not where they should be.

Both of the types of information mentioned do have their uses, of course. Sometimes the specific cure does refer to the receiver and trouble you have—or it can be applied to another receiver if you know enough to make the necessary changes. As for the general suggestions, they may be all you have to start with. Of course, going beyond them does require you to know how they apply to the particular receiver with which you are dealing.

Fortunately, there are many other methods known to service technicians which can be used to find many different troubles in almost any type of receiver; this article will describe some of them.

Most—if not all—of the available techniques for finding troubles in television receivers can be divided into three types: 1. interpreting symptoms and tracing the functioning of the receiver to localize the trouble logically; 2. checking for particular faults which are known to occur frequently; and 3. checking components and adjustments which are easy to check.

Logical tracing of the receiver's functioning begins, of course, with observation of the symptoms. First, though, have the set-owner turn the set on, adjust it, and show you what is wrong with it. The fault may be in his (or her) methods. This also will avoid looking for the wrong trouble.

Sound Section

With one exception, the sound-producing functions of a television receiver are practically identical with those of an FM receiver. In addition, a TV receiver must separate the video signal from the sound. When it does not do so completely, we have the well-known video buzz, one of the most annoying troubles to the set-owner and often one of the hardest for the service technician to find. Actual direct function-tracing in this case is difficult. The best approach is to check each point in the circuit where the fault could be, since there are not very many of them.

First, check the sound i.f. tuned circuits by adjusting them to reduce the buzz. If no improvement is produced by manipulating a particular trimmer, return it to its original position. Second, in an intercarrier receiver, check the video i.f. tuned circuits which are intended to reduce the amplitude of the sound signal entering the video detector. (This requires specific knowledge of the receiver's i.f. alignment.) Third, also in an intercarrier receiver, if the sound is separated from the video signal after one or more stages of video (not video i.f.) amplification, check on the possibility of cross modulation in a video stage because of a weak tube, improper bias, or overloading. Fourth, in any receiver, if the buzz is most noticeable with a strong signal, check the possibility that the mixer tube is drawing grid current, thus offering a varying load which frequency modulates the oscillator. The cure is either to reduce the signal input to the mixer or rewire the circuit to apply a.g.c. bias to its grid. If nothing suggested here does any good, the service technician may console himself—though not his customer—with the thought that many intercarrier receivers of a couple of years ago had a buzz "built-in." The seat of the trouble was a distorting video stage as mentioned in the third suggestion. The cure requires redesign of the receiver, with the sound take-off immediately after the video detector and an additional sound i.f. stage.

Picture Section

In dealing with picture faults, the first step is the hardest: determining exactly which function is not correct. We must recall just what functions are required to produce the picture and examine each one separately. Those functions are: 1. light production, 2. focusing, 3. beam modulation, 4. vertical deflection, 5. horizontal deflection, 6. vertical synchronizing, and 7. horizontal synchronizing.

If the screen is dark or less bright than normal, the trouble is one of the following: heater voltage low or absent, cathode worn, ion trap magnet misadjusted, improper electrode voltage (grid bias and first-anode potentials are possibilities as well as the high voltage), phosphor worn, or other picture tube fault such as loose connection in base.

To check focusing note the width of the scanning lines. They should be as narrow as possible and well-separated from each other, over as much of the area of the screen as possible. Inadequate focusing may be due to improper adjustment of ion trap magnet, improper position of focus coil or magnet, or (in case of focus coil) faulty focus-control, current- or voltage-dividing network.

Beam-modulation faults, indicating improper video signal delivered to the picture tube grid-cathode circuit, are of many different types. "Snow," interference, "ringing," and lack of signal are the principal defects.

"Snow" usually is said to be caused

by a weak signal, but it would be more accurate to say that a weak signal does not override the "snow," which is always present but not visible in the presence of a strong signal. If the signal actually is not weak, the fault may be in the antenna system (insufficient gain, loose connection), or in the r.f. section of the receiver (loose connections, corroded contacts, weak tubes, improper voltages).

A regular pattern superimposed upon the picture indicates an interfering signal. Some clue to the source usually can be obtained by computing the frequency of the interference. If horizontal bars are produced, multiply one-half the number of bars (dark and light), from the top of the picture to the bottom, by 60 cycles. In Fig. 1, two bars are present, so that interference is due to a 60-cycle signal (in this case, hum in the video amplifier or picture-tube circuit). If the bars are vertical or diagonal, multiply one-half the number of bars by 15,750 cycles. The pattern shown in Fig. 2 contains about 120 bars, allowing for the entire width of the screen (Fig. 2 shows only part of the screen) and the horizontal retrace, and the interfering signal is about 1 mc. This effect could be produced either by a 1-mc. signal injected into the video amplifier, or a signal 1 mc. more or less than the video carrier frequency injected into the r.f. or video i.f. sections.

The pattern in Fig. 5 is not caused by an external interfering signal. Note that the bars are not straight and do not cover the entire screen. This effect is caused by "ringing"—oscillation, possibly in the video amplifier, but usually in the video i.f.

A useful technique for diagnosis of faults in the receiver's response to video signals is to draw (or imagine that you have drawn) a picture of the waveshape which would produce a portion of one line as it appears on the screen and as it should appear. (See Fig. 3.) Poor response to either high or low frequencies may be due to misalignment of the video i.f. amplifier or to faulty components in the video amplifier. Poor low-frequency response can be further localized by noticing the effect of manipulating the fine tuning control. If no setting of the control gives adequate low-frequency response, the fault is in the video amplifier. Poor high-frequency response cannot be localized so easily, but usually it is due to i.f. misalignment.

One case of variation in light on the screen is not caused by a grid-cathode signal in the picture-tube circuit at all. (See Fig. 6.) This is due to "ringing" in the horizontal deflection circuit, causing each line to be folded back upon itself. (See Fig. 4.)

Most vertical and horizontal deflection faults, causing insufficient size or nonlinearity, produce easily recognizable effects on the picture. On the other hand, it may be difficult to tell whether certain other faults are in the deflection section or in the synchronizing section of the receiver. Faults in

Fig. 1. Pattern produced on TV screen by 60-cycle hum interference in video.

either one may cause vertical "rolling" or horizontal "tearing." The test is to adjust the hold control very carefully and note the effect. If the picture can be brought into proper synchronization, even momentarily, without going to either extreme of the control's range, the frequency-controlling parts of the deflection circuit are OK and the trouble is in the synchronizing circuits.

Checking the Stage

When a fault has been isolated to a section of the receiver, the faulty stage can be found by signal tracing or signal injection. The most adequate signal tracer for the deflection and synchronizing stages—and even for the video amplifier—is an oscilloscope. For other stages, suitable voltmeters and signal generators can be used. At two points in the receiver, the faulty stage cannot be found by simple stage-to-stage tracing: the mixer and oscillator, and the horizontal a.f.c. circuit. In both cases, two inputs are required to produce the proper single output.

Oscillation of the oscillator can be verified by measuring the developed grid bias in receivers where a test point is provided. If the measurement is made without the benefit of a special test point, precautions must be taken so that the loading effect of the meter will not disturb the functioning of the oscillator. Such a measurement in any case tells nothing about the frequency of oscillation. The frequency may be checked with a frequency meter if available or the functioning of the receiver may be observed using a substitute signal from a signal generator.

The faulty component within a stage

Fig. 5. "Ringing" interference is caused by oscillation in video i.f. amplifier.

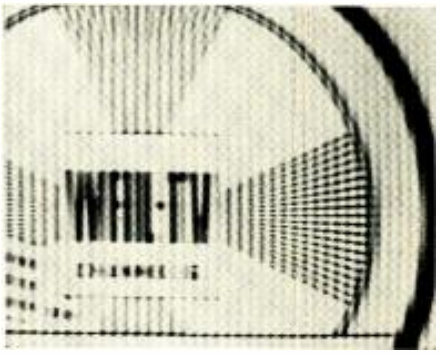


Fig. 2. One-megacycle interference produces this beat pattern on picture tube.

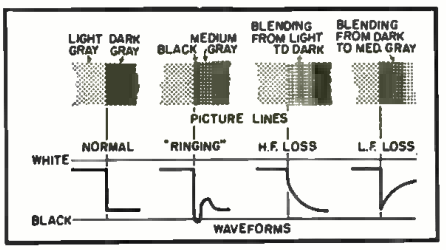


Fig. 3. Matching the appearance of a picture line on the CRT with the type of signal waveform that produces it.

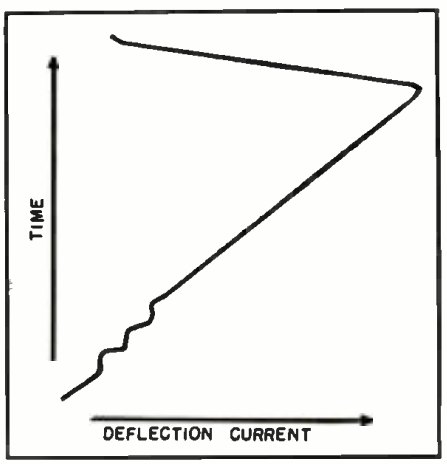


Fig. 4. Horizontal deflection waveform producing vertical lines as in Fig. 6.

can be found by the direct and indirect methods common in troubleshooting: tube replacement, voltage and resistance measurements, condenser bridging, etc.

The systematic method described for localizing the trouble to a section, to a stage, then to a component, sounds

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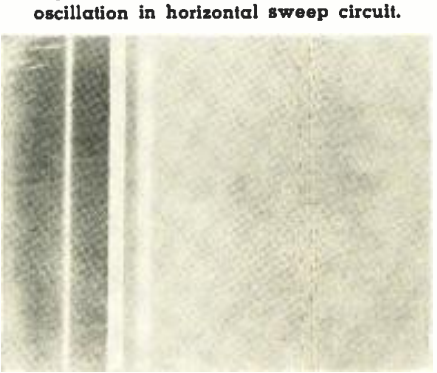
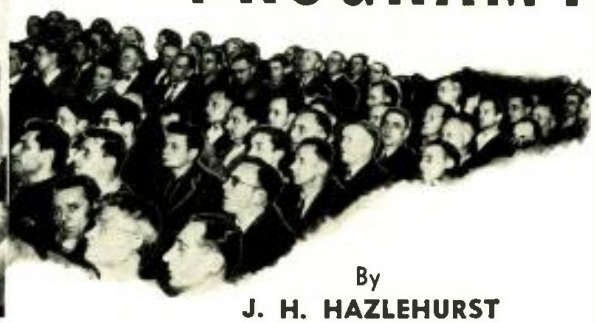
Fig. 6. Vertical white lines caused by oscillation in horizontal sweep circuit.



HOW IS YOUR TRAINING PROGRAM?



Bench consultations, group instruction, and lectures yield advanced TV training.

By
J. H. HAZLEHURST
Business Consultant

Do you have an efficient training program for the radio and TV service technicians in your shop? If not, you stand a chance of losing your key men.

ANY owner of a service shop, if he keeps records on employee "turnover," is aware of the "fluidity" of his shop force, particularly his field men. In a general way, he is also aware of the fact that the staff needs training. In some of the larger shops time may be set aside during which training sessions are held. It is the exceptional owner, however, who has any realization of how much such training periods cost him or, alternately, how much the lack of such formal training costs him in lost time and inefficient servicing.

Unfortunately this is not a problem that the shop owner can take or leave alone. In this respect it is like public relations. The shop owner cannot decide whether he will or won't have a public relations program. He has one. His only decision is whether it will be good or bad. The same is true of training. Whether or not it is recognized, every shop owner has a training program. Any owner or shop foreman who is called to confer with a bench man on a problem set is spending time and money in training. When several men are in a discussion, during working hours, over a "dog," the shop owner has just spent money in training. When a repaired set bounces, some of the money spent in making it good can be charged to training if that is any satisfaction to the shop owner. If you are in the radio and TV servicing business, you are also in the training business whether you know it or not and whether you want to be or not.

If the training challenge is to be met properly, it must be met on two fronts—the industry front and the individual front. Let's consider the industry side first. Perhaps few busy people in the service game realize the extent to which training programs have grown within the electronics industry in general. Consider the phenomenal growth of the organizations supplying service information. Actually, these are "training aids" and the demand for them and the "how-to-do-it" books has increased to an unbelievable extent since the old radio days. The correspondence and home study schools have increased in size and number. Schools with residence courses are still jammed with students. Every manufacturer has field men who put on training meetings covering everything from antennas to test instruments. Most of these are excellent, but the overlap in material is very great. If a shop owner took on all these programs, his men would never be at the bench or out making home calls. It is no wonder, then, that the practical shop man looks with a chilly eye on the eager beaver who wants him to have his men attend a hot meeting, say, by a tube manufacturer.

The fact is that the training aspect of the servicing field is in the same state as the manufacturing branch of the industry in the days when some wanted to scan from left to right and some from right to left, and everyone had his own notion of the proper number of lines per frame and frames per second. The solution to that problem was the NTSC. It is my opinion that the solution to at least a great part of the current training rat race lies in an analogous mechanism for the service field.

Logically, this should be spearheaded by the national associations in the service industry. It is doubtful, though, if this is a practical answer at the present time owing to the fact that these associations do not have the full backing of the service shops of this country, nor do they have the funds to undertake such an enterprise. The greatest weakness of the servicing industry is that it has not yet developed the leadership necessary to make it an integrated segment of the industry that is both vocal and intelligently powerful. Certainly, the leadership is there somewhere, and in time it will assert itself, but meanwhile, it is probably going to be up to the manufacturers to supply the needed unification and streamlining of the welter of training efforts now being made. While this may not be the manufacturer's responsibility, it would be to his advantage to do it. Many a manufacturer has discovered that while it is not his responsibility to do sales training at the retail level, it nevertheless pays off in increased profits.

Much has been said about service charges being high. At the same time, shop owners generally are not getting wealthy. It is very possible that a disproportionate share of the service dollar goes to cover inadequate, faulty, or uneconomical training. If so, a solution to the problem would be reflected in increased profits to service shops, manufacturers, and might even benefit the public in lowered charges. Certainly there are enough dollars being spent in the service field today to pay the costs of such a study and undertaking.

This, then, is the problem of the industry at large, and I believe that the industry will eventually recognize it. Meanwhile, the individual shop has its own job to do. Each shop is an individual enterprise with its own characteristics and no pat formula can be set up to fit them all. There are basic principles, though, that must be recognized as fitting all shops from the largest to the smallest. The first is to realize that training programs are probably here to stay. A shop owner must acknowledge the fact that he must provide some form of training and then try to make it a controlled item. He must study the training tools available in his area, pick out those with the least overlap and the least amount of specialized commercial

(*Continued on page* 172)

NEW COMMUNICATIONS RECEIVER

Front panel view of the new National Model NC-88 communications receiver which offers continuous coverage in four overlapping bands.

Details on a receiver of good performance and rugged dependability which covers all bands 540 kc. to 40 mc.

THE new *National* Model NC-88 is a good example of a communications-type receiver of high performance and rugged dependability. It has been designed to fill the needs of many varied classes, from the amateur and short-wave listener to the many commercial services and civil defense groups. Eight miniature type tubes plus rectifier are utilized in a modern superheterodyne circuit with a continuous frequency coverage of 540 kc. to 40 mc. Both voice and radiotelegraphy reception are provided to permit world-wide coverage over the entire range. The complete frequency coverage of the NC-88 is separated into four bands, with the entire main tuning dial and the 10, 11, 15, 20, 40, and 80 meter amateur bands on the bandspread dial calibrated directly in megacycles. A logging scale on the bandspread dial permits relative calibration of bandspread tuning anywhere within the range of the receiver, while clear markings on both dials, including location of the new civil defense frequencies, contribute to ease of operation.

A phono jack has been installed on the rear of the chassis to accommodate most types of record players in use today, permitting the receiver to be used for music reproduction. Audio is delivered to the built-in loudspeaker, while a two-position tone switch gives the listener his choice of crisp treble or rich bass response. The delayed automatic gain control circuit compensates for fluctuations in the strength of the received signal due to atmospheric conditions, etc., while an extremely effective automatic noise limiter circuit provides maximum suppression of most types of objectionable noise.

Audio output is provided by the built-in five-inch permanent magnet loudspeaker or at the headphone jack located on the front panel. The headphone load impedance is not critical,

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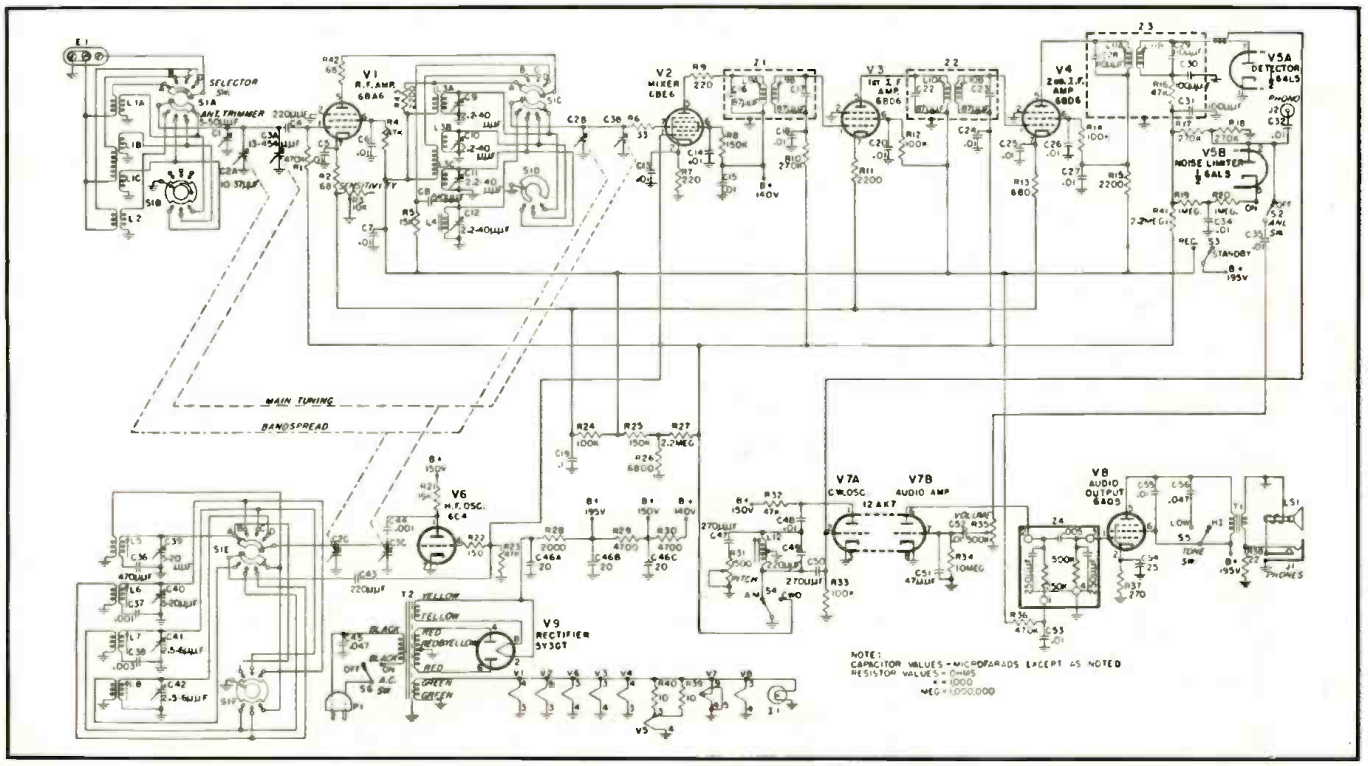
Schematic diagram of the National Model NC-88 communications receiver for amateur, s.w., commercial, and civil defense use.



FUNDAMENTALS OF COLOR TV

Part I. Color fundamentals and their application in color television for radio and TV service technicians.

MILTON S. KIVER
Pres., Television Communications Institute

COLOR forms one of the most intimate contacts in our everyday life —we wear colored clothes, we use colored objects, we live in colored houses, and we eat colored food. Yet, in spite of this close contact with color, most people have only a casual knowledge of the nature of color or of color mixing. To the television technician, color possesses added significance because of its application in color television. Such terms as color primaries, hue, saturation, chromaticity, and luminance will be commonly used in any description of a color television receiver, both from the standpoint of operation and of service. What do these words mean? How do they tie in with color television? These are some of the questions the service technician will be confronted with and now, while the art is still young, is as good a time as any to learn about them.

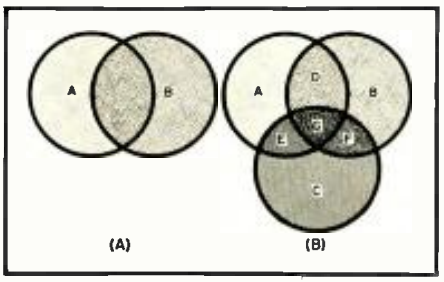
Let us start off with color primaries. Anyone who has ever experimented with projector lamps has discovered that when different colored lights from several projectors are combined, the resultant color seen by an observer will differ from the color of any of the projected beams. Thus, for example, yellow can be formed by combining red and green light; white light can be produced by combining red, green, and blue. The color of the light formed will appear to the eye as a complete color and the eye will be unable to distinguish the various components of the mixture that united to form the new color.

This method of color formation is illustrated in Fig. 1A. Two circles of colored light are projected onto a screen and positioned so that they overlap to some extent. Within the overlapping region, a new color will be produced by the addition of color "A" and color "B." Where the circles of light do not overlap, each light will retain its original color. If a third circle of light is added, as shown in Fig. 1B, then a maximum of seven colors can be obtained. These would be: color "A," color "B," color "C," color "D" (formed from "A" and "B"), color "E" (formed from "A" and "C,"), color "F" (formed from "B" and "C"), and color "G" (formed from "A," "B," and "C") and each would differ from the ther. In the areas where the circles of light overlapped, the eye would not be able to distinguish each of the colors forming the mixture, but instead would see the final color produced. Thus, color "A" and "B" would not appear to the eye as color "A" and color "B," but as some new color which we can call color "D." The same would be true of each of the other combinations.

The number of different colors that can be formed by the use of three colored lights, as shown in Fig. 1B, will depend upon the colors chosen. Experience has indicated that the colors red, blue, and green, when combined with each other in various proportions, will produce a wider range (or gamut) of colors than any other combination of three colors. Note, however, that if we used four different colors in our mixing process, we could produce an even greater number of different colors.

EDITOR'S NOTE: Although color television is a commercial reality, few TV service technicians will have the opportunity to install or work with sets for some time to come. In the meantime, the service technician can ground himself thoroughly on the fundamentals of the subject so as to be prepared when color TV sets become widely available. This article is the first of a series that will attempt to present all the background necessary for the servicing of color TV receivers. Actual schematic diagrams of color TV sets will be analyzed when they become available and once the fundamentals of color TV have been thoroughly covered. Of course, other articles in RADIO & TELEVISION NEWS *will present the latest advances in color TV as they occur.*

Fig. 1. (A) A new color is formed between color "A" and color "B" as a result of mixing color "A" and color "B". (B) Adding three original colors, "A", "B", and "C", results in four new ones.



With the addition of more and more colors to our mixing scheme, the reproducible range would widen somewhat. Obviously, however, a line must be drawn and the use of three colors has been standardized. The three colors chosen, red, green, and blue, are thus referred to as the "primary" colors although, as we shall see, the use of the word primary has been widely misinterpreted to mean that red, green, and blue will, in various combinations, reproduce *all* colors. This is only in a special instance.

The reason why three primaries were chosen, in preference to say four, probably stems from the belief that the eye behaves as though it contains three sets of nerves, with each set of nerves responsive to a different portion of the visible spectrum. Thus, one set of nerves has its greatest sensitivity in the blue region; another set is most sensitive in the green region; and the third set is most sensitive to red. Whether or not three sets of nerves actually exist has never been absolutely established. However, since the eye reacts as though such a condition does exist, it is reasonable to work on the assumption that it does.

The theory which serves to explain the ability of the human eye to distinguish various colors can also be employed to explain color blindness. In the eyes of a color-blind person, all of the color sensitive nerves or retinal cones react in the same way to all colors. Hence, when colored light is viewed by these people, all three sets of nerves are similarly stimulated and the same result is obtained as though equal amounts of red, green, and blue light were intermixed. The color seen would be white, or some intermediate shade of grey. These people can distinguish between dark and light, but no more.

There are also people whose retinal cones differ sufficiently to see some of the colors, but not all. These people are known as partially color blind. Perhaps the best known instance of this is green and red color blindness. In the eyes of these people green or red appears grey. Fortunately, however, over 90 per-cent of the population have normal vision, which means

COLOR ANALYSIS

that they are able to distinguish between all of the spectrum colors.

A diagram which is very convenient to use for color mixing is the tongue-shaped (or horseshoe-shaped) curve shown in Fig. 2. (Another name for this curve is chromaticity diagram.)

Around the perimeter of this curve are listed numbers that range from 400 at the lower left-hand corner to 740 at the farthest point to the right. These figures represent the wavelength of various spectrum colors in millimicrons. Thus, purple (violet) extends from approximately 400 to 450, blue extends from 450 to 500 millimicrons, green extends from 500 to 570 millimicrons, yellow extends from 570 to 590 millimicrons, orange extends from 590 to 610 millimicrons, and red extends from 610 to 740 millimicrons.

Any point not actually on the solid-line curve but within the diagram represents not a pure spectrum color but some mixture of spectrum colors. Since white is such a mixture, it, too, lies within this diagram; specifically, at point "C." This particular point was chosen at an international convention in England and is generally referred to as "illuminant C." Actually, of course, there is no specific white light, since sunlight, skylight, and daylight are all forms of white light and yet the components of each differ considerably. The color quality of a conventional black-and-white television receiver tube is represented by some point in the central region of the diagram about point "C."

The chromaticity chart lends itself readily to color mixing because a straight line joining any two points on the curve will indicate all the different color variations that can be obtained by combining these two colors additively. Thus, consider a line drawn connecting points "R" and "G" representing certain shades of red and green respectively. See Fig. 3. If there is more red light than green light, the exact point representing the new color will lie on the line, but be closer to "R" than "G." Point "R'" might be such a color. On the other hand, if a greater percentage of green light is employed, the color will still lie on the line connecting "R" and "G," but now, it will be closer to "G" than "R." Point "G'" might be such a color. This same line of reasoning can be carried out for any two colors on the chart.

(On the screen of a three-gun tri-color picture tube we can carry out the same experiment by turning off the blue gun and permitting only the electron beams from the green and red guns to reach the phosphor-dot screen. As one beam, say that from the red gun, is made more intense, the resultant color on the screen shifts closer to red. On the other hand, if the red gun is turned down and the green gun beam is turned up, the resultant color takes on more and more of a greenish cast. When both guns are producing beams of equal intensity, yellow will be seen.)

Point "C," in the central region of this diagram, is taken to represent white or daylight. If we draw a line between point "C" and any point around the curve, we have a mixture of white light and a particular spectrum color. Thus, in Fig. 4, a line connects point "C" and green at 545 millimicrons (point "A"), indicating a mixture of white light and spectrum green. If the amount of white light is zero, then the pure spectrum green will be produced. As white light is added, the hue of the green changes and the point representing this mixture moves along the line toward point "C." We might consider this as diluting the green, causing it to become lighter and lighter.

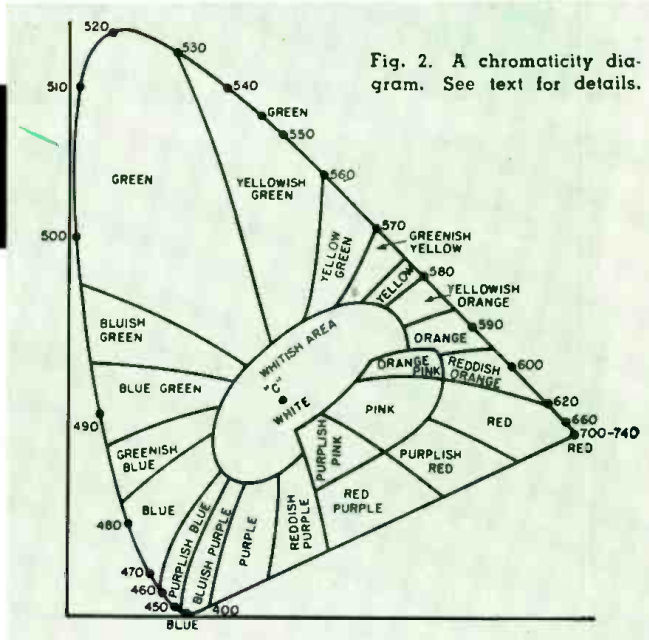


Fig. 2. A chromaticity diagram. See text for details.

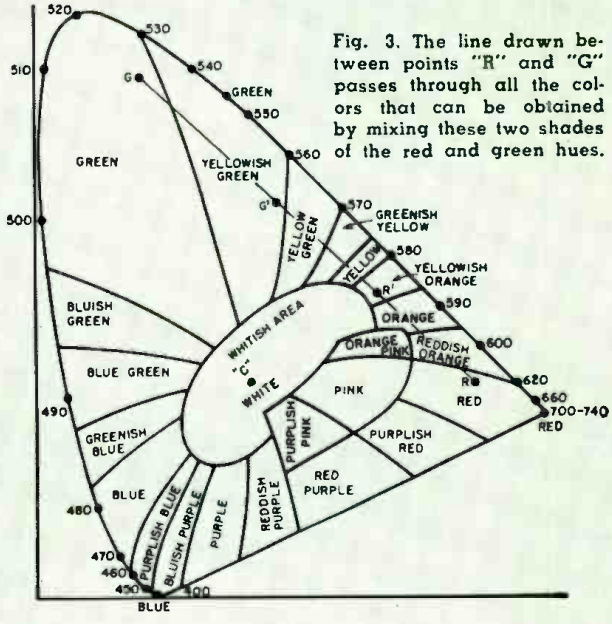


Fig. 3. The line drawn between points "R" and "G" passes through all the colors that can be obtained by mixing these two shades of the red and green hues.

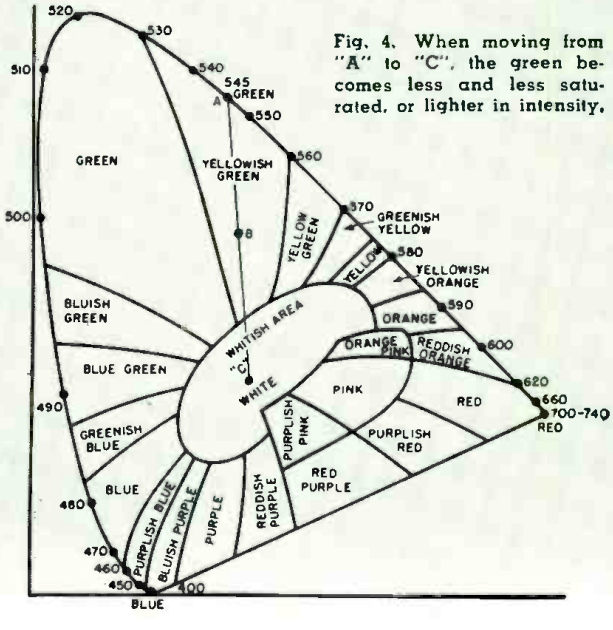


Fig. 4. When moving from "A" to "C", the green becomes less and less saturated, or lighter in intensity.

(In a color tube, we dilute a solid color, say green, by adding more red and blue. The red and blue combines with some of the green to form white, thereby reducing the intensity or depth of the green.)

It is possible to specify the saturation of a color by its distance from point "C." Thus, consider point "B" in Fig. 4. This is half way between point "C" and point "A" and represents a mixture of green diluted 50 per-cent with white light. The saturation of the green at point "B" is 50 per-cent. Had the distance between point "C" and point "B" been 75 per-cent of the total distance between point "C" and point "A," we would have stated that the saturation of the color at point "B" was 75 per-cent. By moving point "B" closer and closer to the spectrum curve, its purity increases until it becomes 100 per-cent at the curve—point "A." By moving point "B" closer to point "C," its saturation decreases. At point "C," the saturation is said to be zero.

In connection with saturation, the word hue is frequently heard. Hue represents colors such as red, green, orange, etc. It is associated with color wavelength and when we label a certain color as green, or orange, or red, we are specifying its hue. Thus, hue refers to the basic color as it appears to us, while saturation tells us how deep the color is. If the color is highly saturated we say that it is a deep color, such as deep red, or deep green. If it contains a considerable amount of white light, we say it appears faded or pale, as a faded red or a pale green. Hue and saturation are psychological terms representing the observer's impression of a color and hence they cannot be defined as precisely as wavelength.

At the bottom end of the chromaticity curve, on the line drawn from deep blue to red, there is a series of colors which are combinations of red and blue in various proportions. These range from bluish purple to purplish red. It can be seen that this line completes the curve of Fig. 2. However, this line should not be considered in the same sense as the rest of the curve. It does not contain any spectrum colors but only combinations obtained from mixing spectrum colors. Because of this, the region at the back end of this tongue-shaped curve is known as the region of non-spectral colors. The boundaries of this region are obtained by drawing dotted lines from point "C" to red at 700 millimicrons and from point "C" to blue at 450 millimicrons. The remainder of the diagram above these dotted lines is known as the region of spectral colors. The entire diagram is known as the domain of real colors.

One further term used in connection with this diagram is complementary color. Any two colors which can by themselves form white are known as complementary colors. Thus, in Fig. 5, the line connecting point "F" with point "G" passes through point "C" and hence, the colors at "F" and "G" are said to be complementary to each other.

We have previously seen that a line drawn between two points representing two different colors contains all of the combinations that can be derived using those two colors. If, now, we wish to determine what range or gamut of colors can be obtained from any three given colors (say "R_1," "G_1," and "B_1"), we would draw connecting lines to each of the colors. See Fig. 6. The result is a triangle. We can produce any color within this triangle by various combinations of the three colors, "R_1," "G_1," and "B_1."

The wavelengths of "R_1," "G_1," and "B_1" chosen for television fall near 610 millimicrons for the red, near 540 millimicrons for the green, and near 470 millimicrons for the blue. These are actually the values used for the triangle drawn in Fig. 6 and by studying this diagram you can see the extent of the color range obtainable on a color television receiver. Note that colors not included within the triangle will not be reproduced by *any* combination of the three primary colors chosen.

This, of course, brings us back again to the statement made previously, that three primary colors cannot reproduce *all* colors simply by adding the three primary colors together. In color television, of course, only those colors which can be produced by adding the primaries together can be considered, this being the only practical approach possible.

The choice of suitable primary colors for television depends principally upon what type of color phosphors can be obtained for the receiver picture tube. Originally it was felt that the color picture would be traced out on a black-and-white screen and then the light passed through a color filter to present the observer with the "color" image. This was the method employed in the *CBS* system and in the early forms of the *RCA* system. However, with the development of a color tube, phosphors are employed which emit colored light directly, leading to a less cumbersome system physically and a more efficient system optically.

A considerable amount of research work is being done on evolving phosphors which will provide as wide a gamut of colors as possible. In recent tubes, a willemite phosphor (Zn_2SiO_4: Mn) was used for the green, a sulphide phosphor (ZnS:Ag:MgO) for the blue, and a third phosphor, $Zn_3(PO_4)_2$: Mn for the red. These primaries provide a fairly wide range of colors, as seen in Fig. 6. By comparison, the area covered by printing inks is much smaller. It may be that as the art advances, the color range of the phosphors will be extended, although the colors now obtainable are wholly satisfactory.

When the NTSC system of color television was under development, a considerable amount of research was

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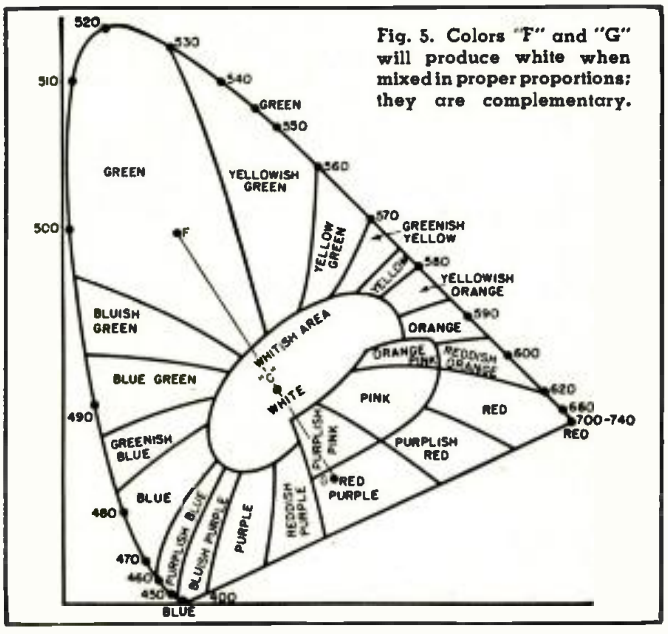


Fig. 5. Colors "F" and "G" will produce white when mixed in proper proportions; they are complementary.

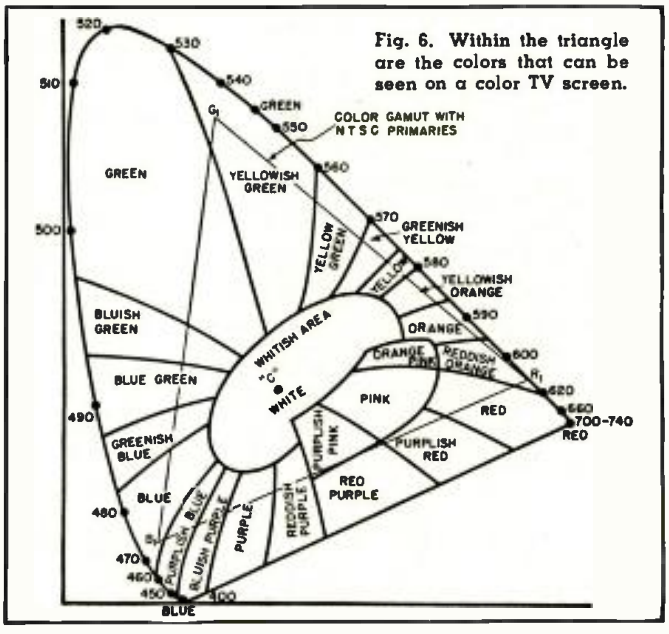
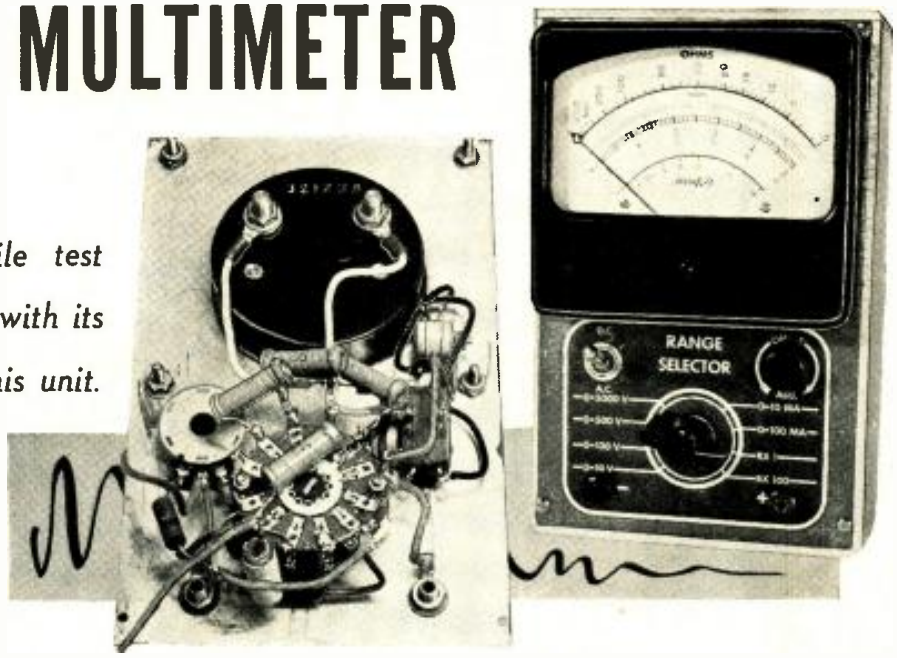


Fig. 6. Within the triangle are the colors that can be seen on a color TV screen.

BUILDING A MULTIMETER

By **ROBERT HILLIARD**
Robert Hilliard Company

Build this compact, versatile test instrument. A 0-1 ma. meter, with its scale redrawn, is used for this unit.



Two views of the meter panel on which all component parts are mounted.

CONSTRUCTION articles describing various sorts of multimeters have been more plentiful than unique. Generally these units consist of a low-range milliammeter with a switching system and multipliers which permit a number of different functions to be read on a single indicator.

The circuit of the multitester to be described is novel in several respects. Among the unique features is resistor R_1 in Fig. 1A. Its function will be discussed in some detail later in the article. The a.c.-d.c. switching system is rather unorthodox in that the input of the bridge system is floating across the meter in the d.c. position. Although this does offer a shunt of several thousand ohms across a 100-ohm meter circuit, its effect is negligible and the savings offered by the resulting simplified switching arrangement are worthwhile.

The balance of the circuit consists of a current-type ohmmeter in the R x 100 position and a voltage divider system in the R x 1 position. Two current scales are provided, one covering the 0-10 ma. range and the other the 0-100 ma. range. These two scales are sufficient for most multimeter applications.

The four voltage ranges are provided by series multipliers in the positive meter leg. All functions are selected by a two-deck, non-shorting type, 11-position wafer switch and the d.p.d.t. a.c.-d.c. switch. The output is read directly across a 500-ohm line through the 0 to 10 volt a.c. position and the db scale. An external .25 μfd. condenser is used if a d.c. component is present.

The components used in this circuit were chosen for their ready availability at most radio wholesale houses. Stock values are used throughout and most junk boxes will yield the bulk of the items needed. Naturally the builder may have to series or parallel a resistor or two to obtain exact values but this is common practice and is entirely acceptable in this construction.

The first step in assembling the multimeter is to prepare the front panel as shown in the photograph since all parts are attached to it. The holes are drilled for the components and the template supplied with the 0-1 ma. meter used to locate the meter cut-out. If you already have the meter or have obtained a surplus unit you will have to make a template for your meter out of paper.

When the holes are drilled and all burrs removed, a coat of primer is applied followed by a coat or two of enamel. Auto body gunmetal grey was used in the author's model. When completely dry, the surface was satin finished by rubbing it lightly with fine steel wool. Rub in one direction only for professional-looking results. The switch plate decal was then positioned over the holes provided in the panel.

Next, the meter was disassembled and the new scale (Fig. 2) was cemented in place on the reverse side of the dial plate. This was done to preserve the original scale for future reconversion should the need arise. The location of this scale is very important and this operation must be performed carefully.

When the face is mounted the meter is re-assembled and installed in the panel. The rest of the components are now installed on the panel as indicated in the left-hand photograph. The selector switch is placed in the center hole in such a way that its two stack screws run laterally and the pole connectors are on the right, as viewed from the back. The a.c.-d.c. switch is in the right-hand upper hole and the rheostat is placed in the left-hand upper hole. The jacks are located in the two 5/16" holes at the bottom.

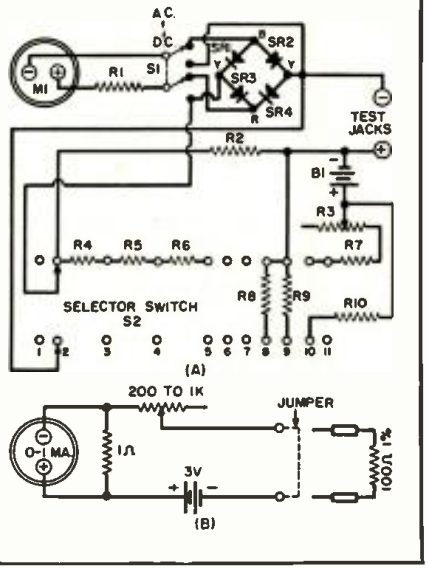
After the parts have been mounted, you are now ready to begin wiring. Care should be taken to provide good solder joints and to keep the leads short and dressed. If a 5000-volt range is employed, be sure to take the necessary precautions regarding high-voltage insulation.

The battery leads consist of two four-inch lengths of wire. One lead is connected to the center post of the

(*Continued on page* 174)

Fig. 1. (A) Complete circuit diagram of the multimeter. (B) Circuit for checking the exact resistance of meter if data is lacking.

R_1—See text
R_2—10,000 ohm, ½ w. res. ±1%
R_3—1000 ohm wirewound rheostat
R_4—90,000 ohm, ½ w. res. ±1%
R_5—400,000 ohm, ½ w. res. ±1%
R_6—4.5 megohm, ½ w. res. ±1%
R_7—2200 ohm, 1 w. res. ±5%
R_8—11 ohm, 1 w. res. ±1% (shunt for 10 ma. scale)
R_9—1 ohm, 1 w. res. ±1% (shunt for 100 ma. scale)
R_{10}—30 ohm. ½ w. res. ±1%
S_1—D.p.d.t. toggle switch
S_2—D.p. 11-pos. switch (Mallory 1321-L or equivalent)
B_1—3 volt battery (two 1½ volt flashlight cells in series)
M_1—0-1 d.c. milliampere meter (either 3" or 4½" meter can be used)
SR_1-SR_2-SR_3-SR_4—Full-wave meter rectifier, dry-disc type



SUPERREGENERATIVE TRANSISTOR RECEIVER

By
JOSEPH M. HUGHES
W9VHJ

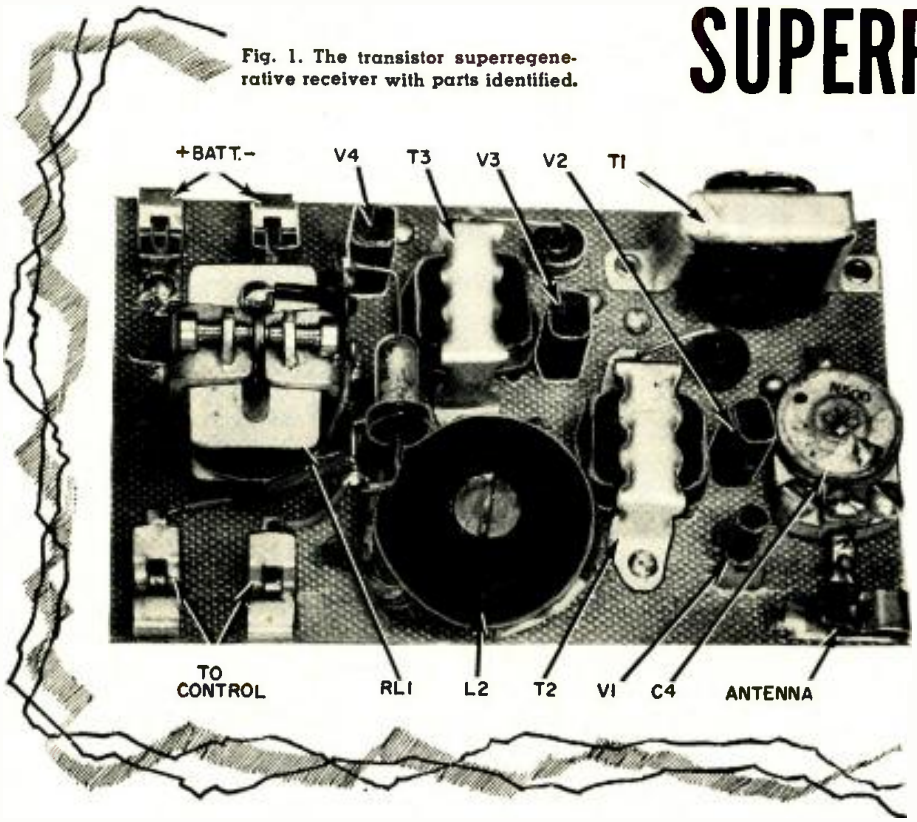


Fig. 1. The transistor superregenerative receiver with parts identified.

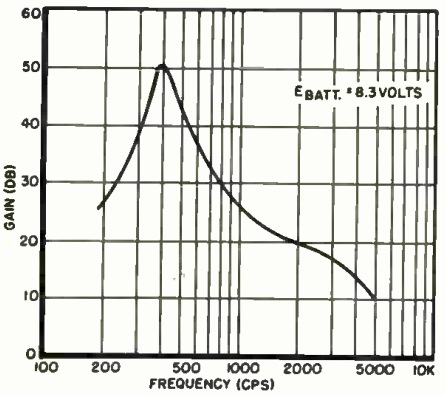
This small transistor receiver for model control features negligible battery drain and is fairly easy to construct.

NOTHING in recent years has captured the interest of the electronics fraternity quite like the introduction of the transistor. Although first announced in 1948, it was not until very recently that reliable units in large quantities were brought within the reach of all of us. Today there are perhaps 20 or 30 firms manufacturing both point contact and junction types and their products are available at almost any large radio supply store. Surely this field of development is still in its infancy and we can be certain that the future will bring many new types of transistors with characteristics to meet the requirements of practically any application.

The recent issues of this and other technical magazines have pretty well covered the principles of operation of the point contact type and the junction type transistors. However, most of us feel that the best way to become familiar with a new device is to incorporate it in something we build ourselves, measure its characteristics, and observe its performance. This article will describe an interesting, practical application of both types of presently-available transistors.

My hobby, for a number of years, has been building and flying radio-controlled model airplanes. Many different types of radio receivers have been used during this period. Each has its good points and its bad features. The requirements for this kind of service are much the same as for any really portable equipment. Light weight, of course, is of prime importance, not only in the receiver itself but particularly of the batteries required for operation. This is the same as saying the current consumption must be held to an absolute minimum if reasonable life is to be obtained with lightweight batteries. The sensitivity must be as good as possible because usually an inefficient receiving antenna must be used. The receiver must be able to absorb a lot of mechanical punishment. You can imagine the shock to which this equipment is subjected when a model plane dives into the ground from several hundred feet altitude under full throttle. Still, a well constructed receiver in a properly designed mounting will survive this sort of treatment. These requirements point very strongly toward what is perhaps the simplest type of receiver, the superregenerative.

Fig. 2. Response of audio amplifier stages.



One of the most foolproof versions of a superregenerative receiver for model airplanes was described by Howard McEntee in the September 1951 issue of RADIO & TELEVISION NEWS. It consists of a superregenerative detector, a stage of audio amplification, and a biased detector operating a relay. Three subminiature tubes are used. The characteristic rushing noise output of the detector in the absence of an incoming signal is amplified and by grid rectification is used to bias the final tube to cut-off. When a signal (unmodulated carrier) is received, the rushing noise from the superregenerative stage disappears. The bias is removed from the last stage and the plate current increases. This operates a sensitive relay in the plate circuit and its contacts are used to energize the control mechanism.

An application such as this looks like a "natural" for transistors. They are light in weight, consume no heater power which means a great saving in battery weight, and have a much longer expected life than any vacuum tube. This is some compensation for their greater initial cost. They too are practically free from microphonic noise which can become a problem when the equipment is subjected to severe vibration as it is in model airplane use. Even the shock from a crash landing should mean nothing to a transistor.

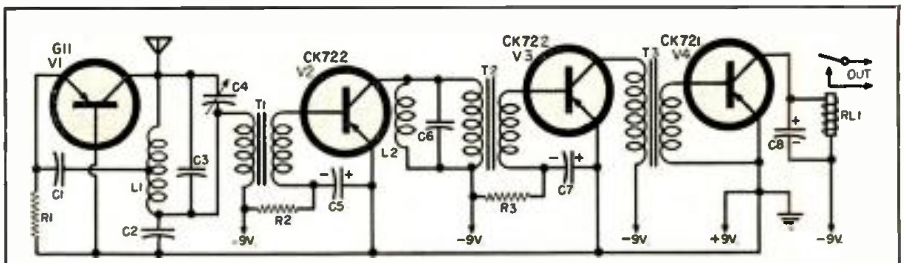
The picture, however, is not quite as rosy as it seems. Most radio control operation is done either on the 50-54 mc. amateur band, the Citizens Band at 460-470 mc., or the new "license free" spot frequency at 27.255 mc. At this time there are no transistors generally available which will operate at any of these frequencies although several manufacturers have models under development which are capable of oscillating at frequencies higher than 100 mc. There are several point contact transistors presently on the market which will operate satisfactorily up to 3 or 4 mc. The equipment to be described operates on the

160-meter amateur band. Currently available junction transistors are primarily suited for audio frequency use because of very limited high frequency response.

There is another consideration which must not be overlooked. Transistors are inherently much noisier than vacuum tubes. For example, most point contact transistors have a noise figure around 50 db, while the figure for junction transistors is around 20 db. The noise figure for a good vacuum tube is on the order of 4 to 6 db. Without going into detail we can see that any transistor amplifier we build will be inherently much noisier than a vacuum-tube amplifier with the same amount of gain. This, then, will be one of the factors which determine the minimum signal level our receiver will be able to distinguish from the noise created within the receiver itself. It should be remembered that noise power is a function of bandwidth, so by reducing the bandwidth of our system this difficulty may be somewhat minimized.

When transistor amplifier stages are cascaded we must also remember that they are essentially power amplifiers. The low-impedance input circuit actually absorbs power from the driving source so some form of matching device, usually a transformer, must be used to efficiently couple the high-impedance output circuit of one stage to the low-impedance input of the next stage. This is quite different from the conventional class A vacuum-tube stage where the input circuit approaches infinite impedance at audio frequencies. Typical power gain for a junction transistor stage is 30-40 db while a single tube stage may have a theoretical power gain of infinity but will easily realize 70-80 db gain in practice. Remember we are speaking of *power* gain. Obviously a high-gain amplifier will need more stages if transistors are used than it would if tubes were used.

Fig. 1 is a photograph and Fig. 3 is the schematic diagram of the receiver. V_1 is a point-contact transistor with a usable current gain up to about 3 mc. The superregenerative stage is essentially a Hartley oscillator. However, the transistor in a grounded-base circuit such as this does not produce a phase reversal between input and output voltages as a tube would do. This is the reason the tap on the tank circuit coil is coupled to the input circuit, rather than the bottom of the coil as is done in vacuum-tube Hartley oscillator circuits. The stage operates as a self-quenched superregenerative detector with the values of R_1, C_1, C_2, and the resistance of the primary winding of T_1 determining the quench frequency. Although this frequency is not critical it must be somewhat greater than the highest modulation frequency the receiver will be expected to handle. On the other hand the quench frequency must not be so high that the superregenerative stage can not operate with discrete bursts of oscillation. The presence of an incoming signal increases the quench frequency in this type of operation. This brings about a condition of "coherence" which shows up as multiple resonance peaks in the selectivity curve when the incoming signal is extremely strong and the quench frequency is too high.



R_1—2000 ohm, ½ w. res.
R_2, R_3—250,000 ohm, ½ w. res.
C_1—.002 μfd., 150 v. cond.
C_2—.0047 μfd., 150 v. cond.
C_3—100 μμfd. mica cond.
C_4—4-30 μμfd. ceramic trimmer cond.
C_5, C_7, C_8—4 μfd., 60 v. tantalum elec. cond. (Fansteel Corp., 2200 Sheridan Rd., North Chicago, Ill.)
C_6—.2 μfd., 150 v. cond. (two .1 μfd. in parallel)
T_1—Miniature plate-to-line trans. (UTC SO-3)
T_2, T_3—Subminiature plate-to-line trans. (UTC-SSO-3)
RL_1—4000 ohm polarized sensitive relay (Available from Polk's Hobbies, Airplane Department, 314 Fifth Avenue, New York City, #ED-4000)
L_1—32 t. #32 Formex wire, c.t., wound on Superex (formerly Grayburne) "Vari-Loopstick" form (old winding removed)
L_2—800 mhy. toroidal inductance (Available from Communication Accessories Co., Box 7, Hickman Mills, Mo., Type 206)
V_1—Point-contact transistor (General Electric #G11)
V_2, V_3—"p-n-p" junction transistor (Raytheon Type CK722)
V_4—"p-n-p" junction transistor (Raytheon Type CK721)

Fig. 3. Schematic of superregenerative transistor receiver for model airplane control.

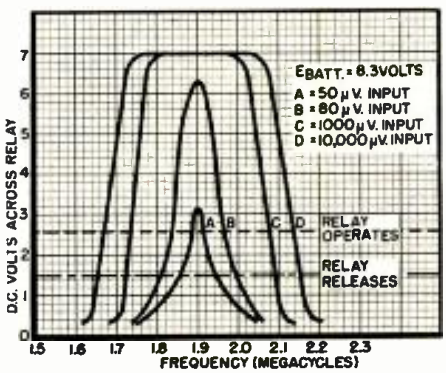


Fig. 4. Selectivity curves for the superregenerative receiver for various inputs.

V_2 is a conventional grounded-emitter stage of audio-frequency amplification with about 30 db maximum gain. The base current is approximately 50 μa. and the collector current .3 ma. L_2-C_6 is a parallel-resonant circuit tuned to 400 cps bridged across the primary of the output transformer. L_2 is an 800 mhy. toroidal inductance which has a "Q" of about 15 at this frequency. This resonant circuit across T_2 results in maximum gain at 400 cps and yet gives appreciable discrimination against the noise inherent to V_1 (random in frequency) and to the quench frequency which in this case is around 10 kc. V_3 is a conventional amplifier stage. The over-all gain as a function of frequency of these two stages is shown in Fig. 2. If this receiver were to be used for voice-modulated signals the resonant circuit would be eliminated at some sacrifice in signal-to-noise ratio.

V_4 operates essentially as a class B amplifier or a "plate" detector. When there is no input signal the collector current is very low, only a few microamperes. The negative half cycles of

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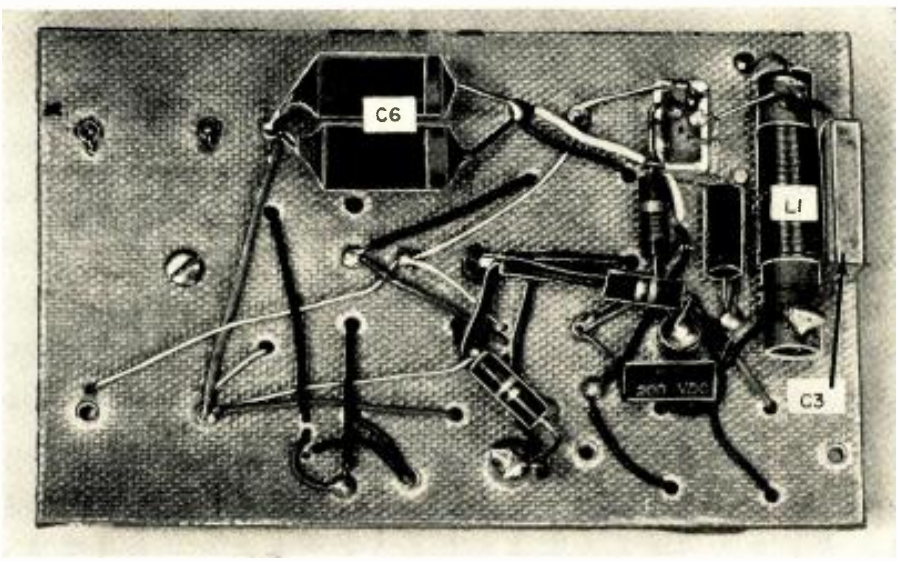
Fig. 5. Underchassis view of transistor receiver showing simplicity of the wiring.



SERVICING TAPE RECORDERS

By **WILLIAM ROCKWELL**
Authorized Factory Service Company, Inc.

Whether you are interested in servicing tape recorders as a business, or in repairing your own machine, this article will give you some valuable tips you can use.

IN THE past few years the home-type tape recorder has gained tremendous popularity and, as a result, there have been at least thirty-five different machines manufactured to date, with the list still growing. What does this mean to the radio and television technician? He can continue his present line of servicing and forget that tape recorders exist; or he can familiarize himself with the different types of machines on the market, and in so doing, he can add tape recorders to his list of services and add new avenues of profit to his business.

To date there have been few, if any, articles written on home tape-recorder service and, as a result, the service technician has been stymied because of the lack of information. That is the purpose of this article—to acquaint the service technician with some of the troubles he can expect to encounter when servicing these machines.

A tape recorder consists of three basic sections:

1. The recording amplifier
2. The playback amplifier
3. The tape transport mechanism

In the home-type tape recorder, the recording and playback amplifier are one, with the different functions selected by a "record-listen" switch. This switch, when in the "record" position, connects the record and playback coil in the head assembly (one coil performs both functions) to the output of the amplifier which supplies the audio voltage to be recorded. In this position, the switch also converts the output stage to an oscillator, usually 30 to 50 kc., to provide bias for the recording head and also erase current for the erase coil in the head. (On some machines a separate bias and erase oscillater is used.) Equalization is also inserted in the amplifier to compensate for frequency response characteristics of the head and tape speed. This equalization is in the form of high-frequency boost. This increases the signal-to-noise ratio of the recording during playback.

In the "playback" position, the recording coil in the head assembly is connected to the input of the amplifier. The bias oscillator is converted back into an output stage, and the high-frequency boost is removed. The equalization in the "playback" position is different than in the "record" position. The high-frequency response is attenuated to retain the balance of the original program material, and the low-frequency response is boosted. The low-frequency equalization is accomplished during playback rather than during recording to prevent the low-frequency components from saturating the tape.

Now we come to the mechanical side of the subject which, in most cases, will be the main source of repairs. This is because the tape recorder is subject to all the woes of any mechanical device. These are: 1. dirt, 2. wear, and 3. lubrication.

A tape transport mechanism must meet certain requirements and perform certain functions in order to qualify for the exacting job it has to perform:

1. Its speed must be constant (wow and flutter held to a low value)
2. It must be quiet in operation
3. It must be able to stand a fair amount of abuse

All this must be accomplished and still keep the machine at a price the public can afford. At the present state of the art, it is simple to produce an amplifier whose response is flat to 8000 cps which, in most cases, is the upper limit at a tape speed of 7½" per second. It is not quite so simple, however, to produce a good mechanism that meets the aforementioned requirements.

A tape transport mechanism consists of the following basic sections:

1. A capstan and flywheel assembly which pulls the tape past the record- and erase-head assembly at a constant rate of speed, usually 3¾" or 7½" per second. This capstan and flywheel assembly is driven by a fairly heavy motor through a rubber idler wheel. The tape is held against the capstan by a spring-loaded rubber pressure roller, and against the heads by a pressure-pad assembly. See Fig. 1.
2. A take-up spindle assembly. This take-up spindle is usually driven by the motor that drives the flywheel through some form of clutch. See Fig. 2. This clutch is needed because the diameter of the take-up reel is constantly changing as it takes up tape, causing it to pull more tape with each revolution, but, the capstan will only feed the tape at a constant rate, so the clutch supplies the necessary slippage.
3. A rewind spindle assembly. This can be driven from the flywheel by a belt or from the motor shaft by a rubber idler wheel. See Fig. 3.

Mechanical Servicing

As stated previously, most of the troubles encountered will be in the tape transport mechanism. The most common offenders will be the rubber wheels used to drive the different moving parts. These wheels will become glazed and start slipping or they will wear and get lumpy, causing wow and flutter. The rubber pressure roller will become foul with oxide from the tape and start to slip. If any oil gets on any of the rubber wheels, they will be ruined.

Wheels that have become glazed after considerable use can be restored by cleaning with alcohol or by holding a piece of fine sandpaper on the wheel while it is running. Be careful not to remove too much rubber if sandpaper is used. Wheels that have had oil on them must be replaced. Cleaning will not help, since oil gets into the pores of the rubber and will seep out.

Motors should be lubricated with one or two drops of No. 10 motor oil. Be sure that no oil gets on any of the

driving surfaces. Cams and levers should be lubricated with a small amount of light grease on the bearing surfaces only. If possible, refer to the manufacturer's lubrication instructions.

The pole pieces in the recording head or heads are also subject to considerable wear. The tape used for magnetic recording is coated with a metal oxide which acts as a fine abrasive, something like crocus cloth. When the pole pieces wear down, the machine will not record and erase properly because the gap dimensions change, causing low volume, poor high-frequency response, and incomplete erase.

Examine the pole pieces with a jeweler's loupe or magnifying glass and notice if the gap is worn or uneven. The "record" gap should be a very fine line, and the spacing along the full length of the gap should be even. The "erase" pole piece has a gap about four or five times the size of the "record" gap, and this also should be even along the full length of the gap. A sure check would be to compare an old head with a new one.

Improper recording and erasing can also be caused by a dirty head. Be sure the head is free from all oxide that may come off the tape. When replacing heads or pole pieces, they must be peaked for maximum high-frequency response. This is done by running a test tape with 7500 cps recorded on it, made on a machine known to be good, and slowly rocking the head back and forth until maximum response is obtained. Then lock the head in position.

Wow and flutter can be traced by listening to its rate, and watching for drive wheels or pulleys that turn at the same rate. For example, a fast flutter would not be caused by a pressure roller that turns at a slower speed than the rate of flutter. Speed should be checked by making a recording of music with piano or wind instruments and listening for wow and flutter. There are instruments made for the measurement of wow and flutter, but these instruments are priced at approximately $500 and therefore, are out of the reach of the average service technician. A 1000-cycle note can also be used for these checks, and after listening to this note on a number of machines the service technician will be able to determine whether the machine is operating properly.

Some precautions to observe when servicing are the following:

Don't over-lubricate.

Don't use carbon tetrachloride to clean rubber wheels as this will ruin them. Use alcohol.

Don't wash oilite bearings in any type of solvent. If you do, you will remove all oil from the pores of the bearing.

Don't use magnetized tools near the recording heads. Be careful not to scratch or mar the pole pieces.

Don't check heads with an ohmmeter unless absolutely necessary, or the heads will become heavily magnetized and cause a high hiss in the background of the recording. If the head does become magnetized, use a head demagnetizer, which should be available from any large supply house that sells recording equipment. If one is not available, place the head near a strong 60-cycle a.c. field, and slowly reduce the field to zero. Do this a number of times.

Make sure the tape being used on the recorder has the correct wind. Tape comes in two winds; "A" wind, which has the oxide wound facing the hub of the reel, and "B" wind, which has the oxide wound facing away from the hub. After threading the tape through the machine, the oxide or dull side of the tape should be against the heads.

Electrical Servicing

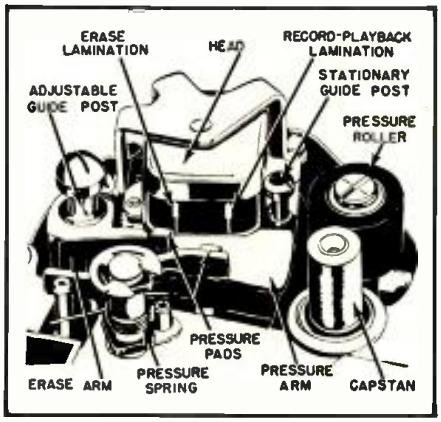
All of the troubles encountered in the amplifier of a tape recorder will respond to conventional servicing techniques. One of the common sources of trouble is the bias-erase oscillator. When this does not function, the machine will not erase and the recordings will be low in volume and very distorted. A quick check can be made by placing a neon bulb on the plate of the oscillator and also on the leads going to the head. If the bulb glows, you can be reasonably sure the oscillator is working. Also, check for worn or dirty pole pieces as they will give the same type of symptoms.

For exact voltage and resistance values, refer to the manufacturer's service manual. When replacing noisy resistors, especially in the low-level stages, be sure to shunt the heat of the soldering iron away from the new resistors, otherwise the new resistors will be as noisy as the old ones. To shunt the soldering iron heat away from the resistor either use a pair of long-nose pliers from the resistor lead to the chassis, or an alligator clip to the chassis.

Following is a list of a few of the tools and lubricants which will be needed in addition to the tools found in the average service shop:

1. A complete set of *Allen* and *Bristol* wrenches.

Fig. 1. The head assembly and capstan of a typical tape recorder. Note that the head assembly includes the record-playback and erase heads in one unit.



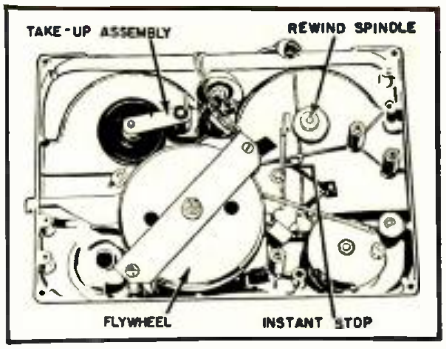


Fig. 2. Shown here is a typical method of using a flywheel for driving the take-up reel of a tape recorder. The flywheel is coupled to the motor via an idler.

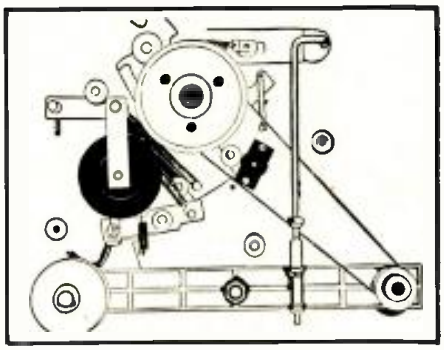


Fig. 3. The rewind spindle in the lower right is driven by means of a chain belt from the motor in the system shown here.

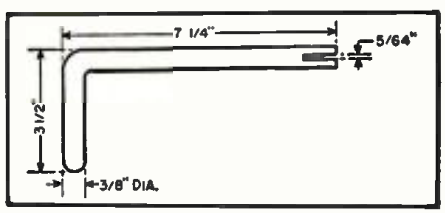


Fig. 4. Dimensions for a bending tool useful for entering inaccessible places in the tape recorder for slight adjustments.

2. A set of small sized open-end wrenches.

3. A bending tool (see Fig. 4) for getting into otherwise inaccessible places in the tape recorder works, for slight bending when necessary.

4. A good test tape containing a 7500 cps note for head alignment.

5. A head demagnetizer.

6. A light grade of grease or lubricant.

7. No. 10 motor oil.

8. Penetrating oil for freeing frozen bearings.

9. Alcohol for cleaning rubber drive wheels and belts.

10. Carbon tetrachloride for cleaning metal parts.

11. A complete set of tape recorder service manuals available either from the manufacturers directly, or from some of the various radio and television service manual and book publishers.

The service technician interested in the theory of magnetic tape recording should read some of the excellent books on this subject appearing in recent years, as well as magazine articles which will keep him up to date. -30-

By **BERT WHYTE**

THE term "Certified" in the title of this column may puzzle some readers who missed the first review when it was introduced last year. For the benefit of these readers and as a restatement of our basic policy, we hasten to explain. As you know, we name the equipment used in reviewing the recordings each month. The naming of this equipment does not necessarily constitute an endorsement of this particular equipment. If we seem to use one certain brand of equipment more consistently than any other, it is primarily for reasons of convenience. In other words, the material is at hand and is familiar enough to quickly and thoroughly *test*. That is what "Certified" means. Each link in the chain of reproduction, from pickup to speaker is checked and rechecked to make absolutely certain that everything is in perfect operating condition. It is only fair to evaluate a recording when this situation exists. It is not right to impose the possibility of defective equipment when reviewing records. Listening to phonograph records is a subjective thing at best; to accuse a record of being inherently distorted, when the distortion actually stems from poor equipment, is to do the manufacturer of the recording and the public a great disservice. Still another factor is important in reviewing records and that is the acoustical environment.

It is said most people listen to records under "living room" conditions. This is a somewhat misleading term. since the size, shape, reflection, and absorption characteristics of walls and floors and the type of furnishing are all variables, and what is true in 10,000 rooms isn't necessarily true in 10,000 other rooms. The brightness of a recording can be changed by such a simple thing as whether the drapes in a room are open or closed! It is because of this that we published a listing of the acoustic conditions under which recordings were reviewed.

I have moved since the first appearance of this column and will list herein my present acoustical conditions: room 26 x 15 ft., 20 ft. of drapes along one wall which may be left at full 20 ft. or reduced to 6 ft. A hard reflective wall with a speaker in each corner, a hard wall opposite speaker wall, extra large (16') sectional sofa, several other upholstered chairs, wall-to-wall carpeting, conventional plaster ceiling. This is a considerably better room for listening than my previous one. Just "live" enough with barely 2-3 seconds reverberation time. Some people I know like a little longer reverb period. That's because they haven't lived with binaural! Believe me, binaural sound in a room with a reverb period over 3 seconds can drive you goofy!

In playing monaural material, disc and tape, I use both speakers phased properly to give me a diffuse sound source. Well, that's my new set-up. If you have a comparable room and equipment of equal quality and your hearing is "normal," you should get just about the same results as I do. However, I must stress again the great number of variables and the subjectivity of listening to music. What is golden to my ear may be garbage to yours and *vice versa*. All I, or any other critic, can do is to call your attention to what is an *apparent* fault or virtue in a given recording. That a critic should make his analysis under as carefully controlled conditions as possible, goes without saying. It's a pity so few adhere to this line of reasoning:

Equipment used this month: *Weathers* pickup and arm, *Rek-O-Kut* T12H turntable, *Fisher* Master Audio Control, two 30-watt *McIntosh* amplifiers, two *Jensen* G-610 Triaxial speakers in a *Read* "Fold-a-flex" enclosure.

RAVEL
CONCERTO IN D MAJOR FOR THE LEFT HAND FOR PIANO AND ORCHESTRA
CONCERTO IN G MAJOR FOR PIANO AND ORCHESTRA
Jacqueline Blancard, pianist, with L'Orchestre de la Suisse Romande conducted by Ernest Ansermet. London LL797, ffrr curve. Price $5.95.

This recording may come as quite a surprise to a great many people since *London* has already issued an LP with the identical repertoire. Of course the other LP was issued in the very early days of *London's* entry into the long-play field and it left something to be desired in the way of sound quality. *London* is to be commended once again for "upgrading" an existing part of its catalogue with this new recording. Those of you who feel a little "put-out" with this state of affairs since you already own the older version, should really take heart that a magnificent new recording of these Ravel works is available. If you liked the music enough to buy the older job, then you'll really go for the new one. It's a far better effort than the previous disc. Soundwise it's one of the best piano recordings on LP. There was no flutter in piano tone that I could detect and *what tone!* Here is truly exciting piano. Properly percussive in a score that calls for prodigious percussiveness and yet a piano that can sing as well. The orchestral accompaniment is something wonderful to hear with splendid, solid bass and sharp biting brass. The opening woodwinds in the "Left Hand" are a marvel of sonority. The jazzy, percussive figurings of the "G Major" are crisp and clean with plenty of punch. Both concerti are played with verve and spirit by Mme. Blancard. On the older disc Mme. Blancard shared honors with another fine pianist, Nicole Henriot.

This new recording arrived just about the time I was able to hear Mme. Henriot play the "G Major" with Mitropoulos and the N. Y. Philharmonic in concert. Strangely. there was little to choose between Mme. Henriot's interpretation and that of Blancard. Blancard's was perhaps more academic, more linear than the volatile reading of Henriot. Other than that, both pianists displayed brilliant technique coupled with solid musicianship. (A note in passing but it always seems to me that the Ravel piano concerti are apparently the exclusive province of women pianists. I cannot recall a male interpretation of these works for a long, long time.)

Mr. Ansermet is a particularly astute gentleman when it comes to conducting Ravel. His readings are always masterful and most obviously a labor of love. In these recordings he chose just the right tempi and was able to keep his orchestra well in hand. The *ffrr* curve reproduced well with no cut or boost necessary in treble or bass. Surfaces in my copy were quiet. In every respect a superior recording.

MOZART
SYMPHONY #38 IN D
SYMPHONY #34 IN C
Chicago Symphony Orchestra conducted by Rafael Kubelik. Mercury "Olympian" MG50015, AES curve. Price $5.95.

As noted last month this is Rafael Kubelik's swan song with *Mercury* and the Chicago Symphony. It is rather fitting that he leaves us with this splendid reading of "The Prague," a score always dear to the heart of a son of Bohemia. That Mr. Kubelik has made his mark in phonographic history is not surprising. His previous efforts for *Mercury* in a very catholic repertoire have been outstanding. I was sorry to hear of Mr. Kubelik's col-

(*Continued on page* 151)

The opinions expressed in this column are those of the reviewer and do not necessarily reflect the views or opinions of the editors or the publisher of this magazine.

1954 TV RECEIVER SPECIFICATIONS

The electrical and mechanical specifications listed below are of direct aid to service technicians. This list will be continued in forthcoming issues to include all major manufacturers.

MFR.	CHASSIS	TUBES							VIDEO I.F. FREQ. (MC.)	H.V.[4] (KV.)	U.H.F. PRO-VISION	POWER (WATTS)	SPECIAL FEA-TURES
		TUNER	I.F.[1]	VIDEO[2]	AUDIO	SWEEP[3]	P.S.	CRT					
ADMIRAL	19B1	6BZ7	6CB6	6AL5	6AU6	12AU7, 6S4	5U4G	17"	25.75	15	Strips	185	
	19F1	or	6CB6	6CB6	6AL5	6SN7GT, 6BQ6GT	1B3GT	21"	25.75	15	Strips	185	
	19F2Z	6BC5	6U8*		6AV6	6AX4GT, 6U8*		21"	25.75	15	Strips	185	8, 9
	19A2	6J6			6AS5			21"	25.75	15	Strips	185	
	19D2				or			21"	25.75	15	Strips	185	9
	19G2				6Y6G			24"	25.75	18	Strips	185	
	19S1							17"	25.75	15	11	195	
	19J1							21"	25.75	15	11	195	
	19B2							21"	25.75	15	11	195	
	19E2							21"	25.75	15	11	195	9
	19K2Z							21"	25.75	15	11	195	8, 9
	19H2							24"	25.75	18	11	195	
	19T1							17"	45.75	15	11	195	
	19L2							21"	45.75	15	11	195	
	19L2Z							21"	45.75	15	11	195	8
	19M2							21"	45.75	15	11	195	9
	19N2Z							21"	45.75	15	11	195	8, 9
	19W1							21"	45.75	15	11	195	
	19R2							24"	45.75	18	11	195	
	22F2	6BZ7	6CB6	12AT7*	12AT7*	6SN7GT, 12AU7	1B3GT	21"	25.75	17.5	Strips	200	
	22F2Z	6J6	6CB6	6CL6	6AU6	6S4, 6AL5	5U4G	21"	25.75	17.5	Strips	200	8
	22A3Z		6AG5	6AU6	6AL5	6SN7GT, 6BQ6GT		21"	25.75	17.5	Strips	200	8
	22D3Z		or		6AV6	6AX4GT		21"	25.75	17.5	Strips	200	8, 9
	22G2		6AU6		6V6GT			21"	25.75	17.5	11	235	
	22G2Z							21"	25.75	17.5	11	235	8
	22B3Z							21"	25.75	17.5	11	235	8
	22J2Z							21"	45.75	17.5	11	235	8
	22H3Z							21"	45.75	17.5	11	235	8
	23E1Z	6BZ7	6CB6	12AT7*	12AT7*	6SN7GT, 6AV5GT	1B3GT	24"	25.75	19	Strips	235	8
	23B1Z	6J6	6CB6	6AU6	6AU6	12AU7, 6AL5	5U4G	27"	25.75	19	Strips	235	8
	23F1Z		6AG5	6CL6	6AL5	6SN7GT, 6CD6G	5U4G	24"	25.75	19	11	235	8
	23C1Z				6AV6	6V3		27"	25.75	19	11	235	8
	23H1Z				6V6GT			24"	45.75	19	11	235	8
	23J1Z							27"	45.75	19	11	235	8
ANDREA	VN-21	6BK7	6CB6	1N105	6AU6	12AX7, 12AU7	5U4	21ZP4A	45.75	15	Strips,		
		6J6	6CB6	6AH6	6AL5	6S4, 12AU7	5U4				or	190	10
			6CB6	6AU6	6AV6	6BQ6, 6AX4	1B3				11		
			6CB6		6K6								
CAPEHART	CX-37	6BQ7	6CB6	1N64	6X8*	6BE6, 12AU7	5U4G	17LP4	45.75	14	Strips	210	5, 10
		6J6	6CB6	6X8*	6BN6	12AU7, 6BF6	1B3GT	21EP4A					
			6CB6	6AQ5	6BK5	6V6GT, 6BQ6GT		21EP4B					
			6CB6	6AU6		6W4GT		21ZP4B					
								21ZP4A					

1. Video i.f. tubes only. 2. Includes detector and a.g.c. 3. Includes sync section and a.f.c. 4. CRT 2nd anode voltage. 5. Removable safety glass. 6. Local-fringe a.g.c. adjustment. 7. High-fidelity sound. 8. Aluminized picture tube. 9. TV-radio-phono combination. 10. Built-in antenna. 11. 82-channel tuner. 12. Adjustable dial light. *Part of tube is used in another section.

(Continued next month.)

HOW'S YOUR RUMBLE?

Fig. 1. Measuring the rhythm of turntable rumble to locate source.

By

JAMES A. MITCHELL

How to establish the causes of low-frequency noise in wide range record playing systems and corrective steps to apply.

A HIGH-FIDELITY fan was describing his new speaker system, "It sounds terrific! The highs are there. The bass is solid. But when we come to a quiet part in the music there is some infernal background noise like someone upstairs moving furniture. It seems that I have acquired a rumble problem." This experience is becoming a common one as speakers with improved bass response come into general use. Unless we learn to select and adjust audio equipment for low noise and rumble, good audio reproduction will not be enjoyed.

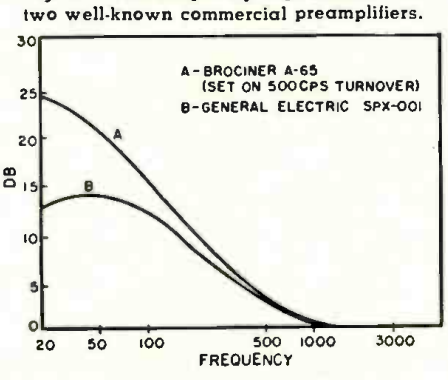
The main source of rumble is the mechanical movement of the turntable. However, each part of the audio system (Fig. 4) can greatly influence the amount and kind of low-frequency noise actually heard. For example, speaker baffles such as open back phonographs which do not produce much response below 75 cps seldom produce rumble. The new corner horns and other improved baffles extend bass response as far as 30 cps. Whether rumble will be objectionable with these speakers depends on the quality and condition of the rest of the equipment, the room acoustics, and the listening habits of the user. With these conditions constant, the lower the response of the speaker system the more rumble will be heard.

From point of view of rumble many amplifiers have too good a low frequency response. I have seen amplifiers which will drive a speaker cone back and forth in rhythm with each turn of an eccentric 78 rpm record. Such amplifiers make tremendous demands on turntables and records. Do not assume that because rumble cannot be heard that it cannot affect your sound. The speaker movements due to rumble can be below the response of the baffle so are not heard, yet they can drive the voice coil into the nonlinear extremes of motion and produce intermodulation distortion. Sometimes the reduction in distortion with elimination of the rumble is noticeable.

The preamplifier used has a great effect on rumble because it is the bass boost in the record equalization circuit of the preamp which amplifies the low frequency noise so much. To provide the correct compensation for records with a 500 cps turnover recording curve the preamp must boost 50 cps 20 db more than 1000 cps and 25 cps 26 db more than 1000 cps. Fig. 2 shows the equalization curves of two preamplifiers. Curve B is the *G-E* SPX-001, a moderately priced unit for home use. Curve A is the *Brociner* A-65 set on the 500 cps turnover position. This is a precision unit for use with wide range equipment. Note the large difference in bass amplification, over 12 decibels below 40 cps. Each of these units has an optimum use, but on wide-range equipment the amount of rumble heard will be very different.

Preamplifiers are often the source of some low-frequency noise themselves. Hum is a common problem. Tube noise can cause trouble because of the high amplification of the low frequencies.

Fig. 2. Low-frequency equalization for two well-known commercial preamplifiers.



Nearly all modern pickup cartridges have excellent bass response. One major cause of emphasized rumble is the tendency of some cartridge arm combinations to have a resonant peak in the low frequencies. This often happens with the short, light arms which are common on record changers. One good way to test for arm resonance is to measure the output of the amplifier while playing a test record with a good low-frequency sweep. The *Cook* Series 10 has such a band extending down to 35 cps. Playing it at 33 rpm allows you to test down to 15 cps. With a *G-E* cartridge in one record changer arm a peak of about 5 decibels was found at 26 cps. While this is of no consequence in a limited-range system it can greatly increase the rumble in a wide range system. The same *G-E* cartridge in a long professional arm showed no such resonance.

When we consider the demands we have made on the turntables with our modern recording systems it is not surprising that we hear rumble. The microgroove record has about 260 lines-per-inch and a maximum groove "wiggle" of about 3 thousandths of an inch. Now since bass frequencies are recorded at constant amplitude, a vibration of 3 thousandths of an inch at any bass frequency will be a rumble as loud as the maximum recording level. If the vibration in the turntable is 3 ten-thousandths of an inch the rumble will be 20 db below the maximum recording level or about the average loudness of the music. This is plenty objectionable. If you want the rumble to be 30 db below the *average* recording level, and this is just acceptable for wide range systems, the

vibration is limited to one hundred-thousandth of an inch! Vibration in the turntable can originate in the motor, the drive wheels and bearings, the rubber drive idler, and the turntable rim and bearings. In order for the vibration to be heard it must be transmitted to the record surface and must be in a direction that produces response in the pickup. Sometimes changing the position of an arm relative to the turntable can lower rumble.

Rumble Measurements

In analyzing a rumble problem in a hi-fi installation it is worthwhile to make certain measurements of the low-frequency noise level as this can help to locate the sources of the trouble and indicate the type of correction needed. The equipment required is simple. An audio test record such as the *Cook* Series 10 or the *Dubbings* phonograph test record can provide the recorded source of tones. An audio oscillator can also be useful. The preferred meter is an a. c. vacuum-tube voltmeter such as the *Heathkit* AV-2. An a. c. multimeter can be used if measurements are made on the 500 ohm output of the amplifier. The meter must be capable of measuring flat to 20 cps. The set-up is shown in Fig. 1.

First, it is good practice to determine the actual low-frequency response of the preamplifier and amplifier using the oscillator. This will tell if the preamp has proper, insufficient, or excessive equalization. It should be noted that rumble measurements can only be compared from one audio system to another when exactly the same response and equalization are obtained.

Now to measure the various sources of low-frequency noise connect the proper size resistor in place of the speaker and connect the a. c. voltmeter across the resistor. See Fig. 3. Put the test record on and track the 1000-cycle tone as a reference. Adjust the volume level so that a meter reading is obtained within the power limits of the amplifier and preferably 50 db above the lowest meter reading that can be made. Set this reference level without the interference of rumble. If your tone control does not affect the 1000-cycle tones turn the bass down when adjusting the level. Record the reference level in decibels and return the bass control to normal for the rest of the measurements. Now without change in gain place the stylus in an unrecorded groove. The *Dubbings* record has a specific band for this. Record the level in decibels and report the total noise and rumble as decibels below the reference level.

To determine the amount of noise contributed by the various parts of the equipment make the following tests, without change in the volume control.

Amplifier Noise: Disconnect the preamp from the amplifier being careful to leave no ungrounded leads to the input. Record the noise level in decibels. Normally this should be 60 decibels or more below the reference. Higher readings are indicative of faulty tubes or improper design.

Low-Frequency Limit of Speaker System	Listening Conditions			
	Moderate Volume—Background Music	Moderate Volume—Critical Listening	Full Volume—Critical Listening	Full Volume—Bass Boost Critical Listening
50-70 cps	—10	—20	—25	—30
40-50 cps	—15	—25	—35	—40
30-40 cps	—20	—30	—40	—50
Expressed as db below standard recorded tone				

Table 1. Noise and rumble for turntables or changers for various listening conditions.

Preamplifier Noise: Reconnect the preamplifier but disconnect the lead from the pickup. Set the equalization to 500 cps turnover if it is adjustable. Record the meter reading as db below the reference. The reading should be between —35 db for home type equipment to —60 db for the best professional types.

Induced Hum in the Pickup: Plug in the pickup. Turn on the turntable and hold the pickup directly over but not touching the record. The increase in noise over the previous reading is due to hum induced in the pickup. Check the shielding on the pickup lead. Also make sure that the turntable and arm are well grounded and that the unit is not close to unshielded transformers.

External Vibration: Place the pickup in a record groove with the turntable turned off. Any increase in noise when the pickup is placed in the groove, compared to being held just above it, indicates external vibration. Better spring mounting of the turntable can help reduce this rumble.

Turntable Motor Vibration: Remove the idler drive wheel from the record changer or turntable so that the phono motor can be turned on without the turntable rotating. Place the stylus in a record groove and turn the motor on. The increase in noise over the previous two readings is a measure of motor quality and condition. One way to tell if the motor bearings are worn is to make this same reading with a new unit of the same type substituted.

Turntable Rotation Vibration: Replace the idler drive wheel and with the turntable going place the stylus in the unrecorded groove of the test record. Record the total noise and rumble. The increase in noise level over the previous reading is the noise and rumble due to the rotation of the turntable and the idler drive. This is usually the largest source of rumble after the motor and is an indication of the condition and quality of the bearings, drive surfaces, and roundness of the idler. It is common experience to have the meter show considerable variation during this reading. This is due to uneven roughness of the drive wheels and turntable rim. It is often possible to detect the location of rough spots on the rim by watching the rhythm of the meter movement and the turntable revolutions.

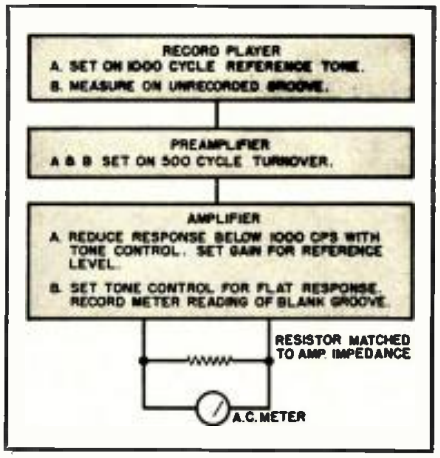


Fig. 3. Block diagram of the low-frequency noise and rumble test set-up. See text.

Accumulated Sources of Noise	High-Fidelity Systems* A	B	C	D
Main Amplifier	—60	—60	—72	—72
Preamplifier	—38	—38	—21	—44
Induced Hum in the Pickup	—33	—36	—18	—39
External Vibration	—32	—36	—18	—39
Turntable Motor Vibration	—18	—31	—12	—29
Turntable Rotation Vibration (Total Noise and Rumble)	—14	—29	—6	—26

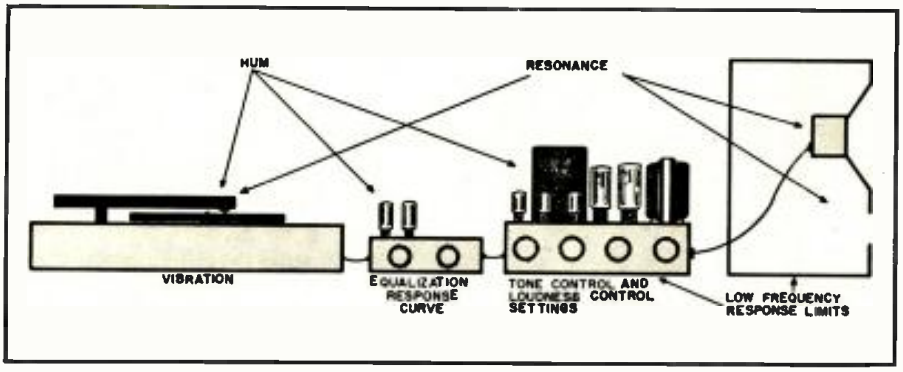
* See text for description of systems
Db below standard recorded reference tone

Table 2. Noise and rumble measurements.

Table 2 lists a series of rumble and noise measurements for typical equip-

(*Continued on page* 168)

Fig. 4. Factors affecting low-frequency noise and rumble in record playing systems.



"SELF-COMPLETING" ELECTRONIC KEY

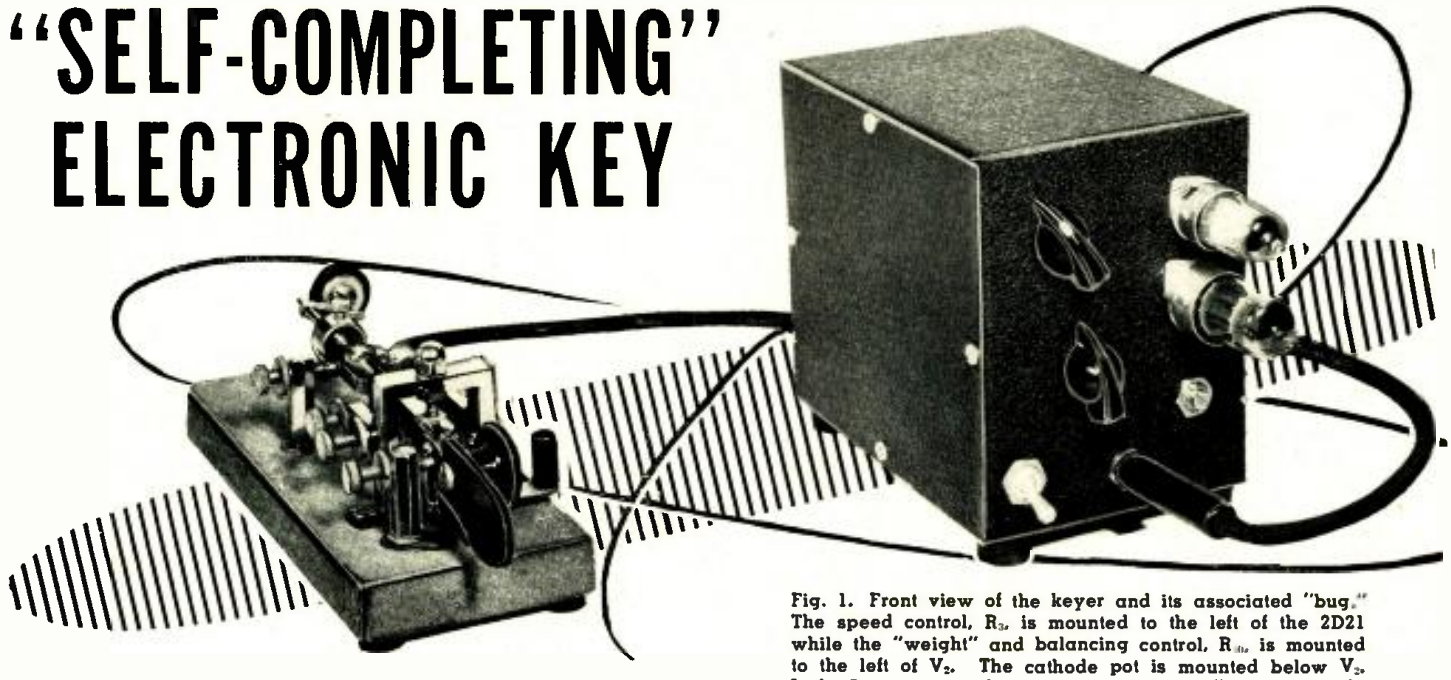


Fig. 1. Front view of the keyer and its associated "bug." The speed control, R_3, is mounted to the left of the 2D21 while the "weight" and balancing control, R_{10}, is mounted to the left of V_2. The cathode pot is mounted below V_2. Jack, J_2, is mounted to the right of the "on-off" switch.

By **JACK D. GALLAGHER, W5HZB**

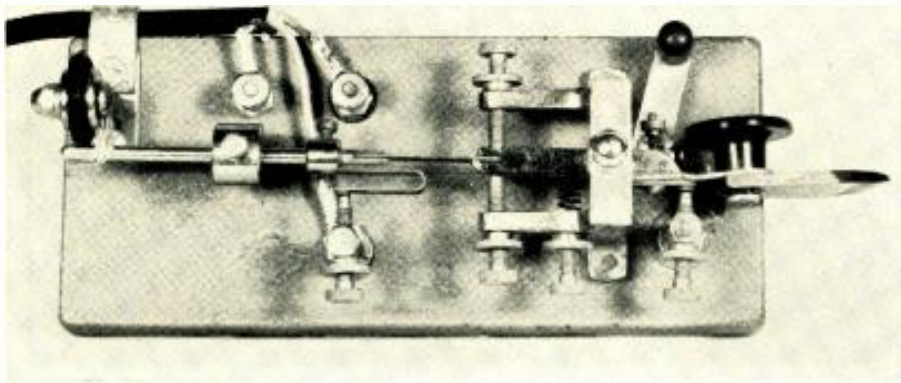
Construction details on an economical keyer which requires no elaborate mechanical changes in the "bug" used with it.

DURING the past few years numerous electronic keys have been described which were designed to reduce strain on the operator and to improve the character of the transmitted signal. The operation of the earlier models was based on the action of a multivibrator, electronically connected to a keyer tube, or connected through a d.c. amplifier to a keyer tube. The plate circuit of the keyer tube was connected to a relay, which keyed the transmitter. The dot-to-dash ratio was governed by the difference in condenser capacities, which was controlled by a contact on the switching mechanism. Unless the operator used exact timing, clipping of signals resulted.

Later models of electronic keys eliminated the multivibrator circuit in favor of a circuit consisting of two relays interconnected between vacuum tubes which caused the keying relay to operate in a more precise manner. The dot-to-dash ratios were improved and the feature of self-completing dots and dashes aided the operator tremendously. It was now impossible to cut dots and dashes short by improper timing, since the circuit was designed to complete one operation before another could be started. Of course, the main disadvantage with this circuit was the two relays that had to be adjusted. Other disadvantages were the number of parts, the number of tubes used, and the power supply requirements.

In order to provide a simpler, more economical keyer, the author described a circuit in the January, 1953 issue of RADIO & TELEVISION NEWS which used only one relay and provided the self-completing action through the use of a small thyratron. However, in order to use the "bug," a few mechanical changes were necessary. Providing extra contacts, insulating contact screws, and other modifications destroyed the future usefulness of the "bug" as a semi-automatic key.

Fig. 2. Close-up view of the "bug" showing the three-conductor cable fastened to the spring arm stop with a cable clamp. See text for details on key modifications.



The "bug" modification for the keyer described in this article does not destroy its usefulness as a semi-automatic key, nor are there any complicated mechanical changes to be made. No additional contacts are necessary, and there are no insulating problems.

A brief description of the circuit and the photographs will make clear its simplicity and ease of construction. The pulse circuit consists of a 2D21 thyratron gas tube, V_1, connected to the timing circuit and the grid of a cathode coupler. The 8.2 megohm resistor connected to the grid of V_1 is returned to the cathode. This resistor causes a small negative "contact" potential when the circuit is completed by closing the key. In order to make the "bug" operate without contact additions, the electrical connection is removed between the dot and dash contact posts. The dot contact post is connected to the grid of V_{2A}, and the dash contact post is connected to the ungrounded terminal of C_1. The frame of the "bug" is connected to the plate of the 2D21. When the key is in the neutral position, the voltage builds up on the timing circuit, consisting of C_1, R_3, and R_1. The condenser, C_1, becomes charged since this section of V_2 has zero grid bias. The cathode of V_{2A} is connected to the grid of V_{2B} through 27,000 ohms. The voltage drop through this resistor causes approximately three volts positive bias on V_{2B}, which results in a heavier plate current flow in this section of the tube. The keying re-

lay is connected from the plate of V_{2B} to the arm of a "balancing" potentiometer, R_{10}. In the idle condition, the balancing potentiometer is adjusted for zero voltage across the relay winding.

Operating the "bug" lever to the dash position causes the following action:

1. The timing condenser is grounded through V_1.

2. Since the voltage is above the firing point, the tube fires and immediately discharges the timing condenser and grounds the grid of V_{2A}.

3. As the timing condenser is discharged, the voltage across V_1 reaches the extinguishing point and will not fire again until the voltage has risen to the firing point. (This action of the thyratron provides the self-completing action in this circuit.)

4. As the grid of V_{2A} is momentarily grounded through V_1, the plate current of V_{2A} is cut off. This causes the voltage across the cathode load resistor and the timing circuit to decrease.

5. Since this timing circuit is connected to the grid of the second section of V_2, the decrease in voltage will cause the grid of V_{2B} to become negative with respect to its cathode. V_{2B} is momentarily cut off.

6. The relay is in one arm of a Wheatstone bridge circuit, and in the idle condition the voltage across the relay winding is adjusted to zero. When dashes are being made, the bridge is unbalanced, and the voltage at the plate of V_{2B} rises. This change in voltage causes the relay to operate.

As soon as the voltage across V_1 reaches the extinguishing point, the circuit tends to resume its idle circuit condition. The grid-to-cathode voltage of V_{2A} drops toward zero causing the plate current to flow through the tube which recharges the timing circuit. As long as the dash contacts are closed, the thyratron will reach the firing point and repeat the operation.

When dots are made, the following action takes place:

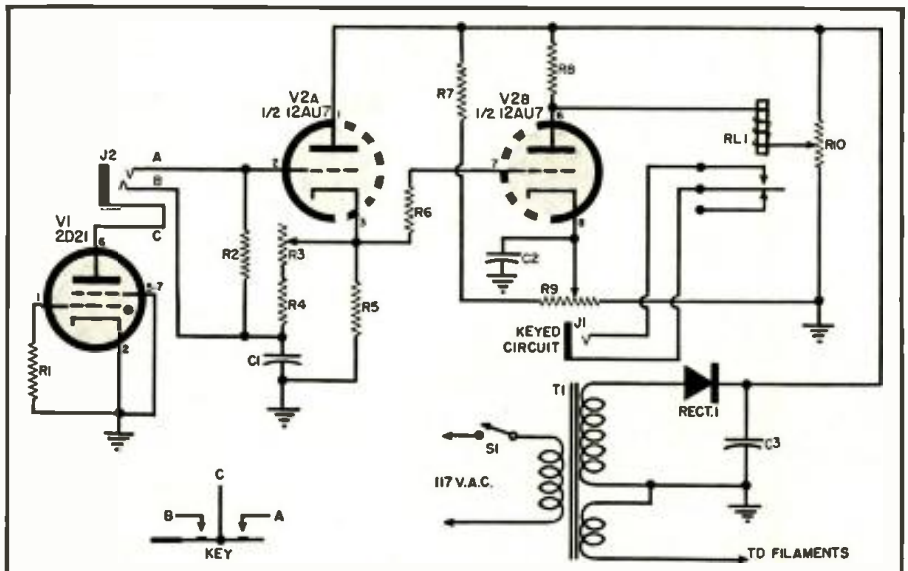
1. The operation of the "bug" to the dot position places R_2 in series with the plate of the pulse tube, V_1, and the timing condenser, C_1. The operation of the thyratron is not affected since it will fire and extinguish as the voltage between its plate and cathode rises and falls.

2. The voltage discharged from the timing condenser is a different value because of the voltage drop across R_2. The grid of V_{2A} is grounded through V_1.

3. Since the timing condenser is not discharged as completely as it was in the case when producing dashes, the condenser recharges in a shorter interval of time. Holding the dot contact closed results in the same action as that described for producing dashes, except that the circuit now produces shorter relay contact closures, or dots.

Within certain limits, the adjustment of R_2 to values other than 33,000 ohms will result in different dash-to-dot ratios. Higher values of plate voltage than that shown in the diagram may

(*Continued on page* 146)



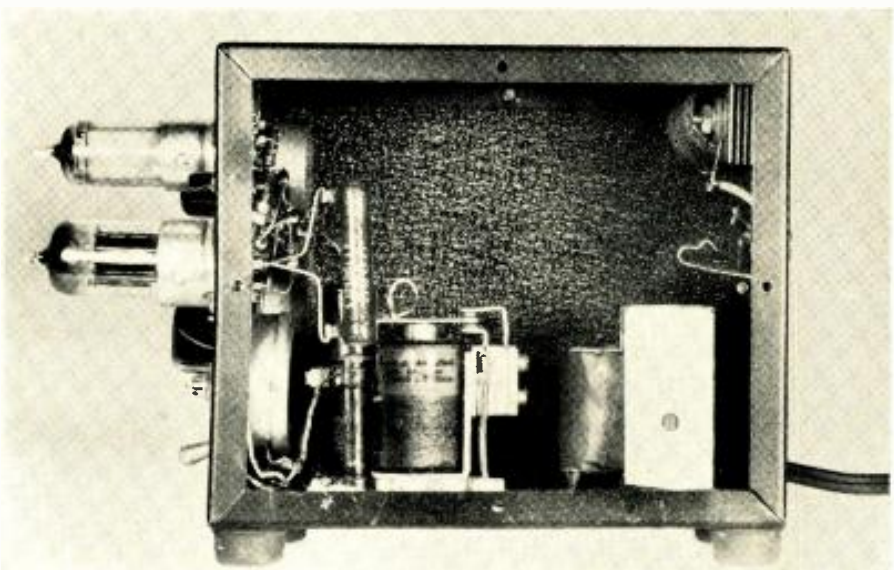
R_1—8.2 megohm, ½ w. res.
R_2—33,000 ohm, ½ w. res.
R_3—1 megohm pot
R_4—220,000 ohm, ½ w. res.
R_5—100,000 ohm, ½ w. res.
R_6—27,000 ohm, ½ w. res.
R_7—6800 ohm, 2 w. res.
R_8—5000 ohm, 2 w. res.
R_9—5000 ohm, 4 w. wirewound pot
R_{10}—15,000 ohm, 4 w. wirewound pot
C_1—.1 μfd., 600 v. molded plastic cond.
C_2—10 μfd., 50 v. elec. cond.
C_3—40 μfd, 150 v. elec. cond.
Rect.$_1$—65 ma. selenium rectifier
T_1—Power trans. 125 v. a.c. @ 50 ma.; 6.3 v. @ 2 amps. (Stancor PA-8421)
RL_1—2000-15,000 ohm plate circuit relay (Potter & Brumfield LM5, Ward Leonard, or Western Electric unit, see text)
S_1—S.p.s.t. switch
J_1—Open circuit jack
J_2—Three-way insulated jack (see text)
V_1—2D21 tube
V_2—12AU7 tube

Fig. 3. Complete schematic of keyer. A 2D21 thyratron was selected for its small size.

RELAY TYPES (See Text)	CONDITION	V_{2A}			V_{2B}		
		1	2	3	6	7	8
Ward Leonard adjustable 2000 ohm coil	Key Up	138	65	96	78	46	43
	Dots	142	23	30	96	30	30
	Dashes	142	16	24	105	23	28
Western Electric non-adjustable 4000 ohm coil	Key Up	138	66	97	82	47	44
	Dots	142	23	30	105	30	31
	Dashes	144	16	24	112	23	28
Surplus "BK-35" adjustable 13,000 ohm coil	Key Up	138	65	96	78	46	43
	Dots	142	23	30	105	30	31
	Dashes	142	16	24	114	23	28
Potter & Brumfield adjustable 10,000 ohm coil	Key Up	138	64	97	78	46	43
	Dots	142	23	30	103	30	31
	Dashes	142	16	24	112	23	28

Table 1. Voltage readings for the four different types of relays tried by the author.

Fig. 4. Side view of keyer. Contact spacing adjustment on relay is indicated here.



A TRANSISTORIZED APPLAUSE METER

By LOUIS E. GARNER, JR.

Fig. 1. Over-all view of the transistorized applause meter. It measures 4" x 6" x 4¼" and is battery-operated.

Build this compact unit for rental or "loan." It can be used as an output meter or for sound-survey work.

WITH the increasing general interest in square-dance competitions, amateur shows, and similar contests, the radio-TV service shop is frequently in a position to pick up extra money or to obtain good publicity by renting or lending and installing p.a. systems, record players, and juke boxes. General practice is to rent the systems or equipment to clubs and money-raising groups, and to "lend" the systems to churches and similar charitable organizations.

At such contests, prizes are often awarded on the basis of "audience reaction." The only fair way to determine audience reaction to a particular act is by means of the impartial judgment of an electronic applause meter. In this way, there is no possibility of favoritism on the part of the emcee, nor any question as to the fairness of decisions.

Since the radio-TV service shop may be called on to furnish or operate the p.a. system, it is only natural that it also be requested to supply or obtain an applause meter or similar device. Commercial applause meters may not only be difficult to obtain locally but quite expensive, so the service organization handling such work may find it worthwhile to consider building its own instrument.

In choosing the design for such an instrument, several features are desirable. The applause meter should be self-contained, compact, light weight, sensitive, easy to use, and, preferably, independent of both the power line and the p.a. system. These last two features are important because the instrument may sometimes be used outdoors where power is not available or in small groups where a p.a. system is not needed.

The instrument shown in Fig. 1 comes close to meeting all of these requirements. It is completely self-contained. No extra "mike" or other pickup is required. It is compact as the over-all dimensions are only 4"x6"x 4¼". It is quite sensitive, yet easy to operate and use—only three simple controls are provided. It is battery operated and no power line connections are necessary!

These features have been made possible by utilizing *p-n-p* junction transistors in the design of the instrument.

Circuit Description

The complete schematic diagram for the transistorized applause meter is given in Fig. 2. The basic circuit consists of a two-stage transformer-coupled transistor amplifier followed by a single stage combination amplifier-detector. A built-in crystal microphone cartridge (Mic.) serves as the pickup.

In operation, audio signals picked up by the microphone are applied to the primary of transformer T_1, a step-down unit used to match the high impedance of the crystal microphone to the low input impedance of the first transistor amplifier stage.

In order to adjust the gain of the instrument for different sized audiences, a simple step-type attenuator, consisting of rotary switch S_1 and resistors R_1, R_2, R_3, R_4, and R_5, is provided between the secondary winding of T_1 and the input to the CK721 amplifier stage.

The audio signal obtained from the "arm" of S_1 is applied through coupling condenser C_1 to the base of the transistor, connected as a conventional "grounded-emitter" amplifier. This basic circuit has been used throughout the instrument as it provides good gain and permits a single battery power source to be employed.

Resistor R_6 serves as the "base return" resistor. Connected to the negative terminal of the power supply, it establishes the base current "bias" for the first stage.

Transformer T_2 is used to match the high output impedance of the first stage to the low input impedance of the second stage, a CK722 "grounded-emitter" amplifier. The primary winding of this transformer serves as the collector load for the CK721 stage.

Coupling condenser C_2 offers a low impedance path for the audio signal to the base of the CK722 amplifier, yet prevents the secondary winding of T_2 from acting as a d.c. short from base to ground. R_7 is the base return resistor for the second stage; again, the value of this resistor determines the base "bias" current.

Condenser C_3 serves to bypass the higher frequency components of the audio signal and thus to reduce the effects of high-pitched whistles on the final meter reading. This condenser also reduces, to some extent, the amplitude of the noise "hiss" generated by transistor amplifier stages.

If desired, crystal headphones may be inserted in the monitor jack, J_1, coupled to the second amplifier stage through condenser C_4. This provision permits the operator to hear the signal as picked up by the applause meter.

Transformer T_3 serves to perform a function similar to that of T_2, that is, its primary winding serves as the collector "load" for the second amplifier stage, and it is used to match the high output impedance of one stage to the low input impedance of the next.

C_5 serves as the coupling condenser to the last stage, a CK722 transistor operated without base "bias" current. Note that base resistor R_8 is returned directly to ground rather than to "B—".

When a transistor amplifier is op-

erated without base "bias" current, it acts to rectify as well as to amplify the applied signal. Thus, collector current depends directly on the amplitude of the applied audio signal and this current is indicated on the microammeter, M_1.

Provision is made for "smoothing out" the peaks of audio signals by means of a large capacity bypass condenser, C_6, across the meter. The use of this filter is optional with the operator, since it may be thrown out of the circuit by means of switch S_3.

Power for the entire instrument is obtained from a single 6 volt battery, B_1, controlled by a s. p. s. t. power switch, S_2.

Construction Hints

The assembly and wiring of the instrument are straightforward and should present no problem to the skilled technician. The placement of major parts is apparent from the interior view of the instrument given in Fig. 3. The microphone cartridge and the input transformer (T_1) are mounted on the back panel.

A small chassis is used for the transistor circuits. An under chassis view is not shown because the final wiring, with the author's layout, must be done with the chassis in place.

The subminiature transformers are held in place by small "Z" brackets.

Wiring and layout are not especially critical, and the builder may modify the layout shown or choose a new one to suit his own requirements. Care should be taken to follow good audio practice, that is, leads should be kept reasonably short and the "input" and "output" portions of the instrument should be kept well separated.

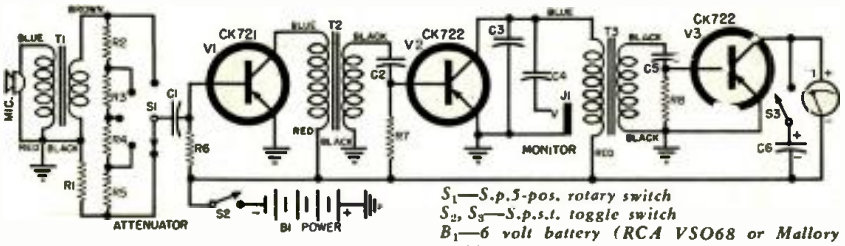
Although the author's model has been assembled in a standard sloping panel utility box, another type cabinet may be preferred by the builder. Almost any small metal box will serve well in this capacity; a *Bud* "Minibox" is a good choice.

The transformer leads are identified by color-coded wires—the proper connections are shown in Fig. 2 for the transformers specified in the parts list.

In rare instances it may be found necessary to readjust the values of the "base return" resistors R_6 and R_7 for optimum results with a particular transistor. To do this experimentally, connect an audio sine-wave generator to the input and an oscilloscope to the output of the stage to be checked. Adjust the value of the resistor for best gain with minimum distortion, but in no case choose a value which permits the collector current to rise above 5 ma.

The builder can use one of two methods when installing the transistors. He may either use sockets or wire the transistors directly into the circuit. Should sockets be preferred, standard 5-pin subminiature tube sockets are suitable.

If the transistors are to be soldered in position, however, special care should be exercised to complete the soldering as quickly as possible to avoid possible damage by overheating these expensive components.



R_1—10 ohm, ½ w. res.
R_2—500 ohm, ½ w. res.
R_3—300 ohm, ½ w. res.
R_4—100 ohm, ½ w. res.
R_5—82 ohm, ½ w. res.
R_6—220,000 ohm, ½ w. res.
R_7—150,000 ohm, ½ w. res.
R_8—10,000 ohm, ½ w. res.
C_1, C_2, C_5—2 μfd., 6 v. miniature cond. (Barco P6-2)
C_3*—.002 μfd. cond.
C_4*—.01 μfd. cond.
C_6—500 μfd., 6 v. elec. cond.
S_1—S.p.5-pos. rotary switch
S_2, S_3—S.p.s.t. toggle switch
B_1—6 volt battery (RCA VSO68 or Mallory 302424)
J_1—Open-circuit phone jack
M_1—0-500 d.c. microammeter, 2" round case
T_1—"Sub-Ouncer" trans. (UTC Type SO-6)
T_2, T_3—"Sub-Ouncer" trans. (UTC Type SO-3)
V_1—"p-n-p" junction transistor (Raytheon CK721)
V_2, V_3—"p-n-p" junction transistor (Raytheon CK722)
Mic.—Crystal microphone (Shure R7)
*The voltage rating is unimportant. Any rating over 6 d.c.w.v. is suitable.

Fig. 2. Complete schematic of the transistorized applause meter. The "p-n-p" type junction transistor has been used in this construction. Three are required.

Circuit Modifications

A considerable number of modifications in the basic applause meter circuit are possible to meet the special needs of the individual builder. However, because the number of possibilities is so large, only a few suggestions are outlined here.

First, the monitor circuit may be eliminated entirely if desired. Simply remove C_4 and J_1. No other circuit changes are necessary.

Another meter may be substituted for the 0-500 microampere unit specified in the parts list without making any other circuit changes. An 0-100 microammeter will provide increased sensitivity, while less sensitivity will be obtained with a 0-1 ma. unit. Irrespective of the meter chosen, however, care must be taken to set the attenuator so that serious overload will not occur. The exact setting will vary with different sized audiences.

In the author's model, the resistors in the attenuation network (R_1, R_2, R_3, R_4 and R_5) were chosen arbitrarily and no attempt was made to provide a precise degree of attenuation at each switch position. This method was employed since the instrument is used only to indicate relative peaks and exact meter readings are unimportant.

Some builders might prefer that the attenuator switch provide precise steps of attenuation, either in terms

(*Continued on page* 120)

Fig. 3. Rear view of instrument. Microphone and transformer are mounted on the panel.

International SHORT-WAVE

Compiled by KENNETH R. BOORD

THIS month's ISW Department finds a heavy file of reports from listeners all over the world who obviously have had good luck with their DX-ing.

Albania—Radio Tirana, 7.850A, noted opening *English* session 1400. (Pearce, England)

Andorra—Radio Andorra, 5.990, noted 1730 with recordings. (Saremba, Va.)

Anglo-Egyptian Sudan—Radio Omdurman, 7.093A, noted with news 1115 on Sun., Wed. (Pearce, England) Heard on 6.593A at 2315-2345, all-Arabic; best *after* 2330. (Stark, Texas)

Angola—Luanda, 11.862, varies its announcements; at times still says "Radio Clube de Angola," at others "Radio Angola," and sometimes "Radio Angola, Emissor Nacional." Noted around 1500-1530 and later. (Pearce, England)

Argentina—LRS, 9.316, *Radio Splendid,* noted 2115 with piano selections. (Tandrow, Calif.) News noted 1800A over LRA, 15.345. (Smits, Minn.) Heard on this outlet 1800-2000 to North America. (Vokral, N. Y.) *Radio El Mundo,* LRX, 9.660, 7.5 kw., LRX1, 6.120, 10 kw., is scheduled 0530-2235. (Kahan, Calif.) LRY, 9.76, heard 2215 at excellent level. (del Rosario, Hawaii)

Australia—VLA15, 15.200, noted 2200 at excellent strength in Hawaii. (del Rosario) VLC9, 9.615, noted at strong level 0700-0845. (McGrath, Iowa) VLM4, 4.917, Brisbane, heard 0410-0450 at good level in Home Service. (Morris, Pa.)

Austria—Radio Wien, 9.664, Vienna, noted 0330 with light musicals. Appears now to identify as "Radio Osterreich." *Blue Danube Network,* 9.617, Salzburg, noted with program preview 1025. (Pearce, England) This one is heard at fair level as late as 1100-1200. (Siggs, Sweden)

Azores—Ponta Delgada, 4.865, noted to 1900 closedown. (ISWL, England) CSA92, 11.090, heard with music 1530-1538. (Morris, Pa.)

Bechuanaland—ZNB, 8.230, Mafeking, is heard in Sweden 1200-1300. (Radio Sweden)

Belgium—ORU, 9.745, Brussels, noted with recordings, announcements in Portuguese at 1618. Heard on 6.000 at 1700 with Spanish for Latin America. (Pearce, England) Heard closing 0805 on 11.805, fair level; noted on 21.510 with fair signal 0700 when reception improves (may change beam then). (Gillett, Australia) Heard on 9.767A with interval 1300, French language. (Smits, Minn.) Noted on 15.335 at 1200 in German. (Saremba, Va.)

Belgian Congo—Radio Congo Belge, Leopoldville, lists OTM1, 6.295, 0000-0130, 0515-0730, 1130-1600; OTM2, 9.380, 0000-0130, 1130-1600; OTM4, 11.720, 0515-0730; OTH, 9.210, 0530-0700, 1130-1330; OTH, 11.670, Sun. *only* 0500-0700. (Cody, Ireland, others) The 9.380 outlet is good level to 1600 closedown in French, but does have occasional CWQRM. (Jannis, S. C.) Good level when checked 0040. (Barnard, Calif.)

Brazil—ZYK3, 9.565, *Radio Jornal do Commercio,* Recife, Pernambuco, is good level in the United Kingdom when presents "Brazil Calling" *(English)* weekdays 2005-2030 (Sun. 1630); ZYK2, 6.085, ZYK32, 11.825, and ZYK33, 15.145, are also used. *Radio Cultura du Sao Paulo,* 6.165A, is being heard well in Canada around 2330 when announces in *English* and asks for reception reports, says will send a "novelty" reply from Radio Cultura, Avenida Sao Goao 1285, Sao Paulo, Brazil; no longer uses 9.745. *Radio Bandeirante,* ZRY77, 6.185, and ZRY78, 11.925, is scheduled now 0400-1100, 1600-0030. (ISWC, London, others)

Radio Record, 9.505, Sao Paulo, heard 1700 with news in Portuguese. (Mesquita e Sousa, Portugal) *Radio Tamandare,* ZYK21, 3.265, heard 1905-1930; *Radio Clube de Para,* PRC5, 4.865, heard 1904-2058 sign-off; *Radiodifusora Amazonas,* ZYS8, 4.805, heard 1900-2130 sign-off; *Radio Quitandinha,* ZYP23, 5.045, noted 1630-1700. (Miemois, Finland)

This young SWL who became a ham is Edward R. Buchholz, W9VBZ of Milwaukee, Wis. Shown are Ed's NC-125 receiver; his transmitter—a Johnson Viking; a Johnson v.f.o.; and the Milwaukee Radio Amateur's Club "Novice Trophy" presented to Ed for the year 1952. His transmitter usually runs 100 watts on the 20- and 75-meter bands. His antenna is a 125-foot center-fed, half-wave, running E-W about 50 feet in air.

British Guiana—ZFY, 3.220A, Georgetown, *Radio Demarara,* noted 1845-1915. (Hill, Mass.)

British Honduras — Radio Belize, 3.300, noted 1925-2000 with *English,* then Spanish news, weather report, and talk in *English;* heavy CWQRM. (Morris, Pa.; Kirby, Mo.)

Bulgaria—Radio Sofia, 9.700, heard well with news 1745. (Roemer, Ky.; Smits, Minn., others) Noted on 7.671A in *English* 1625-1640 through CWQRM. (Morris, Pa.; Keith, N. Y.)

Burma—Radio Rangoon, 4.774, noted with *English* 0915-1015. (Miemois, Finland)

Canada—CJCX, 6.010, Sydney, Nova Scotia, has increased power from 1 to 5 kw. *(WRH)* Heard with news, weather report 0705-0715, then music. (Greco, N. J.) BED, 7.320, Edmonton, Alta., noted 1430, bad QRM, QSB. (Bellington, N. Y.)

Cape Verde Islands—CR4AA, near 7.398, Praia, noted signing on in Portuguese 1500. (Pearce, England) Has news in Portuguese 1545, 1630. (Mesquita e Sousa, Portugal)

Ceylon—VOA relay, 9.57, noted opening 0830 with "Star-Spangled Banner." (Bellington, N. Y.) *Radio Ceylon,* 11.975, heard 0930-1030 and later at good level. (Jones, N. C., others) Strong at 1100 (Lund, Iowa) Heard on 15.120 in *English* 2030-2330, announces 7.190 in parallel. (Crowell, Pa.)

China — Radio Peking, measured 15.058, noted with Chinese at dictation speed 2050; at 2100 had time pips, fair level. (Ferguson, N. C.) Heard on 10.210AV with setting-up exercises 1820, parallel 9.060A. (Niblack, Ind.) Heard on 7.450A in native 1820-1915, good level at times; CWQRM. (Morris, Pa.) Peking is being heard on 6.105, 6.200, 9.010A, and 10.200 to sign-off 1334A; on 11.96 at 2200 in *English* with 15.06 announced as in parallel. (Morgan, Calif.)

(*Continued on page* 126)

(Note: Unless otherwise indicated, all time is expressed in American EST; add 5 hours for GCT. "News" refers to newscasts in the English language. In order to avoid confusion, the 24 hour clock has been used in designating the times of broadcasts. The hours from midnight until noon are shown as 0000 to 1200 while from 1 p.m. to midnight are shown as 1300 to 2400.)

The symbol "V" following a listed frequency indicates "varying." The station may operate either above or below the frequency given. "A" means frequency is approximate.

TV-RADIO SERVICE TECHNICIAN ASSOCIATIONS

Listed below, by state, are the various TV-radio technician associations in the United States and Canada. Service technicians wishing to obtain more information about their local associations should write direct to one of the officers listed.

CALIFORNIA

Long Beach Radio Technicians, Inc., P.O. Box 4085, Long Beach 4—Joseph Martin, Pres.; Merlyn Cochems, Sec'y.

Bureau of Home Appliances of San Diego County, Electric Bldg., San Diego 1—Robert D. Halvorson, Pres.; J. Clark Chamberlain, Sec'y-Mgr.; J. Holloway, Chm. Electronics Div.

San Diego County Electronic Ass'n, Inc., P.O. Box B, Old San Diego Station, San Diego 10—Frederick Palmer, Pres.

Society of Radio & Television Technicians, Inc., P.O. Box 126, Van Nuys—Jimmie Scarsborough, Pres.; Morris Blumbaum, Sec'y.

COLORADO

Rocky Mountain Radio-Television Guild, Inc., 8201 West Grandview, Arvada—Milo G. Scram, Pres.; Tom Sampson, Sec'y-Treas.

FLORIDA

Radio & Television Technicians Guild of Florida, Inc., 8909 N.W. 22nd Ave., Miami—Shan DesJardins, Pres.; Clarence C. Gunn, Sec'y.

ILLINOIS

Greater Chicago Television Service Industry, 135 S. LaSalle St., Chicago 11—Charles Custer, Pres.; M. G. Mackay, Sec'y.

National Alliance of Television & Electronic Service Ass'ns, 5908 S. Troy St., Chicago 29—Frank J. Moch, Pres.; Jack McDowell, Sec'y-Gen.

National Appliance & Radio-TV Dealers' Assn., 1141 Merchandise Mart, Chicago 54—Wallace Johnston, Pres.; Victor P. Joerndt, Sec'y.

Television Installation Service Ass'n. of Illinois, 5908 S. Troy St., Chicago 29—Frank J. Moch, Pres.; Rubin Saxner, Sec'y.

INDIANA

Radio & Television Service Engineers Ass'n., Inc., 1624 W. 9th St., Anderson—Joe Groves, Pres.; E. J. Deilks, Sec'y.

Radio-TV Service Dealer Ass'n., % Snyder Radio Service, 728 11th St., Columbus—Ralph R. Dwenger, Chm.; J. E. Snyder, Sec'y-Treas.

Radio Servicemen's Ass'n., 701 Hess Ave., Evansville—Wayne Stephan, Pres.; Albert J. Bosler, Sec'y-Treas.

Fort Wayne TV-Radio Appliance Ass'n., 112 East Washington, Fort Wayne 2—Ray Adams, Pres.; Edward H. Sharkey, Sec'y.

IOWA

Radio Technicians Ass'n., 515 Church St., Ottumwa—Jerry Brown, Sec'y.

MARYLAND

Certified Television & Electronics Ass'n. of Maryland, 2861-3 W. Franklin St., Baltimore 23—Harry O. Johnson, Pres.; Jerry Jacobson, Sec'y.

MASSACHUSETTS

Radio Television Technicians Guild of New England, 212 Massachusetts Ave., Arlington 78—Ben Sims, Pres.; James Stine, Sec'y.

Association of Television Service Engineers, 18 Jackson St., Cambridge—I. Werlin, Pres.; Russell J. Cummings, Sec'y.

Radio Television Technician's Guild of New England, Inc., P.O. Box 1307, Fall River—Jim Shipley, Pres.; Alfred A. Feisal, Sec'y.

MICHIGAN

Television Service Ass'n. of Michigan, 16311 Grand River, Detroit 27—Harold Chase, Pres.; M. Wright, Sec'y.

Radio Technicians Ass'n., P.O. Box 773, Kalamazoo—Paul M. Goecke, Pres.; James Thayer, Sec'y.

Oakland County Electronic Ass'n., 286 State St., Pontiac—John Stefanski, Pres.; James H. Hampton, Sec'y.

MINNESOTA

Radio Servicemen of America, 1010 Second Ave., S., Minneapolis—A. R. Trovall.

Rochester Radio & Television Servicemen's Ass'n., 505 11th St., N.W., Rochester—George McKinzie, Pres.; V. Norman, Sec'y.

MISSOURI

Television Service Engineers, Inc., 307 Shukert Bldg., 1115 Grand, Kansas City—Albert A. Richards, Pres.; Ray Crawford, Sec'y.

Ass'n. of Television Service Companies of Greater St. Louis, Inc., 1724 S. 39th St., St. Louis 10—Vincent J. Lutz, Pres.; Morton Singer, Sec'y.

NEBRASKA

Nebraska Electronic Service Ass'n., 1617 S. 17th St., Lincoln 2—H. M. Tanquary, Pres.; T. M. Duffield, Sec'y.

NEW JERSEY

Radio Servicemen's Ass'n., Inc., 72 S. Olden Ave., Trenton 9—George Owens, Pres.; Louis E. Peoples, Sec'y.

NEW YORK

Buffalo Radio Institute Alumni, 45 W. Mohawk St., Buffalo—Albert Licata, Pres.; Philip Oehler, Sec'y.

Radio Technicians Ass'n., Inc., 657 Broadway, Buffalo 12—Ted J. Telaak, Pres.; Clarence Jax, Sec'y.

Radio Television Service Ass'n. of Western N. Y., Station E., Box 28, Buffalo—Ferdinand J. Lynn, Pres.; John G. Wick, Sec'y.

Long Island Electronic Technicians Ass'n., 88 4th St., Oceanside, L.I.—William Carey, Pres.; H. F. MacFarland, Exec. Sec'y.

Long Island Television & Radio Technicians Guild, 23 Broadway, Hicksville, L. I.—John A. Wheaton, Pres.; Henry Wawryck, Sec'y.

Editor's Note: Although every attempt has been made to make this list as complete as possible, some groups may have been omitted. If the officers of any such group will send in the exact name, address, and list of officers, we will be happy to include this information in one of our future issues.

Radio Technicians Guild of Rochester, N. Y., Inc., 703 Temple Bldg., Rochester 4—Alfred L. Best, Pres.; Francis G. Stoffel, Sec'y.

Associated Radio-Television Servicemen of N. Y., Inc., 855 Midland Ave., Yonkers—Max Leibowitz, Pres.; Arthur Rhine, Exec. Sec'y.

OHIO

Associated Radio & Television Service Dealers, 2552 N. High St., Columbus—Sam Oppenheimer, Pres.; Robert Tyo, Sec'y.

Electronic Technicians Ass'n. of Toledo, 626 Pleasant Place, Toledo 9—Vern B. LaPlante, Chm.; Orville G. Shanteau, Sec'y.

OKLAHOMA

Oklahoma City Television & Radio Service Ass'n., 2909 N.W. 23rd St., Oklahoma City—H. O. Eales, Pres.; Harry E. Dent, Sec'y-Treas.

PENNSYLVANIA

Lehigh Valley Radio Servicemen's Ass'n., Radio Station WSAN, 39 N. 10th St., Allentown—Claude Kramer, Pres.; Ed Ehritz, Sec'y.

Federation of Radio Servicemen's Ass'ns. of Pa., Carbondale—Milan J. Krupa, Chm.; Leon J. Helk, Sec'y.

Alle-Kiski Chapter of the National Appliance & Radio-TV Dealers Ass'n., P.O. Box 283, Brackenridge—Penny Martin, NARDA Rep.

Conestoga Television Ass'n., 915 New Holland Ave., Lancaster—Lewis I. Mengle, Pres.; Robert G. Wiegand, Sec'y.

Joint Electronics & Radio Committee on Service, Lewis Tower Bldg., Philadelphia—Paul V. Forte, Exec. Sec'y.

Philadelphia Radio Service Men's Ass'n., Inc., 1307 W. Rockland St., Philadelphia 40—Samuel Brenner, Pres.; Fred Cohen, Sec'y.

Television Contractors Ass'n., Lewis Tower Bldg., 15th & Locust Sts., Philadelphia 2—Albert M. Haas, Pres.; Martin Weinberg, Sec'y.

Television Servicing Dealers Ass'n., 6021 Ogontz Ave., Philadelphia—Louis J. Smith, Pres.; Martin Benoff, Sec'y.

Radio Servicemen's Ass'n. of Luzerne County, P.O. Box 309, Wilkes-Barre—William Morgan, Jr., Pres.; Milan J. Krupa, Sec'y.

RHODE ISLAND

R. I. Radiomen's Business Ass'n., P.O. Box 800, Providence 1—Hugo Olobri, Pres.; Edward Oliver, Sec'y.

TEXAS

Fort Worth Radio & Television Ass'n., Inc., 1610 Eighth Ave., Fort Worth—Truett Kimzey, Pres.-Dir.; J. W. Williams, Jr., Sec'y-Treas.

Texas Electronics Ass'n., 511 Hemphill St., Fort Worth—Leonard R. Smith, Pres.; Luther Bradley, Sec'y.

Texas Electronic Technicians Ass'n., P.O. Box 15011, Houston—Ed Grange, Pres.; M. Chaplinsky, Sec'y.

(Continued on page 164)

MAC'S RADIO SERVICE SHOP

By JOHN T. FRYE

TAPE RECORDERS

THE express truck was just driving away from the service shop as Barney returned from his lunch hour, and the youth, who had more curiosity than Dr. Kinsey, immediately hurried inside to find out what new equipment Mac could be purchasing. The boss already had the instrument out of the box and sitting on the service bench, and he was unwrapping some small parts that had been packed with it.

"Hey!" Barney exclaimed, "that's a mighty neat looking tape recorder. Is it for the shop?"

"Yep," Mac answered. "Our old one is pretty well worn out; furthermore, home tape recorders have improved a lot since that one was made. The features of this *Ekotape* 205 represent many of the advances found in most late model recorders."

"Such as . . ." Barney led him on.

"Such as the ability to record at either 3.75 or 7.5 inches-per-second and being able to switch instantly from one speed to the other with proper equalization of the playback amplifier being cut in automatically for either speed. It is a dual-track machine that can put two full hours of program on a seven-inch reel and has a fast forward and rewind for quickly spotting a particular section of the recording. When a program is being taped, it can be heard through the recorder speaker or this can be cut out. There is a full range tone control for boosting either the bass or highs during playback. There is a high-level input jack and a patch cord for taking a recording from any radio, TV, or phono player by simply clipping the ends of this cord directly to the voice coil connections. The same jack, of course, could be used with a shielded cord for taking the program from a high impedance source, such as directly across the volume control or from the output of a phono cartridge.

"As I mentioned, many of these features are found in practically all late model recorders; but here is something in this one that appeals to me for our uses." As he said this, Mac inserted a small device in an opening in front of the recorder and pushed it gently with his thumb. Instantly the reels that had been moving the tape through the recording head stopped going around. As his thumb released the gentle pressure, the reels started revolving again.

"This manual control of tape movement allows you to stop and start the tape instantly at any time while recording or playing back without disturbing any of the other controls. I figure it will be most handy for dictating. A fellow can say a sentence and then stop the gadget while he thinks up another."

Mac removed the hand control and inserted the end of a flexible tube that went down to a foot treadle affair resting on the floor. When he pressed on this with his foot, the tape could be stopped and started again as readily as with the hand control.

"This foot control is a good companion for the hand control," Mac explained. "It allows you to control the recorder while your hands are busy doing something else. For example, Matilda can use it to take down on the typewriter a letter I have dictated on the tape. She can let the tape run for a few words at a time and then hold it while she puts these down, and so on."

"You whizzed something by me awhile ago," Barney complained. "What was that business about different amplifier compensation for each speed?"

"Well, you must know the response curves of an uncompensated tape recording would never serve as a high-fidelity fan's pin-up. It looks like a sort of lopsided parabola with the lows falling away from the peak more gradually than do the highs. By increasing the speed of the tape, we can increase the frequency of this peak response point. In fact, the relationship is a direct one, with the peak response frequency being doubled by doubling the tape speed."

"Hold it!" Barney commanded. "Why?"

"Suppose we used light-sensitive tape instead of magnetic and employed a neon lamp shining through a narrow slit on to the tape as our recording head. When the light was bright, the tape in front of the slit would be turned black; when the light was out, the tape would remain white. Now if we use a low-frequency sine wave to excite the neon lamp, the moving tape will be transformed into alternate bands of white and black. As we increase the frequency of our exciting signal, the width of these bands will decrease until they become narrow vertical lines. Finally, as the frequency goes higher and higher, the alternate lines of black and white will become so narrow that they merge together. Holding our exciting frequency at this point, however, we can double the speed of the tape and so double the width of the lines, making them again easily distinguishable. Only when the exciting frequency is doubled will they merge together once more. Since the recording head prints magnetically on the tape in precisely the same way that this apparatus would print photographically, you can see why increasing the tape speed increases the potential high-frequency response."

"Yes, and I also see why different amplifier compensation would be required to flatten out the curves for each speed. You would need less high-frequency compensation at the higher speed. Right?"

"Right," Mac applauded; "and while this picture is still fresh in your mind, perhaps we had better talk about the importance of head alignment in playing tapes recorded with a recording head that is different from the playback head. Since most home recorders use the same head to perform both jobs, this is not very important as long as the machine is used only for playing tapes recorded on that machine; but now it looks as though we are on the brink of a new era in which there will be a lot of exchanging of tapes."

"What makes you think so?"

"For one thing, it is becoming quite a fad to exchange tapes between recorder fans. In fact there is an organization called *Tape Respondents, International,* with headquarters in San Francisco, that encourages just that sort of thing. Then I saw in *'Time'* a few weeks back where both *Pentron*

(*Continued on page* 170)

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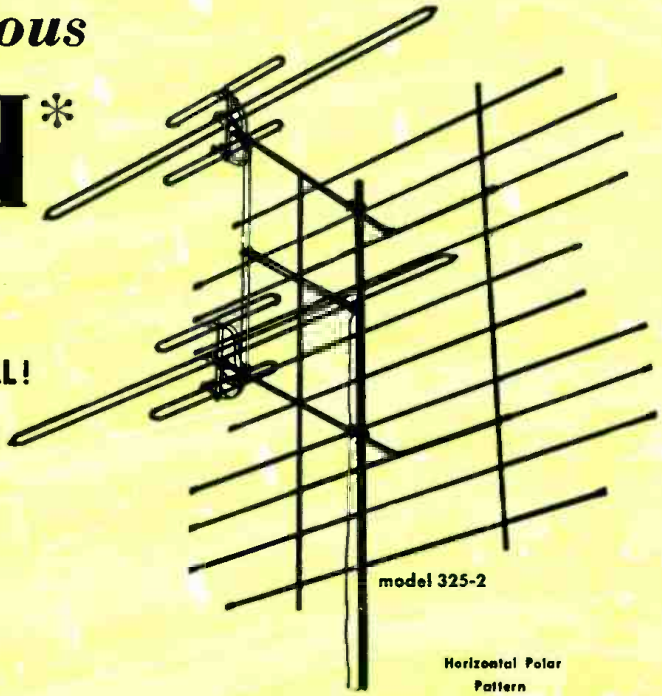

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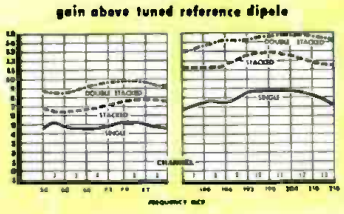

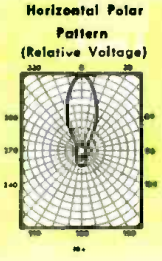

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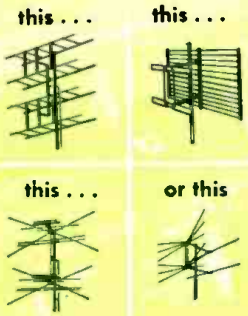

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High and Low Pass filters enable the Triple-Tie to adapt all Hi-Lo VHF installations to UHF — quickly and effectively. "Free-Space" terminals for perfect all-weather UHF reception.

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THE ANTENNA IN COLOR TELEVISION

by Harold Harris, *Vice President, Sales and Engineering*

Now that color telecasting is a reality, we will see an ever-increasing flow of color sets to the consumer. Although much is being said and written on the subject of color sets, many unanswered questions remain about the role of the television receiving antenna in color television.

Will present antennas work on color?

Will a special antenna be needed?

The results of thorough laboratory and field tests made by engineers of the Channel Master Antenna Development Laboratories show that practically all present TV antenna types will perform satisfactorily on color. Gain variations as high as 3 DB across one channel can be tolerated. When this figure is exceeded blurring or smearing of the picture may occur. Although there are certain antennas on the market which do have excessive gain variation, this is not the case of the vast majority of present installations.

There are also indications that fringe area color reception may be more critical. This may necessitate the use of fringe area antennas in areas closer to the TV station.

In the nation's most advanced television research laboratory, Channel Master antennas have always been designed for full band width and minimum variation in gain on any one channel.

For this reason, every Channel Master antenna which you have installed in the past, as well as the ones you install today, will provide reception of outstanding quality when color TV comes to your area.

Channel Master antennas were the antennas selected for the tests which led to the F.C.C.'s approval of the National Television Standards Committee color system.

WIRELESS OPERATORS OF OLD

By **C. HOWARD BOWERS**

OLD TIME Wireless Operators are being heard from all over the country! If you were a commercial operator around 1912, send us a brief resumé of your career as we would like to share your experiences with our readers.

This month we were privileged to hear from J. F. Hammel, Vista, California, who spun this yarn of service and adventure to his friend E. H. Marriner. "JF," as he is known to his friends, started out in San Francisco in 1912 after attending the old Marconi Wireless School.

Our new operator's first ship was a lumber schooner, the "SS Wolverton," followed by several freight and passenger vessels of the *Admiral* Line. Starting pay was $30 a month plus room and board. "Board" was usually restricted to the petty officers' mess adjoining the crew's galley and "room" was that portion of the ship of least use for anything else!

Most of the West Coast operators seemed to have a yen for Alaska and "JF" was no exception as in 1913 he served aboard two lumber schooners in that area. During 1914, however, our Arctic-minded friend made his first voyage away from the U. S. coast and sailed to Chile on the "SS Cuzco" with lumber, returning with nitrates to California. In 1915 he made a European cruise on a *Grace Line* ship. He returned to the Alaska run in 1917.

"JF" continued as a wireless operator until 1937 when he fell into evil ways and became a purser. The list of ships on his service record was longer than a king size cigarette when he quit the sea in 1947 and succumbed to his dreams of a chicken ranch in southern California where he hopes they *do not* become cheaper by the dozen!

Fred H. Zolin

While the majority of those engaged in professional work start as amateurs and wind up as professionals, the reverse is true in the case of Fred H. Zolin of Milwaukee. He started out as a professional telegrapher for *Western Union* about 1910 and did a little dabbling in wireless on the side. Fred was one of the many "boomer" operators and by 1914 he had drifted south to New Orleans and his first glimpse of the Gulf. His first sniff of salt water so stimulated his sea-going appetite that he obtained a First Class Commercial License and packed his bag and hammock.

He signed on the good ship "Alabama" bound for Frontera, Mexico. The ship had just undergone repairs and his first chore was to muck out the wireless shack. The gear was *Telefunken* with a quenched gap—something new to our tyro "sparks." The Chief Mate had to be contacted every time juice was wanted and no one aboard knew the ship's call. Anyway, when the rig was finally cranked up and a general call sent out, our friend promptly received a QRT from a British warship lying off Vera Cruz and what could be sweeter.

His stretches at sea were usually followed by *Western Union* assignments and in 1917 Fred joined the Navy as First Class Electrician's Mate and was sent to London where he served on Admiral Sims' staff in communications. After World War I he served on Herbert Hoover's American Relief Commission and held posts in Paris, Venice, Trieste, and Vienna.

Returning to the States in 1919, Fred again accepted employment with *Western Union* at Milwaukee, Wisconsin, where he is now assistant operations chief. He is also a big-shot amateur radio operator on the side and has served two terms as president of the Milwaukee Radio Amateur Club. This alone is no small job as the club has over 300 members. It might also be added that our friend is still going strong and that he celebrated his "39th" birthday last Christmas Day. Continued success to Fred H. Zolin.

John O. Ashton

Switching signals across the country, we now pick up the story of another old timer, John O. Ashton of 2261 St. Francis Drive, Palo Alto, California.

This old time wireless operator has collected more "fruit salad" than General Marshall ever thought of. It all started in (hold your hat) 1901 when "JO" and his uncle tuned in the now famous "S" signals from Marconi's colleagues in Poldu, Cornwall, in fact the same signals that Marconi and his assistants, Kemp and Paget, were receiving in Newfoundland.

During 1910 "JO" and his friend and colleague, Earl Ovington, demonstrated Professor Tesla's high-frequency apparatus at Madison Square Garden, N. Y., and during the same year he installed his counterpoise antenna on Ovington's small *Bleriot* monoplane and conducted the first two-way radio communication with a plane aloft.

Our fast-moving friend obtained his "Certificate of Skill" in 1912 and became a regular operator atop 42 Broadway in New York City. Later he sailed on *United Wireless* equipped ships and others operated by *United Fruit*. He became an instructor and later an engineer in Latin America and South America. He taught radio school in four different foreign countries. He took post-graduate wireless engineering instructions in Berlin under Professor Braun, inventor of the *Braun* tube from whence come our TV tubes.

In 1913 he was a sales representative

for Lee DeForest in the distribution of *Audion* tubes. He is a member of the IRE, the National Association of Trade Executives, African Explorers Society, Pioneer Radio Station Owners, Association of Research and Development Directors, to name a few.

He is now a consulting engineer and in his spare time he is preparing a series of books on the history and development of radio and electronics covered by his own experience.

Our best wishes to "JO." —30—

Transistor Receiver

(*Continued from page 73*)

an input signal cause collector current to flow. This pulsating current filtered somewhat by C_6 operates the sensitive relay in the collector circuit. Although the class A efficiency of a junction transistor closely approaches the theoretical 50%, in this application we are interested in getting the maximum power output, irrespective of distortion, so the class B operation is much more attractive. The relay, manufactured in England, is a lightweight, sensitive device ideally suited for model airplane work. It weighs about one ounce, has a 4000-ohm winding, and operates on about 3 mw. of power. It features a balanced armature operating in the field of a permanent magnet and is highly resistant to vibration.

The sensitivity of this receiver is surprisingly good. A 40 microvolt signal, modulated 50% with a 400 cycle tone, is sufficient to operate the relay. Any signal greater than 100 microvolts will drive the last stage to saturation which delivers about 12 milliwatts into the relay. With only 3 milliwatts needed to operate the relay this gives a comfortable margin of safety.

The current drawn from the 9-volt battery is about 2 ma. for the V_1 and .3 ma. each for V_2 and V_3. This is a total power consumption of about 23 milliwatts under standby conditions. An incoming signal increases this drain to 50 mw. but then we are delivering 12 mw. to the relay. This is a phenomenal saving of power when we consider that most vacuum-tube receivers of this type consume at least 150 mw. of filament power alone. This receiver is normally operated from six of the smallest available flashlight batteries connected in series.

A 10-watt mobile transmitter feeding into a 12-foot loaded vertical whip antenna was used for range checks. A three-foot vertical antenna was used on the receiver. Operation on the ground was satisfactory at ¼ mile so the range in the air should be more than adequate.

This receiver is not offered as the ultimate for this type of service because its performance leaves much to be desired. The author hopes, however, that this description will stimulate additional activity in the use of transistors in radio receiver applications. —30—

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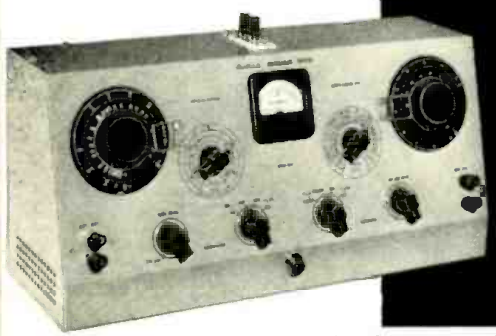
MODEL IB-2

$59.50

SHIPPING WT. 15 LBS.



Features

- Simpson 100-0-100 microampere meter.
- Completely AC operated.
- Built-in phase shift generator and amplifier.
- Battery type tubes, no warm-up required.
- Newly designed two section CRL dial.
- Single knob D, Q, and DQ functions.
- Special impedance matching transformer.
- New modern cabinet styling.
- ½% precision resistors and silver mica condensers.

Another new, outstanding instrument design so typically characteristic of Heathkit operation in producing high quality instrument kits at the lowest possible price. A new, improved model Impedance Bridge kit featuring modern cabinet styling, with slanted panel for convenience of operation and interpretation of scales at a $10.00 price reduction over the preceding model. Built-in adjustable phase shift oscillator and amplifier with all tubes of the battery operated type completely eliminates warm-up time. The instrument is entirely AC line operated. No bothersome battery replacements.

The Heathkit IB-2 Impedance Bridge Kit actually represents four instruments in one compact unit. The Wheatstone Bridge for resistance measurements, the Capacity Comparison Bridge for capacity measurements, Maxwell Bridge for low Q, and Hay Bridge for high Q inductance measurements. Read Q, D, DQ all on one dial thereby eliminating possible confusion due to the incorrect dial reference or adjustment. Only one set of instrument terminals necessary for any measurement function. Panel provisions provided for external generator use.

A newly designed two section CRL dial provides ten separate "units" switch settings with an accuracy of .5%. Fractions of units are read on a continuously variable calibrated wire-wound control. A special minimum capacity, shielded, balanced impedance matching transformer between the generator and the bridge. The correct impedance match is automatically switch selected to provide constant load operation of the generator circuit. The instrument uses ½% precision resistors and condensers in all measurement circuits.

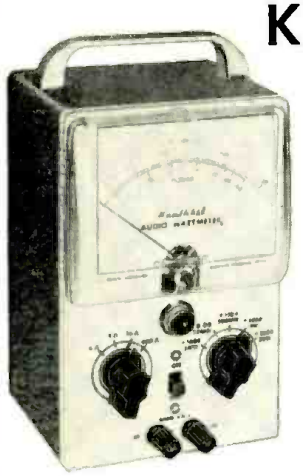
The new Heathkit IB-2 provides outstanding design features not found in any other kit instrument. The single low price includes the power supply, generator, and amplifier stages. No need to purchase separate instrument accessories in order to obtain the type of operation desired.

Heathkit AUDIO WATTMETER KIT

MODEL AW-1

$29.50

SHIPPING WT. 6 LBS.



A new Heathkit design for the audio engineer, serious hi fi enthusiast, recording studio, or broadcast station; the Heathkit Audio Wattmeter Kit. This specialized instrument instantly indicates the output level of the equipment under test without requiring the use of external load resistors. All readings are taken directly from the calibrated scales of a 4½" 200 microampere Simpson meter.

The Heathkit Audio Wattmeter features five full scale power measurement ranges from 5 milliwatts up to 50 watts with db ranges of −15 db to +48 db. The instrument has a power measurement rating of 25 watts continuous and 50 watts maximum for intermittent operation. Non-inductive resistance load impedances of 4, 8, 16, and 600 ohms are provided through a panel impedance selector switch. Frequency effect is negligible from 10 cycles to 250 kc. A conventional VTVM circuit utilizes a 12AU7 twin triode tube. The meter bridge circuit uses four germanium diodes for good linearity.

With the Heathkit AW-1 desired information can be obtained instantly and conveniently without bothering with the irksome setups and calculations usually required. Useful for power curve measurements, frequency response checks, monitoring indicaror, etc. Convenient calibration directly from 110 volt AC line source. This new instrument will help to supply the answers to your audio operating or power output problems.

Heathkit LABORATORY GENERATOR KIT

MODEL LG-1

$39.50

SHIP. WT. 16 LBS.

Another welcome new addition to the popular line of Heathkit instruments, the Heathkit Laboratory Generator. Specifically designed for flexibility of operation, accuracy and versatility beyond the performance level provided by the conventional service type generator. Frequency coverage of the Colpitts oscillator is 150kc to 30mc in five convenient ranges with provisions for internal or external modulation up to 50%, and .1 volt RF output throughout the frequency range. Panel mounted 200 microampere Simpson meter for RF "set reference level" to provide relative indication of RF output. Individually shielded oscillator and shielded variable and step attenuator provide flexible control of RF output.

The circuit features a 6AF4 high frequency oscillator, a 6AV5 amplifier with grid modulation, 12AU7 400 cycle oscillator and modulator, OB2 voltage regulator tube, and a selenium rectifier for the transformer operated power supply. The smart professional instrument appearance and over-all flexibility of operation will prove a decided asset to any industrial or educational laboratory. The Heathkit Laboratory Generator sets a new level of operation, far superior to any instrument in this price classification.

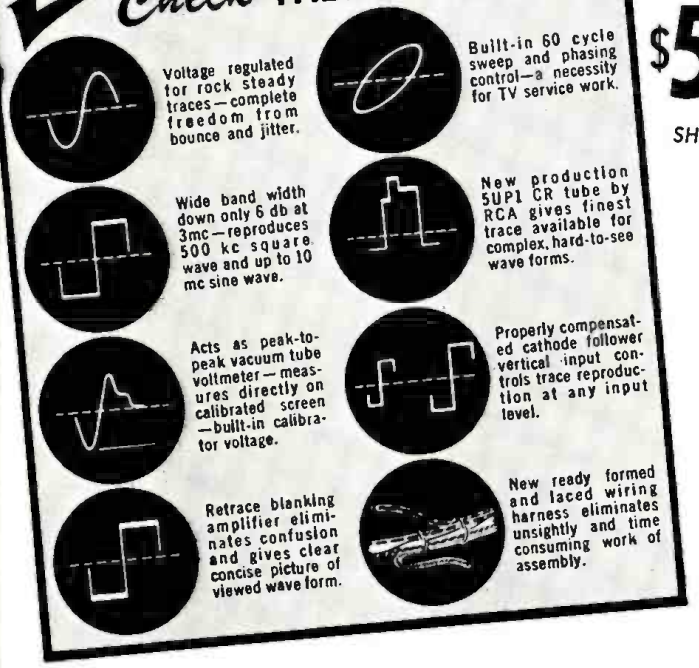
HEATH COMPANY · Benton Harbor 15, Mich.

THE MOST *Outstanding* OSCILLOSCOPE IN HEATHKIT HISTORY

NEW MODEL O-9

OSCILLOSCOPE KIT

Check THESE FEATURES



MODEL O-9

$59.50

SHIPPING WT. 28 LBS.

Announcing the newest addition to a brilliant series of Heathkit Oscilloscopes, the outstanding new model O-9 instrument. This Oscilloscope features a brand new 5UP1 cathode ray tube for really fine hairline focusing, good intensity and freedom from halation.

NEW FEATURES

Efficient voltage regulation system maintains rock steady trace stabilization. New retrace blanking amplifier circuit—amplifier band width further extended through efficient circuitry. Calibrated 1 volt peak-to-peak reference — wiring simplified by ready laced and formed wiring harness—new phasing control.

GOOD DESIGN

Terminal board for quick access to deflection plates—provisions for Z axis input—astigmatism control—balanced push-pull deflection amplifiers—internal sync on either positive or negative peaks.

VERTICAL AMPLIFIER

High impedance input with 6AB4 cathode follower, twin triode 12AT7 Cascade amplifier, 6C4 phase splitter and 12AT7 push-pull high gain deflection amplifier. Sensitivity .025 volts per inch.

HORIZONTAL AMPLIFIER

Five position input switch for choice of external input—line sweep—line sync—internal sync and external sync. Uses 12AU7 input stage, half as triode phase splitter driving 12AT7 push-pull high gain deflection amplifier. The remaining half of the 12AU7 used as retrace blanking amplifier.

POWER SUPPLY

New heavy duty internally shielded 100 milliampere power transformer. Efficient high voltage filtering system—voltage regulation completely eliminates trace bounce or jitter.

The Heathkit O-9 is the ideal general purpose oscilloscope for educational and industrial use. Radio and TV servicing and any other application requiring the instantaneous reproduction and observation of actual wave forms.

Heathkit LOW CAPACITY PROBE KIT

No. 342

$3.50

SHIP. WT. 1 LB.

Oscilloscope investigation of high frequency, high impedance or broad band width circuits requires the use of a low capacity probe. The Heathkit Low Capacity Probe features a variable capacitor to provide the necessary degree of instrument impedance matching.

Heathkit SCOPE DEMODULATOR PROBE KIT

No. 337-B

$3.50

SHIP. WT. 1 LB.

In applications such as trouble shooting TV, RF, IF and video stages, the frequency ranges encountered require the demodulation of signals before oscilloscope presentation. The Heathkit Demodulator Probe will fulfill this function and readily prove its value as a service accessory.

Heathkit VOLTAGE CALIBRATOR KIT

The Heathkit Voltage Calibrator provides a convenient method of making peak-to-peak voltage measurements with an oscilloscope. Peak-to-peak voltages are read directly on the calibrated panel scales in the range of .01 to 100 volts peak-to-peak. A convenient "signal" position on the panel switch can be used to by-pass the calibrator and apply the signal directly to the scope input.

MODEL VC-2

$11.50

SHIP. WT. 4 LBS.

Heathkit ELECTRONIC SWITCH KIT

The basic function of the Heathkit S-2 Electronic Switch kit is to permit simultaneous oscilloscope observation of two separate traces which can be either separated or super-imposed for individual study. Continuously variable switching rates in three ranges from less than 10 cps to over 2000 cps. Individual gain controls for each input channel and a positioning control.

MODEL S-2

$23.50

SHIP. WT. 11 LBS.

Heathkit VACUUM TUBE VOLTMETER KIT

MODEL V-6

$24.50

SHIPPING WT. 6 LBS.

Features

- New 1½ volt full scale low range
- 1,500 volt upper limit DC range
- Increased accuracy through 50% greater scale coverage
- High impedance 11 megohm input
- Center scale zero adjust
- Polarity reversal switch
- 1% precision resistors
- Clearly marked db scales

The beautiful Heathkit Model V-6 VTVM, the world's largest selling kit instrument, now offers many outstanding new features in addition to retaining all of the refinements developed and proven in the production of over 100,000 VTVM's. This is the basic measuring instrument for every branch of electronics. Easily meets all requirements for accuracy, stability, sensitivity, convenience of ranges, meter readability, and modern styling. It will accurately measure DC voltages, AC voltages, offers tremendous ohmmeter range coverage, and a complete db scale for a total of 35 meter ranges.

New 1½ volt full scale low range provides well over 2¼" of scale length per volt. Upper DC scale limit 1,500 volts. DC ranges 0-1.5, 5, 15, 50, 150, 500, 1,500 volts full scale. AC ranges 0-1.5, 5, 15, 50, 150, 500, 1,500 (1,000 volts maximum). Seven ohmmeter ranges from .1 ohm to 1,000 megohms. For added convenience a DC polarity reversing switch and a center scale zero adjustment for FM alignment.

The smartly styled, compact, sturdy, formed aluminum cabinet is finished in an attractive gray crackle exterior. The beautiful two-color, durable, infra-red, baked enamel panel further adds to the over-all professional appearance.

Top quality components used throughout. 1% precision resistors — silver contact range and selector switches — selenium rectifier — transformer operated power supply. Individual calibration on both AC and DC for maximum accuracy. DB scale printed in red for easy identification, all other scales a sharp, crisp black for easy reading. A variety of accessory probes shown on this page still add further to over-all instrument usefulness.

Heathkit 30,000 VOLT DC PROBE KIT

No. 336

$4.50

SHIP. WT. 2 LBS.

For TV service work or any similar application where the measurement of high DC voltage is required, the Heathkit Model 336 High Voltage Probe Kit will prove invaluable. A precision multiplier resistor mounted inside the two-color, sleek, plastic probe body provides a multiplication factor of 100 on the DC ranges of the Heathkit 11 megohm VTVM. The entire kit includes precision resistor, two-color plastic probe, tip connector spring, test lead, phone plug panel connector, and complete assembly instructions.

No. 338-B

$5.50

SHIP. WT. 2 LBS.

Heathkit PEAK-TO-PEAK PROBE KIT

Now read peak-to-peak voltages on the DC scales of the Heathkit 11 megohm VTVM. Readings can be directly made from the VTVM scale without involved calculations. Measurements over the frequency range of 5 kc to 5 mc. Use this probe to extend the usefulness of your VTVM in radio and TV service work. The Peak-to-Peak Probe Kit features the new polished aluminum housing with two-color polystyrene probe ends. Detailed assembly sheet including instructions for probe operation.

Heathkit RF PROBE KIT

No. 309-B

$3.50

SHIP. WT. 2 LBS.

The Heathkit RF Probe used in conjunction with any 11 megohm VTVM will permit RF measurements up to 250 mc, ± 10%. A useful, convenient accessory for those occasions when RF measurements are desired. The RF probe body is housed in the new, smartly-styled polished aluminum probe body featuring two-color polystyrene probe ends and a low capacity flexible shielded test lead. The kit is complete with all necessary material and a detailed assembly sheet as well as instructions for probe operation.

Heathkit AC VACUUM TUBE VOLTMETER KIT

MODEL AV-2

$29.50

SHIPPING WT. 5 LBS.

The new Heathkit AC VTVM that makes possible those sensitive AC measurements required by laboratories, audio enthusiasts, and experimenters. Especially useful for hum investigation, sensitive null detection, phono pick-up output measurements, making frequency response runs, gain measurements, ripple voltage checks, etc. Low level measurements are easy to make because of the complete voltage coverage of the instrument and the one knob operation.

The large 200 microampere Simpson meter has clearly marked and easy to read meter scales. Ten voltage ranges covering from .01 rms full scale to 300 volts rms full scale, with frequency response ± 1 db from 20 cycles to 50,000 cycles. Instrument input impedance 1 megohm, ten db ranges from −52 db to +52 db. For stability and good linearity characteristics the meter bridge circuit features 4 germanium diodes. Attractive instrument styling, a companion piece for the popular Heathkit VTVM and the new AW-1 Audio Wattmeter.

HEATH COMPANY • Benton Harbor 15, Mich.

CHECK THESE *Features*

- 20,000 ohms per volt DC sensitivity, 5,000 ohms per volt on AC
- Polarity reversal switch
- 1% precision multiplier resistors
- 50 microampere 4½" Simpson meter
- Meter ranges for service convenience
- New resistor ring-switch assembly
- Total of 35 meter ranges
- New Modern cabinet styling

NEW *Heathkit*

MULTIMETER KIT

MODEL MM-1

$26.50

SHIPPING WT. 6 LBS.

The most important Heathkit announcement of the year, the new 20,000 ohms per volt Heathkit Multimeter, Model MM-1. The universal service measuring instrument, accurate, sensitive, portable, and completely independent of AC line supply. Particularly designed for service use incorporating many desirable features for the convenience of the service man. Full 20,000 ohms per volt sensitivity on DC ranges — 5,000 ohms per volt sensitivity on AC —polarity reversal switch, no bothersome transferring of test leads — 1% precision multiplier resistors — large 4½" recessed non-glare 50 microampre Simpson meter — conveniently slanted control panel — recessed safety type banana jacks — standard universally available batteries — rugged practical sized cabinet with plastic carrying handle, and a total of 35 calibrated meter ranges.

RANGES

Voltage ranges selected entirely for service convenience. For example 1½ volt full scale low range for measuring portable radio filament voltages, bias voltages, etc., 150 volt full scale range for AC-DC service work, 500 volt full scale range for conventional transformer operated power supply systems. Complete voltage ranges AC and DC, 0-1.5—5—50—150—500—1,500—5,000 volts. DC current ranges, 0-150 microamperes—15 milliamperes—150 milliamperes—500 milliamperes—15 amperes. Resistance measurements from .2 ohms to 20 megohms x 1 x 1,000 x 10,000. DB coverage from —10 db to +65 db.

CONSTRUCTION

Entirely new design permits assembly, mounting and wiring of precision resistors on a ring-switch assembly unit. The major portion of instrument wiring is completed before mounting the ring-switch assembly to the panel. No calibration procedure is required, all precision resistors readily accessible in event of replacement.

CABINET

Strikingly modern cabinet styling featuring two piece construction, durable black Bakelite cabinet, with easy to read panel designations. Cabinet size 5½" wide x 4" deep x 7½" high. Good cabinet physical stability when operated in vertical position.

The Heathkit MM-1 represents a terrific instrument value for a high quality 20,000 ohms per volt unit using all 1% deposited carbon type precision resistors. Here is quality, performance, functional design, and attractive appearance, all combined in one low priced package.

Heathkit

BATTERY TESTER KIT

MODEL BT-1

$8.50

SHIP. WT. 2 LBS.

The Heathkit Battery Tester measures all types of dry batteries between 1½ volts and 150 volts under actual load conditions. Readings are made directly on a three color Good-Weak-Replace scale. Operation is extremely simple and merely requires that the test leads be connected to the battery under test. Only one control to adjust in addition to a panel switch for "A" or "B" battery types. The Heathkit Battery Tester features compact assembly, accurate meter movement, and a three deck wire-wound control, all mounted in a portable rugged plastic cabinet. Checks portable radio batteries, hearing aid batteries, lantern batteries, etc.

Heathkit

HANDITESTER KIT

MODEL M-1

$14.50

SHIPPING WT. 3 LBS.

The Heathkit Model M-1 Handitester readily fulfills major requirements for a compact, portable volt ohm milliammeter. Despite its compact size, the Handitester is packed with every desirable feature required in an instrument of this type. AC or DC voltage ranges full scale, 0-10—30—300—1,000—5,000 volts. Two ohmmeter ranges, 0-3,000 and 0-300,000. Two DC current measurement ranges, 0-10 milliamperes and 0-100 milliamperes. The instrument uses a Simpson 400 microampere meter movement, which is shunted with resistors to provide a uniform 1 milliampere load on both AC and DC ranges. Special type, easily accessible, battery mounting bracket — 1% deposited carbon type precision resistors — hearing aid type ohms adjust control. The Handitester is easily assembled from complete instructions and pictorial diagrams. Necessary test leads are included in the price of this popular kit.

HEATH COMPANY · Benton Harbor 15, Mich.

New *Heathkit* 12 Volt

BATTERY ELIMINATOR KIT

MODEL BE-4

$31.50

SHIPPING WT. 18 LBS.

CHECK THESE *Features*

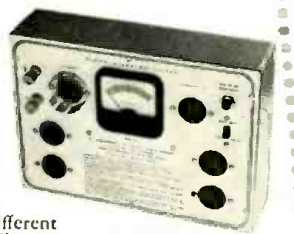
- Either 6 or 12 volt operation
- Continuously variable voltage output
- Constant ammeter and voltmeter monitoring
- Automatic overload relay — self-resetting
- Two 10,000 mf condensers
- New 18 disc split type heavy duty rectifier unit
- Fuse protection

Here is the new Heathkit Battery Eliminator necessary for modern, up-to-date operation of your service shop. The Heathkit Model BE-4 furnishes either 6 volts or 12 volts output which can be selected at the flick of a panel switch. Use the BE-4 to service the new 12 volt car radios in addition to the conventional 6 volt radios.

This new Battery Eliminator provides two continuously variable output ranges, 0-8 volts DC at 10 amperes continuously, or 15 amperes maximum intermittent; 0-16 volts DC at 5 amperes continuously or 7.5 amperes maximum intermittent. The output voltage is clean and well filtered as the circuit uses two 10,000 mf condensers. The continuously variable voltage output feature is a definite aid in determining the starting point of vibrators, the voltage operating range of oscillator circuits, etc. Panel mounted meters constantly monitor voltage and current output and will quickly indicate the presence of a major circuit fault in the equipment under test. The power transformer primary winding is fuse protected and for additional safety an automatic relay of the self-resetting type is incorporated in the DC output circuit. The heavy duty rectifier is a split type 18 plate magnesium copper sulfide unit used either as a full wave rectifier or voltage doubler according to the position of the panel range switch.

Here is the ideal battery eliminator for all of your service problems and as an additional feature, it can also be used as a battery charger. Another new application for the Heathkit Battery Eliminator is a variable source of DC filament supply in audio development and research. More than adequate variable voltage and current range for normal applications.

Heathkit VIBRATOR TESTER KIT



Your repair time is valuable, and service use of the Heathkit Vibrator Tester will save you many hours of work. This tester will instantly tell you the condition of the vibrator being checked. Checks vibrators for proper starting and the easy to read meter indicates quality of output on a large Bad-?-Good scale. The Heathkit VT-1 checks both interrupter and self rectifier types of vibrators. Five different sockets for checking hundreds of vibrator types.

The Heathkit Vibrator Tester operates from any battery eliminator capable of delivering continuously variable voltage from 4 to 6 volts DC at 4 amperes. The new Heathkit Model BE-4 Battery Eliminator would be an ideal source of supply.

MODEL VT-1

$14.50

SHIPPING WT. 6 LBS.

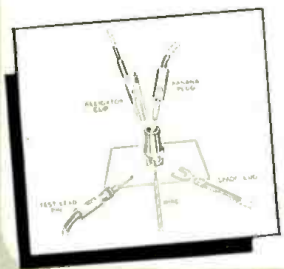
NEW *Heathkit* VARIABLE VOLTAGE ISOLATION TRANSFORMER KIT

The new Heathkit Isolation Transformer Kit provides line isolation for AC-DC radios (not an auto transformer), thereby eliminating shock hazard, hum problems, alignment difficulties, etc. The output voltage is variable from 90 to 130 volts AC and is constantly monitored by a panel mounted AC volt meter. Use it to increase AC supply voltage in order to induce breakdown of faulty components in circuits thereby saving service time. Use it also to simulate varying line voltage conditions and to determine the line voltage level at which oscillator circuits cease functioning, particularly in three-way portable radios. Rated at 100 watts continuous operation and up to 200 watts maximum intermittent operation. A useful radio and TV service tool.

MODEL IT-1

$16.50

SHIP. WT. 9 LBS.



Heathkit BINDING POST

Binding post kit now available so that standardization of all instrument connectors is possible. This new, five-way binding post will accommodate an alligator clip, banana plug, test lead pin, spade lug, or hook-up wire. Sold in units of 20 binding post assemblies. Each assembly includes binding post, flat and shoulder fiber washers, solder lug, and nut. 120 pieces in all. Kit 362, $4.00.

Heathkit TECHNICAL APPLICATION BULLETINS

An exclusive Heathkit service. Technical application bulletins prepared by recognized instrument authorities outlining various combinations of instrument applications. Available now with 40 four-page illustrated bulletins and an attractive flexible loose-leaf binder. Only $2.00. (No c.o.d. on this item, please.)

HEATH COMPANY • Benton Harbor 15, Mich.

CHECK THESE *Features*

- INCREDUCTOR controllable inductor sweep
- TV and IF sweep deviation 12-30 mc
- 4 mc- 220 mc continuous frequency coverage
- Oscillator operation entirely on fundamentals
- Output in excess of 100,000 microvolts
- Automatic amplitude circuit
- Voltage regulation
- Simplified operation

NEW *Heathkit*

TV ALIGNMENT GENERATOR KIT

MODEL TS-3

$44.50

SHIPPING WEIGHT
18 POUNDS

Proudly announcing an entirely new, advanced model TV and FM Sweep Generator, the Heathkit Model TS-3. This new design provides features and combinations of functions not found in any other service type instrument. Every design consideration has been given to the requirements of the TV service man to provide a flexible, variable sweep source with more than adequate RF output and complete frequency coverage throughout the TV and FM spectrum.

The frequency range of the TS-3 is from 4 mc to 220 mc in four switch selected ranges. All frequency ranges are overlapping for complete coverage. A particularly important feature of the instrument is that the oscillator operates entirely on fundamentals, thereby providing complete freedom from spurious oscillation and parasitics normally encountered in beat frequency type oscillators. This circuitry assures a much higher total RF output level and simplifies attenuation problems.

The new TS-3 features an entirely new principle of sweep operation. Sweep action is entirely electronic with no moving parts or electro-mechanical devices so commonly used. The heart of the sweep system is a newly-developed INCREDUCTOR controllable inductor. With this system, the value of inductance of each oscillator coil is electrically varied with an AC control current, and the inductance variation is achieved by a change in the magnetic state of the core on which the oscillator coils are wound. This system provides a sweep deviation of not less than 12 mc on all TV frequencies, and up to a maximum of 30 mc on TV IF frequencies. The high RF output level throughout the instrument frequency range overcomes the most common complaint of the older type sweep generators. A new, automatic amplitude control circuit maintains the output level flat to ± 2 db throughout the instrument range. For convenience of operation a low impedance 50 ohm output is used.

Operation of the instrument has been simplified through the reduction of panel controls and separate panel terminals provide for external synchronization if desired. The circuit uses a voltage regulator tube to maintain stable instrument operation. A built-in variable oscillaror marker further adds to flexibility of instrument operation. Provisions are also made for the use of an external marker, such as your service type signal generator, if desired. Use the Heathkit TS-3 for rapid, accurate TV alignment work, and let it help you solve those time consuming, irksome problems so frequently encountered.

NEW *Heathkit*

SIGNAL GENERATOR KIT

MODEL SG-8

$19.50

SHIPPING WEIGHT
8 POUNDS

Announcing the new Heathkit Model SG-8 service type Signal Generator, incorporating many design features not usually found in an instrument in this price range. The RF output is from 160 kc to 100 mc in five ranges, all on fundamentals, with useful harmonics up to 200 mc. The RF output level is in excess of 100,000 microvolts throughout the frequency range.

The oscillator circuit consists of a 12AT7 twin triode tube. One half is used as a Colpitts oscillator, and the other half as a cathode follower output which acts as a buffer between the oscillator and external load. This circuitry eliminates oscillator frequency shift usually caused by external circuit loading.

All coils are factory wound and adjusted, thereby completely eliminating the need for calibration and the use of additional calibrating equipment. The stable low impedance output features a step and variable attenuator for complete control of RF level. A 6C4 triode acts as a 400 cycle sine wave oscillator and a panel switching system permits a choice of either external or internal modulation.

The transformer operated circuit is easy to assemble, requires no calibration, and meets every service requirement for an adjustable level variable frequency signal source, either modulated or un-modulated.

NEW *Heathkit*

BAR GENERATOR KIT

MODEL BG-1

$14.50

SHIPPING WEIGHT
6 POUNDS

The Heathkit BG-1 Bar Generator represents another welcome addition to the fast growing line of popular Heathkits. The station transmitted test pattern is rapidly disappearing, and the bar generator is the logical answer to the TV service man's problem in obtaining quick, accurate adjustment information without waiting for test patterns.

The Heathkit BG-1 produces a series of horizontal or vertical bars on a TV screen. Since these bars are equally spaced, they will quickly indicate picture linearity of the receiver under test. Panel switch provides "stand-by position" — "horizontal position" — "vertical position." The oscillator unit utilizes a 12AT7 twin triode for the RF oscillator and video carrier frequencies. A neon relaxation oscillator provides low frequency for vertical linearity tests. The instrument will not only produce bar patterns but will also provide an indication of horizontal and vertical sync circuit stability, as well as overall picture size.

Instrument operation is extremely simple, and merely requires connection to the TV receiver antenna terminal. The unit is transformer operated for safety when used in conjunction with universal or transformerless type TV circuits.

HEATH COMPANY • Benton Harbor 15, Mich.

NEW *Heathkit* TUBE CHECKER KIT

MODEL TC-2

$29.50

SHIP. WT. 12 LBS.

CHECK THESE NEW *Features*

- Simplified harness wiring
- Improved, smooth, anti-backlash roll chart action
- Optional roll chart illumination
- Individual element switches
- Portable or counter style cabinet
- Spare blank socket
- Contact type pilot light test socket
- Simplified test set-up procedure
- Line adjust control
- 4½" three-color meter

The new Model TC-2 Heathkit Tube Checker features many circuit improvements, simplified wiring, new roll chart drive and illumination of roll chart. The instrument is primarily designed for the convenience of the radio and TV service man and will check the operating quality of tubes commonly encountered in this type of work. Test set-up procedure is simplified, rapid, and flexible. Panel sockets accommodate 4, 5, 6, and 7 pin tubes, octal and loctal, 7 and 9 pin miniatures, 5 pin Hytron and a blank socket for new tubes. Built-in neon short indicator, individual three-position lever switch for each tube element, spring return test switch, 14 filament voltage ranges, and line set control to compensate for supply voltage variations, all represent important design features of the TC-2. Results of tube tests are read directly from a large 4½" Simpson three-color meter, calibrated in terms of Bad-?-Good. Information that your customer can readily understand. Checks emission, shorted elements, open elements, and continuity.

The use of closer tolerance resistors in critical circuits assures correct test information and eliminates the possibility of inaccurate test interpretation. Improvement has been made in the mechanical roll chart drive system, completely eliminating diagonal running, erratic operation, and backlash. The thumb wheel gear driven action is smooth, positive, and free running. As an additional feature, the roll chart is illuminated for easier reading, particularly when the tube checker is used on radio or TV home service calls.

Wiring procedure has been simplified through the extended use of multicable, color coded wires, providing a harness type installation between tube sockets and lever switches. This procedure insures standard assembly and imparts that "factory built" appearance to instrument construction. Completely detailed information is furnished in the new step-by-step construction manual, regarding the set-up procedure for testing of new or unlisted tube types. No delay necessary for release of factory data.

The new Heathkit Tube Checker will prove its value in building service prestige through usefulness — simplified operation — attractive professional appearance. Don't overlook the fact that the kit price represents a savings of $40.00 to $50.00 over the price of a comparable commercially built instrument. At this low price, no service man need be without the advantages offered by the Heathkit Tube Checker.

New HEATHKIT PORTABLE TUBE CHECKER KIT

MODEL TC-2P

$34.50

SHIP. WT. 14 LBS.

The portable model is supplied with a strikingly attractive two-tone cabinet finished in rich maroon, proxylin impregnated, fabric covering with a contrasting gray on the inside cover. Detachable cover, brass-plated hardware, sturdy plastic handle help to impart a truly professional appearance to the instrument.

PORTABLE TUBE CHECKER CABINET as described above will fit all earlier Heathkit TC-1 Tube Checkers. Shipping weight 7 lbs. Cabinet only, 91-8, $7.50.

No. 355
Ship. Wt. 1 Lb.

$4.50

Heathkit TV PICTURE TUBE TEST ADAPTER

The Heathkit TV Picture Tube Test Adapter used with the Heathkit Tube Checker will quickly check for emission, shorts, etc., and determine picture tube quality. Consists of standard 12 pin TV tube socket, four feet of cable, octal socket connector, and data sheet.

Heathkit POWER SUPPLY KIT

MODEL PS-2

$33.50

SHIPPING WT. 17 LBS.

The Heathkit Laboratory Power Supply features continuously variable, regulated voltage output with good stability under wide load variations. A 4½" Simpson plastic enclosed panel mounted meter provides accurate meter output information of voltage or current. All panel terminals completely isolated from the cabinet. Separate 6.3 volt AC supply at 4 amperes for filament requirements. Ripple component exceptionally low, stand-by switch provided to eliminate warm-up time of the five tube circuit.

LABORATORY AND SERVICE SHOP BOOKLETS

"Planning Your Service Business" by John T. Frye, and "Establishing the Industrial Electronics Laboratory" by Louis B. Garner, Jr., are booklets available to Heathkit customers at no charge. These booklets, written by nationally recognized authorities, outline the various requirements and considerations for establishing your own service business or for setting up an industrial electronics laboratory. Full attention is given to various details that are frequently overlooked when projects of this nature are undertaken. Just write in to the Heath Company requesting your free copy, or attach a memo to your next order.

HEATH COMPANY • Benton Harbor 15, Mich.

CHECK THESE *Features*

- Visual and aural signal tracing
- Two channel input
- High RF sensitivity
- Unique noise locoter circuit
- Calibrated wattmeter
- Substitution test speaker
- Utility amplifier
- RF, audio probes and test leads included

Heathkit VISUAL-AURAL SIGNAL TRACER KIT

MODEL T-3

$23.50

SHIPPING WEIGHT 10 POUNDS

An entirely new type of signal tracer incorporating a combination of features not found in any other instrument. Designed expressly for the radio and TV service man, particularly for the servicing of AM, FM, and TV circuits. Here in a five tube, transformer operated instrument are all of the useful functions so necessary for speedy, accurate isolation of service difficulty.

This new signal tracer features a special high gain RF input channel, used in conjunction with a newly-designed wide frequency range demodulator probe. High RF sensitivity permits signal tracing at the receiver antenna input. A separate low gain channel and probe available for audio circuit exploration. Both input channels are constantly monitored by an electron ray beam indicator, so that visual as well as aural signal indications may be observed. The instrument can also be used for comparative estimation of gain per stage.

A decidedly unusual feature is a noise localizer circuit in conjunction with the audio probe. With this system, a DC potential is applied to a suspected circuit component and the action of the voltage in the component can be seen as well as heard. Invaluable for ferreting out noisy or intermittent condensers, noisy resistors, controls, coils, IF and power transformers, etc. A built-in calibrated wattmeter circuit is very useful for a quick preliminary check of the total wattage consumption of the equipment under test. Separate panel terminals provide external use of the speaker or output transformer for substitution purposes. Saves valuable service time by eliminating the necessity for speaker removal on every service job. The terminals also permit the utilization of other shop equipment, such as your oscilloscope or VTVM. The T-3 Signal Tracer can be used as a high gain amplifier for checking tuners, record changers, microphones, phono crystals, etc.

Don't overlook the interesting service possibilities provided through the use of this new instrument and let it work for you by saving time and money. The kit is supplied complete with all tubes, circuit components, demodulator probe, audio probe, and additional test leads.

Heathkit DECADE RESISTANCE KIT

MODEL DR-1

$19.50

SHIP. WT. 4 LBS.

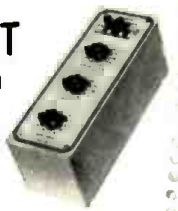
The Decade Resistance Kit provides individual switch selection of resistance values using twenty 1% resistors providing a choice of 1 to 99,999 ohms in 1 ohm steps. Ceramic wafer switches, silver-plated contacts, smooth, positive detent action, baked enamel panel, and handsome, polished birch cabinet.

Heathkit DECADE CONDENSER KIT

MODEL DC-1

$16.50

SHIP WT 4 LBS.



The Heathkit Decade Condenser Kit features silver mica, precision condensers with a rated accuracy of ± 1%. Capacity values are arranged in three decades from 100 mmf to .111 mf in steps of 100 mmf. Ceramic wafer switches with silver-plated contacts and smooth detent action. Useful in laboratory work, for circuit development.

Heathkit RESISTANCE SUBSTITUTION BOX KIT

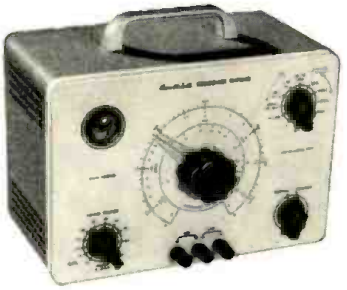
MODEL RS-1

$5.50

SHIP. WT. 2 LBS.

The Heathkit Resistance Substitution Box provides individual switch selection of any one of 36 RTMA 1 watt 10% standard value resistors, ranging from 15 ohms to 10 meghoms. Many applications in circuit development work, and also in radio and TV service work. Ideal for experimentally determining resistance values and for quickly altering circuit operating characteristics. Entire unit housed in attractive Bakelite cabinet, featuring the new universal type Heathkit binding posts to simplify circuit connections.

Heathkit CONDENSER CHECKER KIT



MODEL C-3

$19.50

SHIPPING WT. 8 POUNDS

Use the Heathkit C-3 Condenser Checker to quickly and accurately measure those unknown condenser and resistor values. All readings are taken directly from the calibrated panel scales without requiring any involved calculation. Capacity measurements in four ranges from .00001 mf to 1,000 mf. Checks paper, mica, ceramic, and electrolytic condensers. A power factor control is available for accurate indication of electrolytic condenser measurements. A leakage test switch with switch selection of five polarizing voltages, 25 volts to 450 volts DC, will indicate condenser operating quality under actual load condition. The spring return leakage test switch automatically discharges the condenser under test and eliminates shock hazard to the operator.

Resistance measurements can be made in the range from 100 ohms to 5 megohms. Here again all values are read directly on the calibrated scale. Increased circuit sensitivity coupled with an electron beam null indicator increases overall instrument usefulness.

For safety of operation the circuit is entirely transformer operated and the instrument is housed in the attractive, newly-styled Heathkit cabinet, featuring rounded corners, and drawn aluminum panel. The outstanding low kit price for this surprisingly accurate instrument includes necessary test leads. Good service shop operation requires the use of this specialized instrument, designed for the express purpose of determining unknown condenser values and operating characteristics.

HEATH COMPANY • Benton Harbor 15, Mich.

Heathkit AMATEUR TRANSMITTER KIT

MODEL AT-1

$29.50

SHIPPING WEIGHT 16 POUNDS

CHECK THESE NEW *Features*

- Single knob band switching
- Pre-wound coils
- Metered operation
- 52 ohm coaxial output
- Crystal or VFO excitation
- Built-in power supply
- Rugged, clean construction

Here is the latest Heathkit addition to the ham radio field, the AT-1 Transmitter Kit, incorporating many desirable design features at the lowest possible dollar-per-watts price. Panel mounted crystal socket, stand-by switch, key click filter, AC line filtering, good shielding, etc. VFO or crystal excitation — up to 35 watts input. Built-in power supply provides 425 volts at 100 ma.

This kit features pre-wound coils, single knob band switching, 52 ohm coaxial output, plug in chassis provisions for VFO or modulator and rugged clean construction. Frequency range 80, 40, 20, 15, 11, and 10 meters. Tube line-up 6AG7 oscillator-multiplier, 6L6 amplifier-doubler, 5U4G rectifier. Physical dimensions 8⅛" high x 13⅛" wide x 7" deep.

This amazingly low kit price includes all circuit components, tubes, cabinet, punched chassis, and detailed construction manual. The ideal kit for the novice just breaking into ham radio. It can be used later on as a stand-by rig or an all band exciter for higher powered transmitter.

NEW Heathkit ANTENNA COUPLER KIT

New Heathkit Antenna Coupler, specially designed for the Heathkit AT-1 Transmitter. The Antenna Coupler can be used with any 52 ohm coaxial input — up to 75 watts power. Low pass filter with cut-off frequency of approximately 36 mc — L section tuning network — neon tuning indicator — rugged, compact construction — transmitter type variable condenser, and high Q coil are all outstanding features. The AC-1 has both inductance and capacity tuning for maximum operating versatility. Dimensions 8⅛" wide x 4⅜" high x 4⅞" deep.

MODEL AC-1

$14.50 SHIP. WT. 3 LBS.

Heathkit ANTENNA IMPEDANCE METER

Use the Heathkit Antenna Impedance Meter for measuring antenna impedance for line matching purposes — adjustment of beam antennas — phone monitor, etc. It will determine antenna resistance at resonance, match transmission line for minimum SWR, determine receiver input impedance, and provide a rough indication of SWR. Precision resistors, germanium diode, 100 microampere Simpson meter. Dial calibrated from 0-500 ohms. Shielded aluminum cabinet, 7" long x 2½" wide x 3¼" deep.

$14.50 SHIP. WT. 3 LBS.

MODEL AM-1

Heathkit COMMUNICATIONS RECEIVER KIT

MODEL AR-2

$25.50 SHIP. WT. 12 LBS.

Here is the new receiver kit you have repeatedly asked for, the Heathkit Communications Receiver. The perfect companion piece for the AT-1 Transmitter kit. Many outstandingly desirable features have been incorporated in the design of the AR-2; such as, electrical bandspread for logging and tuning convenience — high gain miniature tubes — IF transformers for high sensitivity and good signal to noise ratio — separate RF gain control with optional automatic volume control or manual volume control, in addition to the conventional audio gain control. Noise limiter — stand-by switch — stable BFO oscillator circuit — headphone jack — transformer operation, etc., all contribute to a high performance standard.

Frequency coverage is continuous from 535 kc to 35 mc in four ranges. For added convenience, various ham bands have been separately identified in respect to their relative placement on the slide rule tuning scale. A chassis mounted, 5½" PM speaker is included with this kit. Tube line up 12BE6 mixer oscillator, 12BA6 IF amplifier, 12AV6 detector AVC audio, 12BA6 BFO oscillator, 12A6 beam power output, 5Y3GT rectifier.

RECEIVER CABINET

Proxylin impregnated, fabric covered, plywood cabinet with aluminum panel designed expressly for the AR-2 Receiver. Part 91-10, shipping weight 5 lbs., $4.50.

IMPROVED Heathkit GRID DIP METER KIT

$19.50 SHIP. WT. 4 LBS.

MODEL GD-1B

The invaluable instrument for service men, hams, and experimenters. Useful in TV service work for alignment of traps, filters, IF stages, peaking compensation networks, etc. Locates spurious oscillation, provides a relative indication of power in transmitter stages, use it for neutralization, locating parasitics, correcting TVI, measuring C, L, and Q of components, and determining RF circuit resonant frequencies. With oscillator energized, useful for finding resonant frequency of tuned circuits. With the oscillator not energized, the instrument acts as an absorption wave meter. Variable meter sensitivity control, head phone jack, 500 microampere Simpson meter. Continuous frequency coverage from 2 mc. to 250 mc. Pre-wound coil kit and rack, new three prong coil mounting, 6AF4 high frequency triode.

Two additional plug-in coils are available and provide continuous extension of low frequency coverage down to 355 kc. Dial correlation curves included. Shipping weight 1 lb., kit 341, $3.00.

HEATH COMPANY • Benton Harbor 15, Mich.

CHECK THESE *Features*

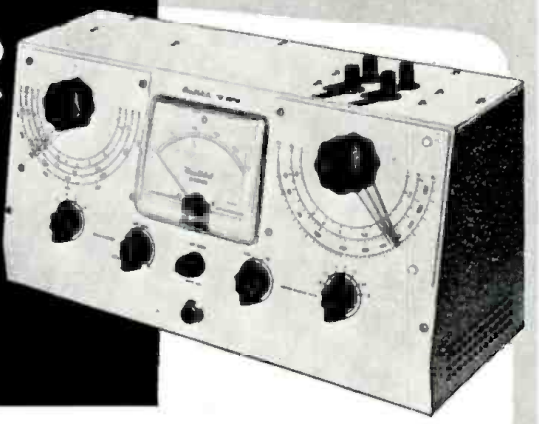
- First popular priced Q Meter
- Reads Q directly on calibrated scale
- Oscillator supplies RF frequencies of 150 kc to 18 mc
- Calibrate capacitor with range of 40 mmf to 450 mmf with vernier of ± 3 mmf
- Measures Q of condensers, RF resistance, and distributed capacity of coils
- Many applications in design and development work
- Useful in TV service work for checking deflection yokes, coils, chokes, etc.

Heathkit "Q" METER KIT

MODEL QM-1

$44.50

SHIPPING WT. 14 POUNDS



Another outstanding example of successful Heathkit engineering effort in producing a Q Meter Kit within the price range of TV service men, schools, laboratories, and experimenters. This Q Meter meets RF design requirements for rapid, accurate measurement of capacity, inductance, and Q at the operating frequency and all indications of value can be read directly on the meter calibrated scales. Oscillator section supplies RF frequencies of 150 kc to 18 mc. Calibrate capacitor with range of 40 mmf to 450 mmf, with vernier of ± 3 mmf.

Particularly useful in TV service work for checking peaking coils, wave traps, chokes, deflection coils, width and linearity coils, etc. At this low kit price research laboratory facilities are within the range of service shops, schools, and experimenters.

Heathkit INTERMODULATION ANALYZER KIT

MODEL IM-1

$39.50

SHIPPING WT. 17 POUNDS

The Heathkit IM-1 is an extremely versatile instrument specifically designed for measuring the degree of inter-action between two signals in any portion of an audio chain. It is primarily intended for making tests of audio amplifiers, but may be used in other applications, such as checking microphones, records, recording equipment, phonograph pick-ups, and loud-speakers. High and low test frequency source, intermodulation unit, power supply, and AC vacuum tube volt meter all in one complete instrument. Per cent intermodulation is directly read on the calibrated scales, 30%, 10%, and 3% full scale. Both 4:1 and 1:1 ratios of low to high frequency easily set up. With this instrument the performance level of present equipment, or newly developed equipment can be easily and accurately checked. At this low price, you can now enjoy the benefits of intermodulation analysis for accurate audio interpretation.

Heathkit AUDIO GENERATOR KIT

A Heathkit Audio Generator with frequency coverage from 20 cycles to 1 mc. Response flat ± 1 db from 20 cycles to 400 kc, down 3 db at 600 kc, and down only 8 db at 1 mc. Calibrated, continuously variable, and step attenuator output controls provide convenient reference output level. Distortion is less than .4% from 100 cps through the audible range. The ideal controllable extended frequency sine wave source for audio circuit investigation and development.

MODEL AG-8

$29.50

SHIP. WT. 11 LBS.

Heathkit AUDIO OSCILLATOR KIT

Sine or square wave coverage from 20 to 20,000 cycles in three ranges at a controllable output level up to 10 volts. Low distortion, 1% precision resistors in multiplier circuits, high level output across entire frequency range, etc., readily qualify this instrument for audio experimentation and development work. Special circuit design consideration features thermistor operation for good control of linearity.

MODEL AO-1

$24.50

SHIP. WT. 11 LBS.

Heathkit AUDIO FREQUENCY METER KIT

MODEL AF-1

$34.50

SHIP. WT. 12 LBS.

The Heathkit Audio Frequency Meter provides a simple and convenient means of checking unknown audio frequencies from 10 cycles to 100 kc at any voltage level between 3 and 300 volts rms with any non-critical wave shape. Instrument operation is entirely electronic. Just set the range switch, feed an unknown frequency into the instrument, and read the frequency directly on the calibrated scale of the Simpson 4½" meter.

Heathkit SQUARE WAVE GENERATOR KIT

MODEL SQ-1

$29.50

SHIP. WT. 12 LBS.

The Heathkit Square Wave Generator provides an excellent square wave frequency source with completely variable coverage from 10 cycles to 100 kc. This generator features low output impedance of 600 ohms and the output voltage is continuously variable between 0 and 20 volts, thereby providing the necessary degree of operating flexibility. An invaluable instrument for those specialized circuit investigations requiring a good, stable, variable square wave source.

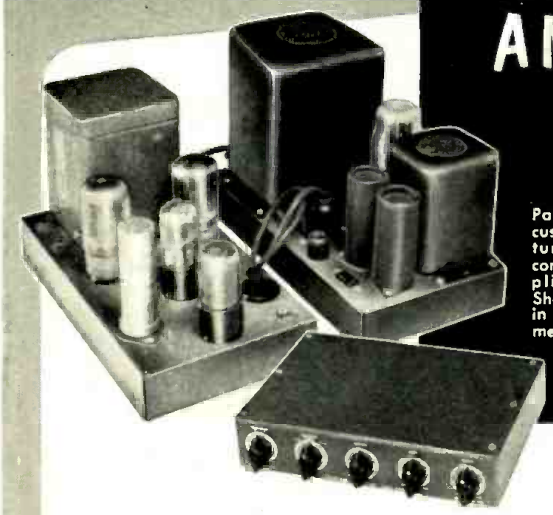
HEATH COMPANY • Benton Harbor 15, Mich.

Heathkit

WILLIAMSON TYPE

AMPLIFIER KIT

MODEL W-2



Particularly designed for custom installations, featuring separate cable connected units for simplicity of installation. Sheet metal work finished in attractive gray hammertone for smart appearance. All contral shafts of the adjustable length break-off type.

$69.50

When selecting an amplifier for the heart of your high fidelity audio system, investigate the outstanding advantages offered by the Heathkit Williamson Type Amplifier. Meets every high fidelity audio requirement and makes listening to recorded music a thrilling new experience.

This outstanding amplifier is offered with optional output transformer operation, providing either the conventional triode output circuit or the new extended power circuity in which the screen supply voltage is obtained from separate transformer primary taps. Frequency response within ± 1 db from 10 cycles to 100 kc. Tube complement — 6SN7 cascade amplifier and phase splitter, 6SN7 push pull driver, two 5881 push pull power amplifiers, one 5V4G cathode type rectifier.

Matching preamplifier available providing three switch selected inputs, correct compensation, and individual bass and treble tone controls. Uses 12AY7 (or 12AX7) preamplifier — 12AU7 tone control amplifier.

Particularly designed for the novice kit builder and requires no specialized knowledge or equipment for successful assembly and operation.

PRICES OF COMBINATIONS

W-2 Amplifier Kit including main amplifier, power supply, and WA-P1 Preamplifier Kit. Shipping Weight 37 lbs. Shipped Express only. **$69.50**

W-2M Amplifier Kit includes main amplifier and power supply. Shipping Weight 29 lbs. Shipped Express only. **$49.75**

WA-P1 Preamplifier Kit only. Shipping Weight 6 lbs. Shipped Express or Parcel Post. **$19.75**

NEW *Heathkit* 20 WATT

High Fidelity AMPLIFIER KIT

MODEL A-9A

$35.50

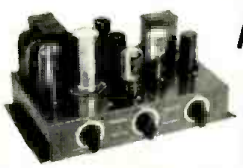
SHIP. WT. 18 LBS.

A new 20 watt high fidelity amplifier, designed especially for custom audio installations demanding clean reproduction, adequate power, and flexibility to meet individual requirements. Separate treble and bass tone controls provide up to 15 db boost or cut. Four switch selected inputs, each with the necessary compensation for the service desired. Output transformer impedances of 4, 8, and 16 ohms.

Preamplifier, tone control, and phase splitter circuits utilize 9 pin twin triode miniature tubes for low hum and noise level. Two 6L6 push pull power output tubes provide full 20 watts power. Frequency response ± 1 db, 20-20,000 cycles. Total harmonic distortion 1% (at 3 db below rated output). Tube line-up: 12AX7 preamplifier, 12AU7 voltage amplifier and tone control, 12AU7 voltage amplifier and phase splitter, two 6L6 push pull pentode power output, 5U4G rectifier. Truly outstanding amplifier performance coupled with low cost.

Heathkit ECONOMY 6 WATT

AMPLIFIER KIT



MODEL A-7B

$15.50

SHIP. WT. 10 LBS.

The new Heathkit Model A-7B Amplifier offers many unusually fine features not normally expected in this low price range. Either of the two input circuits may be individually switch selected for phono or tuner operation. Separate bass and treble tone controls. Output impedances of 4, 8, and 15 ohms. Push pull beam power output stage for balanced reproduction. Excellent voltage gain characteristics, good frequency response, and full 6 watts power output. 12J5 amplifier, 12SL7 second amplifier and phase splitter, two 12A6 beam power output, one 5Y5 GT rectifier.

A-7C incorporates preamplifier stage with special compensated network to provide necessary gain for operation with variable reluctance or low output level phono cartridge. Circuit is properly compensated for microphone operation. $17.50.

NEW *Heathkit*

BROADCAST BAND

RECEIVER KIT

MODEL BR-2

$17.50 SHIP. WT. 11 LBS.

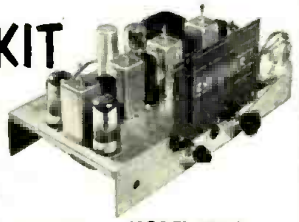
Another new Heathkit for the student, beginner, or hobbyist. If you have ever had the urge to build your own radio receiver, this kit warrants your attention.

New high gain miniature tubes and IF transformers provide excellent sensitivity and good signal to noise ratio. A built-in ferrite core rod type antenna has been provided. A chassis mounted 5½" PM speaker provides excellent tone and volume. Convenient phono input. Can be operated either as a receiver or tuner. Simplified construction manual outlines circuit theory. Ideal for students. Tube line-up: 12BE6 mixer oscillator, 12BA6 IF amplifier, 12AV6 detector-AVC-first audio, 12A6 beam power output, 5Y3GT rectifier.

CABINET — Proxylin impregnated fabric covered plywood cabinet. Shipping weight 5 lbs. Part number 91-9, $4.50.

Heathkit

FM TUNER KIT



MODEL FM-2

$22.50

SHIP. WT. 9 LBS.

The Heathkit FM-2 Tuner was specifically designed for simplified kit construction. Can be operated through the "phono" portion of your radio or with a separate amplifier. The kir features a pre-assembled and adjusted tuning unit, three double tuned IF transformers, and a discriminator transformer in an 8 tube AC operated circuit. Frequency coverage 88 to 108 mc. Experience the thrill of building your own FM tuner and at the same time enjoy all of the advantages of true FM reception.

Free CATALOG

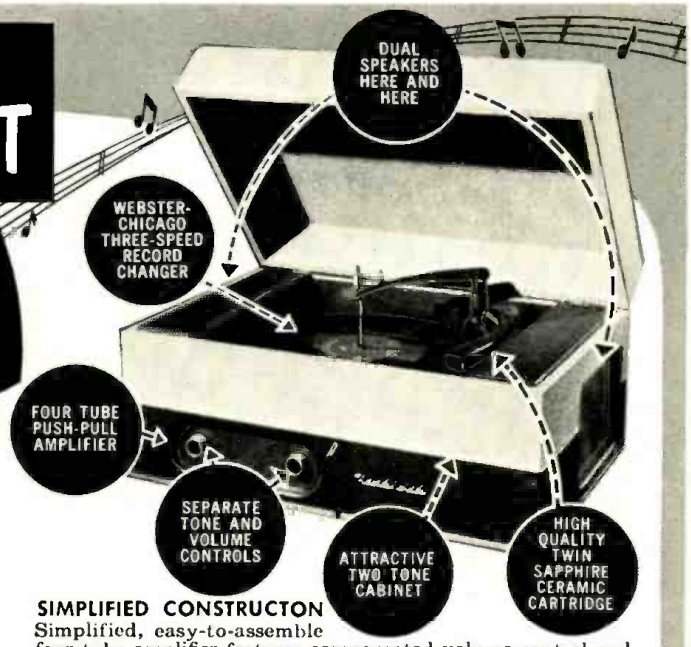
Write for free catalog containing latest price information, schematics, specifications, and descriptions of all Heathkits.

HEATH COMPANY • Benton Harbor 15, Mich.

NEW HEATHKIT *Dual* RECORD PLAYER KIT

DUAL 6" SPEAKERS for diffused room-filling sound

New MODEL RP-2 $69.50 SHIPPING WT. 33 LBS.



DUAL MATCHED SPEAKERS
A new economical introduction to high quality record reproduction. A simple-to-operate, compact, table-top model with two matched speakers in an acoustically correct enclosure reproduce all of the music on the record.

DIFFUSED SOUND
Because of the diffused non-directional properties of the dual speakers, listening to fine recorded music is a thrilling new experience through naturally clear, life-like reproduction of sound at all tonal levels.

HIGH QUALITY PERFORMANCE
The performance level of the Dual is vastly superior to that of the ordinary phonograph or console. Automatic changer plays all three sizes at all three speeds with automatic shutoff after last record is played.

TWIN SAPPHIRE STYLUS
A wide tonal range ceramic cartridge features an ingenious "turn-under" twin sapphire stylus for LP or 78 records providing quick selection of the correct stylus without turning the cartridge.

SIMPLIFIED CONSTRUCTON
Simplified, easy-to-assemble four tube amplifier features compensated volume control and separate tone control. Proxylin impregnated beige and saddle tan fabric covered cabinet supplied completely assembled. You build only the amplifier.

EASY TO BUILD
No specialized tools or knowledge required as the construction manual has been simplified to the point where even the complete novice can successfully construct the Heathkit Dual. The price includes cabinet, record changer, two 6" PM speakers, tubes and all circuit components required for assembly.

Send for free audio booklet "High Fidelity Especially for You."

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Let's Look at Changers

(*Continued from page 57*)

being activated, then determine what mechanical part is binding or not operating, causing failure to trip. On the *Philco,* first see if the weighted cam is dropping to engage the main gear when the trip finger releases it.

Close observation and patience are needed when service is required in the trip and reject system. Each changer is different and has to be approached from a different view. When it is known what the particular record changer is supposed to do, it is not hard to find out what it is not doing.

The Record Drop

Modern record changers use a record drop. The records rest on a record support and centerpost or just on the centerpost itself. The bottom record slides down the centerpost when it is needed. Older changers either used two record supports, slid the records off a stack on the turntable, turned them over, or used other various combinations; but the modern method is much easier on the records, quicker, and simpler.

In modern changers, the records are either pushed off or pulled off. For example, the *Zenith* record changer has a little finger, called an ejector cam, that slides up into the center hole of the record and rotates outward pulling the record off the rest on the centerpost (see Fig. 7C). To service a record dropping failure on this changer, check the ejector cam to see if it enters the center hole properly and rotates far enough to pull the record off. From there, check the ejector lever and link assembly under the turntable that causes the ejector cam to move.

On a *Webcor* changer, a different approach is necessary, for in this changer the records are pushed off the spindle. The record support shelf moves forward and pushes the bottom record off the centerpost rest (see Fig. 7A). If the records are not pushed off properly, the trouble is in the record support shelf. It may be turned so that the record does not rest on it evenly, or perhaps the rocker arm assembly needs adjustment or service to move the record shelf forward or backward to make the record fit.

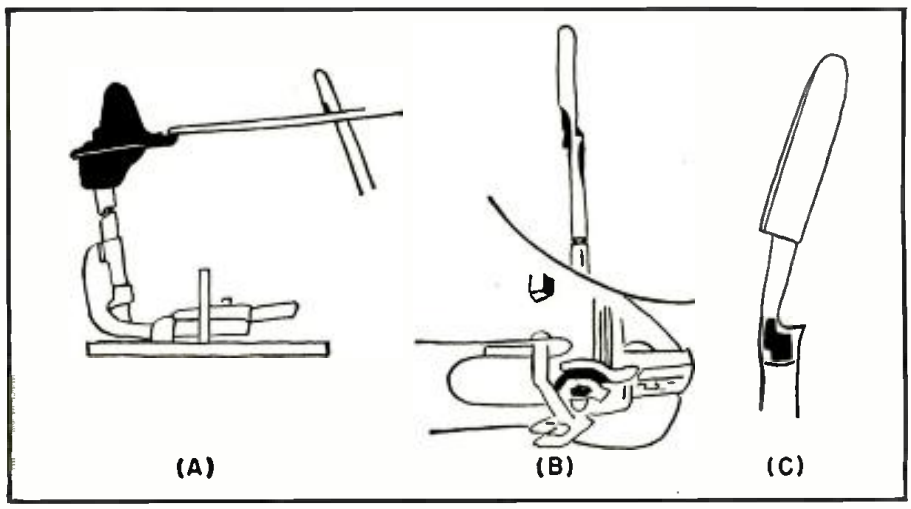
On the *V-M* record changer, still another method is used. Here the records rest entirely upon the centerpost. The record support is used merely to balance the records in position. An ejector cam reaches out of the centerpost and pushes the bottom record off the shelf on which the records rest. See Fig. 7B. Check for a bent centerpost or perhaps a worn ejector cam if record dropping troubles develop in this changer.

The *RCA* 45 rpm record changer uses an entirely different type of record drop than any of the other changers described before. A set of separator knives and record shelves is mounted in the large diameter centerpost of the changer. The knives are located one record thickness above the shelves. At the start of the record drop operation, the shelves are moved out of the centerpost, underneath the record stack, and the knives are moved in to allow one record to drop on the shelves. Then, the knives are moved out, to hold up the rest of the records, and the shelves move in to drop the single record on the turntable. All of this is accomplished by the centerpost rotation about a separator shaft with flat surfaces.

This article has described briefly the most important parts of a record changer. The motor turns the turntable, the record plays, it trips, and the change cycle brings the tone arm out of the way while a new record drops and the tone arm comes to rest on the new record. Sounds simple, doesn't it? Well, record changer servicing is fairly simple if attention is focused on the section needing service, and not on the maze of gears, levers, springs, etc.

Future articles will cover detailed field and bench service on all late model record changers. —30—

Fig. 7. Three popular record drop mechanisms. In (A), the record support shelf does the pushing. in (B) and (C), the centerpost does the dropping.



Now a COLOR TELEVISION HOME STUDY COURSE by RCA Institutes

"Color Television is here—not around the corner, or in the developmental labs, but here! The big question now is . . . Are YOU ready for Color TV?

"You may now have a successful TV servicing business. When color sets come to your bench for servicing, will you be able to handle them?

"Color Television is a vast new field, embodying entirely new concepts . . . principles of light and vision, radically new circuitry."

First Home Study Course in Color TV

Now is the time to prepare. Now, for the first time, you can train yourself for the opportunities in this brand-new field. The just-announced RCA Institutes Home Study Course is the *first* home study course covering all phases of color television. Offered only to those already experienced in radio-television servicing, it explains the "why" of basic theory, as well as the "how-to-do-it" of servicing techniques.

Planned and written by RCA instructors, the entire course is based on the practical experience of RCA engineers—the men who have pioneered in the research and development of color television since the very first color experiments, many years ago.

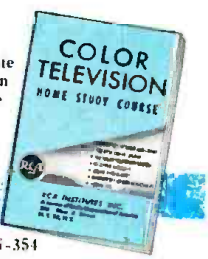
Remember when black-and-white television first became a reality? Overnight, the demand for men who knew television grew. Even now, a shortage of qualified servicemen exists. Think, then—of the even greater demand for servicemen who will understand the many additional problems of color reception!

Costs so little to gain so much

RCA Institutes makes it easy for you to prepare yourself now for color television. Not only is the cost of the home study course for qualified servicemen extremely low, but you pay for the course on a pay-as-you-learn basis.

RCA Institutes conducts a resident school in New York City offering day and evening courses in Radio and TV Servicing, Radio Code and Radio Operating, Radio Broadcasting, Advanced Technology. *Write for free catalog on resident courses.*

Send for FREE Booklet—Mail the coupon, today. Get complete information on the RCA INSTITUTES Home Study Course in Color Television. Booklet gives you a general outline of the course lesson by lesson. See how thoroughly you can learn Color TV. Mail coupon in envelope or paste on postal card.



MAIL COUPON NOW!

RCA INSTITUTES, INC., Home Study Dept. RN-354
350 West Fourth Street, New York 14, N. Y.

Without obligation on my part, please send me copy of booklet "RCA INSTITUTES Home Study Course in COLOR TELEVISION." (No salesman will call.)

Name_____
(please print)

Address_____

City_____ Zone____ State_____

RCA INSTITUTES, INC.
A SERVICE OF RADIO CORPORATION of AMERICA
350 WEST FOURTH STREET, NEW YORK 14, N.Y.

Manufacturers' Literature

The bulletins reviewed in this section are for your convenience; unless otherwise indicated they are available to all our readers. For prompt attention write directly to the manufacturer for literature described.

TUBES AND ACCESSORIES

Amperex Electronic Corporation, 230 Duffy Ave., Hicksville, N. Y., has released a "library reference edition" of its complete catalogue.

Prepared for the benefit of engineers, the new publication provides a permanent and easy reference-record of every electronic tube and tube accessory manufactured by the company for communication, industrial, rectification, amateur, electro-medical, and special purpose applications.

This 578-page manual is bound in a loose leaf ring binder with a permanent plasticized cover. The manual, priced to sell at $2.00, will be made available to qualified engineers. For a copy, write on your business letterhead to Myron Smoler of the Sales Engineering Division of the company.

RECTIFIERS FOR COLOR TV

The Rectifier Division of *Sarkes Tarzian, Inc.*, 415 N. College Ave., Bloomington, Ind., has issued a four-page brochure entitled "Selenium Rectifiers for Color Television."

The booklet includes data on seven of the company's rectifiers suitable for color TV applications along with circuit diagrams illustrating these applications. In addition, information on the company's new plug-in rectifiers is provided with dimensional details and related socket data.

PIPE LOCATORS

Fisher Research Laboratory, Inc., 1961 University Ave., Palo Alto, California, is now offering a 4-page brochure on its "M-Scope" line of locators.

The bulletin explains the operation of these units and illustrates the various models available from the company. Included in the line are pipe and cable finders, leak detectors, box locators, and water level indicators. Literature is available on each of these units individually.

"WALL CATALOGUE"

A novel wall catalogue listing "bread-and-butter" condensers and containing a handy pocket for distributor order cards and "want lists" has been announced by *Sprague Products Company*, 51 Marshall St., North Adams, Mass.

Designed to give the technician a handy reference for the most frequently needed condensers, it also provides him with a means of noting his needs

Buy on our radically new

NO INTEREST!! **Time Payment Plan** NO CARRYING CHARGES!!

Measures 6¼" x 9½" x 4½"

Superior's new Model 670-A SUPER METER

A COMBINATION VOLT-OHM MILLIAMMETER PLUS CAPACITY REACTANCE INDUCTANCE AND DECIBEL MEASUREMENTS

SPECIFICATIONS:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Quality test for electrolytics)
REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms
INDUCTANCE: .15 to 7 Henries 7 to 7,000 Henries
DECIBELS: —6 to +18 +14 to +38 +34 to +58

ADDED FEATURE:

The Model 670-A includes a special GOOD-BAD scale for checking the quality of electrolytic condensers at a test potential of 150 Volts.

The Model 670-A comes housed in a rugged, crackle-finished steel cabinet complete with test leads and operating instructions.

$28.40 NET

Superior's new Model TV-11 TUBE TESTER

SPECIFICATIONS:

★ Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Peanut, Bantam, Hearing Aid, Thyratron, Miniatures, Sub-Miniatures, Novals, Sub-minars, Proximity fuse types, etc.
★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary.
★ The Model TV-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.
★ Free-moving built-in roll chart provides complete data for all tubes.
★ Newly designed Line Voltage Control compensates for variation of any Line Voltage between 105 Volts and 130 Volts.
★ NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

The model TV-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover. .....

$47.50 NET

EXTRA SERVICE—The Model TV-11 may be used as an extremely sensitive Condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute.

SUPERIOR'S NEW MODEL TV-40

C.R.T. TUBE TESTER

★ A complete picture tube tester for little more than the price of a "make-shift" adapter!!

★ Tests *all* magnetically deflected tubes . . . in the set . . . out of the set . . . in the carton!!

The Model TV-40 is absolutely complete! Self-contained, including built-in power supply, it tests picture tubes in the only practical way to efficiently test such tubes: that is by the use of a separate instrument which is designed exclusively to test the ever increasing number of picture tubes!

EASY TO USE:

Simply insert line cord into any 110 volt A.C. outlet, then attach tester socket to tube base *(Ion trap need not be on tube)*. Throw switch up for quality test . . . read direct on Good-Bad scale. Throw switch down for all leakage tests.

SPECIFICATIONS:

- Test *all* magnetically deflected picture tubes from 7 inch to 30 inch types
- Tests for quality by the well established emission method. All readings on "Good-Bad" scale.
- Tests for inter-element shorts and leakages up to 5 megohms.
- Test for open elements.

Model TV-40 C.R.T. Tube Tester comes absolutely complete—nothing else to buy. Housed in round cornered, molded bakelite case. Only .....

$15.85 NET

MOSS ELECTRONIC DISTRIBUTING CO., INC.
Dept. B-95, 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked. I am enclosing the down payment with order and agree to pay the monthly balance as shown. It is understood there will be no carrying, interest or any other charges provided I send my monthly payments when due. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

Name.....

Address.....

City.....Zone.....State.....

- ☐ MODEL 670-A.....Total Price $28.40 $7.40 down payment. Balance $3.50 monthly for 6 months.
- ☐ MODEL TV-11. ....Total Price $47.50 $11.50 down payment. Balance $6.00 monthly for 6 months
- ☐ MODEL TV-40..... Total Price $15.85 $3.85 down payment. Balance $4.00 monthly for 3 months.
- ☐ I enclose $..... ....as down payment.
- ☐ Ship C.O.D. for the down payment.

for either mail, telephone, or distributor-salesman orders.

Details on the "C-452 Hanging Wall Catalogue" are available from the company.

"EICO" KITS

Electronic Instrument Co., Inc., 84 Withers St., Brooklyn 11, New York, has issued a 12-page catalogue covering the *"Eico"* line of kits and factory-wired instruments.

The 30 kits and 33 factory-wired instruments available in the line are pictured and described in detail in this new publication. Complete specifications are given on each instrument in order to enable service technicians, students, engineers, and distributors to select the correct instrument for the job to be done.

A copy of this catalogue will be forwarded without charge upon request.

HICKOK BROCHURES

The Hickok Electrical Instrument Company, 10524 Dupont Ave., Cleveland 8, Ohio, now has available two brochures covering its v.t.v.m. and tube testers.

Form 209A2, a four-page booklet, lists technical specifications and uses of the company's multi-purpose Model 209A capacitance tester and v.t.v.m.

The four-page Form TT5A1 describes ten of the company's dynamic mutual conductance tube testers including those for the radio and TV technician as well as laboratory models. Graphic explanation of the dynamic mutual conductance test is also included.

SWITCH CATALOGUE

The Disc Department of *Erie Resistor Corporation*, Erie, Pa., has issued a new catalogue which gives a full description, illustrations, and specifications on its new line of switches.

Twenty-five item numbers are catalogued, including single and multiple section rotary switches in shorting and non-shorting types, lever action switches, and general purpose switches.

SERVICE PUBLICATION

Simpson Electric Company is sponsoring a new bulletin for television technicians, *"The Technician's Timesaver."*

The new publication is written by Bob Middleton, author of many books and articles dealing with TV servicing. The purpose of the publication is to show effective shortcuts in TV servicing and more practical applications for electronic test equipment.

A complimentary subscription, at no cost or obligation, may be obtained by writing direct to *Simpson*, c/o Service Department, *Howard W. Sams & Co.*, Inc., 2201 E. 46th St., Indianapolis 5, Indiana.

TRANSISTOR BATTERIES

Burgess Battery Company, Freeport, Illinois, has published a four-page folder covering its developments in the field of transistor batteries.

SCOOP of the Month - - -

BC1267 TRANSMITTER AND RECEIVER

154 to 186 Mcs., 1KW pulse oscillator, superhet circuit, 2 RF stages, and 5 stagger tuned IF's, includes 21 tubes; 2C26(2), 3E29/829B(1), 6AG5(7), 6C4(1), 6E5(1), 6H6(1), 6AK5(3), 6J5(2), 6SN7(1), 6V6(1), 9006(1); can be easily converted to 2 meter converter and outboard amplifier, ship. wt. 75 lbs., complete with conversion instructions (NOTE: 3E29/829B is worth $10.00 alone).

excellent condition $14.95 (less tubes) **with 21 tubes $24.95**

AMPLIFIER can be easily converted to 100w outboard amplifier, complete with 3E29/829B and conversion data..... **$14.95 ea.**

CONVERTER can be easily converted to 2 meter converter, with conversion data ..... **$9.95 ea.**

METER 0-1kw 0-10ma 4" Panel Meter..... **$3.95 ea.**

BROADCAST BAND and AERO

Ideal for Use in Boats, etc.

MN-26-C Remote Controlled Navigational Direction finder and communications receiver. Manual DF in any one of three freq. bands, 150 to 1500 KC. 24 V. Self contained dynamotor supply. Complete installation, including receiver, control box, loop, azimuth control, Left-Right Indicator, plugs, loop transmission line and flex. shafts, oper. & main. manual.

ALL UNITS BRAND NEW EXCEPT CONTROL BOX $69.50

MN-26-Y 150 to 325 KC, 325 to 695 KC. 3.4 to 7 megacycles, comp. installation..... 49.50
MN-26-C alone, like new..... 24.95
MN-26-Y as is less tubes..... 4.95
MN-20-E Loop. Brand New..... 6.95
MN-52 Crank drive. New..... 2.50
MN-26L3 Receiver exc. freq. 150-1250 KC. 2.9-6mc 59.50

Low Freq. Crystals—FT 241 A for SSB, lattice filter, ½" spc. 54th harm channels listed by fund. Fractions omitted.
See previous Radio-TV News issues for frequencies
49c each **10 for $3.00**

POWER YOUR RIG FROM AC

RA-34 RECTIFIER. Makes a ground xmtr of BC-191, the 12V version of BC-375-E. Convert BC-375-E to 12V by changing heater link switches and relay connections, power it with RA-34. Input 105-125 or 210-250V, 60 cy. Outputs: For plates, 1000V filtered dc at 350 ma; for relay and mike, 12V filtered dc at 2.4 A; for heaters, 12V ac at 14.25 A. Used condition. F.O.B. **$159.75**

BC-433 RADIO COMPASS RECEIVER

200 to 1700 KC, used, excellent condition less tubes..... $19.95
used, as is, less tubes and cover, excellent for parts only..... $6.95
BC-434 Control box for above. Brand new...$4.65
Used 1.79

VHF TRANSCEIVER

Ideal substitute for SCR-522. freq. range 140-144 mc. crystal controlled. 10 watts. The receiver section has two individual RF sections, feeding a common 3 stage 10mc IF amplifier. Both RF sections may be operated simultaneously, or either one individually. The receiver unit has 13 tubes. The transmitter is of straight forward design. Transmitter unit has 7 tubes, one 2-832 as final modulated by a pair of 6L6 and push-pull. Complete unit in case less tubes, and diagram less dynamotor.
EXCELLENT CONDITION..... **$9.95**
WITH TUBES $19.95

TG-5 Portable Telegraph set—used..... $3.95
3 for 7.00
new 5.95
2 for 11.00

A SWEET OSCILLOSCOPE DEAL

ASB-7 Radar Indicator Unit: For conversion to test scope or for use as modulation monitor. Has standard test-scope CR tube, H Cent, V Cent, Brll, Foc, Gain, and range selection switch. External power source was used. Tubes: 4-6AC7, 3-6116, 1-5BP1. Condition good. NEW..... **$9.95**

BEAM-ROTATOR

Reversible beam rotator motor 8500 rpm, attached to rear reduction box which drops speed to 120 rpm—used **$1.95**
3 for $5.50

Hundreds of items in stock. WRITE FOR NEW BULLETIN AND PRICES. Shipments F.O.B. warehouse. 20% Deposit on orders. Minimum order $5.00. Illinois residents, add regular sales tax remittance. Prices subject to change without notice.

BC-620 TRANSMITTER-RECEIVER UNIT

FM transmitter-receiver, crystal controlled, two channels, freq. range 20-27.9 mc. 13 tubes, dual meter for testing filament and plate circuits. **$39.25**
PE-117 Power supply for above, complete, like new ..... ea. $17.95

RECEIVER

Battery powered heterodyne receiver, 75-150 mc—brand new..... ea. **$10.95**

BC-929-A

Contains power supply 110 V. 400 cycles, has 7 tubes such as 3CP1, brand new, complete with tubes. Each **$19.95**

BC-746 TUNING UNIT

Plug-in transmitter tuning unit from Army Walkie-Talkie. Contains antenna and tank coils, tuning condenser, transmitting and receiving crystals. Ideal transmitter foundation.....ONLY **$1.29**

CONDENSERS

Oil filled—1 mfd at 3600 v. ..... $1.95 ea.
.2.2.2 at 1000 v. ..... $1.75 ea.

ID6/APN4

Made to operate in conjunction with Radio Receiver R-9( )/APN-4. Unit includes 19 tubes, one 5" scope tube, crystal controlled standard oscillator, sweep circuits, marker pulses.
Excellent cond. **$42.50**

MIKES and HEADSETS

T-26 Telephone chest unit with F-1 Western Electric Transmitter $2.39
HS-33 Low Impedance Headset .....exc. $2.95 new $5.45
HS-23 Headset used 1.89 new 4.50
CD-307 Ext. cord for HS-23-33 .....like new .79 new 1.29
Throat Mike—T-30.....new .98
Lip Mike—Navy Type .....new .98
CW-49505 High Impedance headset complete with headband .....Used **98c**
T-45 Lip Mike. New..... $1.75
HS-30. miniature headset. Used $1.49, new 2.49

WOBULATOR

BUILD TV-FM-AM SWEEP GENERATOR

You can build "Versatile Sweep Frequency Generator" with APN-1 magnetic units..$ 5.95
RC-1206 Beacon Receiver . . . 200-400KC. 9.95
TS-184/AP Test Set..... 39.50
IE-19A-SCR522 Test Unit..... 295.00
I-222-Signal Generator.....Used. exc. 95.00

11 TUBE UHF TUNABLE RECEIVER

224-258 mc. less tubes.....$7.95
With conversion diagram to 220.

RA-52 RECTIFIER

Transtat controlled to produce high voltage DC from 110 VAC 60 cycle source. Up to 11,500 VDC @ 50 W. Metered high voltage (0-15 KV) and current (0-20 MA).
Exc. **$69.95**

	As Is Less Tubes	With Tubes	New
BC-454 3 to 6 mc.....	—	$11.95	—
BC-455 Receiver, 6 to 9 mc.....	—	9.95	—
BC-456 Modulator $2.95	4.95		$7.95
BC-458 Transmitter, 5.3 to 7 mc 2.95	—		—
BC-459 Transmitter, 7 to 9 mc 7.95	—		—

Control Boxes, racks, mounts, connectors for above in stock—write.

MG-149F excellent condition.....$ 89.50
MG-149H excellent condition..... 129.50
MG-153 Inverter (3 phase).....Used 89.50

PE-206, inverter, like new.....$11.95
PE-218, inverter, excellent condition..... 24.95

BC-640 .....$695.00
BC-639 with RA 42 rectifier..... 225.00

NATIONALLY ADVERTISED TUBES

5BP1 ..$3.29 3 for $9.00 — 3BP1 ..$3.29 — 5AP1 ..$3.29 3 for $9.00

All Brand New In Original Cartons

304TL .....$5.95 — 808 .....$1.95
830-B .....$1.59 — 720BY $29.50

QUANTITY PRICES AVAILABLE!

1625, 1626, 33, 34, 954, CK1005, 6Z7G, 9002, 9006, 1619, 955, 9004, 12A6, 1F4, 1F5, 2I1, 6F5, 1A6, 1629, 19, 50.

10 for $3.00

RT7/APN-1 TRANSCEIVER UNIT—Used as an altimeter, it may be converted for signaling control circuits, etc. Used, less tubes, as is **$4.95**

RT/34 APS 13 TRANSCEIVER—Used as a tail warning radar on 415 MC. Containing a 30MC IF Strip and various other parts, these units have been stripped of RF sections and all tubes, but are an excellent buy if only for parts and IF Strip. Used..... **$4.95**

R-1/ARR-1—220 MC converted with minor alterations becomes a high gain converter with two stages of RF amplification—(complete with diagram). New..... **$4.95**

ALL THREE ABOVE ITEMS FOR $7.50

BEAM ANTENNA SELSYN TRANSMITTER and indicator, per set..... **$12.00**
BC-684 FM Transmitter, 27-38 mc. used, exc. **$14.95**
BC-604 FM Transmitter, 20-27 mc. used, exc. **$11.95**

LOOK WHAT YOU GET FOR $14.95

- 350 feet of continuous length of 50 ohm coaxial cable
- 100 feet of same coaxial cable
- Cavity type attenuator
- 6 Short lengths of RG8U with connectors and sockets
- In wooden case—shipping weight 30 lbs.—all for $14.95

BC 347 Interphone Amplifier..... $2.95
I-70 Tuning Meter..... .89
APS 13 UHF Antenna, Pair..... .98
I-97 Bias Meter $3.95 4.95
BC 1066 B—150 to 225 MC Portable Receiver adaptable to many amateur uses. Used.....$5.95
One Tube Interphone Amplifier—Small compact aluminum case fully enclosed. 2¼"x3¾"x5¾". Less Tube 79c
BC 709 Battery operated lightweight interphone amplifier. Complete with tube and shock mount, but less battery.....New $3.95

DYNAMOTORS

DYNAMOTORS: The best dynamotor for conversion to 6v. Multiple windings! After conversion you get choice of 190 or 350 v. at 50 MA or 250 v. at 100 MA. Complete dope sheet furnished. BRAND NEW (See "CQ" Aug. issue).... **$4.65**

DM-28—Dynamotor for BC-348—28V DC at 1.25 amps in 220 V at 70 MA output Good $4.95
DM-32A—Dynamotor for Command Receiver 28V at 1.1 input 250V at 60 MA output .....Used 2.95 New 7.50
DM-33—Dynamotor for Command Transmitters—Used $2.95
D-101 Imp. 27V 1.75 Amp. output 285 VC .075 amp .....each $1.95
3 for $5.00
PE-94 .....each $1.95
PE103—6V Dynamotor.....Used $22.95

BC-1033 62-80 mc recvr. Like new, less rubes. ea. $5.95
BC-1023 brand new with tubes..... 9.95

SCR-625—FAMOUS ARMY MINE-DETECTOR

For Prospectors, Miners, Oil Companies, Plumbers, etc. This unit is being offered now at a considerable reduction in price. Recently advertised at $79.50 it is now available in the same brand new wrappings in suitcase style carrying case (less batteries). New **$59.50**
SCR-522—Transceiver, complete in case with top bracket, less tubes **$29.95**
RU-19—Receiver. Complete control box and coils—brand new .....ea. **$17.95**
BC375, exc. $49.50
BC191, exc. 49.50
TU5, exc. 14.95
BD77, used, exc. 14.95

BUY NOW! R W ELECTRONICS Dept. N, 2430 S. Michigan Ave., Chicago 16, Ill. **BUY NOW!**
PHONE: Calumet 5-1281-2-3

The folder describes the requirements for batteries used in transistor circuitry. Typical batteries are illustrated and described.

For a copy of this folder write Transistor Engineers in care of the company.

RMS CATALOGUE

Radio Merchandise Sales, Inc., 2016 Bronxdale Ave., New York 62, N. Y., has published a new catalogue which illustrates and describes the company's complete line of TV antennas and accessories.

Catalogue 55 is a 32-page, multicolored publication which is fully indexed by product groupings. It includes information on packaging and shipping weights as well as the company's gain reference chart.

MID-AMERICA BULLETIN

Mid-America Co., Inc., 2412 S. Michigan Avenue, Chicago 16, Illinois has recently published a 28-page bulletin which lists TV, radio, electronic and related components for manufacturers and wholesalers.

Designated as Bulletin No. 1053, the new publication is available only to recognized manufacturers and jobbers and will be sent on letterhead request from such organizations.

RADIO-PHONE LINE

Roland Radio Corp., 716 S. Columbus Ave., Mt. Vernon, N. Y., is now offering a 4-color, 4-page brochure covering its 1954 line of radios and radio-phonograph combinations.

Each model in the line is shown in a close-up view and specifications accompany each illustration. The back cover leaves space for a dealer imprint.

SPEAKERS AND CABINETS

Kingdom Products Ltd., 23 Park Place, New York 7, N. Y., has issued a four-page catalogue covering *"Lorenz"* speakers and *"Kingdom"* cabinets and combinations of the two components.

In addition to providing complete technical details on these items, the new publication carries a page of construction notes giving mechanical specifications on a series of speaker enclosures.

A copy of "Music Comes Alive" is available on request.

"EDU-KITS" BROCHURE

Progressive "Edu-Kits" Inc., 497 Union Ave., Brooklyn 11, N. Y., has issued a new booklet describing its 1954 radio *"Edu-Kit,"* a home-study course in kit form.

Literature on radio and TV servicing also accompanies this brochure which is available from the company. Address all requests to Mr. R. Nevins.

CONVERSION CHART

The *Cinema Engineering Co.,* Division of *Aerovox Corporation,* 1100 Chestnut St., Burbank, California has issued an audio power conversion chart which will be supplied without charge on request.

Printed in card form for hanging on the wall or placing under glass tops of desks, the chart contains three columns, *i.e.*, power level in watts, power level in db, and voltage across a 600-ohm line.

The tabulation may be used in converting from the old db system to dbm by adding 7.78 db or converting from dbm to the old system by subtracting 7.78 db. Other conversions may also be performed with the chart, complete instructions for which operations are given on the chart.

AUDIO GEAR

The *Dubbings Company, Inc.*, 41-10 45th St., Long Island City, N. Y., has has issued a hi-fi catalogue covering products handled by its new high-fidelity sales department.

Pictured and described are a series of tuners for AM and FM, record players, turntables, pickup arms, cartridges, amplifiers, preamps, speakers, speaker enclosures, tape recorders, disc recorders, microphones, television chassis, phonographs, "basic" audio packages, and test records.

RECTIFIER HANDBOOK

Federal Telephone and Radio Company has issued a second edition of its "Selenium Rectifier Handbook."

This 80-page edition contains a representative listing of the selenium rectifiers made by the company for radio and TV use. It also covers rectifier designs and power supply circuits for such applications as phonographs, audio amplifiers, amateur radios, mobile gear, photocell amplifiers, intercom systems, and other d.c. supply requirements.

Servicing and troubleshooting information is provided in easy-to-use form. The handbook, which is priced at 50 cents a copy, is available from the company's distributors or from the company direct at 100 Kingsland Road in Clifton, N. J.

LAFAYETTE AUDIO

Lafayette Radio, 100 Sixth Avenue, New York 13, N. Y., has just issued a 48-page catalogue comprising a comprehensive listing of high-fidelity music system components.

In addition to illustrating some custom installation ideas, the catalogue pictures and describes amplifiers, tuners, preamps, cabinets, binaural amplifiers, record changers, "packaged" installations in various price ranges, speakers, tone arms and cartridges, tape recorders, recorder accessories, and remote-control TV sets for custom installation.

AUTO RADIO REPLACEMENTS

P. R. Mallory & Co., Inc., P. O. Box 1558, Indianapolis, Ind., has issued an 11-page auto radio replacement control manual which covers most auto radios made since 1946.

The data is listed by manufacturer's make and model, control use, *Mallory* replacement controls and special bushings and switches. —30—

WHAT'S *New in Radio*

The products described in this column are for your convenience in keeping up-to-date on the new equipment being offered by manufacturers. For more complete information on any of these products, write direct to the company involved.

HI-FI ENCLOSURE

Now in production by *Angle Genesee Corp.*, manufacturers of high-quality cabinets, is the *Read* "Fold-a-flex" loudspeaker enclosure. The original "Fold-a-flex" design first appeared in the October, 1953 issue of RADIO & TELEVISION NEWS. An improved folded horn structure has extended the low frequency response materially.

This enclosure, on which patents are

pending, may be used with a 12" or 15" coaxial loudspeaker, as a full 2-way system with woofer and tweeter or a full 3-way system comprising woofer, mid-range horn, and high-frequency tweeter. An isolated compartment, for horns and tweeters, has its own mounting baffle and is available precut to accommodate standard units.

The "Fold-a-flex" incorporates three adjustable ports. These are set, by the user, to provide a choice of: 1. folded horn, 2. infinite baffle, or 3. bass reflex. The reflex port is fully adjustable to the acoustical requirements of any 12" or 15" loudspeaker.

Optimum performance (corner or wall position) is insured in any room with any of the popular high-fidelity speakers. The company is producing the "Fold-a-flex" in traditional or modern cabinetry and in a wide selection of finishes.

Full information and price will be sent promptly on request to the company at 107 Norris Drive, Rochester 10, N. Y.

HEAVY-DUTY ROTATOR

The *Trylon Tower Division* of *Wind Turbine Co.*, West Chester, Pa., is now offering a heavy-duty rotator that is capable of handling the largest beam antennas used in amateur, commercial, and military communications systems.

The rotator supports single- or two-band arrays weighing up to 200 pounds and accommodates two coax, ribbon, or open-wire transmission lines without switching by means of separate low-leakage noise-free couplings.

The unit is driven by a special 1/25 h.p. motor that is instantly reversible for continuous rotation in either direction. The reduction gear train consists of two worm-and-spur gear sets having an over-all ratio of 2400 to 1 to prevent backlash during high winds.

Complete specifications are available from the manufacturer.

PRECISION RESISTORS

Hycor Company, Inc., 11423 Vanowen St., North Hollywood, California, is in full-scale production on the Type 10 wirewound resistor, a molded-in-plastic unit.

The new unit is the first production type to be offered by the company in its new series "H" group of hermetically sealed resistors. It is rated at 1.4 watts at ambient temperatures up to 125 degrees C. Dimensions are ¼" diameter by 13/32" long. It is supplied in resistances from .1 ohm to 300,000 ohms at tolerances as close as 1/20th of 1 per-cent.

Descriptive material on this and other type resistors up to 1 watt is contained in Bulletin "H."

NEW TRANSISTOR

The Receiving Tube Division of *Raytheon Manufacturing Company*, 55 Chapel St., Newton 58, Mass., has announced the addition of a low-noise junction transistor to its line of *p-n-p* junction transistors.

The new type, CK727, has an aver-

age noise factor of 13 db, an average alpha of .97, and an average power amplification of 37 db.

Full details on this new transistor are given in a data sheet which is available from the Technical Information Service of the company.

COMPACT POWER SUPPLY

The *Allied Engineering Division*, Connecticut & Richards Ave., South Norwalk, Conn., is currently offering its Model 302 power supply.

The new unit is designed to conserve bench space as it is housed in a cab-

inet measuring just 8" x 5" x 5½". Two outputs are available: from 150 to 350 volts at 0-80 ma. with either positive or negative grounded to the chassis, and from 0-150 volts at 0-5 ma. with positive internally connected to the negative of output 1.

Ripple is less than 3 millivolts and

the ambient temperature range is 0-40 degrees C. Operating voltage is 105-125 volts r.m.s., 50-60 cycles, 150 watts maximum.

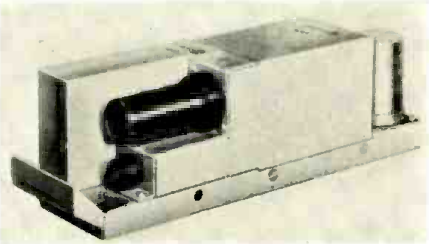
Further information on this unit and a copy of the company's d.c. power supply catalogue are available on request.

PLUG-IN UNITS

Langevin Manufacturing Corporation, 37 West 65th St., New York 23, N. Y. is now marketing two plug-in units which have been designed for applications where space is at a premium.

The Type 5208 plug-in power supply is designed to be used with the 5000 series of miniature plug-in amplifiers. Input is 105-130 volts, 50-60 cycles, single-phase a.c. The d.c. output is 300 volts, 90 ma. continuous. The unit measures 10¼" long x 2⅝" wide x 3" high.

A companion plug-in amplifier, the Type 5117, is also available. The new unit is a two-stage, push-pull, fixed gain amplifier rated at 8 watts. Designed to be mounted on relay racks or in consoles, the amplifier has the same



dimensions as the power supply unit. The amplifier uses two 5879 miniature tubes and two 6V6's. Gain is 55 db.

A catalogue on the company's amplifiers, power supplies, and transformers is available on request.

SPECIAL COMPONENTS

Transvision, Inc. of New Rochelle, N. Y., has set up a special transformer and coil manufacturing division which will design, engineer, and manufacture short transformer and coil runs.

The coils include such items as high-

Now! RAD-TEL Tubes & Parts At Savings!

Wafer Rotary Switch Kit

A choice combination of single, double, etc., from 2 to 8 positions. Special kit of 10 **$1.39**

Smashing Reductions on FP CONDENSERS

All famous makes. Save plenty on these top quality FP Condensers. Made by leading manufacturers. You can't miss—these values are hits no matter how you look at them!

CERAMICON KIT

1 kit of 50 assorted ceramic discs, biplates, tubular condensers. All condensers popular sizes, used in T.V. and F.M. sets. A MUST kit

List price $10.00

$1.99

Hi-Watt RESISTOR KIT

Consisting of 5, 10, 15 and 20 Watt vitreous type resistors by Ward, I. R. C., etc. A top-flight buy!

$1.95

Assorted Kit of 20

Filter CONDENSER KITS* 150 V

*(10 to a pkg. min.)

Kit of 10 20-20. List Price $15 ....$3.25

Kit of 10 40-40. List Price $15 ....$3.25

Kit of 10 50-30. List Price $15 ....$3.25

FILTER CONDENSER 20-20 Mfd, 450 V.

Color-coded leads. Ideal for use where impossible to use metal cans. For top performance at a give-away price. List price $2.40.

49c

BIAS CONDENSERS

Sangamo, Aerovox, Cornell-Dubilier

500 mfd 12V

List Pr. $2 ..35c ea.

Pkg. of 10....$2.95

SPECIAL . . .

4-50 mfd 8-100 VDC

Kit of 7.....$1.29

CAN ELECTROLYTICS

Mfd. by SPRAGUE AEROVOX PHILCO, Etc.

Capacity	DC Working Voltage	Price
40-40-40	450-450-25	$.99
250-1000	10-6	.49
40	450	.49
60-10-10-20	450-450-450-150	.89
80-40-10	450-450-450	.99
20-8-8-8	450-450-450-250	.59
80	500	.79
15-15-20	450-450-25	.59
40-10-100	450-450-200	.79
10-20	450-25 F.P.	.39
10-8-8-8	450-450-450-150	.49

Kit of 10 Assorted Electrolytic Condensers

Consists of singles, doubles, triples and quadruples, all of popular voltages and capacities—all standard popular brands. **$2.39**

Philco TV BOOSTER

Made by PHILCO, famed for quality and precision communications equipment. Completely self-contained, including 2 tubes . . . 1 for High Channels and 1 for Low Channels and selenium rectifier plastic cabinet. In factory-sealed cartons, complete with instructions **$10.95**

In Lots of 3 ...$9.95

2$ Paper BY-PASS CONDENSERS

An assortment of 25 by-pass condensers, made by leading manufacturers. Top quality. Most popular sizes and voltages. Values .002 to .2 MFD .200 to 1000 VDC.

KIT OF 25 **99c**

Hi-Voltage POWER SUPPLY

4500 VOLTS 6 MA.

12AU7 oscillator, 1B3 rectifier completely wired, enclosed in shielded metal case, removable cover. Use as R.F. high voltage supply.

BRAND NEW! **$2.95**

Kit of 2 tubes for above—$1.08

FLY BACK TESTER

"A Must for every Serviceman!"

Fast, sure horizontal trouble-shooting. Responsive to as small a defect as a 1-turn shot. Tested while in receiver! Tests continuity on yokes, coils, speakers, switches, etc.

Your Price **$39.95**

VARIABLE CONDENSERS

Mfd. by Philco, Radio Condenser, etc.

2 Gang AM and FM

contains 2 separate sections for AM and 2 for FM with padder condensers. Attached a slug tuned high frequency coil whose plunger is geared to condenser shaft. Pulley type drive wheel.....89c

2 Gang AM

Equipped with drum pulley and padders.....79c

3 Gang FM

3 Gang Superhet

Complete with padders and drum pulley drive.....89c

Kit of Wafer Sockets

Assortment of 6, 7, 8 and 9 pin sockets. These are brand new, standard manufacture. Kit of $0..$1.49

ALL BRAND NEW PARTS!

TRIMMER KIT

Compression type mica for radio, F.M., T.V. Very few duplications. Don't let this chance pass you by!

25 FOR... **99c**

FILAMENT ISOLATION TRANSFORMER

6.3 V @ 1.2 A

For damper use with 6W4, etc. High voltage insulation between primary and secondary to withstand high voltage surge. Can be used for general replacement. 79c

List Price—$1.75

RCA Type FLYBACK TRANSFORMER Type 215T1

Lowest net price elsewhere—$4.70 At this give-away price, order in quantity while they are available. Each..95c

Vertical OUTPUT TRANSFORMER

Very popular, used in most T.V. sets. Well-known manufacturer. Matches vertical output tube to the deflection yoke. 10 to 1 ratio. A terrific buy on a top performer.....95c

List price—$4.50

BIG SAVINGS YOU CAN'T PASS BY! 70° YOKE

Mfd. by TODD, SICKLE & other top Mfrs.

Very good value, makes conversion profitable and simple. Get 'em while they're still around! ..$1.95

List price—$3.50

55° YOKE...99c

Horizontal Output TRANSFORMER

Type 204T1

A horizontal Output Transformer designed for deflection circuits employing rf-operated high-voltage supplies. Intended for 70° magnetic-deflection kinescopes. Used with RCA Deflecting Yokes 201D1, 201D2, 201D3 or 201D12. **$2.95**

List price—$13.95

HIPO TV rectifier tube—replaces the 5U4 tube directly! Makes pictures bigger, brighter, larger and increases the gain in TV receivers. HIPO 567..... **$1.39**

RESISTORS (Assortment of 200)

Standard RTMA Coded or Value Printed. Uninsulated, ¼ Watt, 1 Watt, 2 Watt, and Some 10 Watt. RAD-TEL SUPER BUY!!! Assortment of 200 for $1.39

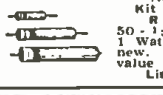
List price—$10.00

Kit of 50 MICA CONDENSERS

All popular sizes of mica condensers. In regular and silver construction. For FM and TV use... **$1.95**

List price—$12.50

American Makes Kit of 100 Insulated RESISTORS



50 - 1 a and ½ watt, 25 - 1 Watt, 25 - 2 Watt. All new, all clean. Good value $2.65

List price—$15.00

Hi-Voltage T.V. CONDENSERS

500 mmfd 10KV.$ .39 ea.
500 mmfd 15KV. .49 ea.
500 mmfd 20KV. .49 ea.
500 mmfd 30KV. 1.59 ea.

Volume Control Kit

Kit of 10 includes 3 wire-wound, 2 dual post, 5 carbon

The price of one (1) for the quantity of ten (10). Short and long shaft. PER KIT $1.79

KNOB KIT (Choice Groups!)

Assortment of home, auto, and T.V. knobs. All colors — plastic, wood and bakelite knobs.

Bag of 50.....$1.29

Super Bag of 100 extra val. 1.95

Sells from 12c to 18c each.

..OLD FASHIONED SAVINGS!

Cathode Ray TUBE REJUVENATOR

Fits all makes of picture tubes. Completely automatic. Easy to install, no tools needed. For A.C. parallel circuits. (Available for all sets.....$1.39

YOUR OLD PICTURE TUBES ARE STILL USEFUL

List price—$5.95

Everyone is a potential user—10 for $12.90

Army - Navy HEADSETS

Individually boxed. Very sensitive. Meets both Army and Navy specifications.

Ea. per set $2.95

List price—$16.00

SPEAKERS—All Standard Brands, Dynamic

Size	Ohms	Price
3"	1000	79c
4"	1800 (tapped at 300)	79c
5"	4 (auto speaker)	79c
6"	2500	99c
10"	2500	1.49
4 x 6	1800	99c
4 x 6	2750	99c
5 x 7	1000	99c
5 x 7	1800	99c
5 x 7	2750	99c
6"	90 (with 6K6 output transformer)	1.49
8"	680 (with 6V6 output transformer)	1.95
6.5"	38	1.49

Alnico V P.M. standard brand Speakers

4" 1.47 oz. with 50L6 output transformer..$1.95

5" 1.47 oz. with 50L6 output transformer..$1.95

6" 2.15 oz.....$2.19

4" .68 oz. with 50L6 output transformer..$1.89

4 x 6 .....$1.95

5" 2.15 oz.....$1.69

7½" 3.16 oz. Mopar $2.95

8" 2.15 oz.....$2.95

10" 2.15 oz. with 6K6 output transformer..$3.95

12" Magnavox.....$5.95

Kit of BATTERY PLUGS

Polarized, 3, 4, 5, etc. 50 for **$1.69**

TERMS: A 25% deposit must accompany all orders—balance C.O.D. All shipments F.O.B. Irvington warehouse. Orders under $10—$1.00 Handling Charge. Subject to prior sale.

SOLDER LUG STRIPS

Kit of 48—very usable assortment of solder lug terminal strips. Brand new. Unusually fine value! Comp. Kit of 48.... **89c**

List price $4.00

TERMINAL STRIPS

Assortment of 50 terminal strips (screw type). Kit contains wide selection to meet every design. Kit of 50..... **89c**

2, 3, 4 and 5 screw strips.

T.V., RADIO, and F.M. COIL KITS

Kit for television servicemen and experimenter consisting of width coil, peaking coil, 4.5 m.c. ratio detector, and 21.9 m.c. IF coil.

TV. Standard kit of ten (10) 99c

TV. Super value; not duplicated. 25—$1.85

Broadcast and short-wave, midget to multi-band replacement coils.

BC. Standard kit of ten (10).....99c

BC. Super value; not duplicated.

Kit of 25.....$1.85

RC Kits include RF, Osc., IF, and detector coils.

Send for Free Illustrated Parts Catalog.

Please send full remittance. Allow for postage and save COD charges! We refund all unused monies.

70% to 90% OFF ON TUBES!

All Tubes Individually Boxed!—1 Year Guarantee!—1 Day Service!

Type	Price	Type	Price	Type	Price
OA2	.74	6BK7	.80	12AY7	.99
OB2	.81	6BL7GT	.83	12BA6	.38
OC3	.72	6BN6	.59	12BA7	.60
OD3	.70	6BQ6GT	.79	12BD6	.45
OZ4M	.55	6BQ7	.90	12BE6	.39
1A5	.30	6BZ7	.90	12BF6	.39
1A7GT	.47	6C4	.37	12BH7	.63
1AX2	.62	6C5	.39	12BY7	.65
1B3GT	.68	6C6	.58	12BZ7	.65
1B7	.30	6CB6	.44	12C8M	.34
1C5	.43	6CD6	1.11	12SC7M	.63
1E7	.29	6E5	.48	12J5GT	.42
1G6	.24	6F5GT	.39	12K8	.59
1H4	.30	6F6	.59	12Q7	.59
1H5GT	.49	6G6	.52	12S8GT	.62
1L4	.46	6H6GT	.41	12SA7GT	.65
1L6	.59	6J5GT	.43	12SF5	.50
1LA4	.59	6J6	.52	12SJ7M	.67
1LC5	.59	6J7	.43	12SK7GT	.63
1LE3	.59	6K5	.47	12SK7M	.63
1LN5	.59	6K6GT	.37	12SL7GT	.47
1N5GT	.67	6K7	.44	12SN7GT	.52
1P5GT	.57	6L6	.64	12SQ7GT	.56
1Q5GT	.58	6L7M	.68	12SR7M	.49
1R5	.49	6Q7	.45	12V6GT	.46
1S4	.59	6S4	.38	12X4	.38
1S5	.43	6S7M	.79	14A5	.59
1T4	.49	6S8GT	.53	14AF7	.59
1U4	.49	6SA7GT	.43	14H7	.59
1U5	.43	6SD7GT	.41	14J7	.30
1V	.53	6SF5GT	.46	14W7	.30
1X2A	.63	6SG7GT	.41	19BG6	.95
2A3	.30	6SH7GT	.49	19C8	.70
2A4G	.24	6SJ7GT	.41	19T9	.69
2W3	.38	6SK7GT	.41	19V8	.79
2X2	.59	6SL7GT	.48	24A	.39
3A4	.45	6SN7GT	.52	25AV5GT	.83
3E5	.46	6SQ7GT	.37	25BQ6GT	.79
3Q4	.48	6SR7GT	.45	25L6GT	.39
3Q5GT	.49	6SS7GT	.42	25W4GT	.59
3S4	.49	6T4	.99	25Z5	.66
3V4	.51	6T8	.56	26	.45
5U4G	.50	6U4	.60	27	.39
5W4GT	.50	6U5	.44	35	.58
5Y3GT	.37	6U6	.59	35B5	.40
5Z3	.45	6U8	.61	35C5	.39
5Z4	.59	6V6GT	.39	35L6GT	.41
6AB4	.44	6W4GT	.44	35W4	.37
6AC7M	.86	6W6GT	.44	35Z3	.59
6AF4	.90	6X4	.37	35Z4	.47
6AG5	.48	6X5GT	.37	35Z5GT	.47
6AG7M	.99	6X8	.75	36	.39
6AH4	.57	6Y6G	.48	41	.42
6AH6	.73	7A4	.47	42	.42
6AJ5	.65	7A5	.59	43	.55
6AK5	.55	7A6	.69	45	.55
6AL5	.38	7A7	.69	45Z3	.44
6AQ5	.39	7AF7	.53	45Z5	.49
6AQ6	.37	7B4	.44	50B5	.43
6AR5	.37	7B6	.69	50C5	.39
6AS5	.50	7C4	.59	50L6GT	.61
6AT6	.37	7C5	.69	50Y7	.50
6AU4GT	.68	7E5	.59	53	.24
6AU5GT	.82	7E6	.30	55	.49
6AU6	.38	7E7	.59	57	.58
6AV5GT	.83	7H7	.59	58	.60
6AV6	.37	7L7	.59	70L7GT	.97
6AX4GT	.53	7X7	.70	76	.44
6B4	.64	7Y4	.69	77	.57
6BA6	.39	7Z4	.59	78	.47
6BA7	.57	12A8GT	.61	80	.35
6BC5	.49	12AL5	.37	83V	.68
6BD5	.59	12AQ5	.52	85	.59
6BD6	.45	12AT6	.37	117L7	.99
6BE6	.39	12AT7	.66	117Z3	.37
6BF5	.41	12AU6	.38	807	.99
6BF6	.37	12AU7	.54	866A	1.39
6BG6G	1.25	12AV6	.39	1274	.30
6BH6	.46	12AV7	.63	2050	.89
6BJ6	.43	12AX4	.56	1000FM	.59
		12AX7	.56	Hi-Po #567	1.39

RAD-TEL TUBE CO.

Ph. Essex 5-2947, Dept. RN-3, 115 Colt St., Irvington 11, N. J.

frequency air cores, multilayer solenoids, peaking, synchro-winding, television r.f., TV i.f., etc., while transformers including audio, power, high voltage, pulse application, synchro, etc., will be made available.

Sketches and blueprints may be sent to the division for estimates. A 4-page brochure on this new service is also available.

1-KW. BALUNS

Barker & Williamson, Inc., 237 Fairfield Ave., Upper Darby, Pa., is now offering a new line of 1-kw. baluns designed to solve the many problems involved in matching feedline systems of radio transmitters to fixed or rotary antennas.

Three of the new baluns have been designed for use with beam antennas employing "T" matching sections. Available in models for 20, 15, or 10 meter input, their input is designed to match a 75-ohm unbalanced feedline system, while the output, in combination with a "T" section, matches 100 ohms.

The remaining baluns in the line are for use with half-wave, folded dipole antennas. Designed for an input of 75 ohms unbalanced to an output of 300 ohms balanced, a total of five models is available for operation on 80, 40, 20, 15, or 10 meters.

Bulletin 700, giving complete details on these units, is available from the company's dealers or the company direct.

LOW-COST INTERCOM

Mark Simpson Mfg. Co., Inc., Long Island City 3, N. Y., is now offering an inexpensive two-station intercom which has been designated as the *Masco* "Small Talk."

The system comes complete with a 50-foot cable. The master unit features an "on-off" switch with volume control, an "on-off" pilot light, and a separate "press-to-talk" switch. The remote unit has a "press-to-talk"

switch which allows the remote station to originate calls to the master station as well as answer calls from a distance up to 40 feet.

The unbreakable all-metal cabinets measure 6½" x 4⅝" x 4⅜".

REPLACEMENT RECTIFIERS

Federal Telephone and Radio Company, Clifton, N. J., has introduced a new "universal" line of selenium rectifiers designed for replacement in any radio or television receiver now equipped with this component.

The new line of four models is available in packages of 12 and 24 to the carton. The rectifiers are of eyelet construction and come equipped with mounting hardware for simplified installation. The four units are: 1236A rated at 300 ma.; 1238A rated at 350 ma.; 1241A rated at 400 ma.; and 1237A rated at 500 ma.

Additional information on these rectifiers is available from local distributors.

¼-INCH TAPE RECORDER

The Stancil-Hoffman Corporation, 921 N. Highland Ave., Hollywood 38, California, has introduced a new ¼" tape recorder-reproducer, the Model P5.

Designed for either standard rack mounting or portable carrying case op-

eration, it is available at two speeds (7½" or 15") with a frequency response flat ± 1 db to 7500 and 15,000 cycles. The total distortion is 1% with a signal-to-noise ratio of better than 50 db.

When rack mounted the unit occupies a total rack space of 22¾" and has a tape reel capacity of 2500 feet.

BX CRYSTAL

Bliley Electric Company, Union Station Building, Erie, Pa., is now offering its "Bantam BX" crystal for use in subminiaturized communications equipment.

The new crystal is hermetically sealed and has wire leads. The range is 15 mc. to 100 mc. It has the same performance characteristics as MIL types CR-23 or CR-32.

The unit may be wired into a miniature socket or soldered to a printed circuit terminal board. Bulletin 46, containing additional technical information on the unit, is available on request.

WIREWOUND CONTROLS

Clarostat Mfg. Co., Inc. of Dover, N. H., is now offering an improved version of its Series 43 wirewound potentiometer.

Known as the Series 43c, the new units feature an improved wiper arm contact and end termination. The new contact allows higher resolution, more intricate tapers, and tighter tolerances in over-all resistance and linearity. Terminals are directly fastened to the winding, insuring low contact resistance. The collector and terminal are now in one piece, eliminating rivets as mechanical fasteners and current conductors.

The new series is available in resistances from 1 ohm to 10,000 ohms at

2 watts. Taps and various tapers are available. A choice of shafts, switching arrangements, and assemblies is available. At present they are being offered as initial-equipment units only.

TROPICALIZED CONDENSERS

Micamold Radio Corp., 1087 Flushing Ave., Brooklyn, N. Y., is now offering a line of molded tubular condensers known as "Tropicaps."

Designed for superior resistance to extreme humidity and ability to withstand severe mechanical and thermal shock and total immersion, the line is available in all standard capacitance and voltage ratings.

Bulletin 106, giving complete engineering data on these units, is available from the company.

PRINTED CIRCUIT TRANSFORMERS

Microtran Company, 2117 Mott Avenue, Far Rockaway, N. Y., has developed a line of miniature transformers which have been especially designed for use with printed circuits.

These units, which range in power handling capacities from 8 milliwatts to 2 watts, are designed with special soldering tabs so that they may be inserted in a printed circuit terminal board and mounted and connected by means of dip soldering.

Resin impregnation is used to insure the strength characteristics required of units of this type. The company will supply additional details on request.

PERSONAL SPEAKER

Wright-Zimmerman of New Brighton, Minn. is now offering a personal speaker for radio and television applications.

Designed especially for the hard of hearing, the speaker can be clipped

across the speaker terminals of any receiver and placed on the back of a chair or across the viewer's shoulder in a convenient position to the ear.

NEW CONNECTOR LINE

Two battery or portable mating receptacles and plugs, equipped with center polarized pins and sockets, have been introduced by *H. H. Buggie, Inc.* of 726 Stanton St., Toledo 4, Ohio for application to walkie-talkie equipment and other similar electronic items.

Both types feature eight contacts. No. 2411 receptacle is pressurized to withstand 5 psi. It is 1⅝" in diameter and ⅞" thick and is designed for panel

mounting with a spanner ring. The mating plug, No. 2413, is equipped with a hood having a pull ring and right-angle cable clamp.

The HHB No. 2412 receptacle has a square flange for panel mounting. The dimensions are 1 1/16" center-to-center holes. Over-all thickness is 3/8". The mating plug, No. 2611, has the same specifications as the No. 2413.

"GUIDE-A-TUBE

S/C Laboratories, Inc., 37 George Street, Newark, N. J., is in production on a newly-patented service aid which has been tradenamed "Guide-A-Tube."

The new unit is a low-loss plastic wafer designed to insure quick, safe, and simple insertion of miniature tubes into their sockets. The wafer is slipped over the tube pins and then the tube can be inserted into the socket with the ease of an octal, according to the company. The device is also said to reduce microphonics and prevent tube breakage.

TEST PROBE

Mic-Con, Inc., 521 Lehigh Ave., Union, N. Y., has introduced a new test probe which provides for instantaneous connection in any electronic circuit irrespective of space or size.

The new probe features a push-to-operate mechanism which frees the operator's hands without disturbing adjacent circuitry. This clip-on mechanism is combined with a chrome-plate hardened steel hook which fits over circuit wiring.

A four-page brochure on this probe is available on request.

PARTS CABINET

Aurora Equipment Company's Equipto Division, Aurora, Illinois, has added six new storage cabinets to its line of equipment for service shops, dealer, and distributor stockrooms.

The new units combine drawers for small parts and drawers for tiny parts in a single cabinet. The small parts drawers measure 5 5/8" wide x 11" deep

x 3 1/8" high and are regularly furnished with two flush-fitting adjustable dividers. The tiny parts drawers measure 11" wide x 11" deep x 1 1/4" high and can be divided into 28 separate adjustable compartments. Any two of the drawers for tiny parts are interchangeable with any two of the small parts drawers.

"SIGNAL SENTRY"

E. F. Johnson Company, Waseca, Minn., has developed a new product of interest to the amateur.

Known as the "Signal Sentry" the new unit is designed to perform four major station functions. It operates on all of the amateur bands to 50 mc. and requires no tuning after initial adjustment. It monitors radiotelephone signals, monitors c.w. signals, acts as an "on-the-air" indicator, and provides for break-in by automatically muting the audio system of the receiver with

which it is used. It can also be used as a code practice oscillator.

Supplied completely wired and tested, it requires only two tubes and can be powered by the receiver power supply.

REMOTE VOLUME CONTROL

Controla-Tone Company, 111 No. Tacoma Ave., Tacoma 2, Washington, is in production on an inexpensive remote control volume control which can be used with either radio or television receivers.

The new unit is a rheostatic volume control which connects to one of the speaker wires in the set. Volume can be set at any level desired by the user.

Simple installation instructions are packed with each unit and installation can be completed in a matter of minutes.

TUBE CADDY

Windsor Electronic Tube Co., 1515 Sheepshead Bay Road, Brooklyn 35, N. Y., is now offering a sturdily-built tube caddy which is capable of holding all the necessary tubes, meters, and tools for servicing in the home.

This compact and light caddy is fully described in an illustrated bulletin which the company will send free on request.

TAPE SPLICER

Cousino, Inc., 2321 Madison Ave., Toledo 2, Ohio has just introduced a new splicing device for magnetic recording tape.

The back of the splicer, formed in plastic, is provided with an adhesive mounting material for firmly attaching it to the tape recorder or work table.

The splice is quickly and neatly accomplished by pressing the tape ends into a groove, overlapping each other about one-half inch. No clamps are necessary, edge friction holding the tape in place. The ends are then trimmed by running a blade through a guide slot and pressing the splicing tape over the joint. The company will send a free folder on request. —30—

TUBES & PARTS

ALL TUBES are guaranteed for one year . . . individually boxed. Very BEST BRANDS available for immediate delivery!

0A4	1.04	2A6	89c	6AH6	1.89	6BH6	69c	6K5GT	.69	6SQ7		7C5	.89	12AU7	.79	12SN7GT	.99	26	59c	57	79c
0Z4	59c	2A7		6AK5	.89	6BJ6		6K6GT	.59	6SQ7GT	59c	7C6	79c	12AV6	.59	12Q7		27		58	
0Z4G		2B3	.89	6AK6	1.08	6BK7	1.19	6K7GT	.69	6SR7GT		7C7		12AV7	.89	12SQ7GT	69c	35A5	.99	70L7	1.49
1A5GT	.79	2B7	.89	6AL5	69c	6BL7	.79	6K8GT	1.19	6SS7	.99	7E5		12AW6	1.19	12SR7GT		35B5		70L7GT	
1A7	.69	2C34	.60	6AQ5		6BN6	1.19	6L5G	.95	6T7G	1.15	7E6	79c	12AX4	.69	12Z3	.95	35C5	69c	71A	.87
1A7GT	.79	2E5	.89	6AQ6	.81	6BQ6G	1.19	6L6G		6T8	.89	7E7		12AX7	.69	14A7	1.05	35L6		75	.79
1B3GT	.95	2X2/879	.74	6AQ7	1.19	6BQ6GT	1.19	6L6GA	95c	6U5		7F7	.89	14AF7	.93	35W4	.59	35C5		77	.69
1B5	.29	3LF4	1.25	6AR5	.79	6BQ7	1.29	6L7	1.19	6U6GT	69c	7F8	1.47	14B6	89c	35Y4	99c	78/6D6	1.10	77	
1N5GT	.59	3Q4	.69	6AT6	.59	6BZ7		6N6G	1.40	6U7G		7F7	1.19	14B8		35Z3		80	.69	78	
1J6GT	69c	3Q5GT	.89	6AS5	.90	6C4	.59	6N7GT	1.19	6U8	.89	7H7	1.05	14C5	1.25	35Z4GT	.75	83	1.45	79	
1L4		3S4	.69	6AU5GT	1.29	6C5GT		6P5GT	.69	6V3	1.29	7J7	1.19	14C7	1.12	35Z5	.55	84/6Z4	.72	85	
1L6	1.29	3V4	.95	6AU6	.59	6C6	69c	6Q7GT	.59	6V6GT	.69	7K7		14F7	1.05	35/51	.79	85	.79	117L7	1.40
1LA4	1.19	5T4	1.40	6AV5GT	.89	6C8G	1.29	6R7GT	.69	6W4GT	.59	7L7	.79	14F8	1.45	36	1.06	VR90	$1.19	117N7	1.95
1LA6	1.19	5U4G	.59	6AV6	.59	6CB6		6S4	.59	6W6	.69	7N7	.69	14H7	1.12	37	.93	VR105		117P7	1.95
1LC5	.69	5V4G	.87	6AX4	.69	6CD6	2.49	6S7GT	1.15	6X4		7Q7	.79	14Q7	1.05	38	88c	VR150		117Z3	.59
1LC6	1.19	5W4	59c	6AX5	.79	6CD6G	1.69	6S8GT	1.25	6X5GT	59c	7R7	1.19	14W7	1.19	39/44		VT51	29c	117Z6	1.19
1LD5		5W4GT		6AX6	.69	6CF6		6SA7GT	69c	6X8	1.29	7S7	1.19	14X7	1.19	41	.72	VT52		715B	7.75
1LE3	1.19	5Y3GT	.45	6AY5GT	.89	6D6/78	1.19	6SC7		6Y6G	.69	7V7	.79	19BG6	1.89	42	.69	VT61A	1.40	807	1.55
1LH4	1.19	5Y4G	.54	6B4G	1.44	6D8G	1.15	6SD7GT	.99	6Z4/84	.72	7W7	1.19	19BG6G		43	72c	117L7		856A	1.49
1LN5	1.19	5X4G	81c	6B8GT	1.15	6E5	.69	6SF5	.59	7A4	.95	7X6	1.05	19T8	.89	45	.69	117N7		1299	49c
1N5GT		5Z3		6BA6	.59	6F5GT	59c	6SF5GT	.59	7A5	1.19	7X7	79c	20	1.45	45Z5		117P7		1619	
1P5GT	79c	6A3	1.68	6BA7	.89	6F6GT		6SG7	69c	7A6	.89	7Y4	.89	24A	.69	50A5	89c	117Z3		2051	1.15
1Q5GT		6A7	89c	6BC5	.69	6r7	1.59	6SH7		7A7	79c	7Z4		25AC5GT	1.04	50A5	1.05	117Z6			
1R5		6A8GT	69c	6BC7	1.05	6F8G	1.59	6SH7GT	.69	7A8		12A7	1.59	25BQ6	1.19	50B5		715B			
1S4	.99	6AB4		6BD5GT	.89	6G6G	.95	6SJ7	.79	7B4	.89	12A8	.69	25BQ6GT		50C5	69c	7155			
1S5		6AB7	1.15	6BE6	.59	6H6GT	.89	6SJ7GT	59c	7B5	.89	12AH7	1.38	25L6GT	.59	50C6G	1.39				
1T4	69c	6AC5GT	.89	6BF5	69c	6J5GT	.59	6SK7GT		7B6	.89	12AL5	.54	25W4GT	.69	50L6	.69				
1U4		6AC7	1.45	6BF6		6J6	.79	6SL7GT	.69	7B7	89c	12AT6	.59	25Z5	.69	50X6	.69				
1U5	.59	6AF4	1.19	6BG6	1.89	6J7G	.69	6SN7GT	.69	7B8		12AT7	.89	25Z6GT	.69	50Y6	.99				
1V	89c	6AG5	1.05	6BG6G		6J8G	1.15			7C4	1.30	12AU6	.69	32L7GT	1.15						
1X2A		6AG7	1.49																		

SPECIAL

10% DISCOUNT

on orders of 100 tubes or more. 5% DISCOUNT on orders of 50 to 99 tubes.

FREE

$20 list value assortment of filter condensers with order of 50 or more tubes.

FILTER CONDENSERS

FP Type or Tubular With Leads.
Fresh Stocks Always

8 mfd.	450 V.	.35	10 mfd.	50 V.	.19
8-8	450 V.	.45	20-	50 V.	.19
10-	450 V.	.39	25-	50 V.	.19
10-10	450 V.	.45	50-	50 V.	.25
20-	450 V.	.45	100-	50 V.	.29
20-20	450 V.	.49			
30	450 V.	.45	20 mfd.	150 V.	.35
30-30	450 V.	.59	20-20	150 V.	.45
40	450 V.	.49	30	150 V.	.45
40-40	450 V.	.69	30-30	150 V.	.49
60	450 V.	.69	40	150 V.	.49
60-40	450 V.	.89	40-20	150 V.	.49
80	450 V.	.69	40-40	150 V.	.49
80-40	450 V.	1.29	50-30	150 V.	.49

Teleron TV Wave Trap

For VHF Channels 2 through 13. Clears VHF picture, stops interference at once. 30 seconds to attach.
ea. net $1.75
All UHF channels $2.75

RADAR TYPE TV ANTENNA

For UHF and VHF
RECEIVES ALL CHANNELS

212 miles reception recorded. 125 miles common. This unbeatable antenna has been reinforced to withstand 150 mile winds.

Satisfaction guaranteed or your money back. Less Mast. List Price $49.95
Your Cost $19.95

5 ft. ALUMINUM MAST heavy gauge 1¼" diam. with interlocking end. Slip two sections together for a ten-footer. 5 sections = 25ft.
Each section $1.25

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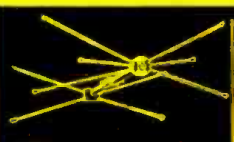
50 Condensers assorted in package $6.95

600 VOLT			400 VOLT	
.001	9c	.05		12c
.002	9c	.1		19c
.005	9c	.25 mfd.		ea. 15c
.01	12c	.5 mfd.		ea. 29c
.02	12c			

TV Antennas



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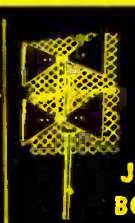
Double bay array, with stacking bars . . $7.75

4 Bay array, with harness and stacking bars $14.95

6 Element Conical. Only $2.95



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UHF Antenna
Bowtie Reflector
Ultra-high Gain

Completely assembled—ready to mount. For all UHF Channels—easy to stack for two or four-bay

Single Bay $4.50
Two Bay, complete . $8.45

Midget Radar Outdoor UHF antenna $4.77

Standard Coil UHF TV tuner strips fit into your tuner in place of unused VHF strips. Set of strips consists of matched antenna & oscillator sections. For all channels 14 through 82. Specify channel wanted as well as letter indicating model of standard coil tuner such as 25K or 19Q or 31F/G etc.
1 set required per channel net each set $7.35

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I. F. TRANSFORMER—456 Kc. . . . 29c
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VOLUME CONTROLS FOR SWITCH. 2" shaft. 1 meg, ½ meg, ¼ meg 34c
SINGLE ION TRAPS 19c
DOUBLE ION TRAPS ..... ea. 29c
OUTPUT TRANSFORMER—for 50L6 29c, for 6V6 39c
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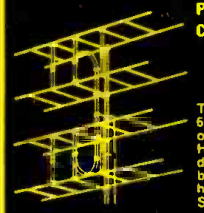
65 mil	.69
75 mil	.79
100 mil	.89
150 mil	1.29
250 mil	1.65
300 mil	1.75
350 mil	1.95
400 mil	2.45
450 mil	2.49
500 mil	2.55

THE DUAL LAZY H



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The dual LAZY H. Only 6 connections instead of 40. A snap-on Lazy H is the serviceman's desire for the UHF-VHF band. One lead in for high gain UHF-VHF. Strictly for the fringes.

UHF Antenna Kit

Includes everything you need.
1.) UHF bow tie antenna with reflector.
2.) 3 mast sections.
3.) Jumbo 300 ohm tubular transmission line.
4.) Sealer cap for UHF transmission line.
5.) Universal mast base.
6.) 50 ft. top quality guy wire.
7.) 3 screw eye anchors for guy wire.
8.) Guy wire ring.
9.) 3 stand off insulators for 300 ohm transmission line.
10.) 2 mast stand off insulators for 300 ohm transmission line.
11.) Illustrated instructions for quick, easy assembly.

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Double bay array complete as above plus 5 mast sections and matching device for proper stacking $11.77

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Insulated ½, 1 and 2-watt assortment of most used values. I.R.C. Ohmite, Stackpole, Speer. 100 for $2.95

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Rectangular Tubes Are Supplied With Daylight Type Dark Face

SIZE	PRICE	SIZE	PRICE
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8BP4	21.00		
10BP4	15.95		
12JP4	18.60	17HP4	25.10
12UP4	19.95	17TP4	28.70
14BP4	21.28	19DP4	
15AP4	21.50	19FP4	29.95
16AP4	22.95	20CP4	32.30
16CP4	23.00	21EP4	
16EP4	26.95	21FP4	32.30
16GP4	23.80	21MP4	67.95
16JP4		21AP4	
16KP4	23.80	24CP4	77.30
16LP4		24DP4	
16MP4	23.80	27EP4	98.50
16WP4		27GP4	
17BP4	25.10	27JP4	98.50
17GP4		27NP4	89.95
17CP4		27RP4	99.95

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12" COAXIAL PM SPEAKERS. High Fidelity with Crossover filter attached. 20 watts! 40-15,000 cps. response! 8 ohm Voice-Coil. ea. $12.95
15" COAXIAL SPEAKER. 20-27,500 cps. ea. $19.95
Very best quality — NATIONAL BRANDS. Individually Packed.

3"	ea. $1.39
4"	ea. 1.59
5"	ea. 1.79
6" SPECIAL PRICE	ea. 1.23
8"	ea. 1.95
10" ea. $5.10	12" ea. $5.95

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Easily installed consisting of rectangular tube, 70 degree yoke, beautiful mask, flyback transformer and width coil.

17" Conversion Kit, as above, complete	$24.95
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21" Conversion Kit, as above, complete	31.95
24" Conversion Kit, as above, complete	89.95
24" Conversion Kit, Round	69.95
27" Conversion Kit, as above, complete	129.95

27" Kit Contains 90° yoke

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55 Mil. 100 ft.	$ 1.59
1,000 ft.	13.95
20 Ga. 80 Mil. 100 ft.	1.89
1,000 ft.	16.95
UHF TUBULAR 300 OHM LINE 1,000 ft.	$34.50
100 ft.	$4.95

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3Q4, 1T4, 1R5, 1S5. List Value $8.00. Tube Kit only.	$1.98
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All Four Tubes for	$2.49
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50L6GT, 35Z5GT, 12SQ7GT, 12SK7G, 12SA7G. 5 Tubes for	

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TERMS: 25% DEPOSIT with order, balance C.O.D. ALL shipments F.O.B. Chicago. ORDERS LESS THAN $5.00—$1.00 SERVICE CHARGE. CABLE ADDRESS: CONTULAB. These prices supersede all previously advertised prices, subject to change

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Applause Meter

(*Continued from page* 83)

of voltage gain or db level. In such a case, new resistors may be chosen for this network. Refer to *Federal's* "Reference Data for Radio Engineers" for the necessary design formulas.

A continuously variable attenuator control may be provided if desired. Simply use a standard 1000 ohm potentiometer in place of S_1 and its associated resistors.

If the completed instrument is to be used in other than "applause meter" applications, the builder may wish to provide frequency selective filter networks so the frequency response of the amplifier can be adjusted for special measurements. Again, filter network design data will be found in the handbook mentioned previously.

Calibration: As long as the instrument is used only as a peak-reading device, there is no need for meter scale calibration, either in db or in other terms, and none is provided in the model. Should the builder wish to use the instrument for absolute sound level measurements, however, not only will scale calibration be necessary, but the attenuator switch will have to provide precisely known amounts of attenuation.

Meter calibration is best carried out by borrowing a standard sound-survey meter or similar instrument and obtaining comparative readings. The final calibration may either be a chart or curve or, if preferred, a new scale may be prepared for the meter itself.

Applications

To use the completed instrument as an applause meter, place it on a small stand or table with the microphone facing the audience. Set the attenuator switch (S_1) in the maximum attenuation (minimum signal) position. The meter switch (S_2) may be set either in the "filter" or "peaks" position, as preferred by the individual operator, but the switch position should be left fixed during any series of tests.

The power switch should now be turned "on." The meter reading should be noted during the program and the attenuator switch adjusted for a one-third to one-half full-scale reading during a particularly good "hand" and before actual "voting" takes place. As an alternative, the audience may be asked for a good "hand" before the program starts, and the attenuator switch adjusted at this time.

Once set, the switch is left in position until all contestant "voting" is completed.

In some cases it may be desirable to have two or three "judges" to note the meter reading during voting to avoid any possibilities of error.

In addition to its use as an applause meter, the completed instrument has many other possible applications. For example, when placed in front of a

receiver's loudspeaker, it may be used as a "no connection" output meter. Good results can be obtained in this application if the background noise level is not too high.

When calibrated, the instrument may be used as a sound-survey meter and, in this application, is useful for checking noise levels in offices, stores, schools, and factories. In many cases, the background noise level has a definite effect on workers' efficiency.

When used in conjunction with a fixed audio signal source, the instrument will permit tests of the comparative sound absorption qualities of different types of draperies, acoustic tile, and floor coverings.

Installers of p.a. systems could use such an instrument for checking sound distribution in a particular installation, both to insure adequate coverage and to prevent "loud spots."

These suggestions cover only the more obvious applications, however. The reader will undoubtedly think of many additional applications both in regard to his own work and of a general nature. -30-

Power Amplifier Output

(*Continued from page 54*)

of 30 watts direct on the "MED" output scale. This means with minimum efficiency we can expect an output of 30 watts from this tube. By pivoting the indicator on 20 and passing through the efficiency range for class C amplifiers we read increasing outputs finally reaching 80 watts at 80 per-cent.

On the other hand, assume that 5 watts of r.f. driving power is required and a buffer of adequate plate dissipation must be selected. Place the indicator on 5 on the "LO" power output scale and on 70 per-cent on the "E" scale. We read a dissipation of slightly more than 2 watts on the "LO" dissipation scale. Pivoting on 5 down toward 60 per-cent we see an increase in dissipation allowance to over 3 watts. Thus, while a 2 watter operating at good efficiency will do, a 3 or 3½ watter would be a safer choice.

It should be remembered when estimating power output that coupling networks may also dissipate power. Generally, these circuits can be made highly efficient by good design and construction, and these losses can be neglected in the estimate. Also remember that push-pull amplifiers have an allowable dissipation of twice the single tube value.

Table 1 is a tabulation of multiplying factors for various amplifier plate efficiencies. A rule-of-thumb for quick mental estimates can be deduced from this table. Notice that if the numerator and the denominator of the efficiency fraction are consecutive integers such as 4/5 or 6/7 the output multiplier is the numerator of this fraction. This rule applies for efficiencies of ½ or more. For

efficiencies of ¼ and ⅓ notice that the multiplying fraction is the same with the denominator diminished by one. For example, if a tube of 250 watts maximum allowable plate dissipation is operated at ¾ efficiency (75 per-cent) the output is 3 x 250 or 750 watts. At ⅓ efficiency (33.3 per-cent) the output is ½ x 250 or 125 watts.

The analytical basis for the nomograph in this article is as follows:

If P_o is power output, P_i is power input, and E is efficiency,

$$E = P_o/P_i \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

and:

$$P_i = P_d + P_o \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

if P_d is the power dissipated in the amplifier. Substituting eq. (2) in (1)

$$E = P_o/(P_d + P_o)$$

rearranging, $P_o = EP_d/(1\text{-}E)$. (3)

—30—

Crystal Substitute

(*Continued from page 47*)

transmitter was wired to key both stages as described in the step-by-step assembly instructions, the oscillator signal on 80 meters does not interfere with listening on that particular frequency. On forty meters the signal is hardly noticeable.

The transmitter is tuned the same way that it would be tuned when using a crystal. However, care should be exercised in setting the oscillator within the amateur bands. This can be done quite easily with a calibrated receiver or by listening for other amateurs on either side of the frequency which you wish to use. If more bandspread is wanted, remove two of the rotor plates from the 50 $\mu\mu$fd. tuning condenser, or substitute a smaller condenser. Of course, on forty meters the dial division coverage will be less than half of the 80-meter band, so make the adjustments carefully.

In the photograph of Fig. 1 showing the v.f.o. and transmitter, the oscillator coil seems to be too close to the transmitter cabinet. This does not affect the operation of the v.f.o., nor does it affect its stability. The oscillator coil should be mounted as far away from the tubes as possible to prevent heat drift.

The photograph of the inside of the v.f.o. box (Fig. 3) shows the arrangement of components. Placement of parts is not too critical and almost any arrangement can be used. The 100 $\mu\mu$fd. padding condenser is mounted so that screwdriver adjustments can be made from the top of the box. Inserting and removing the screwdriver when making adjustments should not cause too much change in the setting of the oscillator frequency.

No trouble should occur by following the general v.f.o. layout shown in the photographs. Careful placement of parts and normal construction procedure will provide a compact, stable v.f.o. —30—

FACTS NOT JUST CLAIMS

FACT- 53 CLAIMS GRANTED IN 5 UNITED STATES PATENTS—

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FACT- These antennas positively receive ALL channels 2-83 from ALL directions without a rotor motor.

MONEY BACK GUARANTEED TO RECEIVE *All* CHANNELS 2-83 FROM *All* DIRECTIONS AND POSITIVELY OUTPERFORM *All* OTHER ANTENNAS WITH OR WITHOUT A ROTORMOTOR

FACT- These antennas have consistently OUT-GAINED and OUT-PERFORMED all others in actual public demonstrations.

FACT- These antennas will unquestionably OUT-PERFORM all others, on YOUR roof, with YOUR set, or YOUR money back.

FACT- SAVES YOU MONEY. Eliminates rotor motor, uses only ONE transmission line, uses only ONE antenna for both UHF & VHF—and only ONE simple, quick installation.

FACT- Perfect pictures have consistently been received as far as 3 times the guaranteed distances.

FACT- ONLY one antenna, ONLY one transmission line, ONLY one installation. You solve once and for all your PRESENT and FUTURE antenna problems.

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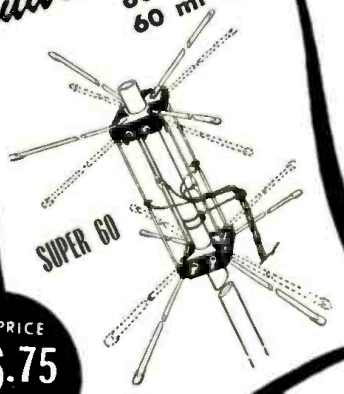

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PRICE INCLUDES

Antenna arrays - necessary stacking bars - 9 position switch - switch-to-set coupler - necessary hook-up harness - 7½" stand-offs Individually boxed in mailable carton.

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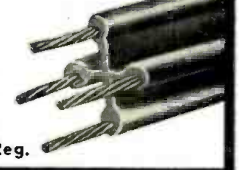

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Technical BOOKS

"GUIDE TO AUDIO REPRODUCTION" by David Fidelman. Published by *John F. Rider Publisher, Inc.,* New York. 228 pages. Price $3.50. Paper bound.

This is a companion volume to Harold D. Weiler's "High Fidelity Simplified" (*Rider*) which was written for the audiophile without technical background. This book is addressed to the experimenter, engineer, and technician. The approach is more technical than the previous volume and delves into the "why's and wherefore's" more deeply.

The text material covers the high-fidelity reproduction of sound, sound principles, sound reproducing systems, input and pickup units, audio amplifier theory, practical audio amplifier circuits, a.f. networks and corrective circuits, loudspeakers and loudspeaker enclosures, complete hi-fi systems, magnetic recording, and the measurement of quality of audio reproduction.

Readers of this magazine are long familiar with the author's style as he has contributed numerous articles on audio subjects. They will find that, like his articles, this book is written in easy-to-understand style. The text material is lavishly illustrated and amplified by means of photographs, circuit diagrams, and graphs.

Those who install, service, or build audio equipment will find this volume a welcome addition to their bookshelves.

* * *

"MOST-OFTEN-NEEDED 1953 RADIO DIAGRAMS" compiled by M. N. Beitman. Published by *Supreme Publications,* Chicago. 192 pages. Price $2.50.

This is the thirteenth volume in the "radio" series published by *Supreme.*

As is the case with the previous volumes, this new publication reproduces factory service data as supplied by the manufacturers represented. Included are AM and FM radio receivers, auto radios, portables, combination sets, record changers, and receivers employing printed circuits.

The products of approximately thirty-five companies are covered in this particular volume.

* * *

"RADIO DATA CHARTS" by R. T. Beatty, revised by J. M. Sowerby. Published by *Iliffe & Sons, Ltd.,* London. Available in the U. S. from *The British Book Centre,* 122 E. 55th Street, New York 22. 91 pages. Price $1.75.

This book is a series of 43 nomographs covering data required in the design of radio receivers.

These nomographs originally appeared in the British technical journal, *"Wireless World",* and have been assembled in this convenient form for reference purposes.

The charts cover such items as frequency and wavelength; inductance, capacity, and frequency; self-inductance; r.f. coil windings; reactance of coils or condensers; transformer design; choke and transformer design; etc.

The only "equipment" required to utilize any of the nomograms is a straightedge. All the desired data can then be read directly.

For the engineer, the experimenter, or the hobbyist who likes to "roll his own" either as a vocation or an avocation, this book should be invaluable.

* * *

"DATA AND CIRCUITS OF TELEVISION RECEIVING VALVES" by J. Jager. Published by *Philips Technical Library,* Eindhoven. Available in the U. S. from *Elsevier Press Inc.,* 402 Lovett Blvd., Houston 6, Texas. 215 pages. Price $4.50.

This is the third in the current *Philips* series dealing with electronic tubes and covers the tubes encountered in modern television receivers.

The discussion centers around tubes made by *Philips* in Holland for receiving sets operating on European standards. In this respect the text is not directly applicable to U. S.-made receivers but the basic engineering data contained in the book as well as the receiver circuitry will be of interest to all in the television field.

The book is divided into three sections. The first discusses each type of tube and provides full information on applications and correct operating conditions. The second section covers typical circuits while the third contains a short description of various measuring instruments suitable for testing, troubleshooting, etc.

* * *

"TECHNIQUES OF TELEVISION PRODUCTION" by Rudy Bretz. Published by *McGraw-Hill Book Company,* New York. 464 pages. Price $10.00.

This is a comprehensive handbook for the studio engineer and technician as it covers all of the equipment and materials used in producing television programs.

The book is divided into twenty chapters which deal with the television cameraman, cameras, and camera handling; TV lenses; cutting; switching equipment; technical limitations and the production problems involved; graphic materials; projection equipment; mirrors and prisms; composite shots and the illusion of space; special effects with graphic materials; studio effects; electronic effects; television scenery, make-up, and lighting; audio problems in TV; and remote pickups.

The author has prepared this material based on the assumption that personnel at the average television station (non-network originating station) has to "double in brass." Many "engineers" in smaller stations are vitally involved in "production" and *vice versa* and the author rightly feels that a broadening of the scope of both the "engineer's" and "production man's" job is a natural process to insure close coordination in all facets of programming.

We predict that this book will be-

come a "standard" in the production field as the material covered is primarily basic and, on the whole, not subject to obsolescence even in the face of the imminence of widespread color telecasting.

* * *

"RADIO AMATEUR QUESTION & ANSWER LICENSE GUIDE" compiled and published by *American Electronics Company,* 1203 Bryant Ave., New York. 32-pages. 50 cents. Paper bound.

This compact handbook carries sample questions and answers for Novice, General, and Technician classes of license examinations.

The material is divided into sections, one covering the Novice class and the balance the General and Technician classes. Practice questions cover the basic electricity, power supplies, transmitters and receivers, and rules and regulations elements for the Novice class and the same elements for the other two classes with the addition of the element covering vacuum tubes and audio amplifiers.

* * *

"UHF TELEVISION ANTENNAS AND CONVERTERS" by Allan Lytel. Published by *John F. Rider Publisher, Inc.,* New York. 113 pages. Price $1.80. Paper bound.

This is a practical handbook for the television service technician. It explains in easy-to-understand terms just how the various u.h.f. conversion systems work and how to select and install suitable antennas to be used with sets operating in the ultra-high television bands.

The book is divided into seven chapters dealing with conversion systems and installation problems, transmission lines, antennas, converter circuits, single-channel converters, full-range converters, and all-channel tuners.

The author describes and discusses some commercial units as typical of the units available. The lavish use of circuit diagrams and photographs enhances the value of this work as a guide to servicing procedures.

Any technician familiar with v.h.f. receiver circuitry will be able to handle the material in this book. Treatment is non-mathematical and explanations are lucid. —30—

READERS' BOOK SERVICE

AT THE suggestion of many of our readers, who either live in communities which do not have adequate bookstore facilities or who would like to enjoy the convenience of receiving their books by mail, we have established a Book Department in this magazine.

This department will be able to supply its readers with any book in print in our field. Each month it will carry advertisements featuring a number of important radio-TV-audio-electronics titles, new and old, issued by leading publishers of this country.

We hope that our readers will find this new department helpful and that you will take full advantage of its facilities. —30—

International Short-Wave

(*Continued from page 84*)

Colombia—Bogota, 6.000, noted 2200-2300 with Spanish news, music. (Zerosh, Pa.) HJKH, 5.070, Sutatenza, announces 5.070 and 1580 kc., closes with National Anthem 2100; announced Sun. opening as 0800; on Sat. has "La Accion Cultural Popular esta en Marcha" before closedown; good level; all-Spanish. (Kahan, Calif.) NNRC reports *Radio Continental*, HJKE, 4.835, Bogota, logged 2105-2200 in Spanish.

Costa Rica—TIFC, 9.645, noted 2300-2330 Sun. with "Old-Fashioned Revival Hour." (Tandrow, Calif.) Heard closing 0005; requested reports to "Lighthouse of the Caribbean," Box 1307, San Jose, Costa Rica. (Smith, Ga.)

Cuba—Radio Reporter, COCW, Prado 53, Havana, lists 6.330 (*measured* 6.314), at 0600-2400, 1 kw. (Roberts, Conn.) COKG, 8.955, Santiago, noted at high level 1530. (Grenell, Ohio)

Czechoslovakia—Prague, 9.504, noted signing on *English* session 0715; ran to 0740. (Pearce, England) Heard on 7.255 at 1930-2000 with news for North America. (Smits, Minn., others)

Denmark—Copenhagen, 15.165, strong 0700-1000; *English* 0950; is beamed to South Asia. (Saylor, Va.; Kirby, Mo.; Earnhardt, N. C., others)

Ecuador—HCJB, 9.745, noted ending Russian 0100, continuing in Spanish. (Wilcox, Mo.; Milnes, Ore., others) Heard on 17.890 to Europe with Swedish 1535. (Saremba, Va.)

Egypt—Radio Cairo, 15.315, noted 0915 with Arabic music; closed 0930 after call in Arabic. (Pearce, England) Noted on 11.965 with Arabic music 1445. (Ferguson, N. C., others) The 9.475 outlet is strong around 1500. (Mitchell, N. Y.; Zerosh, Pa., others)

El Salvador—YSUA, 6.100A, San Salvador, noted in Spanish 2130-2230. (Kahan, Calif.) San Salvador, 9.55A, noted closing in Spanish 2330. (Zerosh, Pa.) YSS, 6.010, heard with marimba music and announcements in Spanish at 2310 to closedown 0006 (Roberts, Conn.) YSWW, Santa Ana, noted *best* 2030-2100. (Stark, Texas) YSAXA, 11.950, noted 1540-1600, good level. (URDXC)

Ethiopia—Radio Addis Ababa, 15.047AV, noted with news some days 1315-1325, then dance music with *English* vocals. (Zerosh, Pa.) Seems to have recorded music 1330-1400 with announcements in *English*. (Earnhardt, N. C.)

Finland—Revised schedules of Helsinki include to South America 0430-0550 on 15.190, 17.800; to North America 0600-0800 on 15.190, 17.800; from 0700 also on 9.555. (*WRH*)

France—Paris, 9.550, noted 0400 with music. (Tandrow, Calif.) Noted closing 1600 on 7.105. (Zerosh, Pa.; Ferguson, N. C.) Heard on 5.955 in Spanish to 1645 closedown. (Stark, Texas) Noted closing 0715 on 21.740. (Gillett, Australia) Excellent on 15.400 closing 1000. (Bishop, Ohio)

French Equatorial Africa—Radio Brazzaville, 11.970, 9.440, has French-*English* lesson ("The French Have a Word For It") at 1445-1500; news to Far East on these channels 1100. (Pearce, England)

French Guiana—Radio Cayenne, 6.205, noted with news in French 1800 (by woman); poor level and with QRM from Rome, 6.210. (Huttemeyer, N. J.; Mercier, France)

French West Africa—Radio Dakar, 9.560, noted with call and news in French 1500; at 0200 with recordings. (Pearce, England) Heard 0100-0300, 0700-0900, 1300-1900. Heard opening 0130 with "La Marseillaise" on 4.950; good level to 0300 tune-out. (Nilsson, Sweden; Morris, Pa.) Noted on 11.896A in French 1355-1550 and later. (Roberts, Conn.)

Germany—Cologne, 11.795, noted 1210-1224 fade-out. (Miller, Ga.)

Greece—The Greek station near 7.088 has been identified as Jannina; strong with recordings when tuned 1300. (Pearce, England) *Forces Station*, 7.420, Athens, is very good strength to 1704 closedown. (Buggins, England)

Greenland—OZL, 7.570, noted 0900-0945 with Danish or Icelandic and playing popular music. (Cody, Ireland)

Guatemala—TGNA, 5.952, noted 1750 with musical program. (Ferguson, N. C.) Heard closing *English* 2345. (Mitchell, N. Y.) TGNB, 9.668A, noted recently parallel TGNA, 5.952 with Spanish-*English* lesson 1900. (Bellington, N. Y.)

Haiti—Radio Haiti, 4VHW, 5.840, and 4VRW, 10.070A, is scheduled 0700-2200 weekdays, 0930-1800 Sun.; QRA is Radio Haiti, P.O. Box 737, Port-au-Prince. (ISWC, London) *Radio Commerce*, 4VC, 9.485, noted from before 0700 (probably still opens 0630) and still on the air at 1710. (Ferguson, N. C.) Heard closing 2300 on 6.095A in French and *English*, followed by National Anthem. (Zerosh, Pa.) 4VEH, 9.667A, good level beginning *English* 0805. (Bishop, Ohio) *Radio Citadelle*, 4VWA, 6.300, Cap Haitien, noted 2058-2205 closedown in French. (Roberts, Conn.)

Hawaii—VOA relay, 6.195, excellent 0515. (Reidler, Pa.)

Holland—Radio Nederland, 9.59, good level with *English* 1100. (Lund, Iowa) Noted on *new* 9.745 channel 1145 with Arabic, parallel 9.59. (Bellington, N. Y.)

Honduras—HRTL, *Radio Tela*, 6.035, is on the air daily *except* Sun. 0900-2300; has American music and songs 2120-2200. (ISWC, London) HRXW, 6.110A, Comayagueia, noted fair level closing 2300. (Niblack, Ind.)

Hong-Kong—ZBW3, 9.525, Victoria, noted with BBC news relay 0600. (Morgan, Calif.)

Hungary—Radio Budapest, 9.833, noted 2215-2230 in *English* with world news. (Rugel, Kansas)

India—Madras, 4.920, noted with news relay from Delhi 1030. Also at that time from Delhi, 9.750A, 4.760A. (Pearce, England) Heard closing on

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7.155 in *English* to Great Britain, Ireland 1644. (Ferguson, N. C.) Heard to South, East Africa 2300-0010 on 15.130, 11.870; to Far East on Sat., Sun. in *English* 0715-0730 over 9.670, 7.155, very strong signals in Tokyo. (Wada, Japan) Heard in French 1500 over 4.940. (Buggins, England) Noted in Calif. on 6.075 from around 0930 to after 1000 with *English* announcements. (Morgan, Balbi, Calif.)

Indo-China (Vietnam)—"The Voice of Vietnam," 9.620, has *English* 0930; *Radio Dalat,* 7.265, has French 0630-0730, closes 0745 with interval signal by native instrument; *Radio Hue,* 7.205, is heard 0815-0900 in French and with music, then closes with National Anthem. (Japanese Short Wave Club) *Radio France-Asie,* Saigon, is heard on 9.750A to Europe in French 1035-1100, then *English* to 1130A when closes with "La Marseillaise." (Pearce, England; Mesquita e Sousa, Portugal, others)

Iran—Radio Sanandaj broadcasts on 6.755 from 0830; heard in Germany. (ISWC, London)

Israel—Tel Aviv, 9.009A, opens 1415. (Niblack, Ind.) Sent verification form letter and listed "Voice of Zion" relay in *English* 1615-1700. (Lusty, Ont.) 4XB44, "Galei Zahal," heard at fair level 1345 on 6.705A with Western music. (*Nattugglan,* Sweden)

Italy—Rome noted on 7.290 signing on *English* 1330 to Great Britain; said parallel over 15.400, 11.80. (Pearce, England) Noted in *English* to North America from 1920A on 9.575. (Geisselbrecht, Texas; Zerosh, Pa., others) On 11.810 with news 1330-1345, good level. (Saylor, Va.) With news 2130-2145 on 7.290. (Zerosh, Pa.) Rome closes 0435 to Australia, New Zealand on 21.560, but opens again 0450 in Indonesian. (Gillett, Australia)

Jamaica—Radio Jamaica, 3.36, is good level to 2300 closedown; at times has QRM. (Jannis, S. C.)

Japan—The 7.180 outlet of *Radio Japan* is heard 0030 with news. (Tandrow, Calif.) Also good on 9.695 in parallel. (Stein, Calif.) When this was compiled, *Radio Japan* was being heard on 11.725 in Eastern USA in beam to South America 1700-1800 in Spanish, Portuguese, Japanese. (Ferguson, N. C.; Niblack, Ind., others) JBD3, 15.225, is fair 2200 to 2300 sign-off, in Japanese. (Morgan, Calif.)

Kenya Colony—VQ7LO, 4.855, Nairobi, is heard 1000-1500; 1300 BBC news relay; 1315 local news, then music; leaves air 1400 Sun. (ISWC, London)

Lebanon—Radio Beirut, 8.036, noted from 1415 tune-in to 1500 with Arabic, then music; news in Arabic 1520-1530 sign-off (Sun.) with National Anthem. (Saylor, Va.)

Libya—The *Forces Broadcasting Service,* Benghazi, has been using 0.5 kw. on 4.782 and 4.965; further *tests* with 7.5 kw. were to begin soon; scheduled 0000-1600; QRA for reports is FBS, Middle East No. 5, Benghazi, Cyrenaica-Libya. (ISWC, London) In verifying, asked for further reports; *not audible lately.* (Pearce, England)

Malaya—BFEBS, 11.820, noted to around 0900. (Stark, Texas) With news 0430. (Balbi, Calif.)

Mexico—XEVC, 9.630A, Mexico City, announces "XEV y XEVC, La Voz y Expression de Mejico," has news in Spanish weekdays 2315. (Kahan, Calif.)

Mozambique—CR7BU, 4.920, Lourenco Marques, is heard in the United Kingdom to 1600 (Sat. to 1700) through heavy CWQRM; CR7BV, 4.872A, has programs in Portuguese 1300-1615. (ISWC, London) News in Portuguese noted on this one 1500. (Mesquita e Sousa, Portugal) The 11.742AV channel is being heard again from 2300 in *English.* (Niblack, Ind.)

Nicaragua—YNBH, 6.547, *Radio Panamericana,* noted going *past* 2405 lately. (Stark, Texas)

Norway—Radio Norway, 11.735, noted Sun. with *English* ("Norway This Week") 1200-1215A. (Roemer, Ky.) Heard on 11.850A at 1050-1100 with church music (Karrer, Pa.) Good level on 7.210 at 2000-2100. (Zerosh, Pa.)

Okinawa—The VOA relay is now scheduled over 6.145 at 0500-0945 to China-Korea. Noted by Ballou, Calif., strong at 0555 on *measured* 6.1463.

Pakistan—Radio Pakistan, 17.710, noted with news 0330. (Cushen, N. Z.) Heard over 7.010, 6.235 with slow-speed news 1310-1330, opening on these channels 1445 to Turkey. (Pearce, England) Heard on 5.990A with news 1015. (Morgan, Calif.)

Panama—HOLA, 9.505, Colon, noted in *English* 1630. (Jannis, S. C.) *Radio Baru,* David, is still on 6.045 and goes past 2045. (Stark, Texas)

Peru — Radio Nacional del Peru, OAX4R, 15.150A, Lima, has special broadcast to Europe and North America 1200-1400 and requests reports; announces in *English,* French, Spanish. (ISWC, London) Heard closing on OAX4T, 9.562, at 2400 in Spanish, *English,* French, followed by National Anthem. (Smith, Ga., others)

Philippines — DZH7, 9.73, Manila, heard as early as 0100, signing off 0145 and returning around 0245; DZH9, 11.855, audible with fair level then. (Balbi, Calif.) DZH5, 9.69, noted at nice level with news 0615. (Saylor, Va.)

Poland—Radio Warsaw noted near 5.93 and 6.192 (varies as high as 6.197) with news 1730-1800; with *English* 1400, 1500 on 6.025. (Pearce, England)

The RCA Color TV Dynamic Demonstrator, which will be used by the RCA Service Company to explain the operation and servicing of color TV to service technicians, is shown here as it was unveiled at the Chicago convention of the National Alliance of Television & Electronic Service Associations. Mr. E. R. Klingemann who helped develop this working model of a color TV set into which troubles may be introduced and their effect on the picture demonstrated, is shown as he lectured to an audience of 300 service technicians.

Heard opening 1501 on 6.195 with *English* for Europe, fair level. (Bellington, N. Y.)

Portugal—Lisbon, 6,374, noted 1700-1830 with Portuguese news, music. (Zerosh, Pa.) Overseas Service is now scheduled 0600-0800, 0945-1200, 15.030; 1230-1530, 11.836, 11.996; 1600-1830, 11.960, 11.996; 1900-2100, 5.976, 6.374, 9.746. (*WRH*) Heard recently on 9.795A around 1340 parallel 9.740. (Earnhardt, N. C.; Bellington, N. Y.)

Portuguese India—Radio Goa, 9.610, now seems to have "The Catholic Hour" in *English daily* 1100-1130; closes down 1230. (Pearce, England)

Portuguese Guinea—CQM, Bissau, has been reported heard in Sweden and Belgium *testing* on 9.380 from 1640 to 1800 closedown. (Radio Sweden)

Reunion—St. Denis is using 4.820, 7.170 in French 2130-2245, 0300-0430, 0900-1330 weekdays, and 2300-0000, 0130-0530, 0900-1330 Sun. (Scheiner, N. J.)

Roumania—Radio Bucharest, 9.254A, noted 1447 with news by man and woman. (Ferguson, N. C.) Heard opening on 9.57 at 1200 preceded by interval signal and a long march sung by chorus; then appeared to use Roumanian. Heard with *English* 2200-2230 to North America; good level but with bad QRM at times. (Saylor, Va.; Bellington, N. Y.)

Sao Tome—Radio Clube de Sao Tome e Principe, CR5SB, 17.677A, noted Sun. 0700-0800, very weak level in Portuguese. (Mesquita e Sousa, Portugal) CR5SC, 4.807, heard 1530-1600 closedown. (Miemois, Finland)

South Africa—SABC noted "calling Africa" closing 1535 on 11.937; news 1500. (Pearce, England)

Spain—FET1, 7.006, Valladolid, noted 1815 with variety program of music; faded out before 1830; all-Spanish; "Transmite Emisora La Radio Puerto Santa Maria," 7.210A, noted 1740 with varied recordings. (Pearce, England) Madrid, 9.363, noted with *English* to North America 2215-2245A. (Irvine, Texas, others) And 1800-1840A. (Parrish, Ga.; Connelly, O., others) A *new* station is *Radio Falange de Villanueva,* 7.015, at 1500-1615; relays news in Spanish from Madrid at 1600. (*WRH*)

Sweden—Radio Sweden, 7.210, noted 1300 with *English* for Africa. (Pearce, England) Heard with news 1930 over 6.065. (Roemer, Ky., others)

Switzerland—Home Service noted over HER22, 3.985, at 1645 with music. Noted opening in *English* to Great Britain, Ireland 1345 on 6.055, 9.665. (Pearce, England) This beam is heard well 1345-1530 closedown over the 9.665 outlet. (Smits, Minn., others) The 11.865 outlet noted opening 1015 at good level. (Welch, Mass.) The 9.535 channel is noted 1325 with news in German. (Saremba, Va.)

Taiwan—"Voice of Free China," Taipeh, noted on 11.735 in *English* 0045 asking for reception reports. (Gillett, Australia) Taipeh, 9.785, heard with Western music 0500-0600, good level. (Balbi, Calif.)

Tangier—Radio Africa, 7.193, noted

with Spanish songs 1700; intermittent QRM. (Pearce, England) *Pan American Radio* uses 1178 kc., 7.290 at 0400-2000 in six languages. (*WRH*)

Thailand—Radio Thailand, 11.670, noted 0855 with Home Service relay; closes 0920. (Pearce, England) With news 0500-0520, in Overseas Service, then with program for Thai Forces in Korea. (Churchill, Calif., others) The North American transmission on 11.670 at 2315-0015 is audible in Australia. *(Radio Australia)* This transmission is seldom if ever heard in North America, however.

Trieste—British Forces Station, 15.125, is heard in Sweden around 1500.

Trinidad—Radio Trinidad, 6.085, Port-of-Spain, noted with popular recordings, time checks 0505-0525. (Morris, Pa.) Lists this outlet at 0500-1700; 3.275 at 0500-2200. (Hardwick, N. Z.)

Vatican—HVJ, 11.685, is coming in fair to good with *English* 1000-1015; and on Tue. *only* with further *English* 1030-1045 (to India, Pakistan, Ceylon). (Miller, Ga., Saylor, Va., others) Noted closing 0545 on 21.740, very good level; schedule on this channel seems *irregular.* (Gillett, Australia) Noted on 9.646A with *English* 1315-1330, good level but with QRM. (Niblack, Ind.)

Venezuela—YVLK, 4.970, Caracas, *Radio Rumbos,* noted closing 2230 with National Anthem; on Mon., Thurs., at 2230 has "Luz de Luna y Sombras." (Kahan, Calif.) YVMF, 4.800, Maracaibo, noted 2230 closing with *English* and Spanish announcements, says "Goodnight, God bless you, and very happy dreams;" asks for reception reports. (Niblack, Ind.) YVMQ, *Radio Barquisimeto,* 4.940, noted 1935 with heavy QRM. (Hill, Mass.)

Yugoslavia—Radio Yugoslavia is using 6.100, 7.200 at 1645 with news. Recently *tested* on 6.100 at 0400-0800. (Pearce, England) Heard 2230 with strong signal in Texas. (Frazier)

* * *

Special DX Broadcast

At press time, tentative arrangements had been made for your short-wave editor, Ken Boord, to present a program of Passion Week and Easter organ melodies, by tape transcription, in a special DX broadcast dedicated to short-wave listeners throughout the world. The program will be aired over TGNA ("Telling the Good News Abroad"), the radio voice of the Central American Mission, Apartado 601, Guatemala City, Guatemala, Central America, at 2315-2345 *EST* on Saturday, April 17 (Easter Sunday, April 18, 0415-0445 *GMT*), over TGNB, 9.668, and TGNC, 11.850.

Harold Van Broekhoven, director of TGNA, airmails that *all correct reception reports will be verified by a QSL card and a mimeographed letter which tells of the work of TGNA—sent by airmail.* "We appreciate it when the listener encloses an IRC," he says, "but we will not make this a requirement."

* * *

Press Time Flashes

A station in Arabic noted on 11.720

around 0930 with Eastern-type music is believed to be ZJM7, Limassol, Cyprus. (Ferguson, N. C.) *Radio Cultura,* 6.165A, Sao Paulo, Brazil, noted with *English* around 2310 and 2325; asked for reports. (Niblack, Ind.) *Indonesian Air Force Station,* Djakarta, 11.945A, heard opening 0425 with plane sounds, followed by American musical program; signs off 1030.

The Japanese Short Wave Club, Box 29, Sendai, Japan, is eager to increase its membership throughout the world; its monthly bulletin is *all-English;* details can be had by writing *direct* to the club. Miller, Ga., reports AFRS relay station in Puerto Rico heard on 7.800A with news 1800. At press time, Pearce, England, noted that *Radio Beirut,* 8.036, Lebanon, appeared to have *dropped* its *English* session 1000-1100; was using Arabic then.

Radio France-Asie, Saigon, Indo-China (Vietnam), noted *moved* from 6.225 to 6.17. (Balbi, Calif., Gillett, Australia, others) Latest schedules list *English* for India, Asia on 7.230, 1830-1900; 11.935, 2030-2045; 11.935, 0900-1115; and with *new* "French by Radio" session to Australia on 15.430 on Tue., Thur., Fri. 0345-0400, to India, Southeast Asia on 11.935 on Sun., Wed., Fri., 1045-1100. (Catch, England) *Radio Tirana,* 7.850, Albania, now has *English* 1400, 1700 *(WRH)*

At press time, *"Deutsche Welle,"* Cologne, Germany, was scheduled 0530-0830 to Far East, 11.795, 15.275; 0930-1230 to Near East, 7.290, 11.795; 1300-1600 to Africa, 7.290, 11.795; 1700-2000 to South America, 2030-2330 to North America, 5.980, 7.290. *(WRH)* Press dispatches from South Korea indicate that *Radio Pusan* was destroyed by fire. Operated on 7.935A. *Back on the air?* (NNRC) *English* news is scheduled from AIR, India, 1930-1940, 9.755, 7.170; 2310-2320, 15.130, 11.870; 0235-0245, 17.740, 15.380; 0835-0845, 11.790, 9.565; 1045-1055, 15.210, 11.790.

Saudi-Arabia plans to have its *new* 100 kw. transmitter completely installed by the end of 1954; then will use Turkish, *English,* other languages in addition to Arabic. (Scheiner, N. J.) TGNA, 5.952, TGNB, 9.668, are used for *English* 2200-2345; asks for reception reports to Box 601, Guatemala City. (Cook, Calif.)

Acknowledgment

Thanks for the fine reports, fellows! Keep them coming to Kenneth R. Boord, 948 Stewartstown Road, Morgantown, West Virginia, USA. Good listening! - - - - - - - - - - - K. R. B.

NEW TV STATIONS ON THE AIR

(As of February 25, 1954)

The following new stations bring the lists published in previous issues up to date.

STATE, CITY	STATION	CHANNEL	FREQUENCY RANGE (IN MC.)	VIDEO WAVELENGTH (IN FT.)	VIDEO POWER* (IN KW.)
Arkansas					
Little Rock	KARK-TV	4	66-72	14.61	100
California					
San Francisco	KSAN-TV	32	578-584	1.7	81
Florida					
Fort Myers	WINK-TV	11	198-204	4.93	12
Jacksonville	WJHP-TV	36	602-608	1.63	120
Georgia					
Augusta	WRDW-TV	12	204-210	4.79	117
Idaho					
Boise	KBOI-TV	2	54-60	17.8	16.5
Illinois					
Harrisburg	WSIL-TV	22	518-524	1.9	10.5
Michigan					
East Lansing	WKAR-TV†	60	746-752	1.32	245
Saginaw	WNEM-TV	5	76-82	12.74	24
Minnesota					
Duluth-Superior	WDSM-TV	6	82-88	11.8	100
Mississippi					
Meridian	WCOC-TV	30	566-572	1.73	251
New Hampshire					
Manchester	WMUR-TV	9	186-192	5.25	112
New York					
Schenectady	WTRI TV	35	596-602	1.65	262
North Carolina					
Wilmington	WMFD-TV	6	82-88	11.8	53.7
South Carolina					
Anderson	WAIM-TV	40	626-632	1.57	166.6
Utah					
Salt Lake City	KUTV	2	54-60	17.8	27.5
Virginia					
Danville	WBTM-TV	24	530-536	1.85	22.5
Wyoming					
Cheyenne	KFBC-TV	5	76-82	12.74	5.2
Alaska					
Anchorage	KTVA	11	198-204	4.93	3.22
Canada					
Montreal	CBMT	6	82-88	11.8	43.8
Vancouver, B. C.	CBUT	2	54-60	17.8	2.5

WJDT-TV, channel 3, Jackson, Mississippi, has changed its call letters to WLBT-TV.

*From Station CP application, †Educational, Michigan State College. The frequency of the video carrier = 1.25 + channel lower freq. limit. Total number of TV stations now on the air in U.S.: 369 (131 of which are u.h.f.).

BARGAINS FROM "WHOLESALE RADIO"

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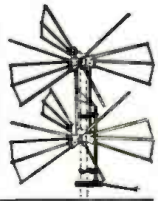
VHF-UHF CHANNELS 2-83

Exclusive Snyder Engineering and design cuts costs to **$24.95**



Powerful, 24 element 2 bay Directronic antenna is electronically beamed to any transmitter in fringe area by 6-position selector sw. No motors or electricity. Extremely high gain. COMPLETE WITH 6-POSITION DIRECTRONIC BEAM SELECTOR, 100' TUBULAR TRI-X CABLE, UNIVERSAL U CLAMPS. Order Snyder model AX-524.

UHF-5 **$1.49**

ALL CHANNEL UHF BOW TIE & REFLECTOR

Channels 14-83

All pre-assembled. Just unfold, tighten and erect. Hi-tensil aluminum bow. All-welded steel screen, all-weather zinc-plated. U clamp included. Model UHF-5.

UHF-6 BOW TIE with Corner Reflector . . . **$3.49**

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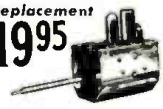
Series TV-2000 For High Profit Replacement



Has tube compliment of 6J6 osc. and conv. and a 6BQ7 or 6BZ7 as RF amp. Designed for inter-carrier circuit and also adaptable for split sound IF circuits such as the "630" and similar types, by use part #XM-752 trap assembly. (Available separately.) IF is adj. 19 to 26 mc. Adaptable to UHF. Shaft length 4½" overall.

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XM-752 TRAP ASSEMBLY $1.14

UHF STRIPS. Available for Standard Coil tuners. Specify channel no. and series designated by letter such as F, G, Q, etc. stamped on each strip of your present tuner. Set (osc. & ant.) **$7.50**

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UHF/VHF DIRECTRONIC INDOOR TV ANTENNA

Flick of beam selector switch electronically rotates antenna for clearest picture on any channel instantly. Equal to outdoor antenna in metropolitan areas. Channels 2 to 83.

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SNYDER BROAD BAND YAGIS

- Higher Gain Than Conventional Yagis
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High signal level for sharp, bright pictures. Hi-tensil ¾" aluminum elements: 7 on low band; 9 on high band. Complete with universal U clamps.

RB2-6 for Ch. 2 thru 6 **$9.95**

RB7-13 for Ch. 7 thru 13 **$4.95**

NOW! TEST CONDENSERS WITHOUT REMOVING THEM FROM THE CIRCUIT!

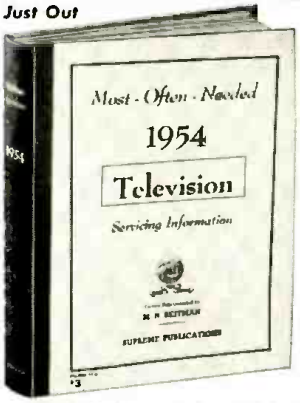
SPRAGUE KT-1 KWIK-TEST CAPACITOR CHECKER

Turns trouble-shooting hours into seconds. Checks condensers for opens, shorts, intermittents, RIGHT IN THE CIRCUIT. Checks bypass, coupling or filters 30 mmf. to 2000 mf, even when in parallel with resistor. A must for profitable servicing of TV receivers **$34.50**

WHOLESALE RADIO PARTS CO., Inc.

311 W. BALTIMORE ST., BALTIMORE 1, MD.

Just Out



This newest giant volume of the **Supreme TV Manuals** covers **1954** factory data on all popular television sets of all makes. There are explanations of new circuits, 192 pages of alignment procedure, test patterns, response curves, pages of waveforms, voltage charts, service hints, production changes, and dozens of double-spread circuit diagrams. Manual-style binding (opens flat). Special price, only **$3**

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COVERS ALL POPULAR SETS

This new *Supreme* **1954 TV** manual has all the required service material on every popular television set of every important manufacturer. Here is helpful, practical, factory-prepared data that will really make TV servicing and adjustment easy for you. More pages, more diagrams, more service data per dollar of cost. This new giant TV manual and previous volumes for other years have complete circuits, alignment facts, test patterns, response curves, service hints, recommended changes, voltage charts, waveforms, and many double-page diagram blueprints. Here is your TV service material to help you do more expert work quicker; and priced at only $3 and $2 per manual covering a whole year of material. See coupon below for complete list of all eight TV volumes, from 1947 to 1954, and the 1953 **UHF Converters** manual. Order for a 10-day trial.

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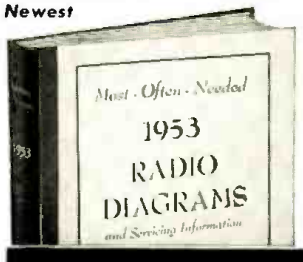

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A FEEDBACK LOUDNESS CONTROL

By **RAY C. WILLIAMS**

Biophysics Dept., Medical College of Va.

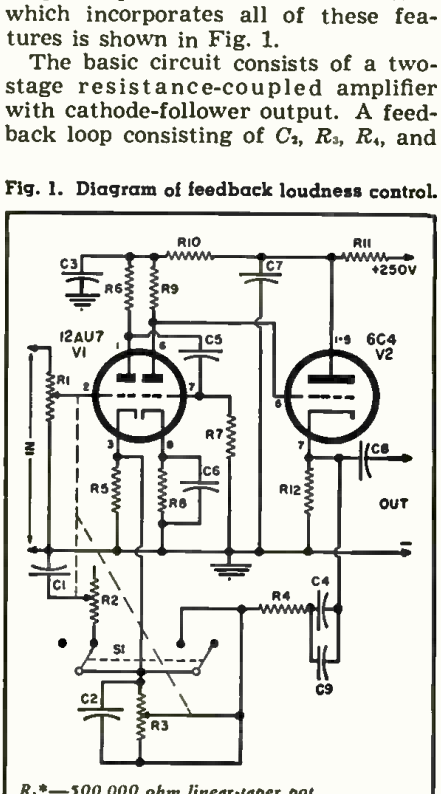
A low output impedance as well as high- and low-frequency compensation characterize this compact control.

LOUDNESS controls which compensate for physiological characteristics of the human ear, as shown by the Fletcher-Munson curves, are considered a "must" by most high-fidelity enthusiasts.

Such a control should have the following features: simplicity, compensation for both high and low frequencies, constant mid-frequency gain when compensation is switched in or out, continuous variability, and low output impedance. A loudness control which incorporates all of these features is shown in Fig. 1.

The basic circuit consists of a two-stage resistance-coupled amplifier with cathode-follower output. A feedback loop consisting of C_2, R_3, R_4, and

Fig. 1. Diagram of feedback loudness control.



R_1*—500,000 ohm linear-taper pot
R_2*—3000 ohm linear-taper pot
R_3*—250,000 ohm audio-taper pot
R_4—3300 ohm, ½ w. res.
R_5—1000 ohm, ½ w. wirewound res.
R_6, R_{11}—47,000 ohm, ½ w. res.
R_7—470,000 ohm, ½ w. res.
R_8—1000 ohm, ½ w. res.
R_{10}, R_{11}—4700 ohm, ½ w. res.
R_{12}—27,000 ohm, ½ w. res.
C_1, C_2—.05 μfd., 400 v. cond.
C_3, C_7—20 μfd., 450 v. elec. cond.
C_4—20 μfd., 150 v. elec. cond.
C_5—.1 μfd., 600 v. cond.
C_6—50 μfd., 25 v. elec. cond.
C_8—.25 μfd., 400 v. cond.
C_9—.01 μfd. ceramic cond. (shunt for C_4)
S_1—D.p.d.t. switch
V_1—12AU7 tube
V_2—6C4 tube

* *All three pots ganged into a single unit. See text.*

C_4, is connected between the cathode-follower output and the cathode of the input stage. C_4 is a 20 μfd., 150 v. electrolytic shunted by a .01 μfd. ceramic condenser and is used for d.c. blocking only. C_2-R_3 give low-frequency compensation and when shunted by C_1-R_2 compensates for the high frequencies. The control element is a three-gang potentiometer and is made of the *IRC* type "Q" and multisections having the values indicated in the parts list.

When the control element is at the maximum clockwise position, C_2 is shorted by R_3 making the feedback loop resistive. Shunt condenser C_1 is in series with R_2 and has little or no effect, the result being a two-stage amplifier having a flat frequency response. When the control element is turned counterclockwise, the reactance of C_2 becomes increasingly large at frequencies downward from 1500 cycles. C_1 becomes an increasingly effective shunt at frequencies upward from 1500 cycles. The reduction of the feedback fraction at the low and high frequency ends, with the mid-frequency fraction remaining constant, results in a marked increase in gain at the low and high frequency ends of the spectrum. Obviously, varying degrees of compensation will be obtained when the control element is turned between these two extremes. Switch S_1 simply shorts C_2-R_3 and opens the circuit of the shunt condenser C_1 to make the feedback loop resistive, resulting in a flat amplifier.

In the maximum counterclockwise position the gain at 1500 cps is 14 db; at 30 cps is 38 db.; and at 15 kc. is 26 db. In the maximum clockwise position the gain from 30 to 15,000 cps is 14 db.

This loudness control can be incorporated into new or existing equipment or built as a separate unit. All grounds should be tied to a common point and the plate supply voltage should be well filtered. —30—

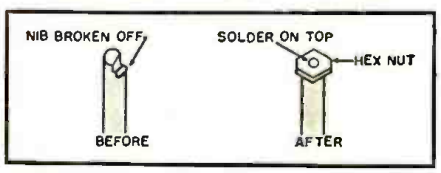
REPAIRING TUNING SLUGS

By CHARLES ERWIN COHN

THE screw slots on the tuning screws of slug-tuned coils are not usually very strong, and sometimes one of the nibs breaks off, making the slot useless. This most often happens when the slug turns hard, and a repair must be made to enable convenient tuning.

This can be easily done by first breaking off the other nib with a pliers and smoothing the end of the screw with a file. After that, a hex nut of the proper size is screwed on so that its surface is flush with the end of the screw, and solder is flowed on the end to hold the nut securely. Then the coil can be tuned with a socket wrench or "Spintite." —30—

Method for salvaging tuning slugs.



NEW TV PRODUCTS on the Market

U.H.F. GENERATOR

Industrial Television, Inc., 369 Lexington Ave., Clifton, N. J., is now offering a u.h.f. television generator which is designed to speed u.h.f. set installation and service and provide

the required u.h.f. signal in locations where u.h.f. stations are not in operation.

The IT-130R uses the signal from a v.h.f. station and translates it to a u.h.f. signal on any channel. In using the equipment to demonstrate u.h.f. receivers when the signal is not available, it will permit customers to compare receiver sensitivity, ease of tuning, channel designation display, switching methods, etc.

Complete technical details on the IT-130R are available from the company on request.

NEW ANTENNAS

Channel Master Corporation, Ellenville, N. Y., has developed a new u.h.f. corner reflector, the Model 409. The new unit features optional 2-way mounting which permits the reflector to be mounted either behind or in front of the mast, depending on installation conditions.

Falcon Electronics Company of Quincy, Illinois, is now offering a new and improved version of the yagi for all-v.h.f. band use. The "88" has 5 elements on the low channels, 4 on the highs, and combines the best features of the conical with the high gain and sharp directivity of the yagi. Complete details are available on request.

JFD Manufacturing Co., Inc., 6101 Sixteenth Ave., Brooklyn 4, N. Y., has added two antennas to its u.h.f. line. The "Golden Rig" corner reflector is designed for fringe reception of channels 14 to 83. It is braced four ways to eliminate ghost-producing vibration. The second antenna is the UHF312 "Ultra Yagi" which has been designed for deep-fringe reception of single u.h.f. channels. The company will supply additional details on either of these antennas on request.

Technical Appliance Corporation of Sherburne, N. Y., is in production on a high-gain, all-channel colinear yagi for v.h.f. Tradenamed the "Trapper," it incorporates newly-developed phasing elements which multiply the effectiveness of the driven elements on high-band channels, according to the company. The antenna comes completely assembled.

HIGH-VOLTAGE CONTROL

Clarostat Mfg. Co., Inc. of Dover, N. H., is now offering a new high-voltage, high-resistance, composition-element control, the Series 51.

Used to control voltage for electrostatic-focus television picture tubes, the Series 51 can be used with three-gun tubes in color television.

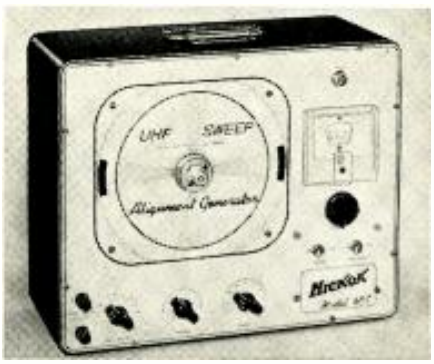
Housed in a low-loss phenolic case with a phenolic disc back that separates the terminals for maximum insulation, the control withstands 10,000 volts d.c. breakdown test between terminals and mounting bushing. It measures 2" in diameter by ⅝" deep. It is available in resistance values from 5000 ohms to 50 megohms linear and is rated at 1 watt.

Additional information is available in the company's Engineering Bulletin No. 119, which will be forwarded on request.

TV TEST EQUIPMENT

The Hickok Electrical Instrument Company, 10524 Dupont Ave., Cleveland 8, Ohio is currently introducing a series of test instruments designed to facilitate television servicing.

Among the new equipment is the Model 697 u.h.f. sweep alignment generator which provides fundamental output on all channels from 14 to 83. The generator features a piston-type attenuator which meets the most critical requirements for accurate attenuation. It provides minimum loading effects of u.h.f. circuits under alignment.



Technical details on this equipment are contained in Form 697 available on request.

The company is also introducing the Model 690 u.h.f.-v.h.f. marker generator which covers frequencies from

4.25 to over 225 mc. on fundamentals with a .25-volt r.f. output. It provides dual markers with any TV sweep generator.

The third item of equipment is the Model 691 heterodyned marker adder which is designed to be used with any sweep marker equipment that has an output of 50,000 microvolts or more. The Model 691 provides a marker visible at all times and will not change in amplitude or distort the response curve in any way.

BOGEN BOOSTER

David Bogen Co., Inc., 29 Ninth Avenue, New York 14, N. Y., has introduced a new u.h.f. television booster, the Model UHB.

According to the company, the new booster increases the reception range

for TV sets operating on channels 14 to 83 inclusive. A gain of 13½ db is obtainable at the lower frequencies while 8 db gain is available at the high end. The noise figure is 11 db at the low-frequency end and 15 db at the high end.

The Model UHB is housed in a compact case which has a vernier-type dial with a pointer behind a screened glass faceplate. A single knob controls the operation of the booster which is automatically turned on and off by the set by means of a thermal-type relay.

A data sheet covering this booster is available from the company.

COMPONENTS FOR COLOR

The Tube Department of *Radio Corporation of America*, Harrison, N. J. has announced that electronic components for color TV will be available in production quantities soon.

Production schedules will be geared to meet the needs of manufacturers who are expected to produce an estimated 100,000 color receivers in '54.

Under present plans, seven of the more critical components will be produced initially. They include the deflection yoke, high-voltage transformer, and several types of focus and convergence coils, all designed to be used with the company's tri-color picture tube.

The components will be made at the firm's Camden, N. J. plant.

"MIRROR-BACK" TUBE

CBS-Hytron of Danvers, Mass. is in production on a new "Mirror-Back" picture tube, the 21FP4C.

This tube, which may be used to

replace the 21FP4, is an aluminized tube with low-voltage, electrostatic focus. Electromagnetically deflected, it incorporates an all-glass, rectangular bulb, and a gray-glass, cylindrical face plate that provides greater contrast and a reflection-free viewing surface.

The 21FP4C has an electron gun designed for use with a single-field, external ion-trap magnet. It also has an outer conductive coating which, when grounded, serves as a high-voltage filter condenser.

U.H.F. HI-PASS FILTER

A u.h.f. hi-pass filter, the HP2, has been announced by *Service Instruments Company* of 422 South Dearborn St., Chicago, Ill.

The new unit is designed to pass u.h.f. frequencies with less than 1 db

attenuation and reject all v.h.f. frequencies from 45 to 50 db. According to the company, the HP2 filter eliminates FM interference on u.h.f., airport interference on strips, i.f. feedthrough, and prevents channel 5 or 6 from interfering on dual-conversion, all-channel tuners.

NEW PICTURE TUBES

The Tube Department of *General Electric Company,* Schenectady, N. Y., has announced two new 21" television picture tube types whose 90-degree deflection angles make them about 3" shorter than corresponding narrower-deflection types.

The tubes, types 21ACP4 and 21ACP4-A (aluminized), are both glass, rectangular types. Both tubes are 20" in over-all length, allowing in-

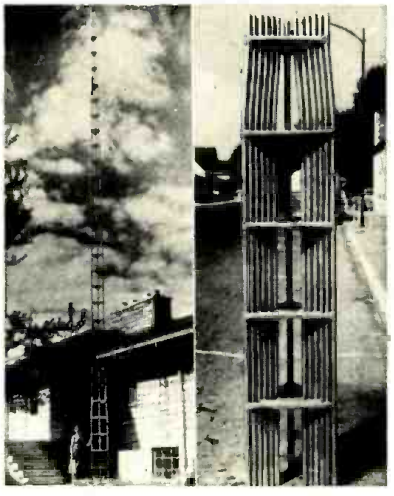
stallation in smaller cabinets than tubes with narrower deflection angles. According to the company, this feature also provides an increase up to 7 percent in screen area. The tubes also incorporate an external conductive coating which acts as a filter condenser when grounded.

The company will provide additional information on these two tubes upon request.

"STRATO-TOWER"

Spaulding Products Company, Box 126, Tipton, Indiana is now offering a new self-supporting tower with all-riveted construction.

An ingenious design allows the six sections of the tower to nest together so compactly that 100 feet of tower occupies warehouse space of less than 2½ square feet. A complete tower



can be hauled in a station wagon or on top of a car as the knocked down package with all accessories is only 8 feet long and 20 x 20 inches at the base.

The tower is of steel, heavily-coated galvanized for longer life. It features all-riveted bracing with no welds to rust. No additional accessories are required to install rotators inside the towers and no wrenches are necessary to assemble this tower.

For complete information and prices, write Department 101 of the company.

COLOR TUBES

Thomas Electronics, Inc., Passaic, N. J., has announced that it will mass produce 21" and larger color picture tubes by summer. Pilot operations are already underway and sample deliveries are being made to manufacturers.

The tubes are being manufactured under the *Lawrence* license and will be of the single-gun type. The company is the first licensee for these tubes in the eastern area.

COLOR TV RECTIFIERS

International Rectifier Corp., 1521 E. Grand Ave., El Segundo, California, has announced the availability of a series of selenium rectifier stacks for color television receivers.

The rectifiers in this series are de-

signed for capacitive loads of 600, 700, and 750 ma. and are produced for maximum input voltage ratings of 130, 172, and 195 volts r.m.s. The construction of this series differs from regular radio and TV selenium rectifiers.

A bellows-type spring contactor, as used in industrial rectifiers, is employed in the assembly of this series. This contactor affords a lower forward drop, lower temperature rise, and longer life, according to the company.

Bulletin ER-178 Supplement covers the electrical and mechanical specifications on all of the units in the series and is available on request.

"UHF-LAMP"

Metal Products Corporation, 807 Northwest 20th St., Miami, Florida is now offering an all-channel, indoor

u.h.f. antenna enclosed in a table lamp which is designated as the "UHF-Lamp."

The antenna-lamp comes in a variety of color combinations and gives a subdued light for television rooms. Tests made in five south Florida cities have shown that the antenna-lamp gives good reception in favorable locations up to five miles from low-powered u.h.f. TV stations.

The company will provide additional details on this and other antennas in its line upon request.

REPLACEMENT FLYBACKS

The *Standard Division* of *Chicago Standard Transformer Corporation,* Addison and Elston, Chicago 18, Illinois, has added three exact replacement flybacks for *Sylvania* receivers.

The new units, A-8227, A-8228, and A-8229, cover almost 90 per-cent of all *Sylvania* production up to 1953. They are supplied as coil and core for quick, easy installation to the original brackets which are a permanent part of the chassis. New filament leads are packed with each transformer.

Stancor Bulletin 478 lists over 170 *Sylvania* models and chassis using these transformers. It is available without charge from the company's distributors or the company direct.

TRANSMISSION LINES

Fenton Company, 15 Moore St., New York 4, N. Y., has introduced two new transmission lines designed to provide better TV reception by reducing interference pickup.

Known as "Fentube-Airspaced" and "Twistube," the new lines have one plain and one Formvar-coated pure copper conductor. The former has one common covering tube which is firmly fused to the spiral cords. Since there is practically no dielectric between conductors, all of the advantages of an open wire line are incorporated without its disadvantages.

The "Twistube," besides being airspaced, incorporates the added feature of being transposed to equalize the average proximity and thus the capacity of both conductors in relation to the mast and other grounded objects.

SIGNAL EQUALIZER

Tele-Matic Industries, Inc., 1 Joralemon St., Brooklyn, N. Y., has introduced an automatic signal equalizer designed for locations where the signals from the low-frequency channels cause overloading and the high-frequency channels are not strong enough to tolerate any attenuation.

The Model AT-25 provides maximum attenuation of the low-frequency channel and minimum attenuation of the high-frequency channel without upsetting the impedance of the receiver.

TUNER REPLACEMENT KIT

Standard Coil Products Co., Inc. has announced the availability of a new tuner replacement kit which contains the small tuner parts which may be needed by the service technician.

Included are 104 of the most-called-for parts for servicing TV-200, TV-1500, TV-2000, and TV-2200 series tuners made by the company. The majority of parts are individually boxed, permitting the distributor to place the contents in stock or to sell the kit as a complete item to his service trade.

CHANNEL SELECTOR

Tech-Master Products Co., 443 Broadway, New York 13, New York, has announced (*Continued on page* 142)

that owners of any 630-type television receiver as well as owners of the company's Models 2430, 2431P, 2430-9, 1930, and C-30 sets, can obtain full 70-station u.h.f. coverage with these receivers by means of a newly-introduced u.h.f. selector.

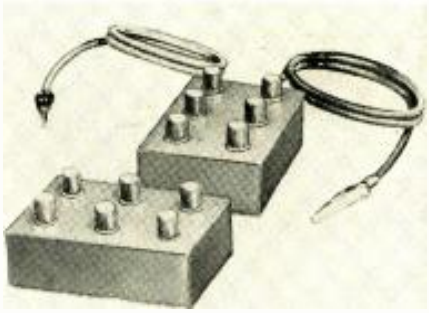
The Model TV101-U fits into the front recess that is common to all 630-type chassis, thereby requiring no cabinet alterations. Mounting is simple, requiring only two internal connections and the antenna lead. One knob, continuous-tuning covers the entire u.h.f. spectrum.

ANTENNA "ORIENTOR"

Mosley Electronics, Inc., 8622 St. Charles Rock Road, St. Louis 14, Mo., has designed a new aid for TV installers which facilitates u.h.f. and v.h.f. antenna orientation.

Called the "Orientor," the new device consists of two pocket-size units comprising an isolation network that permits the single transmission line to carry the signal to the television set and return the video signal without interaction and with little or no insertion loss.

The video signal can be read in terms of relative strength by means of a portable v.o.m. In this way the in-



staller on the roof can tell when the TV set is achieving maximum video signal.

Installers are invited to write for a descriptive folder, Form 903. Address all requests to the company direct.

NEW STANDOFF INSULATOR

A new strap-type standoff insulator that accommodates all standard television transmission lines has been announced by *Insuline Corporation of America*, Long Island City, N. Y.

A low-loss polyethylene grommet in the eye of the device holds flat twin-lead ribbon, tubular twin-lead, oval-tubular lead, or coaxial cable securely. An adjustable steel strap permits the insulator to be used on any pipe from ¾" to 1½" in diameter. The assembly is quickly tightened by means of a captive tension nut, through which the threaded end of the insulator screw-eye passes. All metal surfaces are heavily zinc plated.

FLYBACK CHECKER

Radio City Products Company, 152 W. 25th St., New York, N. Y., is now offering a new instrument for testing the condition of flyback transformers and yokes in the horizontal output circuit of TV receivers.

Known as the Model 123 "Flybacker," the new unit detects a single shorted turn or a number of shorted

turns in both flybacks and yokes. It also shows up short-circuited windings. A large front meter indicates, on a "good-bad" scale, the condition of the unit.

"SILVER ROCKET" 630 CHASSIS

Mattison Television and Radio Corp., 10 West 181st St., New York 53, N. Y., is now in production on a new 630 chassis which features "synchromatic" tuning.

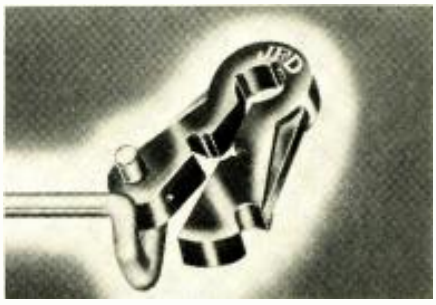
The new tuning feature was designed to synchronize picture and sound with co-channel circuits. Picture and sound tended to drift apart in extreme fringe areas or on the new u.h.f. channels. The viewer can now tune for the best picture and the sound is adjusted automatically.

The company will forward a booklet on this and other new chassis in the series upon request to the engineering department of the company.

TV LINE INSULATOR

JFD Manufacturing Company, Inc. of Brooklyn 4, N. Y. has introduced a new standoff insulator which has been tradenamed "PAL."

Designed for u.h.f. requirements, the new insulator eliminates the necessity



of removing the grommet from the standoff or threading the lead-in through the grommet.

Electrically, this insulator maintains the critical distance between lead-in and metal standoff which prevents impedance mismatch. The new-design insulator is available in every type of the company's standoffs. —30—

Looking Ahead

(*Continued from page* 43)

his new color television receiver. The importance of this is emphasized by one manufacturer who says his three-gun picture tube can be damaged if the chroma (color) control is advanced too far on a strong signal.

Since all these practical considerations may change as set designers whip production models into shape, the important thing to spend time on now is color fundamentals. What are colors? How is a full color picture formed on the face of a color tube? Of what does the composite signal consist? How do these signals flow through a basic set? These are the questions a good technician will try to answer even before he gets to see a color set.

Much material is being published on color these days. If the service technician doesn't choose his study material carefully he runs the risk of becoming more confused than enlightened. Don't spend too much time with authors who seem more intent on dazzling you with their brilliance rather than work sufficiently hard in presenting their material so you can understand it.

The color system, when understood, will be simple to you. If you choose carefully the material you study it won't be too difficult to absorb.

Color sets will probably be available in limited quantities for consumer purchase this fall. At first, we can look forward to direct interest and even some control of service on the part of some manufacturers. But then there is no doubt that, as time goes on, color receivers, just like their black-and-white brothers, will be serviced principally by servicing dealers and independent service technicians. First there will be an increase in service contracts —then a levelling off.

What with color, hi-fi, tape recorders, and the additional growth of u.h.f. and new markets, the service technician can look forward to a busy and exciting future. I hope you get your share of the rewards. —30—

U.H.F. Antennas

(*Continued from page* 58)

completed, mount them on the 1¼" diameter aluminum tubing. Space the assemblies one above the other according to the dimensions shown on the chart. Two straight lengths of #14 tinned copper wire are used to connect the *driven elements* only, as shown.

Attach the 300-ohm lead-in as shown at the exact vertical center of the two copper wires. Be sure to seal the open end of the hollow lead-in wire or you may find water running out of your set or converter some rainy night. When all the joints are tightened and all soldering completed, spray the entire antenna with plastic spray or varnish it with waterproof varnish. —30—

TV Test Equipment

(*Continued from page 49*)

large number of spurious outputs, the operator will note few spurious markers on the r.f. response curve.

Spurious markers are especially troublesome when running video amplifier response curves, because numerous harmonics of the marker generator fall within the video passband when the curve is being marked at lower frequencies. For this reason, absorption markers are used to a considerable extent in video amplifier checks. Some sweep generators have absorption marking facilities built in.

Volt-Ohm-Milliammeters

The volt-ohm-milliammeter, or v.o.m., is basically a simple instrument, but is nevertheless the backbone of many a service operation. The v.o.m. is surpassed in usefulness only by the vacuum tube voltmeter.

Circuit loading is a problem in v.o.m. application, and in this respect, the 20,000 ohms-per-volt instrument is superior to the 1000 ohms-per-volt meter. In turn, the 100,000 ohms-per-volt v.o.m. imposes the least circuit loading of any nonelectronic voltmeter.

The prime consideration in choosing a volt-ohm-milliammeter, aside from circuit loading, is the accuracy of indication. In this regard, it is a fairly good rule that one gets what he pays for. The higher priced instruments utilize meter movements with higher full-scale accuracy, and the multiplier resistors are manufactured to higher tolerances. A typical medium priced instrument may have a full-scale accuracy of ± 2%, and multiplier resistors with a tolerance of ± 1%. The end result is a full-scale accuracy of ± 3%.

The beginner sometimes falls into the error of assuming that if the full-scale accuracy is ±3%, any voltage value indicated on the scale will be accurate to within this tolerance. Such an assumption is completely false. An example will illustrate the fallacy of this argument: If the voltmeter is operating on the 100-volt range, the full-scale accuracy of the meter will be ± 2 volts. When the pointer reads full scale, or 100 volts, it is true that the accuracy of the meter movement is within ± 2%. But consider the situation in which the pointer reads 25 volts on the 100-volt scale; the accuracy is still ± 2 volts, which means that the true voltage falls somewhere between 23 and 27 volts—but this is an accuracy of only ± 8%! The advisability of using a voltmeter on the lowest possible range is apparent.

Isolating probes cannot be used successfully with a v.o.m., because the relatively large current drain of the instrument entails excessive loss of voltage across the isolating resistor. Furthermore, an isolating resistor which is chosen to provide direct readings on one range, will read incorrect-

ly on the next higher range, because the input resistance of the instrument is not constant. The input resistance on any one range is equal to the full-scale value of the range times the ohms-per-volt rating of the instrument; for example, a 100,000 ohms-per-volt instrument has an input resistance of 1 megohm on the 10-volt range, but an input resistance of 10 megohms on the 100-volt range.

The V.T.V.M.

Most v.t.v.m.'s have automatic protection against burnout, which avoids severe damage to the instrument when applied across excessively high voltages. Aside from this important feature in practical work, a v.t.v.m. provides high input resistance on low-voltage ranges, which makes it possible to measure a.g.c. voltages, signal-developed grid bias, and plate-voltage values in pentode amplifier circuits. Almost all service v.t.v.m.'s are designed with an isolating probe for use on the d.c. ranges, so that d.c. voltages can be measured in the presence of high-frequency a.c.

The input resistance of a v.t.v.m. is constant (usually at 10 or 15 megohms) so that when a high-voltage d.c. multiplier probe is used with the instrument, the probe can be used on the low-voltage ranges as well as on the high-voltage ranges. Thus, a v.t.v.m. can be used not only to measure the second anode voltage of a picture tube, for example, but can also be used to measure relatively low d.c. voltage values in the presence of high-voltage a.c. pulses, such as the plate voltage of a horizontal oscillator tube. In the latter application, the high-voltage d.c. probe is being used as an a.c. filter, and the d.c. voltage attenuation is incidental; because of the constant input resistance provided by the v.t.v.m. the probe reads directly on any scale, indicating 1/100 of the applied d.c. voltage.

Many present-day service v.t.v.m.'s provide for measurement of peak-to-peak voltage values. Some instruments have a built-in peak-to-peak voltage indicating network, while others obtain peak-to-peak indication by means of an external probe. The built-in arrangement has an advantage in that higher voltages can be accommodated without damage to the instrument, but has the disadvantage that the input capacitance is somewhat higher, with correspondingly greater circuit loading.

The ohmmeter function of the electronic ohmmeter built into the service v.t.v.m. is superior to that of the v.o.m., since resistances as high as 1000 megohms can be measured with an ohmmeter battery of only 1.5 volts. This is a great advantage, since various delicate circuit components can be damaged by higher voltages.

The accuracy of a v.t.v.m. is seldom as high as that of a v.o.m., but against this, are the advantages afforded by electronic protection against overload, and wider measuring facilities. —30—

Electronic Key

(*Continued from page* 81)

make it necessary to increase or decrease this resistor for a correct two-to-one ratio. The higher the value of R_2, the greater the dash-to-dot ratio. The value of R_2 shown in Fig. 3 gave a two-to-one ratio as determined by an electric counter. The ratio can be determined fairly close by ear, or by slowing the key down so that dots and dashes can be counted. Experience has shown that for correct adjustment, the ratio should be determined by counting rather than by listening to the relay clicks or an oscillator.

The photographs show the general construction procedure followed. Although the parts were mounted in a 4" x 5" x 6" metal box, a 5" x 7" x 3" aluminum chassis would be easier to drill.

In the photograph of Fig. 1 the speed control, R_3, was mounted to the left of the 2D21. The "weight" and balancing control, R_{10}, was mounted to the left of the 12AU7, V_2. The cathode potentiometer was mounted below V_2. In order to accommodate the three wire connection to the "bug," a three way plug and jack were used. The jack, J_2, is mounted to the right of the "on-off" switch, and insulated from the chassis.

The photograph of the "bug," Fig. 2, shows the three-conductor cable fastened to the spring arm stop with a cable clamp. The connection to the dash contact post is made below the bug after the strap from the dash contact post to the dot contact post was removed. By loosening the dot contact post, enough clearance between the metal washer and the stud can be obtained to accommodate a solder lug. To keep the spring arm from bouncing when dots are being made, a rubber band was used to keep the end of the spring arm against the spring arm stop. Only the necessary "bug" modifications are shown, and the reader will undoubtedly have ideas on how to adjust his own "bug." However, for a better "feel" the spacing between contacts should be closer than normally used with a "bug."

The circuit can be easily adjusted by using a vacuum tube voltmeter and an ohmmeter, or combination test instrument.

First, hold the "bug" lever to close the dot contact, and connect the v.t.v.m. between the cathode of V_{2A} and ground. Adjust the speed control potentiometer, R_3, until a varying voltage is noticed on the meter. Set the speed control so that the meter pointer is nearly steady. Note this value.

Next, place the v.t.v.m. across the cathode of V_{2B} and ground. The dot contact should still be closed. Adjust R_9 to give the same average voltage as before.

Release the "bug" lever and connect the v.t.v.m. across the relay winding with the positive meter terminal to the plate end of the relay winding. Adjust the balancing potentiometer, R_{10}, to show zero voltage across the relay. Momentarily ground the grid of V_{2B} and note the voltage.

Close the dot contact and adjust R_9 until half of this reading is obtained. The relay may not operate at this time.

Set the v.t.v.m. or ohmmeter to indicate Rx10, Rx100, or Rx1000 and calibrate it in the usual manner. Connect the ohmmeter across the armature and keying contact of the relay. Hold the dot contact closed as before and adjust the *relay* to give mid-scale indication on the ohmmeter. This generally will insure proper adjustment of the relay. Now close the dash contact on the "bug" and note that the ohmmeter indicates about three-quarters full scale or three-fourths of the way toward the "zero ohms" end of the scale. Rechecking the voltages and rebalancing, as described, will insure that proper adjustments have been made.

If the relay is a non-adjustable type, use the "weight"-balance control, R_{10}, to give the mid-scale indication.

If the dash-to-dot ratio is too great, a lower value of resistor should be tried between the grid of V_{2A} and the timing condenser. Due to the circuit elements in the keying circuit of the transmitter, the "weight" control, R_{10}, should be used in adjusting the transmitted signal.

Relays

Voltage readings under various conditions for four different types of relays are shown in Table 1. These readings were obtained after each relay was connected in the circuit and adjusted as previously described. The voltages shown in the chart, which should be the same, will vary one or two volts depending upon the power line voltage at the time the readings were taken.

The relay marked "BK-35," which was found as a surplus item, is ideal for this circuit, but three others were also checked for performance and ease of adjustment. The *Ward Leonard* relay was purchased about seven years ago, but could not be found in any of the present day catalogues. However, a catalogue number 25038 marked on the relay might be helpful in locating a similar one from the manufacturer. Since it is constructed along the same lines as the "BK-35" relay, it is easy to adjust the contact spacing and spring tension. On the other hand, the only method of adjusting the contact spacing on the *Potter & Brumfield* type LM5 is to bend the back contact down with a pair of pliers. The amount of bend required is shown in the photograph of Fig. 4. The spring tension is adjusted by means of a screw at the top of the relay. The distance between the armature and the pole piece should be about the thickness of a sheet of good-grade typewriter paper for best results. After a few repeated adjustments, this relay worked as well as the others. The *Western Electric* relay is a sealed, non-adjustable type, polar relay which fits a standard octal socket. Since it is sealed-in-glass mercury con-

tact switch whose characteristics are fixed by its design and manufacture, no adjustments are necessary for keying purposes. It was included in the list to show that a non-adjustable type relay having a medium coil resistance would work satisfactorily. However, the relay should be a sensitive plate relay with a winding of from 2000 to 12,000 ohms.

The circuit shown was designed for economy, low supply voltage; a minimum of parts; and ease of adjustment. The low priced semi-automatic key was purchased from the *Electric Specialty Mfg. Co.*, Cedar Rapids, Iowa. As long as the plate voltage does not vary over 10% higher or lower (20% total) the "weight"-balance control, R_{10}, and the speed control will adjust the circuit for different voltages. The only reason for using the 2D21 instead of the larger 2050 was to conserve space.

In closing, the writer wishes to thank W5FRE for his assistance in the construction of the keyer. —30—

RUMBLE FILTER

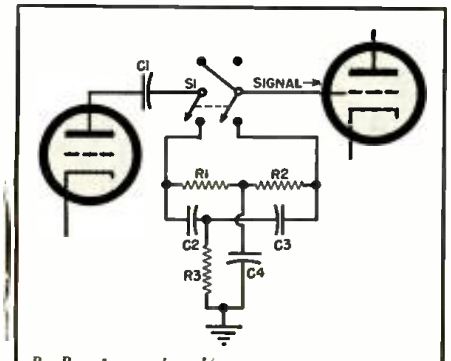
By DAVID KESSEL

THE current trend toward improved low-frequency response in amplifiers and speaker systems has resulted in a corresponding increase in the audibility of so-called turntable rumble. This is especially true of the average system in which a three-speed changer and a loudness control are used.

The most economical method of reducing response below 40 cycles is the insertion of a parallel "T" section between the equalizer tube and the next (high impedance) stage. Unfortunately the mathematics involved in the computation of circuit components for the "T" filter seems to discourage many experimenters.

The author has tested several "T" filters and found that a circuit with a resonant frequency (frequency of minimum response) of 8 cycles eliminates practically all of the Garrard and Webster-Chicago rumble with little effect on frequencies above 40 cycles. The response is down 5 db at 25 cycles; 20 db at 10 cycles; and 20 db at 5 cycles. Apparently most rumble occurs between these frequencies. If this filter is connected in the preamp with a d.p.d.t. switch, the decrease in speaker vibration with the filter switched in is immediately noticeable. —30—

A simple turntable rumble filter.



R_1, R_2—1 megohm, ½ w. res.
R_3—470,000 ohm, ½ w. res.
C_1, C_4—.05 µfd., 400 v. cond.
C_2, C_3—.025 µfd., 400 v. cond.
S_1—D.p.d.t. switch

Communications Receiver

(*Continued from page 67*)

permitting use of a wide variety of headphones. The speaker is silenced when the headphones are inserted into the jack. A larger external speaker, with an impedance of 4-8 ohms, may be plugged into the headphone jack if so desired.

Two slide-rule tuning dials are used, one the main tuning dial and the other the bandspread tuning dial.

The main tuning dial has four scales marked "A," "B," "C," and "D" corresponding to the four bands of frequencies tuned by the NC-88, the position of the red dot on the "selector" switch indicating which of these scales is to be read. Heavy white lines have been placed on certain portions of the short-wave bands corresponding to important frequencies along with a letter to designate the agency which uses each. That is, the letter *A* above a heavy white line indicates a band used chiefly by amateurs, while the letter *F* denotes use by foreign countries, the letter *S*, ships, and *P*, police. There are also small white circles at various points on the scales enclosing an identifying number or letter. These circles indicate the correct setting of the main tuning dial pointer when bandspread tuning is to be used on that band. They are discussed in the paragraph on bandspread tuning. The two circles enclosing the letters *CD* on the broadcast band, however, indicate the two civil defense frequencies and are dealt with in the paragraph on those frequencies.

The "bandspread" dial has five scales calibrated directly in mc. plus a logging scale graduated from 0 to 100. These scales are identified by a letter to indicate the receiver band to be used for a particular amateur band and a number to indicate the amateur band being tuned, with the exception of the logging scale which is identified by the word "log." Six principal amateur bands have been calibrated on the dial, the "log" scale serving for calibration purposes on any other band within the range of the receiver.

Recently the Federal Communications Commission authorized the frequencies 640 and 1240 kc. for use by broadcast stations in the event the United States should be placed under threat of air attack. In that event all transmitters will be required by law to immediately cease all operation, with broadcast stations resuming operation only on those two frequencies. Accordingly, these frequencies have been clearly marked on the "A" scale of the NC-88 and are identified by circles enclosing the letters, *"CD."* To receive either of these two frequencies place the receiver in operation for the broadcast band and set the bandspread pointer on the "set" mark. Then set the "main tuning" dial pointer in the center of either of the two circles and the receiver will be set up for proper reception of emergency bulletins. —30—

TV Troubleshooting Methods

(*Continued from page 65*)

good, but what if it doesn't work? For example, what if signal tracing shows all of the stages of the suspected section to be all right? We may have suspected an innocent section; signal trace other sections which could possibly be guilty and, as a last resort, signal trace the supposedly "innocent bystanders."

What if all of the components in the suspected stage check all right? You guessed it: check the components in other related stages.

Why not just check all of the components and adjustments in the receiver on every job and forget all about the systematic procedure? It may be all right in theory, but what good is it if it may not always work? The answer is that it does work often enough to save most of the time which would otherwise be spent on random checking of components and adjustments. Also, it can be combined with the other two techniques previously mentioned.

Faults which occur frequently enough to be worth checking on even without any definite indication are: bad tubes, blown fuses, and poor connections in the antenna system. These things can also be included among those easy to check, along with visible faults such as broken components and open or shorted wires, and the effects of manipulating the various controls and adjustments, of tuning to a different channel, or of operating the receiver at a different time or in a different location.

A practical troublefinding procedure should include steps such as the following, subject to modification depending on the indications observed and the available equipment:

1. Have set-owner demonstrate and describe trouble.

2. Observe effects of front-panel controls and adjustments. (Any adjustment whose manipulation does not produce an improvement should be returned to its original position.) Check back-of-chassis adjustments, antenna connections, and anything else accessible.

3. By functional analysis, determine section probably faulty.

4. Remove back cover, insert a.c. interlock bypass ("cheater" cord). Adjust ion trap magnet. (They usually need adjustment.) Check whether all tubes are lighted. Refer to tube location guide and replace tubes in suspected section. If no replacement parts except tubes are immediately available, check other tubes.

5. If vacuum tube voltmeter, test-point adapters, and replacement parts other than tubes are available, make voltage and resistance measurements from top of chassis in suspected section and compare with service data. Refer to circuit diagram to determine component probably faulty.

6. Take chassis out of cabinet and to shop. Refer to hints regarding the

receiver and trouble at hand, if any are available from published data or your own records. Continue signal tracing and component checking if necessary.

7. Make record of receiver type, symptoms, and cause, so that you *will* have a hint available next time.

This procedure should be supplemented by a few precautions:

1. Do not change permanently any component or adjustment unless the benefit is immediately obvious.

2. Do not correct any trouble without giving some thought to what may have caused it, especially in a case of burned-out fuses, transformers, resistors, tubes, etc.

3. Do not be sure that a change in a component or adjustment has removed the actual cause of a trouble unless you understand how it could have done so. —30—

Electro-Voice Model 666

(*Continued from page* 63)

trum for which it is designed and, by proper acoustic delay elements, a crossover from one acoustic path to another is achieved smoothly and uniformly. This principle of varying the front-to-back distance is now established as the "Variable D."

The Model 666 is unique in that "boominess" is totally absent on close talking. Variations in bass sensitivity below 100 cps due to the proximity effect are less than ± 2 db when the unit is used from 6 inches to 5 feet. Close talking is facilitated by the insensitivity of pressure-operated dynamic elements to "blooping" from explosive labial sounds, such as those found in the letters "P" and "B." Complete insurance against excessive blooping is effected by the integral blast filter. The blast filter obviates the necessity for wind bags on exterior shots.

This freedom from blooping and proximity effects allows the microphone to be used closer to the vocalist, announcer, or soloist for still further discrimination against unwanted sounds than would be possible with a conventional unidirectional microphone. —30—

TV CONFERENCE

THE Eighth Annual Television Conference, sponsored jointly by the Cincinnati Section of the IRE and the Professional Group on Broadcast and Television Receivers, will be held in Cincinnati on Saturday, April 24th.

The subject of the conference will be "Black and White and Color TV and UHF." Meetings will be held in the Engineering Society of Cincinnati Bldg. at McMillan St. and Woodburn Avenue.

Advance registrations for the conference, including hotel, luncheon, and banquet reservations, should be addressed to J. A. Purdy, 7520 E. Miami River Road, Hamilton, Ohio. Others may register at the Conference if desired. —30—

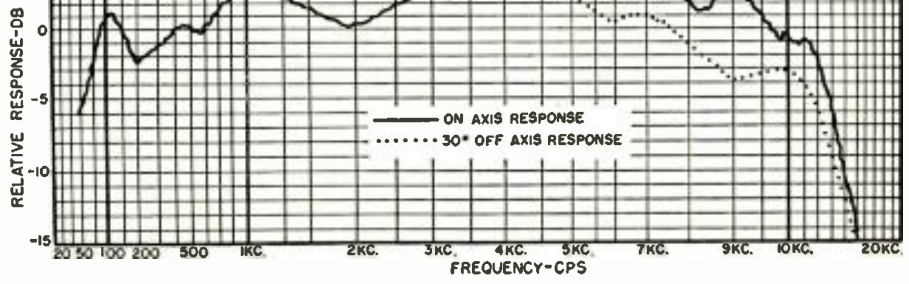
"Diffusicone-8" Enclosure

(*Continued from page* 55)

plywood paneling with all sections well glued and screwed. Internal damping is provided by *"Kimsul"* insulation.

This cabinet has created such wide interest during public demonstrations that it has been exhibited without the decorator's finishing touch (as in the photograph) in order to satisfy the countless listeners that there was only *one* 8-inch speaker working during the demonstration. The home constructor will of course want to put the finishing touches to the cabinet as best suits his needs. The important factor concerning the acoustics of this finish is the grille cloth that covers the face of the speaker. The *University* "Diffusicone-8" employs the patented high-frequency diffusing element which disperses the high frequencies over a wide angle. Thus, whatever grille cloth is used should be selected more on the basis of acoustic transparency rather than artistic appearance. A good rule of thumb to use in selecting a grille cloth is that the cloth be about 50% optically transparent. If these precautions concerning the physical construction of the cabinet are followed, then the combination of the enclosure and the "Diffusicone-8" will give clean strong bass reproduction with well balanced middles; and if the proper grille cloth is used the top end of the spectrum will be completed through the extended-range, wide-angle, high-frequency performance of the diffusion system. —30—

Response frequency characteristics of enclosure using the "Diffusicone-8" speaker.



Certified Record Revue

(*Continued from page 76*)

lapse while conducting the Israel Philharmonic recently. It is typical of the man that he drive himself to a state of exhaustion in his striving for perfection. The same relentless spirit is evidenced in his reading of these Mozartian gems. There are some who may object to a "big hall sound" for Mozart. I don't think this argument is valid here because the spaciousness of the recording is coupled by a fabulous amount of inner detail. I don't think I am exaggerating when I say that this is perhaps the finest sounding Mozart on records. The silken beauty of the strings, the bubbling capriciousness of the clean and articulate woodwinds are a joy to the ear. This is what true high-fidelity recording can do for the classical repertoire.

There is many a person who doesn't like Mozart, who would certainly be won to his cause by this superb reproduction. In "The Prague," Mr. Kubelik has chosen to follow the broad melodic lines and polish and burnish the highlights of the whole by meticulous attention to tempi and dynamics. He is never overly fussy, neither is he sloven of detail. I think it fairly safe to say that his reading ranks with that of Sir Thomas Beecham and I've no doubt there will be many who will prefer it, sacrilegious as this may seem. The "34th in C" is an unjustly neglected work. A thoroughly delightful piece it fairly froths and bubbles with the effervescent reading afforded it by Mr. Kubelik. He recognizes the work for what it is; a light-hearted exposition on "much-ado about nothing." Again the work benefits from the superb fidelity of reproduction.

The AES curve reproduced the record perfectly with no necessity for tone control adjustment. Surface noise was almost non-existent. A wonderful farewell performance by Rafael Kubelik for *Mercury*. I trust we have not seen nor heard the last of Mr. Kubelik in this country.

VIVALDI

LAS PASTORELLA; SONATA FOR FLUTE, BASSOON AND HARPSICHORD IN A MINOR; CONCERTO FOR FLUTE, OBOE, AND BASSOON IN G MINOR; SONATA FOR OBOE AND HARPSICHORD IN C MINOR; CONCERTO FOR FOUR INSTRUMENTS IN F MAJOR

Jean-Pierre Rampal, flute; Robert Gendre, violin; Pierre Pierlot, oboe; Paul Hongne, bassoon; Robert Veyron-Lacroix, harpsichord. Haydn Society HSL-82, NARTB curve. Price $5.95.

A collection of works by one of the greatest of Italian composers, Antonio Vivaldi. Now don't get up on your hind legs and run away! I know that the idea of anything like this strikes terror into you lovers of the hi and the fi. But hold on! There is some really good stuff here if you'll just take the trouble to listen. This admittedly is

music for the more musically mature, but it is not all that formidable. The "La Pastorella" is a lovely work that sparkles like wine in the Italian sun. The quality of woodwind playing found here is exemplary.

Each man is a virtuoso of his chosen instrument and it is evident from the good time they are having that they enjoy this spritely work of Vivaldi. The other works are combinations for the various woodwinds and are splendid examples of Vivaldi's amazing technical facility. Most are in sonata form and show clearly Vivaldi's penchant for contrast in his writing. He made daring innovations for his day, elevating the oboe from the obscurity of the orchestral whole to a solo instrument for which he wrote some exceedingly clever (and difficult) music. The reproduction throughout is very good indeed, the lone violin displaying no annoying edginess, and the woodwinds sibilant, snarly, sonorous as the score demands. A record to be treasured by students and others who appreciate this resurrection of some unjustly neglected Vivaldi. The NARTB curve needed a few db of bass boost to reproduce satisfactorily and the surfaces were a little "ticky"

STRAVINSKY
THE RAKE'S PROGRESS
Hilde Gueden, Blanche Thebom, Eugene Conley, Mack Harrell, Martha Lipton, Norman Scott, Paul Franke, Lawrence Davidson, soloists with Metropolitan Opera Association orchestra and chorus conducted by Igor Stravinsky. Columbia SL125, NARTB curve. Price $11.90.

The advent of any work by Stravinsky is usually cause for much excitement and anticipation. When I heard reports some years back that he was working on a new opera, I made a particular point of watching for news of its completion and premiere. I was somewhat disappointed when the U.S. was bypassed in favor of Venice for the premiere which took place on Sept. 11, in 1951. I was further disappointed by the mixed reaction of the critics, and knew that I would never be satisfied as to its worth until I had heard it myself. By the time "The Rake's Progress" arrived at the Metropolitan, so much had been written *pro* and *con* about this opera, that tickets were a hard thing to come by and I never did get to see or hear the Met production. All this is by way of telling you of the happy appearance of this controversial opera on 2-12" *Columbia* LP's. Ah! The wonders of the age of LP! Not only is this the same Metropolitan production, but Stravinsky himself has been retained to conduct.

Has my wait been worthwhile? Decidedly yes! I can't agree with many of the European critics who rapped it for eclecticism, for lack of dramatic cohesion and goodness knows what else. I feel that if you analyze what Stravinsky had in mind here and what has been produced, you will come to the logical conclusion that this represents but a further extension of a musical philosophy Stravinsky has been developing for some time now. Certainly it smacks of the Mozartian and Italianate. He has been integrating his amazing genius for polyphonic and polyrhythmic writing with 18th century elements ever since he wrote "Pulcinella." So the fact that he produces an opera essentially 18th century in character should come as no surprise to the musically literate.

I think what is really the basis of much criticism is a sort of wishful thinking, a desire for Stravinsky to return to his "wild" period, which produced "LeSacre du Printemps" and "Petrouchka." One cannot blame these people altogether, for I too would like to see Stravinsky produce at least one more work in this genre before he leaves this vale of tears. Well, come what may, I like this present effort and I think many of you will agree. The libretto by famed poet W. H. Auden and Chester Kallman is a moral fable with a pretty familiar story line, owing much to Hogarthian elements.

Space will not permit more than the briefest of story outlines: Boy and girl are in love. Boy wants money sells soul to devil. Carouses wantonly and degenerates morally, devil comes to claim boy's life, but loses out as girl proclaims her love and boy his, and he is saved. Boy goes mad and is committed to Bedlam. Mad love scene ensues between boy and girl and boy finally dies. (I suggest you read the jacket for a far more lucid description of the opera than I have just tendered you!)

The cast is an excellent one with special bows to Eugene Conley for his portrayal of "The Rake" and Mack Harrell as "Nick Shadow" (the devil). Blanche Thebom is delightful as "Baba the Turk," but I was a little disappointed in the character of "Anne," "The Rake's" love, as sung by Hilde Gueden. I felt that a more ingenuous quality was needed in keeping with the story line.

The music is unusually scored since there are no trombone or tuba parts and this gives the trumpets the job of maintaining the bass line. The entire score reminds you more of a chamber concertante than anything else, but nevertheless is not wanting in power and expression when the need arises. The reproduction is top notch, for both vocal and orchestral elements. Strings are smooth and a fine orchestral balance is maintained by Stravinsky. Spaciously recorded but fortunately not so much so that the vocalists are obscured. The fact that the opera is sung in English adds to its attractiveness and the inclusion of a libretto makes for easy understanding. All in all, a major phonographic event and highly recommended. The NARTB curve needed no tone control alteration. The only thing I might quibble about is a good deal more of anticipatory tape echo than is usual. Somebody running too "hot" on the vu meter?

ALBINONI
CONCERTO FOR ORCHESTRA IN D MINOR
CORELLI-GEMINIANI
CONCERTO GROSSO #2
SAMMARTINI
VIOLIN CONCERTO #2
SYMPHONY IN G
Italian Chamber Orchestra conducted by Newell Jenkins. Haydn Society HSL74, NARTB curve. Price $5.95.
ROSETTI
HORN CONCERTO IN E FLAT MAJOR
BOCCHERINI
SYMPHONY IN F MAJOR
Italian Chamber Orchestra conducted by Newell Jenkins. Haydn Society HSL-79, NARTB curve. Price $5.95.

These two records are further evidence that the *Haydn Society* is not above venturing into other musical fields than that which is the province of Papa Haydn. Which is a healthy trend, for ultra-specialization can be a dangerous drug which dulls the creative mind. These discs represent #1 and #6 of a series entitled, "Italian Classical Symphonists." Here the *Haydn Society* has done itself proud in bringing to light a whole group of 18th century Italian composers whose works are comparatively obscure. These are not in the category of what I call "desperation repertoire." In other words they have not been recorded merely because they were never previously recorded. There is a great deal of the trite and the banal being committed to LP these days, most of which is hardly worth wasting vinylite on even for musicological purposes.

Although one might gain the impression that there is too much recorded herein of similar line and invention, such is not the case. The music ranges from the rich contrapuntal textures of Albinoni to Geminiani's masterful transcriptions of his great teacher Corelli and his concerti grossi, to Sammartini and his symphony which was not really a symphony in conventional form as we know it, but which actually anticipated and fathered the sonata. All of these works are played expertly and with considerable clan by Newell Jenkins and the properly Italianate orchestra. Again, this is not fare for the hi-fi; by which I mean to say that there are no booming basses or tinkling triangles. But the fidelity of reproduction is nevertheless of the very top quality, with a warm, rich string tone and excellent acoustics. The NARTB curve was slightly bass deficient, but responded to a few db of boost. Surfaces were quiet.

THOMAS
MIGNON
Geneviève Moizan, Janine Michean, Libero De Luca soloists with chorus of Le Theatre Royal de la Monnaie, Brussels. L'Orchestre National de Belgique conducted by Georges Sebastian. London LLA15, ffrr curve. Price $17.85.

It looks like this must be the month for opera! I know there will be rejoicing with this new version of "Mignon," since it is the first complete recording

on LP. Lovers of this comic opera have had to content themselves with excerpted highlights, not very satisfying to the opera addict. Of course the mere fact that a complete recording of "Mignon" exists does not gain for it immediate acceptance. Among the most canny buyers of records is the opera fan. He's from Missouri and wants to be shown! He can allay any fears he might have with regard to this version herein reviewed. It is a magnificent achievement from any standpoint. Genevieve Moizan as "Mignon" is absolutely splendid, Janine Micheau as "Philine" is her usual brilliant self, and Libero De Luca entirely convincing as "Wilhelm." There might have been a happier choice than Rene Bianco as "Lothario," but he is competent enough as are the other remaining soloists.

The ensemble work is among the finest I've ever heard in an opera. Georges Sebastian conducts, with authority, a better-than-average orchestra and in general keeps a firm but guiding hand on all the forces he commands. The sound is up to the high standards that *London* has set in its opera recordings. String tone is warm and vibrant, percussion very clean and accurate, soloists are projected with splendid clarity. "Big hall" acoustic perspective.

It is interesting to note the unique new method of packaging multi-disc sets that *London* has developed. Enclosed in the usual box-type album, between the inside cover and the record itself is a cube of foam rubber. This cube is somewhat larger than the space between album cover and disc. As a consequence, when the album is in a closed position, the cube compresses and holds the disc quite firmly in its inner shuck. This, of course, is of more practical importance in the shipping of an album to its distribution point. A clever little idea and one that seems to pay off, as there was a minimum of scratches and surface noise in the review copy sent to me. The *ffrr* curve reproduced the disc perfectly with controls flat.

MOUSSORGSKY

PICTURES AT AN EXHIBITION
Philadelphia Orchestra conducted by Eugene Ormandy. Columbia ML4700, NARTB curve. Price $5.95.

PICTURES AT AN EXHIBITION
Chicago Symphony Orchestra conducted by Rafael Kubelik. Mercury MG50000, AES curve. Price $5.95.

Many readers have asked for a comparative review on these discs, ever since the Ormandy version appeared. Whew! You guys don't mind putting me on the spot, do you? These are just about the toughest two discs in the LP catalogue to compare. Why? Well, let it be understood from the start that these two recordings are absolutely tops, each in its own way. As far as fidelity of reproduction is concerned, each is extremely wide range with no particular advantage of one over the other. The *Mercury* disc is now famous

as the initial effort in their "Olympian Series," which also saw the inauguration of the single *Telefunken* mike-over-the-podium pickup. *Columbia* has made some constructional changes (what they are I haven't the vaguest idea) in the Academy of Music in Philadelphia. I presume these constructional changes were accompanied by new pickup techniques. So what is the essential difference between the two recordings, and which do I prefer? The *Mercury*, and for the following reasons. Tempo. This is a matter of performance you say. But, this is a peculiar circumstance in which the type of repertoire we are dealing with actually *sounds* different when played at various tempi. I thought Mr. Ormandy lost a great deal of the punch and the sonority of "Pictures" by conducting at a much faster pace than Kubelik. Acoustics and dynamic range; here is perhaps the crux of the whole matter. As I said, *both* recordings are recorded with equal fidelity. But the *Mercury* disc was recorded in the fortuitous acoustic environment of Orchestra Hall in Chicago. The combination of the repertoire and the acoustics made one of the most sonorous discs yet heard. The weight of the brass was tremendous and the percussion unbelievably solid. May I point out that this theory of repertoire and acoustics has been pretty well borne out by subsequent recordings made by *Mercury* in Orchestra Hall.

Take, for instance, Brahms "First Symphony" as recorded by the same orchestra and conductor, in the same hall. Yes, it is a very good recording. *but* no where near as sensational soundwise as the "Pictures." Many a hi-fi fan went to hear Kubelik play the Moussorgsky piece when the Chicago Symphony was at Carnegie Hall in N. Y. (contrary to popular belief, hi-fi fans *do* go to concerts). They heard the same splendid performance as on the disc, but most were disappointed in the sound. Of course! No two halls are alike as to acoustics and the acoustics of Orchestra Hall in Chicago just seem to go with "Pictures at an Exhibition," like ham with eggs.

You must remember that all the foregoing is just this reviewer's personal opinion. I have no doubt that there are many who prefer the Ormandy version. It *is* a splendid recording, but to me the more exciting result is the Chicago disc. The *Columbia* disc does have one advantage over the *Mercury* and that is the bonus of an excellent performance of Stravinsky's "Firebird Suite" on the flip side of the 12" disc. The *Mercury* version of "Pictures" occupies both sides of a 12" LP and those who have to watch their pennies a little closer than most may prefer the bonus value of the *Columbia* disc. Well, that's it. I am mentally cringing from the weight of wrathful letters I know will descend on my head for this review. But them's my views, Podner, an' I'm stickin' with 'em!

That is the "bag" of recordings for this month. Happy listening! —30—

Chromatic Color Tube

(*Continued from page* 53)

with the NTSC color TV system is shown in Fig. 3. The four video sections, containing the brightness and the three color signals, are required for the NTSC color system since the fine picture detail is transmitted on the brightness signal, and for color information each requires a separate amplifier. For the color signals, the amplifiers are relatively narrow-band stages, but for the brightness signal a 3.5 to 4 mc. bandwidth is desirable. Not shown in Fig. 3 is the synchronous detector which supplies the brightness and color signals. Also omitted are the vertical and horizontal deflection circuits.

The keying section is required to switch the output of each of the three color stages onto the single electron gun. In the *RCA* tri-color picture tube this is not necessary since each color channel is connected to one of the three electron guns. The tri-color tube is essentially a simultaneous device, while the "Chromatron" breaks the simultaneous NTSC system into a dot-sequential picture.

The operation of the color grids and their associated circuits is shown in some detail in Fig. 3. In order to maintain the d.c. focus potential between the two color grids and the aluminized phosphor backing, a center-tapped coil is required to make this potential equal at both grids. In Fig. 3, it is assumed that the secondary of the output transformer is resonated with the color grid capacity and properly matched to the primary for maximum transfer.

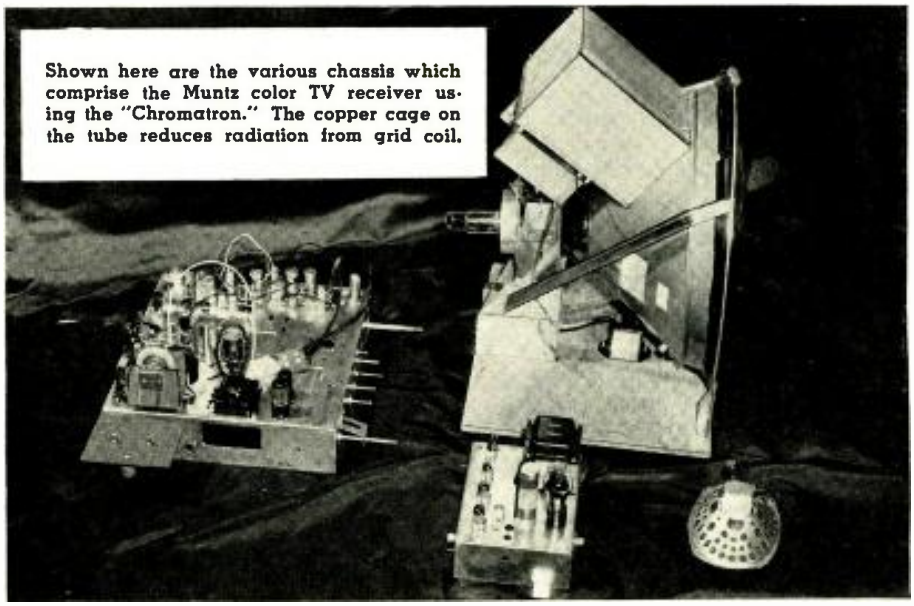
The driver stage can be a power amplifier driven by a voltage amplifier which, in turn, is driven by the color synchronizing oscillator. This 3.58 mc. oscillator is controlled by means of a keyed a.f.c. system from the color synchronizing burst transmitted after each horizontal synchronizing pulse in the composite color signal. In order to obtain true color rendition it is absolutely essential that the frequency remain constant and no phase shift or distortion be introduced.

The high voltage section of the "Chromatron" is somewhat different than for the *RCA* tri-color picture tube. Good regulation of the anode voltage is not required for the "Chromatron" whereas it is for the tri-color tube.

At the time of writing, several demonstrations of the "Chromatron" have been given. When demonstrated with the NTSC color TV system the "Chromatron" itself appears fairly good. The pictures on one of the tubes appeared to have considerable red streaking which apparently was due to the red phosphor's long persistence. This feature can be remedied by using a different red phosphor. At a viewing distance of about 10 feet, the individual lines are not visible and the viewer sees only the complete color picture.

One interesting aspect of the line structure is the fact that the lines and the grid wires behind them can be oriented either vertically or horizontally and both types of tubes have been tested. It was found that when the colored phosphor lines are in the same direction as the horizontal scanning lines the color moire pattern is much less visible at closer viewing distances. The actual width of the color phosphor lines has not been definitely set, but tubes with strips as narrow as 0.010 inch (10 mils) have been built. When these strips are applied horizontally, the resulting line structure is fine enough to enable the viewer at ordinary distances to see the complete color picture exclusively.

Chromatic Television Laboratories and some other tube manufacturers are developing improved tubes. Some of the planned improvements include much narrower phosphor strips, permitting a greater number of strips and therefore better resolution. Color grids will be made of finer wire and a better



Shown here are the various chassis which comprise the Muntz color TV receiver using the "Chromatron." The copper cage on the tube reduces radiation from grid coil.

set of colored phosphors is under consideration. The problem of the persistence of the phosphors can be solved when a color combination is found which produces the correct primary colors and has equal brightness and persistence under the same accelerating potential. In the sample tubes demonstrated so far, the correct phosphor combination was lacking, but some fairly good pictures were observed with a compromise arrangement of phosphors. —30—

Basic Color TV

(*Continued from page 70*)

done on how much color the average human eye really sees. This work, in conjunction with other data which has appeared from time to time, brought forth several very interesting facts.

1. The theory that vision is a three-color process is true only when the object viewed is relatively large. On a television screen, this refers to objects which are produced by video frequencies from 0 to .5 mc.

2 For medium-sized objects, say those produced by .5 mc. to 1.5 mc. video frequencies on a television screen, only two primary colors are needed. Blues and yellows are among the first colors to lose their color and become indistinguishable from gray within this range.

3. For very fine detail, say those reproduced by video frequencies from 1.5 to 4.0 mc., all people with normal vision are color blind. In other words, all that is seen are shades of brightness.

The conclusion to be drawn from the foregoing is that 4 mc. color is not necessary. All we require is color up to 1.5 mc. And even within this range, we need all three colors only to .5 mc. and only two primaries for the color signal extending from .5 mc. to 1.5 mc. In the formation of the NTSC signal, these facts were put to use by employing one color signal, called the "Q" signal, with a range from 0 to .5 mc. and a second color signal, called the "I" signal, with a bandpass from 0 to 1.5 mc. The rest of the video picture, containing all of the fine detail, is reproduced in black-and-white by a monochrome signal and the eye is none the wiser. As a matter of fact, a full color television signal consists of a 0 to 4 mc. monochrome video signal (just as we have in black-and-white broadcasting) plus a color subcarrier containing the "I" and "Q" color signals mentioned previously. It has been truly said that the NTSC system is a "colored" television system.

The monochrome signal possesses such alternate names as brightness signal and luminance signal. The color portion is frequently referred to as the chrominance signal.

In the next article of this series we will see how the NTSC color signal is formed and of what it consists.

(*To be continued*)

SERVICE HINTS ON STEWART-WARNER TV SETS

9120, 9121 & 9122

Poor horizontal linearity.

If it is sometimes difficult to obtain the correct horizontal linearity through adjustment of the horizontal linearity, horizontal drive, and width controls, change condenser 280, in the return lead of the horizontal output transformer (red lead from terminal 6 to deflection yoke), from .1 μfd. to .25 μfd.

9124-A

Critical horizontal hold.

This condition may be due to an increase in the value of resistor 258, which should be 3900 ohms, in the plate circuit (pin 2) of V_{10}, 6SN7GT horizontal multivibrator. Check this resistor and if its ohmic value has increased above 10%, replace it with another ½-watt, 10% tolerance unit.

Also check resistor 263, in the other plate (pin 5) circuit of this tube. The value of this resistor should be 270,000 ohms.

9127

Picture centering trouble.

If it is impossible to center the picture without producing neck shadow, apply the following circuit modifications:

1. Disconnect the yellow lead of the focus coil socket from the 340-volt "B+" supply, and reconnect it to the red lead coming from pin 7 of the deflection yoke socket.
2. Disconnect resistor 363 (12,000 ohm, 2 watt) in the screen circuit (pin 8) of the horizontal output tube (6CD6G) from the 340-volt "B+" supply, and reconnect it to the red lead coming from pin 7 of the deflection yoke.

9200 SERIES

Poor vertical hold.

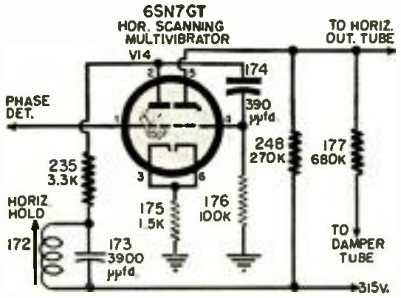
In weak signal areas, or in areas with a great deal of external electrical interference, do the following to improve the vertical sync stability:

1. Change resistor 160, in the plate circuit (pin 6) of the 12AU7 phase splitter (V_{12B}), from 3300 ohms to 6800 ohms.
2. Change resistor 219 (from pin 6 of the 12AU7 phase splitter to terminal 1 of the vertical integrator network), from 56,000 ohms to 27,000 ohms.

Squeal.

During the receiver warm-up period, a high-pitched squeal may be emitted. This comes from the horizontal multivibrator, and can be eliminated by doing the following:

1. Change condenser 174, in the plate circuit (from pin 2 to pin 4) of the 6SN7GT horizontal multivibrator (V_{14}), from 470 μμfd. to 390 μμfd.
2. Change resistor 177 (connected to pin 5 of V_{14}), from 330,000 ohms to 680,000 ohms.
3. Change resistor 235 (connected to pin 2 of V_{14}), from 3900 ohms to 3300 ohms.
4. Add a 270,000-ohm, 10%, ½-watt resistor from pin 5 of V_{14} to the 315-volt "B+" supply.



See accompanying diagram for new circuit.

9202

Vertical bending.

In moderate or strong signal areas, vertical bending may be encountered. To overcome this action, insert a 27,000-ohm isolating resistor in the plate circuit of the 12AU7 phase splitter. This resistor should be inserted between the plate (pin 6) of the 12AU7 and lead 1 of the vertical integrator printed circuit.

9204

Picture centering trouble.

If it is impossible to center the picture without producing neck shadow, disconnect the yellow lead of the focus coil socket from the 315-volt "B+" supply, and reconnect it to the red lead coming from pin 7 of the deflection yoke.

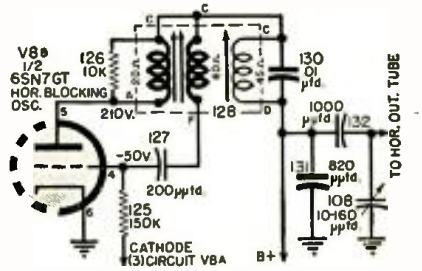
9300 SERIES

Poor horizontal hold.

If the horizontal hold action is critical, follow the procedure outlined below:

1. Check to see that condenser 131 is a siver mica 820-μμfd. unit with ± 5% tolerance.

(See accompanying diagram.)



2. Check to see that condenser 130 is other than a *Sangamo* type (red body). This .01-μfd. condenser should be the type supplied under the *Stewart-Warner* Part No. 512311. Do not use a substitute.
3. If the receiver has a "horizontal range" trimmer condenser, it should be screwed closed.
4. If a 6SN7GTA tube is used as the horizontal a.f.c. locking oscillator (V_5), replace it with a 6SN7GT.
5. Turn the receiver on and allow it to operate for fifteen minutes.
6. Set the horizontal hold control, on the front of the receiver, to its counter-clockwise position.
7. Remove the 6BE6 gated sync separator tube from its socket. This will cause the receiver to lose both horizontal and vertical sync.
8. If it was necessary to replace condenser 130, the receiver will probably be far off of horizontal frequency. This should be corrected by adjusting the bottom slug of the syncro-guide transformer (Part 128) until the picture "hunts" horizontally. The picture will remain intact and slide from side to side across the screen. If condenser 130 was not replaced, do not adjust the bottom slug of transformer 128, but do adjust the top slug for "hunting."
9. Plug the 6BE6 tube back into its socket, and set the front control of the receiver to the center of its range.

21-INCH RECEIVERS

Dark spot on CRT.

A round dark spot, approximately 4 inches in diameter, may appear in the center of the picture tube on some of these receivers. This spot is due to the fact that the picture tube is too close to the safety glass. An electrostatic discharge to the glass reduces the high voltage on the picture tube in a small area, and the dark spot results.

To remedy this, loosen the chassis-mounting bolts, and slide the chassis back as far as it will go. —30—

Howard W. Sams (center) president of the firm bearing his name, accepts the "Friend of Service Management" plaque of the National Alliance of Television-Electronic Service Associations on behalf of his company. Frank J. Moch of Chicago, president of NATESA (right) looks on as Mr. Sams shows the plaque to Fred Colton, NATESA's eastern central vice-president and chairman of the board of the Associated Radio & TV Service Dealers of Columbus. More than 100 civic leaders and electronics executives attended the recent ceremonies.

RADIO-TV Service Industry News

AS REPORTED BY THE TELEVISION TECHNICIANS LECTURE BUREAU

IN RESPONSE to the many inquiries that have been sent to the Bureau, a survey is now being completed that will provide the required information for a chart of standard labor charges for radio and phonograph service. Readers who would like to be notified when these charts are available should send a stamped, addressed envelope to TTLB Information Service, P. O. Box 1321, Indianapolis 6, Indiana, and request information on the Standard Radio Service Labor Charges Chart (RSL-1).

Color TV Service Charges

It will probably be a long time before the independent service industry will be called upon to install and service color television receivers. The set manufacturers will go into the production of color sets very cautiously. Field experience must be acquired both on the stability of circuitry under a great variety of operating conditions and the range of the likes and dislikes of the general public on color variation and deviation.

The early sets will be prototype models that will be closely watched in service by factory field service engineers and distributor service personnel. Even if color picture tube production should build up faster than is currently anticipated, production runs of color sets, which will carry high list prices, will be very limited.

The industry generally anticipates that color receivers will require far more service attention than monochrome receivers even after circuits and components have been perfected to the point where large-scale production is possible.

Quite naturally, charges for contract and C.O.D. service on color receivers will be determined through experience when thousands of sets are in use. But as a starting point, all sets that will be sold in the early days will probably have a mandatory 90-day parts and service warranty which the purchaser must buy and some may even require the purchase of a 1-year parts and service warranty. How much will set purchasers have to pay for these parts and warranty agreements?

Those best qualified to judge the service requirements of color sets during the early stages, say that the average 90-day parts and service warranty will cost the purchaser about ninety dollars and the 1-year service contract and parts warranty will cost him about $295.00. These estimates do not include the installation of an antenna.

Adequate Service Charges

It should be obvious to every service shop operator who handles TV service that he must assume part of the responsibility for educating the set-owning public to pay adequate charges for TV service. Those who still live under the illusion that they can continue to advertise home service calls for $2.50 or $3.00 and make up the difference in loaded tube and parts bills will find more and more realistic operators urging set owners to demand the old tubes and parts removed from their sets. As service customers become wise to the padded parts and tube gimmick, men who have promoted their businesses on the basis of small charges for home service will find themselves squeezed into an impossible position.

All of the factors involved inadequate pricing of service labor are now so well known that there is no reason why anyone should offer to perform TV service at a lower price than it can be given—honestly—and return to the business the sort of income a competent technical business has a right to expect.

The bulk of the income of a service business must come from the sale of labor. Records show that where adequate labor charges are levied for service, and the parts and tubes charged for are held to those really required to service the sets, 80% of the service income comes from labor charges and only 20% from the sale of replacement parts and tubes. In other words, each ten dollars of service income includes $8.00 for a service technician's time and $2.00 for the parts used in repairing the sets.

How much is experienced technical labor worth? If you are a top-flight technician operating your own service business how much "take home pay" should you expect to get from your

business to warrant the application of your time, energies, training, and experience *plus* all of the risks involved in running a business of your own?

Last November, the *RCA Service Company* completed a new contract with its employees' union which provided for the following wage schedule:

	per week	hours
Chief Technician.....	$115.00	40
Journeyman Installation & Service Technician....	95.00	40
Apprentice Installation & Service Technician....	50.00	40

The schedule for apprentices provides for regular increases in the wages paid apprentice technicians every six months until, after 42 months of satisfactory performance and progress, they will receive the journeyman's scale of $95.00 per week.

How good a TV service technician do you consider yourself to be? Do you demand of your business that it pay you $115.00 per week for yourself and family and a return on your investment in equipment, tools, and supplies? If you are running a one-man TV service business and want that business to pay you $115.00 per week for working eight hours per day for five days a week, you will have to get $8.56 net income from each service call you make, and you must average 7 calls regularly every day.

Although most one-man TV service operators work six days per week and ten or more hours per day, few of them are able to consistently average 35 service calls per week. The determining factor is not the number of hours per day or days per week a man works, but what he is able to accomplish in completed service jobs during the time he is available to work.

A great many studies have been made to determine the minimum size, in personnel, a service organization must be to operate profitably, and the optimum size for most efficient and profitable operation. The conclusion reached is that for most cases, a three-man operation is a minimum organization. Generally, where less than three men are employed, the time lost in handling non-income producing details of the business make it impossible for the one- or two-man shops to handle enough income-producing business to pay incomes commensurate with the technical skills of the men who operate the business. That this conclusion is sound is evidenced by the very high mortality rate among one- and two-man shops.

What will color TV demand in organization size for efficient and profitable operation? The following predictions by Paul V. Forte in a recent issue of the "Almo Broadcaster," published by the *Almo Radio Company* of Philadelphia, may prove significant:

"Take the green out of your eye, the red from your face, and don't be blue. The new year will be a colorful one, and particularly in the television industry.

"From its inception, television has been a turbulent business and nine-

teen-fifty-four will have more than its share of turbulence. This is inherent in growth and the business will grow faster than it ever did before, despite some rumors to the contrary. More important, the growth will bring about healthy changes that will hurt some but bring great benefits to the majority.

"Color is to be feared only by the ignorant, no matter what phase of the television business he handles. Our immediate interest, however, lies in its effect on the television service business. We would like to discuss this effect in the form of predictions for the year, a pleasant practice in which we all indulge around the first of the year.

"We predict:

"1. This year will be the beginning of the end for the greatest majority of the individual TV servicemen, particularly those who operate from home or after hours of normal business. The intricacy of color television will require more facilities, resources, equipment, and organization in its service than an individual can provide.

"2. There will be many mergers of service businesses as individuals and small groups realize the necessity and desirability of pooling resources. Efficiency and economy of operation will be demanded by the consumer when he begins to realize the cost of both color and u.h.f. service. As you know, u.h.f. is scheduled to be with us in Philadelphia soon and the lack of consumer education on this score will be seriously felt by service people.

"3. The shortage of really competent service technicians will become even more painfully apparent in the coming year. The larger service organizations will take unusual steps to hold those they have and develop the potential in others where and when they must.

"4. Service trade organizations will become bigger and more influential as service technicians and business operators begin to realize, fully, a proper concept of their functions. That these associations can and will do a job that the individual service operator can't begin to do in his relations with the consumer and the industry will become too obvious to be passed over lightly, as in the past.

"5. Manufacturers and distributors will give more and more attention to the needs of the service industry than they have in the past. They will do this for a very good reason: because it is good business. They are beginning to realize the value of the goodwill of service people, especially as it begins to reflect on balance sheets in the sale of receivers, parts, tubes, and related equipment.

"Mark these predictions! Some of them began to take form months ago but they are still almost shapeless masses. Color television will be the catalytic agent that will make them stand out sharply."

Service in 1954

At the turn of the year, the industry generally was jittery over the possible

effect of color television on the sale of black-and-white sets. The industry had produced TV receivers throughout 1953 at the annual rate of about 7 million sets and there were some fears that a drastic cutback would take place when the public started to sit on its purse strings and wait until they could buy color sets. Forecasts by industry authorities, though, were very optimistic for business this year. Typical of these forecasts that are of special interest to the independent service industry are the following made by *G-E*'s Dr. W. R. G. Baker:

"I believe the industry can look forward to these developments in 1954:

"1. A strong demand for monochrome television station equipment and receivers with the addition of about 200 new TV stations during the year, bringing the total to 550 in operation by the end of 1954.

"2. Introduction of limited color telecasting opening a new market area for broadcast equipment and receivers.

"3. Industry to distributor sales of 5,200,000 monochrome and 100,000 color TV receivers, and continued strong demand for radio receivers with industry production of about 7,600,000 home and portable radios.

"4. Further improvement in monochrome TV picture tubes, intensified research and development in tubes for color TV, and continued growth in total tube sales by the industry."

While industry attention will be focused on color television, service technicians will be offered many training programs to apprise them of the technical aspects of compatible color TV and the installation and servicing requirements for color TV sets. However, color television will not add any appreciable volume of business to the activity of independent servicing during the coming year. As a matter of fact, it may be two years before the service industry has an opportunity to service any considerable quantity of color TV receivers.

Industry thinking about the effect of color TV on the production and sales of other home entertainment electronic devices was more or less summed up in the year-end report of Robert W. Sprague, chairman of the Board of Directors of *RETMA:*

"With good merchandising, I believe the industry should be able to sell at least 6 million television sets and 10 million or more radios in 1954 unless incomes generally drop more sharply than now seems likely. Most manufacturers feel that black-and-white TV sets will continue to constitute the bulk of the set sales for years to come. All agree that relatively few color receivers will be available in 1954, and that these, of necessity, will be very high priced and will have screens that are small in comparison with the larger screen black-and-white sets available at a third the price or less.

"Certainly, color TV programs will be distinctly in the minority for a long while despite understandable ballyhoo that will attend color broadcasts in

1954. Sponsors will be slow to spend money for color programs which so few persons will be able to see, except in black-and-white.

In the meantime, there is a whale of a lot of service work to be done on radios, phonographs, and other electronic devices that are widely used in homes and businesses. In many areas, service operators who have been making a fringe living competing for TV service business have ignored the tremendous need for service on radio sets, phonographs, and wire and tape recorders.

In one city recently checked by your editors, a dealer in office equipment had found it necessary to hire a technician to repair wire and tape recorders in order to protect his market for these devices which he was selling for use as dictating machines. Within six months the service end of his business had grown so much that he had to add a second technician. The increased service business came from owners of recorders who learned about his recorder service facilities. Within eighteen months the profit from his recorder service department exceeded the profit he was making from the sale of new recorders.

During this same period in this same city several dozen service operators were knocking themselves out competing for TV service business at $2.50 per call, slowly starving themselves out of business—blind to the immense pool of profitable service business that was available in radio, phonograph, and recorder repairs.

There are two ways to merchandise service. One is to wait for service business to come to you, the other is to go out after business. The first way is the negative way. It lets your business wobble up and down at the whim of customers who call on you as a last resort and then want good service fast and cheap.

The second way—going out after business—is a positive way. When you merchandise your business that way it puts you in command of it. You are in a business that is unusual in this respect—you have a 100% market for your services. There is hardly a home in your market area right now that doesn't need the services you have to sell on some piece of electronic equipment now in use—or shelved for service. It may be a TV set, a radio set, or a phonograph.

How do you go out after business? It's simple in a business like yours with a 100% market so clearly defined. Use a simple, inexpensive, direct-mail program. Ask your parts jobber about the direct-mail programs the tube manufacturers have prepared for you. They are good, effective, and inexpensive. —30—

Technician Associations

(*Continued from page 85*)

UTAH

Utah Ass'n. of Radio & Television Servicemen, 418 Frick Bldg., 23 E. 1st S., Salt Lake City 1—John F. Burns, Pres.; Robert J. Magness, Sec'y-Treas.

WASHINGTON

The Northwest Appliance & Television Ass'n., 714 American Bldg., Seattle 4—Keith Davis, Pres.; L. Edward Smith, Exec. Sec'y.

CANADA

Victoria & Island Chapter of the Radio Electronic Technicians Ass'n., 783 Fort St., Victoria, B.C.—Dave Banfield, Pres.; George D. Percy, Sec'y.

Radio Electronic Technicians Ass'n., P.O. Box 391, Winnipeg, Manitoba—N. Weibe, Pres.; V. Sexton, Sec'y. —30—

Spot Radio News
(Continued from page 18)

relax its present rules. Specifically, the present minimum of 42 hours of operation would be reduced to 36, and secondary or subsidiary licenses would be offered to those engaged in non-broadcast services which involve special programming on a simplex basis during non-broadcast hours using an ultrasonic (beep) signal to activate special receivers owned or rented by commercial and industrial establishments for the purpose. Secondary licenses would also be available for additional program transmission on a multiplex basis during regular broadcast hours to individuals and organizations who have the necessary multiplexing receivers. These possibilities, it was said, embrace functional music (background, storecasting, and transitcasing), and such appropriate supplemental programming as news, music, time and weather announcements, which would further utilize the FM frequencies, and provide sources of additional income for FM broadcasters. They would not, however, cover such activities as dispatching services, etc. Nor could the FM licensee lease or otherwise delegate such special authorization.

The decision to ease the rules represents quite a turnabout, for only a few years ago it was pointed out that beep operations were inconsistent with basic statutes of the broadcast law, and that technically the licensees had given away the power to alter their service to meet the changing needs of the public because they had entered into contracts to provide subscribers with planned music. The Commission also cited that the elimination of sponsorship, station identification, and other announcements from reception by subscribers, although made to the general public, violated the law, since the requirements of the Act contemplate transmission of such information to the station's *entire* audience and not to the broadcasting of a tone which prevents a portion of the audience from hearing the announcements.

The change in heart was prompted by a reconsideration of the legality of such broadcasts and the serious economic groove in which the FM broadcasters find themselves. Of the 53 independent FM stations reporting in '52, only six showed a profit; five had net incomes before Federal income taxes of $2000 or less, the highest income being $4600. The Commission also noted that 87% of the 616 FM stations on the air were operated by AM licensees, the large majority of which provided the FM service as a bonus.

On the basis of their review of the FM picture, the Commission added, they believed that it might be possible to provide for a more effective use of the frequency space now assigned for FM, making possible the rendering of new and useful services, and enabling

FM broadcasters to alleviate, in part, their financial difficulties.

Commissioner Frieda Hennock did not agree with her fellow Commissioners that the new proposal was a logical one. And in a biting dissent, she said that the new plan, in her opinion, amounts to a reallocation of the FM band, and ". . . no amount of emphasis that . . . the aim . . . is not conversion of the band to some new specialized non-broadcast service . . . will change this result."

Continuing her blast, Madam Commissioner added: "If the spectrum space allocated to FM broadcasting is excessive, or not fully utilized by that service and capable of accommodating the services, all persons interested in radio communications should be given an opportunity to apply for the use of these frequencies. As it is, only FM licensees would be the beneficiaries of this proposal, for only they would be eligible for the proposed SCA (Subsidiary Communications Authorization) to engage in non-broadcast operations. In my opinion, it has not been shown that it would be in the public interest so to restrict the scope of what essentially is a proposal for a new allocation of 20 megacycles of spectrum space."

The proposal to convert the FM band to private non-broadcast use may give FM licensees a windfall from the public domain, the fiery Commissioner added. She viewed the use to which the FM band can be placed through multiplexing as virtually unlimited. "While the Commission emphasizes that the primary use of the band is to remain FM broadcasting," added Commissioner Hennock, "by the very nature of the manifold uses, such as multiplexing, functional music, storecasting, transitcasting, and all other services lying between functional music operation and taxicab dispatching service, FM broadcasting may well be relegated to a subsidiary position. This is certainly a case of the tail wagging the dog."

PREDICTIONS citing the number of stations that would be on the air, offered early in '53, were shattered and splattered as the year came to a close. For instead of the mere 75 stations that it was said would perhaps begin telecasting during '53, the records showed that 225 had joined the television-broadcasting bandwagon, bringing the total number of on-the-air stations to nearly 360. (As this column was being prepared stations appearing in the table below received permits.)

And if somewhat the same processing pace is maintained in '54, at least 200 to 250 more stations are expected to come on the air during the new year.

The records also show that about two-thirds of the new stations were ultra-high operated.

A possibility that station spacing may be altered, permitting more channels to some cities, was set aside by the Commission, who felt that it would not be wise at present to revise any assignment principles. Requests for such changes came from those who

NEW TV GRANTS SINCE FREEZE LIFT

Continuing the listing of construction permits granted by FCC since lifting of freeze. Additional stations will be carried next month.

STATE	CITY	CALL	CHANNEL	FREQUENCY (mc.)	POWER* (Video)
California	Palm Springs	KPAL†	14	470-476	13.275
"	San Diego	. . . . .	21	512-518	186
D.C.	Washington	. . . . .	50	686-692	95.2
Florida	Clearwater	. . . . .	32	578-584	93.5
"	Miami	WMIE-TV	27	548-554	200
"	Miami	WINZ†	33	584-590	182
Georgia	Thomasville	. . . . .	6	82-88	6.03
Illinois	Chicago	WOPA-TV†	44	650-656	205
Kentucky	Lexington	WLAP†	27	548-554	247
Maryland	Baltimore	WSID†	18	494-500	85.2
Michigan	Traverse City	WPBN-TV	7	174-180	51.3
Missouri	Joplin	KSWM†	12	204-210	58.9
"	Kirksville	KBIZ†	3	60-66	100
Minnesota	Duluth	KDAL-TV	3	60-66	100
New York	Bloomingdale (Lake Placid)	. . . . .	5	76-82	3.55
" "	Carthage	. . . . .	7	174-180	190
North Carolina	Asheville	WLOS	13	210-216	170
Ohio	Cleveland	. . . . .	19	500-506	220.3
Oklahoma	Ada	KEOK	10	192-198	251
"	Enid	. . . . .	5	76-82	100
South Carolina	Spartanburg	WORD-TV	7	174-180	316
Tennessee	Jackson	WDXI-TV	9	186-192	56.2
Texas	Amarillo	KLYN-TV	7	174-180	5
"	Corpus Christi	. . . . .	43	644-650	37.1
"	San Antonio	. . . . .	12	204-210	316
Utah	Provo	KOVO	11	198-204	64.6
Virginia	Richmond	WTOB-TV†	29	560-566	17
Washington	Seattle	. . . . .	20	506-512	200
Wisconsin	La Crosse	WKBT	38	614-620	18.2

*ERP = (effective radiated power, kw.). . . = Call letters to be announced † = Temporary call letters.

felt the mileage-spacing ruling should be modified to include a five-mile tolerance instead of the fifteen-mile limitation now on the books; rule now makes a channel available for an unlisted community within 15 miles of the listed city.

A NEW ERA in TV and radio reporting from Washington was ushered in shortly after the new year, when after more than sixteen years of waiting, a huge remodeled room with sparkling new studios on the gallery floor of the Senate wing on the U.S. Capitol was opened.

Now, instead of being shuttled about and crowded in a nook, radio and TV networks, four major film services, and 35 individual radio stations and special news services can use a new TV studio which is 20 by 15¼ feet, or either of four radio rooms.

The refurbished gallery, technically known as G-25, is next door to the press gallery. Many interviews with Congressmen will be forthcoming hereafter from these new studios. Some might be live, some filmed, and some taped. To the broadcasters who initiated the move and to the 83rd Congress who appropriated the money ($33,000), everyone is grateful for this change; a glowing tribute to the maturity and dominance on the American scene radio and TV has achieved. . . L.W.

EDISON HAM AWARD

J. STAN SURBER of Peru, Indiana has been named the outstanding ham of 1953 and awarded the "Edison Amateur Radio Award" by General Electric Co., sponsor of award.

W9NZZ was named for his service as "mailman" for servicemen stationed at Arctic weather stations. Surber was nominated in 112 letters from 28 states and 5 foreign countries. -30-

A wife can watch a variety show while her husband enjoys a different program at the same time on the same screen on the new Du Mont "Duoscopic" television receiver. Viewing is done through polaroid glasses or polaroid panels. By reversing the glasses or panels, the viewer can choose the alternate of the two programs tuned in. Individual earphones are used to separate the sound portions of the programs. A remote control unit permits the viewer to listen to either of the two programs.

How's Your Rumble?

(*Continued from page 79*)

ment. Column A shows the results on one hi-fi set-up using a record changer, a wide range amplifier and a corner horn speaker. The rumble on this system was definitely noticeable at moderate volume levels and very objectionable at high levels. The greatest increase in noise occurs from the vibration of the phono motor. Nothing was found wrong with this motor and when a new unit of the same type was substituted a change in vibration noise of only 1 db was noticed. Thus the rumble in this system was pretty much due to the vibration inherent in this particular type of motor. Column B shows the performance of this same system when an improved type turntable was substituted. The rumble dropped to a level which was just detectable at high-volume listening.

Column C shows the results of these tests on another system. This set-up uses a record changer, a wide range amplifier, and a large bass reflex cabinet. It is obvious from the data that hum or noise from the preamplifier is a problem. The large increase in noise when the turntable is rotated is an indication of a rough turntable rim or idler wheel. The rhythm of the turntable noise coincided with the revolutions of the idler wheel rather than the turntable. Replacement of a noisy tube in the preamplifier and a thorough cleaning of the record changer plus installation of a new idler drive wheel produced the results of column D. The rumble level was considerably improved and satisfactory.

Now it should be made clear that we have not really measured the noise level from each of the components by this method. We have simply seen how noise accumulates as it proceeds through the equipment and this is helpful in telling where the abnormal conditions lie. With a little experience in this method it is easy to size up the noise and rumble problem in a high-fidelity system.

General Considerations

In analyzing a rumble problem the first step is to have it demonstrated to you under actual listening conditions. A few checks of the control settings plus some discussion will enable you to tell if (1) the listener is very critical, (2) if he likes music very loud. (3) or if he likes tremendous bass boost. Each of these three points lowers the amount of rumble which can be tolerated. You can also tell from your knowledge of equipment how low the bass response of the speaker goes. Careful listening will tell if the speaker has a peaked bass response or an over-resonant boom. If either of these troubles is present it would simplify the rumble problem and improve the over-all sound to correct them first.

The main question to be answered

is, can the rumble be fixed by working on the equipment and replacing defective parts or must a higher quality turntable be obtained. Measurements of the rumble and noise content can help to answer the question. The data in Table 1 is an approximation of various rumble levels suitable for different types of installations. This may be helpful to the inexperienced.

In general, record changers have a rumble content of −10 to −35 db when measured on wide-range equipment. Turntables cover the range of −25 to −55 db. Some of the best record changers have rumble content lower than some good turntables. However the best turntables are the most quiet and dependable types of apparatus for critical installations. In setting up a new high-fidelity installation with a wide range speaker the best choice of record playing equipment is a good turntable and arm if the listener does not already have a collection of 78 records. There is really very little need for a changer if you are mainly interested in LP records. However if a record changer is desired for 78 or 45 rpm records and you are still critical of rumble there are three choices. First you can very carefully select a record changer. Some models are quite low in noise. It is a good plan to make listening tests and measurements on a few competitive models in the actual installation. A second plan is to install a dynamic noise suppressor to control rumble. The third choice is to install both a changer and a good turntable. This is often done in custom home audio systems where it is to be used by several members of the family, some preferring the changer for dance and pop music and the turntable for serious listening.

Though we have heard about rumble for many years the new advances in the audio art extending the low-frequency limit of sound equipment have highlighted this problem. Careful equipment selection and maintenance on the part of the audio amateur or service technician can do much to control rumble and increase enjoyment from home sound systems.

-30-

SIMPLIFYING V.T.V.M. CALIBRATION

By KENNETH P. AURELIUS

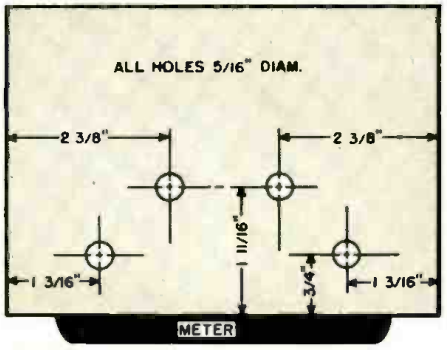
PROBABLY most people who use vacuum-tube voltmeters have, at some time or other, had occasion to recalibrate them because of jarring or aging of components. This process usually involves removal of the chassis from the cabinet.

In the "Eico" unit shown in the photograph, I drilled four holes on the top of the cabinet to obviate the need for removing the chassis. The template shown in the diagram was used to locate the holes. If other types of meters are to be so treated, you simply invert the chassis and make the necessary measurements on the top of the cabinet for the correct location of the holes.

All of the holes are 5/16 inch in diameter. Snap-button hole plugs are inserted to keep the dust out. These plugs are color coded for easy identification. With my v.t.v.m., I used the following color codes: — d.c. calibration (black); + d.c. calibration (red); a.c. zero (no color); and a.c. calibration (green).

Any long handled screwdriver or alignment tool may be used to calibrate the meter. To see the slot in the potentiometer, an adjacent snap-button plug can be removed and, by using a flashlight, the operation is easily visible.

Template used to locate calibration holes in Eico Model 221 vacuum-tube voltmeter.



The few minutes spent in drilling the cabinet pays off handsomely in time saved later on.

-30-

The color-coded holes in the v.t.v.m. cabinet. Screwdriver is inserted through the proper hole to recalibrate the instrument.

Mac's Service Shop

(*Continued from page* 86)

and *Webcor* were planning on releasing pre-recorded tapes of classical music."

"Why does a head not in alignment hurt?"

"Suppose we want to play that photographically printed tape we were talking about," Mac said. "Let's say our playback mechanism consists of a bright light shining through a very narrow slit onto the tape and that this reflected light excites a photoelectric cell that works into our amplifier. Light falling on a white section of tape excites the cell to maximum; when it falls on a black section, the excitation is minimum. When a low frequency recording passes the slit of light, the output of the light cell swings back and forth from a maximum to a minimum at a rate that faithfully reproduces the low note.

"Suppose, though, that we try to reproduce the frequency that printed the tape with the finest distinguishable lines. If the slit through which the light shines is in precise alignment with the lines themselves, the reflected light will be turned on and cut off cleanly by the movement of the fine lines beneath the slit. On the other hand, suppose the slit is canted so that it makes an angle with the lines. Now, long before we reach a frequency at which the lines themselves run together, the slit of light will cease to fall entirely upon a single white or black line. Instead, it will fall across adjacent lines so that part of a white line and part of a black line will always be beneath the slit. That means that the reflected light can never rise to the maximum or fall to the minimum value it attained when proper head alignment allowed all the light to fall upon a single white or black line. In other words, improper head alignment results in a loss of high frequencies. Of course, if the same head is used for both recording and playback, then alignment will matter little, for the recorded lines will have to match the angle of the head, even though both are tilted from the vertical."

"How do you know when a head is in proper alignment?"

Before answering Mac opened a cabinet and took out a roll of tape on a special 5" reel.

"This," he said, "is an alignment tape specifically prepared for head alignment by the *Toogood Recording Company* of Chicago. The recorded signal is .001 inch in wavelength and will reproduce at 7500 cycles-per-second at 7.5 i. p. s. or 15,000 cycles at 15 i. p. s. The signal is vertically aligned on the tape to a tolerance of 1½ minutes of arc. While the tape has been recorded the full width, it can be used effectively on dual-track machines because great care has been taken to make sure the edges of the tape are cleanly recorded. This is

necessary since many half-track heads run over the edge of the tape and would give a false reading if the recording at the edges was inaccurate.

"To align the head of a home recorder, you simply play this tape at 7.5 i. p. s. and adjust the position of the head by the means provided until maximum output is indicated by an audio wattmeter inserted in the external speaker jack or by an ordinary output meter connected across the speaker voice coil. Let me say here and now, though, if you ever erase a single foot of this tape, you had better take to the hills. Furthermore, never rewind the tape or run it forward at high speed for fear of stretching it. After you are through making your alignment test, reverse the reels and let the tape wind back on this reel at playing speed."

"Is there anything else I ought to watch in working on recorders?"

"Onc thing comes to mind. I note some manufacturers specify carbon tet for cleaning rubber drive wheels and others say to use alcohol. Probably the cleaning agent recommended depends on the kind of rubber used, and any other cleaner may soften or damage the rubber. Always stick exactly to the cleaner recommended in the service data.

"In general, never let a recorder go out without cleaning the head thoroughly. This is something home recorder owners are likely to overlook, and it has tremendous effect on the quality of the recording. Check tape speeds with a timing tape. After this has been running for a few seconds, count the proper timing intervals that pass a certain point in exactly a minute. If the speed is off more than one full interval in this length of time, find out why. Always check all tape moving controls thoroughly, making sure they work easily, that the tape is stopped without putting excessive strain on it, and that there is no tendency to spill the tape.

"Make a short recording at an excessively high level and see if the erase head will take this off completely. If not, measure the erase voltage delivered to the head and compare this with what the service data says it should be. If that is all right, make sure the tape is held firmly against the erase head by the pressure pad. If nothing is wrong here, you are probably up against a bad head. Substituting a good head is the best test for that."

"How about checking for wow?"

"Special equipment is needed to measure wow accurately, but you can easily make a rough check by recording a frequency of about one-thousand cycles and then listening to it being played back. You are almost certain to hear some wow on home recorders, but it should not be very pronounced. You will soon learn how much to expect.

"A rough frequency check can be made by recording a good record containing a wide range of sounds. A good piano piece constitutes a tough test. If

this sounds good on playback, the recorder response may be considered satisfactory. For a better test, record 1000, 50, 100, 500, 1000, 2500, 5000, 7500, and 10,000 cycles in that order from our audio generator, keeping the input level constant as measured with the a.c. v.t.v.m. Plug the audio wattmeter into the external speaker jack with the proper load resistor switched into use. Now, with the first 1000 cycle note being played, set the volume control so that a convenient value of output is obtained well below the maximum output rating of the amplifier. One watt should be satisfactory. Note down the reading produced on the wattmeter by each frequency. The departure of these values from the 1000-cycle reading can be converted into decibels and compared with the manufacturer's claims. Of course the tone control should be in the 'flat' position while taking the readings."

"You must be expecting to do quite a bit of recorder service."

"I am. *RCA* predicts that schools alone will buy 50,000 tape recorders this year. More and more families are finding new uses for them around the home. I consider them easier to work on than record changers. One reason I bought this new job for the shop was so that we would have a reasonable standard of home recorder performance always at hand. On top of that, it is sometimes a great help to be able to play a recording made on a doubtful machine back on one known to be good, and *vice versa*. This allows you to spot whether the trouble is in the recording or playback system, or both. Now here are some good books on tape—"

"Oh no you don't!" Barney shouted. "You've already made a bookworm out of me by loading me down with those now-here's-something-you-ought-to-read things; but I'll be darned if you're going to make a tapeworm out of me!"

—30—

Training Program

(*Continued from page* 66)

content, and then budget a fixed amount of shop time for these training efforts. It won't be perfect, and it will have bugs, but it is a first step. And, as the Chinese say, a journey of a thousand miles begins with one step. In his planning, a shop owner should overlook the fact that he may be training for a competitor or that the employee so trained may leave him. That is a separate problem. He must consider only the problem of where a dollar of training will get more than a dollar of good quality production.

The second thing for the shop owner to recognize and work at is the principle known to all good personnel men, namely, that all aspects of personnel control interlock and affect one another. It does no great good to provide good training if your policies are such that men don't like to work for you. Training dollars are wasted if you hire poor material to begin with. The market for technicians is not so free that there is unlimited choice in hiring, but the owner must do the best he can. Based on the material available he must set up the training that best fits his shop needs and those of his men. Then he must take a long, hard look at his general personnel policies. Here he must be competitive, not only with other service shops, but with other opportunities that his men might seek. Here are the questions that a professional personnel man asks about his company. Are my wages in line with those of other possible employers of my men? Is my vacation or sick leave policy in line? Does my sales promotion keep my men on a full time job, or do I have to lay them off during the summer? Do I have the equipment I should? Does a man working for me feel he is learning and

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Allied Radio Corp. recently played host to the Chicago Acoustical and Audio Group at the association's regular dinner meeting. The 150 diners were treated to a demonstration of stereophonic sound in Allied's dining rooms. The demonstration involved the use of three of the company's "Golden Knight" 24-watt amplifiers, three Electro-Voice "Regency III" speaker systems, an Ampex special 3-channel tape recorder, and Ampex stereophonic recorded tape. The same meeting also included a lecture and demonstration on new ceramic cartridges for high-fidelity use by Howard Souther of Electro-Voice, a "black curtain test" of a series of speakers, and a binaural sound demonstration from tape.

growing? Do my men feel that there is opportunity for advancement if they produce for me? If a company can meet the problems posed by these questions, it will not only keep its people, but can demand and get a full measure of work from them.

This is particularly true of the more seasoned men in the shop—the ones who have done some jumping around and perhaps tried a shop of their own and discovered it was no bed of roses. These are the wheel horses of any organization and the ones most costly to lose. Generally, these men place a high value upon security, and more and more companies are studying deferred compensation programs to bring stability to this important group of key men.

There is a general belief in industry that the small company cannot do the same things that the big company can do. This is a stubborn and erroneous idea. The small shop may have to do it differently, or on a more simplified scale, but basic principles apply to all working organizations regardless of size, and to be successful, management must give time to broad policy.

This problem is not an easy one. No management problem is. We cannot give a detailed blueprint here, but the broad approach outlined represents a method of attack that will bring success to the management that believes in it and is persistent in its pursuit.

The shop management that applies these techniques of manpower development need not fear that it will carry its competitors' training burden. It will be working and training for its own profit and its own public acceptance. Furthermore, it will be doing its individual share in the development of a great industry. —30—

NOISE SUPPRESSION

By ROBERT A. THOMASON, W4SUD

IN THE belief that other readers of this magazine would be interested in my recent experiments on vehicular noise suppression in late model ('49-'53) Ford trucks for the Texas Gas Transmission Corporation, of which I am communications foreman, I'd like to pass on these tips.

After reducing ignition and regulator noise to a tolerable level, I found the noise still much higher than was desirable. With the help of a coaxial feed link, tied to the antenna terminals of a 50 mc. receiver, I found most of the noise was coming from the electrical oil pressure gauge (meter block unit).

Also guilty, but to a lesser degree, were the electrical temperature and gas gauges. The noise sounded like someone scratching the antenna with a knife blade. I found that by using .01 μfd. disc ceramic condensers, the noise was effectively bypassed at all three points.

These condensers should be installed with as short leads as possible. The ground side was soldered while the other lead was tightened under the screw terminal. I then tried this same technique on my 4 mc. mobile station with equally good results.

W4MGT, with the Kentucky State Police, reported good results after installing a condenser on the oil gauge. —30—

Building a Multimeter

(*Continued from page* 71)

1000-ohm rheostat and the other to the positive test jack.

The switch legs are numbered from 1 to 11. These run counterclockwise from the pole connectors. The top deck to which the series resistors for the voltage multipliers are attached is the one nearest you when the instrument is on its face. The lower deck is immediately adjacent to the panel.

The wooden case for the meter was made from a piece of ¼" maple, 2½" wide and 30" long. Simple rabbet joints were used and the box assembled using glue and brads. The top edges were rabbeted 1/16" deep for the panel recess and the bottom edges rabbeted ¼" for the plywood back.

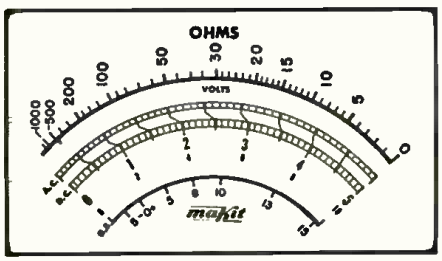
The two size "C" flashlight cells were secured to the back by means of a metal strap ⅝" x 2" and a 1¼" No. 8 screw. The connections to the battery were made through two miniature *Fahnestock* clips soldered to the positive and negative poles. Four ⅜" No. 4 screws were used to hold the completed meter in its case.

The reason for resistor R_1, mentioned earlier, is to facilitate the use of stock value shunts for the two current ranges and to make it an easy matter to match any 0-1 ma. meter of 100 ohms or less to this circuit. R_1 is equal to the meter's internal resistance subtracted from 100 ohms. In other words, if you have a meter with an internal resistance of 55 ohms, R_1 will be 45 ohms. These meters vary, depending on the manufacturer, so if you are not positive of the exact resistance of your meter use the following method to determine it:

1. Install the new meter scale.
2. Wire the circuit shown in Fig. 1B using short, heavy leads.
3. Place a jumper across the test jacks and carefully adjust the meter to full scale deflection.
4. Remove the jumper and insert the 100-ohm resistor.
5. Read the meter resistance directly on the "Ohms" scale.

Caution: Do not attempt to measure the resistance of an instrument with an ohmmeter as the former is ex-

Fig. 2. Scale calibration for the multimeter discussed. This could be photostated and increased in size to fit either a 3 or 4½ inch meter. The 3" meter scale is 2 5/16" wide and the 4½" meter scale is 3 11/16" wide. See Editor's Note at end of article regarding the availability of a commercially drawn scale for meter.



tremely delicate and the current flowing in the circuit is on the order of 90 to 100 ma. which would cause serious damage to the milliammeter under test.

The critical eye will note a built-in compromise or two, such as the fact that a 10,000-ohm resistor was used in a 1000 ohms-per-volt circuit to provide the 0-10 volt range. Actually, this value should be 9900 ohms with a 100-ohm meter resistance but since the difference of 100 ohms is only 1 per-cent, it was considered a worthwhile risk since the stock 10,000 ohm value is easier to obtain than the 9900-ohm resistor.

There is a slight loss of accuracy in the a.c. position but it is less than the 5 per-cent usually quoted for multimeters of this type. To correct these minor shortcomings, a complex switching system and an additional bank of resistors would be required which would result in an increase in both cost and building difficulty. The circuit, as shown, was decided upon as the most practical for these reasons.

Editor's Note: For those who wish to lend a "professional" appearance to their instruments a kit, containing meter scales (for either 3" or 4½" meters), front panel decals, and a builder's manual is available from Robert Hilliard Company, Box 549, Inglewood, California. The kit is $1.00 postpaid in the U. S. When ordering specify whether the scale is to be used with a 3" or a 4½" meter. —30—

STANDOFF CONNECTOR

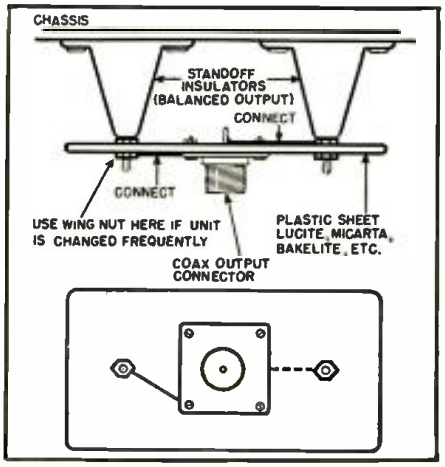
By OTTO WOOLLEY, WØSGG

TRYING to take coaxial output from standoff insulators often results in a makeshift arrangement or mutilated cable. Using the simple adapter diagrammed here makes a firm, solid connection that may be removed or installed in a moment's time.

Construction of this unit is simply a matter of drilling any suitable piece of insulating material to fit the standoff centers, mounting the coax output connector, as shown, with suitable short connecting wires or ribbons.

If the unit is to be changed often, the use of wing nuts on the standoff insulators will be helpful. —30—

A simple adapter which will provide a solid connection to standoff insulators.



Stewart-Warner TV Sets

(*Continued from page 62*)

top of the tuner. (see Fig. 5). The output of this trap is then coupled to the individual antenna coil sections as shown in Fig. 4. The balance of operation of the v.h.f. section of this tuner will not be discussed since it is similar to a standard v.h.f. cascode-type turret tuner.

Signal output from the mixer is coupled through the converter plate i.f. coil, 458, to a coaxial socket and then fed to the receiver's i.f. amplifiers.

Video and Sound Stages

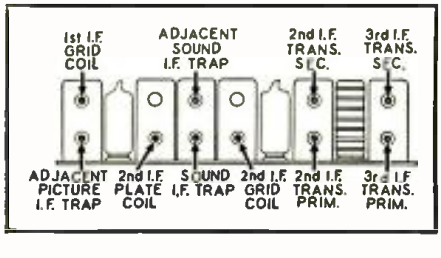
An intercarrier-type i.f. system, containing printed circuit wiring and transformers, is used in the 9340 series chassis. It is a 3-stage i.f. assembly, having a sound carrier of 41.25 mc., and a picture carrier of 45.75 mc. The first two stages are connected as cascode amplifiers, similar to those utilized in the latest type tuner circuitry, and will be discussed in their entirety in a subsequent paragraph.

The transformers, traps, and all components are mounted on a printed wiring panel, and the unit is then dip soldered to provide connection between the components. Whenever any parts have to be replaced, it is suggested that a pencil-type soldering iron be used to prevent excessive heat from destroying the printed circuit wiring. The adjustment screws for the alignment of i.f. transformers and traps are all located on one side of the strip. (See Fig. 6.)

The i.f. transformer between the tuner and the first i.f. amplifier consists of an M-derived bandpass filter. Trapping of the adjacent channel picture i.f. carrier is obtained by one section of this transformer, which highly attenuates frequencies of 39.75 mc. See Fig. 3. Between the first i.f. amplifier and the second i.f. amplifier, another M-derived bandpass filter is used. It consists of transformers 16, 25, and 22 which are mounted in three separate cans. Trapping of the sound i.f. carrier and adjacent channel sound carrier is achieved by transformer 22, which highly attenuates frequencies of 41.25 mc. and 47.75 mc.

Before proceeding further, let us examine the circuitry between the first i.f. amplifier (V_1) and the second i.f. amplifier (V_2). Although voltage is present at the plate of V_1, there is no actual connection to "B+." Also, a.g.c.

Fig. 6. Side view of the video i.f. strip showing major alignment points.



is present at the grid of V_2, yet the grid of V_1 is the only i.f. return to the a.g.c. supply. If we examine the circuit closely, it will be noted that the cathode of V_2 is connected to the plate of V_1 through resistors 29 and 17 and transformer 16. Therefore, these two pentodes are connected in series across a common "B+." Since each tube contains internal resistance, we also think of these tubes as two resistors in series. Therefore, the voltage at the plate of V_1 is the voltage applied to the plate of V_2, less the voltage drop across this tube, and resistors 29 and 17. In order that the potential between the grid and cathode of V_2 remain within design standards, a steady state voltage is applied to the grid of V_2 by the use of a voltage divider network, consisting of resistors 27 and 23.

To explain how a.g.c. voltage is applied to the grid of V_2, let us assume zero a.g.c. voltage on the grid of V_1. The current through both tubes is large at this time and the circuit is so designed that the voltage at the cathode side of resistor 26 is 130 volts. The voltage divider network maintains 130 volts at the grid of V_2. Since there is no difference in potential between the grid side of resistor 26 and the cathode side, no current will flow through this resistor; hence, no bias on the tube. When a.g.c. voltage is applied to the grid of V_1, current through this tube is decreased, which produces a greater voltage drop across V_1. Therefore, the cathode side of resistor 26 has a higher potential than 130 volts. There is now a difference in potential between the grid and cathode sides of resistor 26, causing current to flow through this resistor, producing a bias on V_2.

Two primary reasons are involved for this type of circuit. Under normal arrangements, the plate circuit of V_1 and V_2 would be returned to the 120-volt supply. If this were done, the 120-volt supply would vary considerably, depending upon the area in which the receiver operates since the a.g.c. bias applied to the first two i.f. stages determines the current drain. Upon checking the circuit further, it will be noted that V_{15} (sound output tube) is connected in parallel with filter condenser, 89. Therefore, any variation in current drain of the first two i.f. tubes must pass through V_{15}; hence, an appreciable change in the 120-volt supply, obtained from the cathode of V_{15}, would occur when current varies. Also, this large current variation through V_{15} makes it difficult to design a good sound output stage. By using the cascoded type of circuit for the first two i.f. stages, both of these conditions are alleviated.

Between the second i.f. amplifier and the third i.f. amplifier, and between the third i.f. amplifier and the crystal detector (1N64), double-tuned, mutually-coupled transformers are used. The output of the third i.f. amplifier is coupled to the cathode of the crystal detector, which supplies a negative signal to the grid of the video amplifier (V_4). As will be noted in

Fig. 3, series- and parallel-peaking is used, and coil 241 is incorporated as a trap to suppress radiation of the i.f. frequencies.

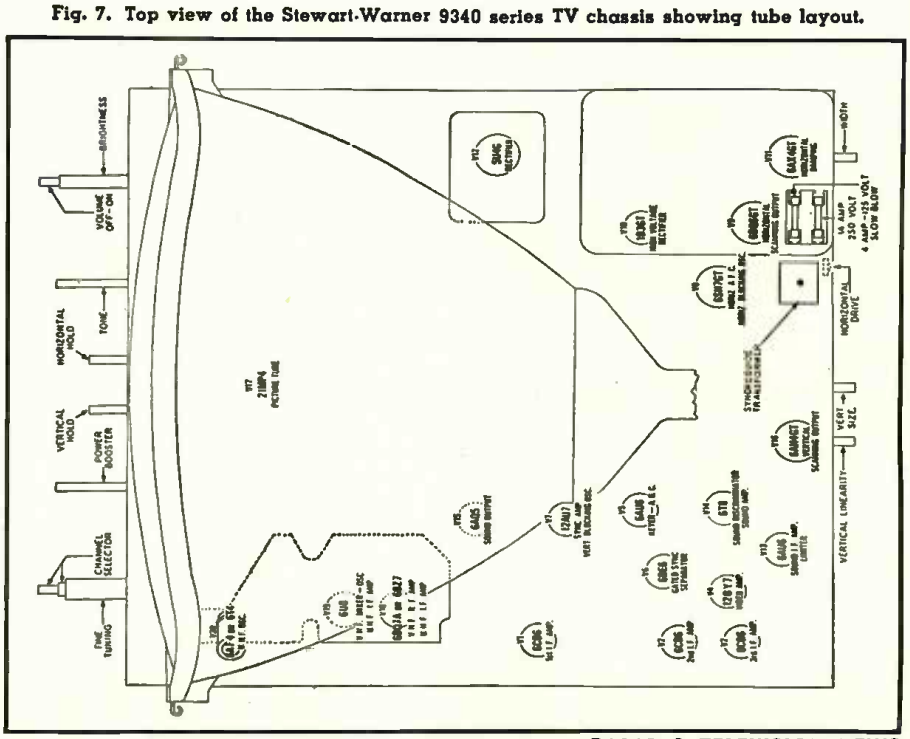
A 12BY7 (V_4) is used in the video amplifier stage. The power booster control, 46, varies the bias which controls the gain of this stage. Series- and parallel-peaking is employed in the plate circuit, and the plate load consists of resistors 54 and 55. So that the 4.5-mc. sound i.f. frequency will not be applied to the picture tube, a sound trap circuit (coil 49 and condenser 50) is connected in series with the output of V_4. Between the video amplifier and the picture tube direct coupling is used; therefore, the plate voltage of V_4 is present at the cathode of the picture tube. Resistors 219 and 64 act as a voltage divider network so that the potential between the heater and cathode of the picture tube is held within its rated value. The brightness control is in the grid circuit of the picture tube, and consists of a potentiometer which varies the positive voltage applied to the grid. This positive voltage is always less than the voltage applied to the cathode. A 21MP4 picture tube is employed and is of the automatic-focusing type.

The keyed a.g.c. circuit uses a 6AU6 tube (V_5). Upon examining the circuit, it will be seen that a positive 15,750-cycle pulse is applied to the plate of V_5 from the horizontal output transformer, and a portion of the positive video signal is applied to its grid. The bias on this tube is such that no conduction takes place unless both the plate and grid are driven positive at the same time. Since the pulse fed to the plate is constant, the amount of conduction will be determined solely by the positive voltage applied to the grid. The circuit is so designed that only the sync pulses of the video signal drive the grid sufficiently positive to allow current flow. Therefore, the strength of the video signal will determine the amplitude of the sync pulse which, in turn, will determine the amount of conduction that takes place in the keyer tube. Resistors 59 and 60 form the plate load, and the voltage developed across resistor 60 is filtered by condenser 58 for a.g.c.

The width of any sync pulse occupies in time about 15 per-cent of one complete video signal for one scanning line. Therefore, 85 per-cent of the noise that may be in the video signal cannot affect the a.g.c. voltage. One of the diode sections of the 6T8 (V_{14B}) is used as an a.g.c. clamper. This will prevent the a.g.c. voltage from becoming positive. Resistor 57, which is connected from the a.g.c. line to the 120-volt supply, places a small positive voltage on the a.g.c. line to cancel the small residual negative voltage developed in the a.g.c. system.

The sound circuit consists of a single 4.5-mc. i.f. amplifier (V_{13}), a ratio detector (V_{14A}), and one audio amplifier (V_{15}). These circuits are conventional with the exception of the 6AQ5 (V_{15}) circuit. As stated previously, this tube is connected across filter condenser 89, which means that all current supplied by the 120-volt supply must pass through V_{15}. Since the tubes in the tuner, third i.f. amplifier, video amplifier, and gated sync separator stages are connected to this voltage source, the current to these stages will vary in different areas of operation. This variation is small enough to be of advantage. The positive voltage applied to the grid of V_{16} is held constant by the use of a voltage divider consisting of resistors 177 and 178. Therefore, the cathode voltage will determine the bias on this tube. If the receiver is operated in a fringe area, the current

Fig. 7. Top view of the Stewart-Warner 9340 series TV chassis showing tube layout.



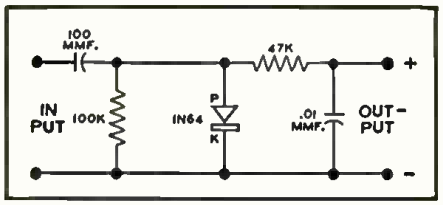


Fig. 8. The detector network used with v.t.v.m. for step 8 in alignment table if h.f. meter probe is not available.

through the 6AQ5 increases, resulting in a lower cathode voltage. The bias is then automatically decreased, increasing the gain of the tube. When the set is operated in a strong signal area, the reverse occurs. Therefore, in strong signal areas, the gain of this stage is minimum and in weak signal areas maximum, yet within design standards for minimum sound distortion.

Sync Stages

The composite video outputs of both the video detector and video amplifier are applied to the gated sync separator stage (V_6). The tube used is a 6BE6 heptode and, in addition to sync separation, it acts as a noise canceller. If we momentarily assume that the first grid (pin 1) is removed, this tube will act as a normal sync separator. Operation of this type of circuit is poor in the presence of noise bursts which are in excess of the sync pulse, as the noise will cause a larger amount of grid current to be drawn. This results in a bias increase bringing about a decreased sync pulse level and, in some instances, a complete loss of sync output. Also, the output still contains the noise pulse which will trigger the sweep oscillator circuits at the random rate of this noise. Both of these limitations bring about poor holding action.

In the gated system used, a composite negative signal is applied to the first grid (pin 1) at the same time the composite positive signal is applied to the second grid (pin 7). Except for polarity and amplitude, both of these signals are identical in shape. The signal applied to the second grid is always larger in amplitude, resulting in a negative sync output. The first grid is biased so that the tube will cut off whenever its voltage becomes slightly more negative than the sync pulse amplitude. Therefore, whenever a noise pulse whose amplitude is in excess of the sync pulse reaches the first grid. the tube cuts off. It then becomes impossible for the second grid to draw current due to the noise, as well as preventing noise pulses in excess of the sync pulse appearing in the output. If, by chance, the noise is riding on the sync pulse, this circuit will eliminate the noise as well as the sync pulse. Fortunately, this will not occur very often, so that the flywheel action of the horizontal oscillator circuit keeps the oscillator in sync for several periods. From the output of this stage, the sync signal is coupled to the sync amplifier (V_{7A}), which merely amplifies

the sync pulse and inverts its polarity for proper use with the horizontal and vertical oscillator stages.

The horizontal oscillator and associated frequency control system consists of a blocking oscillator and pulse-width type a.f.c. circuit. A 6SN7GT tube is used for this purpose. Tube V_{9A} acts as the frequency control section, comparing the horizontal oscillator frequency with that of the incoming sync pulses. The comparison frequency originates from two sources, the output of the horizontal oscillator itself, and a portion of the horizontal output from a tap on the flyback transformer. The position of the feedback pulse on the sync determines the current drain in this section of the tube. Since resistor 117 in the cathode of V_{9A} is also common to the grid of the blocking oscillator (V_{9B}), a change in current drain in V_{9A}, produced by a change in frequency of the feedback pulse, will be felt as a voltage change on the grid of V_{9B}, altering its frequency. The horizontal hold control, 123, varies the plate voltage of V_{9A}, which changes the current through the tube; hence, altering the voltage across resistor 117.

The saw-tooth output of the horizontal oscillator is coupled to the horizontal output stage which utilizes a 6BQ6GT tube (V_9). A flyback transformer of the auto-transformer type is connected to the output of V_9. Through this transformer, in association with the deflection yoke, high voltage is developed as well as boost voltage. Horizontal damping is provided by a 6AX4GT tube (V_{11}), and the width control is located in the plate circuit of this tube. In series with the plate circuit of this tube is the quarter-amp fuse. Horizontal retrace blanking is provided by reshaping a portion of the horizontal output and connecting it to the grid of the picture tube.

The low-voltage power supply in this chassis utilizes a 5U4G tube (V_{12}) which is operated as a full-wave rectifier and the output is separated into four distinct voltage sources. The primary of the power transformer contains a 4-amp slow-blow fuse. The heaters of those tubes, whose cathodes contain a higher-than-normal voltage potential, are returned to the 120-volt supply through isolating resistor 83. This will avoid the possibility of a cathode-to-heater short due to a large potential difference.

Before proceeding to the alignment of this receiver as outlined in Table 1, be sure to do the following:

1. Insulate the oscillator contacts on the tuner strip to render the oscillator inoperative. Use cellulose tape on the first two contacts from the front of the drum assembly.

2. Short the antenna terminals together with a jumper wire.

3. Keep the marker generator output at a level that provides a readable marker but does not distort the curve on the scope.

4. Proceed to step 1, Table 1. —30—

Trends in AM Receivers

(*Continued from page* 51)

In essence, the printed wiring replaces the hookup wire formerly employed to connect the various portions of the circuit together. In these receivers, the printed wiring is permanently fixed to the plastic chassis base by a photoengraving process. See Fig. 1. Normal components, such as resistors, condensers, and coils are then soldered into position. For tubes, appropriate holes are drilled into the panel and then clips are inserted in these holes. The tube pins fit into these clips and thereby make electrical contact with the rest of the circuit.

There are several different methods of fabricating these printed wires. *Motorola,* for example, places the printed wires on both sides of the plastic base and components are mounted on each side. The metal printing extends through holes on the chassis, connecting circuits on the front with those on the rear. *Admiral,* on the other hand, places all of its wiring on one side and all the components on the other side. This permits them to do away with hand soldered connections. After the components (with the exception of the tubes) have been mounted and their wires pulled through holes in the chassis to appropriate points on the printed wiring side, the underside is dipped into a large solder "bath" or pot. This secures the component leads to the printed wiring. The excess solder is then brushed of (literally) and any excess lead length clipped.

Troubleshooting and parts replacement will in general be the same as for receivers wired with hookup wire. However, there are certain precautions to observe when parts must be replaced. These are as follows:

1. Do not use too large a soldering iron when changing parts. 60 watts or less is recommended. Do not use a soldering gun.

2. To remove a defective component, apply the tip of the soldering iron to the point of connection. Keep the soldering iron on the connection just long enough to melt the solder, then quickly tap the chassis against the service bench to shake the solder away from the connection. After the solder is removed, untwist or separate connections. A pick will be helpful for this. After disconnecting wires or lugs, carefully remove components from the top side of the chassis.

Motorola recommends that i.f. transformers, the tuning condenser, volume control, oscillator coil, or the electrolytic condenser be removed by immersing all the lugs simultaneously into a small soldering pot. The component may then be lifted off the chassis easily. *Motorola* feels that the soldering pot is superior to the soldering iron because, with the latter, plated connections may be pulled loose from the chassis.

3. To prevent tube breakage, remove

them before any parts are replaced. Also, when a tube is pulled out, pull it straight out. Wiggling the tube from side to side, a customary procedure in other sets, may cause a tube clip to bend and lead to subsequent poor contact.

4. Before installing replacement components, clean the solder from the connection point so that the leads or lugs can be pushed through the holes in the chassis panel. To avoid running solder into adjacent leads of the printed circuit, use as little solder as possible.

Resistors and condensers may be replaced quickly by clipping out the defective part and soldering the new part to the connecting leads remaining from the original part.

An open or damaged section of printed circuit wiring can be replaced by soldering a jumper of ordinary hookup wire across the connection points. To eliminate the need for complete tube socket replacement, defective tube socket pin clips may be replaced individually.

The chassis of most printed-wire receivers are connected directly to one side of the power line. To avoid possibility of damage to test equipment or to printed circuit wiring, do not place the chassis directly on a metal service bench, tools, or other metal objects.

When taking voltage readings or making resistance measurements, use test leads with needle point prods to avoid possibility of short circuits between sections of the printed circuit wiring. —30—

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ERRATUM

Several readers have written us that they are finding it difficult to obtain the Stanwyck LHO-2 coil specified in the parts list accompanying the "Theremin" article in the January issue. This number is a manufacturer's part number. Its replacement number is the Stanwyck 3582 ringing coil and it is under this number that you will find it at your parts distributors. The Stanwyck 57416 may also be used in this application. If the 3582 is used change the i.d. of L_5-L_6 from 13/16" to 11/16" and L_6-L_7 from 9/16" to 1/32". Change the resistance of L_7 from 30 to 20 ohm.

• • •

Condenser C_{11} in the schematic diagram accompanying "Foolproof 2-Band Transmitter" (page 116, December 1953) should have a value of .001 μfd., 600 volts. The value was omitted from the parts list.

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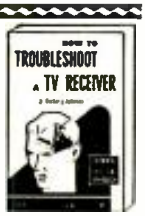

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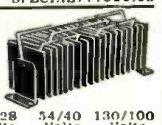

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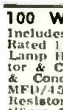

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2J56	149.00	6BQ6GT	1.20	25L6GT	.58	715B	7.94	1N23	1.35		
2J62	49.45	6BQ7	1.65	25Z5	.78	715C	17.98	1N23A	1.98		
2J72	23.48	6CG7	24.55	25Z6GT	.58	717A	3.92	1N23B	2.22		
2K23	11.48	6C4	.52	FG27A	8.24	719A	24.48	1N25	4.98		
2K25	28.49	6C5	.68	28D7	1.94	721A	3.92	1N26	8.75		
2K25/		6CB6	.59	35B5	.52	722A/287	1.94	1N34	1.64		
723AB	23.88	6CD6G	1.69	35L6	.58	723A/B	11.98	1N34A	.90		
2K28	27.4R	6D4	2.70	35T	4.88	724A	3.95	1N35	1.65		
2K29	22.88	C6J/5C21	9.89	35Y4	.68	724B	2.74	1N38A	1.45		
2K33	219.48	6J4	6.66	35Z5	.54	725A	9.98	1N41	8.95		
2K34	134.98	6J5	.54	41	.72	726A	14.48	1N42	16.95		
2K41	126.00	6J6	.58	42	.68	726B	44.88	1N43	1.73		
2K48	99.4R	6K4A	3.68	4523	.88	726C	64.88	1N43	1.43		
2X2	.42	6L6	1.48	46	1.98	801A	.42	1N43	1.73		
3B22	2.48	6L6G	1.08	50A5	.76	803	3.48	1N45	1.08		
3B23/RK22	4.95	6L6GA	1.08	50B5	.54	805	3.22	1N46	.69		
3B24	4.70	6L6GAY	1.98	50C5	.54	807	1.54	1N47	4.00		
3B25	4.39	6SA7GT	.66	50L6GT	.62	808	2.62	1N48	.55		
3B26	3.70	6SC7	.90	RK61		809	1.54	1N51	.45		
3B28	7.90	6SF5	.78	XFG1	2.65	810	10.88	1N54	.78		
3C22	85.00	6SG7	.64	FG67	14.68	811	3.00	1N54A	1.00		
3C23	8.67	6SH7	.61	HY69	4.98	812	2.70	1N58A	1.15		
3C31/C1B	3.45	6SJ7	.58	71A	.74	813	11.98	1N60	.64		
3C33	9.51	6SK7GT	.56	75	.64	814	4.98	1N63/K63	2.49		
3C45	9.98	6SL7GT	.64	78	.78	815	5.98	1N64	.69		
3D21A	8.15	6SN7GT	.68	80	.58	826	.95	1N69	.98		

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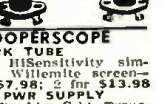

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