RADIO & TELEVISION NEWS

JUNE
1954
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1919 • 1954 35th ANNIVERSARY YEAR

World's Leading Electronics Magazine

IN THIS ISSUE

WHEN THE

RAYTHEON

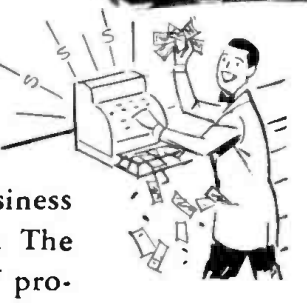
BONDED

ELECTRONIC TECHNICIAN

PROGRAM

REMOVES THIS CHIP...

You're in the chips!



Customer confidence in you and your way of doing business is the greatest single business asset you can have. The *RAYTHEON Bonded ELECTRONIC TECHNICIAN* program, now in its 10th year, has helped and continues to help many thousands of Radio and Television service dealers break down the barrier of public mistrust. And in so doing increases the volume and profit of these Raytheon Bonded Technicians.

Ask your Raytheon Tube Distributor if you can qualify for this priceless sales asset. If you can, the program costs you not one cent, it's Raytheon's investment in *your* future.

RAYTHEON®

Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY

Receiving Tube Division

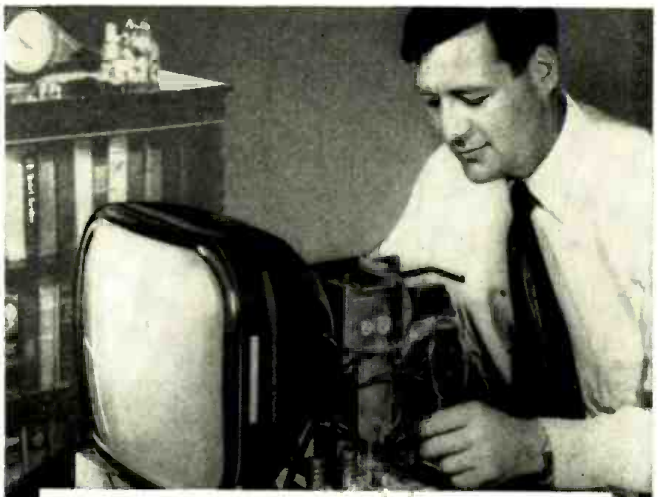
Newton, Mass., Chicago, Ill., Atlanta, Ga., Los Angeles, Cal.

RAYTHEON MAKES ALL THESE:

RECEIVING AND PICTURE TUBES • RELIABLE SUBMINIATURE AND MINIATURE TUBES • SEMICONDUCTOR DIODES AND TRANSISTORS • NUCLEONIC TUBES • MICROWAVE TUBES

Good Pay-Security-Promotions for You

RADIO-TELEVISION BROADCASTING 3000 Radio broadcasting stations operating day and night provide interesting jobs with good pay to tens of thousands of operators and technicians. 200 Television stations on the air now, hundreds more under construction and still more authorized, creating job demand and bright future for men who qualify.



RADIO-TELEVISION SERVICING 115 million home and auto Radios plus 25 million Television homes (with total growing rapidly) mean increasing opportunities for qualified servicemen. Many NRI students make $10, $15 a week extra fixing sets in spare time while training. Many NRI graduates start their own full-time business or take good jobs with dealers.

J. E. SMITH, *President*
NATIONAL RADIO INSTITUTE,
WASHINGTON, D. C.,

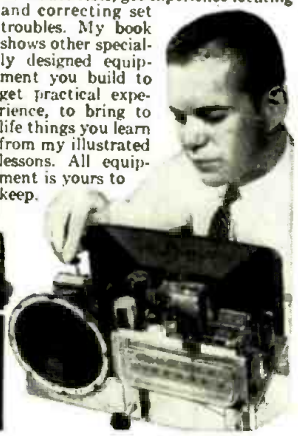
has trained more men for Radio-Television than anyone else. You benefit from his 40 years' experience training men at home.

Let Me Show How You Can Qualify for RADIO-TELEVISION AT HOME in Spare Time

TRAINING plus OPPORTUNITY is the PERFECT combination for ambitious men. Let me send you a sample lesson from my course to prove you can keep your job while TRAINING at home in your spare time, for better pay and a brighter future. I will also send my 64-page book to show you that Radio-Television is today's field of OPPORTUNITY for properly trained men.

Practice Broadcasting or Servicing with Kits of Parts I Send You

Nothing takes the place of practical experience. That's why NRI training is based on LEARNING BY DOING. My training includes kits of parts which you use to build equipment and get practical experience on circuits common to both Radio and Television. Shown at the left is the low-power Broadcasting Transmitter you build as part of my Communications Course. It gives you experience putting a station "on the air," learning procedures required of broadcast station operators. Shown below is the modern Radio you build as part of my Servicing Course. You use it to conduct tests, get experience locating and correcting set troubles. My book shows other specially designed equipment you build to get practical experience, to bring to life things you learn from my illustrated lessons. All equipment is yours to keep.



AVAILABLE TO VETERANS UNDER GI BILLS

Television Growth Making More Good Pay Jobs, Prosperity

Radio is bigger than ever and Television is still growing fast. Government, Aviation, Police, Ship, Micro-wave Relay, Two-way Communications Systems for buses, taxis, trucks, railroads are other growing fields providing good job opportunities and bright futures for men properly trained in Radio-Television.

Start Soon to Make $10, $15 a Week Extra Fixing Sets

You can start to cash in fast. Many men I train fix neighbors' sets, make extra money, starting soon after they enroll. Multitester built with parts I send helps locate and correct set troubles. Read at left how you build actual equipment that gives you practical experience with circuits common to both Radio and Television.

Mail Coupon—Find Out About Tested Way To Better Pay

Act now to enjoy more good things of life. Take NRI training for as little as $5 a month. Many NRI graduates (some with only a grammar school education) make more in two weeks than the total cost of my training. Mail coupon today for Actual Lesson and 64-page Book—BOTH FREE. J. E. SMITH, President, National Radio Institute, Dept. 4FE Washington 9, D. C. OUR 40TH YEAR.

I Trained These Men

Extra Money Spare Time
"Four months after enrolling was servicing Radios and averaged $10 to $15 a week spare time. Now have full-time Radio and Television business."—WILLIAM WEYDE, Brooklyn, New York.

Got Laid Off, Good Thing
"Got laid off my machine shop job which was the best thing that ever happened to me as I opened a full-time shop. Business has been picking up every week."—E. T. SLATE, Corsicana, Texas.

Likes Job At Station WTOP
"I am a technician at WTOP in Washington and I like it very much. Most of my Radio knowledge was obtained from National Radio Institute."—JOHN BRITTO, Hyattsville, Maryland.

Television Technician
"I am now employed as a Technician for a Television Clinic. Here I handle only the tough jobs that cannot be fixed in the home. NRI started me off right."—BERNARD SIERS, Cleveland, Ohio.

Good for Both—FREE

Mr. J. E. SMITH, President, Dept. 4FE
National Radio Institute, Washington 9, D. C.

Mail me Sample Lesson and 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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COVER PHOTO: Making adjustments on a "Sonic Liquid Level Indicator" at the Paterson, New Jersey, plant of Bogue Electric Manufacturing Co. For the operational details see page 46. (Ektachrome by John Reardon)

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RADIO & TELEVISION NEWS

CONTENTS — JUNE, 1954

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SPLITTING HAIRS

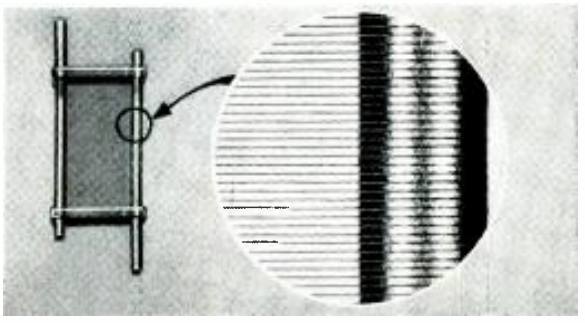
TO SPEED CALLS

This coaxial system electron tube amplifies more voices at the same time because of wider frequency band—made possible by bringing grid and cathode closer together.

To triple the voice-carrying capacity of coaxial cable, Bell Laboratories engineers had to create new amplifying tubes with the grid placed only two-thirds of a hair's breadth from the cathode. Furthermore, the grid wires had to be held rigidly in position; one-quarter of a hair's shifting would cut amplification in half.

Working with their Bell System manufacturing partners at Western Electric, the engineers developed precise optical means for measuring critical spacing insulators. On a rigid molybdenum grid frame they wound tungsten wire three ten-thousandths of an inch thick. To prevent the slightest movement they stretched the wire under more tension for its size than suspension bridge cables, then bonded it to the frame by a new process.

The resulting tube increases coaxial's capacity from 600 to 1800 simultaneous voices — another example of how Bell Telephone Laboratories research helps keep your telephone system growing at the lowest possible cost.



Grid is shown above on left. Picture at right, enlarged 15 times, shows how wires are anchored by glass bond. They will not sag despite nearness of red-hot cathode.

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FOR CREATIVE MEN IN SCIENTIFIC AND TECHNICAL FIELDS

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the CLASSY CHASSIS CARRIER!

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LIGHTING • RADIO • ELECTRONICS • TELEVISION

For the RECORD

BY THE EDITOR

AT HOME WITH COLOR TELEVISION

IT was with feelings of mixed emotion that your editor undertook the responsibility to "guinea pig" a color television receiver at his home during the past several weeks. We knew, for example, that no souped-up laboratory model would provide the necessary data we were seeking. For the purpose a receiver would need to be taken right off a production line in order to serve as a fair basis for our tests.

But production models for immediate delivery to the public were not generally available back in March. The only exception was the announcement by *Westinghouse* that color television sets were now in production and were available for sale and delivery to the public. We decided to request the loan of a receiver from stock for test purposes at the consumer level. Our request was immediately granted and Model 840CK15 arrived promptly at our home in Greenwich, Conn. in its sealed carton *via* truck.

This location is 35 airline miles from the television antennas atop the Empire State Building in New York City. Our antenna is a 2-bay conical, vintage of 1951. It feeds a 2-channel coupler. One channel feeds a 24-inch monochrome receiver. The remaining channel was connected to the color set after curiosity prompted the decision to personally uncrate the set and connect it before the manufacturer's technician could arrive to handle the installation, the same as would be done for a customer (apologies to *Westinghouse*). Somewhat hurriedly we read the tuning instructions and turned on the set. Controls and tuning procedures were found to be about the same as on standard monochrome receivers. All seven channels were in good alignment and monochrome reception was highly acceptable. For comparison, the 24-inch black-and-white receiver was placed near the new color set. As expected, there was an immediate reaction due to the small color screen compared to the large screen to which we had become accustomed. However, experience later showed that one can become acclimated in a hurry providing he draws his chair closer.

No colorcasts were available during the first three days of viewing. We became quite accustomed to the slight sepia tone as viewed on the color screen from black-and-white telecasts and this actually becomes pleasing to the eye. The technician from *Westinghouse* had arrived and checked all controls, utilizing the color test patterns from WNBT. Three days later found us tuning in our first color television at home. It was "The New Review," *CBS*, and from the standpoint of subject matter was a poor example of color possibilities. Skin tones were yellowish and lip makeup was excessive. A slight adjustment of the flesh control partly corrected the jaundiced appearance of the actors. We experimented with the convergence control for the first time and, possibly due to aging of components, was found to be slightly out of register.

Our impatience for more color programming mounted as the days slipped by. We realized that we would have the loan of the receiver for but a limited time and that all too few colorcasts were scheduled. It seemed that we could enjoy about one hour per week of mediocre subjects, including the Scholz-Andrews fight. This editor doubts if any prospect for a color set could be sold from this example. Our enthusiasm for color reached a climax on March 28 when *NBC* set up their color cameras at New York's Botanical Gardens. This production was excellent from both color and production standpoints. It is a real thrill to enjoy the sparkle and life produced by various plants and flowers when seen in their true colors. A three-dimensional effect and an added depth to the picture results from color television. Small objects which are not even noticed on monochrome are readily identifiable. It has been noted that picture quality (at least at this writing) of color signals on the monochrome set were not as compatible as one would expect. For example, reception of color on a color set is found to be in good focus while the same signals received on the monochrome set always appear fuzzy and contrast excessive.

A total of approximately 125 hours use has now been chalked up on the color set. It is interesting to note that no corrections have been required on any secondary control since the first week of use. It is only necessary to adjust the fine tuning and the color control occasionally when receiving colorcasts. Contrary to many opinions, a color receiver is far simpler to tune than several monochrome sets used in the past.

Now that we have good quality color television receivers, the need remains for more and better telecasts in color. Yes—color TV is here and it's terrific!

. . . . . O.R.

ADVANCE! Raise your earning power – learn RADIO-TELEVISION-ELECTRONICS by SHOP-METHOD HOME TRAINING

GOOD JOBS AWAIT THE TRAINED RADIO-TV TECHNICIAN

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Trained technicians are in growing demand at good pay —in manufacturing, broadcasting, television, communications, radar, research laboratories, home Radio-TV service, and other branches of the field. National Schools Master Shop-Method Home Training, with newly added lessons and equipment, trains you in your spare time, right in your own home, for these fascinating opportunities. OUR METHOD IS PROVED BY THE SUCCESS OF NATIONAL SCHOOLS TRAINED MEN, ALL OVER THE WORLD, SINCE 1905.

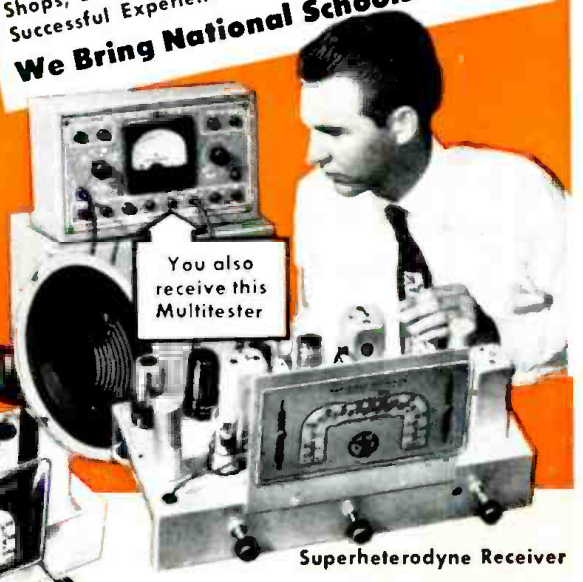
EARN WHILE YOU LEARN

Many National students pay for all or part of their training with spare time earnings. We'll show you how you can do the same! Early in your training, you receive "Spare-time Work" Lessons which will enable you to earn extra money servicing neighbors' and friends' Radio and Television receivers, appliances, etc.

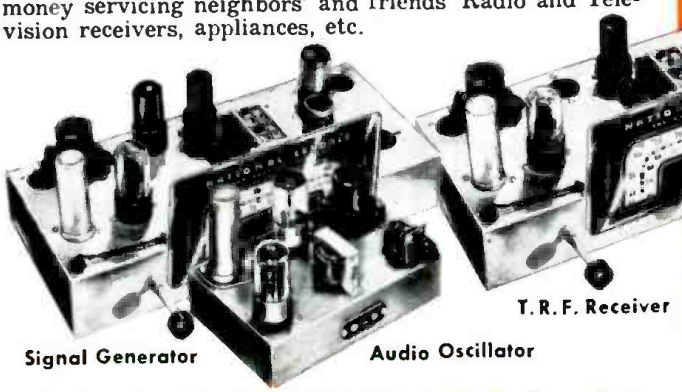
MASTER ALL PHASES!

Get Master Shop-Method Home Training from an Established Practical Resident School with its own Training Shops, Laboratories, Studios — almost 50 Years of Successful Experience in Training Ambitious Men.

We Bring National Schools To You!



Superheterodyne Receiver



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Audio Oscillator

T.R.F. Receiver

LEARN BY DOING

You receive and keep all the modern equipment shown above, including tubes and valuable, professional quality Multitester. *No extra charges.*

National Schools Training is All-Embracing

National Schools prepares you for your choice of many job opportunities. Thousands of home, portable, and auto radios are being sold daily—more than ever before. Television is sweeping the country, too. Co-axial cables are now bringing Television to more cities, towns, and farms every day! National Schools' *complete* training program qualifies you in all fields. Read this partial list of opportunities for trained technicians:

Business of Your Own • Broadcasting
Radio Manufacturing, Sales, Service • Telecasting
Television Manufacturing, Sales, Service
Laboratories: Installation, Maintenance of Electronic Equipment
Electrolysis, Call Systems
Garages: Auto Radio Sales, Service
Sound Systems and Telephone Companies, Engineering Firms
Theatre Sound Systems, Police Radio
And scores of other good jobs in many related fields.

TELEVISION TRAINING

You get a complete series of up-to-the-minute lessons covering all phases of repairing, servicing and construction. The same lesson texts used by resident students in our modern and complete Television broadcast studios, laboratories and classrooms!

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Send FREE Radio-TV Electronics book and FREE sample lesson. No obligation, no salesman will call.

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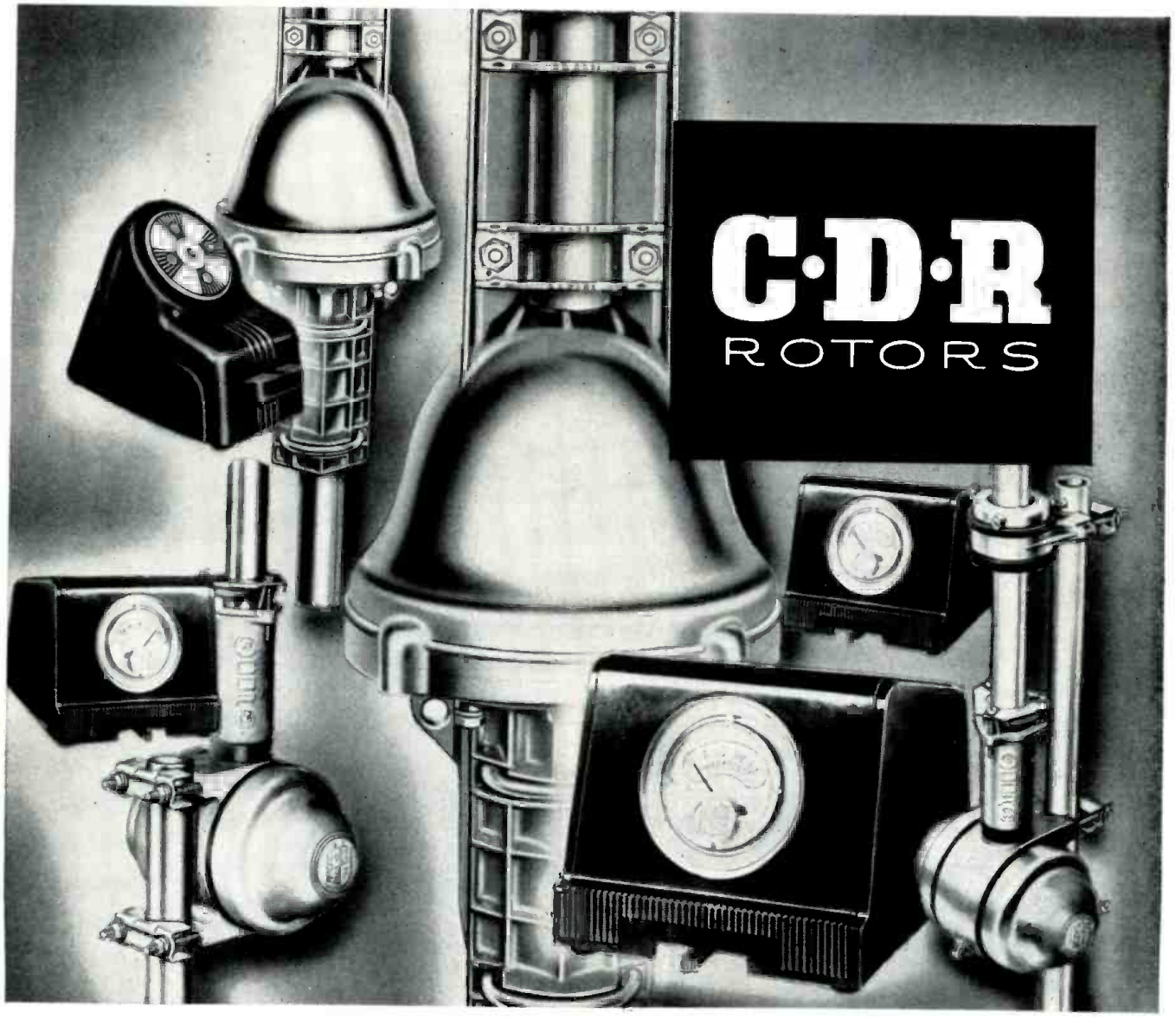
☐ Check if interested ONLY in Resident Training at Los Angeles.

VETERANS: Give Date of Discharge_____



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"Here's proof the CQS Plan can really help your business"

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"So, I'm using the CQS Tags on *every* job. Many of my customers now ask for them. They like the Tag's lay-it-on-the-line certification. Since December, I've ordered three lots of Tags . . . 500, 1000 and 2000."

"I like my customers to know I'm the dependable CQS service-dealer they read about in the big magazines like LIFE and the POST. So I make sure they do . . . by using the CQS Clocks, Signs, Decals, etc., available to *any* service-dealer."

"Take my word for it. Here's a plan that's so simple . . . so sound that *any* service-dealer is missing a real bet, if he doesn't tie in . . . and cash in. The boost that CQS has given my business proves it."

"Look at the 'sell' of these new CQS Streamers! Get aboard this CQS plan. It can do just as fine a job for you as it is doing for me. Take a tip. Find out today the facts about CQS. *Prove* to yourself that CQS can build up *your* business, too."

GET YOUR *Certified* QUALITY SERVICE TAGS... imprinted with *your name and address*. Use them on every job. Get your big, new CQS CBS-Star Kit. It contains:

A. Six smashing, colorful CBS-Stor streamers. Each features a different CBS-TV star: Benny . . . Burns and Allen . . . Gleason . . . Godfrey . . . Murrow . . . and Marie Wilson. Each streamer is a different size and shape. Each one sells the Star Performance of your Certified Quality Service.

B. New colorful inside/outside CQS decal.

C. Business Builders Catalog showing the many hard-hitting sales aids available to you.

CBS-STAR KIT IS *FREE* with your order for CQS Tags . . . Kit alone, 25¢.

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A CBS-Star Kit *only*
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(Please send cash, check, m.o. . . . no C.O.D.'s.)

HERE IS MY 3-LINE IMPRINT FOR TAGS
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Signed .....

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Professionals use Pickering MAGNETIC Cartridges

You're in the best of company if you use a Pickering MAGNETIC Cartridge. You have this in common with:

1. *Leading record companies who use Pickering Cartridges for quality control.*
2. *Leading FM/AM good music stations and network studios.*
3. *Leading manufacturers of professional equipment for radio stations, recording studios, wired music systems and automatic phonographs, who install Pickering Cartridges for the maximum performance of their equipment.*

Why Pickering MAGNETIC Pickups are the Choice of Recording and Broadcast Engineers!

"All modern disc recordings are made with MAGNETIC cutters. Within the geometrical and mechanical limitations of recording and reproducing equipment, a Pickering Pickup will re-generate an exact replica of MAGNETIC cutter response to the original program of music, speech or sound. This is a fundamentally inherent characteristic of the Pickering Pickup, supported by basic electromagnetic theory and countless precise laboratory measurements. This is why Pickering MAGNETIC Pickups provide the most nearly perfect coupling possible, between reproducing equipment and original program. This is why they sound cleaner . . . less distorted.

"Through the medium of the disc material, the reproducing system is effectively driven by the cutter electrical response itself."

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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-5.

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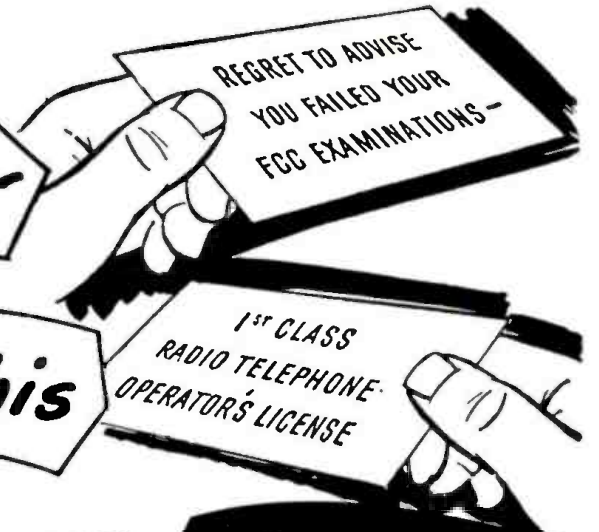
Which Will You Hold?

this-

or this



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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 manufacturer of high quality AM and FM transmitters. "We are very much in need at the present time of radio-electronics technicians and would appreciate any helpful suggestions that you may be able to offer." Salary up to $412 per month to start.

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 samples of the job offers that come to our office periodically. Some licensed radioman 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.

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Clifford E. Vogt, Box 1016, Dania, Florida	1st Phone	20
Francis X. Foerch, 38 Beutler Pl., Bertenfield, New Jersey	1st Phone	38
S. Sgt. Ben H. Davis, 317 North Roosevelt, Lebanon, Illinois	1st Phone	38
Albert Schoell, 110 West 11th St., Escondido, California	2nd Phone	23

Carl E. Smith, E.E., Consulting Engineer, President

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"Thanks to your course I obtained my 2nd phone license, and am now employed by Civil Service at Great Lakes Naval Training Station as an Engineering Specialist."
Kenneth R. Leiser, Fair Oaks, Mtd. Del., McHenry, Ill.

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"I have obtained my 1st class ticket (thanks to your school) and since receiving same I have held good jobs at all times. I am now Chief Radio Operator with the Kentucky State Police."
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"I wish to thank your Job-Finding Service for the help in securing for me the position of transmitter operator here at WCAE, in Pittsburgh."
Walter Koschik, 1442 Ridge Ave., N. Braddock, Pa.

GETS AIRLINES JOB

"Due to your Job-Finding Service, I have been getting many offers from all over the country, and I have taken a job with Capital Airlines in Chicago, as a Radio Mechanic."
Harry Clare, 4537 S. Drexel Blvd., Chicago, Ill.

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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 valuable booklet, "Money-Making FCC License Information." Be sure to tell me about your Television Engineering Course.

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Spot Radio News

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

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

THE ULTRA-HIGHS, shuttled to the grazing grounds for quite a spell while color held sway, have roared out of the quiet hinterland into Washington, to the halls of Congress, the inner sanctum of the Commission, and scores of offices of consultants and lawyers. The raging shift has been brewing since the beginning of the year when the FCC began receiving u.h.f. permits back; it has brought about a full-scale Congressional hearing on . . . "the status and development of the u.h.f. channels in the U.S.," under the chairmanship of Senator Charles E. Potter, heading a special subcommittee on communications on the Senate Interstate and Foreign Commerce Committee. Others named to the new group were Senators Andrew F. Schoeppel, Dwight Griswold, John O. Pastore, and Lester C. Hunt.

The hearing news was applauded by ultra-high operators and the recently-formed u.h.f. association. Senators were also quite keen about the investigation, feeling that now it would be possible to probe thoroughly all of the ways that might be used to develop the upstairs channels, so that they could become solidly united with the low-band system. One of the key problems under survey is the affiliation of networks with the newcomers, particularly in mixed markets. Other points being considered are power, availability of less low-band channels than high-band, differences between systems as to cost and operation, multiple-station acquisition, and the use of v.h.f. profits to build up the ultra-highs.

Reviewing the role that they'll play in the hearings, counsel for the u.h.f. association said: "Since the first of the year, a number of u.h.f. stations have been forced to suspend operations because of economic and regulatory problems beyond their control. Until the FCC and the television manufacturers, as well as the networks, approach the problem of u.h.f. in a more realistic and intelligent fashion, the great expectations of the industry cannot be fully realized. We hope to cooperate with the subcommittee by making available facts and witnesses."

To boost interest in the high bands, several plans have been offered. The Commission has proposed that the present rule be modified to allow one owner to operate seven stations, instead of five, with two of the stations using the high bands. Senator Edwin Johnson, former chairman of the main committee, differed with the Commissioners, declaring that use of the higher bands should be made more attractive to multiple-station operators. He proposed, in a bill, that no one should operate more than five low-band stations; but they could control four v.h.f. and two u.h.f. stations, or three v.h.f. and four u.h.f. stations, or two v.h.f. outlets and six high-band units, or a single low-band and eight ultra-high outlets, or no low-band and ten stations on the higher channels The measure also provides that anyone with a very-high permit, issued before the enactment of the bill, who yields the permit within five years of its enactment, would be entitled to a couple of ultra-high permits, with one of them serving substantially the same area as the abandoned v.h.f. permit.

The problem of power, also a critical factor, prompted the Commission to propose that the minimum power for the high-channels be raised from one to five kilowatts to assure the best possible technical service. The lower powers, now in effect, were authorized because no high-powered gear was available when the ruling was placed on the books. Stations already authorized for low power would not be disturbed, but all new applicants would be obliged to use high power immediately, unless they could show that such high-power equipment was not available. Operators have complained that it was not possible to get high-kilowatt transmitters; now the manufacturers say that such transmitters will be available. Some of the broadcast makers have promised that before the year is out, 1000-kilowatt units will be available.

The affiliation problem has provoked many, and one broadcaster saw to it that the Senators knew the score. In a sizzling letter to a group of the legislators, including Senators Johnson and Potter, Farris E. Rahall, owner of several TV stations, said that some of the stations were operating a monopoly, refusing neighboring stations a tie-in with networks, because they felt that their stations offered sufficient coverage. He cited the case of a station in Philadelphia which insisted that a network use their facilities

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Sprague TVL's fill the top performance bill in the toughest TV circuits. High temperatures, surge voltages, ripple currents won't faze them. Like all Sprague capacitors, Twist-Lok 'Lytics are your first line of defense against expensive call-backs.

Insist on Sprague TEL-OHMIKE®

This capacitor-resistor analyzer is the handiest instrument you can buy! Moderately priced for radio and TV repair shops, the Model TO-4 Tel-Ohmike offers top quality and accuracy for every service need. Priced so you can afford it at **$73.50 NET**

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The smallest TV 'lytics made—and the only small ones for 85°C (185°F) up to 450 volts d-c. Guaranteed for low leakage and long shelf life, they withstand high temperatures, high ripple currents, high surge voltages. From crowded TV chassis to jam-packed portables, Sprague Atoms fit 'em all.

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Get your copy of Sprague's latest radio and TV service catalog C-610. Write Sprague Products Company*, 51 Marshall St., North Adams, Mass.

*Distributors' Division of Sprague Electric Company

WORLD'S LARGEST CAPACITOR MANUFACTURER

only, and there was no need to provide service to any other station in the vicinity. The complaining telecaster pointed out that engineering studies revealed that actually the network station had inadequate coverage in the questioned area, some sixty miles away. Declared Rahall: "If Congress or the FCC is going to permit power stations . . . to dictate to the networks, we can expect approximately 35 TV stations to claim coverage of the U.S. population, which I think establishes monopolistic operations."

Urging support for Senator Johnson's view that networks and power stations should be denied their requests for additional stations, Rahall added that in his opinion the Commission committed an error in permitting power increases to the low-band stations. He felt that such boosts could be compared to the establishment of a number of 50-kilowatt AM broadcast stations.

DIRECTIONAL ANTENNAS were offered as an answer to some of the high-band problems, some believing that such an antenna could be used as a means of gaining more coverage.

When questioned why such antennas were not authorized in the rulings issued on freeze-lift day, a member of the Commission said that an industry-government *ad hoc* committee had studied the proposal and felt that offset carrier frequency operation would help more in reducing co-channel spacing and minimize interference, too.

The fix that u.h.f. stations are in now, appears to have changed this attitude. Even Commissioner George Sterling declared publicly that broadcasters who use the high bands would find help in the beam antenna. At an IRE meeting recently, he said that the rules actually define . . . "a directional antenna as one that is designed or altered for the purpose of obtaining a non-circular radiation pattern. Directional antennas may not be used for reducing minimum mileage separation requirements, but may be employed for improving service."

Detailing the design characteristics of a directional antenna, the Commissioner said that such an antenna . . . "designed for changing the position of the major radiation lobe from the horizontal plane to any other vertical plane is considered a directional antenna for the purposes of licensed power and power limitations. Thus, an antenna designed for beam-tilting would not be considered an omnidirectional antenna in respect to these matters, even though the horizontal radiation pattern is not directional. As a result, such stations would be licensed for the power in the horizontal plane, and would be limited to the maximum powers authorized in the rules in any vertical plane."

The Commission was aware, Sterling added, that . . . "beam tilting may result in a licensed effective radiated power which is less than the maximum radiation. This condition would occur

A Brief Survey of COLOR TV

. . . how its complex character means job opportunity for you

—*by* E. H. RIETZKE,
President, Capitol Radio Engineering Institute

A GOOD MANY YEARS AGO, when he was a young fellow, my Dad was one of the country's fastest typesetters. He could go anywhere and get a highly paid job with any newspaper in the country. *Then came the linotype machine!* Before he knew it, my Dad's job was obsolete. He had to start all over in another line of work.

How will *you* get along in the age of *Color TV* that has already arrived? Will you have to start all over? Or will you be prepared? The choice is a matter of black-and-white—*or color.* As you may know, color tv involves handling an understandably much more complicated signal than for black-and-white; the components must be in perfect balance; the margin for error is practically zero. Technical personnel need new skills in working to closer tolerances. Microwave relays and coaxial cables require added equipment and special adjustments. Before a station can originate color it needs a great deal of additional equipment, much more expensive and vastly more complicated than that for black-and-white. Slide and film equipment also require additional components and maintenance. Color camera chains are much more complex, requiring more highly skilled adjustments and care. Reports of network experiments indicate that live telecasting in color increases technical man-hours required by 30 to 50%. Lighting personnel need more skill in handling new—and delicate—problems. That's a very quick run-down from the transmitter end. Every step is a technical opportunity.

What about color receivers? They'll be bigger—with roughly twice as many receiver tubes as black-and-white. There is at least one more tuning knob —the chroma control for color saturation. Maintenance is complicated, to say the least, with three highly critical video channels to trouble-shoot instead of one. Service contracts for color receivers will cost considerably more than for black-and-white, according to one highly qualified source—which should give you an idea of servicing complexity—and earnings possibilities. So much for transmission and reception. Manufacture of color equipment is another field for *trained* technicians.

Most well-informed sources agree that color television will be spread all over the U.S. by 1956 at the latest. *The years between now and then are crucial.* If you are interested in an honest-to-goodness career in this booming part of the booming electronics industry, here's how you can step ahead of competition, move up to a better job, earn more money, and be sure of a well-paid job: Study radio-television-electronics via CREI. You don't have to be a college graduate. You *do* have to be willing to invest some of your spare time—at home. You can do it while holding down a full-time job. Thousands have.

Since 1927 CREI has provided men with the technical knowledge that leads to more job security—and more money. CREI starts with fundamentals and takes you along at your own speed, not held back by a class, not pushed to keep up with others who have more experience. 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 high specialized applications of radio or television engineering, or aeronautical radio.

The coupon below, properly filled out, will bring you—without cost—a fact-packed booklet, "Your Future in the New World of Electronics," which includes outlines of courses offered, a resume of career opportunities, full details about the school, our Placement Bureau (with more requests for trained men currently on file than we can fill), and the names of some of the organizations using CREI training (like All American Cables & Radio, Inc., Canadian Broadcasting Corp., Columbia Broadcasting System, RCA Victor Division, United Air Lines, to name a few). I urge you—for your own good—to send for this free booklet immediately.

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 (or home study) instruction. Check the coupon for more data.

where the power radiated toward the more distant portions of the service area is reduced by beam tilting for the purpose of increasing the signal strength at relatively close locations."

The Commissioner noted that his colleagues were willing to listen to proposals for changes. "To the extent the Commission might relax its directionalizing rules to aid u.h.f. stations in obtaining better coverage because of their power limitations," Sterling continued, "consideration must be given to the number of people that would gain service, as compared to those who would lose service or have it degraded as well as the remote possibility of co-channel interference."

TOWER SHARING, which has had a phenomenal success in New York City, will soon become a factor in Dallas, where two stations, operating on channels 4 and 8, will become neighbors on a common antenna, 1521 feet above the flatlands of Texas.

The stations, WFAA-TV and KRLD-TV, told the Commission that the antenna site is actually 828 feet above mean sea level, but the effective antenna height above average terrain for each antenna would be 1685 feet. KRLD-TV said that they plan to use a six-bay antenna and operate on 100 kilowatts, while WFAA-TV reported that they would use a 12-bay job and an output of 316 kilowatts. The antenna structure was described as a triangular-guyed tower, with fifteen sets of double-guy wires for support, and the longest guy leads extending to over 1000 feet from the base. The installation will cost over one-million dollars, and will include transmitter buildings for each station, which will house all of the necessary radiating gear.

The structure, a candelabra-type affair, will be located about sixteen and a half miles southwest of Dallas, and will, it was said, provide each station coverage of 80 to 85 miles for class B service.

A UNIQUE VIDEO-RECORDING system, capable of recording up to 80 per-cent of televised information, has been designed and constructed by scientists at the Naval Research Laboratory in Washington.

The development, prompted by the increasing number of applications of TV to military operations, features the use of a film-recording system, with a free-running shutterless camera in conjunction with an electronic shutter, to provide a versatile system adaptable to a wide variety of TV line and frame rates. The electronic shutter, which replaces the more familiar mechanical shutter on the camera, blanks and unblanks the recording picture tube. Used in a 525-line system with a camera having a pull-down time of 72° or less, up to 80 per-cent of televised information can be recorded, using a 24-frame-per-second recording rate. No provisions have been

(*Continued on page 96*)

Here's the expert crew that keeps Keyport's TV's in tip-top shape at Pete's, Inc. Left to right: Leroy Christensen, William Murray and shop manager, Dan Noreen.

"G-E Field Clinics cut repair time, step up number of calls,"

Says M. Kuarloyg, Pete's, Inc., Keyport, N. J.

"Can't keep our men away from those G-E Field Clinics," writes M. Kuarloyg, head man at Pete's, Inc., Keyport, N. J. "Their meetings give us a keen edge over competitors' service methods—we've cut down repair time and stepped up the number of calls. Customer satisfaction increases, too, because when we fix sets they *stay* fixed."

● G-E Field Clinics show the quickest ways to diagnose and correct TV troubles . . . how to increase efficiency of service operations. Call your G-E Distributor for date and location of clinic nearest you.

General Electric Co., Radio & Television Department, Electronics Park, Syracuse, N. Y.

"Greatest contribution provided by *any* company"

"Without reservation, I feel G-E's Field Clinics are the greatest help any company has given the TV service business."

You can put your confidence in—

GENERAL ELECTRIC

NEW INVENTION OUTMODES ALL PRESENT ANTENNAS!

53 CLAIMS GRANTED IN 5 U.S. PATENTS ON NEW REVOLUTIONARY ANTENNA INVENTION!

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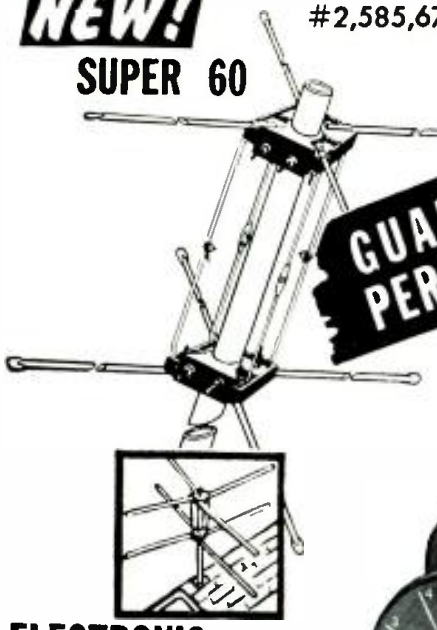


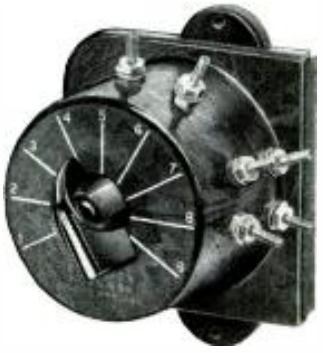
LIST PRICE $36.75 SEE YOUR JOBBER

★ **GUARANTEED TO POSITIVELY OUTPERFORM ALL OTHER ANTENNAS (with or without rotor motors) on ALL UHF, and ALL VHF stations 2 thru 83 from ALL directions.**

★ **GUARANTEED to positively give you the CLEAREST, SHARPEST, most PERFECT GHOST-FREE pictures possible in both COLOR and black-white.**

MONEY BACK GUARANTEED TO RECEIVE *All* CHANNELS 2-83 *FROM All* DIRECTIONS AND POSITIVELY OUTPERFORM *All* OTHER ANTENNAS *WITH OR WITHOUT* A ROTORMOTOR

ELECTRONIC ORIENTATION SWITCH



The 9-position selector switch electronically rotates the antenna in a stationary position.

THIS IS ALL YOU NEED!

The price includes the complete antenna and the 9-position electronic orientation switch. The Air Dielectric Polymicalene Transmission Line is purchased as required for the individual installation.

UP TO 10 TIMES MORE POWERFUL THAN ALL PRESENT CONVENTIONAL ANTENNAS!

New, revolutionary antenna, while being up to 10 times more powerful than conventional antennas, is still able to receive all television and FM stations from all directions without a rotor motor of any kind. The electronic orientation switch used with a new type transmission line developed specifically for this extra powerful antenna now makes it possible to clearly receive stations heretofore considered out of range. It is now possible to put up just one antenna, use just one transmission line, pay for just one installation and receive the finest possible reception from the stations in and coming to your area regardless of their direction.

NEW POLYMICALENE

4 CONDUCTOR TRANSMISSION LINE

- Low Loss External Air Dielectric
- Matched Impedance
- Eliminates End Sealing
- Eliminates Condensation
- Up to 50% Less Loss Than Tubular When Wet
- Easily Spiraled
- No Breaking or Shorting
- Patents Pending - T M. Reg

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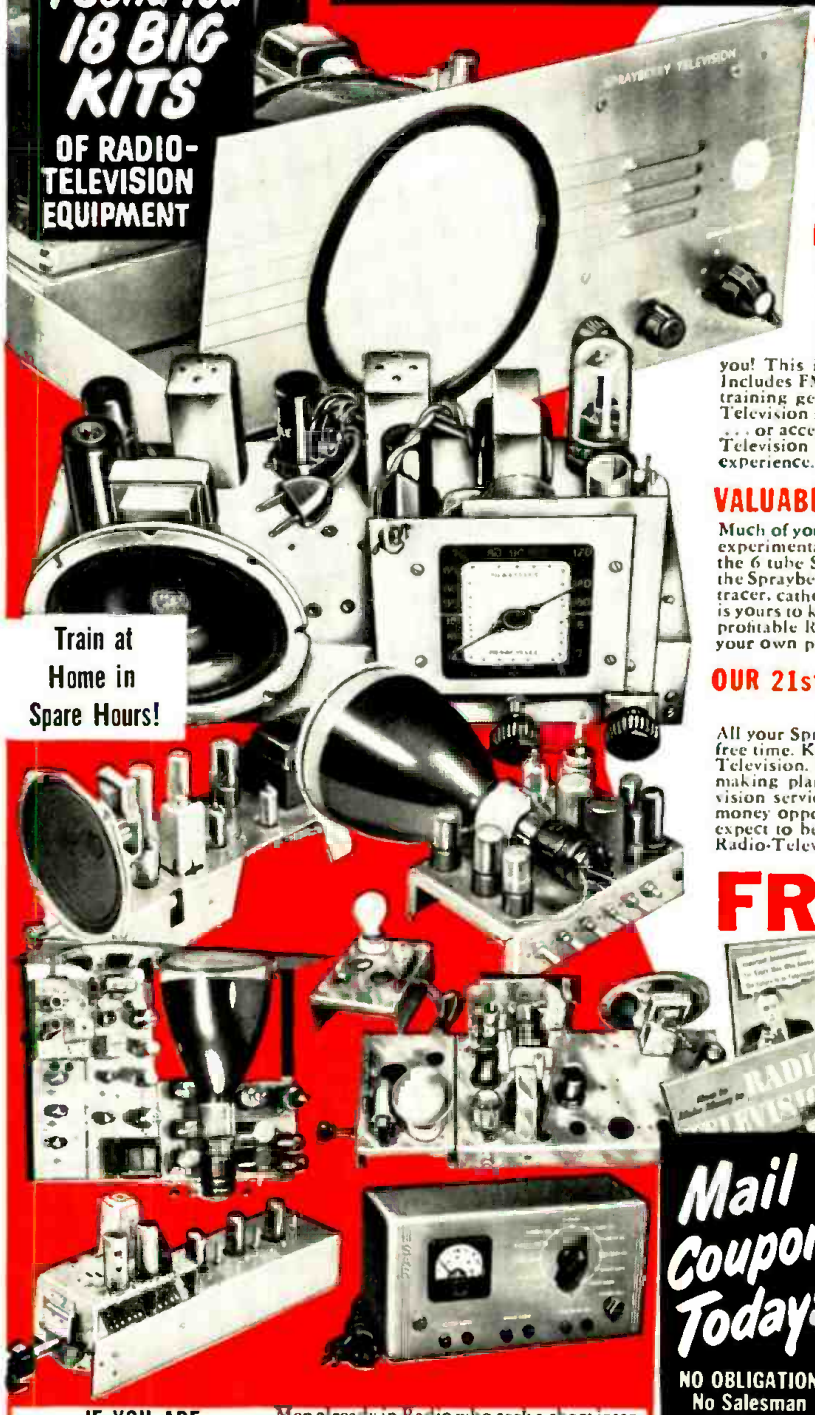
ON *New* NO-OBLIGATION PLAN!

I Send You 18 BIG KITS OF RADIO-TELEVISION EQUIPMENT



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You Have NO MONTHLY PAYMENT CONTRACT

to sign . . . you pay for your training as you learn and earn...ENROLL NOW!

Be Ready in Little as 10 MONTHS!

Now 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 to qualify as a Radio-Television Technician in as short a time as 10 months, or even less! I offer you my training with no monthly payment contract to sign—thus NO RISK and NO OBLIGATION for you! This is America's finest, most modern and really practical training. Includes FM . . . UHF Television and all the most recent developments. My training gets you ready to handle any practical job in the booming Radio-Television industry. Start your own profitable Radio-Television Service Shop . . . or accept a fine paying job. I have trained hundreds of successful Radio-Television technicians—and I can train you regardless of lack of previous experience. Mail coupon and get all the facts—FREE!

VALUABLE EQUIPMENT INCLUDED WITH TRAINING

Much of your Sprayberry Training is actual construction, demonstration and experimentation. You get priceless practical experience this way. You build the 6 tube Sprayberry Short Wave and Broadcast Training Radio Receiver, the Sprayberry Television set, multi-range test meter, signal generator, signal tracer, cathode ray oscilloscope and many other projects. All this equipment is yours to keep. You have practically everything you need to set up your own profitable Radio-Television shop. All lessons and books I send you remain your own property.

OUR 21st YEAR TRAINING MEN FOR RADIO-TELEVISION

Earn Extra Money While You Learn

All your Sprayberry Training is given IN YOUR OWN HOME during your free time. Keep on with your present job and income while learning Radio-Television. With each Sprayberry "Package Training Unit" I include money-making plans and special "Business Builders" for spare time Radio-Television service jobs. New Television stations opening everywhere open big money opportunity for men to install UHF antennas—I tell you how! If you expect to be in the Armed Forces later, there is no better preparation than Radio-Television. Mail coupon below . . . get facts FREE. *No salesman will call.*

FREE TO YOU 3 BIG RADIO-TELEVISION BOOKS

I invite you to get all the facts—

I want you to have ALL the facts—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!

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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.

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

☐ Are you Experienced? ☐ No Experience

IF YOU ARE EXPERIENCED IN RADIO Men already in Radio who seek a short intensive 100% TELEVISION Training with FULL EQUIPMENT INCLUDED are invited to check and mail the coupon at the right.

Within the INDUSTRY

FRANK SWINEHART has joined the engineering department of the *Turner Company*, Cedar Rapids manufacturer of microphones for amateur, broadcasting, and p.a. applications.

He is a graduate of Tri-State College and will be engaged in engineering and research work for the company.

He was formerly associated with *Radiart Corporation*, the *Astatic Corporation*, and *Brush Development Company*. He will now make his headquarters in Cedar Rapids.

* * *

JAMES M. SKINNER, JR. has been named vice-president of *Philco's* television division . . . *Standard Coil Products Co., Inc.* has appointed **HAROLD F. BEALE** to the post of assistant to the president . . . **NAT WELCH** is the new vice-president in charge of sales for *ORRadio Industries, Inc.*, manufacturers of *Irish* sound recording tape . . . **SIDNEY A. STANDING** has rejoined *Raytheon* as manager of its cathode-ray tube division. He will make his headquarters at the firm's new Quincy, Mass. plant . . . **LOUIS W. SELSOR** has been promoted to the post of distributor sales manager for *Jensen Manufacturing Company* of Chicago . . . **ABRAHAM HYMAN** has been named head of the recently expanded TV antenna development section of *Brach Manufacturing Corp.* . . . *Telectro Industries Corp.* has appointed **NATHAN GROSSNER** to the post of chief engineer and sales engineer of its transformer division . . . **E. DUDLEY BELL** is the new general manager of *Solar Manufacturing Corp.* . . . *Westinghouse's* tube division has named **FRANKLIN P. HINMAN** acting manager of manufacturing for the division, and **HARRY F. PULLEY** acting manager of the division's Elmira, N.Y. plant . . . **SEVERIN JONASSEM**, industrial designer, has recently accepted a position with *Philco* in the TV product development department. For the past nine years he has operated his own studios in New York . . . The appointment of **GEORGE J. DESPOSITO** to the executive staff of *Pyramid Electric Company* has been announced by the company. He will be administrative assistant to the executive vice-president . . . **EDWARD JAHNS** has been appointed vice-president in charge of production at the *Recordio* plants of *Wilcox-Gay Corporation* . . . **GEORGE S. BOND** is the new advertising manager of *P. R. Mallory & Co., Inc.* He has been with the firm since 1937 . . . *Radio Craftsmen, Inc.* has promoted **EDWARD S. MILLER** to the post of vice-president and **JOHN NARRACE** to the chief engineer's position . . . **ALLEN S. NELSON** has been appointed manager of distributor sales for *International Rectifier Corp.* of El Segundo, California . . . **GORDON LE MAY** is the new assistant sales manager for *RMS* of New York . . . The equipment sales division of *Raytheon* has named **JOHN F. MORTEN** marketing services manager . . . **SAVA JACOBSON** is the new head of product engineering for *Pacific Mercury Television Mfg. Corp.* of Van Nuys, California . . . **RAUL H. FRYE** has been named vice-president in charge of engineering for *National Company, Inc.* He was formerly with *Raytheon* . . . *Capitol Radio Engineering Institute* has appointed **EDWARD H. GUILFORD** to the post of assistant to the president. He has been associated with the educational branch of radio-electronics field during his entire business career . . . **J. GERALD MAYER**, Washington, D.C. attorney, has been elected executive vice-president of *Micamold Radio Corporation*.

* * *

GRAEME W. STEWART has been appointed advertising and sales promotion manager of *Stewart-Warner Electric*, the radio, television, and electronic products division of *Stewart-Warner Corporation*.

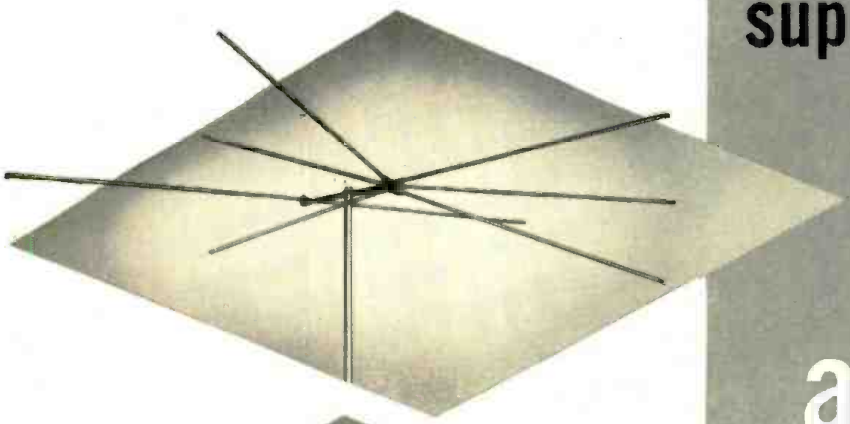
Mr. Stewart, who has been regional sales manager in Indiana, Kentucky, Ohio, and West Virginia for the past year, will be responsible for the expanded national advertising in both consumer and trade magazines and will develop and provide sales helps and plans in the promotion field at the dealer level.

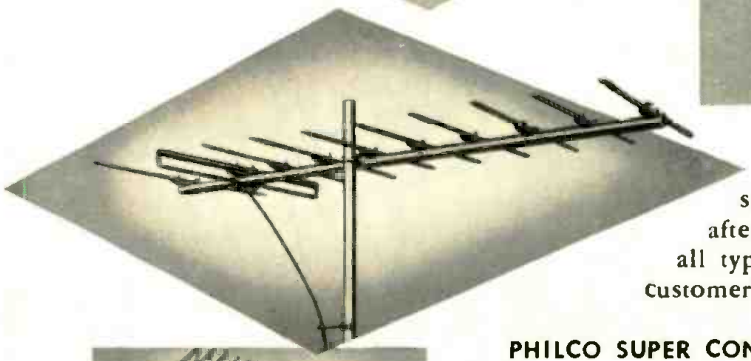
Prior to joining the firm, Mr. Stewart was in business in Denver and Cumberland, Maryland.

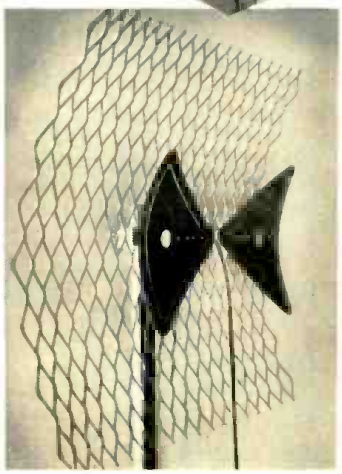
* * *

PRECISION POTENTIOMETERS CORPORATION has been organized as a subsidiary of **MASTER MOBILE MOUNTS, INC.** The new firm, at 1243 West Pico Blvd., Los Angeles, will manufacture precision pots and precision windings . . . **STAN WHITE INC.** has been established at 725 S. LaSalle Street in Chicago to manufacture and sell high-fidelity components. The new firm is a division of **EDDIE BRACKEN ENTERPRISES** . . . Herman Kaye has formed a new organization known as **THE CALTECH ELECTRONICS CORP.** The firm is located in a new, modern structure at 8930 Lindblade Ave., Culver City, California, where a line of hi-fi

PHILCO announces 3 new super-performance TV antennas







The finest TV antennas in their class . . . designed by the world famous Philco Laboratories after thorough research into receiver requirements in all types of locations . . . designed to give complete customer satisfaction . . . to meet competition on any level!

PHILCO SUPER CONICAL UHF-VHF ALL-CHANNEL ANTENNA

Full 45" dowelled aluminum antenna elements and full 53" dowelled aluminum reflector assure strong signal pickup on VHF channels 2 through 13 . . . top quality performance on UHF channels 14 to 83. Single or stacked array Super Conicals produce new balanced performance . . . super picture quality plus high gain. All-aluminum construction in the Super Conical . . . it's easy to erect: Part No. 45-3096.

PHILCO SUPER YAGI VHF ANTENNAS

Quick-rig model with ten elements gives top fringe-performance on VHF channels 2 through 13. Excellent front to back ratio (6 to 1). This Super Yagi eliminates ghosts in strong signal areas . . . selects signals from adjacent weak area channels or co-channel stations. 10 db to 12 db gain depending on channel. Strong, all-aluminum: Part No. 45-3112. (Single channel 2 thru 13 and broadband 2 thru 6; 7 thru 13; 4, 5, 6).

PHILCO PARAFLECTOR ALL-CHANNEL UHF ANTENNA

Light weight pre-assembled all-channel UHF antenna. Outstanding performance in far-fringe areas. High gain . . . 8 to 10 db. Exceeds gain of corner reflector of like dimensions. Impedance matched to 300 ohm line. Completely assembled, all-aluminum construction . . . can be mounted on existing masts for immediate use . . . all-channel paraflector weighs only 1½ lbs: Part No. 45-3071.

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ACCESSORY DIVISION

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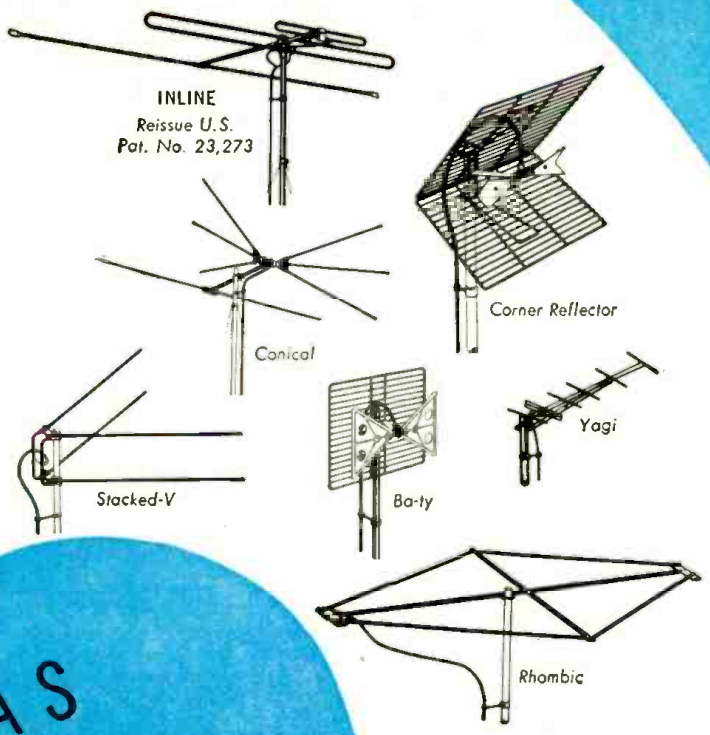
AMPHENOL installation-proved VHF and UHF television antennas are the first choice of dealers, servicemen and distributors because they are easy to sell. Viewers choose AMPHENOL antennas for the very good reason of better picture quality, their assurance of viewing satisfaction.



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AMPHENOL

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AIR-CORE
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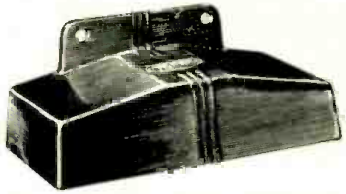

New AMPHENOL Trisonet, Isonet and Tele-Couplers utilize the same attractive case design.

AMPHENOL television accessories are designed by skilled engineers with years of experience in electronics. Each installation accessory, whether it is the new Lightning Arrestor, new Tele-Couplers, or any other part, operates at peak efficiency because of AMPHENOL quality-designing.

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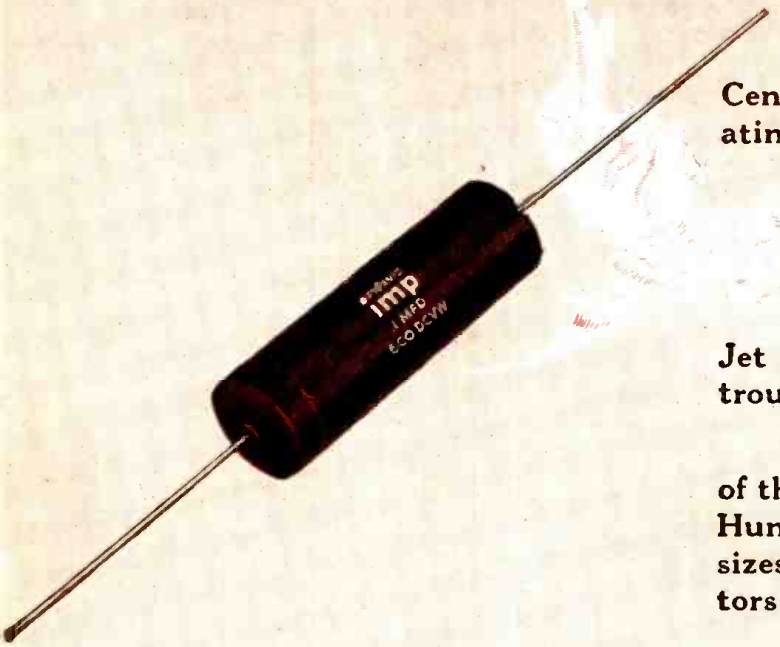
have I had an imp that operated so efficiently in such high temperatures," says L. (Lucifer) Satan, Hades strong man. "What's more, the improved Jet Imps are tough and won't scar under heat."



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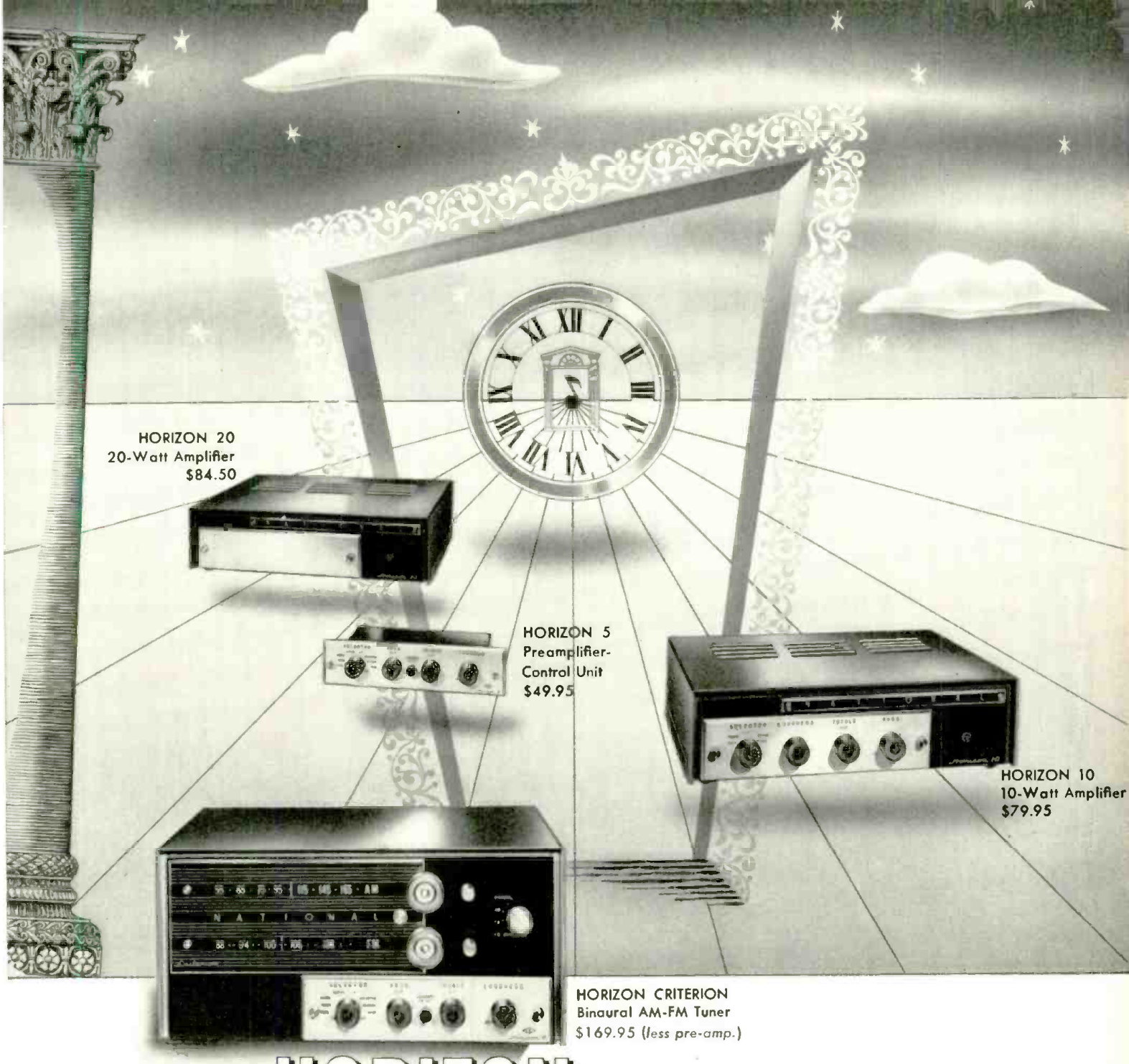

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1A7GT	.79	2E5	.89	6AQ5		6BN6	1.19	6L5G	.95	6T8	.89	7E6	79c	12AX4	.69
1B3GT	.95	2X2/879	.79	6AQ6	.79	6BQ6G	1.19	6L6G		6U5		7E7		12AX7	.69
1B5	29c	3LF4	1.29	6AQ7	1.19	6BQ6GT	1.19	6L6GA	1.39	6U6GT	69c	7F7	.29	12AY7	1.89
1H4		3Q4	.69	6AR5	.79	6BQ7	1.29	6L7	1.19	6U7G		7F8	1.19	12BA6	.59
1H5GT	.59	3S4	.89	6AT6	.59	6BZ7		6N6G	1.29	6U8	.89	7G7	1.19	12BA7	1.19
1J6GT	59c	3V4	.95	6AS5	.89	6C4	.59	6N7GT	1.19	6V3	1.29	7H7	.95	12BE6	
1L4		5T4	1.29	6AU5GT	1.29	6C5GT		6P5GT	.69	6V6GT	.69	7J7	1.19	12BF6	69c
1L6	1.29	5U4G	.69	6AU6	.59	6C6	69c	6Q7GT	.59	6W4GT		7K7		12BH7	.89
1LA4	1.19	5V4G	.89	6AV5GT	.89	6CB6		6R7GT	.69	6W6		7L7	.79	12BY7	.89
1LA6	1.19			6AV6	.59	6CD6	1.29	6S4	.59	6X4		7N7	.69	12BZ7	1.19
1LC6	1.19	5W4	59c	6AX4	.69	6CD6G	1.89	6S7GT	1.19	6X5GT	59c	7Q7	.79	12F5GT	.69
1LD5		5W4GT		6AX5	.79	6CF6	1.19	6S8GT		6X8	1.29	7S7	1.19	12J5GT	69c
1LE3	1.19	5Y3GT	.49	6AX6	.69	6D6/78		6SA7GT	69c	6Y6G	69c	7V7	.79	12K7GT	
1LH4	1.19	5Y4G	.59	6AY5GT	.89	6D8G	1.19	6SC7		6Z4/84		7W7	1.19	12K8	.89
1LN5	1.19			6B4G	1.29	6E5	.69	6SD7GT	.99	7A4	.95	7X6	.95	12Q7GT	.89
1N5GT		5X4G	97c	6B8GT	1.19	6F5		6SF5		7A5	1.19	7X7	79c	12S8	
1P5GT	79c	5Z3		6BA6	.59	6F5GT	59c	6SF5GT	.59	7A6	.89	7Y4		12SA7GT	.69
1Q5GT		6A7	.89	6BA7	.89	6F6GT		6SG7		7A7	79c	7Z4	.89	12SC7	.95
1R5		6A8GT	1.29	6BC5	.69	6F8G	1.59	6SH7	69c	7A8		12A7	1.49	12SF8GT	.69
1S4	.95	6AB4	.69	6BD5GT	.89	6G6G	.95	6SH7GT	.69	7B4	.89	12A8	.69	12SF8GT	.95
1S5		6AB7	1.19	6BE6	.59	6H6GT	.89	6SJ7	.79	7B5	.89	12AH7	1.49	12SG7	.89
1T4	69c	6AC5GT	.89	6BF5	69c	6J5GT	.59	6SJ7GT	59c	7B6	.89	12AL5	59c	12SH7GT	
1U4		6AC7	1.49	6BF6		6J6	.79	6SK7GT		7B7	89c	12AT6		12SJ7GT	69
1U5	.69	6AF4	1.76	6BG6	1.89	6J7G	.69	6SL7GT	.69	7B8		12AT7	.89	12SK7GT	
1V	89c	6AG5	.99	6BG6G		6J8G	1.19	6SN7GT	.79	7C4	1.29	12AU6	.69	12SL7GT	
1X2A		6AG7	1.49												

12SN7GT	.95	26	59c	57	79c	10% discount on orders of 100 tubes or more.									
12SQ7		27		58											
12SQ7GT	69c	35A5	.95	70L7	1.49										
12SR7GT		35B5		70L7GT											
12Z3	.95	35C5	69c	71A	79c										
14A7	95c	35L6		75											
14AF7		35W4	.59	77	.69										
14B6	89c	35Y4	95c	78/6C06	.95										
14B8		35Z3		80	.69										
14C5	1.19	35Z4	.69	83	1.49										
14C7	95c	35Z5	.59	84/6Z4	.69										
14F7		36	.79	85	.75										
14F8	1.29	37	95c	VR90											
14H7		38	88c	VR105	$1.19										
14Q7	.95	39/44		VR150											
14W7	1.19	41		VT51	29c										
14X7	1.19	42	69c	VT52											
19AQ8	1.89	43		117L7	1.49										
19BG6G		45	69c	117N7	1.89										
19T8	.89	45Z5		117P7	1.89										
24A	.69	46		117Z3	.59										
25A6GT	1.19	47	89c	117Z6	1.19										
25BQ6		50A5		715B	5.00										
25BQ6GT	1.19	50B5	69c	807	1.49										
25L6GT	.59	50C5		866A	1.49										
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25Z5	.69	50L6	.79	1619											
25Z6GT	.69	50X6	.69	2051	.95										
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All Tubes Have Daylight Type Dark "A" or "G" Faces

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8BP4	18.95	17GP4	24.90
10BP4B	12.95	17HP4	24.90
12JP4	16.95	17TP4	24.90
12LP4		19AP4B	26.80
12UP4A	17.40	19DP4B	
14BP4	18.40	19FP4B	
14CP4		20CP4	25.95
14GP4	19.90	20DP4	
14HP4		20HP4	27.45
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16AEP4	20.20	21EP4	28.10
16AP4A	20.60	21FP4	29.95
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16JP4A		21ZP4	29.95
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		27RP4	

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15 Month Guarantee

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12" COAXIAL PM SPEAKERS. High Fidelity with Crossover filter attached, 20 watts; 40-16,000 cps. response; 8 ohm Voice coil. ea. $12.85

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Very best quality—NATIONAL BRANDS. Individually Packed.

3"	ea.	$1.39
4"	ea.	1.59
5"	ea.	1.59
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8"	ea.	3.23
10"	ea.	5.95
12"	ea.	

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8-8	450 V.	.45	20-	50 V.	.19
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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
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50 Condensers assorted in package $4.95

600 VOLT		.05	12c
.001	9c	1	19c
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.01	12c	.25 mfd.	19c
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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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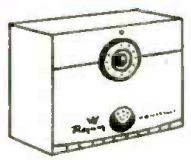
TV INTERLOCK COROS . . . . ea. 49c

Picture tube brightener 5.95 list dealer cost $1.95



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All Channel UHF converter. Hottest news in UHF history, much more gain than strips and fits any set . . . . only **14.96**

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ALLIANCE MODEL U-83

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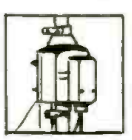

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Prevents buckling and bending of the mast—transfers entire weight of antenna from rotor unit to roof or ground. List $4.95. Dealer Net **2.97**

Stainless Steel Chimney Mount Net **$2.50**

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Mortar nail insulator . . . . each 8c
Twin lead ins. . . . each 3c
Mast ins. . . . each 15c

Ten foot mast. Seamless, expanded end, sturdy enough for the largest arrays only . . . . each **$2.39**

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TV 2-set antenna couplers $1.17 ea.

UHF-VHF Two antenna coupler Low loss water proof mast mounting. List . . . . . 5.95 DEALER NET. 2.39

TELERON TV WAVE TRAP For VHF Channels 2 to 13. Clears VHF picture, stops interference at once, 30 seconds to attach. ea. net $1.75 For All UHF Channels $2.75

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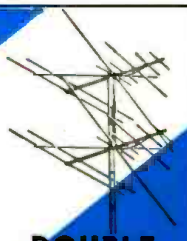
70 degree cosine yoke with 4 leads and network $2.95 ea.



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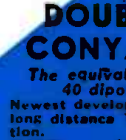
212-miles reception recorded. 125 miles common. This unmatchable antenna has been reinforced to withstand 150 mile winds.

Satisfaction guaranteed or your money back. Lens Mast, List Price $39.95. Your Cost **$19.95**



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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

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1,000 ft. . . . $34.50
100 ft. . . . **$4.95**
50' for $3.95

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Four Conductor Rotor Cable. Clear or Brown. Very special. 1,000 ft. . . . 14.95
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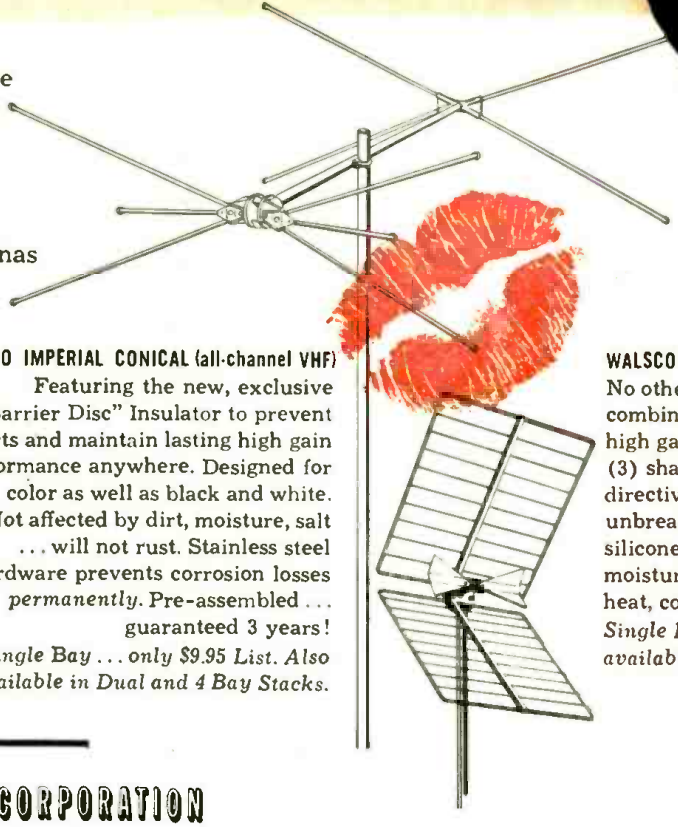

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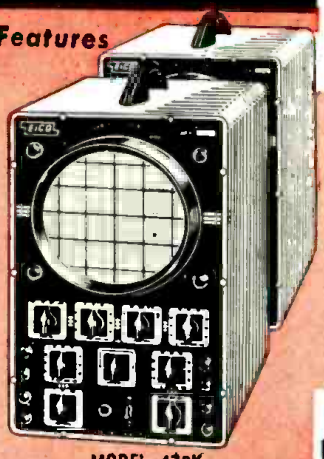

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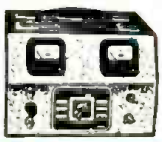

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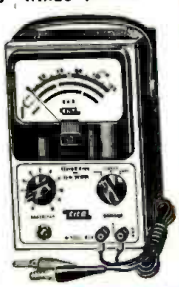
Exclusive separate calibration for air—and iron-core flybacks assures utmost accuracy. Large 4½" meter, 3 colored scales. Compact, portable (8½x5x5"), smart, rugged.



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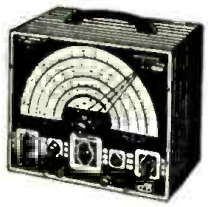

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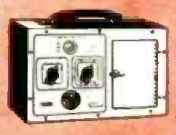

- Checks all types of TV picture and C.R. tubes in the set or carton. Bridge measurement of peak beam current (proportional to screen brightness).
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Large 7½" meter

- Large 7½" meter, can't-burn-out circuit.
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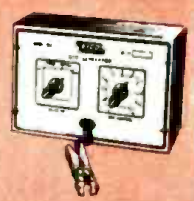

- Enables rapid adjustment of TV picture V & H linearity without hard-to-find station transmitted test pattern.
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- 4-step RF shielded output multiplier: constant output Z.

565K MULTIMETER KIT $24.95 WIRED $29.95.
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377K SINE & SQUARE WAVE AUDIO GEN. KIT $31.95. WIRED $49.95.

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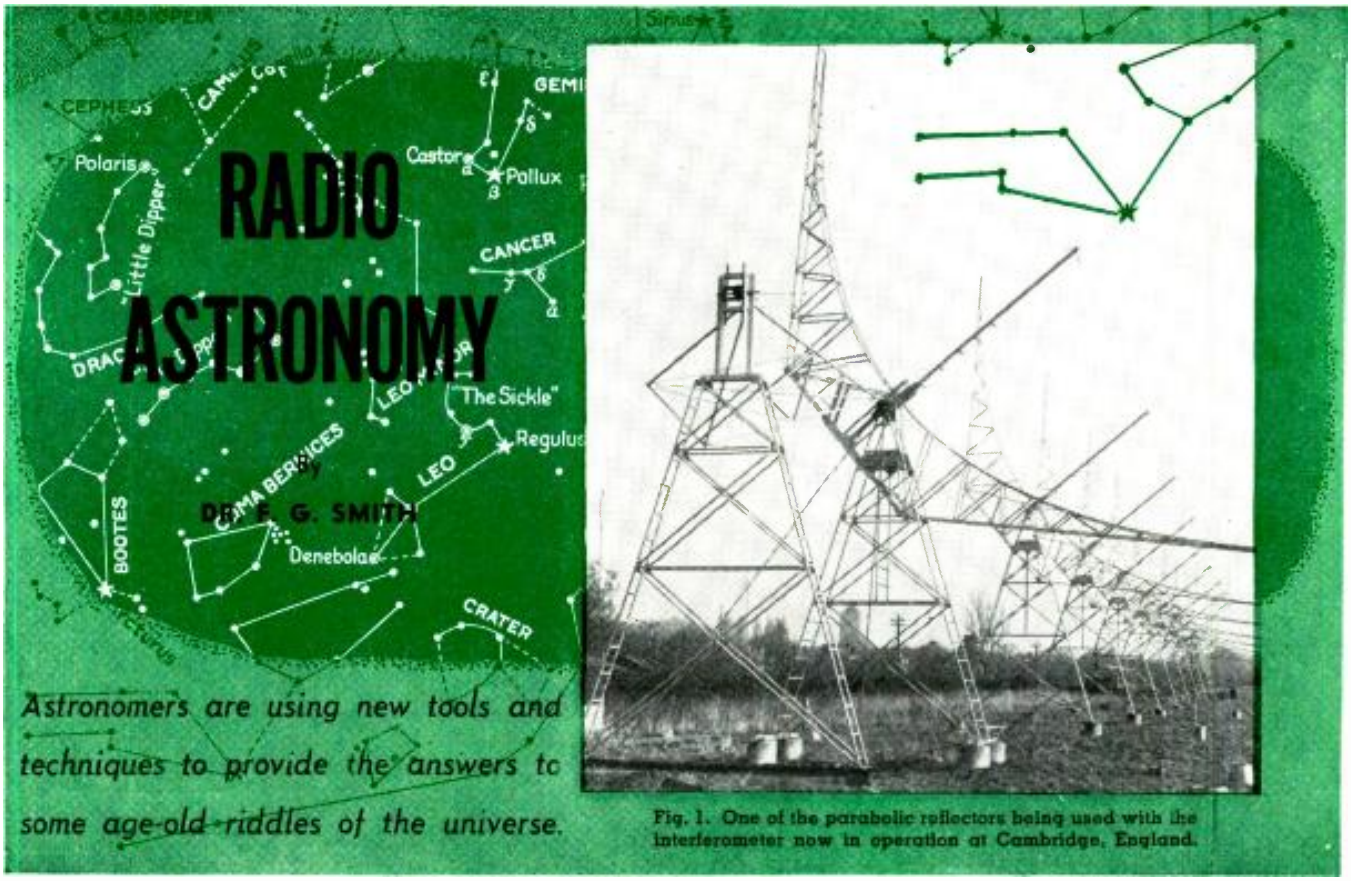


Fig. 1. One of the parabolic reflectors being used with the interferometer now in operation at Cambridge, England.

IN 1942 radar operators in England began to report a new kind of jamming observed on their meter-wavelength receivers. Weak radar echoes became lost in the "grass" on the (radar) screen, as if swamped by "noise" from a powerful transmitter. In the Army Operational Group, a scientist named J. S. Hey—later to be known as one of the pioneers of the new science of radio astronomy—examined the reports. He established that the source of the "jamming" was no enemy station, but the sun, and he noticed that at that time an exceptionally large sunspot was crossing the sun's face.

Radio amateurs can detect this radiation from the sun during periods of sunspot activity, and even television screens are affected by it, but few people know that the sun and some other celestial objects are radiating short radio waves continuously.

The first observations of this steady radiation were made in 1932 by an American radio engineer, Jansky, who was investigating the level of noise picked up by a sensitive receiver on a frequency of 20 mc. He found that a directional antenna gave a greater noise signal when pointing at the constellation of Sagittarius, in the brightest part of the Milky Way, than in directions away from this high concentration of stars. Ten years later, a radio amateur, Reber, built a parabolic reflector antenna 30 feet in diameter, in his own yard, and used this to make a map of received signal strength on frequencies up to 500 mc. over a large part of the sky.

Then came one of the most startling discoveries, again first hinted at by J. S. Hey. Workers in Australia and England found that the radio waves picked up by Jansky and Reber came, not only from the Milky Way but also from some quite definite points in the sky, as though individual stars were transmitting to us. But there were no bright stars at these points, and it was not until 1952 that these "radio stars" were identified with visible objects in the sky; even then the objects were so faint and inconspicuous that it needed the 200-inch Hale telescope at Mt. Palomar to find them. Many astronomers have become interested in this new science as an extension of astronomical techniques, and radio-astronomy is now being put to use in many parts of the world extending our knowledge of the solar corona, interstellar gas, nebulae, and even of our own ionosphere. In this article we shall be concerned less with the results than with the methods, since the problems of technique are of great interest and are not well known.

The two main problems facing the radio-astronomer wishing to study radio waves from some object or region in the sky are simply stated. First, the power available in his antenna is usually not greater than about 10^{-16} watt. Second, the beam width of his antenna is usually vastly greater than the angular size of the object, and the radiation picked up may well have come from many other objects in this region. Both these difficulties, of signal strength and resolving power, clearly call for large antenna systems and the radio astronomers are, in fact, building large antennas for this work. In Manchester, England, there is now under construction a very remarkable parabolic reflector antenna. This will be 250 feet in diameter, and it will be so mounted that it can be directed towards any part of the sky. The reflector will be made of wire mesh, and the accuracy of its surface will be such that it can be used on wavelengths as short as a half meter or less. But many observations can be made with much smaller antennas by using the principle of the radio interferometer.

If two similar antennas spaced several wavelengths apart and both directed towards the sun, are connected to the same receiver, as in Fig. 6A, it is possible to distinguish the radiation received from the sun against a background of radio waves from the stars behind it, although this background may be several times more intense than the solar radiation. The records of total power received from such a radio interferometer as the sun moves slowly across the sky would be like those in Fig. 3, showing some actual records on various wavelengths. In each the sinusoidal variation of signal is due to the sun passing in and out of the interference zones of the spaced antennas, whereas the steady signal, most evident on the longer wavelengths, is from the extended source of the Milky Way background. An improved method of recording recently used makes a record of only the sinusoidally varying signal, giving the intensity of the solar radiation without any confusion from the background radiation. The method of achieving

Fig. 2. Array of full-wave dipoles at 3.7 meters. This array is one-half of an interferometer for detecting radio stars. See text for full details.

The 600-inch "radio telescope" installation at the Naval Research Laboratory which is being used to study radio "signals" from the sun, moon, and stars. Scientists use this research tool to extend man's knowledge of the universe and to assist in forecasting the conditions for radio communications work.

this, known as phase-switching, will be described after we have examined more closely the problem of detecting these exceedingly small signals.

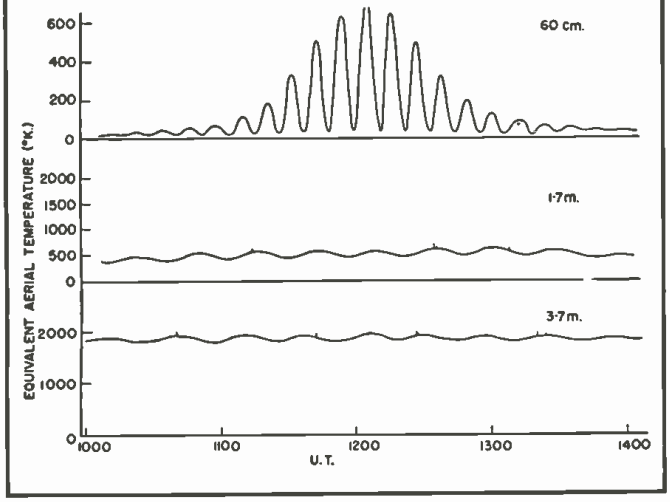
The character of the signals received from the sun and the stars is exactly the same as that of "receiver noise." If we connect the input of a receiver first to an antenna and then to a dummy load, the difference in signal may be demonstrated as a change in the output of a detector circuit, but this change may be only a few per-cent of the output, most of which is due to the receiver noise. It is necessary to record this difference without including receiver noise, and this is achieved in the schematic of Fig. 6B. The use of a phase-sensitive detector enables a long time constant to be used in the output circuit, and the smoothed output records the difference between the two levels of noise. An improvement is again made in Fig. 6C, where the antenna noise is continuously compared with the noise generated in a controllable local source, in practice, a noise diode. The output from the local source is automatically adjusted to equality with the antenna noise, and a record of the current in the diode gives a direct record of antenna noise unaffected by the characteristics of the receiver. The records in Fig. 3 were made in this way.

These methods of detecting small noise signals have been widely used in the measurement of the total noise power received at an antenna. But in radio astronomy it is often necessary to select only that part of the noise which is coming from a small source in the sky, perhaps a radio star or a sunspot, and to disregard a large proportion coming from a diffuse background of other sources. A new method of detection is then used.

In the schematic of Fig. 6D a pair of antennas is connected in a radio interferometer with a device for reversing the phase of the signal from one antenna periodically. The lobes of the interferometer radiation pattern then shift by a half lobe width, due to the phase shift, and the signal from a source smaller than the lobes of this pattern will change periodically by an amount depending on its position in the pattern. Again a phase-sensitive detector is used to measure this periodic change in output. In Fig. 4 we see the recorded output of such a phase-switching receiver connected to a large interferometer operating at a wavelength of 3.7 meters, shown in Fig. 2. The output is centered on zero, and the groups of oscillations each record the passage of a radio star through the antenna receptivity pattern as the earth rotates. This method of recording radio stars has been used in the accurate location of some of the most intense radio stars. A record from the intense radio star in Cassiopeia using part of the same interferometer is shown in Fig. 5.

The interferometer in Fig. 2 is locat-

Fig. 3. Interferometer records of "quiet sun" radiation.



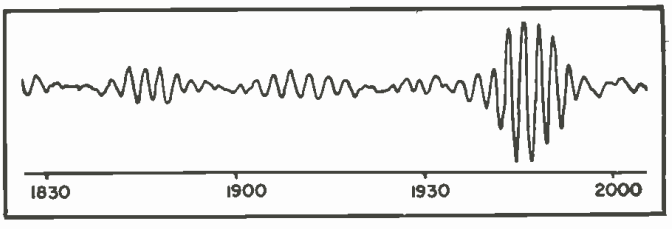
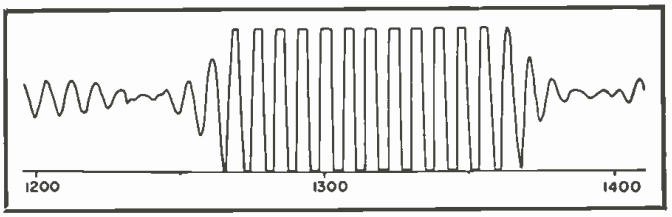


Fig. 4. Part of interferometer recording showing the presence of several of the minor "radio stars."

Fig. 5. Section of record with high sensitivity showing intense source in Cassiopeia. See text for details.



ed along an east-west line so that each radio star is detected as it crosses the meridian, a line from the zenith to the south point. The time of this crossing, found from the record, gives the position of the star in the sky. The timing may often be carried out to an accuracy of about 0.1 second, but unfortunately the actual position of the star cannot be determined quite as accurately as this. For one thing, the position of the interferometer axis must be known, and with the antennas of Fig. 2 this cannot be defined to better than about 2 minutes of arc. The interferometer in Fig. 7 was specially built for such work, and the line joining the bearings of the two parabolic reflectors was determined to 10 seconds of arc. These reflectors are two of the antennas of the "Wurzburg" rac'ar set much used by the Germans during the war. They are 27 feet in diameter, and the two are mounted 900 feet apart, 200 wavelengths at 1.4 meters, the wavelength used in the most accurate direction finding experiment yet made. With this interferometer, a radio star in the constellation of Cassiopeia was located within an area only 10 seconds by 30 seconds of arc. The position was given to astronomers at Mt. Palomar, who found with the 200-inch telescope a new type of nebula exactly in the right place.

This new branch of science is certainly providing new tools for the astronomer in his survey of the heavens, but it may also prove to be a useful approach to some studies of the ionosphere. When Hey first detected radiation from a radio star, he distinguished it from the background because the signal was fluctuating in a peculiar way. This effect we now know to be very similar to the scintillation, or "twinkling," of ordinary stars. It is caused by refraction in irregularities in the earth's ionosphere, through which the radio waves pass, and by studying the fluctuations in signal it has been found that the irregularities are in the upper part of the F-region, inaccessible to pulse-sounding methods. It appears that the top of the F-region occasionally becomes corrugated, to an extent of about one per-cent of its total depth, the wavelength of the corrugations being about 5 km. The whole structure is drifting across the earth at a speed of several hundred miles-per-hour, and the effect on the ground is similar to the moving pattern of sunlight on the bottom of a swimming pool when waves disturb the surface. The cause of this ionospheric disturbance is still unknown.

Another useful way of investigating the ionosphere has been suggested. As the radio waves from a radio star pass through the ionosphere they may be refracted in such a way as to make the star appear in the wrong position. The amount of this displacement may be measured, and depends primarily on the total number of electrons in a vertical column right through the ionosphere. Pulse-sounding methods are not suitable for this measurement, and it is likely that understanding of the ionosphere, still full of mysteries, will be helped by these new experiments.

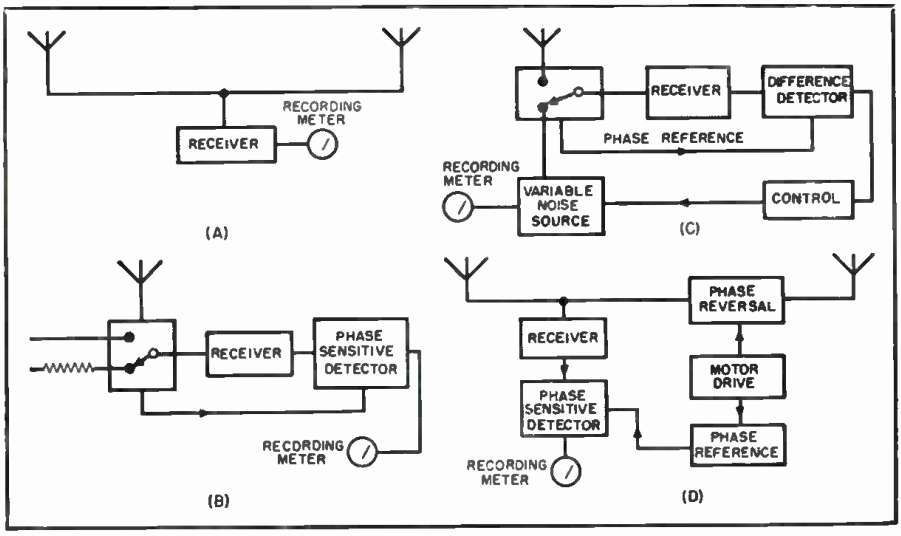


Fig. 6. (A) How two similar antennas, spaced several wavelengths apart, are used to detect radiation from the sun. (B) Use of a phase-sensitive detector to eliminate receiver noise. (C) Improved version of the circuit shown in (B) in which the antenna noise is continuously compared with the noise generated from a controllable local source, a noise diode. (D) A pair of antennas connected in a radio interferometer with a device for reversing phase of the signal from one antenna periodically.

The most exciting discoveries of radio astronomy have been in the search for sources of radio waves in our galaxy and in extragalactic nebulae, and this search is being pursued with great vigor in several places. The new Manchester antenna will be used in this work. Recently some details were published on a new antenna[1] at the Ohio State University designed to carry on the search. There is, however, a large interferometer antenna now in operation at Cambridge, England, which may well be called the largest radio-telescope in the world. Its parabolic reflectors cover an area close to 50,000 square feet. Results from a survey of radio sources in the Northern sky should be available in a few months' time. No description of this instrument has yet been published, and a picture of one of the reflectors in Fig. 1 is the only one available as yet. It is hoped that this instrument will provide some further clues to the solutions of the great problems "What are radio stars?"; "How many are there in our galaxy?"; "Do other galaxies have radio stars like ours?"—questions we may hope to have answered in only a few years from now.

REFERENCE

1. *Kraus, J. D. & Ksinzek, E.; "New Techniques in Radio Astronomy," Electronics, September 1953*

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Fig. 7. Parabolic reflectors used in an interferometer for accurate direction finding.

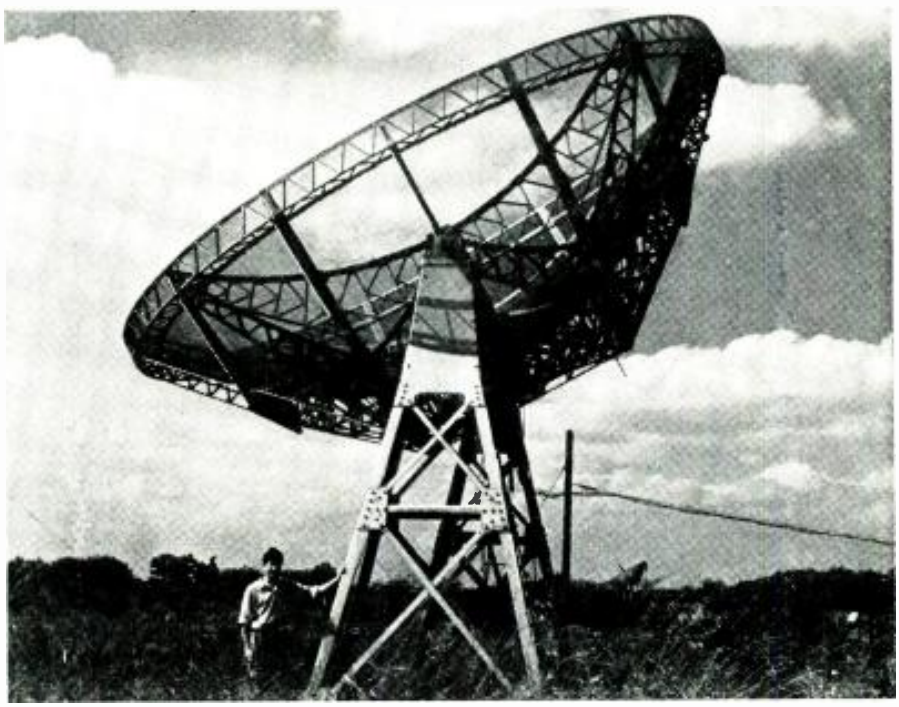


Fig. 1. Appearance of a 1.5 mc. FM beat on the face of a CRT. This pattern is not stationary but changes with the variations in sound carrier modulation.

TVI TROUBLESHOOTING

By
CARL J. QUIRK
Allen B. Du Mont Laboratories
Author, "A Handbook of Television Interference"

Part 2. Tells how TV interference gets into the set, how it may originate in the set, and how to calculate the frequency of the TVI pattern on the picture tube.

IN LAST month's article the five most common types of interference normally encountered in TV receivers were identified. As listed, these are: unmodulated, frequency modulated, video modulated, burst modulated, and mixed modulated. The next step is to determine how these interference signals get into the circuits of the TV set—and where they come from.

Most service technicians are aware that a superheterodyne receiver, whether radio or TV, has numerous responses. These responses can be considered as "slots" or "gates" in the frequency spectrum associated with a desired channel or frequency. It is through these "gates" that the undesired signals will enter to cause trouble.

Video Gate—The video passband of a TV receiver is normally between 0 and 4 mc. Any strong signal whose frequency lies within these limits may be picked up after the video detector. Standard radio broadcast stations are the main source of such trouble.

I.F. Gate—This is the i.f. passband of the receiver which, for all practical purposes, is about 3.5 mc. to 4.0 mc. wide. The opening provided by this "gate" is determined by a design specification of the receiver known as i.f. rejection. There are some cases, however, when two very strong signals will enter the receiver and beat together in the r.f. stage or mixer to produce an i.f. signal. Such a condition is not affected by the i.f. rejection of the receiver. Another source of interference in the i.f. range is the harmonics of the receiver's oscillator, particularly the second harmonic. This beats with the video or sound carriers of other channels to produce an i.f. signal in the set.

3. *Lower Adjacent Channel*—This is the 6 mc. immediately below the desired channel in frequency. The opening provided by this gate is determined by the adjacent channel sound rejection. Interference that enters this way is usually due to another TV station operating in this channel.

4. *Desired Channel*—This is the frequency range of the station to which the set is tuned. Those interference signals which enter through this gate are generally the most difficult to eliminate since there is no filter that can differentiate between a desired signal and an undesired signal having the same frequency. Such interferences normally require elimination at the source or possibly the use of extremely directional antennas. One of the most common sources of this "on-channel" interference is the local oscillator of a neighboring receiver. Another source is the set itself, where harmonics of the video i.f. or sound i.f. fall into the channel to produce annoying interferences. This may also result from co-channel interference, the result of another station operating on the same channel.

5. *Upper Adjacent Channel*—This is the 6 mc. above the desired channel. Most commonly, the interference entering this gate is caused by the video carrier of a TV station occupying this upper channel. This interference exhibits itself as a back-and-forth motion from which it derives its name of "windshield-wiper" effect.

6. *Image Band*—Most TV receivers operate the oscillator on the high side of the incoming signal. The image band is located above the oscillator by an amount equal to the i.f. The opening provided by this "gate" is dependent upon the image rejection of the receiver.

Internal Sources of TVI

Any TV receiver is a potential generator of interference to itself. The number of possible sources of interference in any set depends upon its circuitry. For example, an intercarrier set will not include all of the interference sources of a split-channel set. First, let us consider those sources of interference which are common to both intercarrier and split-channel receivers.

1. *Video Detector.* Harmonics of the video carrier i.f. which are produced in the video detector stage are either radiated back into the tuner, or find their way back through the set wiring to beat with the video carrier. As a rule, this presents a problem only when the harmonic falls directly into the channel being viewed. For example, the 3rd harmonic of a 25.75 mc. video i.f. is 77.25 mc., which is the video carrier of channel 5. The 4th harmonic of a 45.75 mc. video i.f. is 183 mc., which can beat with the video carrier of channel 8 to produce a 1.75 mc. interference.

A relatively common interference seen in many TV sets is the very fine herringbone pattern commonly referred to as "grain." Technically, it is a 4.5 mc. FM beat. The pattern (it must be watched closely) varies with the sound modulation of the desired channel.

This interference originates at the video detector as a result of the heterodyning of the sound i.f. and the video i.f. carriers. Theoretically, if the sound i.f. amplitude at the video detector were very low, the beat would not exist. Its presence is usually more prevalent in intercarrier sets than in split-channel receivers because in the former, the sound carrier runs higher in amplitude at the video detector.

Most TV sets use a 4.5 mc. trap in the video amplifier circuit to attenuate this undesired signal. Fig. 2 shows a 4.5 mc. trap in a *Du Mont* RA-306 chassis.

Sound in picture is another effect originating in these circuits when the sound carrier is too strong. This condition can, in many intercarrier sets, be tuned out by the customer who will still get usable pictures and sound.

However, this is not true for a split-channel set, where the sound would be lost with a small amount of detuning. Fig. 3 illustrates a normal over-all response curve which shows the position of the sound carrier. An intercarrier set should have an average sound attenuation of 30 db with respect to the video carrier. In terms of voltage, the ratio of the video carrier amplitude to the sound carrier amplitude is about 13 to 1. If, however, the ratio of video to sound is only 3 to 1 (approximately 10 db) or less, the sound will be quite evident in the picture. In such a set, it will be necessary to detune and raise the video carrier to provide adequate attenuation, with the resultant loss of fine picture detail.

2. *Horizontal Output Circuit.* Barkhausen oscillation occurring in this circuit will produce a "burst-type" interference, characterized by one or two vertical dark lines on the left side of the CRT. In addition, the 15,750-cycle sweep voltage generated in these circuits may interfere with both the sound and video signals to produce "buzz" and horizontal bars.

Intercarrier receivers have some additional sources of interference which do not apply to split-channel sets. Due to the relatively high level of the 4.5-mc. signal in the video detector of intercarrier sets, a beat is produced with the harmonics of the video i.f. carrier. Because of the 4.5-mc. signal, the interference will vary in accordance with the sound modulation of the program being viewed. For example, the 2nd harmonic of a 25.75 mc. video i.f. plus 4.5 mc. results in a frequency of 56 mc. which, in turn, beats against the video carrier of channel 2 (55.25 mc.) to give an interference of 0.75 mc. The 2nd harmonic of 45.75 mc. (video i.f. of 41 mc. i.f. sets) plus 4.5 mc. may beat with the video carrier of channel 6 (83.25 mc.) with a resultant interference of 3.75 mc. Other interference relationships can be determined in a similar way for high harmonics. Fig. 1 shows the pattern caused by a 1.5 mc. beat of the type described here.

It is, of course, also possible for the various harmonics of the sound i.f. (21.25 or 41.25 mc.) to interfere with the video carrier of a received channel. The interference would be recognizable as FM whose pattern would vary with the sound modulation of the desired channel.

Another possible source of FM interference, particularly in split-channel receivers, is the sound discriminator and, in some cases, the sound limiter. If the level is high enough, harmonics of the sound i.f. are generated and find their way back into the front end to produce "in-channel" interference.

Calculating the Frequency

Throughout the discussion thus far, the interference has been referred to as a beat or heterodyne pattern on the CRT screen. To an experienced observer, a mere look at the pattern will be sufficient to permit him to determine the beat frequency with sufficient accuracy. A completely inexperienced observer may not know quite how to start.

One might ask, "What difference does it make what the frequency of the beat is?" Actually, it makes no difference, *if the source is obvious.* On the other hand, as so often happens, there are a number of possible sources. One method of determining which is the one causing the trouble is to determine the beat frequency. For example, suppose a TV set has an interference pattern on channel 12, and it is suspected that a harmonic of the video i.f. originating at the video detector is the source of the interference. Let us assume that the set uses a 25.75 mc. video i.f.

Now, the 8th harmonic of 25.75 mc. appears at 206 mc. and can beat with the video carrier of channel 12 located at 205.25 mc. to produce a 0.75-mc. signal. If, however, we had no idea what a beat of 0.75 mc. looked like, we could only guess that this was what was appearing on the screen and, in many cases, we would find that prescribed cures for this type interference had no effect. Obviously, the reason they had no effect was because the interference was caused by some other source.

The most usual type of unmodulated interference pattern consists of dark vertical or diagonal lines as shown in Fig. 4. Now, if we were to take one scanning line and concern ourselves with each segment of this line that was dark due to this interference, we would find that the dark segment was caused by the positive half cycle of the interference signal. This assumes that the signal is applied to the cathode of the CRT which is the most common practice at this time. Obviously, the negative half cycle of this signal occurred during the light portion immediately following the blacked-out segment. Since the length of the horizontal scanning line represents a specific length of time, it follows that the greater the number of these dark segments that occur during one line the greater the frequency of the beat at the CRT cathode.

Since the horizontal scanning frequency is 15,750 cps, the time consumed by one complete scanning line including trace and retrace is 1/15,750 seconds or 63.5 microseconds. However, since about 10 microseconds of each scanning line time is lost in blanking and retrace, the visible length of the scanning line represents approximately 54 microseconds. Therefore, to find the frequency of the beat on the CRT, merely divide the distance between two dark lines by the visible length of a scanning line, multiply this by 54, and divide the result into 1. This gives the beat in megacycles. This particular method is quite cumbersome, but probably the most accurate. There is, however, a much simpler way.

Assume that there is a pattern of 10 vertical or diagonal dark interference lines on the screen of the CRT. This means that each scanning line is modulated 10 times. Each scanning line, however, represents one cycle of a 15,750 cps signal. Therefore, the frequency of the beat must be 10 times 15,750, or 157,500 cps. Although not as accurate as the method previously mentioned, this is much simpler and as accurate as necessary for most cases. Merely count the number of lines, either vertical or diagonal, and multiply this number by 15,750 for the fre-

(*Continued on page 77*)

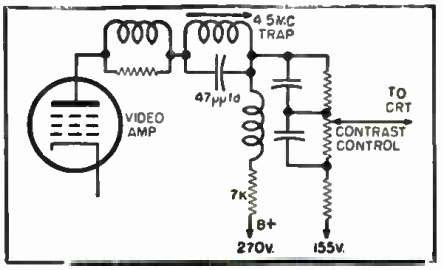


Fig. 2. A 4.5 mc. trap is commonly used between the video amplifier and CRT to eliminate this signal from the picture.

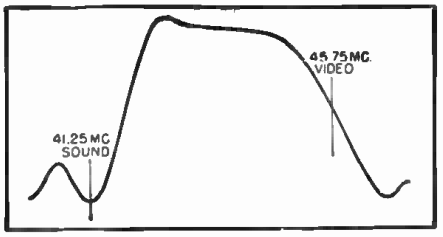


Fig. 3. Typical over-all response curve for an intercarrier set. Note that the sound carrier is at a trapped frequency.

Fig. 4. Beat pattern caused by unmodulated r.f. signal above 15,750 cps. These lines can also appear vertically.

Fig. 5. Horizontal bar interference. Interference signals below 15,750 cps at the CRT cause this type of pattern.

REMOTE CONTROLS FOR MARINE RADIOTELEPHONES

Fig. 1. The "flying bridge," popular on small yachts, is no place for expensive radiotelephone equipment. A remote control unit is very useful on the bridge.

By **ELBERT ROBBERSON**

Simple and economical to build, these units are source of income for marine radio technicians.

THE main disadvantage of the marine radio service business is its periodic slumps. You may have a fleet of a hundred or a thousand boats normally in port—but, come the Fourth of July, and they're gone for a week. You don't have to sit twiddling your thumbs waiting for them to come back, if you fill in with building some of the radiotelephone remote-control units described in this article.

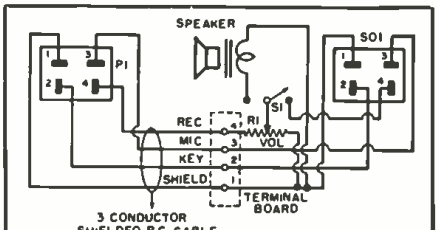
On most boats, the main equipment will have been installed in a cabin below, where it is protected and is close to battery and ground connections. The result is that when the boat is under way and the skipper is at the helm above, as shown in Fig. 1, he is as mute as a mackerel. A regulation handset cord will stretch only four feet, so if he wants to talk on the phone he must stop boating. The obvious solution to his problem (and he will be happy to hear of it) is a remote-control unit at the helm.

Unfortunately, the engineering of many of the smaller manufacturers has not advanced to the point of providing remote control, and the manufacturers who do make remote units design them to be used only with their own gear. Consequently, many boatmen go without or do with makeshift adaptations.

Here is a unit which can be used with any marine radiotelephone on the market employing relays and an electronic push-to-talk circuit. It can be connected to any properly adapted set, and will provide all of the features essential for communication. Construction is simple—extensive facilities are not necessary.

The basic requirements of such a unit are to provide loudspeaker reception of whatever traffic is on the air, a volume control, a means for transferring the audio from the speaker to the handset earpiece, a microphone circuit, and a control circuit. In addition to the control unit a telephone handset with a push-to-talk switch is needed, but a simple arrangement can be made to use the handset for the radiotelephone at both the main and the remote positions.

Fig. 2. Schematic diagram and parts list for remote control unit to be used in conjunction with marine radiotelephone. The socket is for handset shown in Fig. 3.



R_1—30 ohm, 4 w. wirewound pot (Mallory M-30 PX or equiv.)
P_1—4-contact plug (Jones P-304 CCT)
SO_1—4-contact socket (Jones S-304-FP)
S_1—S.p.d.t. toggle switch
Spkr.—5", 4 ohm v.c. speaker
1—Terminal strip (Jones #4-141)
1—Speaker cabinet (ICA #3988)
1—25 ft. length of 3-conductor, with shield, rubber-covered cable (Belden #8423 or equiv.)

The circuit shown in Fig. 2 fulfills all of these requirements. It will be noted from the parts list that components are standard items, available at any parts house. The cost of materials should come to about $12 per unit.

Operation is most easily illustrated with a radiotelephone having the handset circuit of Fig. 3. In this transceiver, handset connections are brought to a 4-contact socket on the panel, and the handset has a mating plug. The ground is a common return, not only for receiver audio, but also the relay-keying circuit and microphone. Voltage for the microphone is provided by the voltage drop across a heavily bypassed portion of the modulator cathode bias resistor, while voltage to actuate the antenna and power-switching relay is obtained from the low-voltage d.c. input.

Since these circuits are all of very low impedance, no crosstalk or noise pickup results, and the ground wire and the other three wires are twisted together in the handset cord. It is perfectly feasible to extend the handset circuits a considerable distance without noticeable loss or objectionable distortion.

Connection between the radiotele-

phone and the remote control is made by means of 3-conductor and shield, rubber-covered cable, with the shield acting as the common return. In the make-up of this cable the transceiver end is soldered into the plug, but the remote end connects into a terminal strip. The reason for not soldering this end right into the circuit is that in most installations the cable must run through numerous bulkheads or lockers. It is much easier and neater to bore round 5/16" holes to snake the bare cable end through than to gnaw out square holes to pass the plug.

Mounting and construction details for the remote control box are shown in Figs. 4 and 5. Fig. 6 shows most of the parts needed.

Some work is required on the radiotelephone if it does not have the panel socket and handset plug mentioned previously. All this will amount to is connecting a short cable and socket to the set's handset strip, and a plug to the handset cord. Handset or remote connections are then made by plugging into this cable socket.

Some radiotelephones will be found to have handset audio supplied by condenser coupling from the plate of the receiver power-amplifier tube. In this case remove the condenser and rewire to the circuit of Fig. 3, a matter of changing a couple of connections. In sets with "floating" input, one side of the battery-input circuit is used for the handset common. On these, disconnect the ground return of the voice coil and the ouput transformer, and connect these returns instead to the common handset circuit. Note that nothing in the remote unit should be grounded or connected to the cabinet.

Operation of the unit is simple. At the main position the desired frequency is selected with the receiver on "loudspeaker." Gain is set for a healthy signal level, then the speaker-handset switch is thrown to "handset." The handset is removed, the remote cable plugged in its place, and the handset taken to the remote station and plugged into the control. At this point, reception may be had in either the speaker or the earpiece by throwing the switch on the control unit, and with audio set to a comfortable level by the volume control. Since most marine-phone modulators work "wide open," with maximum possible gain at all times, no control of microphone level is provided. The transmitter filaments must, of course, be on if instant transmission is desired.

A profitable offshoot from this is the wiring of boats for remote speakers connected to the broadcast radio. It is astonishing to learn the number of people who buy yachts to get away from the annoyance of telephones and radios—and then spend most of their time aboard the boat telephoning and listening to the radio!

Keep track of parts cost and manufacturing labor. A 100% markup is about standard and will cover overhead and give a fair profit. Be as efficient as possible, then do not feel at all bashfull if the price comes to more than peanuts—these units customarily sell for from $40 to $50, plus installation. —30—

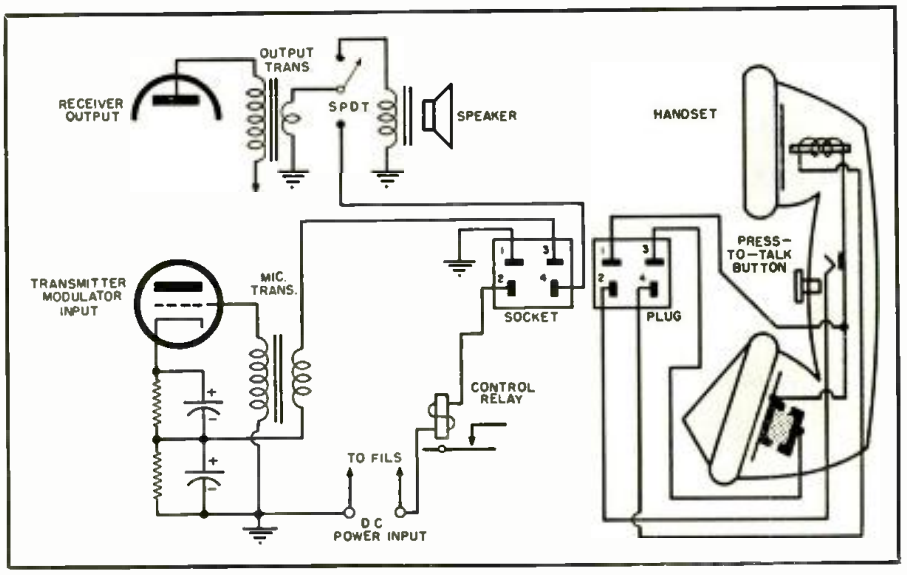


Fig. 3. Typical handset circuit of a marine radiotelephone. The remote unit plugs into the socket shown for the handset and the handset plugs into the remote unit.

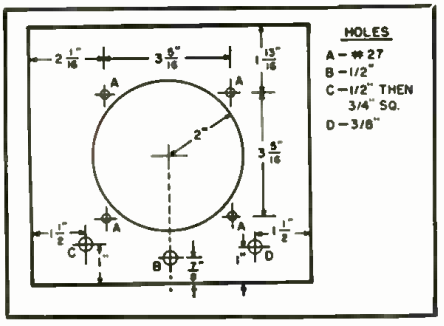


Fig. 4. Front of remote speaker unit showing details for mounting components.

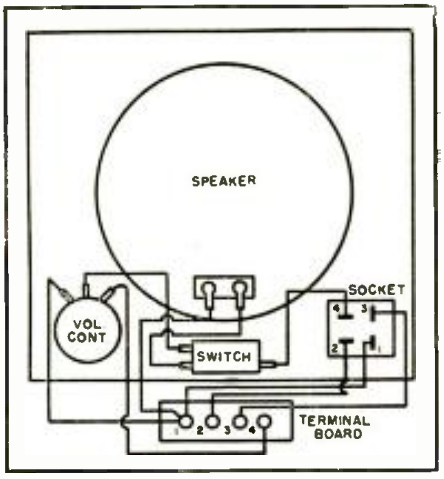
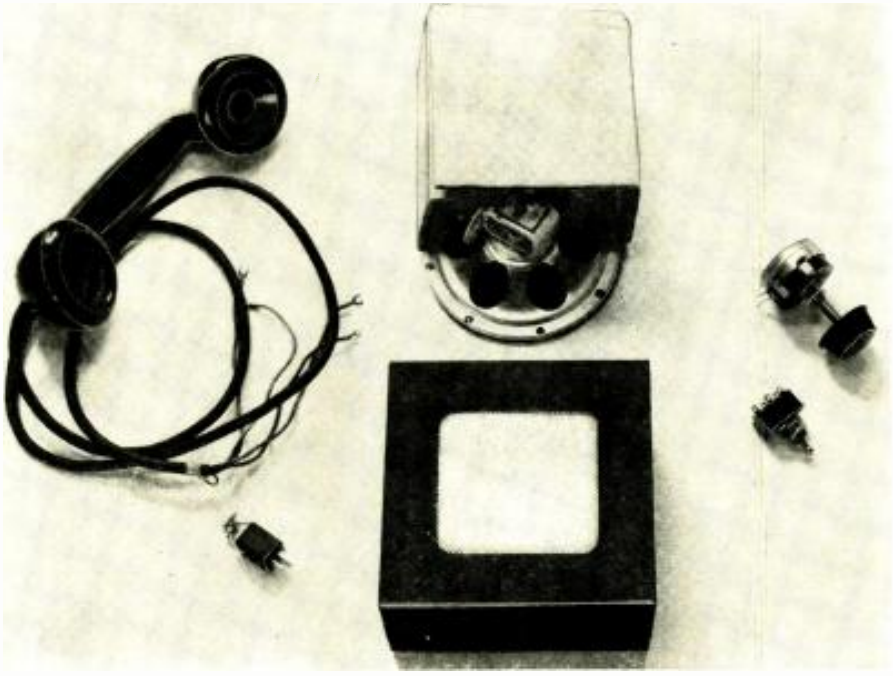


Fig. 5. Rear view of front panel of remote speaker showing position and wiring layout for the various components.

Fig. 6. Components for a marine radiotelephone remote control are standard.



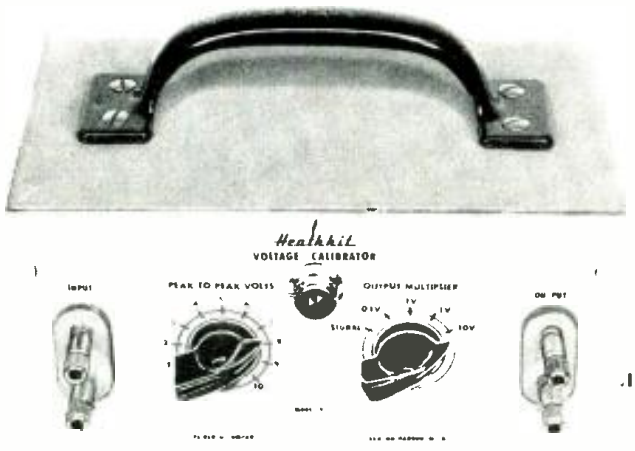


Fig. 1. Over-all view of the "modified" Heath Model VC-1 voltage calibrator.

VOLTAGE STABILIZATION FOR SCOPE CALIBRATORS

By **RONALD L. IVES**

A simple circuit change insures stable operation of this test unit in areas where voltage fluctuations are common.

MANY owners of small oscilloscope voltage calibrators, either of the kit type or "home grown," find that these instrument adjuncts are robbed of much of their usefulness by line voltage fluctuations. This trouble, already severe in many areas, is increasing because loads are growing faster than distribution systems. Fortunately, relatively minor and inexpensive changes in most oscilloscope voltage calibrators will make them dependable to within less than one per-cent at any setting.

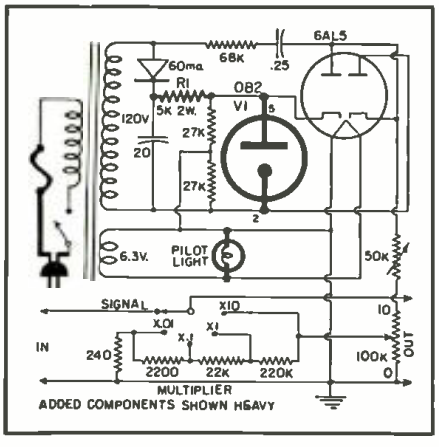


Fig. 2. Original Heathkit voltage calibrator circuit with additions shown in heavy lines. In addition to new input and output terminals, new feet, handle, and shaft lock on the variable 50,000 ohm resistor, circuitwise the changes consist of the addition of a line plug and fuse, a pilot light, resistor R_1, and regulator tube, V1.

The conventional oscilloscope calibrator consists of a source of sine waves, usually the power line; a biased diode, to clip the sine waves into semi-square waves; and a power supply, to bias the diode. One of the more popular circuits is shown in Fig. 2. This is essentially the circuit used in the *Heathkit* Model VC-1 calibrator. (Heavy lines show the alterations made.) In the original circuit, the clipping level is constant only when the d.c. supply voltage is constant, and this voltage depends upon the line voltage.

The d.c. supply voltage, and hence clipping level, can be stabilized in a voltage calibrator of this type by the addition of a voltage regulator tube, a modification costing only a couple of dollars and requiring perhaps an hour of labor. The resultant instrument quite closely resembles, in circuit and performance, the *Du Mont* voltage calibrator, an instrument most of us would like to own if we could afford it.

Operation of an unregulated voltage calibrator is quite simple. Sine waves, derived from the power supply through a resistor and an isolating condenser, are impressed across two halves of a dual diode. The cathode of the first diode is biased positive with respect to ground so that it will not conduct until the positive voltage

(*Continued on page 85*)

Fig. 3. Top view showing how 0B2 regulator tube is mounted.

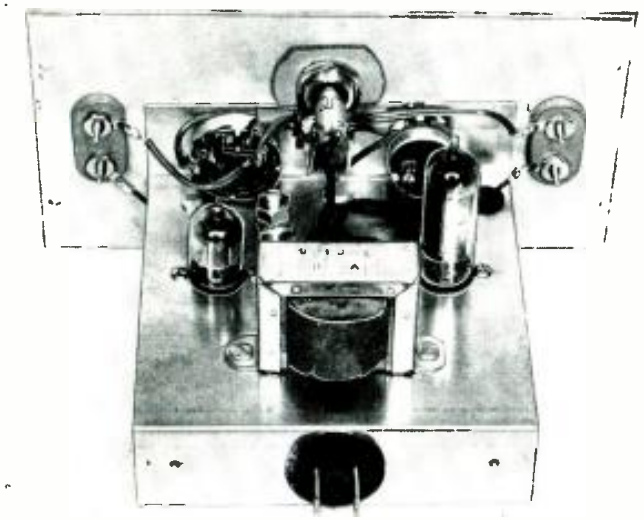


Fig. 4. Bottom view shows parts added to original circuit.

"ULTRA-LINEAR" OPERATION OF 6V6 TUBES

By
DAVID HAFLER
Acro Products Company

One of the best designs in recent years covering an audio amplifier using 6V6 tubes. The author, in this case, has converted a Grommes unit to illustrate his design idea.

Fig. 1. The Grommes 100BA power amplifier after conversion to "Ultra-Linear" operation. See diagram of Fig. 4.

EVER since the introduction of "Ultra-Linear" circuitry,[1] there has been a steadily growing interest in amplifiers utilizing this type of output stage coupling. The basic arrangement has become popular in ardent audiophile circles and has also found commercial and industrial applications where extremely low distortion is required.

Essentially, the "Ultra-Linear" circuit is illustrated in Fig. 2. The screens of beam power output tubes are connected to taps on the primary of the output transformer; or if it is desired to operate the screens at a different a.c. potential than the plates, to a tertiary winding on the output transformer. Either arrangement requires a transformer with the correct ratio of screen load to plate load if optimum results are to be obtained, and a mismatch will lead to inefficiency and/or increased distortion.

The "Ultra-Linear" arrangement has been mistakenly referred to as a feedback circuit. This is not correct since negative feedback would produce a reduction in gain which does not occur with the "Ultra-Linear" circuit. It would be just as incorrect to refer to a triode as a tetrode with feedback as it is to analyze the "Ultra-Linear" circuit as a feedback circuit. Instead it must be considered as a new and different type of tube structure which is neither triode nor tetrode.

The circuit provides some of the advantages of both triodes and tetrodes, and it overcomes some of the disadvantages of each of these types. For example, it is more efficient and provides more power output than triodes. Its capabilities in this respect parallel the capabilities of tetrodes. However, it has low internal impedance, almost as low as triodes and about one-tenth that of tetrodes; this provides good loudspeaker damping. Lastly, and most important of all, it has a more *linear* input-output relationship at most power levels than either triodes or tetrodes which means that its distortion is lower than other methods of operation. This alone justifies the use of the circuit in those cases where low distortion is the guiding criterion.

The "Ultra-Linear" circuit has achieved popularity in deluxe amplifier arrangements such as conversion of the Williamson circuit.[2] It has been widely used with tubes of the KT66, 807, and 5881 type for circuits in the 20 to 30 watt power bracket—for circuits of truly outstanding characteristics suitable for the most critical usage. Naturally, 20 or 30 watts is a lot of power for living room use—just as 200 horsepower is a lot of power for a deluxe automobile. However, there are definite advantages to high powered amplifiers which are operated at a fraction of their potential output just as there are definite advantages to high powered cars which are run at a fraction of their capabilities.

Nevertheless, not all of us want, or can afford, 200 horsepower cars; and not all of us feel the need for, or wish to spend the money for, amplifiers of 20 or more watts power rating. Many audiophiles and music lovers are very happy with amplifiers in the 10 to 15 watt power bracket. The popularity of this range is demonstrated by the sales success of thousands of Williamson-type amplifiers as well as tens of thousands of lower cost amplifiers using 6V6 tubes providing 10 to 15 watts of power output. Undoubtedly, the greatest number of amplifiers in home use utilize the type 6V6 tube in one of several popular circuit arrangements, all of which have essentially similar performance characteristics.

The possibilities of using the "Ultra-Linear" arrangement with 6V6 tubes in medium-powered amplifiers has been investigated carefully. It has been found that the tube is well suited for this mode of operation since its dynamic input-output characteristic can be linearized by proper selection of a tapping point for screen connection.

The characteristics of the 6V6 are not at all similar to the 6L6 family, and the connection arrangement which is optimum for 6V6's is quite different from that which can be used with the large tube types. As a tetrode, the 6V6 permits 10 to 15 watts of output depending on plate supply voltage and bias. These ratings are based on the point where clipping of a sine wave becomes visible—which happens when the grids start to go positive, and the driving source cannot furnish power to the tubes.

If the same tubes are triode connected (by strapping the screen to the plate), power output, using the same criteria, is reduced to 2½ to 3½ watts. When the "Ultra-Linear" connection is used, the power output depends on the position of the screen taps. If a 50% tap is used, power is reduced to about one-half of the tetrode capability. If a greater than 50% tap is used, power is reduced toward the triode limitations. At a tapping point of about 24%, power output is within 90% of the tetrode condition, and distortion at all levels up to maximum is minimized. This point, therefore, has been selected as the optimum operating point for "Ultra-Linear" use.

It would be possible to take an even lower tapping point and obtain slightly more power output than the tetrode connection, but the distortion at low levels and the internal impedance both begin to increase as the tap is brought closer to the zero per-cent point which

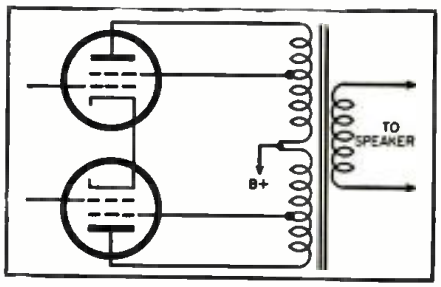


Fig. 2. Basic "Ultra-Linear" arrangement.

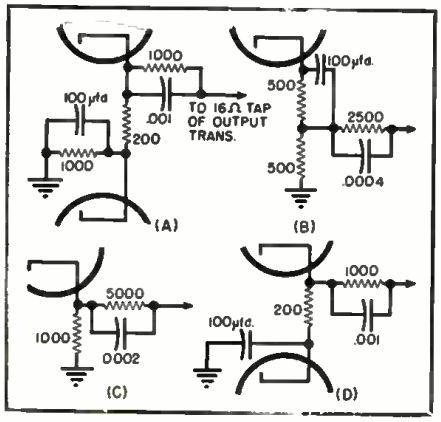


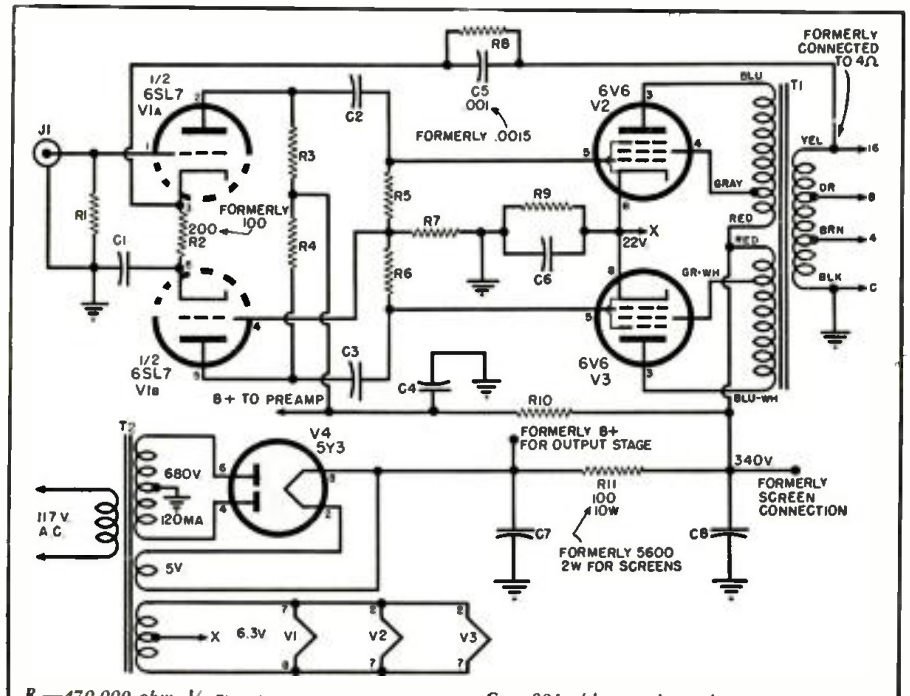
Fig. 3. Various feedback arrangements from voice coil of the output to the cathode of an early stage. See text for discussion.

is coincident with conventional tetrode connection.

Thus the "Ultra-Linear" operating point has been set at a compromise level in which the factors of maximum power output, distortion at various levels, and internal impedance have all been weighed against each other. It must also be mentioned that listening tests at various tapping points *with no feedback around the amplifier* validate this selection of the tapping point. This was done without feedback on the assumption that the best amplifier without feedback would also be the best after the application of feedback. In these listening tests, the triodes fell behind because they could not handle the power (after all, 3 watts is insufficient for musical peaks), the tetrodes were somewhat screechy and boomy (too much internal impedance for satisfactory speaker damping), and the 24% point sounded natural and smooth even without connection of the amplifier feedback loop.

Use of the "Ultra-Linear" circuit involves utilization of an output transformer with the correctly placed taps. A special transformer, the *Acrosound* TO-310, has been designed specifically for this application; and its parameters were selected so that it would not limit the ultimate capabilities inherent in the circuit. For example, its bandwidth has been set at ± 1 db from 10 cps to 100 kc. so as to provide the low phase shift and good transient performance desired in the most critical applications. Similarly, its distortion characteristics complement those of the "Ultra-Linear" circuit and permit low distortion at both high and low levels from 20 cps to over 20 kc.

Fig. 4. The Grommes 100BA power amplifier converted to "Ultra-Linear" operation.



R_1—470,000 ohm, ½ w. res.
R_2—200 ohm, ½ w. res.
R_3, R_4, R_5, R_6, R_7—220,000 ohm, ½ w. res.
R_8—1000 ohm, ½ w. res.
R_9—300 ohm, 10 w. wirewound res.
R_{10}—5600 ohm, 1 w. res.
R_{11}—100 ohm, 10 w. wirewound res.
C_1—100 μfd., 15 v. elec. cond.
C_2, C_3—.1 μfd., 400 v. cond.
C_4—10 μfd., 400 v. elec. cond.
C_5—.001 μfd. ceramic cond.
C_6—40 μfd., 50 v. elec. cond.
C_7-C_8—40/30 μfd., 450 v. elec. cond.
T_1—Output trans. (Acrosound TO-310)
T_2—Power trans. 340-0-340 v. @ 120 ma.; 5 v. @ 2 amps.; 6.3 v. c.t. @ 2 amps.
J_1—Input jack
V_1—6SL7 tube
V_2, V_3—6V6 tube
V_4—5Y3 tube

Circuit Considerations

There are many 6V6 circuits which have become popular, but by far the most commonly used is that in which a twin triode phase inverter is used to drive a pair of 6V6's; and feedback is carried from the output winding of the output transformer to the cathode of one of the triode sections. This basic configuration is simple, practical, economical, and adequate. The a.c. grid-to-grid voltage requirements of the 6V6 output stage are not stringent, and the phase inverter supplies ample drive without the need for an intermediate push-pull stage such as is used in the Williamson-type circuit. Since there are only two stages, the problems of utilizing feedback are simplified (as there is less phase shift in the circuit), and the designer can use less elaborate circuitry and components while preserving a satisfactory margin of stability.

Generally the phase inverter tube is a high mu triode such as the 6SL7 or 12AX7 in order to obtain as much gain as possible within the two stages. Actually, except for gain considerations, the specific type of inverter is of comparatively little consequence—circuit performance is determined almost completely by the mode of operation of the output tubes with respect to bias, supply voltage, and impedance match; the quality of the output transformer; and the proportion of feedback. The voltage amplifier stage contributes relatively little, as compared to the contribution of the output stage, to the over-all quality of the amplifier.

Conversion of these circuits to "Ultra-Linear" operation can be done by substituting an output transformer which has properly placed taps for connection to the 6V6 screens. Generally, this substitution will make an immediate decrease in distortion.

If the original amplifier used a screen dropping resistance, this is removed for "Ultra-Linear" operation; and the screens are connected to the tapping points on the primary of the output transformer. It is important to observe polarity and to connect the screen to the *same* primary side of the transformer as that from which the plate is energized. Otherwise an oscillitory condition will be provoked. Similarly, polarity must be observed between upper and lower output tubes, or the feedback from the secondary side of the transformer may be in the incorrect phase and cause regeneration.

When the screen resistor of the original circuit has been removed, the screen bypass condenser must also be disconnected. This can be readily put to good use by paralleling it across one of the filter condensers of the power supply for extra filtering and lowered power supply impedance.

The only other changes which need be made involve the feedback resistor and feedback compensating condenser which shunts this resistor (or in some circuits bypasses it to ground). The ratio of series resistor to shunt re-

sistor in the feedback path determines both the total gain in the circuit and the proportion of feedback. For example, with a 6SL7 phase inverter and feedback from the 16-ohm tap of the *Acrosound* TO-310 transformer, the power amplifier will have 17 db of feedback and require a maximum input signal of 3 volts to drive it to full output when the ratio of feedback to cathode resistance is 5 to 1. If the ratio is changed to 7.5 to 1, the amplifier will be driven with a 2 volt input, but the feedback is cut down by 3 to 4 decibels. Similarly, a 12AX7 has about 50% more gain than a 6SL7. If this tube is used with a 7.5 to 1 ratio of resistance, the amplifier can be driven to full output with 2 volts of signal while still maintaining 17 db of feedback. In the original construction, it is recommended that the 12AX7 be used so as to obtain this increased sensitivity. However, in converting an existing amplifier, the constructor can leave the 6SL7 tube in the circuit and can adjust for the required sensitivity by varying the feedback resistor. If necessary, he can sacrifice a portion of the feedback in order to maintain sufficient gain for the preamplifier stages which are being used.

In many commercial amplifiers, the power amplifier section must be sufficiently sensitive to be driven by 1 volt of input because of the relatively low gain of the earlier stages. If this is the case, it is necessary to diminish the feedback (by increasing the feedback resistor). However, the most modern preamp designs are intended to supply about a two volt input such as is found on Williamson-type amplifiers. Any of these preamps will handle the converted 6V6 amplifier and still permit 14 or more db of feedback. This is sufficient feedback to reduce distortion, hum, noise, and internal impedance to low values suitable for top quality applications. Thus the more common front-end arrangements will serve with the "Ultra-Linear" 6V6 amplifier while preserving an adequate proportion of feedback. When the 12AX7 is used, the designer has an additional 3 or 4 db of latitude in his choice of gain *versus* proportion of feedback.

In some amplifiers which are of the public-address type rather than the high-fidelity type, inadequate feedback is used which is limited to 6 db or less. Conversion of these amplifiers with the increased feedback which results from a 5 to 1 resistor proportion will produce insufficient gain. In those cases, there must be either a sacrifice of feedback or the addition of more gain in the early stages. However, in these amplifiers the original quality is generally so poor that the substitution of the "Ultra-Linear" output arrangement will make a decided improvement in performance even if only 6 db of feedback is used. The *relative* improvement in a low grade amplifier is even greater than is achieved by converting a fairly good amplifier which has a high proportion of feedback.

When feedback in excess of 12 db is used, there is some possibility that the amplifier response will peak in the ultrasonic region even though the response without feedback is flat over a very wide range. This peaking can be eliminated with a consequent improvement in transient response, by adding a network to change the phase of the feedback voltage in the peaking region. One simple arrangement is to add a small condenser across the feedback resistor. A suitable condenser value in the type of circuit under discussion is one which makes the product of the feedback resistor in ohms and the condenser in microfarads equal to unity. Several typical circuits using a 5 to 1 resistor proportion are illustrated in Fig. 3. In these arrangements, the feedback connection is brought to the cathode or pair of cathodes of the phase inverter stage. All of the arrangements have the same proportion of feedback and the identical phase correction.

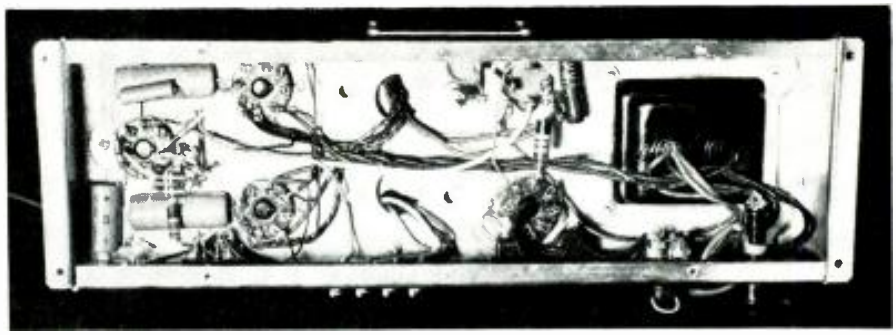


Fig. 5. Bottom view of converted Grommes amplifier showing new output transformer

Circuit Conversion

These conversion considerations are exemplified in the conversion of the *Grommes* 100BA amplifier, Fig. 1, the circuit of which is shown converted in Fig. 4. This amplifier is typical of many which come both with and without preamps in the $40 to $60 price bracket. Both former values and converted ones are indicated on the schematic. There are only three electronic parts changes in addition to the new output transformer.

Physically, it takes only two additional holes for mounting the output transformer—the remaining holes line up without alteration. The transformer fits rather snugly but inasmuch as it contributes no heating, its proximity to other parts causes no difficulty.

Any power supply which is satisfactory for the original circuit is also suitable for the "Ultra-Linear" conversion since the "Ultra-Linear" circuit is less critical as to supply regulation than the tetrode circuit. In the *Grommes* 100BA no filter choke is used, and the converted circuit works just as well without one although a single 100 ohm resistor was added in converting in order to reduce the hum voltage.

The converted amplifier has extraordinary specifications for its size and price. In fact its specs read amazingly like those of a conventional triode Williamson amplifier. Frequency response is flat ± .5 db from 20 cps to over 100 kc. at a 1 watt level. (By increasing the size of the cathode condenser of the 6SL7 the low end response can be made flat to below 5 cps.) At 10 watts, response is flat ± 1 db from 20 cps to over 60 kc., and clean waveform is preserved from 20 cps to 30 kc. even at this high a level.

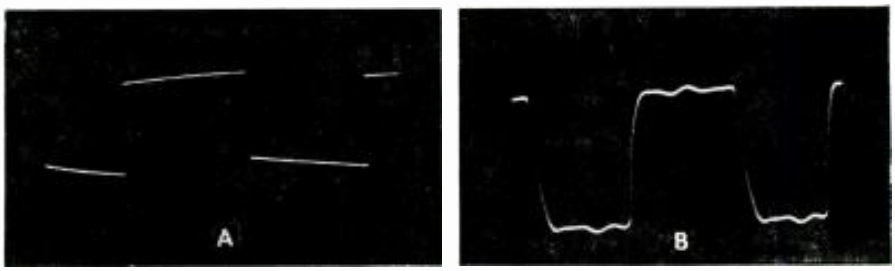
The transient response as evaluated by square waves is shown in Fig. 6. There is a minimum of transient distortion and phase shift at these two extremes of the audio band.

Intermodulation distortion is extremely low. It runs about .1% at 1 watt, rises to .4% at 8 watts, and to .5% at 10 watts. It is still below 1% at 11 watts. These tests were made with 40 and 7000 cps mixed 1 to 1 and are based on equivalent sine-wave output. This is the conventional method of rating which is used for practically all commercial amplifier equipment.

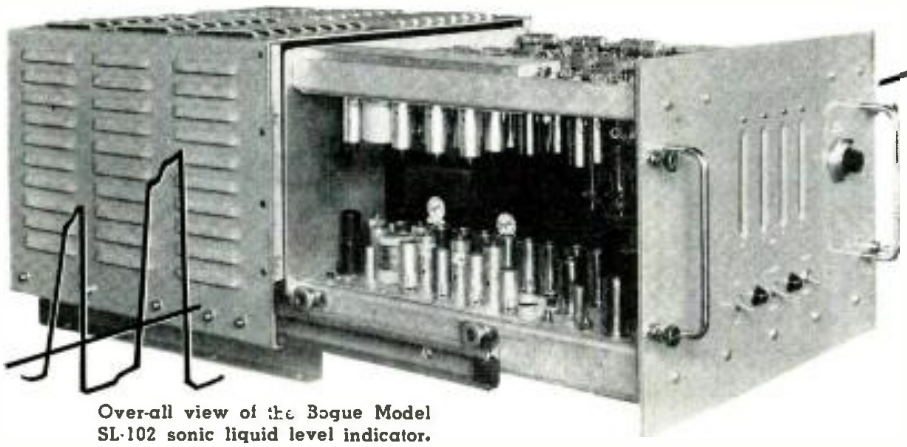
The quality of a low cost 6V6 amplifier is normally not up to the top high-fidelity standards which have been set by the Williamson-type amplifiers produced in recent years. However, it is now possible, by using the "Ultra-Linear" circuit arrangement and a top quality output transformer, to convert these run-of-the-mill amplifiers into ones whose quality is comparable with the best obtainable in the

(*Continued on page* 117)

Fig. 6. Square-wave performance (A) at 20 cps and (B) at 20 kc. See text for details.



SONIC LIQUID LEVEL INDICATOR



Over-all view of the Bogue Model SL-102 sonic liquid level indicator.

A safe, explosion-proof instrument for measuring liquid levels in tanks without floats or other moving parts.

By
CLAYTON R. KIELICH
Systems Engineer
Bogue Electric Manufacturing Co.

TO MEET a long standing need for accurate gauges, free from floats and similar moving parts, *The Bogue Electric Manufacturing Co.*, has developed the SL-102 sonic liquid level indicator, shown being tested on this month's cover. Synchros, potentiometers, and other rotating data transmitters have been eliminated in the sonic system. The system does not use direct current within the tanks, and the liquid is not a conductor of electric current. The equipment is, therefore, safe and explosion-proof.

Sonic liquid level indicators are being used to gauge petroleum storage tanks and similar containers filled with corrosive and radioactive liquids.

The indicators may be arranged to deliver digital level data to commercially available tape printers for inventory purposes. The recorders may be operated up to several thousand feet from the indicators without the use of special equipment. When desirable, level information can be transmitted over greater distances using wire-radio transmission networks.

The SL-102 sonic system is completely automatic, and is capable of compensating for variations in sound velocity due to temperature and gravity changes within the liquid being measured, without any external equipment. It is also possible to read an interface level of two immiscible liquids in the same tank.

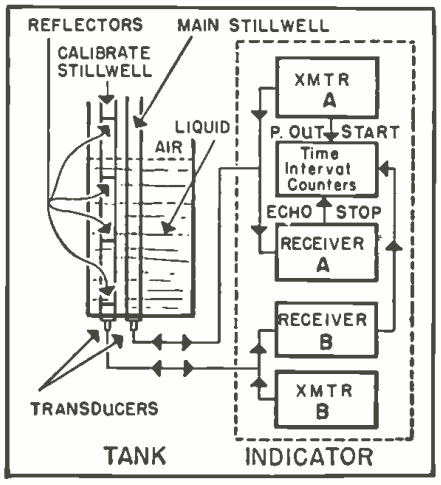
The system consists of an indicator and two transducers in each storage tank being gauged. The transducers, with proper protection, are installed at the bottom of the tank and are the only transmitting and receiving devices to come in contact with the liquid. Any number of tanks containing differing liquids may be read by one SL-102 indicator with the aid of a switching relay, R-102. The accuracy of this instrument is ±.01 foot.

The system consists of two sonic gauges, one measuring the surface level and the other the spacing between a series of acoustic reflectors placed along the sound path of a second transducer.

A pulse transmitted from the level measuring transducer is propagated to the surface of the liquid where it is reflected back to the transducer. The elapsed time interval is used to gate a timing oscillator, the frequency of which is directly proportional to the velocity of propagation of the pulse.

The period of each cycle of the timing oscillator is chosen to equal the time required for a sound pulse to travel .01 foot up and back through a particular liquid, so that the total number of cycles in the interval between transmission and return of an echo equals the actual level in hundredths of a foot. This information is translated to a liquid level reading on the decade counter of the indicator.

Fig. 1. How the indicator system operates to gauge liquids in various storage tanks.



The transmitted pulse train at 400 kilocycles is transmitted at a rate of 20 times-per-second. Each pulse is 40 microseconds in duration. The calibrating pulse is identical to the indicating pulse. The reflectors, located at known distances in the stillwell of the calibrating system, provide pulses to adjust the timing frequency to exactly correspond to the velocity of propagation in the particular liquid. The number of reflectors used will depend on the depth of the tank.

Transmitter A and receiver A, along with the time interval counters, are designated the "main" system and, in conjunction with the associated transducer, gauge the surface level. Fig. 1.

The second system, or the "calibrate" section, consists of transmitter B, which directs the sound pulse along the path fitted with accurately located reflectors, and receiver B which amplifies the received echoes. The amplified reflector echoes are applied to the time interval counters where they calibrate the main system.

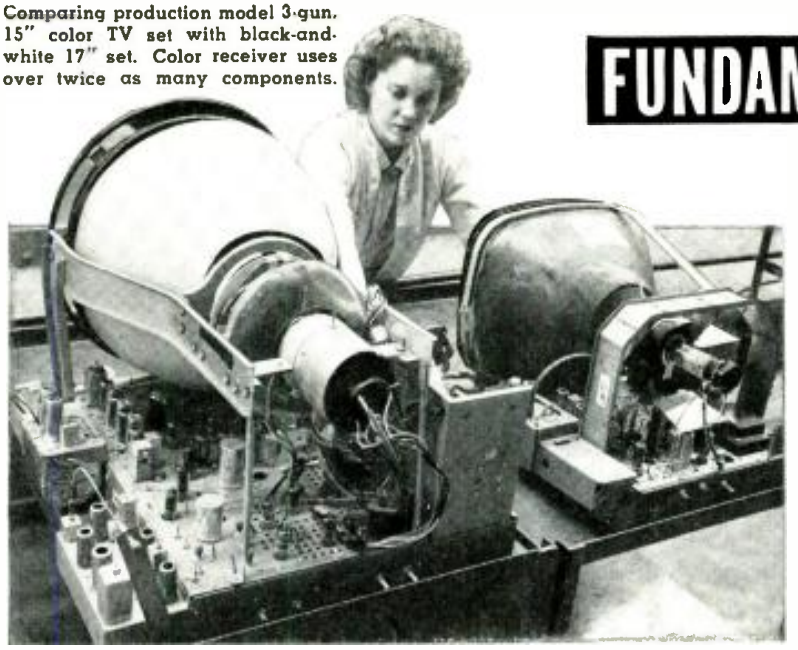
To support the acoustic reflectors in the calibrate section and to contain the sound energies within a small part of the tank, two stillwell pipe assemblies are installed in the tank. These stillwell pipes are acoustically treated internally with a material that is impervious to corrosive and non-corrosive liquids.

The transducers used with the system are made up of ammonium dihydrogen phosphate (adp) crystals. The crystals are encapsulated in a stainless steel container, measuring 5 inches in diameter. The crystals are protected by an acoustically transparent window of teflon that is impervious to corrosive liquids.

The indicator is housed in a table mounting cabinet, 15½ inches high, 19 11/16 inches wide, and 21 inches deep. The weight of the indicator is approximately 116 pounds. The unit is mounted on slide rails making it readily accessible for inspection and maintenance. The system operates from 117 volts, 60 cycles, single-phase power and consumes 270 watts.

—30—

Comparing production model 3-gun, 15" color TV set with black-and-white 17" set. Color receiver uses over twice as many components.



FUNDAMENTALS OF COLOR TV

TRI-GUN RECEIVER CIRCUITS

By MILTON S. KIVER
Pres., Television Communications Institute

Part 4. Tuner, video i.f., video amplifier, and sound circuits of typical color TV sets described in detail.

IN LAST month's article we examined in some detail the block diagram of a color television receiver designed to operate with a tri-gun color picture tube. Now we are ready to consider the actual circuits which each of the blocks represented.

R.F. Tuner. The introduction of color in no way alters or modifies the r.f. section of the television receiver. Thus, the r.f. amplifier should still possess high gain and low noise; the oscillator still provides a signal which, when mixed with the incoming signal, will produce the desired difference or video i.f. frequencies. For the reception of v.h.f. signals, either a turret tuner or a continuous arrangement is employed. For u.h.f. reception, continuous tuning is the most common method although there is also available an 82-channel turret tuner.

A typical v.h.f. turret tuner circuit is shown in Fig. 1. Cascode amplifiers are common in the r.f. stage, although some manufacturers favor single high-frequency miniature pentodes. The oscillator tube is invariably a triode, usually half of the mixer tube. The latter may be another triode (*i.e.*, ½ of a 6J6) or pentode (½ of a 6U8). This arrangement requires only two tubes for the entire tuner section.

In the tuner shown in Fig. 1, the cascode r.f. amplifier uses a 6BZ7 duo-triode. One section of a 6J6 serves as the mixer while the other section functions as the oscillator. Balanced 300-ohm and unbalanced 75-ohm (coaxial line) input impedances are provided by a center-tapped primary winding, L_{101A}. All signals must pass through a high-pass filter designed to attenuate all signals below channel 2.

The secondary winding, L_{101B}, is tuned by the input capacity (of the first triode unit) in series with alignment trimmer C_{105}. Loading of L_{101B} by R_{101} provides the required bandpass, particularly on the lower v.h.f. channels. The a.g.c. bias is applied to the first triode of V_{101} through decoupling resistor R_{102}.

Direct coupling is used between the first triode plate and the second triode cathode. This is normal in cascode circuits. With cathode feed to the second triode, C_{104} is used to place the grid at r.f. ground potential. Since the two triode sections of V_{101} are in series across a common plate supply, the cathode of the second triode is positive with respect to chassis ground. A divider across the "B+," consisting of R_{103} and R_{111}, places the grid of the second triode at a sufficiently positive potential (with respect to its cathode) for proper operating bias.

The signal at the plate of the second triode of V_{101} is inductively coupled into the grid circuit of the mixer. At the same time, a voltage from the oscillator is similarly brought into the mixer circuit. The mixer combines both signals to produce the desired i.f. and then transfers this signal to the following i.f. stages.

The oscillator is of the ultraudion variety with a front panel fine-tuning control.

Video I.F. Section. The video i.f. system follows the r.f. tuner. This will consist, usually, of four and sometimes five separate stages. See Fig. 2. In the conventional black-and-white television receiver, three i.f. stages was the number most frequently used, although four stages were found in some sets. The increased number of i.f. stages in a color receiver stems, in part, from the wider bandpass required (4.2 mc.) and from the greater precautions that must be taken to insure that the response curve will possess the right form.

The desired response curve for the video i.f. section is shown in Fig. 3. Of particular interest is the care with which the low frequency end of the curve must be shaped so that it provides the proper amplification for the color subcarrier and its sidebands. Note that the curve is flat down to approximately 41.65 mc. and then the "roll-off" is quite steep. The steep decline is needed to prevent the sound carrier from receiving too much amplification, producing a 920-kc. beat note at the video second detector which would appear on the screen as an interference pattern. Furthermore, too much sound voltage at the detector will produce a fine-grained 4.5-mc. pattern on the screen and/or sound bars. The latter effect, of course, can occur in all television receivers, whether they be of the black-and-white or color variety. The 920-kc. interference, however, arises only when a color signal is being received.

Video i.f. systems in color receivers

EDITOR'S NOTE: *Part 1 of this series, which appeared in the March, 1954 issue, explained color mixing and its application in color TV. Part 2, appearing in the April issue, described the NTSC color signal. The block diagram of a typical color TV receiver was described in the May issue. This and forthcoming articles will describe and analyze the various circuits used in present color TV sets.*

In view of the many requests received, RADIO & TELEVISION NEWS *will publish this series in reprint form. The first three parts are in a single unit (50 cents), the balance will be reprinted in individual parts at 20 cents each. For quantities of 50 or more, write for quotations. Address your inquiries to* RADIO & TELEVISION NEWS *Reprint Editor, 366 Madison Ave., N. Y. 17, N. Y.*

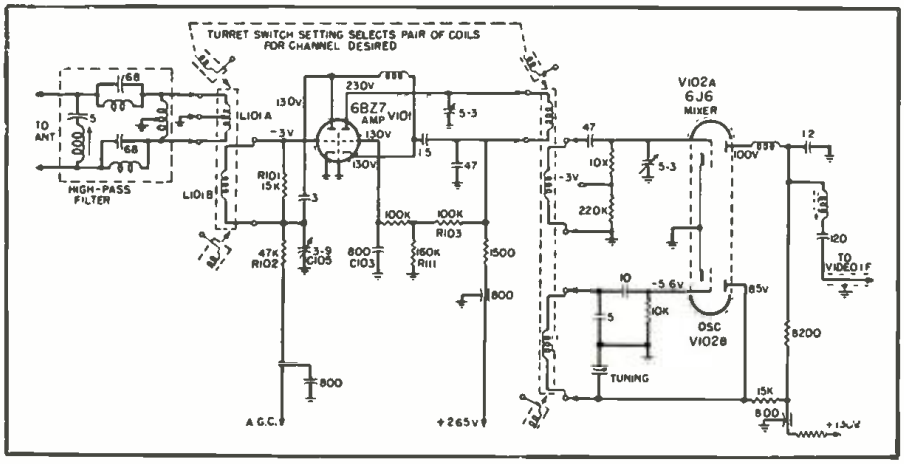


Fig. 1. Typical r.f. tuner used with color TV receiver. This is a turret-type unit for v.h.f. only, however combination v.h.f.-u.h.f. models are also used.

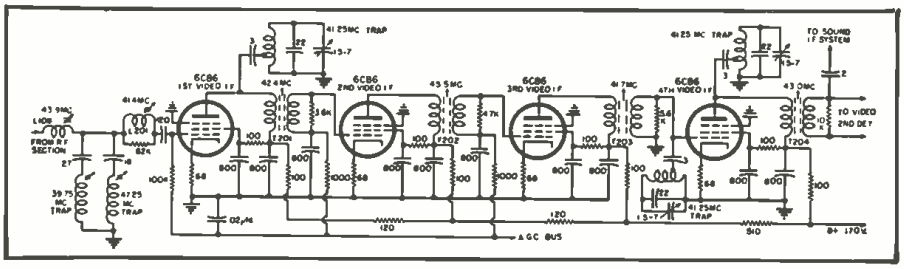


Fig. 2. The video i.f. circuits of one color TV receiver. Four stages are used here to assure a wider and more uniform bandpass than for black-and-white sets.

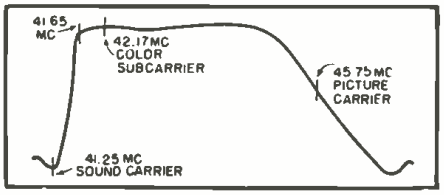


Fig. 3. Video i.f. response curve of a color TV receiver. Note the steep slope of the curve between 41.25 and 41.65 mc.

follow the same practice as for black-and-white receivers in so far as interstage coupling is concerned. Most common types of coupling are bifilar coils and/or single wound coils. For example, the circuit of Fig. 2 uses bifilar coils predominantly (T_{201}, T_{202}, T_{203}, and T_{204}), but two of the tuned circuits have single-wound coils (L_{108} and L_{201}). The interstage coils are stagger-tuned, ranging from a low frequency of 41.4 mc. to a high frequency of 45.5 mc. Also present are five shunt traps, three tuned to the sound i.f. signal of 41.25 mc., one to the video carrier frequency (39.75 mc.) of the adjacent higher channel, and one to the sound carrier frequency (47.25 mc.) of the adjacent lower channel.

A number of sets resort to complex coupling circuits in one or more i.f. stages in order to obtain the desired attenuation at certain trap frequencies, such as the adjacent-channel video carrier, adjacent-channel sound carrier, and the sound carrier of the channel being received.

In one *RCA* color receiver, a bridged-T circuit is inserted between the tuner and the first video i.f. amplifier. See Fig. 4. The network contains a trap tuned to the accompanying sound carrier, 41.25 mc. In order to reduce interference from this source (*i.e.*, cross modulation), the sound carrier is attenuated as soon as possible in the i.f. amplifier. (The signal is not removed completely, however, since enough must be available for the sound system. The latter ties into the video system at a subsequent point.)

A more elaborate bridged-T network, combined with an *m*-derived bandpass circuit, is employed between the first and second i.f. stages. This contains two rejection traps, one tuned to 39.75 mc. (video carrier of adjacent higher channel), the other tuned to 47.25 mc. (sound carrier of adjacent lower channel). A second such complex coupling network is found between the final i.f. stage and the video second detector. This, too, contains two traps, one for the accompanying sound carrier at 41.25 mc. and one for 47.25 mc.

It will be noted from Fig. 4 that the sound take-off occurs in the plate circuit of the final video i.f. amplifier. This does not necessarily denote a split-sound type of receiver, as mentioned earlier, but stems from a desire on the part of the set designer to avoid any interaction between the color subcarrier and the sound carrier that could produce (by mixing) a 920 kc. beat note. The sound carrier is permitted to travel with the video signal up to the plate of the final video i.f. amplifier and then it is diverted to a germanium crystal where it mixes with the video carrier to produce a 4.5 mc. signal. In the meantime, the monochrome and color subcarrier signals proceed to the video second detector for their demodulation. By this arrangement, the sound signal can be strongly attenuated in the video detector thereby minimizing the development of a 920 kc. beat signal.

Automatic gain control is applied to the first two or three video i.f. stages in the same manner, and for the same reason, that it is applied in monochrome receivers. The r.f. amplifier also receives all or a portion of the same a.g.c. voltage.

Sound Channel. As indicated previously, the sound signal is diverted from the video path in the plate circuit of the final video i.f. amplifier. This signal and a portion of the video carrier are then mixed in a germanium diode to produce the desired 4.5 mc. intercarrier sound signal. See Fig. 5. This is followed by several 4.5-mc. i.f. amplifiers and then the signal is applied to a ratio detector. Here the audio intelligence is recovered from the FM signal. Further amplification by audio voltage and power amplifiers raise the signal to the proper level for operating a loudspeaker. Just how extensive this portion of the audio system is will be governed by the price range of the receiver. If a high-fidelity system is desired, then the audio stages can be elaborated, perhaps by the addition of push-pull output, phase inversion, feedback net-

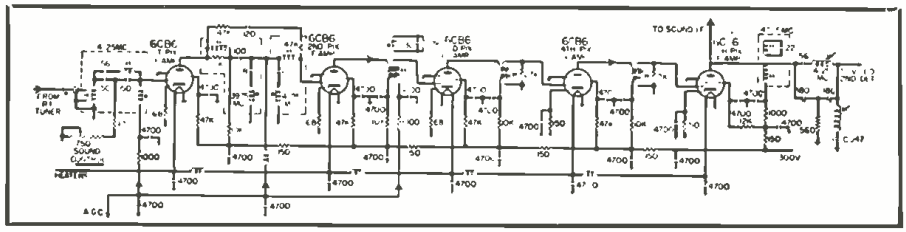
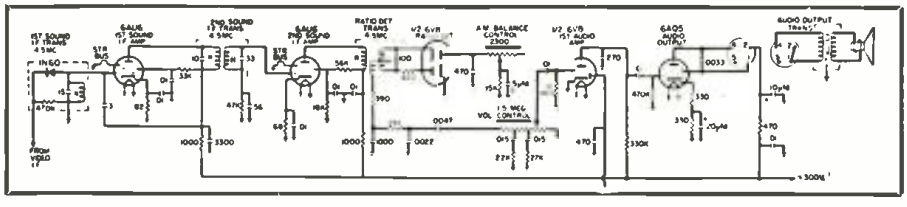


Fig. 4. Five stage video i.f. system employed by RCA in its color TV sets.

Fig. 5. Sound i.f. and audio circuits of a typical color television receiver.



works, etc. The system shown in Fig. 5 is commonly found in most TV receivers where economy and good sound is desired.

Luminance Channel. The video signal is demodulated in the video detector (Fig. 7), providing an output 0 to 4 mc. monochrome signal plus the *I* and *Q* color sidebands. (The color subcarrier, it will be remembered, was deleted at the transmitter.) The detector itself may be either a germanium diode (1N60 or its equivalent) or one section of a vacuum tube. There appears to be a definite swing toward the germanium crystal but vacuum tubes are still widely used.

Beyond the detector, both the monochrome and color sideband signals are applied to at least one stage of amplification before they are separated. In the circuit of Fig. 8, the output from the video second detector is applied first to the triode section of a 6U8, then to the pentode section. Both signals remain together only in the triode because at the grid of the pentode, a portion of the signal is fed to the bandpass amplifier, which is the input stage to the chrominance section of the receiver. Hence, separation of the monochrome and color signals might be said to occur at the output of the triode video amplifier.

The second video amplifier in Fig. 8 deals solely with the monochrome portion of the total color signal. This fact is further accentuated by the 3.58 mc. series trap which is present in the plate circuit of this stage. The trap attenuates any 3.58 mc. color subcarrier voltage which may be present here in order to prevent it from reaching the picture-tube screen and producing a visible interference pattern. The presence of the 3.58 mc. trap limits the response of the luminance or monochrome channel to a somewhat lower value, usually 3.0 or 3.2 mc. Since most present monochrome receivers operate within this bandwidth, both in their i.f. and video amplifier systems, any loss of detail will be no more apparent on color sets than on black-and-white sets.

At this point the reader may wonder why a special 3.58 mc. trap is required when, in fact, no 3.58 mc. color subcarrier is being sent with the signal. The answer rests in the fact that while it is true that at no time is there any voltage at precisely the 3.58 mc. frequency, the phase excursions of the color signal cause the carrier to move back and forth from frequencies above 3.58 mc. to frequencies below 3.58 mc.

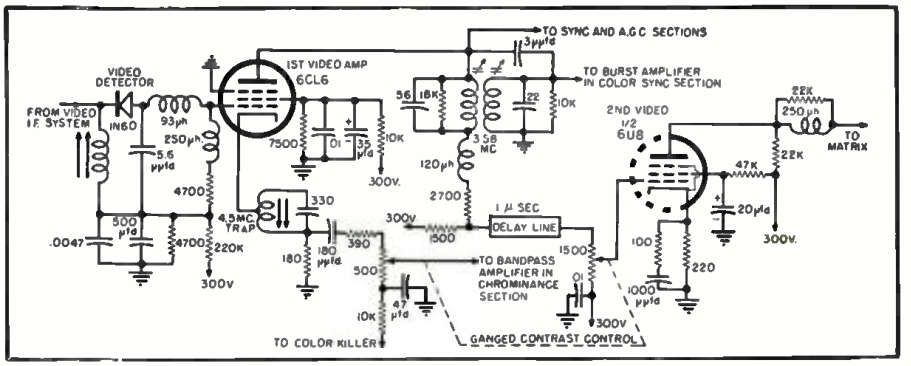


Fig. 6. Video amplifier circuit using two pentodes and a 3.58 mc. trap in the first video plate circuit for recovering the 3.58 mc. burst signal for color synchronizing.

Furthermore, most of the color energy is concentrated in the sidebands around the 3.58 mc. frequency and if we remove the bulk of this energy with a trap, we minimize any tendency of the color signal to produce interference patterns on the screen.

Another fact to note is this: The frequency of the color subcarrier (and hence, the frequency of its sidebands as well) was purposely chosen so that all this energy would fall midway between the clusters of energy of the monochrome signal. Any color signal reaching the screen of a monochrome receiver will tend to at least partially cancel itself out on successive frames so that its visibility is reduced. The same action occurs in a color set when the color signal reaches the screen *via* the luminance channel. Hence, the combination of the 3.58 mc. trap with the frequency interlace principle act to reduce the visibility of any interference pattern from this source to a considerable degree.

Returning to the circuit of Fig. 8, the luminance signal is finally applied to the matrix section where it combines with suitable *I* and *Q* signals to provide the original red, green, and blue voltages.

Two additional representative video amplifier systems are shown in Figs. 6 and 9. The circuit in Fig. 6 is taken from an *RCA* schematic and employs a 1N60 crystal diode as the video second detector. The output of this stage is fed to a 6CL6 video amplifier. Here both chroma and monochrome signals are amplified. The monochrome signal is then transferred to a second video amplifier and from this stage to the matrix network. The chroma signal is taken from the cathode circuit of the 1st video amplifier and transferred to the bandpass amplifier which stands at the head of the chrominance section.

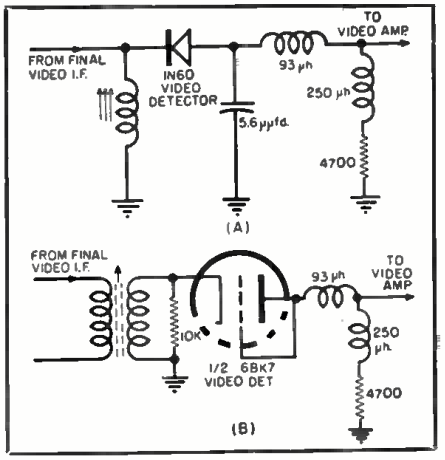


Fig. 7. Two types of video second detectors found in color TV sets. (A) Germanium diode: (B) triode vacuum tube with grid and plate connected to form a diode.

There are a number of things to note about Fig. 6. A 3.58 mc. resonant circuit in the plate circuit of the 1st video amplifier transfers the 3.58 mc. signal to a burst amplifier for use in the color sync section of the receiver. The same arrangement also attenuates the amount of 3.58 mc. voltage reaching the second video amplifier. The response of this latter amplifier extends to approximately 3.2 mc., enabling it to impose additional attenuation on the color subcarrier.

Connection to the sync and a.g.c. circuits is made at the plate of the 1st video amplifier. Also, a 1.0 microsecond delay line is inserted in the path of the luminance signal between the 1st and 2nd video amplifiers. The delay line is terminated in a 1500-ohm potentiometer which serves as a contrast

(*Continued on page* 128)

Fig. 8. Video amplifier circuit using a triode-pentode tube.

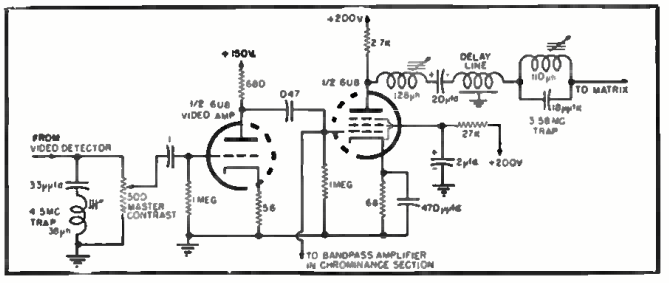
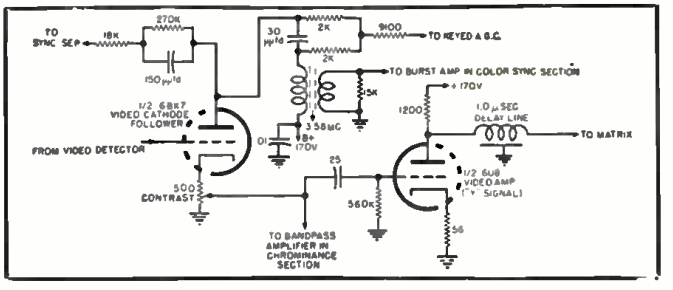
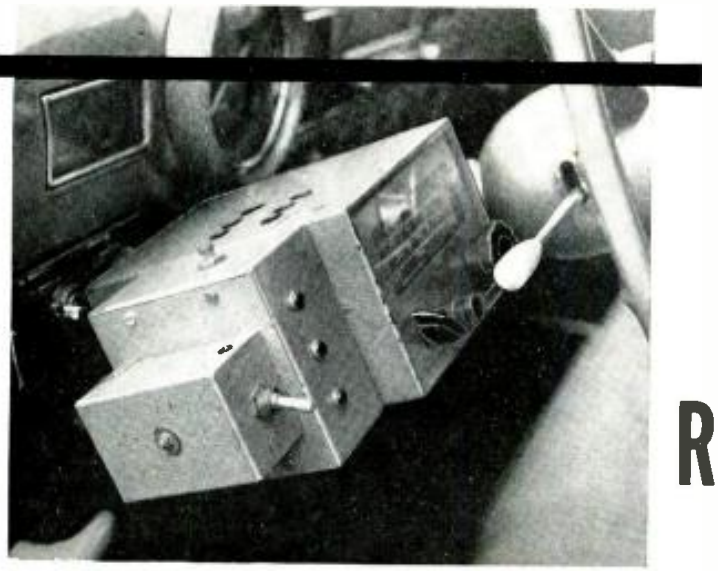


Fig. 9. Cathode follower video amplifier circuit for color TV.



BANDSWITCH YOUR LOADING COILS BY REMOTE CONTROL

By **LEON A. WORTMAN, W2LJU**



The bandswitching mechanism shown mounted on the whip antenna and the dashboard control box with the indicator lights. The entire system is extremely compact and easy to build.

Add a luxury touch to your mobile rig. This inexpensive control unit can be built and installed in a few hours.

"MAN, what luxury!"

That's what they say and that's how I feel when I put W2LJU/mobile on the air. The installation uses a bandswitching transmitter, bandswitching converter, and push-to-talk operation.

"So what? So lots of guys have bandswitching rigs and converters and push-to-talk."

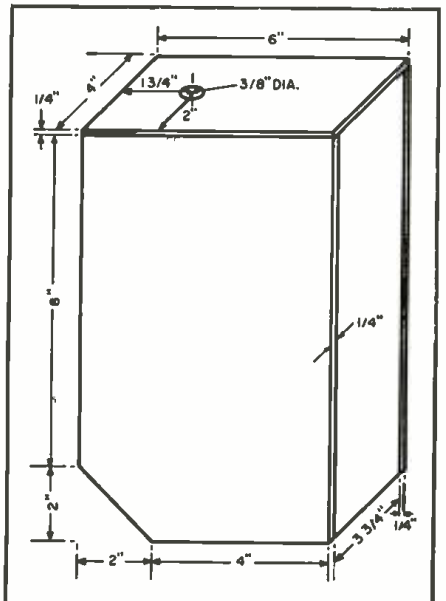
"So this," I say, "I also have bandswitching loading coils on the whip at the rear of the car and remote control for them at the dashboard! I never have to get out from behind the wheel when changing bands. And, what's more, I can change bands and retune in a matter of seconds . . . *while the car is in motion!*"

"Man, what luxury!"

It all came about because I am basically a very lazy fellow, I think. Anything I can devise which adds to convenience or minimizes the expenditure of effort, that's for me. I used to have to drive 45 miles each morning to get to my office in the country from my apartment in New York City. And, of course, I had to make a repeat trip each night in the return direction. Not knowing exactly what time I would get home to the city each night worked a bit of a hardship on the wife. When I would work into the city on my way home on 10-meters, one of the gang would telephone the wife to tell her I was on my way and would arrive in so much time. Some of the fellows even provided a phone patch and the wife was posted about my trip home by direct QSO from the apartment where she was waiting supper to the car speeding along the highway, *via* ham radio.

All well and good, but the fly in this delicious ointment was my penchant for passing the driving time by working the mobile on 75-meters for QSO's with the gang in the country, 20-meter mobile for DX at the half way mark of the drive which took me along the Hudson River with its wonderful conditions for working out, and 10-meter mobile for civilian defense, short skip, and city contacts. When you're highballing along the road and making good time, it's pretty annoying to have to stop the car to change bands. How nice it would be to just push a button instead of having to get up from behind the wheel with the tool kit in hand (maybe it's raining or snowing to add to the misery), unscrew the loading coil, screw in the next one, put the tools away, get back behind the wheel, tune up the rig, start the car, and continue along the way. This can become pretty exasperating, especially should the band drop out right after you've gone through this major operation. It could mean stopping and getting out and going through the whole horrible routine all over again.

After suffering that procedure for quite some unpleasant time and reacting to each necessary band change like most people do to changing a flat tire, I designed and built the unit shown in the accompanying photos and diagrams. It makes bandswitching from the driver's seat completely practicable. The device costs only about $12, exclusive of the loading coils which all multi-band mobiles have anyway. It can be constructed



1—4" x 6" pc. (top)
1—3½" x 10" pc. (back)
1—3½" x 8" pc. (front)
2—6" x 10" pcs. (sides)
All pieces cut from polystyrene or lucite stock, ¼" thick

Details of coil cover. Drill a ⅜" dia. hole in top piece, centered 1¾" from forward edge, 2" from side edges. Cut 2" corner wedges in side pieces as shown to avoid scraping against car body as the whip assembly swings while car is in motion. Parts are joined with liquid cement.

and put in operation in an afternoon's time.

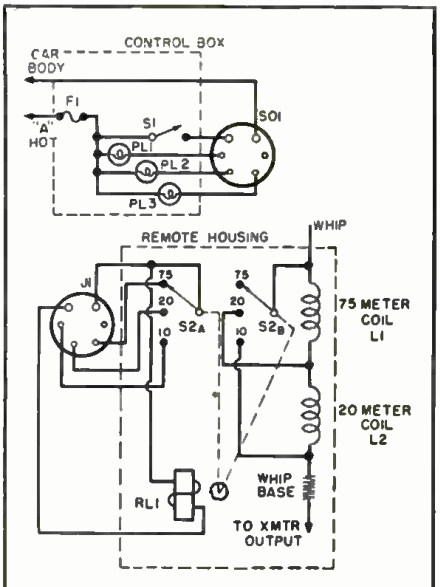
There are available from some of the radio parts houses and surplus outlets 6-volt, impulse-operated, ratchet-type rotary switches. These have shafts and long side bolts which fit standard ceramic switch wafers. Because we have never seen two mobiles exactly alike, each representing the likes and economies of the individual owner-operator, the type numbers of the parts used in W2LJU/mobile are unimportant here. The technique used in achieving the end result is the important thing and sufficient data is given here to guide you in your own construction of a similar unit.

We obtained four ceramic wafers to fit the 6-volt switch. They are of the 3-pole, 3-position, non-shorting type. The 3-pole, 3-position wafers were chosen because of their physical construction which enables continuous rotary action, resulting in the cycle of band selection repeating itself automatically at every fourth impulse. Three of the switch wafers are connected in parallel and used for the r.f. section, contacting the loading coils. The fourth wafer is used for the remote indicator section at the dashboard of the car. The remote indicator is an aluminum box (steel will do as well) 4"x4"x2". Located at the upper edge of the box, for convenience, is the bandswitching control for the loading coils. It is a spring return, push-to-make, single-circuit switch. This switch remotely actuates the 6-volt ratchet unit at the whip. A group of three pilot lights is mounted at the edge of the 4"x4"x2" control box which is most easily seen by the operator seated behind the wheel. These indicate which of the three bands the whip is loaded for. This technique of identification makes it quite impossible to have the *wrong* loading coil "in" for any band when the pilot lights indicate which is the *correct* one.

The setup, as we said earlier, at W2LJU/mobile was for 75, 20, and 10. No coil is necessary for 10, of course. Loading coils are required for the other two bands. Therefore, as seen in the photographs, the two loading coils are screwed together, the lower frequency, or 75-meter coil, at the top side. As shown in the schematic diagram, the 75- and 20-meter coils are in series when operating on 75. For 20-meter operation, the 75-meter coil is shorted out. For 10-meters, both coils are shorted out. The photos and diagram show the wiring technique used. The whole thing is simplicity itself and non-critical in setting up.

For weather protection, a housing was fabricated of ¼" thick sheets of clear plastic. Lighter weight and opaque plastics will probably do just as well and are less expensive. The housing is slipped over the coils and switching mechanism after they have been screwed into the whip mounting in the usual way. The housing is held securely in place by the pressure of the whip screwed down into the top coil. If your loading coils are of the high "Q" type, it may be necessary to trim them a turn or two to restore resonance to that portion of the band in which you intend to do your operating. Adjustments can be made to the coils by unscrewing the whip, lifting the plastic housing, and screwing the whip back onto the coils. The housing has no electrical effects on the coils and can be replaced on the coils when the final adjustments have been made.

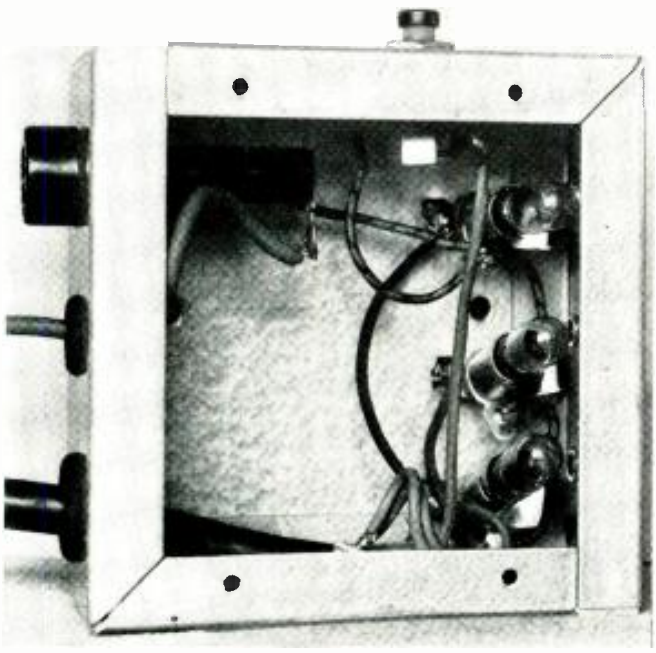
This specific setup has been in operation for over a year now in all sorts of weather from high summer heat to winter freezes, and spring rains. Except for taking the pictures for this story, the housing has not once been removed not even for maintenance. It has never failed to give us loyal and efficient service. Measurements with a diode type field strength meter show no measureable difference in power radiation between the conventional one-coil-at-a-time method and this remote control bandswitching arrangement. This device has been an identification for W2LJU/mobile and has aroused considerable interest among hams who have seen it. And every one says, "Man, what luxury!" —30—



F_1—10 amp. fuse
S_1—S.p. push-to-make, spring-return switch
S_2—3-pole, 3-pos. ceramic switch wafer (to fit RL_1 mechanism, see text)
RL_1—6 volt, d.c. rotary solenoid mechanism (see text)
PL_1, PL_2, PL_3—Pilot lamps, 6-8 volt operation
SO_1—6-prong female connector
J_1—6-prong male connector
L_1—75-meter loading coil
L_2—20-meter loading coil

Schematic and parts list covering the remote control for mobile loading coils.

The dashboard remote indicator housed in a 4" x 4" x 2" aluminum box. The panel lights show for which band whip is loaded.



Close-up view of the switching mechanism. Surplus parts are used and the entire construction costs less than 12 dollars.

A PHOTOTRANSISTORIZED PHOTOELECTRIC COUNTER

By
NATHAN O. SOKAL
and
RICHARD G. SEED

Construction details on a simple "on-off" unit to count interruptions in steady beam of light.

Fig. 1. External and internal views of the photoelectric counter. An X-25 phototransistor is the heart of the device.

ONE of the most fascinating members of the new transistor family is the phototransistor, a photosensitive device of amazing sensitivity with built-in transistor amplification. These units have recently become commercially available, and offer extremely interesting and varied possibilities to the electronic experimenter.

The authors will describe one of the gadgets they have made with this unit; the reader's ingenuity can easily extend these basic ideas to a host of similar projects. The device to be described is a portable phototransistorized photoelectric counter.*

The counter, shown in Figs. 1 and 2, is contained in the proverbial "black box." Fig. 2 is the circuit diagram.

The phototransistor is most easily understood by considering first the photodiode. The photodiode is a germanium crystal which behaves like an ordinary crystal diode, except that the back current depends on the amount of light falling on the sensitive region. The characteristic curves for a typical germanium photodiode are shown in Fig. 4. Note that the voltage and current are in the "back" direction—the direction of high resistance of the rectifier. In the phototransistor, the current of the photodiode is multiplied by transistor action inside the crystal. Fig. 5 illustrates a typical characteristic curve for a phototransistor, showing the increased current sensitivity.

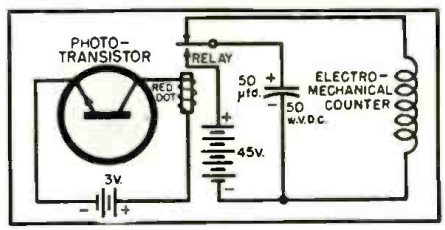
* Patent Pending. The commercial version of this device will be manufactured by Photocontrols Company, 20 Ware St., Cambridge 38, Mass.

Fig. 6 illustrates the optical system. The light source is a small incandescent lamp which has a mirror or a lens to collimate the light into a narrow beam—an ordinary narrow-beam flashlight will do. The collecting lens gathers light from the beam and focuses the light onto the sensitive area of the phototransistor, which is placed at the focal point of the lens.

The sensitive area of the phototransistor is only about 0.05 inch by 0.1 inch. Any off-axis displacement of the image greater than this amount puts the light spot off the sensitive area. Displacement of the light source also displaces the image. Thus the light source must be kept within a certain distance of the optical axis, or it will be ignored. This means that the phototransistor, in a properly-designed optical system, can give very good rejection of strong spurious light while accepting relatively weak light from the intended source. For example, the unit can easily be operated outdoors in bright sunlight by an ordinary flashlight twenty-five feet away.

To get a quantitative idea of this point, refer to Fig. 7. If θ is measured in radians (one radian equals 57.3 degrees) and F_L is the focal length of the lens, then the image displacement, d, is approximately $\theta \times F_L$. Since d cannot exceed about $\pm$ 0.05 inch, and if F_L is about 2.8 inches, then θ is about $\pm$ 0.04 radian, or about 2 degrees total. Thus the device sees only in a rectangular cone about 2 degrees tall and 1 degree wide. The sensitive cone can be widened, if desired, by defocusing the lens. In practice, imperfections of the lens do a certain amount of unavoidable defocusing, so that the angular discrimination of the device would probably be not quite as good as calculated, unless a good-quality lens were used.

Fig. 2. Schematic of photoelectric counter.



Circuit Operation

Referring to the circuit diagram of Fig. 2, the operation of the unit can be traced as follows: A steady beam of light shines on the phototransistor, causing enough current flow to keep the relay closed. When the beam is broken by the object to be counted, the current decreases, and the relay opens, discharging the charged condenser through the counter, advancing the counter one count. When the light beam is restored, the relay closes again and the condenser is again connected to the battery, thus recharging the condenser to be ready for the next count.

This method of counting by charge transfer *via* the condenser usually uses less battery power than the more conventional method of connecting the counter directly to the battery. This is because the beam interruption in most practical cases is much longer than the time required for the counter to operate. With the counter connected directly to the battery, current keeps flowing even after the counter has operated, for as long as the beam remains

interrupted. This drain on the battery *after* the counter has done its job represents wasted power. The condenser, however, delivers a measured amount of energy on every count, just enough to do the job, irrespective of how long the beam is interrupted.

If greater sensitivity is desired, a transistor amplifier can be added, as shown in Fig. 3. A CK722 transistor will extend the operating distance by about three times; a CK721 or 2N34 by about five or six times. Adjust the "dark-current balance" control until the relay contacts open with no light on the phototransistor.

If desired, a photodiode can be substituted for the phototransistor in the circuit of Fig. 3; the performance will then be about the same as that of a phototransistor without the extra transistor amplifier. Because of the variability in transistor characteristics, some CK722's may not work well in the circuit of Fig. 3; all CK721's and 2N34's should be satisfactory.

The phototransistor used in this device was an X-25, *n-p-n* grown-junction type, manufactured by *Transistor Products, Inc.*, Boston 35, Mass. The transistor amplifier shown in Fig. 3 used a CK721, *p-n-p* diffused-junction type, made by *Raytheon Manufacturing Co.*, Newton, Mass.

The collecting lens was a fifty-cent condensing lens 2 inches in diameter and 2.75 inches in focal length, available on the surplus market.

The relay was a 630 ohm, 5 milliwatt, *Advance* sensitive relay which happened to be available. A less expensive choice might be one of the sensitive relays now on the surplus market, having a resistance of several thousand ohms, and a sensitivity of about 20 milliwatts. The experimenter can make the relay more sensitive, if desired, by carefully decreasing the spring tension and the contact gap.

The only limitations on the choice of battery voltage and the relay are that the "light" current should close the relay, the "dark" current should let it open, and the voltage and dissipation on the phototransistor should not exceed 25 volts and 40 milliwatts respectively. If the reader wishes to calculate the proper values, he merely lays off a load line on the characteristic curve of Fig. 5, similar to the one illustrated there. One point of the line lies on the voltage axis at the battery voltage, E, and another point lies on the current axis at a current of E/R, where R is the relay coil resistance. The load line is a straight line connecting these two points, and the circuit operates at point A in the dark, and some point similar to B in the light, the exact point depending on how much light is available. The example shown in Fig. 5 is for a six-volt battery and a 1000 ohm relay.

The authors found that two flashlight cells in series were sufficient to power their unit.

The counter used was a 110 volt a.c. unit operated at 45 volts d.c. from a 50 μfd. condenser. A lower-voltage

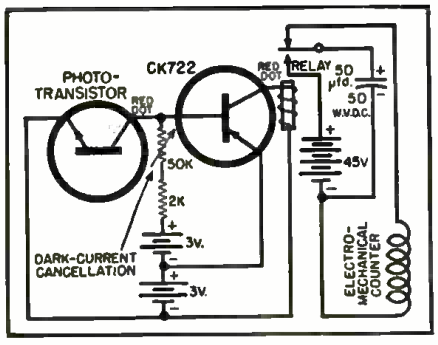


Fig. 3. Circuit of counter with transistor amplifier and dark-current cancellation.

counter would have the advantage that it could use the same battery that powers the transistor and relay. The proper value of capacitance is found by experiment. Use the value that turns over *all* counter wheels simultaneously, *e.g.*, going from 9999 to 0000.

Performance

Reliable operation can be obtained at distances of 25 feet with a flashlight as the light source. The device shows excellent rejection of ambient light, due to its high angular discrimination, and can be operated easily in bright sunlight. With a transistor amplifier, distances well over a hundred feet can be obtained from a flashlight source. The reader is encouraged to test the distance achievable with an automobile headlight but he is cautioned to be very careful when aiming the unit at large distances and keep in mind the tremendous directional sensitivity of the unit.

This photoelectric counter is easy to build and can be an interesting weekend project. It can also serve as an excellent introduction to the fast-growing field of transistors and photosensitive semi-conductor devices.

The authors wish to thank Vladimir Kenn of the *Photocontrols Company* for his help in developing the device.

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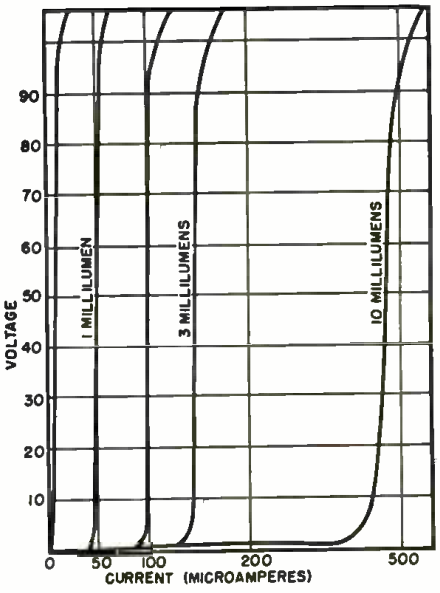

Fig. 4. Characteristics of a typical germanium photodiode. Compare with Fig. 5.

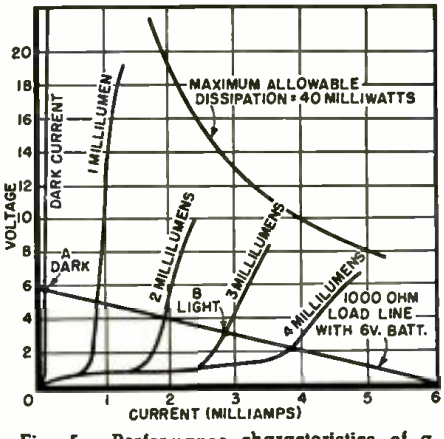

Fig. 5. Performance characteristics of a typical germanium phototransistor. See text.

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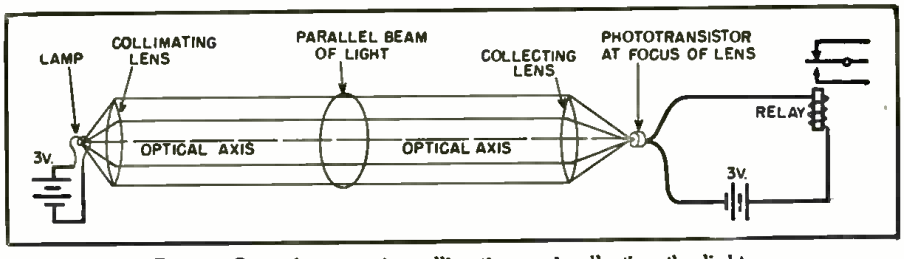
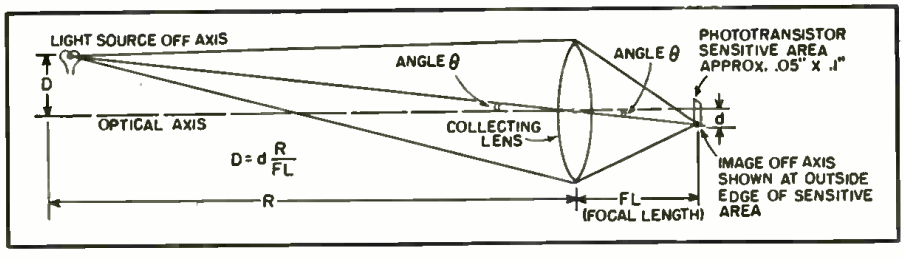


Fig. 6. Optical system for collimating and collecting the light.

Fig. 7. Optical system with an off-axis light source and image.



Comparison Methods for DETERMINING VOLTAGE STANDING-WAVE RATIOS

By

J. F. STERNER

Tube Dept., Radio Corporation of America

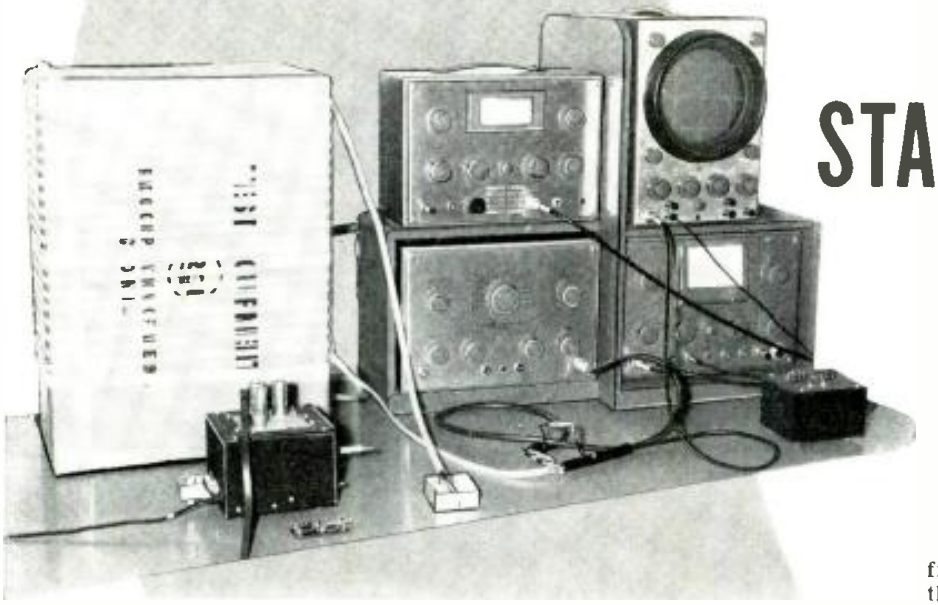


Fig. 1. Bench setup showing arrangement of transmission line for v.h.f. work.

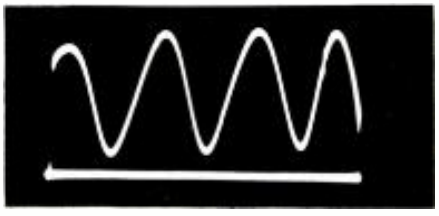
A simple method for matching a load to a transmission line or for determining if a load is correctly matched.

A COMBINATION of high-quality television test equipment such as a sweep generator, a high-gain oscilloscope, and a demodulator probe or detector provides a quick and accurate means for matching impedances, determining voltage standing-wave ratios, and measuring line attenuation. The technique described in this article is based on the observation and measurement of voltage standing-wave ratios to determine impedance matches. A good match between a component or circuit under test and a transmission line results in a v.s.w.r. approaching one. If the v.s.w.r. is not close to one, the circuit or component may be replaced by pure resistive loads having various values until the v.s.w.r. obtained with the original setup is duplicated; the impedance of the component or circuit may then be determined by direct measurement of the substitute resistive load.

The Comparison Method

The complete physical arrangement of a suitable combination of test equipment is shown in Fig. 3. The output cable of the *RCA* WR-59C sweep generator is coupled to one end (input end) of the transmission line. The sweep generator must have good linearity and a constant output voltage over its frequency range. The input of an *RCA* WG-291 demodulator probe or a simple detector is connected to the same end of the line. The output of the demodulator or detector is fed to the vertical input terminals of the *RCA* WO-56A oscilloscope. The scope used in this method must have good linearity and good sensitivity.

Fig. 2. Pattern produced by shorted line.



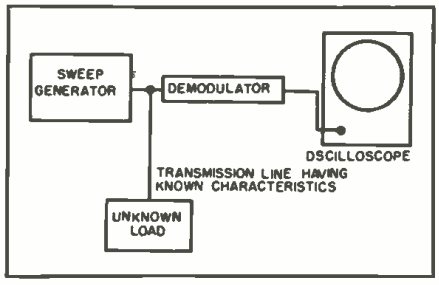


Fig. 3. Test equipment arrangement for determining impedance match by v.s.w.r.

If the impedance of the load and the characteristic impedance of the line are equal, the voltage which appears across the demodulator or detector is independent of the frequency.[1] In other words, if there is a perfect match between the load and the line, the voltage does not change as the generator sweeps through its frequency range.

When the load impedance differs from the characteristic impedance of the line, however, the voltage across the detector or demodulator varies with a change in frequency. The amplitude of this variation is a function of the reflected voltage.

If the line is shorted at the output end, highest impedance appears across the input end of the line at frequencies at which the length of the line is an odd number of quarter-wavelengths. At these frequencies, therefore, maximum voltage develops across the demodulator or detector. Lowest impedance and minimum voltage appear at frequencies at which the line is an even number of quarter-wavelengths. Fig. 2 shows a typical pattern which may be observed on the oscilloscope. The number of voltage peaks in the waveform is directly proportional to the frequency swing of the generator and the length of the line.

This shorted-line method may be used to measure reflected voltage over a wide range of frequencies, provided that the vertical-amplifier gain control of the oscilloscope is adjusted initially so that the peak-to-peak amplitude of the waveform is equal to ten divisions on the screen of the scope. If the cable is then terminated by a load, the vertical distance between the maximum and minimum peaks of the waveform represents the reflected voltage. For example, a waveform having an amplitude of one division represents a reflected voltage equal to ten per-cent of the incident voltage over the range of frequencies covered.

Attenuation in the line may also be measured, provided the sweep generator has blanking of the sweep oscillator so that a zero base line can be observed on the scope. If there are no losses in the line, the reflected wave equals the incident wave, and the voltage minimum is coincident with the

zero base line. The distance from the zero base line to the voltage minimum therefore provides a measure of the attenuation due to losses in the line. Care must be used in this method to prevent the existence of any large degree of reactance at the short itself. To make an effective short for 300-ohm line, it is convenient to strip back the line about one-half inch and twist the leads together. For coaxial lines, it is better to strip back the inner polyethylene insulation about one-quarter inch and short the outside braid directly to the inner conductor.

When measurements are made at v.h.f., the transmission line should be 75 to 100 feet long. 300-ohm line may be wound around a cardboard box, a packing carton, or any low-dielectric form. The spacing between the turns should be equal to or greater than the width of the line being used, as shown in Fig. 1. Coaxial cable may be placed in any convenient location without regard to spacing between turns.

For most applications in which the frequency is below 216 megacycles, the detector or demodulator used in the measurements may be an *RCA* WG-291 demodulator probe or a simple detector such as that shown in Fig. 5A. An alternate detector for balanced input is shown in Fig. 5B. Either of these detectors may be constructed on a phenolic board $\frac{1}{16}$-inch thick.

The entire test setup may be checked by the connection of a $\frac{1}{4}$-watt or $\frac{1}{2}$-watt carbon resistor, having the same value as the line impedance, directly across the termination or output end of the line. The line connection to the resistor leads must be made in the area directly adjacent to the body of the resistor. The pattern observed on the screen of the oscilloscope should be similar to that shown in Fig. 6. It may be necessary to try several resistors having the same nominal value as the line before a good match is obtained because of variations in the resistance values and in the characteristic impedance of the line due to manufacturers' tolerances. When a good match has been obtained, the characteristic impedance of the line may be determined by measurement of the resistor.

Use of Comparison Method

The application of this method to the determination of impedance matches can best be illustrated by an example. If it is desired to determine the match of a 300-ohm transmission line to a television tuner, the tuner is connected as the load in the arrangement shown in Fig. 3. In this case, because the effect of the match is limited to a bandwidth of 4.5 megacycles, a television calibrator such as the *RCA* WR-39C is used in conjunction with the sweep generator and the oscilloscope. The calibrator is loosely coupled to the input end of the line. See Fig. 7.

The sweep generator is set to the same frequency as the television tuner. Fig. 8 shows typical traces produced on the screen of the scope, representing a good match and a mismatch, respectively. The efficiency of the match may be determined from the standing-wave ratio, as follows:

$$Efficiency = (v.s.w.r. - 1)/(v.s.w.r. + 1)$$

where: $v.s.w.r. = E_2/E_1$

E_2 = peak of reflected wave

E_1 = valley of reflected wave

A similar arrangement may be used to determine the transformation ratio of a matching transformer. The primary of the transformer is connected as the load, and resistors are substituted across the secondary until a *v.s.w.r.* of unity is obtained.

This arrangement is also useful in the matching of a transmission line to an antenna. In the case of a two-element array, for example, the sweep generator and demodulator are connected to the same end of the line as the receiver or transmitter, and the antenna is connected as the load. A good match is obtained by adjustment of the spacing between the two elements of the antenna to give a *v.s.w.r.* as close to unity as possible. See Fig. 4.

The technique described in this article is simple, and the instruments are readily available. Accuracy of the method is within ten per-cent of that obtained using a slotted-line technique. The engineer or technician willing to spend the few minutes necessary to set up the equipment will find this method extremely useful.

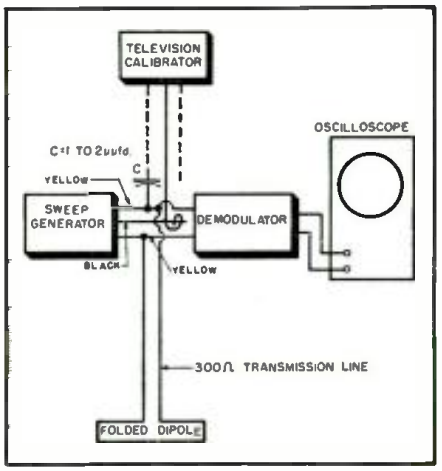


Fig. 4. Simplified block diagram shows the arrangement of test equipment for matching a transmission line to an antenna.

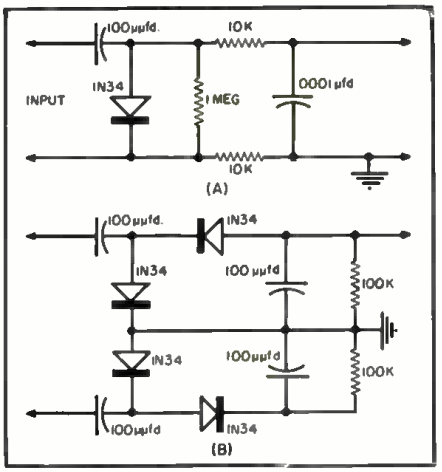


Fig. 5. (A) Detector circuit for use with test equipment shown in Fig. 1. (B) A detector circuit for a balanced input.

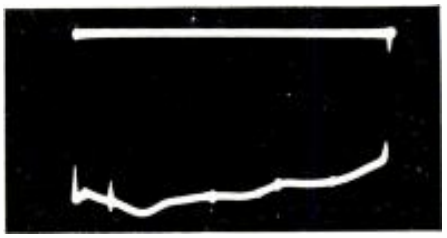


Fig. 6. Oscilloscope pattern produced by a 300-ohm line terminated by 330-ohm resistor.

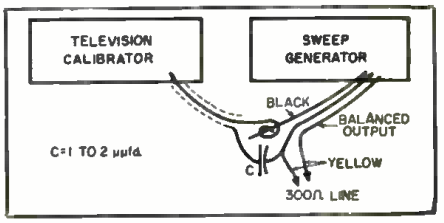


Fig. 7. How a television calibrator is coupled to the input end of transmission line.

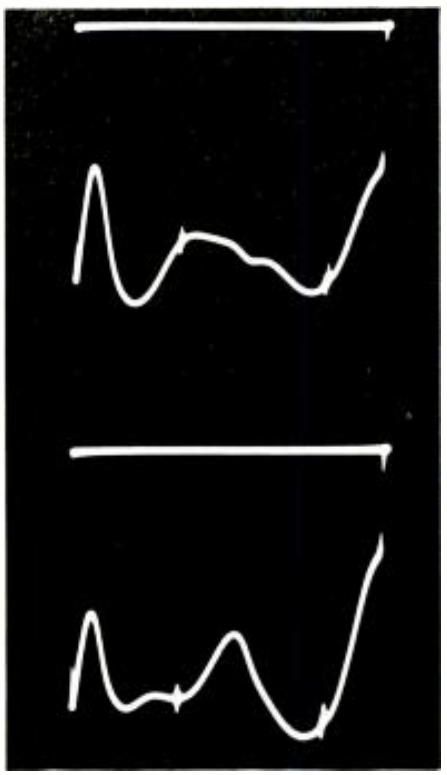


Fig. 8. Tube loading effect across the antenna circuit of a TV tuner. (Top) The tuner presents a good match to the antenna over the passband as indicated by the two marks. This is the condition with the filaments turned on and "B+" applied to the circuit. (Bottom) Trace with the power removed from the tuner and the reactive components of the tuner circuit less tube grid loading causing a mismatch. This shows that the input transformer is properly designed for the type of tube used in this circuit, i.e., the grid circuit applies a resistive component across the antenna transformer so as to effect a good match from the 300-ohm input to the tube.

REFERENCE

1. Bauer, John A.; "Special Applications of Ultra-High-Frequency Wide-Band Sweep Generators," *RCA Review*, Sept. 1947.

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ELIMINATION OF R.F. INTERFERENCE IN AUDIO SYSTEMS

By

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Part 1. A survey of the interference problem, eliminating r.f. at the source, shielding, and grounding procedures.

RADIO-FREQUENCY interference with electronic equipment is a problem as old as radio. The various broadcast and communications services may interfere with each other and, in turn, may suffer interference from household appliances and industrial equipment. As a result, a large body of literature has accumulated on this general subject, augmented by comparatively recent work done to reduce interference in and to television receivers. In this latter connection, there is an excellent summary of corrective measures for TV in a recent *Remington Rand* publication[1].

The present article discusses r.f. interference with audio equipment. This is a phase of the general problem which has received little attention in the literature, at least in this country, and which is becoming increasingly important with the rapid growth of the audio field. The gear subject to r.f. interference includes broadcast audio facilities, tape and disc recorders, motion picture sound systems, high-fidelity home music layouts, public address equipment, intercoms, and other installations operating in the audio spectrum. Some of the remedies listed herein are peculiar to audio systems; others include standard shielding and grounding practices and other general interference suppression techniques.

It should be noted that a well-designed and carefully installed professional plant, such as a recording or broadcast audio facility, should experience little trouble with r.f. interference from transmitters, even in the presence of strong radio frequency fields. However, not all installations approach the ideal, and not many non-professional audio devices, such as home tape recorders and music systems, are designed with "built-in" automatic interference protection. It is hoped these articles will be useful for affected gear in both categories.

The r.f. interference may be heard in the earphones or speaker as the actual transmission of a broadcast or communications transmitter, or as various noises such as clicks, pops, whines, "hash," etc. The familiar radio elements—radiation (and/or conduction), detection, and amplification—are present when this occurs. The fact that the audio gear may have no front end or tuner as such is, alas, no bar to the excellent reception of unwanted r.f.

Radio frequency energy is generated not only by transmitters, but also by motor and generator brushes, household light switches, relay contactors, heating appliance thermostats, and sometimes by the innocent-appearing lamp bulb. The arcs and sparks of some of these devices are essentially oscillatory discharges which create wavetrains of many frequencies. Other possible sources of r.f. noise include the older type of diathermy machines, induction furnaces, and r.f. test equipment. Microphone cables, phonograph cartridge leads, d.c. power supply wiring, and a.c. power lines act as antennas which pick up r.f. from the sources mentioned and re-radiate or conduct it to associated audio equipment. The a.c. lines may also conduct r.f. directly from source equipment to audio facilities. The tendency of various kinds of conductors to collect radio frequency energy is shown by the fact that it is possible, under certain critical conditions, for the long wires carrying the firing current for blasting caps to collect enough r.f. to detonate the cap and set off the explosive charge.[2] Getting back to audio, r.f. may also be picked up by inductive elements like amplifier input transformers. Somewhere in the system, rectification takes place in a nonlinear element. The demodulated energy is then amplified along with the wanted signal. There are two main ways of eliminating or reducing this trouble. One is to prevent it at the source—in other words, the prevention of radiation and/or conduction. The other way is to get rid of the interference after it arrives at the audio gear.

Elimination at Source

The first step, of course, is to identify the source of the interference. This may take some doing unless the offending agency is a broadcast station or other generator whose signal is recognizable. For pin-pointing other sources of r.f., the characteristics of the offending sound may offer clues. A whining noise which occasionally changes pitch suggests a motor or generator with speed varying under changing loads. "Hash" may be due to fluorescent lights or to small a.c./d.c. appliances like shavers or fans. Clicks and pops at irregular intervals may be caused by light and power switches. Other characteristics such as time of day, frequency of the interfering voltage, and rate of repetition may further narrow down the possibilities. In smaller buildings where this is practicable, all lighting and power circuits, except the a.c. feed to the audio gear, can be turned off and restored one by one until the noise reappears. The familiar tracing technique of using a receiver with an electrostatically shielded loop antenna as an exploring coil sometimes brings results.[3] So does a wavemeter and also an ingenious and easily-built neon bulb gadget called an "r.f. sniffer,"[4] in the presence of fairly strong fields. Having located the origin of the trouble, it may be possible to reduce or eliminate the difficulty by one or more of the following measures, which are standard "suppression-at-the-source" techniques used for r.f. protection of various types of electronic gear.

1. Supply a.c. power to the offending equipment through r.f. filters, or use bypass or feedthrough condensers. This prevents radio frequency energy from being carried away from the source equipment by the power lines which

may conduct it or re-radiate it to audio systems. Fig. 1 shows a filter of this type.

2. Induction heating furnaces and some r.f. test gear may require shielded rooms to prevent excessive radiation, even when properly operated and individually well shielded.

3. Keep the negative brush lead on d.c. motors as short as possible.[5]

4. Check with utility company on the possibility of insulators on nearby high-tension lines causing interference. Even if the insulator is not cracked, any roughness on its surface may cause breakdown of the air over that area and cause corona discharge. Low-voltage circuits from the same or adjacent poles may pick up the radiated disturbance and conduct or re-radiate it to audio gear in the building served.[5]

5. Check for "stuttering" thermostats or defective contacts in heating appliances, and chattering power relays that fail to close their contacts firmly.

6. Switches for lighting and power circuits can cause interference by their arcs. This is especially true of heavily inductive circuits. These may be suppressed by *RC* or *LC* filters.[6]

7. Connect condensers from motor and generator brushes to ground or frame, keeping condenser leads as short as possible to reduce radiation. Note that condensers so used may constitute a shock hazard on ungrounded devices. Safety considerations generally limit the size of the condenser to .1 μfd., and the degree of suppression obtainable by this means is therefore limited accordingly.[6, 7] The local electric code authority can be of help on this point.

8. Incandescent bulbs of the rough-service type, old style tungsten lamps with "W" filament[8], and even miniature panel pilot lights[9] may generate very annoying disturbances.

9. Neon bulbs used in oscillator circuits may cause r.f. interference.

10. Fluorescent lamps are a familiar source of trouble and can sometimes be suppressed by a small plug-in type filter inserted in the wall socket supplying the lamp. A typical unit of this type is the *Cornell-Dubilier* "Quietone" IF-6. In aggravated cases, chokes, condensers, or filters like the *Mallory* Z8A may be installed in the internal circuits of the lamp. It may also be helpful to move the ballast reactor closer to the lamp to shorten the internal wiring and thereby reduce radiation.[6] It should be noted that fluorescent lamp interference is often unpredictable. Not all lamps of an identical type will give trouble, and a particular unit may interfere at some times and not at others. It has been the writer's experience that fluorescent lights should not be used in broadcast and recording studios, although there are numerous installations in which they are used successfully.

11. Neon signs are potential causes of trouble if their high-voltage leads have poor connections and/or are not well shielded. All metal portions of the sign, the transformer housing, and the wiring shields should be bonded together and grounded.[6]

12. Mercury rectifier tubes can be silenced by condensers between the positive terminal and ground, and by r.f. chokes in the positive lead.

13. When the number of interfering sources and the number of affected audio installations warrants the cost, the use of the *Aerovox* type ANL37 interference analyzer may simplify selection of the proper type of filter for a.c. power lines.

14. In case of interference from the stepping relays of private automatic telephone exchanges, the telephone company should be asked to install filters.

15. For detailed data on locating and suppressing r.f. interference sources, the reader is referred to G. L. Stephens' excellent volume[6] from which some of the prevention-at-the-source material in this article was obtained.

Suppression at Audio Gear

While it is certainly desirable to eliminate interference at the source, there are numerous occasions when this is difficult or impossible, as for example, in the case of a broadcast transmitter. Remedies must therefore be applied to the affected audio equipment. These include treatment of audio and power lines, modification of circuits, substitution of special components, and most important of all, careful analysis of the shielding and grounding of the entire audio system. In this connection, it bears repeating that r.f. interference from transmitters should be no problem in a professional audio facility if it is carefully designed and installed in accordance with the best broadcast and/or recording standards. The following data includes design and installation precautions of good engineering practice as well as what might be called "brute-force" remedies. The distinction between the two approaches, and the applicability to non-professional equipment of the various measures described, should be obvious from the text.

Faced with an existing r.f. interference problem, the first thing to do is to find out what element in the system is acting as the antenna or the pickup

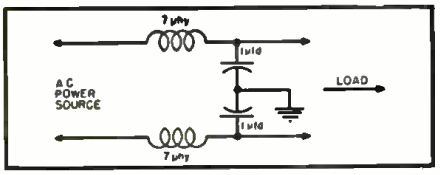
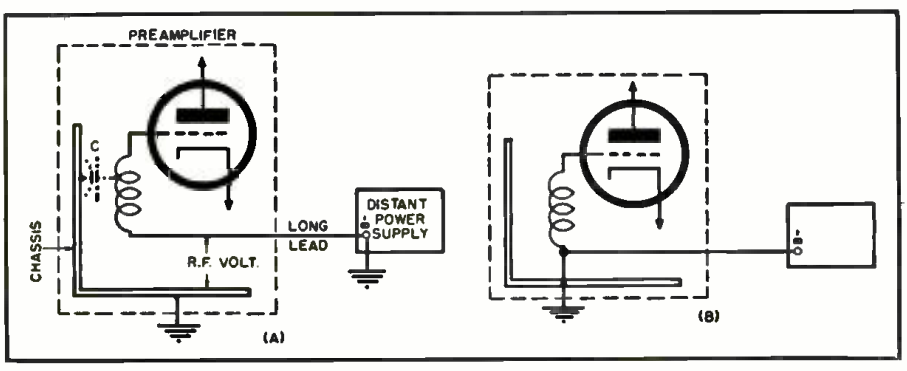


Fig. 1. Filter used to prevent high-frequency industrial equipment from feeding r.f. to a.c. supply line. May also be used in the a.c. leads of audio gear to keep out r.f. conducted along the power line. Inductance values refer to the Ohmite Z-20, 5 ampere power-line choke, in which two 7 μhy. windings are on a single ceramic core. Suppression range includes the b.c. band and extends upward to 15 or 20 mc. Whether condensers are to be on the line side or the load side of the chokes should be determined by trial. Circuit by Ohmite.

coil—the audio wiring, the power cables, or circuit components. An audio pair can be checked by determining whether the interference ceases when the pair is disconnected from its destination across which an equivalent load resistor has been shunted. Inductive elements acting as pickup coils—transformers, filters, and equalizers—can sometimes be located by circuit tracing with a crystal or diode probe feeding a high-gain amplifier. The r.f. pickup and rectification may occur in the same element, or each phenomenon may take place at a different point. In the latter case, the effective point of rectification will be farther along toward the system output. This point may be determined by applying the input of a test amplifier with a shielded audio probe successively to various circuit or chassis components and wiring joints, working back from the system output until the interference disappears. This procedure should be used with caution, to make sure the application of test leads to high impedance circuits does not of itself cause noise, hum, and other interference. Having determined the circuits and/or components involved, the measures described herein may be applied. These are grouped under the headings "Shielding and Grounding" (in this article), "Lines and Cables," "Amplifiers and Power Supplies," "Prevention of Rectification," and "Miscellaneous Remedies" (in Part 2).

(*Continued on page* 90)

Fig. 2. (A) The r.f. voltage appears between ground and long "B—" leads and is coupled to preamplifier proper through stray capacities such as C. (B) Remedy is to ground low side of input transformer secondary to preamplifier chassis and remove ground from power supply to prevent ground loop. Circuit from the book "Elements of Sound Recording" by Frayne and Wolfe, John Wiley & Sons.



By **BERT WHYTE**

THE preface to this column has been used as a sounding board by me, for many purposes. Quite often I let off steam about this or that subject which I feel is not in the best interests of music and high fidelity sound. Sometimes I damn and othertimes, I praise. In all of this I hope I have been at least entertaining and informative, and perhaps, even helpful. You know, help is a funny thing. Some people can't get enough of it, others resent the whole idea, still others cast a cynical and jaundiced eye towards anyone who presumes to offer help. Well, as I've said before, some people like vanilla and some like chocolate. Since the basic premise of this column is to *be* helpful, I'll try to meet this obligation to the best of my ability.

Recently I enjoyed a conducted tour of the *Pickering* magnetic cartridge plant in Oceanside, Long Island. It was a most interesting experience to say the least. I was amazed at the amount of precision work that goes into the manufacture of a magnetic pickup. As is common in most electronic manufacturing plants, most of the delicate work is performed by women. The dexterity of some of these women was fascinating to watch as they wound minute coils, or positioned styli. My reason for mentioning this visit, is because of something I learned which may be helpful to those of you who happen to use *Pickering* cartridges. It seems that there has been a change in the output voltage in recent models of the 120 and 140 series pickups. A little over a year ago, it was found that the 70 millivolt output of the original model cartridge would cause some distortion when used with some of the newer models of front-ends and preamps. This is due to the fact that the phono channels on these units have a gain of over 48 db. To correct for this, the output of the 120 and 140 series cartridges was dropped to 50 millivolts. The output of the new 260 turnover unit is 30 millivolts and presents no problems. So, if you are the owner of a late model preamp and an "older" *Pickering* cartridge, try putting a resistance across the terminals and see if it sounds any different to you. It is certainly not a serious problem, and one which is easily solved. I shall try to find out the serial number which ended the use of the higher output coil in the pickups, and pass it on to you.

STRAVINSKY
LE SACRE DU PRINTEMPS
Minneapolis Symphony Orchestra conducted by Antal Dorati. Mercury "Olympian" MG50030, AES curve. Price $5.95.

I'm going to make some pretty strong statements in this review, so I'd like a few things understood. (A) I do not own any stock in *Mercury Records*. (B) I am not married to the daughter of the chief recording engineer, nor am I a cousin of Antal Dorati. (C) I am under no compulsion or duress and the material contained herein is the product of my own free will.

Having thus unburdened myself, I can proceed with the business at hand. To wit: I think this is the greatest recording since the invention of the phonograph! Yes, you heard me right! Of all the countless thousands of recordings I have heard, this is positively the last word. Let us examine this marvel and see wherein lies its greatness.

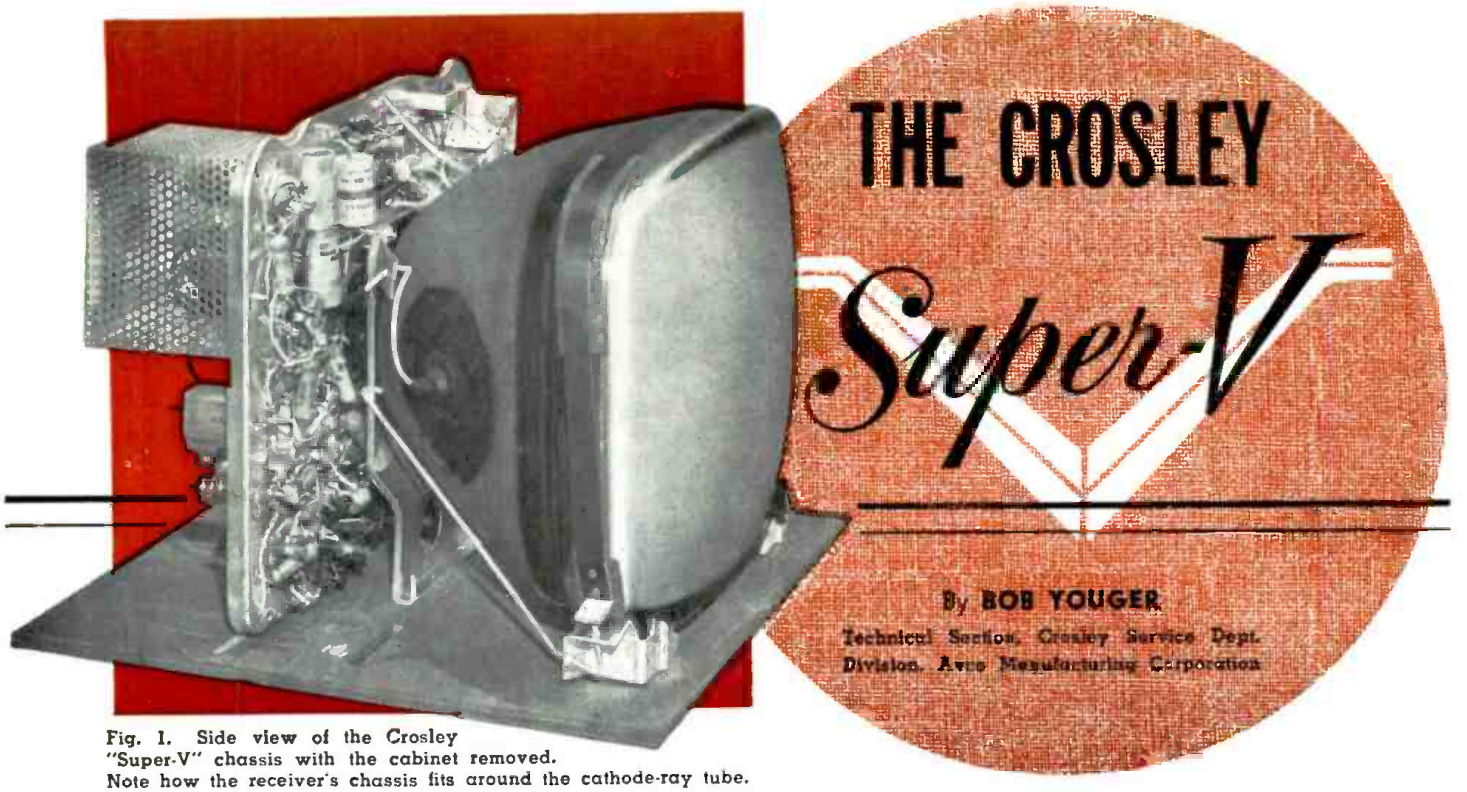
It would be difficult to single out one particular element as the significant contribution to its superiority. Any "favorite" or "best" recording is, of course, a reflection of an individual's taste in repertoire, conductors, and performance, and the technical qualifications. It also goes without saying that "one man's meat is another man's poison." Even when a majority of so-called "experts" agree that such and such a recording is the "best," there will be legions of dissenters for one or another reasons. A person can be told about a certain Beethoven 5th, that has the finest performance and sound. But if that person doesn't like the Beethoven 5th, what cares he for the recording's other qualities? Or this person may love the Beethoven 5th, but can't stand this particular performance or sound. And so *ad infinitum*. The ideal of course, is a magical amalgam of all three pre-requisites. As far as I am concerned this recording comes closest to realizing this ideal. I freely admit I'm prejudiced in favor of the work itself. I've been fascinated and thrilled with this controversial score ever since I heard it in Europe many years ago. What there is about the music that is so compelling is hard to put your finger on. Sure, it is programmatic. But its "primitiveness" stems more from the music itself than from the program ascribed to it. Indeed, with the advent of Disney's "Fantasia" we were shown an entirely new programmatic concept of the score. This is provocative music and it has its private meanings in everyone's private little world. In matters of performance, this version is almost totally different in concept than the other available recordings. Mr. Dorati has realized a particular ambition with this recording, having "pointed" towards conducting "Le Sacre" ever since he was signed for the *Mercury* "Olympian Series." To this end, he has programmed "Le Sacre" as part of the regular concert repertoire of the Minneapolis Symphony, for the past several years. All this careful planning and enthusiastic anticipation has resulted in a performance which is absolutely overwhelming in its impact. In a score which is notable in itself for the generation of excitement, this reading is a blood-tingling, nerve-shattering experience.

Throughout the work, Dorati emphasizes the rhythmic elements which is as it should be. From the Introduction to the "Dances of the Adolescents," and on through the "Game of Abduction" and "Spring Rounds," Dorati drives his men at an almost frenetic tempo. But for all this headlong pace and blazing intensity, the score remains completely articulate. There is no blur or fusion of important polytonalities or polyrhythms. The remainder of the reading from the "Pagan Night" to the final "Sacrificial Dance" is unbelievable. Dorati and his orchestra give an absolutely stunning display of virtuosity. The incredibly difficult polyrhythms of the "Sacrificial Dance" are negotiated without a single "flurp"! From a comparative viewpoint, Dorati's reading is most closely paralleled by that of Stravinsky himself. Strangely, the authenticity usually ascribed to composer-conducted readings, is not fully realized in the Stravinsky recording. Dorati has taken one further step in the direction of rhythm and balance which makes his reading altogether unique.

Now for the all important question of sound: Nothing in my entire experience with recorded music has ever impressed me so much. This is the cleanest, most distortion-free, most beautifully balanced sound in phonographic history! From every possible aspect, this recording wins hands down. Dynamic range? Unbelievably wide. Frequency response? Only the most advanced equipment will do it full justice. You will hear sounds in this recording, you probably thought were impossible to engrave on a disc. Stratospheric, piercing piccolos and flutes.

(*Continued on page* 121)

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.



THE CROSLEY Super-V

By BOB YOUGER
Technical Section, Crosley Service Dept.
Division, Avco Manufacturing Corporation

Fig. 1. Side view of the Crosley "Super-V" chassis with the cabinet removed. Note how the receiver's chassis fits around the cathode-ray tube.

First complete service article on the new Crosley "Super-V" 15-tube TV set with a vertical chassis.

THE *Crosley* "Super-V" represents a completely new design in small, compact television receivers which compares in sensitivity and performance to the larger models. This article will discuss the changes, problems, and features of the "Super-V" chassis which are of interest and importance to the service technician.

A full complement of circuits are used in the "Super-V" receiver. Although only 15 tubes are used, six of them are double tubes and one is a multipurpose tube; thus, this chassis is equivalent circuit-wise to a receiver using 23 single tubes. The sensitivity of the "Super-V" is high, eliminating nuisance calls and performance problems inherent in any receiver designed with a limited sensitivity.

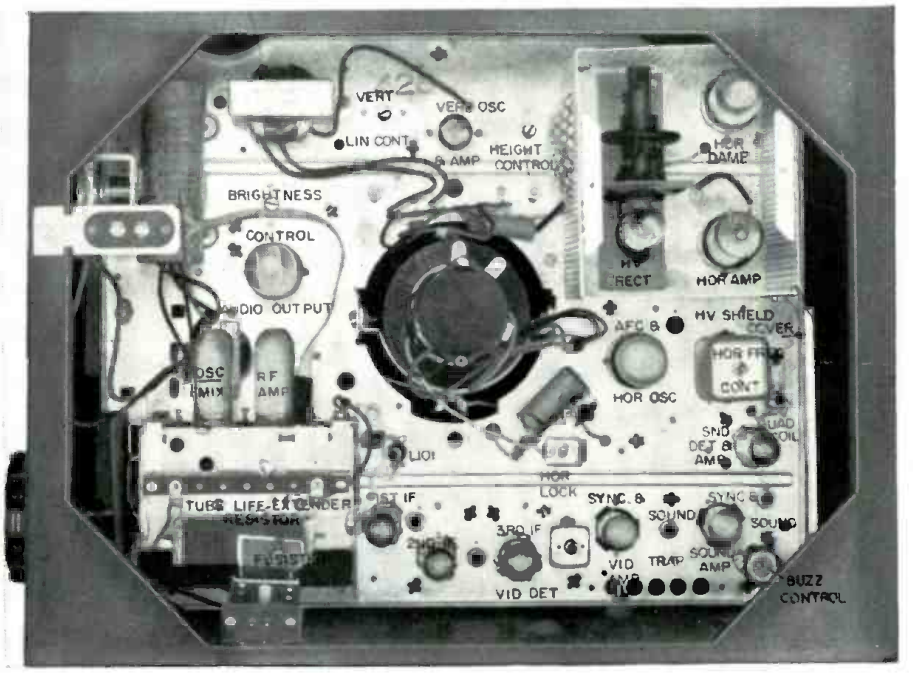
One of the most striking differences in the "Super-V" from the service standpoint is the mechanical changes brought about by the radically new vertical chassis design. The chassis slips over the neck of the picture tube, much like a deflection yoke or focus coil, as shown in Fig. 1. A large circular opening in the center of the chassis provides adequate clearance for the neck of the picture tube, and permits the chassis to be mounted in a position in front of the deflection yoke in a plane parallel to the face of the picture tube. The tube sockets and circuit components are mounted on the chassis in the area surrounding the circular opening. This arrangement permits a small, compact design without crowding the components or eliminating essential circuitry. The chassis and picture tube are independently mounted on the wood baseboard, which is also used as the bottom of the cabinet.

The tuning, volume-on-off, contrast, horizontal hold, and vertical hold controls are located on the side of the cabinet. The brightness, vertical linearity, and vertical size controls are inside, on the chassis, as shown in Fig. 2.

The chassis layout in the "Super-V" is ideal from the tube-changing standpoint. All tubes are on the back side of the chassis and are readily accessible by removing the back of the cabinet. It is possible to see right down into the tube-socket pin holes. *Note:* Turn off the set before removing any of the tubes.

The cabinet is designed to fit over the chassis and tube assembly like a bonnet, as shown in Fig. 6. It is held

Fig. 2. Rear view of the "Super-V" chassis with the back of the cabinet and the high-voltage cage cover removed. Note accessibility of tubes and adjustments.



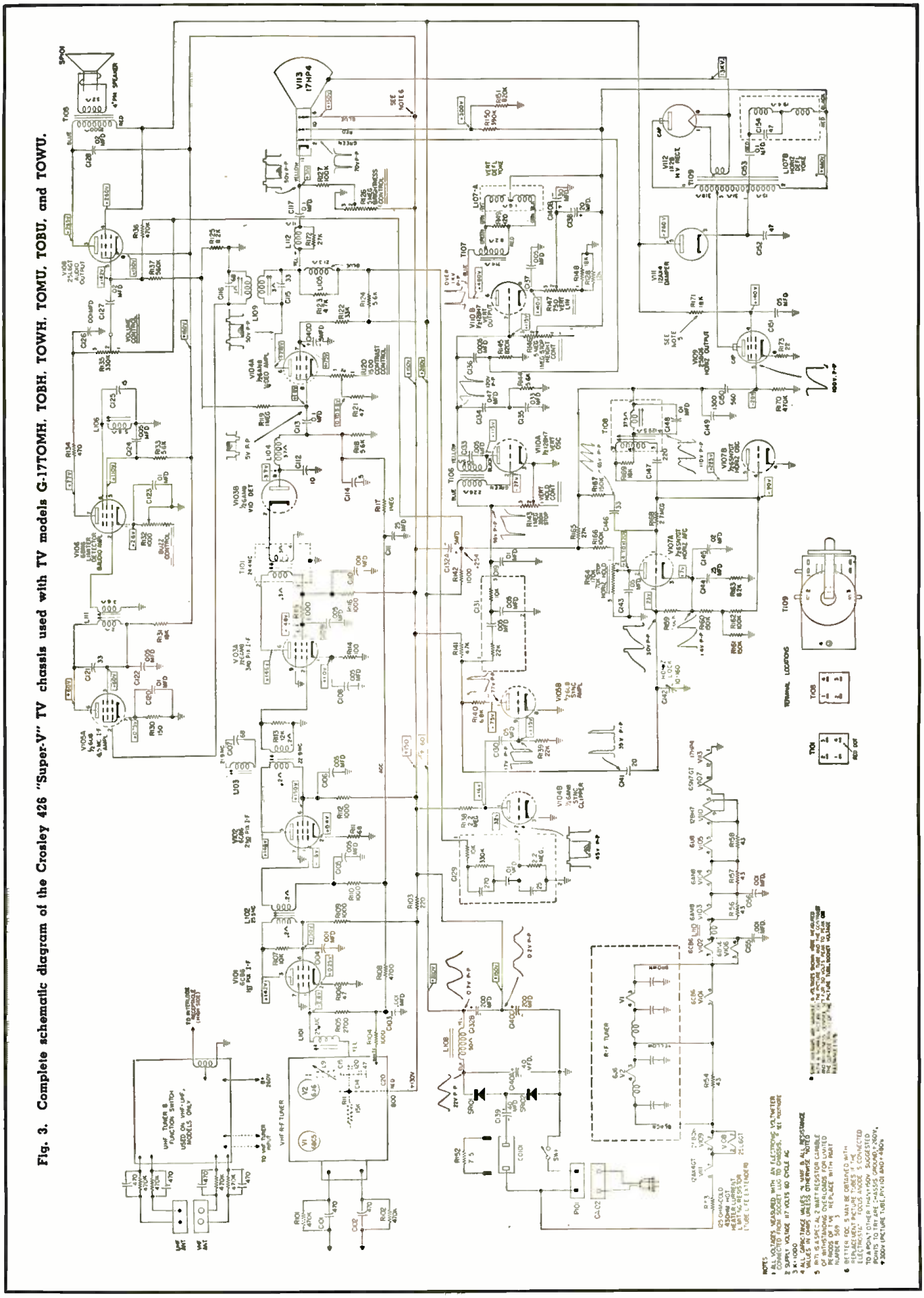


Fig. 3. Complete schematic diagram of the Crosley 426 "Super-V" TV chassis used with TV models G-17TOMH, TOBH, TOWH, TOMU, TOBU, and TOWU.

to the chassis mounting board with four 5/16" hex head machine bolts which extend up through the bottom, two on each side, and three wood screws. One of the wood screws is located in the bottom front, the other two are in the rear corner blocks. To remove the cabinet, take off the back and antenna terminal board, remove or disconnect the speaker, and take out the mounting screws. The lightweight cabinet is easy to handle and, once it is removed, most of the circuit components and the circuitry are exposed to view

"B+" and Heater Circuits

The block diagram of the "B+" and heater circuitry used in the "Super-V" chassis is shown in Fig. 4. A good general working knowledge of this block diagram is very important to any television service technician in tracking down symptoms and locating troubles in the "B+" and heater circuits. Starting with the a.c. power plug, note that one side of the a.c. line passes through the interlock connector and through the "on-off" switch directly to the chassis, which is used for the common electrical ground. This makes the chassis "hot." Since, in most cases, one side of the power line is grounded, the chassis will be either at ground potential or 117-volts a.c. above ground, depending on which way the power plug is inserted into the a.c. outlet. To eliminate the shock hazard associated with this arrangement, take care when working on the chassis to

Table 1. Alignment procedure for the video i.f. and sound circuits of the Crosley 426 "Super-V" TV chassis.

VIDEO I. F. ALIGNMENT

STEP	SIGNAL GENERATOR FREQUENCY	SIGNAL GENERATOR CONNECT TO	OUTPUT INDICATOR	CONNECT TO	ADJUST	REMARKS
1	24.4 mc.	Test point 2 on tuner through a .01-μfd. condenser	V.T.V.M.	Junction of R_{118} and C_{117}	T_{101} for maximum	Limit generator output to give less than —2 volt reading Put —3 v. on a.g.c.
2	22.9 mc.	Same as above	Same as above	Same as above	L_{103} (rear slug) for maximum	Use first peak from Tinnerman-clip end of coil
3	21.9 mc.	Same as above	Same as above	Same as above	L_{103} (front slug) for minimum	Use first null from coil form end. Adjust input level to give at least .5-volt null
4	Repeat steps 2 and 3					
5	25.5 mc.	Same as above	Same as above	Same as above	L_{102} for maximum	
6	25.1 mc.	Same as above	Same as above	Same as above	L_{101} (front slug) for maximum	Use first peak from Tinnerman-clip end of coil
7	27.9 mc.	Same as above	Same as above	Same as above	L_{101} (rear slug) for minimum	Use first null from coil form end. Disregard this step if 27.9 mc. trap has not been added
8	25.1 mc.	Test point 1 on tuner	Same as above	Same as above	L_9 (brass screw) for maximum	Connect a 100-ohm resistor in series with a 1000-μμfd. condenser across L_{101}
9	25 mc. center frequency 10 mc. sweep	Raised tube shield of V_2 (6J6) and chassis	Oscilloscope	High side of R_{120} contrast control and chassis	All i.f. slugs for curve below: 	Set contrast control at minimum

This step is not required in the alignment procedure but is useful as an over-all i.f. check.

SOUND ALIGNMENT

10	4.5 mc. 400 cps amplitude modulated (30% or greater)	Pin 8 of V_{104}	Oscilloscope	Pin 11 of CRT through detector probe	L_{109} (rear slug) for minimum	Set tuner to unused channel
11	Tune in local TV station				L_{106} for maximum sound output	Set "buzz control" (R_{132}) one-quarter turn from clockwise stop
12					L_{111} and L_{109} (front slug) for maximum sound output	If signal in area is too strong to obtain peaks, remove antenna temporarily
13					"Buzz control," R_{132}, for minimum noise & L_{106} for maximum sound	Signal must be weak to allow noise (hash) to come through

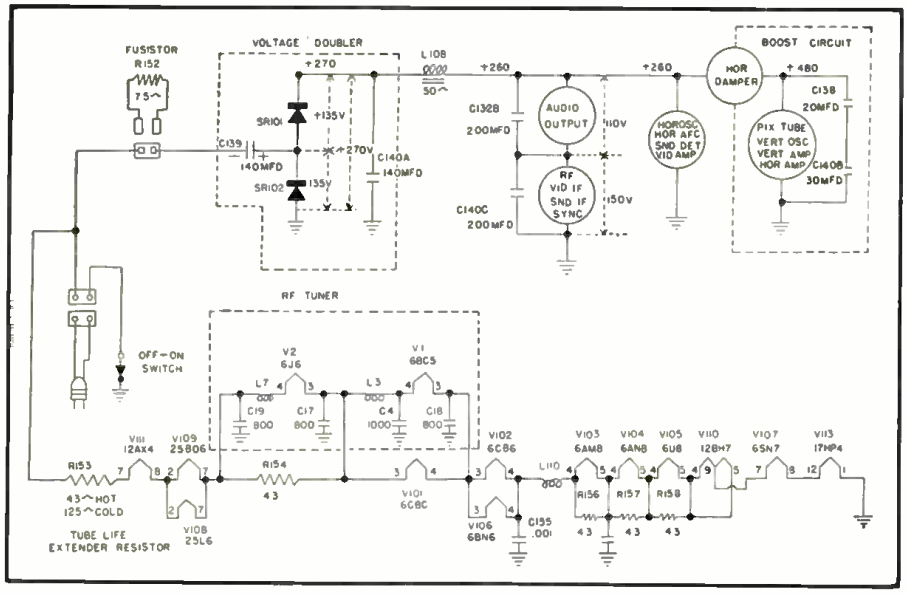


Fig. 4. Block diagram of the "B+" and heater circuits of the "Super-V" chassis.

keep clear of any externally grounded conductors such as antenna leads, water pipes, ground test leads, and other TV chassis.

The other side of the a.c. line passes through the interlock and branches out into two circuits. One goes through the "fusistor" to the half-wave voltage doubler rectifier circuit. The "fusistor" is used as both a fuse, which opens on a direct short or overload, and current-limiting resistor, which limits the maximum current which can flow through the input condenser, C_{139}, during the initial charging period, *i.e.*, when the set is first turned on. This protects both the condensers and selenium rectifiers. The bottom rectifier, SR_{102}, conducts on the negative peak of the a.c. input and develops +135 volts across its terminals. (The amplitude of the rectified voltage is dependent on the "B+" load and is less than the input peak voltage, in this case, 1.41 x 117 volts or 165 volts.) On the positive peak, the top rectifier, SR_{101}, conducts and develops an output of +135 volts. Since the two voltages are in series across the output condenser, C_{140A}, they add to produce a total of approximately 270 volts for the "B+" supply.

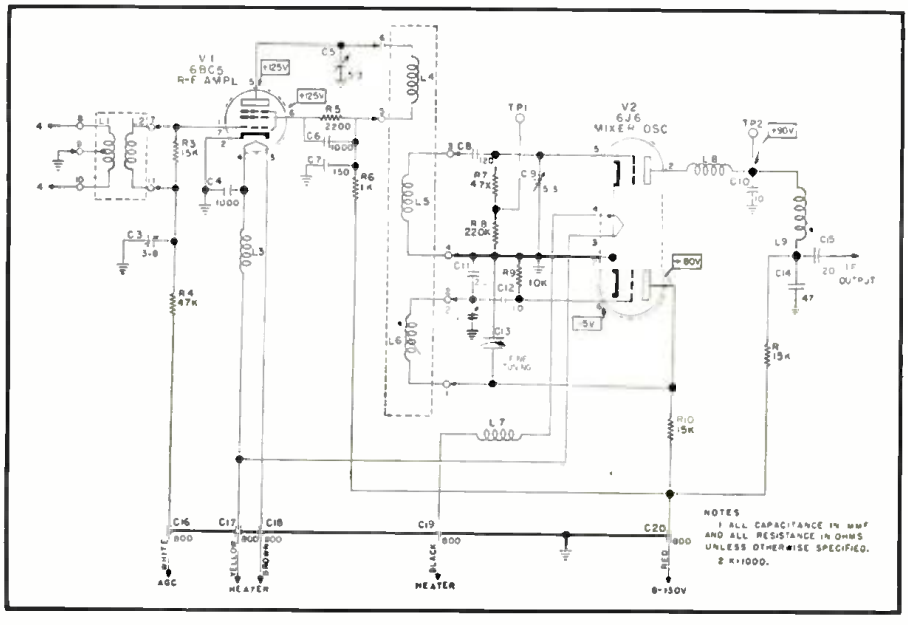
The output from the doubler circuit is passed through the filter, choke L_{108} and condensers C_{132B} and C_{140C}, which eliminates most of the hum component. The +260-volt supply provides the basic power requirements for all the "B+" circuits in the receiver. Some tubes such as the sound detector, video amplifier, horizontal oscillator, and a.f.c. are operated directly off the +260-volt "B+". However, the tubes in the r.f., i.f., and sync circuits must be operated on a lower voltage and are, therefore, connected (in a parallel string) in series with the audio output tube across the +260-volt "B+" circuit. In normal operation, the 25L6 output tube is self-biased to a point which places approximately +150 volts at its cathode. This is the "B+" voltage required by the other tubes. The a.c. coupling and interaction between the circuits is kept to a minimum by using the two 200-μfd. bypass filter condensers, C_{132B} and C_{140C}.

The horizontal and vertical amplifiers, requiring a higher voltage than the 260 volts available from the "B+" supply, obtain 480 volts from the "B+" boost circuit, as in most conventional receivers.

The other lead from the a.c. line is connected through the "tube life extender" resistor R_{153}, to the high side of the heaters which are, in turn, connected in a combination series-parallel circuit, as shown in Fig. 4. The "tube life extender" resistor limits the amount of current flowing in the heater circuit when the set is turned on. The current-limiting resistor is needed because the resistance of the tube heaters is much less when cold than when hot. The high resistance of the current-limiting resistor when it is cold is sufficient to limit the amount of heater current which can flow when the set is first turned on, thus effectively eliminating the high-current surges which would otherwise shorten the life of the tube heaters.

Tubes in the receiver should not be pulled out while the set is turned on. A glance at the heater circuit will show that some of the tube heaters are shunted by either a resistor or another tube. Therefore, should one of the parallel tubes such as V_{106}, V_1, or V_{102} be pulled out while the set is on, the tube that is left is forced to carry the entire load, placing an excessive strain on its heater. Should V_2, V_{103}, V_{104}, or V_{105} be removed while the set is turned on, it will result in an excessive amount of current being forced through the associated shunt resistor, which may cause it to change value or otherwise destroy its usefulness. (*Note:* In later production receivers, the three 43-ohm resistors have been replaced by one 126-ohm, 10-watt resistor.)

Fig. 5. Schematic diagram of the v.h.f. turret tuner using a pentode r.f. amplifier. The test points indicated are used in the alignment procedure of Table 1.



Tuners

The "Super-V" employs a *Standard Coil* turret tuner with a pentode r.f. amplifier. (See Fig. 5.) It can be field converted to receive u.h.f. by replacing unused v.h.f. strips with u.h.f. strips. This chassis is also available with a factory installed continuous-coverage u.h.f. tuner, shown in Fig. 7, which converts u.h.f. signals to channel 5 or 6. The u.h.f. tuner is also available with a complete set of instructions for field conversion, and is recommended for fringe-area reception or wherever full channel coverage is desired.

The u.h.f. tuner employs the same double-conversion system used in previous models. It is, however, a new design and employs several interesting features. New pin-type u.h.f. an-

tenna connections are used because it was found that during the development and field testing of the u.h.f. tuner, conventional screw-type antenna terminals in a 300-ohm balanced line represented a considerable discontinuity which resulted in a poor voltage standing-wave ratio. The conventional screw terminals are satisfactory for v.h.f. reception.

The oscillator in the converter operates approximately 82.5 mc. below the u.h.f. channel frequency to which it is tuned, producing an 82.5-mc. i.f. signal. This is picked up on the "Super-V" by setting the v.h.f. tuner on either channel 5 or 6.

The u.h.f. variable tuning unit is composed of three silver-plated, semicircular rings which act as one-quarter wave tuned lines; two for the r.f. preselector, one for the oscillator. The end inductors L_1, L_2, and L_6 (see Fig. 7), are formed by making a loop in the connecting lead on condensers C_1, C_2, and C_{16}, respectively. The converter is aligned on the high end of the band by adjusting the size and shape of these loops. The preselector is aligned on the low end by adjusting condensers C_4 and C_5. The oscillator is aligned on the low end by varying C_{15}.

A 6T4 u.h.f. oscillator triode is used in a modified Colpitts grounded-plate circuit. The output of the oscillator is inductively coupled to the mixer circuit by means of the loop formed in the lead which passes through the hole in the oscillator shield and connects the oscillator grid, pin 6, to the .1 $\mu\mu$fd. blocking condenser, C_{17}. Moving this loop toward C_5 increases the oscillator-to-mixer coupling, and moving it away decreases it.

There is, in some cases, an appreciable variation in the amount of crystal capacity between crystals of the same type. For this reason, it is usually best when replacing the 1N82 crystal to try three or more different ones. Particular care should be exercised to make sure the crystal contacts are clean and that they make good contact in the socket clips. For best results, the crystal current should not fall below 0.4 milliampere, or exceed 5 milliamperes at any point in the tuning range as measured at the test point (T.P.).

The i.f. signal developed in the crystal mixer circuit is amplified in the 6BK7A cascode amplifier before it is coupled through the function switch, SW_1, to the v.h.f. tuner input. The double-tuned broadband i.f. input transformer (T_1) is aligned at the center frequency of 82.5 mc. The function switch (SW_1) is used both to switch the antenna connections and to control the "B+" to the u.h.f. converter.

To facilitate the construction and testing of u.h.f. units with available u.h.f. signal generator equipment, the u.h.f. tuner is designed with a 50-ohm single-ended input impedance. In order to match this input to a standard 300-ohm antenna system, an impedance-matching network called a balun is used (CA_1 in Fig. 7.) Shown in Fig. 9A, it consists of two pieces of 125-ohm

Fig. 6. Chassis removal is rapid and exposes all tubes and components for servicing.

transmission line, each cut to a quarter-wavelength near the center of the u.h.f. band. The two sections are connected in parallel at the 50-ohm (tuner) end and in series at the 300-ohm (antenna) end, as shown in Fig. 9B.

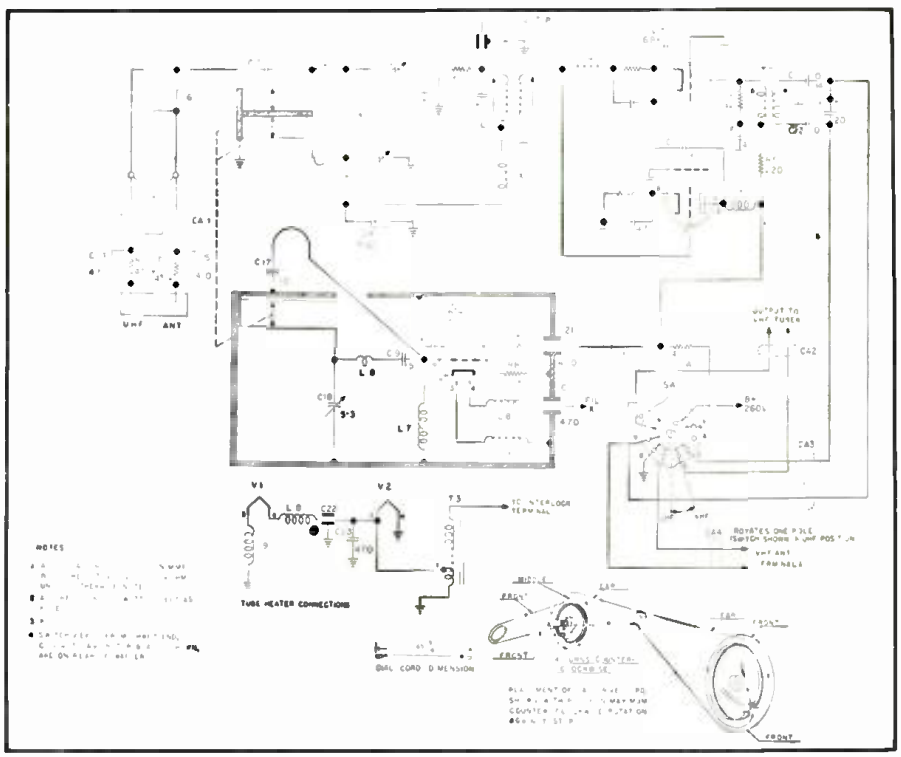
Video I.F. and Amplifier

The three-tube video i.f. circuit is similar to the one used in other *Crosley* models. A broadband circuit employing low-side capacitive coupling is used between the mixer and the 1st i.f. amplifier. (See Fig. 3.) The series circuit formed by L_8 and C_{11} constitutes an effective filter which suppresses the oscillator energy present in the mixer plate circuit. This is an important factor in keeping oscillator radiation to a minimum so as to eliminate interference with other TV sets.

Service technicians in areas plagued with adjacent channel interference will be interested in learning that a 27.9 mc. adjacent-channel trap is available which can be easily installed and adjusted without removing the cabinet. This trap is a small coil and condenser assembly connected together to form a parallel-

(*Continued on page* 108)

Fig. 7. Schematic diagram of the continuous-type u.h.f. tuner available with the "Super-V" chassis either factory installed or for field installation. The dial cord stringing guide in the lower right-hand corner should be followed exactly.



1954 TV RECEIVER SPECIFICATIONS

Continuation of the list of mechanical and electrical specifications on new TV sets for service technicians. See next issue for additional listings.

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					
HALLI-CRAFTERS	C1400D	6BZ7	6CB6	12BY7	6AU6	6BE6, 6SN7	5U4G	24CP4	45.75	18	11	275	5, 10, 12
	D1400D	6J6	6CB6 6CB6 6CB6	6AU6	6AU6 6AL5 6AV6 6AQ5	6AV5, 6AQ7 6SN7, 6CD6 6V3A	5U4G 1B3	or 27RP4A	45.75	18		275	5, 10, 12
HOFFMAN	301	6BQ7 or 6BZ7 6J6	6CB6 6CB6 6CB6	1N60 or 1N64 6AH6	6AU6 6AL5 6AU6 6W6	12AU7, 6AL5 6SN7, 6BQ6	Sel. Rect. 6W4 1B3	21YP4 or 17HP4	41.25	15	11	155	
	406	6BQ7 or 6BZ7 6J6	6CB6 6CB6 6CB6 6CE6	6AL5* 12BY7 12AU7*	6AU6 6AL5 6AV6 6K6	12AU7, 6AL5* 12AU7*, 6BQ6	Sel. Rect. 6W4 1B3	21YP4	41.25	16	Strips	155	
PHILCO	TV-180-3W	6BZ7 12AZ7	6CB6 6CB6 6CB6	1N64 12BY7	6AU6 6T8 6K6GT	6U8, 6BE6 12BH7, 12B4 6AL5, 12AU7 6BQ6GT, 6AX4GT	Sel. Rect. 1B3GT	17YP4 21ZP4A 21WP4 21XP4	26.6	14	All-Channel Tuner Optional	175	5, 10
	TV-190-3W	6X8 6BZ7	6CB6 6CB6 6CB6	1N64 6AU6 6AQ5	6AU6 6T8 6V6GT	6CS6, 12AU7 12B4, 6AL5 6BQ6GT, 6AX4GT 12AU7	Sel. Rect. 1B3GT	17YP4 21ZP4A	45.75	14.5	All-Channel Tuner Optional	175	5, 10
	TV-190-5W	6X8 6BZ7	6CB6 6CB6 6CB6	1N64 6AU6 6AQ5	6AU6 6T8 6L6GA	6CS6, 12AU7 12B4, 6AL5 6BQ6GT, 6AX4GT 12AU7	Sel. Rect. 1B3GT	21ZP4A	45.75	14.5	All-Channel Tuner Optional	190	5, 9, 10
	HF-200-3W	6BZ7 12AZ7	6CB6 6CB6 6CB6 6CB6	1N64 6U8* 6AU6 6AQ5	6BA6 6AU6 6T8 6V6GT	12AU7, 12B4 6AL5, 6BQ6GT 6AX4GT, 6U8* 12AU7, 12AU7	Sel. Rect. 1B3GT	17YP4 21ZP4A 21ZP4B	45.75	15	All-Channel Tuner Optional	200	5, 10
	HF-200-5W							21ZP4A	45.75	15	All-Channel Tuner Optional	215	5, 9, 10
	TV-197	6X8 6BZ7	6CB6 6CB6 6CB6	1N64 6AU6 6AQ5	6AU6 6T6 6V6GT	6CS6, 12AU7 6BQ6GT, 6AL5 6CD6G, 6V3A 12AU7	Sel. Rect. 1B3GT	24VP4A	45.75	18.5	All-Channel Tuner Optional	205	5, 10
	HF-207	6BZ7 12AZ7	6CB6 6CB6 6CB6 6CB6	1N64 6U8* 6AU6 6AQ5	6BA6 6AU6 6T8 6L6GA	12AU7, 6U8* 6BQ6GT, 6AL5 6CD6G, 6V3A 12AU7, 12AU7	Sel. Rect. 1B3GT	27LP4	45.75	19	All-Channel Tuner Optional	205	5, 10
	HF-208							24VP4A	45.75	19	All-Channel Tuner Optional	205	5, 10

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. Euilt-in antenna. 11. 82-channel tuner. 12. Adjustable dial light. *Part of tube is used in another section.

International SHORT-WAVE

Compiled by KENNETH R. BOORD

WHEN this month's column was prepared, a few stations had not yet gone on summer schedules; in such cases, you may find *summer* schedules *one hour earlier* than listed herein.

Albania—Radio Tirana, 7.852A, noted with news 1400. (Pearce, England) Heard in *English* 1745-1800. (Eriksson, Sweden) More recently noted with *English* 1700-1730 closedown. (Cox, Dela.)

Algeria — Radio Algerie, 6.160, is heard best in France around 1300. (La Radio Mondiale, France)

Andorra—Radio Andorra, 5.990A, has French, Spanish programs 0630-0900, 1230-1900. (ISWC, London) *Measured* recently as 5.988 at 1725. (Ferguson. N. C.)

Anglo-Egyptian Sudan—Radio Omdurman, 4.995, noted 1340 with Arabic music; 1350 with Arabic news. (Pearce, England)

Angola — Anglado, Miss., reports CR6R0, 7.580A, heard 1300-1400, and *Radio Clube de Benguela*, 5.042, at 1700. Luanda, 11.862, noted daily from around 1300 to sign-off 1730, good level in Minn. (Rowell) CR6RG, *Radio Diamang*, 9.340, heard in Sweden around 1410. CWQRM. (*Eterstep*, Sweden) Noted in England 1330 with popular musicales and closing 1430 with "A Portuguesa." (Pearce)

Argentina — LRS, 11.880, Buenos Aires, noted 1600 announcing as *Radio Splendid;* LRU, 15.290, heard afternoons *EST* announcing as *Radio El Mundo*. (Cody, Ireland)

Australia — VLI6, 6.090, Sydney, N.S.W., noted 0600-0700. (Pearce, Ill.) VLM4, 4.920, Brisbane, Queensland, heard 0600 with news. (Murphy, N. Y.; Chatfield, N. Y., others) VLC9, 9.615, is good level 1000-1115. (Waltz, Washington; Forster, Ill.) Good over VLA15, 15.200, 2155-2315 to West Coast North America. (Kirby, Mo,)

Austria — Blue Danube Network, 5.080, heard in Europe 0630-0700. (URDXC) And on 9.617 at 0430. (Pearce, England) Vienna, 6.155, is heard in Britain closing 1828 after identification in German. (URDXC)

Balearic Islands — Radio Menorca now uses 7.415 around 1430. (ISWC, London) Heard near 7.405 at 1500 with music; generally closes after taking relay from Madrid 1600-1615. (Pearce, England)

Belgian Congo—OTC, 9.655, good to North America 1900-2200. (McCollum, Ohio; Foster, Ill., others)

Belgium — ORU, 9.767, Brussels, noted in clear 1945. (Rideout, Wisc.; Foster, Ill.)

Bolivia—CP38, 9.442, La Paz, noted closing around 2128A. (Ferguson. N. C.)

Bulgaria—Radio Sofia, 9.700, noted to North America 1800-1815, 1900-1930, 2000-2030. (Welch, Mass.) *English* heard 1500 on 7.256, 6.671. (Eriksson, Sweden)

Burma — Rangoon, 4.775A, is good 0915-1015. (N. Z. DX Times) Weak in Calif. (Morgan)

Brazil—PRL4, 9.770, Rio de Janeiro, is heard occasionally around 2030 with much classical music. (Niblack, Ind.) PRL7, 9.720, Rio de Janeiro, noted Sat. 2100 with announcements in *English* in musical session. (Anglado, Miss.) With news in Portuguese 2130. (de Neuf, N. Y.) *Radio Clube de Pernambuco* noted again on 11.865 from 1500 onwards. (Cody, Ireland) ZYR78, 11.925, Sao Paulo, noted 2200-2300 when identified as "Radio Bandeirantes." (Northrop, N. C.) ZYK3, 9.565, noted with "Brazil Calling" (*English*) 2005-2030. (Reidler, Pa., others)

British Guiana — ZFY lists 5.981, 3.255, at 0545-1145, 1445-2045 Sun.; weekdays 0515-1145, 1445-2045. (Pearce, England) Noted on 3.255 with news 2000, closing 2115. (Bellington, N. Y.)

British Honduras — Radio Belize, 3.300, 4.950, noted around 1900-2130 in *English* and (a little) Spanish. (Rowell, Minn.)

British New Guinea — VLT6, 6.130, Port Moresby, heard 0450-0550 when is blotted out by CHNX, Halifax, N. S., Canada, coming on air. (Pearce, Ill., others)

Canada—CFRX, 6.070, Toronto, Ont., is good level around 1600. (Welch, Mass.) VE9AI, 9.540, Edmonton, Alta., is again audible in Texas around 0900. (Stark) Canada noted over 6.08 at 0100-0145 with news, music. (Garren, Calif.)

Cape Verde Islands — CR4AB, St. Vincent, has been heard in Britain on *measured* 7.092 at 1720. (URDXC) CR4AA, 7.398A, noted opening 1500; 1545 news in Portuguese. (Pearce, England) Good signal around 1700. (Sutton, O.)

Ceylon—Radio Ceylon, 9.52 noted to South India around 1100. (Zahner, Md.)

Chile — CE1515, 15.150, Santiago, noted fair level 1830 in Spanish. (Hill, N. H.)

China—Radio Peking, 15.060, noted 0400 with news, strong level. (Bates, Okinawa) Noted by Balbi, Calif., then on 10.20, 10.26, 9.08, 7.50, 6.20, 6.10; 11.67 does *not* carry news then; Shanghai noted by Balbi on 6.20, excellent signal around 0400; Balbi notes the 0930 news over 11.67 (not 11.69 as *announced*). Ferguson, N. C., recently heard Peking in native at 2040 on 15.060, 15.130A.

Colombia—HJCO-HJKA, 4.99A, Bogota, noted with program schedule in Spanish 0000-0005 and then closing with anthem, good level; HJKD, 6.000, heard 2000 with bilingual musical program in *English*-Spanish, good level; HJFX, 6.054, Cali, noted 2200-2300 with music, some QRM. (Koch, Ore.) HJAE, 4.940, Cartegena, heard closing 0000. (Murphy, N. Y.) *Radio Maria*, 4.824, Pasto, noted 2129-2205; when identifies, uses "Love's Old Sweet Song" as background music. (Roberts, Conn.) HJCT, 6.185A, Bogota, noted at good level evenings *EST*. (Strong, Md.)

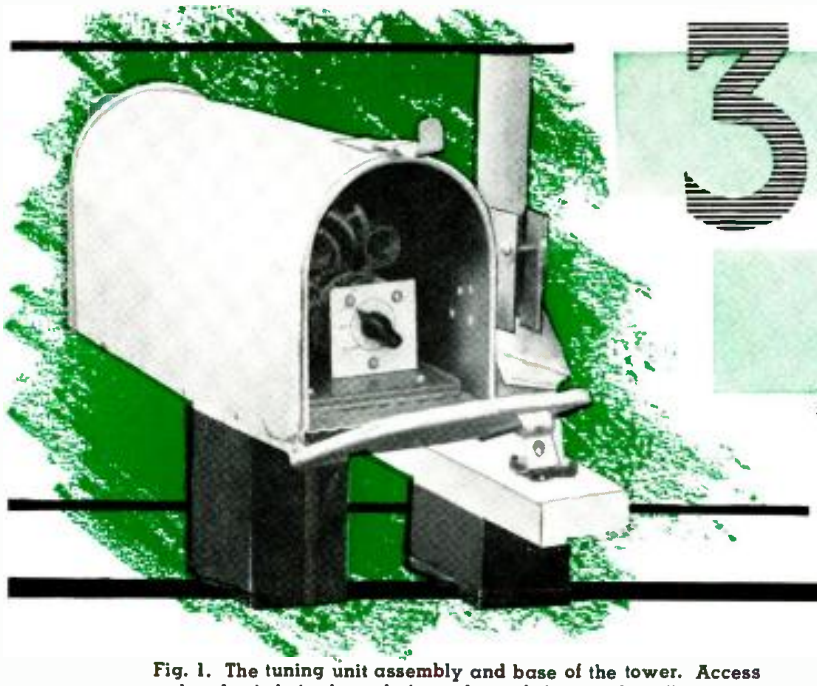
Costa Rica — TIFC, 9.647, is good level to 2305 closedown. (Herd, Dela.) Due to power shortage, schedule is now 0600-1300, 1800-2300. (Cusher, N. Z.; Frazier, Texas)

(*Continued on page* 100)

(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.

This veteran SWL is Bill Roemer, Bowling Green, Ky. His well-equipped listening post includes a National HRO-50, a Hallicrafters S-19R, and DB22A (RME) Preselector, and a BC-221 frequency meter. During both World War II and the war in Korea, Bill did a splendid job of monitoring POW messages and then relaying them to the prisoner's families in the U.S.



3-BANDS 1-VERTICAL

By **WILLIAM H. HARRISON, W6ULD**
Stanford Research Institute
Mount Lee Laboratory

Fig. 1. The tuning unit assembly and base of the tower. Access to bandswitch is through front door of the mailbox "cabinet."

Construction and operational details on a compact, highly efficient antenna system for the 80, 40, and 20 m. bands.

EVERY amateur is faced with the problem of efficiently radiating the energy produced by his transmitter. The antenna described in this article operates well on 80, 40, and 20 meters, requires very little space, is reasonable in cost, and looks professional.

The antenna, a 44-foot vertical, is mounted approximately one foot off the ground supported by standoff insulators on a wooden mount. Ground wire radials are buried just beneath the sod and terminate at the base of the mount. The tuning units are placed in an RFD mailbox beside the antenna.

Some of the important features of the antenna include the following:

1. Radiation of the energy at vertical angles which favor DX communications.
2. Excellent local coverage produced with vertical polarization.
3. Better communications with local mobile installations because they are all vertically polarized.
4. Buried coax line is used to feed the antenna on all bands. (RG-8U)
5. Harmonic radiation is reduced because of the low-pass filter action of the L-networks used to match the antenna and the transmission line.
6. The complete system can be erected on any small city lot.
7. The total cost is approximately $25.00.
8. One final important feature—installation of the ground system is work, however the rest of the job is pure enjoyment.

An antenna height of 44 feet was chosen because this height will produce maximum radiation of energy, on 20 meters, at very low vertical angles. This was discussed in a previous article ("The Ground Plane Grows Up," May 1954, RADIO & TELEVISION NEWS). Briefly, the antenna is .63 wavelength on 20 meters and is similar to an extended double-zepp, except in this case it is vertical and worked against ground. This type of operation has been used by some broadcast stations to obtain added coverage. Note the 20-meter vertical pattern shown in Fig.2A. There is a small high angle lobe caused by a phase reversal on a portion of the antenna. If the antenna was considerably longer it would become a poor radiator on 20 meters as the small high-angle lobe would develop into a large lobe and finally replace the lower lobe altogether. The antenna height is therefore limited by this feature.

Vertical radiation patterns are also included (Figs. 2B and 2C) for 40 and 80 meters. As can be seen from the patterns, 40 meter radiation is at a slightly lower vertical angle than 80 meters whereas 20-meter radiation is concentrated at very low angles. The radiated energy from the antenna on all three bands is concentrated in each case where it will be most beneficial for DX work.

The ground system used with this type of antenna is very important because considerable losses can develop at this point. The outside braid of the coax transmission line is connected to the ground radials at the base of the antenna support where the ground wires are terminated. The ground wires, like spokes of a wheel, form radials from the base of the antenna. If the ground system is poor then losses are developed similar to those that would occur if a resistor were inserted in series with the transmission line. A ground stake is not satisfactory by itself, however it may be used in conjunction with the ground system described. The ground system should include as many radials as possible with lengths up to ¼ wavelength or greater. The author's installation includes 16 radials which vary in length from about 25 to 45 feet. They are made of number 16 galvanized iron wire which is inexpensive and does a good job. Copper wire is slightly better but much more expensive. The radials are buried about 2 inches below the surface. The wire was stretched between two temporary stakes in the position desired and then the ground sliced beside the wire (using the wire as a guide). Two large screwdrivers were used to push the wire down in the slit in the sod. After the wires are in place the sod was then tamped back to normal. The ground installation task was made easier by heavy watering the night before. The coax feedline which runs under the house was also buried and brought out in the operating room in a coaxial wall receptacle mounted on the baseboard.

The tuning network, Fig. 3, for each band is simply a series coil and shunt condenser called an L-network. The values used are dictated by the antenna impedance at the frequency of operation. The 80-meter tuning unit consists of a large shunt capacity (1200 μμfd.) and a large series coil (10 μhy.) The 40-meter unit consists of a series coil (2.1 μhy.) and a shunt condenser (215 μμfd.). The 20-meter coil has an inductance of .6 μhy. but no shunt capacity is used. The measured impedance of the antenna on 20-meters indicated that a shunt capacity of about 15 μμfd. would be needed on the antenna side of the network; however

this is a very small value and in actual practice it was found unnecessary, possibly because the switch and wiring capacities to ground amounted to this value. The coils used were home constructed and self-supporting with the exception of the 80-meter coil which was found on a standard 2½ inch form. Coil lengths, diameters, and number of turns are listed in the parts list accompanying Fig. 3.

Several methods can be used to obtain the necessary capacity for the shunt condensers. A receiving-type variable can be used on 40 meters—such as a 250 μμfd. unit. The author uses a 250 μμfd. variable rated at 1500 volts because it happened to be in the junk box. The 80-meter capacity presents a problem because of its large value. A good solution is to use a fixed mica condenser of 1000 μμfd. and a 210 μμfd. variable condenser in parallel to obtain the correct value. The current developed across the capacity is rather high because the reactance is low. This is not important with air dielectric condensers since they do not break down due to high current until the voltage rating is approached. Mica condensers, however, have definite maximum current limitations even though the voltage rating is not exceeded. This varies with the type of mica condenser, the frequency of operation, and its capacity. If you are using a full kilowatt purchase one of the large mica condensers made specifically for r.f. current, such as the *Solar* type XA, *Aerovox* 1994, or similar condensers, having a 5000 volt d.c. rating and a current capacity of about 9 amperes at this frequency. In the author's particular installation a similar condenser was used (1200 μμfd.), purchased at one of the local radio stores on their surplus table for $.95. 1200 μμfd. is an odd value and probably is not available, however, the author has noticed numerous advertisements mentioning 1000 μμfd. condensers as surplus items at a similar price. Although there seems to be no specific current ratings available for the smaller transmitting mica condensers such as the *C-D* type 4 and 9 or *Sangamo* type A and H (2500 d.c.w.v.), they are being used successfully in similar applications.

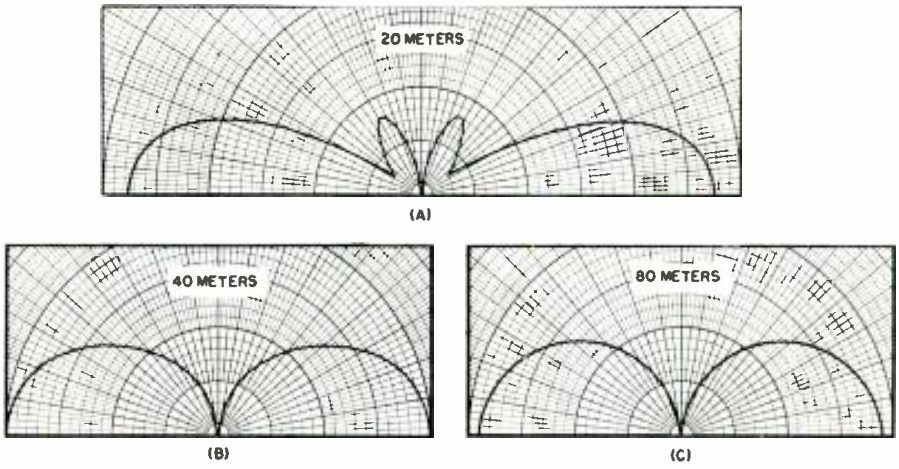
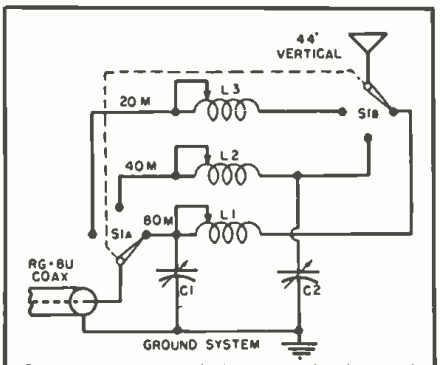


Fig. 2. Vertical plane patterns of antenna at (A) 20, (B) 40, and (C) 80 meters.

Mr. Grammer in his article, "Pi-Network Tank Circuits for High Power" (*QST*, October 1952), describes the use of these smaller mica condensers in a pi-network in the output circuit of a high power amplifier. His experiments indicate that this type of condenser is capable of carrying about 3 amperes r.f. current, thus, for powers up to about 150 watts, a single unit rated at 1000 μμfd./2500 d.c.w.v. would be satisfactory. He mentions the TV 500 μμfd./10,000 d.c.w.v. type condenser works very well in this application; a pair of these in parallel could be used satisfactorily at higher powers. So much for the current limitations of mica condensers. Another method can be used to obtain the correct capacitive reactance (the one the author used). It consists of combining a fixed mica condenser with a small series coil. The coil reduces the capacitive reactance which is the same as increasing the capacity. Calculations had indicated the shunt capacity required on 80 meters would be slightly larger than is actually needed, thus a small coil was placed in series with the 1200 μμfd. (measured 1195 μμfd.) condenser so the effective capacity could be raised. Turns were shorted out in the little series coil until the proper reactance was present. In the author's

(*Continued on page 88*)



C_1—*1200 μμfd. cond. (1000 μμfd. mica cond. in parallel with 250 μμfd. var. or any combination producing 1200 μμfd.—see text)*
C_2—*215 μμfd. cond. (low-voltage 250 μμfd. var. may be used)*
L_1—*80 m.—10 μhy., 18 t. #12 en. wound on 2½" dia. form, 3" winding length. (16 turns are used)*
L_2—*40 m.—2.1 μhy., 20 t. #12 en. airwound, 1" dia., 3½" winding length (19 turns are used)*
L_3—*20 m.—.6 μhy., 10 t. #12 en. airwound, 1" dia., 2" winding length (7 turns are used)*
S_1—*D.p., 3-pos. switch*

Fig. 3. Antenna tuning unit. The 80 and 40 m. networks consist of a series coil and shunt condenser while the 20 m. network uses a coil. See text for details.

Fig. 4. A standard RFD mailbox is used to house tuning unit as it offers weatherproof protection and easy accessibility.

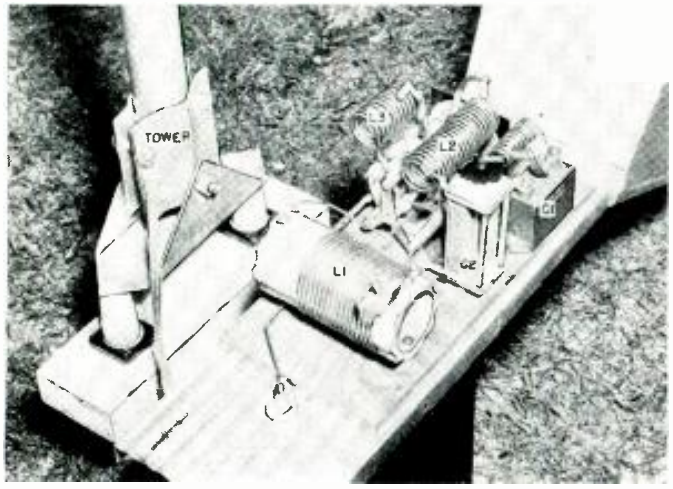
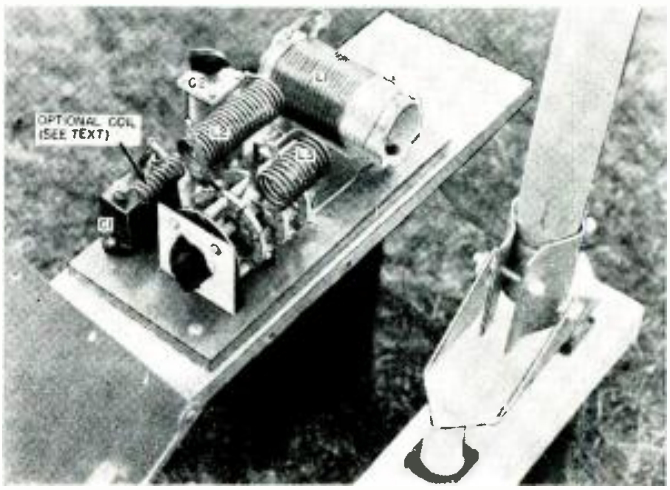


Fig. 5. Top cover of the mailbox may be raised to tune the unit or make adjustments. Normal access is through the door.



MAC'S RADIO SERVICE SHOP

By JOHN T. FRYE

SERVICE SHOP ADVERTISING

BARNEY, late as usual after his lunch hour, came charging into the service department only to be brought up short by the sight of Mac, his boss, wearing something that looked like a doctor's stethoscope. The gadget was plugged into a tape recorder; and the service shop owner, unaware he was being observed, was keeping time to the rhythm on the silently moving tape with a waving forefinger.

"Well, well! If it isn't Old Doctor Kildare himself!" Barney shouted gleefully at the nape of Mac's neck, delighted at catching his employer off guard. "What's your prognosis, Doctor?"

Rather sheepishly Mac removed the apparatus from his ears, shut off the recorder, and turned on his assistant with a fierce scowl. "My prognosis," he announced menacingly, "is that if a certain red-headed Irishman does not knock off his practice of sneaking up behind people and yelling at them, he is not long for this world."

"What you got?" Barney wanted to know.

"It's a new idea in low impedance earphones. See this little housing on the back end of the phone plug?" Mac asked as he touched an object about the size of a small hickory nut sticking out of the "External Speaker" jack of the recorder. "Inside is a midget ¾" inch, six-ohm speaker. The output of this speaker goes through this flexible plastic tube to a 'Y' beneath the chin, and from there anodyzed aluminum tone arms carry the sound to both ears. The whole thing only weighs an ounce and a quarter."

"What's the good of it?"

"Well, for one thing, it can be plugged directly into the external speaker jack of any tape recorder for personal listening. That's handy when you want to listen to a tape privately or when you want to crank up the playback level for listening to a high-fidelity recording without disturbing others. Also it looks like a good unit to use when people want earphones connected to a radio. This will allow us to make a quick, easy, and safe installation. By employing a miniature closed-circuit jack, the secondary of the output transformer can be hooked across the phones when the plug is inserted, and returned to the set speaker voice coil when the plug is removed. Since there is no metallic connection between the earphones proper and the plug, there will be no danger of the wearer being shocked, even when the phones are connected to an a.c.-d.c. set.

"How's the quality?"

"The manufacturer advertises 'response from 50 to 8000 cps or better.' That does not say, of course, within what db limits this response is had. However, take a listen yourself to this recording of the 'Studies in Percussion' track by Hal Reeves that I took off *Capitol's* "Full Dimensional Sound" test record. Keep an ear cocked especially for the triangle, the tambourine, and the bass drum."

Barney adjusted the tips of the tone arms in his ears and listened carefully for two to three minutes. Then he cut off the recorder and announced importantly, "I may not have a golden ear, but those phones sound good to me. That tambourine seemed as though it were being shaken right in front of my face, and I could almost see the bass drum's stretched hide quiver as it gave that last 'whump.'"

"Not to change the subject," Mac remarked as he put the cover back on the recorder, "but never think I failed to notice you were late getting back from lunch again. What was it this time? Did you get held up with flying saucer traffic, or was it really something unusual?"

"Nope; the drugstore was just full of high school kids, and I couldn't get waited on. While sitting there, though, I really saw a demonstration of the power of advertising. Remember a while back when you couldn't turn on your radio or TV set without having a guy on it tell you all about lanolin and sheep's wool and his particular brand of hair dressing? Well, one of those high school hot shots came in and told the druggist he wanted something for his hair. The druggist asked what brand he wanted, and the kid just went 'Ba-a-a-a-a' like a sheep. Without saying another word the druggist reached up and pulled down the kind of hair dressing that bird on radio and TV was plugging. His message certainly must have got across!"

Mac chuckled at Barney's graphic description of the drug store scene as he said, "I'm glad you brought up the subject of advertising, for it's something I've been thinking about lately. If you're not in too great a hurry to get back to work; we might talk it over a little."

"I'll try to restrain myself," Barney murmured languidly as he collapsed on one end of the service bench.

"A fellow moved into our neighborhood recently," Mac explained, "and when he found I ran a service shop, he jumped on me all spraddled out. He says TV service advertising is strictly for the birds and that it makes no consistent sense. To prove his point, he pointed out several ads in a metropolitan newspaper. One shop harped on the expensive equipment and the advanced technical knowledge needed to do modern TV service work. On the next page another shop boasted that practically all service work could be performed right in the customer's home in a very short time.

"This guy then went ahead to say that twice he had had to call a service technician to repair his set. In each case the call was answered by a young kid who, as he put it, 'didn't look as though he were dry behind the ears yet.' This boy came in carrying a small tool box, about two dozen tubes, and a single meter—probably a v.t.v.m. In both cases he looked in the back of the set, noted a burned out tube, replaced it, and was on his way. Where was the 'expensive equipment?' this fellow wanted to know. As for 'advanced technical knowledge,' it required about as much of that as would be needed to find out which bulb was burned out in a floor lamp. According to the way my neighbor looks at it, that business about expensive and delicate instruments being needed to do TV work is a lot of hooey. So is the talk about technical knowledge. The fact that most TV repairs can be made right in the home

(*Continued on page* 118)

BUILD YOUR OWN

Heathkits

- TEST INSTRUMENTS
- AMPLIFIERS
- RECEIVERS, etc.

1. Save by ordering direct from manufacturer.
2. All high quality standard brand components.
3. Increased knowledge through actual construction.
4. Sound engineering insures excellent performance.
5. Kit construction is fascinating and enjoyable.

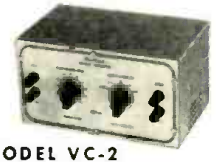
Heathkit MODEL O-9 OSCILLOSCOPE KIT

MODEL O-9 $59.50 Shipping Wt. 28 lbs.

New features unheard of in a kit oscilloscope have been added to the already popular Heathkit series. All top quality components are used including a brand new RCA 5UP1 CRT. Ten other first line tubes complete the lineup. Voltage regulation provides a rock steady pattern regardless of normal line voltage variations. A built-in blanking amplifier eliminates the retrace line entirely. Other important advantages are a phasing control. Z axis input, direct connections to the deflection plates, 1 volt peak-to-peak calibration voltage and a calibrated grid screen.

Wiring is simplified by the use of the harness technique which also results in a neat professional appearance. Extremely wide vertical bandwidth allows accurate reproduction of even a 500 KC square wave. Excellent focusing characteristics are made possible by the use of the new RCA 5UP1 CRT and a spot shape control. One of the most versatile of test instruments, the Heathkit O-9 Oscilloscope will be invaluable in the radio and TV service shop, as a work project in schools and for all types of circuit investigation work in the laboratory. Its new features make Model O-9 comparable in every way to many commercially built oscilloscopes selling for as much as $400. Don't pass up this opportunity to add a really fine instrument to your service or experimental lab.

Heathkit VOLTAGE CALIBRATOR KIT



MODEL VC-2 $11.50 Shipping Wt. 4 lbs.

The use of a Voltage Calibrator will greatly increase oscilloscope usefulness. Provides a convenient method of making peak to peak voltage measurements by establishing a relationship between the unknown wave shape and the Voltage Calibrator. Voltage ranges .01–100 volts peak to peak. The Voltage Calibrator features direct reading scales and a regulated power supply system.

Heathkit ELECTRONIC SWITCH KIT

MODEL S-2 $23.50 Shipping Wt. 11 lbs.

The Heathkit Electronic Switch Kit will further extend scope usefulness by permitting simultaneous observation of two individually controlled traces. Continuously variable switching rates 10 cps to 2,000 cps in three ranges. Will also serve as a square wave generator over the range of switching frequencies.

Heathkit VACUUM TUBE VOLTMETER KIT

MODEL V-6 $24.50 Shipping Wt. 6 lbs.

The beautiful new 1953 Heathkit Model V-6 VTVM, the world's most popular kit instrument, now offers many outstanding new features in addition to retaining all of the refinements developed and proven through the production of over 70,000 VTVM kits. The Heathkit VTVM now features extended voltage ranges with 50% greater coverage on the DC range. New 1½ volt low scale provides well over 2⅓ inches of scale length per volt permitting faster measurements with greater accuracy. AC and DC ranges are 0–1.5–5–15–50–150–500–1500 volts (1,000 volts maximum on AC). Ohmmeter ranges are X1, X10, X100, X1,000, X10K, X100K X1 meg. Measures .1 ohm to 1,000 megohms. Other features are db scale, center scale zero adjust and polarity reversal switch. High 11 megohm input resistance virtually eliminates circuit loading.

The low anti-inflation price of this tremendously popular kit includes all tubes, necessary constructional material, test leads and the construction manual.

Heathkit AC VACUUM TUBE VOLTMETER KIT

MODEL AV-2 $29.50 Shipping Wt. 5 lbs.

A new amplifier type AC VTVM that makes possible those sentitive measurements so essential in laboratory or audio work. Ten voltage ranges covering from .01 RMS full scale to 300 volts RMS full scale. Input impedance 1 megohm with frequency response 20–50,000 cycles. Ten DB ranges from —52 to +52 DB. Four diodes in meter bridge circuit for maximum linearity.

Heathkit HANDITESTER KIT

MODEL M-1 $14.50 Shipping Wt. 3 lbs.

The ever popular Handitester is now supplied with a Simpson 400 microampere meter movement. Provides AC and DC voltage ranges 0–10–30–300–1,000–5,000 volts. Ohmmeter ranges 0–3,000 and 0–300,000 ohms. DC current measurements 0–10 and 0–100 milliamperes. A completely self contained portable instrument.

HEATH COMPANY • Benton Harbor 15, Mich.

HEATHKITS for the ENGINEER

Heathkit VISUAL AURAL SIGNAL TRACER KIT

Designed especially for service applications in AM-SW-FM-TV repair work. RF and audio two channel input. More than adequate sensitivity—new noise locator circuit—calibrated wattmeter—substitution speaker—visual signal indication. Can be used with scope and VTVM, checks phono cartridges, phono mechanisms, microphones, tuners, etc. Let the Heathkit Visual Aural Signal Tracer help you.

MODEL T-3 **$23.50**

Shipping Wt. 10 lbs.

Heathkit RESISTANCE SUBSTITUTION BOX KIT

MODEL RS-1

Ship. Wt. 2 lbs. **$5.50**

Choice of 36 switch selected resistance values 15 ohms to 10 megohms. All standard RTMA 1 watt 10% resistors. Buy several for those lab and service applications.

NEW Heathkit 20,000 OHMS PER VOLT MULTIMETER KIT

Here is the solution to all service problems requiring a portable measuring device of high accuracy. 20,000 ohms/volt sensitivity on DC and 5000 ohms/volt on AC. Full scale voltage ranges of 1.5, 5, 50, 150, 500, 1500 and 5000. DC current ranges of 150 microamperes; 15, 150 and 500 milliamperes; and 15 amperes. Resistances are measured from .2 ohms to 20 megohms in 3 ranges and decibels from —10 to +65 db.

Model MM-1 uses standard commercially available batteries and is not affected by strong RF fields as encountered in and near transmitting equipment. 1% precision resistors on a very easily wired ring type range switch and a highly accurate Simpson 50 microampere meter fully qualifies the Heathkit Multimeter for close tolerance laboratory and service work. The meter movement is placed in a recessed position for maximum non-glare readability. The kit includes the attractive black bakelite cabinet, 2 color meter scales, test leads, batteries and all other necessary components. Overall cabinet size is 5½" wide x 4" deep x 7½" high.

MODEL MM-1 **$26.50**

Ship. Wt. 6 lbs.

Heathkit CONDENSER CHECKER KIT

An instrument designed solely for its particular job. Not a "sideline" or a multiple function instrument. Measures value and quality of unknown condensers and resistors. Capacity range .00001 mfd to 1,000 mfd. Resistance range 100 ohms to 5 megohms. Sensitive electron beam indicator—five polarizing test voltages—safety spring return leakage test switch. An amazingly accurate instrument at this low price.

MODEL C-3 **$19.50** Shipping Wt. 8 lbs.

Heathkit SIGNAL GENERATOR KIT

MODEL SG-8 **$19.50**

Ship. Wt. 8 lbs.

The standard service instrument for alignment work. .1 volts output from 160 KC to 110 MC. Calibrated harmonics up to 220 MC. Internal (400 CPS) and external modulation. Pre-calibrated coils for all 5 bands. Good stability and accuracy. All test leads included.

Heathkit GRID DIP METER KIT

One hand operation. 5 pre-wound coils cover 2—250 MC. Controlled sensitivity. Usable as an oscillator or an absorption wavemeter. Extra low frequency coils available.

MODEL GD-1B **$19.50**

Ship. Wt. 4 lbs.

Heathkit TUBE CHECKER KIT

Checks overall tube quality, filament continuity, and individual elements for shorts and opens. Features chart illumination, harness type wiring, and large 3-color meter scale.

Portable Model TC-2P at $34.50. Wt. 14 lbs. No. 91-8 Cabinet only at $7.50. Wt. 7 lbs. No. 355 TV Picture Tube Adapter at $4.50. Wt. 1 lb.

MODEL TC-2 **$29.50**

Shipping Wt. 12 lbs.

Heathkit LABORATORY GENERATOR KIT

MODEL LG-1

Ship. Wt. 16 lbs. **$39.50**

A professional laboratory instrument designed for extreme accuracy in frequency and output level. Colpitts oscillator operates in 5 ranges from 150 KC to 30 MC. Panel meter calibrated in output voltage and percent of modulation. Output in excess of .1 volts. Features complete shielding of oscillator, buffer and attenuator sections; regulated power supply and 50 ohm output cable. Comparable instruments priced many times higher than the cost of this new kit.

Heathkit LABORATORY REGULATED POWER SUPPLY KIT

A regulated variable 160-450 volt DC output power supply for the lab or service shop. Accurate voltage and current measurements with large Simpson meter. AC supply 6.3 volts at 4 amperes—standby switch eliminates warmup time. Low hum content—5 tube circuit. AC and DC output voltages isolated from panel for maximum operational flexibility.

MODEL PS-2 **$33.50**

Ship. Wt. 20 lbs.

Heathkit AUDIO WATTMETER KIT

Measure output power levels directly with the Heathkit Audio Wattmeter. Flat response to frequencies from 10 CPS to 250 KC. Full scale ranges of 5 MW, 50 MW, 500 MW, 5 W and 50 W. Db calibration from —10 to +48. Uses non-inductive built-in load resistors providing impedances of 4, 8, 16 and 600 ohms. Meter bridge uses 4 germanium diodes.

MODEL AW-1

Ship. Wt. 6 lbs. **$29.50**

HEATH COMPANY • Benton Harbor 15, Mich.

SERVICEMAN · AMATEUR · STUDENT

Heathkit
IMPEDANCE BRIDGE KIT

MODEL IB-2
$59.50
Ship. Wt. 15 lbs.

Modern design with built-in 1 KC generator for AC measurements. A choice of the Wheatstone, Maxwell, Hay or capacitance comparison bridges for measuring resistance, capacitance, inductance, dissipation factor and storage factor. ½% resistors and precision mica condensers provide maximum accuracy. Completely AC operated.

Heathkit
COMMUNICATIONS RECEIVER KIT

MODEL AR-2
Ship. Wt. 12 lbs.
$25.50
(Less Cabinet)

Full coverage from 550 KC to 35 MC on 4 bands, with good sensitivity and selectivity. Features electrical bandspread, BFO, headphone jack, slide rule dial with ham band identification, RF gain control, noise limiter and phone-standby-CW switch. Top quality, high gain components used throughout. Pre-wound coils in a shielded turret assembly and a transformer operated power supply assure trouble-free performance.

Cabinet available separately. No. 91-10. Shipping wt. 5 lbs. Price $4.50.

Heathkit
AUDIO OSCILLATOR KIT

MODEL AO-1
$24.50
Ship. Wt. 11 lbs.

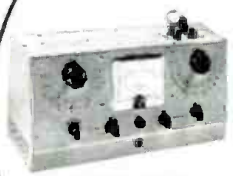
Features sine or square wave coverage from 20–20,000 cycles in 3 ranges. Variable 10 volt output level at 600 ohms impedance. Thermistor controlled linearity—precision multiplier resistors—distortion less than .6%. An outstanding instrument value at this amazing low price.

Heathkit
DECADE RESISTANCE KIT

MODEL DR-1
$19.50
Ship. Wt. 4 lbs.

Individual switch selection of twenty 1% precision resistors in 1 ohm steps from 1 to 99,999 ohms. Sturdy ceramic wafer switches featuring silver plated contacts and smooth, positive detent action.

Heathkit
Q METER KIT



MODEL QM-1
$44.50 Ship. Wt. 14 lbs.

A typical Heathkit invasion of the laboratory instrument field. Here is the first successful low priced Q meter ever offered in kit form. Oscillator supplies RF in the range of 150 KC to 18 mc. Reads Q directly on calibrated meter scales. Measures Q of condensers, RF resistance and distributed capacity of coils. Calibrate capacitor with range of 40 mmf to 450 mmf with vernier ±3 mmf. All measurements made at the operating frequency.

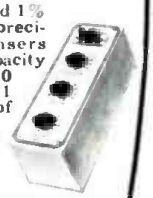
Heathkit AMATEUR
TRANSMITTER KIT

Power input up to 35 watts on 80, 40, 20, 15, 11 and 10 meters. Can be crystal or VFO exciter. Complete with modulator input socket and VFO power output provisions. Other desirable features are good shielding, AC line filter, key click filter, standby switch and a 52 ohm coaxial output. Model AT-1 is AC operated and is suitable as an exciter for a higher powered rig. Complete with full instructions for construction and use.

MODEL AT-1
$29.50
Ship. Wt. 16 lbs.

Heathkit
DECADE CONDENSER KIT

Switch selected 1% silver mica precision condensers providing capacity range of 100 mmf. to 0.111 mfd. in steps of 100 mmf.



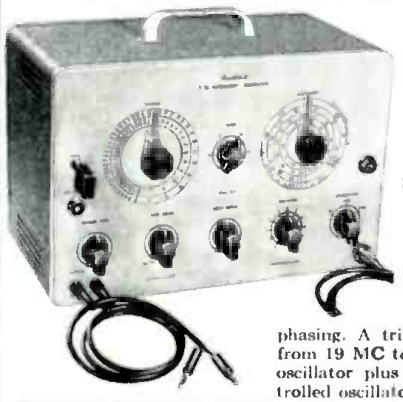
MODEL DC-1
$16.50
Shipping Wt. 4 lbs.

Heathkit
AUDIO GENERATOR KIT

A new extended range 18 cycles —1 megacycle audio instrument at a remarkably low price. Five continuously variable output ranges—600 ohm output impedance—low distortion figure, less than .4% from 100 cps through audible range.

MODEL AG-8
$29.50
Ship. Wt. 11 lbs.

Heathkit
TELEVISION SWEEP GENERATOR KIT



MODEL TS-3
$44.50
Ship. Wt. 18 lbs.

Simplify your TV alignment jobs with the new Heathkit TS-3. Full coverage on fundamentals from 4 MC to 220 MC at an output of well over 100,000 microvolts . . . Automatic blanking and wide range phasing. A triple marker system ranges from 19 MC to 180 MC using a Colpitts oscillator plus the 4.5 MC crystal controlled oscillator for check points (crystal furnished). Provisions are also made for using an external marker.

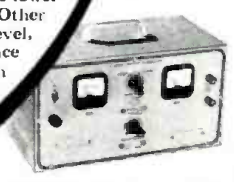
Featured is the new sweep system, using an *INCREDUCTOR controllable inductor. Sweep width is variable from 0 to 12 MC at the lower RF frequencies and increases to 0–50 MC at the highest . . . Other advantages are power supply regulation, constant RF output level, independent marker and RF output control circuits, low impedance output and properly terminated output cables. The construction manual is complete in all detail and with a reasonable amount of care, Model TS-3 will serve faithfully for many years to come.

**Trademark, C.G.S. Laboratories, Stamford, Connecticut*

Heathkit
BAR GENERATOR KIT

Small, compact and easy to use. Model BG-1 supplies horizontal or vertical bars for TV linearity adjustments. Output cable clips directly to the TV receiver antenna terminals.

MODEL BG-1
Ship. Wt. 6 lbs.
$14.50



Heathkit
BATTERY ELIMINATOR KIT

MODEL BE-4
Ship. Wt. 18 lbs.
$31.50

6 or 12 volt operation with current and voltage constantly monitored. Double protection with a fused transformer and automatic overload relay. Well filtered output and all heavy duty components. Designed for auto radio repair and as a storage battery charger.

WRITE FOR *Free*
CATALOG

New 40 page 1954 Catalog lists all kits, specifications, schematics and latest price information.

HEATH COMPANY · Benton Harbor 15, Mich.

Heathkit FM TUNER KIT

MODEL FM-2

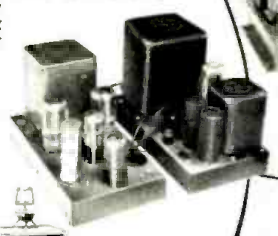
$22.50

Shipping Wt. 9 lbs.

Sensitive transformer operated 8 tube circuit. Frequency coverage 88-108 mc. Pre-assembled and tuned "front end." Vernier tuning with slide rule type dial.

NEW HEATHKIT WILLIAMSON TYPE AMPLIFIER KIT

The ideal amplifier for custom high fidelity audio installations. Tops in performance, value and flexibility of operation. Either Altec Lansing Peerless or Acrosound output transformers available. Frequency response ±1 db 10 CPS to 100 KC, negligible hum and noise levels and plenty of reserve power for complete listening pleasure. First Williamson Type Amplifier supplied with matching preamplifier.



PRICES OF VARIOUS COMBINATIONS:

W-2 Amplifier Kit (Includes Main Amplifier with Peerless Output Transformer, Power Supply and WA-P2 Preamplifier.) Shipping weight 38 lbs. Shipped express only **$69.50**

W-2M Amplifier Kit (Includes Main Amplifier with Peerless Output Transformer and Power Supply.) Shipping weight 30 lbs. Shipped express only..... **$49.75**

W-3 Amplifier Kit (Includes Main Amplifier with Acrosound Output Transformer, Power Supply and WA-P2 Preamplifier.) Shipping weight 38 lbs. Shipped express only **$69.50**

W-3M Amplifier Kit (Includes Main Amplifier with Acrosound Output Transformer and Power Supply.) Shipping weight 30 lbs. Shipped express only..... **$49.75**

Heathkit ECONOMY 6 WATT AMPLIFIER KIT

MODEL A-7B

$15.50

Ship. Wt. 10 lbs.

Dual inputs—separate bass and treble tone controls—output impedances of 4, 8, and 15 ohms. Performance far beyond that normally expected for the price.

A-7C: Includes preamplifier for low level input devices. Price $17.50

NEW Heathkit BROADCAST BAND RECEIVER KIT

MODEL BR-2

$17.50

(Less Cabinet)

Ship. Wt. 11 lbs.

Complete receiver with chassis mounted 5½" PM Speaker and new rod type antenna. Covers the full broadcast band (550 KC-1600 KC) with excellent sensitivity and selectivity. Operates as a receiver, tuner or a phono amplifier. High gain miniature tubes and IF transformers. Easy tuning with direct planetary drive.

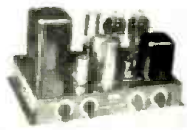
Cabinet available separately. Part No. 91-9. Ship. wt. 5 lbs. Price $4.50.

Heathkit HIGH FIDELITY 20 WATT AMPLIFIER KIT

MODEL A-9B

$35.50

Shipping Wt. 23 lbs.



Outstanding features of the Heathkit 20 Watt Amplifier include a frequency response of ±1 db from 20 CPS to 20 KC, less than 1% harmonic distortion at rated output, separate (boost and cut) bass and treble tone controls, 4 selected input jacks, hum balancing control and output impedances of 4, 8, 16 and 500 ohms. Flexibility is emphasized in the input circuits with built-in preamplifier and proper equalization.

Heathkit LOW PRICED Single UNIT WILLIAMSON TYPE AMPLIFIER KIT

MODEL W-4M

$39.75

Ship. Wt. 28 lbs.

The famous Heathkit Williamson Type Amplifier is now available in a single chassis. Includes power supply and power amplifier. Enjoy the same high quality reproduction at less cost by eliminating the second chassis, connecting cables, etc. Size 15¼" wide—7" high—9" deep. Model W-4 includes W-4M and preamplifier WA-P2. Shipping weight 35 lbs. Price $59.50.

New HEATHKIT HIGH FIDELITY PREAMPLIFIER KIT

MODEL WA-P2

$19.75

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Complete compensation for LP, NARTB, AES and early 78 recording characteristics. An ideal control unit for the custom Hi-Fi system. 5 individually controlled inputs, 4 turnover and roll-off switch positions, 3 twin triode tubes, cathode follower output, monitored recorder output, shock mounted tube chassis and proper shielding. All condensers are of the molded plastic type. Critical input circuits feature low noise deposited carbon resistors. Use it with any conventional high fidelity amplifier.

HEATH COMPANY • Benton Harbor 15, Mich.

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SERVICE HINTS ON CROSLEY TV SETS

MODELS 10-401, 10-404, 10-412, 10-414, 10-416, & 10-418

Unstable horizontal sync.

If the horizontal oscillator drifts, causing the receiver to fall out of horizontal sync after operating several hours, check C_{150}, the .01-μfd. condenser connected to pin 6 of T_{106}, the horizontal oscillator transformer. This condenser, if it is of the molded type, may change capacity with temperature change sufficiently to cause the receiver to fall out of horizontal sync.

Replace the condenser with a .01-μfd., 600-volt paper type, and realign the trimmer at the bottom of T_{106}.

Carrier buzz.

To reduce carrier hum which may accompany high contrast on some sets, change condenser C_{122} (connected to pin 1 of V_{109}, 6AU6 sound driver), 100-μμfd., 500 volts, to 47-μμfd., 500 volts.

Also change resistor R_{134} (in parallel with C_{122}) from 220,000 ohms to 47,000 ohms, ½ watt, and R_{118} (connected to pin 6 of V_{109}) from 56,000 ohms to 27,000 ohms, 10%, 1 watt.

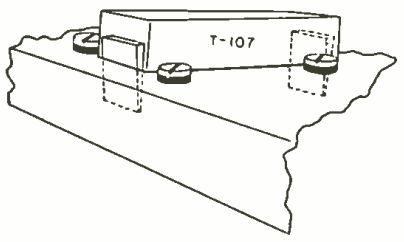
Arcing between the 6BG6 and damper-tube plate lead.

When experiencing breakdown due to arcing between the 6BG6 and damper-tube plate leads, install 3½ inches of *Fiberglas* sleeving over the 6BG6 plate lead. This sleeving should be placed toward the terminal on the horizontal deflection transformer.

MODELS 10-401, 10-404, 10-412, & 10-418

Horizontal sweep sing.

This condition can be caused by vibration of the mounting bracket on the horizontal output transformer, T_{107}. This mounting bracket occasionally vibrates at a subharmonic of the 15,750-cps horizontal sweep frequency. This can be corrected by inserting small wedges between each end of the transformer and chassis, as shown in the accompanying diagram.



It is not necessary to remove the chassis from the cabinet to make this correction.

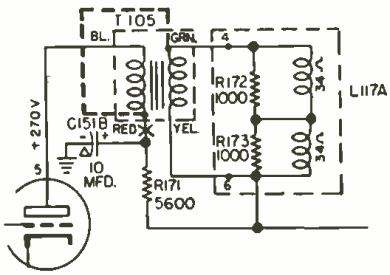
MODELS 10-404MU, 10-404M1U, 10-412, & 10-418

Insufficient vertical size.

To obtain sufficient vertical sweep, make the following changes:

1. Change resistor R_{171} from 5600 ohms to 4700 ohms, 10%, 1 watt.

2. Change the vertical output transformer, T_{105}, to an autotransformer by connecting the secondary winding in series with the primary, as shown by the dotted line in the accompanying diagram. (The diagram shows the circuit before changes.) To make this change, do the following:



a. Remove the red lead of the primary winding of T_{105} at the terminal board where it is soldered beneath the chassis. There is another lead to this lug which is red with a white tracer. Resolder the red lead to the adjacent lug to which two green leads are connected.

b. Remove the yellow lead of the T_{105} secondary winding and the yellow lead of the deflection yoke from the lug of the terminal board nearby where they are both soldered. Resolder these two leads to the lug where the red lead of T_{105} was formerly connected.

"SUPER V" MODELS (CHASSIS 426)

Poor vertical interlace, unstable picture, and intermittent streaks.

This combination is caused by an intermittent contact between the *Aquadag* coating on the picture tube and the grounding strap.

To correct this, take off the grounding strap and reform it so that it makes a firm contact at the *Aquadag* coating when it is in place.

In cases where the *Aquadag* coating has become scraped off by the movement of the tube during shipment, reposition the strap so that the contact falls on a good area.

MODELS 11-442M1U, 11-444MU, 11-453MU, 11-460MU, 11-470BU, 11-472B1U, 11-474BU, & 11-483BU

Hum or buzz.

To reduce this condition, do the following:

1. Make certain that the electrolytic condenser, C_{120} (one section of which goes from pin 6 of the 6AH6 video amplifier to ground), has a good ground connection by soldering the wire from the chassis to one of the ground lugs on the condenser.

2. Replace the shield in back of the contrast control if it has been removed.

3. On sets equipped with a resistor-condenser unit, dress coupling condenser C_{122} (at pin 2 of T_{101}, sound i.f. transformer), as far as possible away from the resistor-condenser unit.

4. If necessary, remove resistor R_{141}, 22 ohms. at pin *B* of the ratio detector transformer.

5. Adjust the ratio detector transformer (T_{102}) secondary for minimum hum or buzz while the set is tuned to a station. Only a slight adjustment is required. If the screw is turned too far, the result may be weak or distorted audio.

6. Check over-all alignment.

ALL SETS

Elimination of corona or arcing at the picture anode button.

If corona or arcing is experienced at the anode button, it is probably due to the accumulation of dirt or to the effect of a corroded rubber suction cover.

To eliminate this trouble, do the following:

1. Disconnect the anode lead from the tube.

2. Clean the area around the anode button with carbon tetrachloride or a scouring powder such as *Bon Ami*.

3. Add a protective coating such as *Crosley* appliance polish.

4. If the original anode connector is without a suction cover, thus permitting free accumulation of dirt, a new anode connector and lead assembly with a neoprene suction cover should be used to replace the original assembly. —30—

SHAFT COUPLINGS

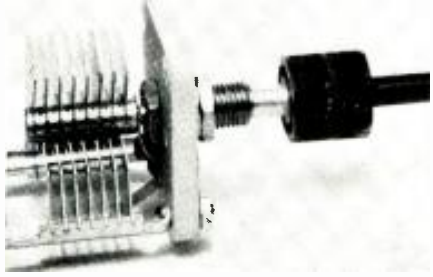
By ARTHUR TRAUFFER

NEEDING some insulated couplings for ¼" extension shafts, I dug into my radio scrap box and fished out some small knobs with set-screws in them. I filed the fronts of the knobs flat and cemented the knobs together (front-to-front) using Duco cement.

The photograph below shows the resulting neat and serviceable insulated coupling installed on the condenser shaft. When cementing the knobs together, be sure that the holes in the knobs line up perfectly so that there will be no eccentric motion of the extension shaft in relation to the condenser shaft.

If you prefer, you can bore through the knobs with a ¼" drill and then cement the knobs together bottom-to-bottom. This may give you a better alignment of the knobs. —30—

Shaft coupling improvised from small knobs.



CRYSTALS

Guaranteed to oscillate!
Your choice of frequencies!
Largest selection in the world!

NOTE! EVERY CRYSTAL TESTED FOR ACTIVITY BEFORE SHIPMENT! All numbers listed are FUNDAMENTAL FREQUENCIES with fractions omitted.

FT-243 HOLDER

Lots of 10 or more. Each 69c
Lots of 5 or more. Each 79c
Individually. Each 99c

1015	2135	2480	2630	2775	2940	3090	3235	6075	6406	7150	7600	7870	8070
1110	2140	2485	2635	2780	2945	3095	3240	6100	6425	7173	7610	7800	8073
1129	2145	2490	2640	2785	2950	3100	3290	6106	6440	7175	7620	7890	8075
1150	2155	2495	2645	2790	2955	3105	3300	6125	6450	7200	7630	7891.7	8083
1195	2165	2505	2650	2795	2960	3110	3310	6140	6473	7206	7640	7900	8100
1525	2175	2510	2655	2815	2965	3115	3320	6142	6475	7225	7650	7910	8108
1900	2180	2515	2660	2825	2970	3120	3340	6150	6500	7240	7660	7920	8110
1915	2195	2520	2665	2830	2975	3125	3410	6173	6506	7273	7666.7	7930	8116
1930	2300	2525	2670	2835	2980	3130	3420	6175	6525	7275	7670	7940	8125
1940	2305	2530	2675	2840	2985	3135	3455	6185	6540	7300	7680	7950	8130
1950	2320	2535	2680	2845	2990	3140	3465	6200	6550	7306	7690	7960	8133
1965	2350	2545	2685	2850	2995	3145	3510	6206	6573	7325	7700	7970	8140
1977	2355	2550	2690	2855	3005	3150	3525	6225	6575	7340	7710	7980	8141
1980	2360	2557	2695	2860	3010	3155	3550	6235	6600	7350	7720	7990	8150
1985	2365	2560	2700	2865	3015	3160	3655	6240	6606	7375	7730	8000	8160
2010	2370	2565	2705	2870	3020	3165	3700	6250	6625	7400	7740	8006	8163.4
2015	2375	2570	2710	2875	3025	3170	3825	6273	6640	7406	7750	8008	8166
2017	2390	2575	2715	2880	3030	3175	3885	6275	6650	7425	7760	8010	8170
2020	2415	2580	2720	2885	3035	3180	3940	6300	7000	7440	7770	8016	8173
2025	2430	2585	2725	2890	3040	3185	3955	6306	7006	7500	7780	8020	8180
2035	2435	2590	2730	2895	3045	3190	3980	6315	7025	7510	7783.3	8025	8183
2040	2440	2595	2735	2900	3050	3195	3990	6325	7040	7520	7790	8030	8190
2055	2442	2600	2740	2905	3055	3200	6000	6335	7050	7530	7800	8033	8191
2060	2450	2603	2745	2910	3060	3202	6006	6340	7073	7540	7810	8040	8200
2065	2455	2605	2750	2915	3065	3205	6025	6350	7075	7550	7820	8041	8206
2090	2460	2610	2755	2920	3070	3210	6040	6362	7100	7560	7830	8050	8208
2105	2465	2615	2760	2925	3075	3220	6042	6373	7106	7570	7840	8058	8220
2125	2470	2620	2765	2930	3080	3225	6050	6375	7125	7580	7850	8060	8225
2130	2475	2625	2770	2935	3085	3230	6073	6405	7140	7590	7860	8066	

FT-243 HOLDER

Lots of 10 or more. Each 34c
Lots of 5 or more. Each 39c
Individually. Each 49c

4035	4300	4635	4930	5295	5645	5782.5	5906.7	6275	6706.6	6906.6	7625	7975	8475
4045	4330	4680	4950	5300	5660	5800	5907.5	6300	6725	6925	7673.3	8240	8500
4080	4340	4695	4980	5305	5675	5806.7	5925	6306	6740	6940	7675	8250	8525
4095	4395	4710	4995	5327.5	5687.5	5820	5940	6325	6750	6950	7706.6	8273	8550
4110	4397.5	4735	5030	5335	5700	5825	5950	6340	6773.3	6973.3	7725	8275	8575
4135	4445	4780	5035	5385	5706.7	5840	5955	6350	6775	6975	7773.3	8300	8600
4165	4450	4785	5090	5397.5	5725	5850	5973.3	6373.3	6800	7450	7775	8306	8625
4175	4490	4815	5127.5	5435	5730	5852.5	5975	6375	6806.6	7473.3	7806.6	8325	8650
4190	4495	4820	5165	5437.5	5740	5860	5995	6400	6825	7475	7825	8340	8675
4215	4535	4840	5180	5485	5750	5873.5	6206.6	6406.6	6840	7506.6	7873.3	8350	8690
4220	4540	4845	5205	5500	5760	5875	6225	6425	6850	7525	7875	8375	
4255	4580	4852.5	5235	5545	5773.3	5880	6240	6673.3	6873.3	7573.3	7906.6	8400	
4280	4610	4880	5245	5582.5	5775	5892.5	6250	6675	6875	7575	7925	8425	
4295	4620	4900	5285	5587.5	5780	5900	6273.5	6700	6900	7606.6	7973.3	8450	

FT-241-A HOLDER

Lots of 10 or more. Each 79c
Lots of 5 or more. Each 89c
Individually. Each 99c

400	442	446	450	453	456	459	463	466	470	474	477	
440	444	447	451	454	457	461	464	468	472	475	479	
441	445	448	452	455	458	462	465	469	473	476	480	

FT-241-A HOLDER

Lots of 10 or more. Each 39c
Lots of 5 or more. Each 44c
Individually. Each 49c

370	381	391	401	409	419	429	438	490	498	508	518	529
372	383	392	402	411	420	430	481	491	501	509	519	530
374	384	393	403	412	422	431	483	492	502	511	520	531
375	385	394	404	413	423	433	484	493	503	512	522	533
376	386	395	405	414	424	434	485	494	504	513	523	534
377	387	396	406	415	425	435	486	495	505	514	525	536
379	388	397	407	416	426	436	487	496	506	515	526	537
380	390	398	408	418	427	437	488	497	507	516	527	538

FT-171 HOLDER

Lots of 10 or more. Each 79c
Lots of 5 or more. Each 89c
Individually. Each 99c

			2123	2280	2415	2582	3010	3422.5	3660	3812.5	3980	4245	5225
			2125	2282.5	2435	2630	3010.5	3500	3667.5	3825	3995	4255	5492.5
			2131	2290	2442.5	2665	3175	3510	3682.5	3870	4012.5	4280	6000
			2145	2300	2467	2725	3202.5	3520	3695	3880	4037.5	4310	6210
			2150	2305	2470	2780	3205.5	3550	3700	3945	4050	4345	7165
			2155	2320	2500	2835	3215	3562	3712.5	3950	4080	4350	7950
1151.8	1940	2045	2191	2340	2532.5	2911	3237.5	3569	3760	3955	4097.5	4360	8000
1562.5	2010	2065	2220	2360	2545	2940	3250	3570	3790	3966.5	4110	4400	9200
1738	2030	2082	2258	2390	2550	2967	3322.5	3580	3807.5	3970	4112	4735	9590
1746	2040	2105	2260	2405	2557	2990	3400	3637.5	3810	3975	4177.5	5200	

NOTE! All items subject to prior sale and change of price without notice. MINIMUM ORDER: $2.50. All orders MUST be accompanied by check, cash or M.O. WITH PAYMENT IN FULL. No C.O.D. CALIFORNIA BUYERS add sales tax. INCLUDE APPROXIMATELY 5c PER CRYSTAL FOR POSTAGE. **DEALERS & JOBBERS: WRITE FOR SPECIAL QUANTITY DISCOUNTS.** All buyers invited to write for FREE crystal catalogue giving complete list of frequencies.

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Fundamental Frequencies

Individually. Ea. $1.25
Lots of 10 or more. Ea. 99c
AVAILABLE IN EITHER DC-34 OR FT-243 HOLDERS. Specify your needs.
All frequencies from **3588 KC THROUGH 3599 KC** in steps of 1 KC. fractions omitted.
Examples: 3588, 3589, 3590, etc.
All frequencies from **3701 KC THROUGH 3748 KC** in steps of 1 KC. fractions omitted.
Examples: 3701, 3702, 3703, etc.

AVAILABLE IN FT-243 HOLDERS ONLY
Individually. Ea. $1.25
Lots of 10 or more. Ea. 99
All frequencies from **7176 KC THROUGH 7198 KC** in steps of 1 KC. fractions omitted.
Examples: 7176, 7177, 7178, etc.

MISCELLANEOUS & SHIP BAND FREQUENCIES

81.95 KC. Octal tube type (Used in SCR-584 & SPM-1) $3.99
200 KC. in FT-241 holder 1.99
200 KC. Type DC-15 in octal tube base type holder 1.99
327.8 KC. No. D-168342. (Used in TS-102/APH) 9.95
500 KC. in FT-241 holder 1.99
1000 KC. in FT-241 holder 2.49
1000 KC. Type DC-9, in octal tube base type holder 3.45
2000 KC. in FT-243 holder 1.99
2142 KC. in DC-34 holder 2.99
2174 KC. in DC-34 holder 2.99
2182 KC. in FT-243 holder 2.99
2500 KC. in FT-243 holder 1.99
2632 KC. in FT-243 holder 2.99
2637 KC. in FT-243 holder 2.99
2638 KC. in DC-34 holder 2.99
2638 KC. in FT-243 holder $2.99
2670 KC. in FT-243 holder 2.99
2847 KC. in FT-243 holder 2.99
2670 KC. in DC-34 holder 2.99
2738 KC. in type 1-C holder 2.99
2738 KC. in FT-243 holder 2.99
2738 KC. in MC-7 holder 2.99
3000 KC. in FT-243 holder 1.99
3088 KC. in FT-243 holder 2.99
3093 KC. in FT-243 holder 2.99
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3188 KC. in FT-243 holder 2.99
3193 KC. in FT-243 holder 2.99
3198 KC. in FT-243 holder 2.99
3203 KC. in FT-243 holder 2.99
5000 KC. in FT-243 holder 1.99
10,000 KC. Type SR-5 Bliley, in CR-1 holder 1.99

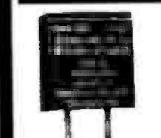
DC-34 & DC-35 CRYSTALS
Your Choice. Ea. only 99c

			2240	2415	2605	2851	3095	3395	3665	3870	4020	4175	4370
			2255	2422	2625	2853	3117	3412.5	3680	3885	4030	4177.5	4380
			2258	2435	2643	2894	3149	3422.5	3695	3890	4035	4192.5	4397.5
			2275	2446	2665	2895	3155	3462	3700	3895	4050	4210	4415
			2280	2466	2685	2899	3161	3480	3750	3905	4055	4215	4435
1690	1890	2090	2295	2467	2710	2925	3190	3485	3760	3920	4065	4235	4440
1705	1910	2105	2300	2478	2711	2926	3201	3500	3765	3925	4080	4240	
1720	1930	2106	2315	2491	2725	2960	3270	3520	3770	3935	4085	4255	
1738	1950	2131	2326	2500	2732	2971	3279	3540	3775	3940	4090	4275	
1746	1970	2155	2335	2510	2745	2980	3280	3550	3790	3950	4095	4280	
1770	1990	2175	2340	2415	2764	3000	3297	3575	3792.5	3960	4097.5	4305	
1790	2010	2195	2355	2527	2775	3010	3311	3580	3807.5	3965	4115	4310	
1810	2030	2202	2360	2540	2776	3023	3317	3610	3825	3985	4130	4325	
1830	2050	2215	2375	2559	2807	3027.5	3365	3630	3830	3995	4135	4335	
1850	2075	2220	2390	2586	2816	3055	3385	3650	3850	4012.5	4150	4345	
1870	2082	2235	2395	2587	2831	3077.5	3390	3655	3855	4015	4155	4350	

CR-1A HOLDERS

Lots of 10 or more 69c
Lots of 5 or more 74c
Individually. Each 79c

			5980	6670	7120	7460	7930	8032	8116	8171.2	8272.5	8340	8423
			6181	6700	7130	7470	7960	8050	8126	8176	8284	8351	8428
			6350	6740	7160	7550	7980	8060	8128	8193.2	8290	8357	8430
			6380	6750	7180	7570	8007	8080	8132.3	8194.2	8297.1	8373	8438.7
			6450	6890	7230	7590	8010	8090	8137	8200	8308	8374	8475
5020	5300	5590	6510	7010	7350	7670	8013	8092	8140	8205	8317	8380	8502.8
5041.6	5520	5677.7	6530	7020	7360	7730	8018	8103.7	8142.8	8216.2	8320	8392	8528.5
5180	5550	5700	6550	7040	7400	7790	8020	8110	8146.1	8220	8328	8400	8554.2
5208.3	5583.3	5722.2	6650	7080	7440	7810	8025	8115	8152	8260	8335	8404	8580
													8590



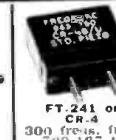
DC-11A HOLDERS

Lots of 10 or more. Each 69c
Lots of 5 or more. Each 74c
Individually. Each 79c

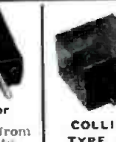
			2589	2960	3355	5001	5990	6510	6650	7400	7920	8198.8	8428
			2740	2993	3500	5230	6010	6520	6666.6	7490	8001.4	8236	8450
			2750	3021	3750	5315	6130	6530	6890	7530	8007 69	8269	8465.4
			2781	3025	3925	5542	6350	6540	7010	7610	8050	8283.5	8476
			2876	3070	4350	5660	6440	6550	7090	7650	8140	8306.2	8502.8
2070	2174	2350	2890	3250	4500	5685	6450	6627.5	7170	7730	8155.8	8361.4	8525
2134	2326	2410	2900	3315	4755	5710	6490	6630	7250	7810	8188	8380	

AR7-W
1500 to 3400 KC.
Ea. $2.99

FT-164
201 to 4300 KC.
Ea. . . $3.99



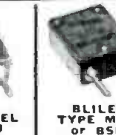
FT-241 or CR-4
300 freqs. from 729.167 to 1040.625 KC. in steps of every 1.041 KC.
Ea. 99c



COLLINS TYPE 1-C
1335 to 4467.5 KC.
Ea. . . . $1.99

RCA MI-8412 A or B
2618 to 5805 KC.
Ea. $1.99

RCA MODEL AVA-10J
160 to 6510 KC.
Ea. . . . $1.99



BLILEY TYPE MC-7 or BSD
143.94 to 8730 KC.
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AVA-S3
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MX9-E
Freqs. & Prices on request.

AA9-A PIEZO ELECTRIC
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Ea. $1.99

AR-4W or FT-249
1398 to 4765 KC.
Ea. $1.99

BSD-180G
956.875 to 1300 KC.
Ea. . . . $1.99

CRYSTALS GRINDING KIT with instructions. 10 crystals, grinding equipment and labels.
For 80 METERS. $7.95
For 40 METERS. 6.95
For 2 METERS. (18th Har.) . . $6.95
For 2 METERS. (24th Har.) . . 6.95

U. S. CRYSTALS, INC.,

805 S. UNION AVE.,
LOS ANGELES 17, CALIF.

MORE OLD TIME OPERATORS REPORT

By C. HOWARD BOWERS

IT IS very interesting to note that the majority of the old time wireless operators we have contacted have prospered in their chosen field, and many have wound up as big wheels in their respective communities. Take Sydney J. Fass, for instance; he now makes his home in Berkeley, Cal., but is identified as one of the larger radio and television dealers in San Francisco. Syd became interested in the fundamentals of wireless back in 1909 and, with some other lads, including Dick Johnstone, Bob Hatch, et al, they put in their spare time learning the code, as Syd himself describes it, "By whistling through their buck teeth!". Anyway, in building his first wireless rig he was aided and abetted by Haradan Pratt, who is now the Aide for Communications to President Eisenhower. From there, his efforts must have been effective because by 1911 Sydney, who was then sixteen, secured his Certificate of Skill from the U. S. Department of Commerce and Labor and soon after was a full fledged sea-going operator. He says he still has his original "ticket" which is endorsed by the skipper of the good ship "Falcon" which he claims was the first steel steam schooner ever built, also by skippers of the tankers "Oleum" and "Washtenaw"—two of the "foulest smelling crude oil carriers on the Pacific Coast!" After that came the old Pacific Mail Liners "San Juan" "San Jose" and "Acapulco" from San Francisco to Central America.

An urge for more schooling brought our ambitious subject ashore and in 1914 he graduated from the California School of Mechanical Arts after spending the summer of that year as operator aboard the Matson liner "Larline" from Pacific ports to Honolulu, T.H. The sea-going urge still prevailed and young Fass continued on to the good ship "Geo. W. Elder" between West Coast ports and Central America.

In 1917, Uncle Sam called Syd for Navy duty and he saw plenty of action in the European Theater.

World War II was no exception and Syd was again in Navy uniform. However, he has now retired as a Commander after 33 years of Naval Reserve service and a liberal collection of "fruit salad" and "scrambled eggs".

During recent years he has followed the natural pattern—amateur radio—and now has one of the finest ham rigs we have seen in years. With a full kw. transmitter, and a Collins receiver, it's no wonder his name frequently appears in ham magazines as holder of DXCC and WAC awards—no wonder! His call is W6NZ and he has enough QSL cards to shingle a roof—a warehouse roof. That's not all. He has a nice wife and a home in the college town of Berkeley, California, across the bay from San Francisco. A success story, if we ever heard one! Continued good luck, Mr. Fass.

* * *

WE HAD to go clear across the continent to catch up with another West Coast Old Timer. It's the story of John M. Boyle, RFD #1, Alma, Georgia, as told to his friend, Jack Williams, of the same city.

John M. first succumbed to the wireless bug in 1911 in the days when iron men and wooden ships frequented San Francisco Harbor and when Pacific Street 'twasn't a boulevard. He reports having secured his Certificate of Skill from R. B. Woolverton, Wireless Inspector at San Francisco in 1912. His first sea-going job was wireless operator aboard the Schooner "Yosemite" sailing between Puget Sound and San Diego with stops at Portland, San Francisco, and San Pedro. Those were the good old days when L. Malarin was chief operator for Marconi and every trip into San Francisco meant a trip to the Merchant's Exchange Building to check with "L.M."

One small vessel followed another until 1914 when he signed on the "S.S. Uncas" operated by the Tank Storage and Carriage Company of London and sailing deep water between San Francisco and the Orient. It was easy those days to pick your own run and in 1914-1915 John pounded brass for Standard Oil Company on various tankers between San Francisco, Chile, Peru, and Vancouver. In 1916 he switched to the Ward Line and was so occupied until the Army tapped him on the shoulder in 1917 for a very important job as Corporal in the

Syd Fass (left) is a young-looking "Old Timer" but as photo below testifies he was an active "op" in the "Good Old Days".

Signal Corps. He followed this duty in 1919 with a tour for Marconi on trans-pacific ships to China and India. (We thought for a second he was going to slow down.) In 1920, John joined the U.S. Army Transport Service and was assigned to "USAT Mt. Vernon" on a voyage to Germany. However, just after passing through the Panama Canal the vessel lost a prop and the trip termintaed at Portsmouth Navy Yard, where he was assigned other duty. After his one hitch in the Army, John evened the score by joining the U. S. Coast Guard in 1914 as a Chief Radioman and served along the east coast until paid off in 1931.

Up to now, our fast moving companion had traveled on everything that boasted a wireless set—well, not quite everything, for in 1932 he accepted employment with the U. S. Airways as operator at various points including Cleveland, Pittsburgh, Erie and—yes he's coming to a stop—Alma, Georgia. There must have been other attractions at Alma besides being Chief Airways Operations Specialist for the now-called U.S. Civil Aeronautics Administration, but our wireless career-man concludes with, "Present communication is a far cry from the old days of 1912." To which we say, "Amen!" Our congratulations, Mr. Boyle on a job well done! —30—

TVI Troubleshooting

(*Continued from page* 39)

quency of the beat. In the event that the lines are horizontal, as in Fig. 5, multiply the number of dark horizontal lines by 60 (since the vertical scanning frequency is 60 cps) for the beat frequency.

Unfortunately, all beat frequencies cannot be determined quite this simply because if the beat is high, one megacycle or more, the number of interfering lines becomes difficult to count. In those cases, use a scale and count the number of lines that occur in one inch. Multiply this number by the number of inches in the picture width, and then multiply this figure by 15,750 cps to obtain the frequency of the beat. In the case of modulated interference signals, make the measurement during the periods of no modulation. With a little experience, it is possible to come very close to the correct frequency even in the presence of the modulation.

A technician may find that in a particular case of interference, the beat frequency changes as he turns the receiver fine tuning control. This means that the interference is "tunable." What does this mean in terms of receiver functioning?

When the fine tuning control is adjusted, the frequency of the oscillator is changed and the i.f. frequencies that correspond to the r.f. video and sound carriers are changed. At the same time, during this fine tuning adjustment, there is absolutely no change in the frequencies of the r.f. video and sound carriers, and in the difference frequency between the two carriers (4.5 mc.). Also, the frequency of any outside interfering signal is not changed by any means within the receiver.

These clues can help us to further identify the interference frequency and type. If the beat is due to an interfering signal heterodyning with the r.f. video carrier frequency, the beat will be untunable, *i.e.*, the fine tuning control will have no effect upon the interference pattern on the CRT. For example, if an interfering signal occurred at 63.25 mc., which is 2 mc. away from the video carrier of channel 3, the oscillator and mixer when properly tuned, will produce a 45.75 mc. i.f. for the carrier and a 43.75 mc. i.f. signal for the interference (assuming a 41-mc. i.f. system). Detuning the oscillator will change the 45.75 mc. i.f. signal, but it will also change the 43.75 mc. i.f. interference signal the same amount, and the difference between the two signals will always be 2 mc.

If, however, the interfering signal entered through the i.f. "gate" at a frequency say of 43.75 mc. (police interference), tuning the oscillator to produce a 45.75 mc. i.f. for the video carrier would produce a beat of 2 mc. Detuning the oscillator in this case would change the 45.75 mc. i.f. for the video carrier, but it could not change the frequency of the 43.75 mc. interfering signal. Therefore, the beat frequency would change and the interference would be "tunable."

The various "gates" previously discussed can be classified according to whether they are sources of "tunable" or "untunable" interference. The "tunable" ones are the i.f. and image gates; the "untunable" ones are the video, desired channel, and upper and lower adjacent channel gates. Since most of the internal sources of interference produce harmonics of the video i.f., the beat produced by them will be "tunable," since detuning the set changes the i.f. frequency and likewise, the frequency of the harmonics.

(To be continued)

PHONE JACK CASE

By HUGH LINEBACK
Oklahoma A & M College

FOR mounting a phone jack at the end of a cable; a neat housing can be easily made from the aluminum cans used for packaging cartridges of 35 mm film. A photo dealer, or a photographic friend, will have discarded containers.

Holes for the jack and for the cable can be punched in the thin material with a center punch, and a rubber grommet inserted in the lid opening to protect the wire. -30-

Details of the handy phone jack case mounted at end of cable. It is easy to make.

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.

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.

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

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-102, 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.
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- ☐ 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.

RADIO-TV Service Industry News

AS REPORTED BY THE TELEVISION TECHNICIANS LECTURE BUREAU

PERHAPS the most significant feature of the recent annual IRE Convention was the clearly evident passing of the vacuum tube from its place of dominance in the electronics industry. As one milled through the vast crowds that swarmed through the immense Kingsbridge Armory every day of the four-day show it was the widespread exhibition of transistorized devices that left the most striking and lasting impressions on many observers.

The rapidly growing magnitude of electronics as an industry was clearly evident in the tremendous volume of registrations at this year's show. And while major engineering attention was given to developments in color TV, transistors, and transistor circuitry, new electronic devices for applications in the medical, biological, and industrial fields indicated the broadening scope of the industry's activities.

In attending these engineering shows, your editors try to appraise these developments on the basis of their possible future effect on the activity of independent service. As "coming events cast their shadows before," the introduction of basically new equipment usually presages changes in the operational structure at all industry levels. This will be especially true of the service field as more complex circuitry demands more skillful technicians, and trained service business management finds ways and means to provide top-flight service and maintain a high level of customer confidence.

When black-and-white television was being readied for sale to the general public there were two schools of thought about its effect on the then radio servicing industry. One group held that monochrome TV would be much too complex for the average radio service technician to comprehend and that, as a result, manufacturers would be forced to set up their own servicing departments to handle the installation and maintenance of their receivers. The other group felt that TV would be absorbed by the radio service industry in time, and that servicing would be handled by thousands and thousands of individual technicians working from their homes and small, inexpensive business establishments.

Television did make some drastic changes in the structure of the independent servicing industry. It did not, however, fall into either pattern visualized by these two schools of thought. It established its own pattern and one that will be thoroughly capable of expanding with the needs of color TV and transistorized devices as they are sold commercially.

Pattern of the Service Industry

For the past six months the Bureau has been receiving registrations for its planned National Electronics Service Directory from service businesses all over the country. More than 15,000 of these registrations have been received and the information supplied on these thousands of registrations provides the clearest picture of the actual structure of what is known as the "independent service industry" that has ever been compiled.

At the present time a complete analysis of these registrations is underway. However, an analysis of a representative sample of these registrations has already been completed. Your editors feel that this sampling provides sufficiently accurate figures to illustrate the type of business structure that has been created to handle monochrome TV servicing.

It should be pointed out that the listings in the National Electronics Service Directory are restricted to full-time service businesses so that the figures cited here represent the activities only of recognized, established service businesses.

The average annual volume of business handled by the service businesses represented in the sampling analysis is $33,463.41. For comparison of the present servicing industry with the prewar radio service industry consider the Department of Commerce figures on the average volume of business done by radio service shops in 1939—$6103.00 per year. This would indicate that the average shop today is doing five times the volume of business that the average radio shop handled in 1939.

The average number of technicians employed in the surveyed service businesses is 4.19. The average number of technicians employed in radio service

YOU'LL FIND BARGAINS GALORE AT PLATT'S NEW "SUPERMARKET"

Now, here's your chance to pick up real super-bargains at PLATT'S newly enlarged giant retail store at 489 BROOME ST., N. Y. C. Unfortunately, this ad permits us to list only a few of our many, many sale items, so why not come down now and browse around.

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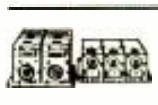
GENERAL ELECTRIC MAZDA LAMPS, #623, 24-28 Volts, 6 candle power—sensationally priced at only **$2.50 per hundred.**

PRE-AMPLIFIER MODEL K-1

The K-1 is used to amplify output level for microphones and phonographs. Operates on 24-28 VDC, can be converted to 110 AC. Comes complete with PL 55 plug and 2-foot 110-B cord. 2 terminal blocks. BRAND NEW ..... SPECIAL! **$3.95**

BC-221 Frequency Meter

Real Value! QUANTITY IS LIMITED —so first come, first served. They are just like new, with original calibration charts. Range 125-20,000 KC with crystal check points in all ranges. Complete with crystal and tubes. Standard with AC power supply **$159.50**
MODULATED TYPE **$179.50**
MODULATED TYPE with AC Power Supply ... **$199.50**
Limited quantity of BRAND NEW MODULATED FREQ. METERS **$210.00**
These Frequency Meters are factory treated, checked for frequency alignment and GUARANTEED.



SCR-274N COMMAND and ARC-5 EQUIPMENT

	USED	EXCELLENT USED	NEW
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BC-453—190 to 550 KC		$24.95	$49.95
BC-454—3 to 6 MC		14.95	24.95
BC-455—6 to 9 MC		12.95	18.95
1.5 to 3			29.95
TRANSMITTERS			
A-958—2.1 to 3 MC			24.95
BC-457—4 to 5.3 MC		12.95	
BC-458—5.3 to 7 MC	$8.95	12.95	
BC-459—7 to 9.1 MC			24.95
T-15 ARC 5—500 to 800 KC			24.95
ADDITIONAL EQUIPMENT			
BC-456 Modulator			6.25
BC-450 Control Box (3 Receiver)		1.95	2.98
BC-451 Control Box (Transmitter)	1.29	1.79	2.49
BC-442 Relay Unit (ANT)			5.49
Flexible Shafting with gear to fit receivers			1.95
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DM-33 Dynamotor for Command Set			3.95

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Complete, Brand New. Special! **$4.95**

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Used with BC-433 & R5-ARN-7 Army Compass Receivers. Excellent, used **$19.95**

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A 12 tube remote control manual direction finder desirable for commercial type navigation on boats and planes. Has a frequency range of 150 kc to 1500 kc in 3 bands. This frequency covers the beacon and standard broadcast bands. Operates on 28 V DC input. Complete installation consists of:

MN26C Receiver—Brand New $39.95
MN26E Rotable Loop 9.95
MN28 Remote Control Box 17.95
2 Flex Shaftings 5.00
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2 Plugs 3.00
1 MN52 Azimuth Control Box 2.95
1 Left to Right Indicator 4.95
SPECIAL! Complete Installation $74.95
(You Save $11.30)

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HS-23 high impedance. BRAND NEW with ear pads $4.65
HS-33 low impedance. BRAND NEW with ear pads, cord and PL54 plug 5.65
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CD-307A Cords, 6 ft. NEW 1.49
HS-16 high impedance—used ..... .98

HEADSET ADAPTER MC-385

Used with headsets HS-33 or HS-38—raising the impedance from low to high. Comes complete with PL 55 PLUG ..... **ONLY 49c**

SPECIAL!

45 Henry 60 ma 625 ohm. **LIMITED QUANTITY OF THESE CHOKES** **$1.00**

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T-44 MIKE—magnetic type consisting of Mike Unit MC-233. Cord CO-287. Plug PL-179 and Jack JK-26 ..... $1.29
T-45 MIKE—Carbon Lip Mike 1.95
T-17 MIKE—Carbon—BRAND NEW 9.75
TS-13 HANDSET—BRAND NEW 7.95
T-12—Western Electric Carbon Hand Mike with Cord & PL-68 Plug. BRAND NEW 3.95

INTERPHONE AMPLIFIER, BC-347-C, NEW ..... $ 2.95
LOCALIZER RECEIVER, 733-D, NEW ... 39.95

TAKE YOUR PICK FROM THESE BARGAINS!

CRYSTALS for the BC-458 Command Transmitter, plug-in type, 6200 KC, BRAND NEW $1.95
Complete set of **COILS** for BC-458 Command Trans. 3.95

BC-357 RADIO BEACON RECEIVER

UHF Aircraft Receiver with frequency range from 62 to 80 mc for receiving 75 mc marker beacon signals. Power requirements are 24 volts DC at .158 amps and 220 volts at 4.5 milliamperes. Used. **SPECIAL! SPECIAL!** **$7.95**

T9/APQ-2 RADAR TRANSMITTER

80/115V 400-260-26 VDC. Designed primarily for aircraft operation.

NEW! $19.95

AS-65/APQ-2 ANTENNA ASSY. FOR APQ-2. COMPLETE—BRAND NEW **$5.95**

BC-433—RADIO COMPASS RECEIVER, 200 to 1700 KC, used, excellent condition, less tubes $24.95
BC-434—CONTROL BOX for above, BRAND NEW 4.95

SENSATIONAL SALE! ARC-5/R-28 2 MTR RCVR

$19.95

Here is the 2-meter superhet you have been looking for! Absolutely one of the BEST available today! Tunes from 100 to 156 Mcs. in four crystal channels. (Easily converted to continuous tuning.) Tube lineup is as follows: 717A—R.F., 717A—Mixer, 2-12SH7—1st and 2nd I.F. 16.9 Mc. 12SL7—Det. AVC Squelch, 12SL7—1st audio-squelch amplifier. 12AG—2nd audio. 12SH7—R.F. Osc.—4th Harmonic Gen. 717A—Trip. 12th Harmonic Gen. 717A—Dblr.—12th Harmonic.

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J37 ..... $1.50
J38 ..... 1.50
J41 ..... .98
J45 ..... 3.95

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For Rural Areas, Hotels, Commercial Steamers, Ball Parks, Etc.

U. S. NAVY type PAE-1 Electric Megaphone equipment is designed for voice reinforcement in much the same manner as, but to a greater degree than, the familiar acoustic megaphone. Consists of Megaphone Unit (which combines a microphone and reproducer in a single assembly). Portable Amplifier which electrically amplifies the output signal of the microphone section of the megaphone and feeds this amplified signal to the reproducer section. Charging Rack for recharging the self-contained storage battery of the portable amplifier. BRAND NEW—A TREMENDOUS VALUE! DEMONSTRATION GIVEN AT PLATT'S STORE **$149.50**

MINIMUM ORDER $2.00

Immediate delivery — send 25% deposit on C.O.D. orders. If sending full remittance, allow for postage and save C.O.D. charges. All shipments F.O.B., N.Y.C. warehouse. (N.Y.C. residents add sales tax.)

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60% TO 90% OFF LIST!

OC3/VR105	.80	6J6	.55	47A	1.19
OD3/VR150	.85	6K8	.65	532A	1.19
1B22	.69	6L6GA	1.05	717	.79
1A7	.69	6L6M	1.20	722A	.99
1L4	.49	6N7	.70	801A	.19
2B22	.49	6S47	.49	826	.39
2C26	.09	6SJ7	.54	832A	6.95
2C26A	.09	6SK7	.54	836	5.50
2D21	1.15	6SL7	.59	837	1.35
2X2	.39	6SN7	.55	841	.29
3B22	1.19	6SS7	.75	843	.17
3D6	.39	6SU7	2.49	864	.19
5R4GSY	1.15	6Y6	.70	931A	4.75
5U4	.70	7C4	.39	1626	.19
6AG5	.70	12A6	.55	1633	.19
6AJ5	1.25	12AH7	1.20	2050	1.30
6AK5	.75	12AT7	.85	2050W	2.35
6AK5W	1.45	12C8	.59	5654	1.85
6AL5	.49	12H6	.55	5670	3.25
6AL5W	.75	12L8	.29	5726	1.25
6AQ5	.52	12SG7	.75	5749	1.25
6AS6	1.90	12SH7	.59	5751	1.50
6BA6	.54	12SJ7	.54	5814	1.70
6BE6	.54	15R	.39	6096 CT	1.75
6BQ6	1.15	28D7	1.50	7193	.19
6C4	.50	39/44	.29	9002	.69
6D4	2.50	114B	.29	9003	1.15
6H6	.50	215A	.09	E1148	.49
6J4	4.25	221A	.29	RK34	.99
		316A	.29	VR92	.14
		388A	.59	VT127	.15

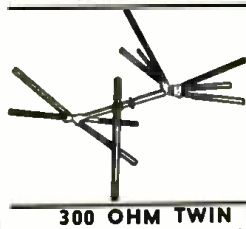
Cathode Ray TUBE REJUVENATOR

Fits all makes of picture tubes. Completely automatic. Easy to install, no tools needed. For A.C. parallel circuits. Your Old Picture Tubes Are Still Useful. List price—$5.95.

TERRIFIC SAVING! BRAND NEW **99c** each

SCOTCH BRAND SOUND RECORDING TAPE 111A

1200 feet (List Price $5.50)
SPECIAL! $2.99



TV ANTENNAS

RMS—8 Element Conical BRAND NEW $2.95
DELSON—10 Element Conical—BRAND NEW $3.25
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shops in 1939 was 1.3. Also, 22% of the businesses covered in the current survey are 1-man shops; 56% employ from 2 to 5 technicians; 18% employ from 6 to 10 technicians; and 4% employ more than 10 technicians. Back in 1939, more than 80% of the radio service businesses were 1-man shops and the percentage that employed more than 2 men was insignificant.

This clearly indicates the growth in size of individual service businesses and a pattern of operation that utilizes the services of four men on an average.

The operation of service businesses has been carefully studied by practically all of the major receiver manufacturers. Any manufacturer who produces equipment that requires continuing service must be constantly cognizant of the availability of competent service wherever his products are sold to maintain consumer confidence in his brand.

Parenthetically, it should be pointed out that, to the best of your editor's knowledge, none of the major set manufacturers have any plans whatsoever for creating their own company-controlled national servicing departments to handle color TV installation and service. It has been proven that, in general, the most efficient, economical, and profitable method of handling consumer electronic service is through capably managed, competently staffed, independent service companies.

It is interesting to note that the analysis of service businesses showed 4% that employed more than ten technicians. It also shows that 4% handle air-conditioning installation and service. This would indicate that all large service organizations have turned to air-conditioning as a means of leveling off their service volume and maintaining their technical staffs the year 'round.

The survey indicates that most of the multiple-manned organizations have expanded their activities to include electronic devices other than home TV and radio sets. For instance, 70% handle wire and tape recorder service; 85% handle auto radio service, but only 13% are handling any work on 2-way communications systems. Four per-cent of these businesses have engineering facilities and have prepared themselves to handle closed-circuit television when that phase of TV starts to expand.

Effect of Color TV

It is possible to make a reasonably accurate projection of the future growth of an activity from an analysis of the need for the services it has to sell. In the case of color television receiver service it is quite obvious that considerably more service calls per set will be required than has been necessary on monochrome TV. The present national average of service calls per TV receiver is said to be somewhere around 2.9 calls per set in operation. The present estimate of the frequency of service that will be required on color TV sets is 12 calls per year. The in-

vestment per technician in test instruments for field service is yet to be determined, but for many color TV ills a man will have to have more than a v.t.v.m.

There is no doubt that contract service will return with the sale of color TV receivers. However, manufacturers and distributors will be more cautious about the qualifications of the service companies they authorize to handle contract service than they were on monochrome TV. And they can be, for there are excellent service facilities available to them in capably managed independent TV service shops in every section of the country.

The present shops that are authorized by manufacturers to handle contract service on color TV receivers will expand their personnel and facilities to handle the volume of business they get. They will work with nonservicing dealers, of course, and even though they are factory-authorized service depots they will have to compete with other service companies for dealers' business.

TV service companies will avoid the mistakes that floored so many service businesses in the early years of TV. Over-expansion, unlimited dealer credit on contract monies, improper accounting and allocation of contract fees, and slip-shod handling of supplies and replacement parts—these are the things that finally spelled disaster to many service businesses in the late forties and early fifties.

Many radio-appliance dealers will add their own service departments to handle color TV installation and service. Thirty-six per-cent of the businesses included in the analysis of service businesses are radio-TV appliance dealers with major service departments. These companies have found their service departments to be consistently profitable operations. An expansion of service departments by set retailers will open up many good opportunities for present small shop operators who cannot finance color TV equipment, to take lucrative jobs as service managers for major retailers.

On the basis of 12 calls per year per set, independent service businesses that handle color TV should expand from an average of 4.19 men per shop to about 15 men per company. The present independent TV service industry can easily support this expansion because the management skill and "know how" is already there—developed by monochrome TV.

Selling Service

Regardless of how good a technician a man may be, if he doesn't get enough work week after week and month after month to pay all of his expenses, and provide a better-than-average income for his family, he will live constantly on the fringe of failure. The constant problem of any business is to maintain a consistent or growing volume of business. This is true of grocery stores, drug stores, department stores, and service shops.

There is no sure fire system of busi-

ness promotion for any business. Each city, town, hamlet, and community has its own small individualities, and local promotions will take these things into account when they are planned. Each type of business, too, has its individual characteristics, so a promotion that works well in one type of business will not necessarily work in another type.

Service businesses compete for dollars that set owners would much rather spend for other things. Television service should be the easiest type of service to sell because the product itself can be "romanced" even from the standpoint of servicing. It is the focal point of interest in the home and any consistent program detailing the beauty of better pictures or more enjoyable sound would have a more receptive audience than service promotional literature on any other device in use in the home. Yet only a handful of TV service companies have done more than advertise that they have the facilities to service TV sets when a set owner needs TV service. The most successful service companies use direct-mail promotions in preference to all other forms of advertising because they have accumulated tested mailing lists.

One of the most aggressive cooperative programs for service selling is one sponsored by the *G. M. Popkey Company*, a wholesale distributing organization in San Francisco. They set up an organization which is known as the *GMP Qualified TV Service Dealers*. Any servicing dealer or independent service operator in northern California can become a member of this organization by agreeing to strictly adhere to the code of ethics and signing a pledge to maintain high ethical standards in the conduct of his business.

The code of ethics provides:

1. Employ qualified trained personnel. No student shall be passed off as a journeyman technician.
2. Avoid trick advertising which offers to service or deliver materials under conditions which are questionable.
3. Issue a standard RETMA guarantee with all work.
4. Have sufficient and proper test equipment to insure good work.
5. Install only such parts and tubes as are really necessary to assure continued performance.
6. Use only new parts and tubes of equal or better quality than original equipment.
7. Issue an itemized bill.
8. Service sets at home whenever possible and practical.
9. Carry adequate insurance coverage.
10. Be honest, courteous, and treat each client in an accepted professional manner.

Each member of the *GMP Qualified TV Service Dealers* signs the following pledge:

"I pledge that I will conduct my business activities as a dealer in such a manner as to cast no discredit on myself, my competitors, or the television service industry.

"I further pledge that I will promptly take all necessary steps to correct any legitimate complaints which may be brought against me during the course of my business.

"I further pledge my assistance to the *G. M. Popkey Company* in carrying out its plans for educating the public and to maintain the standards of ethical and technical practices in the industry."

In support of the *GMP Qualified TV Service Dealers*, the *G. M. Popkey Company* has sponsored a highly popular TV program, coordinated member advertising in local newspapers in support of this program, and just recently launched a TV service time payment plan that enables the members to sell service on a time payment basis with no down payment required and monthly payments as low as five dollars per month. The important feature of this plan to dealers is that the finance company handles the paper without recourse. Space does not permit a detailed outline of this plan but readers who are interested in having these complete details may obtain them by writing to TTLB Special Services, P. O. Box 1321, Indianapolis 6, Indiana. —30—

Jack Sterner, K6ATA; Dr. Jose Polak, XE1VA, vice-president of the Mexican Radio Experimenter's League; John Griggs, W6KW, ARRL director for Southern California; Guy Dennis, W6DI, U. S. convention manager; and Ed Luckey, W6MJ, public relations manager for the U. S. get together to discuss the international convention being held in Acapulco May 27th through 30th. The 22nd annual convention of the Mexican group is being opened to hams, technicians, engineers, service technicians, and electronic manufacturers throughout the world to help promote brotherhood and fraternity among such groups. In addition to exhibits, technical sessions, and contests the meet will feature a diversified program of fiestas, sightseeing trips, a banquet and ball, as well as fishing and cruising at the resort city of Acapulco.

Scope Calibrator

(*Continued from page 42*)

impressed on the plate exceeds the bias value. The plate of the second diode is biased negative with respect to ground by an equal amount so that there is no conduction across that section until the impressed negative voltage exceeds the bias voltage. When the voltage impressed across a diode section exceeds the bias voltage, diode conduction takes place, "shorting out" all voltage above the bias value, so that the peak value of the output voltage cannot exceed the bias voltage. In consequence of this connection, the sine-wave input is clipped, with the positive and negative peaks being equal and flat, and the peak-to-peak output voltage equal to the total bias voltage. This clipped sine-wave ("semi-square wave") output is then fed to a calibrated voltage divider through a calibration resistor, and from this circuit clipped sine waves of known peak-to-peak value can be coupled to the oscilloscope.

Rather extensive use of a simple unregulated oscilloscope calibrator of this design disclosed that, although it performed exactly as advertised, its utility was greatly restricted by vagaries of the local supply voltage. To improve the electrical operation, regulation of the bias voltage was necessary. At the same time, a few mechanical changes, largely a matter of personal taste, were found desirable. These included the addition of a strong handle on the case, to prevent droppage; replacement of the line cord by a plug; addition of new rubber feet; and addition of a pilot light, so that the calibrator would not be left on overnight. A change in binding posts, to match those used on other equipment was also made; and a fuse was added, so that the instrument would comply with the local electrical code.

This circuit as shown in Fig. 2 with all alterations incorporated is now operationally equivalent to the best 60-cycle calibrator now commercially available. The panel view of the modified calibrator is shown in Fig. 1. The handle, a Stanley #3 door pull, is ideally suited for electronic equipment because it is large enough to fit a man's hand, and the mounting holes exactly fit a standard 10-32 rack screw. During remodeling, all screw holes were tapped 6-32, and the self-tapping screws supplied with the instrument were replaced by 6-32 binding head machine screws.

Interior above-chassis view of the modified voltage calibrator is shown in Fig. 3. The socket for the regulator tube, an 0B2, is mounted in the hole formerly occupied by the calibration resistor (after some reaming); and the calibration resistor was moved to a vacant area between the rear of the multiplier switch and the dual diode. So that the instrument would

not creep out of calibration, a *Millen* shaft lock was added to this control. Optimum panel location for the pilot light is on the vertical center line, just above the upper edge of the Z-shaped chassis. So that the pilot light bracket would seat firmly, a large washer, with the lower periphery flattened to clear the chassis and the upper to clear the cabinet, was placed between the panel and the pilot light mounting bracket. An *Amphenol* type 61-M plug was mounted in the center back of the chassis to replace the line cord. This also required enlarging the cord hole in the case.

Changes beneath the chassis were few, and consisted of adding a fuse clip (Fig. 4) in the a.c. circuit; mounting the dropping resistor for the regulator tube; attaching cable-clamp hold-downs over the two condensers; and recabling the wiring. The clamp ring of the a.c. plug was soldered to the chassis to prevent rotation or creeping of the plug. Under-chassis appearance of the instrument is shown in Fig. 4.

These modifications necessitated readjustment of the calibration resistor. This was done in the following manner: The calibrator output was connected to the oscilloscope input, and both instruments were turned on and allowed to warm up and stabilize. A maximum reading of 100 volts peak-to-peak was desired. As peak-to-peak volts are 2.828 times the r.m.s. value obtained from sine waves, a sine-wave voltage input of 35.36 volts r.m.s. is needed for calibration. With the multiplier switch of the calibrator turned to *signal*, this voltage (obtained from the filament supply of a tube-checker) was applied across the input of the calibrator, and a good a.c. voltmeter was shunted across it, to insure that the applied voltage, at the time of calibration, remained at 35.36. The oscilloscope gain was then adjusted until the sine-wave pattern was exactly two inches high (Any other convenient height may be used). The calibrator switch was then set to X 10, and the potentiometer to 10, and, being sure that the oscilloscope gain has not been changed and that the input voltage to the calibrator is still 35.36, the calibration resistor of the calibrator was adjusted until the semi-square wave pattern was exactly two inches high. After locking the calibrator shaft, and checking the adjustment, the calibrator was put in its case. It is now completely ready for operation.

This voltage calibrator performs satisfactorily in actual use, and appears to be operationally as good as some commercial models costing more than three times as much. Rather interestingly, although it would not be economical to make an oscilloscope calibrator "from scratch," it is definitely cheaper to modify a kit calibrator than it is to buy a commercial model, if your time is worth $5.00 per hour or less!

—30—

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3-Bands, 1-Vertical

(*Continued from page 67*)

unit this took place when all turns but one were shorted out. The single turn lowers the reactance to the same value obtained with a 1200 $\mu\mu$fd. condenser. While discussing the 80-meter tuning network it might be well to mention that it is realized that the antenna can be brought to resonance and the feed-point matched by using a slightly smaller inductance in the series position and substituting an inductance at the same point we are now using the shunt condenser. This eliminates the need for the large condenser, however, the network is no longer a low-pass filter and harmonics will receive little attenuation. By using the condenser, the system is properly matched and at the same time undesirable harmonics greatly attenuated.

An r.f. bridge was used to determine the values of resistance and reactance of the antenna on each band. This was necessary to provide information for designing the L-networks; however to duplicate the antenna system it is only necessary to have some form of standing wave indicator which can be placed in the transmission line so the tuning network may be adjusted to the exact value to produce a low standing wave on the line. It is only necessary to watch the standing wave indicator while making a small change in the shunt capacity of the L-network. After it is set at the lowest reading, the inductance is then adjusted slightly to improve the standing wave ratio even further, after which the condenser adjustment is made again. The two operations are repeated several times until the standing wave is reduced to a very low value. Since the network corrects for both reactance and resistance values of the tower it is possible to obtain an excellent standing wave ratio. It is better to adjust the system as described rather than trying to duplicate the original installation to the letter. Small variables such as proximity of the antenna to other objects or a slightly different base mount will make it necessary to make minor changes in the antenna tuning network settings.

You will notice that C_1, the condenser used on 80 meters, is positioned on the coax side of the coil, while C_2 (40 meters) is on the antenna side of the coil. This is because the antenna base resistance is lower than the characteristic impedance of the transmission line when used on 80 meters. Just the reverse is true on 40 meters. In each case the antenna impedance is made to look like 52 ohms at the coax side of the network. The amount the impedance is raised or lowered by the network is determined by the relationship between the coil, condenser, and antenna impedance.

The tuning network assembly is enclosed in an ordinary RFD mailbox, see Figs. 1, 4, and 5. Several different containers were tried but the mailbox has proved most satisfactory since it is rainproof, sturdy, and easily accessible. The rivets along the side of the box were removed so the top cover may be hinged back from the tuning units when they are adjusted. When changing bands it is only necessary to open the front door. The mail box is mounted beside the antenna base and a piece of copper braid about 10 inches long connects to the antenna. The braid was made from a piece of the outer conductor of RG-8U coax. Any double-pole, three-position switch with low-loss insulation will work well. The type used for high-voltage meter switching or tank circuits is excellent. Standard inductor clips are used to tap the coils. The tower consists of a 30-foot TV mast with two sections of thin-wall steel conduit added to the top to bring the total length to 44 feet.

The antenna has been in use for quite some time with satisfactory results. During the past "Sweepstakes" contest, while running 100 watts and using the antenna, 465 contacts were established in 69 of the 73 sections. The author is not attempting to say that this antenna will out-perform the well-elevated beam or a good rhombic but it works exceedingly well and fills a definite need for the average ham.

-30-

DIODE CHECKER

By PHIL WEISS

HERE is a simple and practical way to check a germanium diode detector in a TV set without unsoldering any leads. This is important since germanium diodes cannot stand much heat and the leads are usually pretty short.

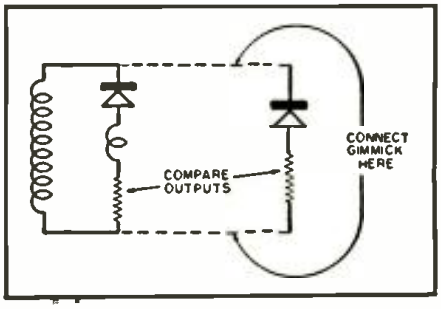
Make up a gimmick consisting of a good germanium diode in series with a 3900 ohm load resistor. Attach an alligator clip to each end of the gimmick.

In order to test a germanium diode in a set, clip the gimmick across the diode and its load resistor, as shown in the diagram, being careful to observe the same polarity. Now turn on the set and observe the video across each of the two load resistors with an oscilloscope. If both diodes are good they will have approximately the same output. A bad diode will give little or no output across its load resistor.

If the TV set does not develop any i.f. voltage at the input of the diode detector, a signal generator can be used. The generator should be set at some video i.f. frequency and modulated.

The gimmick can, of course, be used over and over again. -30-

How the gimmick described above is connected into the TV circuit to check detector.



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R.F. in Audio Systems

(*Continued from page 57*)

Shielding and Grounding

1. Analyze and lay out the grounding system with care. Run a very heavy conductor from a central grounding point in the studio, either to a cold water pipe as close as possible to the street main—or to a transmitter-type radial ground system. *Do not ground to a.c. conduit.* One network uses #4 copper conductor in conduit for the ground lead and specifies a maximum d.c. resistance of .1 ohm over its length. Use a heavy conductor to bond all rack and console frames to the central grounding point which may be a heavy bolt in the bottom of one rack. Bond all amplifier chassis firmly to their racks.

2. Run a heavy ground bus up the inside of each rack and connect to it all cable shields and the low sides of any unbalanced circuits. The rack bus should be grounded to the rack frame at only one point.

3. Shields and unbalanced circuits should be grounded only at one end to avoid ground loops which are one of the main causes of r.f. interference. When a shield or conductor is grounded at two points some distance apart, an r.f. voltage may appear across these points, since what appears as a dead short to d.c. may present an impedance to r.f.

4. Determine by trial whether or not to ground the center taps of balanced transformer windings and balanced pads. Such grounding may do more harm than good from an r.f. or longitudinal voltage standpoint.[10]

5. The r.f. pickup may occur in a preamplifier in which the input transformer secondary low side is grounded to the "B-minus" terminal of a distant power supply, instead of to the preamplifier chassis. See Fig. 2. An r.f. voltage may appear between the "B-minus" lead and the chassis and be coupled to the preamplifier proper through stray capacitances. The remedy is to ground the transformer secondary low side to the chassis, and remove the ground from the "B-minus" lead at the power supply, to avoid a ground loop.[11]

6. Use cables whose shields are tightly woven, especially in low-level circuits. This condition is often expressed as a high percentage of shielding. It should be a minimum of 80%, which means that the metal in the braid should constitute 80% of the braid area.

7. In cases of severe r.f. interference, install a second shielding braid over the cable insulation. The added shield should be carefully soldered all around to the original braid. Whether this should be done at one or both ends should be determined by trial.

8. Use shielding covers on open-bottom amplifier and power supply chassis.

9. Shield the glass tubes in low-level stages, and make sure the shell of

metal tubes (generally #1 socket pin) is grounded.

10. It may be necessary to shield not only the grid lead but also the plate lead and the plate load resistor in low level stages. The resistor shield should be of copper, brass, or other metal of high electrical conductivity.

11. Under extreme conditions of interference, build a shield of copper screening around preamplifiers, and a sheet copper shield around inductive elements like equalizers, and ground the shield. Larger sheet metal shields should have their edges turned over to form a flat surface on which to mount the cover. To maintain good contact for a removable cover, knitted wire mesh gaskets are available (*Metal Textile Corporation*. Roselle, N. J.). Such shields are obviously a "brute-force" expedient and should rarely be necessary in an audio installation.

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(To be continued)

MOUNTING CRYSTAL DIODES

By CHARLES ERWIN COHN

CRYSTAL diodes are handy components to wire into a circuit, but their installation is complicated by the fact that they can be injured permanently by excess heat during the soldering process. Furthermore, when wired and unwired many times in experimental work their leads tend to break off.

In the case of a resistor costing five cents one can take such a loss without too much grumbling, however a dollar diode is an entirely different matter and one always hopes to be able to salvage an otherwise good unit.

Soldering new leads to the diode is not too practical for the previously mentioned problem of heat damage.

All of these considerations point to the desirability of a solderless mounting for crystal diodes. Fortunately, there are two convenient methods available. Where it is possible to mount on a panel or chassis, the diode can be slipped into an 8AG fuse clip, which is just the right proportions to hold it firmly after the leads have been clipped off. Of course, this applies only to the Sylvania 1N34 and similar types with the ceramic body and two metal end caps.

If it is desired to mount the diode on leads, then the end caps can be pushed into octal-type grid clips. The National Type 8 is preferable because the diode end caps are slightly oversize. —30—

WHAT'S New in Radio

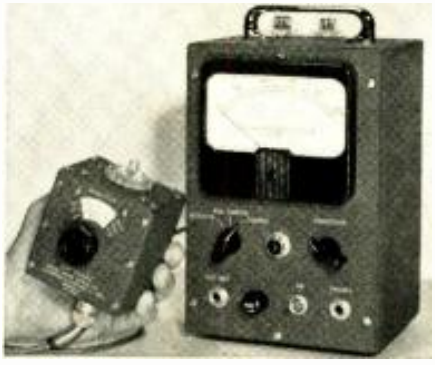
The products described in this column are for your convenience in keeping up-to-date on the new equipment being offered by manufacturers. For more complete information on any of these products, write direct to the company involved.

U.H.F. GRID DIP METER

Boonton Electronics Corp., Boonton, N. J. has announced a new u.h.f. grid dip meter, the Model 101B.

The instrument operates in the frequency range 300 to 1000 mc. in three steps. The frequency scale is approximately linear throughout the ranges which include 300-425 mc.; 425-650 mc.; and 650-1000 mc. employing three plug-in coils mounted externally on the u.h.f. probe, allowing ease of coupling to the circuits to be measured. The dial is individually calibrated to a frequency accuracy of ± 2%.

The instrument may be used to measure capacity, inductance, circuit "Q", and choke resonance as well as functioning as an auxiliary signal generator, an absorption wavemeter, and



as a means of determining many other factors in u.h.f. circuitry.

Full details on the Model 101B are available from the company without charge.

CD RECEIVER

A small radio receiver which can be worn like a hearing aid has been developed by two engineers at *General Electric Company's* Syracuse plant.

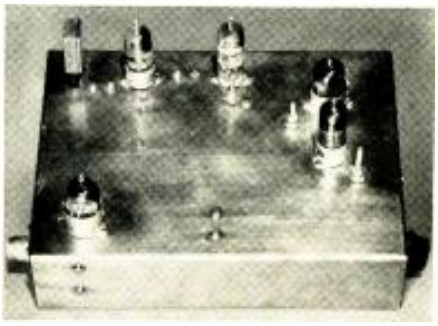
Designed primarily for civil defense applications where a compact, lightweight receiver operating from a minimum number of flashlight cells is required, the radio is tuned to a single broadcast frequency of 1240 kc.

The radio has a hearing-aid type earphone and weighs about five ounces. Further development work is being done before the radio is mass produced.

CONVERTER

Palisade Electronic Corp., 1025 Palisade Ave., Palisade, N. J. is now offering a new crystal-controlled converter, the UHF-C2.

The new unit tunes the frequency range 432-436 mc. and can be used with any receiver that covers from 11 to 15 mc. The chassis is of copper-plated steel and uses five tubes. A 6AJ4 is used as a tunable tuned-line r.f. amplifier, a 6AM4 is the mixer, a 6CB6 functions as the 11 to 15 mc. i.f. amplifier while two 6J6's are used as



the crystal oscillator and frequency multiplier. The input and output fittings are coax.

The approximate gain of the converter is 25 db and the noise figure is 7 db. Sensitivity is 2 microvolts. Bulletin UHF-4 covering this unit is available on request.

SINGLE-SIDEBAND FILTER

Burnell & Company, 45 Warburton Ave., Yonkers, N. Y. is currently marketing a single-sideband filter for amateur receivers.

Designated as the Type S-15000, the new filter utilizes a toroid coil instead of the crystal filters formerly required. The unit is compact in size and easy to install. Fixed-tuned and hermetically sealed, it requires no adjustment, is rugged and trouble-free. It may be installed in any existing amateur receiver and is also suitable for incorporation in new equipment.

Descriptive literature, including a schematic and response curve, is available from Dept. D of the company.

RADIATION DETECTOR

El-Tronics, Inc. of 5th & Noble Streets, Philadelphia, Pa. has recently introduced a radiological survey instrument, the "Rad-Tek."

Approved for use by the Federal Civil Defense Administration, the new

unit was built to FCDA's rigid specifications and requirements. It is a ruggedized ionization-type of instru-

ment, and will measure radiation intensities from .02 to 50 roentgens per hour. It operates on ordinary flashlight and hearing aid batteries capable of giving over 100 hours of operation.

The unit is lightweight, watertight, and easy to operate.

AUDIO OSCILLATOR

The Nuclid Corporation, 45 W. Union St., Pasadena, California is in production on a new line of compact, fixed-frequency, low-distortion audio

oscillators, featuring zero impedance output of 10 volts at 2 watts and a variable voltage output at low impedance.

The new DK-1 provides an inexpensive source of essentially pure, highly stabilized sine-wave power for general lab use and production testing. Frequency coverage from 300 to 10,000 cps, by hundreds, is available in stock models while the range 301 to 9999 is available on special order at no extra cost.

Housed in a ventilated metal case, the circuit is an *LC* bridge-type incorporating a high "*Q*" toroid, mica condenser and air trimmer, combined with a self-balancing feedback amplifier.

HEATH PREAMP KIT

Heath Company of Benton Harbor, Michigan has added a preamplifier kit to its line of assemble-it-yourself units.

The Model WA-P2 has three high-level and two low-level inputs with in-

dividual level controls for each input. There are two outputs—one to the main amplifier which is variable from 0 to at least 2.5 volts r.m.s. from any normal program source and one to a recorder input providing a minimum of .25 volt r.m.s. from any normal program source.

Frequency response is ± 1 db from 25 to 30,000 cps and ± 1.5 db from 15 to 35,000 cps. Low frequency compensation is provided by a four-position turnover control while the high-fre-

quency compensation is furnished by a four-position roll-off control. The unit has separate bass and treble tone controls with the bass control providing approximately 18 db boost and 12 db cut at 50 cps. Treble control provides approximately 15 db boost and 20 db cut at 15,000 cps.

DYNAMIC NOISE SUPPRESSOR

Hermon Hosmer Scott, Inc., 385 Putnam Ave., Cambridge 39, Mass. is currently marketing a new Dynaural noise suppressor, the Type 114-A.

According to the company, the new

unit virtually eliminates turntable rumble and record scratch or hiss without losing music audible to the ear. It is designed as an accessory unit for use with the company's 99 transcription amplifier or with its 214 remote control amplifier.

Frequency response is flat from 19 to 20,000 cps. Two controls are provided, the Dynaural control for adjusting the degree of noise suppression and the Dynaural range control which offers a choice of 20, 12, or 6 kc. high-frequency cut-offs each with both rumble and scratch suppression, a position for dynamic rumble suppression only and a position for suppression off. The unit is normally plugged into a circuit between the preamp and subsequent amplifying stages.

BELL AMPLIFIER

Bell Sound Systems, Inc., 535 Marion Road, Columbus 7, Ohio is now offering a redesigned version of its Model 2199 amplifier.

The new Model 2199-B features a seven-position equalization and selector switch to compensate for five types

of recording curves and for radio and tape. A loudness control is also provided. Output impedances of 4, 8, and 16 ohms, plus an auxiliary high-impedance jack are also available.

A special input is provided for frequency-modulated and ceramic pick-

ups. Output power is 12 watts at ½ of 1% distortion with a peak of 20 watts to provide performance over a wide range of operating conditions.

Complete specifications on the Model 2199-B are available from the company.

PENTRON "TAPE-MATE"

Pentron Corporation, 221 E. Cullerton, Chicago 16, Illinois is currently marketing a new AM-FM tuner which incorporates a function selector with a tape position. Selection of this position permits tape recordings to be fed through the tuner and modified by the tuner's tone control system.

The Model AFM permits program material to be recorded on tape at the same time it is being heard by listeners. A tape output is built-in and a flat response is fed to the recording device while the listener compensates the "listening program" to suit his own taste.

Complete details and specifications on the Model AFM are available from the company.

NEW MICROPHONES

Altec Lansing Corporation, 161 Sixth Avenue, New York 13, N. Y. has just introduced three new microphones to the trade.

The new Model 21C is of the condenser type and is sufficiently small to be used on the coat lapel, be hand-held, or stand-mounted. The Model 670 cardioid is similar in appearance to the manufacturer's *Western Electric* Type 639 but is a newer and smaller version.

The third microphone, the 21-BR-150, is a medical microphone which possess the ability to detect and register the beat of the human heart. It is intended for teaching and demonstration purposes in medical schools and for research and study applications.

-30-

Spot Radio News

(*Continued from page* 20)

made in this system for inclusion of simultaneous sound recording or of recording of color television.

RADAR EQUIPMENT, which will tell how successfully broadcasts from long-range transmitters, such as the "Voice of America," are reaching their destinations, was announced recently by the Air Force's Air Research and Development Command Headquarters in Baltimore.

The new setup, coded *Cozi* (communications zone indicator) was also said to indicate approximately how strong the signals are when they get to their destination, and might also reveal whether an enemy was deliberately jamming that particular frequency with static and interference.

To test a signal, the indicator equipment transmits a radar beam from the station's own antenna. The beam follows the same path taken by the radio waves. The difference, however, is that the Cozi beam comes back and tells where it has been, and often, whether it has run into any interference at its destination. The radar device is made in two units, each about the size of a steamer trunk; one is the transmitter and the other the receiver. In testing, it is necessary to interrupt the broadcast momentarily, while the radar beam is sent out. A reading is obtained instantly, and broadcasting is resumed without any appreciable break or loss of time.

The Air Force said that they intend to make extensive use of Cozi to increase the efficiency and reliability of its world-wide communications system. Interest has also been displayed by Radio Free Europe, and by several commercial radio stations in this country and Canada. It was also reported that several large industrial and shipping groups were studying the practicality of using the new radar system as a standard accessory for long-range, directional radio-broadcasting equipment.

INTERFERENCE has become one of the biggest jobs of the members of the FCC field engineering and monitoring bureau. With some 600,000 transmitters now authorized, it has become difficult enough to see that transmitters do not collide with another. But the field task has been magnified by the accidental or careless release of emissions by a host of new devices and gadgets which use r.f. energy for various non-communication purposes.

In their annual report, the Commis-

sion cited several odd cases of interference that came up during the year. Recently, many other unusual radiation cases have appeared. To illustrate, a resident of Chicago complained about the persistent annoyance to his and other TV receivers in the neighborhood. He was surprised to be told, after investigation, that the source was an electronic door-opening device on his own garage.

Complaints of interference which gave a Massachusetts city "pictureless TV" on one channel resulted in the cause being traced to test equipment in a local radio tube plant; one of the complainants.

A new TV station which went on the air in San Diego, California, was blamed for spoiling reception from other stations. Inquiry showed that the fault was receiver overloading through the use of high-gain antennas employed by viewers to extend their reception to Los Angeles. Set owners were instructed to use a quarter-wave stub to remedy the trouble.

An investigation extending over many months was required to solve an intermittent TV interference problem in Marion, Mass. The cause was finally proved to be spark-type discharges in the antenna system of a military installation located in that area.

A report from the Puerto Rico field office illustrated the down-to-earth human relations problems with which the Commission's engineers must deal in the course of their interference investigatory work. The case involved a complaint by a woman that a neighborhood ham station was interfering with the operation of a radio-phono. The amateur involved was elderly and in poor health, and his principal interest was his ham station which had been constructed and serviced for him by several fellow amateurs. Investigation of the ham gear revealed no trouble. And thus the FCC probers went to the home of the complainant. They found that interference was observed in an all-wave set only when it was in the phono position. It was further noted that the antenna consisted of a short length of insulated wire wrapped around a line cord of a very messy electric system. When the an-

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)
Alabama	Montgomery	WSFA	12	204-210	316
North Dakota	Grand Forks	KNOX-TV	10	192-198	2.82
South Carolina	Charleston	WUSN-TV	2	54-60	54.2
Texas	El Paso	KELP-TV	13	210-216	49
Vermont	Montpelier	WMVT	3	60-66	18.3
Washington	Spokane	KREM†	2	54-60	100
Wisconsin	Green Bay	.....	5	76-82	100

NEW CALL LETTER ASSIGNMENTS

Arkansas	Hot Springs	KTVR	9	186-192
California	El Centro	KELB	16	482-488
"	Stockton	KHOF	13	210-216
Florida	Clearwater	WPGT	32	578-584
Georgia	Macon	WNEX-TV	47	668-674
Massachusetts	New Bedford	WTEV-TV	28	554-560
Minnesota	Hibbing	KHTV	10	192-198
New York	Bloomingdale	WBLD	5	76-82
"	Syracuse	WHEN-TV	8	180-186
Oklahoma	Tulsa	KSPG	17	488-494
Pennsylvania	Sharon	WSHA	39	620-626
South Carolina	Spartanburg	WSPA-TV	7	174-180
Texas	Tyler	KLTV	7	174-180
Wisconsin	LaCrosse	WTLB	38	614-620

*ERP = (effective radiated power, kw.). . . = Call letters to be announced † = Temporary call letters.

tenna was unwrapped from the line cord and the line plug reversed, the interference ceased.

Some time later, however, another report was received from the same complainant. This time the agitated lady claimed that whenever she put her hand near the radio-phono pickup to change records, the amateur's voice would break through. This phenomena, she raged, was making her nervous and affecting her health. The investigating engineer discovered that the latest apparition was due to pickup in the phono-pickup leads. So he devised a wavetrap which eliminated the woman's haunt, and the amateur could continue to operate his station, which according to him . . . "made life worth living."

FOR THE FIRST TIME since the Commission began processing of new applications for TV stations, the boys are out of the woods, at least for all practical purposes.

Hearings are now being scheduled as quickly as the respective applications in a particular city are in a position to be designated for hearing. Technically, said the Commission, applications will hereafter be considered chronologically, and the temporary processing procedure and city-priority listings will be discontinued.

Notwithstanding the cleaned-up slate,

NEW TV STATIONS ON THE AIR

(As of May 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.)
California Sacramento	KBIE-TV	46	662-668	1.49	207
Florida Orlando	WDBO-TV	6	82-88	11.8	100
Maine Portland	WGAN-TV	13	210-216	4.65	239
New York Kingston	WKNY-TV	66	782-788	1.26	21.4
Tennessee Chattanooga	WDEF-TV	12	204-210	4.79	105.2
Wisconsin Madison	WHA-TV†	21	512-518	1.92	10.7
Canada Hamilton, Ont.	CHCH-TV	11	198-204	4.93	42.9

KETX, channel 19, Tyler, Texas; WACH, channel 33, Newport News, Virginia; and WOSH-TV, channel 48, Oshkosh, Wisconsin, have gone off the air.

The frequency of the video carrier = 1.25 + channel lower freq. limit. Total number of TV stations now on the air in U.S.: 384 (135 of which are u.h.f.). †Educational. *From Station CP application.

comparatively few station grants are being issued, because of hearing extensions, and delayed interest of many, awaiting the outcome of the Congressional investigation.

At this writing, channel assignments shown on page 98 have been made.

ONE OF THE MOST IMPORTANT anniversaries, of concern to every scientist in this country was celebrated in mid-Spring. The date . . . April 10 . . . and the occasion, truly the birthday of American industrial progress. On that date, in 1790, George Washington signed the bill that established our patent system, which introduced a new era and sparked so many great inventions.

When Lee de Forest took the Edison effect, in a light bulb, and converted it into a tube, he probably little realized that he would live to see the day of our modern electronic industry, built up through a chain of ingenious inventions, protected by patents.

Certainly, April 10 is a memorable date that all should remember. . . L.W.

PACIFIC ARRL MEET

THE Santa Clara County Amateur Radio Assn. is sponsoring the Pacific Division ARRL convention in San Jose, California, July 3, 4, and 5.

The program for the first two days will be held in the Municipal Auditorium in San Jose with the last day devoted to outdoor activities. Harry Engwicht, W6IIC, is chairman. -30-

International Short-Wave

(*Continued from page 65*)

Cuba—CMAS, 5.780, heard relaying program from Hollywood recently 1745. (Cody, Ireland) Santiago, 8.955, noted closing in Spanish-*English* 0030. (Barnard, Calif.)

Cyprus—Limassol noted on 6.790 at 2304 with news in Arabic, good level; weaker on 6.125, 6.170 in parallel. (Cox, Dela.) Heard on 9.650 at poor level 1025. (Barnard, Calif.)

Czechoslovakia—Radio Prague, 9.504, noted 1400 with *English* for Europe. (Sawyer, Ont.) On 7.255 to North America 1930. (Esser, Sexton, Pa.; Haycock, N. J.) Has repeat 2305 over 9.550. (Greco, N. Y.)

Denmark—OZF7, 15.165, heard opening 0400 with Town Hall chimes, anthem. (Pearce, England)

Dominican Republic—HI2T, 9.727A, noted in Spanish 1815-1830 with good music. (Rugel, Kans.) HIG, 9.590A, noted at good level in Spanish. (Barnard, Calif.)

Ecuador—HC2LT has *moved* to 6.885A from *listed* 6.795; generally good around 2200. (Hill, N. H.) HCJB, 11.915, noted 2100 with religious session in *English*, good level. (Sicks, Ore.) Heard on 9.743A at 0000 with German session. (Calos, Calif.)

Egypt—Radio Cairo, 9.475, noted in news session 1330-1340. (Leake, N. J.; Golden, Mass.) Heard on 15.315 ending *English* news 0840, then continuing with Eastern music. (Ferguson, N. C.) Arabic Service noted on 12.030, 7.060 around 0000-0200. (Cushen, N. Z.) At 1100 on 11.965 and near 7.035; another day at 1040 near 9.740; another day around 1400 near 7.060. (Pearce, England)

Ethiopia—Radio Addis Ababa, 15.054A, weekdays has news 1315. (Pearce, England) Noted with recordings Sun. around 1400-1430 close, widely heard in USA. (West, Va.; Sutton, O.; Huttemeyer, N. J., others)

Fiji Islands—ZJV3, 3.980, Suva, noted 0615 with music. (Sanderson, Australia) Has newscast 0400. (Morgan, Calif.; Saylor, Va.)

Finland—Helsinki, 15.190, heard opening 0430 with news in French, then news in *English* 0445. (Pearce, England) Should have news for America 0600 now.

France—Paris, 15.295A, noted opening 0820A with "La Marseillaise." (Silverman, N. Y.) Is using 7.220 for "French by Radio" 0245. (ISWC, London) Noted on 15.100 around 1030-1045. (Stark, Texas)

French Africa—Brazzaville, 9.440, good level in news 1745. (Grace, Conn.) Heard with *English* 1400 over 15.595. (Cox, Dela.)

French Guiana—Radio Cayenne, 6.232A, noted around 1730-1830 when closes with "La Marseillaise." (Swayer, Ont., others)

French W. Africa—Dakar, 11.894A, noted 1500 with news in French. (Pearce, England) The 9.562 outlet is

widely heard with *English* 1715-1730 on Mon., Wed., Fri., Sat.; Portuguese that time Tue., Thur. (Esser, Pa., others)

Germany—Cologne, 15.275, noted closing 0830 with announcements in German, *English*, French in beam to Far East; said 11.795 was parallel. (Silverman, N. Y.) This transmission heard opening 0530 on 11.795. (Pearce, England) Noted some days around 1315 on 11.795. (Niblack, Ind.) *Radio Liberation*, Munich, now uses 6.055, 6.175, 7.130. (ISWC, London) Home Service noted from NWDR, 6.075, Hamburg, at 1750 with classical music, announcements in German by man. (Bellington, N. Y.)

Greece—Athens, 9.607, has news in French 1230, in *English* 1245. *Forces Station*, Athens, near 7.420, noted 0730 with Greek Songs, and closing 1700 with Greek National Anthem. (Pearce, England)

Guatemala—TGTN, 5.970, noted with Spanish music 2230-2300. (Middleton, O.) TGNC, 9.668, is good in *English* session 2200-2345. (Klein, Va.; Sexton, Pa.) And parallel over TGNC, 11.850. (de Neuf, N. Y.)

Guadeloupe—FGHAA, 6.066A, Basse-Terre, noted 1815 in French with QRM from XEXE, Mexico (Cox, Dela.) Poor level 1730 in heavy CWQRM. (Barnard, Calif.)

Haiti—Radio Citadelle, 4VWA, 6.153AV, Cap Haitien, noted 1900 when identified in French. (Niblack, Ind.) 4VC, 9.485, is excellent around 1730. (Middleton, O.) 4VEH is using 9.658A mornings and 9.675 (Sun., Mon.) evenings *EST*. (West, Va.) 4VCP operates on 6.365, has French news 1850. (*La Radio Mondiale*, France)

Hawaii—VOA relay, 6.195, good in oriental languages 0630-0700. (Roberts, Conn.

Holland—Hilversum noted on 6.025 at 1630-1710 at fair level in *English*. (Parsons, Pa.)

Honduras—HRN, 5.885, good nightly, best around 2000-2100. (Pearce, Ill.)

Hong-Kong—ZBW3, 9.525, heard 0600 with BBC news relay, then music. (Sanderson, Australia) Heard opening 0400 now—*one hour earlier than formerly*. (Balbi, Calif.)

Hungary—Budapest, 9.833, noted relaying Moscow from 1400. (Sawyer, Ont.) Heard on 6.248 with news 1500. (Sutton, O.)

Iceland—TFJ, 15.175, Reykjavik, is heard Sun. (*only*) at good strength 1115-1130. (ISWL, England)

India—AIR, 5.990, noted with news and music; on 9.755 at 1930 with news; at 2030 with news on 11.870. (Sanderson, Australia) *English* news sessions now are 1930-1940, 11.950, 9.755; 2310-2320, 15.130, 11.870; 0235-0245, 17.740, 15.380; 0835-0845, 11.960, 9.565; 1045-1055, 15.380, 11.920.

Indo-China (Vietnam)—Radio France-Asie, 15.420, noted 0430 with *English* program of music and news. (Sanderson, Australia)

Iran—EQO, 3.786A, Teheran, is strong in New Zealand with French 1500, *English* news 1515-1530 close-

down. (Cushen) Johansson, Sweden, says noted with native and Western music 1300-1445 on 6.155, 9.680, 3.850. Eriksson, Sweden, says *English* 1515-1530 closedown is noted over 6.155, 9.680.

Iraq—Baghdad is now on 11.705. (Cushen, N. Z.) Noted by Collett, N. Z., opening 2330 with chirping of bird identification; has severe interference from Moscow from 0045; closes 0205. (Radio Australia)

Israel—Tel Aviv, 9.010A, noted in *English* 1615-1700 closedown. (Leake, N. J.) Heard with news 1515. (Welch, Mass.) *Forces Station. listed* 6.725, noted *nearer* 6.705 at 1445 with dance recordings, closing 1500 with "Lights Out" (bugle). (Pearce, England)

Italy—Rome, 9.570A, noted 1920-1935 with news, steady level. (Howard, Fla.) With French 1935-1945A. (Grace, Conn.) Lately, 9.780 has been noted in parallel. (Ferguson, N. C., others) Heard opening 0540 to Far East on 17.800, 15.400, 15.120. (Pearce, England) Noted on 7.290 at 2150 with news. (Bigley, Pa.)

Jamaica—Radio Jamaica, 3.360, noted closing 2308 with "God Save the Queen." (Bellington, N. Y.)

Japan—The *first commercial* shortwave station in Japan is expected to be on the air from "Nippon Tanpa Hoso" (Japanese Shortwave Broadcasting Co.) in July; will use JOZ, 3.925, 5 kw., and JOZ2, 6.095, 5 kw.; programs will include educational features sponsored by Japanese Ministry of Education; studios, transmitters are in Tokyo. (Wada, Japan, others) Tokyo noted on 9.695 at 0005-0100. (McDonald, Calif.) And then 0200 with news. (Kahan, Calif.)

Luxembourg—Radio Luxembourg, 6.090, noted around 1530 and later. (Sawyer, Ont.)

Madagascar—Radio Tananarive, 9.515, noted at weak strength 2300 in French. (Cox, Dela.)

Malaya—BFEBS, Singapore, noted opening 0415 on 15.435, 11.820, news 0415. Heard on 7.120, 9.690 at 1045 with BBC sports relay. (Cooper, Morgan, Calif.) Heard on 11.820 at 0800 with BBC news relay. (Sawyer, Ont.) The 11.955 outlet is again heard to 0930 closedown. (Stark, Texas, others)

Radio Malaya, 7.200, Singapore, noted 0630 with musical selections, then stock quotations. (Sanderson, Australia) Kuala Lumpur, 6.025, is good level 0630. (Christie, Calif.) *Forces Station.* Singapore, noted on 5.010A at 0745 with native music, man in Fijian; weak level. (Morgan, Calif.)

Monaco—Radio Monte Carlo, 7.349, noted daily around 1515-1730A sign-off; fair level, mostly French, sometimes with *English.* (Levy, N. Y.) Noted on 6.03A at 1815-1845 in French. (Winthrop, N. C.)

Mozambique—The *English* request session from 2300 is noted over 3.480 parallel 11.742A, 4.916A. (Morgan, Balbi, Calif., others)

New Caledonia—Radio Noumea, 6.028A, noted opening 0200, good level but with interference from AFRS out-

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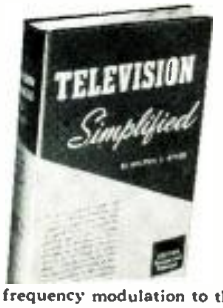

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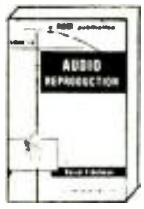

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let on 6.040; closes 0535. (Sawyer, Ont.; Morgan, Christie, Calif.) Heard on 3.375 at 0530 with news in French, music. (Sanderson, Australia)

New Zealand—Revised summer schedules of *Radio New Zealand* include 1300-1545, 9.520; 1600-2345, 11.830; 0000-close, 9.520 to Australia. At 1300-1545, 9.540; 1600-2345, 11.780; 0000-to close, 9.540 to the Pacific Islands; close is 0545 weekdays, 0620 Sat., 0500 Sun. (Morgan, Calif.)

Nicaragua—Saylor, Va., says YNWW, *Radio Sport,* has *moved* from 7.850A to 8.000A, noted at 1800 and still going strong at 2300.

Nigeria—Fairs, England, says Kaduna, 3.327, has increased power from 300 w. to 7.5 kw. and is audible in England around 1430. (URDXC)

North Korea—Radio Pyongyang, 6.250A, has Korean news and music around 0500. (Sanderson, Australia)

Norway—The *summer* schedules of *Radio Norway* include to North America, North Atlantic 2000-2100, 6.130, 7.210, 9.610, 1578 kc.; to North America West Coast, Pacific, East Africa 2300-0000, 6.130, 7.210, 9.610, 1578 kc.; on Sun. each transmission is extended by 20 minutes for "Norway This Week" (*English*). (Halvorsen, Norway)

Okinawa—VOA Relay Base is using 7.165A in parallel with 6.145. (Balbi, Calif.)

Pakistan—Karachi's *new* 10 kw. outlet on 3.395 is strong with *English* news 1015. (Cushen, N. Z.) Heard on 9.645 at 2015-2100, good level. (*N. Z. DX Times*) Noted with news 1015 on 7.010; with slow-speed news 1310-1330 on 7.010, 6.235. (Pearce, England) Noted on 9.645 at 1930 with *English* program of news, music; at 1600 on 6.235. (Sanderson, Australia)

Panama—HORT, 6.060A, *Radio Balboa,* Panama City, noted at excellent level 1930. (Niblack, Ind.)

Paraguay—ZPA4, *Radio Stentor,* 9.735, is scheduled 1730-2200, sometimes has bad QRM from HI2T, Dominican Republic; heard in Germany. (ISWC, London) *Radio Teleco,* 11.85, lately has had fair signals as early as 1750; closes around 2105. (Gay, Calif.)

Peru—OAX4T, 9.562, Lima, noted closing 0000, good level. (Koch, Ore.) Is nice signal around 2015. (Hill, N. H.) *Radio San Cristobal,* 6.216, Lima, heard to 0000. *Radio Excelsior,* 6.153V, OBX4G, Lima, noted at fair level around 2400. (Rastorfer, N. Y.)

Philippines—VOA Relay Base, San Fernando, North Luzon, heard at good level 1030 on 9.655. (Churchill, Calif.) DZH8, 15.300, Manila, noted with news 2300. (Cooper, Calif.) Heard over 9.73 and 11.855 in *English* 1015-1030, both good level. (Koch, Ore.)

Pitcairn Island—ZBP now operates in *English* over 12.110, 500 watts, 0000-0100. (Scheiner, N. J.)

Poland—Warsaw, 11.740, noted with *English* 0730, good level. (Niblack, Ind.)

Portugal—Lisbon heard on *new* 12.140 outlet opening with time pips, "A Portuguesa" at 0945 and closing

1200; opening another day 0600. (Pearce, England) Noted on 9.74A at 1730 in Portuguese, strong level. (Chatfield, N. Y.)

Portuguese India—Radio Goa, 9.610, noted 1105 with popular musicals and songs in Portuguese; 1130 with request program in *English.* (Pearce, England)

Reunion—Radio St. Denis, 7.170, noted at poor level with heavy QRM 1015. (Barnard, Calif.)

Roumania—Bucharest, 6.143A and 9.570, is heard irregularly with *English* for North America now both 2200-2230, 2330-2400 closedown. (Morgan, Balbi, Cooper, Calif.) Audible 1430 with *English* on 6.210, 9.252A, 6.145, 9.570. (Pearce, England)

Sao Tome—CR5SC, 4.807, noted opening 1600 with 3 strokes of gong. (Sutton, O.)

South Africa—SABC, 11.93, noted 1400 with news. (Pearce, England) Johannesburg, 4.895, noted with setting-up exercises in Afrikaans 2345. (Cox, Dela., others) Heard on *experimental* 9.680 at 1135. (Calos, Calif.)

Spain—Radio Murcia, near 7.105, noted 1750 with Spanish recordings; closed 1800 with Nationalist March-Anthem; Santa Maria, 7.210, also audible with popular musicals 1745 and closed similarly 1800. (Pearce, England) After *testing* on 9.585 for a time, Madrid is back on 9.363 (permanently, says) with *English* still 1515, 1800, 2205A. (Parsons, Ray, Pa.; Strong, Md., many others)

Surinam—PZC, 15.405, Paramaribo, noted 1930 with dance music, announcements in Dutch. (Ferguson, N. C.)

Switzerland—The 2030-2300 session to North America during *summer* is being radiated over 6.165, 7.210, 9.535.

Syria—Damascus, 7.235, noted in French 1530-1630, *English* then to 1730 closedown. (Pearce, England)

Taiwan (Formosa)—Taipeh's 15.235 and 11.725 outlets have had better signals lately with *English* 2300-2330, 0030-0100. (Gay, Morgan, Calif.) BED32, 9.778A, noted 0530 with Western music, then news in Chinese. (Sanderson, Australia) Heard in native on 7.134A around 0530-0730. (Chatfield, N. Y., others)

Tangier—"The Radio Voice of International Evangelism," Box 219, British Post Office, Tangier, listed frequency of 7.305, call of WIET, schedule of weekdays 1500-1600, Sun. 0800-0900. (Cody, Ireland) Heard closing 1600 with announcements in *English,* Spanish, and asking for reports. (Pearce, England) *Reklame Radio,* 7.305, is carrying out further *tests* irregularly around 1400-1500, 1700-1800: wants reports to Rosenorns Alle 58, Copenhagen, Denmark. (ISWC, London) This one noted 1440 with varied musicals. (Pearce, England) Has no regular schedule as yet. (Fledelius, Denmark) VOA relay of *Radio Maroc,* French Morocco, on 15.205 at 0730-0930 is widely heard throughout the world.

Thailand—HSK9, 11.670, Bangkok, noted with *English* and Thai identifi-

cation prior to 0655 closedown with National Anthem. (Ferguson, N. C.) Heard closing Home Service around 0928. (Pearce, England; Sawyer, Ont., others) Noted 0415 to Thai Forces in Korea, closed 0520 and reopened 0525. (Balbi, Calif.)

Trinidad—VP4RD, 6.085, is good level 0545-0600 when often is blocked by YSC, El Salvador. (Pearce, Ill.) Just audible on 3.275 with news 2100.

Turkey—Ankara is noted in Europe well with *English* on 7.285, 9.465 at 1600-1645. (*"SWL"*, Norway) TAT, 9.515, noted in *English* 1815-1900 to North America, good level. (Howard, Fla.; Welch, Mass.; Marsha, Pa.; Strong, Md.; Haycock, N. J., others) *Technical University of Istanbul Radio*, 7.030, noted 1425 with classical music.

Vatican—HVJ noted with *English* 1000, 1315 over 9.550, 11.685. (Eriksson, Sweden)

* * *

Press Time Flashes

An interesting novel based on amateur (ham) radio is *"Stand By for Danger"* by E. G. Mygatt, published by *Longmans, Green and Co.* and which has been running serially in *"Boys' Life,"* the national Boy Scout journal; included at the end of the book is some valuable factual information on ham radio, carefully checked by ARRL. This is a fine book for teen-agers written out of the author's "intense conviction that, so far, ham radio has only scratched the surface possibilities of direct communication between young people the world over."

"SWL" is the house organ of Kristiansand S. DX Club of Norway.

WWK37, Box 3746, San Juan, Puerto Rico, heard 1900 with *test* transmission; QSL letter states that *Radio Corporation of Puerto Rico*, which operates this one, uses it only for overseas radiotelephone service, is *not* a broadcasting station. (Smith, N. Y.) By now, Israel's *new* 50 kw. transmitter should be on the air. (Klein, Va., others) At press time, Niblack, Ind., reported picking up *Radio Ceylon* on *new* 11.770 opening 2030, announcing 7.190 as in dual.

Summer schedule for the "Happy Station Programs" from Hilversum, Holland, Sun., are—0530-0700 to Europe, Asia, South Pacific, 17.775, 15.425, 15.220, 11.950, 6.025; 1100-1230 to Europe, Near and Middle East, 15.425, 15.220, 11.950, 11.730, 6.025; 1630-1800 to Spain, Portugal, South America, 11.730, 9.590, 6.025, and 2130-2300 to USA-Canada, 9.590, 6.025.

A *new* Brazilian is Radio Clube Paranense Ltd., C. Postal 448, Curitiba, Parana, Brazil, operating on 11.935 from around 1530; call is PRB2, is 1 kw., soon to be increased to 25 kw. Will have regular transmissions as soon as equipment installation has been completed. (ISWC, London) Sunspot count predictions, as heard from Berne, Switzerland, are—June 3, July 3, August 3, Sept. 3. (Ferguson, N. C.)

Cushen, N. Z., flashes that *Radio Tahiti* now is scheduled 2300-0000, 6.135, 7.027 (Tahitian); 0000-0200,

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7.025, 7.125 (French); 1700-1715, 7.025, 7.125 (Tahitian), and 1715-1800, 7.025, 7.125 (French). *Radio Espana Independiente,* clandestine, has been heard in Britain on *measured* 7.616 at 1440. (URDXC)

Revised *summer* schedules for *Radio Japan* are 0000-0100, 9.695. 11.780; 0200-0300, 15.135, 11.780; 0400-0500, 15.135, 11.725; 0530-0730, 9.695, 7.180; 0745-0845, 9.695, 11.725; 0900-1000, 9.695, 11.725; 1000-1100, 9.695, 11.725; 1115-1215, 9.695, 11.725; 1230-1330, 9.695, 7.180; 1400-1500, 9.695, 7.180; 1800-1900, 15.135, 11.780. Domestic stations include 7.2755, 1500-0500; 7.285, 1600-0500; 4.910, 1600-1715; 9.655, 1725-0500; 15.225, 2200-2300, and 11.800, 0500-0800. (Wada, Japan)

At press time, Balbi, Morgan, Christie, Calif., furnished this latest data on Indo-Chinese stations—"Voice of Vietnam" has news 0930 over 9.625, 6.17; the 7.29 outlet carries native-type program then; all three close 1000; 9.625 noted at excellent level opening 0400. *Radio France-Asie* noted on 6.115 with news in French 1015, closing 1030; heard on 9.750A with news 1100-1130 closedown; on 11.830 with news 0900, closing 1120A; the 7.230 outlet is heard in French and/or native from around 0500 and closing around 0900.

A station heard on 7.935A weak to fair around 0600 in Korean and with music is believed Pusan, South Korea, back on the air after having been destroyed by fire some months ago. (Balbi, Calif.)

Eddie Startz of PCJ, Hilversum, tells me it is hoped that *Radio Nederland* will have its first 100 kw. station in operation by the end of 1954, with three more to follow in 1955 and 1956.

A harmonic of CKCW, Moncton, New Brunswick, Canada. is widely heard at times around 7.300A.

* * *

Acknowledgment

Thanks for all the FB reports! Keep them coming during the summer to Kenneth R. Boord, 948 Stewartstown Road, Morgantown, West Virginia, USA. Good listening, fellows!

.....K. R. B.

The Crosley "Super-V"

(Continued from page 63)

tuned absorption-type trap. It is easily installed by sliding it down over the coil form of L_{101} to within approximately 3/32" of the secondary winding. (See Fig. 10.) It can be fixed in place by holding a hot soldering iron near enough to fuse the wax on the form. Once the coil is in place, it can be readily tuned by inserting the iron core in the top end of L_{101} and adjusting it to the setting where the interference disappears.

Bifilar-wound interstage i.f. transformers are used to obtain maximum gain and bandwidth, and a low time constant in the grid circuits.

Diode detection is used in the "Super-V." The diode is housed in the same envelope with the pentode used for the 3rd i.f. amplifier.

The video amplifier grid resistor, R_{119}, is returned to a point which is approximately 2-volts positive. This gives the video amplifier greater signal handling ability, and thus prevents the peaks of the negative-going sync tips from cutting off the tube at high-input levels. Without this positive-going bias, the sync tips are compressed (*i.e.*, the ratio of the sync pulse to the total signal is reduced) in the plate circuit at high-signal inputs, causing unstable pictures or even a total loss of sync.

A double-tuned transformer, L_{105}, is used to couple the 4.5-mc. sound i.f. signal from the video amplifier plate circuit to the sound i.f. amplifier grid. This type of coupling provides maximum selectivity and, at the same time, the primary serves as an effective 4.5-mc. trap to keep the 4.5-mc. sound i.f. off the picture-tube cathode.

An electrostatically-focused picture tube is used in the "Super-V." It has many features which warrant its use. Its adjustment is not too critical, it provides even focus over the entire picture, and the focus does not change appreciably with changes in line voltage. It also does not require a bulky focus coil or magnet.

A fixed voltage is applied to the focus element by connecting it to the +150-volt circuit. If, at some future date, a replacement tube is installed which requires a higher or lower focusing potential, it can be readily obtained by disconnecting the focus lead from the +150-volt circuit and connecting it either to the +260-volt or the +480-volt boost circuit, or to the chassis.

Fig. 8. Bottom view of the continuous-type u.h.f. tuner. Note the shielding.

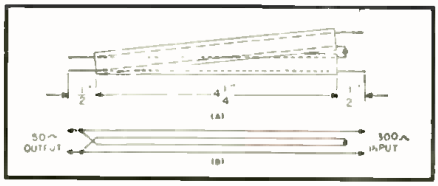


Fig. 9. Details of the balun for matching the 50-ohm input of the continuous u.h.f. tuner to the 300-ohm antenna line.

The brightness control varies the bias on the cathode of the picture tube. It is mounted on the vertical chassis just above the 25L6 audio output tube. (See Fig. 2.) In most locations, the brightness control does not have to be changed when tuning from one station to another. However, in cases where an external control is desired, a special extension shaft, *Crosley* part #158188, is available as an accessory item to adjust the brightness control without removing the back.

Sync and Sweep

The sync-clipper circuit uses the triode section of the 6AN8, and features a double time-constant circuit in the input stage. This provides maximum noise immunity for a wide range of noise impulses. The components have been grouped together in the printed-circuit *Couplate*, C_{129}.

When a single time-constant circuit is used, high-noise impulses quickly charge the condenser (due to the low grid impedance of the tube when it is drawing grid current) to a peak value higher than the sync pulses. Thus, the bias on this tube immediately after a series of high-noise pulses is too high to allow the sync tips to cause the tube to conduct. The result is a loss of sync immediately following heavy noise pulses. To overcome this problem, a second time-constant circuit is used, consisting of the 330,000-ohm resistor shunted with the 270-$\mu\mu$fd. condenser. The 330,000-ohm resistor slows the charging time of the .01-μfd. condenser so its charge is determined only by the repetitive sync pulses and not by random noise. The 270-$\mu\mu$fd. condenser prevents attenuation of the horizontal sync pulses.

The 10,000-ohm resistor in series with the input to the *Couplate* isolates the stray capacity in the *Couplate* from the video amplifier circuit. The 25-$\mu\mu$fd. condenser from the sync clipper grid to ground is helpful in bypassing high-frequency video signals.

The output of the sync clipper is coupled in the usual manner to the triode section of a 6U8 sync amplifier. The output of the sync amplifier is coupled through the integrating network, C_{131}, to the vertical oscillator circuit and through the 20-$\mu\mu$fd. condenser, C_{141}, to the horizontal a.f.c. circuit.

Because of its inherent stability, the time-proven "synchro-guide" or pulse-

width type of horizontal a.f.c. is used. This circuit is in most respects identical to that used in previous *Crosley* models. Should the horizontal hold control shift out of range, it can be brought back into range by adjusting the top core on the horizontal frequency coil, T_{105}.

The horizontal sweep circuit is similar to the type used in previous models. There are, however, several important differences. Note that no horizontal drive or width controls have been provided. These have been eliminated in the interest of simplicity.

Horizontal drive on modern TV receivers is relatively non-critical, providing sufficient drive is used. The circuit constants in the "Super-V" have been chosen to provide ample drive, therefore no adjustment is required. In rare cases, a build-up of tolerances in circuit constants and tubes causes overdrive, which shows up on the picture tube as a vertical white line left of center on the tube. To correct this condition, a ½-watt, 22-ohm resistor can be inserted in the 25BQ6 cathode circuit in order to provide a small amount of degeneration. This resistor is used on later production receivers.

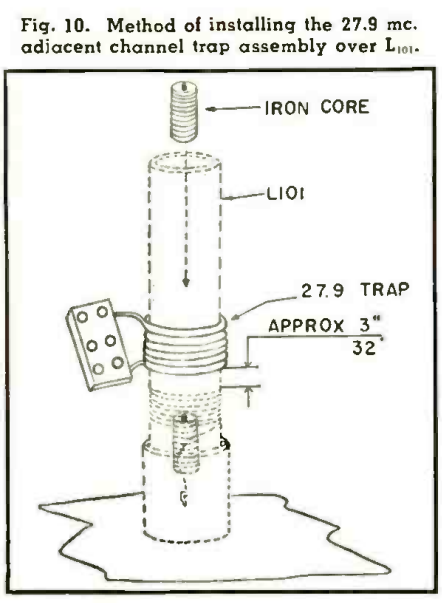
The same situation exists regarding width controls. Present-day practice calls for setting the width so that it is ample for low line-voltage conditions, and accepting the slight overscan that results at higher line voltages. In the "Super-V," the correct width at low line voltage is designed into the receiver. It may be noted, however, that a variation in width can be obtained by changing the value of the width condenser, C_{152}. Be sure, however, to use a condenser rated at 3000 volts or more. Increasing the value of this condenser makes the picture wider; decreasing it makes it smaller. To prevent horizontal foldover, do not add more than 60 $\mu\mu$fd.

The vertical sweep circuit uses a 12BH7 in a direct-coupled circuit.

Sound Circuit

The 6BN6 gated-beam tube is a

Fig. 10. Method of installing the 27.9 mc. adjacent channel trap assembly over L_{101}.



multipurpose tube that functions in this chassis as an FM limiter, detector, and 1st audio amplifier. This particular circuit was selected because the 6BN6 detector requires much less i.f. drive to obtain effective limiting than a conventional ratio detector, resulting in a better signal-to-noise ratio at low inputs. It has a high audio output, sufficient to drive the 25L6 directly, thus taking the place of an audio amplifier. The adjustable control ("buzz control") in the cathode circuit of the 6BN6 makes it possible to obtain a very effective intercarrier-buzz null. Although the circuit is critical as to adjustment, it can be easily aligned on a local TV station, thus eliminating the need for an FM generator. The adjustments can be made without removing the cabinet.

To align the circuit, refer to Table 1. Due to the interaction between the quadrature coil adjustment and the buzz control setting, and since a few degrees turn in either direction can throw the alignment off, it may be necessary to repeat the adjustments several times. Typical symptoms of a misadjusted sound circuit are excessive sync buzz, weak sound, and distortion in the sound—all of which can be corrected by properly aligning the sound circuits.

Before proceeding with the alignment of this receiver as per the instructions given in Table 1, connect the negative lead of a 3-volt bias battery to the white lead coming from the tuner, and the positive lead of the battery to the chassis. In Table 1, where reference is made to the rear of the chassis, it means the side of the chassis with the tubes. —30—

HAMFEST-PICNIC

THE North Fork Amateur Radio Club of Southwest Oklahoma is holding its annual hamfest and picnic at Quartz Mountain State Park on June 12 and 13.

Prizes and a generous measure of fun await attendees. Reservations may be made with Elmer Triplitt, secretary, Sayre, Oklahoma. —30—

Jerry B. Minter president of the Audio Engineering Society, and Harry N. Reizes, managing director of Audio Fairs, sign a sponsorship renewal agreement as C. R. Sawyer of Bell Labs and Walter Stanton of Pickering, governors of AES, look on. The AES will sponsor the Audio Fair for the years 1954 and 1955. This year's event will be held October 14, 15, 16, and 17 at the Hotel New Yorker in New York City.

Within the Industry

(Continued from page 26)

at its new 422,000 square foot television set assembly plant in Batavia, N.Y. . . . **EL MEC LABORATORIES** has moved its entire plant and office to 730 Boulevard, Kenilworth, N.J. The new location provides approximately twice the space for engineering, development, and manufacturing as was available at the old location . . . **BUXTON INDUSTRIES,** manufacturer of a line of TV antennas, has moved into a new plant at 88 North Fair Oakes Avenue in Pasadena where almost triple the old plant area will be available . . . **TELE-MATIC INDUSTRIES, INC.** has opened a warehouse at 6115 Denton Drive in Dallas to service the southwest territory . . . **GENERAL ELECTRIC COMPANY** has consolidated its Indiana receiving tube manufacturing operations at its Tell City plant and will close its feeder operation at Huntingburg. The processing formerly done at Huntingburg has been transferred to the new Tell City plant addition . . . **AEROVOX CORPORATION** has opened two new plants in California. One plant will house the company's **CINEMA ENGINEERING CO.** division at 1100 Chestnut St. in Burbank and the other will house both **ACME ELECTRONICS, INC.** and the Pacific Coast division of the parent firm at 2724 S. Peck Road, Monrovia . . . **FEDERAL ELECTRIC PRODUCTS COMPANY** has completed new executive and sales headquarters at its Newark, N.J. plant. The new addition provides approximately 12,000 square feet of space . . . **PRECISION APPARATUS CO., INC.** will move its manufacturing, engineering, and administrative facilities to a new plant in Glendale, Long Island by midsummer. The new two-story air-conditioned building occupies a plot of ground running from 84th St. to 88th St. south of Cooper Ave. in Glendale . . . **STRUTHERS-DUNN, INC.** has moved to Lambs Road, Pitman. N.J. The firm was formerly located in Philadelphia . . . **ZENITH** has opened a new high-fidelity salon at 333 N. Michigan Avenue in Chicago.

* * *

ERIC B. T. KINDQUIST has been appointed vice-president and general manager of the *Garfield Wire Division* of the *Overlakes Corporation.*

He began his metallurgical career in the research laboratory of *International Nickel Co.,* later becoming a research engineer for *RCA* at Harrison, N.J. He received his degree in chemical engineering from Pratt Institute and has taken graduate work at N.Y.U. and Ohio State.

The *Garfield* firm manufactures a line of wire for the electrical and electronic industries. —30—

NEW TV PRODUCTS on the Market

NEW ANTENNAS

Brach Manufacturing Corp. of 200 Central Ave., Newark 4, N. J. has released its Model 556 "Delta-Vee" beam for v.h.f.-u.h.f. black-and-white and color reception.

Channel Master Corporation, Ellenville, N. Y. is offering its "Econo-Vee" Model 411 antenna to the trade. This fully preassembled antenna is designed to operate effectively in secondary and fringe u.h.f. areas as well as primary v.h.f. areas.

Fink Electronics, Inc., 518 E. 95th St., Chicago, Ill. has introduced an indoor antenna which the company claims is effective even with color TV. Known as "Diron," the new antenna covers all v.h.f. television channels plus the FM frequencies. It comes completely assembled and tested.

Insuline Corporation of America, Manchester, N. H. is offering a "Combo-Fan" which may be used to convert existing v.h.f. antennas to u.h.f. reception. The device is a fan-shaped, weatherproof, all-aluminum antenna giving high gain on channels 14 through 83 without affecting normal operation on the v.h.f. channels.

JFD Manufacturing Company, Inc., 6101 Sixteenth Ave., Brooklyn 4, N. Y. has restyled its "Pace-Setter" series of conical antennas for channels 2 to 13. This new series features seamless aluminum cross arms, dowel-reinforcement at both ends for extra strength, wood-dowel reinforcement of the aluminum elements, and a double reinforced U-bolt mast clamp assembly.

Television Hardware Mfg. Co., 919 Taylor Ave., Rockford, Ill. is offering two new window-mounted TV antennas for applications where roof mounting is impractical or forhidden. The "bow tie" style is designed for u.h.f. reception while the "double V" model can be used for u.h.f. and v.h.f. in primary and secondary signal areas. The "Window-Tennas" are now at distributors.

Tricraft Products Company, 1535 N. Ashland Ave., Chicago 22, Ill. is now marketing a new indoor u.h.f. antenna, the Model 222 "Radome." This moderately priced unit covers channels 14 through 83 and measures 12" x 12" x 3⅜".

COLOR TV TUBES

CBS-Hytron, Danvers, Mass. is currently in production on two new tubes which have been developed specifically for color TV circuits.

The 3A3 is a high-voltage, half-wave vacuum rectifier designed to be used in the high-voltage system of a color set. It may also be employed in any rectifier application where high peak-inverse plate voltage and high-peak plate current are required. Bulletin E-225 gives complete data on this tube.

The second tube is the 6BD4, a high-voltage regulator for anode and convergence supplies in color receivers. Bulletin E-226 gives complete specifications on this tube.

LARGE COLOR TUBE

A new color television picture tube that produces a 20" (diagonal) color picture, comparable in contour and size to the standard 21" black-and-white tube, is now under development at the Electronic Tube Division of *Westinghouse Electric Corporation.*

A significant advancement in the new tube is its larger screen size coupled with the use of a phosphor screen which has 20 complete color groups per inch compared to 17 previously used. This gives improved resolution and good color definition at normal viewing distances. The total viewing area is approximately 200 square inches.

"CHROMALYZER"

Telechrome, Inc., 632 Merrick Road, Amityville, Long Island, N. Y. has developed an elaborate test unit for checking and aligning home color receivers, the Model 636-B "Chromalyzer."

The new instrument provides all the standard color signals needed for service work. By push-button control, the unit produces eleven bars of blue, red, magenta, green, cyan, yellow, G-Y (greater than 90 degrees), R-Y, B-Y, Q, I, in addition to black, white, sync, and color burst.

Light and portable and held to high accuracy by crystal control, the unit

operates with a self-contained, fully-regulated power supply and produces signals at video or r.f. with both picture and sound carrier on any channel from 2 to 6.

COLOR SIGNAL GENERATOR

Radio Corporation of America, Camden, N. J. has developed an inexpensive color signal generator for use in

television stations to expedite installation or performance checks of color TV receivers in homes while black-and-white programs are on the air.

The new device, when used by the station, will enable service technicians to check color set reception during normal servicing hours without waiting for color signals to be aired.

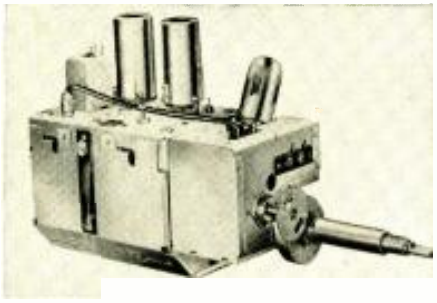
The color test signal is a narrow vertical yellow-green bar which is visible at the extreme edge of color receivers but is practically unnoticeable on black-and-white sets.

The device will be made available through the company's Engineering Products Division.

COMBINATION TUNER

General Instrument Corporation is now offering a combination all-channel v.h.f.-u.h.f. tuner, the Model 80.

The new unit is composed of a new



13-position turret-type v.h.f. tuner (Model 78) and a new, compact, continuously-tuned u.h.f. unit (Model 79). The combination unit is so designed that the v.h.f. section can be purchased and installed separately in sets. If the manufacturer's market should change, he or his distributor can add the u.h.f. section in the field.

The combination tuner measures less than 7" long and 3½" wide and was designed especially to meet the demand for smaller cabinets and larger picture tubes.

NEW ROOF MOUNTS

Commercial Products, 201 Division Street, Toledo 2, Ohio has announced five new models of roof mounts for simplified installation of TV antennas.

Designed to be used with "walking up" masts, the new units are in addition to the four already offered by the company.

A catalogue containing complete details on all nine of the mounts is available on request.

ANTENNA ROTATOR

Crown Controls Company, Inc., New Bremen, Ohio has added a new unit to its line of antenna rotators.

A new design permits the entire mast assembly support to be preassembled, thus simplifying installation. The size of the mast support base has been increased to provide a wider, stronger support for antenna masts. It will accommodate masts from ¾" to 2" and up to 175 pounds in weight.

The unit also features an exclusive "weather-guard" design, automatic braking which prevents coasting and windmilling, a lifetime-lubricated con-

denser motor, and 365 degree rotation in 60 seconds.

Complete literature is available on this new rotator.

NEW MALLORY CONVERTER

P. R. Mallory & Co., Inc. of Indianapolis, Ind. has announced the availability of a concealed u.h.f. converter, the Model 188.

According to the company, the new unit is the first all-channel converter designed to fit completely inside a TV set. Installation requires no chassis or cabinet alterations. All that can be seen of the finished installation is the clear plastic selector dial and switch.

The converter offers a choice of mounting positions, left, right, or inside top of the cabinet.

CONTINUITY TESTER

Kapner Hardware, Inc., 2248 Second Ave., New York 29, N. Y. is now offering a self-contained, all-electric continuity tester, the Model 170-A.

The instrument indicates resistance from a fraction of an ohm to 5 megohms. A safeguard resistor limits the output to 1 ma. The testing procedure is simple and quick. One lead is clipped to one side of the circuit or resistance under test while the test prod is then touched to the other side. An indicator light tells whether the resistance is low, high, or open.

It can also be used for checking filaments of all radio and television tubes. The low output of the unit makes it impossible to damage even battery or hearing-aid tubes.

TUBES FOR COLOR TV

The Tube Department of *General Electric Company* has announced the development of four new receiving type tubes which have been designed for color TV sets.

The new units include a 2V2 high-voltage rectifier; a 5AU4 high-output, full-wave rectifier; a 6AR8 sheet-beam synchronous detector; and a 6BU5 high-voltage pentode for shunt regulation.

Complete information on these new tubes is available from the Tube Department at Schenectady 5, New York.

TELEVISION ADAPTER

Textronix, Inc., P.O. Box 831, Portland 7, Oregon has announced the availability of a new television adapter, the Type 124.

The new unit adapts any triggered

wide-band oscilloscope to the observation of the composite video signal. The delayed-trigger output of the new unit

is continuously variable from zero to 25 milliseconds after receipt of a vertical sync pulse. By adjusting the delay, an oscilloscope can be triggered at the start of any desired line in a field. A panel push-button provides instant shift to the opposite field. Triggering occurs at half the television vertical rate. Duration of the output pulse is less than 1 microsecond and amplitude is 2 volts positive.

To make use of the time-marker output of the Type 124, the scope should have a positive gate output and a CRT cathode terminal.

COMPONENT TESTER

Transvision, Inc. of New Rochelle, N. Y. has recently introduced a new

TV component tester which will check the following parts: flyback transformers and yokes, selenium rectifiers, and picture tubes as well as reactivating the picture tubes.

The new component tester will make positive checks on color tubes and extend the life of weak color tubes with low emission. Additional information on the unit will be supplied by the manufacturer on request.

NEW "TENNA-TIE"

Channel Master Corporation of Ellenville, N. Y. is now offering an improved version of its "Tenna-Tie," an inter-action filter which joins high- and low-band v.h.f. antennas for use with a single transmission line.

The new unit now incorporates separate high- and low-pass filters, replacing the parallel resonant circuit previously used. With the new circuit, the installer may connect leads of any length between the antennas and the unit without affecting the efficiency of the filter. Lead lengths are no longer critical.

The new version is catalogued as Model No. 9033-A.

COLOR TEST GEAR

The Tube Division, *Radio Corporation of America*, Harrison, N. J. is in production on three types of test equipment essential to the installation and maintenance of home color television receivers.

The new equipment includes the

RCA WR-61A, a service-type color-bar generator; the *RCA* WR-36A, a portable dot-bar generator; and the *RCA* WO-78A, a 5" dual-bandwidth oscilloscope.

The line was developed with the needs of service technicians, design engineers, and color receiver manufacturers in mind. The dot-bar and color-bar generators are wholly new types of test instruments while the oscilloscope has been redesigned for color applications.

FLYBACK-YOKE TESTER

Electronic Instrument Co., Inc., 84 Withers Street. Brooklyn 11, N.Y. is currently offering a flyback transformer and yoke tester in both kit and wired instrument form.

The *Eico* Model 944 operates on the grid-dip principle and detects even a single shorted turn. It has separate calibration for air core and iron core flybacks to insure accurate testing of all types of video flyback transformers.

The unit may also be used to check and test the continuity of any inductance whose impedance is not too low. The 4½" meter with its three separate three-colored scales makes for easy reading. The tester measures 8½"x5"x 5". In kit form it is known as the Model 944-K.

TV COMPONENTS

General Instrument Corporation's F. W. Sickles Division, Chicopee, Mass. is now in production on a new line of television components.

Included among the new products are a horizontal deflection yoke, a horizontal convergence coil for color sets, a low-voltage high-sensitivity deflection system for 17 and 21 inch black-and-white 70 degree sets, as well as flybacks, purity coils, and delay lines for color TV and a number of components which may be used interchangeably or with slight modification in both color and monochrome sets.

CONTACT CLEANER

Workman TV, Inc. of Teaneck, N. J. has developed an electronic contact and tuner cleaner and lubricant which is being marketed under the tradename "Wissh".

The new formula is designed to perform the dual function of cleaning parts, points, and tuners as well as acting as a lubricant for the equipment.

The product is now available at local jobbers.

U.H.F. TUNER

Granco Products Inc., 36-17 20th Avenue, Long Island City, N. Y. has developed a new "Hideaway" tuner for u.h.f. conversion applications.

For concealed installation with a minimum of effort, the compact metal-cased tuner mounts at the rear of the TV set. Just the slide-rule tuning dial

protrudes slightly above the top while the tuning knob and selector switch are accessible at the right rear. The unit can also be placed on top or alongside the TV set if concealment is not required.

Three models of the "Hideaway" are currently available.

SELF-SUPPORTING CONTROL

Chicago Telephone Supply Corporation, Elkhart, Indiana has announced the availability of a new variable composition resistor which features a unique self-supporting snap-in bracket designed for mounting directly to a printed circuit panel.

The Type YGC-B45 simplifies assembly by snapping into place on the printed circuit panel. The control is held tightly by the mounting bracket during the soldering process and is permanently anchored to the circuit panel by solder. The bracket eliminates the need for a separate supporting panel and the usual mounting hardware.

Manufacturers are invited to write for complete details on this control.

PRINTED CIRCUIT AID

Gorn Electric Company, 871 Main St., Stamford, Conn. is now offering a new receptacle connector with 6, 8, 10, 12, 15, 18, or 22 contacts to receive printed circuit cards.

The body of the connector is compression molded melamine for high dielectric and mechanical strength. Contacts are of spring-tempered beryllium copper, gold plated over silver for ease of soldering and prevention of corrosion.

Design of the contacts provides positive mating of the connector with printed circuit cards of from .061" to .071" thickness. Proper tension to insure constant conductivity is maintained at all times. —30—

"Ultra-Linear" 6V6's

(*Continued from page 45*)

10 to 15 watt power range. For many people this power range is ample for all home requirements.

Careful listening tests have borne out the justification for the "Ultra-Linear" conversion. Particularly in the low frequency range there is substantial improvement. The solidness and clarity of the heavy bass passages is a revelation when one contrasts old and new amplifiers. The silkiness and smoothness of the treble range also stand out in a side-by-side comparison. In short, the improvement in measured characteristics is confirmed and substantiated by a corresponding improvement in listenability.

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1. Hafler, David & Keroes, Herbert L.: "An Ultra-Linear Amplifier", *Audio Engineering, November 1954*
2. ———: "Improving the Williamson Amplifier", RADIO & TELEVISION NEWS, *February 1953*
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Mac's Service Shop
(*Continued from page 68*)

by a man who has not been shaving too long, using only a v.t.v.m., proves to him he is right."

"He *has* built up quite a case," Barney observed.

"On the surface, yes; but it has a lot of holes in it. As I told him, you do not need to have a long gray beard to be a TV expert because television itself, as we know it, is hardly ten years old. Youth, with its eagerness to learn about new things, is a natural for this brand-new field. Probably the age of the youngster who fixed the set would be about the same as that of the men who are designing, testing, and flying our modern jets; and the Air Force seems satisfied with the job they are doing.

"I also pointed out that when he called for service he was doubtless asked about the make, model, and symptoms of his receiver. Using this information, the technician called upon his technical knowledge and his rich fund of experience and probably made a very shrewd guess as to the likely cause of the trouble before he hung up the telephone. Then he consulted his service library, in which he would have invested a minimum of $400. to determine exactly what tubes he would need to take along for that particular job. Finally, from his array of service instruments. in which he would have invested from $1000 upwards, he selected the one best suited to determine whether or not the set could be repaired in the home if his original guess as to the cause of trouble proved wrong."

"The knowledge and equipment that a set owner sees displayed when a technician makes a home call is only a very small per-cent of that at his disposal," Barney threw in. "It's kind of like an iceberg that has nine-tenths of its bulk hidden below the surface supporting the one-tenth that is in plain view."

"Exactly," Mac agreed. "At the same time I must admit my neighbor has a point in there being inconsistency in service shop advertising. When one shop talks about the expensive equipment and extensive technical knowledge needed to perform service work and another stresses how quickly and easily it can be done right in the customer's home, this is confusing to say the least.

"The inconsistency lies in the fact that two different types of service operation are being described. Abrupt set failures are usually produced by faults that can be quickly detected and corrected by a skilled technician right in the home. On the other hand, all television sets are subject to a gradual deterioration in performance as the months go by. Tubes lose a bit of their emission; condensers develop slight leakage; resistors change value; dirt accumulates on the tube face and on

the selector contacts; circuits drift out of alignment. The total effect of these defects is arrived at so gradually that quite often the owner fails to notice how much his reception has suffered. The only way in which the receiver can be restored to the kind of operation it had when it was new is for the receiver to be checked over completely, using expensive and delicate instruments that cannot be lugged around in a service truck. In other words, a receiver cannot practically be kept in first-class working condition unless it makes periodic visits to a service shop."

Mac paused for a moment and then went on. "What I am going to try to do in our advertising is to persuade our customers that this is so. To get the point across, I'm going to resort to analogy. For example, to reach the women customers, I plan to say something like, 'If you are a good housewife, you sweep and dust every day; yet you still give your home a general housecleaning at least once a year. Your TV set needs a complete going over once a year, too.' For the men I propose something like this: 'If a fan belt breaks, you stop in a filling station for a new one and are on your way; but every so often you leave your car at a garage for a complete check. Your TV set deserves a careful annual inspection also.' Then I'll go ahead to urge our customers to let us have their sets while they are on vacation. This, of course, will help fill in our slack summer season; but more important, it will give us plenty of time to go over each set completely, locating and correcting every defect, and to bench-test it thoroughly—something we can't do when the customer is yelling for it back every hour on the hour."

"Are you going to say this will prevent the customer's having set failures during the rest of the year?"

"No, because no one can honestly promise that. A tube heater can open up or a condenser pop at any time. Certainly the likelihood of failure will be lessened by these annual checks, but the principal advantage to the customer will lie in the fact that his set will be operating in tip-top shape. If a particular part fails, it can be replaced with confidence that this will be *all* that is needed to restore the set to perfect operation. We cannot guarantee uninterrupted reception with these annual checks, but we certainly will be able to promise *good* reception; and you know as well as I how many sets we see that produce some kind of a picture and some sort of sound but are a long, long way from providing the kind of reception they were designed to give."

Barney heaved a big sigh and slid off the bench. "And I was just looking forward to a nice long slow-business summer," he murmured.

"My deepest sympathy," grinned Mac. "You certainly are the most abused service shop assistant that ever soldered a lead!" —30—

A VIDEO-MAGNETIC TAPE RECORDER

Details on an improved system for recording TV pictures on standard recording tape. The unit is now in production.

A RE-DESIGNED and improved video tape recorder has been announced by *Bing Crosby Enterprises, Inc.* of Los Angeles. The new "VTR" systems are now ready to be put into production in limited quantities for military applications.

Operation of "VTR" is based on a method which is introduced primarily to conserve tape velocity. In this way at least 15 minutes running time is possible from reels of reasonable size. Ten tracks are employed simultaneously for recording video information. An eleventh track records the necessary vertical and horizontal synchronizing signals while the twelfth carries the sound channel. On playback, signals from the ten video tracks combine to produce a high-definition picture.

An alternating signal is recorded on each track. Both positive and negative halves of this signal represent bits of picture information. This alternating rate is 169 kc. Consequently each head records 339,000 bits per second and since there are ten heads the system is capable of recording 3,390,000 bits per second, or video signal information up to 1.69 mc.

It is not necessary to employ bias in this form of recording since the minimum signal amplitude remains sufficiently high to result in linear amplitude response.

On playback each of the ten video heads is excited by a strong carrier frequency rate of 169 kc. amplitude modulated in accordance with the original video information. By means of a full-wave rectifier, each signal is converted at the output of its preamp from 169 kc. a.c. to d.c. with a strong 339 kc. component. This rate is used to control the sampling pulse generation and timing since it exists even at minimum signal levels.

The vertical and horizontal sync signals are recorded in track number eleven since they must be played back free from the results of sampling. If this were not done, the playback sampling rates would cause the horizontal sync to lock in incorrectly at certain places in the picture.

The sound is recorded on one track by means of a high-quality FM system. A carrier of 100 kc. is modulated through wide deviation from 50 to 150 kc. On playback this results in a better than 65 db signal-to-noise ratio measured below ½% harmonic distortion.

The machine occupies a floor area of 40" x 26". It operates the tape at 100 inches-per-second. It can accommodate reels of tape providing more than 16 minutes of continuous recording, thus sufficient overlap time is allowed for starting a second machine where half-hour programs are re-broadcast.

In operation, tape unwinds from the left spindle, past the capstan drive and head assembly to be taken up on the right hub. Rolls of tape are essentially self-supporting. No reels are required for ½" tape. For re-winding at high speed, a "tight winder" is employed. No equipment other than drive motors is concealed in the cabinet.

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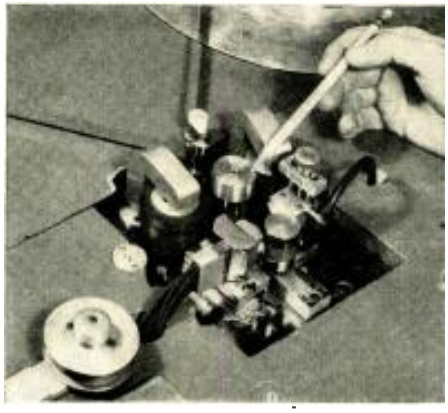
John T. Mullin, chief engineer of Bing Crosby Enterprises, explains new "VTR" system to TV and movie star Dan Duryea.

Close-up of the tape drive mechanism.



Ponderous crashing chords from trombone and tubas. Trumpets, in a very high and strident register. Almost all of the brass work in this composition is in the form of short, staccato bursts and will tax the transient response of your system. The percussion I still don't believe! Thundering bass drum and tympani so sharp and clean, you can literally "feel" the tautness of the drumskins! In the section called the "Evocation of the Ancestors" there is a series of tympani rolls followed by another staccato figure, which is quite fantastic. I guarantee this will make you sit bolt upright, and start you to wondering whether your speaker cone can withstand this assault! The strings are in this work too, and are clean and edgeless. However you don't seem to notice them as much in this composition, partly because there is so much else going on, and partly because they are used in pizzicato fashion so often and blend in with the other rhythmic elements. In the finale, the "Sacrificial Dance," the orchestra virtually explodes in as madly orgiastic sound as you're ever likely to hear again. So furious and complex is this last section that Stravinsky made some revisions in it in 1943 to make it easier to perform. Mr. Dorati has essayed the original version and the Minneapolis has responded with magnificent precision. Acoustically, the recording has just the right amount of reverb. Too much in a work like this could be disastrous, making the sound run together and completely destroying its distinctive texture. In spite of all these huge sonorities and what may seem to some like special effects, especially in the percussion, I can assure you that this disc was recorded with the usual "Olympian" technique, meaning the single *Telefunken* mike and the transfer from tape to disc *via* the *Miller* cutter. Well, that's it. I know this review has been longer than most, but it was necessary to justify my enthusiasms. The recording conformed perfectly to the AES curve and the surfaces on my copy were quiet.

STRAVINSKY
PULCINELLA
Cleveland Orchestra conducted by Igor Stravinsky. Mary Simmons, soprano; Glenn Schnittke, tenor; Phillip MacGregor, bass. Columbia ML4830. NARTB curve. Price $5.95.

While we are on the subject of Stravinsky, let's stay with him awhile and give "ear to this latest version of his one act ballet with song," "Pulcinella." The notation "after Pergolesi" is usually added to the title, because of the derivative source of much of the score. However, it would be a gross error to convey the idea that this work is anything less than a major and distinctive effort by Stravinsky. It is true that there are certain passages which are

little changed from Pergolesi, but the rest bears the unmistakable imprint of Stravinsky. He has freely transposed, embellished, introduced the rhythmic figures so typical of his other works, and changed harmonies. The result is something that sounds "18th Century-ish," but obviously is not.

If you are at all familiar with Stravinsky, no more than a few bars will serve to identify this as his music. The parts for voice do not bear any direct relation to the plot of the story and are in fact, more or less incidental. Brief as they are, they are nonetheless pleasant little airs and are sung admirably by the soloists involved. Stravinsky has handled the orchestra so well, that although there are no tympani or percussion instruments in the score, the strength of the rythmic means, especially in the strings, is such that you would swear this *is* percussion. A thoroughly delightful work, this is by far the best version on discs. The other versions are more fragmentary and are not particularly distinguished for their sound. Here, the knowing hand of Stravinsky is much in evidence. Under his direction this is a much more lively and spirited work than a hearing of the other discs would seem to indicate. The sound is splendid. *Columbia* has managed to combine the need for sharp, "close-to" recording, essential to the delineation of this work, with a good spacious acoustic perspective. Woodwinds are especially clean and crisp. If you have never been overly impressed with this work, try this version. It could well change your mind. Approximately 2 db of bass boost added to the NARTB curve made the recording sound better to me.

MASSENET
WERTHER

Ferrucio Tagliavini, tenor; Pia Tassinari, soprano; and others with Orchestra of Radio Italiana (Turin) and chorus conducted by Francesco Molinari Pradelli. Cetra C1245. AES curve. Price $17.85. Three discs.

This is a brand new recording of "Werther," superior in nearly all respects to the other effort on *Urania*. The opera itself is not heard very often these days, which seems strange to me as it has much to recommend itself over many "staples" in the current repertoire. Taken from Goethe's "The Sorrows of Young Werther," it is admittedly a gloomy work. Nevertheless, it is so cleverly written, that the characters in the secondary roles add a great deal of life and zest to the plot. At least they act as a balance to the virtually psychopathic Werther. Mounted in a snappy new setting by the "Met." and cast as well as has been done in this recording, I'm sure the opera would find new favor. It is in the casting where this recording shines, as the illustrious Tagliavini gives an exciting and moving portrayal of Werther. Pia Tassinari is in splendid voice as the beloved "Charlotte." Marcello Cortis is an effective "Albert" and Vittorio Neviani, a sympathetic "Sophie." The other roles are equally well sung; espe-

cially noteworthy is Giuliano Ferrein as the "Bailiff." The ensemble work was good, but it is in this department that the *Urania* disc at least was its equal. Pradelli lends his considerable talent to the proceedings and his orchestra is always complementary and in balance with the vocalists. Sound is generally well above average, as far as operatic recordings go. Strings were smooth, woodwinds a little ragged, brass was bright and clean, but unfortunately at times became somewhat strident. Percussion good, except for occasional muddiness. Over-all, a thoroughly enjoyable recording, highly recommended to those of you who are looking for an opera a little off the beaten track. AES curve was adequate with a slight assist in the bass and a slight cut in the treble helping the balance.

BARTOK
PIANO CONCERTO #3
PROKOFIEV
PIANO CONCERTO #3
Julius Katchen, pianist with L'Orchestre de la Suisse Romande conducted by Ernest Ansermet. London LL945. ffrr curve. Price $5.95.

This record would be distinguished if for no other reason than the coupling of these two great concerti. This has always seemed to me to be an eminently logical pairing, instead of the opposite-ends-of-the-poles repertoire both works have been saddled with. Happily, there is much more musical substance here than in previous recordings of these concerti. The Bartok concerto has always impressed me as being one of the composer's most listenable works. Oh, it has all of the usual dissonances associated with Bartok, but its construction is so clever, that this element seems less apparent. In addition, since this is the last of Bartok's works and a product of his more advanced years, it is possible to detect more than a little "mellowing" in his musical philosophy. Of the two other recordings of this work, only the Sandor-Ormandy version on *Columbia* offers this new disc any competition. Julius Katchen is a better pianist than Sandor, and Ansermet's supporting reading more perceptive than Ormandy's. There is much to be said for Katchen's precision and ultra-careful phrasing, but it is this very quality that keeps this from being an outstanding reading. Sandor misses a few notes here and there, and in general is not the craftsman that is Katchen. But for all this, his reading is full of dash and fire and Katchen suffers by comparison. Soundwise this is a different matter. The *Columbia* piano had a tone that was on the hard side, and the orchestral accompaniment was restricted in range. This is not too surprising, since the Sandor recording appeared early in the LP catalogue, and I'm pretty sure it was a transfer from 78 rpm. Good sound for its day, but not equal to this present recording. The piano here is liquidly beautiful, very clean toned, little evidence of wow or flutter. The piano is used quite percussively in this score, and this quality is recorded with virtually no harshness

or "ringing." Ansermet maintains a fine rapport with the pianist throughout the work and his orchestra is well recorded with sharp, incisive strings, clean woodwinds, and solid, authoritative percussion.

In the Prokofiev 3rd, we have a similar situation with the Bartok recording, though on a lesser scale. By that I mean that Katchen again comes off as the best pianist, as compared to the artists on the three other discs of this work. And once again, in spite of his technical superiority, his reading is less exciting than is, for instance, the late William Kapell's. I'll admit that Kapell's essay of the score might be called theatrical; but this music can stand up to that sort of treatment and I find I prefer it to the leaner, less hurried, more deliberate reading of Katchen. The situation is the same with the sound. The *London* disc is far superior in all respects to either the *Angel, Victor,* or *Columbia* efforts. In fact for many of you this superiority of sound may be the deciding factor, for if the Katchen readings are not outstanding, they are nonetheless honest and competent. All a matter of taste in this. A few db of bass boost helped the *fflr* curve in my set-up. Quiet surfaces.

LISZT
MEPHISTO WALTZ
CHOPIN
BARCAROLLE IN F SHARP MINOR
Leonard Pennario, pianist. Capitol H8246. AES curve. Price $2.98.

The popular "Mephisto Waltz" is given a supercharged reading on this disc by Leonard Pennario, a young pianist who is really making quite a name for himself. He takes the florid, flamboyant passages of this work at a terrific pace, and from his sheer momentum makes this overblown piece newly enjoyable. In the "Barcarolle," Pennario calms down and the result is a finely wrought performance, a model of balance and good taste. The sound of the piano is good on this disc, but for my taste a little too "close" with "dry" acoustics. The AES curve was adequate without further adjustment. Very quiet surface.

BARBER
ADAGIO FOR STRINGS
DIAMOND
ROUNDS
COPLAND
QUIET CITY
CRESTON
TWO CHORIC DANCES
Concert Arts Orchestra conducted by Vladimir Golschmann. Capitol P8245. AES curve. Price $5.70.

Another in the exemplary series of the Concert Arts Orchestra so successfully introduced last month by *Capitol.* Some of *Capitol's* very finest recording is to be found in this series, as this latest disc will testify. Two of the numbers have been recorded before on *Mercury* discs. These are the "Adagio for Strings" and "Quiet City." There is very little to choose between the performances on the two labels. The "Adagio" is conducted at almost the identical tempo by Hanson and Golsch-

more in the spirit of the music. The boys are beautifully trained and benefit, of course, from the composer's guidance in the performance. The recording is startling in its clarity, with the harp in perfect balance with the young voices. If you don't know this music, try this for a real off-beat vocal treat. One of the loveliest things on records. The *ffrr* curve was "just right" as is, no fiddling necessary.

HINDEMITH
MATHIS DER MALER
CONCERT FOR STRINGS AND BRASS
Philadelphia Orchestra conducted by Eugene Ormandy. Columbia ML4816. NARTB curve. Price $5.95.

A new recording of one of my favorite works, and one that was badly needed. "Mathis der Maler" is certainly one of the masterpieces of twentieth century music and I think the best thing to come from the pen of the versatile Paul Hindemith. Intensely dramatic, the score is a tremendous achievement in the art of powerful, evocative orchestration. You will find the atonalities that Hindemith is noted for in this music. You will also find some of the most beautiful, almost "other-worldly" music ever written.

Ormandy's performance is magnificent. While the old Hindemith performance on *Capitol* is good, it suffers from the relatively poor sound, and the fact that it is broken up on two sides of a 10" LP. Curiously, the Hindemith and Ormandy versions are almost carbon copies in matter of tempo, something that does not happen too often. Ormandy is evidently fully "at home" with this music and he makes the best of it. The strings of the Philadelphia are a miracle of tone and precision, brass is properly weighty, and percussion is more than adequate to the demands of the score. I thought that the reading by Guido Cantelli was very good on the *Victor* label, but Ormandy's exposition is head and shoulders above it.

The "Concert Music for Strings and Brass" is more in keeping with what most people expect of Paul Hindemith. Dry, almost astringent scoring characterizes this piece, which also is a much more dissonant affair than the "Mathis der Maler." Again the string work of the Philadelphia is outstanding and there is also some magnificent playing from the French horns and trombones. I noticed something I thought was odd when I listened to both of these works, one after the other. This was that while the "Mathis der Maler" is an excellent recording, it did not seem to have the brilliance and range of the "Concert Music for Strings and Brass." An examination of the record jacket disclosed that both works were recorded at the Academy of Music in Philadelphia, but nearly a year separates the "Concert Music" from the earlier "Mathis der Maler." I concluded the difference in sound was due to the constructional changes which were undertaken at the Academy during 1953, and which were tacitly announced with

the *Columbia* recording of Tschaikovsky's "Pathetique." This is a good opportunity to study the way these changes have affected acoustic perspective, over-all brilliance, etc. At any rate, this is a top-notch record and is worth your attention. NARTB curve was better with a little bass boost. Quiet surfaces. —30—

Color TV

(Continued from page 49)

control for the luminance signal. A contrast control for the chrominance portion of the signal is mechanically ganged to the luminance contrast control, thereby insuring that both signals will be varied in equal amounts. This is required to maintain the proper voltage relationship between the two signals.

A 4.5 mc. trap in the cathode leg of the 1st video amplifier attenuates any 4.5 mc. voltage that may develop in the video detector through the beating of the video and sound carriers.

For the color TV video amplifier circuit shown in Fig. 9, the detector stage is formed by using one-half of a 6BK7 duo-triode. The grid and plate are tied together so the triode function as a diode. The second triode section of the 6BK7 is operated as a cathode follower, thereby permitting a number of circuits to obtain their signals from the detector without imposing any capacitive loading on this stage.

The plate circuit of the cathode follower provides signal voltages for the sync separator, a.g.c., and burst amplifiers. The cathode of the same tube contains a 500-ohm potentiometer which provides the signal for both a luminance amplifier and a bandpass amplifier and controls the contrast for both channels simultaneously.

The brightness or luminance signal is amplified by a single triode stage and then passed through a 1.0 microsecond delay line that is terminated in the matrix network. There are no special traps in this circuit, but response falls off rapidly beyond 3.2 mc., attenuating any color subcarrier and 4.5-mc. voltages that might be present.

(To be continued)

ARIZONA HAM PLATES

ARIZONA'S amateurs have won a dramatic victory with the recent passage of their call-letter license plate bill. Two previous attempts had received only lukewarm support in the Legislature. The current bill won support because of a unified program followed by the hams.

Features of "Operation Call-Plate" included a state-wide simulated demonstration from the capitol grounds, operation from the floor of the House, and an hour-long test of the emergency nets on a state-wide basis.

Similar programs by hams in other states might go a long way toward getting official approval of call-letter plates in the states where such requests have been rejected or not considered. —30—

TAPE IDENTIFICATION

By J. GORDON HOLT

TAPE recordists who must use reels over and over often find that the back of the reel box becomes a mass of scrawlings, crossings-out, and unsuccessful erasures. A simple way to mark the boxes legibly and *temporarily* is to use a bright red grease pencil of the "china-marking" variety.

One of these pencils, which can be purchased at any stationer's store, will leave clear markings that can be easily and completely erased from reel boxes with an ordinary art gum eraser.

The grease pencil is also capable of writing identification material directly on metal or plastic tape reels. It can be removed from plastic reels by rubbing with a dry, clean piece of cloth, while a cloth moistened with carbon tetrachloride will clean the metal reels. —30—

View of World Radio Laboratories' radio "supermart" salesroom. The firm has recently moved into a new, air-conditioned, fireproof building at 3415-27 Broadway in Cedar Rapids, Iowa. In addition to the "supermart" pictured, the new facility includes a hi-fi sound room, an amateur radio display room with transmitting facilities for visiting hams, a printing plant, export department, modern lunchroom, mail order department, a large warehousing area, a factory, and general office space. A full acre of parking area is provided for the firm's "drive-in" customers.

Technical BOOKS

"TELEVISION SIMPLIFIED" by Milton S. Kiver. Published by *D. Van Nostrand Company, Inc.*, New York. 527 pages. Price $6.75. Fourth Edition.

That a new and enlarged edition of the author's basic television text is now available should be good news to all Kiver fans.

As with the previous editions, the author has treated his subject matter clearly, concisely, and completely. The only prerequisite for an understanding of this text is a working knowledge of standard broadcast receivers.

This new edition contains many new illustrations and schematics as well as two completely new chapters on u.h.f. and color television. The added material includes more data on TV tuners, an explanation of keyed a.g.c. systems and their application, d.c. video amplifiers, and cascode amplifiers and their operation. In addition to an enlarged intercarrier receiver section, two television receivers are completely analyzed and the new 45 mc. i.f. systems as well as the older 25 mc. i.f. circuits are discussed.

Those who use this book as a home-study text will find the self-check questions at the end of each chapter particularly valuable. Whether the reader uses this book as a basic text or as a reference volume, he will find it a uniformly valuable addition to his library.

* * *

"HIGHLIGHTS OF COLOR TELEVISION" by John R. Locke, Jr. Published by *John F. Rider Publisher, Inc.*, New York. 43 pages. Price 99 cents. Paper bound.

This compact little book, written by an engineer from *General Electric Company's* radio and television department, is an introduction to the subject of color based on the standards recommended by the NTSC, and subsequently adopted by the FCC.

The discussion deals with only those features or circuits which are unique to color receivers. Circuits and techniques found in standard monochrome receivers are not covered. The discussion covers colorimetry, the NTSC color signal, the transmitter, the color receiver, the tri-color picture tube, and color receiver circuitry.

Those interested in the new medium will find this book enlightening and instructive, providing information that applies to all receivers designed to conform to the NTSC standard.

* * *

"ELEMENTS OF MATHEMATICS FOR RADIO, TELEVISION AND ELECTRONICS" by Bernhard Fischer & Herbert Jacobs. Published by *The Macmillan Company*, 60 Fifth Avenue, New York. 522 pages. Price $7.20.

With the passing of the "screwdriver" mechanic and the introduction of new and more complex circuitry,

"cut and try" methods of servicing are gradually being replaced by formalized procedures based on mathematical formulas.

The book is divided into two separate sections, the first dealing with the principles of arithmetic and their application to problems in radio and television. The second section covers algebraic material which deals with negative numbers, literal equations, ratio and proportion, exponents, elements of logarithms, and a discussion of sine and square waves.

An interesting and surprising addition to the text is a section on "business mathematics" for radiomen. This chapter includes procedures for computing profit and loss, compound interest, amortization, and installment selling rates. Five appendices provide basic material on wire sizes, logarithms, decibels, etc.

The authors provide a number of exercises throughout the text and when these are solved and checked against the answers provided, the user can evaluate his grasp of the subject matter.

In specializing on mathematics for the industry, the authors have granted a real boon which has long been withheld from the radio-TV worker.

* * *

"TELEVISION SERVICING" by Walter H. Buchsbaum. Published by *Prentice-Hall, Inc.*, New York. 359 pages. Price $5.95. Second Edition.

The problem of keeping up with the fast-moving television industry would be a hopeless one were it not for the fact that magazine and book publishers have assumed the responsibility for keeping the industry informed.

This second edition of Mr. Buchsbaum's basic servicing text has been revised and brought up-to-date with the progress that has been made since the original volume appeared in 1950.

Like the first edition, the book is divided into three parts and covers the theory of TV circuits in relation to the technician's work, the second section covers the actual installation of antennas and receivers, while the third part covers troubleshooting procedures.

The material presented is basic, simply written, and completely understandable. The layman or television student can derive almost as much benefit from the discussion as can the more seasoned technician.

The author's presentation is familiar to readers of this magazine and those using this text will find that same practical and enlightening treatment as characterizes his regular contributions to Radio & Television News.

* * *

"INTRODUCTION TO COLOR TV" by M. Kaufman & H. Thomas. Published by *John F. Rider Publisher, Inc.*, New York. 137 pages. Price $2.10. Paper bound.

This little handbook has been designed for the service technician, student, and engineer who wants to keep abreast of current color developments. The receiver circuitry covered is based

on the NTSC system and represents the earliest production ideas.

Since industry thinking on single-gun and tri-gun tubes for the new receivers has not been crystallized, the authors have "played it safe" and presented both systems—the tri-gun tube in greater detail as it is being used more extensively at present.

Of special interest to technicians is the inclusion of two complete color receiver schematics for study purposes.

While few color receivers are in the hands of the public at the present time, the day the first colorset arrives at the express office is too late for the technician to think about "boning up" on the circuitry. Progressive and alert technicians will recognize the trend and prepare for a successful and lucrative chromatic future.

* * *

"TELEVISION SERVICING COURSE" compiled by M. N. Beitman. Published by *Supreme Publications*, Chicago. 192 pages. Price $3.00. Paper bound.

This book is designed as a home-study text for those with a working radio knowledge but no prior television training.

Rather than involve the student in a complex discussion of transmission of TV signals, etc., this text plunges right into the subject matter by considering simple adjustments that can be made by the veriest tyro. From this beginning the material becomes progressively more advanced and covers circuit faults visible on the tube, locating bad tubes by checking the picture tube, antenna principles and practices, CR tubes, how to troubleshoot a receiver, converters and tuners for u.h.f., TV test equipment and alignment, step-by-step procedures for aligning four popular TV receivers, and advanced troubleshooting by means of television picture analysis.

Those seeking a fast-moving introduction to television servicing will find this book a practical answer to their problems.

* * *

"SPECIALIZED HOME AND PORTABLE RADIO MANUAL" compiled by the Rider Staff. Published by *John F. Rider Publisher, Inc.*, New York. 96 pages. Price $1.65. Paper bound. Volume 8.

This volume is devoted exclusively to *RCA* receivers and covers sets produced in the period June 1951 through December 1953.

Each receiver model covered is pictured and described. Alignment procedures are outlined and the complete schematic and parts list provided. The manual is designed to be used on the service bench—the type is large and clear and the circuit diagrams are jumbo size for high-speed servicing of the receivers.

These specialized manuals meet a definite need for authoritative and low-cost service data.

The earlier volumes are still available. Information on them will be supplied by publisher. —30—

MANUFACTURERS' LITERATURE

The various listings presented in this section are for your convenience. The bulletins, unless otherwise indicated, are available to all our readers. For prompt attention write directly to the manufacturer for this literature.

SHALLCROSS BULLETIN

Shallcross Manufacturing Company, Collingdale, Pa. has issued an engineering bulletin which gives complete specifications and laboratory performance data on its "P" type encapsulated precision wirewound resistors.

This unusually detailed bulletin, L-30, lists eleven different "P" type resistors in both radial lug and axial lead styles. Charts showing the effects of temperature cycling, load life, moisture resistance, and short-time overload tests are also included.

Copies of this bulletin are available only on letterhead request.

THORDARSON CATALOGUE

Thordarson-Meissner, Seventh and Bellmont, Mt. Carmel, Illinois has announced the availability of a new catalogue covering the *Thordarson* line of transformers and reactors and featuring a new, complete TV replacement section, a new output transformer chart, and complete cross-reference data.

Catalogue 400-L may be obtained without charge from the company.

ACOUSTICS STANDARD

The American Standards Association, 70 E. 45th Street, New York 17, N. Y. has just completed and published a new standard for letter symbols for acoustics.

The standard presents symbols and terminology used in studies of acoustical, shock, and vibrational problems. Harry F. Olson of *RCA* was chairman of the committee that set up the new standard.

Known as "The American Standard Letter Symbols for Acoustics, Y10.11-1953," the new publication may be obtained from the Association for $1.00 a copy.

TRANSISTOR CURVE TRACER

Magnetic Amplifiers, Inc., 632 Tinton Ave., New York 55, N. Y. has published a bulletin describing its automatic universal transistor curve tracer.

The new booklet, which is available without charge, explains the operation of the unit and details both electrical and physical specifications.

BATTERY PROMOTION

National Carbon Company is now distributing a new motion display, promoting the year around uses of portable radios, as the featured piece in its complete point-of-sale kit on *Eveready* batteries.

In addition to the motion display, the kit includes small cards, a jumbo banner, pennants, streamers, and a copy of the 1954 radio battery replacement guide.

The kit is available through the company's distributors who will provide details on how it may be obtained free of charge.

TEST EQUIPMENT

Complete specifications and data on its test equipment line have been included in the new catalogue just released by *Clough-Brengle Co.*, 6014 Broadway, Chicago 40, Illinois.

Catalogue No. 54-A lists sweep generators, b.f.o.'s, automatic generators, transmission measuring sets, r.f. signal generators, capacity-resistance-inductance bridges, and extended range audio oscillators.

Dept. RE of the company will supply a copy of this publication without charge.

RIDER CATALOGUE

John F. Rider Publisher, Inc., 480 Canal Street, New York 13, N. Y. has announced the availability of its 1954 book catalogue.

The publication contains 32 pages and is a complete, up-to-date listing of the latest books, "Tek-File," and manuals published by the company. Copies of the catalogue are free and are available from the company's distributors and bookstores or direct from the publisher, Box RC-54.

SOLENOID CATALOGUE

West Coast Electrical Mfg. Corp.'s AC Division 215, 233 W. 116th Place, Los Angeles, California now has available a new AC solenoid catalogue.

The new publication presents in easy-to-read form, solenoid design information, engineering drawings, solenoid performance charts, work and temperature curves.

This catalogue is available only on company letterhead request.

MALLORY GUIDE

A cross-reference guide, covering radio and television components by means of manufacturers' part numbers, has just been published by the Distributor Division of *P. R. Mallory & Co., Inc.*, P.O. Box 1558, Indianapolis, Ind.

Separated into four sections, the guide provides a cross reference for dry electrolytics, TV and radio controls (including carbon and wirewound single-section, universal-section, and

preassembled dual controls and "L" and "T" pads), radio and TV selenium rectifier stacks, and communications and auto radio vibrators.

Copies of the new guide are available from the firm's distributors or from the company direct.

ONAN PLANTS

D. W. Onan & Sons Inc., Minneapolis 14, Minn. pictures and describes six interesting installations of its electric generating plants in its new pocket-size, 12-page booklet.

The new publication is Volume 10, No. 2 of the company's publication "Power Points Digest" and will be sent without charge to those specifying the volume and issue number in their requests.

ANTENNA DATA

Tennalab, Quincy, Illinois has issued a two-color, four-page bulletin covering its line of TV antennas.

Pictured and described are units for all-channel applications, single-channel yagis, multi-channel yagis, and accessories to be used with the various antennas.

A copy of the new publication is available upon request.

SCOPE HANDBOOK

The Hickok Electrical Instrument Co., 10524 Dupont Ave., Cleveland 8, Ohio is offering a 24-page handbook on cathode-ray oscilloscopes to service engineers, technicians, experimenters, and students.

This free publication contains an explanation and illustration of the basic characteristics of the oscilloscope, explains how it works, and provides tips on its more general uses. The handbook also lists features and performance specifications on models ranging from a 3" portable unit to large technician bench models as well as the highly accurate industrial-electronic laboratory types.

CONDENSER DATA

The Astron Corporation, 255 Grant Avenue, East Newark, N. J. is offering a copy of its new condenser manual, AC-4, which contains detailed engineering data and specification information on its complete line.

Condensers are grouped into three broad categories; electrolytic, paper, and metallized paper. Within each category, the condenser types are grouped according to operating temperature range and construction styles and ratings that are available as standard.

The catalogue is available on company or professional letterhead request only.

MAST TUBING

Bellevue Tube Mill, Inc., Box 4465, Philadelphia 40, Pa. has just issued a revised catalogue of its products which is being distributed to interested persons without charge.

The catalogue illustrates and de-

scribes the company's line of electro-welded TV antenna masts and butt and lock seam tubing. The antenna masts are 1¼" o.d. "3-Cote" units while the other sections illustrated are 1¼" o.d. "2-Cote" 20-gauge sections.

Requests for catalogues should be addressed to Dick Morris, the sales manager. -30-

MORE SERVICE GROUPS

IN the March issue of RADIO & TELEVISION NEWS, on page 84, there appeared a list of radio and television service associations in the United States and Canada. Since that list was published the following additional associations have been brought to our attention:

Associated Qualified TV Technicians, 406 W. Capitol St., Jackson, Miss.—Ivan Scott, Pres.; M. M. Sage, Sec'y.

Radio & Television Electronic Technicians, 52 E. 19th St., New York 3, N. Y.—Charles J. Vassallo, Pres.; Carlos Boxill, Sec'y.

Northeast Television Service Dealers Ass'n., 6321 Frankford Ave., Philadelphia 35, Pa.—R. H. Cherrill, Pres.; Roy Colen, Sec'y.

Southern Pennsylvania Radio & Television Technicians Ass'n., 734 E. Market St., York, Pa.—Joseph Hausee, Pres., Willard Stroyer, Sec'y. -30-

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59, 60, 62, 63, 108	Crosley Division, Avco Mfg. Corp.
110	Audio Fairs
120	Bing Crosby Enterprises, Inc.
128	World Radio Laboratories

ADDENDUM & ERRATUM

In connection with Fig. 5 of "A Transistorized Light-Beam Communications System" (May 1954) there is a slight possibility of damaging the transistor if a pot is used for resistor R and the pot is turned to zero. To avoid damage the authors suggest that a 47,000 ohm fixed resistor should be placed in series with a 1 megohm pot for R thus eliminating any chance of transistor burnout. The maximum resistance which gives undistorted output should be used to conserve power and reduce transistor collector power dissipation.

* * *

In the article "The Audio Cathode Follower" which appeared in the April 1954 issue, the captions for the photographs on page 51 were inadvertently interchanged. In addition, although not too clearly indicated, it was not the intention of the author to provide construction details on the tone controls and preamp.

The photographs were included merely to show the equipment he used with his driver unit.

Classified

Rate 50c per word. Minimum 10 words

RADIO ENGINEERING

COMPLETE radio, electronics theory & practice: television; broadcasting; servicing; aviation, marine, police radio. 12 or 18 months. Catalog. Valparaiso Technical Institute, Dept. N, Valparaiso, Ind.

FOR SALE

ISOLATION transformer 35w 117v sec. 117 or 135 plus 6.3v .45a tap. 3 lbs. $2.45 plus postage. Send for Flyer. Surplus bought. Empire Electronics Co., 409a Ave. L, Brooklyn 30, N. Y.

DIAGRAMS—Radio $1.00; record changers, recorders $1.25. Television with service data $2.00. Where model unknown, give part numbers. Kramer's Radio Service, Dept. S53, 36 Columbus Ave., New York 23, N. Y.

TAPE Recorders, Tapes, Accessories. Unusual Values. Dressner, 624-R East 20th St., N.Y.C. 9.

FREE: Get our monthly electronic lists. Dick Rose, Everett, Wash.

RESISTORS, condensers, micas, electrolytics, tubulars, latest pigtail types, new, every piece usable, some short leads. 5 lbs.—$5.00, 10 lbs.—$8.50. Prepaid. Cagan, Box 1152, Rochester, N. Y.

TUBES and equipment bought, sold, and exchanged. For action and a fair deal, write B. N. Gensler, W2LNI, 136F Liberty, N. Y. 6, N. Y.

BRAND New Components. Give away prices. Get gigantic lists. Roland Bond, 6255 Desco, Dallas 25, Texas.

CODE practice oscillators New, guaranteed, $4.00 postpaid. Stout, 2241 E. Broadway, Muskegon, Michigan.

CUSTOM Built Hifi: Speaker, Bass Reflex, 15 inch Co-axial. Amplifier Triode. High Gain, U.T.C. Components. Jensen Customode Cabinets. Blonde Mahogany (Rare at any price) Turntable Recko cut 3 speeds, dual Livingston Arms G. E. Broadcast. Including packing and crating price $1050.00. C. Chadwick, The Manor, Alden Park, Phila. 44, Penna.

CIRCUIT Diagrams will save your precious time. Radio $1.00. Television $2.00. Give make and model. Carleton Radio, 39 Daniel, East Hartford 8, Conn.

TELEVISION Receivers, $30 up. W4APL, 1420 South Randolph, Arlington 4, Virginia.

TV-FM antennas. All types including UHF. Mounts, Accessories. Lowest prices. Wholesale Supply Co., Dept. H, Lunenburg, Mass.

AN/Apr-4, other "APR-," "ARR-," "TS-," "LE-," ARC-1, ARC-3, ART-13, everything surplus; Tubes, Manuals, Laboratory equipment. Describe, price in first letter. Engineering Associates, 434 Patterson Rd., Dayton 9, Ohio.

TV Sweep & Marker Gen., xtal controlled, new $900.00 value. $195.00. W. Vogel, 1108 Lexington, Wheaton, Illinois.

USED Radio Vibrators Rejuvenated $1.25 each. 30 day guarantee. Radio Products Service, S. J. Boysel, 204 N. Florence Street, Springfield, Ohio.

USED Television sets $25.00. Jones, 1115 Rambler Ave., Pottstown, Pa.

ALUMINUM tubing, angle and channel, plain and perforated sheet. Willard Radcliff, Fostoria, Ohio.

$90.00 TRADE-IN allowance for any Tape Recorder on purchase of new, latest model Concertone Professional Tape Recorder. Other terrific bargains! Telcoa Audio Exchange, Azurelee Dome, Globe 6—2611 Malibu, Calif.

WANTED

HIGHEST prices paid for BC610 transmitter, JB70 junction box, BC939 or BC729 Ant. tuning units, BC614 speech amp. & all BC610 coils & TU'S, TS184/AP spectrum analyzer, G. R. VTVM Model 1800A, Dumont 331A Scope, Boonton Q Meters Model 260A and 190A with accessories.. Transmitting tubes 3C22, 3C15, 3D21A, 3E29, 4C35, 4D21, 4-125A, 5C22, 450TL, 723AB, 810, 813, 829B, 832, all W. E. tubes. We buy all types. Receiving, transmitting, industrial, "TAB," 111 Liberty St., N. Y. 6, N. Y.

WILL buy all ART-13/type T-47A $200.00; ART-13/type T-47, $150.00; BC-348 unmodified $65.00, BC-348 modified $50.00; APN-9 $200.00; ARC-3 complete $600.00; R77 Receivers $300.00; ARC-1 $300.00; BC-312 $60.00; BC-342 $60.00. Ship via Express C.O.D., subject to inspection to: H. Finnegan, 49 Washington Avenue, Little Ferry, N. J.

TELETYPEWRITERS, tape send-receive or receive only, Model 14, any quantity or condition. Box 540, Radio & Television News.

MINIFON Recorder must be reasonable. A. Siegel, 1516 Shakespeare Ave., N.Y.C. 52.

BUSINESS OPPORTUNITIES

SALESMEN—Part or full time—Sell at Manufacturers low prices Television wire to local Appliance-Radio-Service repair stores. 10% commission—original and repeat orders. Write for free samples. No charge. King Mfg. Co., 45 Huron Rd., Mohegan Heights, Yonkers, New York.

CORRESPONDENCE COURSES

USED correspondence Courses and Books sold and rented. Money back guarantee. Catalog free. (Courses bought.) Lee Mountain, Pisgah, Ala.

MISCELLANEOUS

FREE money saving bargain list. 10 MFD/600WV Oil Capacitor 98c; RCA 3APIA $5.95; add postage. Mark Electronic, 1888 Randell Ave., Bronx 72, N. Y.

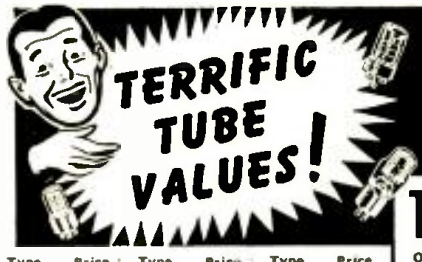
SPEAKERS repaired, wholesale, guaranteed. Jobbers wanted. Amprite Speaker Service, 70 Vesey St., New York 7, N. Y.

BUILD your own electronic organ or miniature electronic brain. Jim Kirk, W6DEG, 1552 Church St., San Francisco 14, Calif.

SPEAKERS repaired, guaranteed. 24 hours service, 50% off dealers. Send to Dept. A. Sweeney's Reconing Service, 922 W. 5th, Winona, Minnesota.

CATALOGUES, Brochures, Layouts. Creative Industrial Art. Gilbert Associates, 275 Fifth Ave., N.Y.C., Mu 4-0680.

TEST Equipment Repaired and calibrated by factory staff. All makes. Solar, Simpson, Triplett, Heath, etc. Immediate service. Douglas Instrument Laboratory, 176 Norfolk Avenue, Boston 19, Mass.



TOP QUALITY
FULLY GUARANTEED TUBES
BELOW MFRS' PRICES

THIS MONTH'S SPECIALS

Our new policy brings you greater tube savings than you thought possible! As a GOODWILL offering, we are giving, each month, a number of popular tube types (listed below in extra bold) AT PRICES BELOW OUR OWN COST! Look for these terrific offers of different types each month, in industry-wide publications!

We specialize in TUBES—of every kind and description—serving the industry for years. More than 3000 different types in stock for IMMEDIATE DELIVERY—including hard-to-get and discontinued numbers. All tubes exhaustively tested in our fully equipped laboratories, and re-tested at time of shipment. FULL ONE-YEAR GUARANTEE. All tubes individually boxed and coded.

Type	Price
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0A3 VR75	.99
0A4G	.65
0B2	.74
0B3 VR90	.95
0C3 VR105	.98
0D3 VR150	.89
0Z4	.54
1A5GT	.39
1A7	.49
1AB5	.39
1AX2	.61
1B3	**.59**
1D8GT	.77
1G6GT	.25
1H5GT	.48
1J6G	.59
1L4	.45
1LA4	.79
1LA6	.79
1LB4	.79
1LC5	.69
1LC6	.79
1LD5	.77
1LE3	.78
1LG5	.77
1LH4	.78
1LN5	.59
1N5	.61
1P5GT	.56
1Q5GT	.57
1R4	.89
1R5	**.42**
1S4	.58
1S5	.42
1SA6	.48
1T4	.48
1U4	.48
1U5	.48
1X2A	**.55**
2A3	.95
2A4G	.99
2A5	.89
2A6	.49
2A7	.64
2B7	.62
2X2	.39
2X2A	1.15
3A4	.44
3A5	.93
3A8	.60
3B7	.39
3D6	.39
3LF4	.79
3Q4	.48
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3S4	.48
3V4	.51
5T4	1.28
5U4G	.53
5W4	.50
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5Y3GT	.36
5Z3	**.33**
6A6	.47
6A7	.62
6A8	.69
6AB4	.49
6AB7	.75
6AC5GT	.99
6AC7	**.69**
6AF4	.85
6AF6	.75
6AG5	.46
6AG7	.95
6AJ5	.89
6AK5	**.49**
6AL5	**.29**
6AQ5	.37
6AR5	.39
6AS5	.50
6AT6	.37
6AU6	.40
6AV5	.79
6AV6	.37
6AX4GT	.55
6B7	.95
6B8	.85
6B8G	**.29**
6BA6	.40
6BA7	.56
6BC5	.49
6BD6	.44
6BE6	.37
6BG6	1.18
6BH6	.45
6BJ6	.42
6BK7	.95
6BN6	.79
6BQ6	.79
6BQ7A	.88
6BZ7	**.79**
6C4	.37
6C5	.39
6C6G	.57
6C8G	.85
6CB6	.45
6CD6	1.10
6D6	.69
6D8G	.98
6E5	.48
6F5	.39
6F6	.45
6F7	.93
6F8G	.69
6G6G	.65
6H6	.49
6J5	.40
6J6	.49
6J7	.49
6J8G	.95
6K7	.39
6K8G	.65
6L5G	.79
6L7	.85
6L7G	**.39**
6N7	.98
6Q7	.49
6R7	.49
6S4	.42
6S7G	.59
6SA7	.40
6SC7	.79
6SD7GT	.38
6SF5	.45
6SF7	.59
6SG7GT	.40
6SH7	.60
6SH7GT	.50
6SJ7	**.39**
6SK7	.40
6SL7GT	.49
6SN7GT	.49
6SQ7	.41
6SR7	.45
6ST7	.49
6T8	.59
6U7G	.45
6U8	.59
6V6GT	.39
6W4GT	**.39**
6W6	.46
6X4	.36
6X5GT	.35
6X8	.74
6Z7G	.75
7A5	.59
7A6	.69
7A7	.69
7AD7	.95
7AG7	.55
7AH7	.56
7B4	.44
7B5	.59
7B6	.59
7C4	.58
7C5	**.49**
7C7	.65
7E5	.59
7F7	.65
7H7	.59
7J7	.75
7K7	.79
7L7	.59
7N7	.62
707	.61
7R7	.65
757	.85
7T7	.91
7V7	.91
7W7	.85
7X7	.70
7Y4	.44
7Z4	.49
7Z7	.85
10Y	.69
12A6	.59
12AH7	.89
12AT6	.39
12AT7	**.55**
12AU6	.39
12AU7	**.49**
12AV6	.49
12AV7	.69
12AX4GT	.59
12AX7	.59
12AY7	.79
12BA6	.49
12BA7	.59
12BD6	.49
12BE6	.49
12BH7	.65
12BY7	.65
12BZ7	.63
12C8	.34
12F5GT	.35
12H6	.45
12J5GT	.39
12J7GT	.58
12K7	.55
12K8	.58
12L8GT	1.30
12Q7GT	.59
12S8GT	.61
12SA7GT	.64
12SC7	.69
12SF5	.49
12SF7GT	.69
12SG7	.75
12SH7	.75
12SJ7	.59
12SK7GT	.62
12SL7GT	.49
12SN7GT	.58
12SQ7GT	.56
12SR7	.49
12Z3	.39
14A4	.69
14A5	.59
14AF7	.59
14B8	.65
14C7	.69
14E7	.83
14F7	.67
14F8	.95
14N7	.59
14N7	.69
14Y4	.69
19	.49
19BG6	.99
19T8	.79
22	.44
25AV5GT	.84
25BQ6GT	**.68**
25L6GT	.39
25Z5	.64
25Z6GT	.44
26	.44
27	.38
32L7GT	.98
35C5	.37
35W4	.37
35Y4	.45
35Z3	.43
35Z5GT	.48
42	.41
43	.55
45Z3	.42
46	.49
47	.89
49	.44
50B5	.40
50C5	.44
50L6GT	**.55**
50X6	.64
50Y6GT	.59
56	.49
57	.55
58	.58
70L7GT	1.00
71A	.54
76	.43
77	.55
78	.45
81	1.11
82	.69
83	.79
84	.54
85	.59
89/Y	**.29**
117Z3	.38
117Z4GT	.75
807	1.39
2051	.95
9001	1.49
9002	.98
9003	1.48
9004	.97
9006	.68
CATHODE RAY	
3EP1	5.50
5BP1	**3.55**
5BP4	5.95
5CP1	5.95
7BP7	7.45
12DP7	19.50
16HP4A	24.95
16DP4	24.95
INDUSTRIAL	
1B22	1.80
1B24	8.89
1B32	1.90
1N23	1.95
2C40	6.95
2C44	.89
2D21	1.09
2J26	26.95
3C24	1.75
211	2.21
304TL	7.50
307A	4.80
316A	2.50
446A	3.40
705A	1.50
715B	6.50
717A	.58
721A	2.50
726A	9.50
801A	.39
803	2.90
815	3.90
826	.89
836	3.95
837	1.40
841	1.30
842	.60
860	6.85
864	.85
874	1.30
954	.34
955	.54
991	.60
CK1005	.60
1616	1.95
1619	.35
1624	1.70
1625	.29
1626	.49
1629	.44
1630	1.10
1631	1.40
1632	.65
1633	.89
1634	1.10
7193	.55
8012	2.50
8013A	3.80
8020	2.90

FREE OFFER! Seven Assorted 12, 7, 6, 1 and 2-volt type tubes. List Value approx. $23.00. FREE with every order for $25.00 or more!

Our Gain is YOUR GAIN too! Enormous volume of our Tube business enables us to absorb overhead costs and pass on to you substantial savings in the form of Sensationally Low Prices, on the items shown below:

STANDARD BOOSTER

Powerful 12-channel TV Booster, with self-contained power supply, for 110 V. AC. Handsome plastic cabinet. List $23.00. Your Net Cost, Each.....only **$6.96**
lots of three, each..$6.58

TRACTOR RADIO

FARM HOME TRUCK
RANCH MARINE TRACTOR

Ideal mobile radio, for Tractor, Truck, Marine use. 6 Tubes plus rectifier. Pushpull 6V6 output, 10 watts audio power. 6X9 PM Speaker, 6.8 oz. magnet. Complete with whip antenna. For 6 Volt Operation. List $99.75. Your Net Cost, Each... **$29.77**

HEADSET SPECIAL

Exceptionally fine army-navy spec. headphones, individually boxed. List Value $16.

Your Net Cost each..... **$2.89**
lots of three, each..$2.58

FREE! SEND FOR OUR LATEST LISTING. Minimum order $10. Please include 25% deposit with order. Prices subject to change without notice. All prices F.O.B. our warehouse, N.Y.C. Write for types not listed.

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140 DUANE STREET • NEW YORK 13, N. Y. • Phone: BArclay 7-7616

INDEX OF Advertisers

JUNE 1954

[While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.]

70% to 90% OFF on TUBES — INDIVIDUALLY BOXED — FULL YEAR GUARANTEE!

SAME DAY SERVICE . . . OVER 300 TYPES IN STOCK AT ALL TIMES!

Compare! Save!..on RAD-TEL TUBES and PARTS!

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.

Model TB-3

10.95 Ea.
In Lots of 3 $9.95

Granco "Star" UHF CONVERTER

Brand new! Latest model! Unit is highly engineered, receives all UHF channels. Coaxial tuned cavity elements complete with 6AF4 oscillator, 6CB6 I-F and crystal mixer. Shipped ready to install and operate. List Price $29.95.

22.45

De luxe model Five Star UHF Converter. Preselector 1N82—6BQ7 cascode and 6AF4 oscillator. List price $39.95.

29.97

STANDARD BOOSTER

L channel RF Amplifier with self-contained AC power supply. Handsome plastic cabinet. List price $23.00.

each 6.95 — Lots of 3 each 6.45

SELENIUM RECTIFIERS

Mfd. by FEDERAL

MA	PRICE
65	59¢
75	69¢
100	79¢
150	84¢
200	1.25
250-1010A	1.75
250-1028A	1.75
300	1.39
350-1238A	1.59
350-1023A	1.59
400	1.50
500	1.99

UNIVERSAL FLYBACK

High efficiency FERRITE core horizontal transformer . . . supplies 14,000 Volts. For all 63° to 70° kinescopes. Famous Type. In constant demand.

List Price $11.50

1.95 Each

Lots of 3 1.85 Each

CATHODE RAY TUBE REJUVENATOR

Fits all makes of picture tubes. Completely automatic. Easy to install, no tools needed. For A.C. parallel circuits. Your old Picture Tubes Are Still Useful. List price—$3.95.

Lots of 10 1.09 each — 1.39 each

All New Parts At Old Fashioned SAVINGS!

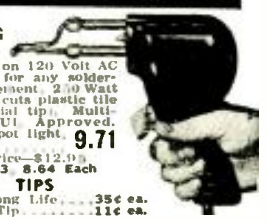
VOLUME CONTROL KIT

Kit of 10 includes wire-wound, dual and carbon

The price of one (1) for the quantity of ten (10). Short and long shaft.

Lots of 3 Kits 1.59 Ea.
1.79 PER KIT

WEN SOLDERING GUN



3 seconds on 120 Volt AC readies it for any soldering requirement. 250 Watt size. Also cuts plastic tile (with special tip). Multi-useful! UL Approved. Built in spot light.

Each 9.71
List price—$12.95
Lots of 3 8.64 Each

TIPS

Feralov Long Life . . . . 35¢ ea.
Standard Tip . . . . . 11¢ ea.

Famous Make—Giant 21" Picture TABLE MODEL TV

Giant 21" self-focusing picture tube. Famous STANDARD Cascode tuner. Fine tuning adjustment for fringe areas. Cabinet hand rubbed to a smooth glossy finish. Beautiful furniture piece, compact size fits standard size desk or table. Rich gold finish trim. Mahogany or blond. Wt. 100 lbs.

144.50 Each — Lots of 3 139.50 Each

Available with all channel tuner. Tunes any 12 VHF and 70 UHF station channels. Order No. 44U. Slight additional charge.

Personal Portable BATTERY RADIO

4 TUBES (2 DUAL-PURPOSE)

Has extra long life hundred hour batteries. Long distance reception. Large dynamic speaker. Thumb wheel tuning. All stations, plastic case, with collapsible handle. Rich gold finish trim. Red, brown or grey. Complete with batteries and leather case, each $19.95 complete.

Lots of 3 $19 ea.

Sensational! New! Famous 3-Way INDOOR ANTENNA

For UHF, VHF and FM radio. Delta-beam. 50% increase in pulling power by extending dipoles. For average, fringe and UHF areas. For movie-clear pictures.

Single antenna . . 3.95
Lots of 6 . . . . . 3.69

RESISTORS
(Asst. of 200)
Uninsulated, ½ Watt, 1 Watt, 2 Watt, and some 10 Watt.
List price—$10.00 . . . . . $1.39

KNOB KIT

(Choice Groups!) Assortment of home, auto and TV knobs. All colors—plastic, wood and bakelite knobs.

Bag of 50 1.29
Super Bag of 100 extra val. 1.95
Sells 12¢ to 18¢ each

2-STATION INTERCOM

For instant communication. Easily installed and operated. Uses 110 V A.C. or D.C. Ready 24 hrs. a day. Uses no current when in "off" position. Completely wired ready to use. With master unit and remote unit and 50 ft. plug in cable. Portable, install it yourself, no tools needed. Plastic cabinet in ebony and gold, 6¾ x 5¼ x 2¼.

$24.75 complete

Type	Price	Type	Price	Type	Price	Type	Price
OA2	.74	**6AV6**	**.37**	7AF7	.53	14C7	.79
OA4	.68	**6AX4GT**	**.65**	7B4	.44	14E6	.75
OB2	.81	6B4	.64	7B5	.45	14E7	.88
OC3	.72	**6BA6**	**.39**	7B6	.69	14F7	.65
OD3	.70	**6BA7**	**.57**	**7B7**	**.49**	14H7	.59
OZ4M	**.55**	**6BC5**	**.49**	7C4	.59	14J7	.30
1A5	.49	6BD5	.59	**7C5**	**.69**	14N7	.84
1A7GT	**.47**	**6BD6**	**.45**	**7C6**	**.59**	**14R7**	**.79**
1AX2	**.62**	**6BE6**	**.39**	7E5	.59	14S7	.89
1B3GT	**.73**	6BF5	.41	7E6	.30	14W7	.30
1C5	.43	6BF6	.37	7E7	.59	14X7	.69
1E7	.29	**6BG6G**	**1.25**	**7F7**	**.79**	14Y7	.62
1G6	.24	**6BH6**	**.46**	7G7	.89	19BG6	.95
1H4	.30	**6BJ6**	**.43**	**7H7**	**.59**	19C8	.70
1H5GT	**.49**	6BK7	.80	7J7	.79	**19T8**	**.69**
1L4	**.46**	6BL7GT	.83	7K7	.69	19V8	.79
1L6	.59	6BN6	.59	7L7	.59	24A	.39
1LA4	.59	**6BQ6GT**	**.79**	**7N7**	**.69**	**25AV5GT**	**.83**
1LA6	**.69**	**6BQ7**	**.90**	**7Q7**	**.66**	**25BQ6GT**	**.79**
1LC5	.59	**6BZ7**	**.90**	7R7	.89	**25L6GT**	**.51**
1LC6	.79	**6C4**	**.37**	7S7	.79	25W4GT	.59
1LD5	.59	**6C5**	**.39**	7V7	.89	**25Z5**	**.66**
1LE3	.59	6C6	.58	7X6	.54	25Z6	.49
1LG5	.69	**6CB6**	**.44**	7X7	.70	26	.45
1LH4	**.69**	**6CD6**	**1.11**	**7Y4**	**.69**	27	.39
1LN5	**.59**	6D6	.59	7Z4	.59	32L7	.89
1N5GT	**.67**	**6E5**	**.48**	12A6	.54	35	.58
1P5GT	.57	6F5GT	.39	12A8GT	.61	**35B5**	**.40**
1Q5GT	.58	**6F6**	**.59**	**12AL5**	**.37**	**35C5**	**.39**
1R5	**.49**	6G6	.52	12AQ5	.52	**35L6GT**	**.41**
1S4	.59	**6H6GT**	**.41**	**12AT6**	**.37**	**35W4**	**.47**
1S5	**.43**	**6J5GT**	**.43**	**12AT7**	**.66**	**35Y4**	**.54**
1T4	**.49**	**6J6**	**.52**	**12AU6**	**.38**	**35Z3**	**.59**
1U4	**.49**	**6J7**	**.43**	**12AU7**	**.54**	35Z4	.47
1U5	**.43**	6K5	.47	**12AV6**	**.39**	**35Z5GT**	**.47**
1V	.53	**6K6GT**	**.37**	**12AV7**	**.63**	36	.39
1X2A	**.63**	**6K7**	**.44**	12AX4	.56	41	.42
2A3	.30	**6L6**	**.64**	**12AX7**	**.56**	42	.42
2A4G	.24	6L7M	.68	12AY7	.99	43	.55
2W3	.38	6N7M	.63	12AZ7	.59	45	.55
2X2	.59	**6Q7**	**.45**	**12BA6**	**.38**	45Z3	.44
3A4	.45	6R7	.69	**12BA7**	**.60**	45Z5	.49
3E5	.46	**6S4**	**.38**	12BD6	.45	**50A5**	**.55**
3LF4	.69	6S7M	.79	**12BE6**	**.51**	**50B5**	**.52**
3Q4	**.48**	6S8GT	.53	12BF6	.39	**50C5**	**.51**
3Q5GT	**.49**	**6SA7GT**	**.43**	**12BH7**	**.63**	**50L6GT**	**.61**
3S4	**.49**	6SD7GT	.41	**12BY7**	**.65**	50Y6	.49
3V4	**.51**	6SF5GT	.46	12BZ7	.65	50Y7	.50
5U4G	**.55**	6SG7GT	.41	12C8M	.34	55	.49
5W4GT	.50	6SH7GT	.49	12H6	.56	5E	.49
5Y3GT	**.37**	6SJ7GT	.41	12SC7M	.63	57	.58
5Z3	**.45**	**6SK7GT**	**.41**	12J5	.42	58	.60
6A6	.51	**6SL7GT**	**.48**	12J7	.49	70L7	.97
6AB4	**.44**	**6SN7GT**	**.52**	12K8	.59	75	.49
6A7	.69	**6SQ7GT**	**.37**	12Q7	.59	76	.44
6AC7M	**.86**	6SR7GT	.45	12S8GT	.62	77	.57
6AF4	**.90**	6SS7GT	.42	**12SA7GT**	**.65**	78	.47
6AG5	**.48**	6T4	.99	12SF5	.50	80	.35
6AG7M	**.99**	**6T8**	**.80**	12SG7	.51	83V	.68
6AH4	**.57**	6U6	.59	12SJ7M	.67	84/6Z3	.46
6AH6	**.73**	**6U8**	**.61**	**12SK7GT**	**.63**	85	.59
6AJ5	.65	**6V6GT**	**.50**	**12SK7M**	**.63**	117L7	.99
6AK5	**.55**	**6W4GT**	**.44**	**12SL7GT**	**.47**	117P7	.99
6AK6	**.59**	**6W6GT**	**.44**	**12SN7GT**	**.52**	**117Z3**	**.37**
6AL5	**.38**	**6X4**	**.37**	**12SQ7GT**	**.56**	117Z6	.69
6AQ5	**.39**	**6X5GT**	**.37**	12SR7M	.49	807	.99
6AQ6	**.37**	**6X8**	**.75**	**12V6GT**	**.46**	866A	1.39
6AR5	**.37**	**6Y6G**	**.48**	**12X4**	**.38**	1274	.30
6AS5	**.50**	7A4	.47	14A4	.69	Hi-Po #567	1.39
6AT6	**.37**	7A5	.59	14A5	.59		
6AU4GT	**.68**	7A6	.69	**14A7**	**.63**		
6AU5GT	**.82**	**7A7**	**.69**	14AF7	.59		
6AU6	**.46**	**7A8**	**.68**	**14B6**	**.63**		
6AV5GT	.83	7AD7	.79	14B8	.63		

RAD-TEL TUBE CO.

Dept. RE6 — 115 Coit St., Irvington 11, N. J. — *"Integrity Is Our Chief Asset"*

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.

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STEATITE	30c; 4 for $1.00
±123-209 (866A)	90c; 2 for $1.49
±122-247 (829B)	55c; 3 for 1.00
±123-211 (872A)	1.30; 4 for 4.80
±122-237 (813)	50c; 3 for 1.00
±122-234 (5D21-715)	1.25; 4 for 3.98
±124-213 (304TL)	1.30; 2 for 2.49
±122-227 (1625)	30c; 4 for 1.00
±122-225 (807)	35c; 4 for 1.20
5 46-S811C (Magnal)	59c; 2 for 1.00
5 prong (4 Acorn)	35c; 4 for 1.00
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Octal (bakelite) saddle mtg.	15 for 1.00
Octal (mica) saddle mtg.	12 for 1.00
Octal (steatite) saddle mtg.	12 for 2.00
Loktal (steatite) ring mtg.	10 for 2.00
Loktal (mica) saddle mtg.	12 for 1.00
7 pin min (mica) base shld.	12 for 2.00
7 pin min (mica) bottom mtg.	10 for 1.00
7 pin min (blkt) rubber shock mtg.	12 for 2.00
7 pin min wafer	15 for 1.00
9 pin min (mica) bottom mtg.	12 for 2.00
9 pin min (blkt) bottom mtg.	7 for 1.00
9 pin min (blkt) base shld.	5 for 1.00

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Includes ML Flash Lamp and 150 Watt Second Flash Gun and Reflector & Cable. Power Trans & Condensers (10) 100 MFD/450V/100 Watt Sec. Resistors, Capacitors, Rectifiers & Sockets $29.98

Above Kit with only (2) condensers rated 525MFD/450V each. Total (1050MFD) $39.98

525MFD/450V condensers NEW. Low leakage. Reg. $27.50. "TAB" PRICE. $9.00; SPECIAL. . . . 2 for $17.00; 6 for $48.00

100 Watt Second Condenser Bank. .72MFD/1800V per unit/85 units equals 61.2MFD/100 Watt Second. SPECIAL. $4.98

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"Tab" No.	Replaces	Max. W-Sec	Each
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TLW	GE FT 118	150	5.98
TH1	AMGLO 5804X	100	10.98
25ST	GE FT 203	200	9.98
THVA	SYLV. 4330	200	10.98
V4X4	X400	200	10.98
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RG59U 73ohm 100 ft $5; 500 ft. . . . $22

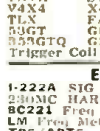
Hi-V 20KV Anode wire 50' $1.50; 1000' $26

MIKE CABLE 1Cond LO-CAP 6c ft; 500' $27

MIKE CABLE 2Cond LO-CAP 6c ft; 500' $33

MIKE CABLE 2Cond,LO-CAP Rolls 50' $2.98

COAXIAL SPEAKERS



All 8 Ohm V.C. Alnico V Magnets, inbuilt net work. 2 wires needed for HF & LF response. Famous Hi-Fi speaker mfrs. 3½" Coaxial & 5" Tweeter. 25 Watt/20-17,500cy. Ship. wgt 13 lbs. Mod P25CO. $23.75

12" Coaxial & 3½" Tweeter. 12 Watt/45-15KC. Shpg wt. 8 lbs. Mod P12CO . . . $12.75; 3/$35

8" Coaxial & 2½" Tweeter, 8Watt/70-15,000cy. Mod. P8CO $7.98

GE A1-400 12" Hi-Fi Coaxial $37.00

12" Hi-Fi PM 10W 35 to 14000CPS $9.95

8" Hi-Fi PM 7W Same as 10,000CPS . $7.25

Tweeter 5"/10W 2-15KC 16 ohm VC. $3.25

Tweeter 3½"/10W 2-15KC/16ohmVC $3.75

Horn&DriverTweet,30W/750to15KC $23.50

12" Cone Woofer25W 20-1KC/3DB. $32.44

AUDIO COMPONENTS

Electrovoice triplay cart. . $1.98

GE RPX040 78 Goldtone . . . $5.25

GE RPX041 MG Goldtone . . . $5.25

GE RPX050 Dual triplay . . . $5.25

GE RPX052 Dual (D&S) . . . $17.75

GE RPX053 1.0il & .003 diamonds $25.98

"TAB" GTD Phono Needle Replacements

RPJ010 Dual .001 & .003 sapphire . $1.95

RPJ012 Dual .001 & .003 diamonds. $20.89

RPJ001 78 or RPJ005 .001 sapphire. $1.35

RPJ003 78 or RPJ004 1/2 diamond . $10.89

RPJ013 Dual diamond & sapphire . $12.89

MG or 78 single osmium. . . $9c; 12/$5.98

MG or 78 single sapphire $1.35

MG or 78 single diamond $9.98

MG & 78 dlm & sapphire $12.89

MG & 78 dual diamond $25.98

TUBE CADDY

HEAVY DUTY TUBE CASE

5/16" plywood. Lock-cornered construction. Durable plastic handle, nickel plated hardware & reinforced with metal clamps. Leatherette finish. Holds approx. 125 tubes plus tools & meters. 6¾"L/8¼"W/13¾"H.

"TAB" Special $12.98

Free with $125 net receiving tube order.

TOGGLE SWITCHES

SPOT 15A/125V center off AN3022-1B . . . 89c; 5/$2.50

SPST 5A/125V Bat Handle fused! . . . . . 4/$1.00

SPDT 15A/125V Cntr off Mom AN3022-7B 79c; 3 $2.00

SPDT 15A/125V AN3022-3B 59c; 3/$1.25

DPST 20A/125V AN3027-2B 69c; 5/$2.50

DPST 3A/125V All&ll Laminated 3/$1.00

DPST 5A/125V Bkit Cased. . . 49c; 3/$1.20

3PDT 22A/125V C'Hammer.$1.49; 2/$1.98

4POT 10A/125V All&ll. . . $1.98; 3/$5.00

"TAB"

THAT'S A BUY

WATCH THIS SECTION EVERY MONTH

RHEOSTATS—OHMITE—IRC—W. LEONARD

15 ohm 25W w/knob	$1.10; 10 for $7.00
20 ohm 50W Model J	1.98; 10 for 14.00
40 ohm 50W w/knob	1.98; 10 for 14.00
100 ohm 50W w/knob	1.50; 10 for 9.00
125 ohm 25W Model H	1.10; 10 for 7.00
225 ohm 50W	1.98; 10 for 15.00
250 ohm 25W	1.10; 10 for 6.00
300 ohm 225W Mod.-P	2.98; 5 for 10.00
500 ohm 25W Model H	1.10; 10 for 7.50
800 ohm 50W Model J	1.98; 10 for 15.00
1200 ohm 225W Mod. P	2.98; 2 for 5.00
2500 ohm 25W	1.10; 10 for 7.00
5000 ohm 25W Mod. H	1.25; 10 for 9.00

VARIABLE VOLTAGE TRANSFORMERS

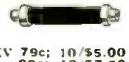
SUPERIOR—GR—STACO

0-135V/3A/0.4KVA

	$11.25
CSD/135V/7.5A	20.70
UCSD/135V/7.5A	21.20
CSD/0-270V/3AMP	23.40
UCSD 270V/3A	18.00
CASED/135V/15A	41.98
CASED/0-270V/9A	41.98
GR50A 0-135V/45A LN	100.00
GR50B 0-270V/31A LN	115.00
30008U 0-135V 30A Uncased	49.00
30008/0-135V/30A Cased	55.00
30208U 0-270V/12A Uncased	49.00
30208/0-270V/12A Cased	55.00
Staco LRL-5/Metered 140V/5A	41.50
Staco PAL-7/Metered/135V/7.5A	40.50

Write for Catalogue & Quantity Prices

HI-MEG HI-VOLT IRC RESISTORS



.75 Meg "MVP" 10W 10KV 79c; 10/$5.00

2 Meg "MVG" 4W 5KV. .89c; 10/$7.50

2 Meg Sprague 5W 10KV 99c; 10/$8.50

2.5 Meg "MVA" 20W 25KV $1.50; 10/$12

2.5 Meg "MVT" 5W 7.5KV 89c; 10/$7.00

7 Meg "MVP" 10W 10KV $1.35; 10/$12.00

10 Meg "MVP" 10W 10KV $1.69; 10/$15

12 Meg Sprague 10W 10KV $1.69; 10/$15

20 Meg "MVO" 35W 50KV $2.25; 10/$20

50 Meg "MVE" 25W 40KV $2.75; 10/$25

100 Meg "MVP" 10W 10KV $2.25; 10/$20

TELEVISION ANTENNA

VEE CONICAL Broad response, all channel, powerful for fringe areas. $8.95

FOLDED DIPOLE III & low antennas, all channel, sturdy const. $4.95

TV CONICAL ANTENNA All Channel, Sturdy lneids 8 elements, Cross Bar & Clamp $3.95

WINDOW CONICAL ANT All Channel, Hvy Const. Mounts outside window $3.95

5 FOOT Interlocking Mast Sections, Hvy Duty, rustproof. . . 2 for $1.49; 10 for $7

INDUSTRIALS WRITE ON YOUR LETTERHEAD FOR POWER RECTIFIER CATALOG

SELENIUM RECTIFIERS

We specialize in Rectifiers and Power supplies to specifications. Immediate delivery.

Current (cont.)	18/14 Volts	36/28 Volts	54/40 Volts	130/100 Volts
1AMP	1.35	2.75	3.70	8.50
2AMP	2.20	3.60	6.00	10.50
4AMP	4.25	7.95	12.95	25.25
6AMP	4.75	9.00	13.50	33.00
10AMP	6.75	12.75	20.00	44.95
12AMP	8.50	16.25	30.50	49.00
20AMP	13.25	25.50	38.00	87.50
24AMP	16.25	32.50	45.00	95.00

Full Wave Rectifier & Transformer

All 115V/60 cy inputs

up to 14VDC at 12 amps	$19.98
up to 28VDC at 4 amps	14.98
up to 28VDC at 12 amps	29.98
up to 28VDC at 24 amps	63.98
up to 28VDC at 50 amps	127.00

2000V-Pk. inverse/1600VDC SELENIUM RECTIFIER 1.5MA ½WAVE Pigtail type ¼" dia. 2" lgth. for Sepes, TV. Photoflash & HV Supplies. Use in series for higher volts. $3.00; 2 for $5; 12 for $25

Write "TAB" any Rectifier to Specs.

RECTIFIER XFMR

PRIMARY 115V., 60 cycle. SECONDARY 0-9-12-18-24-36V

4 Amp $8.75 @ . 2 $15.75

12 Amp $16.75 @ . 2/$29.95

24 Amp $35.75 @ . 2 $69.95

RECTIFIER CHOKES

4 Amp .07	Hy .6	Ohm	$7.95
12 Amp .01	Hy .1	Ohm	14.95
24 Amp .004	Hy. 025	Ohm	29.95

BATTERY CHARGER RECTIFIER

13-0-13V (CT) 100 Amp., fan cooled. Replace your old ineffielent sulfide rectifier w/new selenium type. . . $11.98; 3 for $33

HIGH CURRENT PWR SUPPLIES

Variable 0-28VDC. Completely Built, Ready to Go. Full Wave Selenium Rectifier, Transformer, Variac, volts & Amp Meters, Switch, Terminals & Fuse. In Heavy Duty Steel Cabinet. Standard input 115V 60cy. 220V to order. Write!

T28V5A	0-28VDC at 5 Amp	$ 47.75
T28V12A	0-28VDC at 12 Amp	89.00
T28V24A	0-28VDC at 24 Amp	129.50
T28V50A	0-28VDC at 50 Amp	239.50
T816	0-8, 0-16V, variable 0-10 Amps. Rated 6 or 12 V, continuous, metered $35.	

DC POWER SUPPLY

Variable DC Power supply, full wave rectification, 6000 MFD condenser Filter, fused. Completely built, ready to go. Input 115V 60cy. Output 0 to 6VDC or 12VDC at 2Amp. Model 2DCF . . . $12.98

As above except 4Amp Model 4DCF $20.98

NEW RELAY LIST

Tremendous Price Reductions

R15T1 Stevens Arnold Resonant Relay ±189. Plug-in Freq. 240cy. $5.98; 3 for $15

R2WE1 Western Elect. Mercury Relay D-171584 plug-in SPDT transfer contacts 36VDC/4500, Ohm/6MA/DC . . $7.75; 3/$21

R3WE2 West. Elec. D-163781 SPST, 10VDC/2500, Ohm/4MA plug-in Sig ±227587-17 P O SCR545A . . . . . $16.95; 3 for $48

R4KU1 SPST/MINI/115VAC/4A cts. $1.39

R5KU2 SPDT/MINI/115VAC/4A cts. $1.69

R6KU3 Kurman DPDNO&NC/4MADC 700 Ohm/5A cts. . . . . $4.49; 3 for $12

R7CL1 Clare SK5010VAC/SLD DPDT 18-28VDC/3A cts octal base $2.98; 3/$7.50

R8RB1 SPNO MINI/115VAC/8A cts. $1.89

R9AC1 SPST/MINI/4MADC/3000 Ohm $1.25

R10S01 SPST/115VAC/30A cts. . . $2.00

R11AC2 DPDT/115VDC/5A cts. . . . $1.39

R12AC3 Allied DPDT/6VDC/5A cts. . $1.49

R13LE1 DPDT/28VDC/3A cts. $1.98

R14AU1 DPDT/SENSO 12VDC/10 cts. $2.25

R15GE1 G.E. SPST/28VDC/50A cts. $2.98

R16GE2 G.E. K35A406/SPDT/2000. Ohm, 8MA/5A cts. Plug-in. . . . $2.95; 2 for $5

R17GM1 SPST/24VDC/20A cts. . . . $1.49

R18LE2 DPST/115VDC/10A cts. . . . $1.49

R19S02 S'Dumn-32A/6-10Cy/Sec. Overload 115VAC/10MA . . . . $4.95; 2 for $9

R20CH1 C'Hammer-B8/7-24VDC/200-1200 Amp. . . . . $2.98; 2 for $5

R21GA1 DPST/8VDC/10A cts. $1.98

R22AD1 Advance-400 DPDT/SPNO-115 VDC RF—Ceramic Insulation . $4.50; 2/$8

R23AB1 A'Bradley—810 Magnetic Overload/Adjustable 18.1-15.2-12.9-6.3 Amp.-600V MAX . . . . . $3.98; 2 for $7.00

Selenium Rectifier FW 115VAC/40MA, 79c

TRANSFORMERS

All 115 V 60 Cyc Input TV & CR Pwr Xmfr up to 20" tubes. HI VOLTS to 20 KV (w/quadrupler ckt.) ALL Tubes. PL & FIL wndgs 300 VDC 275 Ma Full-Wave; 6.4V/10.3A. 5.4V/8A. 2.5V/3A all filted. $4.98; 2 for $8.50; 6 for $22

2500V 20MA, 6.3V/6A, 2.5V/1.75A. 4/BC412 Scope Replmnt. $7.98

1600VCT/5Ma, 6.3VCT/3A. 6.3VCT 10A 5.4V/5A . . . . . $4.98; 2 for $14

950VCT/100MA, 5V/2.5A, 5V/5A, 45V/1A, 10V/1.5A . . . . . $4.98; 3 for $13.00

900V/35MA, 2X2.5V/2A, XCLENT 1800V DBLER TWO 2X2 FIL WNDGS. $2.25

850VCT 148MA 5V/3A, 6.3/5A, 6.3V 3A . . . . . $4.98; 2 for $9.00

778VCT/200MA, 5V/3A, 6.3VCT/3A Thordarson. . . . . $4.98; 2 for $9; 6 for $24

780VCT 250MA, 5V6A, 12.6V/5.5A. $7.95

770V 2.5MA, 2.5V/3A, HVIns Himsld. Includes Filter Parts. . . . $3.69; 2/$6; 4/$10

700VCT 70MA, 5VCT/3A, 6.3VCT/2.5A . . . . . $4.95; 2 for $8.00

600VCT/50MA, 6V/3A, 6V/1.5A, 5V/1A . . . . . $2.49; 2 for $4.50; 10 for $20

550VCT/250MA . . . 5V/2A, 6.3VCT/2.5A, 12.6V/3.5A. CSD/RCA . . $4.50 @ 2 for $8

500VCT 60MA, 6.3V/4A, HMSLD . . $2.98

420VCT 90MA, 6.3V/1.6A, W. UPTR 6, 12, 24, 115VDC & 115 & 230 VAC @ . . $3.49

2X330VCT 10MA each wndg. $3.49

FILAMENT TRANS.

2x12V/2A or 24V/2A . . . $3.69; 3 for $10

2.5VCT/10A 12.5KVins $5.50; 3 for $14

2.5VCT 10A 5KVins 3.59

5VCT 13A 5KVins UTC S-50 . . . . . 3.95

7.5VCT 12A 15KVins $10.95; 2 for 17.50

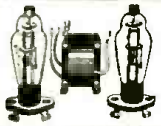
42.5V 2A Sel Rect Xfmr. 2.95

64V 1AMP HMSLD. . . $3.49; 2 for 5.00

814A 1.25A CSD @ . . $1.98; two for 3.49

PRI 220 440V Sec 3X2.5VCT 10A/3rd 2.5V/15A 5.95

DIODE PROBE TUBE Unexcelled for No-Loss VHF testing. New, w/data V892 . . . . . 25c; 5 for $1



866A KIT and XFORMER

2 Tubes, Sckts, xmfr. 115v60cve Inpt, outpt 2.5VCT/10A/3rd 5VCT/5A

FILTER CHOKES

Check These Reduced Prices

12Hy/80Ma/Hsld/3KVins . . $2.25

50Hy/125ma/Csd/Hsld 2.89

20Hy/300ma or 15Hy/400ma 12.5KVins 8.95

13.5 Hy 1 Amp./17KVins Raytheon . . 35.00

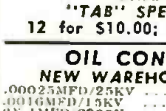
Dual 2Hy/300ma. USN. . . . 95c; 2 for 1.49

10Hy 100 MA Freed. 1.39

3Hy 40ma UTC HI . . . . . 69c 2 for 98c

5-30Hy/50ma swinging 6.49

TRANSFORMER SPECIAL



6.3 Volt 3¾ Amp

Continuous. 115VAC input. Size 2 5/16"H/2"L/1⅛"W. mtg entr 2¾"; hvy channel mtg RM, SM. Mfrs. Jobbers, Dlrs. . . . Order now this $1.98 value. $1.98

"TAB" SPECIAL $1.00

12 for $10.00; 100 for $75.00

OIL CONDENSERS

NEW WAREHOUSE LISTING

.00025MFD/25KV	$4.00: 2 for $ 7.00
.0015MFD/15KV	$7.00; 2 for $12.00
2.1MFD 2000V	$1.39; 2 for $2.00
.5MFD/600V	25c; 6 for $1.00
.5MFD 1500V	85c; 3 for $2.00
1MFD/500V	33c; 4 for $1.00
1MFD/600V	39c; 3 for $1.00
1MFD/1000V	39c; 3 for $1.00
2MFD/600V	59c; 2 for $2.00
4MFD 3000V	$7.98; 2 for $14.00
4MFD/5000V	$19.95; 2 for $35.00
5MFD/600V	$1.50; 3 for $4.00
16MFD/600VAC/1800VDC	$5.95; 2/$10.00

OIL CONDENSER SPECIAL

10 MFD 600 VDC $1.75 ea. lots of 3

Case dimensions, not including insulators 1 4/4ll x 3¾"W x 1¼"D. Smaller Quantities, special $1.98

Money Back Guarantee (Cost of Mdse. Only) $5 Min. Order F.O.B. N.Y.C. Add Shpg. Charges or 25% Dep. Tubes Ctd. via R-Exp. only. Prices subject to Change Without Notice. Rector 2-6245

TUBES

"TAB" TESTED & GUARANTEED

PRICES SUBJECT TO CHANGE

WRITE FOR COMPLETE LISTING

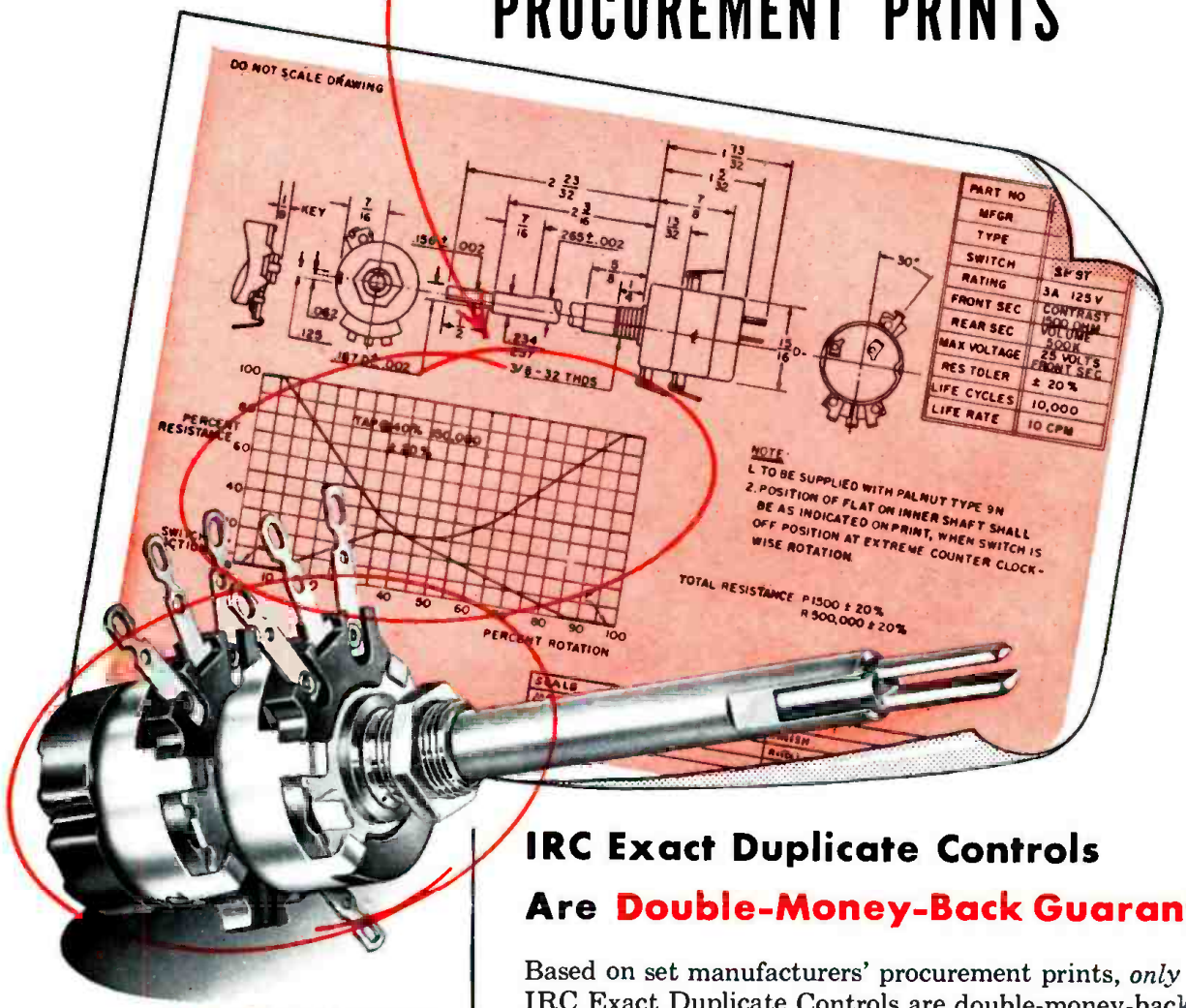
0A2	$0.88	3022	13.97	6SQ7GT	.62	81	1.38	829	7.94
0A3/VR75	1.04	3023	4.90	6SR7	.62	83	1.12	829B	12.48
0B2	1.39	3E29	14.49	6SS7	.88	83V	1.22	832	7.72
0B3 VR90	.96	4CS35	23.21	6SU7GTY	2.69	84/6Z4	.62	832A	29.98
0C3/VR105	.92	4D21	18.99	6T8	.96	100TH	9.88	833A	39.45
0D3/VR150	.92	4E27	22.49	6U4	.74	FG105	19.48	834	5.95
1B3 R016	.80	4J22	129.51	6U8	.99	117L		836	5.95
1B22	1.89	4J31	99.51	6V6	1.39	117M7GT	1.98	837	5.95
1B23	8.87	4J52	199.99	6V6GT	.59	117Z6GT	.96	849	29.45
1B24	8.98	EL5BNO	15.99	6W4GT	.52	CV148	7.98	860	4.48
1B26	2.24	5C21/C6J	9.89	6X5GT	.54	FG166	48.49	861	22.48
1B27	11.98	5C22	38.95	6Y6G	.88	FG172	29.97	866A	1.50
1B32/532A	2.48	5D21	14.98	7A8	.68	250TH	18.97	866A	1.50
1B35	9.15	5J29	11.92	7C7	.76	250TL	17.75	872A	3.29
1B37	14.87	5R4GY	1.20	7F7	.82	304TH	12.49	CK100S	.68
1B38	29.45	5R4GYW	1.75	7F8	1.22	304TL	12.49	873	.82
1B41	49.95	5U4	.55	7H7	.72	328A4	1.49	1614	1.95
1B42	17.48	5V4G	.95	7N7	.92	WL417A	8.48	1619	.36
1B46	1.98	5Y3GY	.43	7V7	1.06	417A/		1625	.32
1B63	45.00	6AG5	.71	7Y4	.68	5842	18.50	1632	.98
1D21 5N4	3.89	6AG7	1.14	8D21	298.00	GL434A	12.69	1633	.98
1L4	.48	6AH6	1.21	12A6	.48	446B	3.48	1634	1.18
1L6	1.35	6AJ5	1.40	12AH7GT	1.45	450TH	49.97	1635	1.69
1LD5	.98	6AK5	.87	12AL5	.54	450TL	52.00	1636	3.08
1LN5	.76	6AK6	.92	12AT6	.54	460-P		1638	.62
1R4	1.29	6AL5	.48	12AT7	.89	HF200	15.95	1644	.92
1R5	.59	6AL7GT	.98	12AU6	.72	CK502AX	1.49	2050	1.48
1U4	.52	6AN5	3.27	12AU7	.69	CK503AX	1.49	2050W	2.48
1U5	.54	6AQ5	.52	12AV6	.52	CK505AX	1.49	5749	1.72
1X2A	.98	6AQ6	.81	12AV7	.98	CK512AX	1.45	5670	3.44
2A4G	1.18	6AQ7GT	1.29	12AW6	1.18	CK5310X	1.89	CK5672	1.20
2C36	27.00	6AR6	3.27	12AX7	.98	531	5.72	CK5678	1.28
2C39A	26.98	6AS7G	3.48	12BA6	1.69	CK532DX	1.89	5687	1.74
2C40	4.98	6AT6	.51	12BA6	.59	WL532A	3.68	CK5702	2.90
2C43	17.48	6AU5GT	1.10	12BA7	.94	CK533AX	1.29	CK5703	1.29
2C51	1.15	6AU6	.56	12BD6	.99	CK536AX	.99	5713	120.00
2E51	3.88	6AV5GT	.98	12BE6	.59	CK538DX	.98	5732	2.98
2D21	1.18	6AV6	.49	12BF6	.85	CK539DX	2.15	5R14	2.08
2E31	1.49	6AW6	1.09	12BH7	1.29	CK541OX	1.99	5840	7.98
2E43	1.49	6B4G	1.18	12SA7GT	.68	CK543OX	.99	8012	2.58
2J31	27.00	6BA6	.54	12SC7	1.08	CK544DX	.99	8013A	3.92
2J49	27.00	6BA7	1.09	12SF7GT	.84	CK5476A	1.99	8013A	4.49
2J33	27.00	6BC5	.63	12SG7	.80	CK571AX/		9001	1.12
2J34	24.98	6BC7	1.23	12SH7	.63	5R6	2.49	9002	.82
2J37	12.70	6BD6	.83	12SJ7	.54	CK573AX/		9003	1.12
2J38	69.98	6BE6	.54	12SK7	.66	5R29	3.49		
2J39	6.98	6BF5	.98	12SL7GT	.62	WL676	34.98		
2J42	148.98	6BG6G	1.58	12SN7GT	.68	703A	4.72	XTAL DIODES	
2J4R	24.45	6BH6	.63	12SQ7GT	.54	705A	1.88		
2J49	84.98	6BK7	.69	12SR7	.61	707A DX	1.98		
2J50	99.9A	6BK7	1.58	FG17	3.90	707B	14.88	1N21A	1.55
2J51	238.9A	6BL7GT	1.19	24G 3C24	1.32	715A	4.96	1N21B	2.10
2J55	84.9A	6BN7	2.69	25BQ6GT	.98	715B	7.94	1N22	1.22
2J56	149.00	6BQ6GT	1.20	25L6GT	.77	715C	17.98	1N23	1.35
2J62	49.45	6BZ7	.65	25Z5	.78	717A	.88	1N23A	1.89
2K22	23.4R	6C21	24.50	25Z6GT	.58	719A	24.4R	1N23B	2.10
2K23	11.48	6C4	.52	FG27A	8.24	721A	3.92	1N25	4.98
2K25	28.49	6C5	.68	28D7	1.98	723A /2R7	1.98	1N26	8.75
2K25/		6C8G	.59	35B5	.52	723A/B	16.98	1N27	1.55
723AB	23.8R	6CD6G	1.69	35L6	.67	724A	3.95	1N34	.64
2K28	27.4R	6D4	2.70	35T	4.88	724B	2.74	1N34A	.88
2K29	22.8R	6GJ/5C21	9.89	35Y4	.68	725A	9.98	1N35A	1.65
2K33	215.00	6J5	6.66	35Z5	.54	726A	14.48	1N38	1.29
2K39	134.99	6J5	.54	41	.72	726B	44.8R	1N38A	8.95
2K41	126.00	6J6	.58	42	.68	726C	64.8R	1N41	16.95
2K4R	99.4R	6K4A	3.68	45Z3	.88	R01A	.42	1N43	1.73
2X2		6L6	1.48	50A5	1.98	R02	3.48	1N43	1.45
3B22	2.48	6L6G	1.08	50A5	.76	R05	3.22	1N45	.69
3B23/RK22	4.95	6L6GA	1.08	50B5	.54	R07	1.54	1N46	4.00
3B24	4.70	6L6GAY	1.98	50C5	.54	R08	2.62	1N47	.47
3B25	4.39	6L6GT	.66	50L6GT	.62	R09	1.98	1N48	.45
3B26	3.70	6SC7	.90	RK61/		R10	10.8R	1N51	.78
3B2R	7.90	6SF5	.78	XFG1	2.65	R11	3.00	1N54	1.00
3C22	85.00	6SG7	.64	FG67	14.6R	R12	2.70	1N54A	1.15
3C23	8.67	6SK7	.61	HY69	4.98	R13	11.4R	1N55A	.60
3C31/C1B	3.45	6SJ7	.58	71A	.74	R14	4.9R	1N60	2.49
3C33	9.51	6SK7GT	.56	75	.64	R15	5.9R	1N63/K63	.69
3C45	9.98	6SL7GT	.64	78	.78	R26	.95	1N64	.98
3D21A	8.15	6SN7GT	.68	80	.58	828	9.25	1N69	

THAT'S A BUY — "TAB" — THAT'S A BUY

DEPT. 6-RN — 111 LIBERTY STREET — NEW YORK 6, N. Y., U. S. A.

ASSURED ELECTRICAL ACCURACY

BASED ON MANUFACTURERS' PROCUREMENT PRINTS



ONLY IRC GUARANTEES ACCURATE ELECTRICAL OPERATION AND SATISFACTORY MECHANICAL FIT OR DOUBLE-YOUR-MONEY-BACK

Electrical specifications of this typical manufacturer's procurement print are exactly duplicated by IRC's QJ-412 control (shown). CONCENTRIKIT assembly includes P1-206 and R1-223 shafts with B17-109 and B13-133X Base Elements and 76-1 Switch.

IRC

Wherever the Circuit Says ~~~

IRC Exact Duplicate Controls Are Double-Money-Back Guaranteed

Based on set manufacturers' procurement prints, *only* IRC Exact Duplicate Controls are double-money-back guaranteed for accurate electrical operation. This firm guarantee applies to both IRC factory-assembled Exact Duplicates *and* universal CONCENTRIKIT equivalents.

Set manufacturers' electrical specifications are closely followed.

Resistance values are carefully selected to match.

Tapers are watched carefully; IRC doesn't arbitrarily substitute tapers to obtain wide coverage.

For exact duplicate controls of guaranteed accuracy, specify IRC. Most Service Technicians do.

INTERNATIONAL RESISTANCE CO.

415 N. BROAD ST., PHILADELPHIA 8, PA.