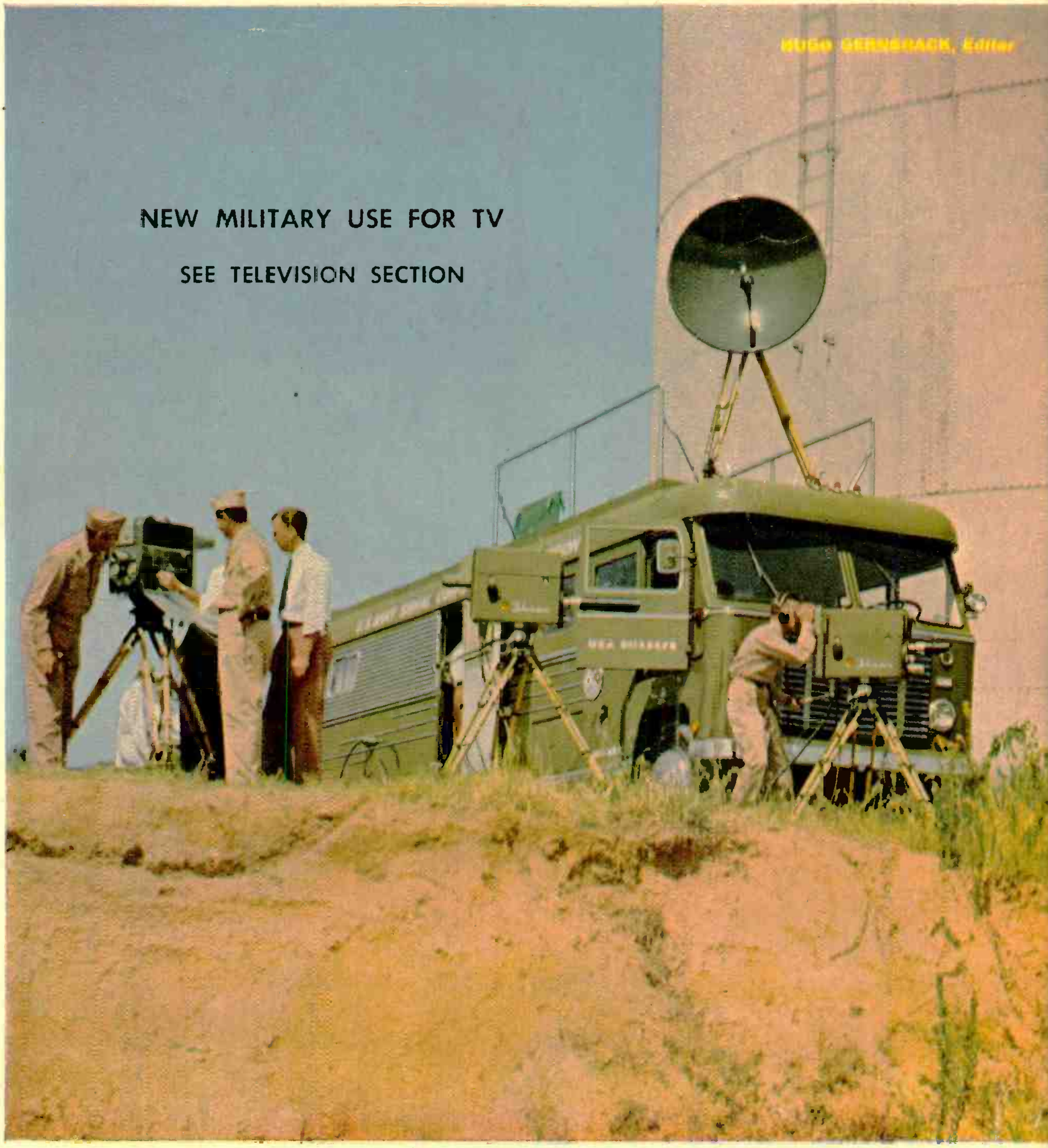
ANNUAL TELEVISION NUMBER

JANUARY 1952

RADIO-ELECTRONICS

LATEST IN TELEVISION • SERVICING • AUDIO



50¢
U.S. and
CANADA

In this Issue: **TV receiver, antenna and booster directories**
U.h.f. antennas • TV servicing articles

CATHODE-RAY TUBE DIVISION, ALLEN B. DU MONT LABORATORIES, INC., CLIFTON, N. J.

BE A RADIO-TELEVISION TECHNICIAN

Train at Home in Spare Time

J. E. SMITH, President, National Radio Institute, Washington, D. C.

There's a Bright Future For You In America's Fast Growing Industry

Do you want good pay, a job with a bright future and security? Would you like to have a profitable shop or store of your own? If so, find out how you can realize your ambition in the fast growing RADIO-TELEVISION industry. Even without Television, the industry is bigger than ever before. 90 million home and auto Radios, 3,100 Broadcasting Stations, expanding use of Aviation and Police Radio, Micro-Wave Relay, Two-Way Radio for buses, taxis, etc. are making opportunities for Servicing and Communications Technicians and FCC Licensed Operators.

You Learn by Practicing with Kits I Furnish

With both my Servicing Course and my NEW Communications Course I send you many Valuable Kits of Parts. They "bring to life" theory you learn in my illustrated texts. Some equipment from both courses is shown below and on previous page. All equipment I send is yours to keep. Among equipment you build is a Tester. Use it to make extra money fixing neighbors' sets while training. Special booklets show you how.

Training Features Television

Both my Servicing and Communications training include up-to-date lessons on TV principles. Throughout the country my graduates are filling jobs, making good money in both Radio and Television. Remember the way to a successful career in Television is through experience in Radio.

Send NOW for 2 Books FREE—Mail Card

Send the Postage-Free card now for my FREE DOUBLE OFFER. You get Sample Servicing Lesson to show you how you learn at home. Also my 64-page book, "How to Be a Success in Radio-Television." Read what my graduates are doing, earning; see equipment you practice with at home. Mail card now. We pay postage. J. E. SMITH, President, National Radio Institute, Washington 9, D. C. Our 38th Year.

IMPORTANT!
See Other Side

Read What Successful NRI Graduates Say:

Radio Operator with ABC

"I was a bookkeeper with a hand-to-mouth salary. Now, a Radio Operator." — N. H. Ward, Ridgefield Park, N. J.

Can Step Into FM, Television

"When I enrolled with N.R.I., was a laborer. Now I have a position paying over $10 a day."—R. Ford, Phila., Pa.

Is Broadcasting Operator

"Now employed at station WHAW as operator. I have also opened my own Radio business."—R. J. Bailey, Weston, W. Va.

$10 Week In Spare Time

"Before finishing your course, I earned $10 a week in Radio servicing in my spare time."—S. J. Petruff, Miami, Fla.

$10 to $15 Week Spare Time

"4 months after enrolling averaged $10-$15 a week spare time servicing Radios. Now have business."—W. B. Weyde, Brooklyn, N. Y.

Lost Job, Now Has Own Shop

"Got laid off. Best thing that ever happened as I opened a Radio shop."—E. T. Slate, Corsicanna, Texas.

Make Extra Money While Learning

Keep your job while training. Learn Radio-Television principles from illustrated lessons. Get Practical Experience experimenting with circuits common to Radio and Television. Many students make $5, $10 a week extra fixing neighbors' Radios in spare time while learning. I send you special booklets that start teaching you the day you enroll.

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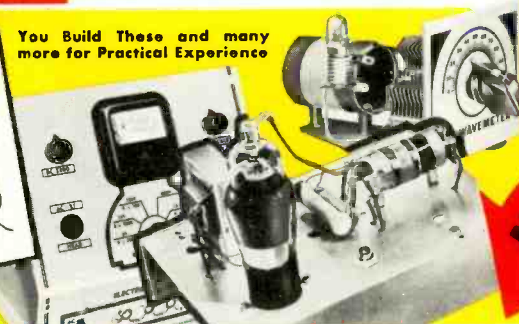
You Build These and many more for Practical Experience



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Want Your Own Business?

Let me show you how you can be your own boss. Many N.R.I.-trained men start their own business with capital earned in spare time. Robert Dohmen, New Prague, Minn., whose store is shown at right, says, "Am now tied in with two television outfits and do warranty work for dealers. Often fall back to N. R. I. textbooks for information on installing Television sets."

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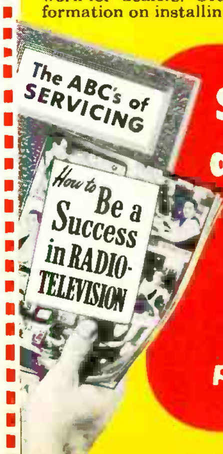

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RADIO-ELECTRONICS

Formerly RADIO-CRAFT • Incorporating SHORT WAVE CRAFT • TELEVISION NEWS • RADIO & TELEVISION*

CONTENTS — JANUARY 1952

ON THE COVER:
The television truck designed to increase the number of students who might be able to "see" a military problem under actual field conditions. (Color photo courtesy of RCA.)

MEMBER Audit Bureau of Circulations • *Trademark registered U.S. Patent Office

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Today's wary customers are more interested in the *business ethics* of a Television and Radio Service Dealer than they are in his *technical ability*.

They look for a Service Dealer who will treat them fairly, a Service Dealer whose guarantee is sound, and then take it for granted that the results will be satisfactory.

The RAYTHEON *Bonded* Electronic Technician Program gives customers just what they are looking for. If you can qualify as a Raytheon *Bonded* Electronic Technician your 90-day guarantee on service and parts is cash-protected by a *bond* issued by the American Mutual Liability Insurance Company. You are presented with a Registered Bond Certificate, Creed Displays and Identification Cards all featuring an 8-point Code of Ethics that will convince the most skeptical customers of your integrity and ability.

Back up your business with the Raytheon *Bond*. Ask your Raytheon Tube Distributor if you qualify for this exclusive business asset. It's yours *at no cost*, if you can.

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RAYTHEON MANUFACTURING COMPANY

Receiving Tube Division,

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

Excellence in Electronics

RECEIVING AND PICTURE TUBES • RELIABLE SUBMINIATURE AND MINIATURE TUBES • GERMANIUM DIODES AND TRANSISTORS • RADIAC TUBES • MICROWAVE TUBES

NO MATTER HOW YOU LOOK AT IT . .

the TURNER is a better BOOSTER!

From every angle the new Turner Model TV-1 Booster is the finest on the market today. Under the worst possible fringe area receiving conditions, the TV-1 consistently produces sharper, clearer pictures and crisper, more natural sound.

There are many reasons for the superiority of the Turner Booster, but the two most important are advanced electronic engineering and finest construction using only high quality component parts.

Turner's low-noise-level **cascode** circuit stabilizes the picture, reduces noise and snow to a minimum.... makes viewing a real pleasure.

The Turner TV-1 is simple in operation. A single tuning knob permits fine adjustment for the best reception of picture and sound over all 12 TV channels. And because it tunes continuously from 54 to 216 megacycles, you can use the TV-1 to amplify FM, aviation and mobile radio signals. Three position control switch turns on the TV set only, the TV set and Booster, or shuts off both set and Booster.

The unit is quickly and easily installed. Attaches to any television set. Attractive styling and neutral finish harmonize with any furniture design.

CHECK THESE SUPERIOR FEATURES

- Continuous Tuning - single knob control for finest adjustment to permit best possible reception of both picture and sound.
- Cascode Circuit - inherent low noise level circuit with great stability and high signal-to-noise ratio.
- Construction - finest quality materials carefully assembled to rigid Turner standards assure years of continuous, repair-free use.
- Appearance - handsome cabinet designed to harmonize with any furniture design and finish.
- Uses - amplifies FM, mobile and aviation radio signals as well as TV.
- Results - most important, the Turner TV-1 produces an excellent picture under conditions which nullify the best efforts of many other boosters.

List Price $57.50

FOR THE BEST POSSIBLE TV RECEPTION, TURN TO

THE TURNER BOOSTER

THE TURNER COMPANY, 933 17th Street, N. E. Cedar Rapids, Iowa

Toronto, Ont., and Branches
In Canada: Canadian Marconi Co.,

Export: Ad. Auriema, Inc.
89 Broad St., New York 4

IRE ELECTED Dr. Donald B. Sinclair as president, and Harold L. Kirke, vice-president for the 1952 term.

Dr. Sinclair is noted for his work in the development of high-frequency measuring instruments. He received the President's Certificate for merit for outstanding services during World War II for his work in the guided missile division of the National Defense Research Committee.

Harold L. Kirke is currently the assistant chief engineer of the British Broadcasting Corp. His election to office maintains the traditional recognition of the international nature of the Institute's membership and activities.

The newly elected directors are John D. Ryder, professor and head of the electrical engineering department of the University of Illinois, and Ernst Weber, professor and head of the electrical engineering department of the Polytechnic Institute of Brooklyn.

Regional directors elected for the new term are: Region 1, Glenn H. Browning, president of Browning Laboratories; Region 3, Irving G. Wolff, director of the Radio Tube Research Laboratory, RCA Laboratories Division; Region 5, Alois W. Graf, patent lawyer, Region 7, Karl Spangenburg, professor of electrical engineering.

IRE AWARDS for 1952 will be conferred upon a number of noted men for outstanding contributions in the diversified field of radio technology: Dr. William Shockley, of Bell Telephone Laboratories, will be awarded the Morris Liebmann Memorial Prize "in recognition of his contributions to the creation and development of the transistor." B. D. Loughlin, of Hazeltine Electronics Corporation, will receive the Vladimir K. Zworykin Television Prize Award for outstanding technical contributions toward fully electronic television. H. W. Welch, Jr., research physicist at the University of Michigan, will receive the Browder J. Thompson Memorial Prize for the best combination of technical contribution and presentation in his paper entitled "Effects of Space Charge on Frequency Characteristics of Magnetrons." Jerome Freedman, of Watson Laboratories, Griffis Air Force Base, will be granted the Editor's Award for good English in technical writing in his paper "Resolution in Radar Systems."

Presentation of the awards will be made by the president at the IRE Annual Banquet at the Waldorf-Astoria during the 1952 IRE National Convention in New York City on March 3 to 6.

A LIGHT AMPLIFIER is television's greatest present need, according to David Sarnoff. Speaking at a gathering commemorating his 45th year of service in radio and renaming the RCA Laboratories at Princeton "the David Sarnoff Research Center," General Sarnoff said: ". . . an electronic amplifier of light will do for television what the amplifier of sound does for radio broadcasting. . . . An amplifier of sound gave radio a loudspeaker, and an amplifier of light would give television a 'big-looker.' "

Two other needed inventions, he said, are a television recorder that would record the video signals of television on an inexpensive tape, and an electronic air-conditioner for the home that would operate with tubes, or possibly through the action of electrons in solids, and without moving parts.

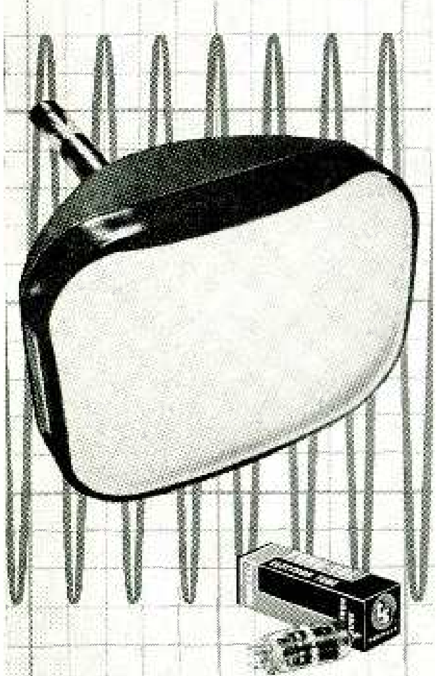
General Sarnoff requested that the three inventions, which he called *Magnalux*, *Videograph*, and *Electronair*, be developed by scientists of the Research Center by the time of his 50th anniversary in radio, in 1956.

A TV CODE OF ETHICS has been formulated by the members of NARTB (The National Association of Radio and Television Broadcasters). Representatives of 61 TV broadcasters throughout the nation accepted and recommended for adoption by the directors of NARTB a set of guiding principles or code governing: acceptability, presentation, and the time allocation of advertising; acceptability of program material and decency in its production; coverage and treatment of news events; time for religious programs and requests for time for airing views on controversial issues.

A Television Code Review Board of six members will be established upon ratification of the code. Five members of the Review Board shall be selected from the NARTB membership with Judge Justin Miller, chairman of the board of directors, serving as ex-officio member.

NOVICE, TECHNICIAN HAMS have been authorized to join the Military Amateur Radio System (MARS). The prospective member must either be in the Armed Services or Reserves, or a civilian 21 years or older and possessing the necessary equipment to operate on the military frequency of 3497.5 kc. He must operate (while on the MARS frequency) at such time and in such manner as the MARS Command Director may direct, and using the special military call signs assigned to him. The Army and Air Force jointly determine MARS policy but operational procedures are separate. Hams desiring more information are invited to write to MARS Headquarters (Army, Office of the Chief Signal Officer; Air Force, Director of Communications, AF), Washington 25, D. C.

A TV PACT affecting the assignment of channels along the U.S.-Mexican border has been concluded after two years of negotiations between the two countries. The assignment plan agreed that stations within 250 miles of the border were not to exceed an effective radiated power of 100 kilowatts for the lower band and 200 kilowatts for the upper band. The assignments which would be affected under the assignment plan are: (in the United States) Arizona, 15; California, 10; Nevada, 5; New Mexico, 10; Texas, 23; (in Mexico) Baja California, 16; Chihuahua, 7; Coahuila, 11.



TV RECORDING direct on magnetic tape was demonstrated last month by Ampex Co., the electronic division of Crosby Enterprises, Inc. This may well be the "Videograph" envisioned by David Sarnoff as television's most-needed invention.

The recorder, according to press reports, uses standard Scotch magnetic recording tape. At present the picture is "rather fuzzy" but it is expected to be improved greatly before public demonstrations are staged about six months from now.

If the recorder becomes commercially practical, it should reduce greatly both the cost and complexity of TV recording. Optical methods must be used at present, the screen being photographed with a moving-picture camera.

NEW RECORD SPEED has been announced by the Wagner Research Corporation of New York City. Their records will play at the hitherto-unheard-of speed of 16 revolutions per minute. It will be possible to play the new records on a standard $33\frac{1}{3}$ r.p.m. player with the help of a simple attachment.

The new records, of thin vinylite $4\frac{3}{4}$ inches in diameter, will have 448 grooves to the inch and will play more than an hour (one-half hour per side).

The new records are intended to be used for transcribing readings of classical literature, rather than for music. Work with the blind, according to the company's president, Robert Wagner, inspired the development.

The company intends to market the records for about a dollar each, and a kit containing two records and the attachment for a $33\frac{1}{3}$ r.p.m. player will probably cost about $12. Mr. Wagner said that the latest Zenith phonographs are also capable of playing at 16 r.p.m. but will require a special stylus.

HARBOR RADAR TESTS conducted by the Port of New York Authority have been extended for another six months according to Howard S. Cullman, chairman of the agency. Commencing last March with equipment donated by Raytheon Manufacturing Co. and Sperry Gyroscope Co. some 60 large ships have participated closely with the radar crews at the Fort Wadsworth installation.

Recently developed electronic identification devices will also be tested in the winter months ahead under conditions of heavy fog, rain and snow. An additional $30,000 has been appropriated by the board for these continued tests which will allow data over a whole year's operation to be accumulated. Definite and considerable reduction in time and money lost in ship delays caused by bad visibility and navigation hazards are expected if a permanent installation is found to be practical and feasible.

UNDERSEA TELEVISION may be used by the Navy to protect divers and to aid them in their work, Admiral Homer N. Wallin, Chief of the Navy Bureau of Ships, discloses. The new underwater TV cameras enable viewers to explore the ocean floor and study it for conditions dangerous to divers. When working at 200 feet or more, divers spend more time descending and ascending than they do on the bottom. Actual working time is short. Cameras can be lowered and raised much quicker than a diver and can be operated for long periods. Remote-control circuits provide for camera adjustments.

FINAL TV ALLOCATIONS are believed to be in the offing according to observers. Recent developments tending to substantiate this view have been noted. WSB-TV (formerly WCON-TV) has been granted a temporary authorization to operate on a commercial basis with modification in power for not later than February 15, 1952. The FCC has assigned at least 15 staff members to the necessary task of reading and evaluating the hundreds of sworn statements filed in connection with the TV allocation proceedings. The FCC postponed the theatre TV proceedings from November to February 25, 1952 with an opinion and order which stated that the TV allocations necessitated the postponement. Also cited was the speech by vice-chairman Paul A. Walker in which he expressed indications of TV coverage of the whole nation in the near future.

—end—

Courtesy Wagner Research Corp.

Photo of a 16-r.p.m. record and adapter on a standard Dynavox record player.

Merchandising and Promotion

Merit Transformer Corp., Chicago, is shipping its No. 1,000 TV kit to distributors. The kit contains three major components for conversion and replacement: The HVO-7, a 77J-1 type flyback transformer with universal mounting brackets; an MWC-1 width-linearity coil with a.g.c. winding; and an MDF-70 cosine-wound deflection yoke. The kit also contains data sheets.

Bendix Radio Division of Bendix Aviation Corp., Baltimore, published a cartoon booklet, the "Blue Book of TV Servicing." The booklet humorously presents the "dos and don'ts" for TV service technicians in their relations with the public.

Erie Resistor Corp., Erie, Pa., designed a new "Breakaway" package consisting of two drawer trays and a sleeve. The sleeve may be broken apart so that each half of the package makes a complete drawer tray unit containing Erie Ceramicons of five different capacitances.

Circle-X Antenna Corp., Perth Amboy, N. J., launched a $100,000 sales campaign, "The Circle-X Round-Up," offering incentive merchandise to distributors' salesmen to promote the sale of its antennas.

The RCA Tube Department, Harrison, N. J., inaugurated a sales promotion campaign to familiarize the names and services of RCA tube distributors in the minds of their broadcast and industrial customers. Built around the "forget-me-not" theme, the campaign offers a wide variety of useful items imprinted with the distributor's name. The give-away merchandise includes such items as a three-year wall calendar, an electric clock, an automatic pencil, the RCA reference book, and a tie or a money clip. The Tube Department is also offering, free, a three-ring leatherette binder through its distributors to service technicians who purchase at least $10 worth of RCA Victor service data.

Belmont Radio Corp., Chicago, manufacturers of Raytheon TV receivers, prepared a service manual and presentation which directs TV service technicians to study the picture for clues to circuit troubles. Titled "How to Interpret What You See," the presentation, under the direction of Carroll Hoshour, Belmont service manager, was shown to 850 TV technicians in Philadelphia and Chicago and has now become a "road show."

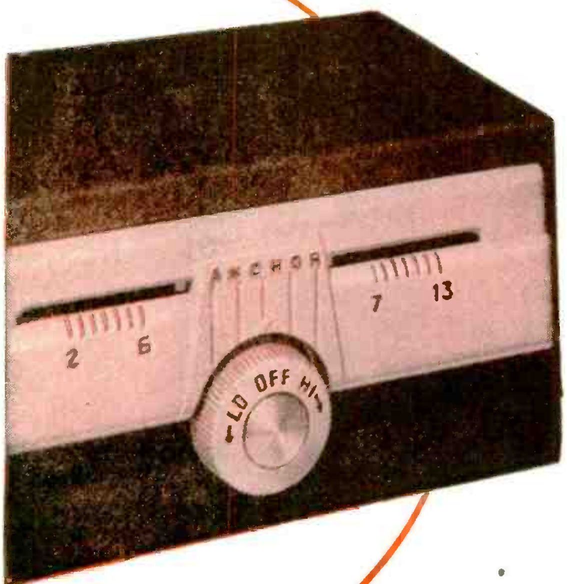
Allen B. Du Mont Laboratories' Electronic Parts Department is sponsoring a campaign by which service technicians may offer their customers a trade-in allowance on their present tuners if they purchase a Du Mont Inputuner. The plan is meant to reduce the customer's cost of converting a straight TV receiver to an FM-TV combination. The plan will be in effect for a limited time only.

Jensen Industries, Inc., Chicago, released a circular describing its needle kits and new cutting needles, and also

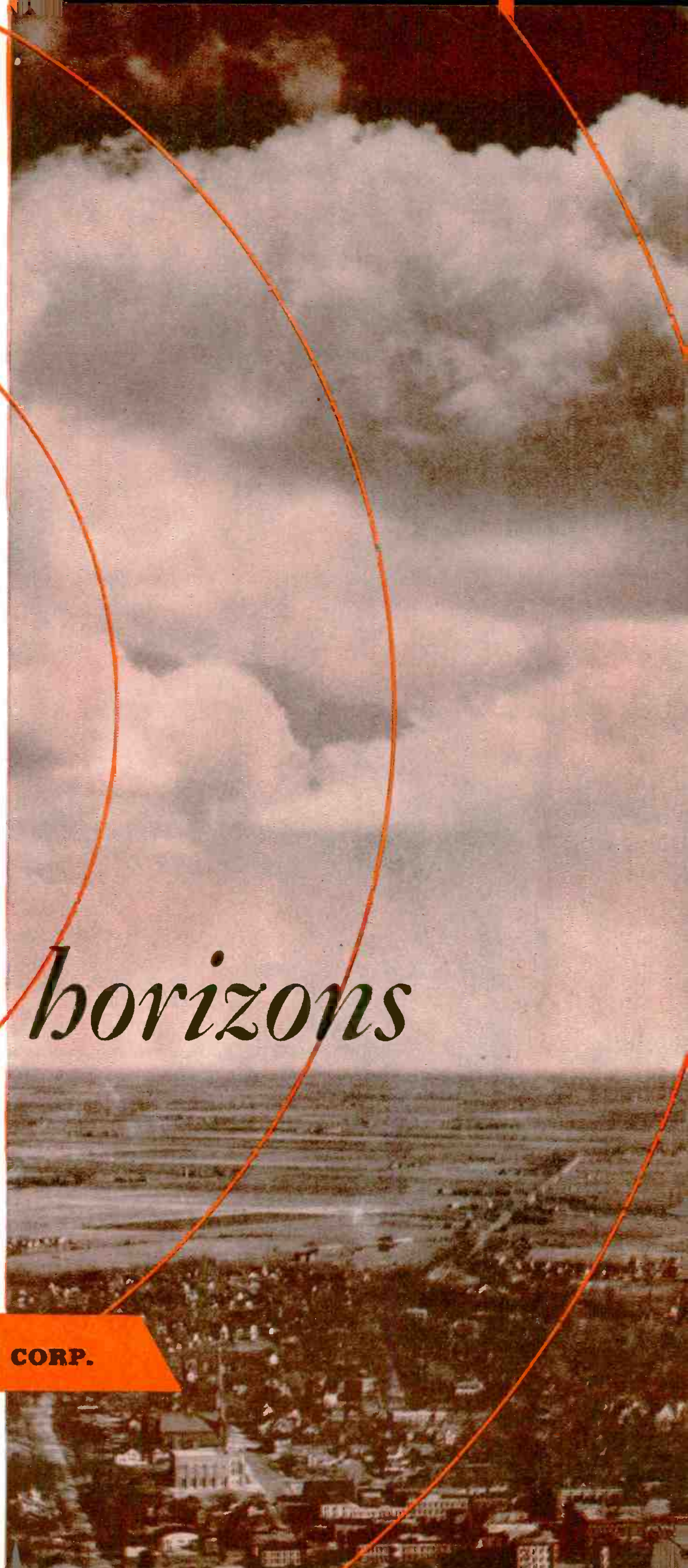
(*Continued on page* 20)

ANCHOR Boosters

First in Preference!
First in Fringe Reception!



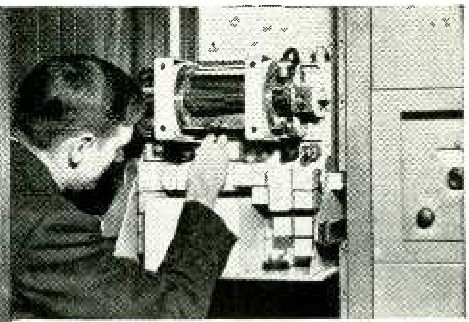
REACHING NEW *horizons*



Anchor engineering always a year ahead!

ANCHOR RADIO CORP.

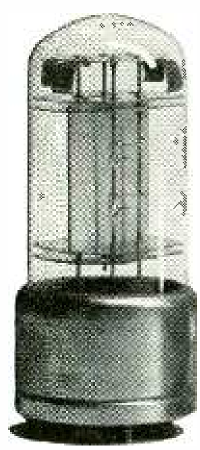
2215 SOUTH ST. LOUIS AVENUE
CHICAGO 23, ILLINOIS



Each crystal is enclosed in a cylindrical oven which holds the crystal temperature to within 1/100 of a degree.

At the A. T. & T. building at 195 Broadway, New York, passersby set watches by the world's most accurate public clock, which is controlled by the master standard.

↑ Front of the new frequency-time standard at Bell Telephone Laboratories. In the rear there are 600 electron tubes and 25,000 soldered connections. Room temperature is maintained within two degrees.



The controlling quartz crystal vibrates in vacuum at 100,000 cycles per second. The standard is powered by storage batteries, with steam turbo-generator standing by, just in case of emergency.

A vibrating crystal keeps master time

Ever since Galileo watched a lamp swinging in the Cathedral of Pisa three centuries ago, steady vibration has provided the practical measure of time. In the 1920s Bell Laboratories physicists proved that the quartz crystal oscillators they had developed to control electrical vibration frequency in your telephone system could pace out time more accurately than ever before.

The Laboratories' latest master standard keeps an electric current vibrating at a frequency that varies only one part in a billion, keeping time to one ten-thousandth second a day.

Through secondary standards, a master oscillator governs the carrier frequencies of the Bell System's ship-to-shore, overseas and mobile radiotelephone services, the coaxial and *Radio-Relay* systems which transmit hundreds of simultaneous conversations, or television. In the northeastern states, it keeps electric clocks on time through check signals supplied to electric light and power companies.

The new standard also provides an independent reference for time measurements made by the U. S. Naval Observatory and the National Bureau of Standards. Thus, world science benefits from a Laboratories development originally aimed at producing more and better telephone service.

BELL TELEPHONE LABORATORIES

Improving telephone service for America provides careers for creative men in scientific and technical fields.

showing electrotypes of cuts of its products available for distributor catalogs.

Production and Sales

The NBC TV Sales Planning and Research Department reported that there were 14,555,800 TV sets installed in the United States as of November 1. New York City led with 2,630,000, followed by Los Angeles with 1,045,000, Chicago 1,020,000, Philadelphia 940,000 and Boston 809,000.

The RTMA reported that receiving-tube sales for September had increased to 27,946,193 over the 23,761,253 sold in August. Of the September sales, 16,176,604 tubes were for new sets, 7,363,721 for replacement, and the balance for export and Government agencies. The sales of TV picture tubes to TV set manufacturers also increased during September—294,951 units were sold compared to 210,043 in August. Of the picture tubes sold in September, 97% were 16 inches or larger and 98% were rectangular.

Allen B. Du Mont Laboratories' president, Dr. Allen B. Du Mont, estimated that the company's sales during 1952 would be at least 25% more than any previous year due to the increase of defense orders.

RTMA president Glen McDaniel predicted that the industry would not be able to produce more than 1,000,000 to 1,250,000 TV sets during the fourth quarter of 1951, which would bring the total output for 1951 to between 5,000,000 and 5,250,000 sets as compared with 7,400,000 in 1950.

New Plants and Expansions

Haydu Brothers, Plainfield, N. J., completed a two-story building in connection with its main plant at Mount Bethel, N. J. The need for the new plant was dictated by the company's Government program for the production of electronic assemblies and parts for the Air Force and Signal Corps.

Budelman Radio Corp., Stamford, Conn., was formed as a new manufacturing and engineering corporation for radio and electronic equipment.

Astron Corp., East Newark, N. J., signed a long-term lease for additional space, virtually doubling its production facilities for its line of capacitors and r.f. interference filters.

Shallcross Manufacturing Co., Collingdale, Pa., is nearing completion of its building program which includes a new wing on its main factory, expansion of its instrument laboratory, and a large component development laboratory.

TV-"Q" Custombilt Corp. moved its plant and offices to new quarters in Hawthorne, N. J.

Business Briefs

. . . Jensen Manufacturing Co., Chicago, announced that its Viking loudspeakers would now be identified by the phrase, "Viking by Jensen." It was formerly a private brand line for low-cost replacement. The brand will be given extensive publicity and promotion.

—end—

You'll see better . .

NATIONAL TELEVISION

Demand the N.V.C. trade mark on every picture tube.

America's largest Independent* Manufacturer

PRODUCING THE WORLD'S FINEST TELEVISION TUBES

*Independently sound engineering, carefully selected quality materials and tightly controlled precision workmanship make N.V.C. television tubes the finest—for at N.V.C. all efforts, all personal attention is given to a single thing alone—better tubes designed for conversion and replacement in every standard set to give a *better, more* clearer picture.

Write for name of Representative nearest you
3019 West 47th Street, Chicago, Ill.

Three plants with over 17 acres of coordinated machinery and personnel, producing the world's finest television picture and receiving tubes.

National Video Corporation

3019 W. 47th St. Chicago | Grays Lake Illinois | 901 W. Huron St. Chicago

Television at the Crossroads

. . . . "Television is about to enter a new cycle" . . . .

By HUGO GERNSBACK

The television industry is about to undergo a new and far-reaching upheaval, beginning some time in 1952. It is perhaps the most important change that the industry has faced since its beginning.

We are not referring to color television, which has been frozen for the time being by the NPA, due to strategic shortages of materials. We refer to the imminent end of the television freeze order of the Federal Communications Commission—the freeze having been in effect for some three years. The FCC realized, back in 1948, that unless drastic steps were taken, new television stations would have continued to swamp the country, with mutual interference to such an extent that good reception for a large part of the country would have been impossible.

Unfortunately, the country started out on the wrong foot by adopting v.h.f. (very high frequency) transmission when we should have had u.h.f. (ultra high frequency), which is just now about to be opened up.

According to Curtis P. Plummer, chief of the FCC's Broadcasting Bureau, the new schedule will work somewhat as follows:

1. Between February 1 and March 1, 1952, the present freeze, in all probability, will be lifted.
2. About April 1, 1952, the Commission will begin granting new u.h.f. station permits.
3. About July, 1952, there is a possibility that some eighty new stations will have been authorized.
4. About the middle of 1953, these new stations should be on the air.

While it is most desirable and necessary that the country have new television stations to open up territories not served at the present time, the industry faces a number of formidable difficulties, which so far have not been ironed out.

The trouble stems from the fact that some time during 1952 there will be in existence over 19,000,000 television receivers. Not all of these will be in use, as perhaps a half-million or more of them may still be in warehouses, stores, etc. These receivers are all designed for v.h.f. and the majority of them cannot receive u.h.f. signals when the new stations go on the air. It is true that the owner of the present day v.h.f. television set can get ultra high frequency reception by an external converter or u.h.f. strips in his present receiver's tuner. This, however, isn't the most satisfactory means of getting reception, as at best, converters are makeshifts.

The industry also faces a technical difficulty in equipping the new u.h.f. television sets with efficient tuning devices. So far, no manufacturer has placed one on the market. It is, however, probable that continuous tuners, rather than the step-by-step type we now have on most receivers will be used. The continuous tuner will be similar in operation to what we have in our present day radios (and some TV sets), and there is a strong possibility that this will be the best solution.

If such a device proves satisfactory—and most engineers feel that it will be—the majority of the new television sets will be thus equipped. That means that the new sets then will receive both v.h.f. and u.h.f, enabling reception in the present bands as well as the new one. The sets may become known as *All-Frequency TV receivers.*

How many of the new type television sets will be manufactured in 1952 is anyone's guess, due to the critical shortage of materials and the uncertainty of their allotments to manufacturers by the government.

As it seems to be probable that sooner or later all of the television stations will transmit on u.h.f., it follows that some 19,000,000 or more present-day sets eventually will become obsolete. This does not mean that they will be obsolete in the near future, as the v.h.f. stations will probably continue broadcasting for many years to come, but taking a long range view, it would appear that by 1970 or thereabouts, nearly all stations will be u.h.f.

By that time existing sets will be obsolete anyway, and will certainly have outlived their utility.

The newer television receivers several years hence will also have to be able to receive either black-and-white or color, and will do so without the necessity of requiring a separate receiver for color.

It is therefore to be hoped that the FCC will clear up the problems of color "compatibility" so that all u.h.f. receivers can receive *all* transmissions in black-and-white, at least.

From this it will be seen that the television picture for the near future looks complicated, but it need not necessarily remain so if vigorous action is taken by all concerned at the earliest opportunity.

Another minor factor also bothers the industry. That is that the antenna requirements for u.h.f. are quite a bit different from v.h.f., at least at the present.

This, however, is a technical point that can be overcome, as similar technical difficulties have been overcome in the history of radio. It too, in its heyday, had similar difficulties, some of them looking more insurmountable than the television problems which we face today. Technical ingenuity overcame all of them and we feel sanguine that whatever technical problems there are now in television will be solved in due time.

—end—

FAIR WEATHER AHEAD

By RAYMOND F. GUY*

EXACTLY 100 years ago, the Congress of the United States was dissuaded from building a chain of semaphore stations from Washington to New Orleans for "rapid" communications. They were dissuaded by Samuel F. B. Morse, a "dreamer" of his day, who not only had faith and conviction in electrical wire telegraphy, but also had some powers of persuasion. Only about 50 years ago, radio for the first time was usefully employed for telegraphing from point to point. Not until 1921 did transmission of speech and music reach the stage where its technical development could be combined with vision and enterprise to create the sound-broadcasting industry which in its day revolutionized our habits and thinking. Modern broadcasting has become a Colossus by comparison with the imaginative concepts of those of us who developed it from the beginning, as witnessed by the more than 90 million home receivers and the 2,900 stations devoted to sound broadcasting. A great new revolution is now taking place as a result of the combination of sight and sound which can be delivered with a high degree of perfection into our living rooms.

Only six years ago television had its great opportunity to expand and provide an outlet for the imagination and enterprise of those with unshakeable confidence in its tremendous future. The 6,000 television receivers which constituted our complete national inventory of five years ago have skyrocketed to 14,000,000 upon the stimulus provided by only 108 television stations, a great many of which duplicate their services in individual areas. What of the future?

The coming expansion

One must give reign to his imagination in prophecy. During television's lean years in the late 1930's and through the war, those of us who were intricately involved in it were frequently reluctant to express fully our prophecies because they sounded like wild dreams. But wild as they seemed, they have been proven to have been conservative. The readers of these pages have cause to be pleased with the opportunities which television has already made bountiful. But an insatiable public appetite for television service—held in leash only by the current television freeze—will require a phenomenal growth of television facilities throughout our country to feed upon.

In years to come, our present 108 television stations may grow to 3,000 or even more. Our present 14,000,000 receivers may grow to 50,000,000 or more, and the widespread use of color television a few years hence will present to the manufacturer, the broadcaster, and the service technician an opportunity to profitably serve the public to an exciting and stimulating degree. Unfreezing the construction of new v.h.f. stations in itself will provide television service to many millions of persons now without it. The addition of 70 new u.h.f. channels will insure television service to all parts of our country where there are people to support it.

In 1945, following the postwar all-service frequency allocation hearings, it was apparent that the number of channels available for television would not give service throughout all of the communities of our country. To provide for future expansion, the u.h.f. block from 470 to 890 mc was earmarked for television use. But in 1945, those concerned with allocation and transmission problems had insufficient knowledge of, and experience with, u.h.f. propagation to permit the wise formulation of rules and standards. It was necessary to know how to calculate and determine the area which a u.h.f. station could serve. It was necessary to know the minimum co-channel station separation necessary to prevent destructive interference. It was necessary to know more about receiver characteristics so that minimum adjacent-channel separation could be determined. It was necessary to study the problems created by oscillator radiation and the establishment of suitable intermediate frequencies in receivers, and to allocate channels in specific areas to avoid the obvious difficulties which could arise without adequate provision against such effects. Recognizing these needs, RCA, NBC, and various other groups in the industry established research programs and through the ensuing years have been contributing information to the FCC.

A u.h.f. laboratory

In particular, the NBC experimental u.h.f. station at Bridgeport (Radio-Electronics, August, 1950) has been referred to by the press as "The nursery of u.h.f." In operation nearly two years, this station carries the full program service of WNBT. Seventy manufacturing companies have taken advantage of this prototype operation to familiarize themselves with various aspects of u.h.f. performance. Of this number many have field-tested their designs of u.h.f. receivers and converters, and demonstrated them to dealers, to service organization representatives, and to the Federal Communications Commission. Those interested in a comprehensive report of the NBC investigations of u.h.f. transmission and reception, may find information of the apparatus utilized and the propagation studies referred in papers by the author in the *RCA Review* issues of March, 1950, and March, 1951.

We are now on the threshold of the long-awaited unfreezing, with assurance that when allocation of frequencies and construction of facilities is resumed, it will be on a solid foundation of technical facts and considered judgment.

Television's tremendous national impact has been felt despite the fact that at present:

15 states have no stations,
10 states have only one station each,
14 states have only two stations each,
2 states have only three stations each.

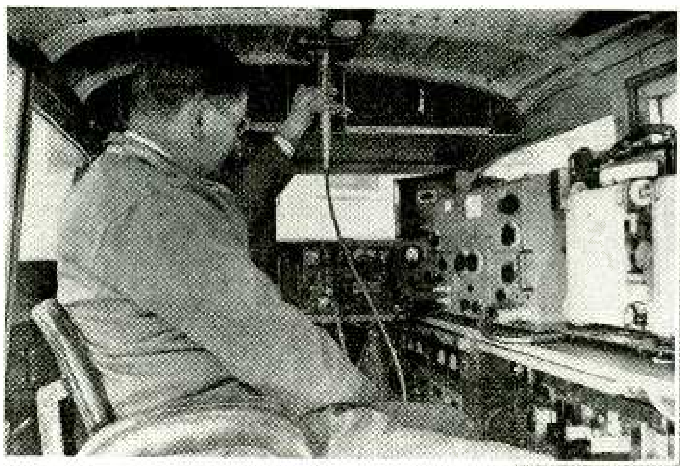
The remaining 64 stations are concentrated in only 7 states and the District of Columbia.

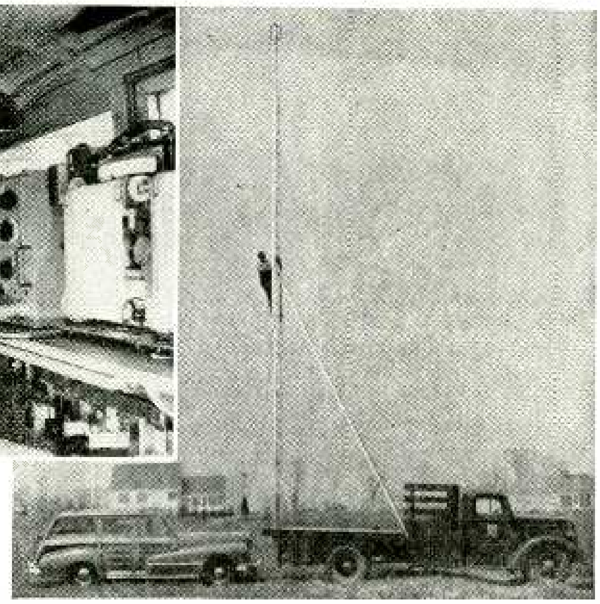
A total of 65 cities at present have stations. But under the proposed FCC plan 558 v.h.f. stations may be built in 342 cities. And, combining u.h.f. and v.h.f. in the new proposals, 1,916 stations are specifically provided for, without making allowance for possible expansion of the specified list. A presentation of the proposed United States television assignments appears in map form on pages 28 and 29 of this issue of Radio-Electronics.

TV technicians needed

With a total of 14,000,000 existing receivers, and a probable growth to at least 50,000,000, it seems inevitable that 36,000,000 new receivers will be pur-

*Manager, Radio and Allocations Engineering, National Broadcasting Company.





Above—Interior of the NBC engineering car used in making the tests and measurements. Right—A mobile antenna rig used in making the tests described in the two charts, as well as checking antenna types, etc.

chased. Add to this the replacement demand for larger-screen sets and the millions of color receivers which the public will demand a few years hence, and the future appears exciting indeed. But it also presents a challenge.

It is authoritatively estimated that over 90,000,000 radio receivers are in use in the United States, nearly two per home. But this growth has extended over 30 years since about a dozen persons—including your author—launched the world's first broadcasting service. Television, on the other hand, has attained its great growth during the last five or six years, during three of which the FCC freeze has prohibited construction of new stations. This freeze, coupled with the tremendous unsatisfied public demand for television in unserved areas, has created a situation which is analogous to a coiled spring. A new "TV day" is imminent when the issuance of new TV station construction permits will be resumed by the FCC; nation-wide construction of new TV stations will be undertaken and millions of families will represent a virgin market for television receivers.

The Bell Telephone System is rapidly extending its microwave and coaxial cable facilities throughout the nation to meet the demand for TV network connections. Superb network program service is already available. And the manufacturers of transmitting and receiving equipment are completing their designs and preparations to supply the apparatus which will be needed.

Of particular significance to the readers of these pages is the coming concentrated demand for the services of competent and well-equipped installation and maintenance men in thousands of communities which will for the first time have television service, as well as those obtaining more adequate service. To meet this demand will be a challenge to the skill and resourcefulness of the servicing industry. It portends for the foreseeing and prepared dealers and service technicians a bright prospect for new business, with fine opportunities and ample rewards for business enterprise and services rendered. And it presents to the technical schools an opportunity to train the thousands of men who will require knowledge of u.h.f. and v.h.f. receivers and antennas and of the intricacies of vertical and horizontal synchronizing circuits and frequency converters, of the importance of optimum antenna location, particularly in marginal receiving areas and more particularly in u.h.f. where wave interference patterns are somewhat more complex.

There is little productive reward for the amateur receiver repair man in television. The competent and well-equipped professional is indispensable. And therein lies an added responsibility and opportunity. Television receivers are more complex and costly than sound-broadcasting receivers, and maintenance, installation, and repair costs are correspondingly higher. It appears axiomatic that the service technician will assume higher stature in fact and in the customer's estimation for these reasons. He must have greater knowledge and skill, and thereby will do more business and become a more important and integral part of his community.

Propagation peculiarities

Certain phases of the knowledge gained in the Bridgeport project will be of particular interest to service technicians. It is well known that effective reflection of radio waves requires that a reflecting surface shall have dimensions not smaller than some function of a wavelength. There is no abrupt discontinuity, and for illustrative purpose we will assume one-half wavelength. For channel 5 such a surface would be about 6.5 feet square. For a u.h.f. station on 770 mc it would be about 8 inches square. It follows that a given sized surface will produce more distinct reflection at the short wavelengths (higher frequencies). Hence, in residential areas characterized by homes, power and telephone lines, and other objects, the field of a u.h.f. station may vary over a wide range within distances of a few feet because of the random combination of the direct field and indirect fields reflected from nearby surfaces or reradiated by wires. Knowledge of this effect gives the installation technician a useful tool with which to work.

This effect was investigated in scores of actual home installations and also by a more precise statistical analysis of field intensity measurements. In the latter analysis an antenna at an altitude of 30 feet was moved through a horizontal range of 5 or more feet as the field intensity was recorded on charts. This was done at 91 locations. The averaged results are shown on Fig. 1. The field intensity varied over a range of as much as 7 to 1 within a few feet and at 10% of the locations it was 3 to 1. This study, combined with experience in installing about 100 receivers or converters in homes, illustrates the importance of exploring the area of the proposed antenna location to take

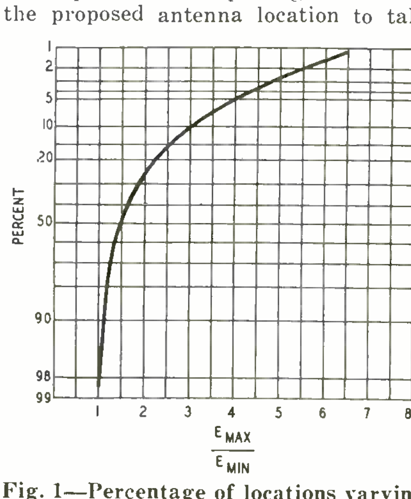


Fig. 1—Percentage of locations varying from standard and amount of variation.

maximum advantage of this effect. A threefold increase in signal intensity obtained by such an exploration would be equivalent to increasing the power of the transmitting station 900%.

At Bridgeport, such exploration was conducted by two men, one at the receiver and one on the roof. With communication by interphone, optimum antenna location was found easily by visual inspection of the picture or maximum indication on a meter. In marginal locations where the efforts are warranted this exploration may be fruitfully conducted in various areas on top of homes. In most cases where a reasonably strong signal is received, the antenna location is not so critical as to prevent its being located in the desired location.

Studies of signal intensity variations in the horizontal plane have been mentioned. Similar studies were conducted of the relationship of u.h.f. signal intensity and antenna height at 107 locations in the service area of the Bridgeport station. Measurements at individual locations also show the effects of random reflections from the earth and other objects, and of local shadowing. Integrating the results of the 107 sets

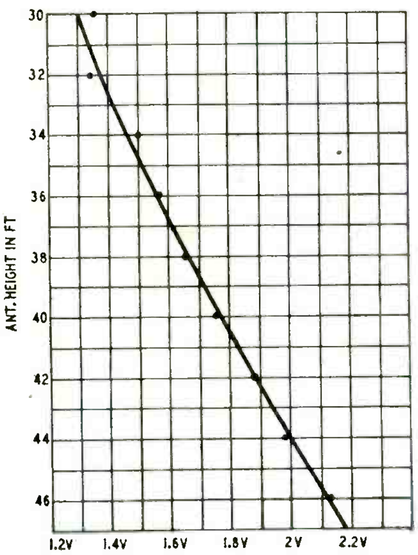


Fig. 2—Voltage increase over 10-foot height exceeded at 50% of the locations.

of measurements, as shown on Fig. 2, shows that on the average the field intensity increases with antenna height. But ordinarily it is not possible accurately to predict the optimum antenna height in specific locations. Here again, knowledge provides the installation technician with a useful tool by which he may take advantage of these effects.

Interference to u.h.f. reception from neighborhood sources, such as diathermy and automobile ignition systems, is almost completely absent. And multipath images may be expected to be at a minimum because the greater directivity afforded by u.h.f. receiving antennas of practical dimensions provides greater discrimination against reflected signals from random directions.

—end—

TELEVISION, U. S. A.

Present and proposed network routes (Bell coaxial, Bell microwave and independent) and present and future television allocations as envisioned by present FCC plans. Allocations are approximate only, the plans being so made as to provide flexibility.


EXISTING 1951 TV NETWORK ROUTES
PROPOSED 1952 TV NETWORK ROUTES
EXISTING OR PROPOSED VHF ALLOCATIONS
PROPOSED UHF ALLOCATIONS
VHF AND UHF ALLOCATIONS, EXISTING OR PROPOSED
N. DAK.
MINN.
S. DAK.
NEBR.
IOWA
WIS.
MICH.
ILL.
IND.
OHIO
PENN.
MO.
KY.
TENN.
OKLA.
TEXAS
ARK.
LA.
MISS.
ALA.
GA.
S. C.
N. C.
FLA.
MD.
N.J.
CONN.
VT.
N. H.
ME.
LAKE SUPERIOR
L. ONTARIO
MINNEAPOLIS-ST. PAUL
GRAND RAPIDS
KALAMAZOO
MILWAUKEE
DETROIT
BUFFALO
LANSING
ROCH
SYR
UTICA
SCHENECT
BOSTON
PROVID.
BINGHAM
ERIE
CHICAGO
CLEVE.
JOHNSTOWN
NEW YORK
PHILADELPHIA
LANCASTER
WILMINGTON
BALTIMORE
WASH
AMES
DAVENP'T
OMAHA
ROCK ISLAND
TOLEDO
COLUMB
INDIANAP.
DAYTON
BLOOMINGTON
CINN
HUNTINGTON
RICHMOND
NORFOLK
KANSAS CITY
ST. LOUIS
LOUISVILLE
GREENSBORO
NASHVILLE
CHARLOTTE
TULSA
OKLAHOMA CITY
MEMPHIS
ATLANTA
BIRMINGHAM
FT. WORTH
DALLAS
JACKSONVILLE
NEW ORLEANS
HOUSTON
SAN ANTONIO
MIAMI

NOVEL 1952 TV CIRCUITS

The new TV receivers include several circuits that might be found puzzling by the unprepared technician

By ROBERT F. SCOTT

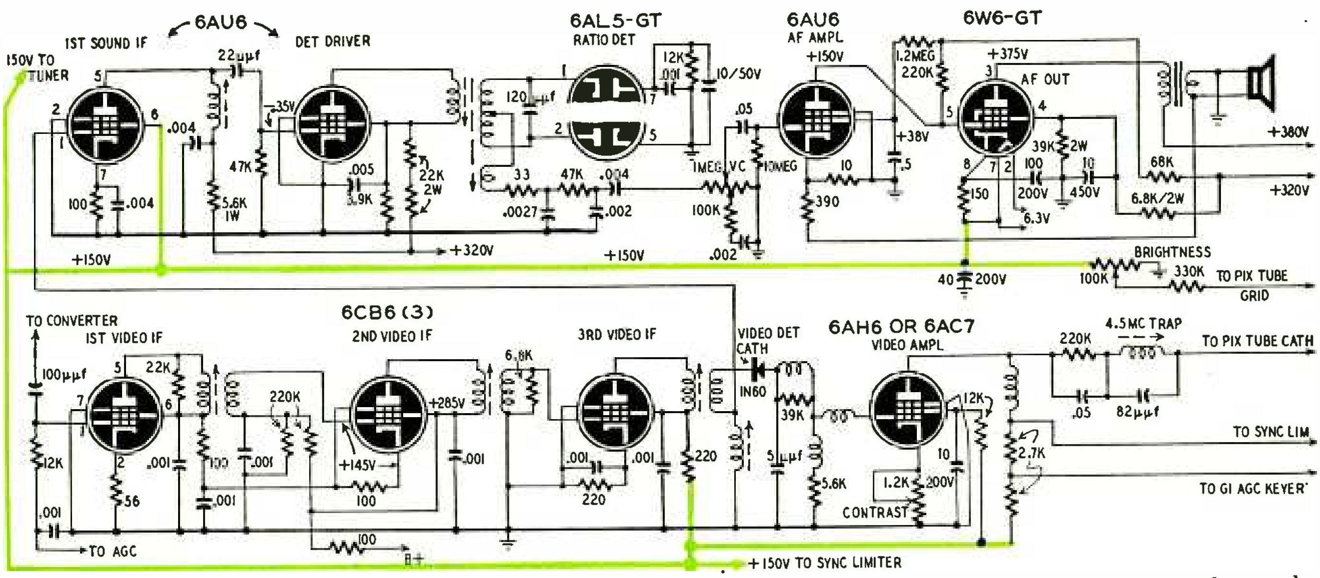


Fig. 1—Features of the new Bendix long-range chassis include series-coupled i.f.'s and a regulated 150-volt supply.

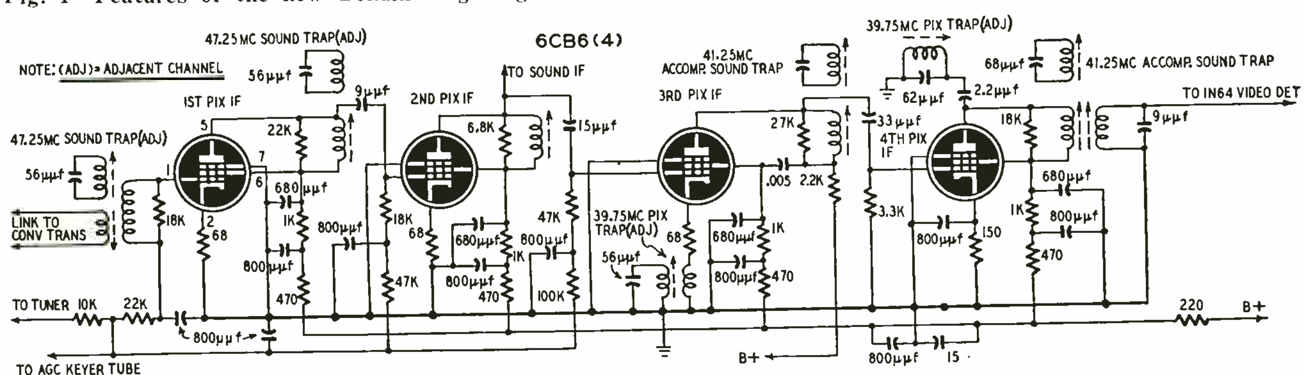


Fig. 2—Very complete trapping, both for adjacent and accompanying signals, marks the new General Electric TV receivers.

THE latest series of TV receivers are featuring a number of innovations and circuit changes. These modifications are designed to meet the increasing demands for larger and simpler picture tubes, modifications for imminent u.h.f. transmissions, increased usable sensitivity, and improved selectivity and sync stability.

This article discusses some of the more interesting modifications of these new TV sets.

Bendix long-range chassis

The new Bendix standard and long-range chassis employ several unusual circuit innovations which are indicative of wide-awake engineering—but which are likely to cause the uninitiated service technician to blow his wig if he doesn't have a diagram handy. The standard chassis is simple when compared to the long-range chassis. The most interesting circuits used in the latter chassis include a direct-coupled audio amplifier, series-connected first and second video i.f. amplifiers, and a circuit arrangement which makes it possible to use the cathode of the audio-output tube as a regulated source of 150 volts medium B-plus for the tuner, first sound i.f., third video i.f., sync limiter, and video amplifier stages. This circuit is shown in Fig. 1.

The color lines indicate the B-plus bus obtained from the cathode of the audio amplifier. This voltage is held constant at approximately 150 volts by the constant-current characteristic of the class-A power amplifier. Drain on the power supply is reduced because tubes supplied from the cathode of the 6W6-GT power amplifier do not add to the current load on the power supply.

High-fidelity output is obtained from the audio amplifier by using direct coupling between the 6AU6 first a.f. amplifier and the power-amplifier stage. Distortion usually produced by single-ended pentode amplifiers is greatly reduced by inverse feedback. Approxi-

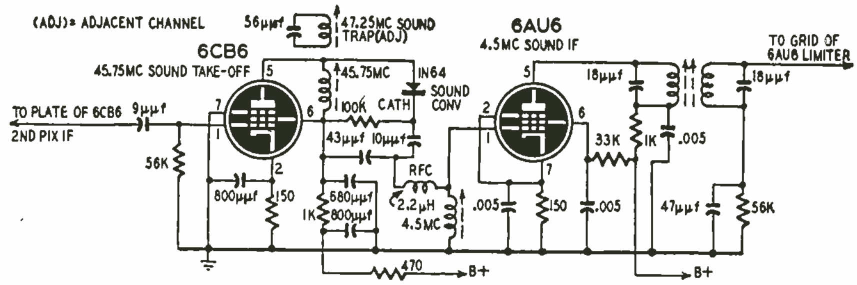


Fig. 3—An interesting sound i.f. circuit is found in the General Electric model 24C101.

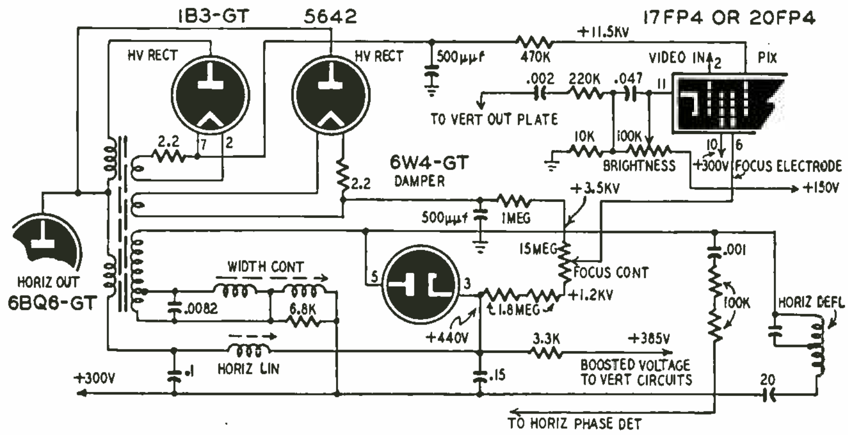


Fig. 4—Typical focusing circuits as found in some of the Zenith receivers. High-voltage focusing is used.

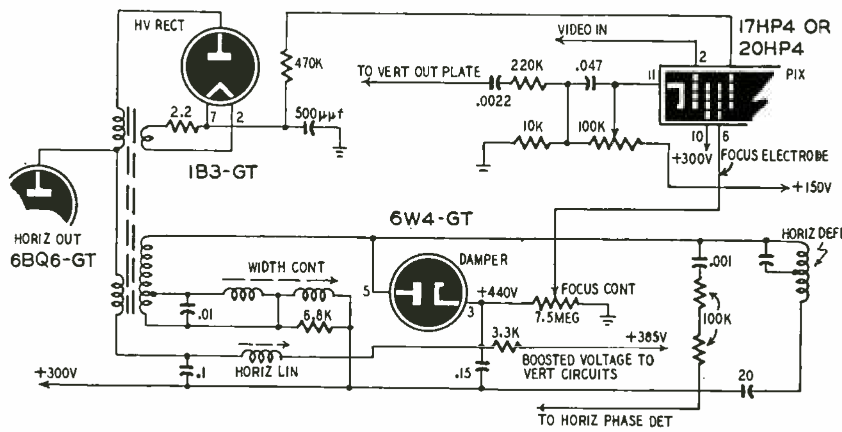


Fig. 5—The circuit of one of the newer low-voltage focusing tubes. Voltage of focus electrode is 440.

mately 18 db of inverse feedback is applied from one side of the voice coil to the cathode circuit of the 6AU6 first a.f. amplifier.

Note that the cathode of the 6W6-GT output tube is approximately 150 volts positive. Heater-to-cathode breakdown is minimized by connecting one side of the filament winding to the cathode. Breakdown between heater and cathode of the damper tube, a.g.c. keyer tube, and the second video i.f. amplifier is minimized by supplying these heaters from the same filament winding supplying the a.f. output tube.

The first and second video i.f. stages are connected in series with approximately 285 volts applied to the plate and screen of the second stage. The cathode of this stage is approximately 145 volts positive and is used as a source of supply voltage for the plate and screen of the first stage. This connection effects a further reduction in current drain from the power supply by eliminating the plate and screen currents drawn by one stage. With this circuit arrangement, the over-all impedance is very high, yielding greater gain and making it possible to obtain wider bandwidth.

Since the two stages are in series, their cathode currents are equal. Both can be controlled by a.g.c. voltage merely by applying a.g.c. bias to the first stage. This is possible because any change in the cathode current of the first stage will be automatically reflected to the second.

Novel G-E circuit

G-E comes up with more complete trapping in their new receivers. The circuit of the video i.f. strip of the 24C101 is shown in Fig. 2. Parallel-tuned adjacent-channel sound traps are in the grid and plate circuits of the first video i.f. amplifier stage. The third video i.f. amplifier has a 39.75-mc adjacent-channel picture trap in the cathode circuit and a 41.25-mc parallel-tuned trap in its plate circuit to absorb accompanying sound carrier. The plate circuit of the fourth i.f. stage has two traps. One is tuned to 39.75 mc for the adjacent-channel picture carrier and the other to 41.25 mc to trap out any sound carrier of the channel being tuned in which has leaked through. A 4.5-mc trap is in series with the signal lead to the cathode of the picture tube. This removes the 4.5-mc beat, indicated by picture hash, between the sound and picture carriers.

After glancing over the sound i.f. section of this set, we immediately pegged it as a split-carrier model because the sound take-off preceded the video detector. The second glance showed that the set has a 4.5-mc ratio detector, which by most standards would make it an intercarrier model. It

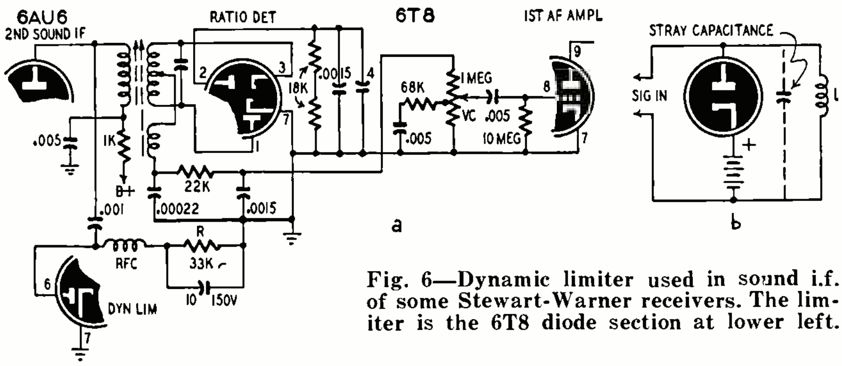


Fig. 6—Dynamic limiter used in sound i.f. of some Stewart-Warner receivers. The limiter is the 6T8 diode section at lower left.

looks to us to be about 25% split-carrier and 75% intercarrier. We don't know what to call it, but this is how it works: The sound i.f. strip consists of a 6CB6 sound take-off (45.75 mc) tube, 6AU6 4.5-mc audio i.f. amplifier, 6AU6 limiter, and 6AL5 ratio detector. The 6CB6 sound take-off tube (see Fig. 3) picks up the signal at the plate of the second video i.f. amplifier and develops it across the 45.75-mc tuned circuit which constitutes its plate load. This tuned circuit, peaked at the video i.f., is paralleled by a 1N64 germanium diode and a 100,000-ohm resistor. The germanium crystal is the sound converter. It rectifies the signal in the same manner as a video detector in an intercarrier receiver, and develops a 4.5-mc signal voltage across the 100,000-ohm load resistor. This signal is applied to a 4.5-mc tuned circuit in the grid circuit of the 6AU6 sound i.f. amplifier, and after amplification goes to a 6AU6 limiter, and is rectified by the ratio detector in the conventional manner. Adjacent-channel sound interference is eliminated by the 47.25-mc parallel-tuned trap coupled to the plate circuit of the sound take-off tube.

Electrostatically focused tubes

You have probably wondered just what changes would be required in using the new high-voltage electrostatically focused picture tubes. The focusing circuits in the new Zenith sets are typical of those used with these new tubes. The 17FP4 and 20FP4, used in the models 21J20 and 21J21, are tubes which require focusing voltages approximately one-third as high as the voltage applied to the second anode of the tube. The focusing circuit used in these sets is shown in Fig. 4. The anode voltage (11,500 volts) is supplied by the conventional 1B3-GT in the flyback power supply. The high voltage for the focusing electrode is obtained in a similar manner. For this purpose, a 5642 high-voltage rectifier is used. It rectifies the voltage peaks appearing at the plate of the 6GQ6-GT horizontal output tube and develops approximately 3,500 volts on the high side of the 15-megohm focus control in a voltage-divider network.

The Zenith 20J21 and 20J22 use 17HP4 and 20HP4 picture tubes which require much lower focusing voltages than the 17FP4 and 20FP4 mentioned above. With these tubes, 440 volts available at the damper tube cathode is applied across the 7.5-megohm focus control. See Fig. 5.

Dynamic limiter

An effective device which is likely to be taken for a circuit error is used in the sound i.f. amplifier of the Stewart-Warner 9120 series and in the Firestone models 13-G-46 and 13-G-47. A *dynamic limiter* is used in the sound i.f. strip. This consists of a biased diode connected across the primary of the ratio-detector transformer as shown in Fig. 6. Theoretically, a ratio detector is capable of complete suppression of AM signals; however, circuit adjustments are critical and best AM noise suppression and sound linearity seldom occur together. The sound output of intercarrier TV receivers is often affected by video-carrier buzz, interference, and amplitude modulation of the FM signal caused by multipath reflections commonly observed as aircraft-flutter.

The dynamic limiter is the diode (pins 6 and 7) of the 6T8 which functions as ratio detector and first audio amplifier. The basic circuit is shown at *b* in Fig. 6. The diode is initially heavily biased by the battery in series with the cathode return. Since an FM signal is normally free from amplitude modulation, the positive bias can be set to approximately equal the peak r.f. voltage produced by the FM signal. Any amplitude modulation on the signal causes the peak r.f. voltage to exceed the bias, causing the diode to conduct on peaks. The high-Q tuned circuit may be considered as a generator having a high internal impedance. When the diode conducts, it represents a very low impedance across the generator. This loads the tuned circuit and sharply limits any tendency for the output voltage to rise.

In the practical circuit shown at *a*, the battery is replaced by resistor R which develops the bias voltage when the tube conducts. Capacitor C charges and holds it charge for a period determined by the time-constant of the R-C combination. The time-constant of the network is made equal to or greater than the period of repetition of any amplitude-modulated signal.

Capehart sound take-off

In most intercarrier receivers, the sound take-off is situated at some point between the video detector and the grid of the first video amplifier. This is not the case in the Capehart-Farnsworth CX-33DX and similar chassis. The design engineers have worked out a neat trick which the draftsmen apparently tried their darnedest to conceal! We discovered their secret when we redrew portions of the circuit. We found that they have effected a saving in the sound i.f. amplifier of several components and one or more tubes. The circuit as redrawn is shown in Fig. 7.

The 6AH6 *video amplifier* may also be considered the first *sound i.f. amplifier* because the primary of the 4.5-mc sound i.f. transformer in the plate circuit couples a 4.5-mc sound signal into the grid circuit of the 6AU6 sound i.f. stage. However, if we neglect the secondary of the transformer, the primary becames a parallel-tuned 4.5-mc trap in series with the usual peaking coil and load resistor. The circuit then becomes that of a conventional video amplifier.

TV receiver manufacturers have taken steps to reduce glare from light striking the face of the picture tube. Some are tilting the tube and safety glass slightly downward or using a curved safety-glass surface. Others are using the new cylindrical-face tubes such as the 21EP4, 21FP4, etc. The cylindrical front section eliminates reflections by scattering upward and downward the light which strikes the face of the tube.

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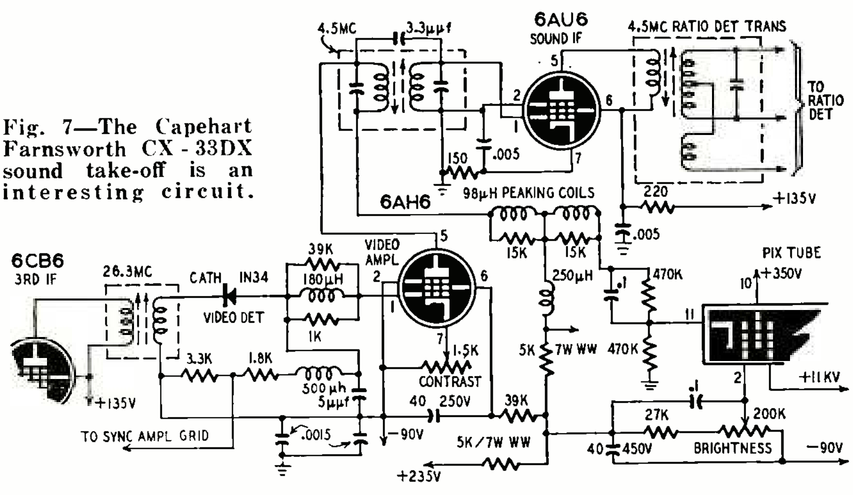
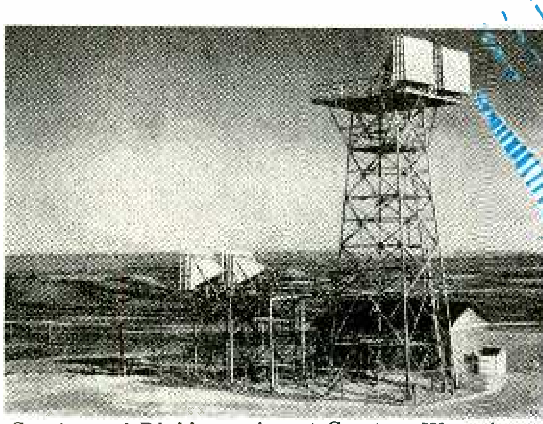


Fig. 7—The Capehart Farnsworth CX-33DX sound take-off is an interesting circuit.

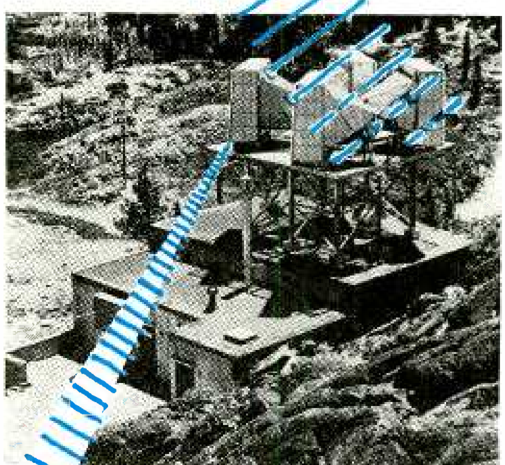
TV MICROWAVE RELAY

Stretching 3,000 miles from New York to San Francisco, the Bell System microwave link is communications electronics' greatest achievement. Its 107 towers are placed on an average of 30 miles apart (not in a straight line but staggered slightly so that beams do not overlap and interfere). They range from a mere 14 feet high on the flats west of Great Salt Lake to 427 feet at Des Moines and 450 feet at the New York home station. Operating frequency is 3,700 to 4,200 mc, a bandwidth of 500 *megacycles* which permits carrying thousands of simultaneous telephone conversations as well as the east-west and west-east television channels. Together with the coaxial cable link, this microwave system ties all important television cities in the United States into one network, so that an important East Coast news event or a Hollywood opening can be viewed instantaneously on the television screens of the audience on the opposite coast as during the recent cross-country Presidential telecast.

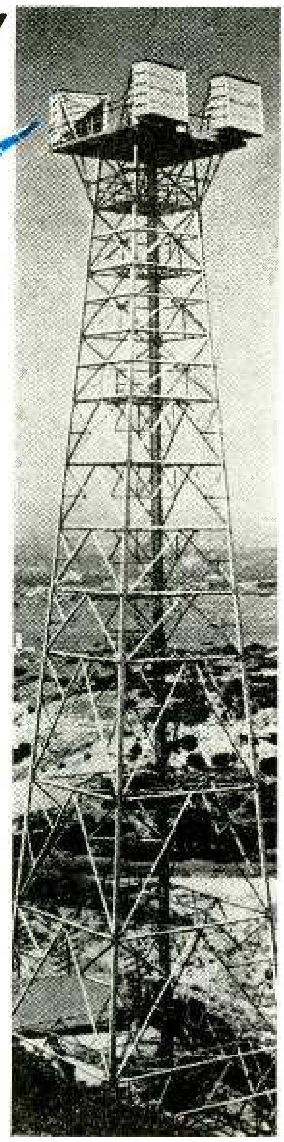


Continental Divide station at Creston, Wyoming.

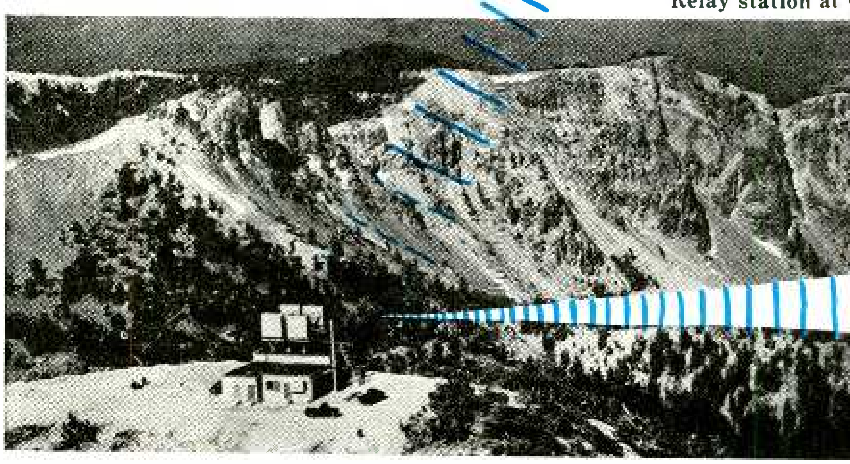
The microwave nets have solved the contradiction between coverage of vast areas and short transmission ranges. They bridge distances and serve regions that else might wait years for a coaxial line.



Relay station at Cisco Butte, California.

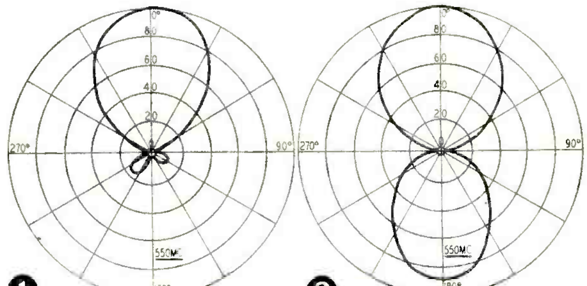


The 200-foot steel tower at Salt Lake City, Utah.



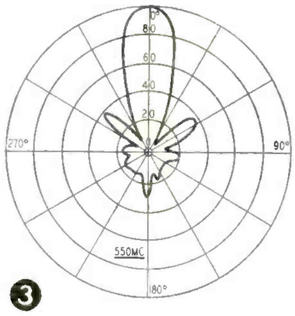
System's highest station, at Mt. Rose, Nevada, is 10,000 feet above sea level.

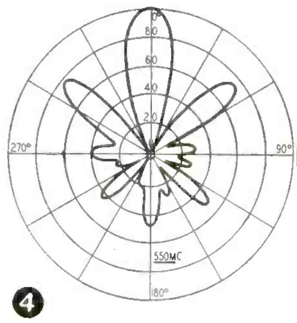
All photographs courtesy Long Lines Dept., American Telephone & Telegraph Company.

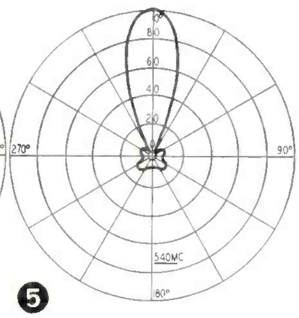


1 2

NEW IDEAS IN U.H.F. ANTENNAS







THE installation technician will have a new world of antennas to conquer when u.h.f. receivers reach the customer. While cut-down versions of v.h.f. antennas will operate well, the need for excellent signal pickup and the possibility of using types that would be cumbersome at lower frequencies will without question create new favorite types.

A number of these are forecast in a report by E. O. Johnson, of the Advanced Development Section, RCA Victor Home Instrument Department, and J. D. Callaghan, of the RCA Service Co. Their report, based on actual experience in the service area of NBC's u.h.f. station at Bridgeport, Conn., is unusually complete and is illustrated with photos of the various antennas tried.

One of the most useful of the new types is the corner reflector, an antenna which is so cumbersome at lower frequencies that it is not commonly used. The horizontal directivity pattern is shown in polar pattern 1 above, and the gain and bandwidth in graph 1. A simple dipole, or a fan dipole, may be placed in the focus of the reflector.

The fan dipole will probably be the most popular antenna in medium- or strong-signal areas. It is a slight modification of the standard dipole, and has somewhat greater gain and roughly the same directivity. See polar pattern and graph 2.

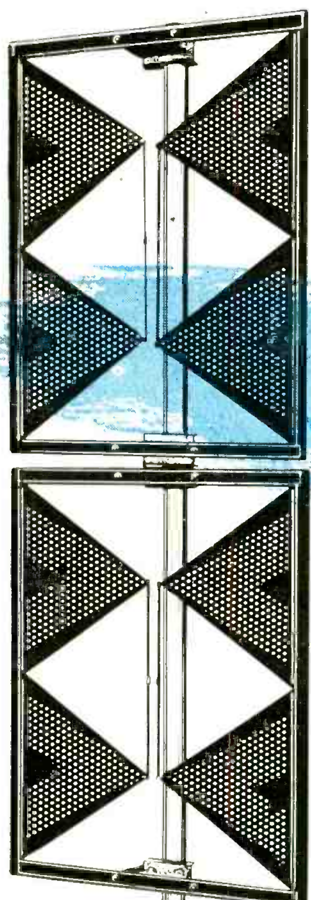
The rhombic, illustrated in the lower left corner and described in pattern and graph 3, is another high-gain antenna whose size limits its use on v.h.f. On the u.h.f. it can come into its own, and will probably be the preferred antenna where great gain, high directivity, and broad-band response must be combined.

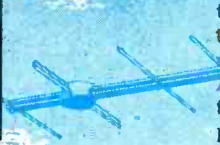
The V antenna is theoretically a half rhombic and combines efficiency with simplicity and ease of installation. It lends itself well to stacking, as shown in the photo, and its gain increases with frequency (see graph 4), which is a very desirable feature at u.h.f. Graph and pattern 4 are for the stacked V.

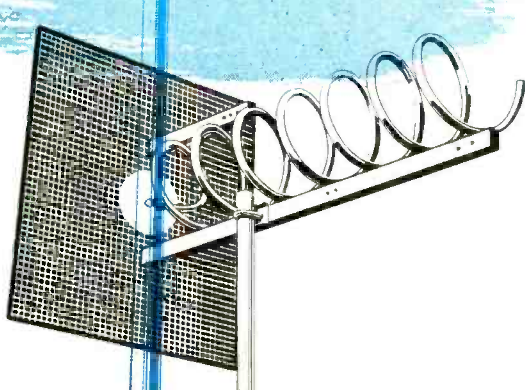
Stacking can be used with excellent results for other types of u.h.f. antennas. The rhombic can be stacked for greater vertical directivity, as can the dipole.

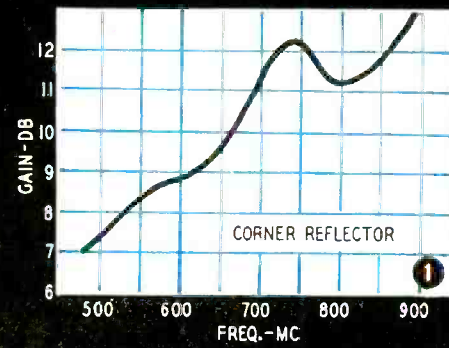
The old standard Yagi is more than ever valuable in cases where bandwidth can be sacrificed for high gain. Used to receive a single channel, it produces more gain and has higher directivity than any antenna of comparable cost. See polar pattern and graph 5.

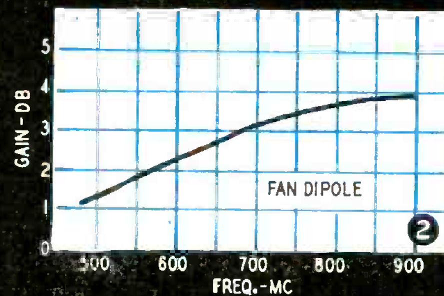
A number of other types, such as the helical antenna illustrated here, are likely to be used. Some of them, such as the billboard, parabolic, and slot antennas, are modifications of equipment used in radar and v.h.f. broadcast work. Actual experience under varied conditions will determine if they will compete with the types already described.

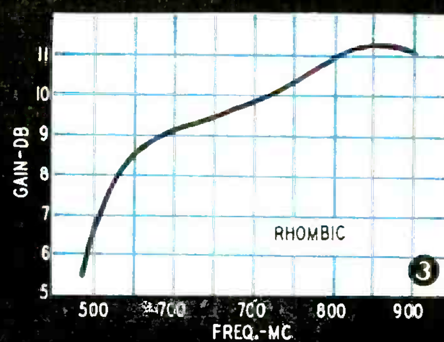


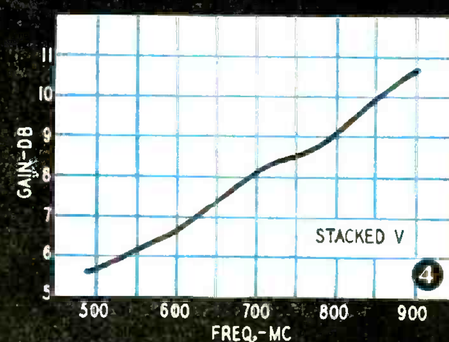


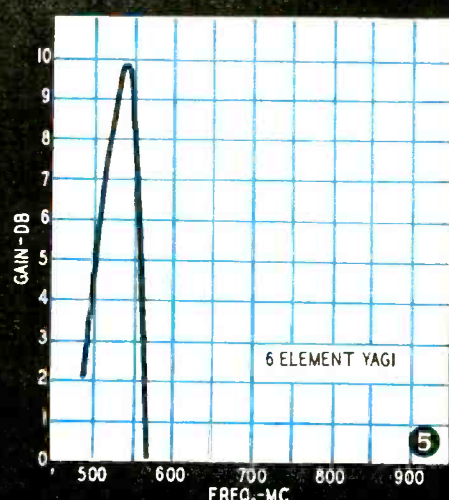


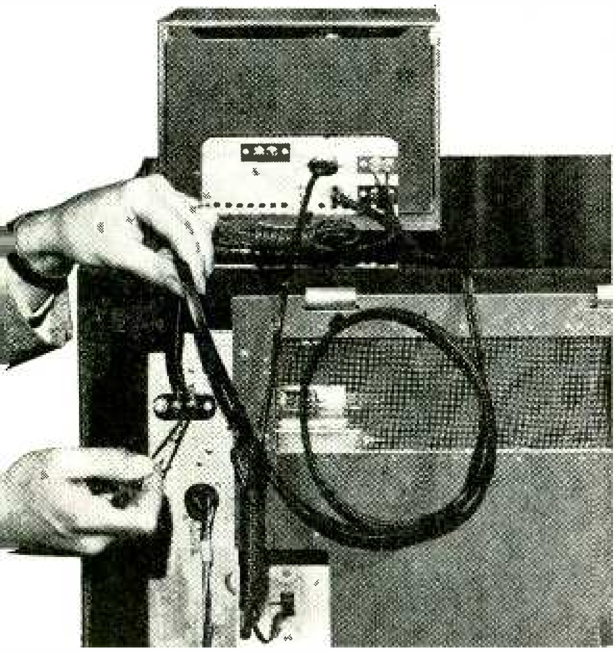








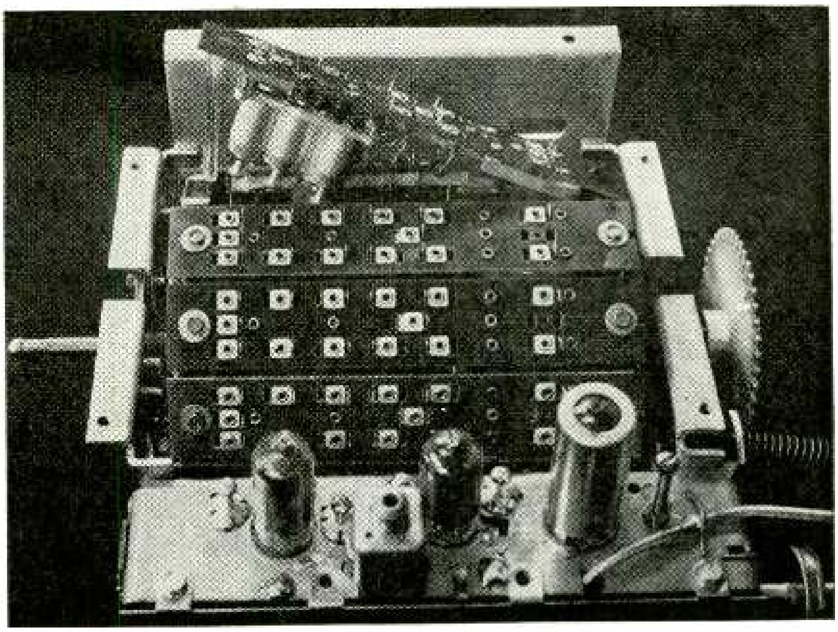




Within two years we may have 1337 new television stations on the air. Set owners will universally want to have u.h.f. converters and antennas installed

By RUDY FRANK

U.H.F. Reception on V.H.F. Receivers



Above — Installing an external u.h.f. converter is as simple as adding a booster. Right — U.h.f. strip as used in Zenith and other front ends.

THIRTEEN hundred and thirty-seven new television stations will go on the air within two years after the lifting of the freeze on the ultra-highs. With this distribution of u.h.f. TV stations to every nook and corner of the United States, service technicians may look forward to a bonanza. Set owners will universally want to have u.h.f. converters and antennas installed so they can avail themselves of the signals from the new stations in their communities.

The author has observed transmission from the experimental u.h.f. television station KC2XAK at Stratford, Connecticut, ever since it first went on the air in early 1950. After many tests and observations under all sorts of conditions we are satisfied that u.h.f. television is commercially practical and in some ways a service superior to the present v.h.f. type of transmission. Manufacturers came to this conclusion early in the NBC-RCA experiment at Stratford and have developed u.h.f. converters which undeniably may be greatly improved upon in the future, but which are commercially practical for home installations right now.

There are two main ways in which the problem of u.h.f. conversion has been approached. One, which uses a separate external converter, is employed by manufacturers such as RCA-Victor, Crosley, Stromberg-Carlson, General Electric, Philco, and Westinghouse. With this type of conversion, the entire u.h.f. band from 470 to 890 megacycles is made available to the set owner. Stations are tuned continuously on the converter. The second approach to the problem is employed by manufacturers who use the turret-type front end. Tuned, movable strips are supplied for the various ultra-high frequencies available in any given community. This method is of course limited in the number of stations which may be received to the number of positions on the turret-tuner. Two leading manufacturers will make this type of conversion available to set owners who have their receivers. One is Zenith which manufactures its own 13-position tuners. The other is the Standard Coil Corporation which although not a manufacturer of receivers

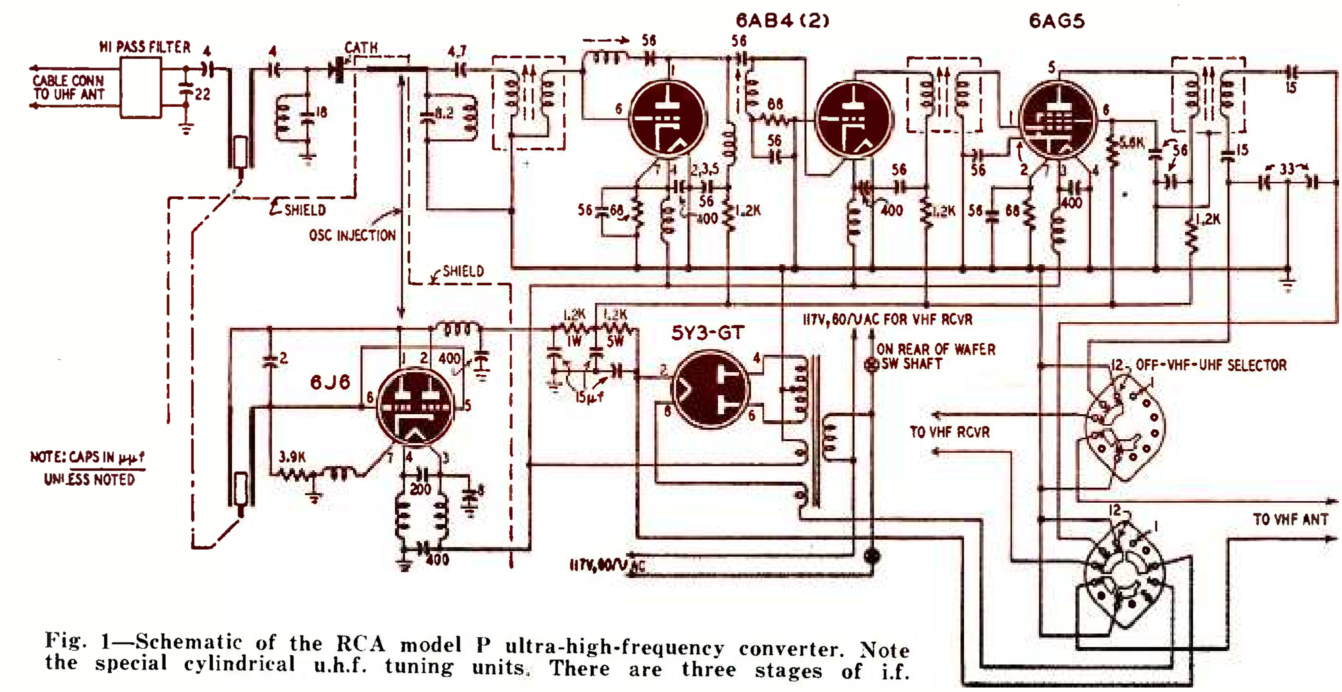


Fig. 1—Schematic of the RCA model P ultra-high-frequency converter. Note the special cylindrical u.h.f. tuning units. There are three stages of i.f.

has supplied its front ends to an estimated 40% of all television receivers. The RCA-Victor converter above is an example of the external continuous-tuning type, and to the Zenith u.h.f. tuner strip as an example of the other, which was described in the August, 1951, issue of this magazine.

The RCA-Victor converter is the model P developed in the main by Dr. Wen Yuan Pan of RCA. The converter as illustrated in the photo and in Fig. 1 is self-contained and requires no wiring changes in the receiver upon installation. The converter uses an i.f. from 204 to 216 megacycles, making it possible to use either channel 12 or 13 for u.h.f. reception. The relatively high i.f. results in high rejection of image and spurious responses and low oscillator radiation with only one r.f. tuned circuit. The oscillator tunes from 290 to 490 megacycles. A 6J6 tube covers the necessary frequency range within the ratings of the tube. Because of the high i.f. the oscillator frequency is sufficiently low to minimize microphonic tendencies and drift.

The u.h.f. input signal is fed to a high-pass filter through a 75-ohm coaxial cable. The filter cuts off at approximately 485 megacycles and has an insertion loss of about 2 db in the pass band. The r.f. tuned circuit (together with impedance transformation networks to maintain proper matching) serves as a selective coupling device between the filters and the crystal mixer. Under these conditions, the r.f. band is approximately 18 megacycles, which corresponds to an operating Q of 35. The standing wave ratio is fairly low and uniform throughout the entire tuning range. The selectivity of the r.f. tuned circuit—with the aid of the high-pass filter—effectively rejects the image and other spurious responses such as those formed by the generation of second and third harmonics during the conversion process in the G-7 germanium crystal mixer. An oscillator-injection equalizer is used which, as far as oscillator injection is concerned, is a bandpass filter of broad cutoff characteristic. The bandpass occurs at frequencies where the amplitude of the normal oscillator injection, without the equalizer, would be a minimum. Thus it produces uniform injection over the whole tuning range.

The i.f. amplifier consists of a driven grounded-grid stage using two 6AB4 tubes, and a pentode stage using a 6AG5 tube. The i.f. transformers are conventionally constructed with 4 turns of No. 19 wire on the primary and 3 o the secondary. The complete i.f. has six tuned circuits which effectively prevent interaction between the harmonics of the local oscillator in the v.h.f. receiver and the converter oscillator.

The Zenith method of conversion is applicable to receivers of that concern only. This company has developed a u.h.f. channel strip (Fig. 2) which converts the tuner of the receiver into a conventional superheterodyne. The local oscillator signal on which the mixer operates is derived from a harmonic of the receiver's own oscillator. No alterations to the receiver itself are required. Any service technician can install the channel strips in a matter of minutes. Technicians in the Bridgeport area are already doing just that. The u.h.f. 529–534-megacycle strips are available at a cost of $10 plus installation, and the demand is brisk.

The Zenith strip incorporates a u.h.f. preselector. The whole high-frequency portion of the strip is housed in a small metal die casting with three separate cavities. Mounted in these cavities are the r.f., mixer, and multiplier tuned circuits. They are completely shielded from one another and from external influences such as hand capacitance and adjacent strips. Inductance for the u.h.f. tuned circuits is two small solenoids wound with flat strip. Capacitance for these circuits is a combination of three capacitances: the capacitance between the top end of the coil and the cavity, the distributed capacitance of the coil, and the capacitance of the adjustable screw as it enters the top of the coil. Such a tuned circuit has an extremely small tuning capacitance and a relatively large tuning inductance.

The author would like to express his appreciation for the help and advice given to him in the preparation of this article to John L. Seibert of the National Broadcasting Company, in charge of experimental u.h.f. television station KC2XAK, Stratford, Conn., to Dr. Wen Yuan Pan, RCA-Victor Home Products Division; and to Harry Tellis of the Plymouth Electric Company, New Haven.

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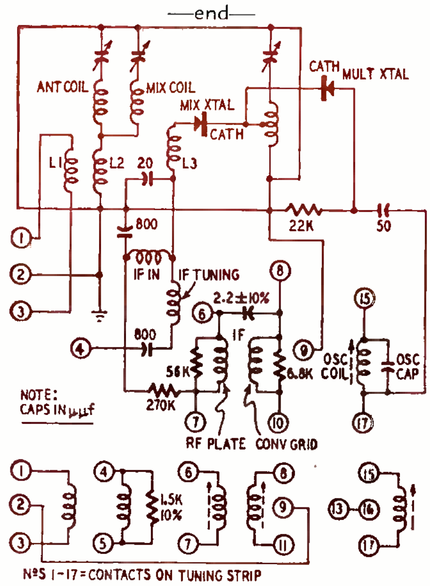


Fig. 2—Hookup of Zenith u.h.f. strip.

44-MC I.F. Amplifiers for TV

By DAVID T. ARMSTRONG

FM sound i.f. has climbed the stairway to the stars from 2.1 to 4.3 to 10.7 to 21.75, and now to 41.25 mc. Video i.f.'s have moved from 8.25 to 12.25 to 25.75, and now to 45.75.

The frequency to which an i.f. amplifier is to be tuned is a subject to which much thought and many barrels of ink have been devoted. The search is always for an intermediate frequency with the maximum number of advantages and the minimum number of disadvantages. The choice of a satisfactory frequency has been the subject of much study and debate in the councils of the RTMA.

The values of 21.25 to 21.9 for sound and 25.75 to 26.4 for video were adopted because it was generally believed that these values represented the most satisfactory compromise of all the factors bearing on the matter. Most current-model television receivers employ the nominal 24-mc i.f.

Practical field experience with the 24-mc i.f. has been exceptionally good except for the peculiar problems caused by spurious oscillator radiation. There have also been minor disadvantages, including direct i.f. interference from hams and from medical and industrial equipment, from powerful FM stations inducing image interference, and from the international short-wave distortions. It was mainly the problem of oscillator radiation that caused the RTMA to advocate the new 44-mc standard.

Advantages of a 44-mc i.f.

The chief advantage of the new frequency is that it eliminates undesirable defects found at 24 mc. These defects are not troublesome on all channels nor in all sections of the country. The most important ones which can be corrected by the new 44-mc i.f. are:

1. *Oscillator radiation:* The oscillator of one TV receiver may cause interference in a nearby receiver tuned to another channel. The manner in which such interference appears is presented in Table I. Study of the data indicates that possibility of oscillator radiation interference exists only with 24-mc i.f., and that it may occur on 5 of the 12 channel allocations. The phenomenal number of receivers sold in 1950 and early in 1951 has increased the sources of interference from local oscillator radiation.

2. *Image frequency:* Powerful FM stations may cause interference when they are received as image frequencies. When the present 24-mc i.f. was adopted, channel 1 was still in the TV allocation, and FM broadcasting was in the 42–50 mc band. While either or both of these were in the picture a 44-mc i.f. was out of the question. Of course there are some assignments in the 44–50 mc band, but they are low-power stations and their interference usually may be removed by a simple wavetrap. (Ten kilowatts is not too low power—see page 29 of the October, 1951, RADIO-ELECTRONICS.—*Editor*)

3. *Industrial and miscellaneous interference:* With the 24-mc i.f., interference is caused by diathermy equipment, industrial electronic equipment, and radio transmitters which have frequency assignments in the 21- to 27-mc band. A number of 44-mc i.f. receivers have been air-tested by a manufacturer of diathermy equipment. There was TVI for the 24-mc i.f. but none for the 45-mc i.f.

In general then the new 44-mc i.f. eliminates all the 24-mc i.f. defects and, so far as field experience at this time indicates, introduces no new problems. Note that in Table I data are presented showing the oscillator above the signal frequency on all 12 channels, as well as above signal on channels 2 to 6 and below signal on channels 7 to 13. The data in the table shows there is no noticeable interference from oscillator radiation on other receivers using the 44-mc i.f. when the oscillator is above signal on all 12 channels. Neither is there any image interference from FM stations when the oscillator is above signal frequency. Image interference in general is of course less troublesome at the higher than at the lower i.f.

There is little second-harmonic i.f. interference on channel 6. The second harmonic of the sound i.f. at 82.5 mc is 0.75 mc below the picture carrier for channel 6. The interference level is about the same as the third-harmonic interference with the 24-mc i.f. on channel 5.

4. *Suitability for u.h.f. work:* This new i.f. may be satisfactory for the u.h.f. TV bands. It is possible to design front-end tuners capable of covering the present 12 channels and the 52 additional 6-mc channels in the 469–782 mc band, using a 44-mc i.f. strip.

Disadvantages of 44 mc

Like anything else in life the new frequency is not without problems. Let us consider briefly the outstanding disadvantages, which may be listed as follows:

1. *Stability:* The higher the i.f. the more critical the oscillator stability. In general the stability of the 44-mc i.f. is only about 65% as good as the stability of the 24-mc i.f. Stability is worse for receivers with separate video and separate sound i.f. systems since the sound i.f. at 41.25 mc is a narrow band. The stability of the amplifier system is better with intercarrier sound if the i.f. is 44 mc.

2. *Interference and 44 mc i.f.:* The purchaser of a 44-mc i.f. receiver produces no oscillator radiation that will cause TVI for his neighbors, but his set may be subject to interference from them because their sets may radiate. The benefits of 44 mc are achievable only when all sets in a given area use it. This may come eventually, but in the meantime TVI will be bothersome to many TV set owners.

3. *Alignment:* Procedure is similar to that used at 24 mc, but the importance of short leads, even from the signal generator, becomes a dominant factor. Short leads are absolutely necessary; lead dress is critical. Bypassing to the right spot is a problem. Regeneration can be serious with some tube types (though none seems to be evident with the 12AT7 converter in the G-E adaptation). Stability and symmetry for all values of a.g.c. or contrast bias create vexing problems that require much care to solve satisfactorily. G-E solved these problems in a transformerless cold chassis type model (see Fig. 1) and RCA has developed a fine 44-mc i.f.

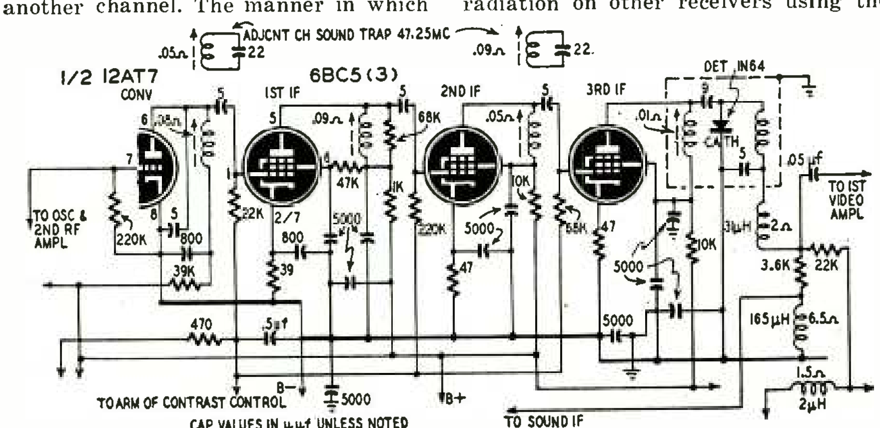


Fig. 1—Diagram of General Electric's 44-mc i.f. strip used in the 16T3, 16C113, and similar models. Two 47.25-mc traps suppress the adjacent-channel sound.

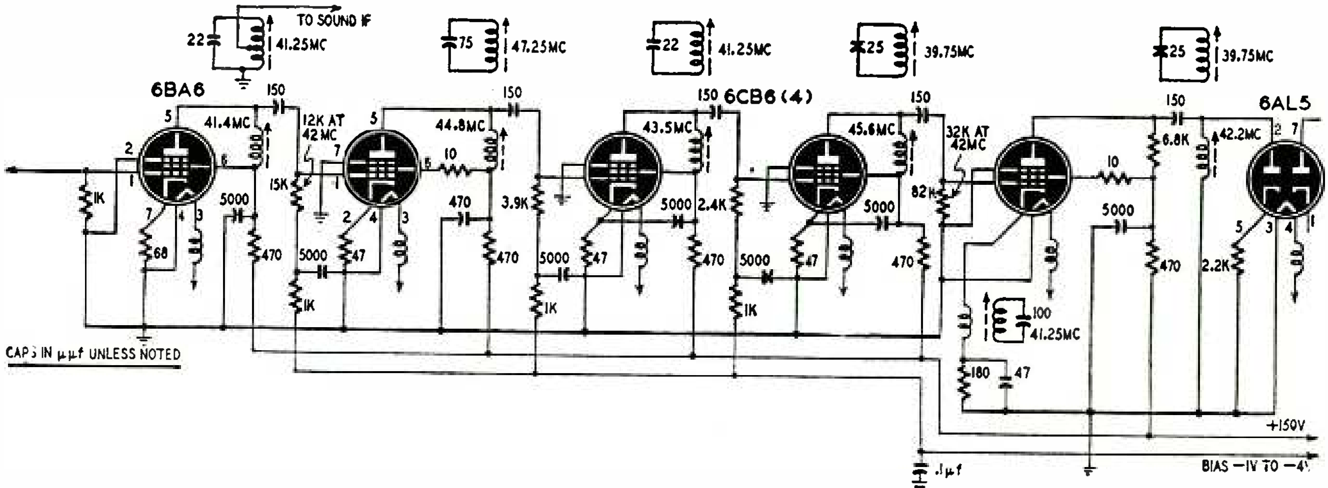


Fig. 2—One version of RCA's stagger-tuned 44-mc video i.f. strip. The 6AU6 is the converter; 6CB6's are amplifiers. Two 41.25-mc parallel-resonant circuits trap out the accompanying sound channel while the 47.25-mc circuit traps out the adjacent-channel sound. Two 39.75-mc circuits are included in the third and fourth stages to trap adjacent-channel video.

strip. RCA uses the 6CB6, and G-E the 6BC5.

4, *Servicing:* The higher i.f. makes servicing a more serious matter. Location of a ground is important. Placement of a bypass capacitor can affect performance. Replacement with exact duplicate parts is desirable. Alignment is more frequently necessary after servicing (even when only a tube is replaced), particularly with permeability slugs. Where any direct i.f. interference is a problem installing an i.f. trap in the antenna lead-in usually corrects the condition.

Circuit considerations

A suitable television i.f. amplifier tube requires high transconductance for high gain and low grid-plate capacitance for low feedback. The combination of reduced grid-plate capacitance and high transconductance of the 6CB6 make it possible to obtain higher gain with this tube than with others.

Note the over-all gain as well as the effective stage gain for the tubes listed in Table II. The 6CB6 tube is highly suited for both the 24- and 44-mc i.f. band. The separate grid No. 3 connection of the 6CB6 makes it possible to use an unbypassed cathode resistor to reduce variations in input capacitance and conductance with changes in bias.

Because the only capacitance in the tuned circuits of most television i.f. amplifiers is that of the tube electrodes and associated wiring, a large increase in output capacitance causes a decrease in plate circuit impedance and a consequent loss in gain. The maximum grid-plate capacitance for the 6CB6 is 0.020 μμf and its output capacitance is only 1.9 μμf.

When the grid bias of an i.f. amplifier is changed to vary the gain, both input capacitance and input conductance of the tube vary also, and the shape of the pass band is changed. In a TV receiver employing a.g.c. the i.f. response will vary. To compensate for changes in input capacitance and input conductance an unbypassed cathode resistor should be used with the 6CB6 because of its separate grid No. 3 connection. A 47-ohm resistor is just about optimum, but because it is too small to provide proper bias, it must be supplemented with fixed bias, or with additional cathode bias supplied by a 130-ohm bypassed resistor. The circuit shown in Fig. 2 requires fixed bias of −1 to −4 volts.

Because tube capacitance varies slightly from tube to tube, retuning is necessary when tubes are changed to obtain the same bandpass characteristics. At frequencies higher than 30 mc it becomes difficult to ground the screen grid effectively because of the inductance of its leads and those of the bypass capacitor. It may be necessary to adjust the lead inductances so that they are in series resonance with the bypass capacitor to ground the screen grid effectively.

These remarks apply specifically to the circuit shown in Fig. 2, which is an RCA development of a 44-mc i.f. circuit designed around the characteristics of their 6CB6.

—end—

TABLE I

Channel	Channel band in mc.	Picture carrier frequency	Sound carrier frequency	21.25-mc i.f. sound; osc. above on all channels	41.25-mc i.f. sound; osc. above on all channels	41.25 mc-i.f. sound; osc. above on channels 2–6 and below on channels 7–13
2	54–60	55.25	59.75	81.0 [1]	101.0 [4]	101.0 [4]
3	60–66	61.25	65.75	87.0 [2]	107.0	107.0
4	66–72	67.25	71.75	93.0	113.0	113.0
5	76–82	77.25	81.75	103.0	123.0	123.0
6	82–88	83.25	87.75	109.0	129.0	129.0
7	174–180	175.25	179.75	201.0 [3]	221.0	138.5 [5,6]
8	180–186	181.25	185.75	207.0 [3]	227.0	144.5 [6]
9	186–192	187.25	191.75	213.0 [3]	233.0	150.5 [6]
10	192–198	193.25	197.75	219.0	239.0	156.5 [6]
11	198–204	199.25	203.75	225.0	245.0	162.5
12	204–210	205.25	209.75	231.0	251.0	168.5
13	210–216	211.25	215.75	237.0	257.0	174.5

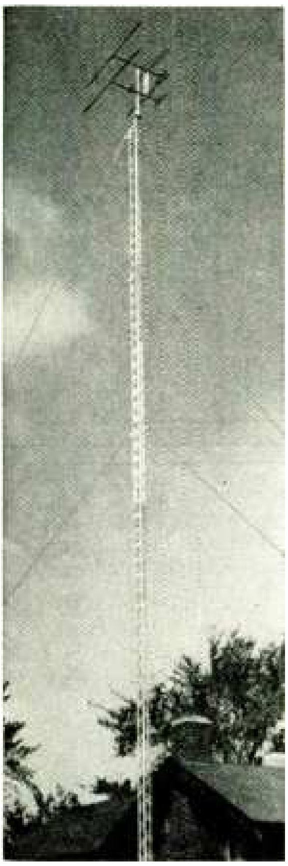
NOTES:

[1] There may be channel 5 interference as a result of oscillator radiation. FM stations may also be received on the image frequency.
[2] There may be oscillator radiation interference on channel 6.
[3] There is likely to be oscillator radiation interference on channels 11, 12, and 13.
[4] In some localities there may be image interference from 144-mc amateurs.
[5] There may be image interference from channel 6.
[6] There may be image interference from FM broadcast stations.

TABLE II

4-TUBE COMPLEMENT FOR STAGGER-TUNED I.F. AMPLIFIER

Tube	Over-all Gain	Effective Average stage gain	Interelectrode capacitances input μμf	output μμf	g-p μμf	gm μmhos
24 mc only						
6BA6	1,300	6.0	5.5	5.5	0.0035	4400
6AU6	3,000	7.5	5.5	5.0	0.0035	5200
6AG5	6,500	9.0	6.5	1.8	0.025	5100
24 or 44 mc						
6AK5	10,000	10.0	4.0	2.8	0.02	5100
6CB6	14,500	11.0	6.3	1.9	0.020	6200



The antenna of observer M.C. Butler of Burlington, Iowa.

TV DX IN 1951

By

EDWARD P. TILTON*

An analysis of the year's reports, with a glance at the possibilities for 1952.

ONE June day back in the early 1930's, hams working the 5-meter band in the cities of the Eastern Seaboard were amazed to hear interfering signals from midwestern stations breaking through. The frequency band used was 56 to 60 mc, now the upper two-thirds of TV channel 2. Amateurs had been developing interest in this band for several years. There had been scattered reports of 1,000-mile dx as far back as 1926, but few workers placed much faith in them. After all, didn't the best authorities in the propagation field state that there could be no ionospheric reflection of frequencies higher than about 30 mc or so?

*V.h.f. editor, *QST*.

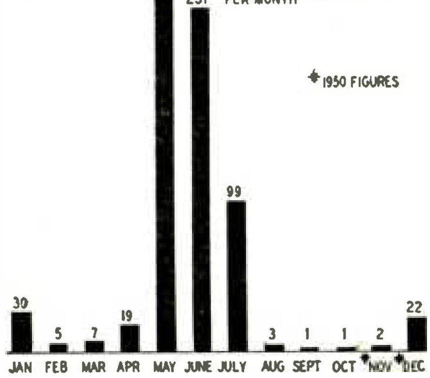


Fig. 1—Periodicity of dx-time is obvious.

Many, including myself, felt that they were being tricked, and were a bit reticent about discussing their experiences, for fear of being laughed down if they showed any signs of "falling for it." But as they began to compare notes, principally through the reports published in the magazine *QST*, it became apparent that dx on "5" was an accomplished fact.

What a tantalizing will-of-the-wisp it was! Appearing out of nowhere, the dx stations would boom in for a few minutes and then, with a precipitate fade quite unlike anything in previous dx experience, drop out again, perhaps to be replaced by signals from another section of the country in a matter of minutes. What manner of dx was this? After nearly 20 years of observation and study we still don't have all the answers, but we have learned quite a bit. Detailed observation by amateurs and TV dx enthusiasts[1] has been very useful in formulating some rules and predictions.

It is now generally accepted that this reflection back to earth of signals that otherwise would dissipate into space is the result of patches of dense ionization in the E-layer region of the ionosphere, some 50 miles above the earth's surface. We know that there are two definite times when such dx is most likely to occur: one period from May through July, and the other period around the end of the year. We also know that despite this well-defined pattern, TV dx can take place at any season. We observe a general diurnal pattern, with peaks in the morning and early evening hours, but it does not always work that way. The usual dx range is between 600 and 1,200 miles, but signals have been received as close as 300 miles—the maximum dx is largely a matter of conjecture. We have evidence that sporadic-E dx is associated with solar phenomena, but attempts at direct correlation with sunspot observations have been largely unsuccessful.

This still rather unpredictable nature of sporadic-E dx is a considerable factor in the popularity of this hobby. Considerable interest has been evidenced by the receipt by RADIO-ELECTRONICS in recent months of hundreds of individual observations of TV dx from 33 states, the District of Columbia, 3 Canadian provinces, and Mexico. These reports have been (and are still being) studied for possible new light on this intriguing phenomenon.

[1]Tilton: "What's The Mystery behind Television DX?" RADIO-ELECTRONICS, May, 1951, Page 28.

What the observations show

The seasonal nature of this dx is indicated by the charts of Fig. 1. The upper one, giving the number of days in each month when dx was observed, shows June as the top month for TV dx. Note that only four days showed no dx report, and on at least two of these observations by amateurs working on 50 mc (not included in the chart) suggest that TV dx might have been possible. Yet we still encounter individuals who regard TV dx as something rare or freakish!

The lower chart indicates the number of reports for each month. The apparently contradictory reports for May and June in these graphs is probably the result of an especially favorable condition on May 30, a holiday when more than the usual number of daytime observations would be made.

Reports for 1950 are used to illustrate the minor year-end peak because the autumn figures are not complete as this material is being prepared for publication.

The inverse relationship between transmitter frequency and E-layer dx is shown graphically in Fig. 2. Here we see that low-end channel 2, with only 12% of the stations, accounted for nearly 28% of the reports. The champion dx station of the country, KPRC, Houston, Texas, was reported no less than 71 times—nearly as many loggings as for all 30 stations on channels 5 and 6 combined! From the tabulation of stations it may be seen that all known stations on channels 2 and 3 were logged. Of 28 stations on channel 4, all but 2 were reported. Four channel 5 stations eluded the dx'ers, and only 6 out of 11 stations on channel 6 made the grade. The remaining stations; WNHC, WHAM, WTVN, WFIL, and WTVR are all fair game and make nice targets for avid TV dx'ers.

The data on Fig. 2 agrees well with a similar chart in the May issue that was prepared from the much smaller number of 1950 observations. The slight disparity in station totals is the result of the inclusion in this year's analysis of stations in Cuba, Mexico, and Brazil.

Obviously, a station in the center of the country has a better chance of running up an impressive total than one in a coastal area. Nonetheless the greater prevalence of sporadic-E in southern latitudes can be seen from the tabulation of dx reports by station and channel.

The impressive record of KPRC is, certainly at least in part, the result of a combination of these factors; but notice the preponderance of southern stations in the upper brackets of dx reports. Only on channel 3, which has no representative in the Deep South, is the lead held by a Midwestern station, KMTV of Omaha, Neb. The top ten listings for channel 4 shows no station above the Mason-Dixon line. WBAP of Fort Worth, Texas almost monopolizes the channel 5 score, and CMQ of Havana, Cuba, KOTV of Tulsa, Okla., and WDSU of New Orleans, La., seem to dominate on channel 6.

Some outstanding records

With reports running into the hundreds for the more active months, it is obviously impossible to publish them all in detail. Several deserve special mention, however. Observer Canning, of Halifax, Nova Scotia, is the proud possessor of the verification from PRF-3, Sao Paulo, Brazil, reproduced on page 31 of the October issue of RADIO-ELECTRONICS. This record of reception over a distance of nearly 5,000 miles is shared by observer Jordan, of Grand Rapids, Mich., who also picked up PRF-3 on June 11. This is one TV dx record that has no counterpart in amateur two-way v.h.f. communication. No U.S. or Canadian amateur has yet contacted Brazil on 50 mc. Observer Canning also claims one of the longest distances ever logged for a U. S. station, with KPRC of Houston, Texas—over 1,900 miles.

Worthy of note is the unusually complete and concise log of D. V. Dixon, of the Service Appliance Co., Deming, New Mexico. Despite a high noise level, Dixon was able to log dx on 31 out of 67 days from May 23 to August 1. On several other days there was intermittent dx that was not identifiable.

Down in Miami, observer Hall was able to pick up dx almost daily after the latter half of April. On July 9 and 10 he logged 26 different stations in a period of less than 24 hours, including Mexico City and San Francisco. The latter is the only transcontinental TV dx reported to date. The log of Jim Morrow of Brantford, Ontario, contains 41 different calls.

The reports of the more than 100 other keen observers listed at the end of this article were extremely helpful, and their co-operation is appreciated.

What about the high channels?

The foregoing is all very well for channels 2 through 6, but where do the more than 35 different stations now telecasting on channels 7 through 13 come in? The answer is that they don't—at least as far as ionospheric dx is concerned. The absolute limit for the reflection of signals from the E-layer is not precisely known, but indications point to a frequency well below channel 7.

As pointed out in the May article, signals on the higher channels have a pretty good chance of being received at distances of a few hundred miles as a result of the greater ease with which they are refracted by temperature and humidity variations in the lower atmospheric strata. Since this bending takes place in the first few thousand feet above the ground level, the resultant dx is more an extension of the normal coverage than the ionospheric skip effect as observed in the reports.

A typical example is reported by observer Canning, who has picked up WJAR, Providence, R. I., on channel 11, and by observer Smith of Hampton, Va., who has logged the same station when weather conditions were favorable. The distances involved were 400 miles or more. Such reception of high-band signals over distances of 500 miles and more is fairly common in areas where stable stratifications occur frequently in the lower atmosphere. The "smoke bar" over the Great Lakes or a river valley at dusk, with thin over-running high cloudiness, are two usually favorable signs. Undoubtedly many observers have achieved excellent results on these frequencies, but these instances of high-band dx have gone unreported, because the distances involved are not quite so spectacular as those reported for the lower channels.

Prospects for 1952

There is as yet no magic formula with which we can make detailed predictions for E-layer dx a year in advance. Analysis of the data in Fig. 1 however, will enable us to get a fair idea of what is in prospect. Careful ob-

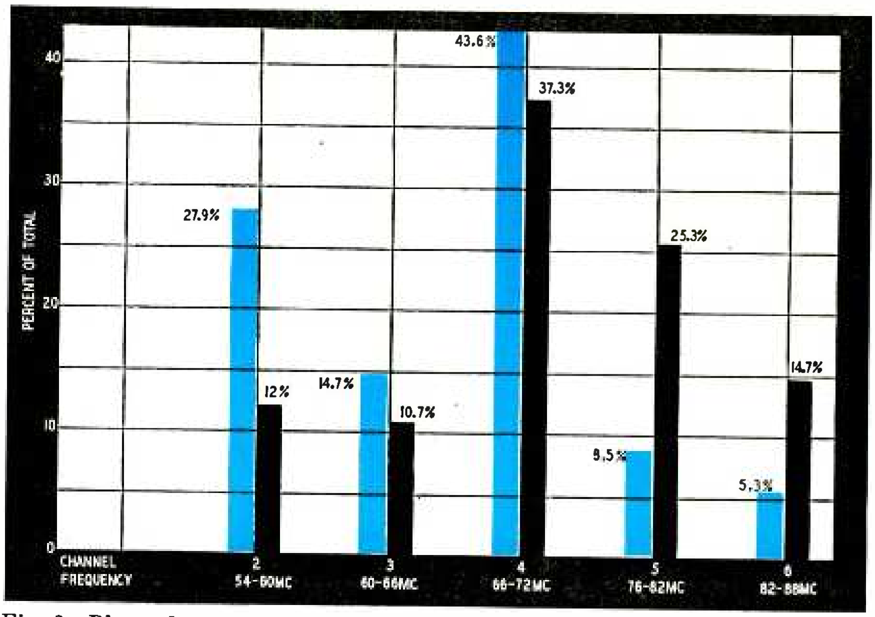


Fig. 2—Blue columns indicate reports, black columns stations, on each channel.

servation of weather conditions at the beginning of the dx season should furnish a few clues as to the periods when the biggest skip reception opportunities will develop. (The 27-day cycle becomes a useful rule-of-thumb.)

The variation from year to year seems to be a matter of degree. It is well known that there is more dx some years than others, but we're not sure just why. There is some indication that sporadic-E dx is more prevalent in years of low sunspot numbers (which should make 1952 a good year). Unfortunately the long interruption of amateur v.h.f. operation during the war years cost us our first chance to observe the workings of a complete 11-year solar cycle.

There are, however, some important compensations: Receivers and antenna designs are improving, particularly for the high bands. Transmitters are being licensed for higher effective radiated power, so signals will be carrying somewhat farther. New dual-triode front-end designs effect as much as 10 db improvement in the signal-to-noise ratio of some 1952 receivers. By using some really high-gain antenna arrays designed especially for the high channels we should be in for some dx surprises.

Of course there's also the prospect of u.h.f. TV. Barring unfavorable international or economic conditions we'll probably have some commercial exploitation of the u.h.f. band before 1952 is over. Many receivers, at first, will be makeshifts, incapable of making full use of the u.h.f. possibilities. But they will improve, just as today's receivers are so tremendously advanced over those of a few years ago. Activity in the u.h.f. field will be a bonanza for the inventive experimenter. It would not surprise me if next year's Television Issue of RADIO-ELECTRONICS included some u.h.f. dx reports!

LIST OF OBSERVERS

Alday, Carl, Lamar, Ohio
Allen, James P., Fayette, Miss.
Alverman, H. W., Toledo, Ohio
Anderson, Clarence, Burlington, Kan.
Anderson, John, Centerville, Iowa
Austin, G. R., Shownee, Okla.
Barr, Robert L., Canton, N. Y.
Bashta, William, Los Alamos, N. Mex.
Baxter, R. H., Logtown, Miss.
Beverlin, R. S., Toledo, Ohio
Billings, Ray A., Shira, Texas.
Boyce, Jack, Green Bay, Wis.
Brenner, Syd, Montreal, Quebec
Brewer, Elmo M., Crossville, Tenn.
Brookner, Stephen, Providence, R. I.
Brown, Pvt. Maurice, Camp Pickett, Va.
Brown, N. L., St. Johnsville, N. Y.
Buterbaugh, Ralph, New Philadelphia, Ohio
Callan, Olive M., Altoona, Pa.
Canning, L. A., Halifax, N. S.
Champlin, C. E., Lyons, Mich.
Christy, John, Sherman Oaks, Cal.
Colbert, Ralph, South Bend, Ind.
Coovert, Richard, Willard, Ohio
Culmer, Thad W., II, Robinson, Ill.
DeGroot, F. E., Salamanca, N. Y.
DePeter, R., Harrisburg, Pa.
Dixon, D. V., Deming, N. Mex.
Dull, Rex, Washington, D. C.
Dunn, John L., Springfield, Mo.
Durrell, Bruce, Knowlton, Quebec
Elwell, James L., Italy Valley, N. Y.
Everist, O. G., Easton, Ill.
Forshay, E. P., Amite, La.
Foster, E. G., Goodland, Kan.
Garvey, Walter H., Andover, Ohio
Germain, J., Opa Locka, Fla.
Gervais, Gerry, Moira, N. Y.
Glahe, Fred R., Cookeville, Tenn.
Goldmeister, Morris, Gaylord, Minn.
Good, Wendell, Erie, Pa.
Greynolds, Mrs. Earl, Adamay, W. Va.
Grout, Robert M., Medina, N. Y.
Groves, A. L., Brooke, Va.
Gummo, Mrs. Wm. L., Harrisburg, Pa.
Gunderson, Alfred, Savanna, Ill.
Hall, E. R., Miami, Fla.
Hapman, R. C., Portsmouth, Ohio
Harpole, Tony H., Clinton, Ky.
Haugland, B. W., Pequot Lakes, Minn.
Hiatt, Richard L., Portsmouth, Ohio
Higginson, Howard, Blytheville, Ark.
Holmes, Ira, DeLand, Fla.
Horn, Mac, Los Angeles, Cal.
Hubbell, Courtland G., Ashburnham, Mass.
Huff, Hadley, Leesburg, Ohio
Johnson, Ronald E., Webster, N. Y.
Jordan, Frank, Grand Rapids, Mich.
Kastner, R. W., New Braunfels, Texas
Keyser, R. W., Van Wert, Ohio
Knutson, George, Pequot Lakes, Minn.
Kravitz, Herbert, Atlantic City, N. J.
LaBrecque, Leon J., Lincoln, N. H.
Langlois, Darius, Ste. Marie Cte Beacue, Quebec
Laskaris, Leon, Warren, Pa.
Lazarus, Billy, Houston, Texas
Lofgren, R. L., Rush City, Minn.
Lundy, Robert, Findlay, Ohio
Malwitz, Harry A., Sheboygan, Wis.
Manning, G. N., Dalton, Ga.
Martin, Jack H., Port Credit, Ont.
Matz, Dr. Homer F., Ash Grove, Mo.
Maupin, Ted, Yuba City, Cal.
McCall, Leland W., Woodston, Kan.
McCallon, Lt. V. L., Atlantic, Va.
McLaughlin, C. F., Birmingham, Ala.
Meares, C. B., Enka, N. C.
Meyer, Julien, Benson, Minn.
Miller, Albert A., Palm Beach, Fla.
Miller, C. L., Chattanooga, Tenn.
Millott, Don, Hopkins, Minn.
Mitchell, A., Fallbrook, Cal.
Morrow, Jim, Brantford, Ont.
Murphy, William, Granite City, Ill.
Needy, W. H., Hagerstown, Md.
Newton, Reed, Greenville, Ill.
Nichols, Den, Mason, Mich.
Oyamburu, Francisco, Mexico City
Parrott, C. M., Houston, Texas
Pate, Rembert, Clio, S. C.
Patterson, N. Gentry, Sedalia, Mo.
Penc, Stanley J., Utica, N. Y.
Pigden, Gordon, Madoc, Ont.
Pyrow, Earl, Athens, Ga.
Randall, John, Hanover, Mass.
Rawley, David, High Point, N. C.
Robarge, R. J., Chicopee Falls, Mass.
Robbins, Howard L., Tampa, Fla.
Robinson, Clair, Rush City, Minn.
Robson, C. A., Cedar Rapids, Iowa
Roeder, Jack, Spencerville, Ohio
Rutledge, Jerry, Waseca, Minn.
Sagel, Leslie, Wildwood, N. J.
Schield, Richard K., Scranton, Pa.
Scherf, Paul, Andalusia, Ala.
Schmidt, W. H., Washington, D. C.
Scholey, W. B., Toronto, Ont.
Shreve, Joe, Flint, Mich.
Simons, Donold, Winsted, Conn.
Smith, Sterlin, Hampton, Va.
Smith, William, Strabane, Pa.
Sparks, Coy M., Alice, Texas
Spencer, Verne, Jeanette, Pa.
Staner, M. C., Tulsa, Okla.
Stanley, P. J., Minneapolis, Minn.
Stevenson, E. N., Decatur, Ill.
Stevenson, M. L., Wichita, Kan.
Storch, Clarence, San Antonio, Texas
Swanson, Earl, Rockford, Ill.
Symons, Arthur, Larksville, Pa.
Thomson, W. H., Peoria, Ill.
Troyan, James A., Youngstown, Ohio
Upholster, Russell, Latrobe, Pa.
Vail, Joe F., Indianapolis, Ind.
Vanderstelt, Paul, Muskegon Hts., Mich.
Van Hook, Donald, Tecumseh, Mich.
Ventolo, Joseph, Jr., Enon, Ohio
Wallace, W. H., Santa Anna, Texas
Word, John F., Jr., Norfolk, Va.
Whiteside, Richard, Corcoran, Cal.
Whitfield, L. A., Altoona, Pa.
Wilcox, W. W., Richmond, Va.
Willis, J. E., St. Petersburg, Fla.
Wilson, R. P., Toronto, Ont.
Wnukowski, P. P., Kingston, Pa.
Yeager, Claude C., Wichita, Kan.

TABULATION OF DX REPORTS BY STATION AND CHANNEL

Channel 2, 54–60 Mc., 9 stations

KPRC	Houston, Texas	71	WFMY	Greensboro, N. C.	14
WMAR	Baltimore, Md.	24	KTSL	Los Angeles, Cal.	11
WJBK	Detroit, Mich.	19	XETV	Mexico City	4
WCBS	New York City	19	XEW	Northern Mexico	3
K12XBN	Atlanta, Ga.	3			

Channel 3, 60–66 Mc., 8 stations

KMTV	Omaha, Neb.	22	WTMJ	Milwaukee, Wis.	7
WPTZ	Philadelphia, Pa.	18	WDTV	Pittsburgh, Pa.	6
WBTV	Charlotte, N. C.	17	WKZO	Kalamazoo, Mich.	3
WLW-C	Columbus, Ohio	13	PRF-3	Sao Paulo, Brazil	2

Channel 4, 66–72 Mc., 28 stations

WKY	Oklahoma City, Okla.	27	WOI	Ames, Iowa	6
WMBR	Jacksonville, Fla.	24	WRGB	Schenectady, N. Y.	6
WOAI	San Antonio, Texas	23	WBEN	Buffalo, N. Y.	5
WDAF	Kansas City, Mo.	21	WBZ	Boston, Mass.	5
KRLD	Dallas, Texas	20	WSM	Nashville, Tenn.	4
CMUR	Havana, Cuba	19	KRON	San Francisco, Cal.	4
XHTV	Mexico City	18	WNBW	Washington, D. C.	4
WMCT	Memphis, Tenn.	17	WNBK	Cleveland, Ohio	2
WTVJ	Miami, Fla.	16	KNBH	Los Angeles, Cal.	2
WTAR	Norfolk, Va.	9	WNBT	New York City	2
WTCN	Minneapolis, Minn.	8	WLW-T	Cincinnati, Ohio	2
WHBF	Rock Island, Ill.	8	WWJ	Detroit, Mich.	1
WBRC	Birmingham, Ala.	6	KDYL	Salt Lake City, Utah	1

Channel 5, 76–82 Mc., 19 stations

WBAP	Ft. Worth, Texas	17	KSL	Salt Lake City, Utah	2
KEYL	San Antonio, Texas	5	WEWS	Cleveland, Ohio	2
WOC	Davenport, Iowa	5	WABD	New York City	1
KPIX	San Francisco, Cal.	4	WTTG	Washington, D. C.	1
KTSP	St. Paul, Minn.	3	KSD	St. Louis, Mo.	1
WNBQ	Chicago, Ill.	3	KTLA	Los Angeles, Cal.	1
WAGA	Atlanta, Ga.	2	KPHO	Phoenix, Ariz.	1
WSAZ	Huntington, W. Va.	1			

Channel 6, 82–88 Mc., 11 stations

CMQ	Havana, Cuba	15	WFBM	Indianapolis, Ind.	2
KOTV	Tulsa, Okla.	6	WOW	Omaha, Neb.	2
WDSU	New Orleans, La.	5	WJIM	Lansing, Mich.	1

—end—

New Military Use for TV

THE 31-foot television truck on our cover represents possibly the boldest stroke in education by television ever made. The Army Signal Corps will use it to televise intricate military exercises and maneuvers, transmitting the signals back to base where they can be viewed on television screens by much larger numbers than could see them on the spot.

Not only can instruction in field problems be revolutionized by actually televising them on the field, but the camera will make visible "all the little things you wouldn't see if you *were* there," as one fan put it when describing a televised football game. Instruction can be more intensive as well as extensive.

The "caravan", as it has been called, consists of four special 10-ton 6-wheel coaches, each 31 feet long. The first contains the camera pickup and transmitting unit. It is equipped with three complete TV field camera chains, a microwave transmitter for transmitting the video signals, and a 45-watt FM transmitter for the sound signals.

The second mobile unit contains the power supply for the transmitting equipment. This consists of two 15-kva gas-driven generating units, each of which supply 120/208, 3-phase, 4-wire, 60-cycle power. One of the generators is designated for standby use, or for supplying power to special lighting equipment for illuminating the scene to be televised. By a switching arrangement, the truck batteries are able to supply power to the two-way radio communication system when the caravan is in motion and the generators are not in use.

Receiving coaches

The receiver-display unit is the third coach in the caravan. In addition to housing the FM and microwave receiving equipment, it contains ten 16-inch picture monitors, a 16-mm TV projector and film camera, slide projector, and a large-screen television projector.

This equipment is so interconnected that TV picture and sound received by microwave can be switched to the ten monitors, or if desired, film can be used on the 16-mm TV projector and the picture and sound fed to the monitors or to the large-screen projector, which can be set up in a nearby building or shelter. The monitors are 16-inch TV receivers modified to receive only the video signal. Individual cables 500 feet in length for the ten receivers are stored on reels installed inside the vehicle. During setup, these cables are pulled out through small doors in the side of the coach and connected between the receivers and a distribution box. Two cables are required for each receiver. One carries the audio and video, the other is an a.c. power cable. Special dollies stored in compartments can be quickly attached to the receivers for mobility over the viewing area.

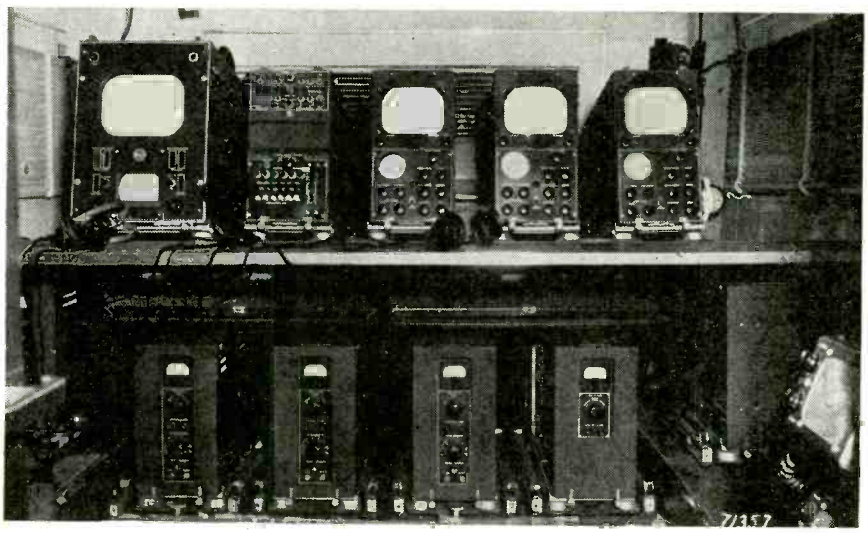
The fourth coach contains a 15-kva gas-engine generator of the same type used in the transmitting unit. This generator supplies a.c. for the receiving equipment.

Microwave visual system

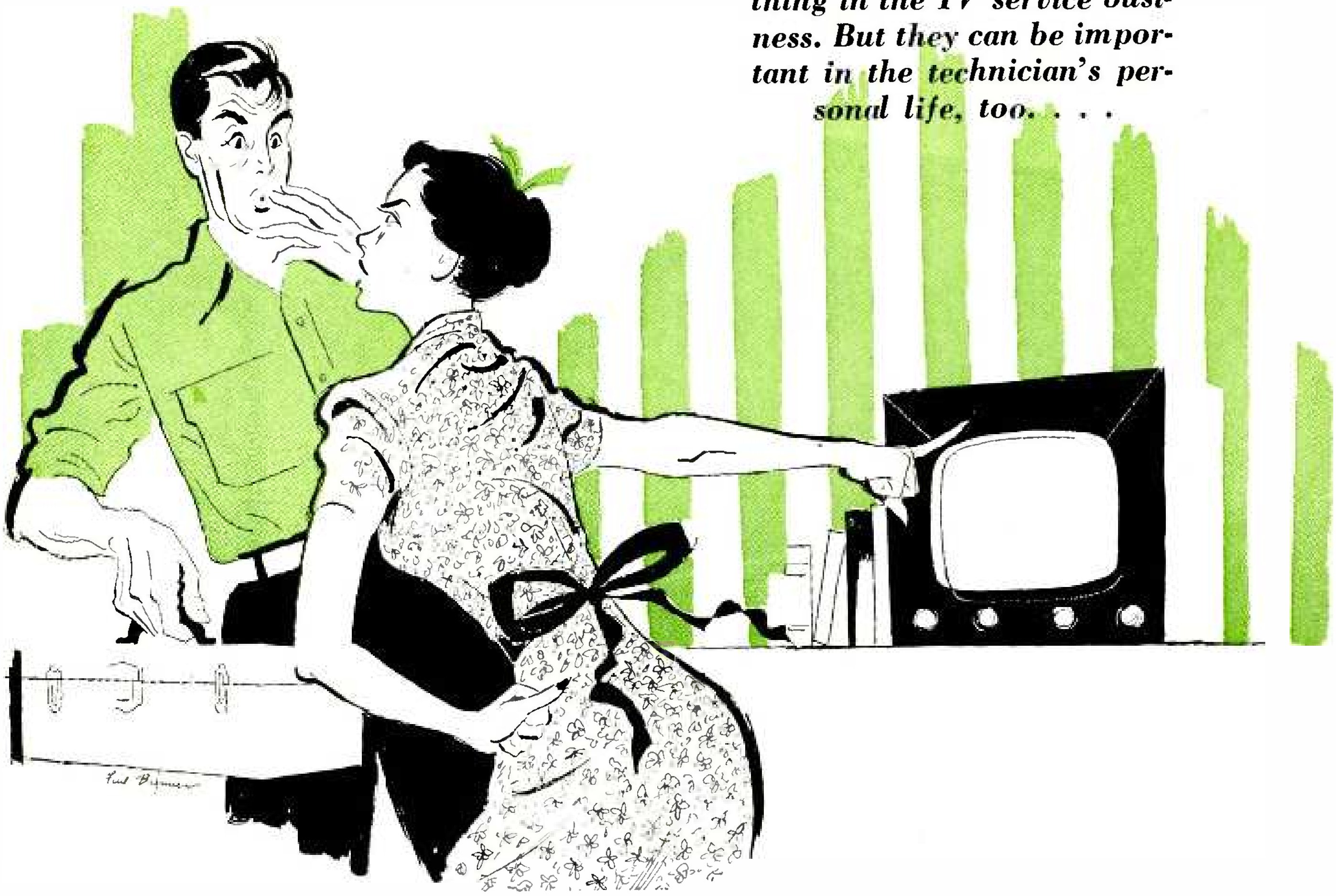
The RCA microwave transmitting and receiving system which handles the visual part of the TV signal is identical to that supplied by RCA to TV broadcast stations for studio-to-transmitter link and relay purposes. The 4-foot parabola provides a gain of 5,000 which —multiplied by the 100-milliwatt output of a klystron oscillator which feeds it—provides an equivalent power output of 500 watts. Since a 7,000-mc frequency is used, transmission is limited to a line-of-sight path. The parabolas at the transmit and receive positions are beamed toward each other to provide a high-intensity signal path. Transmitter and receiver units are mounted directly on the transmitting and receiving parabolas. In addition to these, control units for the transmitter and receiver are rack-mounted in the coaches. The control unit for the transmitter contains a video amplifier and modulator which frequency-modulates the klystron by varying the voltage on the repeller plate.

—end—

Right—The desk mounted units in the transmitting coach are from left to right the master monitor, field switcher, and three field-type camera controls. Below these are the three field-type power supplies and a sync generator. Below—Transmitting truck with parabolic reflector and its companion power generating equipment truck.



Customer relations are certainly the most important thing in the TV service business. But they can be important in the technician's personal life, too. . . .



The Toughest Customer

By GUY SLAUGHTER

RADCLIFFE Bowman Junior surveyed the forest of antenna masts and guy wires dejectedly, shivered in the freezing wind, and softly cursed the fate that put him up on other people's roofs in the dead of winter. Then he singled out one of the antennas that looked unfamiliar to him, and eyed it closely.

"Nope," he said aloud. "Not mine." He followed the twisting ribbon of its transmission line across the roof to the parapet running around its edge, and leaned far out to look down. The transmission line entered a window several stories below, and he took a bearing on it. "Third window from the left," he muttered, "four stories down. That'd be the fourth floor." He picked up his tool kit and headed for the roof door, hunching up against the icy wind.

The third window from the left on the fourth floor proved to belong to apartment 4D. "Miss Nancy Hammond," the little card said. Rad leaned on the doorbell, hoping she wouldn't be an unreasonable old hag. When the door opened he saw she was neither old nor haggy, and she didn't look unreasonable. She looked, instead, young and luscious. Her eyes were warm and her figure precisely filled her swishy housedress. She cocked an inquiring eyebrow at him.

"I represent Bowman Radio Service," Rad said in his best business voice. "I'm investigating the complaints of several of my customers here in the Brumley Apartments."

"How nice for them," Nancy Hammond said, her smile growing wide. "And there's something I can do?"

"Yes," Rad said, "there *is* something you can do."

"Well, come in." She swung the door wider. "Tell me about it."

"How long have you had your TV set?"

"About a week." She pursed her lips thoughtfully. "But if you're looking for business I'm afraid I haven't any. My set works fine. You can leave your card, though, and if I ever do have trouble I can call you."

"Thanks," Rad said. "But that isn't what I had in mind. Is your picture okay during the daytime?"

She shrugged. "I never use it during

the day."

Rad nodded thoughtfully. The interference came only at night, according to his complaint cards; and it had begun just about a week ago.

"Would you mind turning your set on?"

"Not at all." She swished over to the disguised-plywood console, flipped a knob, and smiled back at him over her shoulder. "It takes a minute to warm up," she confided.

"Yeah, I know. Have you got a telephone?"

She pointed at the handset on the little table near the door, and a look of puzzlement crossed her features.

"Thanks," Rad said. He flipped one of the complaint cards from his pocket, found a number, dialed it. The handset buzzed in his ear, crackled, and then a voice grunted at him. "This is Bowman Radio Service," he said into the mouthpiece. "Is your TV set on now? Well, turn it on, will you? Yes. To the channel that's been giving you trouble. Yes, I'll wait." He turned to the girl. "Will you switch to the channel you use most, please?"

The girl frowned at him in mystification, shrugged, and flipped the selector switch. A swarthy-faced tenor filled the screen with teeth and the room with an aria. Rad put his finger to his lips, and she turned the volume down to a mere whisper.

"What's this all about?" she asked.

"What have you got?" Rad spoke into the telephone. "Wavy lines, huh? Sort of a moving herringbone suit? Like a rumpled pair of tweeds? Yeah. Well, watch now." He put his hand over the mouthpiece. "Turn it off, please."

The girl, looking more mystified than ever, snapped the switch, and the screen went blank.

"How now?" Rad asked the telephone. "Yeah? Okay, thanks." He hung up, and turned to the girl again. "Your set radiates," he mourned.

"Huh?"

"Your TV set. It radiates a signal. It's lousing up my installations. I've got nine sets here in the building, and yours sabotages all of them."

Nancy Hammond's demeanor changed abruptly. Her chin thrust out belligerently, and her hands went to her hips. She was breathing hard, and from her eyes lightning flashed. For an instant Rad thought he heard the ominous rumble of rolling thunder.

"Just a darn minute," she was saying. "Who do you think you are, coming into my apartment like this and accusing my set of . . . of . . . of whatever you're accusing it of? It's a perfectly good set, and I get a good picture, and . . . and I think you're mean!"

She was advancing on him now, the lightning flashing more dangerously. He put up his hands and backed toward the door.

"Wait a minute," he said hoarsely. "Don't get me wrong. I . . . you . . . it's not your fault. It's just that it's a cheap set. You got gypped! You can't. . . ." He broke off as she seized a bronze bookend from atop a handy table and heaved it at his head. He ducked, whirled, grabbed his tool kit, and ran for the door. Something heavy splintered the panels as he slammed it shut behind him. He raced down the hall to the elevator, dove inside the cage, and slid the gate closed before he dared take a breath. He fumbled in his pocket for his handkerchief, and mopped his sodden brow. "Wow!" he said aloud. "Is that dame a heller!" And then a mental image of her formed in his mind, and he sighed deeply. "But berrother, what a dish. . . ."

He pondered his dilemma all the way back to the shop. Here was a girl—and what a girl—with a bargain TV set that radiated like WLW and fouled up nine of his installations. The logical approach was to convince her of the fact, and then work the set over; shield the front end, maybe install a booster, whatever it took to kill the radiation. But judging from the lightning in her eyes, the bookend she had thrown, the heavy object that had all but broken the door down behind him—she wouldn't convince. He sighed, manhandled the truck into a parking place in front of the shop and climbed out, shaking his head wearily.

Bill Samples, his big, red-headed bench man listened to his troubles sympathetically. Then he waved a hand.

"A tough customer, huh?" He shrugged. "Call her up. Reason with her. Threaten her with the FCC if you have to. She can't throw anything at you over the phone line."

"Yeah," Rad breathed happily. "Sure. Bill, you're a genius. How'd you happen to think of that?"

"Aw," the red-head said modestly, turning back to the bench. "It just came to me." He dove into an upturned chassis and began snipping wires.

Rad went through the phone book feverishly, stabbed the number with a shaking finger, and dialed it wrong twice before he got the call through. His eagerness was natural enough, he told himself. He was merely anxious to serve his nine customers. The fact that the girl was a knockout had nothing to do with it. Nothing at all!

"Hello," he said cautiously into the mouthpiece when the click came through. "This is Radcliffe Bowman Junior, of Bowman Radio Service. Remember me?"

"Of course," she said softly. "I'm sorry I lost my temper, Mr. Bowman. You see I. . . ."

"Think nothing of it," Rad said magnanimously. "All my fault." He gulped, swallowed. "And call me Rad."

"Thank you, Rad," she purred. "You're sweet."

"About your television set," he continued. "It does radiate, you know. Something fierce. I. . . ." He paused, listening to a pretty dead wire. Muttering under his breath, he dialed the number again and talked fast when the click sounded. "Would you like to go to a movie with me this evening? I mean. . . . You would? I'll pick you up about seven? Okay. Bye." He cradled the phone and stood a minute lost in thought.

Bill Sample's sarcastic voice broke into his reverie. "Fine way to out-maneuver a tough customer, that is," he snickered. "Boy, what a general you'd make."

"If you can't lick 'em, join 'em," Rad countered. "It was an inspiration, regular fifth column stuff. I'll get to know her better, and then I can talk her into letting me work her set over."

"Nuts," the bench man drawled. "If you'd handled her right in the first place all this wouldn't be necessary. Where's your customer psychology? You know you can't tell a person his stuff's no good, especially a *dame*." He giggled. "Boy, you were really usin' the old brain when you called her set a cheapie."

"Yeah," Rad agreed. "But I can recover that fumble. If I take her out tonight she can't play her TV set and those other nine people *won't* be bothered with the interference." He nodded thoughtfully. "Yeah . . . I'll keep her out 'til after the stations are off for the night."

It was long after the final sign-off of the latest-running TV station in the area when Radcliffe Bowman Junior said his final goodnight to Nancy Hammond. The next morning when he got down to the shop he felt fine.

"Hi, General," Bill Samples said drily. "What a skirmish you must've had last night." He leered at Rad, winked owlishly. "I haven't heard you whistling like that since the day we got the Hotel Griffin installation contract."

"It's a nice day," Rad said cautiously. "I feel good. Any reason why I shouldn't whistle?"

"Yup. Seven reasons." He held up a handful of complaint cards. "Got seven calls from that apartment house so far this morning. There's still two to go—but it's early yet."

"Go on," Rad said incredulously, "you're kidding."

"Nope. Same old story. Interference patterns lousing up all seven sets most of the evening." His cheery smile irked Rad no end.

"But . . . but she wasn't home," Rad said. "How could. . .?"

The red-head shrugged, his grin growing.

"Maybe it ain't her set after all."

"It's her set all right," Rad insisted. "I'll bet she forgot to turn it off when I called for her." He nodded sagely. "That must be it. I'll check it myself, tonight."

"Tonight?" Bill echoed, his grin fading.

"Tonight," Rad said firmly.

Radcliffe Bowman Junior floated through the evening in a rapturous daze, smugly reflecting that while he was enjoying Nancy's company he was serving the best interests of his customers as well. His nine clients in the Brumley apartments would be pleasantly entertained by the programs of their choice, unmarred by lines or patterns. While Nancy was getting her coat from the closet he had scrupulously made it a point not only to turn off her set, but even to pull the power plug from the wall receptacle so that there would be no mistake. Furthermore, he intended to keep her out until the programs ended—strictly for his customers' sake.

The next morning he couldn't believe his eyes when he walked into the shop and saw Bill Samples gleefully waving aloft a handful of complaint cards for his inspection.

"Hi, General," Bill leered, "the war ain't over yet."

Rad stared at the cards belligerently, grabbed them, and leafed through them. There were eight of them today, all from the Brumley Apartments. Every blessed one complained of severe and lasting interference last night. Five of the cards bore notations to the effect that Bowman Radio had better either fix their sets or come and get them. Rad reached for a handful of hair, found it, and tugged wildly.

"It can't be," he moaned. "I checked every other possible source in the building, and her set is the one. Besides I didn't take her home 'til long after midnight."

"Maybe she's got company," Bill leered. "Maybe the iceman cometh in and uses her set while you're out with her."

"Yeah," Rad said doubtfully. "Maybe an uncle or a cousin. . . ."

"Or a boy friend," Bill finished. "Got a date tonight?" Rad nodded. "Fine," the red-head continued, winking, "I'll head up there while you two are out and see who's home. It'll be sort of a flanking strategy. Okay, General?"

Rad nodded, wordlessly.

"And if someone *is* home," the bench man went on smugly, "*I'll* use customer psychology." He winked again. "With the right approach I'll be able to look the set over and do whatever I want to do, no questions asked."

"The cousin or uncle or whoever it is will heave you out," Rad said. "It's a tough family, if they're all like Nancy." Then he set his jaw and clenched his fists. "I'll win this battle myself. I'll put it up to her tonight. I'll tell her what would happen if I had to take back nine TV sets and refund the customers' money. I'll convince her she should cooperate and let me iron out the trouble." He took a deep breath. "I think we're well enough acquainted now." He looked at the floor, flushing modestly. "I figure she's pretty much interested in my welfare."

"Forget that angle," Bill Samples said cynically, shaking his head. "'She's a dame, ain't she?"

"Yeah," Rad breathed enthusiastically. "And how. . . ."

The evening had gone well, so far. The movie had been good, the popcorn dripping with butter, and here in the restaurant the juke box was moaning soft music as they chomped contentedly at their hamburgers. Radcliffe Bowman Junior finished his, automatically noting the juke's hum-level, wondered how long those filters had been in and wiped his mouth on a paper napkin. He drained that last drop of his coffee, and cleared his throat.

"Uh, Nancy," he coo-ed. "Uh, there's something I've been meaning to say."

"Yes?"

"I. . .well, the fact is, your TV set radiates," he began diplomatically.

"*Yes?*" Something in her tone sounded a little alarm in the back of his head, but he ignored it and plunged on, staring at the table cloth.

"I've got nine customers in your building and if you don't let me fix your set they'll make me take their sets back, and there's really nothing wrong with them. Nine TV sets cost an awful lot of money, and. . . ." He broke off, sensing her movement, and looked up. Nancy Hammond was standing up, her chin outthrust, her hands on her hips, breathing heavily.

"So that's why you've gotten so chummy," she snapped. "I should have known. You've been dating me every evening just so I couldn't play my set. And you're the one who unplugged it last night. My father thought it was broken when he came home from work and if he hadn't just happened to notice the plug out he wouldn't have been able to use it all evening!" Her voice shrilled higher and higher, and every customer in the place started goggling at them.

"I. . .I. . . ." Rad began, and then he saw her grab the heavy glass ashtray off the table and hurl it at his head. He tried to duck. Thunk. Something exploded inside his brain, and he was up on a high roof in a cold wind, dodging under guy wires, reaching for a mast, twisting it with a pipe wrench so that the dipole high above his head swung forty-five degrees around. Then he fell off the roof, drifting slowly down past hundreds of windows out of which hundreds of beautiful Nancy Hammonds winked invitingly at him, and landed on his head in a soft, warm snowdrift.

He opened his eyes, looked foggily about, surprised to find himself still in the restaurant, stretched out on the floor. His head thumped like a jungle tom-tom, but he didn't mind—it was cradled in a soft lap, and above the lap, next to his ear, there rose a waist, and above the waist there was a face, and in the face the eyes were brimming with tears. A voice floated down to him.

"Oh, Rad," it was saying between sobs. "I'm so sorry I hurt you. I lost my temper when I found out you didn't really like me for myself. . . ."

"Nonsense!" Radcliffe Bowman Junior said gallantly. He started to sit up, and on second thought, settled back into the lap again. He flicked a hand at the people crowding around them. "Beat it! Can't a couple have any privacy around here?" The crowd dispersed, and he looked up into the face again, making his voice come out stern and determined. "I'll not have any more of these childish temper tantrums, do you hear? And you're not to throw things, ever again!"

"Yes, Rad," Nancy Hammond said, and her voice was tiny and obedient. . . .

"Hi, General," grunted Bill Samples dispiritedly, holding one hand over his left eye, when Radcliffe Bowman Junior entered the shop the next morning. "We lost the war."

"We did?" Rad murmured airily.

"Yup. Her old man's the bozo that plays the set at night. He lives with her, and he won't listen to reason. Most unreasonable man I ever saw. Used my best customer psychology, too. I told him he'd won a booster in a drawing we'd held, and tried to install it for him, figuring it would kill the radiation by isolating the antenna from the front end of the set." He sighed deeply. "But the old guy wasn't having any. Said it took extra current, ran up the light bill, and didn't help the picture anyway."

"Too bad," sympathized Rad.

"Yeah, but that ain't all. I got mad and told him he had a bargain set that radiated, and he bopped me. See?" He dropped his hand to display a beautiful shiner neatly outlining his left eye, and shrugged disconsolately. "He's a toughie."

"Yeah," Radcliffe Bowman Junior said cheerfully. He paused. "You could have gone up on the roof and rotated the antenna until the signal pick-up fell off, and *then* brought in your booster." He cocked a quizzical eyebrow at his bench man.

"Hey!" Bill said admiringly, a sickly grin showing on his face. "Good strategy, General. Then the old man could see an improvement in his picture, and he'd be tickled to have the booster."

"Roger," confirmed Rad. He sighed contentedly. "But you can forget the booster business."

"How come?" The red-head's grin faded.

"I met Mr. Hammond last night, too. Along about midnight. And I twisted his antenna around when I left. As soon as he calls up tonight complaining of weak signals and bad pictures, you rush him out a new set to use. Bring his old one in. And don't forget to re-orient the antenna when you get the new set hooked up."

"What makes you think he'll call *us?*" Bill demanded, mouth agape.

"He'll have to. I left our card on the table, and stole his phone directory."

"Even so," Bill persisted, "I thought he was mad at Bowman Radio."

"Not any more. All is forgiven. We won the war, Corporal. Strategic tactics did it." He paused, smiled condescendingly, went on. "We'll loan Mr. Hammond a new set, and you can work over his old one while I'm gone. A little front end shielding ought to do the trick."

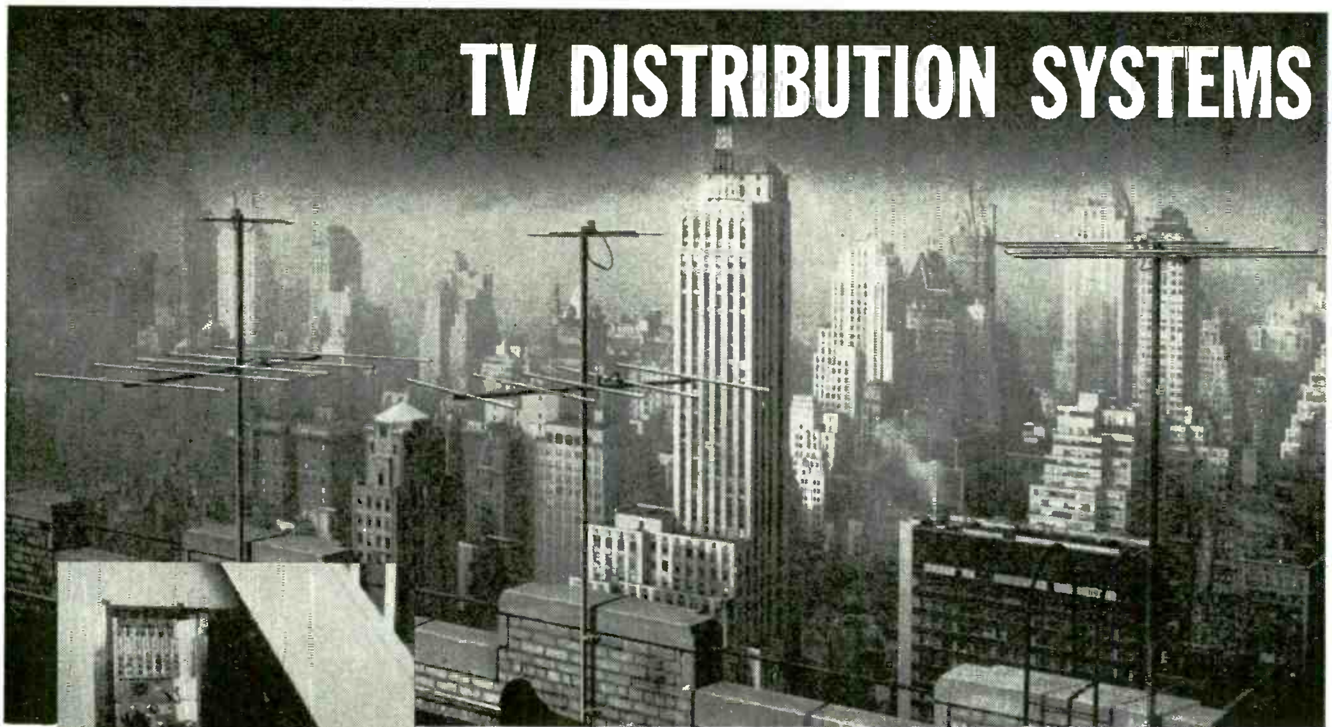
"Yeah," Bill Samples said uncertainly. "Where. . .where you going?"

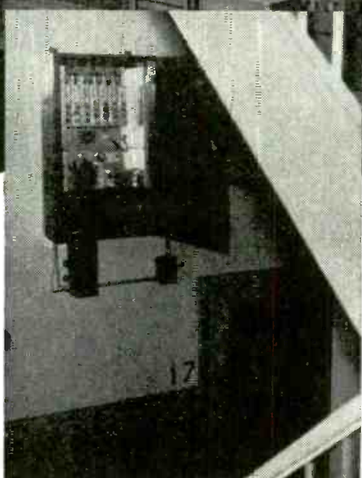
Radcliffe Bowman Junior bestowed a look of pity on his slow-witted employee, and dropped one eyelid in a slow wink.

"If you can't lick 'em, join 'em," he said expansively. "To City Hall to get a marriage license, bonehead. Where did you think?"

—end—

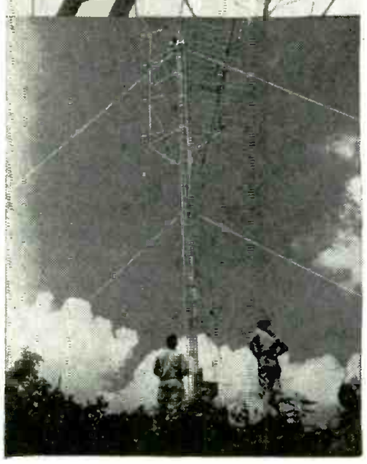
TV DISTRIBUTION SYSTEMS



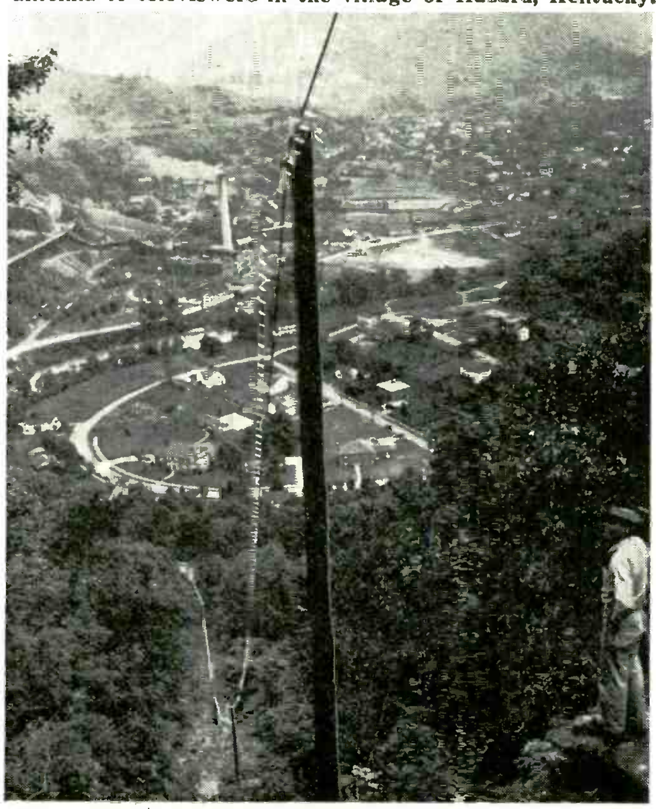


These installations, bringing TV to "hidden valley" communities and the steel-shielded and interference-ridden caves of urban cliff-dwellers, are becoming increasingly important to the industry.

Above — Part of antenna system on the Hotel Waldorf-Astoria, as seen against New York's skyline. Note that lead-ins come down through mast and into conduit, making this a completely shielded installation. Below — Part of 3,000 feet of Gonset line which brings signals from a 1,000-foot-high antenna to televiewers in the village of Hazard, Kentucky.



Top — Sub-system amplifier on the 17th floor of the Hotel Waldorf-Astoria. Middle — Tapping subscriber's line off the feeder in a community TV system. Bottom — Mountain-top antenna of the Hazard, Ky., TV distribution system.



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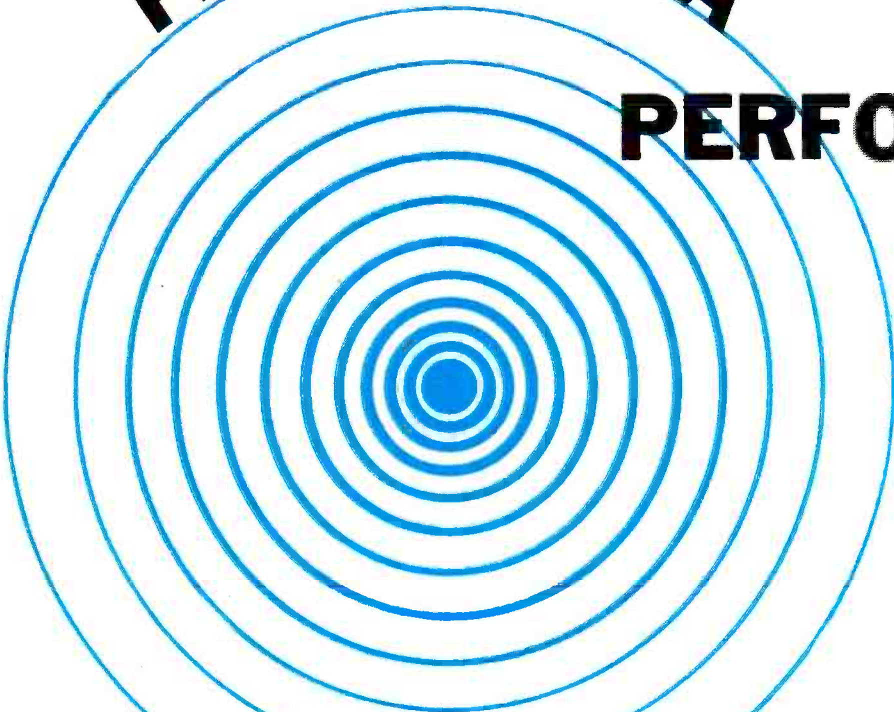
FRINGE AREA PERFORMANCE



By EDWARD M. NOLL

FRINGE-AREA performance is judged on the basis of four considerations:

Gain and sensitivity of antenna system and receiver.

Clarity and minimum background noise in picture.

Rejection of signal interference.

Influence of impulse and signal interference on synchronization.

Not so long ago gain and sensitivity were the only major concerns in fringe-area reception. The appearance of a picture on the screen accompanied with a very tolerant attitude on the part of the viewer as to how often the picture would flop, tear, and become obscured by noise constituted acceptable fringe-area reception. Thanks to extensive research on this problem developments that improved fringe-area results rapidly emerged—higher-sensitivity tuners and antenna systems, peaked alignment, horizontal sync control systems that minimized picture tear, fact-acting a.g.c. systems that minimized influence of impulse noises (particularly aircraft flutter). Additional improvements have been made recently in the form of low-noise tubes and amplifier circuits, and better vertical-deflection circuits with improved noise immunity. A more complete knowledge of the factors which improved antenna system and booster performance has contributed markedly to this over-all advance. How do these developments affect fringe-area performance?

Snow-effect

Snow in a fringe area picture is caused by high noise level in the tuner or booster, inability to apply enough signal to receiver input to permit signal domination over noise (antenna system or fringe propagation conditions), antenna system with a high noise level, or one that through mismatch or reactive effects increases the noise output of booster or tuner.

To improve the quality of a picture it is necessary to increase the signal level and at same time keep the noise level at a minimum. The following suggestions, singly or in combination, help to improve the fringe-area picture.

1. Choose a receiver that uses a low-noise-level tuner. Modified cascode triode types using the new 6BK7 or 6BQ7 dual triodes have excellent signal-to-noise ratios. Fig. 1 is a diagram of a commercial circuit using these tubes.

2. Choose a booster with low-noise-level features. A high-noise-level booster used with a low-noise-level receiver results in a stronger signal but more snow in the picture. Cascode and push-pull triode types are preferred.

3. For reception of a limited number of channels in far fringe areas, an antenna-mounted booster permits signal-to-noise improvement because the signal dominates transmission-line noise pick-up and the input noise level of tuner.

4. Use an antenna system of high gain and low noise content. Performance of the antenna should be based on the channel or channels desired. For single-channel operation (or perhaps reception of two or three adjacent channels) the Yagi is a preferred type. When wide-band performance particularly on low-band channels, the Directronic, fanned, double-v's, or conical types, though they do not have peak gain of the Yagi, are preferred in fringe operations.

Co-channel interference

A very trying fringe problem in many areas is co-channel interference (two stations on same channel). Solution to the problem, or at least a reduction of the interference, is strictly an antenna-system problem.

1. Use a high-gain single-lobe antenna such as the Yagi to minimize sensitivity of the antenna in all directions except the desired one.

2. If co-channel interference enters from back of the antenna, screening can be useful. The screen should be at least 3/2 wavelength square to be effective at all.

3. If co-channel interference arrives from almost the same direction as the desired signal, the collinear arrangement of the Yagis can be used to sharpen the horizontal sensitivity pattern, as suggested in Fig. 2.

4. If interference is on a high-band channel, avoid use of antennas that have multi-lobes on these channels (low-band cut elements).

5. Use a length of tin foil on the transmission line. Adjust its position for best relative phasing between the competing signals by observing the screen with co-channel interference present.

Adjacent channel interference

Still another difficult problem to solve is adjacent channel interference. This is particularly trying in an area where the desired station is weak and the adjacent channel station very strong. Such is the case in the area northeast of of Philadelphia. In this area, reception of channels 2 and 4 from New York is hampered by a strong Philadelphia channel 3; channel 5, by a strong 6; and channels 9 and 11, by a strong 10.

There are two ways that an adjacent channel can cause trouble. A signal on a given channel can be interfered with by the picture carrier of the next highest channel or the sound carrier from the next lower channel. For example, channel 4 is affected by channel 3 sound and channel 2 by channel 3 picture signal.

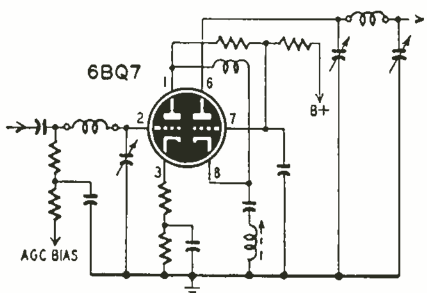


Fig. 1—The cascode r.f. amplifier.

These factors can be minimized by following these instructions:

1. Adjust adjacent-channel sound traps of the receiver under actual reception conditions. For example, set receiver on channel 4, and adjust traps for minimum sound bars and very best picture. Needless to say, if the tuner is not properly aligned or the i.f. strip has no traps, elimination of adjacent-channel interference is greatly hampered.

Due to the wide-band nature of picture carrier interference (channel 3 picture on channel 2) its elimination is difficult. Adjust trap slowly as channel 2 picture is observed. It is advisable to switch back to channel 3 frequently and observe picture resolution. If trap adjustment is carried too far it disturbs the low-frequency end of the i.f. amplifier response and can put broad echoes in the picture.

2. Choice of a proper antenna will minimize adjacent-channel sensitivity. For example in one test using a channel 2 Yagi, the received signal was strong but interference from channel 3 was severe. When a single fan and reflector was used on channel 2, the channel 2 signal was weaker but interference from channel 3 was reduced and a better over-all picture was obtained. Upon consulting an antenna dimension chart it was found that a channel 2 cut director has the same length as a channel 3 cut reflector. Consequently, a channel 2 Yagi would show good sensitivity in the opposite direction on channel 3 and would undesirably boost adjacent-channel sensitivity. (Increasing the length of the director by 5% and decreasing the spacing between reflectors by 10% should narrow the antenna bandpass and attenuate the higher frequency adjacent-channel response.—*Editor*)

Local oscillator interference

Local oscillator interference in fringe areas is particularly objectionable because desired signals are weak and local oscillator interference levels remain unchanged. Again its elimination is primarily an antenna problem, although a direct solution would be the installation of traps or a booster at the offending receiver.

1. Use an antenna with a highly directional pattern in the desired direction. A switched-beam or motor-rotated antenna can be oriented away from interference.

2. If the interference comes from the same directiòn as the desired signal, a change in antenna height often helps.

3. The added selectivity of a booster and tuning the transmsision line with stubs or tin foil helps the signal to override interference.

4. An antenna-installed booster can reduce the effects of local oscillator radiation pickup by the lead-in.

Vertical instability

The modern television receiver has high sensitivity and an improved horizontal synchronization system. In fact, impulse noises and interference are likely to affect the vertical synchronization,

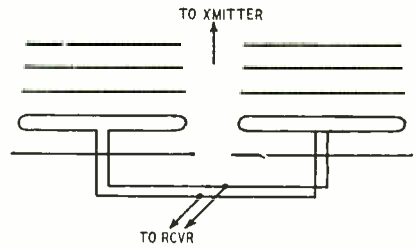


Fig. 2—Colinear antennas are used to greatly increase horizontal directivity.

with consequent flipover and loss of interlace, more readily than other sections of the receiver.

1. Use stacked antenna systems because they exhibit weak sensitivity to ground level pickup. If noise sources are very close by, use well-shielded and properly routed transmission line.

2. The added selectivity of a booster can make a signal dominate the noise level to a greater degree—particularly an antenna-mounted installation. With the newer, more sensitive receivers a fine picture can be obtained without any booster if a.g.c. is set at its least active position. This method of operation permits a good picture but does make the receiver more vulnerable to impulse noises, when present, due to the weaker a.g.c. action. Use of a booster, although it does not appreciably improve the picture, makes the receiver less susceptible to impulse noises because a.g.c. action can be turned up and contrast control reduced when receiving stronger signals.

3. Use a receiver with two or three sync amplifier-separator stages, multisection integrator network, and vertical retrace line suppressor circuit.

—end—

NEW IDEA IN TV ANTENNAS

A new and highly original television antenna was exhibited at the 1951 Cleveland show of the National Electronic Distributors Association by Fretco Television Company, of Pittsburgh, designers and manufacturers of special antennas. Because of its numerous unique features, the new antenna merits description in considerable detail. The sales engineer of Fretco explains it as follows:

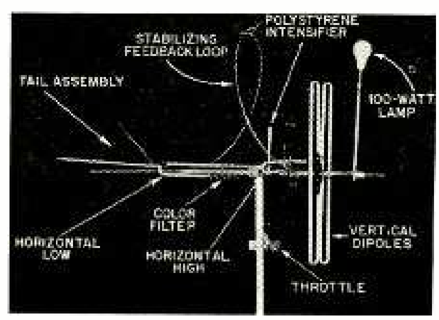
"This super outfit features a polystyrene intensifier rod that doubles the signal every time the signal passes.

"The expert amateur signal getters in Pittsburgh found out that a light bulb hooked up with an antenna would give a lot more signal, so we incorporated that idea. The light also keeps airplanes from landing on the antenna.

"Two folded dipoles have more gain than one, so the antenna has two vertical dipoles and one horizontal high and one horizontal low. The tail assembly was patterned after the P80 *Shooting Star*. It has a vertical stabilizer to stabilize any signal that happens to come by. Naturally *Fretline* is used to transmit the signal from one part to another. For strong-signal reception the antenna is equipped with a spigot or throttle to turn the signal down. For normal cruising it is recommended that the spigot be closed. 200 miles or more from the station, open it a little.

"We are now working on a new and improved model that will do everything—manufacture its own signal, show the picture—this might even do away with television receivers!"

—end—



SERVICING HORIZONTAL LOCKS

By MATTHEW MANDL

WHILE the latest type of horizontal lock systems use fewer tubes than the older ones, the circuits are still complex and give rise to many of the troubles which occur in television receivers. Common defects are:

Horizontal pull or weaving
Foldover
Intermittent instability
Total horizontal sync loss
Picture shift
Inadequate hold control range

These faults are usually caused by changes of parts values and tube characteristics, slight maladjustments. If the system was properly adjusted, the horizontal hold control range is usually adequate for quite some time and only decided tube aging and part value change would prevent good synchronization.

The older "synchrolock" and "phase detector" systems used several tubes to secure good lock, and adjustments were rather simple. Modern systems use fewer tubes but adjustment procedures are much more exacting, and complex, and only by critical alignment procedures will stable sync be secured.

The two systems generally used with new receivers are the phase detector system and the synchroguide method. The synchroguide system is by far the most popular and used in numerous receivers including RCA, Admiral, DuMont, Hallicrafters, and a host of others. The primary advantage of the synchroguide is that only a single 6SN7-GT tube need be used for both the control circuit and the sweep oscillator.

The phase detector system is used by Westinghouse in a number of their models, as well as by Motorola in their later receivers. While slight variations exist among different models, the one shown in Fig. 1 is typical of the phase detector system and represents that used by Motorola in their TS-216 chassis.

The phase detector consists of one-half of a 6SN7-GT tube and compares the sync pulses from the sync clipper with the sawtooth developed in the horizontal output. By such phase comparison a correcting voltage (which restores proper phase relationship) is generated and applied to the grid of the horizontal oscillator.

The oscillator is a conventional cathode-coupled multivibrator with a stabilizing coil (L16). This stage also uses a 6SN7-GT tube and the second triode section feeds the horizontal output tube. The waveshapes shown in Fig. 1 apply to any such system, though relative voltage amplitudes will vary from one manufacturer to another.

In order to facilitate adjustment of the horizontal sweep system a test socket is provided on the rear of the receiver chassis. (Several other manufacturers are including test terminals on their receivers for easy accessibility and rapid checking.) The test socket shown in Fig. 1 provides:

A simple means of shorting the oscillator coil during lock adjustments by putting a jumper from pin 1 to pin 6.
A check on B+ voltage (pins 1 or 8).
Provision for checking video output (pin 7 connects to the output of the video amplifier).

Phase system alignment

If instability is present or if the hold control range is inadequate, the entire system should be adjusted. The procedures are not as complicated as with the synchroguide; for the phase detector shown in Fig. 1, the following are typical step-by-step adjustments:

a. Use a jumper to short out the oscillator coil (L16).
b. Adjust horizontal centering control so that the right-hand edge of the raster is visible.
c. Adjust horizontal hold control to the approximate middle of its range and note width of the blanking bar at the right edge of raster.
d. Remove jumper from oscillator coil.
e. Adjust horizontal oscillator coil slug until the blanking pulse which now appears has the same width as was seen in step "c" above.
f. Vary hold control and change stations to check general stability. Repeat above procedures if necessary.
g. Readjust centering control for proper picture masking.

Modern synchroguide

The synchroguide type of horizontal lock systems is not strictly new, but like the phase detector system previously described, the latest versions are simpler and have greater stability.

A typical modern version of the synchroguide is shown in Fig. 2. It is the system used in the latest Hallicrafters receivers (Models 815, 822, etc.). This circuit is basically identical to those used by many other manufacturers.

In the synchroguide the first triode section of the 6SN7-GT tube acts as the control tube. The second section is a conventional blocking oscillator circuit using a transformer for plate to grid feedback. At the transformer tap a coil and capacitor (C148) form a resonant section for increased stability.

As with the phase detector, the synchroguide gives good stability, when properly adjusted, for most of the middle range of the horizontal hold control. At one extreme setting sync will be lost immediately, while at the other extreme setting of the hold control sync will only be lost during station change (or momentary removal of sync pulses during station break). In a misadjusted system, or one in which component parts values have changed materially, there will be a gradual narrowing down of the stability range of the hold control, and readjustment becomes necessary. The following instructions apply in general to all synchroguide systems, though some manufacturers give only a condensed version in their service notes.

Synchroguide alignment

a. Turn the horizontal hold control fully clockwise and adjust the horizontal range adjustment (Fig. 3) (so that the picture displaces to the right) until a vertical bar appears. This procedure must be done with a station tuned in. A station pattern is preferable and a fairly strong signal is desirable.

b. Turn hold control fully counterclockwise. Use the station selector knob and turn to another channel, then switch back again. Three or four horizontal or slanting bars should then appear on the screen. If too many or too few bars appear, adjust the horizontal lock trimmer (see Fig. 2), until only three or four bars are present.

c. Repeat step "a" after which center the hold control and check lock-in and general sync stability on all local stations. (Weak stations may give some sync instability) Repeat these steps if sync is not sufficiently stable.

d. If sync stability is still poor connect an oscilloscope to point *C* as shown in Fig. 3. Adjust the tertiary waveform slug until the wave form shown at *B* of Fig. 3 has equal amplitudes. That is, the broad peak P1 should be as high as the sharp peak P2. Adjustment of the tertiary slug will throw sync out and it must be restored by adjusting the horizontal range slug each time. The lead to the vertical amplifier of the scope should be unshielded to minimize effect of probe capacity.

e. Remove the scope and check general sync stability and range of lock-in. Repeat steps "a" and "b" if necessary.

The waveform peak adjustment is very important with any synchroguide

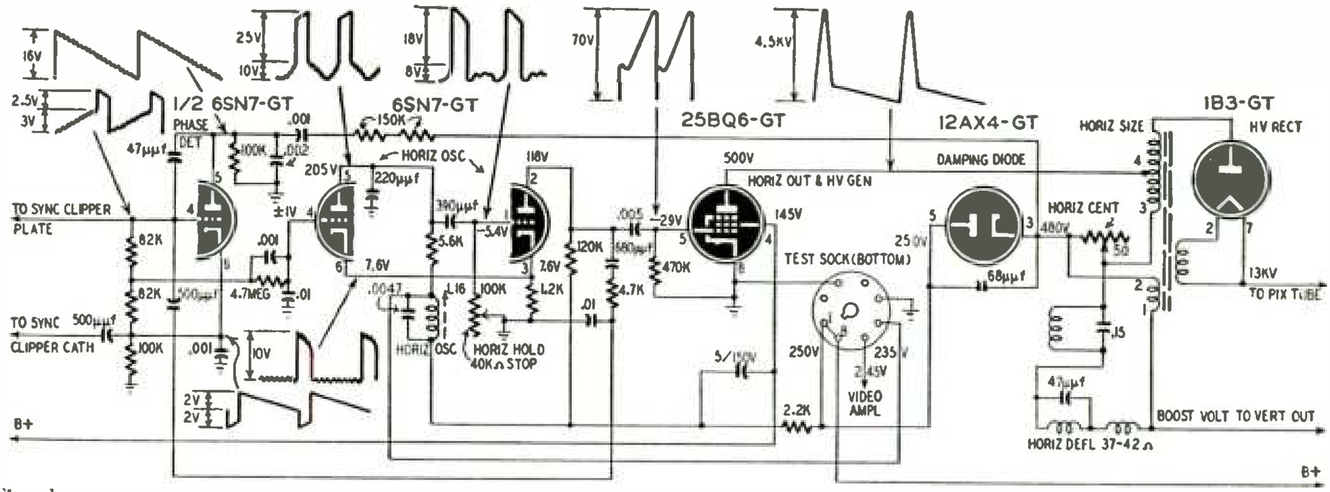


Fig. 1

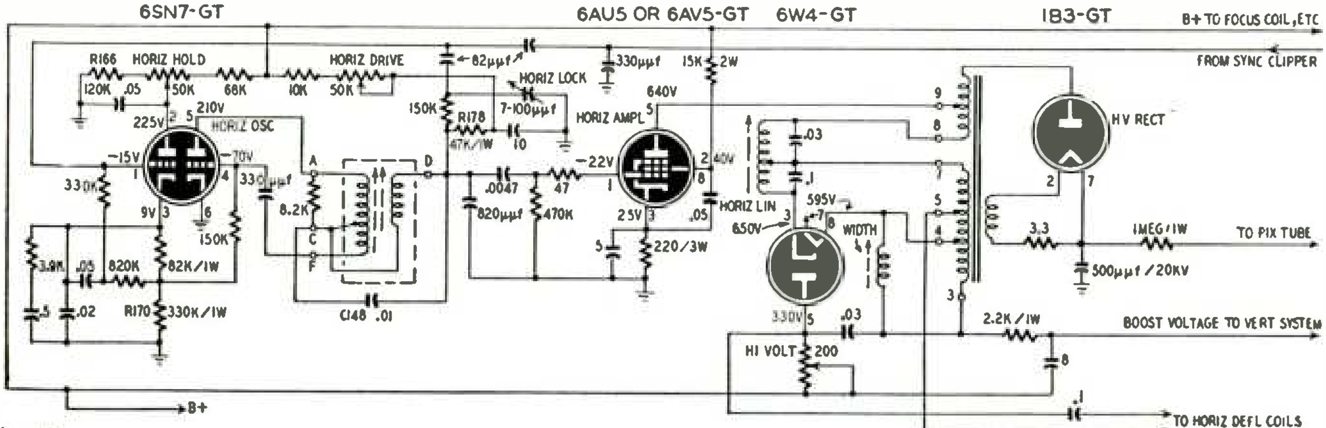


Fig. 2

system if good sync stability is to be assured. If the broad peak is lower than the sharp peak the oscillator drifts and is more susceptible to noise interference. If the broad peak is higher the oscillator is actually "overstabilized" and the setting of the hold control becomes critical. Pull-in—the ability of the system to pull into sync with almost instantaneous action—will also be affected.

While the scope is being used, other waveform checks can also be made to evaluate the general operation of the system. If, for instance, the waveform shown in Fig. 4 is obtained at the grid of the oscillator (pin 4) it indicates correct operation. These patterns also are useful in signal tracing the sweep system and help localize the stage which is causing sync instability.

When replacing components in any horizontal lock circuit it is important that close-tolerance parts be used. Some of the resistor values, for instance, are quite critical and exact replacement is important for good stability. In Fig. 2, for instance, the values of R-166, R-170 and R-178 are quite critical, and some manufacturers recommend tolerances of 5% and even as low as 1%! Often one or two of these resistors may be of the negative coefficient type in order to compensate for drift during warm-up.

During servicing, try not to disturb the position of parts and wiring. When replacing *any* components associated with the grid of either the control tube or the oscillator section of the 6SN7-GT, dress leads up and away from the chassis.

An incorrectly adjusted synchroguide or phase detector system will influence width, linearity, and picture brightness with the fly-back high voltage systems. Poor stability will also cause some horizontal fold-over which is corrected when the system is aligned properly. The grid drive to the horizontal output tube is established by oscillator output.

Identical symptoms, however, will also result with defects in the output stage. This fact must be recognized and checks made when adjustments to the oscillator section fail to eliminate the trouble. An incorrectly set drive control will give poor linearity (stretching of the left side of the picture) and also have a loading effect on the oscillator and consequent instability.

In the system shown in Fig. 2 it is necessary that both the horizontal output tube and the damper tube be good performers. Circuit values are quite critical, to establish the proper relationship between trace, flyback, and general efficiency. To secure the proper distributed capacity necessary for high efficiency, one leg of the damper tube filament is connected to a tap in the transformer. This provides approximately 60 μμf of capacitance and a tube with

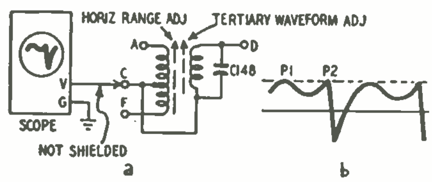


Fig. 3

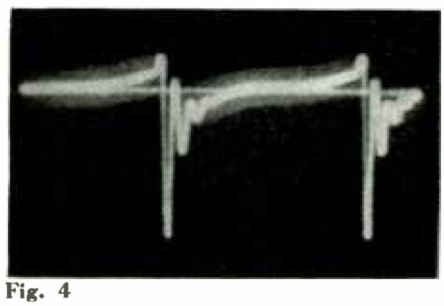


Fig. 4

poor characteristics will considerably reduce efficiency. Correction can sometimes be made by placing small capacitors (value determined experimentally) across the transformer terminals 7 and 5 or 4 to increase width and improve general performance. It is better however, to check tubes and parts and replace when necessary. A poor damper tube can, for instance, cause foldover; unless this is suspected, considerable unnecessary alignment work may be done on the oscillator system.

—end—

Television Service Clinic

Conducted By MATTHEW MANDL

WE wish to extend to the readers of our Clinic the hope that the forthcoming year will prove to be a prosperous one for them, whether they are engaged in television servicing or in other technical endeavors. The art is still growing and with it the inevitable opportunities for expansion in activities and acquisition of new concepts and techniques. The prospect of ultra-high-frequency station allocations has already influenced design in new television receivers.

Many of these receivers are designed for subsequent u.h.f. reception with converters or by insertion of special u.h.f. coils in drum-type tuners. The increased popularity of the latter type has been of advantage to the servicing technician because such tuners lend themselves readily to repair.

Fig. 1 illustrates the printed-circuit tuner used by Hallicrafters. Removal of wire springs at each end of the tuner permits withdrawal of the entire drum and shaft section from the housing. A similar arrangement is employed in the Standard tuner and others used in modern receivers.

With the drum removed all parts are exposed and can be checked or replaced with ease. The phosphor bronze springs which make contact with the coil terminals can be cleaned, lubricated, and bent upward to insure good contact and eliminate noisy or intermittent operation.

Not only can u.h.f. coils be inserted into the drum, but the present v.h.f. ones are readily removed and replaced when defective. This feature is a welcome change from the complexity of earlier tuners, in which it was virtually impossible to replace a defective capacitor or resistor without tearing the entire unit apart. With those, most technicians were forced to take out the entire tuner with considerable loss of time in wiring and retracking the replacement tuner.

It is gratifying to note that even the new wafer-tier tuners in the newer receivers are far less complex than their older counterparts and also exhibit certain advantages in maintenance work. Let's hope that such progressive thinking will be applied to other circuits in the television receiver.

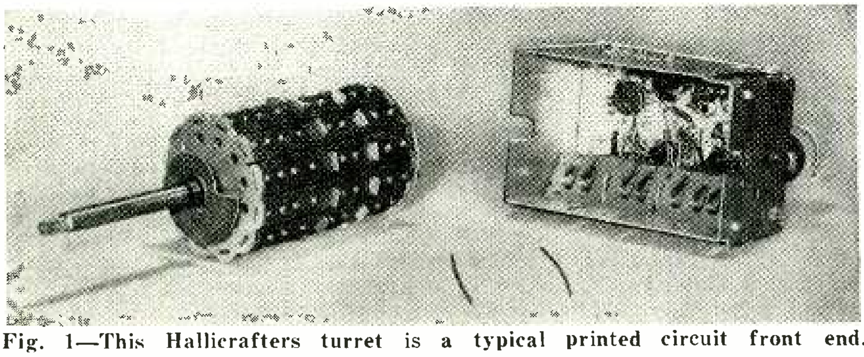


Fig. 1—This Hallicrafters turret is a typical printed circuit front end.

White line at top of picture

A short while after replacing the vertical output transformer in a Bendix receiver a bright white line appeared across the top of the picture. Adjustment of controls did not help, nor did replacement of tubes. I've taken voltage and resistive checks, but values seem close to normal. The transformer was not an exact replacement, but was one designed for a similar circuit. G. K. Baltimore, Md.

The characteristics of the new transformer may be sufficiently different from the original to cause this trouble. The white line indicates crowding of the initial vertical sweep trace and possible transient oscillations in the vertical system. Make several checks to verify if the transformer is the offender before replacing it.

First of all, check the network of resistors and capacitors (the integrator circuit) feeding the vertical oscillator. If these components check okay use your scope to observe waveform linearity at the input and output of the vertical amplifier. This will help you to determine where the nonlinearity occurs and so localize the trouble.

Crowding at right

I replaced the yoke on an RCA type 630 chassis with the new type designed to give full focus. Since then I've been unable to correct for crowding on the right-hand side of the picture. Replacing tubes didn't help and all parts check all right. Is it possible that the new yoke does not match the flyback transformer? J. S., Long Island, N. Y.

A compressed right side of the picture, as shown in Fig. 2, could very well be caused by a mismatch. For good results in terms of linearity and general performance, both the horizontal output transformer and horizontal deflection coils should be matched.

Try adjusting linearity, drive and width controls, readjusting each one slightly after changing the other. Also try different values of capacitors in the linearity filter of the damper-tube.

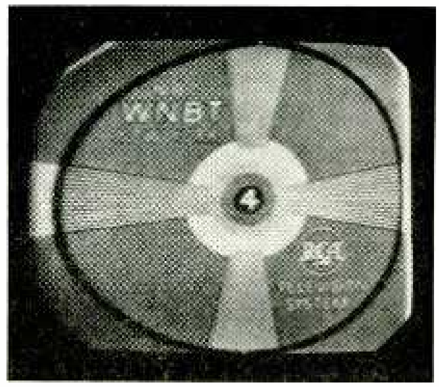


Fig. 2—Compression at picture's right.

If these measures do not yield satisfactory horizontal linearity, you will have to get a matching output transformer for the yoke, or vice versa.

Booster overload

I am located in a fringe area, and in using a booster with an Admiral 17K12 there is a noticeable pulling and distortion of the picture when the booster is tuned for maximum signal strength. I can eliminate this condition by reducing booster output through detuning, but lose picture quality. How can I get maximum signal without distortion? W. A. R., Hazleton, Pa.

Severe pulling is usually indicative of clipped sync, an overloaded a.g.c. system, or an oscillating stage in either booster or receiver due to excessive signal amplitude.

Your symptoms indicate excessive output from the booster because the trouble disappears when you detune. Inasmuch as most boosters have no means of controlling gain you should provide a means for varying booster bias, or use low-value resistors across the transmission line (values determined experimentally). If pulling occurs for all stations you can increase booster-tube bias by increasing cathode resistor value until output is at the desired level.

Picture weave at top

On a converted RCA 721 a slight vertical tremor exists, the picture is bent slightly at the top and weaves on the point of tearing. I have replaced all integrator capacitors, have made a.f.c. adjustments according to the manufacturer's manual, and have checked vertical and horizontal sweep-circuit tubes. S. R., Bergenfield, N. J.

Bending at the top of the picture, as shown in Fig. 3, indicates insufficient sync pulse amplitude and possibly a change of sweep-circuit operating characteristics.

Try a new V104B, 6AL5 sync-limiter tube as well as a new 6SN7-GT sync amplifier-separator. A change of characteristics in the 12AU7 video amplifier (dual video amp) can also clip the sync pulses even though the tube checks O.K. in an ordinary tester.

Check for proper plate voltages at both sweep oscillators, particularly for

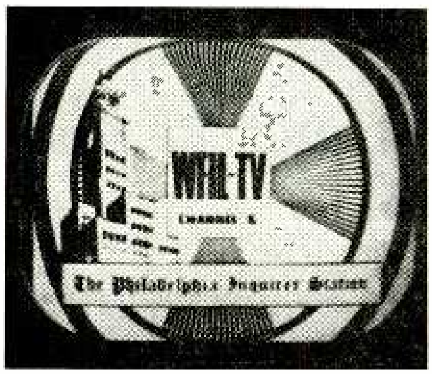


Fig. 3—Bending at top of the picture is the result of insufficient sync pulse and trouble in the sweep circuit.

increases in voltage boost brought on by conversion. Improper alignment of video i.f. stages can also cause the symptoms you describe because it can contribute to poor low-frequency response and thus decrease sync amplitude.

Interlock fuse trouble

I have had persistent trouble with a Philco 51-T1870 in which the interlock fuse burns out on an average of once a week. I've measured the line voltage where the receiver is used and it reads 125 volts consistently. How can I remedy this situation? E. S., Havana, Cuba.

Inasmuch as most receivers are designed for operation from 110 to 117 volts a.c. the high line voltage you mention would increase the voltages in the receiver and thus cause abnormal current drain. A heavier fuse could be installed but it would not decrease excessive screen and plate voltages in the receiver. You can use a line-voltage-dropping resistor provided that its wattage rating is adequate in dissipating the heat developed by the current through it. A more expensive but highly satisfactory solution is to use one of the voltage-control transformers sold by a number of manufacturers—RCA Isotap WP-25A, Sola CVA constant voltage transformer, or UTC Varitran, or an equivalent type.

Increasing fringe gain

I have used good high-gain antennas to receive the four television stations from Chicago, which is 100 miles from here, with pretty good results when using a booster. I have been thinking of building an elaborate booster, similar to the Jerrold master booster used with their community antenna systems, in order to assure consistently good reception. I intend using this for a single receiver only, not community work, and would appreciate your comments on this. E. B., Wauwatosa, Wis.

Inasmuch as your results are almost what you desire we would not advise going to the trouble of building a complex booster. Instead, why not try increasing signal pickup by using two boosters in series? These, if properly tuned, will give substantial signal increase. You could also use open-wire line, for this has less loss than the flexible solid plastic types. Also increase antenna height, if possible.

You could install four Yagi antennas (5-element affairs) which should give you a gain of around 10 db. You would have to run four transmission lines to the receiver and use a switching arrangement. While slightly inconvenient, this is less expensive than the complex booster you propose.

Each Yagi, of course, should be designed for the single channel it is to pick up and must be oriented carefully. Yagi antennas have not only extremely narrow band response (good for only one or two channels) but a sharp unidirectional pickup lobe which steps up both gain and selectivity.

Ineffective horizontal hold

I've encountered some trouble lately with two Bendix model 2051 receivers in which the horizontal sync drifts and requires constant resetting of the horizontal hold during the first hour. After that time the hold control is set at the extreme end and horizontal sync is no longer possible. How can I remedy this? A. S., Laurel, Md.

These receivers use a phase detector and a blocking oscillator type of sync-lock system. Other than the hold-control adjustment, no means are provided for correct alignment when loss of horizontal sync occurs.

Try several 6SN7-GT tubes in the horizontal oscillator-phase detector circuit to see if one gives better stability than the other. Some 6SN7-GT tubes have sufficiently different characteristics to make considerable difference in horizontal stability range.

Check for incorrect value resistors in the plate circuit of the 6SN7 section which is connected to the hold control. If necessary check all sweep circuit parts and replace those components which do not test within 5% of the schematic values.

A.c.-d.c. receiver conversion

What suggestions do you have for converting a Belmont 10DX22 (a.c.-d.c. model) to a 14- or 20-inch tube? I would like to leave the a.c.-d.c. feature undisturbed. H. C., Detroit, Mich.

This receiver uses three horizontal output tubes (50B5) and an r.f. type of high-voltage supply with dual 35L6-GT tubes. Conversion to the rectangular tubes or any others having a high deflection angle is not recommended because of the extensive changes which would be necessary. Inasmuch as you do not want to disturb the general features of the receiver, you could use any of the 12-inch tubes without making major changes. Depending on the choice of tube type minor changes in the ion trap or 2nd anode plug for the picture tube may have to be made. Sixteen-inch round tubes having small deflection angles such as the 16LP4, 16MP4, and the 16ZP4 (the latter using a single ion trap) can also be used. Others could also be used but some have no outer conductive coating such as your present 10BP4 tube and would require the addition of another h.v. filter capacitor. Still others are metal and require special precautions and high-voltage insulated mountings.

Decreased brilliancy

When I turn the brightness control on my receiver, the brilliancy increases up to a certain point. When I turn the control farther, the brilliancy actually decreases instead of getting better. At full setting of the control the picture is much dimmer that at half-setting. R. W., Chicago, Ill.

Often a decrease in brightness for an advance of the brilliancy control is due to a faulty 1B3 high-voltage rectifier. When the 1B3 emission falls off and the high voltage is slightly reduced the symptoms you describe will occur. As the brilliancy control is advanced it increases the electron stream within the tube and the space charge effects around the tube phospher increase also. With reduced velocity (due to lower high voltage) there isn't sufficient force to dislodge a proportionate number of electrons by the secondary emission process and the result is decreased instead of increased brilliancy. Substitute a new 1B3 tube and also check horizontal output and damper tubes, as well as the ion trap setting.

Note: Letters addressed to this Clinic are answered directly and those of general interest are published. When writing to this department enclose a self-addressed envelope and give model number of receiver, manufacturer, chassis number, and tube complement. List all of the symptoms pertinent to reliable evaluation and accurate diagnosis. Include such information as antenna type, channel numbers of stations which can be received in your area, and what preliminary checks you have undertaken prior to writing us.

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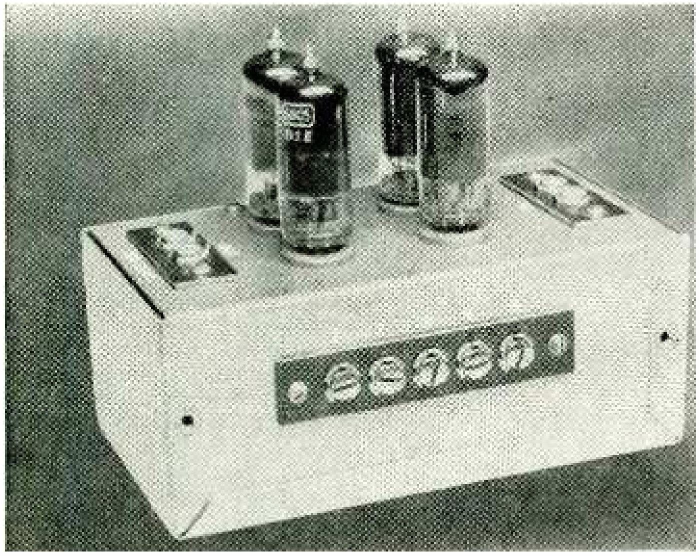


Symmetry is the fundamental feature of the amplifier. A maximum of three receivers may be used with this unit.

A device which makes it possible to use two or three receivers on one antenna without loss of signal strength

By EDWIN BOHR

TV DISTRIBUTION AMPLIFIER

IN SERVICE shops, in homes with more than one TV set, and in fringe areas, it is often desirable to operate several receivers from a single master antenna system. Here is a distribution unit that will operate as many as three TV receivers from a single antenna, and with additional stages will provide as many additional outlets as are needed.

The distribution amplifier consists of push-pull 6BC5 stages arranged along a 300-ohm artificial transmission line. A single pair of 6BC5 tubes serve each distribution outlet. At first glance this may seem poor economy in tubes, but it results in some very worth-while features.

First: It results in greater dependability since the failure of one tube does not cause a complete signal loss. The signal is lowered only slightly at one outlet when a tube fails. This is important when the distribution amplifier is placed in remote locations, and as many as 10 or more outlets are used.

Second: The push-pull circuit results in greater bandwidth, better r.f. bypassing with better line balance and impedance match.

The gain of each stage is approximately unity over the entire range of TV channels and the FM band. Bandwidth is extremely broad by virtue of the low value of load resistance used in each plate—300 ohms plate-to-plate.

Artificial line

The heart of the distribution amplifier is the 300-ohm artificial line. Amplifier tubes are connected at intervals along this line, distributing the signal to other points. The artificial line behaves just as a regular transmission line, but in a regular transmission line the impedance is determined by the *distributed* capacitance and inductance of the two parallel conductors. In the artificial line the capacitance and inductance is not distributed but *lumped.*

This lumped inductance is furnished by the coils L1, L2, L3, and L4 (see Fig. 1); and the capacitance is supplied by the grid-to-cathode capacitance of the tubes connected to these inductance coils. Since the input capacitance of the tubes is actually part of this low-impedance line, the tubes produce only a very small disturbing effect on the signal as it is propagated down the line.

Here is what happens: The signal arriving at the "300-ohm in" terminals is fed to the artificial 300-ohm line. As the signal travels along the line, it reaches the first pair of 6BC5 tubes and is fed to the first outlet. The signal reaches the second stage and is fed to the second outlet. When the signal arrives at the end of the line it can be used to supply a third receiver or can be fed to another distribution unit. If only two outlets are needed, the signal can be terminated in a 300-ohm carbon resistor connected across the "300-ohm out" terminals.

Construction

Since the amplifier is constructed on a small aluminum utility box, the size of the chassis in terms of signal wave-

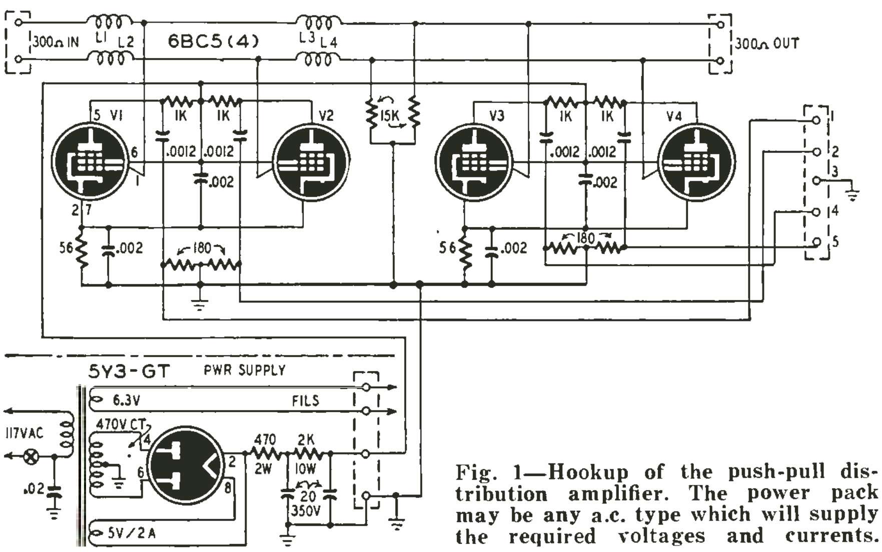
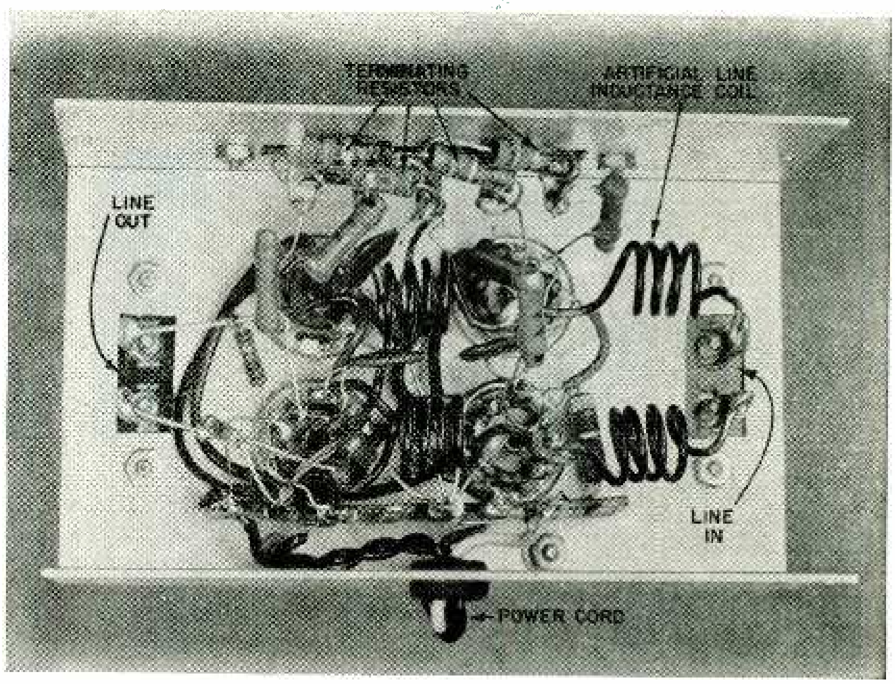


Fig. 1—Hookup of the push-pull distribution amplifier. The power pack may be any a.c. type which will supply the required voltages and currents.



Underchassis view gives a good idea of the symmetrical placement of the artificial transmission lines and terminating resistors.

length is small. This, in addition to the push-pull feature, reduces bypassing problems. Be sure to use physically small capacitors and to trim the lead wires until they are just sufficiently long to reach from one connection to another.

Wire in the artificial line coils first because these are the least easily deformed and rearranged. The 15,000-ohm resistors from each side of the artificial line to ground simply prevent the 6BC5 grids from floating.

No power supply is built into the amplifier. This design is more flexible and allows a smaller and better shielded r.f. chassis. Any power supply that will provide from 110 volts to 125 volts d.c. at 40 milliamperes and 6.3 volts at 1.2 amperes will work. If extra outlet stages are added it will take an extra 10 milliamperes plate current and 0.3 amperes filament current for each additional tube.

Applications

Since its voltage gain is approximately unity, the unit is actually a power amplifier—the same signal voltage is developed across several 300-ohm loads. If a booster is presently used ahead of a single TV set the same booster should be used ahead of the distribution amplifier. See Figs. 2-a and 2-b. When several TV stations are received from the same direction a broad-band high-gain antenna system, such as a rhombic or conical, may be fed to the distribution amplifier for all-channel operation. In this case, if a booster is needed between the antenna and distribution unit, all-band boosters that require no tuning should be used.

Two separate single-channel antennas and boosters can be connected to the distribution unit as shown in Fig. 2-c. Two boosters can be paralleled with quarter-wave crossover sections of 300-ohm line. According to Fig. 2-c, best match for channel "Y" will be obtained by pruning the lead from the channel "X" booster and vice versa. In other words, the lead from each booster acts as a stub for the other booster.

Fig. 2-d shows how two units may be connected in series for additional outlets. Theoretically, the number of receivers that may be added is limitless, and if an odd number of receivers is to be used in the system, one of them can take the place of the resistor.

If no-loss signal distribution is desired and isolation is needed between receivers to reduce interference, this feed system is just the thing. FM receivers can be fed with TV receivers, making possible universal TV and FM outlets for several service benches in a repair shop. With experience other uses for the broad-band amplifier will suggest themselves to the experimenter-constructor.

Materials for distribution unit

Resistors: 2—56, 2—15,000, 4—180, 4—1,000 ohms (all ½ watt).
Capacitors: 4—.002 μf, disk ceramic; 4—.0012 μf, tubular ceramic.
Inductors: L1, L2, L3, L4: Four turns No. 14 enameled copper wire, ⅜-inch diameter, spaced out to ¾-inch length.
Miscellaneous: 4—6BC5 tubes, aluminum box chassis, 3 screw terminal strips, 1 4-lug tie strip, 4 tube sockets, hookup wire, assorted hardware.

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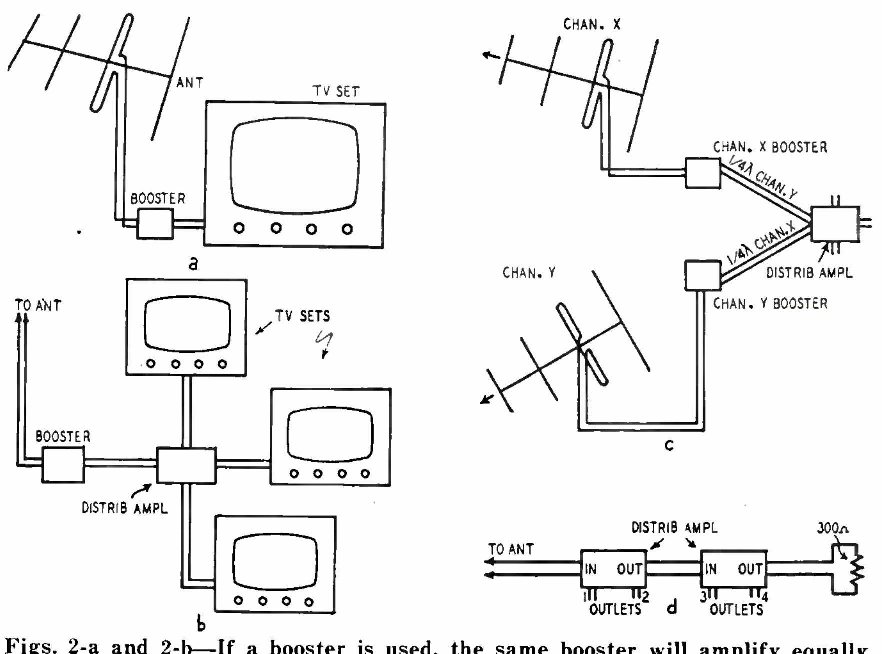


Figs. 2-a and 2-b—If a booster is used, the same booster will amplify equally for all three receivers if placed where indicated. (It may also be placed in any one of the three leads if only one set requires a booster.) Fig. 2-c—If two antennas are used, they may be hooked up as shown, using the lead from the one channel as a tuning stub for the other. Fig. 2-d—If any even number of receivers are connected to one antenna, a 300-ohm resistor terminates the OUT lead.

630 TO 17"

By T. E. CANTOR

THE 630-type TV chassis, manufactured by most companies since 1947, is considered one of the best chassis in the field and is still featured as a fringe-area and custom model by many firms. Since the initial cost of the 10-inch 630 model was higher than many large-screen console models today, the owners are reluctant to part with their fine performing but small-screen sets for the few dollars of trade-in allowed them toward a 17- or 20-inch rectangular-tube model.

The technician who is on his toes can show the set owner how he may "have his cake and eat it too," by converting his old 630.

The argument may have been offered that the chassis will be overloaded in providing the extra sweep and high voltage required for the rectangular tubes. This is a fallacy since the use of a high-efficiency ferrite-core flyback transformer and yoke and the elimination of the 5,300-ohm resistor shunting the 5V4-damper tube will enable the deflection circuit to deliver more high voltage and deflection power at no increase in B-plus drain. The Du Mont H1A1 flyback transformer and Y2A1 ferrite yoke provide edge-to-edge sharpness on 70° tubes. They are mechanically interchangeable with the original components and perform well in 630 conversions.

When the 630 is fully converted according to the instructions given here, the reserve of high voltage and deflection power is so great that it is possible to interchange 14-, 16-, 17-, 20-, and 24-inch rectangular tubes directly in the same chassis. Resetting the horizontal drive control is the only adjustment required.

Horizontal output modifications

Fig. 1 shows the horizontal deflection circuit of the typical 630-type receiver. Original wiring and components are shown in BLACK and components or wiring which must be added or changed are shown in BLUE.

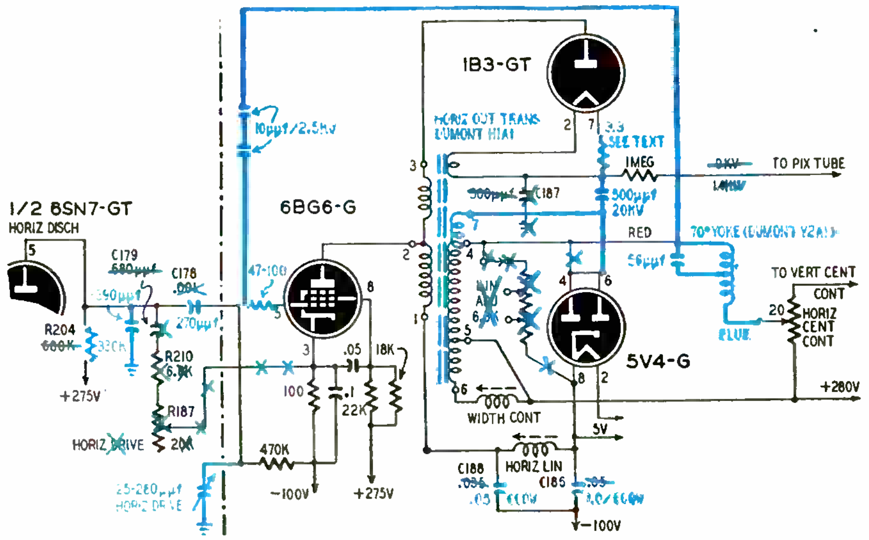


Fig. 1—The required modifications for the 630 conversion are indicated in blue.

The diagram is divided into two sections by a dashed line just to the left of the 6BG6-G. The 12 steps required for successful modification of the horizontal circuit of most sets are applied to the section of the circuit on the right of the dashed line. Make these changes first:

1. Remove the original yoke and flyback transformer. The original linearity and width coils may be used.

2. Remove 6,300-ohm damping resistor, connected between plate and cathode of the 5V4-G damper tube.

3. Replace the high-voltage filter capacitor with one rated for 20 kv. Connect the negative side to the plates of 5V4-G damper tube instead of to ground as in the original circuit. This adds the boosted voltage in series with the high voltage, raising it about 1.5 kv.

If an insulated mounting is not provided for the high-voltage filter capacitor, construct one from bakelite sheet and fasten it across the punched hole in the chassis where the original capacitor was mounted. This is shown at *a* in Fig. 2. An alternate method is to support the bakelite sheet on two bakelite or ceramic standoff insulators as at *b* in Fig. 2. In either case, take care that the positive terminal of the capacitor is at least 1 inch away from any low-potential points, and the negative terminal at least ⅜ inch away.

4. When converting doubler circuits, disconnect one rectifier tube socket and wire up the other for single rectifier operation. The high-efficiency components provide more high voltage with better regulation than the original doubler circuit.

5. Fasten the new flyback transformer to the chassis in the mounting holes of the original transformer.

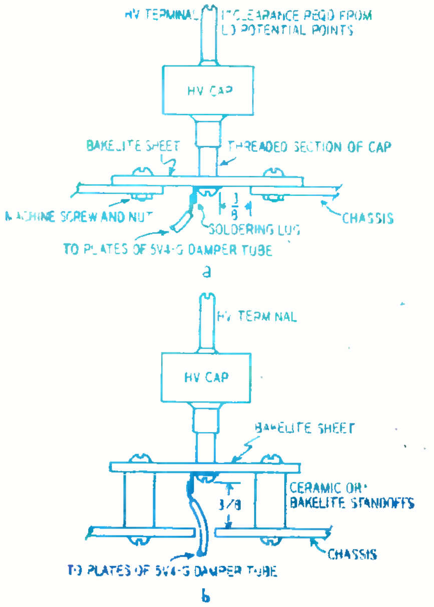


Fig. 2—Ways of mounting h.v. filter

6. Omit the 3.3-ohm series resistor if the flyback transformer has a one-turn filament winding. Solder the filament leads directly to pins 2 and 7 on the 1B3-GT socket. The resistor must be used if the transformer has two filament turns.

7. Connect a wide-angle ferrite yoke as in the original circuit except for the following change: Connect the red horizontal lead to terminal 4 alone of the flyback transformer and disconnect the damper plates.

8. Connect terminal 7 of the flyback transformer to the plates of the 5V4-G damper tube and connect terminal 5 to B-plus. Connect terminal 1 to the end of the linearity coil that connected to terminal 1 of the original flyback transformer.

9. Connect the width coil across to terminals 5 and 6 of the flyback transformer. Omit the width coil if maximum width is desired.

10. Insert a 47- to 100-ohm, ½-watt parasitic suppressor resistor in series with the 6BG6-G grid if not already in the circuit.

11. Change the values of C186 and C188 (bypassing the linearity coil) to 1.0 and .05 μf respectively. Use 600-volt units.

12. Connect two 10-μμf, 2,500-volt capacitors in series from terminal 4 of the flyback transformer to the grid of the 6BG6-G. This provides feedback which produces additional sweep and high voltage.

Increasing horizontal drive

If still more horizontal sweep and high voltage are required make the changes shown in RED left of the dashed line dividing Fig. 1. The following changes will increase the horizontal drive.

1. Change resistor R204, in the plate circuit of the 6SN7-GT horizontal discharge tube from 680,000 to 330,000 ohms, and the .001-μf coupling capacitor C178 to 270 μμf.

2. Remove the original horizontal drive circuit consisting of C179 (680 μμf), R210 (6,800 ohms), and the 20,000 ohm drive potentiometer R187.

3. Add a 25-280-μμf padder capacitor from the grid resistor of the 6BG6G to ground, and a 390-μμf discharge capacitor, in the plate circuit of the 6SN7-GT horizontal discharge tube. These changes provide more than enough horizontal drive. Coupling capacitor C178 was changed to 270 μμf to bring the drive down to a usable range. Use the original value (.001 μf) if maximum drive is required.

4. Use the padder capacitor as the drive control. Turn the adjusting screw counterclockwise until white overdrive lines appear on the screen, then clockwise until the lines just fade out. This is the point of maximum usable drive.

Vertical sweep circuit

The increased high voltage makes it necessary to provide more vertical sweep than it is possible to obtain with optimum adjustment of the vertical height and linearity controls. In this case, make the changes shown in red in Fig. 3 and described in detail below.

1. Substitute a 6V6 for the 6K6 vertical output tube.

2. Increase the voltage on the plate of the vertical output tube by reducing the value of resistor R179 (in series with the red primary lead of the vertical output transformer) from 10,000 to 5,000, 2,000, or 1,000 ohms as in Fig. 3, connection A. Use the highest resistance that will provide sufficient vertical sweep with good linearity.

3. If still more vertical sweep is desired, then disconnect the red lead of the vertical output transformer from B-plus and connect it to the boosted voltage at pin 1 of the flyback transformer through 10,000 to 5,000 ohms, 2 watts, as in Fig. 3, connection B. Be sure the 10-μf, 450-volt decoupling capacitor C221C is NOT disconnected. Use the highest resistance that will provide good vertical linearity and sufficient sweep, as this connection loads down the boost voltage and reduces the high voltage about 1 kv.

Foldover

The large distributed capacitance of the high-efficiency yokes and flyback transformers often increases the horizontal retrace time to 10–15 microseconds, resulting in one side of the picture being folded over.

Adjusting the phasing slug (underneath the chassis) of sync discriminator transformer may make it possible to position the foldover off the screen. If the condition is still evident, then the negative pulse which produces the retrace may be applied directly to the screen grid of the kinescope to blank out the screen during the retrace. See Fig. 4. The screen grid (pin 10 on the kinescope socket) is the red lead in the kinescope cable. The 50-μμf coupling capacitor may be varied from 20 to 100 μμf

Focusing

Remove the 1,800-ohm resistor R183, shunted across the focus coil as in Fig. 5. This provides the higher focusing current required for the higher anode voltage. If the proper focusing range is still not available, then substitute an RCA 202D2 or RTMA-JETEC109 focus coil. These units have a resistance of 470 ohms and a somewhat different mounting, but are electrically interchangeable with the original focus coil.

Elimination of arcing and corona

The majority of converted sets were designed originally for voltage of 7–10 kv. It will be necessary to take special precautions to avoid corona or arc-over in the high-voltage cage. Be sure all connections on the high-voltage rectifier socket are rounded and free from sharp points. If arcing occurs from the rectifier socket to ground, insert a sheet of bakelite ⅛ inch to ¼ inch thick, or layers of rubber tape, on the chassis directly under the socket to effectively insulate it from ground. If arcing occurs from the cap of the rectifier tube to the top of the high-voltage cage, replace the spring clip on the cap with an Alden or Warren type plastic cap or cut out a section of the cage directly above the cap. If corona is present, apply a thick coat of Amphenol polystyrene dope to all high-voltage surfaces. Be sure the dope is completely dry before applying power, as its solvent is inflammable.

—end—

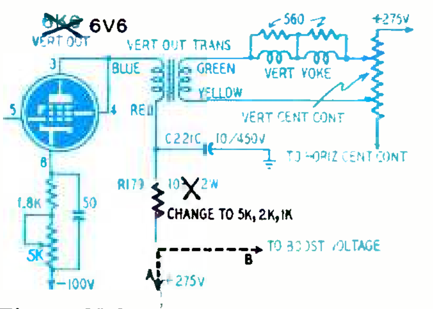


Fig. 3—Make changes shown in black if greater vertical sweep range is needed.

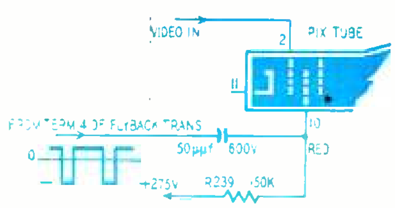


Fig. 4—Circuit for reducing foldover.

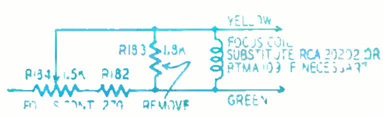


Fig. 5—Remove R183 to improve focus.

PICTURE TUBE REPLACEMENT GUIDE

By E. WM. SCOTT

THIS tabulation of picture-tube characteristics is prepared to assist the technician and tube salesman in selecting the tube best suited for a particular job. Tubes are listed in groups according to size, shape, construction (metal or glass), method of focusing, and deflection angle. Tubes having the same electrical and physical characteristics and differing only in the type of face plate are completely interchangeable without modifying the circuit or cabinet. For example: the 19AP4, 19AP4-A, 19AP4-B, 19AP4-C, and 19AP4-D are identical except for the treatment of the face plate. All types employ magnetic focusing except where specified in heading in the table.

Picture tubes can be divided roughly into two classes according to their deflection angles. The first covers tubes from 50 to 60 degrees and the second includes the wide-angle 66- to 70-degree types. Rectangular tubes which have 50-degree vertical and 65- to 66-degree horizontal deflection angles are listed according to the diagonal deflection angle (70 degrees) in accordance with the method which seems almost universal among tube manufacturers and the TV service industry. A new deflection yoke and possibly a new high-voltage and deflection transformer will be required when replacing a 50- to 60-degree tube with one of the 70-degree types.

The new electrostatically focused picture tubes are available in three types. In one type, the focusing anode must be supplied with a potential of 2,000 to 5,000 volts. This type requires a separate high-voltage rectifier to supply the focusing potential. A second type requires focusing voltages between 0 and 500. The newest of the electrostatically focused types have a new electron gun designed so the electron beam is always focused without special focusing potentials. In fact, these tubes do not even have an outside terminal connection for the focusing electrode.

Operating voltages must be considered when converting a set to use a picture tube several inches larger than the original. The circuit changes required can be minimized by observing the operating potentials on the original tube and selecting a replacement tube which will provide satisfactory service under similar conditions. As a rule, a difference of 15% in operating voltages can be tolerated. Maximum accelerator (grid No. 2) voltage is 410 for most tubes regardless of size—except for the 10EP4 and 12AP4 whose maximum voltages are 330 and 250 respectively.

The maximum anode voltage is approximately 1,000 volts for each inch of screen diameter or width in rectangular

Tube type	Bulb diameter or diagonal (inches)	Over-all length	Ion trap type	Base diagram Fig. No.	Anode connector	notes
10-inch glass round, 50 degrees						
10BP4	10 1/2	17 5/8	Double	1	Cavity	
10EP4	10 1/2	17 5/8	Double	1	Ball	
10FP4	10 1/2	17 5/8	None	1	Cavity	
10MP4	10 1/2	17	Single	2	Cavity	
10CP4	10 1/2	16 5/8	None	1	Ball	
10-inch glass round, 50 degrees, electrostatic focus						
10DP4	10 1/2	17 5/8	None	5	Cavity	a
12½-inch glass round, 50 degrees						
12LP4	12 7/16	18 3/4	Double	1	Cavity	
12TP4	12 7/16	18 3/4	Double	1	Cavity	a
12CP4	12 1/16	18 5/8	None	3	Cavity	a, b, c
12VP4	12 7/16	18	Single	2	Cavity	
12WP4	12 7/16	17 3/4	Single	7	Special	
12KP4	12 7/16	17 5/8	None	1	Cavity	
12QP4	12 7/16	17 1/2	Single	1	Ball	
12JP4	12	17 1/2	None	1	Ball	d
12RP4	12	17 1/2	Single	1	Ball	d
12½-inch glass round, 40 degrees, electrostatic focus						
12AP4	12 3/16	25 3/8	None	4	Cap	a, c
12½-inch metal round, 54 degrees						
12UP4	12 7/16	18 5/8	Double	1	Cone lip	a
14-inch glass rectangular, 70 degrees						
14BP4	13 11/16	16 13/16	Double	1	Cavity	
14EP4	13 11/16	16 13/16	Double	1	Cavity	
14CP4	13 11/16	16 3/4	Single	1	Cavity	
14DP4	13 11/16	16 3/4	Double	1	Cavity	
14-inch glass rectangular, 70 degrees h.v. electrostatic focus						
14GP4	12 21/32	17 3/16	Single	5	Cavity	
15-inch glass round, 50 degrees						
15CP4	15 3/4	21 7/8	Double	1	Cavity	a
15-inch glass round, 57 degrees						
15AP4	15 3/4	20 7/8	None	1	Ball	a
15DP4	15 3/4	20 7/8	Single	1	Cavity	a
16-inch glass rectangular, 70 degrees						
16QP4	16 1/8	19 1/8	Double	1	Cavity	a, e
16KP4	16 1/8	18 3/4	Single	1	Cavity	
16RP4	16 1/8	18 3/4	Single	1	Cavity	
16XP4	16 1/8	18 3/4	Double	1	Cavity	a
16UP4	17 1/8	18 1/8	Single	1	Cavity	a
16TP4	16 1/8	18 1/8	Single	1	Cavity	
16-inch glass round, 50–60 degrees						
16LP4	15 7/8	22 1/4	Double	1	Cavity	f, g
16MP4	16 1/8	21 3/4	Double	1	Cavity	
16CP4	15 7/8	21 1/2	Double	1	Cavity	a, f, g
16FP4	16 1/8	21 1/4	Single	1	Ball	a
16HP4	15 7/8	21 1/4	Double	1	Cavity	f
16JB4	16 1/8	20 3/4	Double	1	Cavity	
16DP4	15 7/8	20 3/4	Double	1	Cavity	a
16-inch glass round, 70 degrees						
16ZP4	15 7/8	22 1/4	Double	1	Cavity	h
16WP4	15 7/8	17 3/4	Double	1	Cavity	a, h
16SP4	15 7/8	17 5/16	Single	1	Cavity	h
16YP4	15 7/8	17 5/16	Single	1	Cavity	h
16VP4	15 7/8	17 3/16	Single	1	Cavity	a
16-inch metal round, 53 degrees						
16AP4	15 7/8	22 5/16	Double	1	Cone	a
16-inch metal round, 60 degrees						
16EP4	15 7/8	19 5/8	Double	1	Cone	a
16-inch metal round, 70 degrees						
16GP4	15 7/18	17 11/17	Single	1	Cone	a, i
16-inch glass round, 60 degrees, self-focus						
16ACP4	15 7/8	20 7/8	Single	6	Cavity	
17-inch glass rectangular, 70 degrees						
17BP4	16 5/8	19 5/8	Single	1	Cavity	
17AP4	16 5/8	18 5/8	Single	1	Cavity	


Fig.1


Fig.2


Fig.3


Fig.4

Fig.5


Fig.6


Fig.7

Tube type	Bulb diameter or diagonal (inches)	Over-all length	Ion trap type	Base diagram Fig. No.	Anode connector	notes
17-inch glass rectangular, 70 degrees h.v. electrostatic focus						
17FP4	16 3/4	19 5/8	Single	5	Cavity	
17-inch glass rectangular, 70 degrees, l.v. electrostatic focus						
17HP4	19 3/16	16 5/8	Single	5	Cavity	
17-inch metal rectangular, 70 degrees						
17CP4	17	19	Single	1	Cone	a
17-inch metal rectangular, 70 degrees h.v. electrostatic focus						
17GP4	15 17/16	18 1/16	Single	5	Cone	a
17-inch glass rectangular, 70 degrees, self-focus						
17KP4	16 5/8	19 1/4	Single	6	Cavity	
17RP4	16 5/8	19 1/4	Single	6	Cavity	
17SP4	16 5/8	19 3/16	Single	6	Cavity	
17-inch metal rectangular, 70 degrees, l.v. electrostatic focus						
17TP4	16 13/16	19 5/16	Single	5	Cone	a
19-inch glass round, 66 degrees						
19FP4	18 7/8	22	Double	1	Cavity	a
19DP4	18 7/8	21 1/2	Double	1	Cavity	e
19GP4	18 7/8	21 1/4	Single	1	Cavity	a
19-inch metal round, 66 degrees						
19AP4	18 3/4	22	Single	1	Cone	a
19-inch glass rectangular, 70 degrees						
19JP4	18 5/8	21 3/16	Single	1	Cavity	a
19EP4	17 1/8	21 1/2	Double	1	Cavity	
20-inch glass round, 54 degrees						
20BP4	20 3/8	28 3/4	None	1	Cap	a
20-inch glass rectangular, 70 degrees						
20DP4	20 3/32	21 7/8	Single	1	Cavity	
20CP4	20 3/32	21 7/16	Single	1	Cavity	
20-inch glass rectangular, 70 degrees, h.v. electrostatic focus						
20FP4	20 3/32	22 1/8	Single	5	Cavity	
20GP4	20 3/32	22 1/8	Single	5	Cavity	
20-inch glass rectangular, 70 degrees, l.v. electrostatic focus						
20HP4	20 3/32	21 3/4	Single	5	Cavity	
20-inch glass rectangular, 70 degrees, self-focus						
20JP4	20 3/32	21 3/4	Single	6	Cavity	
21-inch metal rectangular, 70 degrees						
21AP4	20 3/4	22 5/16	Single	1	Cone	a
21-inch glass rectangular, 70 degrees						
21EP4	21 7/32	23 3/8	Single	1	Cavity	
21-inch glass rectangular, 70 degrees, self-focus						
21KP4	21 7/32	22 7/8	Single	6	Cavity	
22-inch metal round, 70 degrees						
22AP4	21 11/16	22 7/8	Single	1	Cone	a
24-inch metal round, 70 degrees						
24AP4	24 1/8	23 15/16	Single	1	Cone	a
24-inch metal round, 70 degrees, l.v. electrostatic focus						
24BP4	24 1/8	24 1/4	Single	5	Cone	
30-inch metal round, 90 degrees						
30BP4	30 1/8	23 9/16	Single	1	Cone	a

tubes. For typical operation, anode voltages range from 9,000 to 11,000 for 10- to 12-inch tubes, up to 12 kv for 14- to 16-inch types, and 12,000 to 16,000 for tubes up to 24 inches. The 30BP4 has a maximum anode voltage of 30,000, with 23,000 being typical in practice.

Self-focusing and low-voltage electrostatically focused tubes can, in some instances, replace magnetically focused types. High-voltage types can be used in conversions where the high-voltage transformer is replaced. Typical circuits employing electrostatically focused tubes are shown in Figs. 4 and 5 of the article "Novel 1952 TV Circuits" in this issue. These circuits show Zenith's method of supplying operating voltages to the focusing electrodes. Other manufacturers may use slightly different circuits.

We have listed only magnetically deflected tubes of 10 inches and larger. There are only a few electrostatically deflected types. These are not readily replaced by electromagnetic types. In each particular group of tubes, the types are listed in descending order of size. Thus, when substituting a tube of the same screen size as the original or when selecting a tube for a conversion job, a tube low on the list is preferable to any of the types above it when best utility of small cabinet size is an important factor in the selection. For example, if you are looking for a 12-inch tube to squeeze into a 10-inch cabinet, a 12JP4 or 12RP4 will be more likely to fit than a 12LP4 or 12TP4 because the former types are 1¼ inches shorter and about ½ inch smaller in diameter than the latter types.

Footnotes:

a—Tube has no exterior conductive coating. Add 500-μμf, high-voltage filter capacitor when using tube as replacement for type having exterior coating. When this type is replaced by tube having outside coating, ground the coating to the chassis.

b—Triode-type tube. Has no No. 2 grid. For circuitry, refer to diagrams of sets using triode- and tetrode-type tubes. Alter circuits where necessary to permit use of tube being used as replacement.

c—This tube has 2.5-volt, 2.1 ampere heater. All others have 6.3-volt, 600 ma heaters.

d—Face-plate curvature has 20-inch radius; all others in this group have 40-inch radius.

e—Requires JETEC-RMA 106 focus coil. Others in this group use type 109 focus coil.

f—Face-plate curvature has 56-inch radius; others in this grouping have 27-inch radius.

g—Deflection angle is 50 degrees. The deflection angle is 60 degrees for other tubes in this group.

h—Radius of face-plate curvature is 56 inches.

i—Radius of face-plate curvature is 40 inches; all others in this group have 27-inch radius.

j—17BP4-A and -B have outside conductive coatings; 17BP4 has not.

Tube types printed in light-face type (12AP4, 12CP4) are obsolete.

—end—

TELEVISION ANTENNA

Alliance Mfg. Co.
Alliance, Ohio
Antenna rotators. Three models.

All Channel Antenna Corp.
70-07 Queens Blvd.
Woodside, N. Y.
Super-fan conical antennas, double-V's, Yagis, folded and straight high-low antennas, window antennas. Masts and other accessories.

Alprodco, Inc.
Kempton, Ind.
Mineral Wells, Tex.
Telescoping test tower. Permanent aluminum towers. Three models.

American Phenolic Corp.
1830 S. 54 Ave.
Chicago 50, Ill.
In-line antennas, single-bay and stacked arrays, piggy-back, indoor antennas. Eleven models. Rotators, lightning arrestor, standoff insulators, and mast sections.

Antenna Products
3628 N. Lincoln Ave.
Chicago 13, Ill.
Dual and single-channel Yagi arrays, conical Yagi arrays. High- and low-band folded dipole arrays. Chimney mounts, wall mounts, vent mounts, and accessories. Twenty-nine antenna models.

Baker Mfg. Co.
Evansville, Wis.
Forty-foot tower, 30- and 20-foot telescopic masts, 10-foot plain mast sections, 10-foot fitted-end mast sections, and foot mounts.

Beacon Corp.
2846 Milwaukee Ave.
Chicago 18, Ill.
Spiral-type horizontal-element indoor antenna.

Blonder-Tongue Laboratories
38 N. Second Ave.
Mount Vernon, N. Y.
TV preamplifiers, line amplifiers, master antenna system, 2-outlet and 8-outlet distribution amplifiers.

Brach Mfg. Corp.
Division of General Bronze Corp.
200 Central Ave., Newark, N. J.
Four- and 6-element conicals and 2- and 4-bay stacked conicals, in-line types, bow-tie V, FM crossed dipoles, indoor antennas. Nine models. Master antenna system, amplified and nonamplified. Two- and 4-set couplers, coaxial plugs, boosters, lightning arresters, masts, mast mounts, and mast bases.

Bud Radio, Inc.
2118 E. 55th St.
Cleveland 3, Ohio
Adjustable chimney mounts, universal and heavy-duty wall mounts, corner mounting brackets, guying clamps, mast couplers, and towers.

Camburn, Inc.
32-40 57th St.
Woodside, N. Y.
Telescoping indoor antennas, outdoor conical arrays, straight and folded high-low dipoles, window antennas, and Yagis. Masts, rubber standoffs, swivel-base brackets, lightning arresters, guy-wire rings, and other accessories.

Channel Master Corp.
Ellenville, N. Y.
Fan, conical, Yagi, in-line, V, high-low antennas for single-channel and broad-band use. More than 50 models. Twenty, 30, 40 and 50-foot telescoping masts. Couplings, guy rings, wall mounts, roof mounts, base mounts, and other accessories. Aluminum and steel triangular towers with associated mounts and brackets.

Circle-X Antenna Corp.
500 Market St.
Perth Amboy, N. J.
Broad-band Circle-X antennas, conical V's, and folded dipoles. Twenty-seven models. Masts, guy wires, ground rods.

Cornell-Dubilier Electric Corp.
South Plainfield, N. J.
Conical, high-low, indoor, super-V, Yagi, straight-line antennas. Seventeen models. Antenna rotators, four models. Chimney mounts, lightning arresters.

Crown Controls Co.
124 S. Washington St.
New Bremen, Ohio
Rotators. Two models. Roller-bearing guy ring.

Delson Mfg. Co.
126 Eleventh Ave.
New York 11, N. Y.
Window and indoor antennas. Five models. Two-set couplers.

R. L. Drake Co.
11 Longworth St.
Dayton 2, Ohio
TVI filters. Nine models.

Easy-Up Tower Co.
427 Romayne Ave.
Racine, Wis.
TV towers, roof mounts, rotating and fixed-pole rings, guy-wire clamps, and twin-line testers. Eleven models.

Electronic Indicator Co.
259 Green St.
Brooklyn, N. Y.
Conical, folded dipole, Yagi, and double-V antennas. Chimney mounts and accessories.

Energy Farm Equipment Co.
Monticello, Iowa
All-hydraulic sectional TV mast, extended height about 60 feet.

Ferro Electric Products, Inc.
Kirkland, Ill.
Single-, 2-, and 4-bay conical antennas. Nine models. Accessories, ground rods, etc.

Fretco Television Co.
1041 Forbes St.
Pittsburgh 19, Pa.
Straight and folded dipoles. Three-, 4-, 5-, 6-element Yagis cut to channel. In-line folded high-low with directors and reflector. Conicals, collinear arrays, super-loop, broad-side arrays, phased arrays, custom-built arrays. "Fretline" open wire transmission line. TV lights. Seventy-seven models.

Gadgets, Inc.
3629 N. Dixie Drive
Dayton, Ohio
Indoor circular dipole.

Gee-Lar Mfg. Co.
1330 10th Ave.
Rockford, Ill.
Single-, 2-, and 4-bay conical antennas. Three models.

General Cement Mfg. Co.
919 Taylor Ave.
Rockford, Ill.
Single-, 2-, and 4-bay conical antennas. Indoor dipole. Chimney mounts, wall mounts, standoff insulators, lightning arresters, and other accessories.

Gonset Co.
72 E. Tujunga Ave.
Burbank, Calif.
Radar-type arrays, including dipole mattress types and quadrature-phased dipole curtain types; high-low-band and all-channel models. Telescopic masts. Low-loss open-wire line.

Don Good, Inc.
1014 Fair Oaks Ave.
South Pasadena, Calif.
Low-loss perforated TV lead-in wire. High-pass filters, TVI traps. Seven models.

Haygren Electronic Mfg., Inc.
436 18th St.
Brooklyn 15, N. Y.
Chimney mounts, wall brackets, clamps, insulators, and other accessories.

Hi-Lo TV Antenna Corp.
3540 N. Ravenswood Ave.
Chicago 13, Ill.
Indoor, outdoor spiral antennas. Two models.

Hy-Lite Antennae, Inc.
242 E. 137th St.
New York 51, N. Y.
Yagi, folded dipole, straight dipole, in-line, conical, bat-wing, V, and double-V antennas. Thirty models.

Insuline Corp. of America
36-02 35th Ave.
Long Island City, N. Y.
Wide-band systems, including conical and biconical single, double, and quadruple arrays in standard and heavy-duty models, folded dipoles and indoor-outdoor folded dipoles; 5-element Yagi types; kits and preassembled units. Forty-eight models. Masts, brackets, arresters, mounts, and other accessories.

JFD Mfg. Co.
6101 16th Ave.
Brooklyn, N. Y.
Multielement and multibay dipoles, folded dipoles, and conicals with various modifications; Yagis, window and indoor antennas, boosters. One hundred thirty-five models. Antenna kits, filters, masts, extensions, turnbuckles, cables, guy wires and rings, cable clamps, and other accessories.

Jerrold Electronics Corp.
26th and Dickinson Sts.
Philadelphia 46, Pa.
Master antenna systems for apartment houses, dealers, and communities.

Kay-Townes Antenna Co.
Box 92
Rockmart, Ga.
High-gain, all-band, fringe-area antennas. Twelve models. Cast-aluminum chimney mounts.

Kenwood Engineering Co., Inc.
Kenilworth, N. J.
TV antenna mounts, including eave, all-position, and parapet mounts; two sizes of wall brackets.

Knepper Aircraft Service Co.
Aero Television Tower Div.
1016-24 Linden St.
Allentown, Pa.
Tubular steel towers and poles. Ten-foot components, 20-foot one-piece tower and pole. Four tower models. Six pole models.

La Pointe-Plascomold Corp.
(Vee-D-X)
Windsor Locks, Conn.
Seven types of Yagi, two of collinear. Six series of Yagis, single-channel, two types of Yagi for multichannel use, three collinear antennas, conicals, folded dipoles and reflectors, dipoles and reflectors. Towers, boosters, lightning arresters, switches, and other accessories.

Louis Brothers
3543 E. 16th St.
Los Angeles 23, Calif.
Wide- and narrow-band arrays, masts, accessories. Seven models.

Milner Mfg. Co.
4359 Northview Drive
Jackson, Miss.
All-aluminum mast for 10- to 100-foot installations. Accessories.

National Electronic Mfg. Corp.
42-08 Vernon Blvd.
Long Island City, N. Y.
Wide-band antenna systems, including conical and quadruple arrays in standard and heavy-duty models; folded dipoles and arrays, window antennas; indoor dipoles and indoor-outdoor folded dipoles; 5-element Yagi types; kits and preassembled units. Forty-seven models. Masts, brackets, arresters, mounts, and other accessories.

Oak Ridge Products
37-01 Vernon Blvd.
Long Island City 1, N. Y.
High- and low-band antennas, straight and folded dipoles, in-line, conicals, fan-type arrays and Yagi arrays for all channels. Thirteen models.

Ohio Aerial Co.
4553 Lewis Ave.
Toledo, Ohio
Conical antennas. Two models. Accessories.

Walter E. Peek, Inc.
132 E. 44th St.
Indianapolis 5, Ind.
Six, 12-, and 16-element arrays with telescopic elements. Five models. Broad-band, double-stacked, collinear-dipole conical. One model.

Peerless Products Industries
812 N. Pulaski Road
Chicago 51, Ill.
Indoor brass dipoles. Two models.

Penn Boiler & Burner Mfg. Corp.
Lancaster, Pa.
Triangular and rectangular towers and poles, in various lengths, both guyed and self-supporting. Tower-top rotating motor mounts, concrete base blocks, pole bases, and associated hardware.

PRODUCTS DIRECTORY

Penn Television Products Co.
3336-40 Frankford Ave.
Philadelphia 34, Pa.
Two- and 3-channel switches. Two-set coupler; base, chimney, roof-peak mounts. Guy-wire rings, collars, and clamps. Twelve models.

Philco Corp.
A St. and Allegheny Ave.
Philadelphia 34, Pa.
Fan, V, and double-V broadband antennas. Folded high-low antennas. Yagis, cut to channel. Master antenna system. Lightning arresters, two models. TV booster, one model. Chimney, roof, and wall mounts, eight models. Steel masts, two models. Insulators, guy wire, coaxial cable.

Philson Mfg. Co., Inc.
60 Sackett St.
Brooklyn 31, N. Y.
Wide- and narrow-band arrays, conical, Yagi, indoor, and V antennas. Masts, chimney mounts, wall mounts.

Phoenix Electronics, Inc.
Lawrence, Mass.
Yagi, in-line, conical, folded dipole, and stacked antennas. Over 60 models. Chimney, roof, wall, vent-pipe, eave, and universal mounts. Ten models. Standoff insulators and other accessories.

Price Tenna-Trailer Co.
Watseka, Ill.
Portable TV demonstrating unit. TV masts.

Radelco Mfg. Co.
7580 Garfield Blvd.
Cleveland 25, Ohio
Folded dipoles, conicals, tri-channel and preassembled Yagis and indoor antennas. Twenty models. Stacking kits, wall and chimney mounts, and other accessories.

The Radiart Corp.
3571 W. 62nd St.
Cleveland 2, Ohio
Indoor antennas, conical, all-channel, single- and double-stacked units, folded dipoles and reflectors, high-low, and straight-line antennas. Yagis cut to channel. Twenty-one models. Stacking kits for conicals, super-V's, straight-line antennas, and Yagis. Mounting equipment, standoff insulators, lightning arresters, transmission line, masts.

Radio Corp. of America
Electronic Components
Harrison, N. J.
Unidirectional all-channel antennas, lobe-switching, reversible-beam, unidirectional arrays, V attachments. Lightning arresters, guy rings, and mounting brackets.

The Radion Corp.
1130 W. Wisconsin Ave.
Chicago, Ill.
Indoor dipoles, printed-circuit, and window antennas, high-low folded dipoles, conicals, and Yagis. Base mounts.

Radio Merchandise Sales, Inc.
1165 Southern Blvd.
New York 59, N. Y.
Corner arrays, Yagis, folded dipoles, combinations, in-line, conicals, super-conicals, indoor and window antennas. Masts, lightning arresters, boosters; open transmission line.

Ramsey Radio & Television Co.
Box 297
Ramsey, Ill.
Tubular steel towers in 10-foot sections; 27-foot roof-mounting tower with telescoping mast.

Ray Mfg. Co.
441 Summit
Toledo, Ohio
Conical antennas, motorless, "rotating," double-stacked conicals.

Walter L. Schott Co. (Walsco)
3225 Exposition Place
Los Angeles 18, Calif.
Conicals, double-V's, in single-, 2-, and 4-bay stacks. Yagis. Stacking kits, mast bases, guy rings, guy wire, standoff insulators, feed-through bushings.

Snyder Mfg. Co.
22nd and Ontario
Philadelphia, Pa.
Conicals, folded and straight dipoles, Yagis, window, indoor, and outoor antennas. Clamps, guy rings, brackets, standoff insulators, and other accessories.

South River Metal Products Co., Inc.
377-379 Turnpike
South River, N. J.
Chimney-mount antenna bases. Five models. Wall brackets, vent-pipe mounts, roof mounts, eave mounts, guy clamps, universal guy rings, screw eyes, adjustable mast standoffs, snap-ons.

Spirling Products Co., Inc.
62 Grand St.
New York 13, N. Y.
Indoor and outdoor antennas. Yagis, conicals, single, and stacked. Eight models.

Square Root Mfg. Corp.
391 Saw Mill River Road
Yonkers 2, N. Y.
Outdoor antennas, built-in quadraphased antennas, indoor and window antennas.

Tele-Matic Industries, Inc.
1 Joralemon St.
Brooklyn, N. Y.
Conicals, 1 bay, 2-stacked, 4-stacked, straight and folded high-low, straight low-folded high; in-line; broad-band Yagis, narrow-band Yagis; square-corner reflectors; high-gain narrow-beam vector antennas; double-V, 1-bay, 2-stacked, 4-stacked; double-driven single-channel Yagis, double-driven 2-channel Yagis. Twenty-four models.

T.V. Development Corp.
2024 McDonald Ave.
Brooklyn 23, N. Y.
Indoor antennas. Four models.

T-V Products Co.
152 Sandford St.
Brooklyn 5, N. Y.
Yagis, V's, in-lines, straight and folded dipoles, conical antennas. Roof, chimney, and wall mounts. Masts and joiners. Fifty-four models.

Taylor Mfg. Co.
P.O. Box 851
Lima, Ohio
Antenna mast mountings, chimney, wall, and roof types. Mast couplers and guy-wire clamps. Eleven models.

Technical Appliance Corp. (Taco)
Sherburne, N. Y.
Broad-band, all-channel antennas, conical and high-low types. Yagis, twin-driven 5-element, indoor, dipole, and folded dipole antennas. Sixty models. Accessories, mast mounts, lightning arresters, antenna amplifiers, master antenna distribution systems.

Tel-A-Ray Enterprises, Inc.
P.O. Box 332
Henderson, Ky.
Five-element, wide-spaced Yagis, cut to single channel. Thirteen models. Three-element wide-spaced Yagis, cut to single channel. Thirteen models. Antenna-mounted preamplifier.

Television Laboratories, Inc.
5045 W. Lake St.
Chicago 44, Ill.
Printed-circuit and under-rug antennas. Thirteen models.

Telrex, Inc.
Asbury Park, N. J.
Conical V beams, all-band arrays, indoor, outdoor, window, and Yagi antennas. Thirty-one models.

Tempo T-V Products
2450 Ramona Blvd.
Los Angeles 33, Calif.
Eighteen sizes of steel telescopic masts, from 20 to 70 feet. Steel bases and guy rings.

Thomas Mold & Die Co.
Box 126
Wooster, Ohio
Forty-, 60-, 80-, and 100-foot telescopic masts. Two models. Truck and trailer mounts.

Towers Corp.
3332 E. 55th St.
Cleveland 27, Ohio
Towers, mast extensions, guy rings, and hardware.

Tricraft Products Co.
1535 N. Ashland Ave.
Chicago 22, Ill.
Loaded dipoles, high-low folded dipole and reflector, single and stacked conical, cut-to-channel Yagis, all-wave Yagis, indoor and window antennas. Masts, kits, and accessories. Twenty-six models.

Trio Mfg. Co.
Griggsville, Ill.
Single and 2-channel double-dipole Yagi arrays. Phasing units, rotators, aluminum towers, and accessories. Thirteen antenna models.

Veri-Best Electronics Co.
655 Main St.
Westbury, Long Island, N. Y.
Conical, straight and folded dipoles, Yagi, V and H types, Bazuka antennas, window Bazuka antennas, in-line and barrage antennas. Single-channel, pre-tuned boosters, 2-set couplers, inductive couplers, high-pass filters, chimney and wall mounts, masts, base mounts.

Walnut Machine Co.
1525 S. Walnut St.
South Bend 14, Ind.
Stacked array with aluminum phasing harness. Antenna mount.

Ward Products Corp.—
Div. of The Gabriel Co.
1523 E. 45th St.
Cleveland 3, Ohio
Installation kits, Para-Cons, Yagis, high-low, in-line, Perma-tube. Twenty-one models.

Warren Mfg. Co., Inc.
250 East St.
New Haven, Conn.
Conical, indoor, Yagi, high-low straight and folded dipole, single and stacked V antennas. Thirty-two models. Chimney, swivel, and eave mounts. Wall brackets, guying and mast clamps, and extenders.

Wells and Winegard
323 S. 8th St.
Burlington, Iowa
Combination-channel Yagi antennas. Four models. Boosters.

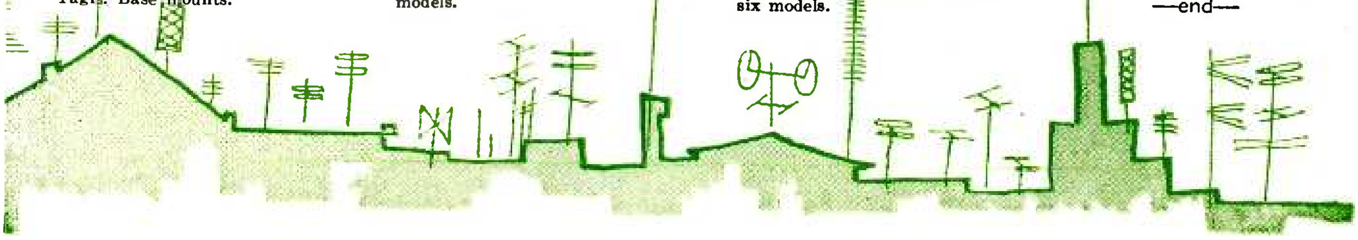
Western Coil & Electrical Co.
215 State St.
Racine, Wis.
TV towers, sixteen models. Partially telescoping masts. 19 to 46 feet high, four models. Guy rings, insulators, and other accessories.

Wincharger Corp.
East 7th at Division St.
Sioux City 2, Iowa
Guyed and self-supporting towers. Insulated and noninsulated uniform, triangular cross-section, guyed towers.

Wind Turbine Co.
266 E. Market St.
West Chester, Pa.
Masts, guyed; steel ladder towers, antenna support brackets. Twenty-five models.

The Workshop Associates—
Div. of The Gabriel Co.
135 Crescent Road
Needham Heights 94, Mass.
Double-V all-channel antennas, cut-to-channel beams. Matching transformers, coaxial switches, connectors, and other accessories.

—end—



BOOSTERS

THE TV technician may sometimes solve reception problems by installing a booster. In fringe areas, they may raise signal strength enough to bring in a viewable picture. In city locations where outside antennas are sometimes prohibited, a booster and an indoor antenna may bring in a usable signal not obtainable with the indoor antenna alone. A booster may improve the signal-to-noise ratio enough at bad locations to raise a poor picture to an enjoyable level. Under some circumstances a booster may also be useful in reducing interference.

Boosters fall into four groups: The standard type which mounts beside or on top of the set; the booster mounted on the rear of the cabinet; the antenna-mounted type; and the i.f. booster.

The r.f. booster is far more common than the i.f. type, and of the r.f. boosters the single-tube (usually 6J6) unit is most popular. These usually have switches to change from high- to low-band coils (or portions of the same coil) and slug-tuning to select channels within each band. The circuit is tuned-plate-tuned-grid, neutralized or "balanced" to prevent oscillation. Boosters with capacitor tuning can be found, and one (the DeciMeter *Professional*) uses switching for each channel, all fine adjustments being factory preset.

The next most common type is the wide-band booster. Its tuning circuits are designed to resonate over a wide range of frequencies—across either the high or low television band. Some of these boosters use separate amplifiers for the high and low bands, with input coils so arranged that no switching is necessary. Others switch to high or low bands, using either a single amplifier or occasionally two separate ones. In some cases the booster will accommodate separate high- and low-band antennas.

The hideaway type of booster, designed to mount on the back of the cabinet, invariably has a thermal or magnetic relay which puts it into operation when the receiver switch is turned on. This automatic feature is found in some standard boosters, as well as a semiautomatic variation in which the receiver is turned on with the booster switch.

The antenna-mounted booster follows standard circuitry. At least two companies use identically the same hookup for their antenna-mounted booster that they use with their regular unit. Power is supplied along the transmission line, with filters at the power supply and booster to keep the TV signal from dissipating into the power circuits. An automatic switch cuts off power to the booster when the TV set is turned off. Antenna boosters designed for commercial 24-hour use have a separate power lead and a manual switch.

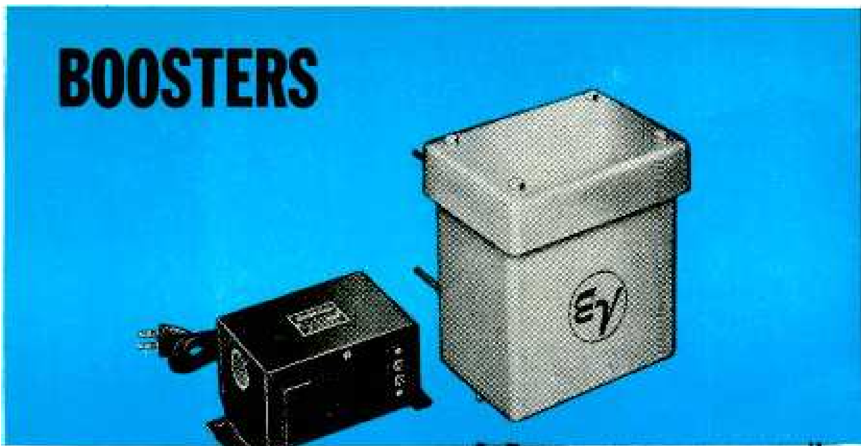
Other variations are the single-channel unit, which is just a special kind of tuned booster; the continuous-tuning type, which usually has a Mallory In-

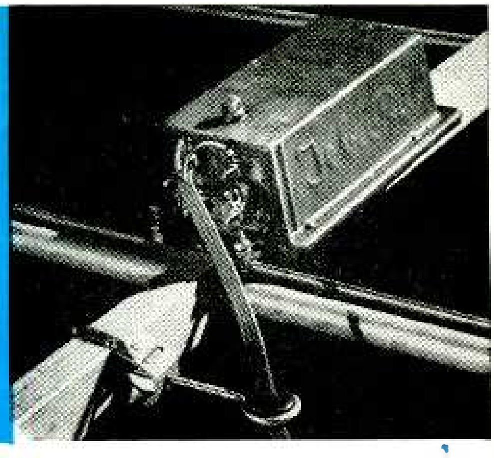
(*Turn to page* 64)

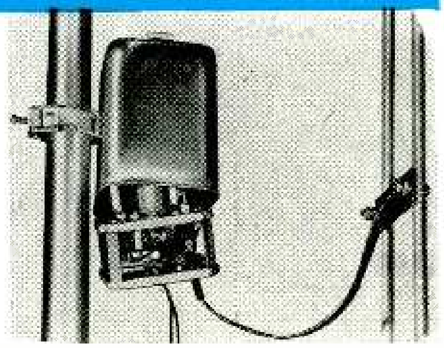
Manufacturer	Model	Band selection	Channel tuning	Tube(s)	Circuit	Instal-lation	Other features
Alliance Manufacturing Co. Lake Park Blvd., Alliance, Ohio	Tenna-Scope AB	Switching sep. amps	Slug	2–6J6	T.p.t.g.	St.	Auto.
Anchor Radio Corporation 2215 So. St. Louis Ave. Chicago 23, Ill.	ARC-101-75	All-channel switching	Slug	1–6AK5	T.p.t.g.	St.	
	ARC-101-100	All-channel switching	Slug	2–6AK5	2-stage		
Approved Electronic Inst. Corp. 142 Liberty St., New York, N. Y.	A-TVB	Chan. 12-13	Untuned	2–6J6	2-stage	St.	
The Astatic Corp. Conneaut, Ohio	AT-1	Switching sep. amps	2 capacitor conts.	4–6AK5	2-stage	St.	
	BT-1 & BT-2[1]	Continuous	Inductuner	1–6AK5	T.p.t.g.	St.	
Blonder-Tongue Labs. 38 North 2nd Ave. Mount Vernon, N. Y.	HA-2-M Antensifier	All-channel wide-band	Untuned	3–6J6 1–12AV7	4-stage	St.	Auto.
David Bogen Co., Ltd. 663 Broadway, New York, N. Y.	BB1 and BB2[2]	Switching sep. amps	Slug	2–6J6	T.p.t.g.	St.	Auto.
Brach Manufacturing Corp. 200 Central Ave., Newark, N. J.	50825	Sep. amps wide-band	Slug adjust.	1–6AK5 1–6CB6	T.p.t.g.	St.	
DeciMeter, Inc. 1430 Market St., Denver 2, Colo.	"Professional"	All-channel with switches	Switch-tuned	4–6J6	2-stage	St.	
Electro-Voice, Inc. Buchanan, Mich.	3000	Sep. amps wide-band	Untuned	4–6J6	2-stage	St.	Auto. 1 or 2-ant. input
	3002	Sep. amps wide-band	Untuned	2–6BK7	1-stage broad-band	St.	Auto.
	3010	Sep. amps wide-band	Untuned	4–6J6	2-stage broad-band	Ant.	Auto. 1 or 2-ant. input
I.D.E.A. Inc. 55 No. New Jersey St. Indianapolis 4, Ind.	Regency DB-410	All-channel switching	Slug	1–6J6	T.p.t.g.	St.	
Industrial Television, Inc. 359 Lexington Avenue Clifton, N. J.	IT-75A[3]	Sep. amps wide-band	Slug adjust.	1–6AK5 1–6CB6	T.p.t.g.	Rear	Auto. 1 or 2-ant. input
	IT-96A	Single channel	Fixed	2–6CB6 1–6AK5	2-stage	Rear	Auto. adj. gain
	IT-90A	Sep. amps wide-band	Untuned	1–6CB6 1–6BQ7 1–6X4	2-stage cascode	Rear	Auto. adj. gain 1 or 2-ant. input
J F D Manufacturing Co. 6101-23 Sixteenth Ave. Brooklyn 4, N. Y.	VB (channel No.)[4]	Single channel	Factory preset	1–6J6	T.p.t.g.	Rear	
	SW (channel No.)	Single channel	Factory preset	1–6J6	T.p.t.g.	Rear	Bypassing switch
The La Pointe-Plascomold Corp. Windsor Locks, Conn.	Vee-D-X Outboard	Single channel	Slug adjust.	1–6J6	T.p.t.g.	Rear	Auto.
	Vee-D-X Rocket	Single channel	Slug adjust.	1–6J6	T.p.t.g.	Ant.	Auto.
Masco Electronic Sales Corp. 32-28 49th St. Long Island City 3, N. Y.	Sky Chief	All-channel switching	Slug	2–6J6	T.p.t.g.	St.	
	Super Sky Chief	All-channel switching	Slug	4–6J6	T.p.t.g.	St.	
National Co. Inc. 61 Sherman St., Malden, Mass.	TVB-2B	All-channel turret	Capacitor	1–6AK5	T.p.t.g.	St.	Separate output tuning control
Oak Electronics 150 Oak St., Buffalo, N. Y.	Oak	Continuous 54—220 mc	Inductuner	1–6AK5 1–6AG5	T.p.t.g.	St.	Auto.
Radio Merchandise Sales, Inc. 1165 Southern Blvd. New York 59, N. Y.	SP-5	All-channel switching	Slug	1–6AK5	T.p.t.g.		
Regency—See I.D.E.A.							
Sonic Industries Inc. 221 W. 17th St., New York, N. Y.	Super Sonic	Continuous 50—220 mc	Spiral	1–6J6	T.p.t.g.	St.	
Standard Coil Products Co. 2329 No. Pulaski Rd. Chicago 39, Ill.	B-51	All-channel wide-band	Untuned	1–6AK5	T.p.t.g.	St.	
Sutton Electronics Co. 426 West Short St. Lexington, Ky.	16B	All-channel switching	Slug	1–6J6	T.p.t.g.	St.	
Tech-Master Products Co. 443 Broadway, New York, N. Y.	TVB	All-channel switching	Capacitor	1–6AK5	Tuned plate	St.	Kit form
Technical Appliance Corp. Sherburne, N. Y.	Taco 1628	Single channel	Factory preset	1–6AK5	T.p.t.g.	Ant.	Auto.
Tel-A-Ray Enterprises, Inc. Box 332, Henderson, Ky.	TB (channel No.)	Single channel	Fixed	1–6J6	T.p.t.g.	Ant.	Auto., separate power lead
The Turner Company Cedar Rapids, Iowa	TVI	Continuous 54—216 mc	Inductuner	1–12AT7	Cascode	St.	Auto.

Footnotes

[1] BT-1, wooden; BT-2, plastic cabinet.
[2] BB1, metal cabinet; BB2, wood cabinet.
[3] IT-75A Autobooster is a home type; Multibooster a commercial type amplifier designed for 24-hour use in distribution systems.
[4] These are made for all TV channels. In addition there are four two-channel models and one for the FM band.







ductuner and is useful across the FM band; and the multistage amplifier, whose tuning systems may be any one of those already described.

The table on page 63 presents the characteristics of all boosters on which we have been able to obtain data. As used in the table, the term "wide-band" refers to an amplifier which operates over one or both of the TV bands without tuning. Some of those with separate amplifiers for high and low bands need neither tuning nor switching. The term "switching," under the heading "Band selection," refers to an amplifier which switches from low to high bands, whether it has a single amplifier or one for each band. "Standard" ("St." in the table) simply means the common type of installation in which the booster is mounted beside or on top of the receiver. "Auto," refers to automatic turning on and off with the receiver, and "T.p.t.g." means tuned-plate-tuned-grid circuit. All other terms are probably self-explanatory.

A close relative of the standard booster is the commercial r.f. amplifier. These in some cases may differ from the home booster only in their more careful design and rugged construction. The Blonder-Tongue CA-1-M is simply the commercial version of the home booster HA-1-M (now superseded by the HA-2-M). The ITI Multibooster is a commercial form of the Autobooster, and differs from it in that it has a gain control and lacks the automatic on–off feature. Since commercial boosters are often designed for 24-hour use, a manual switch is sufficient. One of the JFD antenna-mounted jobs is built to commercial as well as to consumer specifications, and the Brach 01630 is another of the commercial amplifier group.

Distribution systems

An important kind of booster is the *television distribution system.* These are arrays of equipment in which the signal from one antenna is amplified and fed to a number of sets. They may be elaborate sets like those of Jerrold (Philco), TACO, or RCA, intended for apartment houses but actually capable of supplying large villages with otherwise unobtainable television signals. On the other hand, they may be small two-output jobs, such as the Blonder-Tongue DA2-1-M.

The two-output and eight-output boosters of the smaller multiple-unit systems can be hooked together with these single-output jobs to form multiple installations for stores or small buildings. The large distribution systems for apartment-house use have multitube amplifiers for each channel, often combined with single-output boosters in the line when twin-lead runs are long. Each installation job—whether small or large—is a problem in itself, and the installer should check his own ideas and calculations with those of the manufacturer's engineers before buying a number of units.

A less common type of booster adds another i.f. stage to the receiver. Such boosters are made by Barb City Industries of DeKalb, Ill., Grayburne Corporation of Yonkers, N. Y., and—in a specialized form—by Raytheon. The booster is constructed to plug into one of the i.f. sockets. The i.f. tube which was removed is then plugged back into one of the booster sockets and an additional tube of the same type plugged into an additional socket mounted above it. The additional i.f. tube is the same type as those in the set, if the receiver's filaments are wired in parallel. For series-wired sets, two 6BJ6 or 6BH6's are used in parallel to draw the standard 0.3 ampere. Trimmers to tune the additional stage to the common TV intermediate frequencies are provided.

The Raytheon i.f. booster is intended for the sound channel of certain receivers in the Raytheon-Belmont line, to adapt them to rural fringe-area reception, where the excellent video i.f. succeeds in picking up a good picture beyond the receiver's sound range.

Making the installation

Installation procedure for standard boosters is simple. The manufacturer's literature often assumes that the set owner will install his own booster. However, the service technician will be called on to make many installations of boosters—some with the original sale of the set, some for those who have sets but prefer not to do any work on their receivers.

It is worth while to note that the instructions often overlook important points. A number of manufacturers urge that the leads to the set be as short as possible. One supplies a pre-cut booster-receiver connection. A few suggest matching antenna to booster and booster to set by running the hand—or sliding the familiar piece of tin foil—along the line till the picture is brightest. The lead may then be cut and the equipment attached at that point, or the tin foil may be secured with tape and left there. At least one manufacturer emphasizes that the point of maximum satisfaction will be true for one channel only, and suggests the set and booster should be matched to the weakest channel, or the particular one to be favored. Rear-mounted boosters require the same care in matching as the standard type, plus tuning adjustments and occasionally gain adjustments.

Attenuators may in some cases be required if the booster is being used to improve selectivity in strong-signal areas. A booster, of course, requires service the same as any other piece of television equipment. —end—

Directory of TV Receiver Characteristics

Manufacturer	Model	Chassis number	Cabinet or chassis type	AM-FM-SW	C-R tube size (inches) & type	C-R tube anode kilovolts	Number of tubes	Intercarrier sound	Type of AGC	Video i.f. stages	Video i.f. megacycles	Provision for u.h.f.	Speaker type and size (inches)	Type of tuner	Accessories
Admiral Corp. 3800 West Cortland St. Chicago 47, Ill.	15K21	20T1	T	No	14CP4	12	20	Yes	Ord	3	25.75	Yes	5PM	Tur	No
	17K22, 17M16	21P1, -F1	T	No	17BP4[12]	14	21	Yes	Key	3	25.75	Yes	5PM	Tur	No
	27K85, 27K86, 27K87	21P1, -F1	C	No	17BP4[12]	14	21	Yes	Key	3	25.75	Yes	10PM	Tur	No
	37K55, 37K56, 37K67	21G1, -Q1	C	AM	17BP4[12]	14	21	Yes	Key	3	25.75	Yes	8PM	Tur	Ph
	37F55, 37F56, 37F67	21G1, -Q1	C	AM-FM	17BP4[12]	14	21	Yes	Key	3	25.75	Yes	8PM	Tur	Ph
	121K15, 121K16, 121K17	21M1	T	No	20CP4[6]	14	21	Yes	Key	3	25.75	Yes	5 or 6 PM	Tur	No
	221K45, 221K46, 221K47	21M1	C	No	20CP4[6]	14	21	Yes	Key	3	25.75	Yes	8PM	Tur	No
	321F65, 321F66, 321F67	21N1	C	AM-FM	20CP4[6]	14	21	Yes	Key	3	25.75	Yes	10PM	Tur	Ph
	321K65, 321K66, 321K67	21N1	C	AM	20CP4[6]	14	21	Yes	Key	3	25.75	Yes	10PM	Tur	Ph
Affiliated Retailers, Inc. (Artone) 855 6th Ave. New York, N. Y.	17RO		T	No	17		19	Yes	Ord				6		
	17CD, 17CR		C	No	17		19	Yes	Ord				6		
	20RO		T	No	20		19	Yes	Ord				6		
	20CD, 20CR		C	No	20		19	Yes	Ord				6		
Andrea Radio Corp. 27-01 Bridge Plaza North Long Island City 1, N. Y.	Brewster C-VL-17	VL-17	C	FM	17CP4	13.5	23	No	Key	4	26.2	No	12PM	Con	No
	Caronia CO-VL 19	VL-19	C	AM-FM	19AP4	14	29	No	Key	4	26.2	No	12PM	Con	Ph
	Fleetwood CO-VL 16	VL-16	C	FM	16GP4	13.5	26	No	Key	4	26.2	No	10PM	Con	Ph
	Gotham T-VL 17	VL-17	T	FM	17CP4	13.5	23	No	Key	4	26.2	No	7PM	Con	No
	Sutton C-VL 16	VL-16	C	FM	16GP4	13.5	26	No	Key	4	26.2	No	12PM	Con	No
Arvin Industries, Inc. Columbus, Ind.	5170, 5171, 5171TM, 5172, 5173	TE302	T	No	17BP4	12	26	Yes	Key	4	45.75	Yes	6D	Sw	PJ-LD
	5204, 5206	TE300	C	No	20CP4[6]	13	26	Yes	Key	4	45.75	Yes	10D	Sw	PJ-LD
	5210, 5211, 5212, 5212CFP	TE315	C	No	21AP4	15	26	Yes	Key	4	45.75	Yes	10D	Sw	PJ-LD
Automatic Radio Mfg. Co., Inc. 122 Brookline Ave., Boston 15, Mass.	5116R & 5160	4	C	No	17BP4	14	21	Yes	Ord	3	25.75	Yes	10	Tur	No
	5217	4	T	No	17BP4	14	21	Yes	Ord	3	25.75	Yes	6	Tur	No
	5220	4	C	No	20CP4	14	21	Yes	Ord	3	25.75	Yes	12	Tur	No
	5220T	4	T	No	20CP4	14	21	Yes	Ord	3	25.75	Yes	6	Tur	No
Bace Television Corp. Green and Lenning Sts. South Hackensack, N. J.	170C, 170HD, 170FD	630	C	No	17	13.5	30	No	Key	4	25.75		12		PJ
	170TM	630	T	No	17	13.5	30	No	Key	4	25.75		5x7		PJ
	20C	630	C	No	20	13.5	28	No	Key	4	25.75		12		PJ
	20RCH	630	C	No	20	13.5	28	No	Key	4	25.75		12		PRC
	Club 24	630	C	No	24	13.5	28	No	Key	4	25.75		12		RC
Bell Television, Inc. 552 W. 53rd St. New York 19, N. Y.	R916	1631	T	No	16DP4	10	31	No	Key	4	25.75	No	12PM	Tur	RC
	R920	1930	T	No	20CP4	12	30	No	Key	4	25.75	No	12PM	Tur	RC
	R924	1930	T	No	24AP4A	15	30	No	Key	4	25.75	No	12PM	Tur	RC
Belmont Radio Corp. (Raytheon Manufacturing Co.) 5921 W. Dickens Ave. Chicago, Ill.	1720	17AY27	C&T	AM	17BP4	12	22	Yes	Key	4	26.75	Yes	6PM	Con	3PI
	C1714	17AY21	C&T	No	17BP4	12	22	Yes	Key	4	26.75	Yes	6PM	Con	No
	C1715	17AY21	C		17BP4	12	22	Yes	Key	4	26.75	Yes	6PM	Con	No
	C1724	17AY21	C		17BP4	12	22	Yes	Key	4	26.75	Yes	10PM	Con	No
	C2001, C2002, C2006	20AY21	C	No	20CP4	17	25	Yes	Key	4	26.75	Yes	10PM	Con	No
	M1711, M1712, M1725[3]	17AY21	T	No	17BP4	12	22	Yes	Key	4	26.75	Yes	6PM	Con	No
	M2007, M2008[3]	20AY21	T	No	20CP4	17	25	Yes	Key	4	26.75	Yes	10PM	Con	PJ
	RC-1718, RC-1720[3]	17AY21	C	AM	17BP4	12	22	Yes	Key	4	26.75	Yes	6PM	Con	3PI
	RC-2005[3]	20AY21	C	AM-FM	20CP4	17	25	Yes	Key	4	26.75	Yes	12PM	Con	3PI

Manufacturer	Model	Chassis number	Cabinet or chassis type	AM-FM-SW	C-R tube size (inches) & type	C-R tube anode kilovolts	Number of tubes	Intercarrier sound	Type of AGC	Video i.f. stages	Video i.f. megacycles	Provision for u.h.f.	Speaker type and size (inches)	Type of tuner	Accessories
Bendix Radio Baltimore 4, Md.	C172, C182, C200	T9	C	No	17BP4[8]	11	22	Yes	Key	3	25.75	Yes	12PM	Sw-Tur	No
	C174, C176B	T5	C	No	17BP4	11	17	Yes	Ord	2	25.75	Yes	12PM	Sw-Tur	No
	T170, T173, T190	T5	T	No	17BP4	11	17	Yes	Ord	2	25.75	Yes	8PM	Sw-Tur	No
	T171	T9	T	No	17BP4[8]	11	22	Yes	Key	3	25.75	Yes	8PM	Sw-Tur	No
Cadillac Electronic Corp. 19 West 26th St. New York 10, N. Y.	1651		T	No	16		19	Yes	Ord			Yes	12	Tur	No
	1652, 1654		C	No	16		19	Yes	Ord			Yes	12	Tur	No
	1653		C	No	20		19	Yes	Ord			Yes	12	Tur	No
Capehart-Farnsworth Corp. 3702 E. Pontiac Ave. Ft. Wayne, Ind.	320B, 320M, 321B, 321M	CX-33	T	No	17	11	23	Yes	Ord	3	25.75	Yes	6PM	Tur	No
	322RAB, 322RAM, 324M, 324RB, 324AF	CX-33	C	No	17	11	23	Yes	Ord	3	25.75	Yes	12PM	Tur	No
	335M, 338, 339, 340, 341	CX-33	C	No	20	11	23	Yes	Ord	3	25.75	Yes	12PM	Tur	No
	328M	CX-33	C	AM-FM	17	11	21	Yes	Ord	3	25.75	Yes	12PM	Tur	3PI
	337CN, 337M	CX-33	C	AM-FM	19	11	21	Yes	Ord	3	25.75	Yes	12PM[21]	Tur	3PI
	337RCM, 337RM	CX-33	C	AM-FM	19	11	21	Yes	Ord	3	25.75	Yes	12PM	Tur	3PI
	337RACM, 337RAM	CX-33	C	AM-FM	20	11	21	Yes	Ord	3	25.75	Yes	12PM	Tur	3PI
Cascade Television Company 153 Chestnut Ave. Irvington 11, N. J.	503	630K3C	C	No	17BP4[8]	14.5	30	No	Key	4	26.25	Yes	12	Tur	PJ
	LD24	630K24	WC	No	24AP4	16	36	No	Key	4	26.25	Yes	12	Tur	RC
	F42-4X3	630K	C	No	5TP4[9]	25	42	No	Key	4	26.25	Yes	12	Tur	RC
Certified Radio Laboratories 5507 13th Ave. Brooklyn 19, N. Y.		4920	K	No	16HP4	11	20	Yes	Ord	4	25.75	Yes	4x6	Tur	No
		5120	WC	No	20CP4	14	20	Yes	Ord	4	25.75	Yes	12	Tur	No
Conrac, Inc. 19217 E. Foothill, Glendora, Cal.	27M40, 27W40, 28B40	40	C	No	20CP4	13.5	24	No	Ord	4	25.75	Yes	12PM	Tur	PJ
	32M44, 33B44, 34P44	44	C	No	24AP4	16	24	No	Ord	4	25.75	Yes	12PM	Tur	PJ
Covideo, Inc. 212 Broadway, New York, N. Y.	T-2020		T	No	20	11	20	Yes	Ord	3	25.75		5		CO
Crosley Division Avco Mfg. Corp. 1325 Arlington St. Cincinnati 25, Ohio	DU17TOB, -TOL, -TOM	356-1	T	No	17BP4A	12	19	Yes	Key	4	26.4	Yes	5 1/4 PM	Con	No
	DU17CDB, -CDM, -CHB, -CHM, -CHN, -COB, -COM	356-1	C	No	17BP4A	12	19	Yes	Key	4	26.4	Yes	10PM	Con	No
	DU17PDM, -PDB	359	C	No	17BP4A	12	19	Yes	Key	4	26.4	Yes	10PM	Con	Ph
	DU17PHB, -PHM, -PHN	359	C	AM	17BP4A	12	19	Yes	Key	4	26.4	Yes	6x9PM	Con	Ph
	DU20CDM, -CHM, -COB, -COM	357	C	No	20CP4	12	19	Yes	Key	4	26.4	Yes	10PM	Con	No
	DU20PDM	363	C	AM-FM	20CP4	12	19	Yes	Key	4	26.4	Yes	10PM	Con	Ph
De Wald Radio Mfg. Corp. 35-15 37th Ave. Long Island City, N. Y.	ET140	ET140	T	No	14CP4	11.5	20	Yes	Ord	4	21.75	Yes	6PM	Con & Tur	No
	ET170	ET170	T	No	17BP4	11.5	20	Yes	Ord	4	21.75	Yes	6PM	Con & Tur	No
	ET171	ET171	C	AM	17BP4	11.5	20	Yes	Ord	4	21.75	Yes	10PM	Con & Tur	Ph
	ET172	ET172	C	No	17BP4	11.5	20	Yes	Ord	4	21.75	Yes	10PM	Con & Tur	No
	ET190	ET190	C	No	20CP4	11.5	20	Yes	Ord	4	21.75	Yes	10PM	Con & Tur	No
	ET1020	ET1020	T	No	10BP4	11.5	20	Yes	Ord	4	21.75	Yes	6PM	Con & Tur	No
Allen B. Du Mont Laboratories, Inc. 35 Market St. East Paterson, N. J.	Andover	RA147A	C	FM	17BP4	10	23	No	Ord	4	26.25	EC	10PM	Con	TE-PJ-VJ
	Ardmore, Mt. Vernon, Westerly	RA112A	C	FM	19AP4A	13	25	No	Ord	4	26.25	EC	10PM	Con	TE-PJ-VJ
	Brookville, Burlingame, Revere	RA113B	C	FM	17BP4	13	25	No	Ord	4	26.25	EC	10PM	Con	TE-PJ
	Carlton, Sumter	RA117A	T	No	17BP4	10	23	No	Ord	4	26.25	EC	5PM	Con	TE-PJ-VJ
	Hanover	RA109A[1]	C	FM	19AP4	16	34	No	Ord	4	26.25	CMC	10PM	Con	TE-PJ
	Park Lane, Strathmore	RA117A	C	No	17BP4	10	23	No	Ord	4	26.25	EC	10PM	Con	TE-PJ-VJ

Allen B. DuMont Laboratories, Inc. (continued)	Park Lane	RA147A	C	FM	17BP4	10	23	No	Ord	4	26.25	EC	10PM	Con	TE-PJ-VJ
	Royal Sovereign	RA119A[1]	C	FM	30BP4	22	45	No	Ord	4	26.25	EC	10PM	Con	TE-PJ-VJ
	Sherbrooke	RA109A[1]	C	AM-FM	19AP4	16	34	No	Ord	4	26.25	CMC	12PM	Con	TE-3PI
	Sherbrooke	RA130A[1]	C	AM-FM	21EP4A	16	35	No	Ord	5	26.25	CMC	12PM	Con	TE-3PI-VJ
	Tarrytown	RA120A	C	AM-FM	17BP4	13	25	No	Ord	4	26.25	EC	12PM	Con	TE-3PI-VJ
	Westbury II	RA109A[1]	C	FM	19AP4A	16	34	No	Ord	4[2]	26.25	CMC	10PM	Con	TE-PJ-VJ
Electro Technical Industries 1432 N. Broad St., Philadelphia, Pa.	19C	19C	K, T, or C		[5]	14	17	Yes	Ord	3	25.75	No	4x6PM	Sw	
Emerson Radio & Phonograph Corp. 111 Eighth Ave. New York 11, N. Y.	665	120131B[7]	C	AM	12LP4	10.5	17	Yes	Ord	3	25.75	Yes	12D	Tur	3PI
	666	120135B	C	AM-FM	16GP4	11-14	22	Yes	Ord	4	25.75	Yes	12PM	Tur	3PI
	680	120140B	T	No	17BP4	11-14	23	Yes	Ord	4	25.75	Yes	6PM	Tur	No
		120144B	T	No	17CP4	11-14	23	Yes	Ord	4	25.75	Yes	6PM	Tur	No
	681	120143B	C	No	17CP4	13	23	Yes	Ord	3	25.75	Yes	12PM	Tur	No
	686	120143B	C	No	17CP4	13	23	Yes	Ord	3	25.75	Yes	12PM	Tur	No
		120142B	C	No	17BP4	13	23	Yes	Ord	3	25.75	Yes	12PM	Tur	No
	687	120143B	C	No	17CP4	13	23	Yes	Ord	3	25.75	Yes	12PM	Tur	No
		120142D	C	No	17BP4	13	23	Yes	Ord	3	25.75	Yes	12PM	Tur	No
	690B	120129B	C	No	19AP4	12-14	23	Yes	Ord	4	25.75	Yes	12PM	Tur	No
	693B	120129D	C	No	20CP4	12-14	23	Yes	Ord	4	25.75	Yes	12PM	Tur	No
	694B	120129D	C	No	20CP4	12-14	23	Yes	Ord	4	25.75	Yes	12PM	Tur	No
	696	120143B	T	No	17CP4	13	23	Yes	Ord	3	25.75	Yes	6PM	Tur	No
		120142B	T	No	17BP4	13	23	Yes	Ord	3	25.75	Yes	6PM	Tur	No
	697B	120129D	C	No	20CP4	12-14	23	Yes	Ord	4	25.75	Yes	6PM	Tur	No
	699	120148B	C	No	17CP4	13	23	Yes	Ord	3	25.75	Yes	12PM	Tur	3PI
Fada Radio & Electric Co., Inc. 525 Main St. Belleville, N. J.	R7C15	None	C	No	17BP4	13	27	No	Key	4	25.75	Yes	10PM	Tur	No
	R7C25	None	C	No	17BP4	13	27	No	Key	4	25.75	Yes	10PM	Tur	No
	R1045	None	T	No	12LP4	11	24	No	Key	4	25.75	Yes	6PM	Tur	No
	S7C20, S7C30	None	C	No	17BP4	13	21	Yes	Ord	3	26.1	Yes	10PM	Con	No
	S7T65, 1070	None	T	No	17BP4	13	21	Yes	Ord	3	26.1	Yes	6PM	Con	No
	S20C10	None	C	No	20CP4	14	21	Yes	Ord	3	26.1	Yes	10PM	Con	No
	S20T20	None	T	No	20CP4	14	21	Yes	Ord	3	26.1	Yes	6PM	Con	No
Firestone Tire and Rubber Co. 1200 Firestone Pkwy. Akron, Ohio	13G55	70093	C	No	17BP4	12	19	Yes	Ord	3	26.2	No	10	Tur	No
	13G56	9T25A	C	No	20CP4	16	22	Yes	Key	3	26.2	No	12PM	Tur	No
	13G57	1T28A	C	AM	17BP4	13	22	Yes	Key	3	26.2	No	8PM	Tur	Ph
	13G59	70096	T	No	17BP4	12	19	Yes	Ord	3	26.2	No	5	Tur	No
Freed-Eisemann (Freed Radio Corp.) 200 Hudson St. New York, N. Y.	108	1916-19	C	FM	20DP4	14	28	No	Key	4	25.75	No	12D	Con	No
	109	1916-16	C	No	20DP4	14	28	No	Key	4	25.75	Yes	12D	Tur	No
	110, 111, 112	700-140	C	No	20DP4	14	20	Yes	Ord	3	25.7	No	10PM	Sw	No
	118	1916-16	C	No	20DP4	14	28	No	Key	4	25.75	Yes	12D	Tur	No
	120	700-140	T	No	20DP4	14	20	Yes	Ord	3	25.7	No	5PM	Sw	No
	121	700-021	C	No	20DP4	14	20	Yes	Ord	3	25.7	No	10PM	Sw	No
General Electric Co. Electronics Park Syracuse, N. Y.	17-C-112, 17-C-114	A[7]	C	No	17BP4A[19]	12	20	Yes	Specl.	3	45.75	No	12	Sw	No
	17-C-113, 17-C-115, 17-C-120	A/C[7]	C	No	17BP4A	12	20	Yes	Specl.	3	45.75	No	12	Sw	No
	17-T-4, 17-T-5, 17-T-6	A[7]	T	No	17BP4A[19]	12	20	Yes	Specl.	3	45.75	No	5¼	Sw	No
	17-T-7	A/C[7]	T	No	17BP4A	12	20	Yes	Specl.	3	45.75	No	5¼	Sw	No
	20-C-105	A/C[7]	C	No	20CP4	14	20	Yes	Specl.	3	45.75	No	12	Sw	No
	20-C-150, 20-C-151	C[7]	C	No	20AP4	14	25	Yes	Key	4	45.75	No	12	Sw	No
	20-T-2	A/C[7]	T	No	20CP4	14	20	Yes	Specl.	3	45.75	No	5¼	Sw	No

Manufacturer	Model	Chassis number	Cabinet or chassis type	AM-FM-SW	C-R tube size (inches) & type	C-R tube anode kilovolts	Number of tubes	Intercarrier sound	Type of AGC	Video i.f. stages	Video i.f. megacycles	Provision for u.h.f.	Speaker type and size (inches)	Type of tuner	Accessories
The Hallicrafters Co. 4401 W. Fifth Ave. Chicago, Ill.	17905	L1000S	T	No	16RP4	12	17	Yes	Ord	2	26.25	Yes	5PM	Tur	No
	17906	P1000D	T	No	17BP4A	12	22	Yes	Ord	3	26.25	Yes	5PM	Tur	No
	17907	S1000D	T	No	16RP4	12	22	Yes	Ord	3	26.25	Yes	5PM	Tur	No
	17908	E1000D	T	No	17BP4	12	22	Yes	Ord	3	26.25	Yes	5PM	Tur	No
	17922	E1000D	C	No	17BP4	12	22	Yes	Ord	3	26.25	Yes	5PM	Tur	No
	17922CD	T1000D	C	No	17BP4	12	22	Yes	Ord	3	26.25	Yes	5PM	Tur	No
	17930, 17931, 17932	N1000D	C	No	17CP4	12	22	Yes	Ord	3	26.25	Yes	8PM	Tur	No
	17933, 17934	M1000D	C	No	17CP4	12	22	Yes	Ord	3	26.25	Yes	8PM	Tur	No
	21923	Q1000D	C	No	20BP4	12	22	Yes	Ord	3	26.25	Yes	5PM	Tur	No
	21928	K1000D	T	No	20BP4	12	22	Yes	Ord	3	26.25	Yes	5PM	Tur	No
	21939	G1000D	C	No	21AP4	12	22	Yes	Ord	3	26.25	Yes	8PM	Tur	No
	21940	Q1000D	C	No	20BP4	12	22	Yes	Ord	3	26.25	Yes	8PM	Tur	No
	21941	C1000D	C	AM	21AP4	12	22	Yes	Ord	3	26.25	Yes	8PM	Tur	Ph
	21943	G1000D	C	No	21AP4	12	22	Yes	Ord	3	26.25	Yes	10PM	Tur	No
	21980	D900D	C	No	19AP4	12	22	Yes	Ord	3	26.25	Yes	10PM	Tur	No
Hoffman Radio Corp. 3761 So. Hill St. Los Angeles, Calif.	636, 637	183	T	No	17BP4A	14	23	No	Key	4	26.1	No	6x12PM	Tur	No
	880, 881, 882, 883, 884, 885, 886, 887	183	C	No	17AP4A	14	23	No	Key	4	26.1	Yes	12PM	Tur	No
	893, 894, 895	185	C	No	20CP4	14	23	No	Key	4	26.1	Yes	12PM	Tur	No
	896, 897	185	C	No	19AP4A	14	23	No	Key	4	26.1	Yes	12PM	Tur	No
	953, 954	184	C	AM-FM	17BP4A	14	23	No	Key	4	26.1	Yes	12PM	Tur	Ph
	963, 964, 965	186	C	AM-FM	20CP4	14	23	No	Key	4	26.1	Yes	12PM	Tur	Ph
	24B707, 24M708	187	C	No	24AP4	15.5	23	No	Key	4	26.1	Yes	12PM	Tur	No
Industrial Television, Inc. 359 Lexington Ave. Clifton, N. J.	Century 776	IT76R	T	No	17R		20	Yes	Ord	3	21.25	No	8PM	Tur	No
	Century 1176	IT76R	C	No	17R		20	Yes	Ord	3	21.25	No	8PM	Tur	No
	Century 1376	IT76R	C	No	20R		20	Yes	Ord	3	21.25	No	8PM	Tur	No
	Century 379	ITS7R & IT79R	C	No	20R		27	No	Ord	3	21.25	No	12PM	Tur	RC
	Industrial IT-82R	ITS7R IT79R	Tavern	No	20R		27	No	Ord	3	21.25	No	12PM	Tur	RC
International Television Corp. 238 William St. New York, N. Y.	E-16	None	T	No	16RP4	11	20	Yes	Ord	3	25.75	Yes	6PM	Tur	No
			C	No	20RP4	11	20	Yes	Ord	3	25.75	Yes	12PM	Tur	No
	F-16	None	T	No	16RP4	11	20	Yes	Ord	3	25.75	Yes	6PM	Tur	No
			C	No	20RP4	11	20	Yes	Ord	3	25.75	Yes	12PM	Tur	No
Jackson Industries, Inc. 500 E. 40th St. Chicago, Ill.	17XT, 17XC, 1700T	117H	C	No	17BP4	12	20	Yes	Ord	3	25.75	Yes	10PM	Tur	No
	1700C, 3170	117H	T	No	17BP4	12	20	Yes	Ord	3	25.75	Yes	10PM	Tur	No
	20XT, 20XC, 2000C, 5120	120H	C	No	20CP4	12	20	Yes	Ord	3	25.75	Yes	10PM	Tur	No
		120H	T	No	20CP4	12	20	Yes	Ord	3	25.75	Yes	10PM	Tur	No
Kaye-Halbert Corp. 3555 Hayden Ave., Culver City, Cal.	Console	253	C	No	24AP4	16	25	No	Key	3	25	Yes	12	Tur	No
	Table Model	253	T	No	20CP4	14	25	No	Key	3	25	Yes	5	Tur	No
Lytle Engineering and Mfg. Co. 4721 N. Kedzie Ave. Chicago 25, Ill.	20" Combination	CTV-222A	C	FM	20CP4	11	18	No	Ord	3	25.75	No	12	Lytle	Ph
	16" Combination	CTV-220A	C	FM	16RP4	11	15	No	Ord	3	25.75	No	6x9	Lytle	Ph
	16" Television	CTV-216A	C	No	16RP4	11	18	No	Ord	3	25.75	No	8	Lytle	
Majestic Radio & Television Division of the Wilcox-Gay Corp. 385 Fourth Ave. New York 16, N. Y.	17C62, 700, 701, 712	106	C	No	17BP4	12	19	Yes	Ord	3	24.75	Yes	10PM	Tur	No
	17T62, 17T6A1, 17T6B1, 70, 72, 73	106	T	No	17BP4	12	19	Yes	Ord	3	24.75	Yes	5PM	Tur	No
	20C82, 20C83	108	C	No	20CP4	12	19	Yes	Ord	3	24.75	Yes	10PM	Tur	No
	20T8A1, 20T82, 20T83	108	T	No	20CP4	12	19	Yes	Ord	3	24.75	Yes	5PM	Tur	No

Mars Television, Inc. 112-33 Colonial Ave. Corona, L. I., N. Y.	Dartmouth	630	Combo	AM-FM	20CP4	15	31	No	Key	4	24	Yes	12PM[13]	Tur	Ph
	Hampton, Versailles, Oriental, Warwick, Regent	630	C	No	20CP4	15	31	No	Key	4	24	Yes	10PM	Tur	PJ
	T200	630	T	No	20CP4	15	31	No	Key	4	24	Yes	5x7PM	Tur	PJ
	T240	630	T	No	24AP4	18	31	No	Key	4	24	Yes	5x7PM	Tur	PJ
	T241	630	Combo	FM	24AP4	18	31	No	Key	4	24	Yes	10PM	Tur	PJ
Mattison Television & Radio Corp. 893 Broadway New York, N. Y.	630-5	630-5	WC	No	16 thru 24	15	30	No	Key	4	25.75	Yes	12	Tur	Ph
		630-5BC	WC	No	16 thru 24	15	32	No	Key	4	25.75	Yes	12	Tur	Ph
		630-5SRC	WC	No	16 thru 24	15	30	No	Key	4	25.75	Yes	12	Tur	Ph
John Meck Industries 1020 N. Rush St. Chicago, Ill.	JM717C	9021	C	No	17BP4	13	20	Yes	Ord	4	26.1	No	8	Sw	No
	JM720C	9021	C	No	20CP4	14	20	Yes	Ord	4	26.1	No	8	Sw	No
	M616T	9018	T	No	16TP4	13	19	Yes	Ord	3	26.1	No	5	Con	No
Midwest Radio & Television Corp. 909 Broadway Cincinnati, Ohio	N20	BT-20	C	AM-FM	20CP4	14	24	Yes	Key	4	25.75	Yes	12PM	Sw	No
	NC20	BT-20	C	AM-FM	20CP4	14	24	Yes	Key	4	25.75	Yes	12PM	Sw	3PJ
	NV20	CV-20	C		20CP4	14	24	Yes	Key	4	25.75	Yes	12PM	Sw	No
Mitchell Mfg. Company 2525 N. Clybourn Ave. Chicago 14, Ill.	T16-M, T16-B	None	C	No	16TP4	13	20	Yes	Ord	3	26.1	No	8PM	Con	PJ
	T17-M, T17-B	None	C	No	17BP4	13	20	Yes	Ord	3	26.1	No	8PM	Con	PJ
Motorola, Inc.	Declined Invitation to Submit	Information													
Multiple Television Mfg. Co. 987 Hegeman Ave. Brooklyn 8, N. Y.	T17-20	26-V	T	No	20CP4	14.5	27	No	Key	4	25.75	Yes	12PM	Tur	RC
	T17-24	K4	T	No	24CP4	16	30	No	Key	4	25.75	Yes	12PM	Tur	RC
	L-24	K4	C	No	24CP4	16	30	No	Key	4	25.75	Yes	12PM	Tur	No
Muntz TV, Inc.	See Tele-Vogue, Inc.														
National Company, Inc. 61 Sherman St. Malden, Mass.	1701		T	No	17BP4A	13	24	Yes	Ord	4	26	Yes	4x6	Tur	No
	1725, 1729		C	No	17BP4A	13	24	Yes	Ord	4	26	Yes	10	Tur	No
	2029, 2030		C	No	20CP4	13	24	Yes	Ord	4	26	Yes	10	Tur	No
Olympic Radio & Television, Inc. Olympic Bldg., 34-01 38th Ave. Long Island City, N. Y.	752, 758, 791	TA	T	No	17BP4A	14	20	No	Ord	3	25.75	Yes	5PM	Tur	No
	765, 769	TA	C	No	17BP4A	14	20	No	Ord	3	25.75	Yes	12PM	Tur	No
	773	TA	C	No	17BP4A	14	20	No	Ord	3	25.75	Yes	10PM	Tur	No
	970, 972	TD	T	No	20CP4	15	22	No	Ord	4	25.75	Yes	8	Tur	No
	971, 973	TD	C	No	20CP4	15	22	No	Ord	4	25.75	Yes	10	Tur	No
	20T21	TE	T	No	20CP4	15	20	No	Ord	3	25.75	Yes	8	Tur	No
	20C22	TE	C	No	20CP4	15	20	No	Ord	3	25.75	Yes	10	Tur	No
Packard-Bell Company 12333 W. Olympic Blvd. Los Angeles 64, Calif.	2115	2115-2	T	No	17KP4[10]	12	21	Yes	Ord	3	25	Yes	6½	Tur	No
	2116	2115-2	C	No	17KP4[10]	12	21	Yes	Ord	3	25	Yes	10	Tur	No
	2117	2117	C	No	20HP4[11]	12	21	Yes	Ord	3	25	Yes	10	Tur	No
	2118	2118	C	No	24AP4A	16	21	Yes	Ord	3	25	Yes	10	Tur	No
	2611	2611	C	AM-FM	17KP4[10]	12	21	Yes	Ord	3	25	Yes	10	Tur	3PJ
	2811	2811	C	AM-FM	20DP4[8]	14	23	Yes	Ord	3	25	Yes	12	Tur	3PJ
Pathe Television Corp. 250 West 57th St. New York 19, N. Y.	17-21	700-96	C	No	17BP4A	11	20	Yes	Ord	3	21.25	Yes	10PM	Sw or Tur	No
	17-25	700-96	C	No	17BP4A	11	20	Yes	Ord	3	21.25	Yes	10PM	Sw or Tur	No
	20-30	700-140	C	No	20CP4A	13	20	Yes	Ord	3	21.25	Yes	10PM	Sw or Tur	No
	20-31	700-140	C	No	20CP4A	13	20	Yes	Ord	3	21.25	Yes	10PM	Sw or Tur	No
	20-32	700-140	C	No	20CP4A	13	20	Yes	Ord	3	21.25	Yes	10PM	Sw or Tur	No
Philco Corporation	No Information Supplied														
Philharmonic Radio & Television Corp. 235 Jersey Ave. New Brunswick, N. J.	520, 620	20	T	No	20DP4	13	19	Yes	Ord	3	24	Yes	5	Tur	No
	6120	20	C	No	20DP4	13	19	Yes	Ord	3	24	Yes	8	Tur	No
	5820	20	C	No	20DP4	13	19	Yes	Ord	3	24	Yes	10	Tur	No

Manufacturer	Model	Chassis number	Cabinet or chassis type	AM-FM-SW	C-R tube size (inches) & type	C-R tube anode kilovolts	Number of tubes	Intercarrier sound	Type of AGC	Video i.f. stages	Video i.f. megacycles	Provision for u.h.f.	Speaker type and size (inches)	Type of tuner	Accessories
Philmore Mfg. Co., Inc. 113 University Place New York 3, N. Y.	CP731D		WC, K, T	FM[13]	16 to 24	15	31	No	Key	4	25.75	Yes	12PM	Tur	Ph
	CP730S		WC, K, T	FM[13]	16 to 24	16	30	No	Key	4	25.75	Yes	12PM	Tur	Ph
Pilot Radio Corp. 37-06 36th Street Long Island City, N. Y.	TV-167B		C	FM	16TP4	13	25	Yes	Ord	4	25.75	Yes	12PM	Con	PJ
	TV-191, TV-192		C	FM	19AP4	13	25	Yes	Ord	4	25.75	Yes	12PM	Con	PJ
	TV-271		T	No	17BP4A	14	25	Yes	Ord	4	25.75	Yes	8PM	Con	PJ
	TV-273		C	No	17BP4A	14	25	Yes	Ord	4	25.75	Yes	12PM	Con	PJ
	TV-293		C	No	20DP4A	14	25	Yes	Ord	4	25.75	Yes	12PM	Con	PJ
RCA Victor Div. of RCA Camden, N. J.	17T153, 17T154, 17T155	KCS66	T	No	17GP4	13.5	23	Yes	Key	4	40	Yes	8PM	Sw	PJ
	17T160, 17T162, 17T172, 17T174	KCS66A	C	No	17GP4	13.5	23	Yes	Key	4	40	Yes	8 or 12PM	Sw	PJ
	21T176, 21T177, 21T178, 21T179	KCS68C	C	No	21AP4	17.5	25	Yes	Key	4	40	Yes	12PM	Sw	PJ
	4T101	KCS61	T	No	14EP4	10.1	23	No	Ord	4	25.5	No	5x7PM	Sw	PJ
	7T103, 7T104	KCS47F	T	No	17GP4	12	23	No	Ord	4	25.5	No	8PM	Sw	PJ
	7T111	KCS47GF-2	C	No	17GP4	12	23	Yes	Ord	4	25.5	No	8PM	Sw	PJ
	7T112	KCS47G	C	No	17GP4	12	23	No	Ord	4	25.5	No	12PM	Sw	PJ
	7T112-1C	KCS47G-2	C	No	17GP4	12	23	Yes	Ord	4	25.5	No	12PM	Sw	PJ
	7T122	KCS47G	C	No	17GP4	12	23	No	Ord	4	25.5	No	12PM	Sw	PJ
	7T122-1C	KCS47G-2	C	No	17GP4	12	23	Yes	Ord	4	25.5	No	12PM	Sw	PJ
	7T123	KCS47G	C	No	17GP4	12	23	No	Ord	4	25.5	No	12PM	Sw	PJ
	7T123-1C	KCS47G-2	C	No	17GP4	12	23	Yes	Ord	4	25.5	No	12PM	Sw	PJ
	7T132	KCS47D	C	No	17GP4	12	23	No	Ord	4	25.5	No	12PM	Sw	Ph[22]
	9T105	KCS49B	T	No	19AP4A	12	23	No	Ord	4	25.5	No	8PM	Sw	PJ
	9T105-1C	KCS49B-2	T	No	19AP4A	12	23	Yes	Ord	4	25.5	Yes	8PM	Sw	PJ
	9T126, 9T126-1C	KCS49C	C	No	19AP4A	12	23	Yes	Ord	4	25.5	No	12PM	Sw	PJ
	16T152	KCS47E	T	No	16GP4	12	22	Yes	Ord	4	25.5	No	8PM	Sw	PJ
The Radio Craftsmen, Inc. 4401 N. Ravenswood Ave. Chicago, Ill.	C101	[4]	WC	No	24AP4[8]	16	24	No	Key	4	26.1	Yes	None[20]	Tur	No
	C200	[4]	WC	FM	24AP4[8]	16	28	No	Key	4	26.1	No	None	Con	PJ
	C201	[4]	WC	No	24AP4[8]	16	27	No	Key	4	26.1	Yes	None	Tur	No
Raytheon	See Belmont Radio														
Regal Electronics Corp. 603 West 130th St. New York, N. Y.	17C22N	T22	C	No	17BP4	13	22	Yes	Ord	4	25.7	Yes	8 PM	Tur	No
	17T22N	T22	T	No	17BP4	13	22	Yes	Ord	4	25.7	Yes	5x7PM	Tur	No
	20C22N	T22	C	No	20CP4	14	22	Yes	Ord	4	25.7	Yes	8PM	Tur	No
	20T22N	T22	T	No	20CP4	14	22	Yes	Ord	4	25.7	Yes	5x7PM	Tur	No
	2031	630	WC	No	17 to 24	16	31	No	Key	4	25.2	Yes	12PM	Tur	No
	2036	630	WC	No	17 to 24	16	31	No	Key	4	25.2	Yes	12PM	Tur	PJ
Scott Radio Laboratories, Inc. 4541 Ravenswood Ave. Chicago 40, Ill.	AC17 Ravenswood	720	C	No	17BP4	12	21	Yes	Ord	4	26.1	Yes	12PM	Sw	No
	AT17 Ravenswood	720	T	No	17BP4	12	21	Yes	Ord	4	26.1	Yes	8PM	Sw	No
	310TS Stuart	720, 310	C	AM-FM	17BP4	12	21	Yes	Ord	4	26.1	Yes	12PM	Sw	Ph
	510TC-3 Cressy	920, 510	C	AM-FM	20DP4	12	21	Yes	Ord	4	26.1	Yes	12PM[15]	Sw	Ph
	924W Wellington	924	C	No	24AP4	15	21	Yes	Ord	4	26.1	Yes	12PM	Sw	No
	1000TC Chippendale	924, 1000	C	AM-FM	24AP4	15	21	Yes	Ord	4	26.1	Yes	15PM[15]	Sw	Ph
	1510TA Ashby	920, 1510	C	AM-FM	20DP4	12	21	Yes	Ord	4	26.1	Yes	12PM[15]	Sw	Ph
Sentinel Radio Corp. 2100 Dempster St. Evanston, Ill.	438-TVM, 438-TVB		T	No	17BP4A	14	21	Yes	Ord	4	25	Yes	6	Sw	No
	439-CVM, -CVB, 440-CVM		C	No	17BP4A	14	21	Yes	Ord	4	25	Yes	8	Sw	No
	440-CVB, 441-CVM, -CVB		C	No	17BP4A	14	21	Yes	Ord	4	25	Yes	8	Sw	No

	443-CVM, 443-CVB		C	No	21EP4A	14	21	Yes	Ord	4	25	Yes	10	Sw	No
	444-CVM, 444-CVB		C	No	21EP4A	14	21	Yes	Ord	4	25	Yes	10	Sw	No
	446-TVM		T	No	20CP4	14	21	Yes	Ord	4	25	Yes	8	Sw	No
Setchell Carlson, Inc. New Brighton, Minn.	151-A17	151	T	AM	17	14.5	23	Yes	Key	2	26.1	Yes	6	Tur	No
	151-A17LR	151	T	No	17	14.5	23	Yes	Key	2	26.1	Yes	6	Tur	No
	151-B17	151	C	AM	17	14.5	23	Yes	Key	2	26.1	Yes	6	Tur	No
	151-B17LR	151	C	No	17	14.5	23	Yes	Key	2	26.1	Yes	6	Tur	No
	151-B20	151	C	AM	20	14.5	23	Yes	Key	2	26.1	Yes	6	Tur	No
	151-B20LR	151	C	No	20	14.5	23	Yes	Key	2	26.1	Yes	6	Tur	No
	151-C20	151	C	AM	20	14.5	23	Yes	Key	2	26.1	Yes	10	Tur	Ph
Sheraton Television Corp. 2061 Broadway New York 23, N. Y.	Super Video DX Console, Sussex	260DX	C	No	20CP4	14.5	26	No	Key	4	26.25	Yes	12PM	Tur	PJ
	Super Video DX Table	260DX	T	No	20CP4	14.5	26	No	Key	4	26.25	Yes	6PM	Tur	PJ
	Windsor	260V24	C	No	24AP4	16	26	No	Key	4	26.25	Yes	12PM	Tur	PJ
Sightmaster Corp. New Rochelle, N. Y.	17E52	4	T	No	17BP4	14	24	No	Key	3	26.75	No	8	Sw	No
	20K52	4	C	No	20CP4	16	24	No	Key	3	26.75	No	8	Sw	No
Snaider Television Corp. 540 Bushwick Ave. Brooklyn, N. Y.	Auditorium	P520	C	SW-FM	5TP4[9]	27	37	No	Ord	5	26.1		12		No
	Champion	1230	T	SW-FM	12LP4	10	31	No	No	5	26.1		12		No
	Champion	1630	C	SW-FM	16RP4	10	31	No	No	5	26.1		12		No
	Champion	1930	C	SW-FM	19AP4	10	31	No	No	5	26.1		12		No
	Crusader	1221	T	No	12LP4	10	21	Yes	Ord	3	25.75		10		No
	Crusader	1621	C	No	16RP4	10	21	Yes	Ord	3	25.75		10		No
	Crusader	1921	C	No	19AP4	10	21	Yes	Ord	3	25.75		10		No
	Portojector	M-PJ-521	P	No	5TP4[9]	30	21								
Starrett Television Corp. 601 West 26th St. New York 1, N. Y.	17BM1, 17TW, 17BG-1, 17C1, 17C2, 17C3, 17CG, 17CD, 17CD-B	12S1	C, T	No	17BP4A	13	20	Yes	Ord	3	26.1	No	5PM	Sw or Tur	Ph
	20TW, 20TG, 20C, 20C1, 20CP, 20CD	15S1	C, T	No	20CP4A	13	20	Yes	Ord	3	26.1	No	5PM	Sw or Tur	Ph
	A17BM1, A17TW, A17TG-1, A17C1, A17C2, A17C3, A17CG, A17CD, A17CD-B	17S1	C, T	No	17BP4A	12	19	Yes	Ord	3	26.1	No	5PM	Sw or Tur	No
Stewart-Warner Electric 1300 North Kostner Ave. Chicago, Ill.	9121-A	9121-E	C	AM-FM	16TP4[16]		26	Yes	Key	4	26.1	Yes	6x9PM	Tur	3PJ
	9121-E	9121-E	C	No	17BP4		26	Yes	Key	4	26.1	Yes	12PM	Tur	3PJ
	9122-A	9122-A	C	AM-FM	19AP4		26	Yes	Key	4	26.1	Yes	12PM	Tur	PJ
	9124-A	9124-A	C	AM-FM	20CP4		26	Yes	Key	4	26.1	Yes	12PM	Tur	PJ
	9126-A	9126-A	T	No	17BP4A		26	Yes	Key	4	26.1	Yes	6PM	Tur	No
	9126-B, 9126-C	9126-B	C	No	17BP4A		26	Yes	Key	4	26.1	Yes	6x9PM	Tur	No
	9127-A	9127-A	C	No	20CP4		26	Yes	Key	4	26.1	Yes	6x9PM	Tur	No
	9202-C, 9202-F	4	C	No	17BP4A		19	Yes	Ord	3	25.75	Yes	6x9PM	Tur	No
	9202-E	9202-E	C	No	17BP4A		19	Yes	Ord	3	25.75	Yes	6x9PM	Tur	No
	9202-DA, 9202-DB, 9202-DD	4	T	No	17BP4A		19	Yes	Ord	3	25.75	Yes	6PM	Tur	No
	9202-DAX, 9202-DDX	9202-DA 9202-DD	C	No	17BP4A		19	Yes	Ord	3	25.75	Yes	6PM	Tur	No
	9204-A	9204-A	C	No	20CP4		19	Yes	Ord	3	25.75	Yes	6x9PM	Tur	No
Stromberg-Carlson Co. 100 Carlson Road Rochester 7, N. Y.	17C2M	112116	C	No	17BP4A	12	26	Yes	Key	4	26.4	Yes	12PM	Con	PJ
	24CM	112126	C	No	24AP4A	16	30	Yes	Key	4	26.4	Yes	12PM	Con	PJ
	24RPM	112119	C	AM-FM	24AP4A	16	30	Yes	Key	4	26.4	Yes	12PM	Con	3PJ
	119CDM, 119CM	112107	C	No	19AP4A	13.5	29	Yes	Key	4	26.4	Yes	12PM	Con	PJ
	119M5M, 119RPM	112114	C	AM-FM	19AP4A	13.5	29	Yes	Key	4	26.4	Yes	12PM	Con	3PJ
	317C5D, 317CO	112121	C	No	17BP4A	15	23	Yes	Key	4	26.4	Yes	12PM	Con	PJ
	317M20, 317RPM	112120	C	AM	17BP4A	15	24	Yes	Key	4	26.4	Yes	12PM	Con	3PJ
	317RPM4	112120	C	AM	17BP4A	15	24	Yes	Key	4	26.4	Yes	8PM	Con	3PJ
	317TM	112121	T	No	17BP4A	15	23	Yes	Key	4	26.4	Yes	5½PM	Con	PJ
	321C2M, 321CD2M, 321CF	112127	C	No	20CP4A	17	23	Yes	Key	4	26.4	Yes	12PM	Con	PJ
	324C5M, 324CDM	112129	C	No	24AP4A	17	23	Yes	Key	4	26.4	Yes	12PM	Con	PJ

Manufacturer	Model	Chassis number	Cabinet or chassis type	AM-FM-SW	C-R tube size (inches) & type	C-R tube anode kilovolts	Number of tubes	Intercarrier sound	Type of AGC	Video i.f. stages	Video i.f. megacycles	Provision for u.h.f.	Speaker type and size (inches)	Type of tuner	Accessories
Sylvania Electric Products, Inc. Radio & Television Division 254 Rano St. Buffalo 7, N. Y.	22	1-387	T	No	20DP4A	15	25	Yes	Ord	4	21.9	Yes		Con	Ph
	23	1-507-1	C	No	20BP4	13	24	Yes	Ord	3	21.9	Yes		Con	No
	24	1-387-2	C	No	20DP4A	15	25	Yes	Ord	4	21.9	Yes			Ph
	25	1-387-1	C	No	20DP4A	15	25	Yes	Ord	4	21.9	Yes		Con	Ph
	72	1-366	T	No	17BP4	13	25	Yes	Ord	4	21.9	Yes		Con	No
	73	1-366	C	No	17BP4	13	25	Yes	Ord	4	21.7	Yes		Con	No
	74	1-437-1	C	No	17BP4A	13	25	Yes	Ord	4	21.9	Yes		Con	Ph
	75	1-437-1	C	No	17BP4A	13	25	Yes	Ord	4	21.9	Yes		Con	Ph
	7111	1-366	T	No	17BP4	13	25	Yes	Ord	4	21.7	Yes		Con	No
	7130	1-366	C	No	17BP4	13	25	Yes	Ord	4	21.7	Yes		Con	No
Tech Master Products Co. 443 Broadway New York 13, N. Y.	2430	2430	WC	No	16 to 24	16	30	No	Key	4	25.75	Yes	5x7	Tur	No
	2431C	2431C	WC	No	16 to 24	16	31	No	Key	4	25.75	Yes	12PM	Con	No
	2431P	2431P	WC	No	16 to 24	16	31	No	Key	4	25.75	Yes	12PM	Tur	No
	5116	5116[7]	K	No	10 to 16	9	17	Yes	Ord	3	25.75	Yes	4x6PM	Tur	No
	5120	5120[7]	WC	No	14 to 20	11	20	No	Ord	3	25.75	Yes	4x6PM	Tur	No
	630D19 & 630S19	[4]	K	No	12 to 20	14	30	No	Key	4	25.75	Yes	5x7PM	Tur	No
Tele King Corp. 601 W. 26th St. New York, N. Y.	K21	TVJ[7]	T	No	20CP4	14.5	18	Yes	Ord	3	25.1	No	4x6PM	Sw	No
	K72, K73L	TVJ[7]	T	No	17BP4	14.5	18	Yes	Ord	3	25.1	No	4x6PM	Sw	No
	KC21, KD21M, KD22B	TVJ[7]	C	No	20CP4	14.5	18	Yes	Ord	3	25.1	No	10PM	Sw	No
	KC71	TVJ[7]	C	No	17BP4	14.5	18	Yes	Ord	3	25.1	No	8PM	Sw	No
	KD71, KD72B	TVJ[7]	C	No	17BP4	14.5	18	Yes	Ord	3	25.1	No	10PM	Sw	No
Telequip Radio Co. 2559 West 21st St. Chicago 8, Ill.	C317MF, C517M, C517B, C617M, C617B, C320MF, C720M, C720B, C820M, C820B T217L, T417M, T417L, T417MF, T417B, T520MF, T620M	All use Chassis 5060	C&T	No	17 & 20	12	19	Yes	Ord	3	26.1	Yes	5, 8, 10	Tur	Ph
Teletone Radio Corp. Myrtle & Amboy Sts. Bayway Terminal Elizabeth, N. J.	TV357, TV365, TV379	8009	T	No	17BP4	12	21	Yes	Key	3	37.3	Yes	6	Sw	No
	TV383	8009	C	No	17BP4	12	21	Yes	Key	3	37.3	Yes	10	Sw	No
	TV385	8009	T	No	20CP4	14	21	Yes	Key	3	37.3	Yes	6	Sw	No
	TV386	8009	C	No	20CP4	14	21	Yes	Key	3	37.3	Yes	10	Sw	No
Tele-Vogue, Inc. (Muntz) 1735 W. Belmont Ave. Chicago 13, Ill.	2053A, 2056A	17B2	C	No	20CP4	16	16	Yes	Ord	3	25.75	Yes	10PM	Tur	RC[13]
	2055A	17B2	T	No	20CP4	16	16	Yes	Ord	3	25.75	Yes	5¼PM	Tur	RC[13]
	2457A	17B4	C	No	24AP4	16	16	Yes	Ord	3	25.75	Yes	10PM	Tur	
Trad Television Corp. 1001 First Ave. Asbury Park, N. J.	T1720	T-20-D	T	No	17CP4	13.5	21	No	Ord	3	25.75	Yes	5PM	Tur	No
	C2020	T-20-E	C	No	20CP4	13.5	21	No	Ord	3	25.75	Yes	8PM	Tur	No
	C2420	T-20-E2	C	No	24AP4	14	21	No	Ord	3	25.75	Yes	10PM	Tur	No
Transvision, Inc. 460 North Ave. New Rochelle, N. Y.	A4 Standard	None	C,WC, T	No	17RP4 or 20RP4	14	25	No	Ord	3	26.4	No	6x9PM	Sw	RC-Ph
	A4 De Luxe	None	C,WC, T	FM	17RP4 or 20RP4	14	25	No	Ord	3	26.4	No	6x9PM	Sw	RC-Ph
Trans-Vue Corp. 58 East Cullerton St. Chicago, Ill.	1400T, 1400TB	114H	T&C	No	14BP4	11	20	Yes	Ord	3	25.75	Yes	6 & 10	Tur	No
	1700B, 1700C, 1700T, 17XC, 17XT, 1700TB	117H	T&C	No	17BP4	11	20	Yes	Ord	3	25.75	Yes	6 & 10	Tur	No
	20XT, 20XC, 200C, 2000CB	120H	T&C	No	20CP4	11	20	Yes	Ord	3	25.75	Yes	6 & 10	Tur	No

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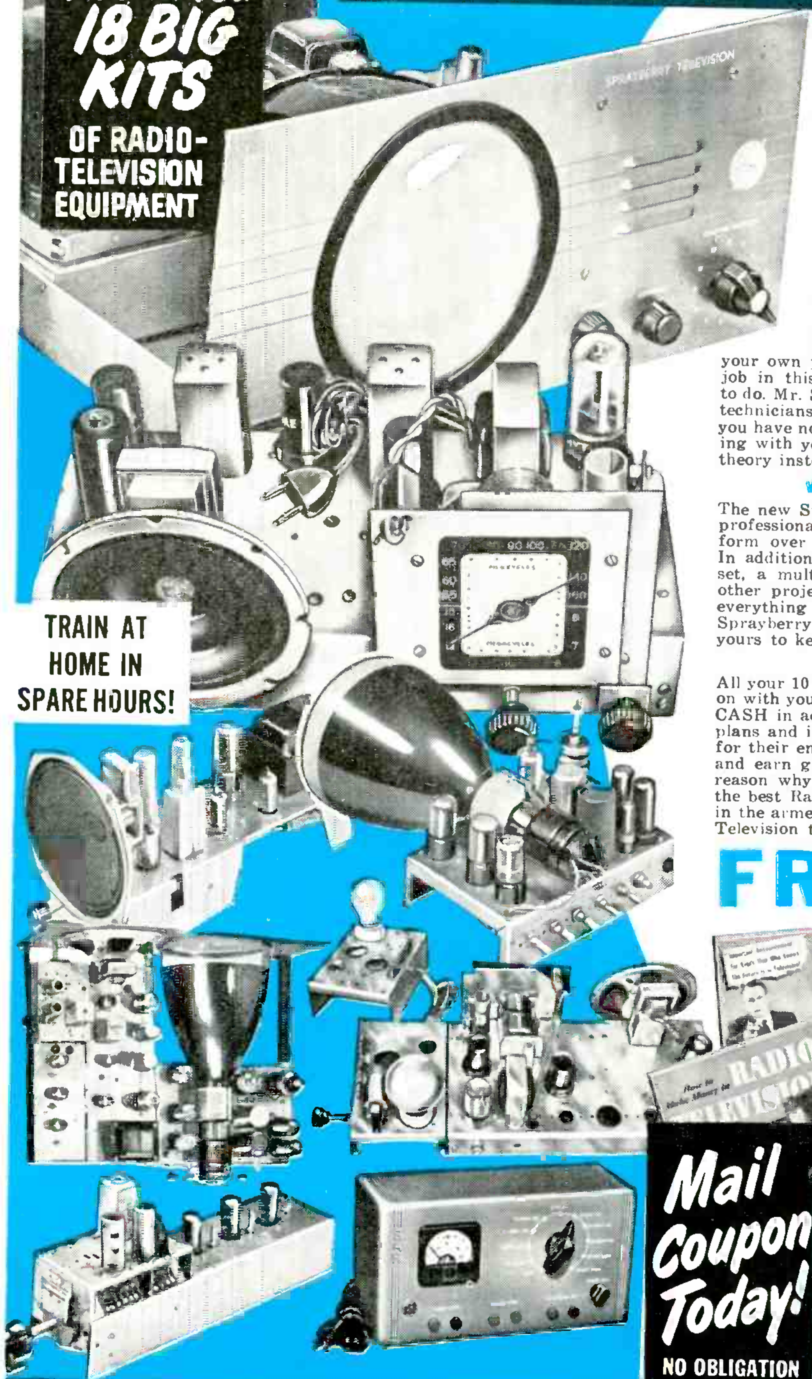

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Manufacturer	Model	Chassis number	Cabinet or chassis type	AM-FM-SW	C-R tube size (inches) & type	C-R tube anode kilovolts	Number of tubes	Intercarrier sound	Type of AGC	Video i.f. stages	Video i.f. megacycles	Provision for u.h.f.	Speaker type and size (inches)	Type of tuner	Accessories
Trav-Ler Radio Corp., 571 W. Jackson Blvd., Chicago 6, Ill.	217-10, 217-12		T	No	17HP4	12	21	Yes	Ord	3		Yes	4x6PM	Sw	No
	217-11, 217-14		C	No	17HP4	12	21	Yes	Ord	4		Yes	4x6PM	Sw	No
	219-8, 219-8B		C	No	19QP4	12	24	Yes	Ord			Yes	4x6PM	PB	No
	220-9, 220-9B		C	No	20HP4A	11.2	21	Yes	Ord	3		Yes	6x9PM	Sw	No
United States Television Mfg. Corp., 3 West 61st St., New York 23, N. Y.	C-2430		C	No	24	14	30	No	Key	4	25	Yes	12	Tur	No
	C-20302		C	No	20	14	30	No	Key	4	25	Yes	12	Tur	No
Video Corp. of America, 229 West 28th St., New York 1, N. Y.	C-20	630	C	FM	20	14	30	No	Key	5	25.75	Yes	12	Tur	No
	M-20	630	C	FM	20	14	30	No	Key	5	25.75	Yes	12	Tur	No
	P-20	630	C	No	20	14	30	No	Key	5	25.75	Yes	12	Tur	No
	2020, 2025, 2091		C	No	20	14	19	Yes	Ord	3	25.75	Yes	12PM	Tur	No
Video Products Corp., 2061 Broadway, New York, N. Y.	630DX, 630K3C		WC	No	16 thru 21	14.5	30	No	Key	4	26.25	Yes	12PM	Tur	PJ
	630K24		WC	No	16 thru 21	16	30	No	Key	4	26.25	Yes	12PM	Tur	PJ
Westinghouse Elec. Corp., Sunbury, Pa.	H-648T20	V-2201-1	T	No	20DP4	14	22	Yes	Key	3	45.75	No	5¼PM	Sw	No
	H-649T17, H-650T17	V-2192-4 or V-2200-1	T	No	17AP4A	14	22	Yes	Key	3	45.75	No	5¼PM	Sw	No
	H-651K17, H-655K17, H-657K17	V2200-1	C	No	17AP4A	14	22	Yes	Key	3	45.75	No	10PM	Sw	No
	H-652K20, H-662K20	V-2201-3	C	No	20DP4	14	22	Yes	Key	3	45.75	No	10PM	Sw	No
	H-653K24	V-2202-2	C	No	24AP4	16	23	Yes	Key	3	45.75	No	10D	Sw	No
	H-659T17	V-2204-1	T	No	17AP4A	14	22	Yes	Key	3	45.75	No	5¼PM	Sw	No
	H-660C17, H-661C17	V-2203-3	C	AM-FM	17BP4A	14	23	Yes	Key	3	45.75	No	10PM	Sw	Ph
Zenith Radio Corp., 6001 West Dickens, Chicago 39, Ill.	J2026R	20J22	T	No	20HP4	11.5	20	Yes	Key	3	45.75	Yes	5¼	Tur	RC[13]
	J2027R, J2027E, J2029E, J2029R, J2030E, J2030R	20J21	T	No	17HP4	11.5	20	Yes	Key	3	45.75	Yes	5¼	Tur	RC[13]
	J2040E, J2042R, J2043R, J2044E, J2044R	20J21	C	No	17HP4	11.5	20	Yes	Key	3	45.75	Yes	10	Tur	RC[13]
	J2051E, J2053R, J2054R, J2055R	20J22	C	No	20HP4	11.5	20	Yes	Key	3	45.75	Yes	10	Tur	RC[13]
	J2126R	21J21	T	No	20FP4[17]	11.5	21	Yes	Key	3	45.75	Yes	5¼	Tur	RC[13]
	J2127E, J2127R, J2129R, J2129E, J2130E, J2130R	21J20	T	No	17FP4A	11.5	21	Yes	Key	3	45.75	Yes	5¼	Tur	RC[13]
	J2140E, J2142R, J2143R, J2144E, J2144R	21J20	C	No	17FP4A	11.5	21	Yes	Key	3	45.75	Yes	10	Tur	RC[13]
	J2151E, J2153R, J2154R, J2155R	21J21	C	No	20FP4[17]	11.5	21	Yes	Key	3	45.75	Yes	10	Tur	RC[13]
	J2868R, J3069E	20J21	C	AM-FM	17HP4	11.5	20	Yes	Key	3	45.75	Yes	12	Tur	RC[13]
	J2968R, J3169E	21J20	C	AM-FM	17FP4A	11.5	21	Yes	Key	3	45.75	Yes	12	Tur	RC[13]

C Console
CMC Cabinet-mounted converter
CO Coin operated
Con Continuous tuning
D Electro-dynamic
EC External converter
K Kit
LD Local-distance switch
ORC Optional remote control
P Portable
PB Push-button tuner

Ph Phono
PJ Phono jack
3PI 3-speed record player
PM Permanent magnet
RC Remote control
Sw Switch-type tuner
T Table model
TE Tuning eye
Tur Turret-type tuner
VJ Video jack
WC Wired chassis

1 Regulated power supply.
2 5 stages in late 1951 models.
3 Suffix "U" indicates model has u.h.f. tuner.
4 Same as model number.
5 Uses 16- through 20-inch tubes.
6 Also uses 20DP4.
7 Uses transformerless power supply.
8 Also uses 20CP4.
9 Projection tube.
10 Also uses 17HP4.
11 Also uses 20JP4.
12 Also uses 17CP4.
13 Optional.
14 Also uses 24AP4B.
15 Coaxial.
16 Also uses 16RP4.
17 Also uses 20GP4.
18 Also makes sets for John Wanamaker and Ambassador brand names.
19 Also uses 24BP4B.
20 Tuner—has no a.f. amplifier.
21 Twin speakers.
22 45 r.p.m.

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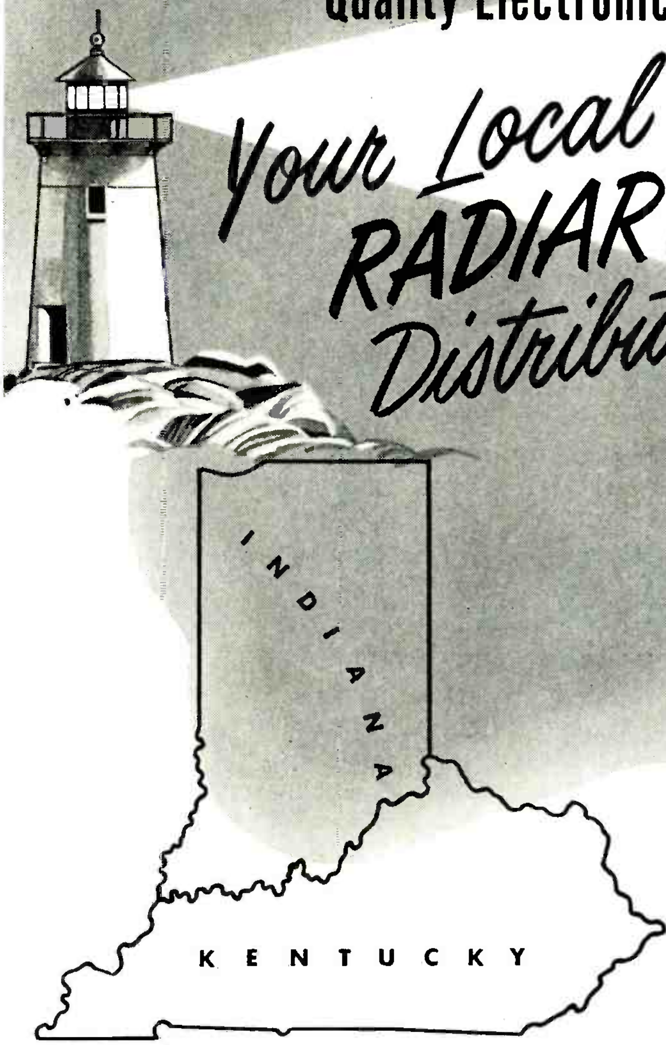

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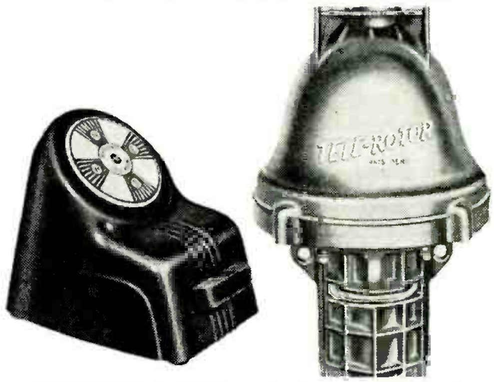

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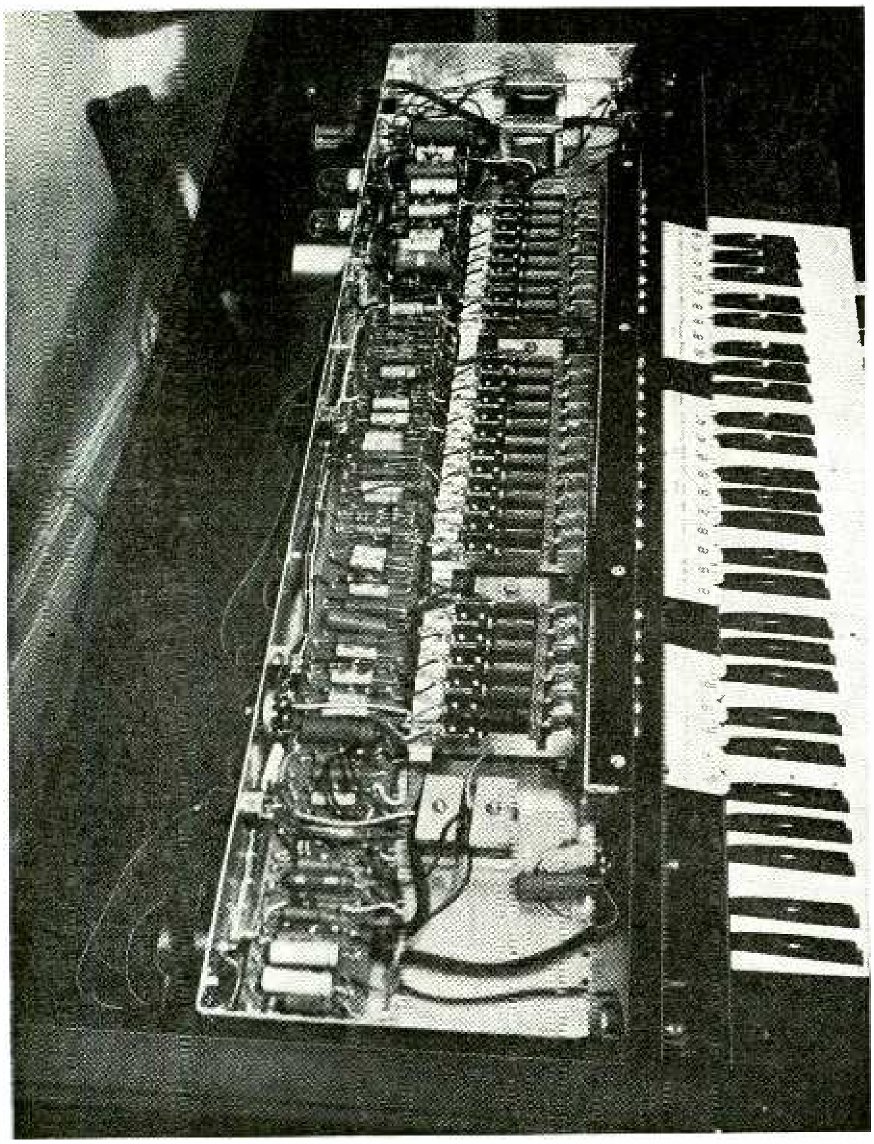
ELECTRONICS and MUSIC

part XIX
More on the Baldwin . . . Tone coloring and note blending circuits

By RICHARD H. DORF

IN THE Baldwin electronic organ, as well as in pipe organs, two classes of organ tones are extremely important in addition to those discussed last month. These are the diapason family and the "stopped" tone colors. Both have the peculiarity of having prominent odd harmonics, with even harmonics fairly subdued. Even harmonics do appear with some effect in the diapasons, but they are almost completely missing in the stopped colors. These tones have a hollow kind of sound like those produced by a clarinet when played in the low register.



A side, top view of the tone-color box of the Baldwin Organ containing all the filter elements for the stops, the stop switches, outphaser, and the preamplifier.

To produce the stopped tones it is necessary not only to pass them through formant filters like other types of tones but to begin with a generator waveform which has almost entirely odd harmonics. The sawtooth has both odd and even, and an ingenious system is used in the Baldwin to eliminate the evens. It is done by mixing octave-related sawtooth waves to produce a square wave which, being symmetrical, is composed almost entirely of odd harmonics which create that pleasing tone effect.

The mixing process is illustrated graphically in Fig. 1. When a given key on the swell manual is pressed, an 8-foot and a 4-foot tone are switched into their respective networks and emerge through the network outputs. They have approximately the same amplitude, a sawtooth waveshape, and are in phase.

A special outphasing circuit is employed for the mixing, and *a* of Fig. 1 shows how the waves are mixed. A is the 8-foot, or lower-frequency, wave. B is the 4-foot wave, one octave above wave A. Wave A has been reversed in phase before the mixing and wave B has been reduced to half the amplitude of A. Now, by simple graphical analysis, it can be seen that the resultant is a square wave, as in *b* of Fig. 1.

The mid-point or average value of instantaneous values of waves A and B, when added graphically or algebraically, produces or defines the resultant square wave. The reader can prove this for himself. At each of several points in *a* of Fig. 1, place a point at the resultant value of voltage. This point is halfway between the individual values of the two waves. When all the points are connected the result will be a square wave.

Let's look at it in another way. We start with an 8-foot tone of, let us say, 1,000 cycles. Its second, third, and fourth harmonics are 2,000, 3,000, and 4,000 cycles. We mix with it a 4-foot tone of 2,000 cycles, in phase opposition. Each harmonic of the second tone will buck out any harmonic of the first tone whose frequency coincides, since the

two are in phase opposition. The coinciding frequencies are all the even harmonics of the lower-frequency tone, leaving only the odd-numbered frequencies, 1,000, 3,000, 5,000, etc. The result is a practically square wave of the 8-foot fundamental frequency. The circuit which does the outphasing appears in Fig. 4, which will be explained later

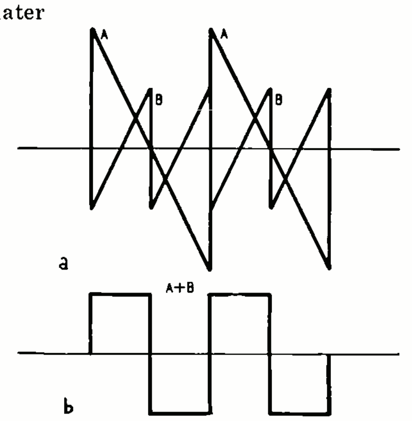


Fig. 1—To produce the "hollow" woodwind effect, even harmonics are phased out by mixing 8-foot and 4-foot tones in correct ratios and phase relations.

Fig. 7 of last month's article showed the keying circuit with which all the tones of the generators are keyed and channeled through successive attenuator networks to their outputs. The illustrations on these pages show what happens next to these tones.

The tone-color box

The tone-color box is shown in the photograph. It is a shallow metal "tray" containing all the R-C-L filters which form the tone colors for the various stops in accordance with the formant principle discussed last month. The box is just under the top cover of the organ console. Its components can be reached by first removing the wooden top, then unscrewing and removing the metal top of the box itself.

The tone-color box also contains three tubes—one for the outphasing circuit and two for the preamplifier which follows all the filters. Along its front edge are ranged all the stop switches. These are gradual-contact switches of the same type used for keying. Circuit-wise they follow each filter. For simplicity they are shown as ordinary s.p.s.t. switches in the diagrams of Figs. 2, 4, and 5. The resistor R preceding each one is the 5,000-ohm printed-circuit resistance between the input terminal of each switch and the leaf contactor.

Fig. 2 shows the tone-coloring system for the pedal clavier. There are two outputs from the pedal switching system—8-foot and 16-foot. The pedal 8-foot FLUTE stop is a soft-voiced one, used to add clarity to the pedal in soft music. Let us briefly analyze the filter which produces it to show how the system works.

The filter is made up of three L-section R-C filters in cascade, each giving, theoretically, an attenuation of about 3 db per octave above its turnover frequency. The 47,000-ohm resistor and .01-μf capacitor have a turnover frequency of about 320 cycles. The next two sections have turnovers of about 160 and 65 cycles, respectively. The resultant curve of the entire filter has low-pass action, with a slope carefully engineered to produce the most lifelike and pleasing tone. The spectrum of this curve agrees closely with the typical flute spectrum shown in Fig. 10 of last month's article.

Most of the stop filters do not have attenuation curves as steep as that of the 8-foot pedal FLUTE, and the curves vary widely. In general, however, most do have low-pass action. While this attenuates harmonics of each generated tone to form the correct spectrum characteristic, it also has the effect of attenuating the fundamentals of the generated tones as the tones become higher in pitch. The attenuator network following the switches, shown in Fig. 7 last month, partially offsets this. The outputs of the switching networks are taken from the high-frequency end, which means that the higher tones are initially louder. If this were not done, some of the higher notes would be barely audible. As each of the stop qualities is described below, examine the filter and note now the effect is achieved.

The 8-foot pedal CELLO is a string-type stop, moderately voiced and somewhat like the orchestral cello. The diapason family is the backbone of the organ, not imitative of any orchestral instrument. The pedal 16-foot OPEN DIAPASON is voiced rather loud. Notice that it has a fairly large harmonic content, with only a single-section R-C filter from the 16-foot sawtooth source. Note, too, that it has a certain amount of 8-foot tone added. As with a few other stops, a dual switch is required to avoid disturbing the busses. As with all the stops, the loudness of a particular tone quality is governed by the resistor which follows the filter, just preceding R (as well as by the filter itself, of course).

The 16-foot BOURDON is a softly voiced stop of the flute family, with great depth and clarity. The 16-foot pedal DULCIANA is as the name implies, a very soft tone, and belongs to the diapason family. The output lead of the pedal department (marked W) goes to the preamplifier.

The great manual is the lower one and its filter schematic appears in Fig. 3. The 16-foot GREAT BOURDON is a soft flute stop which adds body to an ensemble.

Note that the 4-foot CLARION filter is fed from the low-frequency end of the 4-foot great switching network. This is because it is a high-pass filter and deals with high-pitched tones. If it were fed from the high-frequency end, the higher notes would be too pronounced and the lows would almost disappear.

The remainder of the great stops have two inputs each. One is from the 8-foot or 4-foot great switching network, as shown, but the other is from lead X in the pedal department, where one of the stop switches is labeled "8′ GREAT TO 8′ PEDAL." This is a coupler, and when the switch is closed the tones coming from the 8-foot pedal switching network pass not only through the pedal stops but also through whatever great stops have been selected. Thus the resources of the great can be made available to the pedal as well. The great also has a coupler (Fig. 3), Swell to GREAT 8′. This coupler sends 4-foot great tones to the 4-foot swell stops and 8-foot great tones to the 8-foot swell stops. Thus when playing on the great manual the swell stops can be used in addition to the great stops. The swell has no couplers and when playing on the swell manual the player can use only the swell stops.

The great 4-foot CLARION is a very keen reed tone of great brilliance. It has a definite formant range in which fundamentals and harmonics are greatly emphasized, due to the resonant L-C filter. The great 4-foot VIOLINA is a string-type stop with a high-pass characteristic. The OCTAVE is a diapason tone in the 4-foot register.

The 8-foot TRUMPET is a loud, heavy-voiced reed, again with a resonant filter. It is a surprisingly good imitation of the orchestral trumpet when played in certain ways. The 8-foot great DULCIANA is much like the pedal DULCIANA, but in a higher register. The 8-foot MELODIA is a soft flute-type tone. The 8-foot OPEN DIAPASON possesses the tone quality of which the average person

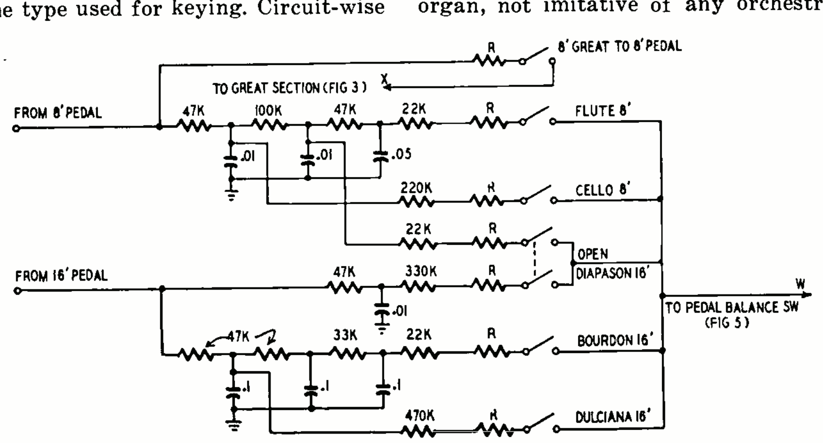


Fig. 2—The resources of the pedal department include five stops and a coupler.

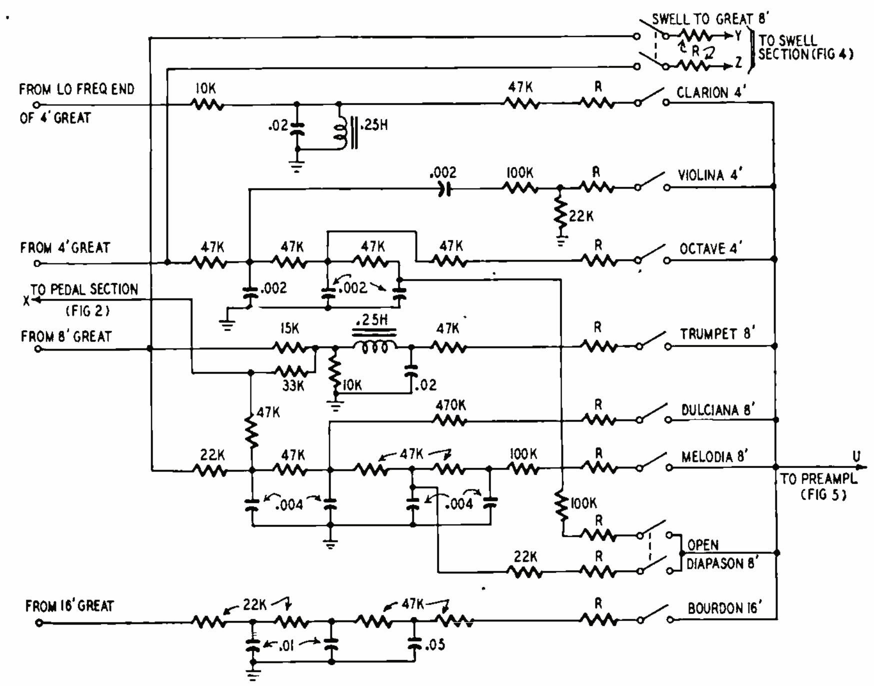


Fig. 3—Great department with eight stops and coupler are used with three registers.

immediately thinks in connection with organs. It is extensively used to accompany a choir. It is the basic organ tone, heavy enough to give a good, solid foundation, and bright enough (note that some 4-foot-register tone is added to it) to make a melody stand out. The OPEN DIAPASON is overused by inexpert organists who count on sheer heaviness and volume for effect.

The great manual is ordinarily used for accompaniment and for full-bodied playing. The swell, the stops of which are diagrammed in Fig. 4, is often used for solo playing; it includes all the solo stops. Frequently the swell is used as a monophonic instrument, a "one-finger" melody played on its OBOE stop, for instance, with an accompaniment on the great MELODIA or DULCIANA, and a foundation of 16-foot DULCIANA on the pedals.

Most of the swell filters have two inputs, as have the great. The second input in each case carries tones from the great coupler so that stops selected on the swell may be heard when the great is played.

The DOLCE CORNET is a reed stop rich in upper harmonics because of the high frequency of the resonant filter (above 2,000 cycles). The 4-foot SALICET filter is a high-pass unit giving a very keen string tone; it is softly voiced, however, because of the 220,000-ohm series resistor. The 4-foot FLUTE is a soft tone without very much harmonic content. The 8-foot OBOE is one of the finest solo stops on any good pipe organ, and it is particularly good on the Baldwin. It is of the reed family but rather mildly voiced. It is an excellent imitation of the orchestral oboe, with its rather nasal tone but without enough sharpness to be irritating.

The FRENCH HORN sounds much like its orchestral namesake; it is very useful for solo work. The TROMPETTE is a moderately voiced reed stop somewhat like the TRUMPET but not like any particular orchestral instrument. (Organ terminology calls certain stops "reeds" even though their orchestral counterparts are horns, because reeds produce these tones in most pipe organs.) The SALICIONAL is the basic string stop of the swell department. The VIOLIN DIAPASON is a moderately voiced diapason tone with some string quality added for increased brightness.

The remaining three swell stops are not fed directly from the swell key switching network but from the outphaser whose action was described earlier and pictured in Fig. 1. Eight-foot tones are fed to the input of one 7F8

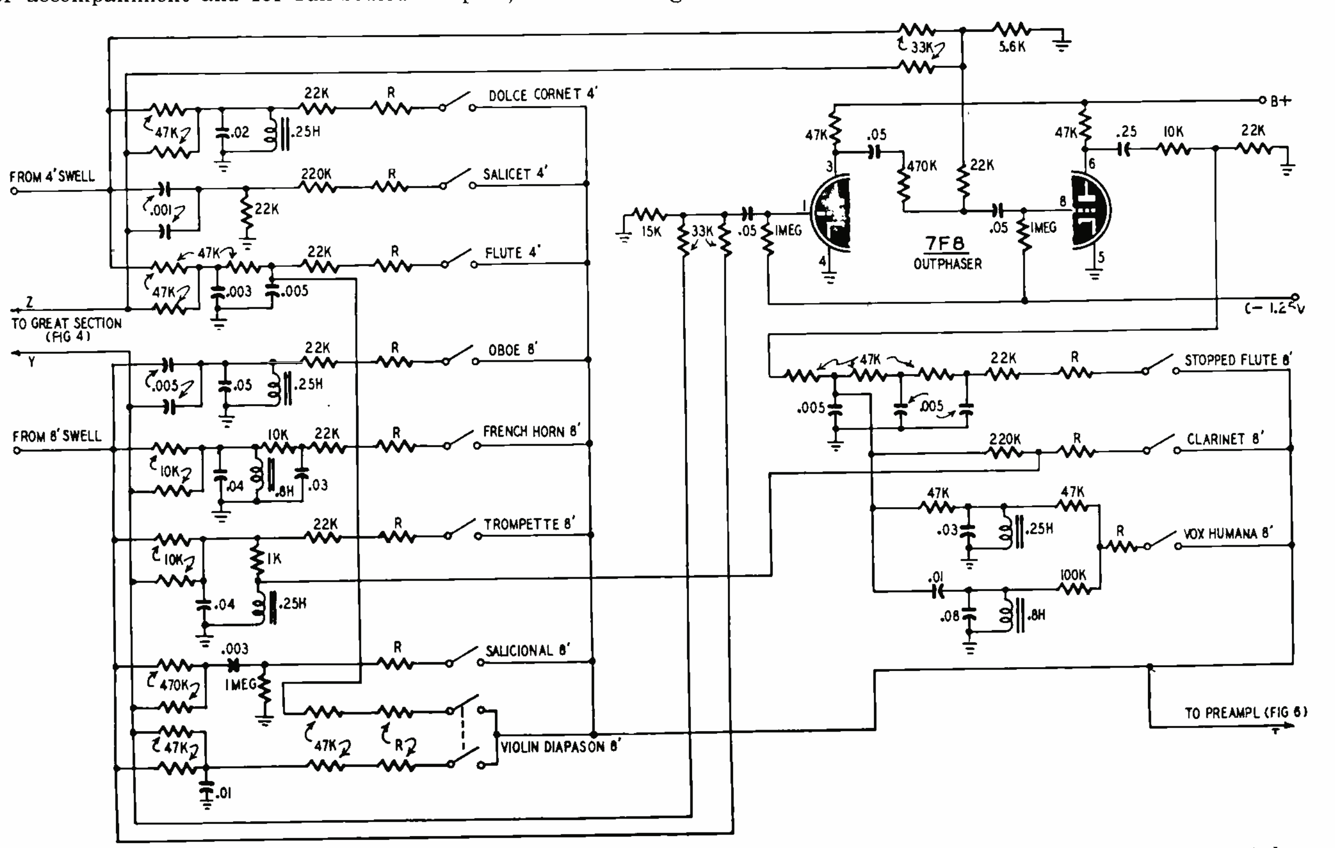
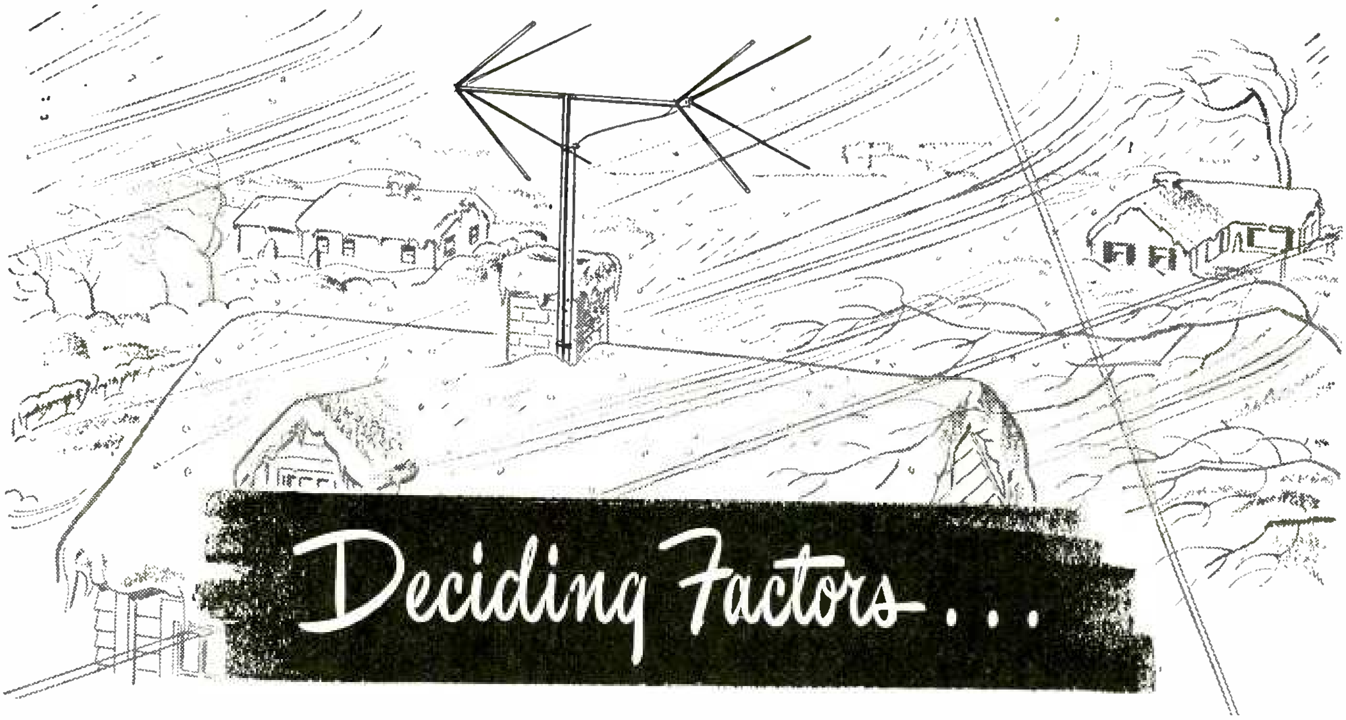


Fig. 4—Meticulous engineering has gone into the elaborate swell department with its 11 stops and the special outphaser.



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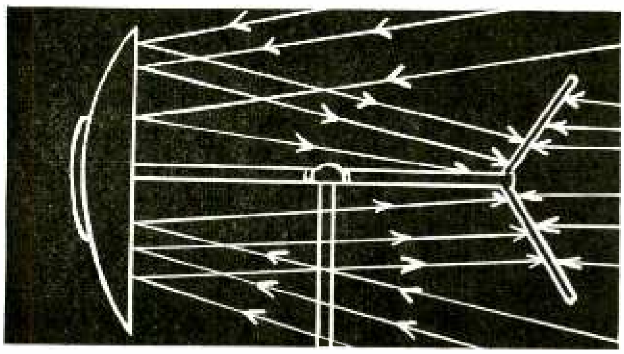

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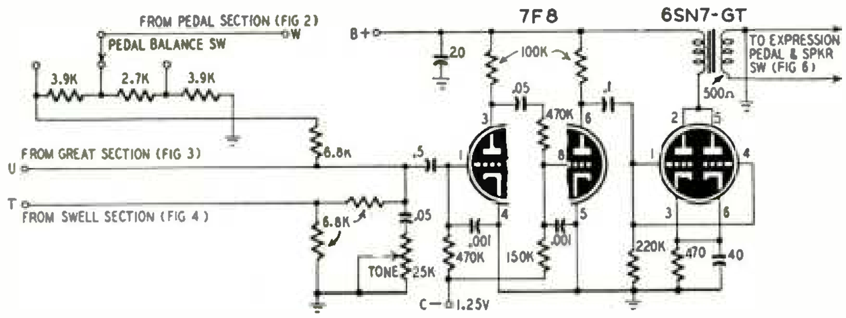


Fig. 5—The preamplifier, located in the tone color box, has three separate inputs.

triode, both from the swell key network and from the swell-to-great coupler. At the output of the first triode the phase is reversed. The tones are then fed through the second triode, along with 4-foot tones mixed in, at the proper strength, between the two stages. The output, consisting of 8-foot tone with even harmonics very much attenuated, is fed to the next three stop filters.

The STOPPED FLUTE is a fairly heavy flute tone. Since only odd harmonics are

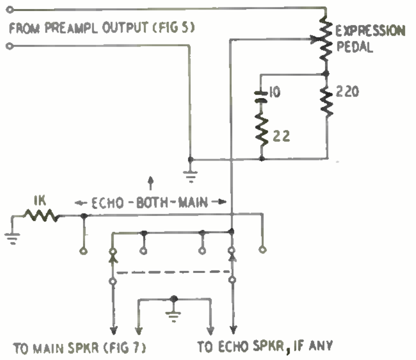


Fig. 6—Preamplifier output goes to the expression pedal, and speaker switch.

heard it has a hollow sound peculiar to woodwind instruments and to organ pipes with one closed end. The CLARINET is much like the orchestral instrument, again with the typical hollow, woodwind sound. The VOX HUMANA, originally conceived in organ tradition as imitating the human voice, is a reed stop of unusual quality. In the Baldwin this is produced by the outphaser and by the fact that it has two distinct formants, one around 600 cycles and the other in the neighborhood of 2,000 cycles.

Preamplifier circuit

The output of each of the three departments goes to the preamplifier diagrammed in Fig. 5, in the tone-color box. Lead W from the pedal department goes to the arm of a voltage-divider switch so that the volume of the pedal tones can be adjusted during installation. The pedal clavier controls some fairly loud tones as low as 32 cycles. At this low frequency sound diffuses extensively, and windows, fixtures, and furnishings may tend to vibrate. The setting of the pedal balance switch depends on the acoustics of the room or hall in which the organ is located.

Lead T from the swell section enters the preamplifier through a simple isolating network, while lead U from the great department enters without any isolation resistor of its own, the isolation of the other two inputs being sufficient. The .05-µf capacitor and variable 25,000-ohm resistor between preamplifier grid and ground make up a tone control. With the resistor at maximum resistance, the capacitor has least shunting effect and tone is most brilliant. As the resistor value is reduced, more and more of the higher tones and harmonics are shunted to ground. The setting of this control, which is on the front of the console panel, depends somewhat on the acoustics of the room or hall, but is often varied during playing. It is seldom left at the full brilliant position, especially when, as in some cases, special speaker systems with high-efficiency tweeters are used. The preamplifier terminates in a 500-ohm transformer.

Two additional controls appear on the organ console. The first is the usual expression or swell pedal which controls volume. The pedal operates a potentiometer (Fig. 6), which is connected to the preamplifier output and returns through a tone-compensating and limiting network to ground. The 22- and 220-ohm resistors and the 10-µf capacitor constitute a lower net impedance for high frequencies than for lows. When the potentiometer arm is at the bottom the proportion of middle and high frequencies appearing at the output of the attenuator network is less than the lows. This compensates to some extent for the characteristic of the human ear which hears less bass when volume is low. It is, in effect, a simple loudness control, or compensated volume control of the type used on many receivers. The attenuator output goes to a panel switch with three positions.

In pipe organs one set of pipes, known as the echo organ, is sometimes located at a distance from the others so that the effect is that of having tones float in from a distance. The effect is especially marked in a very large church with strongly reflective walls. This effect can be produced in the Baldwin by adding a separate set of loudspeakers and a power amplifier at some distance. The switch of Fig. 6 connects the attenuator output to either the main speakers or the echo speakers, or to both. When only one set is being used, a 1,000-ohm resistor shorts the line to the other set preventing an open-ended line.

Tone cabinets

Several different styles of tone cabinets containing loudspeakers and power amplifiers are available. At least two 15-inch loudspeakers are used in all of them. It is possible, however, to employ any amplifier and speaker combination desired and some installations are very elaborate indeed. Two amplifier models are supplied, one with 20-watt maximum output and the other with 40-watt. The 40-watt amplifier is diagrammed in Fig. 7. It is simple but quite adequate. It has only two stages, an input and phase-inverter stage combined, and a paralleled push-pull output, with inverse feedback from output transformer secondary to the input triode cathode. So-called high fidelity is not a requirement in an organ from a frequency response standpoint, although freedom from intermodulation is. There is, however, a very marked difference

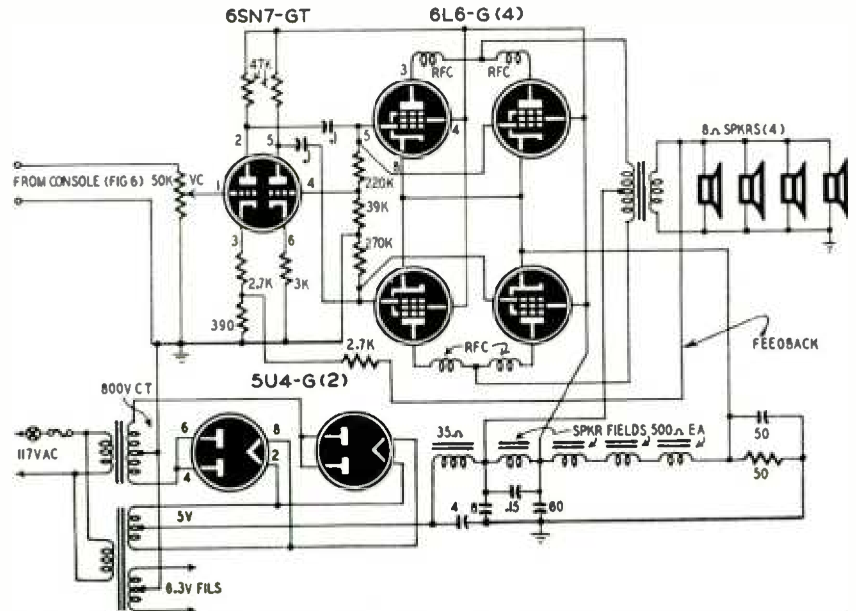


Fig. 7—The Baldwin uses 20- or 40-watt speaker systems. This is the 40-watt unit.

in the way the tone colors come out when various amplifiers and speaker systems are used. This is not surprising in view of the formant principle, in which any element of the system which affects the spectrum or frequency-response characteristic alters the tone quality.

Fixed bias of a sort is used in the amplifier; the speaker fields across the power supply form a voltage divider with the 50-ohm resistor at the bottom. The 19 volts appearing across this resistor is fed to the 6L6 cathodes.

A bleeder current of about 200 milliamperes flows through the speaker fields. This is roughly equivalent to the current drain of the push-pull paralleled 6L6 output tubes and serves to stabilize the bias on these tubes.

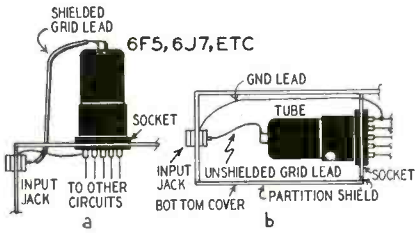
As with any musical instrument, the acoustics of the installation are of paramount importance. The ideal installation includes a tone chamber for the loudspeaker units. The speakers can be faced toward one of the hard walls of the chamber so that when the sound emerges it has diffused to some extent. In addition, the multiple reflections from the walls and ceiling cause some phase shift among the tones, changing with frequency. These effects, as well as a certain amount of reverberation in the hall, are very desirable in eliminating the point-source effect of loudspeakers and the undesirable perfection of electronically generated tones. Straight speaker cabinets, when they are placed properly can also be used with good effect. The company has established a number of rules of thumb and procedures to help the installers in this respect.

When correctly installed, the Baldwin organ is a fine musical instrument—entirely aside from the ingenuity which has gone into its design. It is suited not only for church work, but has been widely accepted for concert performance in both the baroque and modern styles and is equally suitable for theater and radio music. While not superior to a really good pipe organ, it is better than most. It represents a truly happy wedding of the art of the electronic engineer and the music-maker.

—end—

AUDIO CONSTRUCTION TIP

When constructing high-gain audio amplifiers and similar equipment, it is desirable to keep the grid of the input stage isolated from the other circuits to minimize hum and feedback. It is easy to isolate the control grid and input circuit of double-ended tubes such as the 6J7 and 6F5 but the usual construction methods do not take full advantage of the tube. The usual arrangement is shown at *a* in the illustration. The grid lead is comparatively long and must be well shielded to avoid hum and feedback. A suitable shield on the grid lead increases the input capacitance of the circuit and can cause loss of highs.



A better layout is shown at *b*. The tube is mounted under the chassis in a partition shield which effectively isolates the tube and its input circuit from the circuits on the rest of the chassis. With this arrangement the grid lead can be short and unshielded, thus decreasing stray capacitance and increasing high-frequency response.

The usual precautions in low-level amplifiers—placing the tube and shield away from the magnetic fields of power transformers and filter chokes as well as the output transformer and its leads—of course apply.

Replacing the tube is a little more difficult than when the conventional mounting is used, but since replacements are infrequent, the inconvenience is of little consequence. It is advisable to drill a few ¼-inch holes in the chassis above the tube to allow for air circulation and heat dissipation.—*Charles Erwin Cohn*

DISTORTION IN PHONOS

Distortion which cannot be traced to the amplifier or which occurs only when using the phonograph section of a combination can often be traced to the record-player unit. In most instances, distortion is of two types.

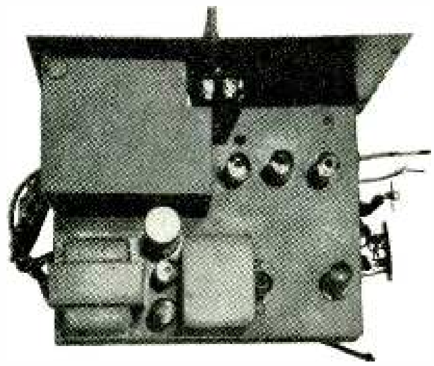
Distortion caused by a bad crystal is usually accompanied by low output. It clears up when the defective crystal is replaced with a new one.

Distortion due to motor rumble or wow is usually more noticeable when the needle nears the center of a record—particularly on LP types. Some motors develop enough vibration to cause distortion by modulating the crystal output at the frequency of the vibration. The solution to this problem is to tighten the motor mounting or change the motor. *Do not increase needle pressure by reducing the weight of the counterweight.* This practice shortens the life of needle and records.—*Admiral Service Bulletin*

Remote Controlled Amplifier

Featuring remote volume control, low current drain, inverse feedback, and nine miniature tubes, this public address amplifier is ideal for mobile announcing

By PAUL W. STREETER



Back chassis view and layout of parts.

WE required an amplifier which:

1.—would deliver enough power to drive two husky re-entrant speakers;
2.—could be permanently mounted on the fire-wall of the car out of the way;
3.—would have a small, compact remote-control unit mounted within easy reach of the driver on the steering column or under the edge of the instrument panel; 4.—would include an automatic record changer if needed.

Auto radio components were used as far as possible, and since space was at a premium, miniature tubes were selected for use throughout the entire amplifier. Inverse feedback was incorporated, to reduce distortion.

It was essential that the amplifier run on a minimum of battery current, since effective use of the sound car requires that it cruise at slow speeds with very little opportunity for the car's generator to recharge the battery. Larger amplifiers (such as the 35-watt job described by this writer in the June, 1949, issue of RADIO-ELECTRONICS) require over 20 amperes continuously. Car speeds necessary to allow the car's generator to deliver this much current are higher than desirable, and if the equipment was used over long periods of time the battery was discharged.

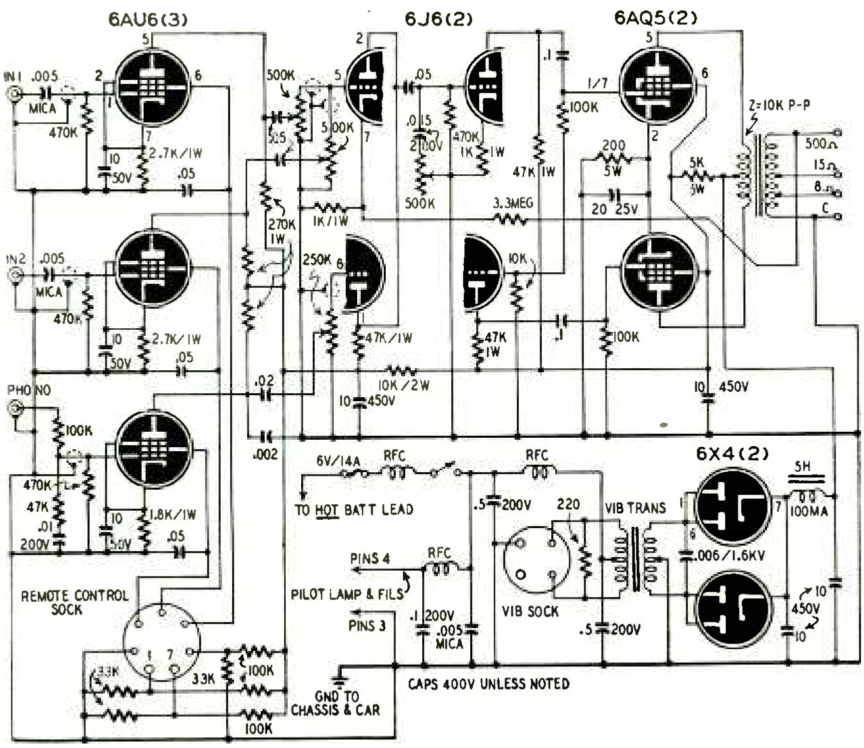


Fig. 1—Schematic of the remote-controlled, miniature-tube mobile amplifier.

The phonograph equipment

Phonograph input was provided for use where "background" music was desired. Unlike the previously described amplifier, however, this miniature-tube amplifier will not furnish 110 volts 60-cycle alternating current to operate a phonograph turntable motor. A separate converter was built for that purpose.

We have been using crystal phonograph pickups, not because they are the best pickups available, but because they can be easily obtained and replaced if necessary, and will stand up under ordinary abuse. Also, they give good reproduction when used in a properly filtered circuit. Such a filter is incorporated in the phonograph input circuit (see Fig. 1). The values shown for its components have been selected for use with a crystal pickup having 1.4 volts output —such as the Astatic L26A. These crystal cartridges may not give true high-fidelity transcription reproduction since they do have fairly low cutoff frequency. But they will stand up under the rough service encountered in mobile use and (since the music is primarily to attract attention) there is no reason for especially high fidelity.

The 6AU6 tubes serve as microphone and phonograph preamplifiers. The output from these tubes is fed to the 6J6 mixer-tube grids. Input volume to this mixer tube can be controlled by the screen voltage of the individual 6AU6 tubes, or by the master gain controls in the 6J6 mixer-tube grid circuit. The output of the mixer is fed to another 6J6 amplifier and phase inverter which, in turn, feeds into the 6AQ5 grids. Since the 6AU6 tubes and the 6J6 mixer tube are operated with reduced plate voltage, control of volume is noiseless and smooth over a wide operating range.

Two 6X4 rectifier tubes are used in a conventional full-wave rectifier circuit. One 6X4 could be used under most oper-

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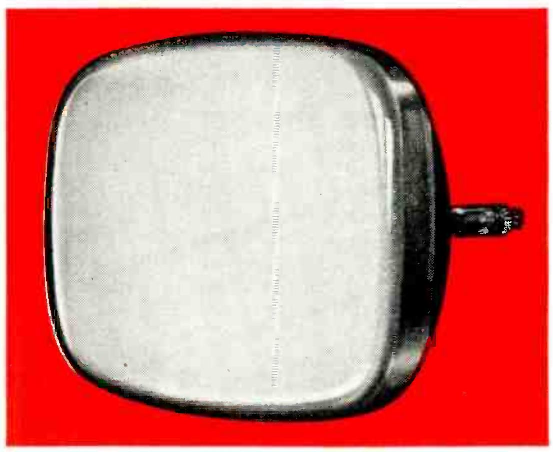

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ating conditions, but under full volume becomes seriously overloaded. Two tubes should be used for dependable results. Since considerable heat is developed by these tubes, good steatite sockets should be used to avoid breakdown. We tried phenolic sockets and found that they would not stand up under the heat and vibration.

The amplifier was built on a chassis 7 x 9 x 2 inches. The completed amplifier, without cabinet, is just over 7½ inches high. All parts should be laid out on the chassis and all mounting holes marked and drilled before any wiring is attempted, since the underchassis parts occupy most of the available space and can easily be damaged by later drilling. It will be advantageous to lay out the 6AU6 and the 6J6 tube sockets with just enough space between them so that the plate-to-grid coupling capacitors can be wired in place and will lie flat against the underside of the chassis with very short leads to the socket.

The 6AU6 tubes are mounted along the left front of the chassis and the 6J6 tubes are placed behind them. Enough space should be left for the master gain controls and their respective input coupling capacitors, between the front of the chassis and the 6AU6 sockets.

The two 6AQ5 tubes are mounted in the rear right corner, between the output transformer and the filter choke. All the power-supply components—except the filter choke—are mounted on the right front side of the chassis and covered with a shield can. In addition, the leads which will run from the power transformer to the vibrator and the rectifier-tube plates on the underside of the chassis should be enclosed with a small metal shield. It will save time if these cans are made up and the necessary holes for mounting them drilled before any parts are installed.

Dimensions of these shields are not critical. Probably—if parts are carefully placed—they can be made of available discarded shield cans originally used for other purposes.

Wiring the amplifier

A piece of solid, bare No. 14 copper wire should be spot-soldered to the underside of the chassis in the form of a U, starting directly under the center of the power transformer and proceeding along the front to the opposite side; then to the rear edge of the chassis; then back to a point directly under the output transformer. All ground-return leads are brought to the nearest point on this wire; except that all leads from the power-supply components should be fastened to the wire where it is placed under the power transformer.

Tube sockets and master gain controls can be mounted on the chassis first and all filament wiring completed; then the shielded leads from the master gain controls installed. We used ordinary pushback hookup wire loosely inserted in woven shielding removed from phonograph pickup wire. The metal backs of the gain controls should

TRIPLETT

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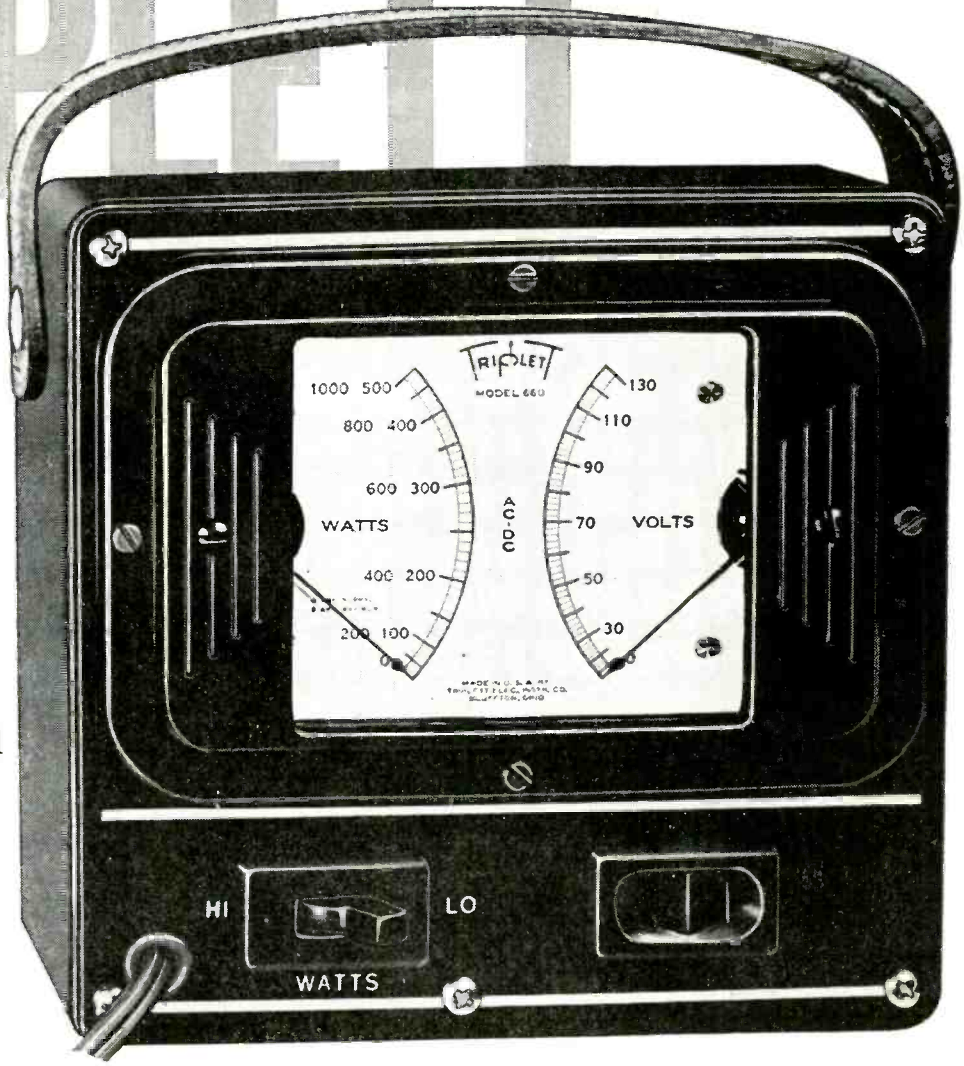
Servicing by Power Consumption

MODEL 660



LOAD-CHEK *for the first time* makes it possible for every technician to utilize what is perhaps the simplest and quickest of all service methods—Servicing by Power Consumption Measurements.

Power consumption measurement has long been proved by auto-radio servicemen as a rapid method of localizing troubles in auto radios. But Triplett's new LOAD-CHEK is the *first* Wattmeter to be produced *at moderate cost*, and with the *proper ranges*, to bring this short-cut method within the reach of *every* radio and TV service man.

Basis of the LOAD-CHEK method is the tag or label on every radio and TV chassis which shows the normal power consumption. The following examples are only two of many time-saving uses of this new instrument.

LOCATING A SHORT—The chassis tag may show a normal consumption of 225 Watts. Simply plug the power cord of the chassis into LOAD-CHEK (there are no loose ends to connect or be in the way). Note the reading—which should be possibly 350 Watts. By removing the rectifier tube you can determine at once which side of the tube the short is on. With a soldering iron and long-nosed pliers you can check through the chassis, locate and correct the trouble without having to lay down tools or to check with lead wires!

REPLACING BURNED OUT RESISTORS—With the chassis to be repaired plugged into a LOAD-CHEK MODEL 660, note the wattage reading with the burned out resistor circuit open. Now replace the resistor. Should the increase in watts be greater than that of the resistor rating being installed, it indicates that an extra load has caused the trouble which has not been cleared.

LOAD-CHEK is made-to-order for the busy service man and can help stop costly "come back" repair jobs. It's a profit-maker because it's a Time-Saver. And at its moderate cost LOAD-CHEK can be standard equipment on *every* service bench. *By all means*, inspect this versatile instrument at your distributor and place your order, for under present conditions we must fill all orders on a basis of "First Come, First Served."

SEE MODEL 660 LOAD-CHEK AT YOUR DISTRIBUTOR'S

FOR THE MAN WHO TAKES PRIDE IN HIS WORK

Triplett

TRIPLETT ELECTRICAL INSTRUMENT COMPANY · BLUFFTON OHIO U S A be grounded directly to the chassis, together with one end of each shielding. Most controls have removable backs held in place with small metal tabs. One of these tabs on each control should be bent out with the blade of a knife until it contacts the chassis, and secured in place with a small spot of solder.

Next, capacitors and resistors should be installed. Careful layout of these parts will result in easy wiring, in spite of the close quarters around tube sockets. It will help if alternate socket prongs are spread outward on the 6AU6 and the 6J6 sockets, to allow more room for the soldering iron. Solder must be used sparingly on all tube-socket prongs. Rosin-core solder and a small hot iron—or transformer-type soldering gun—should be employed. Make all connections mechanically tight before applying any solder, and depend on the solder *only* for a tight electrical connection. This can best be done by looping the wire through the hole in the socket prong and closing the loop with needle-nose pliers before applying the solder.

Wire the plate-to-grid coupling capacitors in place with short leads and so that they lie flat against the chassis. The B-supply resistors for the 6J6's and the screen resistor of the 6AQ5's may be mounted on a small bakelite strip near the second 6J6 tube socket to save space and for ease in wiring.

Input coupling capacitors for inputs 1 and 2 are installed at the microphone input connectors and wired to the 6AU6 No. 1 grids with shielded flexible leads. The grid resistors in these circuits are connected from the socket pins directly to the grounding copper bus with *very short* leads at the grid end of the resistors. The phonograph input circuit is made up similarly, with the input resistors and capacitor mounted at the input jack and a shielded lead to the tube socket with the grid resistor direct to ground from the grid pin of the socket.

The three r.f. chokes in the power supply should be made of No. 14 d.c.c. solid wire. Each choke consists of 24 turns, close-wound in one layer on a piece of ⅜-inch dowel. After winding, the dowel is removed and the choke is tied with strong thread to hold its shape. These chokes are mounted by their own leads.

Transformer and vibrator

The vibrator power transformer should be one capable of delivering 300 volts at 100 ma each side of center-tap. The transformer we selected was a Stancor P-6131. It is designed to operate with a vibrator whose reed frequency is 115 cycles. We selected a Cornell-Dubilier CS15 vibrator to use with it. If other transformers that will deliver the above mentioned voltage and current are available, they can be used successfully, but be careful not to pick a transformer designed to be used at a higher frequency than the vibrator will deliver, or that will otherwise mismatch the units. Since considerably more current is needed than that furnished by the average auto radio power pack. Synchronous vibrators should be avoided because of the higher "hash" level in the output. Battery polarity becomes a problem when using sync vibrators, too.

In general, a transformer that meets the above specifications may be used with an appropriate nonsync vibrator with no trouble if the frequency of the transformer and the vibrator are matched, and are 115 cycles or more. Some vibrators and transformers now on the market are designed for frequencies as high as 180 cycles.

After all possible underchassis wiring has been completed, mount and wire the components on top of the chassis. The r.f. choke connected to the vibrator transformer center-tap and the two capacitors between its terminal and ground are wired to mounting strips placed on top of the power transformer. Take care that they are so placed that they will not interfere with the shield that will be installed over them. The resistor across the vibrator transformer primary should be wired directly across the vibrator socket contacts, and then the vibrator transformer secondary capacitor should be jumpered across the 6X4 sockets with leads as short as possible (the leads can be used to jumper each socket's No. 1 and No. 6 pins).

When all wiring is completed, double-check for accuracy and tightness, and place a drop of bright-colored paint on each soldered connection. This paint will often be an aid in detecting a later developed poor connection (caused by vibration) since the paint will flake and fall away if any looseness develops. It also serves as a check.

The remote control unit (Fig. 2-a) consists of three volume controls mounted compactly in a small box suitably arranged for mounting on the steering column or under the instrument panel of the car. The box we used measured 2¾ x 5 x ¾ inches. It is bolted under the car instrument panel, just to the left of center, within easy reach of the driver. The leads from the remote-control unit consist of a shielded 7-wire cable terminating in a 7-prong plug which can readily be inserted in the amplifier's remote-control socket. After assembly the control box was given two coats of black crackle finish and a dial plate and knobs were installed.

If desired, the remote control may be omitted, and a dummy plug can be made up as shown at *b* in Fig. 2, and inserted in the amplifier socket. The master gain controls will then be used to control volume level. Such a plug is also handy for checking the amplifier when removed from the car for servicing.

After all wiring has been completed, install tubes and shield covers. Before the amplifier is placed in the cabinet, however, it is advisable to drill the cabinet for the mounting bolts and also lay out and drill similar holes for mounting the equipment in the car. Any paint around these holes should be scraped away to make a good electrical

(*Continued on page* 94)

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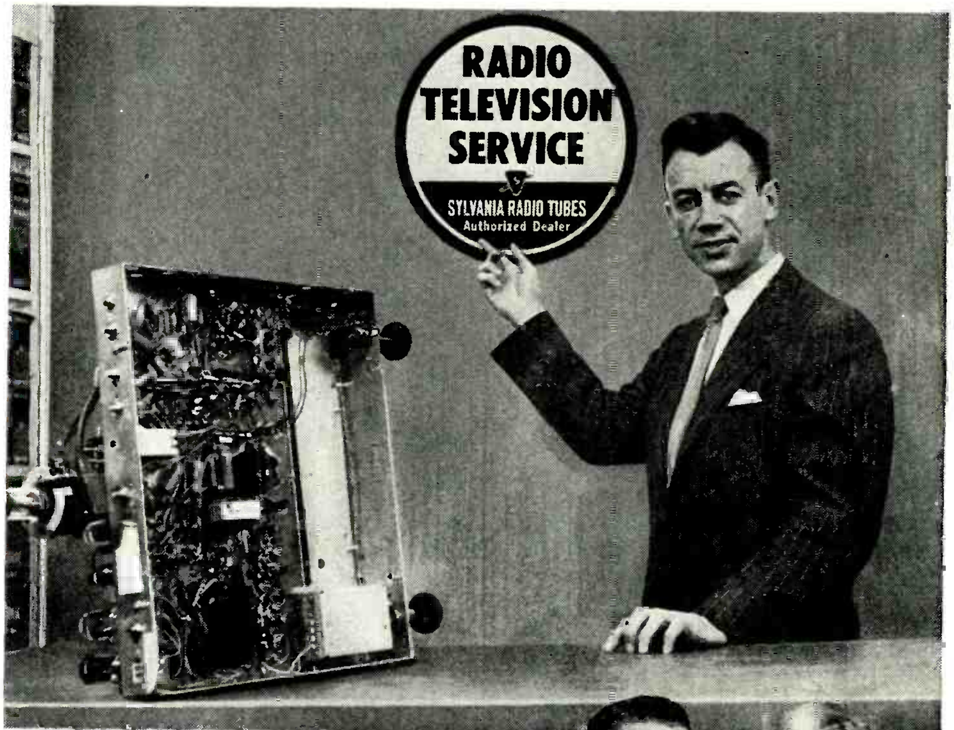

You're an "expert, reliable serv-ice-man who does a tough job well," Bill Shipley, crack CBS-TV announcer, tells your prospects. And, he adds: "Always look for that Sylvania Service Emblem." That's how the hard-hitting, full-minute commercials on Sylvania's CBS-TV show, "Beat the Clock," put Bill Shipley, Roxanne, and Bud Collyer on your sales staff.

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connection between the car and the case.

Test and operation

The amplifier can be easily checked before installation in the car. One terminal of a 6-volt storage battery should be connected to the hot lead of the amplifier and the other connected to the case. Polarity is not important. Any good high-impedance crystal or dynamic microphone will serve and should be connected to the microphone input connector of the stage under test. A speaker rated at 15 watts or more should be connected to the amplifier output. With the master gain control about halfway on, fairly high output should be obtained when the remote control is turned all the way up. With similar control settings, each input should give substantially the same output.

In use, the master gain controls on the amplifier can be left on and each channel can be individually regulated by the remote control unit. The remote gain controls of those inputs which are not being used should be kept turned off. The controls are available, however, to allow any combination of mixing or fading of the various inputs.

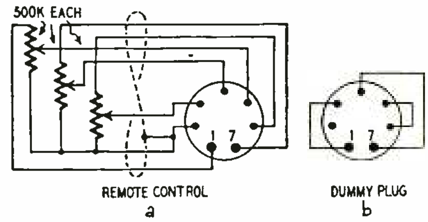


Fig. 2-a—Detail of remote-control unit.
Fig. 2-b—Remote socket dummy plug.

No audio amplifier should ever be operated without adequate speaker loading. This one is no exception. If operated without a suitable output load, high audio voltages in the final-amplifier plate circuit will cause insulation breakdown in the output transformer, in the final-amplifier tube sockets, or in the power-supply components. For that reason, always check the speaker connections before operating the amplifier. Be sure they are tight.

If more than one speaker is used, connect the speakers in parallel and properly phase for maximum output. Most of the 25-watt driver units available today have 15-ohm voice coils. Two such units will match the 8-ohm winding of the amplifier's output when paralleled. The amplifier will provide sufficient drive for two speakers to be heard for distances up to a half mile or more if straight or re-entrant horns are employed.

Materials for amplifier

Resistors: 1—220, 1—10,000, 3—33,000, 1—47,000, 3—100,000, 4—470,000 ohms, 1—3.3 megohms, ½ watt; 2—1,000, 1—1,800, 2—2,700, 3—47,000, 3—100,000, 3—270,000 ohms, 1 watt; 1—10,000 ohms, 2 watts; 1—200, 1—5,000 ohms, 5 watts; 1—0.25-megohm, 6—0.5 megohm volume controls.

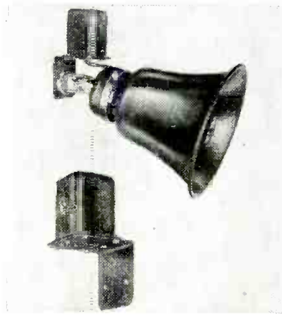
Capacitors: (Paper) 1—.01, 1—.015, 1—0.1, 2—0.5 μf, 200 volts; 1—.002, 1—.02, 6—.05, 2—0.1 μf, 400 volts; 1—.006 μf, 1,600 volts. (Mica) 3—.005 μf. (Electrolytic) 1—20 μf, 25 volts; 3—10 μf, 50 volts; 4—10 μf, 450 volts.

Miscellaneous: 1—Stancor A3311 output transformer; 1—Stancor P-6131 vibrator transformer (see text); 1—Stancor C-2305 or equivalent 5-henry, 100-ma filter choke; 1—vibrator, C-D CS15 (see text); 1—fuse, 6-volt, 14-ampere type; 1—switch, s.p.s.t., 20-ampere type; r.f. chokes, self-wound (see text); chassis, case, miscellaneous hardware, wire, etc.

—end—

LINE TRANSFORMERS

Atlas Sound Corp., 1449 39th St., Brooklyn 18, N. Y., has developed two new weatherproof line-matching transformers designed to match their dual-projector and paging and talk-back speakers to either constant-voltage (70-volt line) or constant-impedance systems. Transformer tops are marked so as to eliminate complex computations. The units are rated at 12 watts and have 4- and 8-ohm secondaries.

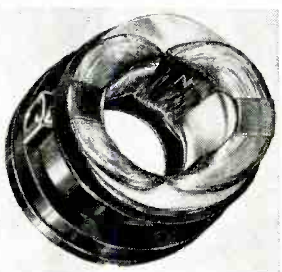


The model T-11 has a 2,000-ohm primary tapped at 1,500, 1,000, and 500 ohms. The T-12 has a 45-ohm primary. The frequency response of these units is shaped to insure efficient operation over the range required for public address work.

These transformers are mounted in heavy steel housings which prevent mechanical and atmospheric damage. The mounting brackets are integrated with the speaker mounting brackets so that no extra fastenings are required.

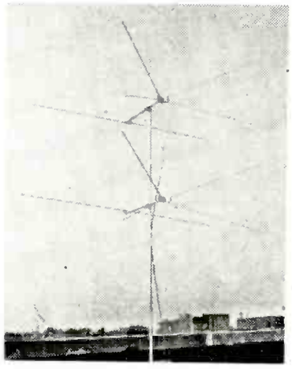
TV DEFLECTION YOKES

Standard Transformer Corp., 3580 Elston Ave., Chicago 18, Ill., has recently added the type DY-8 and DY-9 deflection yokes to their line of TV replacement components. Both units have cosine-type windings and ferrite cores and are designed for 70-degree deflection. The inductance of the horizontal coil is 8.5 and 13.5 mh for the DY-8 and DY-9, respectively. Vertical coil inductance is 50 mh in each.



ALL-CHANNEL TV ANTENNA

The Brach Mfg. Corp., 200 Central Ave., Newark, N. J., announces its new Air Special all-channel TV antenna. The length and forward tilt of the elements is designed to provide maximum forward gain with a single-bar reflector. The reflector is adjustable for peaking on channels 2 through 6. The single-bay unit is the model TA-462 and the stacked model shown is the TA-464. Both antennas match 300-ohm lines.

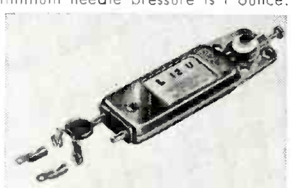


PHONO CARTRIDGE

The Astatic Corp., Conneaut, Ohio, announces the new L-12-U dual-voltage phonograph cartridge which is designed as a replacement for more than 125 different standard 78-r.p.m. cartridges. The L-12-U is supplied with a capacitor-harness fitted over its output terminals.

Removing the harness raises the output from a low of 1.2 volts (at 1,000 cycles) to a high of 4 volts.

The range of the L-12-U is to 5,000 cycles. The cartridge weighs 19 grams; minimum needle pressure is 1 ounce.



All specifications given on these pages are from manufacturers' data.

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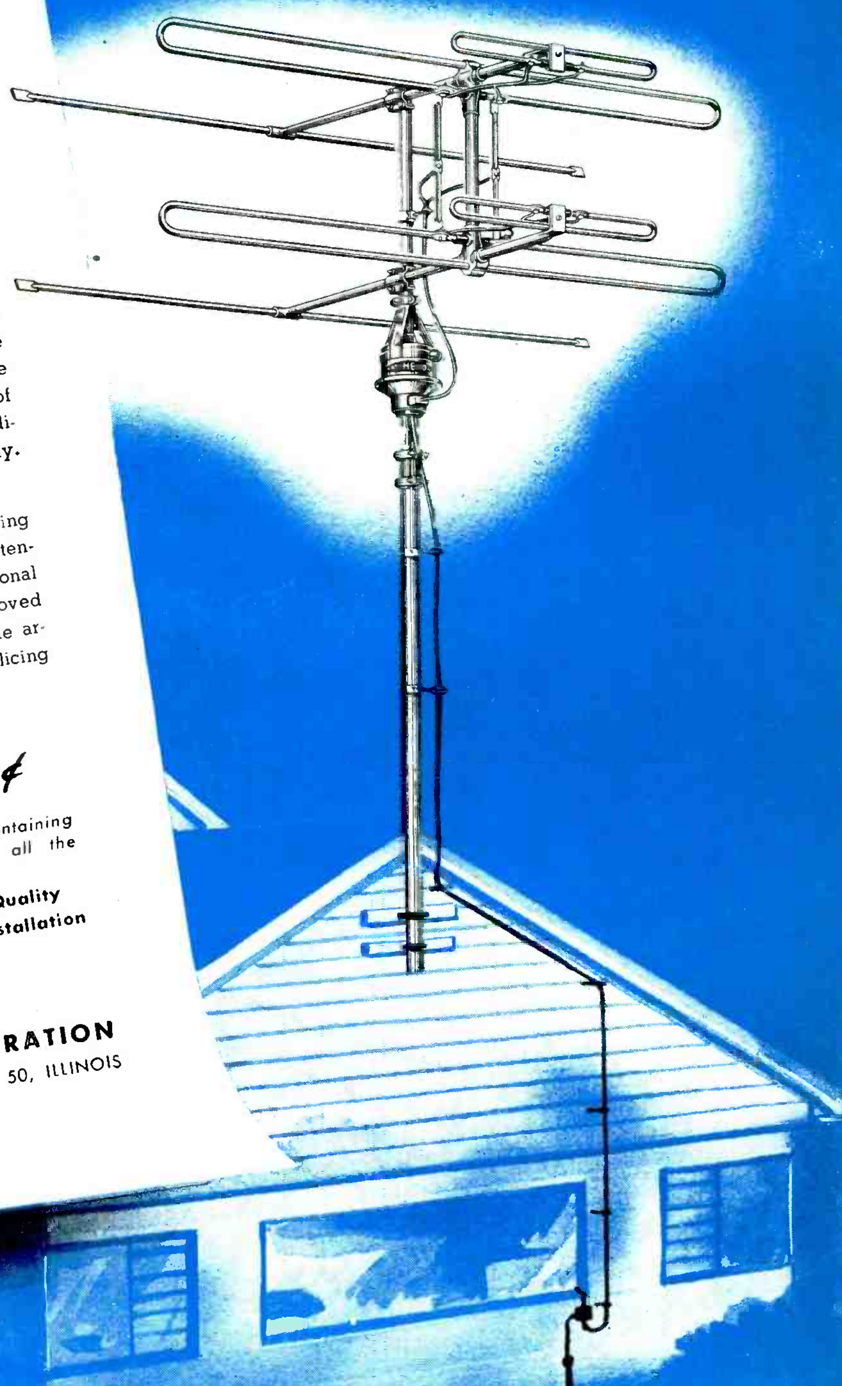
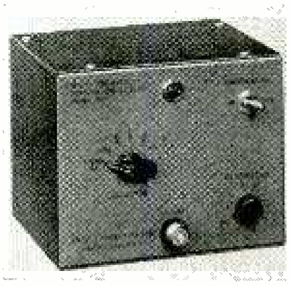


TV CRYSTAL OSCILLATOR

Crest Laboratories, Whitehall Bldg., Far Rockaway, L. I., N. Y., announces the new model 50 multi-frequency, high-output crystal-controlled signal generator for spot frequency alignment of TV and military receivers. Compact in size, it provides five spot frequencies in the 4.5 to 50 mc range. Maximum output is 1 volt from the

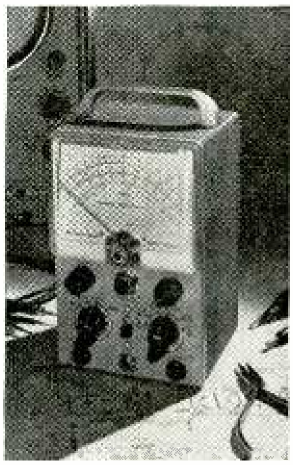


72-ohm terminated probe. It uses five harmonic-type crystals which are available as accessories. Internal 400-cycle modulation is available. The unit incorporates a transformer-type power supply which operates from 117-volt, 60-cycle lines.

HEATHKIT V.T.V.M.

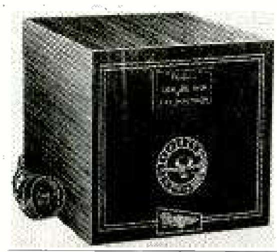
The Heath Co., Benton Harbor 20, Mich., announces its new model V-5 v.t.v.m. featuring a new cabinet design which is smaller and more professional in appearance than the earlier model. The 4½-inch, 200-μa meter has a shatterproof plastic face and a two-color scale. The instrument reads a.c. and d.c. with full scale ranges of 3, 10, 30, 100, 300, and 1,000 volts; resistance from 0.1 to 1 billion ohms; and decibels from minus 20 to plus 15. Controls include d.c. polarity reversing switch and zero centering.

The kit comes complete with all parts including tubes, meter, transformer, test leads, cabinet, etc. Construction manual includes step-by-step assembly instructions, pictorials, schematic, and circuit description.



C-R TUBE REACTIVATOR

Transvision Inc., 460 North Ave., New Rochelle, N. Y., announces the release of its new C-R tube reactivator. It is a line-operated instrument which can be used in the customer's home without removing the picture tube from the TV set. The reactivator will not work on tubes having shorted elements, open heaters, or broken glass.

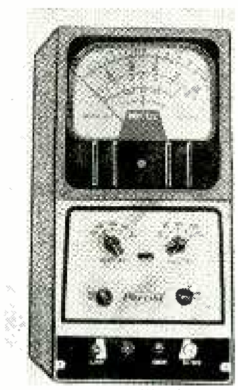


KIT OR WIRED V.T.V.M.

Precise Development Corp., 999 Long Beach Road, Oceanside, L. I., N. Y., is producing its new model 907 vacuum-tube voltmeter as a kit and a wired model. The instrument features a 7½-inch easy-to-read meter. It measures d.c. and a.c. with full-scale ranges of 5, 25, 250, 500, and 1,000 volts, decibels from minus 20 to plus 55, and resistances from 0 to 1 billion ohms in five ranges. When measuring d.c. voltages, polarity can be reversed simply by throwing the function switch.

High-voltage and r.f. probes—available as accessories—are used to increase the frequency range to over 250 mc and the voltage range to over 30,000 volts.

The model 907 is available in two cabinet styles which make it possible for the prospective owner to select the style which fits more readily into his tool bag or into available space in the test panel above the workbench. One is assembled in a case 16 inches wide, 8 inches high, and 5 inches deep. The style shown in the photo is in a case 8 inches wide, 16 inches high, and



5 inches deep. Each weighs 15 pounds, operates from 117-volt, 60-cycle lines, and is delivered complete with test leads, wire, and batteries.

VACUUM TUBE VOLTMETER

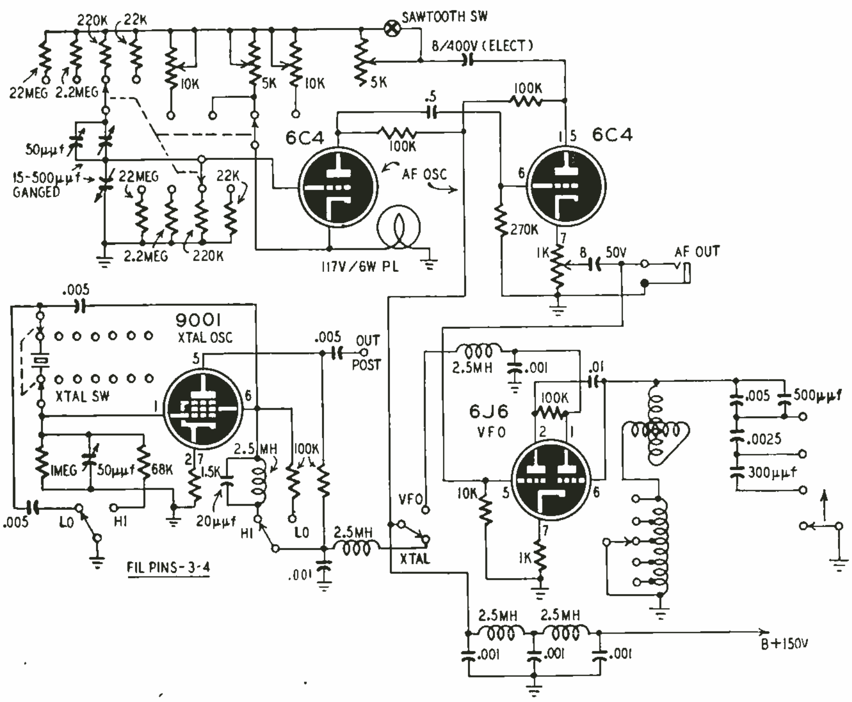
Electronic Measurements Corp., 280 Lafayette St., New York 12, N.Y., announces the model 106 v.t.v.m., the latest addition to the EMC line of electrical testing equipment. Designed

for field alignment of radio and television sets, the 106 is completely electronic on all functions and ranges and has five a.c.-d.c. and ohms ranges. The instrument includes a special zero-center scale and centering control which are useful in aligning AFC, and FM discriminator circuits. Featuring a 1½-volt range for both a.c.-d.c. volts, this instrument is housed in a molded bakelite case that measures 7¼ x 5¼ x 2⅞ inches with a net weight of three pounds.

NEW TV ANTENNAS

The Walter L. Schott Co., 3225 Exposition Pl., Los Angeles 18, Cal., introduces its new model M antenna which is constructed largely of chromate-coated magnesium which is one-third lighter than aluminum and almost as strong as steel. The antenna has a director which minimizes ghosts and improves gain on the high channels.

—end—



The complete diagram—the a.f. output jack is also used for r.f. signal output.

Multi-Unit Signal GENERATOR

By JOSEPH MARSHALL

THIS test-signal generator provides every type of test signal required for servicing communication and high-fidelity receivers and amplifiers. It can be used, without any changes or modifications, to service any type of radio receiver. The model illustrated was built principally of surplus parts, but standard parts can be used without any difficulty.

The instrument consists of three sections which can be used independently or inter-relatedly. They are:

1. An R-C type audio oscillator with a range from 8 to 80,000 cycles.
2. A variable-frequency oscillator covering the frequencies from 175 to 5000 kc.
3. A crystal-controlled oscillator accommodating 11 crystals in the frequency range from 100 kc to 10 mc.

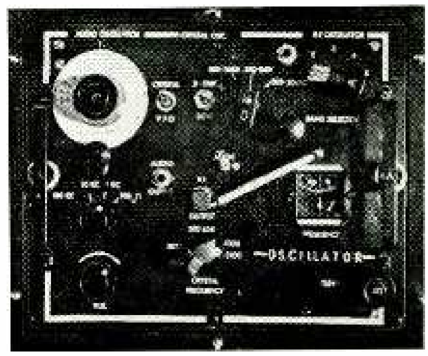
Any of the sections may be used successfully in an independent instrument. They are the result of considerable experimentation and although simple in design permit quality performance.

The instrument is contained in the chassis and case of a range A tuning unit for the Navy GP-7 transmitter. The v.f.o. uses the master-oscillator section with very few modifications. The range A tuning unit was designed to cover 400 to 800 kc. Instead of using a variable capacitor for tuning, it used a variable inductor and fixed mica capacitors.

The variable tapped inductor is very large and wound with heavy wire on a heavy ceramic form. The dial tuning ratio is especially suitable for precision setting of an oscillator. With the given value of capacitance, a frequency range of 2 to 1 is covered by 4,000 dial divisions. The tuning mechanism has no backlash at all. Given a stable oscillator circuit, the components promised a stability and reset accuracy of a very high order, and the promise was easily attained in the actual instrument.

The original circuit was a Colpitts. To obtain greater versatility and stability, we modified it to use the cathode-coupled, 2-terminal oscillator. We employed a 6J6 tube mounted on the partition which separates the master oscillator from the rest of the unit. The tube is outside the compartment, while the socket is inside for easy wiring. The wiring is very simple and few changes are required. Heavy bus-bar wire is essential for all wiring in the v.f.o. for stability.

Originally the circuit used a .005- and a .0025-µf mica capacitor in series, with the cathode of the oscillator connected to the mid-tap. In this circuit the oscillator covered the range 400–800 kc in five bands and a total of 4,000 dial divisions. A look at the layout indicated that the 2-terminal oscillator presented an opportunity for obtaining additional ranges. By adding a 4-position switch (one of the original ceramic switches) and two silver-mica capacitors, it was possible to provide a total of four bands, each covered by 4,000 dial divisions. With the .005-µf capacitor alone a range of 205 to 440 kc could be covered. We added a 500-µµf silver mica in parallel with the .005-µf unit to drop the oscillator down to 175 kc (useful for some i.f. work), and to obtain 200 kc which is very valuable for dial calibration purposes. With the .005- and .0025-µf capacitors in series, the original range was modified to cover from 350 to 800 kc. We then added a 300 µµf capacitor in series with these and obtained a range of 800–2000 kc. Finally, by removing all capacitors and operating with the stray wiring capacitance and the distributed capacitance of the coil, which is considerable, we obtained a range of 2000 to 5000 kc. Now we had any frequency between 175 and 5000 kc on hand, plus, of course, the even frequencies 200, 500, 1000, 2000 and 5000 kc, which are invaluable for calibration purposes.



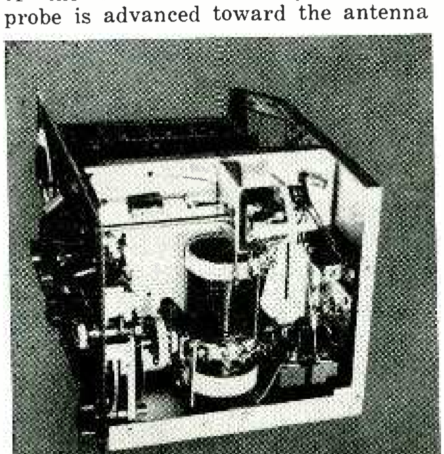
Panel view of the test signal generator.

There is one inconvenience: it takes two switches to cover all the ranges. This is more than made up for by the performance of the unit. Thanks to the mechanical rigidity, the size of the frequency-determining tank, the low temperature rise due to excluding the power supply from the case, and the use of the very stable cathode-coupled circuit, the stability obtained is remarkable. Even the highest range which has the poorest L-C ratio is astonishingly stable. The lower ranges will maintain frequency with a variation of less than 50 cycles for hours from a cold start. The reset accuracy is also excellent. The dial is not calibrated, and tuning is facilitated by calibrated charts. However, when the errors of plotting, reading, and setting are combined, it is still possible to reset the oscillator to within extremely close limits.

Incidentally, a similar tuning unit would make an excellent v.f.o. for ham transmitters. Using the Clapp circuit with the three capacitors in series, a range of from 1500 to 2000 kc over 800 dial divisions with very high stability and reset accuracy would be provided. The remainder of the case could be used for frequency-multiplying stages. We are at present planning a unit along this line.

It will be noted that the v.f.o. is modulated in the second grid circuit by the variable audio oscillator. It will be noted, also, that the r.f. output is taken from this same grid and out of the same jack as the audio. This is a desirable feature approaching the electron-coupled-oscillator type of circuit in the isolation it provides. In actual operation the frequency varies only very slightly when the oscillator is loaded.

Rapid signal tracing is aided by using the same output jack for both audio and v.f.o. output. For initial trouble-shooting the audio oscillator is set to 1,000 cycles and the v.f.o. to the i.f. of the receiver on test. The output probe is then systematically moved from the audio amplifier toward the front end of the receiver. No changes in the setting of the oscillators are needed. The a.f. responds only to the a.f. component of the signal; the i.f. will respond to the modulated r.f. The receiver is then tuned to the second or third harmonic of the intermediate frequency. The probe is advanced toward the antenna until the signal stops or is greatly reduced. This pins down the stage in which trouble exists.



The VFO section is sturdily constructed.

For rapid and accurate alignment of all-wave receivers on the short-wave bands the quickly switched crystal oscillator with a choice of correct test frequencies cannot be surpassed. The middle section of this signal generator consists of a simple crystal oscillator accommodating 11 crystals in the 100- to 10,000-kc range. Any clean crystal will oscillate satisfactorily in this circuit. It uses a 9001 in a Pierce oscillator with the output from the plate but the feedback from the screen. A 2-pole 2-position switch changes components to provide good oscillation at both low and high frequencies.

The output of the crystal oscillator goes to a binding post on the panel. For ease in operation we use a short telescoping antenna in this binding post. This allows using the generator without any direct connection to the receiver under test and offers a simple means of attenuation. The antenna radiates enough signal to be picked up by any receiver with a foot or so of antenna. With the antenna extended to its full length of about 1 foot the radiated signal is about R9 plus 20 db on most communication receivers. Retracted to its shortest length (6 inches) the radiation gives an R9 signal. With the oscillator antenna removed and the radiation confined entirely to the small binding post, the input strength at the receiver approximates 5 microvolts, which is just right in aligning for weak signal levels.

The crystal oscillator in this specific instrument was built around the switch and chassis assembly of the surplus CGQ crystal calibrator. The switch and assembly was simply removed from the old CGQ case and mounted in the new case. However, any 11-point, 2-pole switch and a number of different crystal sockets can be wired up to duplicate this arrangement. A slotted-shaft 50-μμf midget variable capacitor, with the slot accessible from the panel, makes possible a slight change in the frequency of the crystals so that a 500-kc crystal, for instance, can be set to exact frequency by zero-beating with WWV.

For our purpose we use a 455- and a 500-kc crystal in the low position. The 455-kc crystal is not usually used for actual alignment but rather to spot the correct frequency for the v.f.o. The 500-kc crystal is used for dial calibration and for checking tracking on the short-wave band.

A group of high-frequency crystals provides test signals for aligning the r.f. end of all-wave receivers. Crystals cut to around 2000, 3000, 3500 and 5000 kc will provide enough check points, using fundamental and harmonics, to align upper and lower ends of the short-wave bands.

The third harmonic of a 3570-kc crystal is used for alignment of 10.7 FM i.f.'s; 3545- and 3595-kc crystals, also using the third harmonic, for markers at the extreme ends of the linear portion of the S-shaped curve of the de-

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tector output when aligning the discriminator and ratio detectors. These crystal values (obtainable from surplus) are useful for 80-meter ham operation, and may be purchased for far less than crystals cut to the high frequencies. An 8800-kc crystal is used for FM r.f. alignment, providing check points at 88, 96.8, and 105.6 mc. Since my area has not been blessed with television coverage yet, no crystals are listed for TV service. However, the circuit could be copied for supplying television test frequencies.

The crystal oscillator is very slightly modulated by the audio oscillator through the common plate-supply coupling. The modulation is just sufficient to make the signal recognizable when tuning a receiver.

Audio Oscillator

The audio oscillator is a simple version of the R-C or Wien bridge type of oscillator. It uses only two 6C4 tubes. The tuning capacitor is a 3-gang 15–500-μμf capacitor obtained from surplus. Only two gangs are used. If care is taken in wiring to keep the stray capacitance low, it is possible to cover a 10-to-1 frequency ratio. A 2-gang 365-μμf capacity could be used, although it will probably not yield a 10-to-1 ratio. If the attained ratio is only 8 to 1 or so, it should still be satisfactory for test purposes.

We did not use precision resistors but selected matched pairs of carbon resistors with a Wheatstone bridge. We found that out of any 10 resistors of a given value, it was possible to find one pair which balanced to about 1% and produced the desired frequency to within 5%. Resistor balance is more important—in order to produce constant amplitude and good waveform—than exact value. Precision resistors will insure the multiplication of the scale exactly in the four ranges. However, the carbon resistors provide a multiplication exact enough for practical use. We felt that waveform and constant amplitude were more important than exact calibration.

A third section of the range switch cuts in separate feedback controls for the high and low frequencies, in order to stabilize output over the whole range. With a single feedback ratio it is difficult to maintain constant output at the extreme ends of the range. By providing separate controls for the two extreme ranges, and one for the mid-ranges, we attained an output which was constant to plus 1 db. This variation occurs in the upper one-third of each range and is constant throughout the four ranges. With due allowance, the oscillator can be used as a substantially constant-amplitude oscillator.

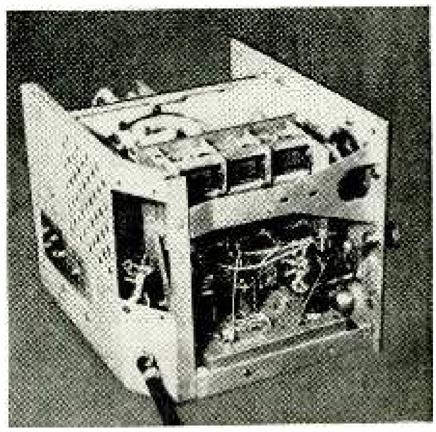
A series feedback control, which can be cut in and out by means of a toggle switch, provides for a choice of either sine-wave or square-wave output. With the switch open, adjust the 5,000-ohm potentiometer across it till a good square wave is produced. Check with a scope. All feedback controls are mounted on the chassis and are used only for initial calibration. Only the main tuning dial, the range switch, and the output attenuator are on the panel. For TV the wave-shaper toggle switch may also be mounted on the panel. Feedback is adjusted by observing the waveform of the oscillator on an oscilloscope. The range switch is turned to one of the mid-frequencies and the capacitor is opened all the way. The mid-range feedback control is adjusted to give the best possible sine-wave shape. The switch is turned to the lowest range and the capacitor is turned to the maximum capacitance position. Now the low-range feedback control is adjusted to give good waveform and amplitude equal to that at mid-range. The capacitor is turned to minimum and the trimmer on its upper section adjusted to give good waveform and proper output with the lowest possible capacitance. Next the range switch is turned to the highest range and the feedback control of this range is adjusted to give an output as nearly equal to the other ranges as possible.

The calibration of the Wien bridge oscillator has been covered in other articles of this magazine.*

A simpler method using a frequency test record and feeding both the record and the oscillator output into a common audio amplifier and loudspeaker allows quick calibration. The easiest range to calibrate is the 100- to 1,000-cycle range. It will be found that as the variable oscillator approaches the test-record frequency a beat note will be set up in the ear. It is possible to zero-beat the variable oscillator roughly to the record frequency. Once this range is calibrated, the other ranges will be multiples of it, if the resistors are accurately selected. This method of calibration is not as accurate as the oscilloscopic one, but will be adequate for test purposes. Exact frequency is very seldom important in audio servicing. It is the over-all response which is important; and an oscillator which is calibrated plus or minus 10% will often do as well as one more accurately calibrated.

The output is taken from the cathode of the second tube. This produces very little loading of the oscillator and makes it possible to use shielded output cable with no signal attenuation. The maxi-

*"Calibrating Audio Oscillators," by R. D. Henry, RADIO-ELECTRONICS, October, 1948.



Ganged capacitor is on a Masonite board.

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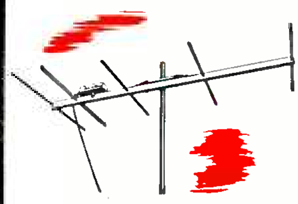

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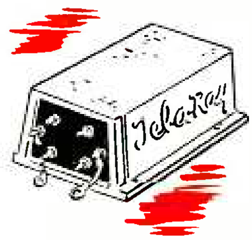

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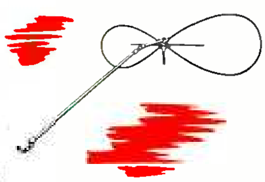

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mum output is about 2 volts. All leads and components to grids and plates should be kept well away from the chassis to insure low stray capacitance. Bus-bar wiring is recommended. The capacitor, of course, must be insulated from the chassis. It is mounted on a piece of masonite which serves also as a partition between this section and the crystal-oscillator section.

Heating and consequent frequency drift are minimized by using an external power supply. Any power supply capable of delivering 150 to 300 volts can be used, but a regulated 150 volts for the two r.f. oscillators and 250 volts for the audio oscillator gives the best all-around results.

Several filters and shielded leads are used to keep the power-supply cable from radiating. Each of the r.f. oscillators has a single-section filter, and all three units are fed through a common two-section filter.

The care employed in shielding and construction resulted in gratifyingly low signal leakage. It amounts to about 1 microvolt for the v.f.o. and about 5 microvolts for the crystal oscillator, the latter being accounted for by binding-post radiation.

Mechanically the construction was determined by the original layout of the tuning unit. The velvet vernier dial and the insulated coupling were left in place and used for the audio-oscillator tuning control. A paper calibrated scale was added to the dial for direct reading. The 4-position ceramic switch had to be mounted in the middle section. The layout of panel controls, while not entirely what might be desired from the standpoint of appearance, is functionally sound.

The 11-position switch, marked CRYSTAL FREQUENCY, is located in the lower center part of the panel. Since completion of the unit I have added a 10.7- and a 21.25-mc crystal and labeled these two extra frequencies on the panel. The R-C values for the audio-frequency generator, though calculated for the 8–80, etc., range, proved to give a range of 10–100, 100–1,000, etc. (The exact ranges are determined by circuit-wiring capacitance, resistor and capacitor tolerance, and tuning capacitor characteristics.) The 4-position capacitor switch is the basic r.f. range selector, but the settings on the inductor tap switch allow an electronic bandspread of from 50 to 500 kc. Originally, the jack between the v.f.o. range switches was used for r.f. output, but subsequent check showed that taking audio or r.f. signals from one output was quite feasible.

The original panel was a very thin piece of aluminum which was easily removed. Upon completion of the instrument the underlying panel was labeled with Techni-cals which gave the job that "dressed up" look.

The total cost of the instrument was about $30, including crystals. We've never obtained so much usefulness per dollar in any instrument before.

—end—

V.T.V.M. in PA Work

By A. T. PARKER

THE vacuum-tube voltmeter is a most useful and versatile tool to the service technician who deals with public address and audio systems. With a little imagination and ingenuity mixed with a knowledge of the methods of applying the v.t.v.m, the most difficult problems can be solved.

The modern v.t.v.m. measures either a.c. or d.c. voltages. It requires essentially no power from the circuit to which it is connected, thus enabling measurement of true r.m.s. voltages in high-impedance circuits and true d.c. voltages in complicated series circuits.

Fig. 1 illustrates a typical phase inverter and output stage as found in

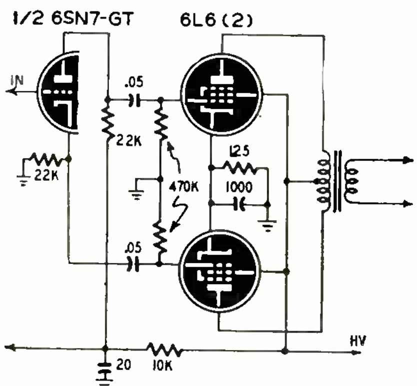

Fig. 1—Idealized a.f. phase inverter.

many high-quality amplifiers. The v.t.v.m. can be used to check the balance of the audio voltages applied to the output-tube grids. In this circuit it is particularly important that the value of the cathode resistor in the phase inverter match that of the plate resistor. With a constant audio signal applied to the input of the amplifier from an oscillator, the audio (a.c.) voltage appearing on one output-tube control grid should be identical with that on the other tube's control grid. If the voltages from each grid to chassis differ by more than a few percent, the quality of the amplifier will be seriously impaired.

There are several possible causes of unbalance in the circuit shown. Values of the grid resistors in the output stage should be the same. They should be checked with an ohmmeter and replacements selected which match in value. The value of the coupling capacitor in series with each output grid will affect the balance at low audio frequencies. For best results, these should be the same. The capacitance of the coupling capacitor is chosen to have negligible reactance at the lowest frequency the amplifier is required to produce. The .05-μf capacitors in Fig. 1 have a reactance of approximately 31,850 ohms at 100 cycles per second.

At any given frequency of operation the capacitor can be considered a resistor in series with the grid resistance. The reactance of the capacitor is thus indicated as R1 in Fig. 2. The grid resistor is R2. This simplified diagram shows how the reactance of the capacitor forms a voltage-dividing network, with the grid resistor as the output portion. Since the reactance of a capacitor varies inversely with frequency, it can be seen that the voltage at the grid of the tube would suffer if the capacitor value were too low and its reactance high at the lower frequencies of operation.

Coupling and bypass capacitors

The effectiveness of the coupling capacitor at all frequencies of operation can be measured with the v.t.v.m. Connect an audio oscillator to the input of the amplifier and measure the audio voltage to chassis on both sides, the input and output sides, of the coupling capacitor. Write down the voltage measured on each side, using different audio frequencies from the audio oscillator. As the frequency is made lower and lower, the difference between the voltages measured on the input and output sides of the capacitor will become greater. The low-frequency response of the amplifier can be improved, of course, by using bigger coupling capacitors.

If the coupling capacitor is leaky and permits d.c. to pass, the v.t.v.m. will detect it. Set it up to measure d.c. and connect it to the output side of the coupling capacitor. With the following tube removed, there should be no d.c. present unless the capacitor is defective. Replacement coupling capacitors

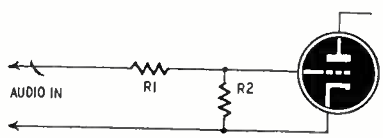

Fig. 2—R1 indicates coupling reactance.

should be high quality, mica or paper insulated, with a voltage rating several times that of the d.c. on the plate of the preceding tube.

The effectiveness of bypass capacitors can be checked simply with the v.t.v.m. and an audio oscillator. With the oscillator connected as shown in Fig. 3, from grid to chassis (adjusted

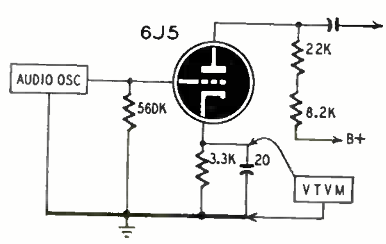

Fig. 3—V.t.v.m. checks cathode bypass.

to an output voltage less than the d.c. bias on the grid) and the v.t.v.m. across the cathode bypass capacitor, no audio voltage should be indicated. This test should be conducted at the lowest frequency the amplifier is expected to reproduce. If audio voltage is shown, the stage will be degenerative at that fre-

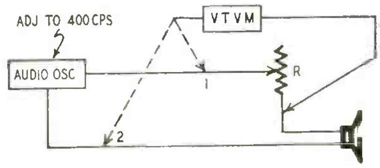

Fig. 4—Checking voice-coil impedance.

quency and all lower frequencies. To improve the low-frequency response, replace the bypass with a larger one. The reactance of a 20-μf capacitor at 100 cycles is 80 ohms. Since this is small compared with the value of the cathode resistor, 3,300 ohms, the amplifier's response at 100 cycles should be good.

Loudspeaker and gain

Determining the voice-coil impedance of a loudspeaker to be used in public address systems is often a problem. Many speakers are not marked and the information is not readily available. An audio oscillator is connected to the

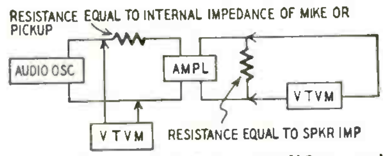

Fig. 5—Measuring a.f. amplifier gain.

speaker as shown in Fig. 4. An adjustable resistor with a maximum value of 20 or 25 ohms is connected in series with the voice coil across the oscillator. One terminal of the v.t.v.m. is connected to the midpoint of the two. The other connection to the v.t.v.m. is alternately shifted from point 1 to point 2. The resistor R is adjusted until the v.t.v.m. reads the same voltage at both points. Measure the resistance value of R with an ohmmeter. If the audio oscillator is adjusted to 400 cycles for this test, the value of R is equivalent to the impedance of the voice coil when the voltages are equal.

The gain of an amplifier is easily measured with the v.t.v.m. The input power and output power as measured by it are converted to *decibels of gain*. Set up the amplifier as shown in Fig. 5 with resistors to simulate the input and output devices. Adjust the volume control for maximum gain. If the resistor in the input is intended to simulate the internal impedance of a dynamic microphone it will be approximately 25,000 ohms. (It is best to get exact data on the internal impedance of a microphone or pickup from the manufacturer.) Adjust the output of the audio oscillator to one volt as indicated by the v.t.v.m. The input power is then found by the formula:

$$W = E^2/R.$$

Since E, the voltage is 1, E^2 is 1×1 or 1. Dividing by 25,000 gives an input power of .00004 watts. For convenience, this might be called .04 milliwatt.

Supposing the output load resistor is made equal to a speaker impedance of 8 ohms, the output power can be computed in the same way. If the v.t.v.m. reads, say, 13 volts across the 8 ohms, the power output is 13×13 (or 169) divided by 8. This gives 21 watts output.

The output power divided by the input power is the "power ratio" and will

(*Continued on page* 115)

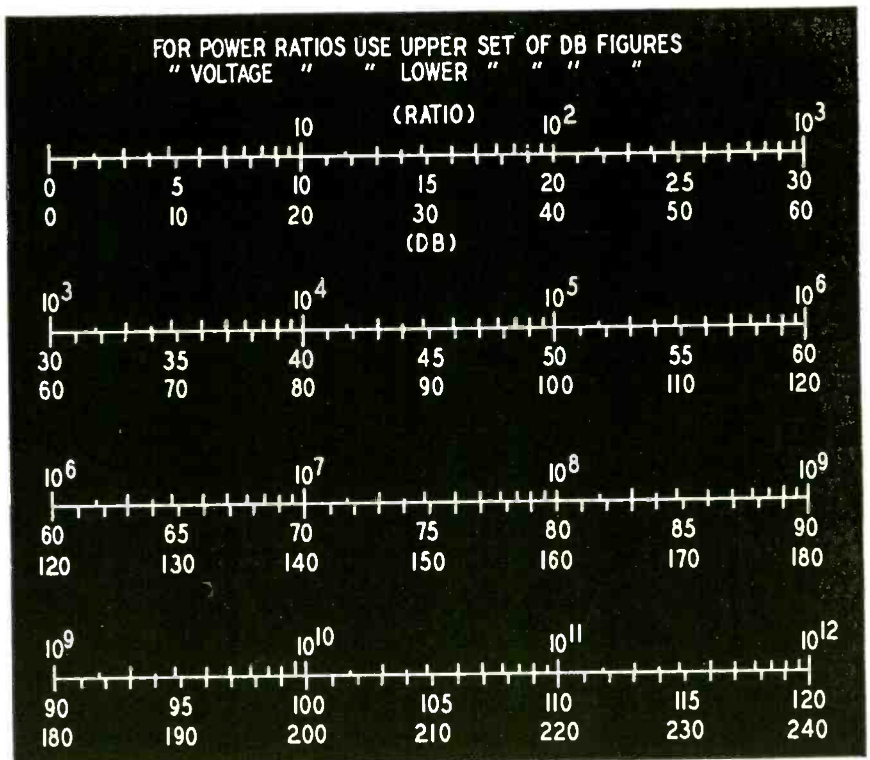

Fig. 6—This chart simplifies conversion of power and voltage ratios to decibels.

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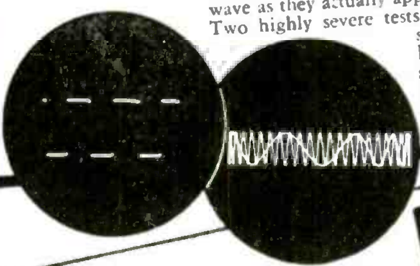
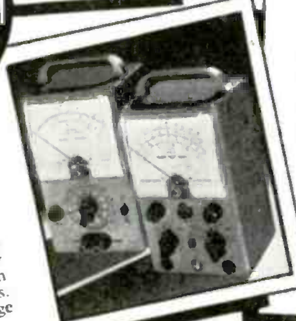
Below are actual, unretouched photographs showing the outstanding frequency response characteristics of the NEW 1952 HEATHKIT OSCILLOSCOPE MODEL O-7. To the left is a 10 KC square wave — to the right a 4 MC sine wave as they actually appear on the screen. Two highly severe tests to make on any scope (only the best of scopes will show traces like these) — and the O-7 really comes through.



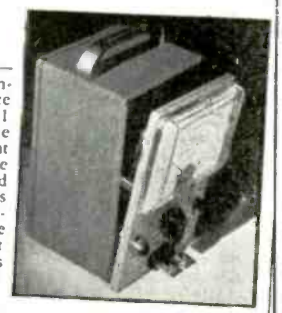
COMPANION VACUUM TUBE VOLTMETERS

Here are the two NEW 1952 VACUUM TUBE VOLTMETER COMPANION PIECES. Matched instruments of new design to open up the whole field of DC, AC, and resistance measurements for you. The new greatly reduced size combines style, beauty, and compactness — The V-5 and AV-1 have the new panel and cabinet construction as shown on the right. A tremendous pair of voltmeters. Small in size but virtual giants in the range of measurements they make.



NEW STYLE AND BEAUTY

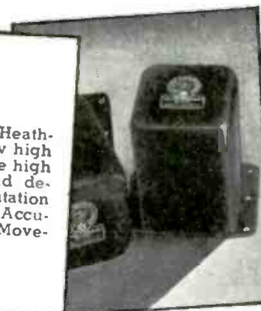
Style that's modern, yet functional — that's the trend of today — and Heathkits are right up to the minute. Note the cut showing the new V-5 and AV-1 cabinet and panel construction. The front panel and rear cover slide right over the recessed flange of the case thereby eliminating sharp edges and pointed corners. The voltmeter kits aren't "shelf" or "mounted" instruments — they're moved about on the bench a lot and thus the new compact size and specially designed cabinets — Another 1952 Heathkit feature.



A STATEMENT FROM SIMPSON ELECTRIC CO.

In choosing Simpson Meters for their Heathkit VTVM, the Heath Co. has set a new high standard of kit meter quality. The same high quality of material, workmanship and design that has given Simpson the reputation for building "Instruments That Stay Accurate" is found in the Heathkit Meter Movement.

SIGNED
SIMPSON ELECTRIC CO.



A STATEMENT FROM CHICAGO TRANSFORMER

It is indeed gratifying to note the outstanding sales records you are building with your Heathkits.

This sales success is readily understandable, since we are cognizant of the high quality standards you have established for your component suppliers.

We at Chicago Transformer are proud that our product has contributed to the recognized quality and increasing popularity of Heathkits.

CHICAGO TRANSFORMER DIVISION
Essex Wire Corporation

L. S. RACINE
Vice-President and Sales Manager

HEATHKIT PRECISION RESISTORS

Where exact resistance values are required for instrument accuracy, the Heath Co. has spared no effort in supplying the finest resistors available. Precision resistors as manufactured by Continental Carbon Inc., and Wilcor Corp., meet the rigorous JAN (Joint Army-Navy) specifications and are small in size, extremely non-inductive, highly stable, have a low temperature coefficient, and can be held to great accuracy. You'll find quality components in Heathkits.

COLLEGES USE HEATHKITS

Colleges and Universities throughout the country are using Heathkits in their electrical engineering, radio, and physics laboratories — Heathkits are the answer to good test equipment at low cost, plus being rugged, dependable, and accurate. Trade schools are having their students build Heathkits to obtain a first hand working knowledge of test equipment and to get the practical experience gained by construction. Heathkits fill school needs.

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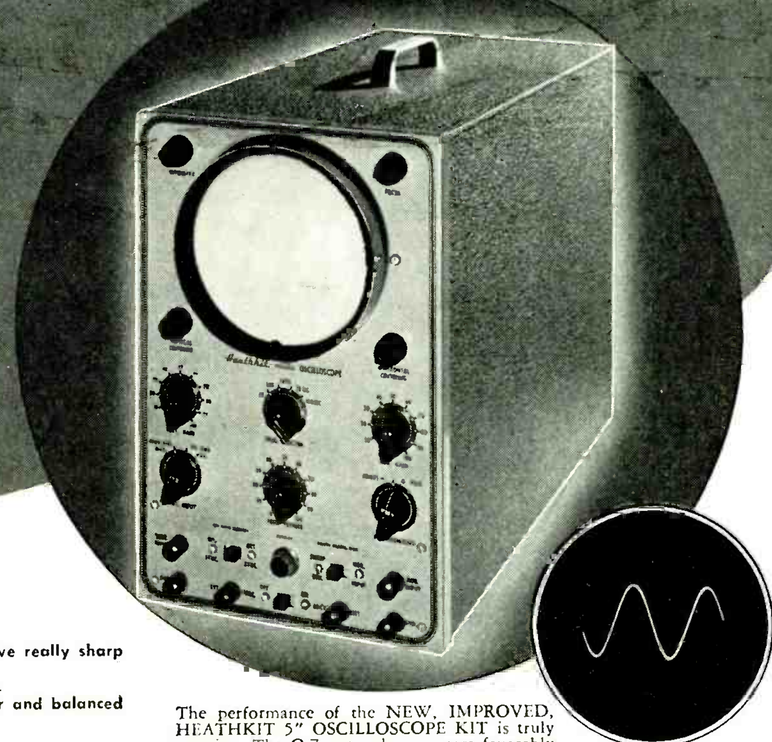
The HEATH COMPANY
... BENTON HARBOR 20, MICHIGAN

THE *New* 1952 *Heathkit* OSCILLOSCOPE KIT

MODEL O-7
SHIPPING WEIGHT 24 LBS.

$43.50



Features

- New "spot shape" control for spot adjustment — to give really sharp focusing.
- A total of ten tubes including CR tube and five miniatures.
- Cascaded vertical amplifiers followed by phase splitter and balanced push-pull deflection amplifiers.
- Greatly reduced retrace time.
- Step attenuated — frequency compensated — cathode follower vertical input.
- Low impedance vertical gain control for minimum distortion.
- New mounting of phase splitter and deflection amplifier tubes near CR tube base.
- Greatly simplified wiring layout.
- Increased frequency response — useful to 5 Mc.
- Tremendous sensitivity .03V RMS per inch Vertical — .6V RMS per inch Horizontal.
- Dual control in vernier sweep frequency circuit — smoother acting.
- Positive or negative peak internal synchronization.

The performance of the NEW, IMPROVED, HEATHKIT 5" OSCILLOSCOPE KIT is truly amazing. The O-7 not only compares favorably with equipment costing 4 and 5 times as much, but in many cases literally surpasses the really expensive equipment. The new, and carefully engineered circuit incorporates the best in electronic design — and a multitude of excellent features all contribute to the outstanding performance of the new scope.

The VERTICAL CHANNEL has a step attenuated, frequency compensated vertical input which feeds a cathode follower stage — this accomplishes improved frequency response, presents a high impedance input, and places the vertical gain control in a low impedance circuit for minimum distortion. Following the cathode follower stage is a twin triode — cascaded amplifiers to contribute to the scope's extremely high sensitivity. Next comes a phase splitter stage which properly drives the push-pull, hi-gain, deflection amplifiers (whose plates are directly coupled to the vertical deflection plates). This fine tube lineup and circuitry give a sensitivity of .03V per inch RMS vertical and useful frequency response to 5 Mc.

The HORIZONTAL CHANNEL consists of a triode phase splitter with a dual potentiometer (horizontal gain control) in its plate and cathode circuits for smooth, proper driving of the push-pull horizontal deflection amplifiers. As in the vertical channel, horizontal deflection amplifier plates are direct coupled to the CR tube horizontal deflection plates (for improved frequency response).

The WIDE-RANGE SWEEP GENERATOR circuit incorporates a twin triode multivibrator stage for producing a good saw-tooth sweep frequency (with faster retrace time). Has both coarse and vernier sweep frequency controls.

And the scope has internal synchronization which operates on either positive or negative peaks of the input signal — both high and low voltage rectifiers — Z axis modulation (intensity modulation) — new spot shape (astigmatism) control for spot adjustment — provisions for external synchronization — vertical centering and horizontal centering controls, wide range focus control — and an intensity control for giving plenty of trace brilliance.

The Model O-7 EVEN HAS GREAT NEW MECHANICAL FEATURES — A special extra-wide CR tube mounting bracket is provided so that the vertical cascade amplifier, vertical phase splitter, vertical deflection amplifier, and horizontal deflection amplifier can mount near the base of the CR tube. This permits close connection between the above stages and to the deflection plates; distributed wiring capacity is greatly reduced, thereby affording increased high frequency response.

The power transformer is specially designed so as to keep its electrostatic and electromagnetic fields to a minimum — also has an internal shield with external ground lead.

You'll like the complete instructions showing all details for easily building the kit — includes pictorials, step-by-step construction procedure, numerous sketches, schematic, circuit description. All necessary components included — transformer, cabinet, all tubes (including CR tube), completely punched and formed chassis—nothing else to buy.

NEW INEXPENSIVE *Heathkit* ELECTRONIC SWITCH KIT

The companion piece to a scope — Feed two different signals into the switch, connect its output to a scope, and you can observe both signals — each as an individual trace. Gain of each input is easily set (gain A and gain B controls), the switching frequency is simple to adjust (coarse and fine frequency controls) and the traces can be superimposed for comparison or separated for individual study (position control).

Use the switch to see distortion, phase shift, clipping due to improper bias, both the input and output traces of an amplifier — as a square wave generator over limited range.

The kit is complete; all tubes, switches, cabinet, power transformer and all other parts, plus a clear detailed construction manual.

Model S-2
Shipping Wt. 11 lbs.

Only **$19.50**

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THE *New* 1952 *Heathkit* VTVM KIT

MODEL V-5
SHIPPING WT. 5 LBS.

$24.50

Features

- New styling, — formed case for beauty.
- New truly compact size. Cabinet 4⅛" deep by 4-11/16" wide by 7¾" high.
- Quality 200 microamp meter.
- New ohms battery holding clamp and spring clip — assurance of good electrical contact.
- Highest quality precision resistors in multiplier circuit.
- Calibrates on both AC and DC for maximum accuracy.
- Terrific coverage — reads from ½V to 1000V AC, ½V to 1000V DC, and .1 to over 1 billion ohms resistance.
- Large, clearly marked meter scales indicate ohms, AC Volts, DC Volts, and DB — has zero set mark for FM alignment.
- New styling presents attractive and professional appearance.

A real beauty — you'll have only highest praise for this NEW MODEL VACUUM TUBE VOLTMETER. Truly a beautiful little instrument — and it's more compact than any of our previous models. Note the new rounded edges on the front panel and rear cover. The size is greatly reduced to occupy a minimum of space on your workbench — yet the meter remains the same large size with plainly marked scales.

A set of specially designed control mounting brackets permit calibration to be performed with greatest ease — also makes for ease in wiring. New battery mounting clamp holds ohms battery tightly into place, and base spring clip insures a good connection to the ohms string of resistors.

The circuitry employs two vacuum tubes — A duo diode operating when AC voltage measurements are taken, and a twin triode in the circuit at all times. The cathode balancing circuit of the twin triode assures sensitive measurements, and yet offers complete protection to the meter movement. Makes the meter burn-out proof in a properly constructed instrument.

Quality components are used throughout —1% precision resistors in the multiplier circuit—conservatively rated power transformer—Simpson meter movement — excellent positive detent, smooth acting switches — sturdy cabinet, etc.

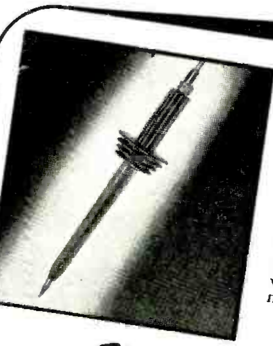
And you can make a tremendous range of measurements — ½V to 1000V AC, ½V to 1000V DC, .1 to over 1 billion ohms, and DB. Has mid-scale zero level marking for quick FM alignment. DB scale in red for easy identification — all other scales a sharp, crisp black for easy reading.

A four position selector switch allows operator to rapidly set the instrument for type or reading desired—positions include ACV, DC+V, DC-V, and Ohms. DC— position allow negative voltage to be rapidly taken. Zero adjust and ohms adjust controls are conveniently located on front panel.

Enjoy the numerous advantages of using a VTVM. Its high input impedance doesn't "load" circuits under test — therefore, assures more accurate and dependable readings in high impedance circuits such as resistance coupled amplifiers, AVC circuits, etc. Note the 30,000 VDC probe kit and the RF probe kit — available at low extra cost and specially designed for use with this instrument. With these two probes, you can make DC voltage measurements up to 30,000V, or make RF measurements — added usefulness to an already highly useful instrument.

The instruction manual is absolutely complete — contains a host of figures, pictorials, schematic, detailed step-by-step instructions, and circuit description. These clear, detailed instructions make assembly a cinch.

And every part is included — meter, all controls, pilot light, switches, test leads, cabinet, instruction manual, etc.



Heathkit 30,000V DC PROBE KIT

A new 30,000 V DC Probe Kit to handle high voltages with safety. For TV service work and all other high voltage applications. Sleek looking — Two color molded plastic — Red body and guard — jet black handle. Comes with connector, cable, and PL55 type plug. Plugs into Heathkit VTVM so that 300V scale is conveniently multiplied by 100. Can be used with any standard 11 megohm VTVM.

$5.50

No. 336 High Voltage Probe Kit
Shipping Wt. 2 lbs.

Heathkit RF PROBE KIT

This RF Probe Kit comes complete with probe housing, crystal diode detector, connector, lead and plug and all other parts plus clear assembly instructions. Extends range of Heathkit VTVM to 250 Mc. ± 10%. Works on any 11 megohm input VTVM. Specify No. 309 RF Probe Kit.

$5.50

Ship. Wt. 1 lb.

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New LABORATORY LINE HEATHKITS

NEW *Heathkit* A.C. VACUUM TUBE VOLTMETER KIT

MODEL AV-1
Shipping weight 5 lbs.

$29.50

Now — as a Heathkit — at a price anyone can afford, an AC VTVM.
A new kit to make possible those sensitive AC measurements required by audio enthusiasts, laboratories, and experimentors. Here is the kit that the audio men have been looking for. Its tremendous range of coverage makes possible measurements of audio amplifier frequency response — gain or loss of audio stages — characteristics of audio filters and attenuators — hum investigation — and literally a multitude of others. Ten ranges consisting of full scale .01, .03, .1, .3, 1, 3, 10, 30, 100, 300 volts RMS assure easy and more accurate readings. Ten ranges on DB provide for measurements from −52 to +52 DB. Frequency response within 1 DB from 20 cycles to 50 KC.

The ingenious circuitry incorporates precision multiplier resistors for accuracy, two amplifier stages using miniature tubes, a unique bridge rectifier meter circuit, quality Simpson meter with 200 microampere movement, and a clean layout of parts for easy wiring. A high degree of inverse feedback provides for stability and linearity.

Simple operation is accomplished by the use of only one control, a range switch which changes the voltage ranges in multiples of 1 and 3, and DB ranges in steps of 10.

The instrument is extremely compact, cabinet size — 4⅛" deep x 4-11/16" wide x 7⅜" high, and the newly designed cabinet makes this the companion piece to the VTVM. For audio work, this kit is a natural.

NEW *Heathkit* AUDIO FREQUENCY METER KIT

MODEL AF-1
Shipping weight 12 lbs.

$34.50

A NEW Heathkit Audio Frequency Meter — the ideal instrument for determining frequencies from 20 cycles to 100 KC. Set the selector switch to the proper range — feed the signal into the input terminals — and read the frequency from the meter — completely simple to operate, and yet dependable results.

Quality Simpson 200 microampere meter has two plainly marked scales (0-100 0-300. These scales, read in conjunction with the seven position selector switch, give full scale readings of 100, 300, 1000, 3000, 10,000, 30,000, and 100,000 cycles. Convenient ranges for fast and easy readings.

For greatest accuracy, the 1-3-10 ratio of ranges is maintained and each range has individual calibrating control.

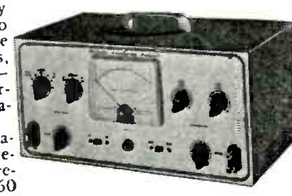
Input impedance is high (1 megohm) for negligible circuit loading. A signal voltage anywhere between 2 and 300V can be fed directly into the instrument and a change in signal voltage between these limits will not affect the meter reading. In addition, input wave shape is not critical (the unit will read the frequency of either sine wave or square wave input).

The tube complement consists of a 6SJ7 amplifier and clipper, 6V6 amplifier and clipper, 6H6 meter pulse rectifier, 6X5 power supply rectifier, and OD3/VR150 voltage regulator.

Construction is simple, and quality components are used throughout.

NEW *Heathkit* INTERMODULATION ANALYZER KIT

Intermodulation testing of audio equipment is rapidly being accepted by more and more engineers and audio experts as the best way to determine the characteristics of audio amplifiers, recording systems, networks, etc. — shows up those undesirable characteristics that contribute to listening fatigue when all other methods fail.



MODEL IM-1
Shipping wt. 18 lbs.

$39.50

The Heathkit Intermodulation Analyzer supplies a choice of two high frequencies (3000 cycles and a higher frequency) and one low frequency (60 cycles). Both 1:1 or 4:1 ratios of low to high frequencies can be set up for IM testing, and the ratios are easily set by means of a panel control and the instrument's own VTVM. An output level control supplies the mixed signal at the desired level with an output impedance of two thousand ohms. The Analyzer section has input level control and proper filter circuits feeding the instrument's VTVM to read intermodulation directly on full scale ranges of 30%, 10% and 3%. Built-in power supply furnishes all necessary voltages for operating the instrument.

You won't want to be without this new and efficient means of testing.

NEW *Heathkit* SQUARE WAVE GENERATOR KIT

The new Heathkit Square Wave Generator Kit with its 100 KC square wave opens an entirely new field of audio testing. Square wave testing over this wide range will quickly show high and low frequency response characteristics of circuits — permit easy adjustment of high frequency compensating networks used in vidio amplifiers — identify ringing in circuits — demonstrate transformer characteristics, etc.

The circuitry consists of a multivibrator stage, a clipping and squaring stage, and a cathode follower output stage. The power supply is transformer operated and utilizes a full wave rectifier tube with 2 sections of LC filtering.

As a multivibrator cannot be accurately calibrated, a provision is provided to allow the instrument to be accurately synchronized with an accurate external source when extreme accuracy is required.

The low impedance output is continuously variable between 0 and 25 volts and operation is simple. You'll really appreciate the wide range of this instrument, 10 cycles to 100 kilocycles — continuously variable. Kit is complete with all parts and instruction manual, and is easy to build.

MODEL SQ-1
Shipping wt. 14 lbs.

$29.50

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Heathkit IMPEDANCE BRIDGE KIT

This Impedance Bridge Kit is really a favorite with schools, industrial laboratories, and serious experimenters. An invaluable instrument for those doing electrical measurements work. Reads resistance from .01 Ohms to 10 meg., capacitance from .00001 to 100 MFD, inductance from 10 microhenries to 100 henries, dissipation factor from .002 to 1, and storage factor from 1 to 1000. And you don't have to worry about selecting the proper bridge circuit for the various measurements — the instrument automatically makes the correct circuit when you set up for taking the measurement you want. Bridge utilizes Wheatstone, Hay, Maxwell, and capacitance comparison circuits for the wide range and types of measurements possible. And it's self powered — has internal battery and 1000 cycle hummer. No external generator required — has provisions for external generator if measurements at other than 1000 cycles are desired. Kit utilizes only highest quality parts, General Radio main calibrated control, Mallory ceramic switches, excellent 200 microamp zero center galvanometer, laboratory type binding posts with standard ¾ inch centers, 1% precision ceramic-body type multiplier resistors, beautiful birch cabinet and ready calibrated panel. (Headphones not included.)

Take the guesswork out of electrical measurements — order your Heathkit Impedance Bridge kit today — you'll like it.

Model IB-1B
Shipping Wt. 15 lbs.

$69.50

Heathkit LABORATORY RESISTANCE DECADE KIT

An indispensable piece of laboratory equipment — the Heathkit Resistance Decade Kit gives you resistance settings from 1 to 99,999 ohms IN ONE OHM STEPS. For greatest accuracy, 1% precision ceramic-body type resistors and highest quality ceramic wafer switches are used.

$19.50

Shipping Wt. 4 lbs.

Designed to match the Impedance Bridge above, the Resistance Decade Kit has a beautiful birch cabinet and attractive panel. It's easy to build, and comes complete with all parts and construction manual.

Heathkit LABORATORY POWER SUPPLY KITS

Limits:

No load	Variable	150-400V DC
25 MA	Variable	30-310V DC
50 MA	Variable	25-250V DC

Higher loads: Voltage drops off proportionally

Every experimenter needs a good power supply for electronic setups of all kinds. This unit has been expressly designed to act as a HV supply and a 6.3 V filament voltage source. Voltage control allows selection of HV output desired (continuously variable within limits outlined), and a Volts-Ma switch provides choice of output metering. A large plainly marked and direct reading meter scale indicates either DC voltage output in Volts or DC current output in Ma. (Range of meter 0-500V D.C., 0-200 Ma. D.C.). Instrument has convenient stand-by position and pilot light.

$29.50

Model PS-1 ... Ship. Wt. 20 lbs.

Comes with power transformer, filament transformer, meter, 5Y3 rectifier, two 1619 control tubes, completely punched and formed chassis, panel, cabinet, detailed construction manual, and all other parts to make the kit complete.

Heathkit ECONOMY . . . 6 WATT AMPLIFIER KIT

Model A-4
Ship. Wt. 8 lbs.

$12.50

No. 304 12 inch speaker . . . **$6.95**

This fine Heathkit Amplifier was designed to give quality reproduction and yet remain low in price. Has two preamp stages, phase inverter stage, and push-pull beam power output. Comes complete with six tubes, quality output transformer (to 3-4 ohm voice coil), husky cased power transformer and all other parts. Has tone and volume controls. Instruction manual has pictorial for easy assembly. Six watts output with response flat ± 1½ db from 50 to 15,000 cycles. A quality amplifier kit at a low price. Better build one.

Heathkit HIGH FIDELITY . . . 20 WATT AMPLIFIER KIT

Our latest and finest amplifier — the model A-6 (or A-6A) is capable of a full 20 Watts of high fidelity output — good faithful reproduction made possible through careful circuit design and the use of only highest quality components. Frequency response within ± 1 db from 20-20,000 cycles. Distortion at 3 db below maximum power output (at 1000 cycles) is only .8%. The power transformer is rugged and conservatively rated and will deliver full plate and filament supply with ease. The output transformer was selected because of its exceptionally good frequency response and wide range of output impedances (4-8-16-150-600 ohms). Both are Chicago Transformers in drawn steel case for shielding and maximum protection to windings. The unit has dual tone controls to set the output for the tonal quality desired — treble control attentuates up to 15 db at 10,000 cycles — bass control gives bass boost up to 10 db at 50 cycles.

$33.50

Shipping Wt. 18 lbs.

Tube complement consists of 5U4G rectifier, 6SJ7 voltage amplifier, 6SN7 amplifier and phase splitter, and two 6L6's in push-pull output. Comes complete with all parts and detailed construction manual. (Speaker not included.)

MODEL A-6: For tuner and crystal phono inputs. Has two position selector switch for convenient switching to type of input desired.

MODEL A-6A: Features an added 6SJ7 stage (preamplifier) for operating from variable reluctance cartridge phono pickup, mike input, and either tuner or standard crystal phono pickup. A three position selector switch provides flexible switching. Shipping Wt. 18 lbs. **$35.50**

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NEW 1952 *Heathkit*

BATTERY ELIMINATOR KIT

$24.50

Model BE-3
Shipping Wt. 17 lbs.

- Can be used as battery charger.
- Continuously variable output 0 - 8 Volts — not switch type.
- Heavy duty Mallory 17 disk type magnesium copper sulfide rectifier.
- Automatic overload relay for maximum protection. Self-resetting type.
- Ideal for battery, aircraft and marine radios.
- Dual Volt and Ammeters read both voltage and amperage continually — no switching.

The new Heathkit Model BE-2 incorporates the best. Continuously variable output control is of the variable transformer type with smooth wiper type contacts.

There are no switches or steps and voltage between 0 and 8 Volts is available at 10 Amperés continuous and 15 Amperes intermittent. Maximum safety from overloads and shorts provided by automatic overload relay which resets itself when overload is removed.

The new rectifier is a 17 plate Mallory magnesium copper sulfide type. This is the most rugged type available for long trouble-free use.

Output is continuously metered by both a 0 - 10 Volt Voltmeter and a 0 - 15 Amp Ammeter. Shorted vibrators indicated instantly by ammeter.

Equip now for all types of service — aircraft — marine — auto and battery radios — this inexpensive instrument vastly increases service possibilities — better be ready when the customer walks in.

NEW *Heathkit*

SINE AND SQUARE WAVE

AUDIO GENERATOR KIT

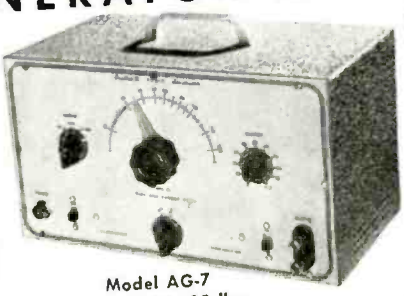
Designed with versatility, usefulness, and dependability in mind, the AG-7 gives you the two most needed wave shapes right at your fingertips — the sine wave and the square wave.

The range switch and plainly calibrated frequency scale give rapid and easy frequency selection, and the output control permits setting the output to any desired level.

A high-low impedance switch sets the instrument for either high or low impedance output —on high to connect a high impedance load, and on low to work into a low impedance DC retransformer with negligible DC resistance.

Coverage is from 20 to 20,000 cycles, and distortion is at a minimum — you can really trust the output wave shape.

Six tubes, quality 4 gang tuning condenser, power transformer, metal cased filter condenser, 1% precision resistors in the frequency determining circuit, and all other parts come with the kit —plus, a complete construction manual — A tremendous kit, and the price is truly low.



Model AG-7
Shipping Wt. 15 lbs.

$34.50

THE NEW *Heathkit*

HANDITESTER KIT

A precision portable volt-ohm milliammeter. Uses only high quality parts — All precision 1% resistors, three deck switch for trouble-free mounting of parts, specially designed battery mounting bracket, smooth acting ohm adjust control, beautiful molded bakelite case, 400 micro-amp meter movement, etc.

DC and AC voltage ranges 10 - 30 - 300 - 1000 - 5000V. Ohms range 0 - 3000 and 0 - 300,000. Range Milliamperes 0 - 10 Ma, 0 - 100 Ma. Easily assembled from complete instructions and pictorial diagrams.

$13.50

Model M-1
Shipping Wt. 3 lbs.

NEW *Heathkit*

T.V. ALIGNMENT GENERATOR KIT

Here is an excellent TV Alignment Generator designed to do TV service work quickly, easily, and properly. The Model TS-2 when used in conjunction with an oscilloscope provides a means of correctly aligning television receivers.

The instrument provides a frequency modulated signal covering, in two bands, the range of 10 to 90 Mc. and 150 to 230 Mc. — thus, ALL ALLOCATED TV CHANNELS AS WELL AS IF FREQUENCIES ARE COVERED.

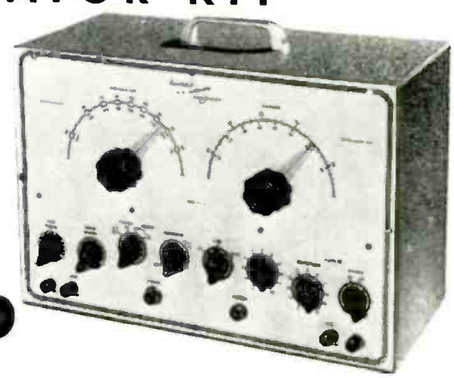
An absorption type frequency marker covers from 20 to 75 Mc. in two ranges — therefore, you have a simple, convenient means of frequency checking of IF's, independent of oscillator calibration.

Sweep width is controlled from the front panel and covers a sweep deviation of 0-12 Mc. — all the sweep you could possibly need or want.

And still other excellent features are: Horizontal sweep voltage available at the front panel (and controlled with a phasing control — both step and continuously variable attenuation for setting the output signal to the desired level — a convenient instrument stand-by position — vernier drive of both oscillator and marker tuning condensers — and blanking for establishing a single trace with base reference level. Make your work easier, save time, and repair with confidence — order your Heathkit TV Alignment Generator now!

Model TS-2
Shipping Wt. 20 lbs.

$39.50



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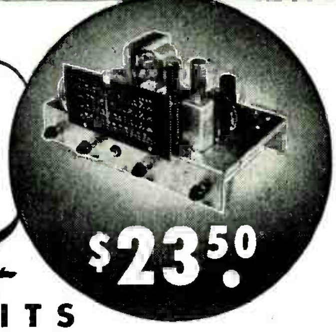
Heathkit RECEIVER & TUNER KITS for AM and FM

Model BR-1 Broadcast Model Kit covers 550 to 1600 Kc. Shipping Wt. 10 lbs.

$19.50

Model AR-1 3 Band Receiver Kit covers 550 Kc. to over 20 Mc. continuous. Extremely high sensitivity. Shipping Wt. 10 lbs.



$23.50

TWO HIGH QUALITY *Heathkit* SUPERHETRODYNE RECEIVER KITS

Two excellent Heathkits. Ideal for schools, replacement of worn out receivers, amateur and custom installations.
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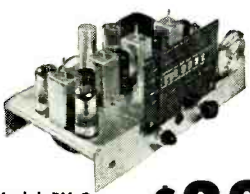

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give the gain of the amplifier in decibels by the formula:

$$db = 10\ log_{10} \times \text{power ratio}.$$

A decibel chart

Rather than go to the trouble of finding the *log* and working this out the hard way, the chart of Fig. 6 is supplied to make it simple. Locate the power ratio on the upper scale and read opposite it the gain in db. For power ratios, read the upper set of db figures. For the example we have chosen, the power ratio is 21 divided by .00004, or 525,000 to 1. Find 525,000 on the second scale and read opposite it approximately 57.3 db. The gain of the amplifier is 57.3 db. For convenience, the equivalent values of powers of ten are shown in Table I.

If the amplifier has the same impedance at both input and output, such as the 600 ohms used commonly in line amplifiers, the task of determining gain is considerably simpler. The gain of such an amplifier can be figured from the ratio of the *voltages* appearing across the input and output without converting to power ratios. Using the same setup as shown in Fig. 5, measure the two voltages. Divide the larger voltage by the smaller one. This data can be used to determine gain by the formula:

$$db = 20\ log_{10} \times \text{voltage ratio}.$$

Again, instead of working it out, refer to Fig. 6. Using the lower set of db figures, read the gain opposite the voltage ratio. For example, if the voltage across the input is 1 volt and the voltage across the output is 200, the voltage ratio is 200/1 or 200. Locating this ratio in the chart will show a gain of 46 db opposite the ratio.

The over-all fidelity of the amplifier can be measured by plotting the gain as measured by these methods at a number of frequencies. For example, plot the gain at:

100 cycles	1,000 cycles	7,000 cycles
300	1,500	10,000
500	3,000	15,000
700	5,000	20,000

The variations in gain in db with reference to the gain at 1,000 cycles indicate the over-all fidelity of the system.

As indicated briefly in this article, the uses of the v.t.v.m. in servicing and designing public address systems are many. The enterprising service technician can use it to determine the effectiveness of negative feedback, the response and gain of amplifiers, stages or transformers, to measure hum, measure the effectiveness of bypass and coupling capacitors, measure power output, and for other needs.

Table I

Powers of Ten	Numerical Value
1	1
10	10
10^2	100
10^3	1000
10^4	10,000
10^5	100,000
10^6	1,000,000
10^7	10,000,000
10^8	100,000,000
10^9	1,000,000,000
10^{10}	10,000,000,000
10^{11}	100,000,000,000
10^{12}	1,000,000,000,000

—end—

TV CONVERSION ARTICLES APPEARING IN PAST ISSUES OF R-E

Safety First and TV Antennas

The need for forethought and care in TV antenna installations is dramatically illustrated in the photos

Photo A—Inadequate guying, despite its height and weight-adding rotator, caused this mast to fall across power wires, causing both injury and damage.

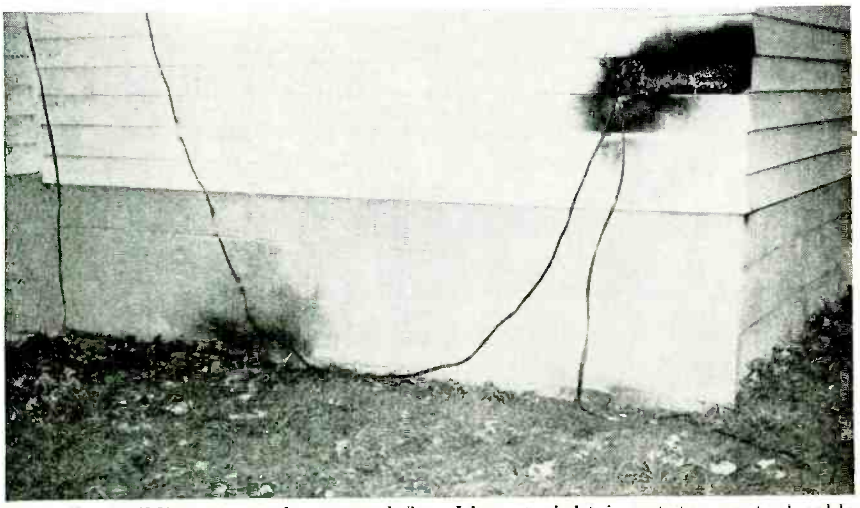


Photo B—Building narrowly escaped fire. Line at right is rotator control cable.

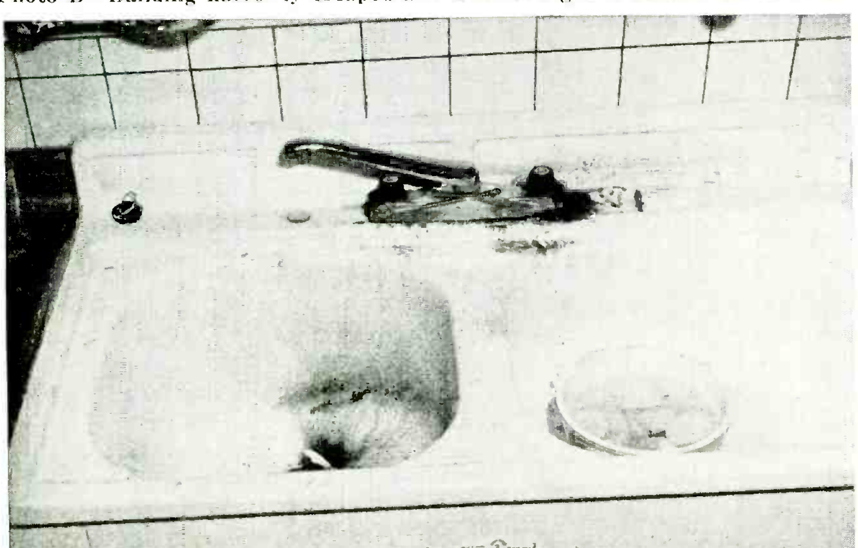


Photo C—Where injury took place. Flashover could well have had fatal results.

All photos courtesy National Fire Protection Association

SAFETY precautions often take second place to signal strength when a television antenna is installed. The accompanying photographs show that "safety first" is just as applicable to television antennas as to any of the other appliances and equipment with which we have to live. Even less excusable are the cases where an antenna is installed dangerously because of carelessness or the pure ignorance and incompetence of inexperienced workers.

The antenna pictured in Photo A was mounted on a tall pole and not properly guyed. A moderate storm was sufficient to cause it to fall into the electric wires running past the house. Considerable damage was done to the side of the building, as shown in Photo B, and the lady of the house was severely burned on the face and arms as she was standing in front of the sink in Photo C. (Investigators believe the current was trying to reach ground through a path from the sanitary stack vent pipes to the water pipes, causing the flashover at the sink.)

These photographs are the highlights of a booklet published by the National Fire Protection Association of 60 Batterymarch St., Boston, Mass, and illustrate only one of the ways that hazards of death may be introduced into a television antenna installation. Next to mechanical risks, such as attaching to chimneys in such a way that antenna and chimney are likely to come down together in the next severe storm—lightning is probably the greatest danger. Arresters and ground wires are very frequently so installed as to make them useless or worse. For example, "grounding" to the top of a sanitary stack vent pipe may result in serious life and fire hazards. Arresters can be so installed as to give adequate protection, or in such a way as to be almost useless, or even to expose at least the receiver to severe damage. The booklet, which sells at 25¢, is well worth the attention of all television installation men and television service contractors.

—end—

Use Wire Tables In Service Work

By VERGNIAUD H. RICHARD

Many service technicians believe that the only information they can get out of a wire table is that relative to sizes, current-carrying capacities, and types of insulation of wires for coil and transformer design. The wire table, they feel, was made up originally for electricians and only mere gleanings are useful to the radioman. A great deal more can be gotten out of wire tables. How much depends entirely upon the kind of table used and the ingenuity of the service technician.

The helpful wire table gives, in addition to the usual data (gauge number, diameter in mils, circular mils area, type of insulation, current-carrying capacity, feet per pound), turns per linear inch and per square inch and ohms per 1000 feet for the different sizes of wires and types of insulation. The following are some cases in which the table will come in handy for computations and calculations:

1. We have on hand a 0-1 ma meter whose range is to be increased to 10 milliamperes. Upon calculation, we find that the required shunt must have a resistance of 3 ohms. The uninventive man will be stuck if he does not have some resistance wire, whereas if he consults a good wire-table he will be rewarded for his investigation. Assume further that we find in the usual junk box some No. 38 enamel wire. The table reveals that 1,000 ft. of No. 38 wire has a resistance of 672.6 ohms. The resistance being proportional to the length, our shunt is then: 1000 x 3/672.6=53 17/32 inches long. Now we must find out if our wire is capable of carrying the 9 milliamperes without undue heating. Upon consultation the table says O.K. and there is our shunt. (The nearer the maximum current-carrying capacity of the wire is to the required ma range, the less bulky will be the shunt.)

2. Having a certain quantity of wire of unknown size taken from an old transformer, we decide to use it to build a coil. How can we find the wire size, no micrometer and no wire gauge being handy? Here again the table comes to the rescue All we have to do is to wind, closely, enough turns on a pencil or other convenient dowel to fill in one inch (previously marked off). Suppose we find x turns and our wire is enamel coated. The wire table will specify that the enamel wire whose turns per linear inch amount to x is No. y. If the wire is very fine, some convenient fraction of an inch should be chosen to save time and avoid eye strain and confusion.

(The technician or experimenter may wish to build up a library of pieces of wire of known sizes, either discovered by the method above or taken from a marked spool. These can be cemented at one end to a piece of *white* card and wire of unknown size calibrated by holding it parallel and close to the known pieces for comparison. It is surprising how much difference there is between No. 36 and No. 38 when both are held close together.—*Editor*)

3. Coils in the high-frequency stages of receivers usually have such low resistance as to be continual puzzles to the service technician unless he has a diagram of the set with these resistances indicated. In close-wound single-layer coils the problem is solved without a circuit drawing. First the size of the wire is found as above, by measuring the length of the coil and *counting* the number of turns. The next step is to calculate the length of the wire by multiplying the circumference of the coil by the number of the turns. This done, we refer again to the table which gives us the resistance per 1,000 feet for that size of wire, and compute the ohmic value for the given length. The result is then compared with the ohmeter's reading and we have an exact idea of the coil's condition.

4. The table is again useful in replacing filament, bleeder, cathode, and other resistors of low values. Calculate the resistance and wattage required. The necessary data are the following: voltage of the source, voltage and current ratings of the load. It is understood, naturally, that the source is able to furnish the required energy. The resistance being calculated according to Ohm's law, the next step is to find what size wire is capable of handling the amperage without overheating. Then the length is easily computed.

5. The wire table and a quantity of wire of small sizes may help—in an emergency—to recalibrate cheap instruments using carbon resistors. If the original resistors are burned out or are far from their original values, the wire-wound calibrating resistors should be used in their stead.

6. The table again can help find the internal resistance of meters. Carbon resistors being unreliable on account of their tolerances, wires of sufficient resistance are preferable. Use is then made of the formula:

$$Rm = Rs \times n-1,$$

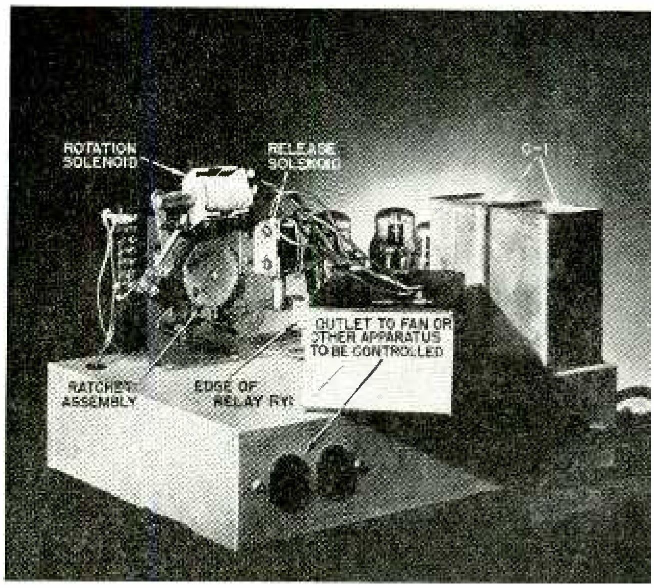
where Rm = the internal resistance of the meter that it is required to find, Rs = the resistance of a piece of wire calculated with the the help of the table, and n = the number of times that the meter's reading is multiplied. If a piece of wire is cut which will exactly double the meter reading, n = 2, and Rs then equals 2 – 1 (in other words, has the same resistance as the meter).

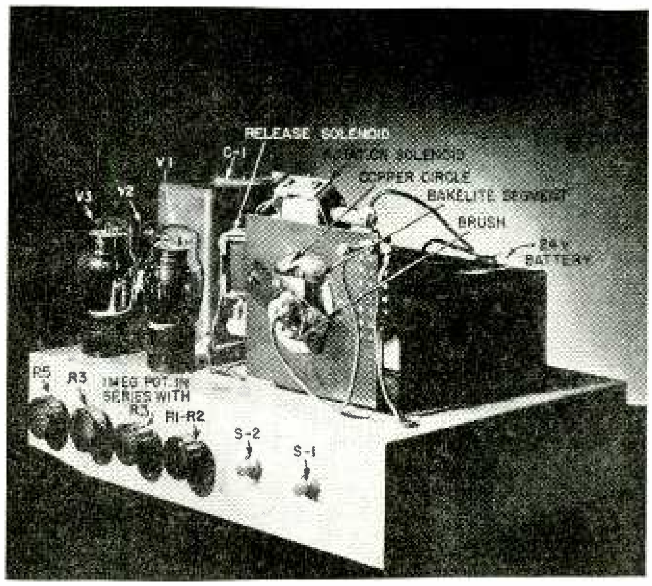
(Wire also has a certain tolerance in its manufacture, especially in the smaller sizes, therefore precision results are not to be expected from calculated wire resistors. Shunts of copper wire should be of a wire large enough to avoid heating in normal use. The resistance of copper changes appreciably with heat.—*Editor*)

—end—

Timer for Long Intervals

By FRED UPTON





Rear of timer (left) shows ratchet relay on left and battery in foreground. Front view (right) shows the brush and commutator added to the relay. A second 43 tube replaced the 25Z5 (see Fig. 1) as a line dropping resistor on the 117-volt line.

IN ALMOST every home there is a use for a timing device such as this. The one I have constructed is used for cutting off a window fan after a definite time interval.

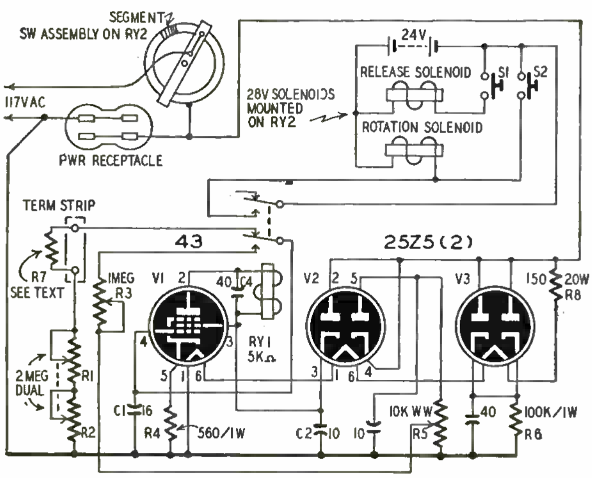
This eliminates an unnecesary, groping trip out of bed, and allows me to slumber undisturbed.

The timer is very simple and not very expensive. I used only three tubes in its construction. See Fig. 1. V3 could be omitted by substituting a 220-ohm resistor in place of R8. The timer can be set for intervals from a fraction of a second to approximately 25 minutes by adjusting R1, R2, R7, and R5.

V2 is used to obtain positive voltage for the plate and screen of V1 and negative voltage for charging C1 (two 8-μf oil-filled, 600-volt capacitors wired in parallel) and biasing the grid of V1 beyond cutoff. R5 varies the voltage supplied to the grid of V1.

The operation of the basic timer follows: When the grid of V1 is at zero or above cutoff the tube conducts, causing the relay RY1 to operate. The bottom contacts of RY1 close and a negative voltage is applied to the grid of V1 and C1 through R3. The time it takes to charge C1 to cutoff is dependent on the capacitance of C1, the resistance of R3, and the applied negative voltage as determined by the setting of R5. C1 should be a high-quality paper or oil-filled capacitor to minimize leakage. I used oil-filled capacitors because I had them on hand. As soon as C1 has charged to a negative voltage sufficient to cutoff V1, RY1 releases and the top contacts close. A 40-μf electrolytic capacitor (C4) was used across the RY1 winding to prevent chatter. The negative charge on the grid of V1 leaks off through R7, R1, R2, hence their value (in addition to the settings of R3 and R5) determine the timing interval. For greater control, another 1-meg pot was added in series with R3. It appears in the photo but not the schematic.

RY2 is a ratchet-type relay. It cuts off the current to the electric fan and inactivates the timer after a predetermined number of pulses. When the relay RY1 is operated it closes the battery circuit to the rotation solenoid, causing it to operate and remain operated until RY1 releases. This causes the ratchet assembly to move forward one step for each timed interval (which I have set



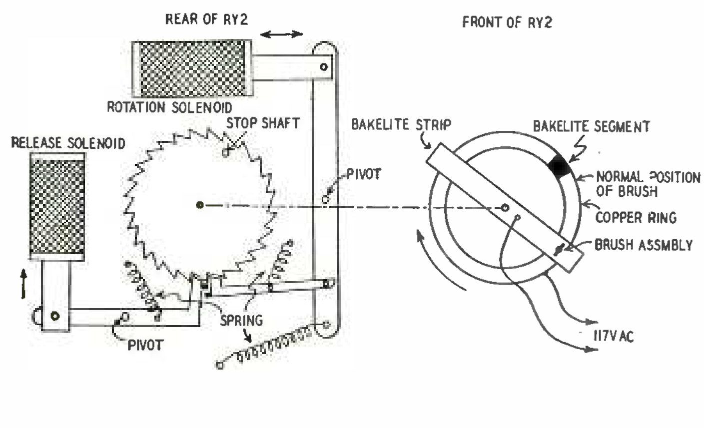


Fig. 1—Timer diagram. To omit V3, change R8 to 220 ohms. Fig. 2—Drawings showing construction of ratchet relay.

for 20 minutes in my case by using 40 megohms of resistance as R7). There are 27 step positions on this relay and 26 twenty-minute intervals allow a timing period of almost nine hours. The twenty-seventh notch is aligned with the bakelite segment of the ring assembly used to cut off the a.c. supply. The release solenoid is used to prevent the ratchet assembly from returning to normal except when the solenoid is energized. When it is energized by pressing S1, the ratchet returns to normal through the action of a spring coil mounted on the assembly.

The switch assembly on RY2 uses a carbon or metal brush mounted on a bakelite strip firmly mounted to the other end of the ratchet wheel shaft. This is shown in Fig. 2. The brush presses against a copper circle from which a segment has been cut and replaced by bakelite. When the brush steps to the position of the bakelite the a.c. is cut off to both the fan and the timer. The a.c. remains off until S1 is pressed, operating the release solenoid, which in turn allows the spring coil mounted on the ratchet assembly to return the brush to normal, and the a.c. is again applied.

R3 and R5 should be set so that RY1 is held energized for only a short period of time since the rotation solenoid draws almost 3 amperes when operating. The relay in this particular unit operates for only a fraction of a second, and the battery has held up very well. A low-voltage, dry rectifier supply could easily replace the batteries. The relay RY2 is surplus but the copper circle and brush assembly is my own modification. The versatility of this equipment can be enhanced by additional copper rings cut into different segments. S2 is used to step the ratchet assembly to the desired position before the timing cycle starts. V3 is used primarily as a filament-dropping resistor, but may furnish useful plate power to some other piece of equipment. The complete assembly including battery space, was built on a 10 by 14-inch chassis.

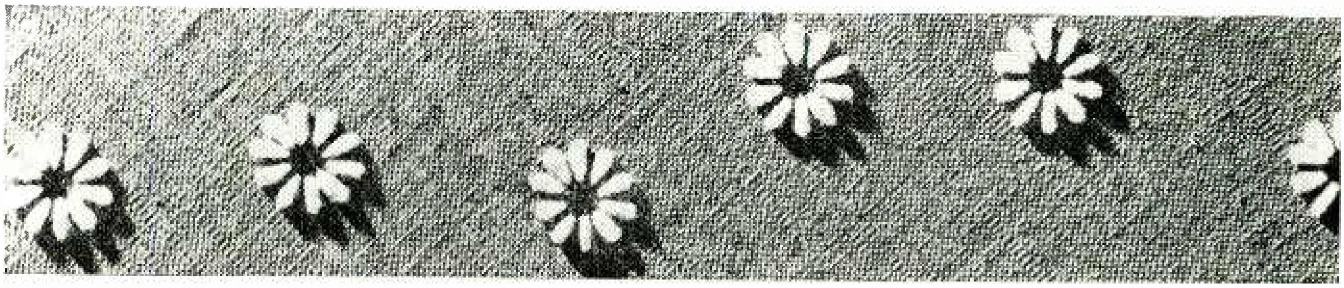
Materials for timer

Resistors: 1—560, 1—100,000 ohm, 1 watt; R7 value as desired, 40 megohms for 20 minutes time interval, 1—150 ohm wirewound, 20 watts; (potentiometers) 1—10,000 wirewound, 2—1 megohm, 1—dual, 2 megohm.
Capacitors: 2—8 μf 600 volt, oil-filled (in parallel), 2—10 μf 150 volt electrolytic, 2—40 μf 150 volt electrolytic.
Relays: 1—ratchet relay to be used on 24 volt battery or other power source, 1—5,000 ohm plate coil d p.d t. throw.
Miscellaneous: 2—pushbutton switches s.p.s.t., 2—25Z5 tubes, 1—43 tube, dual female power receptacle, chassis, hardware, hookup wire, etc.

—end—

Gambling curbs are demanded in an FCC-sponsored bill under consideration by the Senate Interstate and Foreign Commerce Committee. The Commission bill would prohibit the publishing by newspapers and broadcasting by radio of betting odds and prices paid on any sporting event. FCC Chairman Wayne Coy in testimony before Congress indicated that "undue hardship" would result from adoption of the proposal of the Senate Crime Investigation Committee to license all carriers of sports information.

ELECTROSTATIC PRECIPITATION



Sample of a fabric with raised design produced with short textile fibers in a precipitation process superior to weaving.

By ED BUKSTEIN

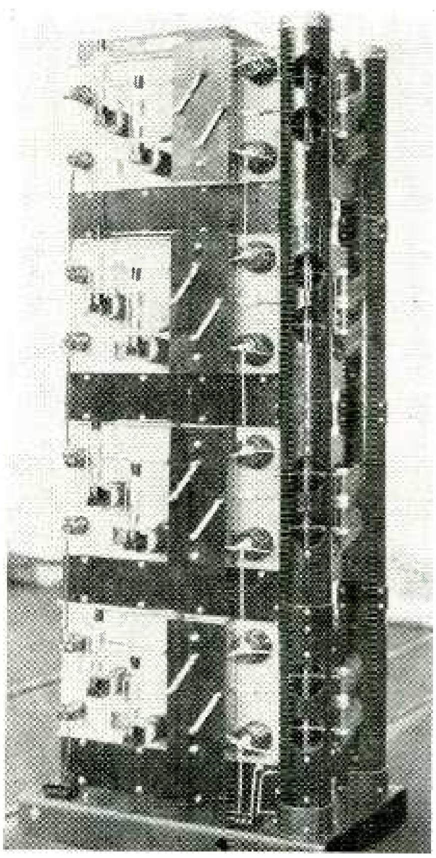
Using a principle known for thousands of years, the modern high-voltage precipitator is giving yeoman service in the home, industrial plant and hospital.

HOW cleanse the air of cigarette smoke particles though these particles may be less than a hundreth of a thousandth of an inch in diameter? How recover minute particles of valuable chemicals that might otherwise go up as waste through factory chimneys? How make a spray of paint follow curved paths so that it coats the back of the object to be painted? The solution is—electrostatic precipitation, a branch of industrial electronics dealing with the control of minute particles of matter.

Electrostatic attraction has been known for at least 25 centuries. Thales of Miletus, philosopher and mathematician of ancient Greece, observed that dried leaves and light straws were attracted to a piece of amber which had been rubbed with silk. Radio students have rubbed a glass rod with a piece of silk and noted that the glass attracts small bits of paper. A hard rubber comb, after being passed through the hair, likewise attracts paper.

These experiments are generalized in the well-known law of charges: like charges (two positives or two negatives) repel each other, and unlike charges attract. To control a small particle of matter it is necessary only to give that particle an electric charge. The particle will then be attracted to a collector plate bearing an opposite charge.

Service technicians are familiar with the phenomena in practical radio work. The face plate of a picture tube, if not sealed, collects dust. Dust also collects on the high-voltage winding of the flyback transformer in TV sets. Both of these conditions are caused by electrostatic precipitation.



A commercial two-stage precipitator.

Precipitation action

The underlying principle of electrostatic precipitation is illustrated in Fig. 1. The output of a high-voltage power supply is connected to a thin wire and a flat metal plate. Because of the high potential, the air around the wire is ionized. This is *corona discharge*; it appears as a faint glow around the *wire*. The air is thus broken down into positive and negative ions. The positive ions are attracted to the nearby wire, and the negative ions must travel across the gap to the plate. As a result, the space between the wire and the plate is filled with negative ions.

The air to be filtered is passed between the wire and the plate. Air-borne particles of dust, smoke, soot, etc., collide with the negative ions. They become charged. The *negatively* charged particles are then attracted to the *positive* plate, and the air emerges clean and ready for reuse. The collector plate is cleaned at regular intervals by rapping, washing, or scraping away the accumulated waste.

Pipe type (a) and plate type (b) precipitators (Fig. 2) are used in practice. The pipe type consists of a number of hollow cylinders with a thin wire running coaxially through each. Dust-laden air is passed through these cylinders, and the dust collects on the inner walls of the cylinders. The plate type consists of a number of flat metal plates with the wires spaced in between them. These plates can be arranged either horizontally or vertically, depending on the particular installation.

Commercial types

The precipitators in Fig. 2 are one-stage types and are used in small units such as those for the home. The two-stage precipitator, Fig. 3, is used in large, industrial installations. This type has two sections, the ionizer or dust charger and the collector cell.

The ionizer is made of thin wires spaced between larger diameter rods. Rods and wires are alternately negative and positive. The high voltage applied to the ionizer produces corona discharge and causes the air between the wires and the rods to become ionized. As the dust-laden air passes through this ionized region, its particles become *positively* charged.

The second section of the two-stage precipitator consists of two sets of oppositely charged plates. As the positively charged particles enter the collector cell, they are repelled by the positive plates and attracted by and adhere to the negative plates. Periodically, the plates of the collector cell are cleaned, either manually or automatically.

Power requirements

Depending upon its size and purpose, an electrostatic precipitator will require potentials from 10,000 to 100,000 volts. The current drain may range from 10 to 250 ma. Both electronic and mechanical rectifiers have been used in practice. The electronic types consist of conventional half-wave, full-wave, or voltage-doubler rectifiers. Voltage-doublers are sometimes cascaded when extremely high voltages are required.

The mechanical rectifier is a motor-driven switch which reverses the load connections at each reversal of the power-line polarity. The motor is a synchronous type to "keep step" with the line-voltage alternations. The mechanical rectifier is similar in appearance and function to the commutator of a d.c. generator.

In practice, electronic rectifiers are more popular than the mechanical types. This greater popularity results from the well-known advantages of the electronic rectifier. It is quiet in operation, it has no moving parts to wear out, and it does not generate noise

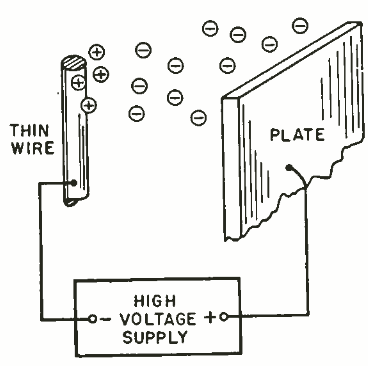


Fig. 1—The basic cell used in all units.

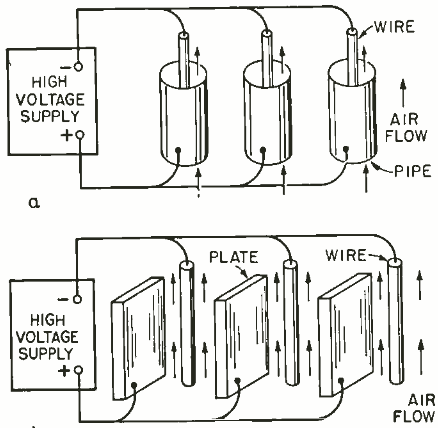


Fig. 2—One-stage type in home units.

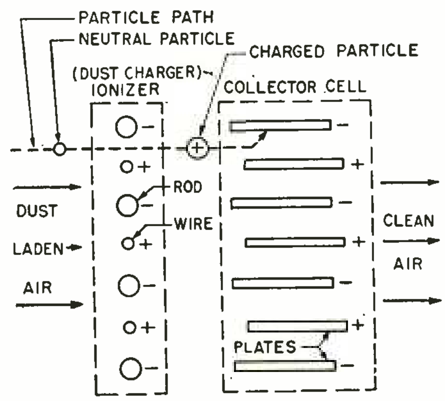


Fig. 3—Type of heavy duty two-stage unit used in industrial installations.

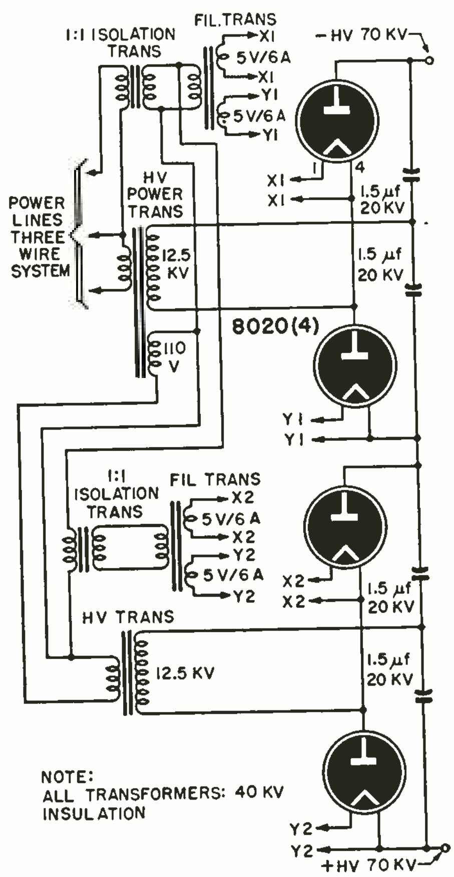


Fig. 4—Power supply for industrial unit employs cascaded voltage doubler.

voltages to interfere with radio reception. Fig. 4 is a simplified schematic of a two-unit cascade rectifier. Each unit is a voltage doubler and is rated at 35,000 volts, 30 milliamperes.

Nuisance abatement

No other practical system of air cleaning compares with the efficiency of electrostatic precipitation. It cleanses the air of particles as small as 1/250,000 inch in diameter, which would pass through ordinary mechanical filters. Electrostatic air filters trap over 90% of the air-borne particles; mechanical systems operate at about 10 to 20% efficiency. Commercially available precipitators range in capacity from the 1,200 cubic-feet-per-minute home unit, to the larger industrial types capable of handling 40,000 cubic feet of air per minute.

Electrostatic precipitators are often used to remove particles of cigarette smoke. In night clubs, restaurants, offices, and homes, this produces a healthier and more pleasant atmosphere. It also reduces laundering, cleaning, and decorating costs. Curtains, draperies, and furniture remain fresh and clean for longer periods, and mirrors and glassware do not become clouded with the familiar blue haze.

Industry has often adopted the electrostatic dust and smoke eliminator as an aid to better public relations. Many communities have instituted nuisance abatement ordinances and will not issue building permits for cement plants, blast furnaces, refineries, etc. unless electrostatic precipitation is included in the plans.

Precision industry

Some industries require a dust-free atmosphere as essential to the quality of the product. In the manufacture of delicate watch movements or electrical instruments, for instance, microscopic particles of dust can produce wear and inaccuracies. Manufacturers of photographic film, precision optical instruments, electron tubes, drugs and pharmaceuticals, and many other products employ electrostatic precipitators.

In machine shops and other industrial plants employing high-speed machinery, large quantities of oil coolant are used. Friction-generated heat transforms the liquid coolant into mist-fine particles of oil suspended in the air. This oil mist covers windows and lighting fixtures, cutting down illumination. It attacks the rubber insulation on electrical wiring. It makes pulley belts slippery, and it coats the floor with a slippery film. Electrostatic precipitation has successfully solved the oil-mist problem. Not only is the nuisance of oil-mist eliminated, but the reclaimed oil can be used over again.

Food products

Food product manufacturers find improved quality and reduced wastage results when electrostatic precipitation is used. In the manufacture of powdered milk, for instance, the elimination of bacteria-laden dust helps the product withstand extreme temperatures. Geographical distribution is thus greatly extended. Meat packers have solved the problem of moldy bacon by eliminating air-borne bacteria from the slicing rooms. In breweries, precipitation equipment prevents mold spores from entering the fermentation vats.

Material recovery

Nuisance abatement is not the only reason for the use of precipitation equipment in industrial plants. In many cases, the recovered particles are of considerable value. This is particularly true in smelting and refining plants. Particles of gold, silver, cadmium, lead, mercury, etc., that might otherwise be lost as chimney waste are reclaimed and used again. Single precipitator installations have recovered as much as $1,000,000 a year.

Spray painting

In the field of spray painting, electrostatic precipitation has effected many advantages in quality and economy. The object to be painted is connected to the positive terminal of a high-voltage power supply. The negative terminal is connected to a screen mesh containing many sharp points to aid corona discharge.

Paint particles sprayed into the electrostatic field become negatively charged and are attracted to the positively charged object. Paint particles which, because of their initial velocity, travel past the object will reverse their direction and return. This feature provides a convenient method of painting the back of the object without rotating it and without moving the spray gun.

Overspray reduction results in considerable savings. With ordinary spraying methods, only about 50% of the paint reaches the work. Precipitation equipment increases the efficiency to 95%. Ventilation problems are reduced, and fewer guns and operators can handle the same volume of work.

Material deposition

In the manufacture of sandpaper and emery cloth, grains of abrasive material are electrostatically deposited on the glued backing. These grains tend to align themselves with the electrostatic field, and are deposited with their sharp points outward. This improves the abrasive quality of the product.

Electrocoating of fabrics is also being practiced. A design is printed with adhesive material on a cloth backing. Short pieces of textile fiber, known as flock, are electrostatically impelled against the backing cloth. The fibers not only stick to the adhesive, they actually penetrate the backing cloth, giving the appearance of a woven fabric. Rugs manufactured by this method are easier to produce and have greater durability. More than a quarter of a million fibers per square inch can be deposited in this manner. This is a fiber density about ten times greater than can be achieved by ordinary weaving methods.

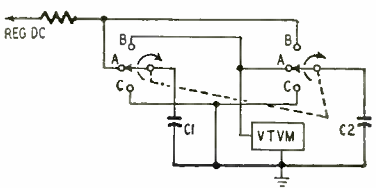
—end—

COUNTING RATE INSTRUMENT

By I. QUEEN

A new idea in electromechanical counting-rate meters is used in the Berkeley Scientific Corp.* model 1600 computer. The instrument has rapid response, wide counting range and high accuracy.

In the circuit shown, C1 and C2 are matched. A ganged rotary switch connects C1 to a source of regulated d.c. through a resistor, while C2 is across a voltmeter. This switch is controlled by a scaler or divider. As an example, the scaler might provide a single pulse for every 100 pulses from a Geiger counter. Then, after every 100 counts from the Geiger, the switch is flipped from A to B (or from B to A) by the scaler.



While one capacitor is being charged, the other is being tested by the v.t.v.m. If it should require 10 seconds for the Geiger count to reach 100, the switch will remain in the same position for 10 seconds. If it should require 30 seconds, for example, a much greater charge will accumulate on the charging capacitor before the switch is flipped. The meter scale is calibrated in reverse (like a series ohmmeter) since a rapid rate corresponds to a small deflection.

Each capacitor is shorted to ground by momentary contact with grounded terminal C after its charge is measured.

Each measurement is independent of previous ones, since the capacitor charge is shorted out after a reading. Since there are two capacitors which are measured alternately, there is no interruption. The greater the counting rate, the more often a reading is taken. The maximum number of readings is 400 per minute.

*Richmond, Cal.

ELECTRONIC EYES NEEDED

Electronic eyes and brains will have to take over in flying supersonic planes that travel 1,800 miles per hour, Dr. Richard A. Byrnes told the Aero Medical Association at a meeting in Denver recently.

Dr. Byrnes, of the U. S. Air Force School of Aviation Medicine, illustrated his point with this example: A plane traveling at 1,800 miles per hour will go about a fifth of a mile before it is even seen, because the eye and brain take between three-hundredths to three-tenths of a second to see at all. But in that distance the brain will not recognize the object as a plane. The aviator would not know he was seeing a plane until the supersonic plane had gone a half mile. While the brain is deciding what to do, the plane would have traveled almost a mile.

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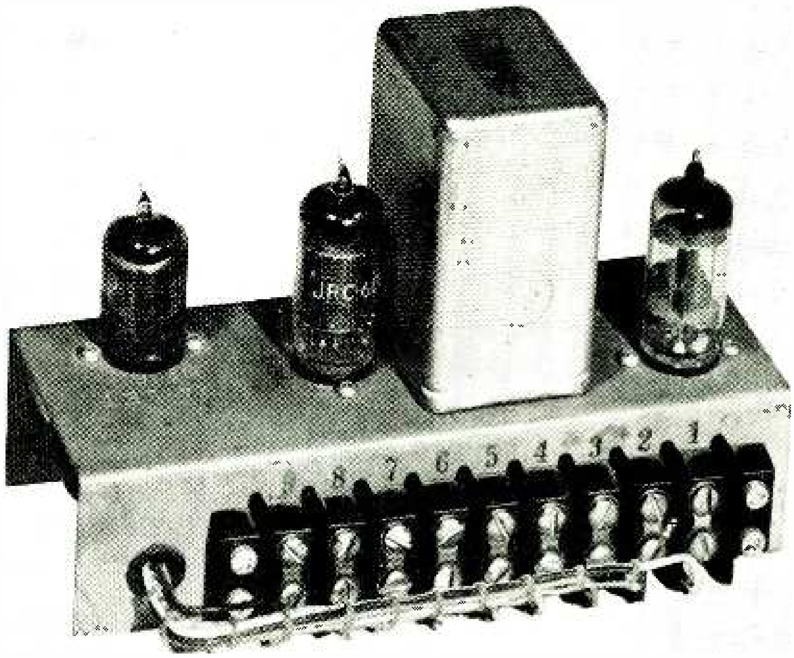


The high utility value and modest dimensions justify a spot on the ham shelf.

Useful Phone-C.W. Monitor

By JOHN E. PITTS, W6CQP

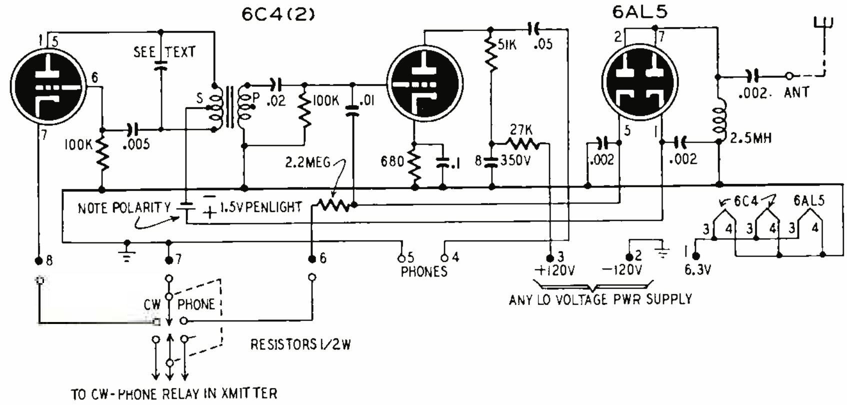
WHETHER a ham operates on phone or c.w. he should know at all times how his voice or his keying sounds to the other fellow, and not have to ask the traditional question, " 'Cw's by bodulajun, Ode Ban?"

The monitor described here was designed to be as uncomplicated as possible, yet operate satisfactorily on either phone or c.w., being switched with the transmitter PHONE-C.W. switch to either type of emission. It was built on a piece of scrap sheet steel, 6 inches long, 2 inches wide, and with sides bent to give a height of 1½ inches. All external connections are made to a 9-terminal strip (see photos).

It comprises a 6AL5 duo-diode to provide plate voltage from the rectified transmitter carrier for the series-fed Hartley oscillator. Phone carriers are demodulated by the other half of the 6AL5. The 6C4 amplifier is used to build up the output level enough to give a comfortable signal in the phones.

How it operates

With the PHONE-C.W. switch of the transmitter set to C.W., the 1-7 pin section of the 6AL5 receives r.f. from the antenna. The cathode of the 6AL5 supplies a slight positive voltage to the center tap of the oscillator transformer, causing the 6C4 oscillator to oscillate. The diode's d.c. return is through the 2.5-mh r.f. choke. The frequency of oscillation can be set over a moderate range by the capacitor across the center-tapped winding. In the instance here, a value of 100 μμf produces a tone of about 800 cycles.



This circuit monitors phone signals and provides keyed tones when used on cw.

The output of the oscillator is amplified by the second 6C4, being coupled to the amplifier grid through the .02-µf capacitor. Terminals 4 and 5 may be connected in parallel with the high-impedance output of the station's receiver or by any other suitable means to the phones.

It will be noted that a 1.5-volt penlite cell is connected in *reverse* polarity in the plate lead to the oscillator. This was found necessary because the oscillator was sufficiently sensitive to oscillate weakly on the contact potential of the 6AL5 diode, probably not more than a few hundredths of a volt. The reverse potential cured the oscillation.

For phone operation, the PHONE-C.W. switch of the transmitter is set at PHONE. This breaks the cathode circuit of the 6C4 oscillator, and makes the return circuit of the 5-2 pin diode section of the 6AL5 through the 2.2-meg diode load resistor. The varying audio across the 2.2-meg resistor is impressed on the grid of the 6C4 amplifier through the .01-µf capacitor. An exact replica of the modulation as heard at the other fellow's station is produced in the phones, as actually a minute portion of the carrier is sampled and demodulated at the station.

This monitor will not check for chirps on c.w., or out-of-band operation. But every station is supposed to have a reliable frequency-measuring device, is it not? However, any a.c. modulation of the c.w. signal will produce modulation of the audio tone heard from the oscillator, and will give a good check on the purity of the emitted signal.

The length of antenna connected to terminal 9 will be determined by the power output of the station's transmitter, of course. Used with the author's transmitter, running a kilowatt to a pair of 304TL's, only 4 inches of antenna gives a good signal on either phone or c.w.

(The monitor will be more convenient to use if you connect a 0.5 megohm potentiometer across terminals 4 and 5 and run a shielded lead from the variable arm to the hot side of the receiver's volume control and adjust the monitor level to the customary receiver level. With this connection, it will not be necessary to use an extra pair of phones for the monitor. An audio voltage divider may be inserted to reduce the monitor output to the level of the second detector in the set. If the send-receive switch breaks the B-minus lead in the set, rewire it so it is in series with the B-plus lead to the r.f. and i.f. circuits, leaving B-plus applied to the audio circuits of the set. With this connection, you won't have to reset the volume control each time you switch from send to receive.—*Editor*)

Materials for monitor

Capacitors: (paper) 3—.002, 1—.005, 1—.01, 1—.02, 1—.05, 1—0.1 µf. (electrolytic) 1—8 µf.
Resistors: 1—680, 1—27,000, 1—51,000, 2—100,000 ohms, 1—2.2 megohms.
Tubes: 2—6C4, 1—6AL5.
Miscellaneous: 1—push-pull interstage or input audio transformer; 1 s.p.d.t. relay (part of d.p.d.t. relay in transmitter) 1—RFC, 2.5 mh; 1 penlite cell; tube sockets; terminal strip; chassis; phones; accessories; wiring.

—end—

ACTIVITIES OF NETSDA AND ITS LOCAL CHAPTERS

The National Electronic Technicians and Service Dealers Association (NETSDA) held its annual meeting in the Hotel Stacy Trent in Trenton, New Jersey on November 11, 1951. E. W. Merriam, Service Manager for the Radio Television Manufacturers Association, was guest speaker. He gave an outline of his proposed plans to forward the proposals presented by NETSDA at the Chicago meeting of the Radio Television Manufacturers Association's Service Committee.

At the close of Mr. Merriam's talk, the score or more delegates present from the various chapters presented a series of questions to Mr. Merriam, who tried to answer as many as possible. A series of requests and demands was also given to Mr. Merriam to present to the RTMA Service Committee at its next meeting. The delegates then voted to give all the cooperation necessary to Mr. Merriam in helping him to promote a concrete program for the servicing industry.

The National Electronic Technicians and Service Dealers Association's delegates voted to hold a national meeting of representatives of all servicing associations throughout the country. The meeting was tentatively set for May 1952, at which time, representatives of the manufacturers, distributors, broadcasters, and sales representatives will also be requested to attend. A definite date and location has not been selected as yet, but will be after a survey is made among all radio and television technicians and service dealers associations in the U.S.A.

A national code of ethics was adopted by the body and will be presented for vote and ratification by all Chapters.

The Federation of Radio Servicemen's Associations of Pennsylvania (FRSAP) met in Scranton, Pa. October 21, 1951. Delegates from all chapters were present. In addition, representatives from the Southern Pennsylvania Radio and Television Technicians Association (of York, Pa.), headed by their president, Mr. Sheffer, presented their application for membership to the state group which was voted upon and accepted. This makes the tenth chapter in the state federation.

Officers of the new association are: Carl Sheffer, president; Eugene Klinedinst, vice-president; Joseph Hauser, secretary; James Geiselman, treasurer; and Gerald Dean, public relations.

The new organization has applied for membership in the Federation of Radio Servicemen's Associations of Pennsylvania.

The 50-point program as prepared by delegates of the Federation and presented to the RTMA, National Electronic Distributors Association, and set distributors association, was thoroughly covered at this meeting.

Each year, as in the past four years, the Federation appoints a committee to arrange for a statewide vote in all Chapters to select the individual, organization, or the publication who has made an outstanding contribution to the servicing industry. For this, the Federation awards its annual plaque. The committee appointed this year is the delegation from Altoona. The new speaking schedule for 1952 will include John Rider, nationally known publisher, and speakers from Capehart-Farnsworth, Howard W. Sams, and Motorola.

The Radio Servicemens Association of Luzerne County is carrying on with a full line of business and social activities, with lectures and demonstrations on TV receivers and circuitry, u.h.f., better business methods, and other subjects. The local Association is looking forward to the future lectures which have been arranged by the State Federation and is at present doing its part in promoting licensing.

September 16, 1951, the annual basket picnic was held at Toby Park, Blakeslee. Prior to the basket picnic, the annual sponsorship of a Grove Theater play, "Dark of the Moon" took place on Tuesday, August 28, 1951.

Max Liebowitz, president of the Associated Radio-Television Servicemen of New York (City) has recently arranged for a series of articles in the local daily newspapers on the need for licensing. He has also supplied a story entitled "Here's A Law to Protect You." to the *TV Guide* whose circulation in New York City runs into many thousands. On November 12, Mr. Liebowitz appeared as a guest on a program on WCBS-TV in New York City, at which time, he presented the service technicians' views on licensing.

Oak Ridge Products Co. will supply necessary test equipment for ARTSNY's clubroom. A committee has been appointed to select nominees for election to offices for 1952.

The Radio Servicemen's Association of Trenton, New Jersey, has arranged a series of technical and business lectures to promote a more progressive and active program within the association for the benefit of its members. They will be held in the studios of the local broadcasting stations.

Gibson Grandly of Trenton has been appointed chairman of the new membership committee and already good results have been obtained. Membership is now open to all radio and television technicians and service dealers in the area.

The Long Island Television and Radio Technicians Guild president Eugene Laper has appointed a nominating committee to select officers for 1952. A series of lectures are being arranged for by the Educational Committee on television and radio servicing as a business.

The Guild has decided to make a bigger effort to take a more active part in the Empire State Federation and in the NETSDA.

The Kingston Radio Servicemen's Association officers, under leadership of their President, Raymond E. Trumpait, will undertake a campaign to visit all technicians and service dealers in the area to obtain additional membership. A series of lectures and social events are being scheduled for 1952.

Philadelphia Radio Servicemen's Association is preparing a program of public relations to be carried directly to the homes of the thousands of customers serviced daily by Association members. The magazine committee is now completing the mailing list which will include most of the four thousand members in the State Federation and the officers of a hundred or more individual Radio and Television technicians and service dealers' associations throughout the country. *PRSMA News*, which is the voice of the local service technicians will, therefore, be available to all those interested. Copies can be obtained by writing Mr. Stan Myers, 1643 S. Wilton Street, Philadelphia 43, Pennsylvania.

Mid-State Radio Servicemen's Association members attended a series of technical lectures at Harrisburg, sponsored by RCA in September, General Electric in October, and Raytheon in November. The Raytheon lecture was one of the finest the local technicians have heard in a long time. In addition to the hundred or more members, scores of invited technicians from Harrisburg and surrounding areas were present.

The Lackawanna Radio Technicians Association is contemplating a new advertising and publicity campaign for its entire membership through newspapers and radio ads. The election of new officers at the last meeting and the committee heads will again promote an active program for the Lackawanna technicians.

Blair County Association of Radio Service Engineers, through the promotion of its technical talks to the technicians in the surrounding area, has obtained over thirty-five new members in the past six months. Delegates to the State Federation have brought in additional business and technical programs to round out the balance of the year. A publicity campaign to promote the association emblem to the public is now under consideration.

LICENSE BILL PASSED

Television technicians and contractors of New York City will require licenses or permits to work after February first, according to the terms of a bill passed by the City Council in November.

Television contractors would be licensed in two groups. The "A" contractors would include those considered financially able to carry out their obligations and to refund balances of contract payments if for any reason they should not be able to complete the contracts. The "B" group would not have to show the same financial strength, but would have to satisfy the license board of their dependability as service concerns.

Technicians now working as such would be issued a permit until such time as they can sit for an examination for a technician's license. All technicians would be expected to take an examination before July 1, 1953, and after that date none but licensed technicians will be permitted to do service work on television or radio-TV combinations.

Fees of $15 are to be charged for technician permits or licenses, with an annual $5 renewal fee. A less skilled group is to be given apprentice permits at a $5 fee, also with a $5 yearly renewal.

The law will be administered by a city commissioner, with the help of an eight-man board, consisting of one member from the city's law department, one from its Board of Education, an electronic engineer, a service technician, a service contractor, a television dealer, a receiving set distributor, and a parts distributor.

A mixed reaction to the bill was noted. The press generally welcomed it as protection for the TV set owner. The president of ARTSNY, Max Liebowitz, points out "The bill is for the protection of the public, but is in the best interests of the service industry." On the other hand, officials of large service companies and the spokesman of a dealer's association believe that "the bill will not be effective," that it will not cure all the industry's evils (a reasonable assumption, indeed!) or even that "It's another racket to get more money for the city." One of the four councilmen who voted against it felt that it restricted honest service people who have been doing ethical business for a long time. It should be noted that the bill covers licensing of *television* service only.

COLUMBUS ADVERTISES

The Associated Radio-Television service Dealers of Columbus, Ohio, have been running a series of ads in the local *Sunday Citizen*, on the Radio-Television page. Effect has been good, in the opinion of members.

BALTIMORE UNITES

A new service association to be known as the Certified Television and Electronics Association (CTEA) of Maryland, has been formed in Baltimore. Twenty-seven members were reported to have signed up.

Speakers at the organization meeting included Frank Moch, president of the National Alliance of Television and Electronic Service Associations (NATESA) and Mal Parks, Chicago radio and television editor. Mr. Moch discussed the parts warranty problem and Western Union's plan to handle radio and television servicing. Mr. Parks talked on servicing prospects and problems, among other things urging that all service companies return to the service contract system, and criticizing present manufacturing standards. Out of a recent check of 60 sets, he stated, 40 were missing a tube, or connections had not been properly soldered.

LICENSES FOR SHOPS

Los Angeles County will license all television shops in unincorporated parts of the county (those outside the city of Los Angeles) under a recently passed ordinance. The bill makes no provision for examination and licensing of technicians, but is confined to service shops not engaged in selling new sets. Fee will be $36 per year.

According to County Sheriff Biscailuz, "The background of each repairman will be investigated, and . . . a dishonest one will not be licensed for business."

A conference was proposed by the county supervisors, with the idea of exploring the possibilities of examining and granting certificates to individual repairmen, with the idea of protecting the public against incompetent service as well as the protection against dishonesty expected to result from the ordinance already passed.

NETSDA'S PROPOSED CODE

The following Code of Ethics was adopted by the National meeting of NETSDA at Trenton, N. J. It has been sent to member chapters for approval or further suggestions.

I pledge myself:

1. To at all times perform my work to the best of my ability and knowledge. In addition, to make a sincere effort to improve my knowledge of the technical and business requirements of my profession, thereby enabling me to render more competent service.
2. To use whenever possible, original factory replacement parts. Where this is impractical, to use parts of equivalent or better quality.
3. To exercise special care in handling customers' property.
4. To guarantee all service performed and parts replaced by me for a period of 90 days (unless otherwise specified).
5. To charge a fair and just price for all work, and to display these prices prominently.
6. To refrain from unfair or unethical practices, untruthful advertising, unreliable statements, unjust or unfair criticism of other technicians, or any conduct which might lead to lack of confidence in my self or in my fellow technician.

NATESA MEETING

The 1951 Convention of the National Alliance of Television and Electronic Service Associations (NATESA) was held in Chicago November 18, 1951. Nineteen members were present, representing five states, and proxies for three more member associations were voted. In addition, visitor representatives from five states were also present.

Six new associations affiliated with NATESA during the convention. These were the Associated Radio & Television Service Dealers, Columbus, Ohio; Television Service Engineers, Inc., Kansas City, Mo.; California TV Service Dealers Association Inc., Hollywood, Calif.; Certified Television Electronics Association, Baltimore, Md.; Radio Service Dealers Association of Kansas, Inc., Wichita, Kan.; and the Radio Television Service Association, Minneapolis, Minn.

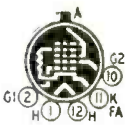
E. W. Merriam, the Service Secretary of the RTMA, and Mal Parks, of *What's New in Television*, addressed the gathering. Major problems such as parts warranty, procurement, and Western Union, were discussed, and a new constitution for the Alliance was adopted.

—end—

TUBE OF THE MONTH

A new all-glass rectangular 21-inch TV picture tube has been released for replacement or original manufacturer equipment by the Cathode-ray Tube Division of the Allen B. Du Mont Laboratories, Inc.

The tube, the 21KP4A, features a picture area of 242 square inches (more than previous metal-cone 21-inch tubes). A filter-glass face plate improves contrast and cylindrical face surface minimizes reflections by scattering incident light upward and downward, away from the eyes of the viewer.



The base connections of the 21KP4A

The new 21KP4A is a Selfocus type and does not require a focus control or associated circuitry. It may replace electromagnetically or electrostatically focused picture tubes, usually without circuit change.

It is provided with an external conductive coating and the standard 5-pin duodecal base. The overall dimensions are 23 inches with a 70° diagonal deflection angle. Heater rating is the usual 6.3 volts at 0.6 amperes with maximum recommended voltages of 500 for first anode and 18 kv for second anode.

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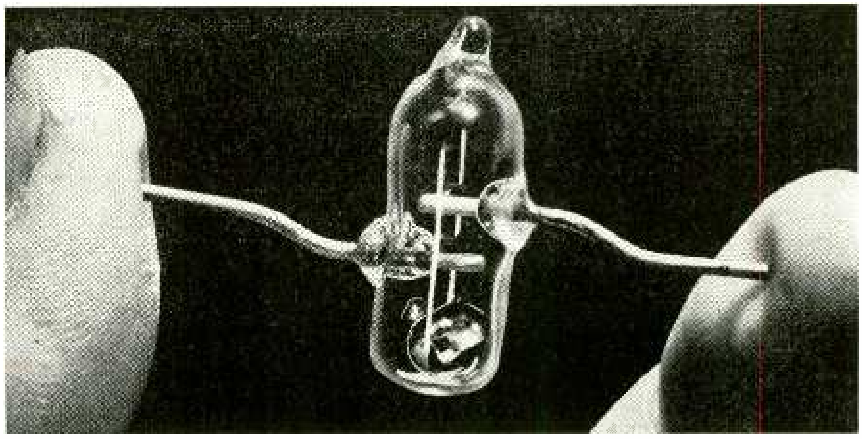


The large mercury globule insures positive, but momentary, contact across leads.

Small, Chatter-proof Interruptor Meets Special Switching Needs

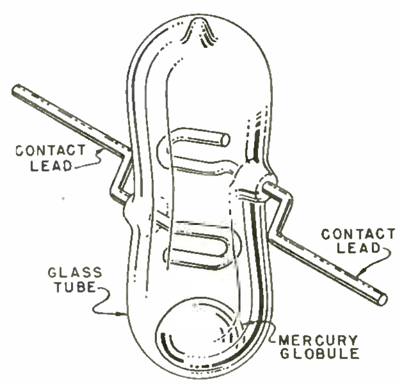
Mercury contacts have proven their reliability for many years. From the control of refrigerators to oil burners, from operating the light in the glove compartment of automobiles to making a host of other contacts, mercury switches are an accepted and trustworthy element of construction.

Essentially all mercury contacts known heretofore either make or interrupt the electric current. A new contacting device has now been developed by Dr. Erwin J. Saxl, of the Saxl Instrument Company of Harvard, Mass., whereby the arrangement of electrodes and mercury is such that under no condition can the electrodes remain permanently connected in the pool of mercury.

Like all basic developments, his design is simple, as shown in the schematic patent drawing. The drop of mercury is at one end of a glass tube which is evacuated or filled with the proper gas for avoiding oxidation of the contacts. Upon tilting the glass tube, the mercury runs along it toward the other end. In doing so it passes by two electrodes adequately spaced from each other. During the short time while the mercury runs between them, both electrodes are connected and temporary contact is established. No possibility exists that the contact will remain closed. The *contact is first established and positively extinguished thereafter*, since the droplet of mercury irrevocably passes beyond the contacting leads.

This device is self-healing. Having made and broken electric contact, the mercury accumulates at the other end of the tube and is ready for operation again.

The new contactor has a wide range of possible applications, which are best understood if we think of it as a relay turned inside out, in which a small amount of mechanical power releases a large pulse of electric power. As such, it may be used to make more efficient watt-hour meters—in which electric pulses replace gearing—and has applications in counters and other equipment. It covers the gap between the heavy switching arrangement of electromechanical construction on one hand and photoelectric or electronic equipment on the other hand.



The new mercury momentary contactor.

As a speed governor the mercury contactor may be mounted with the axis of its electrodes at right angles to the axis of rotation of the member to be controlled. When the rotational speed diminishes to the point where the force of gravity exceeds the centrifugal force acting on the globule the liquid runs past the electrodes, makes contact, and allows energizing impulses (through a suitable electromechanical system) to be applied to the rotating member such as to bring it out of its stalling or dragging, overloaded condition.

Since under no conditions can the mercury remain between the two electrodes, interruption as well as contact is sharp and positive. Vibrating or frozen contacts are impossible. This may make it useful for vending machines, electrical coin changers, and other devices in which sticking or chattering contacts may result in loss or danger.

—end—

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Build a Professional Signal Tracer
Build a Code Oscillator
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FREE! • ELECTRICAL AND RADIO TESTER • RADIO TELEVISION SERVICING LESSONS • BOOK ON TELEVISION • MEMBERSHIP IN RADIO-TELEVISION CLUB • ELECTRIC SOLDERING IRON • CONSULTATION SERVICE • QUIZZES

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LEARN TROUBLE SHOOTING . . . THEORY . . . WIRING . . . CODE!

WHAT THE NEW IMPROVED 1952 PROGRESSIVE RADIO "EDU-KIT" OFFERS YOU

The Progressive Radio "Edu-Kit" offers you a home study course at a rock bottom price. Our kit is designed to train Radio Technicians, with the basic facts of Radio Theory and Construction Practice expressed simply and clearly. You will gain a knowledge of basic Radio Principles involved in Radio Reception, Radio Transmission and Audio Amplification.

You will learn how to identify Radio Symbols and Diagrams; how to build radios, using regular radio circuit schematics; how to mount various radio parts; how to wire and solder in a professional manner. You will learn how to operate Receivers, Transmitters, and Audio Amplifiers. You will learn how to service and trouble-shoot radios. In brief, you will receive a basic education in Radio exactly like the kind you would expect to receive in a Radio Course costing several hundreds of dollars.

THE KIT FOR EVERYONE

The Progressive Radio "Edu-Kit" was specifically prepared for any person who has a desire to learn Radio. The Kit has been used successfully by young and old in all parts of the world. It is not necessary that you have even the slightest background in science or radio.

The Progressive Radio "Edu-Kit" is used by many Radio Schools and Clubs in this country and abroad. It is used by the Veterans Administration for Vocational Guidance and Training.

The Progressive Radio "Edu-Kit" requires no instructor. All instructions are included. All parts are individually boxed, and identified by name, photograph and diagram. Every step involved in building these sets is carefully explained. You cannot make a mistake.

THE PROGRESSIVE RADIO "EDU-KIT" IS COMPLETE

You will receive every part necessary to build 15 different radio sets. This includes tubes, tube sockets, variable condensers, electrolytic condensers, mica condensers, paper condensers, resistors, tie strips, coils, tubing, hardware, etc. Every part that you need is included. In addition these parts are individually packaged, so that you can easily identify every item.

TROUBLE-SHOOTING LESSONS

Trouble-shooting and servicing lessons are included. You will be taught to recognize and repair troubles. While you are learning in this practical way, you will be able to do many a repair job for your neighbors and friends, and charge fees which will far exceed the cost of the Kit. Here is an opportunity for you to learn radio and have others pay for it. You build a professional Signal Tracer which alone, is worth more than the price of the complete Kit.

THE PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" comes complete with instructions. These instructions are arranged in a clear, simple and progressive manner. The theory of Radio Transmission, Radio Reception, Audio Amplification and Servicing by Signal Tracing is clearly explained. Every part is identified by photograph and diagram; you will learn the function and theory of every part used.

The Progressive Radio "Edu-Kit" uses the principle of "Learn By Doing." Therefore you will build radios to illustrate the principles which you learn. These radios are designed in a modern manner, according to the best principles of present-day educational practice. You begin by building a simple radio. The next set that you build is slightly more advanced. Gradually, in a progressive manner, you will find yourself constructing still more advanced radio sets, and doing work like a professional Radio Technician. Altogether you will build fifteen radios, including Receivers, Amplifiers, Transmitters, Code Oscillator & Signal Tracer.

THE PUBLIC APPROVES!

COMMENTS FROM SATISFIED USERS OF THE PROGRESSIVE RADIO "EDU-KIT"

VETERANS ADMINISTRATION,
PHYSICAL MEDICINE REHABILITATION SERVICE,
WASHINGTON, D. C.

"This morning I was showing the Progressive Radio 'Edu-Kit' to one of our representatives from our Branch Office in Richmond, and already he wants me to purchase some for his hospitals . . . As indicated in previous correspondence, I took the Progressive Radio 'Edu-Kit' to our Veterans Administration Hospital at Fort Thomas, Kentucky. Both instructors and patients worked them, and they proved quite satisfactory."

ROBERT L. SHUFF,
1534 Monroe Ave., Huntington, W. Va.

"Thought I would drop you a few lines to say that I have bought a Progressive Radio 'Edu-Kit' and was really amazed that such a bargain can be had at such a low price. I have already started repairing radios and radio-phonographs. Friends were really surprised to see me get into the swing of it so quickly. The trouble-shooting tester that came with the kit is really swell, and finds the trouble if there is any to be found. Everything you say about your kit is true."

DOMINICK STRACUZZA,
111 Clarence St., London, Ontario

"I am very satisfied with the Progressive Radio 'Edu-Kit' which I bought from you. I did not know anything about radio, but now I feel as though I have been in the radio business for years. Your kit is simple and educational. I enjoy working with it."

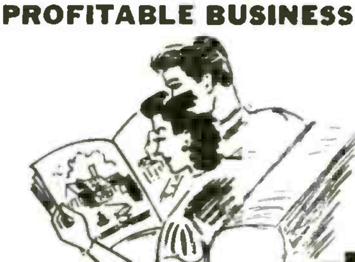
Order your Progressive Radio "EDU-KIT" Today, or send for further information.

Postage prepaid on cash orders—C.O.D. orders accepted in U. S. A.

BECOME A RADIO AMATEUR

GET A WELL-PAYING JOB

GO INTO A PROFITABLE BUSINESS



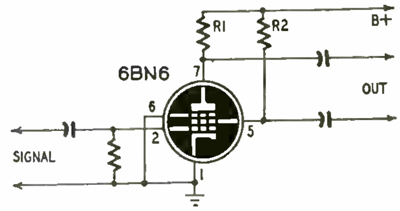
PROGRESSIVE ELECTRONICS CO.
497 UNION AVE., DEPT. RE-55 BROOKLYN 11, N. Y.

PHASE SPLITTER

Patent No. 2,571,431
Kurt Enslein, Rochester, N. Y.
(Assigned to Stromberg-Carlson Co.)

The 6BN6 tube is a gated-beam type. Its operation was described on page 78 of the Feb. 1951 issue. The tube is used here as a phase-splitter.

The electron beam of the 6BN6 is focused to a narrow stream. Electrons pass through the control grids (pins 2 and 6) on the way to the plate. The tube construction is such that electrons cannot return to the cathode even when they are repelled by the grids. Those electrons which are prevented from reaching the plate are diverted to the accelerator, pin 5.



In this circuit, only the first grid is used to control the electron beam. When the r.f. or a.f. signal drives the grid negative, fewer electrons land on the plate but more are available at the accelerator. Plate output is out-of-phase with the control grid. Accelerator output is in phase.

To compensate for the lower Gm of the accelerator element, R2 is made larger than R1. The signals at each output terminal can be made equal as well as opposite in polarity.

TRANSISTOR FLIP-FLOP

Patent No. 2,569,345
Richard F. Shea, Syracuse, N. Y.
(Assigned to General Electric Co.)

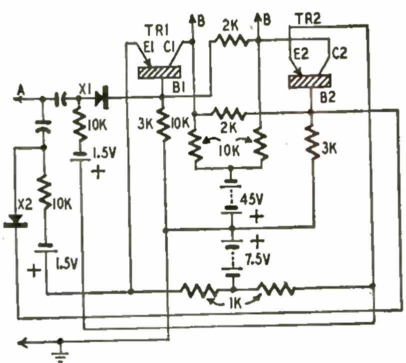
Transistors make ideal flip-flop elements. Two transistor multivibrators were described on page 92 of the Sept., 1951, issue. A new circuit is even simpler and more effective because it contains no time-constant networks. It requires a pair of transistors in grounded-base circuits.

A transistor conducts when its base is *negative* with respect to its emitter. The transistor is blocked when its base is sufficiently *positive*. In this multivibrator, the base of each transistor is coupled to the collector of the other unit.

Initially, assume that TR1 tends towards *less* conduction for some reason. The negative voltage on C1 tends to approach the battery value, −45 volts. The increase in negative voltage is fed to B2. A more negative base permits greater conduction in TR2, so its collector passes more current. The negative voltage at C2 (and B1) is reduced. Therefore TR1 has a more positive base and it conducts even less. In a very short time TR1 is completely blocked and TR2 conducts fully. The multivibrator remains in this condition until it is disturbed by a positive pulse at A.

The pulse appears at the anodes of two rectifiers, X1 and X2. The first of these is biased beyond cutoff by the positive base, B1. The cathode of the second rectifier X2 is connected to B2 which is negative. Therefore X2 can conduct the positive pulse to B2. Now the transistors reverse action. TR2 conduction decreases towards cut-off and forces TR1 towards full conduction.

The next positive pulse at A finds X2 blocked and X1 able to conduct. Therefore the pulse can affect only TR1. It blocks TR1 so that TR2 can conduct fully. Successive pulses trigger the multivibrator. If pulses are equally spaced, output (from terminals B) is a symmetrical square wave.

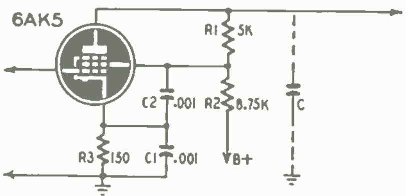


WIDE-BAND AMPLIFIER

Patent No. 2,566,508
Howard M. Zeidler, Palo Alto, Cal.
(Assigned to Hewlett-Packard Co.)

This amplifier has a remarkably wide frequency range. Strangely enough, it is conventional except that the screen and cathode capacitors are too small.

At high frequencies the circuit is that of an ordinary pentode with plate load R1. C1 and C2 providing adequate bypassing. At lower frequencies, C1 and C2 become inadequate for bypassing,



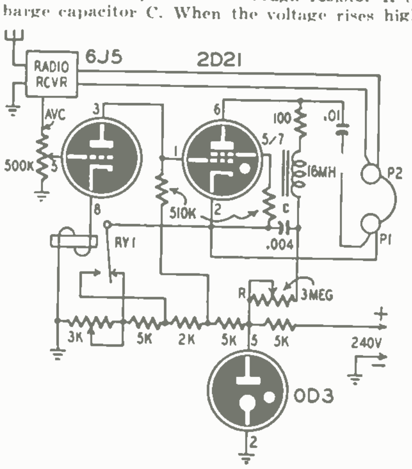
introducing degeneration. But now R2 becomes part of the output load, thus tending to increase the gain. By properly proportioning resistors R1 and R2 and capacitors C1 and C2, it has been found possible to maintain a fairly flat gain characteristic from the low audio frequencies to about 2 mc. With the values shown, stage gain approximates 26 db.

INDICATOR RADIO RANGE

Patent No. 2,571,368
Leonord R. Kahn and Donald S. Sanford, New York City.

A radio beam guides planes to their airport. If the plane is not on the beam a code letter, either A or N, is heard. This indicates that the aircraft is on one side or the other of the true bearing. When riding the beam, these letters blend to form a constant tone. When the plane is off the beam, it is difficult to determine whether it is flying toward or away from the center of the beam. This invention indicates direction by a variable tone. If the frequency increases, the aircraft is approaching the beam.

A 2D21 thyratron generates the variable tone. Current from B-plus flows through resistor R to charge capacitor C. When the voltage rises high



enough, it fires the tube. The frequency of this sawtooth is partly controlled by the bias on the thyratron. A more positive grid in the tube produces a higher a.f. sawtooth.

The a.v.c. from the receiver biases a 6J5 amplifier. A strong signal produces a highly negative a.v.c. voltage. This in turn provides a more positive bias to the thyratron and a higher frequency is heard in P1.

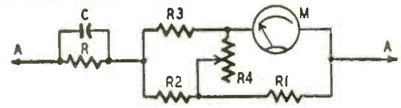
The pilot hears two simultaneous signals which are fed to the separate earpieces of a pair of headphones. P2 indicates in the usual way on or off the beam. If he is off, he listens to the tone coming through P1.

Typical circuit components are shown. In order to double the range over which variable tones are heard, a relay RY is connected as shown. When the 6J5 cathode current is high enough, it energizes the relay. This connects the thyratron cathode to a more positive point along the bleeder. It abruptly changes the sound in P1 from a high note to a low one, and another cycle of rising (or falling) tone is possible.

METER DAMPING CIRCUIT

Patent No. 2,567,688
John E. Bigelow, Schenectady, N. Y.
(Assigned to General Electric Co.)

The damping of a d.c. meter determines how its indicator deflects. If the damping is high, the needle moves slowly towards its final position. If too low, the needle may oscillate before coming to rest. When damping is optimum, the needle deflection occurs in the shortest possible time and without oscillation. Damping is often controlled by a resistor shunting the meter. A low shunt provides heavy damping, and vice versa. Unfortunately, a change in shunt resistance affects the meter calibration. In the new circuit, damping is adjusted as desired without affecting the calibration.



The circuit includes a balanced bridge network with meter M as one of the arms. A paralleled R-C network is added in series with the bridge as shown. R and C are used to speed the initial deflection. When d.c. is fed between terminals A, a relatively large current charges C and flows into M. This "kicks" the needle and speeds it on its way.

The slowing down process is a question of damping. Since the bridge is balanced, no current flows through R4. This resistor may be adjusted without upsetting balance or the calibration of the meter. R4 controls damping, however, since it determines the total resistance shunting M.

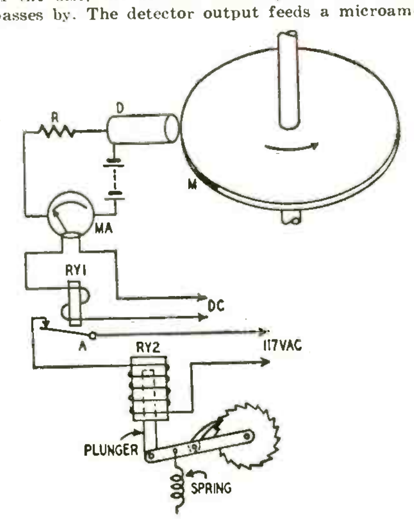
R1 should be relatively low. It should provide *more* than sufficient damping when R4 is zero. Then, with the resistance of M and R1 known, the other bridge arms are chosen for balance. Finally, R4 is adjusted for desired damping.

REVOLUTION COUNTER

Patent No. 2,566,868
Domenico J. Allia, Worcester, Mass.

This instrument counts the revolutions of a disc or wheel without loading down the motion. It is applicable to testing watt-hour meters and similar equipment.

A speck of radioactive material M is placed at the rim of the disc. D, a radiation detector, is positioned near the rim. At each revolution of the disc, the detector is energized once as M passes by. The detector output feeds a microammeter relay MA which closes a d.c. circuit containing RY1. RY1 attracts armature A.



When A closes its contact, RY2 is energized from the a.c. line. This lifts the plunger and advances a calibrated ratchet wheel.

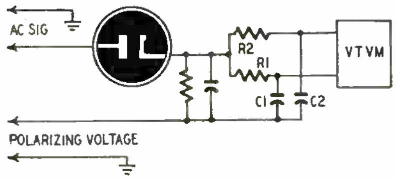
RATE OF CHANGE METER

Patent No. 2,564,829
Leslie Herbert Bedford, London, and John Bell and Eric Miles Langham, Teddington, England.
(Assigned to A. C. Cossor, Ltd., London)

This instrument indicates the rate at which a direct current is increasing or decreasing. If

.c. is measured, a rectifier and filter are needed. n addition, a polarizing voltage may be added to prevent a change in polarity of the signal.

The d.c. is impressed on R1, C1 and R2, C2, the first of which has a smaller time-constant han the second network. If the d.c. remains constant, C1 and C2 charge to the same voltage. Then the meter remains at rest. Preferably the v.t.v.m. is of the center-zero type.



If the d.c. increases, C1 charges before C2 and he meter shows a deflection in one direction. A ecrease in voltage causes C1 to discharge before 2. Therefore the meter needle deflects in the pposite direction. In either case a more rapid hange is shown by a greater deflection.

IMPROVED FACSIMILE TRANSMISSION

Patent No. 2,564,556

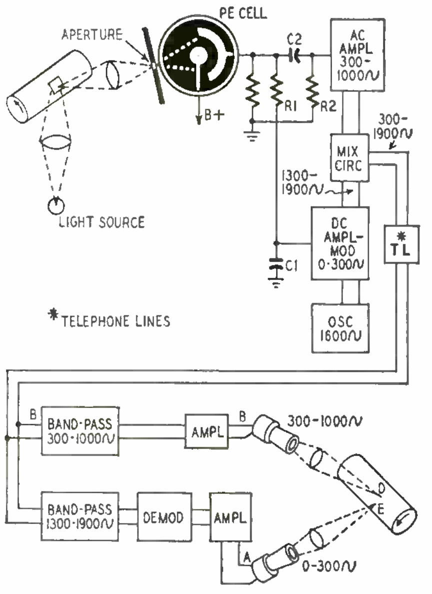
Maurice Artzt, Princeton, N. J.

(Assigned to Radio Corp. of America)

This invention eliminates distortion due to telehone lines. Relatively high frequencies, say 2 ., travel much more slowly than those of a few undred cycles. This factor is negligible on voice mmunication, but facsimile and telephoto ages are seriously affected.

The figure shows a transmitter and a receiver bottom), connected by telephone wires. A facsimile image is placed around a revolving drum s shown. A light beam scans the image as the rum rotates. The density changes modulate the flected light which is focused on a PE cell. utput frequencies extend from 1,000 cycles to 0.

A low-pass filter, R1, C1, transmits 0-300 cycles hich is marked band A. The high-pass filter 2, C2, transmits band B, from 300-1,000 cycles. 1,600-cycle oscillator heterodynes with A. The eat (1,300-1,900 cycles) combines with B and th are fed to the phone lines. The transmitted ange lies between 300-1,900 cycles.



At the receiver, the signal is divided as shown. Band B is amplified and fed to a recording lamp focused at point D on the rotating drum. The frequency portion between 1,300-1,900 cycles is demodulated to give band A. This is focused at point E by a second recording lamp. Note that E is ahead of D on the drum.

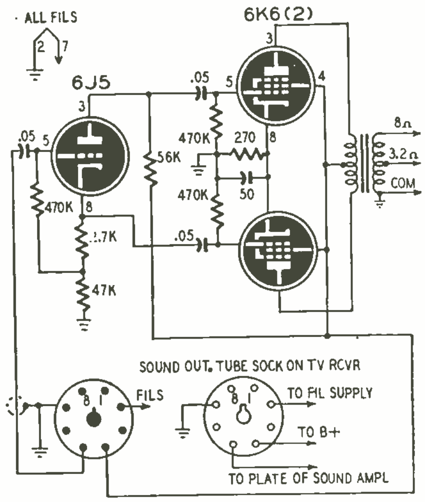
Band A is carried on the telephone lines by a carrier of 1,600 cycles. Therefore the time-delay in transmission is greater than for band B. This lag is balanced out by adjusting point E ahead of D. When the adjustment is correct, distortion is minimum.

—end—

AMPLIFIER FOR TV AUDIO

Television service technicians and set owners have long bemoaned the fact that the sound systems of most TV sets leave much to be desired. The compact little amplifier illustrated offers a rather novel solution to this deficiency.

The amplifier (small enough to be mounted in most cabinets) employs a pair of 6K6 tubes in push-pull driven by a 6J5 cathode-follower.



Power is obtained through a cord and plug which is inserted in the final audio stage of the TV set. Provision is made on the unit for 3.2-or 8-ohm voice coils. The leads from the speaker voice coil to the old output transformer are disconnected and transferred to the output of the unit. Field coil leads, of course, remain undisturbed. (This unit is not usable on sets where output tube currents flow through the focus coil or where the audio output cathode supplies bias or operating voltage for other stages.—*Editor*)

For best results the makers of the device, Vidaire Electronics Manufacturing Company, suggest replacing the old speaker with a large good-quality one.

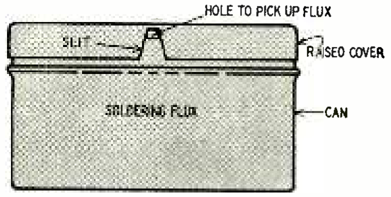
HANDY TEST-LEAD SWITCHING

We often see radio and TV service benches cluttered with snarls of test leads dangling from a number of different test instruments. You can eliminate this by using one set of test leads and a 2-circuit rotary switch having at least as many positions as there are test instruments. The negative test lead connects to the arm of one switch section and the positive lead to the other. The negative or ground leads from the various instruments connect to the taps on the section of the switch connected to the negative test lead, and the positive or hot leads connect to taps on the remaining section of the switch.

I have seven instruments connected in this way to an 8-position switch. The unused position disconnects the test leads from all instruments. This system saves wear and tear on test leads, but it does not work out well when two instruments are needed at the same time.
—*R. C. Sandison*

FLUX SAVER

Most radio service technicians have a can of soldering paste on the work-bench for those tough soldering jobs. A brand new can of flux is always a pleasure to use because it is nice and clean. But it doesn't take long for the flux to become contaminated with dirt and small pieces of wire and solder because it seems that most technicians are always *too* busy to replace the cover when the job is completed.



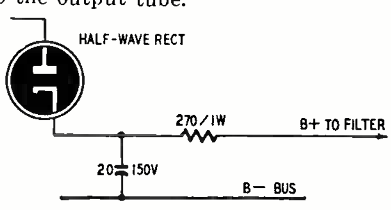
A simple solution to the problem is to cut a slit in the side of the cover (see drawing) so it can be left on the can in the raised position. This allows solder to be inserted to pick up flux and transfer it to the work. Besides keeping out dirt, the slit prevents picking up too much paste. Too much paste can do more harm than good. It produces a messy job and is often the cause of leakage, noisy contacts, intermittents, and other troubles.—*George H. Hague*

V.H.F. ANTENNA TERMINALS

After a few months exposure to the elements, terminals on TV and other v.h.f. antennas usually are so badly corroded that they cannot be loosened. To eliminate this trouble and to avoid high-resistance connections, I coat all terminals, nuts, and bolts with battery-terminal sealing compound. This protects the terminals against weathering and the coating is easy to strip off when necessary. It can be purchased at most automotive supply stores.—*Leonard Pfeiffer*

IMPROVING A.C.-D.C. FILTERS

A high residual hum level is one of the undesirable characteristics of most inexpensive a.c.-d.c. radios and phonographs. If the set has an electromagnetic speaker, the 60- or 120-cycle component in the d.c. feeding the speaker field coil will produce hum in the output. If there is ripple on the d.c. line feeding the plate of the output tube, it will produce a pulsating magnetic field which may affect the field of a PM speaker, which is usually placed close to the output tube.



Note that in either case the hum is caused by d.c. ripple rather than a.c. pickup from the power line or heater string. Hum of this type can be greatly reduced or eliminated by attenuating the ripple component of the d.c. supply.

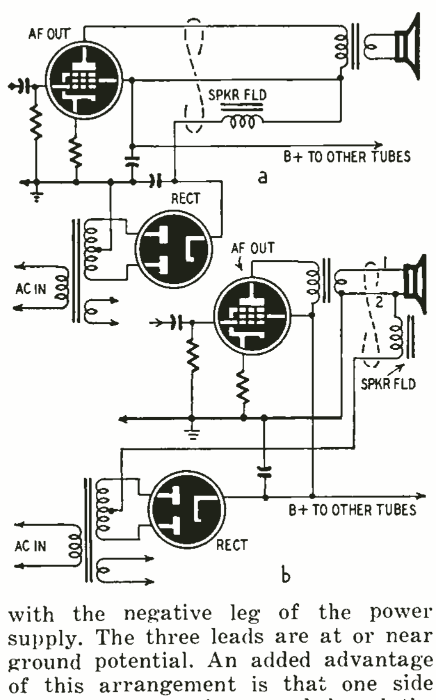
The simplest method of doing this is to install a simple R-C filter right at the cathode of the rectifier—ahead of any other filter components. A typical R-C filter is shown in the diagram. The filter should consist of the largest capacitance which can be used without raising the peak voltage or current to dangerous proportions and the highest resistance which can be employed without causing a noticeable reduction in the d.c. supply voltage at the output of the filter.

The values which produce the most effective filtering in most cases are 20 µf and 270 ohms. Adding a simple filter of this type will greatly decrease the hum level of almost all a.c.-d.c. sets—even new ones.—*David Gnessin*

AMPLIFIER MODIFICATIONS

Many low-power PA systems—particularly those of prewar vintage—are equipped with electrodynamic speakers connected to the amplifier through a three-wire cable connected as shown at *a*. The disadvantage of this system is that all the speaker leads are at B-plus potential. There is a constant danger of someone being shocked or the power supply being short-circuited should one of the cables or connectors become exposed. This happens quite frequently in portable equipment where the cables are often laid out on the ground or floor where they are subjected to rubbing and scuffing.

The possibility of one receiving a shock or of short-circuiting the power supply can be eliminated by rewiring the circuit as shown at *b*. Here, the output transformer is moved to the amplifier end of the cable and the speaker field is connected in series



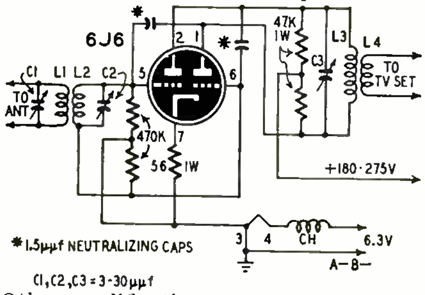
with the negative leg of the power supply. The three leads are at or near ground potential. An added advantage of this arrangement is that one side of the voice coil is grounded and the other is convenient for connecting an inverse-feedback network. This would not be possible with the arrangement at *a* without running two extra leads in the speaker cable.—*Charles Erwin Cohn*

—end—

LOW-BAND TV BOOSTER

After reading and hearing a lot about the advantages of triodes over pentodes in TV boosters, I decided to construct one using push-pull triodes. The unit shown in the diagram and photos is my version of the booster described on page 64 of the March, 1949, issue and page 79 of the November, 1950, issue.

I constructed the unit in a surplus jack box with a lucite platform at one end for mounting the antenna input terminals and trimmer capacitor C1.



Other modifications include the use of National AR-5 coils for L2 and L3. L1 and L4 are 2 or 3 turns of insulated hookup wire wound in the grooves around L2 and L3. The unit is tuned with three 30-μμf air trimmers fitted with pointer knobs which make it easy to return to the correct settings for FM and low-band TV stations. Short lengths of No. 24 insulated wire twisted together were used as substitutes for the 1.5-μμf neutralizing capacitors shown in the schematic.

If you need a high-gain booster for the lower television band or for FM reception, you will probably find this one satisfactory in all respects.—*Augustine Mayer.*

SYNTHETIC BASS CIRCUIT

Various types of circuits have been designed to produce synthetic bass response from small, poorly baffled speakers by generating or emphasizing harmonics of low-frequency notes which are below the range of the amplifier or which cannot be handled adequately by the speaker and its enclosure. The ear, upon hearing the harmonics, is tricked into supplying the missing fundamental tone.

A novel means of producing artificial bass is described in *Wireless World* (London, England). The circuit is shown on page 144.

The audio signal applied to the input is amplified by V1, a 6SF5, one-half a 12AX7, or similar high-mu triode, and fed to the grids of V2 and V3. V2 is a conventional voltage amplifier having tone controls R1, R2, and R3 in its grid circuit to adjust the levels of the high medium, and low frequencies. A linear negative feedback voltage is fed to the cathode of V2 from the secondary of the output transformer.

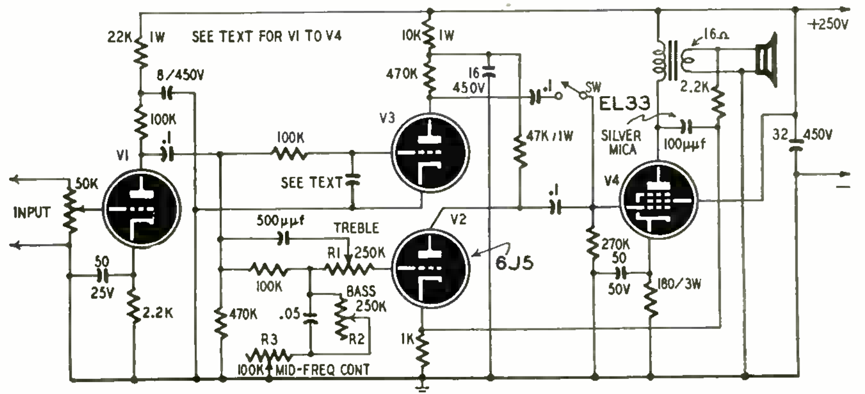
V3 is the high-mu triode which may be of the same type as V1. It is fed through a low-pass filter which cuts off at about 100 cycles. V3 operates with zero bias and a high plate-load resistance. This condition produces grid-circuit distortion which results in the production of the desired harmonics.

The output of V3—those frequencies below 100 cycles plus the harmonics of each—is fed to the grid of V4, the power-amplifier tube. The signal which reaches the speaker is a mixture of the input signal—as shaped by the tone controls—and the artificial bass produced by V3. A switch is provided for cutting out V3 when desired.

This circuit works best when used with a speaker having bass resonance below 60 cycles. Resonance at about 30 cycles provides cleanest low-frequency output. The optimum size of the capacitor between grid and cathode of V3 varies with the type of speaker and the area of the front of the baffle. A 0.1-μf unit is used with baffles in excess of 4 square feet. A .03-μf unit should be tried if the baffle area is 1 square foot or less, and a .05-μf for baffle areas between 1 and 4 square feet. Increase the value of this capacitor if distortion is noticed with the middle-frequency tone control turned down.

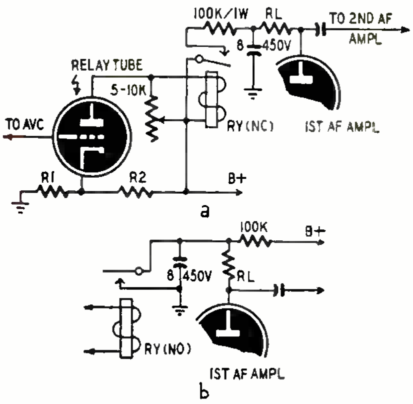
V4, the power-amplifier tube, is British EL33. Its plate resistance is 50,000 ohms and load resistance 7,000 ohms, with 6 volts bias and 250 volts on plate and screen. Plate and screen-grid currents are 36 and 4 ma, respectively. Its transconductance is 9,000 ohms. Power output is 4.5 watts. An equivalent American-type power-amplifier tube may be used.

The 2,200-ohm, 1-watt resistor in the feedback network is used with 16-ohm speakers and a 6SF5 or equivalent for V2. Try other values for best results. The 100-μμf capacitor between the cathode of V2 and plate of V4 compensates for leakage inductance of the output transformer at high frequencies.



AUTOMATIC SQUELCH CIRCUIT

The squelch circuits shown are designed for use in sensitive receivers which have a high background noise level when no signal is being received. This *codan*—carrier-operated device, antinoise—was described by G. A. French in *Radio Constructor* (London, England). The circuit shown at *a* is designed for use with a plate-circuit relay having a 1,000- to 5,000-ohm coil and normally closed contacts. The relay is in the plate circuit of a relay-control tube which may be any convenient triode or triode-connected pentode. The grid of the tube is connected to the a.v.c. line of the receiver, and the relay contacts are connected in series with the plate of the first a.f. amplifier tube and B-plus. When no signal is being received, the a.v.c. voltage is low, permitting the control tube to draw sufficient current to excite the relay and open its contacts, thus breaking the plate-supply circuit to the a.f. amplifier. When a signal comes in the a.v.c. line goes negative, cutting off the relay tube and closing the circuit to the a.f. tube.



In some sets, there may be sufficient noise pickup to make the a.v.c. line a few volts negative at all times, in which case cathode resistor R1 may be made very small or eliminated entirely. If a cathode resistor is required to prevent the tube from operating without bias, and normal relay operation requires a value greater than 300 ohms, reduce the value of R1 to about 200 ohms and add R2 of sufficient value to provide normal operation. A potentiometer of 5,000 to 10,000 ohms may be required across the relay to control its sensitivity.

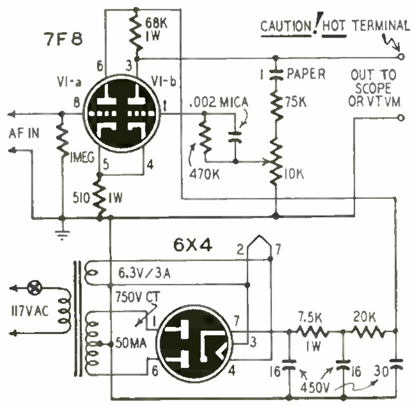
A time-delay circuit is provided by the 100,000-ohm resistor and 8-μf capacitor. The capacitor charges and discharges slowly so there is no abrupt "pop" when the squelch cuts in and out.

The circuit at *b* is used with a normally open relay. With no signal input, the relay contacts close and ground the d.c. plate-supply voltage for the a.f. amplifier tube.

PREAMP FOR SCOPE OR VTVM

Very often service technicians and experimenters have difficulty measuring very low a.c. voltages on a scope or v.t.v.m. Such voltages can be measured accurately and easily by using a suitable preamplifier ahead of the scope or meter. A preamplifier designed for this purpose is described in *Sylvania News.* The circuit shown is designed especially for use with Sylvania polymeters and scopes but is of course suitable for use with equipment of other makes.

The preamplifier provides a voltage gain of 10 with inputs from .001 to 1.5 volts in the frequency range of 20 to 50,000 cycles. One unit will provide a full-scale range of 0.3 volt for a meter whose lowest full-scale range is 3 volts. Two preamplifiers in series will reduce the full-scale range to .03 volt, and thereby increasing its sensitivity one hundred times.



V1-a is a cathode follower used to maintain a high input impedance. V1-b amplifies the signal and feeds it to the output terminals which connect to the scope or meter. The circuit is stabilized, noise is suppressed, and over-all gain is reduced to exactly 10 times by employing inverse feedback between the plate and grid of V1-b.

When wiring the unit, isolate the power supply and a.f. stages, use twisted pair for the heater leads, ground pin 2 of the 7F8, and use a common ground return. This practice minimizes noise which causes errors when measuring low voltages. Note that there is no blocking capacitor between the plate of V1-b and the output terminal. One is not used in the circuit because most scopes and v.t.v.m.'s have blocking capacitors in their input circuits.

The ungrounded output terminal is HOT with approximately 250 volts on it. Use insulated terminal jacks and always be sure to disconnect the test lead from the preamp before disconnecting it from the scope or meter.

To calibrate the preamplifier, connect a 10-to-1 resistive voltage divider (use carbon or noninductive resistors) across the output of a convenient source of audio voltage—you can use 60 cycles from a filament transformer—and adjust the output of the source so it is delivering exactly 1 volt to the divider network. One-tenth of this voltage is fed to the preamplifier. Switch the meter to the output of the preamp and adjust the 10,000-ohm potentiometer so the meter again reads exactly 1 volt.

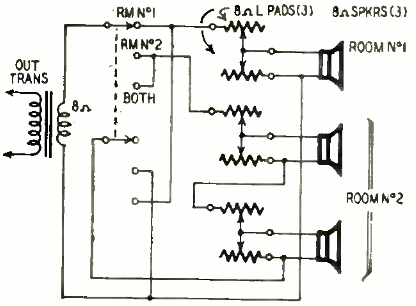
Carefully made and calibrated, this instrument is a valuable addition to any experimenter's lab.

—end—

SPEAKER SWITCHING SYSTEM

? *I have an amplifier with an 8-ohm output, and three 8-ohm speakers with matching L pads. I want to install two of the speakers in one room and the third in another. Please design a switching system which will permit me to select the speakers in either room or to use them simultaneously.—R. W. H., Pittsburgh, Pa.*

A. One method of switching the speakers is shown in the diagram. The match to the output of the amplifier will be

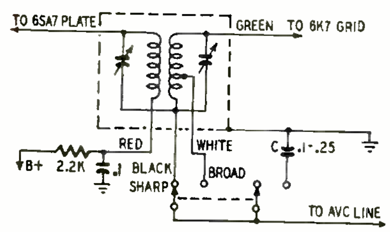


perfect only when the single speaker is used. The speakers are mismatched when two or three are connected in series across the load. This causes a reduction in the maximum power which is available from the amplifier. However, this will be of little consequence if you do not normally operate the amplifier at more than about half its full output. Full output can, of course, be obtained when working into the single speaker.

VARIABLE-SELECTIVITY I.F.

? *I have started constructing the variable-bandwidth AM tuner described in the November, 1950, issue. I'm being held up because I cannot find a variable-bandwidth i.f. transformer. Can you give me the make and type number of the one used by Mr. Drenner?—V. M. S., Grangeville, Idaho.*

A. The variable-selectivity transformer used in the original tuner was a Meissner type 17-7412 or 17-7416. We



have been advised that these types have been discontinued. However, you may be able to find one by shopping around among local and mail-order radio supply houses. You can substitute a Miller type F-512-C1 or F-612-C1 transformer. The 512 is an air-core unit while the 612 has a powdered-iron core. Either will work.

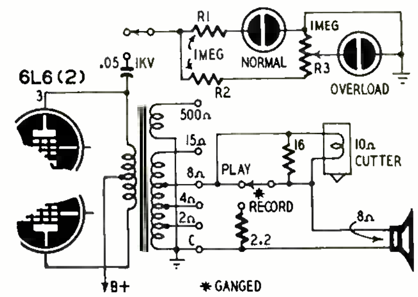
These transformers have only two selectivity positions; one sharp and the other broad. The circuit shows how they may be connected. Experiment with the value of capacitor C to minimize flutter when the switch is in the broad position.

RECORDING-LEVEL INDICATORS

? *I have a Masco MA-17 amplifier and a G.I. basic disc recording unit. Please show how I can connect these along with the necessary switching circuits for recording, playback, and monitoring. Show two neon lamps as level indicators.—L. L., Struthers.*

A. The circuit shows how a 10-ohm magnetic cutter and an 8-ohm speaker can be connected to the output of the amplifier. The monitoring level is about 10 db below the recording level.

Values of R1, R2, and R3 are approximate and should be determined accurately by experimenting. Make a test record and determine the minimum vol-

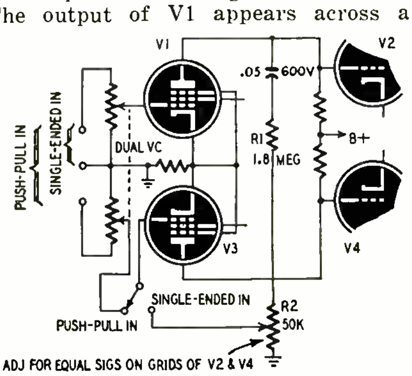


ume which will produce good results. Adjust the value of R1 so the NORMAL lamp remains lighted most of the time that sound is fed into the input of the amplifier. Now, turn up the gain control to the point where a further increase results in overloading and distortion. Adjust the value of R2 and the setting of R3 so the OVERLOAD lamp is out or flashes only at rare intervals.

COMBINATION INPUT

? *I have a direct-coupled all push-pull amplifier with which I would like to use the preamplifier described on page 27 of the February, 1951, issue. The preamplifier has single-ended output, the amplifier push-pull input. I wish to connect them—C. S., Los Angeles, Cal.*

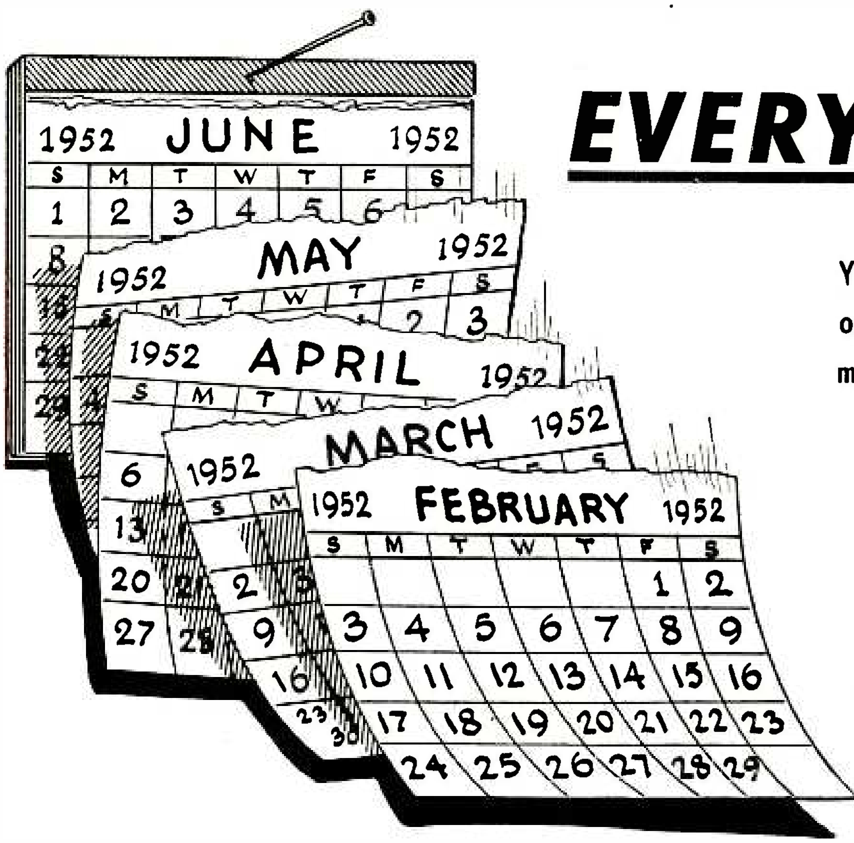
A. The circuit shows how the input of a push-pull amplifier stage can be modified to provide for single-ended inputs. The output of V1 appears across a



.05 capacitor and resistors R1 and R2 in series. The voltage across this combination is 180 degrees out of phase with the signal applied to the grid of V1. A portion of the voltage appearing across R2 is tapped off and fed to the grid of V3 which acts as a phase inverter when the switch is in the SINGLE-ENDED INPUT position. Adjust R2 for equal signals on the grids of V2 and V4 with the switch set for single-ended input.

—end—

NEXT MONTH — AND



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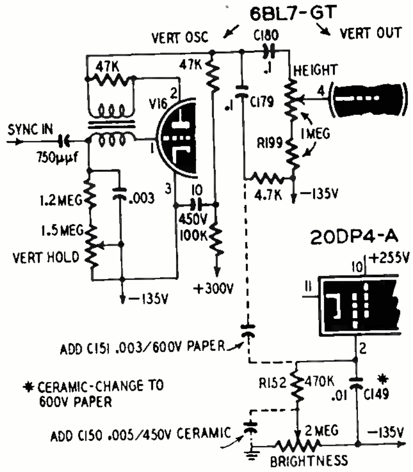
SYLVANIA RETRACE BLANKING

The changes shown in the diagram have been added to the Sylvania 1-387 chassis to suppress vertical retrace



lines. The changes have been made in chassis bearing codes C03 and later. They can be made in earlier chassis.—*Sylvania Service Notes*

BENDIX 3001U TV SET

Loss of horizontal sync can be traced to a change in the value of the screen-dropping resistor for the 6BG6-G horizontal output tube. This resistor is made up of three series-connected 4,700-ohm resistors which have a total nominal value of 15,000 ohms. A pulse is taken off between the first and second resistor and applied to the phase detector in the a.f.c. circuit. A change in value of any of these components will usually cause the sync circuit to fail. The three resistors should be replaced.—*James Moudry*

TV TUBE SUBSTITUTION

During a temporary shortage of 6BQ6-GT's, I tried 6W6-GT's as replacements in several sets and found that they worked nicely. The latter type is a single-ended tube so I wired the plate-cap lead to pin 3 on the socket. No other changes were needed.

The 6W6-GT heater draws 50 ma more than the 6BQ6-GT, and its plate, screen, and bias voltages are lower, so it is advisable to study the circuit, tube characteristics, and operating voltages before making the substitution.—*Edward Tanrath*

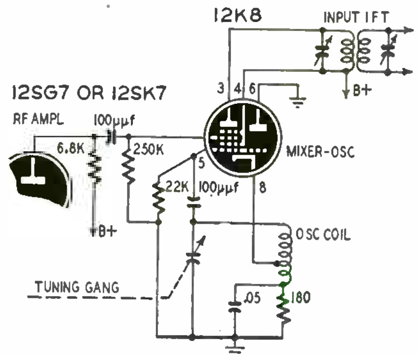
MAGNAVOX CT-273CA

The complaint was tearing out of several lines when the controls were set for normal picture contrast. Using a scope to examine the composite sync in the clipper stage, we found that the horizontal sync was being wiped out over a portion of each field. Moving the scope to the output of the video amplifier showed a 60-cycle sine wave superimposed on the signal although there was no characteristic shading in the picture.

Further investigation revealed a 4-megohm leakage between filament and grid in the 6CB6 first i.f. amplifier. Replacing this tube cleared up the trouble.—*Arthur D. Marikle*

UNUSUAL MIXER CIRCUIT

The model FS-16 radio set distributed by McGee Radio Co. uses the rather unusual mixer-oscillator circuit shown in the diagram. The converter tube is 12K8 with its hexode section connected in a circuit similar to that used with 6A7's and similar tubes. The triode plate is grounded.



Problems of poor sensitivity can be handled simply by disconnecting the triode plate (pin 6) from ground and leaving it floating or connecting it to the screen grid (pin 4).

Although this circuit is comparatively rare, it is not confined to the FS-16. A similar circuit is used in an old 6-tube Philco which uses a 6K8 as the converter tube.—*G. P. Oberto*

ALIGNMENT HINT

When a set becomes unstable or breaks into oscillation when you attempt to align it, check the filter capacitors for reduced capacitance. A reduction in capacitance may produce a considerable increase in r.f. impedance without being sufficient to raise the hum level. The increased impedance causes r.f. feedback and oscillation.

Try to keep this hint foremost in your mind because it is so easy to overlook a source of trouble such as this when working on the r.f. or i.f. end of a set.—*C. E. L. Payne*

TRANSFORMERLESS TV SETS

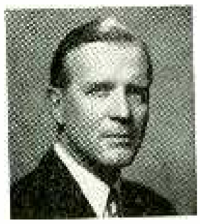
This set was one of the transformerless Emerson models which uses a flock of selenium rectifiers in the power-supply circuit. It worked O.K. with the exception that the picture was distorted and too narrow. The defect seemed to be in the horizontal output stage. Replacing tubes, checking voltages and resistances, and a thorough visual examination showed nothing wrong. We tried a new deflection yoke and a substitute low-voltage supply without success. As the last resort, we replaced the horizontal output transformer. The set worked perfectly. Apparently, a few turns had shorted out in the secondary of the transformer. This trouble can occur in most TV sets, so if you have the same symptoms and everything checks O.K., try a new horizontal output transformer.

Incidentally, if you are not familiar with the voltage-multiplier circuits used in transformerless TV sets, voltage checks will produce some surprising figures. Always use the service manual when there is any doubt whatever.—*Jacob Dubinsky*

—end—

Rear-Admiral Stanley F. Patten, U.S.N. (Ret.) was elected vice-president of ALLEN B. DU MONT LABORATORIES, INC. Admiral Patten has been with Du Mont since 1947 as assistant to the president. Du Mont also announced the appointment of Keeton Arnett as general assistant to the president. He comes to the company from the Fred Eldean public relations firm.

S. F. Patten

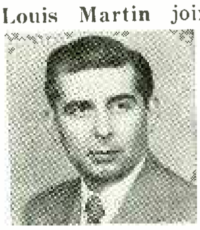


K. Arnett

H. Laurence Kunz was promoted to the position of general manager of the Capacitor Division of the SANGAMO ELECTRIC CO., Springfield, Ill. He will make his headquarters at the factory in Marion, Ill. Mr. Kunz had been sales manager of the division for the past six years.

H. L. Kunz

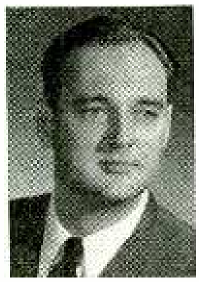
Louis Martin joined STANDARD COIL PRODUCTS CO., INC., Chicago, in the newly created position of general sales manager. He was formerly sales manager of the General Instrument Corp.



L. Martin

W. D. (Bill) Renner was upped to the position of manager of sales engineering for HOWARD W. SAMS & CO., Indianapolis, publishers of Photofact Folders. He was formerly chief field engineer and technical advisor.

Robert J. Reigel joined the STANDARD TRANSFORMER CORP. as distributor sales co-ordinator. He comes to the company from the Thordarson-Meissner Division of Maguire Industries where he had been sales manager.



R. J. Reigel

Obituaries

Allen D. Cardwell, inventor and founder of the electrical instrument manufacturing company which bore his name, died in Nassau Hospital, Mineola, N. Y.

Ernest H. Scott, founder and former president of SCOTT RADIO LABORATORIES, died in Victoria, B. C.

Personnel Notes

. . . William F. E. Long was appointed as the first director of statistics of the

RTMA. He had been director of the Statistical Division of the National Paint, Varnish and Lacquer Association.

. . . **William W. Taylor**, for several years a member of the SANGAMO ELECTRIC Co.'s advertising, sales research and publicity division at Springfield, Ill., handling capacitor advertising and promotion, was advanced to the position of sales promotion manager, Capacitor Division, with complete charge of all phases of capacitor advertising activities. His headquarters are to be at the Sangamo capacitor plant located in Marion, Ill.

. . . **Dr. Lan Jen Chu**, internationally known physicist, joined the GABRIEL Co., Cleveland, as director of research. Gabriel is the parent company of the Ward Products and Workshop Associates Divisions.

. . . **Harry Ehle**, vice-president of INTERNATIONAL RESISTANCE Co., Phila., was honored recently upon the occasion of his 20th Anniversary with the company.

. . . **Frederic J. Robinson** was appointed director of the International Sales Division of SYLVANIA ELECTRIC PRODUCTS. He was formerly Sylvania's sales manager for Latin America. The company also announced the appointment of C. J. Luten as editor of *Sylvania News*. He succeeds Robert A. Penfield who was promoted to Advertising and Sales Promotion supervisor.

. . . **Henry F. Argento** was elected an assistant vice-president of RAYTHEON MANUFACTURING Co., Waltham, Mass., and appointed assistant manager of the Power Tube Division in which he held the position of sales manager since 1941.

. . . **Leonard F. Cramer** was appointed assistant general manager of the CROSLEY DIVISION of AVCO MANUFACTURING Co. He was previously executive vice-president and director of Allen B. Du Mont Laboratories.

. . . **Dr. Constantin S. Szegho**, director of research of the RAULAND CORP., was awarded the grade of Fellow in the I.R.E.

. . . **George W. Henyan**, manager of GENERAL ELECTRIC Industrial and Transmitting Tube operations, accepted a temporary appointment as chief of the components branch of the NPA. G-E also announced the appointments of D. S. Beldon and D. E. Weston, Jr., as national account sales manager and radio sales manager respectively of General Electric's Receiver Department.

. . . **Frank K. Spiro** joined JFD MANUFACTURING Co., Brooklyn, N. Y., as assistant advertising manager. He was formerly with Fawcett Publications and Kenyon & Eckhardt Advertising Agency.

. . . **W. H. Garrett, Victor Williams, C. A. Brokaw**, and **W. H. Allen** were promoted to newly created posts as district managers of the RCA Tube Department Renewal Sales field activities in the company's Central, Southeastern, Western, and Eastern districts, respectively.

—end—

ELECTRONIC LITERATURE

Any or all of these catalogs, bulletins, or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of Radio-Electronics on which the item appears. All literature offers void after six months.

SOUND EQUIPMENT CATALOG

The Bell line of sound equipment is described in their catalog No. 5152 which has just been released. Equipment listed includes high-fidelity and public address amplifiers, industrial-type apparatus for plant broadcasting and paging, tape and disc recorders, intercoms, microphones, speakers, and accessories.

Interested parties may obtain copies of the catalog by writing to Bell Sound Systems, 555 Marion Road, Columbus 7, Ohio. Gratis.

HEATHKIT CATALOG

The new Heathkit catalog describes the full line of kits for constructing a variety of test equipment, audio amplifiers, power supplies, AM receivers and FM tuners.

Write to The Heath Co., Benton Harbor 20, Mich. for copies of the catalog. Gratis.

TV CONTROL SUPPLEMENT

Clarostat is offering a supplement to their TV control replacement manual issued last spring. The supplement gives manufacturers' part numbers and numbers of exact-duplicate replacement units. It also lists by manufacturer, the frequency of use of the various controls. Thus, the technician can stock the replacement controls needed to service the prevailing makes of receivers in his territory.

Available through Clarostat jobbers. Gratis.

TV STATION BOOKLET

Du Mont is distributing to TV station managers and engineers, a new booklet, *Station Planning*, which explains the facilities and functions of all equipment required for normal operation of a TV station. Suggested equipment layouts, floor plans, and exploded views are included in the booklet.

The booklet will be sent to all TV station managers and engineers requesting it on their company letterheads. Send request to Television Transmitter Division of Allen B. Du Mont Laboratories, Inc., 1000 Main Ave., Clifton, N. J.

GENERAL CEMENT CATALOG

General Cement's catalog No. 155 is just off the presses. Listing the full GC line of radio chemicals, alignment and repair tools, and radio and TV parts and hardware, the catalog is made available to all radio and TV service technicians who request a copy from General Cement Mfg. Co., 919 Taylor Ave., Rockford, Ill. Gratis.

CAPACITOR BULLETIN

A new booklet (Bulletin GEC-808) describes the new G-E Tantalytic capacitors designed for low-voltage d.c. applications where small size and long life are major considerations. The Tantalytic capacitor is a foil-type, tantalum electrode, electrolytic capacitor offering greater capacitance per unit volume and longer minimum shelf-life than similar aluminum units.

Bulletin GEC-808 may be obtained from General Electric Co., Schenectady 5, N. Y. Gratis to interested parties.

POWER RECTIFIER CATALOG

Sarkes Tarzian has just released a new catalog (No. PR1) covering power-type selenium rectifiers. It contains numerous performance charts showing the effects of temperature and frequency on forward voltage drop, reverse current, and output voltage. It also lists electrical and mechanical specifications for the various power-type selenium rectifiers made by the firm.

Available upon request from Sarkes Tarzian Inc., Rectifier Division, 415 N. College Ave., Bloomington, Ind. Gratis.

TV ANTENNA CATALOG

A catalog covering the Speed line of TV antennas, mounts, and accessories is available gratis from Phoenix Electronics, Inc., Lawrence, Mass.

Radio Thirty-Five Years Ago

In Gernsback Publications

HUGO GERNSBACK
Founder

Modern Electrics	1908
Wireless Association of America	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Television	1927
Radio-Craft	1929
Short-Wave Craft	1930
Television News	1931

Some of the larger libraries still have copies of ELECTRICAL EXPERIMENTER on file for interested readers.

JANUARY, 1918
ELECTRICAL EXPERIMENTER

Raising Sunken Treasures, by H. Gernsback
Fog Warning by Radiophone, by George Holmes
Ground Telegraphy in War, by H. Gernsback
The "Electro-Magnetic Depth Bomb"
Modern Physics and the Electron
"Electrician—Radio U. S. N.," by Willard Connely, U. S. N. R. F.
Measurements of Radio Antennae on Shipboard
The "Smallest Audion"
French Aeroplane Radio Great Aid to Artillery
A Short-Cut to Code-Learning, by Thomas Reed
"Ham" Aerials, by W. J. Howell
A Mechanical Inductance Changer, by Frederick J. Schlink
A High Potential Storage Battery, by Thomas Lewis Herren
Method for Increasing Sensitiveness of Silicon and Galena, by Robert W. Jaeger

—end—

SOCIAL SECURITY

Are you working for yourself as the owner of a trade or business? If so, you may be one of the 4½ million individuals who became covered for the first time under the Social Security Act on January 1, 1951. Until this year, it was not possible for a self-employed individual to earn credits toward old-age and survivor's insurance benefits.

Under the provisions of the new act, you may collect up to $80 per month on your retirement at 65; or after your death, your widow, if she has minor children or is over 65, may collect up to $60. This may be increased to as much as $150 if there are two or more minor children.

Steps should be taken now so that your self-employment income will be credited to your account at the proper time. The first thing to do is to be sure you have a social security card. If you have had a card before and lost it, get a duplicate card at your nearest field office. If you have never had a card, the field office will assign one to you.

Self-employed individuals make only one report each year to the Social Security Administration regarding their net earnings. This report will be filed with the regular Income Tax return.

Self-employed individuals, with the exception of farm operators and certain professional groups listed below who were excluded by law, are covered on a compulsory basis. Only two requirements are to be met. One is that the business or profession is not one of the excepted groups listed below. The other is that the individual have net earnings from self-employment of at least $400 during the taxable year. All individuals who meet these two requirements are covered and will be required to file an annual report on their net earnings. You should *not* report your earnings on any quarterly report you file for your employees.

The law specifically exempts from coverage:

Farm operators	Veterinarians
Lawyers	Architects
Dentists	Certified, licensed, registered, or full time accountants
Physicians	Christian Science practitioners
Osteopaths	Professional engineers
Chiropractors	Funeral directors
Optometrists	
Naturopaths	

If any individual in the above category is employed by someone else, he would, of course, be reported as an employee on his employer's regular quarterly tax return.

Unless you have net earnings from self-employment of at least $400 for a calendar or taxable year beginning on or after January 1, 1951, it is not necessary for you to make the report at the end of the year. However, if your net earnings are $400 or more, you must report and pay the social security tax of 2¼% on the first $3600.

Any Social Security Administration office will assist you on Social Security matters, whether it be to issue a Social Security card or to furnish information or a booklet to you.

—end—

THE FUND NEARS $9,000

HELP-FREDDIE-WALK FUND

The continued response to our appeal for funds to help assure little Freddie Thomason, the armless and legless son of Arkansas radio technician, Herschel Thomason, a normal and constructive life is heartwarming. To date, our readers have contributed almost $9,000.00 to this worthy cause, and donations, large and small, are received daily.

It seems to be a basic characteristic of life that no matter how hard-up we are, we can usually find the means to aid someone less fortunate than ourselves. This has most certainly been true of our readers, to many of whom even a seemingly small contribution represents a sacrifice of some sort. Through the collective efforts of his doctors, his parents, and these hundreds of friends, it has been possible for Freddie to gain daily in his fight.

However, this is only the beginning. Many more thousands of dollars will be needed, for as Freddie grows older, the mechanical appliances on which he depends must "grow" with him. Therefore, we urge every reader to make any donation he can, whenever he can.

We should like to make special mention of the $10.00 donation from Stan Burn Radio and Friends this month.

Make all checks, money orders, etc., payable to Herschel Thomason. Please address all letters to:

Help-Freddie-Walk Fund
c/o RADIO-ELECTRONICS
25 West Broadway
New York 7, New York.

FAMILY CIRCLE CONTRIBUTIONS

Balance as of October 19, 1951	$477.50
Lee A. Cosgrove, Pittsburgh, Pa.	5 00
Leona Mae House, Canton, Ohio	3.00
Jeffrey Johnston, Santa Monica, Calif.	3.00
Michael & Deborah Kennedy, Darby, Pa.	1.00
Mrs. Mary Kraft, Santa Rosa, Calif.	2.00
Mrs. Donald Newton, El Cajon, Calif.	1.00
Mrs. Fred Roche, Washington, D. C.	1.00
FAMILY CIRCLE Contributions received to November 19, 1951	$493.50

RADIO-ELECTRONICS CONTRIBUTIONS

Balance as of October 19, 1951	$8,399.60
A Mother, Father & Baby, N.Y.C.	1.00
Anonymous, Altadena, Calif.	1.00
Anonymous, Glendale Calif.	2.00
Anonymous, Wichita, Kansas	1.00
Anonymous, Huntsville, Missouri	2.00
Anonymous, Pittston, Pennsylvania	1.00
Pvt. Hugh M. Booda, Camp Gordon, Ga.	1.00
Nicholas Bozzay, W2LVD, Caldwell, N. J.	2.00
Leland De Long, Assumption, Ill.	1.00
J. M. & Irene H. Finnegan, Mountain View, N.J.	2.00
Leven W. Foster, Glens Falls, N. Y.	3.00
L. C. Gaumer, Urbana, Ill.	5.00
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Herman M. Neistadt, Baltimore, Md.	1.00
J. D. Newsom, Burlington, N. C.	10.00
J. S. Polson, Long Beach, Calif.	1.00
F. C. Purkeypile, Corvallis, Ore.	10.00
L. L. Reedholm, S. Gate, Calif.	1.00
Alex Rys, Minneapolis, Minn.	2.00
Stan Burn Radio & Friends N.Y.C.	10 00
Thomas W. Stewart, Merchantville, N. J.	5 00
William Stroemel, Jr., U.S.N.	5.00
B. Van Dyke, Schenectady, N. Y.	5.00
Alexander Voronin, Whitestone, N. Y.	3.00
Fred R. Wagner, W. Englewood, N. J.	2.00
RADIO-ELECTRONICS Contributions	$8,482.60
FAMILY CIRCLE Contributions	493.50
TOTAL RECEIPTS to November 19, 1951	$8,976.10

—end—

A BANKER'S VIEWPOINT

Dear Editor:

That you may know a little about me I wish to inform you that by profession I am a banker, that as a hobby I follow electronics with a deep interest in television and radio. It has been my privilege to have contacts with the businesses selling these products and with individuals and shops doing service work.

In RADIO-ELECTRONICS for August 1951 appeared your article "Service Technicians' Trials," which I read with much pleasure. I surmise, however, that the circulation of your magazine is among persons interested in the radio, television and electronics field from the angles of industry, science and hobby, and that it does not reach a vast majority of the service technician's problem children. The article thereby becomes one of consolation or eulogy to those who already and long have known the story. Every service technician has experienced what you have written.

Your story should be *in every newspaper* in the country and along with it should be some convincing evidence that there are many capable service technicians who render efficient service and are entitled to adequate compensation for the service they render. Permit a little pun, sir. In television as in the case of a wife, it's not the initial cost that hurts, it's the upkeep.

Who is gypping the public—the manufacturer, the dealer or the service technician? I believe that the skilled technician operating in the field is doing all that he can to maintain satisfied customers. I believe that dealers and merchants, vendors of general merchandise, have been granted the opportunity to sell an intricate device of which they know nothing, the complexities of which are far greater than the intricacies of any purely mechanical device on the market, and their ignorance and irresponsibility has been blithely pushed off as a problem of the service industry. But, let's not call them "gyps" but just plain greedy.

If "gypping" exists, responsibility must be laid in the lap of the manufacturer, for it is in his power to correct any injustices that may exist:

First, by a process of franchising qualified service shops to perform service work either under guarantees or under customer contracts.

Second, by supplying the franchised shop with full data, schematics, parts lists, changes and so on, relating to the units manufactured.

Third, that an adequate supply of the parts peculiar to their units, be made available at the shop at all times, availability to be on consignment basis subject to audit accounting.

Fourth, all sales contracts ultimately to be in the hands of service technicians too. * * * *

R. A. C.

Lorain, Ohio

ULTRAHIGH FREQUENCY ENGINEERING, by Thomas L. Martin, Jr. Published by Prentice-Hall, Inc., 70 Fifth Ave., New York N. Y. 5½ x 8¼ inches, 456 pages, Price $8.00.

This text is intended for senior college students, but will be understood by technicians who know algebra and calculus. There are separate chapters on wave-shaping, trigger circuits, waveguides, klystrons, and magnetrons. The subjects are presented logically and clearly.

The author has a flair for bringing out less obvious facts. Often he approaches his subject from more than one viewpoint, to the advantage of the reader.

Unfortunately, symbol co-ordination is lacking in a number of places. For example, R_t and R_T are used interchangeably in one discussion. An equation refers to e_c but the corresponding diagram shows e_g. The symbol r is used in several places to represent the *voltage* of a *capacitor.* Capacitor polarity is shown indiscriminately. These are minor errors but they may slow up the reader who likes to follow through solidly.

ELECTRONICS, by Jacob Millman, Ph.D. and Samuel Seely, Ph.D. Second Edition. Published by McGraw-Hill Book Co., Inc., 330 West 42 St., New York, N. Y. 6 x 9 inches. 598 pages. Price $7.25.

This is the new edition of a well-known text. Much of the material has been clarified and modernized. Knowledge of calculus is assumed, but physical explanations are given throughout.

The book begins with analysis of the path and motion of an electron in a field. This leads to oscilloscopes, magnetrons, cyclotrons and betatrons. Next follows the behavior of electrons in metals, for an understanding of semiconductors, contact potential, cathodes, and similar subjects. There are several chapters on electrons in gases. Technicians will find this section interesting because it deals with characteristics of thyratrons, ignitrons, fluorescent lamps, mercury vapor and similar types.

Problems and references are given at the end of chapters.

WIRELESS SERVICING MANUAL (Eighth Edition) by W. T. Cocking. Published for Wireless World by Iliffe & Sons, Ltd., Dorset House, Stamford Street, London S.E. 1, England. 4¼ x 7 inches, 296 pages. Price 12s. 6d.

This manual has aided service technicians since 1936. This latest edition covers modern servicing of AM receivers, broadcast and short wave. There is also an introduction to TV servicing. The author shows how to locate and cure various troubles in amplifiers, converters, a.f.c. and other circuits. Motorboating, instability, hum, whistles and distortion are discussed. Much space is devoted to capacitor ganging in t.r.f. and superhet receivers. Some information is also given on meters, oscilloscopes, signal generators and tube testers.

In spite of space limitations the manual contains clear and useful information. The appendix has wire tables, formulas, and color codes.—*IQ*

Cash in on TV Service Profits!

PRACTICAL TELEVISION SERVICING

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RADIO COMMUNICATION AT U.H.F., by John Thomson. Published by John Wiley & Sons, Inc., New York, N. Y. 5¼ x 8½ inches, 203 pages. Price $5.50.

This book is definitely not for the radio beginner or the practical service technician. It deals with more advanced concepts of u.h.f. circuits and tubes. The material is unusually concise. Little space is wasted on details or information which an experienced engineer may himself possess or derive. The language is largely mathematical. Informative charts and tables are included.

The text is based on the postwar experience of the author and his associates. Among the chapters are: traveling wave tubes, magnetrons, noise, mixers and oscillators, control by molecular absorption, and frequency control.

ROCKETS, MISSILES, AND SPACE TRAVEL, by Willy Ley. Published by The Viking Press, 18 East 48th Street, New York. N. Y. 6 x 8½ inches, 436 pages. Price $5.95.

Here is a documented, exciting account of the history of rockets from their early use as weapons of war to the more intriguing prospective applications in space travel. The gradual evolution of the space rocket is covered in considerable detail. The question of space travel is not one of derring-do, but rather of mathematical travail. Space travel, when it comes, must be based on taking advantage of well-established natural laws. The problems of space travel may be reduced through the use of multiple-step rockets and space terminals, both are discussed.

For rocket enthusiasts the primary concern is space travel itself. The assumption is made that existing methods of communication and space navigation by radar would be satisfactory, hence present no insoluble difficulties. The author does discuss these topics very briefly and passes along the novel idea of having a system of three space stations, revolving around the earth for world-wide radio and TV coverage.

Based on the author's many years of experience with rocket theory and experiment, on the surface more fantastic yet ultimately more believable than science fiction, Willy Ley's very authentic book props up the old cliche about truth being stranger than fiction.—*MC*

DESIGN, CONSTRUCTION AND OPERATING PRINCIPLES OF ELECTROMAGNETS FOR ATTRACTING COPPER, ALUMINUM AND OTHER NONFERROUS METALS, by Leonard R. Crow. Published by Scientific Book Publishing Co., Vincennes, Indiana. 5½ x 8½ inches, 38 pages. Price $1.00 paper binding, $1.25 cloth binding.

This educational booklet, which should interest experimenters and students, uses text, photographs, and diagrams in a study of practical magnetism. Step-by-step, the subject matter progresses from ordinary magnets to a special unit which attracts nonferrous metals. The special electromagnet operates on the same principle as that of a shaded-pole motor.

ADVERTISING INDEX

RADIO SCHOOL DIRECTORY

(Page 160)

Radio-Electronics does not assume responsibility for any errors appearing in above index.

ELEMENTS OF TELEVISION SYSTEMS, by George E. Anner. Published by Prentice-Hall, Inc., 70 Fifth Ave., New York, N. Y. 5½ x 8½ inches. 804 pages. Price $10.35.

This volume packs much TV information for the service technician, transmitter operator, and hobbyist. Scanning, camera tubes, synchronization, and stagger tuning are some of the important subjects described in detail. There are also chapters on televising of motion pictures, antennas, color TV, etc.

Much of the treatment is nonmathematical. However, many equations, charts, and diagrams are provided. Practical and detailed numerical examples show how to design multivibrators, compensated video amplifiers, and other circuits.

The basic information given here will remain useful for years to come. Nevertheless, the rapid changes in TV are apparent. Schematics are supplied for several 7, 10, and 12-inch kinescope receivers. There is nothing on the modern high-voltage supplies or the larger size kinescopes.

MATERIALS TECHNOLOGY FOR ELECTRON TUBES, by Walter H. Kohl. Published by Rheinhold Publishing Corporation, 330 W. 42nd Street, New York, N. Y. 6¼ x 9¼ inches, 493 pages. Price $10.00.

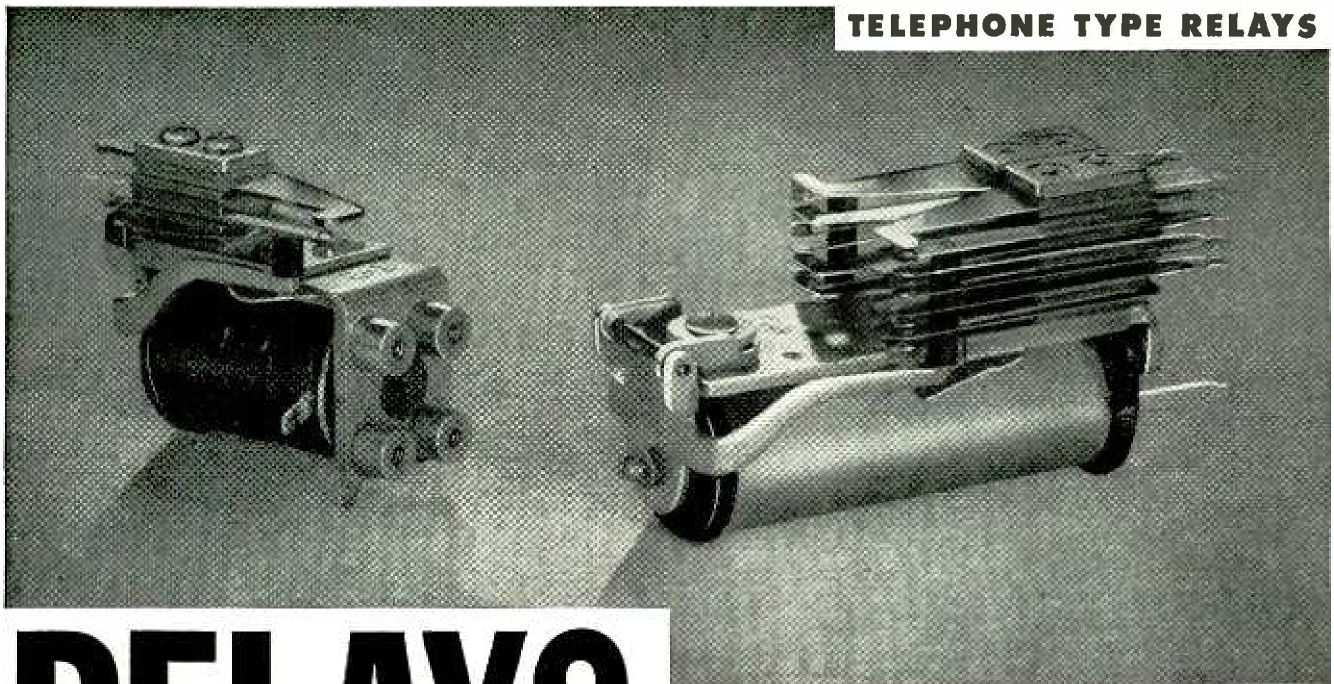
Vacuum tube designers and manufacturers, or electronic technicians are provided with a wealth of data and techniques in this book which endeavors to include in one text most of the pertinent research work in high vacuum construction work. Data on the characteristics of nickel, tungsten, molybdenum, tantalum, copper, ceramics, and glass used in the art are presented. The coverage on different glasses is unusually comprehensive.

A broad index of authors and reviewers permit the worker seeking specialized data on processes and applications to pinpoint additional search. A review of atomic theory, classification of crystals, and an outline of the salient factors of the phase rule, high vacuum technique, and thermionic emission provide a theoretical basis for the mechanical and chemical processes described in the text. Soldering, brazing and advanced welding techniques used with the many alloys listed are presented at length. Many graphs and illustrations are presented with each chapter and reinforce the text content. A large index allows quick reference to any of the varied topics discussed.

RESPONSE OF PHYSICAL SYSTEMS, by John D. Trimmer. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 5⅜ x 8⅝ inches, 268 pages. Price $5.00.

This book offers aid to workers in such fields as physics, sociology, biology, mechanics, etc., by applying cybernetic concepts to problems in instrumentation. A working knowledge of calculus and differential equations is needed for successful application of mathematics to physical systems.

—end—



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R-770	24 VDC	150	1A/10 Amps	1.45
R-368	8/12 VDC	200	1B	1.40
R-771	24 VDC	200	1A/10 Amps	1.45
R-603	18/24 VDC	400	2A	1.55
R-575	24 VDC	500	2C	2.40
R-764	48 VDC	1000	1C&2A	2.00
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R-113	12 VDC	150	4A	1.55
R-689	12/24 VDC	255	1C	1.55
R-799	24 VDC	500	NONE	1.00
R-115	24 VDC	500	1C	1.70
R-110	24/32 VDC	3500	1C	2/3.45
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R-122	150 VDC	5000	2C/Octal Base	2.50
R-634	150/250 VDC	6000	1A&1B	2.45
R-369	8/12 VDC	150	2A, 2B	1.60
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R-517	12 VDC	250	2A	1.50
R-116	85 VDC	3000	1B	3.05
R-631	100/125 VDC	3300	2A	1.90
R-545	110/250 VDC	7000	1C	2.40
R-124	300 VDC	12,000	1A	1.55
R-511	24 VDC	200	W/MICRO N.O.	3.05
R-160	6 VDC	12	3C&3A	3.00
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R-591	6 VDC	40	1B&1C	1.35
R-155	12 VDC	100	4A&4B	1.45
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R-385	6/12 VDC	500	1B Split	2.50
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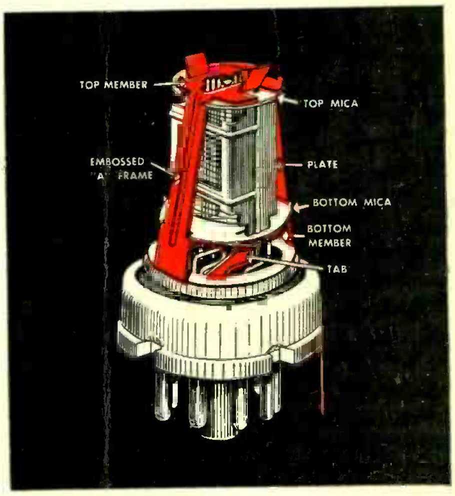

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