MARCH 1952

RADIO-ELECTRONICS

LATEST IN TELEVISION • SERVICING • AUDIO

30¢
U. S. and CANADA

In this issue: **Servicing Oscillator Circuits • TV Conversion Details • Improving Listenability**

CYLINDRICAL

reflection-free

21 inch

245 sq. in.

the largest 21″ CRT available!

21KP4A

Selfocus Teletron. Maintains focus automatically at all times. Requires no focus coil or control.

21EP4A

Magnetic focusing and deflection. Utilizes Du Mont bent-gun for edge-to-edge focus.

21FP4A

Low-voltage electrostatic Teletron. Focuses in range of −65 to +350v. at 16 kv anode voltage.

DU MONT

*Teletrons**

Cathode-ray Tube Division,
Allen B. Du Mont Laboratories, Inc.,
Clifton, N. J.

*trade mark

RADIO-ELECTRONICS

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

CONTENTS — MARCH 1952

ON THE COVER: Technician Ed Walter, of the RCA Service Company's Bushwick (Brooklyn) branch, adjusts a TV receiver in the customer's home (See P. 48).

MEMBER Audit Bureau of Circulations

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MAKE THE MONEY YOU'VE ALWAYS DREAMED OF!

LEARN RADIO -TELEVISION

AND ELECTRONICS BY EASY SHOP METHOD TRAINING AT HOME!

You get all the parts—even tubes!— for this modern Superheterodyne Receiver. You learn to build it step by step. And you keep it! Get all the facts. Mail coupon now.

Let NATIONAL SCHOOLS—a resident-training school for nearly 50 years—train you at home for today's unlimited opportunities in Radio-Television-Electronics. National Schools is one of the largest schools of its kind. It is located in Los Angeles—the center of Radio and TV world! It has four large buildings of modern shops and labs. Its faculty is considered tops in the business.

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Page after page—in color—tells you everything you want to know. Mail the coupon. Get this valuable book today. And if you hurry—YOU GET A FREE SAMPLE LESSON, TOO! Shows how easy National Schools Home Training is. Mail the coupon today.

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Think of it! With guided missiles, radar, and other electronic devices so important to national defense! With big, new developments in TV. With over 90,000,000 home and auto radios, over 12,000,000 TV sets. With more than 3100 radio stations...over 100 TV stations—and more building every day... yes, imagine the great opportunity you have today!

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Job Security! Big Money! For YOU! in Today's Expanding Industries!

Trained Radio and Television technicians really make important money these days. Thousands of National Schools graduates—men just like you—are earning good money all over the country. Why not you?

And—National Schools graduates get the personal satisfaction of being highly-skilled technicians. Men people respect. Men who *enjoy* their work—rather than having to drag along in just any old job.

National Schools Has Trained 1000's of Successful Men! Why Not YOU?

In almost every state—and many foreign countries—National Schools graduates are filling big jobs with famous companies. Or running their own successful businesses. What are YOU waiting for? National Schools training is *complete* training. So when you graduate you can take advantage of today's big opportunities in Radio-Television-Electronics—fast.

You Train At Home—In Your Spare Time

National Schools Shop Method Home Training gives you basic and advanced instruction in *all* phases of Radio-TV-Electronics. And remember—your training is based on resident school training principles. You learn *fast* from hundreds of diagrams and pictures. All instructions are written by experienced technicians who work in Radio and TV every day. All instructions have been developed and tested in National Schools' own labs and studios, which are equipped with the latest RCA equipment. No wonder this National Schools course is so up-to-date, practical, interesting. And so easy to learn! And no wonder it is held in such high regard by leaders of American industry! Approved for eligible Veterans.

We Teach You How To Make Welcome Extra Money—While You Learn!

Many National Schools students—men like you—make plenty of extra dollars each week in spare time! Fixing neighbors' radios, appliances—and other ways we teach you. You start learning and earning from the day you enroll. From the very first lesson!

WE SEND YOU LOTS OF PARTS LIKE THIS!

With National Schools Shop Method Home Training, you get basic principles and plenty of *practical* training. *You learn by doing.* No wonder you learn so fast! We send you many parts—all of professional, modern quality. You do lots of practical experiments. You advance day by day, step by step. Until you can even build the modern Superheterodyne Receiver you see above—plus other important testing units. The free book tells you all about it. The free sample lesson shows how easy the training is. Use the coupon. Send today — without fail!

Only National Schools Gives You This Professional Multi-Tester!

You get this amazing, new testing instrument—factory-made and tested—complete—ready to use! Simple to operate. Accurate and dependable. An instrument every Radio-TV man needs. Light enough to carry around—so you can use it at home or on service calls. You'll be proud to own this valuable equipment.

Here are only a Few of the Good-Paying Jobs You Can Choose

Radio Station Engineer, District Service Manager, Aircraft Radio Inspector, Own Your Own Repair Shop, Inspector Technician, Service Specialist, Special Government Jobs, Complete TV Service, Sound Truck Operator. Many more!

National Schools graduates have secure, good-paying jobs like these! So don't wait—mail the coupon today. Now—while you're thinking about it!

Attention! Men Going into Service Soon!

National Schools' course quickly prepares you for many important jobs in the Armed Services. With National Schools Training you have an opportunity to get into *special* service classifications—with higher pay and grade—immediately!

FREE SERVICE FOR GRADUATES

National Schools uses its great influence and prestige to help you find your place in the field of your choice. Don't put it off! Start yourself toward a skilled trade! Get the big pay you've always wanted!

NATIONAL SCHOOLS

LOS ANGELES 37, CALIFORNIA • ESTABLISHED 1905

DON'T PUT IT OFF! GET THE BIG SALARY YOU HAVE ALWAYS WANTED!

MAIL THIS COUPON TODAY—WITHOUT FAIL!

NATIONAL SCHOOLS, Dept. GR-32
4000 South Figueroa Street
Los Angeles 37, California

Mail in envelope or paste on penny post card.

Mail me FREE the book mentioned in this ad. Also a free sample lesson. I understand no salesman will call on me.

NAME__________________ AGE____

ADDRESS__________________

CITY____________ ZONE____ STATE______

☐ Check here if you were released from the Service less than 4 years ago.

Be Sure of Your Installations

Get the *Aptitude-Tested* RG/U TRANSMISSION LINE CABLES

● You know what you are doing when you use Belden RG/U Transmission Line Cables — they're aptitude rated. They are designed to provide desirable electrical characteristics, and rigid control assures constant quality. Specify Belden Radio Wires.

Belden Manufacturing Co., 4623 W. Van Buren St., Chicago 44, Ill.

FOR 50 YEARS *Wiremaker for Industry*

To You,

Belden's Golden Anniversary Means

—product performance that can come only from a "know-how" that has grown through actual service since the inception of Radio.

—an ability to co-operate in pioneering new wires to meet or anticipate industry's growing needs.

In the years that follow

This Belden Program Is—

—TO BE CONTINUED

APTITUDE RATING No. 8236		APTITUDE RATING No. 8237		APTITUDE RATING No. 8238		APTITUDE RATING No. 8239		APTITUDE RAT[ING] No. 8241			
Frequency (Mc)	Attenuation per 100 ft	Frequency (Mc)	Attenuation per 100 ft	Frequency (Mc)	Attenuation per 100 ft	Frequency (Mc)	Attenuation per 100 ft	Frequency (Mc)	Attenuation per 100 ft		
100.	2.65	100.	2.10	100.	1.90	100.	3.10	100.	3.75		
200.	3.85	200.	3.30	200.	2.85	200.	4.40	200.	5.60	[illegible]	
300.	4.80	300.	4.10	300.	3.60	300.	5.70	300.	7.10	300.	
400.	5.60	400.	4.50	400.	4.35	400.	6.70	400.	8.30	400.	

Belden *Radio* **WIRE**

The *Aptitude-Tested* LINE

HIDDEN VALLEY is at last to receive the benefits of "hidden valley" television. The valley with the name so familiar to persons interested in TV distribution systems is located near Lafayette, California, and is to receive signals via an antenna on an 800-foot hill in full range of signals from the San Francisco area.

Jerrold community antenna equipment will be used to bring the signals from the hilltop tower to viewers in Hidden Valley and the adjacent Acalanes Valley. The signals will be boosted on leaving the antenna, and again after being piped 2,200 feet through coaxial cable to the floor of Hidden Valley.

An interesting feature of the project is that cables will run underground instead of overhead, as is more common in such installations.

TV BROADCASTING IN BRAZIL has been reinforced by a new 5-kilowatt station operating on Channel 5 in Saõ Paulo, "the Chicago of South America." The station services an estimated 20,000 TV sets in the Saõ Paulo area and is housed in a new 12-story building on Avenida Reboucas 62 overlooking the residential section.

A portable TV microwave link and equipment for the station, owned and operated by Radio Televisao Paulista, S.A., was supplied through International Standard Electric Corporation, New York, an associate of the International Telephone and Telegraph Corporation.

A COLOR TELECAST linking Los Angeles, Chicago and New York over a closed circuit, lasting for one hour, enabled hundreds of doctors to watch a delicate operation performed at the Los Angeles County Hospital. This first transcontinental color telecast was sponsored by the Columbia Broadcasting System laboratories division and Smith, Kline and French, a Philadelphia pharmaceutical concern.

Doctors said the colors of nerves and tissues were accurately transmitted. At the American Medical Association convention, Dr. John W. Cline, president, said that the telecast was a "milestone" in helping isolated practitioners.

TAPE RECORDING network for the benefit of sick and disabled veterans in VA hospitals has proved to be an excellent morale-booster. Tape records of special programs by nationally known entertainers and celebrities visiting a hospital are circulated among the 50 or so member hospitals of the network. Presentations written, acted and directed by talented veteran-patients have been recorded and circulated and enjoy a wide popularity. Patients confined to their beds listen to the programs over receiving units placed right by the pillows.

PILFERAGE of television parts and equipment was held to be one of the main causes of the dramatic failure of Conlan Electric of Brooklyn. The firm declared itself in bankruptcy in January. It held more than 20,000 television service contracts.

Less dramatic but possibly more significant was the statement made by the company's attorney, Nathan Korn, that the financial difficulties resulted almost entirely from the television installation and service contract phase of the firm's activities. Other activities of the 48-year-old firm have always made a profit, but losses on TV contracts were too great to be absorbed by the other branches of the business, he said.

Of the 20,000 contracts, more than 17,000 are bonded, according to Mr. Korn. It is expected that with the co-operation of the bonding companies, a new organization may be formed to service these and possibly the other 3,000 sets covered by unexpired contracts.

"TV ATTENDANCE" is greater in actual time than schoolroom attendance, according to a survey of sixth and seventh grade school children conducted by Xavier University, Cincinnati, Ohio, in co-operation with the Crosley Broadcasting Corporation. The study of 998 children revealed that the average pupil spends 30 hours a week watching TV as compared with 25 hours spent in school.

There was no appreciable difference in the school work of children with TV sets at home compared with those not having TV sets. The child whose televiewing habits are controlled by parents (not as common as originally believed) did not manifest superior scholarship to the uncontrolled child.

Since the report was concerned only with the present complexion of TV programs—recreational—there was no implication drawn concerning special TV programs designed to aid learning.

The report showed that the children in TV homes had a later bedtime, and that children with lower IQ's were avid watchers of mystery-crime and wrestling programs.

AN ALUMINUM SHEATH is used in a new type of coaxial cable which is cheaper and, reportedly, more efficient than that usually used for microwave transmission. The applications to remote pickup TV transmission lines are held promising.

The aluminum pipe is made by a new continuous extrusion process invented by Heinz Horn of Cologne and further developed in Germany. The cable already is used in 150 installations in Europe and is being marketed in this country by the Phelps Dodge Copper Products Corporation under agreement with the Cologne manufacturers.

IRE'S NATIONAL CONVENTION and Radio Engineering Show will be held in New York City, March 3rd through 6th. Convention headquarters will be at the Waldorf-Astoria Hotel. The Show has been expanded to include four floors of exhibits at the Grand Central Palace. Over 350 exhibitors will occupy booth space. RADIO-ELECTRONICS will again have a display at Booth S-2 on the mezzanine floor.

Charles E. Wilson, Director of Defense Mobilization, will be the guest speaker at the annual banquet.

MISLEADING TV SET ADS are expected to be curbed by the plan set forth by the Better Business Bureau of New York City. The plan, also affecting home appliances, implements the enforcement of the advertising and selling standards adopted by the trade over 18 months ago. A five-man, industry advisory panel consisting of three TV and appliance advertisers, one non-advertiser and one wholesale distributor will review advertising practices with the bureau and conduct hearings when an advertiser disputes a BBB charge of violation of the standards.

An advertiser whose copy is considered in violation of the standards will be notified by registered mail and requested to give written assurance within 72 hours that it will be discontinued. It places responsibility on the advertiser to substantiate with proof any advertised claims deemed questionable. Further action could mean publicity and referral to law-enforcement authorities.

FARSIGHTED ENTERPRISE has been shown by the Capitol Appliance Co. of Boise, Idaho, in advertising the sale of 161 nationally known, quality brands, traded-in TV sets. The prices quoted ranged from $1 up for table models, $3 up for consoles, and $10 up for radio-phono-TV combinations!

Since Boise is far from the nearest TV station, there may have been some question in the minds of the residents as to what they could do with the 161 used sets from Salt Lake City, Utah. The ad settled this natural query by stating that when TV *does* come to Boise the advertiser will allow the full purchase price of the traded-in set as a trade-in allowance on a new TV set.

The ad resulted in "a lot of interest and a few sales."

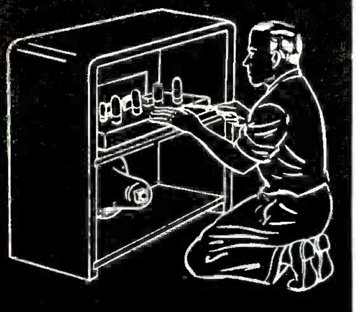
A £50,000 AWARD, tax free, was made to Sir Robert Watson-Watt, president of Britain's Royal Meteorological Association and the Institute of Navigation, for his pioneer work in developing radar before and during World War II. Nine of his research associates are to receive an additional £37,900 government award. In a joint claim last year, the ten stated that "without radar the Battle of Britain would have been lost and these islands invaded."

This prize is the largest since 1948 when Sir Frank Whittle received £100,000 for inventing the jet engine.

1952 ELECTIONS AND TV will be closely linked, according to statements by David Sarnoff, and Dr. Allen B. Du Mont. General Sarnoff indicated that TV has a great destiny in providing "an open forum in which every home has a front-row seat in the discussion of national and international problems." Dr. Du Mont believed that television's quality of honesty in separating the wheat from the chaff had its effect in recent elections. He indicated that it is up to the candidates to use television's "unerring ability to distinguish the demagogue from the statesman."

—end—

Where Will You be in ELECTRONICS 6 Months from Today?



ADD TECHNICAL TRAINING TO YOUR PRACTICAL EXPERIENCE

GET YOUR FCC LICENSE IN A HURRY!

Then use our Amazingly Effective JOB-FINDING SERVICE

Get this Valuable Booklet FREE

Money-Making FCC Commercial Radio Operator LICENSE Information

TELLS HOW YOU CAN GET A FREE TELEVISION ENGINEERING COURSE

TELLS HOW—

WE GUARANTEE
TO TRAIN AND COACH YOU AT HOME IN SPARE TIME UNTIL YOU GET
YOUR FCC LICENSE

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

TELLS HOW— Employers make

JOB OFFERS like These to Our Graduates Every Month

Letter, October 11, 1951, from Chief Engineer, Broadcost Station, North Carolina. "Need men with radiotelephone 1st class license, no experience necessary. Will learn more than at average station for we are equipped with Diesel Electric power, transmitting and studio equipment."

Telegram, October 2, 1951, from Chief Engineer, Broadcast Station, Wyoming. "Please send latest list available first class operators. Have November 10th opening for two combo men."

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

HERE'S PROOF FCC LICENSES ARE OFTEN SECURED IN A FEW HOURS OF STUDY With OUR Coaching AT HOME in Spare Time.

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

CLEVELAND INSTITUTE OF RADIO ELECTRONICS
Desk RE-39, 4900 Euclid Bldg., Cleveland 3, Ohio

TELLS HOW—

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

Here are a few recent examples of Job-Finding results:

GETS JOB WITH CAA

"I have had a half dozen or so offers since I mailed some fifty of the two hundred employment applications your school forwarded me. I accepted a position with the Civil Aeronautics Administration as a Maintenance Technician. Thank you very much for the fine cooperation and help your organization has given me in finding a job in the radio field."

Dale E. Young, 122 Robbins St., Owosso, Mich.

GETS FIVE JOB-OFFERS FROM BROADCAST STATIONS

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

Elmer Powell, Box 271, Sparta, Tenn.

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

GETS CIVIL SERVICE JOB

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

Charles E. Loomis, 4516 Genesee Ave., Dayton, Ohio.

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

Get All 3 FREE

MAIL COUPON NOW

CLEVELAND INSTITUTE OF RADIO ELECTRONICS
Desk RE-39—4900 Euclid Bldg., Cleveland 3, Ohio
(Address to Desk No. to avoid delay)

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

☐ Tell me how I can get your Free Television Course.

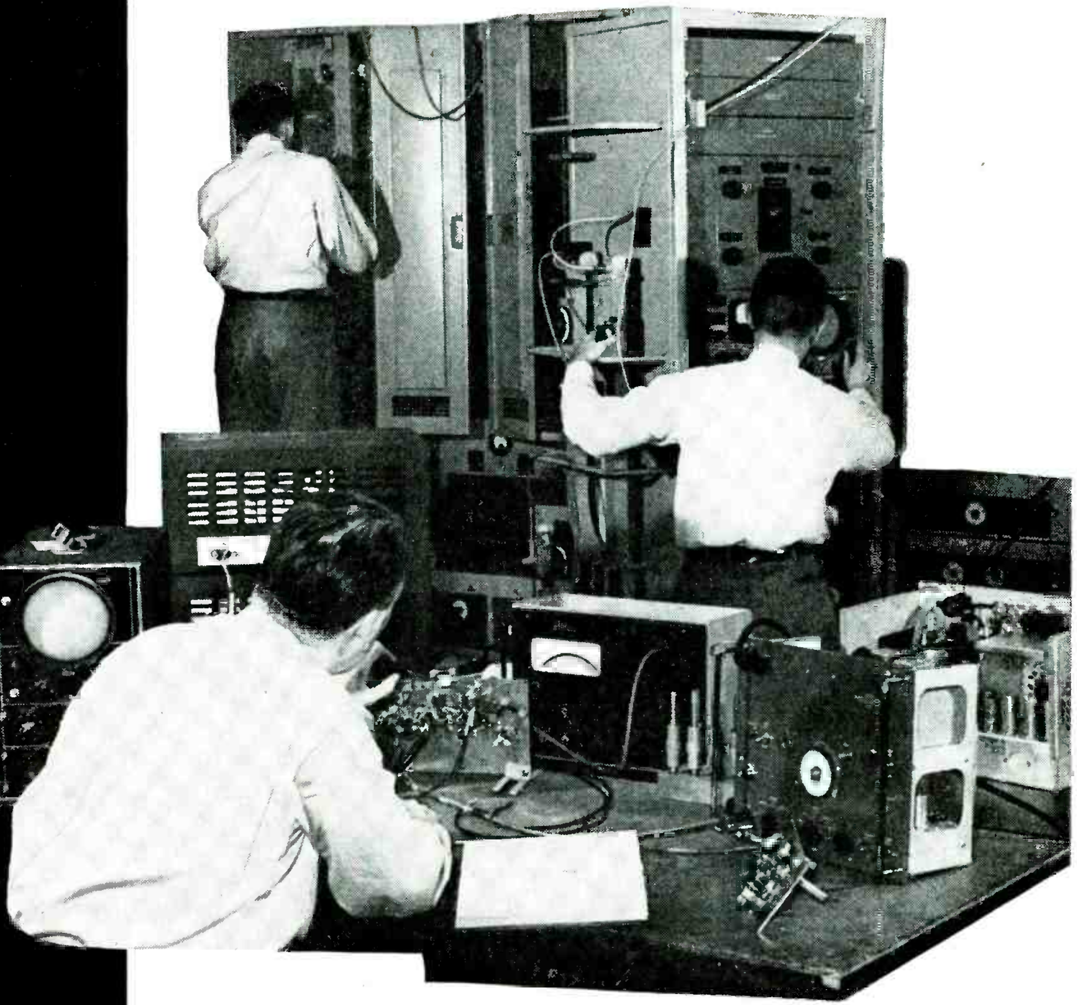
Name ....

Address ....

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

Paste on penny postcard or send air mail.

What kind of men?



What kind of men are the 2500 scientists and engineers of Bell Telephone Laboratories?

They are men of many types, yet they work well together, for all have good minds as a foundation, years of study in the fundamentals of their science and in the methods of research and design. Vital, too, is their teamwork — for without the co-operation of many individuals the products of research and development could never be perfected.

Above all else these men have "the spirit to adventure, the wit to question, and the wisdom to accept and use."

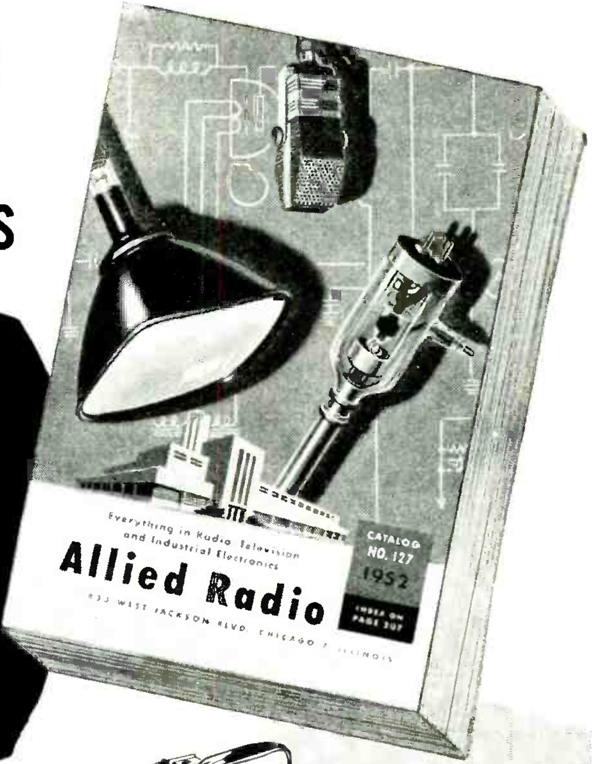
Such men can develop the world's finest telephone systems — and have done so.

Perhaps there is a place among them for you. Write the Employment Director, Bell Telephone Laboratories, New York 14.

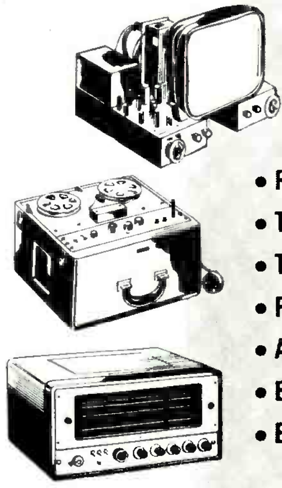
BELL TELEPHONE LABORATORIES

• EXPLORING AND INVENTING, DEVISING AND PERFECTING FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE

the only complete catalog for everything in Radio, TV & Industrial Electronics



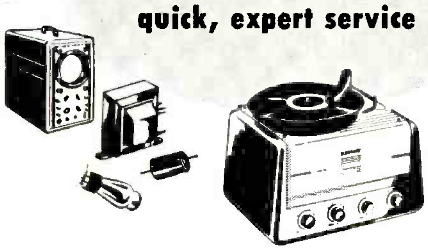
your 1952 free! ALLIED 212-page value-packed catalog



the world's largest stocks

- Radio Parts Unlimited
- Test Instruments
- Television & Home Radios
- P.A. and Hi-Fi Equipment
- Amateur Station Gear
- Builders' Supplies
- Equipment for Industry

quick, expert service



Send for it today!

Here's the *one* authoritative, complete, up-to-date Buying Guide to TV, Radio and Industrial Electronics. Make your selections from the world's largest stocks of quality equipment at lowest, money-saving prices. See the latest and most complete presentation of electronic apparatus: new TV, AM and FM receivers; High-Fidelity Custom Sound components; latest P.A. Systems and accessories; recorders; fullest selections of Amateur receivers and station gear; specialized industrial electronic equipment; test instruments; builders' kits; huge listings of parts, tubes, tools, books—the world's *most complete stocks* of quality equipment.

ALLIED gives you *every* buying advantage: speedy delivery, expert personal help, lowest prices, liberal time payment terms, assured satisfaction. Get the latest 1952 ALLIED Catalog. Keep it handy—and save time and money. Send for your FREE copy today!

ALLIED IS YOUR TV and HI-FI HEADQUARTERS

TV

Count on ALLIED for the latest in TV! If it's made—we have it for quick delivery. We specialize, too, in High-Fidelity sound components—everything in amplifiers, speakers, tuners, phono gear and accessories. For TV or Hi-Fi—think of ALLIED!

HI-FI

free SEND TODAY FOR RADIO'S LEADING BUYING GUIDE

ALLIED RADIO

the World's Largest Radio Supply House

EVERYTHING IN ELECTRONICS

ALLIED RADIO CORP., Dept. 2-C-2
833 W. Jackson Blvd., Chicago 7, Illinois

☐ Send FREE 212-page 1952 ALLIED Catalog No. 127.

Name ______________________

Address ______________________

City ____________ *Zone* ______ *State* ____________

Today's wary customers want to know *how you do business* as well as *how capable a technician you are.* That's why thousands of Radio and Television Service Dealers across the nation are discovering that, all other things being equal, their status as RAYTHEON *Bonded* Electronic Technicians tips the scales in their favor.

If you don't know how this exclusive Raytheon *Bonded* Program builds customer confidence and good will by cash-protecting your radio and television service 90-day guarantee, *at no cost to you*, you'd better get in touch with your Raytheon Tube Distributor. He'll be happy to tell you whether you can qualify for this important sales aid.

RIGHT...FOR SOUND AND SIGHT

RAYTHEON®

RAYTHEON MANUFACTURING COMPANY

Receiving Tube Division

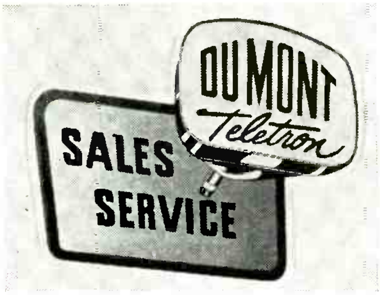
Newton, Mass., Chicago, Ill., Atlanta, Ga., Los Angeles, Calif.

Excellence in Electronics

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

Merchandising and promotion

Allen B. Du Mont Laboratories, Cathode-Ray Tube Division, Clifton, N. J., issued a new weatherproof three-color decalcomania for use in store windows,



truck panels, etc. The decals are available to distributors, dealers, and service technicians.

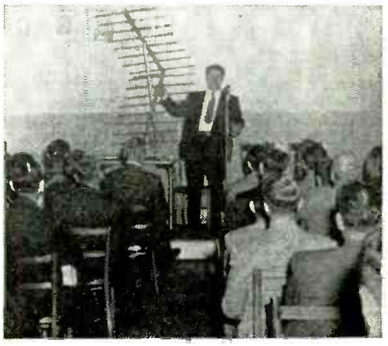
General Electric's Tube Department is conducting a mail survey of radio and TV service technicians. Upon completion of the survey, G-E will tabulate the information and supply it to service technicians so that they may compare their operations with those of others in the servicing industry. The Tube Department also announced that its recent "Hit the Trail" sales promotion campaign directed to distributor personnel was one of the most successful in its history.

Brach Mfg. Corp., Newark, N. J., launched a TV lecture program in cooperation with its TV parts distributors for the benefit of TV service technicians throughout the country. The illustrated lectures are given by Ira Kamen, Brach director of TV sales, on the subjects: "TV Antennas and Installations" and "Making Profitable Master TV Antenna Installations." Brach also announced the publication of a jobber-dealer booklet, "How to Sell Brach Products," covering the company's complete line.

Sprague Products Co., North Adams, Mass., developed a new "Service Package" system which, it states, makes it easy for service technicians to carry complete stocks of the proper replacement capacitors for the brand of TV sets they most frequently service. Each of 22 of the most popular makes of TV sets are represented in the "Service Package" system.

Jensen Industries, Inc., Chicago, released a mailing piece describing the sales aids it issues backing its line of phonograph needles.

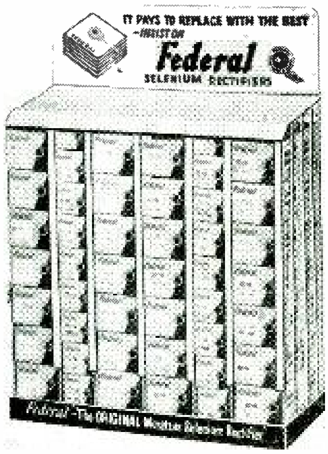
Radio Merchandise Sales, Inc., (RMS) New York City, is continuing its series



of forums on ultra-high frequencies and techniques and accessories for improved fringe-area television. Discussions were recently held in Dallas, Fort Worth, Austin, San Antonio, and Amarillo, Texas, under the sponsorship of local service associations. The forums are conducted by Martin Bettan, RMS sales manager.

JFD Manufacturing Co., Inc., Brooklyn, N. Y., released a new brochure describing its "Tuck-Away" line of single-channel TV boosters.

Federal Telephone and Radio Corp., Selenium-Intelin Division, Clifton, N. J., has launched a sales promotion campaign aimed at the replacement market



for its selenium rectifiers. The campaign includes a selenium rectifier dispenser offered to distributors and a handbook and replacement guide containing technical information for the service technician.

M. A. Miller Mfg. Co., Chicago, designed a plastic leatherette wallet phono needle carrier which holds one dozen individually-carded replacement needles. The wallet and 12 needles sell for $7.95.

Production and sales

The **NBC Sales Planning and Research Department** reported that as of January 1, 1952, there were 15,787,000 TV sets in the United States. New York City was first with 2,800,000 followed by Los Angeles and Chicago with 1,090,000 each, Philadelphia 1,001,000 and Boston 848,000.

The **RTMA** reported that 4,062,375 TV picture tubes valued at $97,937,583 were sold during the first 11 months of 1951. The Association also announced that 4,415,422 TV sets had been sold to dealers in the first 11 months of 1951.

New plants and expansions

Raytheon Manufacturing Co., Waltham, Mass., leased a one-story building, now under construction. The new building will provide Raytheon with 50,000 square feet of space on a 100,000-square-foot tract, it will be used for the company's expanding Research and Manufacturing Divisions and is expected to be ready early in May.

Ohmite Manufacturing Co., Chicago, manufacturer of resistors announced plans for a new and larger manufacturing plant in Skokie, Illinois. The new plant will provide for the company's expanded activities in defense work.

The RTMA moved its offices to larger quarters in the Wyatt Building, 777 Fourteenth St., N. W., Washington, D. C.

Electronic Instrument Co., Inc., Brooklyn, N. Y., manufacturer of *Eico* test equipment and kits, moved to a new 6-story factory building at 84 Withers St., Brooklyn, N. Y.

Kay-Townes Antenna Co., Rockmart, Ga., has relocated its plants and offices in larger quarters in Rome, Ga.

Hoffman Radio Corp. acquired a one-story building immediately adjacent to its No. 5 plant in Los Angeles.

Lowell Manufacturing Co., St. Louis manufacturer of low-volume ceiling-type loudspeakers, moved to a new and larger plant at 330 Laclede Station Road.

Synthane Corp., Oaks, Pa., opened an Indianapolis sales office under the direction of Duane W. Roland, formerly of the New York sales staff. The new office will provide service for industrial users of Synthane plastics in southern Indiana, southwest Ohio, and Kentucky.

Chatham Electronics Corp., Newark, N. J., has contracted to purchase a 17-acre tract in Livingston, N. J., as a site for a one-story plant to be devoted to the manufacture of electronic products.

Multi-Tron Laboratory, Chicago, moved to larger quarters which will be devoted to research and manufacture in electronic and nuclear physics.

Business briefs

. . . **Raytheon Mfg. Co.** in conjunction with the Massachusetts State Division of Employment Security worked out a recruitment plan for skilled technical personnel. The plan has been in operation for over six months and has been hailed as highly successful by both the company and state officials.

. . . **Lion Mfg. Corp.**, Chicago, manufacturer of coin-operated amusement devices, announced plans to manufacture television sets. Paul H. Eckstein, previously with Hallicrafters Co., has been named general manager of Lion's new Television Division.

. . . **Pacific Mercury Television**, Van Nuys, Cal., **Trutone Electronic Engineering Co.**, Hollywood, and **Davis Electronics**, Los Angeles, were elected as new members to the Los Angeles Council of the West Coast Electronic Manufacturers Association.

. . . The **RTMA Engineering Department** released a 14-point chart on electronic equipment reliability for the use of equipment designers. The association also scheduled its annual fall radio meetings for 1952 and 1953. The 1952 meeting will be held in Syracuse, N. Y., and the 1953 meeting in Toronto, Canada.

. . . **The 1952 Electronic Parts Show**, Educational Committee, mailed out a questionaire to distributors in an effort to determine what problems they want discussed at the seminars and educational meetings to be held in conjunction with the Show in Chicago, May 20 and 21. The plan was announced by Jack A. Berman, chairman of the Show Educational Committee.

. . . **The Institute of Inventive Research**, San Antonio, Texas, has acquired exclusive patent development rights for the Western Hemisphere on the Ionophone—the inertialess loudspeaker—developed by the French inventor Siegfried Klein. The Ionophone was described in the November and December issues of RADIO-ELECTRONICS. A public demonstration is planned.

. . . **Park Metalware Co., Inc.**, Orchard Park, N. Y., maker of hand tools for the mechanical, electrical, and electronic fields, changed its name to Xcelite, Inc.

. . . **Raytheon Manufacturing Co.** announced that Interstate Supply Co., St. Louis distributor of Raytheon tubes, held a series of meetings announcing the sponsorship of the Raytheon Bonded Electronic Technician Program. The firm also has announced the publication of "Raytheon News," a monthly newspaper distributed among employees. It is a revival of an earlier publication bearing the same name, which was discontinued in 1945.

. . . **Snyder Manufacturing Co.**, Philadelphia, announced that it would continue its highly successful consumer advertising campaign. New media are being spot tested. The company used national advertising in consumer newspapers for the first time last fall to introduce its "Directronic" antenna system to TV owners. New advertising will be in the form of news articles advising the layman of the function of the antenna in TV reception. The articles will be written by Edward M. Noll, consulting engineer at Snyder and a faculty member of Temple University.

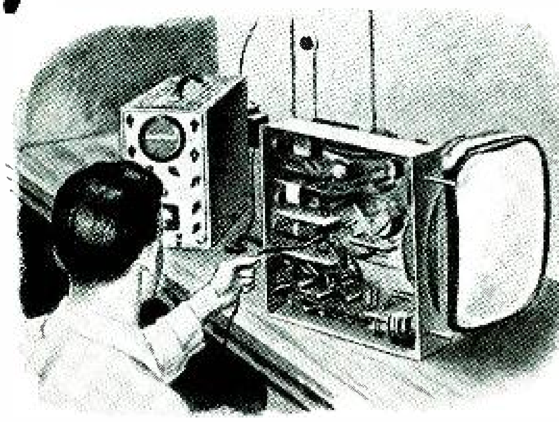
. . . **The G-E Tube Department** announced plans for a campaign designed to promote more efficient use of three types of industrial tubes. The first stage of the campaign includes an eight point program aimed at lengthening the life of thyratrons, the most widely used industrial tubes.

. . . **Sylvania Electric Products Inc.** announced a new Glass Allowance Program by which radio-TV service technicians will be given a trade-in allowance of from $2.25 to $5.25 on used television picture tubes. Under the terms of the plan, one new Sylvania picture tube of any type must be purchased to earn the credit for each used tube returned. It operates through Sylvania's 450 radio and TV tube distributors.

. . . **The National Electronic Distributors Association** prepared a four-page brochure outlining the structure and functions of electronic parts distributors' organizations. The booklet was prepared as an answer to the many queries of people outside the industry, particularly in government circles, as to just what constitutes an electronic parts distributor.

—end—

Here's *your* Opportunity



to prepare for a good job or a business of your own in TV SERVICING

There are today more good jobs open in TV Servicing than there are trained and experienced men to fill them. Yes, thousands of opportunities exist now for good-pay jobs offering employment security for years and years to come. Thousands of TV Servicing jobs are going begging. Do you want one of them?

Experts agree, that because of the critical shortage of trained and experienced TV Servicemen, and the tremendous future growth of the industry, no vocational field today offers more opportunities than TV Servicing.

The Big New Industry with a Great Future

Television is just in the beginning stages of its big industrial boom. Look at these amazing facts:

- Lifting the freeze on new TV stations will open many new TV areas and will improve the coverage of existing areas. The result will be an enormous demand for TV receivers.
- Within a few years over 1000 TV stations will be telecasting compared with 108 TV stations now on the air.
- Nearly one-half of all families living within the present TV areas do not yet own TV receivers.
- The new trans-continental video network plus better and more interesting programs plus larger viewing screens and color TV will increase the installation of new receivers, will induce present owners of 12-inch and smaller size viewing screens to buy newer model receivers.
- The power increases of many existing stations and improved reception range of current receivers will result in receivers being installed and serviced in the fringe areas of present stations.
- Under the FCC proposal, over 70 per cent of all communities will be served by UHF channels exclusively. This means TV servicemen must know UHF receivers before the new UHF stations in their area are opened.
- No one yet knows how great the industrial TV market will be.

RCA Institutes Home Study Course prepares you for a Career in TV Servicing

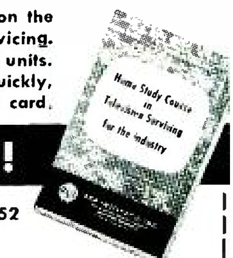
The addition of the RCA Institutes TV Service Training to your present radio-electronics experience will qualify you to step out and grasp the golden opportunities that now exist in television—America's fastest growing industry.

Learn at home—in your spare time—while you study the practical *how-to-do-it* techniques with *how-it-works* information. Easy-to-read and easy-to-understand lessons under the supervision of RCA engineers and experienced instructors quickly train you to qualify for the many good jobs now waiting for trained TV servicemen. Don't pass up this lifetime opportunity for financial security and a bright future in TV. Learn TV Servicing from RCA—pioneers and leaders in radio, television and electronic developments.

RCA Institutes conducts a resident school in New York City offering day and evening courses in Radio and TV Servicing, Radio Code and Radio Operating, Radio Broadcasting, Advanced Technology. *Write for free catalog on resident courses.*

Send for FREE BOOKLET

Mail the coupon—today. Get complete information on the RCA INSTITUTES Home Study Course in Television Servicing. Booklet gives you a general outline of the course by units. See how this practical home study course trains you quickly, easily. Mail coupon in envelope or paste on postal card.



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Without obligation on my part, please send me copy of booklet "RCA INSTITUTES Home Study Course in TELEVISION SERVICING." (No salesman will call.)

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MICROWAVE EVOLUTION

. . . New means for quick, efficient, low-price communication. . . .

By HUGO GERNSBACK

INDUSTRY and commerce today more and more require ultrafast communication. This is particularly true of our big industries and corporations which must have instantaneous service between branches, their factories, and elsewhere, when seconds saved are often of the utmost importance. The telephone, the telegraph are no longer quick enough and in some ways are too costly. Even radio communication through independent communication companies has become far too slow.

Hence, many of our larger corporations have installed their own communication systems, taking advantage of the flexibility and comparative low cost of modern microwaves. These microwave (u.h.f.) private networks operate on frequencies from about 950 to 5000 mc.

Nearly 150 of our large corporations, many of which are oil companies, use the u.h.f. networks not only for communications but also to telemeter, run teletypes, open and close distant switches, operate direct phone networks and many other similar services. The corporations have their own private operators and their systems therefore are self-contained in all respects. Many of them maintain twenty-four-hour microwave service, every day of the week.

Microwaves are highly attractive because their use is far more economical than using telegraph or telephone lines, as was the case in older private communication systems. The cost per mile is less than half with microwaves and the maintenance cost is very low. During sleet storms and hurricanes wire-line damages run high, whereas with microwaves the communication towers are anywhere from twenty-five to fifty miles apart, cutting maintenance costs sharply.

It is interesting to note that even old-time corporations such as Western Union, which at one time relied mainly on pole wire lines and for years operated in the red, finally began making a profit when they switched to microwaves. Western Union is now busily engaged in extending its microwave system throughout the country, at a huge saving in maintenance and operating costs.

To date, the American Telephone and Telegraph Company is the largest user of the microwaves, having pioneered in it over many years. The recent successful completion of their coast to coast network uses microwaves not only—as is often erroneously thought—for television, but more for multiplex phone communication from coast to coast besides other services of the corporation. Microwaves are so flexible that a single channel can carry up to 2500 simultaneous messages, against 1800 on the older (and more costly) coaxial cable.

But microwave channels are not used solely by our large corporations. One of the important new users is the recently opened *New Jersey Turnpike*, operated by the State of New Jersey. This new toll superhighway operates its own statewide network on 960 mc. The system now has seven microwave towers, each about one hundred and fifty feet high. These have been erected near Newark, New Brunswick, Trenton, Bordentown, Moorestown, and Swedesboro. Two towers have been erected near Newark.

The system consists of a voice channel which monitors the entire system. There is also a dial phone for administrative calls as well as two voice channels used for communication with state police cars and maintenance trucks. In addition to this, there is also a teletype one-party line. An innovation is that it is possible to cover the entire length of the new turnpike with two-way mobile coverage for instant communication. This is effected by having a number of v.h.f. base stations at five of the system's seven microwave towers for communicating with the vehicles. The system is so well integrated that the dial phones and teletypes can link the police for the entire length of the turnpike with one another as well as with the state police headquarters in Trenton. The same is the case with state troopers, maintenance trucks and all toll gates along the road. Over $100,000 has so far been expended on this new microwave communication network.

Another highway system now making use of microwave communication is the Pennsylvania Turnpike Commission, whose system is similar to that of the New Jersey Turnpike.

Another user, at present experimenting with microwaves in the Northwest, is the Bonneville Power Administration. The versatile waves will be used by Bonneville to monitor its power lines, compute the location of line breaks, and automatically record the time of the failure.

The Atomic Energy Commission is another newcomer which requires microwaves chiefly for remote control purposes. Due to the fact that atomic workers cannot be exposed to dangerous radiations, many atomic plants must be operated from a distance. This is a most complex undertaking, because many of the operations must be checked and doublechecked without any human being on the spot to supervise plant operation and other facilities. Through a variety of interlocking devices, microwaves furnish the key for safe operation. In fact they can do anything that humans do—and often do tasks impossible for humans. This particular branch of microwaves is due for great future expansion.

But to date, numerically the oil companies are in the advance guard as users of microwaves. In the telemetering and supervision of their long pipelines, opening and closing distant valves, controlling pressures in pipes, starting and stopping pumps, getting reports on distant oil flow, the oil companies have found a most versatile tool in microwaves. Such companies as the Peoples Gas Light and Coke Company obtains automatic reports on distant gas pressure, gas flow, metering, etc., by microwave. The Transcontinental Gas Pipe Line Corporation is now considering installation of a microwave system for its new 1,800-mile pipeline from Texas to New York. Most of the large pipelines are certain to follow suit in the near future.

All in all, microwaves for industry and commerce are bound to expand enormously in the foreseeable future, with expenditures for installation alone running into tens of millions of dollars.

TV marries the MOVIES

By AARON NADELL

TELEVISION and the motion picture theater are getting married. Theater owners do not wish their two and a half billion dollar investment jeopardized by video, so they are taking the gal right into their family. Equipment manufacturers have found amazingly ingenious ways of encouraging the match.

Theaters equipped for TV do more than just pick standard telecasts out of the air. They all do that; but some of them also maintain camera crews and buy exclusive rights to special events, thus giving their paying customers programs that cannot be seen at home. By pooling their resources, theaters in different cities now are linked by coaxial or microwave nets to handle sports events or other special features on an exclusive basis.

Programs obtained from either of these sources are placed before theatergoers through any of five general types of equipment.

Three of the five general types of TV installations now in theater use provide enlarged, projected images up to 24 feet wide. A fourth, similar to one of the three just referred to, supplies projected images not more than 8 or 9 feet wide. It is used principally in the "television lounges" that showmen are now installing as a sort of theater within a theater. The fifth type of theater system is merely a home receiver, set up in a lobby, foyer or television lounge.

Only this last type, it should be noted, is likely to offer the average television dealer or service technician much opportunity in a business way. The first four systems, which are priced up to $25,000 each, have been put on the market through established theater-supply dealers, not through television dealers. Their maintenance and repair has been arranged for, by their manufacturers, through organizations that now service theater projection and sound equipment. Sale and maintenance of a home-type unit for lobby use is a wide-open field that anyone may enter.

Theaters use TV for a number of different purposes, all considered important. A lobby set diverts patrons who cannot find seats immediately. A TV lounge encourages attendance by those who prefer to see their movies from the beginning and might not come in to wait if there were no other entertainment to keep them amused until the next show starts. Reproduction of regular telecasts by either of these means attracts those who would not come to the theater if that meant missing some favored video program. The lounge enables family groups to separate while attending the same theater: thus, Papa can watch the boxing matches while Mama sobs through the drama; or both parents can watch TV while the kiddies sit through a Western.

Further, TV is used to attract patrons by showing special events not available in the home or tavern, as mentioned above. Showmen located in or beyond fringe areas have put up receiving antennas that mere home-owners can't afford.

Photo A shows essentially home-type equipment giving direct-view presentation on a standard picture tube. The minor problem of keeping patrons from fiddling with the controls is met by mounting the tube in a wall so only its face is visible, the controls being elsewhere in a locked room and adjusted with the help of a monitor tube.

Photo B shows a lounge-type installation delivering an optically projected image that can be as much as 8 or 9 feet wide. The optical arrangements are similar to those invented for astronomical work. They are called Schmidt optics, after their inventor. A small picture tube—usually 3 or 5 inches across—faces a spherically curved mirror. The stem of the tube protrudes through a hole centrally located in a thin *correcting lens*, also called *corrector plate*. The mirror projects the image to the 9-foot screen through this lens, which counteracts and neutralizes the spherical aberration. The "optical barrel" that houses the tube and optical system is atop the cabinet at the front of the center aisle (Photo B). The rest of the TV receiver is in the cabinet.

A larger C-R tube and optical system projects theater images up to 24 feet wide. The picture tube is 7 inches in face diameter and operates at an anode potential of 80 kv. The spherical mirror is 30 inches in diameter. Picture brilliance in general approaches but does not equal the standard set some years ago by the Society of Motion Picture Engineers.

Film storage system

The fourth and fifth kinds of theater TV in current use are variations of the so-called *film storage* or *film intermediate* method of enlargement and projection.

In this system the image on the picture tube is reversed to present a negative—black where white should be, and vice versa—and photographed by a motion picture camera. The film runs continuously from the camera through automatic high-speed development and thence directly into a motion picture projector. It is thus shown like any other film, and can be given the theater's standard image width and brightness. Because the developing solutions operate at elevated temperature, the time lag between photographing the image and projecting it before the audience may be as little as 40 seconds. The fourth standard is 35-mm film and standard theater projection equipment; the fifth is a similar system using 16-mm

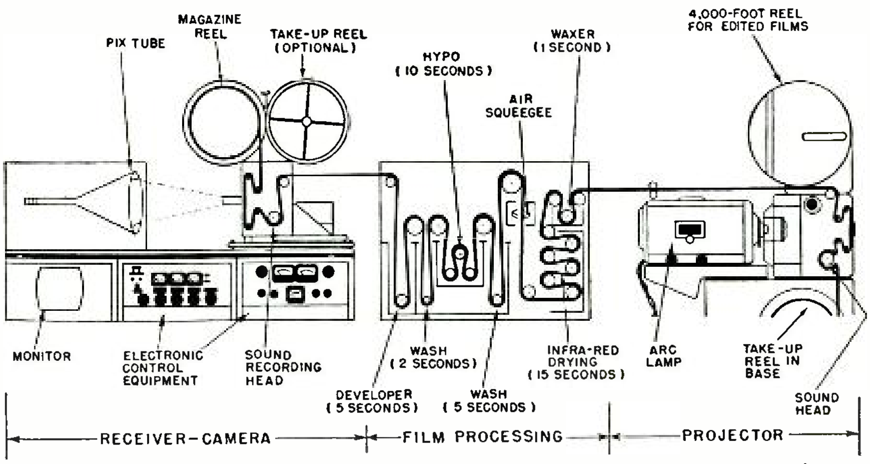

Fig. 1—The film's course from kinescope through developer and to the projector.

film and a 16-mm projector. Photo C shows some control equipment and a part of the film-processing equipment.

It is in these systems that the 30-frames-per-second of television must be converted to the 24-frames-per-second for standard movie projectors. Several effective but intricate methods for doing this have been worked out. Some are mechanical. The one associated with Fig. 1 is completely electronic.

This arrangement includes what is, in effect, an electronic counter. The C-R tube remains dark until the camera film has been pulled down one frame and is motionless behind the lens. Then a circuit associated with the camera mechanism turns on the tube. The electronic counter goes into action immediately, and after the 525th horizontal scanning pulse has been counted, darkens the tube again. It remains dark until the camera once more turns it on, after the next frame of film has been pulled down. This cycle is repeated 24 times a second. Each time, ¼ TV frame is lost out of every 1¼ TV frames. Thus 24 images per second are photographed, regardless of the fact that 30 are supplied to the tube. Sound is recorded simultaneously.

Film produced in this way remains a permanent record that can be shown again in the same theater or "bicycled" to affiliated theaters for subsequent showings. This was done during a recent Presidential broadcast. The telecast was piped over coax to the New York Paramount and projected there with a time lag of about 60 seconds, then rushed across the river to the Brooklyn Paramount.

Other theaters, in New York and elsewhere about the country, took the telecast from the air.

Smaller theaters, using home-type or lounge equipment, show nothing but commercial telecasts. Larger theaters may have their own TV camera crews, or several noncompetitive theaters may share the cost of one crew. Equalized coaxial lines or the theater's own microwave links may be used to get the program to its destination. These processes were begun in 1948, were expanded in 1949, and still further expanded in 1950. Plans announced before the imposition of government restrictions called for ballooning expansion in 1951-52. Whether that will now be possible remains doubtful at this moment.

But there is no doubt at all that television and the motion picture theater are definitely getting married. Whatever may happen with respect to the larger equipments during this emergency, the smaller ones seem destined to become as common a theater facility as the popcorn machine. Their advantages are many and evident; their price is low, and operation costs almost nothing. As a final endorsement on the marriage license, it may be noted, the Society of Motion Picture Engineers has changed its name to Society of Motion Picture and Television Engineers, and now admits to membership persons whose backgrounds lie in either field.

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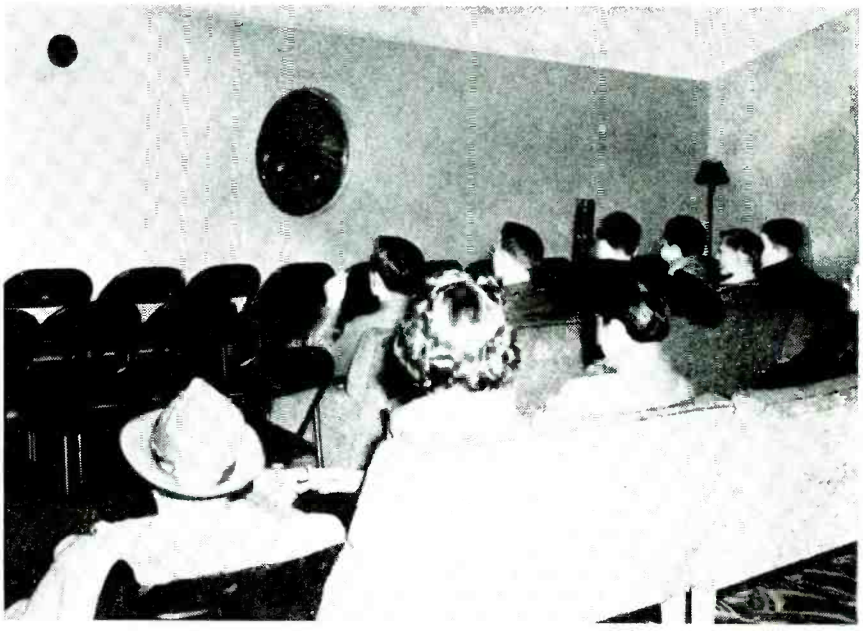


Photo A.—Moviegoers don't mind waiting for seats in the homelike TV lounge.

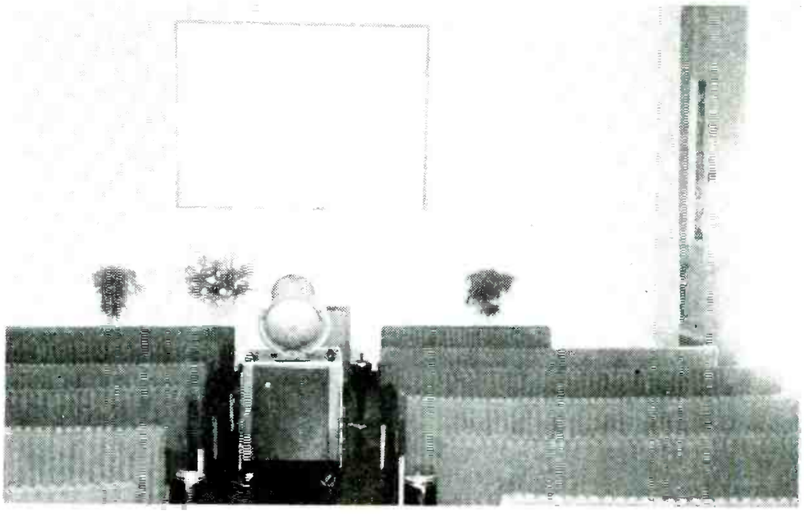


Photo B.—Projection unit provides a large TV picture for waiting audience.

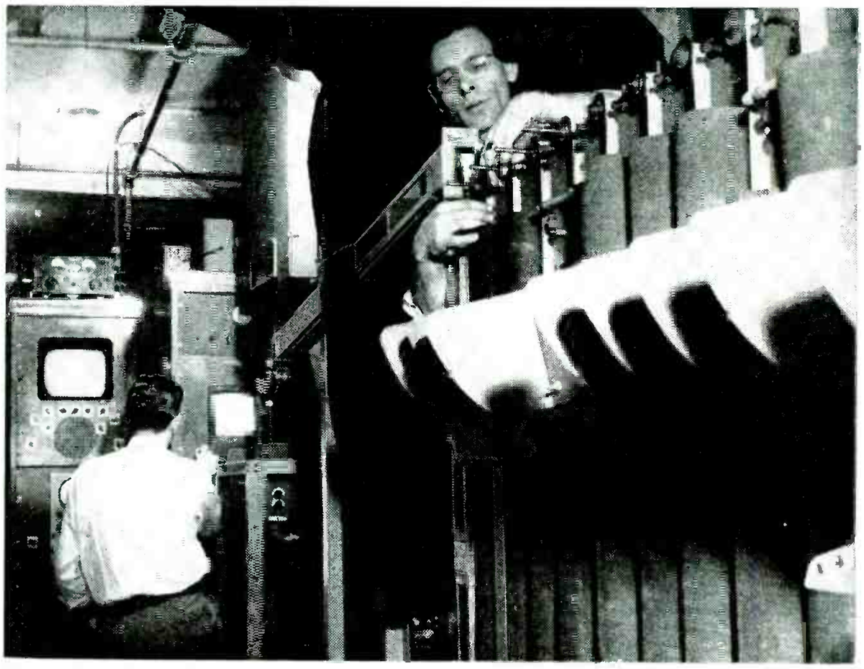


Photo C.—Control and film-processing equipment in large theatre installation.

TV CONVERSION DETAILS

For the past year we have been sending a brochure on big-tube conversion to all readers who requested it. The brochure was prepared originally by Walter Buchsbaum and later revised by Matthew Mandl. The demand for it has been increasing regularly, so we are printing it herewith for the benefit of all our readers.

THIS article on conversion deals with the electromagnetically deflected receivers. Electrostatic 7-inch receivers require major design changes and conversion is not recommended. Slave units are much more satisfactory for such receivers (see page 22 of RADIO-ELECTRONICS for August, 1951).

Complete kits, containing all matching components as well as an accompanying instruction sheet, make conversions easier. These are available and occasionally advertised in the pages of RADIO-ELECTRONICS.

Three primary factors must be considered in any conversion: The cabinet size, the tube type, and the necessary circuit changes. If the cabinet is not to be changed, the tube will be limited to the next larger size unless the cabinet is very roomy. Mechanical problems include changing the picture-face cabinet aperture and mask, mounting the picture tube on new brackets to raise it to the required height, and extending leads to the socket and neck assemblies. Such factors depend on the size of picture tube required and whether or not a new cabinet is to be utilized, therefore only the electrical aspects of conversion will be discussed here.

Changing a 10-inch to a 12-inch tube usually requires no major electrical modifications. Tubes often can be replaced without yoke change if the larger tubes do not have deflection angles in excess of 65 degrees. When rectangular tubes or large round picture tubes are to replace 10- and 12-inch ones, major changes must be made in the horizontal flyback section of the receiver. A new yoke, a matching transformer, and often a new width coil and focus coil are needed. Besides this, second-anode voltages must be higher, and changes in the vertical-sweep section may be necessary to secure the required additional height for the larger tube.

Horizontal-sweep section

In most modern receivers the horizontal-sweep system uses a flyback transformer for horizontal output and high voltage. If the radio-frequency type high-voltage system is used it would be advisable to rewire the high-voltage compartment for the flyback deflection system.

There are a number of different components as well as circuit variations for conversion to the large-screen picture tubes. In many cases the set's original circuit can be used, with some modifications for the higher voltages and greater sweep.

The yoke must match the flyback transformer. For this reason it is preferable to secure a transformer and yoke recommended by the manufacturer for use together. Thus, for conversion to the 14- or 16-inch tubes with a deflection angle of 70 degrees, the Merit HVO-6 flyback transformer can be used with the Merit MDF-70 yoke. In addition, a Merit MWC-1 width coil can be used and a Merit MF2 focus coil. A General Electric RTO-085 kickback transformer can be used in conjunction with the G-E RLD-024 yoke. An RLD-017 or 019 width coil can be used. If the original focus coil is inadequate, an RLF-038 focus coil can be used.

The same holds true for the 19- or 20-inch tubes which have a deflection angle of 66 to 70 degrees. An RCA 225T1 transformer can be used with a 209D1 or 211D1 yoke. An RCA 202D2 focus coil can be used in conjunction with this combination. A Ram X053 transformer can be used with Y70F10 yoke. This combination will furnish approximately 17,000 volts as compared with the 16,000 for the previously mentioned transformer. A Ram 201R11 width coil will work with these. A Quam QFC focalizer can be used instead of the focus coil, or the RCA 202D2 can be utilized. Merit also has a combination for the 20-inch tubes which uses a cosine wide-focus yoke such as the MDF-70. An HVO-7 flyback transformer can be used in connection with a Merit MWC-1 width coil.

For the 24-inch tubes a Merit HVO-8 transformer can be used with an MDF-30 cosine yoke. Ram also has a transformer for direct-drive circuits in the X035. The matching yoke is the Y70F10 and the width coil is the 201R4.

A typical circuit for a 14- or 16-inch conversion is shown in Fig. 1. This uses a minimum of new components and does not require any more filament or B-power than most of the 10- or 12-inch receivers already have. The 6BQ6-GT tube is recommended because it is somewhat more efficient than the 6BG6-G. The 6CD6-G can be used as a direct replacement for the 6BG6-G, though greater filament current is required. Care should be taken that the 6CD6-G does not exceed the rating of the power transformer. Otherwise an additional filament transformer must be installed. When using the 6BQ6-GT the socket will have to be rewired as shown in Fig. 1. If the 6BG6-G is to be retained, increase the screen voltage by using a lower value of screen-dropping resistor. The maximum screen rating of the 6BG6-G is 350 volts; the 6CD6-G 175; and the 6BQ6-GT 200. All these can be exceeded by approximately 25 volts without damaging the tube.

WARNING!

We have received requests for conversion information from persons who state they have had little radio training. *Conversion is no job for the unskilled man!* Unless you are an experienced technician, familiar with the precautions necessary in handling picture tubes, and with some knowledge of television circuits, keep away from it! You face danger of injury or death from high voltage or possible tube implosion, and the set or tube may be damaged by wrong adjustments of ion traps or wrong connections. Let a qualified service technician do the job.

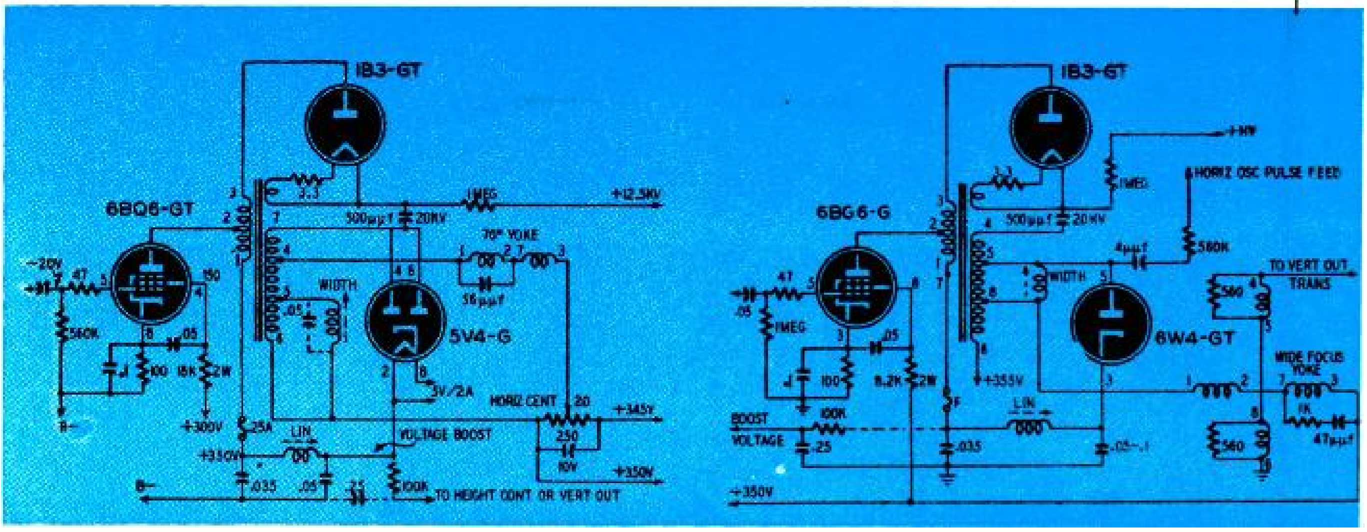


Fig. 1—Diagram of horizontal output for 14- or 16-inch jobs. Fig. 2—A circuit useful for 19- or 20-inch conversions.

The circuit of Fig. 1 uses a Ram X030 high-efficiency output transformer which usually mounts in the same holes and space as most of the older transformers such as the RCA 211T1, 211T3, etc. The same width and linearity coils can be used as in the original circuit. Thus, the width coil is an RCA 201R1 and the linearity coil an RCA 201R3. This circuit incorporates a horizontal centering control similar to the type used in the RCA 630 receivers as well as many others. If mechanical centering is used, a 20-ohm, 2-watt resistor may be connected between the deflection yoke lead and the B-plus terminal of Fig. 1.

The damper tube shown in Fig. 1 is a 5V4-G. It requires 5 volts for the heater connections. A 6W4-GT, which requires 6.3 volts, can be used as shown in Fig. 2. It is a more rugged tube and preferable.

A 1X2 miniature rectifier can be used instead of the 1B3-GT shown. The wiring is identical except that the anode connector clip must be changed to fit the 1X2. The deflection yoke should be a 70-degree type. For rectangular tubes or other short-necked picture tubes the length of the yoke is very important. If the yoke is too long the focus coil and ion-trap magnet will not fit properly and a dim or partly cut-off picture will result. The total length of the coils should not exceed 2⅜ inches. Otherwise neck shadows and other faults will result.

A suitable circuit for the 20-inch tubes is shown in Fig. 2. It uses a Merit HVO-7 output transformer with a matching MFD-70 deflection yoke. An MWC-1 width coil is used with this combination. Fig. 2 is for receivers in which the chassis is the ground, as compared with the RCA 630 types which use a B-minus as in Fig. 1. The first voltage-boost capacitor below the damper tube can be changed from .05 to 0.1 or to some intermediate values to minimize linearity defects and reduce transient oscillations caused by improper damping. The latter will sometimes produce white vertical bars to the left of the screen. The 47-ohm resistor in series with the grid circuit of both systems illustrated is to reduce Barkhausen oscillations which will produce dark vertical bars to the left of the screen. In Fig. 2 a connection for feeding a pulse to the horizontal oscillator is shown. This connection is required in some sync-lock circuits.

If the new tube does not have an outer conductive coating, an additional filter capacitor may have to be placed beyond the 1-megohm series resistor in the high-voltage line. This should be a 500-μμf, 20,000-volt filter.

Vertical-sweep section

Many older receivers have a vertical-sweep system with sufficient reserve power to give the necessary increase in height for the large tubes. Unless the sweep amplitude on the old tube was barely sufficient for full height, no changes should be made until the horizontal system has been completed. If increased vertical sweep is necessary the voltage to the plate of the vertical-output tube can be increased, or the vertical-output tube can be changed to one giving a greater output. If, for instance, a 6SN7-GT tube is used as a combination oscillator and vertical output, a 6BL7-GT can be substituted without circuit change. A 12BH7 is a direct substitute for the 12AU7 and will give increased height. When a 6K6 tube is used, substituting a 6V6 will usually help.

These substitutions will function only in sets with filaments wired in parallel. If a pentode is used but connected as a triode, rewire the tube socket and connect the screen grid to a well-filtered B-plus point in the low-voltage power supply. Check with the tube manual for proper screen voltage.

If tube substitution is not possible or does not increase height enough, connect the B-plus side of the height control to the boost voltage as shown in the dotted line sections of Fig. 1 or Fig. 2. The 100,000-ohm resistor and 0.25μf capacitor are a decoupling network. If the height is still insufficient, connect the B-plus side of the vertical-output transformer to the boost voltage instead of the height control. For this change use a 5,000-ohm, 2-watt resistor and an 8-μf, 600-volt filter capacitor in place of the 0.25 shunt. However, this will tend to reduce the high voltage and width slightly. Experiment with different values of resistors and capacitors for maximum efficiency in both the vertical and horizontal circuits.

Focus coil and ion trap

All the larger tubes beyond the 14-inch size require a greater magnetic field in the focus coil. The easiest change is to substitute a new focus coil in place of the old one. For Fig. 1 the RMA 109 (Tech-Master 2D2, Stancor FC-11. Quam QF2, RCA 202D2, etc.) can be used. It is larger than the old types and has a round steel case. Its resistance is approximately 470 ohms. If focus cannot be obtained with the new coil, reverse the connections and note the results.

Focus-coil current can be increased when needed by changing the associated resistor values around the focus control. A shunt resistor can be removed or any resistor which is in series with the focus coil can be shunted. Make sure such resistors are in the focus-coil circuit only and do not affect other circuits. For instance, in the Admiral 30A1 chassis, a decreased resistance in the focus network will also increase the voltage to grid 2 of the picture tube because the focus network is a resistor in series with the B-plus supply. (This increased voltage to grid 2 of the picture tube is all right in this case because most of the large tubes require about 50 volts more on grid 2 than do the smaller types.)

Receivers which use a combination of electromagnetic and permanent-magnet focus coils may require a new coil or else a full PM focus ring. If high voltage is raised above 15,000, some PM focus devices don't have enough field strength to focus the picture.

Three types of electrostatic tubes are being manufactured: The one requiring high voltage on the focus electrode; the type which uses low voltage from the B supply; and the self-focus type requiring no focus electrode voltage. The high-voltage type appears to be going out, and is not recommended.

For low-voltage types like the 17HP4 and 20HP4, voltage for the focusing electrode can be obtained from the low-voltage power supply, using a potentiometer for the control. Voltage values depend on tube type and should be those recommended by the manufacturer. Focus coil is not used, but the old focus coil would not be placed on the neck. The focus coil should be left in the circuit or replaced with a resistor having the same value as the d.c. resistance of the coil. Make the necessary socket changes.

For the newer self-focusing C-R tubes, direct replacement can be made without use of focus coil. (The latter should be left in the circuit, however, as described above.) No focus control is used, though the old one can be left in circuit or replaced with a resistor.

Practically all of the newer large-screen tubes use either a single- or double-magnet ion trap. If the old receiver used an electromagnetic ion trap of two coils, it can be left in the circuit by removing it from the tube and taping it to the chassis. A PM ion trap then can be placed on the new tube. Be sure to use the correct type of trap for the new tube, because damage to the screen material can result from an incorrect ion trap. (See "Ion Burns" in the February, 1952, issue.)

In converting sets several years old, change all tubes from the horizontal oscillator through to the deflection-coil circuit. Also replace the low-voltage rectifiers. Tubes used for a long time have lower output. Installing a new discharge tube, horizontal output, high-voltage rectifier, and damping tube will give the increased efficiency necessary for the larger-sized picture tube.

Corona or arcing: Because of the new higher voltages the high-voltage section may have corona or even arc-over. To avoid it, keep all high-voltage connections smooth. Avoid sharp bends and keep high-voltage wires away from each other and from the chassis. Clean all insulating surfaces with carbon tet. If necessary, paint the high-voltage socket with Glyptal or polystyrene coil dope. Coat grounded parts near high-voltage points with the same material. If there is no corona ring on the high-voltage socket, connect all unused tube pins together with No. 18 bare wire. Leave smooth, well-soldered joints.

Insufficient width: Check all low voltages (except that at the plate of the horizontal-output tube—there are 6,000-volt pulses there!). If there is not enough bias on the output tube (about 18 volts for a 6BQ6) increase the value of the grid-coupling capacitor. Also increase the voltage on the horizontal oscillator or discharge tube by decreasing series plate resistance. In the synchro-lock circuits, reduce the discharge capacitor and increase the resistor in series with it experimentally. Connect a .05-μf capacitor across the width coil as shown by the dotted lines in Fig. 1. This reduces high-voltage supply but increases width. Increasing the screen voltage of the horizontal output tube (as previously mentioned) also helps. Also check the low-voltage power-supply system because in some instances a gradual decrease in the low-voltage output over the years may have been compensated for by increasing the height and width-control settings. Replace the low-voltage rectifier tubes and check the filter capacitors for leakage.

Picture blooming: Blooming is caused by too low second-anode voltage. This decreases beam velocity and the electron stream is more strongly influenced by the magnetic fields of the yoke. It is therefore swept too much. If the high voltage is too low and the preceding measures have not helped, a voltage-doubling circuit may be needed.

Excessive high voltage will reduce the picture size because the magnetic fields of the yoke cannot sweep the beam fully because of increased velocity. High voltage tests should be made in such an instance to discover whether the insufficient picture size is caused by increased high voltage or by insufficient sweep. A defective low-voltage supply will also decrease picture size.

Many special points—mechanical as well as electrical—have been discussed in articles and short items in this magazine. They contain detailed information on conversion of various models, hints on the furniture aspects of conversion, and other information useful in converting sets for bigger tubes. The more important articles are listed below.

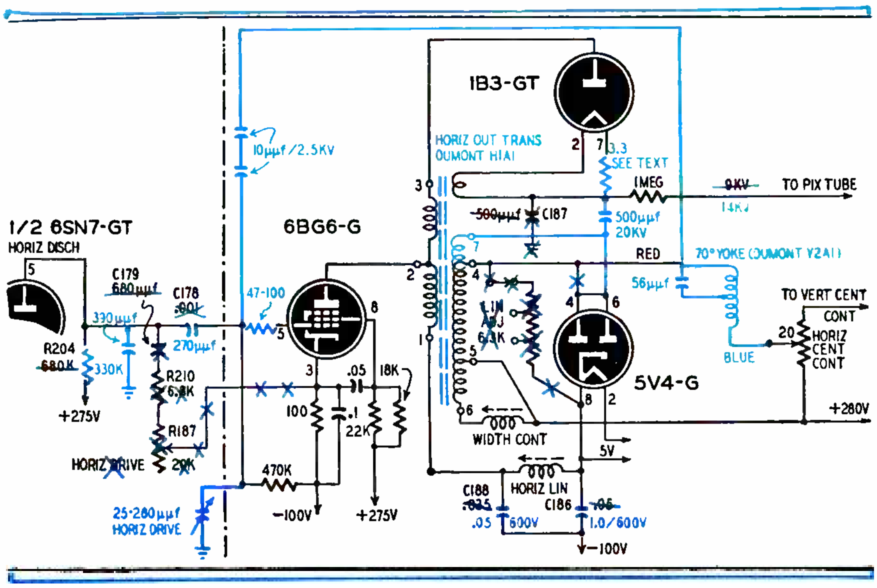
References:

Big-Tube Conversions Are Profitable....Jan., 1951
Converting to Bigger TV Tubes..........May, 1951
Slave Unit for 7-Inch Conversions........Aug., 1951
Special Problems in TV Conversions .....Aug., 1951
TV Conversion Components..............Aug., 1951
Profitable Conversion with Rectangular Tubes..........Aug. and Sept., 1951
630 to 17 inches ....Jan., 1952

—end—

CORRECT "630 TO 17 INCHES" DIAGRAM

In a large number of the copies of the January issue, the diagram on page 56 was printed badly out of register, making it difficult or impossible to understand. The corrected diagram is below. The changes in the circuit are printed in blue, while the original parts are shown in black.



TV DX FOR MARCH

TV receiving conditions during March will be generally similar to those of February over most of the country, though there will be some evenings of fairly good propagation that will be a foretaste of better things to come as spring advances. As warmer weather comes to the Gulf states and the Southwest, the average quality of fringe-area reception will improve appreciably.

Sporadic-E dx will be rare in March, as in February, though years of experience have shown that this phenomenon that brings us low-band TV signals from 600 to 1,300 miles away *can* happen anytime. The openings observed during March are not likely to be of long duration, nor is the reception apt to be of "program quality" for long.

For viewers in the northern states and adjacent Canadian areas there will be pronounced auroral activity, with the likelihood that the disturbances will be strong enough to affect the lower TV channels. This is most commonly seen as co-channel interference on channel 4, as it is most heavily saturated with stations, and to a lesser extent on other low-band channels.

To what extent aurora is capable of affecting the high-band channels is still a matter of conjecture, and may be answered by discerning TV dx observers.

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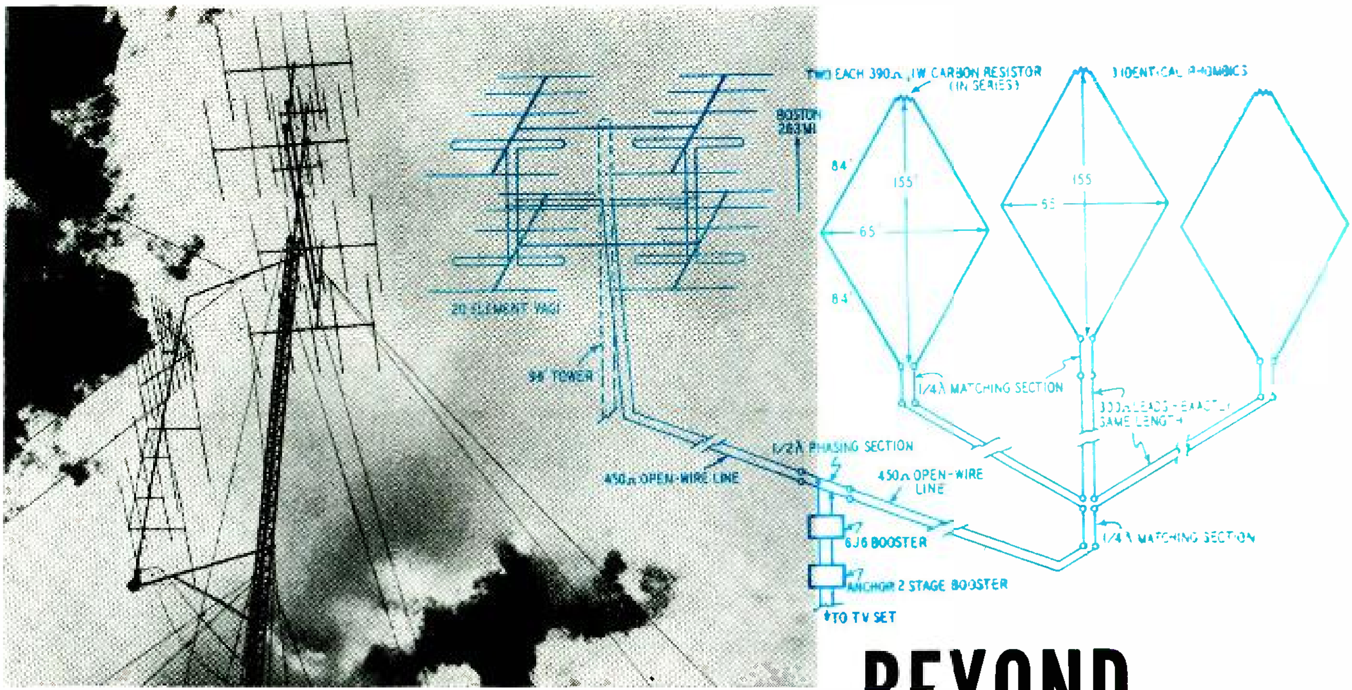
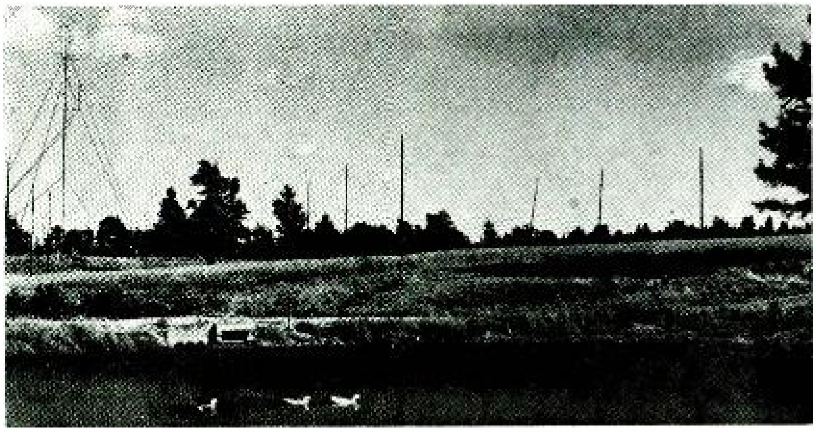


Above—The Yagi arrays for 4 and 7. Below—The "ten-acre-field" rhombic array.



BEYOND THE FRINGES

by
T. W. MORGAN
and
R. J. BUCHAN

IMPROVEMENTS in antennas and receivers, plus increased transmitter power, have stretched the range of TV signals so that 75 to 150 miles is considered "fringe" by many stations. Thomas W. Morgan at West Pembroke, Maine, has succeeded in stretching this distance with an elaborate antenna system to an almost unbelievable 263 miles. Three large rhombics, 84 feet to a leg, *in parallel* with a 20-element Yagi, mounted on a 98-foot tower, for channel 4, plus an assortment of three arrays for channel 7 should qualify as the world's largest antenna receiving installation.

The system of connecting the three rhombics, which are in parallel with the 20-element Yagi, is shown in the figure. The quarter-wave matching sections connecting the rhombics to the twin lead are 42 inches in length, and constructed of No. 14 wire, spaced two inches. The quarter-wave matching section at the junction of the three leads from the rhombics matches the 100-ohm resultant impedance of the three leads in parallel to the 450-ohm open wire line. It has an impedance of 210 ohms, and is constructed from ⅜-inch outside diameter copper tubing 42 inches in length, spaced 1¼ inches. The impedance of the quarter-wave phasing section between the two antennas is not critical, and can be made of bare wire or tubing. If made 42 inches long, it may be necessary to reverse the lead from one antenna in order to cover a 180-degree phase difference so that the signals from the two antennas will add. It can be made 84 inches long. In this case moving the connections to the booster between the two ends should result in a point of maximum brightness—when the correct point is found—without reversing one antenna lead.

If an antenna having a small amount of gain is connected to a high-gain antenna, very little, if any, differences will be noted as the connections are varied along the phasing strip. However, the situation changes when two antennas having equal gain are phased out. At a point 180 degrees out of phase, the signal will be zero, and at a point in phase, it will be 3 db better than with either antenna when used alone. The signal received with the entire system is definitely better than either the 20-element Yagi or the rhombic alone. This shows that more than one antenna can be connected to a set, provided they are properly phased out and impedances are matched.

A 30-foot gin pole has been permanently set back of the 98-foot tower so that, with the use of two blocks and tackles (the second one as a safety measure), the tower can be lowered or raised in a few minutes.

Two boosters are normally used—a custom-built one first, using the well-known 6J6 neutralized triode circuit, plus an Anchor two-stage booster for additional amplification. Various sets have been used. The present one is a 20-inch Sheraton with which sound is received 75% and a picture about 30% of the time the set is tuned in from WBZ-TV, channel 4, Boston, Mass.

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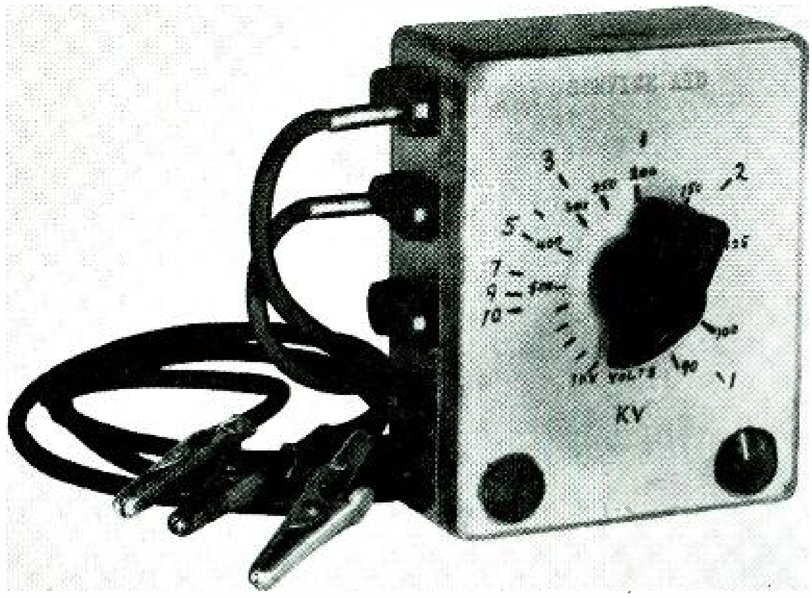


This simple TV Service Aid may be as useful as much more expensive apparatus.

A pocket-size device using no meters or other expensive components, this is an excellent TV test unit for student use and service in the home

By
CHARLES G. BUSCOMBE*

THE TV "SERVICE AID"

THERE is no disputing the value of accurate test equipment such as the sweep and marker generator, oscilloscope, tube checker and vacuum-tube voltmeter for fast, efficient, complete TV receiver servicing.

But there are times when the technician is called upon to service a set without any of these instruments. The amount of apparatus that can be carried into a customer's home is strictly limited, to give one example. When regulation type test instruments are not readily available, the *skilled* technician can do nicely with nothing more than a kit of replacement tubes, an R-C decade box or an assortment of resistors and capacitors, plus the usual hand tools. His greatest asset in such work is a plentiful supply of down-to-earth "know-how" and a good knowledge of circuit theory.

To supplement the above, the writer has designed and constructed the simple *Service Aid* described in this article. It is cheaper and more rugged than the standard v.t.v.m. or multitester, and because it is specifically designed for television set testing, may be even more useful. With this instrument and the intelligent use of suitable techniques, it is possible to locate close to 90% of the troubles encountered in any section of the TV receiver.

The TV Service Aid is a tubeless, meterless instrument of vest-pocket size, that will enable a capable technician to perform all the tests normally performed in a customer's home with reasonable accuracy and speed.

It was originally constructed experimentally and put to use with some reservations as to its ultimate value, considering its utter simplicity. But over a period of several months it has more than lived up to expectations.

Such a Service Aid can be of great value to the busy technician on house calls, or even in the shop when his regular equipment is tied up on other jobs. It can be used:

For measuring plate and screen voltages and taking other readings in low-voltage supplies. The hot lead is connected to terminal B (See circuit diagram) with black ground lead clipped to chassis. The control potentiometer is then slowly varied until the neon bulb just barely fires. Voltage is read directly from the calibrated scale, which is graduated from 80 to 1,000 volts. (It was found after considerable experiment that the average neon lamp could not be made to fire at less than about 70 volts. This of course prevents it being used for bias tests.) Its reliability over the calibrated range is extremely good, as proven by continued accuracy over several months of use.

For measuring output of high voltage power supplies. Use terminal A and ground lead. Readings are taken as for low voltages. *Be careful not to touch bared ends of hot leads because of the shock hazard.* Scale is calibrated from 1 to 50 kv. Negligible loading is imposed on the circuit under test (multiplier totals over 70 megohms and firing current of bulb is only a few microamps.

Audio signal generator, using conventional relaxation-type oscillator circuit. Terminal B is connected to a convenient B-plus point in the set under test. Audio signal of approximately 1,000 cycles is taken from terminal C. It can be used for signal tracing in both audio and video amplifier circuits. Control is varied until desired tone at proper level is obtained. The setting will vary according to the amount of B-voltage used.

Signal tracing of all stages (front end, pix i.f. video, sound i.f., a.f., sync and sweep circuits). Uses a 1N34 crystal diode.

Probe lead is taken from terminal C and applied to circuit under test. Signals can be monitored by plugging phones into the jack or—what is usually more convenient—making use of the audio amplifier in the set. This is done by connecting terminal D to the volume control or to first a.f. grid. To prevent possible overload to crystal when tracing high amplitude signals, probe should be connected to terminal E, using potentiometer as an attenuator.

For tracing inaudible horizontal sync and sawtooth voltages, use a lead to jump test pulses to the a.f. amplifier input. Then use the neon voltage tester for visual indication by connecting C to the a.f. output plate. A little practice will enable the user to recognize the control setting which indicates approximately correct pulse levels. The setting at which the neon tube fires will of course vary somewhat with different amplifiers.

Control voltage for a.g.c. and sync stabilization. To obtain a small amount of negative voltage to stabilize a.g.c. during alignment, connect A or B to some negative voltage point in set, with black lead to chassis. Stabilizing voltage is taken from terminal E, and varied with control.

*Western Radio Television Inst.
Los Angeles, Calif.

To determine if horizontal or vertical sweep oscillators are free-running too fast or too slow, and to make necessary frequency correction, thus providing a temporary sync or hold control: Connect E direct to sweep oscillator grid. (If oscillator frequency is too high a negative voltage is required, and if too low, connect A or B to B-plus of set).

To find why high-voltage fuse blows: Connect dial light across fuse (terminal F and black lead). The brightness of the bulb will give a relative idea as to overload conditions. Pulling tubes which may be responsible may then locate the trouble.

The dial light is also a handy continuity tester in all circuits where normal current should light it within its normal brilliancy range.

Capacitor testing and continuity checks: With connections as for low-voltage measurements, connect capacitor in series with hot lead and B-plus, and adjust for glow on neon bulb. Its brilliance and/or flicker rate is the indication. Continuity tests on high resistance components are made in the same manner.

Constructing the Testaide

The original unit was built into a plastic box of the type used as container for small parts and hardware, as sold by most parts stores. It was chosen for its insulating properties and because of its small size (3⅜ x 2¾ x 1⅜ inches). Cover has a ⅜-inch hole at its center for mounting the control pot. On right side is another ⅜-inch hole for phone jack and a ⅛-inch hole to accommodate the black ground lead. Left side has six ¼-inch holes for pin jacks and two ⅛-inch holes for the two red "hot" leads, which must be good quality heavy rubber covered test lead wire. All three leads are fitted with alligator clips, and the red leads only, have pin tips for inserting in the jacks.

To keep the two red leads in place, four holes were made in the case as shown in the photograph, and the leads were threaded through them. This prevents pulling the leads out of the jacks, while in no way making it less convenient to insert them. Some constructors may not wish to have the leads permanently connected to the instruments, in which case these holes will not be needed, and another jack should be provided for the negative lead.

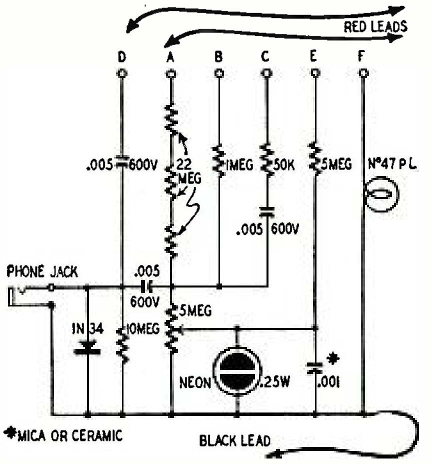
To avoid cracking the thin plastic, the holes were not drilled. Instead, they were burned through with heated rods of the correct sizes.

Needless to say, all components and connections must be well spaced. Particularly keep the three 22-meg high-voltage multipliers clear of other parts. Because of the small size, sub-assembly techniques were employed, first mounting as many components as possible on the control pot, crystal and jacks. This leaves only a few connections to solder as the two sections of box are brought together. Don't touch the plastic with the hot iron!

The neon bulb was soldered to a small bracket that uses the same mounting hole as the control. A small dab of paint on one side of the glass makes it possible to identify polarity of any d.c. voltage (a.c. of course causes both plates to glow).

For easy replacement of dial light when necessary, its socket was soldered to tip jack F. It is necessary only to raise cover slightly and turn or twist the socket and jack a little to one side, making bulb easily accessible.

The Service Aid was simply calibrated against a Simpson 303. A card was fastened to the front cover and the voltage and kilovoltage calibrations made. Then it was cemented to the inside of the cover, forming the "meter scale." Another card with the necessary terminal identifications and circuit diagram was cemented inside the rear of the box. The two half-inch windows in the front card are for observing the neon and dial-light bulbs.



The instrument could hardly be simpler.

Materials for Service Aid.

Resistors: 1—50,000 ohms, 1—1 meg, 1—5 meg, 1—10 meg, 3—22 meg, ½-watt, 1—5-meg potentiometer.

Capacitors: 1—.001-µf mica or ceramic; 3—.005-µf, 600-volt type (C-D Tinychief or equivalent).

Miscellaneous: 1 open circuit phone jack; 1 crystal diode, 1N34; 1 No. 47 dial light with bayonet socket; 1 ¼-watt neon bulb, 6 red tip jacks, plugs to match, wire, leads, etc.

—end—

Everything Does Happen in TV Service

RESPONSE to "Unusual Television Troubles" proves that anything not only can but does happen in television. This one was sent in by Alfred Huntington of New Bedford, Mass.

"We never did get channel 7 from Boston very well, but chalked it off to the fact that our antenna is right behind the gas works.

As you may know, New Bedford is one of the foggiest places in the U. S. This is caused by the Gulf Stream hitting the colder water of the Labrador Current from the north. A pea-soup fog bank rolls in early in the evening and leaves in the morning when the sun comes out.

One warm foggy night we were surprised to get excellent reception on channel 7. The next foggy night we invited a friend over to watch the Boston station, but it wouldn't come in.

Reception was good on the next foggy night after we had moved the antenna around a little. We quickly called our friend in again. 'What can it be?' he said, 'there is nothing out there but the ocean.'

Evidently *something* was out there reflecting the signals. We soon spotted the 'something.' On the mornings following good reception we always saw a string of barges or a tanker which had been lying out in the bay until the fog cleared. No ships—no reception.

Our friend, a witty fellow, remarked how convenient it would be to have the Queen Mary run aground out there."

Indoor antenna problem

When you are ready to toss the set out the window, think of David E. Berry's story.

"The customer lived in an apartment and was permitted to use only an indoor antenna. When I arrived there on a service call, I found a pretty fair picture. My customer couldn't understand it.

We soon found that the picture was good when the steel casement window was open. Closing the window ruined the picture.

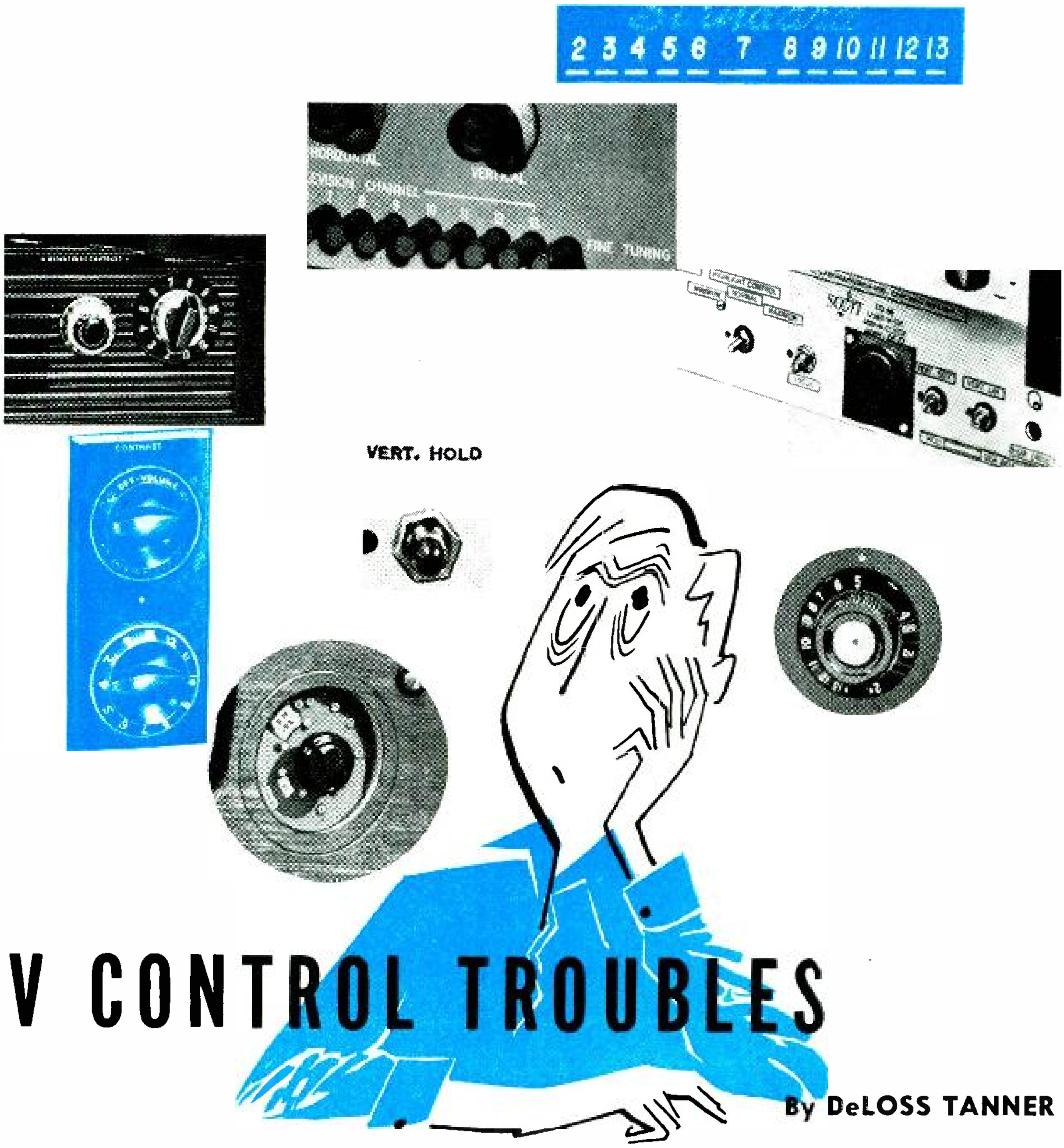
We finally managed to get a good picture with the window closed by putting an under-the-rug antenna alongside a radiator near the window."

If ghosts are your problem, don't despair. Just throw your troubles to the winds like Buster Henderson of Cartersville, Georgia, did.

"One windy day this set began to pick up ghosts that ruined the signal. I went up to the roof to adjust the antenna, but before I touched it, my assistant signalled 'Hold it, that's good'. By the time I got back down the ghosts had returned."

We noticed that the neighbor's antenna, about 80 feet away and at the same height, was swinging in the wind. In certain positions with respect to our antenna it would cause severe ghosts on our set. We had to fix the *neighbor's* antenna."

—end—



TV CONTROL TROUBLES

By DeLOSS TANNER

TV RECEIVERS often leave the factory with some of their controls giving best results when set close to one end of their range. Slight aging of tubes or components can then cause the correct constants to fall outside the range of these components (usually variable resistors). Then customers are dissatisfied and extra service calls result.

All the controls (especially the "user-adjust" ones at the front of the receiver) of course should reach correct settings at approximately the center of their ranges. (Incidentally, some of the control settings—such as focus—vary with the line voltage, and the service technician will find it worth while in these cases to try to duplicate the customer's evening line voltage when adjusting these controls.)

This article will be confined to controls on modern magnetically deflected sets. Some of the older sets had circuits not used today. For example, the potentiometer as a horizontal drive control has been largely displaced by the variable trimmer capacitor. Some manufacturers still use a variable trimmer-type capacitor as a width control.

Before making any changes in control adjustments, check all parts in the circuit! Some component may be going bad and throwing the adjustment off.

Vertical hold control

If the picture does not sync in vertically or syncs in at the end of the control's range, first try replacing the vertical oscillator tube. If this makes no difference, check all components as above, especially the resistance of the hold control and the resistor (R1) in series with it (Fig. 1). If everything is approximately normal, increase or decrease the series resistance. If all or most of the resistance in the hold control is used to get the best setting, obviously the series resistance should be increased, and if the control is "all out" for best results, it should be decreased. Try different values till the hold control syncs in near the center of its range. In some cases, the value of C1 may be incorrect. This will affect hold range, too.

Vertical height control

Values of parts in this circuit being normal, check line and B-voltages. Too low voltages can cause insufficient height (and width). Correct these troubles if present. If height is still insufficient, decrease the resistor R2 in series with the height control.

Notice that the height control has its largest effect on the bottom of the picture. This is normal. The vertical linearity control (Fig. 2) usually has its greatest effect on the top of the picture. Before varying the resistor in series with the linearity control check the vertical output tube by substitution.

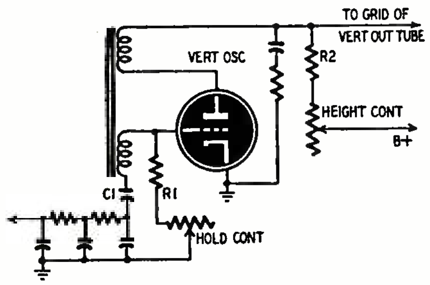


Fig. 1—A type of vertical oscillator.

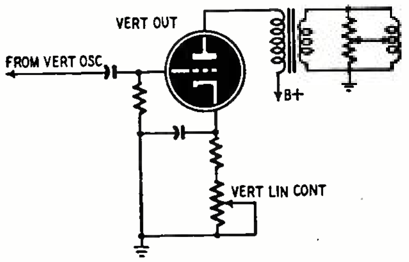


Fig. 2—Basic vertical output circuit.

Horizontal hold and lock

Read the article, "Servicing Horizontal Locks," on page 50 of the January issue. Follow manufacturers' instructions for adjusting the circuit. Since almost any component in the horizontal oscillator could be responsible for inadequate control range, the components check is especially important. Try replacing the horizontal oscillator tube first, then check the value of the hold control and its series resistor. Next in line for checking are the coils and capacitors.

Width control

Insufficient width with the control slug all in may be caused by low line voltage, poor tubes, low B voltages, or incorrectly adjusted horizontal drive control (Fig. 3). If there is not enough width with all voltages correct, try placing a paper bypass capacitor across the width coil. Use the smallest that will do the job, as the bigger it is, the lower the high voltage will be. A typical value would be .005 μf.

Horizontal linearity

This control usually has a limited effect on the picture. It will usually suffice to just leave it alone when adjusting the set. If adjustment is necessary, remember that the width and horizontal drive controls may have more effect on horizontal linearity than the linearity control itself. Using a test pattern, adjust all three controls alternately till linearity is good.

Focus controls

If a set comes into the shop with poor focus or with correct focus at one end of its rotation, check the voltage across the coil while rotating the control toward the end where best focus is obtained. If the voltage increases, the coil has too little current through it; if it decreases, it has too much.

Check the coil's resistance. It may be partly shorted out. If O.K., too much current may be due to high voltage, caused by having the drive control trimmer set too far out. If there are no drive lines in the picture throughout the pull-in range of the horizontal hold control, the drive adjustment is probably O.K. and it will be necessary to check further.

Lack of current through the focus control may be due to decreased current through stages whose return path is through it. Try replacing the audio-output tube, the horizontal-output tube and the low-voltage rectifier, in that order. Other tubes may be guilty—as may be other components. Irregularities in the values of horizontal oscillator components may cause poor focus, along with decreased brightness and decreased picture width. If everything seems O.K. but the position of correct focus is near one end of the control setting, increase or decrease the resistance in series with the focus control (Fig. 4) or shunt an additional resistor across the coil.

Remember also that poor focus can be caused by a bad or gassy picture tube (though this is not common). In sets using a PM focus unit, poor focus may be due to too strong or too weak magnets. Where the unit is doubted, check with an exact replacement.

Brightness control

If the brightness control cannot be turned far enough up or down (or both) check it and other resistors between the video amplifier output and the picture tube before going ahead with a general components check. In sets where the video output is coupled through a d.c. resistance path to the cathode-ray tube, the resistor values may be critical.

In some sets the control's brightest setting may be limited excessively by design. Try a slight decrease of the resistance between the control and B-plus, but don't overdo it! Lack of brightness may be due also to incorrect ion trap adjustment, which may also damage the tube.

Centering controls

If a set uses electrical centering controls and the picture cannot be correctly centered with them, it will be necessary to adjust the focus coil and possibly the ion trap and yoke. Turn both centering controls to their center setting and shove the yoke as far ahead as it will go. Next adjust the ion trap. Read "Ion Burns" on page 34 of the February issue very carefully before attempting such adjustment. Next, adjust the focus coil by moving and tilting it till the picture is centered. After adjusting the focus control be sure to recheck the ion trap for maximum brightness.

Do not use the ion trap to eliminate shadows. Do it with the focus coil. If shadows persist and it is impossible to get rid of them while keeping the picture centered, try rotating the tube a little.

Sets with no electrical centering controls and without the centering attachments or levers commonly found on the best modern receivers are harder to center, but the job can be done with care and patience. Remember that when the focus coil is moved the electron beam moves in a line perpendicular to the direction of movement.

Before attempting to center the picture it is often good to position the focus coil or magnet assembly so that its inner surface is equidistant from the outside of the neck all the way round.

Other controls

If you cannot get enough volume or contrast when these controls are all the way up it is usually not the fault of the control but of some other component or adjustment which is preventing the video or audio signal from being amplified normally.

Weak sound or video may be due to a poorly adjusted fine-tuning control, poor alignment, and of course, to weak tubes or defective components.

From the customer's point of view, the fine tuning control settings are the most important ones on the receiver. It is essential that they be adjusted so that stations come in best at or near their center settings. This is a question of oscillator adjustment and front-end alignment, and is covered in great detail in manufacturers' service data.

Control adjustment may seem a minor part of servicing, but it is very important in cutting service costs on future calls by reducing a situation that might otherwise call for pulling the chassis for a simple adjustment. And centered adjustments in controls accessible to the user are unparalleled prestige builders!

—end—

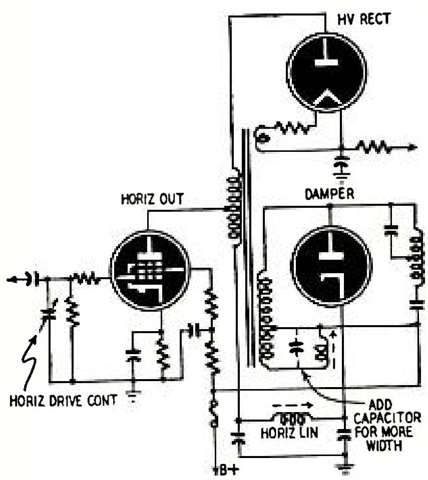


Fig. 3—A conventional flyback circuit.

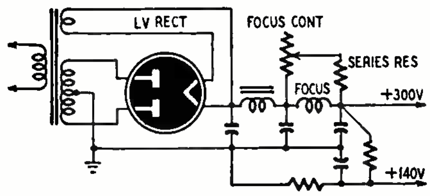


Fig. 4—Focus circuit used in some sets.

PEDRO and the INCENTIVE PLAN

By GUY SLAUGHTER

HE'S a little short guy in a beat-up felt hat, and his tiny mustache twitches like a rabbit's nose. He stands just inside the door for a long moment, the radio tucked under his arm, while his eyes dart about the store.

"Good morning," I say, leaning on the counter and wondering what he's looking for. "Got some radio trouble?"

His eyes stop on my face, then drop to the floor, and he shuffles up to me.

"Yeah," he says, in a high, whiney voice. "You the boss?" He looks almost disappointed when I nod, then taps the radio with his free hand. "It's got a whistle in it." He sets it down on the counter.

"Birdies, hunh?" I undo the line cord and plug it in. I flip it on and give it the quick once-over while it's warming up. It's a conventional little a.c.-d.c. job in a plastic cabinet, and it looks good for its three or four years of age; the cabinet isn't cracked, the dial glass is clean, and even the cardboard loop cover is intact.

The little set comes on and I tune the band. It isn't particularly hot, especially on the high end of the dial where the sensitivity falls way off, but it sounds pretty good. No trace of a birdie.

"Do you get the whistle all over the dial?" I ask, cutting the volume.

The little guy shakes his head, crinkles up his thin face, and his mustache twitches violently.

"Unh-uh!" he gurgles. "Just on WLW. You can hear the station okay, but there's a whistle on it."

"All the time?"

"Evenings, mostly. Not all the time."

I flip the dial pointer to the 700 mark, and run the gain up. WLW is clear.

"Sounds okay," I say. "It's probably local interference in your area."

"Yeah?" the guy yeahs vaguely.

"Yup. But the set needs aligning anyway, so why don't you leave it a day or so? Then if the whistle shows up, we can fix that too."

The customer licks his lips, looks at the floor, and lets his mustache twitch twice.

"Okay," he agrees finally. "That'll be okay."

I reach under the counter for a job ticket.

"Name?"

"Hunh?" The mustache twitches.

"Your name?" I repeat.

"Oh. Yeah. Alverson. Frank Alverson."

I write it down, ask for his address, wait while the mustache twitches a couple more times, and write *it* down. The guy starts for the door, stuffing his claim stub into a worn wallet. But he pauses with his hand on the knob, turns back toward me, his eyes darting about the store again.

"I'm interested in a television," he whines. "Those for sale?" He jerks his head at the line of consoles along the wall.

"Sure," I say. "And I've got a good selection in back, too. If you'd care. . . ."

"Not now," he interrupts me. "In a hurry. You here all the time?"

"Mornings," I nod. "And sometimes afternoons. Usually, though, I do my outside work in the afternoons."

"Anybody here then?"

"Oh, sure," I say. "We're open all day, and evenings by appointment. If I'm not here myself, Pedro can give you a demonstration."

The mustache twitches twice, he eyes one of the TV consoles for a moment while he digests this, and then he jerks the door open and shuffles out.

"Okay," he throws back over his shoulder at me. "Be seeing you."

I carry the little set back to the service bench, plug it in, and let it play while I dive into the line-up of chassis waiting there for me. It's still going strong with no sign of a birdie when Pedro shows up after lunch.

"Hi, Herk," he greets me, bustling in with a beat-up, sorry-looking chassis under his arm.

"Hi, Pedro," I return. I straighten up, grateful for an excuse to take a breather, and reach for a cigarette. "Where'd you get the relic?"

"It's home-made," he says, grinning at me and laying the alleged radio on the bench.

"No kidding." I try to ignore the messy-looking little two tuber, but the gobs of hookup wire hanging from its innards finally get the better of my curiosity, and I give it the quick scan. Evidently it's been wired by a left-handed baboon with nine thumbs. Every soldered joint looks like a wad of crumpled-up tinfoil.

"Got to fix it," Pedro reports. "Noisy volume control. Carbon tet, hunh?"

"Depends," I say. "If it's just dirty, carbon tet'll do it. But if the resistance element is worn through in spots you'll have to replace the control.

Pedro's forehead wrinkles.

"Seems to me I read someplace you can fix 'em with a lead pencil."

"Not recommended. The graphite treatment is an emergency measure. Wartime stuff when you can't get controls."

Pedro jerks his thumb at his two-tuber, grins at me.

"It's a regenerative set," he confides. "You got two windings on the coil, and one of 'em feeds back part of the signal from the plate to the grid and that gives it lots of amplification."

"Well whattaya know," I breathe, playing it straight. "Clever, hunh?"

Pedro beams and nods.

"Lots of kids make 'em. We got a club."

"Great," I say. "Look, Pedro, lug these carcasses out to the truck, will you? I'm about ready to take off."

"Sure, Herk," he says, starting to pick up one of the chassis. Then he pauses, clears his throat, and I can tell something is coming. He fixes his big eyes on me and clears his throat again.

"Okay, kid," I say resignedly, leaning back against the bench. "What now?"

"I figure . . . I mean I think I should get a commission on sales," he says. "I got no kick on my wages, Herk, but I been reading about the 'incentive plan' and I'm for it."

"You would be," I laugh.

"No, I mean it Herk," he says seriously. "If I've got a personal interest in making a sale, I'll do a better job. See, Herk?"

I chuckle again, in spite of myself.

"Yeah, I see. But maybe it's a good idea at that. Okay, Pedro, you're on commission as of now. How does one percent of retail price suit you?"

"I figured on five. . . ." he begins, but I cut him off.

"That's settled, then," I say quickly. "*Two* percent commission you get on every set you sell, radio, TV, or whatever. Now lug those chassis out before I change my mind."

"Sure, Herk," Pedro says happily. "They're practically loaded."

"And Pedro," I add. "Keep your ear on that little a.c.-d.c. job while I'm gone. See if it develops a whistle on WLW."

"Roger," Pedro says, a chassis under each arm. "Can do, Herk."

I spend a few minutes on mustache's a.c.-d.c. set the next morning, checking for a loose or intermittently-open capacitor, or maybe a corroded chassis tie-lug. But I don't really expect to find anything, since the whistle only bothers WLW, so I finally settle for a realignment job.

"Tell this guy there's nothing wrong

with his radio," I instruct Pedro when he comes in. "Must be local interference on WLW in his neighborhood. And if he wants to look at a TV set you give him a demonstration, will you?"

"Sure will, Herk. For two percent I'll give him a good one."

"Load up the truck, then, so I can take off. I've got lots of stops today." I climb into my coat, fiddle around collecting call cards and mentally planning my itinerary, and he's all through by the time I get back to the bench again. "How's your regenerator?" I ask.

"Fine. Carbon tet did it."

"Glad to hear it. See you later, kid."

But it's late when I get back, and Pedro has already gone. The first thing I see is a note he has propped up on the cash register that almost gives me heart failure. It says I owe him nine dollars and thirty cents, and I cuss incentive plans whole-heartedly while I jerk open the cash drawer, a premonition of disaster nudging me. Sure enough there's a check inside, signed by one Frank Alverson. It's for four hundred sixty five dollars. Across the bottom Pedro has printed "payment in full for one RCA TV console combination."

So now I know why Frank Alverson has such shifty, darting eyes, why his mustache twitches, and why he has been careful to find out when I'm not in store.

I scrabble through the job tickets in the day's pile, grab the one with Alverson's name on it, and head for the address it lists as fast as the truck can travel. It's a vacant lot. . . .

The cop is still there when Pedro comes into the shop the next day. He stares at the uniform with big, round eyes, and then fixes his gaze on me.

"In trouble again, Herk?" he asks.

"Yeah," I snap. "But not like you think. How'd he haul the TV set away?"

"Who?" Pedro asks. Suddenly comprehension dawns on his face. "Oh, him. He had a truck."

The cop goes to work on Pedro, then, throwing questions right and left. Did he get the license number? Didn't he suspect the guy of being a rubber check artist? Did he have any scars or marks that might make identification easy? Had he ever seen him before? Did he have any kind of an accent? What did it say on the side of the truck? Finally he turns back to me, shoulders hunched.

"What've we got to go on?" he asks sadly. "It's prob'ly the same gee that's been passin' checks for TV sets all over town, but he don't leave a trace."

"You've got a description," I say wearily. "That should help."

"Sure," the cop growls disgustedly. "A little guy in a beat-up felt hat and a mustache. I should have a buck for every guy in town who looks like that."

"Yeah," I say. "I'll go through it again. Maybe I missed something." So I tell the whole incident of his coming into the shop with the radio, and describe every move either of us made, every word either of us said. When I finish Pedro is looking at me queerly.

"Hey, Herk," he says. "You going to pay me my commission?"

I draw my hand back into firing position, but he jumps out of reach.

"Well, then, if we find the guy and get the set back will you pay me my commission?"

"Yeah," I snort. "The day we find him you get paid."

"Tomorrow, maybe today yet," Pedro says smugly. "I'll find him. See you later, Herk," he calls back over his shoulder, and then the door slams shut behind him.

"—he worked for me I'd can him," the cop mutters darkly. "Takin' a bum check like that."

I wave a hand wearily.

"My own fault. I should have spotted the guy for a phoney when I first saw him. Besides, Pedro's just a kid, and this incentive plan made him too eager for a sale. I should have warned him about things like that."

"Yeah," the cop says. "Well, we'll let you know if anythin' turns up." He smiles feebly and leaves.

"Fine," I say without enthusiasm. "Do that." I wander back to the bench and dive into a chassis. Pedro doesn't show up again, so I work there until closing. After that I stop off for a hamburger and fiddle around uptown a while, so it's late when I get home. There is a figure waiting for me on the porch. It's Pedro.

"Hi, Herk," he says with elaborate casualness. "Nice evening."

"Yeah," I return suspiciously. "Ain't it."

"Herk," Pedro goes on, gazing up at the streetlight, "let's get it straight. If I find the guy I get my commission. Right?"

"Forget it, kid," I say gruffly. "We just ain't going to find that bozo."

"But *if*," Pedro insists. "*If* I find him, I get paid, hunh?"

"Sure," I nod. "Sure. But. . . ."

"I found him," Pedro cuts in proudly. "And I called the cops and they took him down to the station. You got to identify him and claim your TV set."

"Look," I say severely. "If you're pulling my leg, I'll break every bone. . . ."

"No kidding, Herk," Pedro assures me solemnly. "It was easy. You said the whistle on his radio was local interference in his neighborhood, so we found his neighborhood."

"How?" I demand. "And who's 'we'?"

"My radio club. We got guys all over town. So I called a meeting and told everybody to monitor WLW. Three guys finally heard the whistle come on about seven o'clock, and phoned me."

"Yeah," I say. "But. . . ."

"So I rode my bike over to their bailiwick and tracked down the whistle with my portable radio."

I just nod my head dumbly, and Pedro goes on.

"Where the whistle was the loudest there was a house with a big, long aerial running to a tree, and through the window I could see a kid listening to a home-made set. I beat on the door. A lady came, and I asked for her boy."

"Yeah," I say again. "But. . . ."

"I asked the kid if he always listened to WLW, and he said that was the only station his regenerator could get any good." Pedro shakes his head pityingly. "He was a dumb kid, Herk. He had his aerial coupled too tight, and he didn't know how to tune his rig right. Anyway, I asked him if he ever saw a little short man with a mustache and a funny hat around the neighborhood."

"Hey," I breathe reverently, a bell ringing in my head. "Pedro, that was smart figuring."

"Yup," he agrees, matter-of-factly. "So the kid said a guy that looked like that lived right across the street. I called the cops, and there he was. Our TV set was in the garage, and there were half a dozen more, too."

"Pedro," I mumble, my head starting to spin again. "You're a genius."

"I wouldn't say that, exactly," he says, staring modestly down at his shoe. "I'm just on the ball." Then he holds out his hand, fixes his eyes on my face, and breaks into a big grin. "For a commission, of course. Great stuff, this incentive plan, hunh Herk?"

"Yeah," I say reverently, digging deep for a ten-dollar bill. "Yeah, Pedro. Damned if it ain't!"

—end—

TV SERVICE CLINIC

Conducted by MATTHEW MANDL

ALL television receivers in use today are unfortunately not designed for the ideal 4-mc i.f. bandpass. If the video i.f. amplifier consists of only two or three stages, bandwidth is sacrificed in order to get adequate gain. This poses an impossible problem for the servicing technician when the customer insists on better picture quality.

If slight defects in the receiver are contributing to the poor definition, corrective measures can often be taken. Careful checks should be made on the focus control system, the video i.f. alignment, the r.f. tracking, and the antenna system. With these working at peak performance, remarkable improvement is often realized.

Initial checks should be made on the focus control circuit. If the focus control requires an extreme setting, or is entirely ineffective, the voltage across the focus coil as well as the current through the resistive network of the control should be tested against manufacturers data. Changes in resistance values in the focus control circuit or a defective focus coil can bring about inability to secure good focus. Low or abnormal high voltage can also produce defocusing.

If the focus control gives best results at around mid-range but the picture is not satisfactory then the trouble, most likely, is elsewhere. This could include improper alignment of the i.f. system or poor tracking in the tuner. Improper alignment gives poor picture quality on all stations, while improper tracking may affect only *some* stations. This depends on the tuner used. Poor tracking is sometimes encountered in the drum type tuners using plug-in coils.

A contributing cause to poor picture quality would be standing waves on the transmission line. A mismatch between the line and the receiver input means that all the energy is not absorbed by the receiver's r.f. stage. The unabsorbed energy is reflected back to the antenna and sent back down the line again. Simultaneous reception of the direct signal and the reflected signal of the lead-in can displace picture line structure enough to blur the picture. The length of the line may not be sufficient to cause severe displacement—such as occurs during ghost reception. A small displacement will, however, blur the picture. This is shown in the photo above in which line reflections were present. The photo at the left on the opposite page shows the same receiver on another channel which, due to the difference in frequency, allows a better match between the antenna and receiver. Matching the transmission line to the receiver impedance will help a great deal on blurry channels. Of course, any mis-orientation of the antenna to the station being received will ordinarily make any further work on the picture in vain (photo at the right).

"Ringing" or a slight "echo" effect which causes repeats to the right of sharp vertical lines due to transient oscillations in the picture system can also cause poor picture quality. This calls for a check of the peaking coils in the video amplifier and, in addition, the r.f. tracking and i.f. alignment. If the video response curve favors the high-frequency sideband components, r.f. or i.f. stages can easily be pulsed into damped oscillations.

An oval beam within the picture tube instead of a perfectly round beam will cause poor definition. This can be ascertained by rotating the picture tube approximately 90 degrees. In such a case, if the horizontal wedge is slightly obscured but the vertical wedge is clear the opposite would be true after the tube is turned. This immediately gives an indication of an incorrectly formed electron beam which cannot be focused to a circular pin-point on the phosphor screen. Tube replacement is, of course, necessary in correcting this condition.

Intermittent Ghost

In a Tech-Master receiver the picture seems to have a ghost after the first fifteen minutes of warm-up. The picture also becomes slightly blurred. If the station selector is turned the ghost disappears. Within fifteen to twenty minutes, however, the ghost reappears. Twisting the station selector always causes the ghost to disappear. The condition exists on all stations and is affected by fine tuning. I have checked all tubes. J. A., Brooklyn, N. Y.

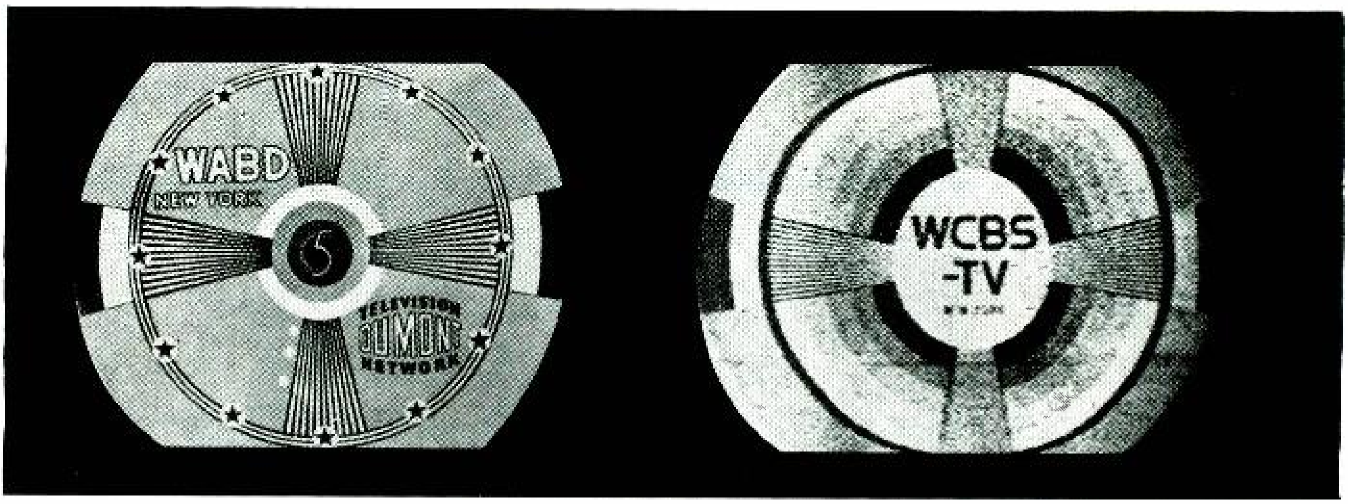
True ghost reception can only be caused by receiving a reflected signal as well as a direct signal from the station simultaneously. What often appears as a ghost, however, is the condition known as echo effect in which picture displacement is very small at all times. Ghosts may show a picture displacement from a small separation to as much as an inch or two, depending on arrival time and screen size. Your condition appears to be caused by a defective component which changes the resonant condition of your tuner and blurred picture and echo effect.

An intermittent shunting resistor such as the 3,900-ohm resistor across the grid coil of the r.f. amplifier can bring this about. Inasmuch as there also are resistors across the primary and secondary of the transformer between the r.f. amplifier and the mixer, these *could* give trouble. Check these as well as tubes and other parts in the tuner. A change of value and a reduction of bandwidth would increase the Q of the circuit. The narrowed bandpass would destroy fine detail and cause "ringing." A change in the high-frequency sideband components would also cause some echo effect due to excess amplification in that part of the picture spectrum.

Narrow Focus

On an Admiral 10-inch receiver I have trouble getting good focus over most of the tube face. Adjusting the focus control causes the center focused area to split into two sections. How can I extend the focus across the face of the tube? B. M., Buffalo, N. Y.

The focus conditions you describe can be improved somewhat by careful positioning of the focus coil with respect to the yoke. Make sure the latter is snug against the flare of the tube. With improper positioning, narrow focus is obtained as you describe. Adjustment of the focus control will split up the



focus as you observed, giving sharp focus at the edges and not at the center, or vice-versa.

Only by using special types of yokes such as the "cosine" type specially designed for full focus, can you get sharp focus over the entire tube face up to the very edges. By carefully experimenting with the focus coil setting, however, you should be able to get some improvement.

Poor Vertical Linearity

In a Trav—ler 16G50A receiver, the vertical linearity is very poor and cannot be corrected with the controls. Also, on fine tuning or contrast adjustments the picture pulls sharply to the side. Tube replacements have not helped the pulling condition. H. C., New Orleans, La.

You should try a new 6S4 vertical output tube. If this does not improve vertical linearity try a new 100-μf capacitor in the cathode circuit of the output tube. After the new capacitor is installed, readjust the linearity control to see whether or not good linearity can be secured. If the control is still ineffective, check the series resistor associated with it as well as the control itself.

If the picture pulls when the fine tuning or contrast is adjusted it would indicate troubles in the a.g.c. system. If a new 6AL5 detector a.g.c. tube does not help, check all resistors and capacitors in the a.g.c. feed line to the r.f. and i.f. amplifier tubes.

X-Ray Radiation

What is the danger of X-Rays from picture tubes during servicing procedures? I. G., Lonsdale, R. I.

X-Ray radiation is more of a factor with projection type picture tubes in which second anode voltages of 20,000 to 30,000 are encountered. Consequently —aside from the glaring image—projection tubes should not be viewed directly during servicing. In actual service these tubes are housed in a metal barrel which eliminates radiation hazard.

The larger 24- and 30-inch picture tubes using anode voltages in excess of 20,000 volts exhibit some X-Ray radiation; but it is of such low intensity that the protective panel glass filters it out.

With the protective glass removed, as when the set is on the bench, the danger is of course increased, especially for long and repeated exposure. The best rule is to keep out of the beam path as much as possible.

Repeated Rectifier Failure

In a Zenith Model H-2352 receiver the high voltage rectifier 1X2 constantly goes bad. I have changed the rectifier to a 1B3-GT with the same results. There is arcing within the tube if the horizontal drive is advanced, but a reduction of drive results in loss of brightness and insufficient width. I have changed the horizontal output tubes as well as the high-voltage filter capacitor but this did not help. The line voltage is normal in this area. H. F., Anderson, Ind.

Excessive drive will shorten the life of the high-voltage rectifier tube. The fact that the reduction of drive decreases your brightness may be caused by an improperly adjusted ion trap. Adjust the ion trap with a rotary, back and forth movement for maximum brilliancy. If this fails to give you sufficient brilliance and it is necessary to advance the drive control to the point of arcing, place a 4.7-ohm, ½-watt wire-wound insulated resistor in series with the filament lead of the 1X2 rectifier tube.

On some Zenith receivers a 2.2 ohm resistor was used but this value may not be high enough. A 5.6 ohm can also be used, though the 4.7 is preferable. As a last resort try decreasing the plate voltage to the horizontal output tubes by approximately 30 volts.

Picture Bounce

In an Arvin receiver, Model 2160, the picture has a continuous jump. It does not roll but has a bounce for all stations. I have checked tubes and parts in the vertical oscillator. R. P., Clio, S. C.

This would indicate defective components in the vertical sweep system. Inasmuch as you have checked tubes as well as the components, the trouble may lie in the integrating network which pulses the vertical sweep oscillator. Check the sync separator tubes and parts also for these could contribute some instability in the vertical circuit not apparent in the horizontal system due to the lock stabilization. You do not state whether you replaced any resistors in the vertical system; however, any of them off by more than 10% of rated value should be replaced. The trouble, probably, is in the integrating network of resistors and capacitors at the input of the vertical sweep oscillator.

Reduced Width

On a Capehart TV receiver the picture is compressed at both sides and I am unable to correct this condition. This model (CX-33L) has no width control and the picture width can only be changed by the horizontal drive. Previous models included a width control. How can I correct the reduced width? H. S., Baltimore, Md.

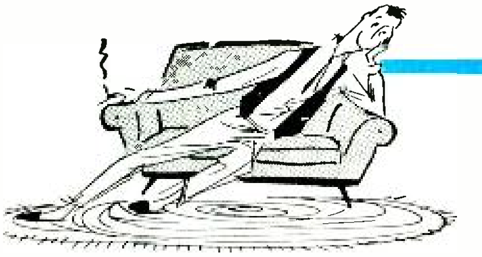
The reduction of width can be caused by a defective 6BG6-G horizontal output tube or a defective 6SN7-GT horizontal oscillator-discharge tube. You should try these tube substitutions first. If replacement fails to correct the trouble check the .1-μf, 200-volt capacitor in the cathode circuit of the 6BG6-G output tube.

If the trouble persists the following changes recommended by the manufacturer should be tried. On some Capehart CX-33L models these changes have already been made:

1. Add a .1 μf, 200 volt capacitor across the R-291 cathode resistor of the 6BG6 tube.
2. Change R-286 (this may be 150,000 ohms in some early models) to 47,000 ohms.
3. Connect a 30-μμf, 6,000-volt capacitor from the cathode of the 6W4-GT to ground. If additional width is needed, connect the capacitor from the 6BG6-G plate to ground.
4. Interchange coupling capacitors C253 and C257, .0047 and .001 μf, respectively.

—end—

...IMPROVING



By NATHAN GROSSMAN

AUDIO enthusiasts and sound men often complain that amplifiers and speaker systems, despite theoretical excellence, fail to come up to expected standards in "listenability." Sometimes there is a lack of upper treble response, or bass, or the presence of some undesirable effect on the ear. Many audio installations have to be modified to get optimum results.

The need for modification arises from differences in listener preferences, room conditions, speakers, speaker housings and positions, and also from inadequate compensation for Fletcher-Munson effects (loss of bass and treble at lower listening levels). Many amplifiers, including some of the better ones, do not provide enough or proper bass or treble boost to cope with these effects. Bass boost should begin as high as 800 cycles and be able to furnish as much as 20 db compensation at the low-frequency end; treble boost should begin above 1500 cycles and be able to furnish as much as 15 db compensation at the higher frequencies.

Much of the desired range compensation can be made in the amplifier and some with the speaker. Sometimes it is necessary to make adjustments to both simultaneously.

Fig. 1 shows the principal points where changes in the audio amplifier can be made. These are:

1. the de-emphasis capacitor in the FM receiver;
2. the RC constant of the d.c. blocking capacitor and the grid resistor of the interstage coupling in resistance-coupled amplifiers;
3. the cathode bypass capacitors;
4. the R-C constant of the bass boost (R2, C1) and the amount of the boost;
5. the R-C constant of the treble boost (R5, C2) and the amount of the boost;
6. the d.c. blocking capacitor in the plate circuit of the interstage audio transformer (Fig. 2).
7. the R-C constant of the inverse feedback circuit (R3, C3);
8. the speaker treble pass capacitor;
9. the potentiometer across the tweeter controlling the amount of energy fed into this speaker.

The frequencies emphasized or depressed will influence the pleasantness or realism of the sound. Emphasis at about 2,000 cycles will cause shrillness without real improvement in the treble, whereas, emphasis above 4,000 cycles will tend to overcome Fletcher-Munson effects and produce realism in speech and in the sound of metal musical instruments, or metal-stringed ones. If the starting point of the de-emphasis in the output of the FM tuner, at point 1 of Fig. 1 is too low, say, 500 cycles or lower, it will cut out much *edge*. If bass boost starts too high, say 1,500 cycles, and is used in conjunction with a record player employing a crystal pickup, *boominess* will result.

The resistor and capacitor combinations at points 2, 3, 4, 5, and 7, will determine the frequency of the point at which the boost or depression begins to operate. The following table lists these:

R (in ohms) × C (in μf)	Starting frequency
80	2,000
100	1,600
333	500
400	400
800	200
1600	100
8000	20

If we want bass boost below 500 cycles, then the resistor and capacitor at points 4 or 7, in Fig. 1 should result in a product of 333. The maximum amount of boost will be determined by the ratios of the resistors which form the voltage divider in these two circuits. At point 4 the voltage divider is roughly R2 plus reactance of C1 divided by R1 plus R2 plus reactance of C1. As the reactance of the shunt capacitor increases with the lowering of frequency, the ratio of the voltage step-down decreases so that bass is boosted. We can increase the amount of boost by decreasing either R2 or C1. However, a change in either of the latter without a corresponding change in the other will change the frequency at which the bass boost begins to operate. At point 7 the voltage divider is roughly R4 divided by R4 plus R3 plus reactance of C3, and operates in the same way that the voltage divider at point 4 does. Since the ratio of R3 to R4 is determined by other considerations, an increase in bass boost can be obtained by decreasing the value of C3; by doing so there will be less inverse feedback as the reactance of C3 increases with lowering frequency.

In many commercially built amplifiers the bass response may be improved by adding capacitors across the bias resistors at point 3 in Fig. 1, or increasing the values of the ones already in the amplifier. In practice the R-C of the bias circuit of the amplifier and output stages should equal 25,000 for full bass response.

In the older amplifiers bass can be improved by removing the direct current from the primary of the interstage transformer, by using parallel feed such as at point 6 (Fig. 2). This change will produce an improvement of from 2 to 5 db in the low register.

Where it is desired to cut down bass, the capacitors at points 2, and 3, in Fig. 1 should be reduced in value so that the product of the resistor and capacitor combination is below 8,000. The value of the capacitor at point 7, in Fig. 1, on the contrary has to be increased to reduce bass. This will shift the frequency at which a boost of about 2 db generally occurs, to a point lower in the bass spectrum and below the audible range, where cutting-off factors may be operating.

Suppose that we want treble boost of only the extreme highs. In such a case the product of the resistor and capacitor combination at point 5 in Fig. 1 should be about 80. The boost obtained at this point is also through a voltage divider, which is roughly R6/R6 plus R5. As the reactance of the capacitor shunting R5 decreases with rise in frequency the effective impedance of the combination becomes smaller until there is no longer a voltage divider and no

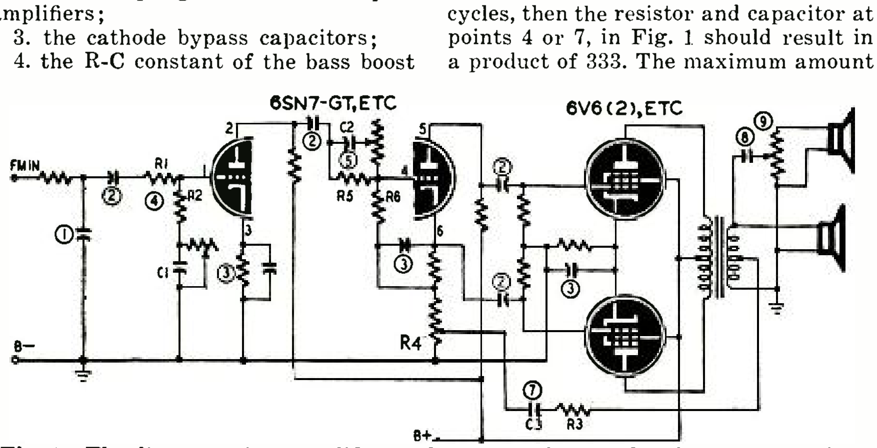
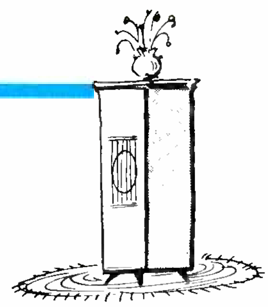


Fig. 1—The diagram of an amplifier with separate bass and treble compensation.

"LISTENABILITY"



loss on the higher treble frequencies. Treble boost can be increased by decreasing R6, increasing R5, or increasing the value of the capacitor across it. When either is changed without a corresponding change in the other, the treble boost is started at a lower frequency.

It is possible to use the volume control to get some treble boost without any loss in gain. The volume control in an audio amplifier is a voltage divider (Fig. 3). When the usual operation of the amplifier is such as to permit the arm of the volume-control potentiometer to be set at mid-position or lower, considerable gain in higher treble frequencies can be obtained by placing a small shunting capacitor across the input and arm. The resistance between the input and the usual setting of the arm should be regarded as similar to R5 at

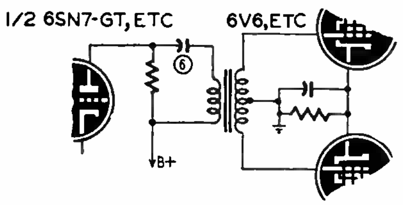


Fig. 2—**Bass is improved by this change.**

point 5. By measuring the resistance of this part of the volume control, the size of the shunting capacitor can be calculated. To overcome the loss of highs from Miller effect due to the input capacitance of high-mu triode amplifier tubes the R-C should be about 40; to compensate for falling off of high frequencies in output transformers or speakers the R-C should be between 60 and 120; and where clarity and crispness of speech is desired the R-C should be between 150 and 300. We have used the circuit in Fig. 3 with a low-priced speaker and crystal microphone in a system used for voice amplification and occasional dance music from a record player. When the microphone was used the switch was closed, and considerable treble boost was obtained, although the bass boost control was not touched.

Despite the excellence of published response curves some speaker systems may seem to lack treble or "edge". This loss is often due to the way the tweeter or speaker is mounted in the baffle. Placing the tweeter low in the speaker housing will direct the treble frequencies where they will be absorbed by furniture and carpets. Interesting but annoying to many sound men has been the loss of edge when a tweeter with a multicell horn is mounted so that the entire mouth of the tweeter is recessed behind the line of the front panel of the speaker cabinet. In one such cabinet the published curve showed a 10-db drop at the very high audio frequencies. This can be corrected by moving the tweeter forward so that the entire mouth of the horn is out of the cabinet. An effective way to secure edge from a horn-type tweeter is to take it entirely out of the cabinet and place it on top. By doing so, not only is the bad effect of the speaker cabinet upon the tweeter overcome, but in addition the axis of projection of sound from the tweeter is raised slightly from the horizontal. The result is that most of the sound energy goes directly into the area of the room where the listening is usually done, and is not dissipated on furniture and rugs. However, separating the tweeter and woofer too much will cause loss of presence. Some critical listeners may be dissatisfied with this solution. Where a single broad-range, or coaxial speaker is used, the highs may be lost by placing the speaker near a cloth-covered chair, or on a floor which tilts the speaker cabinet so that sound is projected slightly downward. In the first case, adjustments in the amplifier were of no avail. However, when the speaker cabinet was accidentally moved but six inches further away from this chair, high treble was heard again. The effect of the tilted floor was overcome by placing thick coasters under the front legs of the speaker cabinet; and in one instance, by tilting back about two inches the upper edge of the panel on which the speaker was mounted, allowing a still greater rise to the speaker axis.

Maximum bass can be obtained from a speaker when it is placed on the floor and in the corner of the room. The three sides of the corner act as a continuation of the baffle. Conversely, of course, moving the speaker from such a position reduces excess bass rendition. The writer has seen installations where the speakers were mounted near the ceiling and tilted upwards. This caused bass almost to disappear.

When a reflex housing is used, bass can be reduced by closing the port.

Students of speaker characteristics have found that the same speaker in various positions in the room gives different response curves. Differences in the shapes of rooms, placement of furniture, and sound-reflecting and sound-absorbing materials in the listening area, affect speaker response. For this reason sound men will often say that in some rooms all speakers, regardless of their original tonal characteristics, will sound too bassy, or on the other hand too shrill. On one occasion we tried the same sound system in two adjoining rooms; in one of these the higher treble frequencies were attenuated to the vanishing point. On another occasion, we tried the same system in two meeting rooms of about the same size. In one room the speaker was pointed across the room width. About 70 persons were present. Speech was clear and distinctly heard throughout the room. In the other room, one side of which was heavily draped, the speaker was pointed down its length. Only 20 persons were present. Yet with the treble control set at maximum, speech was muffled and indistinct.

The output of the tweeter may be cut

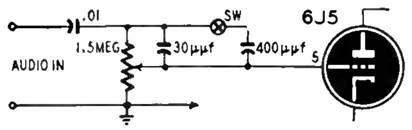


Fig. 3—**A useful treble boost circuit.**

by reducing the size of the capacitor at point 8, in Fig. 1. Even where a crossover network is employed, an effective method is to use a 5–50-ohm potentiometer across the tweeter as shown at point 9 in Fig. 1. This is often a necessity with a horn type of tweeter as it is generally more efficient than the direct-radiator woofer.

Connecting the tweeter out of phase with the woofer may depress some frequencies.

Speaker phasing sometimes produces tricky effects. We once made an installation in which a considerable amount of bass without sacrifice of tone range was desired, to furnish dance music in the social hall of a summer resort. A loud speaker capable of handling a considerable amount of power but with a limited tone range and inadequate bass already was in use. This speaker had been mounted on a large celotex baffle at the juncture of wall and ceiling, with the speaker aimed down the length of the room. We placed a wide-range speaker in a bass-reflex cabinet on the floor about 15 feet away from the first speaker facing the width of the room. This speaker was connected in series with the first speaker. Only a slight improvement in over-all and bass response resulted. There was, however, good distribution of sound throughout the room. The leads of the new speaker were then reversed, and the over-all range and bass improved considerably.

—end—

ELECTRONICS and MUSIC

Part XXI—Second half of a discussion of the Connsonata—keying, mixing, and tremolo injection circuitry.

By RICHARD H. DORF

LAST month I showed in Fig. 3 how a single oscillator may be keyed. The actual system, however, is more complex because of the couplers, each of which is a 73-pole, single-throw relay.

The circuit is diagrammed in Fig. 1. The figure shows only the seven C's of the swell manual, but the same switching system and the same relays are used for all the 61 notes of the swell manual. Another complete system is used for the great.

Each key operates a 5-pole, single-throw, normally open switch. One side of all poles is a common so that when the key is pressed all contacts come together. There are 5 relay coils at the left. Each of these, when energized, attracts all 73 contacts (only 7 of which are shown).

Seventy-three oscillators are provided for each manual. Sixty-one of them correspond to the 61 keys of the 5-octave manual and the other 12 are added to obtain 4-foot tones (one octave above the key pressed). Each oscillator grid resistor junction is wired to a bus to which the relay contacts are closed.

To see how this operates, let us concentrate on the key switch corresponding to middle C, which is labeled C3 in Fig. 1. Assume that we have closed the SWELL UNISON switch, energizing the swell unison relay. This causes contact A of the relay to make with the bus connected to the oscillator generating note C3. It also causes all the relay contacts in a horizontal line with contact A to close with their respective oscillator buses.

Now, pressing key C3, the right-hand key switch contact connects the rest of the contacts either to ground or to the tremolo generator output, depending on the position of the tremolo switch. The second-from-right switch contact goes to a relay contact which is not touching its bus. But the center switch contact goes to relay contact A, which *is* touching its bus. The grid of oscillator C3 is now grounded for d.c. and that note is routed to the amplifier circuits.

The same is true for any other key switch. Pressing key C5, for instance, connects ground through relay contact B, which is also touching its bus, to oscillator C5. Hence, pressing any key will produce a tone of the pitch corresponding to that key.

Let us also close the SWELL 16 switch. This energizes the swell 16 relay and presses all contacts in a horizontal line with that relay to their busses. Now when we press key C3, the left-hand contact of the key switch connects ground, through contact C of the relay, to oscillator C2, and we hear not only the tone of C3 but also that of C2 one octave lower. Thus we have added the 16-foot register to the tones we are playing. Similarly, closing the SWELL 4 or SWELL 2 switches adds tones one and two octaves above our middle C. Of course, the same will happen with

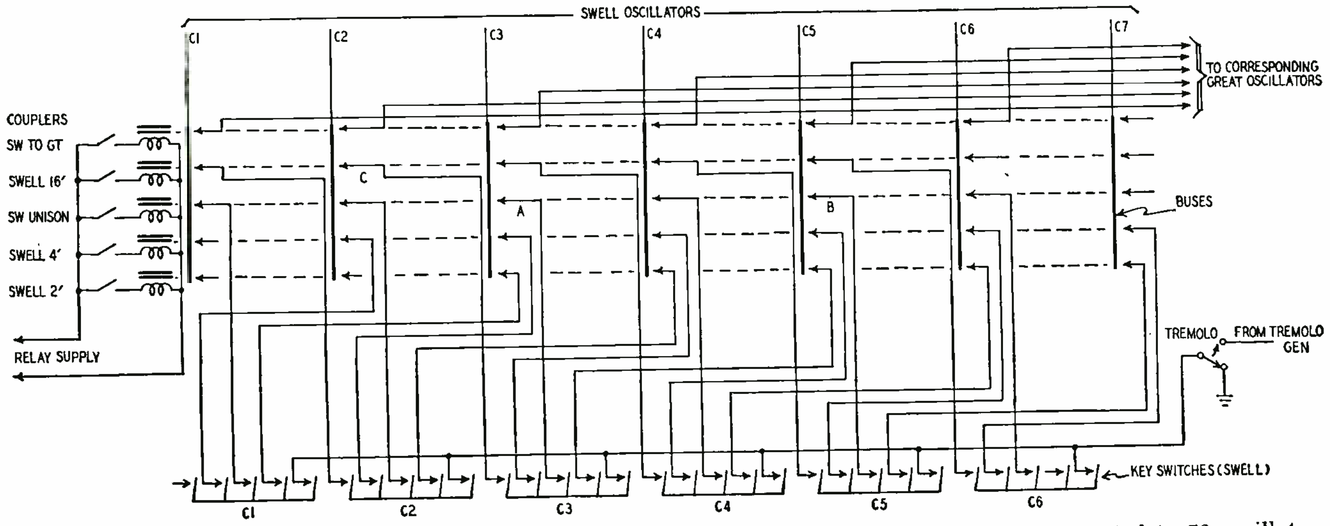


Fig. 1—The swell manual keying system. Each of the five coupler relays (shown at left) is connected to 73 oscillators.

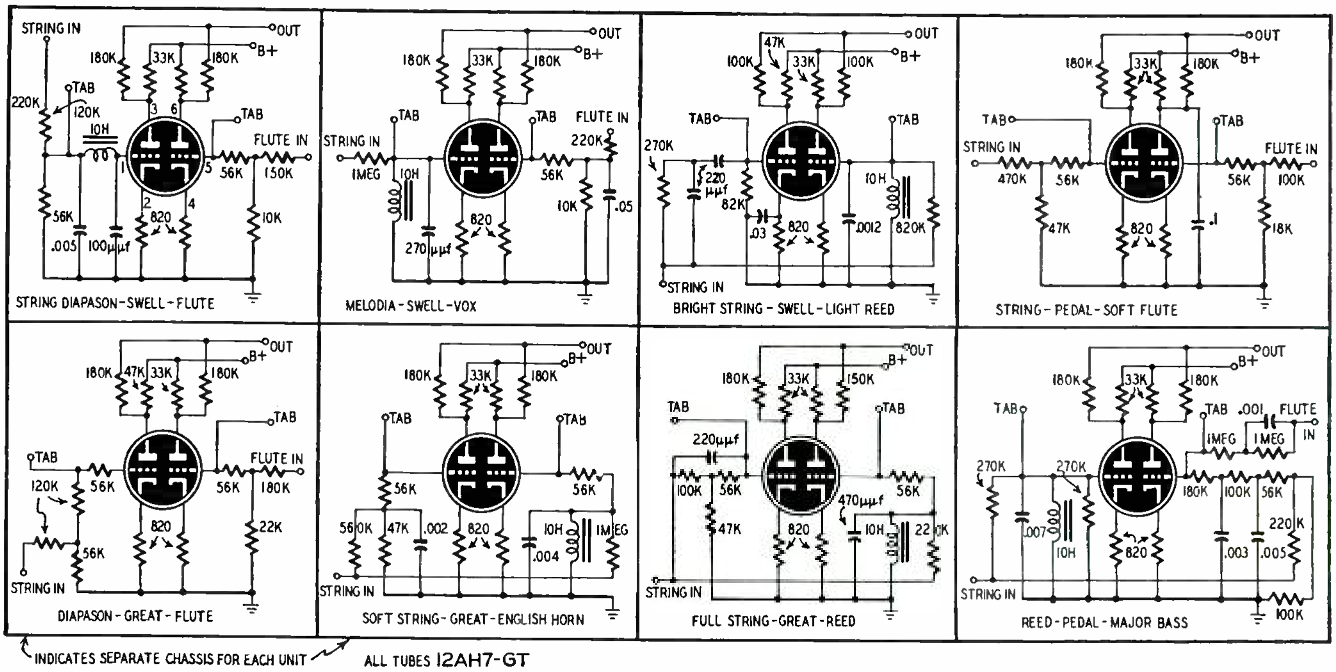


Fig. 2—Eight separate chassis contain the 16 mixers providing the tone coloring in the Model 2A2 Connsonata organ.

every note. By now, we realize that we are simply switching in the standard organ registers, except that we are using the term "unison" instead of "8-foot."

The SWELL TO GREAT relay closes the top line of contacts. Each contact is connected to one of the key switch contacts on the great manual so that when the great is played the swell oscillators are keyed as well. This makes one less key contact available for each great-manual key switch, and only unison, 16-foot, and 4-foot registers are available on the great. Otherwise the setup for the great manual is as illustrated for the swell in Fig. 1. There are only three coupler relays on the great, since neither a 2-foot nor a manual-to-manual coupler is needed. Separate tremolo switches are provided for the great and swell so that, for instance, a solo may be played on the swell with tremolo and an accompaniment, without tremolo, on the great.

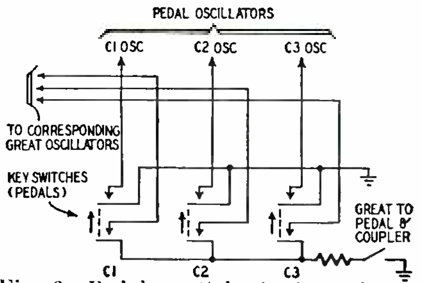


Fig. 3—Pedals switch single registers.

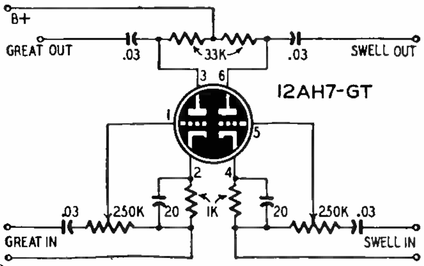


Fig. 4—Booster chassis with dual input.

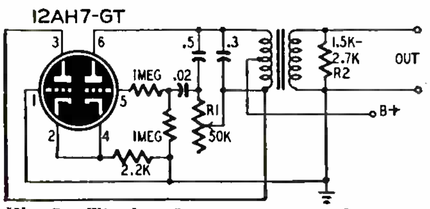


Fig. 5—The low frequency tremolo stage.

The pedal keying system is illustrated in Fig. 3. There are 32 oscillators, of which three C oscillator lines are shown. The key switches are double-pole, single-throw. The upper section simply grounds the grid of the corresponding oscillator when the pedal is pressed; no tremolo is available. The lower-section contact of each switch goes to the corresponding oscillator of the great department, and the GREAT TO PEDAL coupler switch is placed between the other contacts of these pairs and ground. When this switch is closed, pressing a pedal connects ground to a great oscillator as well as to a pedal oscillator. The approximately two-and-one-half-octave pedal range begins one octave below the range of either manual; since the first great oscillator is unblocked when the first pedal is pressed (assuming the GREAT TO PEDAL coupler switch is closed) the great note added to the pedal tone is an octave higher. Whether, under these circumstances, the GREAT TO PEDAL coupler should be labelled 8-foot is of little importance as long as the actual relationship is kept in mind.

Tone-shaping circuits

The entire tone-shaping section of the Connsonata is diagrammed in Fig. 2. It has all been placed on one drawing, but in the instrument each pair of mixers, as they are called, occupies a chassis, which has been indicated with heavy lines. Each circuit has been labeled with the name of the stop tab which is pulled to produce the tone. The tab switches actuate single-pole, single-throw, normally closed switches. These keep the grids shorted to ground when the tone is not wanted. When the tab is pushed down the short is removed and the desired tone comes through. The tones can be mixed in the same way as in a standard pipe organ by simply pulling two or more stops in combination.

All outputs from the mixers for a single manual are paralleled and fed to the input of a booster. The great-swell booster is diagrammed in Fig. 4.

Additional components

The tremolo generator appears in Fig. 5. It is an L-C oscillator with controls for presetting tremolo intensity and rate. Resistor R2 is selected during manufacture to give 5.1 volts output with a given setting of R1.

Power to operate the coupler relays and the filaments of the oscillator tubes is obtained from a supply which includes a dry-disc rectifier for the relays. This supply is also a junction box for connecting the power amplifier (and an external amplifier if desired) to the a.c. line and also includes a connector leading to the main a.c. switch on the console.

The power amplifier is fairly conventional, but contrary to practice in most organs, it is built into the console. Its power supply furnishes all but the filament voltages for the oscillators, mixers, boosters, and power for relays.

Except for the Connsonette, which is a single-manual unit with a slightly different scheme of tone-color switching using slide switches, the several models of the Connsonata differ principally in registration resources and appearance.

(to be continued)

Front view. Tube sockets act as jacks for speaker and cutter.

COMPACT MULTI-PURPOSE AMPLIFIER

By JOHN W. STRAEDE

THE amplifier described here is a very compact job suitable for public address work, recording and playback. It is high powered for its size, yet reliable because of the comparative simplicity of its circuit.

Constants are so chosen that either 6V6's or 6L6's (or English or Dutch EL5G tubes) can be used for the push-pull output stage, the power output being 15 or 22 watts for 6V6 or 6L6 tubes respectively. Even with the small 6V6 tubes (there's enough room for glass envelope 6L6's), sound can be projected up to a mile or more if efficient longhorn type speakers are used.

Although the circuit is very similar to that of the simpler conventional three-stage amplifiers, there are several slight additions. Each one is small but nevertheless adds to the value of the complete job. Electrolytic capacitors are connected in series on the high-voltage side of the filter circuit for increased reliability. Low-voltage electrolytics are completely avoided.

Some of the controls are in the form of toggle switches as it is thought that four knobs are quite enough adjustments for any operator to worry over—a switch is something definite!

A simple output filter consisting of a rotary switch and an assortment of high-voltage capacitors is connected across the primary of the output transformer and provides a more rapid attenuation of the highs than does the usual capacitor and variable resistor in the plate circuit of a previous tube. The reasons for this greater effectiveness are in the inductance and the leakage reactance of the output transformer. This output filter (together with a bass-attenuation or speech-music switch), is the only provision for controlling the tone of reproduced sound when the microphone input is used. It seems quite adequate, possibly because when using a microphone you are at least *starting* with real and therefore 100%-fidelity sound, while when playing from a disc you may be starting with almost anything under the sun.

Speech-music control

One toggle switch, the speech-music switch S3 (so called because lower frequencies are often deliberately attenuated when reproducing speech), acts in two ways. The switch is a double one—it breaks one circuit while closing another. When switched to SPEECH an extra .001-μf capacitor is placed in series with the grid of the top 6V6. This small capacitor has a high reactance at low frequencies, attenuating them greatly. This is a distinct advantage in recording and in public address work, particularly if a ribbon microphone is used. The attenuation is limited by a 1.5-megohm resistor. In the other position, the capacitor is shorted out, but a peculiar network comes into operation in the phase-changing circuit.

Phase inverters often suffer from a false shift at lower frequencies, so that the two output signals are not quite 180 degrees out of phase. Also the "second" signal to the lower output tube is often smaller at the lower frequencies. The simple phase-shift network shown helps to compensate for the deficiencies. At high frequencies the reactance of the 0.25-μf capacitor is negligible and the 10,000 and 22,000-ohm resistors are effectively in parallel, equivalent to about 7,000 ohms. At low frequencies, the impedance rises (becoming 10,000 ohms at zero frequency). This gives the lower output tube more signal. If you are interested in experimenting, try interchanging the 10,000 and 22,000-ohm resistors—you'll get quite a bass-boost effect.

Two other toggle switches (S1 and S2) are ON-OFF and CUTTER-SPEAKER controls. The first is a simple s.p.s.t. in the line; the other connects a high-impedance cutting head to the primary of the output transformer or a pair of low-impedance dynamic speakers to the secondary. Like the SPEECH-MUSIC switch it breaks one circuit while closing another.

Recording monitor

It will be noted that one pair of contacts is shunted by a small resistor, so that the speakers are operating faintly while the cutter is in action. This provides either a monitor action or extra reverberation, depending upon whether or not the speakers are located in the same room as the microphone. 56 ohms, ½ watt is usually suitable though the optimum value depends on the voice-coil impedance.

If the speaker field coils are used as B+ filter chokes, at least one speaker must be plugged in at all times.

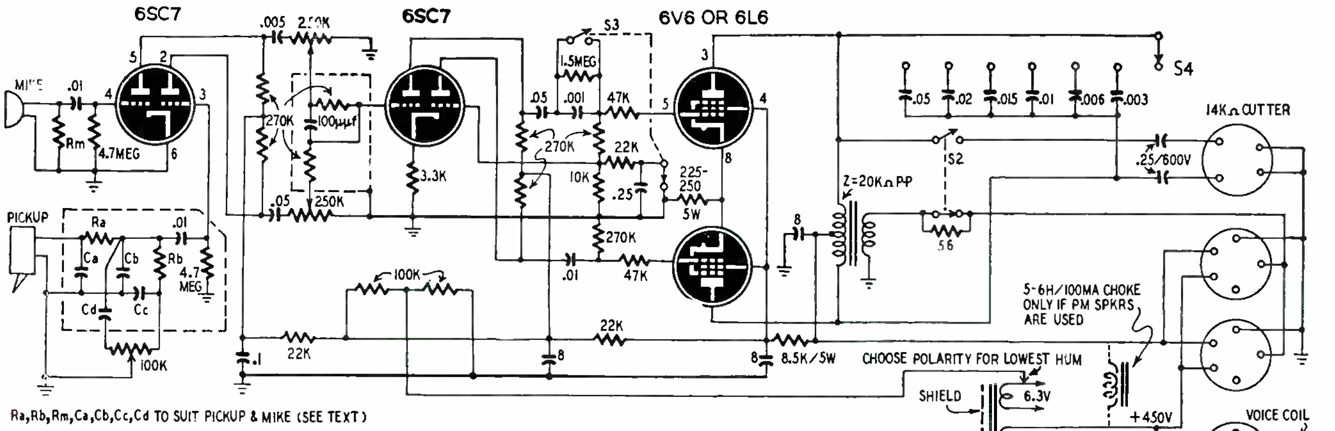
When using a pick-up, tone is controlled in three ways: Not only can the output filter be used to give a sudden "chop" (preferably just below the needle resonant frequency if a wide-range pick-up is used), but the bass can be attenuated by the speech-music switch (handy if you're using some cheap crystal pick-up with no decent high-frequency response). The general balance between "highs" and "lows" can be adjusted by a simple variable resistance connected in the pick-up filter. When the pick-up tone control is set at one end an extra bypass capacitor (Cd in the circuit diagram), is connected across the pick-up input causing a reduction of the high frequency response. When set at the opposite end, the bass boost network is put out of action by the shorting of capacitor Cc. At the midway position the tone control affects neither the highs nor the lows.

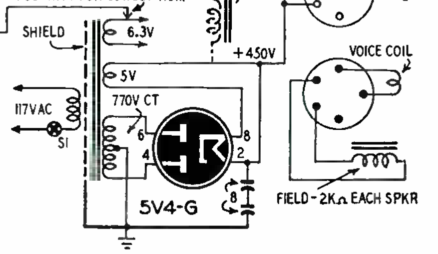
Bass compensation

The pick-up "filter" is practically a standard bass-boost network (see Bibliography for reference), consisting of resistors Ra and Rb and capacitor Cc. There are also two fixed capacitors Ca and Cb, the former to give moderately sharp cut-off at the highest frequency to be reproduced, the latter to balance the customary treble-boost found in most modern records.

The values of Ca, etc., depend upon the type of pick-up used and average characteristics of the records most often played. Typical values are given in Table I for two English pick-ups, one American and the writer's own needle-armature magnetic.

Although the basic amplifier circuit is standard, there are a few small points worth considering: Two-in-one tubes are used thus keeping the layout compact and wiring short, resulting in low hum level. Both microphone and pick-up pre-amplifiers (the first 6SC7 tube), are grid-leak biased to keep





Pick-Up		Ra	Rb	Ca	Cb	Cc	Cd
MAKE	TYPE	ohms	ohms	µf	µf	µf	µf
Garrard	Models E, F.	33 K	4.7 K	.0001	.001	.25	.02
Garrard	Senior Hi Fi	47 K	6.8 K	.0001	.001	.2	.01
Webster	Magnetic	47 K	4.7 K	—	.001	.5	.01
BTH-Ed:sw an	Needle Arm.	150 K	47 K	—	.0002	.03	.005
Med. Imped. Armature.	Needle	33 K	6.8 K	.0001	.0005	.2	.01

N.B: Rm is to suit microphone, approx. .5 megohm for crystal.

Schematic of the multi-purpose amplifier is above and Table I at left.

down the hum. Further reductions in hum-level are provided in several ways. All connections to the chassis are made at one place—where the common cathode of the first tube is grounded. No other connection is made to the chassis—even the power transformer and output transformer are insulated from the chassis. Separate leads to the common ground point are run from the can over the pick-up filter and from the metal shields over the volume controls. Even the metal case is not connected directly to the chassis. Instead, a screw at the extreme left of the front panel connects the metal case to a solder lug connected also to the common ground. Metal shielding braid over hook-up wire is insulated (with adhesive tape), where it passes through the chassis.

Two other hum-prevention ideas that are included are the separation of power transformer and speaker transformer (at opposite ends of the chassis), and the connecting of one side (select the side giving lowest hum) of the filament supply to a positive potential of about 100 volts, thus preventing any emission from the filaments themselves. As far as possible, all resistors and capacitors are as compact as can be obtained.

One extra precaution against hum may be necessary in some locations—a small capacitor, say .002-uf and 600 volt rating connected between one side of the A.C. line and the chassis. Reversing the A.C. line plug also helps to cut down some types of hum.

Output circuit

The load for the output tubes is something of a compromise, first because speaker and cutting head impedances vary considerably with frequency and operating conditions, and second because sometimes one and sometimes two speakers may be used. About 10,000 ohms is correct so an output transformer labelled "20,000 ohm" is about right—this used with two speakers gives ½ of 20,000 or 10,000 ohms, the correct load at the time when greatest power is needed. The mismatch of 2:1 when a single speaker is used is of little consequence.

Some high impedance magnetic cutting-heads require small adjustments of the circuit, usually either a shunt resistor of about 10,000 ohms or a .25-µf capacitor in series. Crystal cutters require shunt resistors to limit the output voltage to a safe figure.

Constructional details and layout are fairly obvious from the photographs. The front panel of quarter-inch Masonite is the sole support of the 18-gauge steel chassis. Edges of the panel are bevelled and the whole panel is crackle painted with a black paint containing a rubber emulsion. Lettering on the panel is done by smoothing the paint where necessary, moistening slightly and writing with white show-card ink. A light spray of shellac or clear duco helps to anchor the dried white ink.

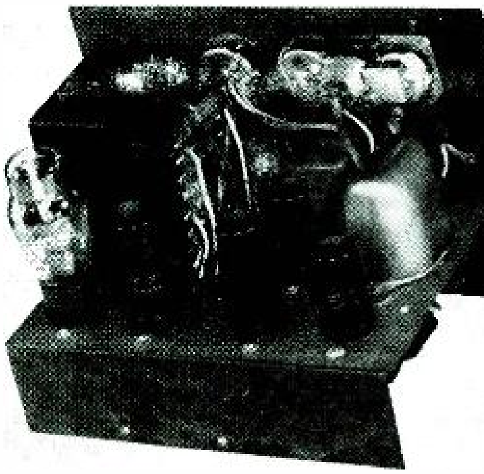
As panel size is only 10 x 7¼ ins. and chassis size only 9 x 6 x 2 ins. it is suggested that parts first be tried in various positions until a nice uniform spacing is devised.

A fourth toggle switch, to the left of the speech-music switch, is a dummy. Originally it was intended to vary the bias resistor when changing from 6V6 to 6L6 tubes. but this was found unnecessary in practice—the bias resistor was not critical, even 300 ohms being satisfactory so far as the ear could tell.

What is obtained from the amplifier depends to a very large extent on the efficiency of the output transformer. Best results in recording speech are obtained with the speech-music switch S3 set to SPEECH and the output filter S4 to OFF. Simply throw the switch to MUSIC for music recording. For playing speech records or for PA work, set the switch to SPEECH and the output filter for moderate attenuation. For music, try various settings of both input and output networks.

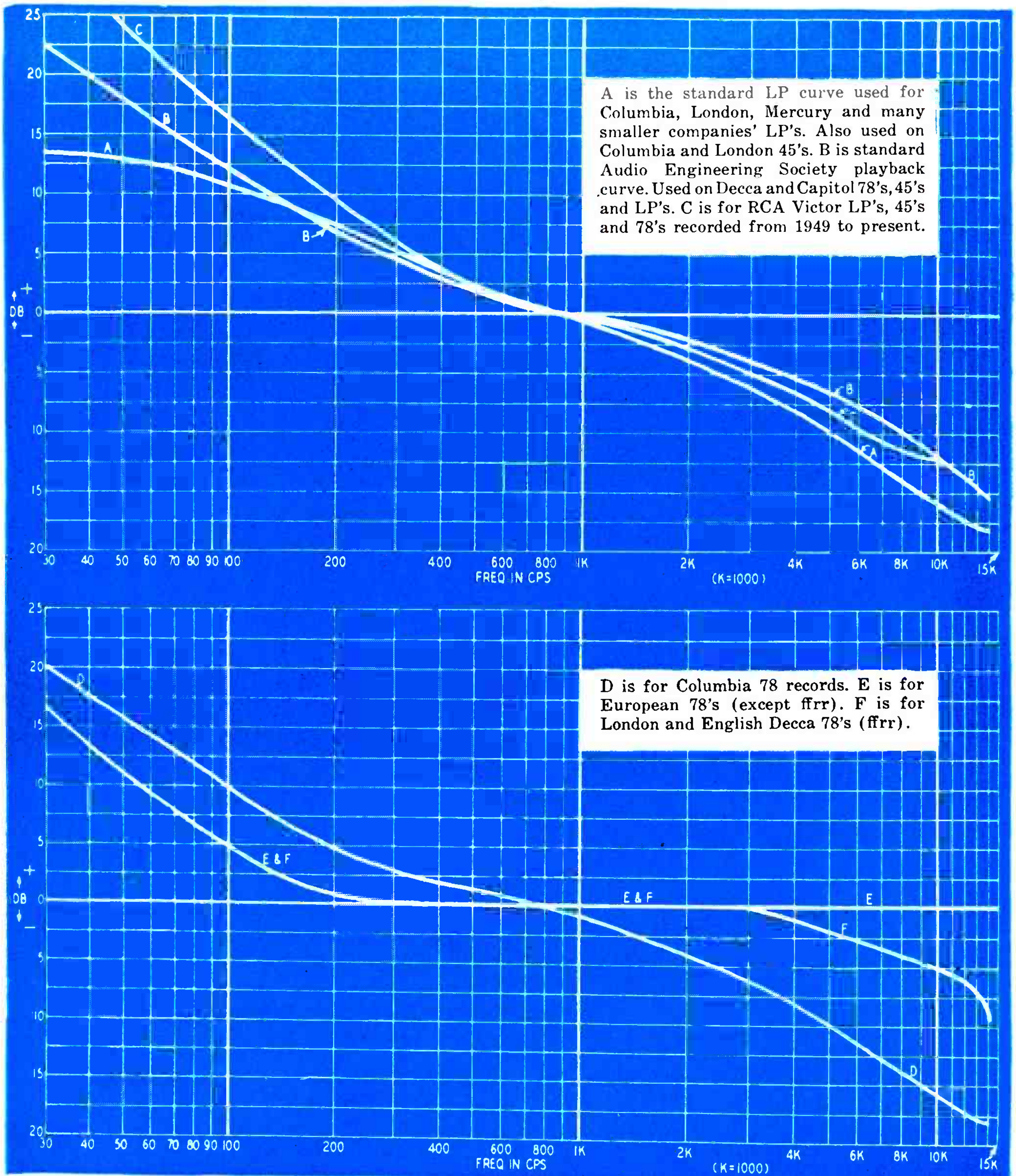
—end—

Rear view. This job has a distinctly Australian appearance to the American reader, but has the advantages of compactness and portability.



Playback response curves

for LP, 45 and 78 r.p.m. records



NOTE: Although these curves are *electrically* correct, *acoustic* balance at time of recording may make additional equalization necessary on some records. Older 78 r.p.m records were recorded with a number of different curves, depending on date and manufacturer. In general, prewar 78's had a lower crossover (250-400 cycles) than current 78's.

Curves prepared from information supplied by record manufacturers.

servicing OSCILLATORS

By ROBERT M. FIELD

THE oscillator of a superheterodyne is, ordinarily, the most difficult section of a receiver to service. If its oscillator is not working properly, there rarely is a signal to trace through the set.

A simple check may be made to determine whether or not the oscillator stage is working. Having first determined that a signal does pass through the i.f. section with a circuit-disturbance test or by using a signal generator, short out the oscillator tuning capacitor with a screwdriver. If the oscillator is working, a thump should be heard from the speaker. Touching a finger to the oscillator grid, or the hot side of the oscillator coil, should cause the same result. The oscillator is not working if there is no sound from the speaker. A more positive indication of oscillation, and one not dependent upon the operation of any other stage in the set, is a v.t.v.m. reading of the voltage across the oscillator grid leak. The grid should be negative with respect to ground. A typical reading at the low end of the broadcast band is–6 volts. On sets for which you have no circuit diagram, or the grid bias reading is not listed, look up the typical operation characteristics of the oscillator tube in a tube manual. In older sets that have no grid leak, the voltage drop across the cathode resistor gives a clue to its operation.

Most oscillator trouble is caused by faulty tubes. Low transconductance, especially in battery-operated tubes, is a common source of trouble. A customer who lived where no power lines were available, brought in her battery set. She had purchased a new long-life battery a few weeks before, but her set was fading out after the first few minutes of operation. The set worked steadily on a new battery in the shop, so I checked the 1A7 converter tube. Its transconductance was down only about 15% in the tester, but the tube looked old, so I replaced it. I explained to the lady that without her own battery there to check the set, I couldn't be certain that a new tube would fix it; I told her to bring the tube back for a refund if it didn't work. It must have been all right, for she never brought it back. Many instances of apparently shortened battery life are not due to faulty batteries, but to low emission (or transconductance) of the oscillator portion of the mixer.

Low filament voltage (when the set is operated from the a.c. line) is a common source of oscillator trouble in 3-way portables. Check the B-voltage at the input filter capacitor; it should be the same, or slightly higher, than the line voltage. A poor rectifier or input filter will cause a substantially lower reading. Many new sets use selenium rectifiers, and low B-voltage can be traced, in many cases, to defects in this rectifier. They may be tested with an ohmmeter: The forward resistance should not exceed a few hundred ohms, and the reverse resistance should be a hundred or more times greater. One selenium rectifier I came across had a front-to-back ratio of about 2; the resultant a.c. current flow blew the current-limiting resistor (in series from rectifier to input filter).

In sets where the filaments are in series with the cathode circuit of an a.c.-d.c. audio-output tube and where a new tube does not bring the filament voltage up, try a shunting resistor from screen to cathode of the output tube—20,000 ohms at 1 watt is a good starter—and work up or down from that value as necessary.

Loss of plate voltage is a common cause of oscillator failure in sets where this voltage is obtained through a series resistor. It was once the practice of some set manufacturers to bypass this resistor with a 200 volt paper capacitor. With age the capacitor breaks down under the strain, and then the series-dropping resistor goes too.

A less common cause of no plate voltage is an open plate winding of the oscillator coil. The break is usually near either end of the coil, and unwinding a turn or two and resoldering the wire to its terminal lug will often fix it. In this connection it might be mentioned that a small percentage of oscillator coils have rosin joints or fault from some simple error, such as leaving the enamel on or neglecting to solder the connections during assembly and manufacture. A steady ohmmeter reading usually indicates a good coil. A grid-dip meter will give an excellent indication of the condition of the tuned circuit as a whole.

Grid capacitors give little trouble, as a rule, but are tough to locate when they do act up. A simple check may be made by shunting a 100-$\mu\mu$f mica across the suspected capacitor. Some sets use an extra winding on the oscillator coil as a coupling capacitor. Since this is an open winding, no satisfactory check can be made with an ohmmeter. If in doubt, try a small mica capacitor from oscillator grid to the hot side of the oscillator coil.

Paper padding capacitors have given me trouble; bad ones are almost always intermittent. Variable mica pads occasionally become shorted (due to a broken piece of mica) but they may be easily spotted by turning the adjusting screw while measuring the grid bias. I have replaced a few fixed mica pads that were noisy or intermittent, in fact, a silver mica pad that I put into a communication receiver caused an intermittent frequency shift, noticeable when receiving code, due to just a single plate making and breaking connection.

I have heard of a case in which a customer adjusted the trimmers on the ganged capacitors and caused the mica and screw to fall off. On replacing the pieces he put the mica over the trimmer and tightened down the screw! The tuning capacitor thereupon was shorted and the set was *very* dead.

I have yet to find an open grid leak, but during either the assembling or servicing of a set, the pigtail going to grid sometimes gets pushed against another lead and shorts the grid to ground.

Trouble with tuning capacitors is mainly confined to bent plates or metal filings (or dirt) between the plates. In personal portables, if the batteries are left in the set after they are exhausted, battery goo may get to the tuning capacitor and short out the plates. A simple remedy is to flush the goo off with warm water and dry the capacitor with compressed air. Only in extreme cases is it necessary to replace the capacitor. My customers get a gentle lecture on the folly of leaving dead batteries in their radios, together with a set of "sealed" dry cells, when a job of that kind comes in.

In case you think that oscillators aren't so tough: Just recently a set came in. "Must be some simple little thing," said the customer, "it just goes off and on."

"It's always something simple," I thought, but said merely, "Yes sir." At first it *did* look easy; bending the chassis just right would stop the set. It didn't take long to discover that the oscillator was the culprit—but I spent a good hour, with the chassis upside down, checking and rechecking every piece of the oscillator circuit. After there was nothing else left, I decided it had to be the tuning capacitor, although a quick look previously had indicated that all was well. Turning the chassis right side up disclosed the trouble. The capacitor was shock-mounted on rubber grommets, and the grounding connection (a little soldering lug) had a rosin joint. It goes to show that when it comes to oscillators, you just can't trust a thing.

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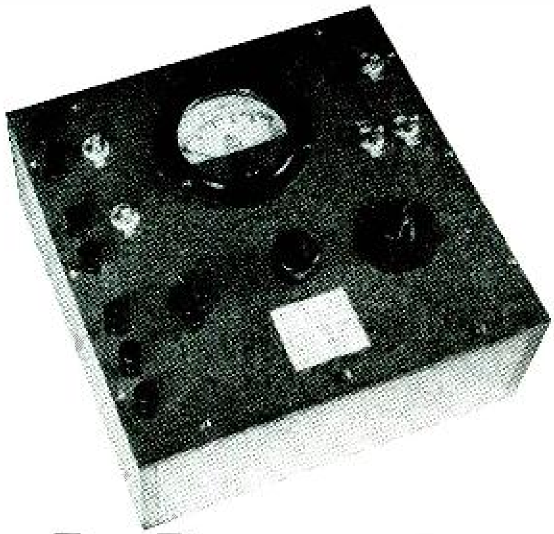

Useful as a primary or auxiliary tester, this economical unit will give valuable service

By WM. C. STOECKER

A Practical Multitester

MANY experimenters and service technicians seem to overlook the possibility of making their own test equipment. Construction of a volt-ohm-milliampere meter is feasible and can be an economical project. Furthermore, the experience to be gained from making such a unit is not to be underestimated.

This multitester employs a 0–1 milliampere meter and is a reliable and convenient instrument for many general testing purposes. A meter with a 1,000 ohms-per-volt sensitivity can be inexpensive and fairly rugged, and may be used with wire-wound resistors at a cost much lower than would be possible with a meter of higher sensitivity. The only calibration required is a check with another a.c. voltmeter at a few points. Some voltage measurements, of course, require higher sensitivity, but those are commonly made with a vacuum-tube voltmeter. This instrument is built around an ordinary 0–1 ma meter having an accuracy rating of 2% at full scale and an internal resistance of approximately 45 ohms. The tester provides 8 d.c. voltage ranges, 7 a.c. voltage ranges, 4 d.c. milliampere ranges, and 2 ohmmeter ranges.

No attempt was made to mark scales on the meter directly. D.c. voltage and d.c. milliampere ranges use simple multipliers and shunts. Ohms and a.c. volts are read from the meter scale with the aid of tables. For accuracy wire-wound 1% precision resistors were used as multipliers and shunts. D.c. measurements on any range are nearly as accurate as the meter itself at the particular part of the scale where the reading falls. The limiting factor for accuracy in resistance measurement is the linearity of the scale.

Construction details

The general layout is indicated by the photo above. All parts except the internal batteries were mounted on the 3/16-inch Masonite panel. The usual milliammeter is not shielded, and accuracy will be affected if ferro-magnetic material is mounted close to it. Therefore a clearance of approximately 1 inch was provided between the meter and parts. The voltage multipliers were mounted on the rear section of the rotary switch; the front section was used as the ohmmeter range selector. The rectifier and fuse holder were mounted on small pieces of Masonite, providing insulation for these items. Heavy-duty toggle switches (3 amperes) were used in the milliampere section, since contact resistances must be kept low. This section should be wired with No. 18 wire, or heavier, and the shunt leads should be kept as short as possible.

The assembly was mounted in a sturdy oak box the bottom of which was a piece of ⅛-inch Masonite with rubber feet attached to its corners. The overall dimensions of the box with panel and bottom attached are 8¾ x 8¾ x 3¾ inches. This plan of construction facilitates assembly and wiring, and allows space for adjustments and replacements. The arrangement of parts is not critical and any desired layout can be used according to the preference of the constructor. Fig. 1 shows the circuit.

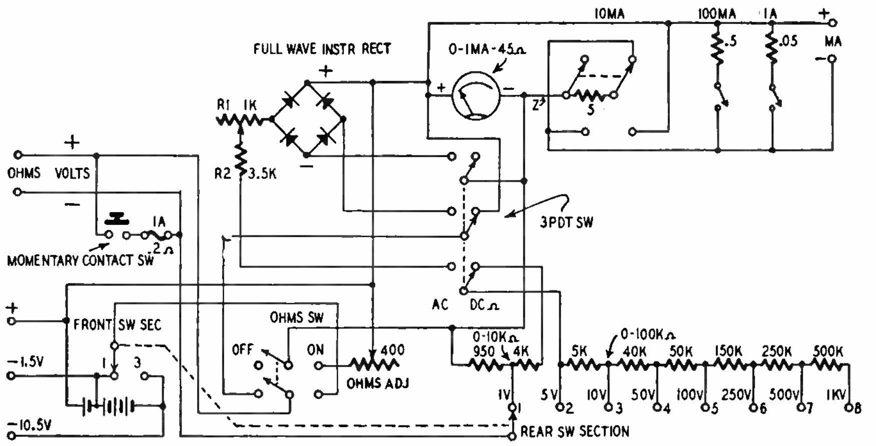

Fig. 1—Diagram of the tester. Positions 1 and 3 are the two ohmmeter ranges.

Voltmeter section

The required resistance for each d.c. range was calculated from Ohm's law, assuming a current of 1 milliampere for full-scale deflection. On selector point 1, for example, a 950-ohm resistance (theoretically 955) was added to the meter resistance to provide a circuit resistance of 1,000 ohms, and on point 2 an additional 4,000 ohms brought the circuit resistance to 5,000 ohms. Since a 950-ohm precision resistor was not available, a 900-ohm and a 50-ohm resistor were connected in series.

On a.c. voltage measurement the scale is not linear, but shows a certain amount of crowding near zero. This is because rectifier efficiency, which is the ratio of forward to inverse rectifier current, decreases at low currents. This is true of all ranges. An effect noticeable on low voltage ranges is the increase in rectifier resistance with decreasing rectifier current. If this resistance change is not negligible in comparison with the total resistance in the multiplier circuit, an additional distortion will result. For this reason, the 1-volt scale was not used for a.c. voltage measurement. A chart supplied with the rectifier showed the comparison of an a.c. scale with a linear d.c. scale. By accurate interpolation from it, values were obtained giving the comparison for 100 points on the d.c. scale.

A compensator consisting of R1 and R2 was connected in series with the rectifier input to provide an adjustable correction for rectifier resistance. R1 and R2 (not shown in the photograph) were mounted on a brass angle behind the panel. If the readings on all a.c. ranges are to be made proportional to the d.c. multipliers it is necessary to adjust the effective resistance of each multiplier resistance 10% below the nominal value for d.c. Since rectifier characteristics vary, it will be necessary to determine R2 by experiment. Starting with a 3,900- or 3,300-ohm carbon resistor, one should be found which will permit adjustment for correct reading on the lowest ranges by varying R1.

Prepare an a.c. voltmeter table from the scale conversion chart supplied for the particular rectifier used. With a borrowed a.c. voltmeter locate a series of points. Adjust R1, and if necessary R2, for correct readings on the 5- and 10-volts ranges. Revise your table or chart to fit the other ranges, if necessary.

Since each voltage multiplier resistance for a.c. would be 10% lower (depending on rectifier efficiency) than the d.c. units, it would be more accurate to use separate precision resistors for a.c. ranges. We found the chart more convenient. It is possible, of course, *for use with 60-cycle a.c. voltages*, to connect proper value paper capacitors across each multiplier resistance such as to lower the a.c. impedance (correcting the a.c. reading) without affecting the d.c. ranges. The voltage rating for the higher resistance multiplier shunt capacitors should be 600 volts or better.

Ohmmeter section

The tester measures resistances from 0 to over 10,000 ohms on the low range (980 mid-scale), and from 0 to well over 100,000 ohms on the high range (10,000 mid-scale). An internal battery supplies 1.5 volts for the low range and 10.5 volts for the high range. The rotary range-selector switch selects the proper battery voltage and circuit resistance for the two ohmmeter positions, points 1 and 3, and a d.p.d.t. toggle switch connects the battery and ohms-adjust shunt. Battery terminals are connected to three binding posts on the panel for external battery use. A momentary contact switch shorting the ohmmeter terminals has proved to be a great convenience in making the full-scale zero ohms adjustment.

In measuring an unknown resistance the instrument is first set for ohms on the proper range and then adjusted for full-scale deflection of the meter. With an unknown resistance connected to the terminals, the meter will read some value less than full scale, 1 milliampere. If R_c is the total circuit resistance of the instrument, the unknown resistance R is given by

$$R = \frac{R_c}{I} R_c$$

R_c was calculated at 980 ohms for the low scale and 10,000 ohms for the high scale, taking into account the resistance of the meter and the effect of its adjustable shunt. The resistance of a battery in good condition may be neglected. For each range a table was prepared containing 100 calculated resistance values, one for each half-division on the scale. The tables have proved to be rapid and convenient in use; the small effort involved in calculating a value for each half-division has been well justified.

(If a quantity of resistors are available, it is simpler and quicker to calibrate direct rather than by calculation. Use what precision resistors you have, and for other values use 5% or better resistors, checking them by measuring a number. If three out of five resistors have approximately the same resistance, it's probably very close to the rated value.—*Editor.*)

Milliammeter section

Milliamperes are measured on four current ranges, 0–1, 0–10, 0–100, and 0–1,000. The meter itself covers the 0–1 ma range, and for each of the other ranges it is shunted by a resistor.

For a meter having an internal resistance R_m, the required shunt resistance R_s for any scale multiplier n is found by the formula,

$$R_s = R_m/(n-1)$$

The meter used has an internal resistance of almost exactly 45 ohms, therefore a shunt of 5 ohms resistance was required for the 0 to 10 ma range. The 5-ohm shunt was arranged so that it could be switched in series with the meter for the two higher ranges, making the effective meter resistance 50 ohms. Note that connecting a resistor in series with the meter in the manner shown in the circuit diagram is equivalent to substituting a meter having an internal resistance which is greater by the amount of resistance added. Using this arrangement, shunts of 0.505 and 0.05005 ohms resistance were calculated for scale multipliers of 100 and 1,000 respectively. Even-value resistors of 0.5 and 0.05 ohms were used, the latter being secured by connecting two 0.1-ohm resistors in parallel.

There would of course be no point in using the series-shunt switch in cases where the meter resistance is not nine-tenths of a convenient round number, as (in this case) 45 or 27 or 90. Compensation can be made readily for a lower (or slightly higher) resistance by inserting additional resistance at point Z on the diagram to make up the difference between it and 50 ohms. For meters far from 50 ohms, it would be better to calculate the shunts. Remember that the n – 1 of the formula means that to multiply 10 times, you have to

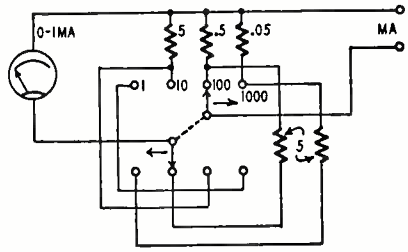

Fig. 2—A modified milliammeter circuit.

use a shunt 1/9 the resistance of the meter; for 100 times, a shunt of 1/99 the meter resistance is needed, and so on.

Before setting up the milliampere section, the internal resistance of the meter must be accurately determined. The following method is satisfactory, and does not require costly equipment: Connect the meter to a good 9-volt battery *in series* with a resistor of approximately 10,000 ohms and note the deflection. Now shunt the meter with a 50-ohm precision resistor or any resistor of approximately that value which has been accurately calibrated, and again note the deflection. Calculate the meter resistance by substituting in the shunt formula above, using for the value of n the first deflection divided by the second. (By a process similar to this, it is possible to use the tester for measurement of very low resistance.)

It must be emphasized that should any of the switches in the milliammeter section become defective or dirty, all the current being measured would flow through the meter, and probably destroy it. While there has been no trouble with this particular instrument, an improved method of switching the current shunts into the meter circuit is indicated in Fig. 2. As will be noted, the three toggle switches are replaced by one 1-pole 4-position rotary switch (which may be a section of the main range-selector switch used). With this circuit any imperfect or dirty contacts will take the meter out of the circuit and eliminate any possibility of excess, unshunted current from flowing through the meter and injuring it. The two extra 5-ohm resistors should be the same type as the 10-ma, 5-ohm shunt. They serve to maintain an effective meter resistance of 50 ohms for the 100- and 1,000-ma ranges.

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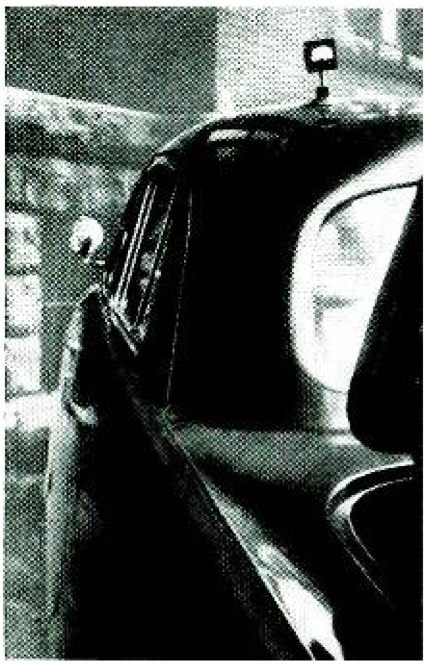

The technician watches the field strength meter when adjusting the transmitter.

MAINTAINING TWO-WAY RADIO

By HARDIN G. STRATMAN

Part I—Equipment and installation kinks, plus a few servicing problems

RECENT improvements in the design, installation, and maintenance of mobile two-way radio have greatly increased the role that vehicular communication plays in our society. Besides police and fire departments, taxis, buses, many utilities, factories, and farmers co-operatives have adopted this facility as an aid in their operations.

With these advances have come improved radio communications. This applies especially to the 152- to 162-megacycle band. The increased familiarity with the higher frequencies brought about by the war, and increased interest in TV and FM have helped make this so. With just a few watts frequency modulated on this band, good, clear reception can be had over a distance of approximately 10 miles. On several occasions, while repairs were being made on a 3-watt transmitter, the control station was contacted from inside a garage constructed of steel and concrete over a distance of about 3 miles. With some of the larger units whose output is approximately 30 watts, excellent reception was obtained up to about 50 miles of hilly terrain.

The control or master station

Setting up and maintaining the fixed station will not present any great problem. The antenna installation, however, may involve considerable work before the desired coverage and radiation pattern is achieved. If satisfactory transmission and reception is desired over a large area, the highest spot that the local terrain allows is picked for the antenna. This often turns out to be the town's water standpipe. After the somewhat difficult job of properly mounting the antenna is accomplished, future trouble with this item will be rare.

The fixed station may be either locally or remotely controlled. There are pros and cons to either type. If locally controlled, it is not likely that the antenna has been placed in the best spot. However, if trouble occurs, all parts of the equipment will be immediately accessible. If the unit is remotely controlled a good spot has probably been chosen for the antenna but a special line is required for the transfer of intelligence and relay control voltages from the operating point to the transmitter. Trouble may be caused by power failure at either one of the two points. A gasoline-driven generator unit is a valuable asset in maintaining uninterrupted operation. The extra line used when operating remotely will invariably be an ordinary telephone line with a line amplifier at the operating position. Besides acting as a preamplifier for the microphone and amplifying the incoming signals from the receivers, the line amplifier sometimes contains a tone oscillator which is used on occasion to attract the attention of the listeners to important messages. The line amplifier contains a B-plus supply and voltage-divider system to actuate specific relays for shifting to different frequencies.

The method used to shift from one frequency to another may be of interest. When the operator presses the microphone button, a voltage of say, plus 70 volts is applied to the line controlling the transmitter. This actuates the B-plus relay, energizing the transmitter, and at the same time another relay closes, switching in a specific crystal. If a different frequency is desired, the operator turns a switch and presses the mike button, and a voltage of approximately plus 120 volts is applied to the line feeding the transmitter. This again closes the B-plus relay but the added voltage will cause a different crystal relay to switch in. If a third frequency is desired, the voltage feeding the transmitter may be reversed, switching in still another crystal. In almost all cases these frequencies will be channeled through the same tubes and circuits with no retuning required since the bandpass is very wide. No loss of power will be noticed. The range of transmitting frequencies will usually cover 200 to 300 kc. It could be considerably less since most of the receivers are double superheterodynes and, consequently, very selective.

The most troublesome components of the fixed station are the frequency-shifting relays, as many of them are multicontact units. If they are under a dust cover, clean the contacts only when they commence giving trouble since any slight bend in the reeds throws them off. A considerable amount of servicing time will be involved with tubes, especially rectifiers.

Mobile units

The mobile radio communication equipment is installed in the trunk of the car, thereby maintaining cruising comfort in the car. Instead of drilling a number of holes in the floor of the trunk to mount the main units and using the sheet metal screws supplied with the equipment, a board straddling the gas tank is recommended. Mount it with four stove bolts, clearing the gas tank on both sides to eliminate the danger of puncturing the gas tank. The possibility of the bolts loosening through vibration will be minimized if the bolts are double-nutted. Since mobile units are subject to constant vibration, secure mounting will prevent trouble later. A mounting board can give shock-absorbing action and allow provision for additional shock mounts if deemed necessary. As a rule, shock mounts will lengthen tube life and reduce stress on the units' components. Since the radio units usually outlast the cars many times over, having the units already mounted on a board will speed up reinstallation in other cars. Over a period of several years many hours will be saved in equipment change-over. The chassis must be bonded to the frame of the car. Half-inch-wide copper strap or braid has proven completely satisfactory. Although the first few units had the bonding brazed to the car frame, self-tapping screws were later tried and found to work just as well. It is easier to drill a hole through the copper braid, if some solder is flowed onto the ends first.

Installation entails running cables to the battery under the hood and to the control panel on the dashboard. For best results separate the cables into two equal sets, usually two cables to each set, and run them along each side of the car under the floor matting close to the doors instead of next to the transmission housing. The cables are easily run along the side and behind the back seat to the trunk but if placed next to the transmission housing, the back seat will refuse to fit properly in the catches and will be a continuous source of annoyance. Furthermore, placing cables next to the transmission housing will interfere with the proper operation of the clutch, brake, and gas pedals, as the cables will drift around after a time.

A roof-mounted antenna will be the touchiest and toughest part of the mobile installation. The coaxial feed line to the trunk will present some unique problems. A roof installation, besides the extra height, provides a large radiating plane free of obstructions. The best spot is on the center line of the car slightly back of the front and back door center post and between roof ribs. It is practically impossible to get the coaxial line from the antenna mounting hole to the trunk in one operation without marring and disturbing the upholstery. After the mounting hole has been drilled, the upholstery immediately above one of the rear windows should be loosened for about a foot and a length of semiflexible wire, such as No. 8 or 10 copper bus, should then be inserted down the channel just above the window and run down along the side of the car where the wires to the ceiling light of the car will probably be found. The bus wire should be poked down the channel till the end reaches the trunk compartment. One end of the antenna coax lead can then be taped or tied to the end of the bus in the trunk and then pulled back to a point above the window. The coax lead is loosened from the bus wire which is then inserted through the hole in the top of the car and worked over to the side of the car above the window where the end of the antenna coax protrudes. It is again fastened to the end of the bus wire and pulled through the hole in the roof and connected to the antenna. Soldering the coaxial lead to the antenna must be carefully done or the center conductor may short to the outer shield if allowed to get too hot.

The loosening and refitting of the upholstery above the window can be neatly done, as follows: With a wide-blade screwdriver, pry up slightly the metal strip along the top edge of one rear window and unhook the upholstery from the teeth on the strip, leaving the molding still attached to the frame. Loosening about one foot should give ample working room. After the installation of the antenna has been completed, the metal strip should be forced firmly back along the window frame and the upholstery tucked under the metal strip. A little clear varnish around the antenna mounting hole will prevent moisture from seeping into the car and ruining the upholstery.

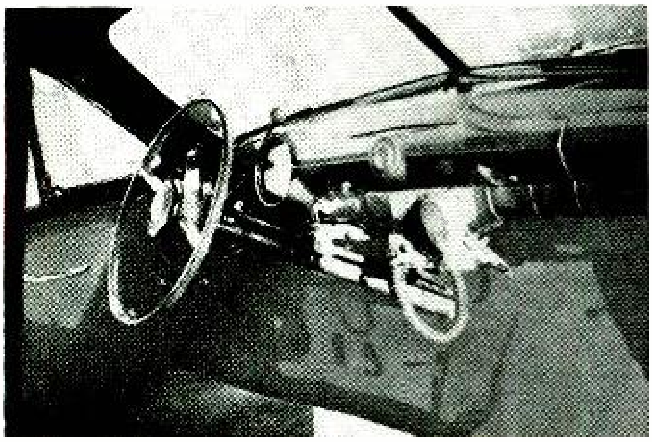
A *must* in every good mobile installation is that the car have an oversize generator. Some of the larger radio units draw as much as 40 amperes and the battery must be kept up or it will be continually going dead. It is especially important that the battery terminals be kept clean, as a very slight resistance developing here due to corrosion can cause a lot of trouble. It often does not show up except under load while transmitting; checking across the terminals with a voltmeter will show no trouble. If the entire outfit, one fine day, should suddenly go dead when the mike button is depressed, the trouble can usually be traced to corroded battery terminals. After cleaning them, a small amount of vasoline on the terminals will retard further corrosion.

Complaints of intermittent operation in mobile equipment will often be traced to tubes not properly seated in their sockets. Lower-powered transmitters and receivers use vibrator type power supplies. They will be subject, of course, to the usual limited life of about six months of almost continuous service.

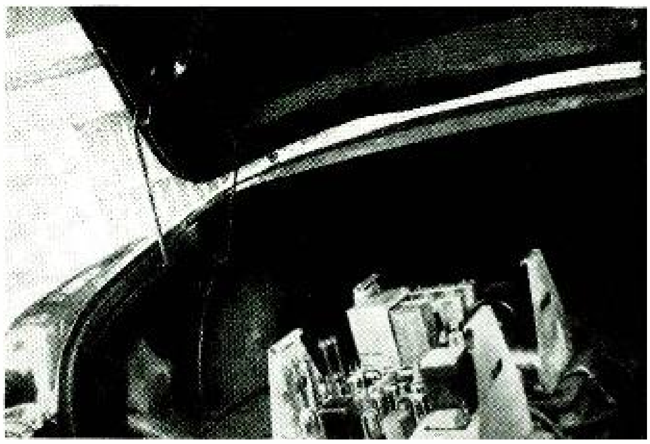
When the fuse on a particular receiver is continually blowing for no apparent reason, the logical thing to suspect is the vibrator. Replacing it will usually clear up the trouble. Speaker hum can almost always be traced to a bad filter capacitor in the power supply, just as in any conventional radio receiver. Buffer capacitors with a 1,600-volt rating will very seldom break down. An operator will occasionally complain of distortion, and if the transmitter tubes all check okay and all stages meter properly, the modulator tubes are a sure bet to be somehow at fault. A lot of outfits use a 2E24 or 2E26 tube in the driver and power amplifier stages and if the drive to the grids is not kept high considerable trouble results. If the driver tube of a transmitter becomes even slightly weak, it is a good idea to replace it to protect the final stages from burning out. In the long run this will pay off in less expense and trouble. The brushes in the motor-generator of the more powerful mobile units should be checked regularly and cup grease kept on the bearings. After approximately three or four years, the motor and generator commutators will require turning down on a lathe to eliminate arcing and noise.

Since the plate relay which supplies B-plus to the output tubes passes considerable current through its contacts, they will become burned and pitted. They can be filed and cleaned just so often before the relay must be replaced. Its life can be extended by operating the power output tubes well within their limits.

(to be continued)



Mobile control panel. Speaker is on firewall under the dash.



Units with covers off. Transmitter uses a motor generator.

Efficient TV Service in the Customer's Home

Explanations to the customer are an important part of in-the-home servicing.

By W. M. TOMLIN*

EFFICIENT and satisfactory television servicing can be performed almost entirely in the customer's home. In fact, RCA Service Company television service branches handle more than 90% of their service work in the home.

While our methods of operation may differ somewhat from the other service organizations, they at least typify the many factors involved in rendering efficient and satisfactory service to our many customers, whether the chassis is repaired in the home or brought to the shop for repairs.

The high cost of bringing the chassis to the shop makes it necessary that every effort be made to handle in the home such repairs as replacement of tubes, capacitors, resistors, and similar defective parts. Conversely, the chassis that are brought to the shop for repairs are those that would be too costly to service in the field.

These chassis usually are the ones that require replacement for major parts or have certain intermittent conditions that involve the use of special shop testing equipment. No r.f. and i.f. alignment is performed in the field, so these sets end up in the shop.

The most important factor in home service is the original diagnosis of the trouble. The use of test points found in most chassis, of course, expedites diagnosis. These test points are located at converter grid, i.f. bias bus, second detector output, and in the video amplifier circuit. Once the trouble has been isolated to a particular circuit, it is necessary to explore only this circuit to find the cause of trouble.

The trained technician usually handles from eight to ten service calls per day. Therefore, it is important that he waste no time exploring other circuits which obviously do not contribute to the trouble. The so-called "know-how" in television service is knowing, from the symptoms observed, the exact part of the receiver to check, and quickly locating the trouble by systematic check and analysis of the circuit. The experienced technician usually knows the eccentricities of individual chassis and can locate these troubles readily.

*Engineering Dept., RCA Service Company. Inc.

Proper tools for the job

For field service, our technicians are equipped with a volt-ohmmeter (20,000 ohms per volt) which is satisfactory for analyzing the common troubles encountered in home service. The necessary hand tools, screw drivers, socket wrenches, adjusting tools, soldering iron, line cord, drop cloth, etc., are neatly arranged in a tool box so that they can be easily located when needed. This also includes such convenience items as extension cables, picture tube and yoke cables, etc. (usually made up by the service technician on his own, to expedite his work).

Besides the tools, the technician carries a complete kit of tubes and parts normally required. These parts usually consist of an assortment of resistors, capacitors, and other specific components known to be sources of trouble in the various chassis.

If the technician finds that a part needed is not in his kit, the part number is obtained from the parts list of the service data for the model being serviced and ordered when he returns to the branch at the end of the day. The part is placed in his personal parts bin in the shop by the stockman, for delivery to the customer the next day.

Because of the increase in the number of different sizes and types of picture tubes, it is impossible for the technician to carry all types and sizes, unless his calls are scheduled on similar models. If a picture tube replacement is needed and is not available from the technician's kit of tubes, it is usually handled the same as other parts not normally carried by the technician, and delivered the following day. However, sometimes special delivery of picture tubes can be obtained by a phone call to the branch. The tube is dispatched to the customer's home and installed by a follow-up technician from a truck equipped with a complete stock of all sizes and types of picture tubes.

Why do they go wrong?

Any successful servicing operation calls for a periodic review of the "causes of need for service." Just what happens to a television receiver when it becomes inoperative? An analysis of 3,000 service calls made during November, 1951, in 15 different locations throughout the country revealed the following facts:

Reason for Failure	% of Calls
Tubes	44.3
Minor picture adjustments, centering, size, a.g.c., etc.	18.8
Component parts, capacitors, resistors, transformers, etc.	10.8
Miscellaneous — interference, nuisance calls, duplications, minor rechecks, instruction, checkup, etc.	22.9
Antenna work—reorienting, repairs, transmission lines, etc.	3.2

(These figures also include replacements on older receivers when life expectancy enters into the problem)

Among this group of 3,000 calls, it was found necessary to return only 120 receivers to the shop for repairs—46 of these for realignment, the remainder for troubles not easy for the technician to diagnose in the home.

These figures are very interesting

and refute the popular belief that realignment is a major problem in TV receiver servicing. The figures also support the claims of major servicing agencies that more than 80% of the receivers can be serviced *in the home*.

Customer handling, basic training in the shop of the service technician, proper scheduling and briefing before making the call, and adequacy of tools, tubes, and parts, are the prerequisites that help solve many home servicing problems. To this must be added the initiative and the will-to-try of the technician. This combination will work in most any size servicing operation.

Formula for efficiency

What then is the *formula* for successful servicing of television receivers? Any successful operation starts with the initial conversation with the customer reporting that his receiver is inoperative. The handling of the customer at this moment is just as important as the technical excellence of the man assigned to the job, or the complexity of the equipment that he uses. The customer *has* a legitimate complaint—he has reason to be annoyed. His major form of entertainment has been interrupted. He is to be treated with respect and sympathy—not irritability or argument. Right here, in 99% of the cases, is determined whether the service technician can fix that receiver in the home. Psychology at this moment is of much more value than a B.S. degree.

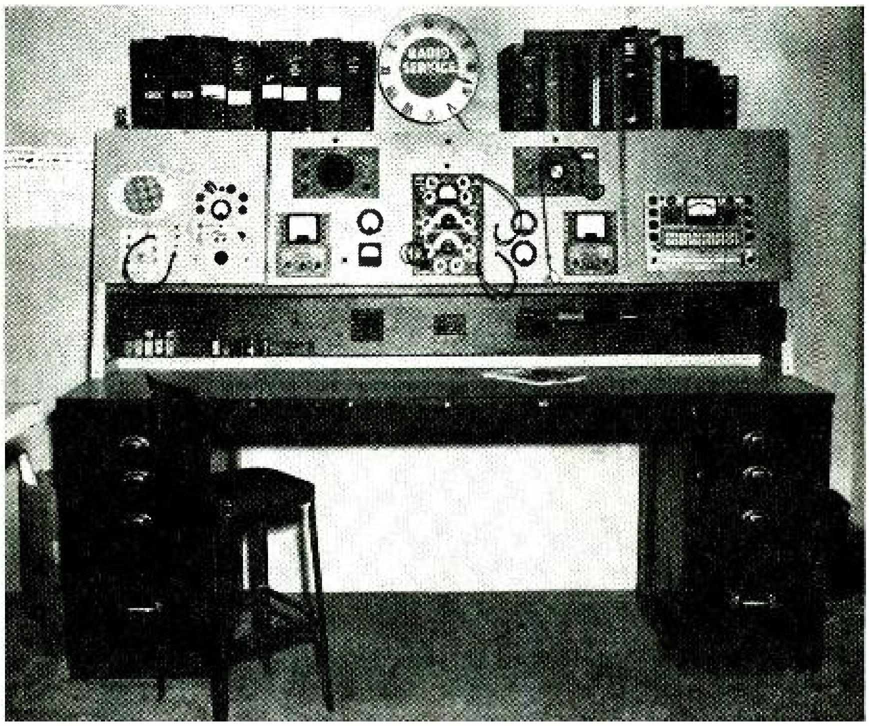
The next step toward solving this particular complaint is in selecting the technician who will handle the call. Avoid clash of personalities wherever possible. The nature of the complaint should be outlined fully on the job card handed the technician, so he can equip himself with the expected tubes and parts that may be at fault. Scheduling this call with other calls in the vicinity —and if possible, on similar models—is a *must* in the interest of economy and efficiency. If he needs coaching on how to handle this particular trouble—give him such assistance. Needless to say, he should have the necessary schematics and case histories that go with that particular model receiver. One minute briefing in the shop may save thirty minutes in the home. Make sure he knows the location of the customer's residence, and that the customer will be at home.

A very important part of the successful servicing program is explaining to the customer what was done, and demonstrating the improved performance. Time permitting, it is also an admirable point of professional courtesy to call the customer the next day to check on the work that was done.

In handling almost all our service work in the home, we do not use any secret or miraculous methods, but rather the down-to-earth common-sense practices that have been relied on by good technicians of the radio service industry for years.

—end—

RADIO-ELECTRONICS
Service Bench Contest
Second Prize



Mr. Whitton's panel design permits maximum utilization of the working space.

ACCENT ON SPACE

By C. J. WHITTON*

LIKE most service technicians, our preferences in a test bench were divided between the flexibility and convenience of individual unmounted instruments and the solid and impressive appearance (to the customer) of a symmetrical mounted panel. This test bench and panel was designed to meet both these requirements.

As you will note from the photograph, we have used the accepted patch-cord method of making instruments available at all positions on the bench, without having to move the chassis or other instruments being used. Obsolescence was also considered in the arrangement and construction of the panel. The large center panel contains instruments least apt to become obsolete, while instruments such as the tube tester and others whose life is likely to be short are mounted in the smaller end panels. These panel sections are made of quarter-inch tempered Masonite and are painted with auto enamel (with the color code recorded so they may be accurately matched when replacement is necessary).

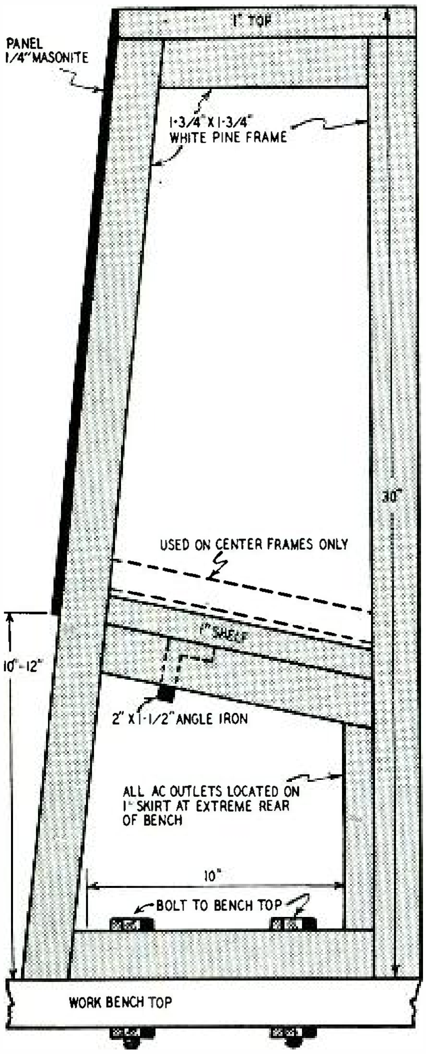
Another feature that has proven very convenient in use, is the mounting of the panel to the work bench. The lower edge of panel projects 10 inches over the work top and is raised 12 inches above the bench top. This places all controls within easy reach and still leaves ample bench area for the average chassis.

The frame for the panel support is made of 1¾ x 1¾ (2 x 2) material. There are two end supports as shown in the drawing. Stringers run across the bench at the rear top and bottom (see photo), along the front of the top and along the lower edge of the panel at the front. There is another stringer at the back about 8 inches from the bench—just so placed that it and the panel would make two sides of a square.

The center brace on each end piece runs between these two lower stringers, and a piece of 1-inch shelving runs the length of the bench on top of them,

*Denison, Texas

making a floor for the panel section. Two middle support sections are also made. They are like the end section, but have no lower leg section. One of these is placed at each panel break. The



End section of the panel support frame.

bottom edges rest on the shelf and are screwed firmly to it.

For better center support, a length of 1-inch angle iron runs the full length of the panel (see photo). It is externally grounded and serves as a convenient grounding bus that cannot be accidentally contacted but may be used along the length of the bench by using alligator-clip leads.

The work bench proper is simple in design. The base consists of two identical drawer sections. Work top trusses are of 2- x 4-inch material with a 1-inch top covered with tempered Masonite and painted with a good grade floor enamel. Drawer sizes may vary with individual requirements, but ours were designed to hold small bench tools and small parts not easily stocked on open shelving.

The choice of instruments and their grouping was not due to haphazard decision but was the result of eight years of study, and planning what we wanted in a permanent test bench:

The left panel section consists of an audio-control panel, a vibrator analyzer, voltage control for d.c. supply, and a row of patching jacks.

The right panel section contains the tube tester and a row of patching jacks.

The center panel contains a resistance bridge, two volt-ohmmeters, a 15-volt d.c. meter, a 30-amp d.c. meter, polarized d.c. metered output jack (for auto radios), patch network jacks, Analyst, a 150-volt a.c. meter, a 75-watt a.c. wattmeter (this meter is on single a.c. outlet skirt under panel), and an FM-AM signal generator.

All instruments are standard commercial units and require no description other than the fact that each unit has its own red-jeweled indicator. The entire panel is controlled by a 20-amp automatic circuit breaker which has a green-jeweled indicator in top center of main panel.

As you may note in the photo, there is a row of patch jacks within easy reach of all instruments. Each end section carries five standard tip and sleeve jacks. The two top jacks in each section are connected in parallel with low-loss coaxial shielded cable with shields commonly grounded to sleeve connection of jacks. Each of the lower three jacks is horizontally connected with its opposite number on the other end panel with parallel cord with no common connections. Thus an instrument on one end panel may be plugged into the jack near it with a jumper cord and may be used at the other end of the bench by plugging into the corresponding jack. When the photograph was taken only four jacks were in use. A fifth jack was added later.

The audio panel consists of an a.c. control switch; pilot light; input jacks for standard phono plug, microphone, and electrical instrument pickups; and output jacks for external speaker. All shielded input leads, speaker leads, and a.c. supply leads from this panel terminate at one of our standard 25-watt rental PA amplifiers, which is mounted under the back edge of the bench with controls accessible to the technician. This amplifier may be easily removed when peak PA rentals demand its use. The panel test speaker may be switched to the amplifier's output or to bottom row of patch jacks, thus making test speaker connections available at any point along the bench.

Another customer-convincing feature of this panel is the use of the noise test jack usually incorporated in the present-day tube checker. Plug the noise test jack on tester to shielded patch jack, then jumper the corresponding jack to input of audio panel, switch the test speaker to output, and presto! the noises that may appear in the tube under test will sound convincing indeed to the customer. To make this test more usable and to generally increase the efficiency of the entire panel, all instruments should be properly phased and grounded. —end—

Corona a Problem With Big Tubes

A number of service organizations find an undue amount of corona and arcing in the high-voltage power supplies of new large-screen receivers. In these sets, especially those using the 19-inch and larger tubes, the high voltage power supply develops between 12-18 kv for the picture tube. At these high voltages the tendency toward arcing or corona is much greater than at the 8-9 kv commonly used for smaller picture tubes. It is especially bothersome in damp locations and during humid weather. Near the ocean and the Great Lakes where the air has a large moisture content, corona is one of the most frequent reasons for service calls on large screen receivers.

Corona is apparent usually in reduced brightness and a buzzing sound, regardless of volume control setting. The decrease in brightness is caused by the extra loading which the corona presents to the high-voltage circuit, and which decreases the second-anode potential. Corona occurs when the potential at one point is so great that it forces all free electrons to the surface, and the surface is so small that electrons are "crowded out" and pushed into the air where they change oxygen molecules into ozone molecules. Ozone is the clean-smelling gas present after severe electrical discharges. Often one can smell the ozone at the back of the receiver as a sure indication of corona. In addition, corona can be seen in the dark as a bluish glow around a thin wire or sharp point.

One of the cures for corona is to smooth out sharp points by applying solder and letting it flow smoothly. Painting all exposed metal surfaces with polystyrene coil dope or Glyptal will also help, especially when the corona source is hard to locate exactly. Dust and dirt on insulating material often form a leakage path for corona or arcing. A good cleaning with carbon tetrachloride and subsequent application of coil dope will clear it up.

—end—

Have you had an interesting servicing experience recently? Or learned something new about the business end of servicing? Or maybe you have built a better TV service instrument, shortwave receiver or what have you? If so, chances are RADIO-ELECTRONICS readers would like to hear about it. We pay excellent rates for good down-to-earth articles. Let us know what you are thinking of writing about and ask for an Author's Guide.

FIX IT YOURSELF....

By ERIC LESLIE

THE TV repairman is suffering from a rash—a rash of "fix-it-yourself" TV books. They are announced by radio and TV broadcast, in newspaper advertising, and even in the windows of TV and parts dealers (some of whom should know better). The TV technician is rightly troubled because his profession is being belittled by the shouted suggestion that anyone with a fifty-cent book can be a fair TV repairman. Even more he resents the implication that the average TV repairman is a racketeer which dominates much of the advertising (though far less prominent in the books themselves). Just how useful or harmful are these works? What will be their impact on the TV service technician?

Four representative specimens appear in the photograph. They may be a little better than average, since at least two of them were sent to this magazine in good faith, with a request for review.

The cheapest of these, "How to Adjust Your Television" sells for 50¢. It has 47 pages in four chapters. The theme of the book is: "Eighty-five percent of the things that require servicing a TV set are repairable by ADJUSTMENTS or TUBE REPLACEMENTS." Chapter I describes adjustments, telling the set owner how to vary horizontal and vertical amplification, center the picture, adjust the ion trap (!), etc. The second chapter discusses the antenna and lead-in, the third, common tube failures, and the fourth is a short lesson on television theory. Then follows some useful information on possible modifications (color, big-tube conversion, etc.) and an order blank with which the set owner can obtain a tube layout for his set for $1.00.

The book is obviously written by someone familiar with television. Its chief fault is ambition. More than one set owner is going to get in wrong making some of the adjustments. Much of the material will be over the reader's head. There seems to be little reason for giving the set owner a glossary of technical terms, though chapter IV "How You Get a TV Picture" may be interesting if not useful. The service technician is mentioned in the introduction, which states that due to the shortage of technicians ". . . in many cases boys who should be installing antennas are sent out as 'repairmen.' This is costly both to the repair dealer and the set owner."

Two code-type books

Of an entirely different type is "Now You Can Fix Your Own TV Set." It makes no attempt to instruct the owner in the principles of television, but simply prints tube layouts of 107 TV receivers, with a list of trouble symptoms below. Each symptom is given one or a series of code numbers. These code numbers appear as callouts on the layouts above, with lines running from the tubes that might be responsible.

A set owner *might* be able, with this book and a spare set of tubes, to fix a fair proportion of the troubles in his receiver. A spare set of tubes, however, would make the book unnecessary. All the owner would have to do is replace *all* his tubes when his set goes wrong. Then he could put the old ones back one by one, till the symptoms show up again. The last tube in would be the guilty one.

The owner would probably be at a loss in the numerous cases where tube failure is a symptom of some other trouble. These books should carry a note: "If the new tube goes bad a few hours after installing it, call a service technician." Such a note would cover a large percentage—but not all—of such cases.

"Now You Can Fix" contains some introductory information, including instructions on removing and replacing tubes safely. The inexperienced set owner is warned against touching the controls on the back of the set. ("Adjustments" have no place in the picture, apparently.) According to the preface ". . . up to 75% of all troubles in television sets are caused by either defective tubes or faulty antennas."

The other code-type book is written by an author familiar to service technicians. It is "The Television Doctor" by H.G. Cisin, well known electronic engineer and author of articles in this and other magazines. This book sells for $1. The set owner is asked to check three things: the picture, the raster (called "bright area") and the sound. Various conditions of each of these are given in three lists on the inside front cover. There are 69 picture conditions and a smaller number of the other two. Each is numbered or indicated by a letter.

The set owner runs down the lists to the symptoms that describe his troubles, combines their numbers and letters into a phone-number-like code and searches for the remedy under this code. For example, the code for "no picture" is 1, that for "no bright area" is A and for "weak sound" is 11. Hence the code combination for this condition is 1A11. Next step is to turn to the second chapter "Trouble Location Guide" to identify the code symbol and find what's wrong. It's disappointing to find no 1A11—in fact nothing between 1A7 and 2A7. This may be one of the troubles a set owner cannot repair, and possibly this code appears in "*Rapid Trouble Shooting*", a companion book for TV service technicians. The symptoms given in the three lists can be combined into more than 35,000 different codes, so it might be too much to expect them all in *any* one book!

Cisin quite plainly has had first-hand experience in TV servicing, and one of his difficulties is dropping into terms not familiar to the set owner. The third chapter explains many of these terms, and the fourth goes into tube replacement. Even picture tube replacement is covered, and the owner is given detailed instructions, including how to adjust the ion trap, and even disposing of the old tube.

Unlike some authors, Cisin does not represent the TV technician as a racketeer, but as a good-natured individual who will be rather pleased if he finds the set owner intelligent enough to make small adjustments or replace burnt-out tubes: "As a matter of fact, he prefers not to be called on trivial matters," because then "he is obliged to charge you what may seem to you an unreasonable price, but you must remember that his time is valuable and he must be recompensed for it." A point of view which is original even to some service technicians!

A smoother job

A book which takes a somewhat different view is "TV Owner's Guide to Operation and Repair" an ambitious-looking job that sells for $1.98. Apparently written by a non-technical writer to help non-technical readers to purchase, operate, and install their own televisers, it is a mixture of common-sense advice and delicious nonsense, with the latter predominating.

On the one hand, the author performs a real service by printing genuine copies of warranties, purchase and service contracts, and points out many pitfalls which the customer can avoid if forewarned.

On the other hand, the reader might lose all these advantages by following the instructions for installation and repair. The author shows—as an example—a picture of an antenna installation which looks for all the world like a combination of two pictures published by a fire protection association to show how an antenna should *not* be installed. "To ground the mast" for instance, "simply wind a wire round the bottom of the mast, then wind that same wire firmly around a pipe or other metal fixture on the roof."

He is careful to warn the reader to be sure the carton is sealed when he receives his set, and after opening it, to make sure the serial number is intact. But he does not warn that ion traps are often moved out of position for shipping, an important fact for the owner who would like to make his picture tube last.

It is in the chapters on servicing that the "Guide" is most erratic. Aiming—apparently in good faith—to protect the set owner, its instructions would cause him to reject the honest service organization and search for gyps.

"You yourself can fix 90% of all the things that go wrong . . . ," the book says, in a chapter headed "If You Must Send Your Set to a Repairman." (This chapter trains the reader "to diagnose major repairs" and know "how much any one repair should cost you.") It goes on: "We are going to let you in on some of the most vicious repair rackets—not because most repairmen are dishonest, which they are certainly not—but because we don't want you to be one of the unfortunates who pay these gyp artists' salaries."

Some good advice follows. The customer is warned against fly-by-nighters, "membership plans," and "club discount houses," as well as picture tube insurance, and given some hints on how to find a good service technician.

Once the technician is in the house, however, the picture is different. Mind you, our skilled customer has already exhausted the "90%" of faults that can be repaired in the home. The trouble is obscure. Yet, if the technician cannot tell what is wrong with the set or "tells you that he'll have to take it to his shop for further experimentation—call another serviceman"!

If the service technician *can* tell what's wrong, "MAKE HIM TELL YOU IN ADVANCE HOW MUCH HE THINKS THE REPAIR WILL COST YOU." This estimate is to be checked with a "chart" which contains exactly five items:

Defective picture tube	$50.00-$60.00
Not enough electronic power	6.50- 7.50
Shorted picture tube	50.00- 60.00
Burnt-out condensor	6.00- 10.00
Burnt-out resistor	6.00- 12.00

(The spelling of "condensor" is consistent throughout the book.)

If by some chance it agrees with the chart "MAKE HIM GIVE YOU AN EXACT DAY" (when he will return the set).

Only the gyp, endowed by nature with X-ray vision and a mental analog computer for simultaneously (and instantly) evaluating "electronic power", a bill of materials, and the customer's bank balance, can glibly tell the owner what troubles shop examination will turn up, estimate exact charges, and predict the return date. The honest service technician is virtually excluded by this interesting technique. And, unless something is wrong with the picture tube, the only defect that justifies removing the set to the shop is "insufficient electronic power" (whatever that may be).

The book winds up with a chapter on repairing your AM radio. Instructions for repairing one common trouble—a defective line plug—are clear, detailed, and correct. Information on curing other troubles is not as accurate.

What impact will they have?

What effect are these books going to have on television servicing? The best guess is: "none." They *will* give the set owner a better idea of the complexities of TV receiver servicing. The explanations of TV theory will so confuse him that he will likely believe that the TV technician—who presumably understands these mysteries—is a superintellect.

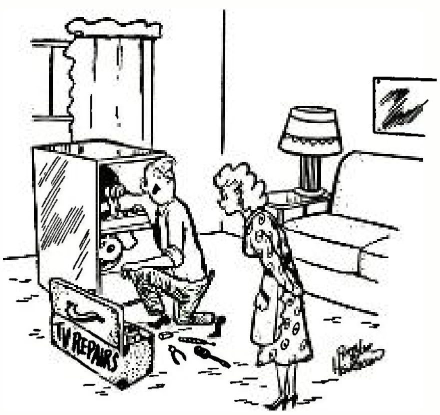
They are going to produce their crop of service calls, some of which may be distressing. (There is no meaner customer than the man who has to replace a picture tube, and does not intend to admit to his family—or even to himself—that he is responsible for the damage.) On the other hand, the better books may channel the incurable experimenter's tinkering into non-destructive channels. The "TV Doctor" warns about turning trimmers, and tells the set owner exactly how they look. The more intelligent T-viewer may even learn to make certain minor repairs and replacements which the service technician would otherwise be called on to do.

Books like these cannot help the prestige of the repair technician. Only one of the four studied suggests that he is a capable man whose time is worth money. The others, while giving lip-service to the "near-miracles" of the TV service industry and the "thousands of conscientious repairmen," justify their existence by the assumption that the industry is so largely made up of incompetents and high-school boys, if not racketeers, as to make it worth the set owner's while to try to make his own repairs.

Even worse than the books is some of the advertising heard on the radio. This however is not a new problem to the technician and service organization, and is one which must be met by counter-publicity and counter-advertising.

In the long run, the amount of business lost to TV set owners making their own repairs should be balanced almost exactly (at least dollarwise) by the amount of additional business gained from owners who try—without sufficient knowledge—to apply the instructions of some of these books. And any loss in prestige will be more than overbalanced by the increased respect readers will have for anyone who really understands television. The total result should be a greater understanding of the TV technician's problems by the set owner.

—end—



Suggested by Arthur Henrikson, Chicago, Ill.

"Oh yes. Of course it's simple! I just replace the tube that isn't hot!"

VARIABLE LINE VOLTAGE

By PHIL HINER

A VERY practical aid in radio and television servicing that has been generally overlooked is the power line transformer with manually-controlled, variable output voltage. With the very rapid increase of TV servicing in the metropolitan areas, a device for instantly varying the input voltage to a set under test has become almost a necessity.

The experienced service technician is aware that line voltage varies greatly from district to district in most of our cities, and also varies from hour to hour within the same district. These variations affect the operation of many electrical appliances—but particularly radio and television. We have frequently seen line voltage drop so low in a large Illinois city that normal battery-electric radios became inoperative due to cutting-out of the sets' local oscillators.

Television servicing requires a much closer check on line voltage than does normal radio servicing. A few volts variation in line voltage may make considerable difference in required size, focus, and picture linearity adjustments. As a result, a picture that was adjusted with loving care at the shop may be away off when it is turned on in the customer's home. This annoyance is now being obviated by some technicians simply by checking the line voltage in the customer's home when picking up the set and then setting the variable transformer in the shop test panel to that same voltage before aligning the set and adjusting the picture. (*Note:* Remember that in areas where the voltage varies at different times during the 24-hour period the peak-load evening voltage is the one that must be used, as the owner will do most of his viewing at that time.) Very little, if any readjustment then will be necessary in the customer's home.

In actual bench servicing, innumerable tests can be made on both TV and radio sets by varying the input voltage. As an example, suppose a TV set has a normal raster but no sound or picture and you suspect the r.f. oscillator. Arrested oscillation is most frequently caused by either low emission of the oscillator tube, a tired rectifier, or defective electrolytics across the low-voltage rectifier. As a quick check, a slightly raised input voltage is useful, as it will for a brief period counteract any of these conditions and artifically restore oscillation.

Most battery-electric portables derive their filament current from a voltage-dividing network in the B-plus supply, consequently, a substantial drop in line voltage means a drop in filament voltage below the level necessary to sustain oscillation. With a variable line voltage it is possible to determine quickly and precisely at what voltage the set signal fades and whether such trouble is due to low line voltage or to defects within the set such as electrolytic filter capacitors that have dropped in efficiency below the point that will maintain proper B-plus voltage.

Frequently, it is desirable to make voltage tests on a set when an excessive wattmeter reading or some other evidence of overload indicates a B-plus short. This *can* be done for a brief period, minimizing the danger of injuring good parts, by decreasing line voltage 20 to 30 volts below normal. Some sort of wattage indicating device is a very valuable addition to any test panel. A variety of such circuits are available and can easily be constructed in the shop. A low-cost, satisfactory wattage indicator can be built around an electron ray 6E5 or 6U5 indicating tube, using a circuit similar to that found in the RCA Chanalyst.

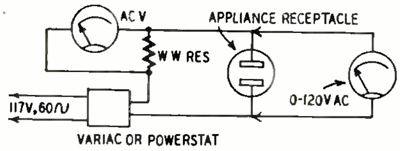
A simple hookup is shown in the drawing. A low-value resistor is inserted in the line and the voltage across it is measured with a low-range a.c. voltmeter. The meter may have a range of 3 volts, and the resister should have a drop of about 1 to 1.5 volts with apparatus most commonly tested. Thus for television receivers, a ½-ohm resistor would be good, and for midgets a 2- or 3-ohm resistor would give best indications. Many technicians use a 1-ohm resistor as a compromise.

The device is actually an a.c. ammeter, not a wattmeter, though in practical application the number of amperes flowing through it multiplied by the line voltage will give the approximate wattage. With a line voltage of 120, for example, and a ½-ohm resistor, 1 volt on the meter would indicate 2 amperes, or 240 watts.

A chart can be drawn up, based on ordinary line voltage, to show watts against voltage readings on the meter. The line should also be frequently checked (as suggested in the figure).

There are, of course, several methods of attacking the problem of intermittents, one of the most satisfactory being the use of momentary surges of high line voltage. The voltage is increased to 125 to 130 volts, but only for a short time. Many old-time service technicians use momentary applications of high line voltage to polish off worn parts on the theory that the components that go west are borderline and should be replaced. Some prefer to remove all tubes but the rectifier, thereby impressing high voltages across capacitors. On occasion the writer has successfully used this technique in breaking down and locating leaking capacitors. The practice is controversial, however, and it places abnormal stress upon good parts as well as bad.

An ideal device for varying line voltage is an isolation-type transformer constructed with either a continuously variable secondary or a switch-controlled multitapped secondary, and a built-in voltmeter. Several such transformers are now available. A transformer that has suitable characteristics is the Staco. model LR-5. This transformer is metered and has a continuously variable secondary from 70 to 140 volts. A similar transformer by the same manufacturer, model LRL-5, has a continuously variable secondary, from zero to 140 volts, available at a slightly higher cost. An autotransformer variac such as Stancor's testing transformer. model P-6299, also may be used, but it does not provide the isolation from the power line that is particularly advantageous in working with a.c.-d.c. sets. The "hot chassis" is a long-standing source of annoyance to service technicians and a possible source of real danger when plugging directly into a power receptacle. This hazard is completely eliminated by using an isolation transformer with the set under test. The RCA Isotap provides such isolation with variable voltage.



Other types of variable-output transformers or autotransformers are obtainable, with a wide range of power-handling capabilities, number of taps, and prices. Among these are the Merit P-3177, UTC's Varitran V-1, the Stancor PV-6443, and a number of others.

Much commercial test equipment is dependent to some degree upon a constant input voltage for accuracy. Since line voltage in metropolitan areas may drop as much as 5 to 15 volts during periods of heavy power consumption, many modern shops have found it advisable to energize their test equipment through a separate variable transformer or variac, making it possible to maintain a constant input voltage at any hour of the day or night.

While not literally a test instrument. the variable line transformer does afford control over an ever-present variable in electronic trouble-shooting. The ability to control or reproduce certain conditions results in more effective and economical servicing.

—end—

Scene of action in studio of television station WRGB.

Operating TV

Part II—Equipment, techniques and practice in the TV studio

THE operating techniques of a TV camera are briefly as follows:

Depth of field. If inadequate depth of field is apparent, three possible corrective adjustments may be made:

1. Camera may be moved back. The farther the object is from the lens (for a given focal length and iris opening), the greater the depth of field, also the smaller the image.

2. Use of smaller iris opening. The smaller the opening (for a given focal length and distance), the greater the depth of field. It must be borne in mind also that the illumination required increases with the *square of the ratios* of the f:numbers of the diaphragm as the lens is "stopped down."

3. Use of a lens with shorter focal length. This increases the depth of field, widens horizontal and vertical angles, and reduces the image size. Use of a shorter focal length, however, complicates the problem of obtaining good pictorial quality, due to the smallness of the image and a *flat field.*

Focusing. The image is focused by a knob on the right-hand side of the camera, which moves the image orthicon tube and yoke assembly in respect to the lens. Inspection of Fig. 4 in the February issue shows that the field *in focus* is about twice as great to the rear of the object upon which the camera is focused than in front of the object. This characteristic has a direct bearing on focusing technique as practiced by the cameraman. When he adjusts the focusing of the camera on the subject or scene, the lens is focused on a plane about one-third of the distance between the limit of the depth of field closest to the lens and the rear limit farthest from the camera. In this way the camera is properly focused for activity within the *depth of field* of the area likely to be used.

Special effects are sometimes called for which require the cameraman to use the focus control in an unorthodox manner. One common example is a deliberate defocusing (blurring of the entire scene), and then refocusing to impart the illusion of a transition of time.

Using the Iris. The iris controls the stop openings or aperture of the lens, and is adjustable from the rear of the camera, or in some cases, is motor-driven from the camera-control unit. This adjustment is a vital part of camera technique.

The *lens stop* is usually engraved on the rim of the iris and on remote iris controls, and is prefixed with a small letter f. The lens speed is rated by its widest stop, such as f:1.9; f:2.7; f:3.5 for a *fast* lens, or f:16 or f:22 for a comparatively *slow* lens. The iris enables the operator to use a smaller aperture (higher stop number) than the maximum available. The wider the aperture, the more light gets through to the photocathode of the tube. The smaller the aperture, the less light but the greater the depth of field. The scene composition, lighting facilities, and the scenic effects desired are contributing factors in determining the iris adjustments. In practice, adequate light is used so that the lens may be stopped down to the f:number allowing the maximum depth of focus necessary for the sequence of operations.

Panning. Turning the pickup head right or left to follow movement across a scene requires considerably more practice than one would think. The movement must be smooth and even. Motion that is too fast causes a breakup of the image in the horizontal lines. Proper technique requires one thing: *practice.* Panning is done by grasping the lever at the rear which swivels the pickup head on the tripod or dolly, and moving it easily in the direction the pan is to be made.

Dollying. This term refers to the action of moving in, out, or around a scene. A camera dolly mounted on wheels and sometimes operated by a dolly man is used. It is obvious that the cameraman must continually adjust his focusing control if the movement is in or out.

The above discussion of course is only an outline of camera technique. Several electrical adjustments yet remain in the cameraman's bag of tricks which affect picture quality and produce the special effects that may be called for.

Final image orthicon adjustments

After the initial focus and alignment adjustments have been made, the remaining settings are *beam current* and *target potential.* These adjustments are made simultaneously and only when the scene composition and lighting conditions are known.

In order to better understand these adjustments, consider for a moment the nature of the video signal currents. The electron gun emits a stream of electrons which constitute the *beam current.* Before scanning, this beam current is a direct current. The image focused upon the photocathode creates a varying target charge. Upon scanning, the electrons are attracted to the target, partially neutralizing the target image charge, subtracting from the original

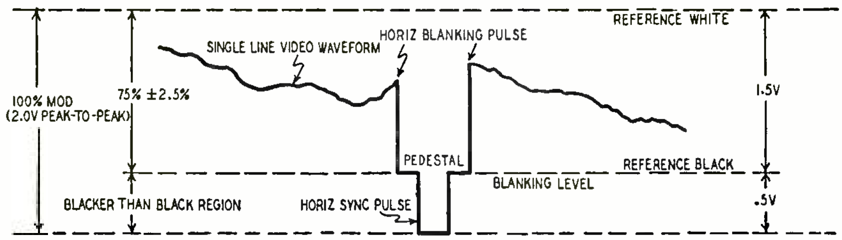


Fig. 1—Parts of two single video lines separated by horizontal blanking pulse.

Studio Equipment

By HAROLD ENNES

Photo of the Du Mont field-type monitor.

beam current, and causing modulation of the returning beam. (See Fig. 1 in last issue). This returning beam undergoes current multiplication in the electron multiplier, flows through the output load resistor, and creates the video signal for the wide-band video preamp.

When no light (a dark portion of the scene) is impressed upon the photocathode, all of the scanning electrons return to the multiplier section. When a comparatively large amount of light is present (such as highlights of a scene), few electrons will return, since most of them are removed from the original beam in neutralizing the charge on the target.

If the beam current is increased excessively, the excess electrons not required to neutralize the target charge will be returned to the multiplier section along with those of the black portion of the scene, resulting in a relative loss of detail. Also, the *beam noise* is proportional to the square root of the beam current, so that the higher the beam current, the lower will be the signal-to-noise ratio.

It is the operator's job to adjust beam current and target potential so that the highest highlights are just adequately discharged, while maintaining highest signal-to-noise ratio possible.

The target voltage may be varied in practice over a range of from minus 3 to plus 3 volts d.c. If the target voltage is gradually reduced (made more negative), the operator notices a point where the picture disappears. This is known as *target cutoff voltage*. If the target is operated at a potential just slightly higher than this value, the greys are deteriorated and the blacks compressed, with very poor detail and low signal-to-noise ratio.

With higher target voltage, however, more beam current is required to discharge the strongest highlights in the scene. In order to attain a high signal-to-noise ratio, the operator must use only enough target potential to provide good resolution. In practice this occurs at a target potential of 1.8 to 2.2 volts *above cutoff potential.*

Beam current is adjusted to the point where good resolution of the strongest highlights is obtained. In practice, if the operator encounters an unforeseen excess of light in a scene, he does not hold it down by a more negative target voltage or by more beam current, but by *stopping down the lens iris.*

After the target potential and beam current adjustments have been made, the video amplifier gain controls may be adjusted for proper level.

Interpreting the camera monitor

Referring back to Fig. 1 in last month's issue, it is noted that each camera is connected to its own camera control and monitor unit, and that all of these units feed a mixer-amplifier monitor unit. Each of these units contain a cathode-ray tube used as a picture monitor (usually 7-inch), and a cathode-ray tube (usually 3-inch) used to monitor either line waveform (7,875-cycle sweep), or frame (30-cycle sweep) waveform.

The interpretation of the waveform monitor warrants some description.

Fig. 1 is a representation of the composition of the video line. Since the waveform monitor may show the control pulses either on top or bottom, depending upon which stage it is connected in, we have arbitrarily chosen to show the blacker-than-black region at the bottom. The picture signal is shown by a varying line representing the varying light content from left to right of the scene. Television standards call for a maximum of 75% of the total signal to be allowed for this signal level, allowing 25% for sync and control pulses. The horizontal blanking voltage (pedestal) blanks out the return trace of the horizontal sawtooth in monitor and receiver scanners, making the return trace invisible to the viewers. During this time, the horizontal sync pulse is transmitted. After each line is scanned a horizontal pedestal voltage is applied.

The pedestal voltage and the various sync and control pulses for the pickup head are usually injected at the camera-control unit. The small waveform scopes on camera and line monitors supply the information needed for proper adjustment of video and pulse amplitudes. In practice, 100% modulation of the transmitter is usually referred to 2.0 volts (peak-to-peak) on this monitor screen. This includes the sync pulse peaks as shown in Fig. 1.

Fig. 2-a is a representation of a typical pattern as observed on the waveform monitor when the sweep is set to observe the horizontal line waveform. Two horizontal lines will be traced out on the screen for each scope sweep. A single horizontal pedestal is observed marking the end of one line of picture information and the beginning of the next. This screen image, however, needs some explanation since the horizontal line picture information is not a simple line of varying amplitude as in Fig. 1. The scope should be considered as scanning the video signal of all the lines of the

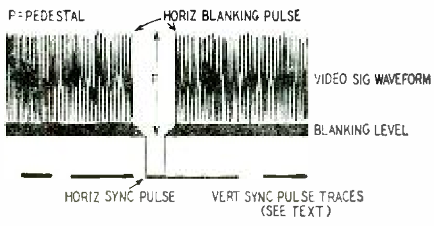


Fig. 2-a—Waveform of horizontal lines.

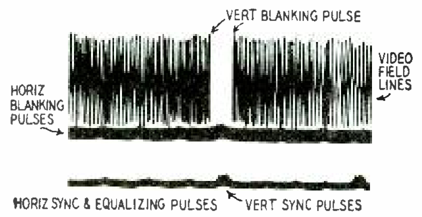


Fig. 2-b—Waveform at field frequency.

entire picture as covered by the camera. Since each line is different in shape from every other, the pattern on the scope is irregular—often referred to by the operator as "the grass." The persistence of the fluorescent screen and of the human eye are factors affecting the appearance of this pattern, since the horizontal lines of the picture are being traced out on top of each other.

The heavy line appearing at the blanking level in Fig. 2-a merits some explanation. At the end of each field (262.5 lines) the camera scanning beam returns to the top left of the picture in order to start scanning the alternate 262.5 lines to complete the frame. At the bottom of each field where the scanning beam must be returned to the top, the vertical blanking pedestal is applied to the video signal to blank the receiver-tube response. Since the monitoring scope beam is still sweeping the screen during this time and is not blanked out, it traces out the vertical pedestal voltage in the horizontal direction shown. It is a heavy line because the vertical pedestal is as long in duration as several horizontal lines and will thus be swept over a wide portion of the screen as shown. The serrated vertical sync pulses are placed on the vertical blanking (pedestal) pulse. These appear on the screen as dashed lines at the extreme bottom.

The sync signal shown appears on the camera control waveform pattern only when one camera is used. When more than one camera or other source is used, requiring switching between control units, the receiver sync signal is inserted *after* the switcher unit, to eliminate the possibility of momentarily interrupting the sync signal. Thus when more than one source is used, the pattern on the waveform scope in the camera-control unit appears *without* the transmitted sync signal. The "on-air" monitor at a point in the system following the switcher unit then shows the composite waveform as above.

When the waveform monitor scope sweep is set at 30 c.p.s., a trace similar to Fig. 2-b is obtained. A single scope beam scan now takes place in 1/30th of a second, and the lines of the first field are traced out in one-half of this time, or 1/60th of a second. This one field is shown to the left, separated by the vertical blanking pulse from the field shown on the right. One field consists of even lines, and the other of the odd lines; it is not necessary to tell which field is which.

The bottom line consists of horizontal sync pulses for the lines traced out on the field pattern immediately above the horizontal blanking pulses. Since the serrated pulses which make up the vertical sync pulse are of very short duration they are not sharply defined on the screen.

The actual number of serrated pulses, however, may be counted. By adjusting the fine frequency control on a test scope sweep, the vertical sync pulses at the extreme bottom right may be made to *roll-off* onto the retrace. It will thus be elongated to the extent that the operator may count six equalizing pulses at the right of the vertical pulse, six longer vertical sync pulses (serrations), then six more short equalizing pulses to the left.

The horizontal sync pulses, as mentioned earlier, appear in the bottom line as shown in the drawing.

Camera mixer and switcher unit

There are two general types of mixer and switcher units used in TV studios. The first is the regular studio unit; the second is the field type, or portable unit, used in many studios.

A regular studio camera mixing and switching unit is exemplified by the RCA TS-10A unit. It selects any of the six input cables (from cameras, film controls, field or network cables, etc), switches or fades the desired signal to the program line, switches instantly from one signal to another, superimposes two signals with any desired degree of brightness for each signal, monitors picture and waveform. A push-button selector arrangement, consisting of two rows of six push-buttons each, performs the video switching. Any one of six input signals may be used, and pilot lights indicate the "on-air" position for any input. Since the push-buttons feed separate amplifiers, superimposing or lap-dissolving of two pictures may be accomplished. For example, by pressing number 1 camera button in one bank and number 3 camera button in the other bank, the signals are fed through A channel and B channel respectively, and combined in the output. Relative brightness of each picture is adjusted by associated video controls on the panel, one for each row of push-buttons. Either picture or both may be faded out entirely. The fader controls are handle-type vertical controls at the end of the push-button rows. Instantaneous switching is accomplished by using one bank of switches.

The field-type switcher operates somewhat differently. The DuMont type 5031-A mixer amplifier and monitor uses a 4-channel electronic fading circuit. A photo of the unit appears on the preceding page. Fig. 3 illustrates a highly simplified version of the circuit used.

The 6C4 cathode followers, followed by 6AK5 pentodes, amplify the outputs of the camera-control units. The pentodes plates are paralleled and supplied with plate voltage thru a common peaking coil and plate load resistor. When the operator desires to switch (for example) from channel 1 to channel 2, he may gradually increase the bias for the 6AK5 pentode on channel 1, while gradually reducing the bias for the corresponding tube for channel 2. This unit provides automatic control of the rate of fading between channels by using R-C combinations which predetermine the rate of rise or fall of bias potentials. Instantaneous switching also may be accomplished when needed. Bouncing which would ordinarily occur upon instantaneous switching (due to rapid changes of plate current when one tube is instantly biased to cutoff, and current through another one increased) is eliminated by using a clamping circuit in the following line amplifier.

Production co-ordination

Co-ordination between directors in the control room and operators in the studio is a must in any TV production. An intercom system enables the audio operator, technical director, and floor director to communicate with studio personnel. Note the headphones on the camera operator in the photo on page 54. The camera on the left is mounted on a crane-type dolly, the one on the right on a pedestal-type dolly. The music background for the vocalist is picked up by the boom mike suspended just out of camera range. (The boom operator is not shown in this photo). All operators wear headphones for instructions from the control-room positions. During rehearsals, these operators often wear breast-plate microphones, allowing two-way conversation.

Pilot lights on the front panel of the cameras indicate to the performers which camera is on the air at the moment. Knowing this, the actor is prepared to face the TV viewing audience at all times.

—end—

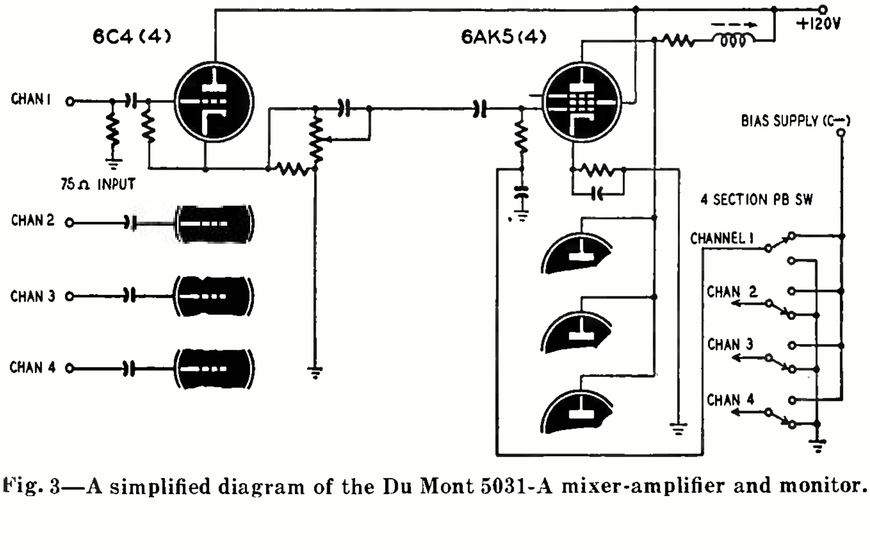
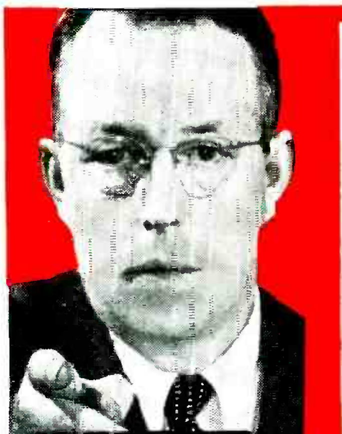


Fig. 3—A simplified diagram of the Du Mont 5031-A mixer-amplifier and monitor.



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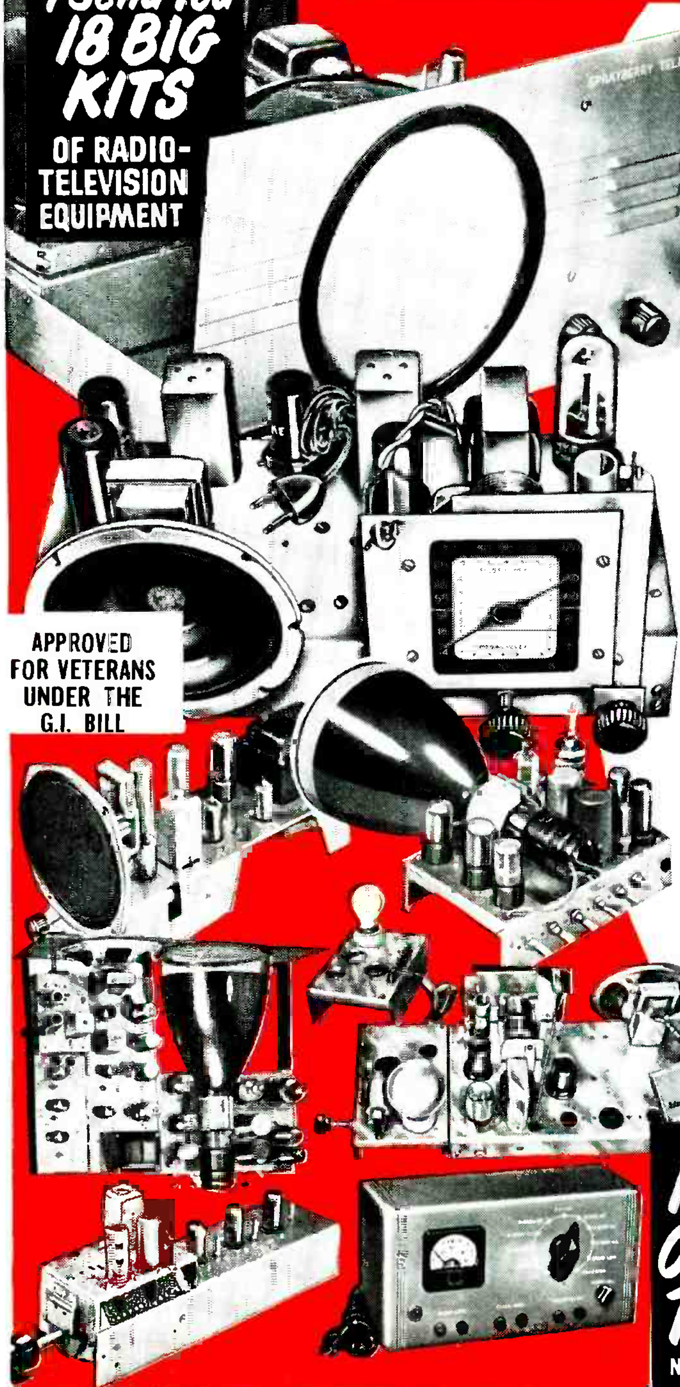

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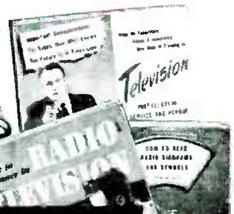

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Automatic 150-kw Station

World's largest remotely switched transmitter has some new design features

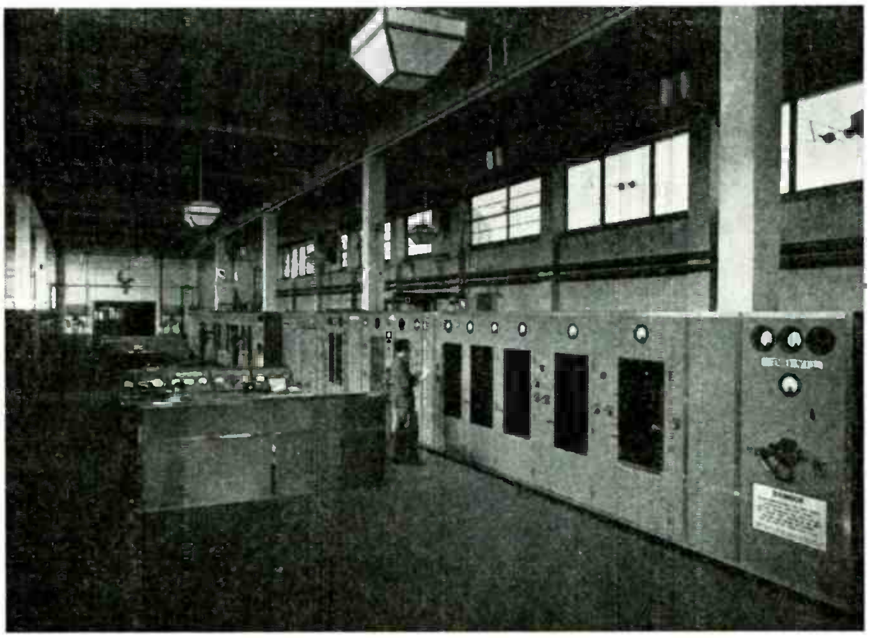
By T. W. DRESSER

LAST summer marked the opening of a new BBC high-power transmitter and mast radiator at Daventry, England, for the Third Program on the present wavelength of 464 meters (647 kc).

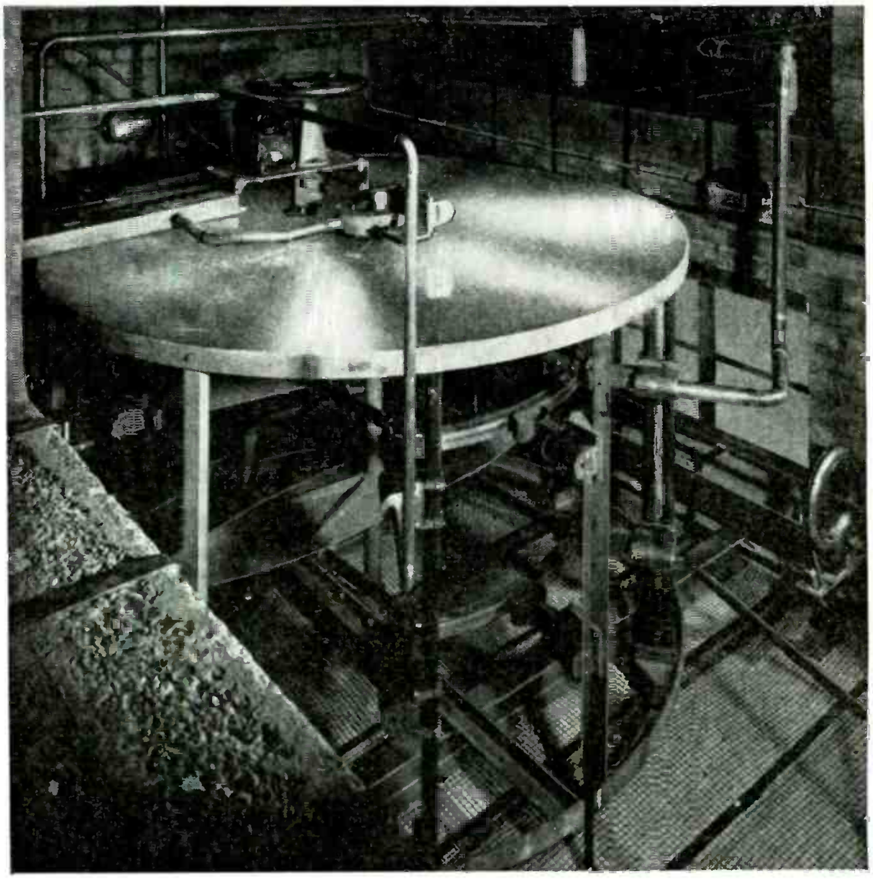
With a power of 150 kilowatts the new transmitter is more than twice as powerful as its predecessor, and has also been provided with a more efficient aerial, specifically designed to give as large a fading-free service area as possible.

Daventry has the longest history of any BBC transmitting station. Just over 26 years ago (in 1925) the BBC's first high-power transmitter for long-wave broadcasting—Daventry 5XX—was installed there, to be followed two years later by the high-power medium-wave transmitter 5GB. In 1932 the station was rechristened the Daventry Empire Station, following the installation of transmitters for broadcasting to the Empire on short waves. By 1937 the number of short-wave transmitters had increased to six, with a further increase to 11 by 1940, making Daventry at that time the BBC's most powerful short-wave broadcasting station. Meanwhile the long- and medium-wave services had been transferred to new and more powerful transmitters at Droitwich.

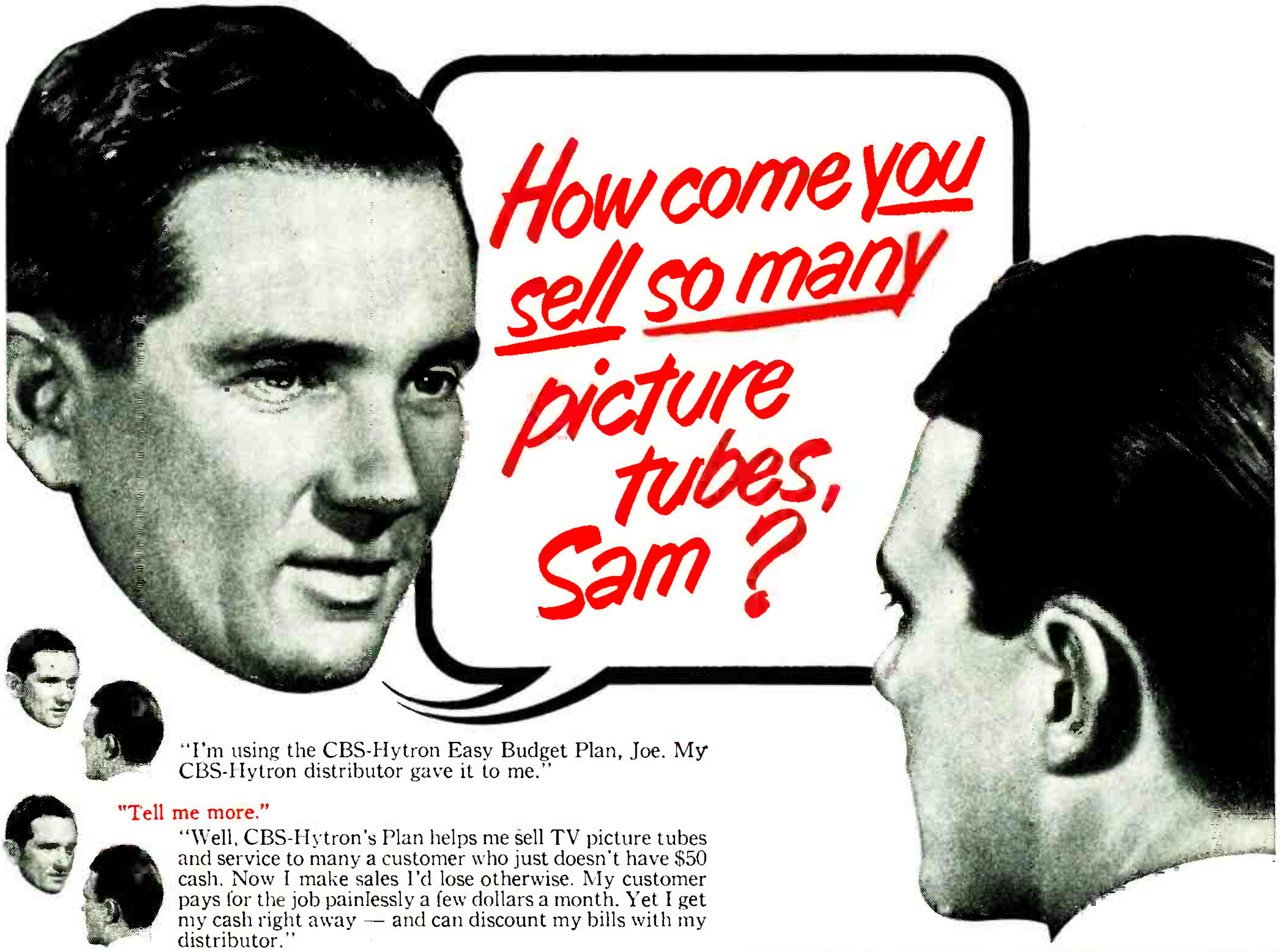
The new transmitter, designed and manufactured by Marconi's Wireless Telegraph Co., Ltd., is in the building that originally housed the 5XX transmitter. It consists of two identical transmitter units which can work in parallel, each complete in itself and each capable of an unmodulated carrier output power of 100 kilowatts. To conform with the Copenhagen wavelength plan the actual power used will be limited to 150 kilowatts. All the tubes—including those in the output stage—are air-cooled, a new departure for a BBC transmitter of this power and one that makes maintenance and remote control easier, for the transmitter is designed so that it will ultimately be possible to operate it from a remote point—from another building at Daventry or from Broadcasting House, London, for example—by means of signals sent over a single telephone channel. The BBC has had low-power remotely controlled



The automatic station's main transmitting hall, showing four 100-kw transmitters.



With this switch the antenna may be remotely connected to either transmitter.



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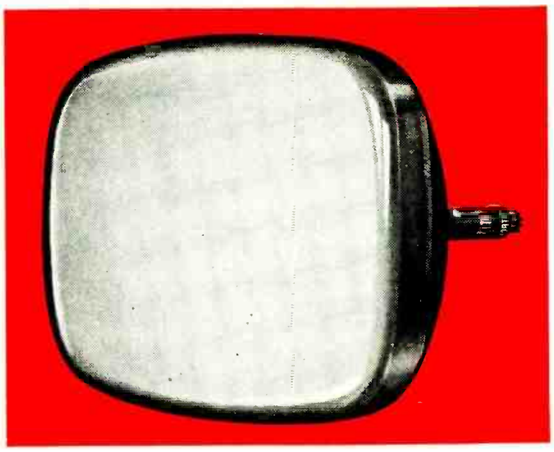

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transmitters in service for some time, but this is the first time that an attempt has been made to apply remote control to one of its high-power transmitters.

About 1¼ miles east of the transmitter building on a site 460 feet above sea level a 725-foot mast radiator has been erected for the new transmitter, the tallest mast yet installed by the BBC for a medium-wave transmitter.

The mast is of lattice-steel construction and is triangular in cross-section, each face being 9 feet across. The base of the mast is poised on an insulator shaped like two truncated cones placed apex to apex. It is capable of withstanding a peak voltage of over 100 kilovolts without flashing over, even when wet. Between the two halves of the insulator is a ball joint which permits the mast to deflect several degrees from the vertical.

At a point 460 feet above the base the mast is divided into two sections by an insulator similar to the one at the base. Thus the lower section extends up to a height of 460 feet, then comes the insulator at the "nodal" point, and above it is the top section extending up another 265 feet. At the masthead there is a capacity top load consisting of a number of spokes projecting out to a distance of 35 feet, with their extremities connected together by wires. The spokes are hinged close to the mast so that they can be folded down if the capacity top is not required.

The most interesting feature about this mast radiator is that the radio-frequency power is fed into it across the insulator at the 460-foot level instead of at the base. This method is expected to reduce fading by minimizing the effect of the feed current, which with a conventional base feed distorts the vertical polar diagram by increasing the high-angle radiation.

The transmitter output is connected to the antenna tuning house at the base of the mast by a 12-wire unbalanced open-wire transmission line supported on steel poles 18-feet high and spaced at 150-foot intervals. The outer conductor of the line is formed by eight wires on a pitch circle having a diameter of 1 foot 6 inches, and the inner by four wires on a circle of ½-inch diameter. The length of the feeder is 2,640 yards, and the loss is approximately 0.35 db. The ground system consists of a 90-foot square screen of wires and a spider's web of wires radiating out to a distance of 750 feet at 5 degree intervals, and buried nine inches underground.

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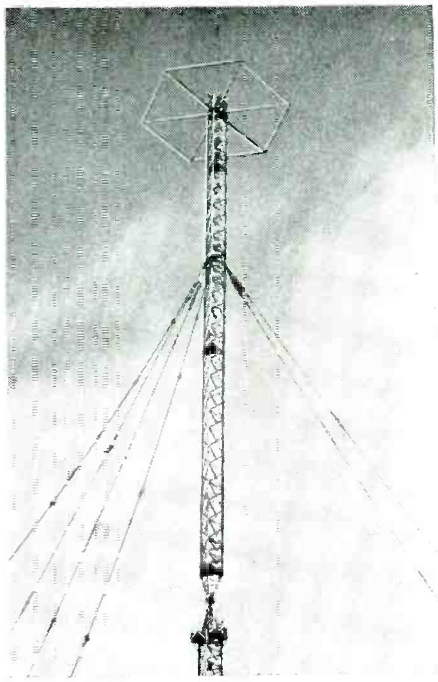
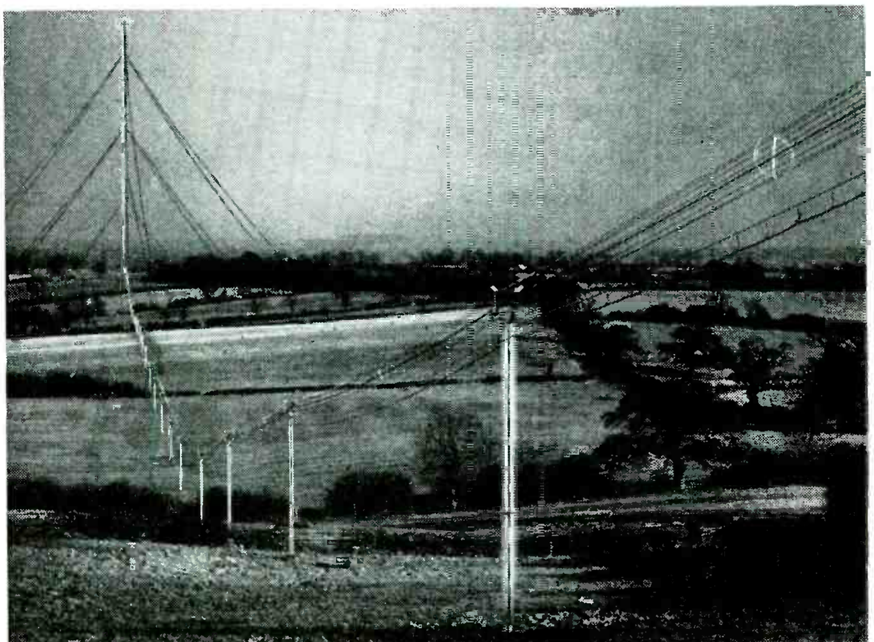

Upper section of the 725-foot top-loaded radiator. The insulator near bottom of photo is 460 feet from the ground.


All photos courtesy British Broadcasting Co.

A twelve-wire unbalanced line runs between the transmitter and antenna tuning house.

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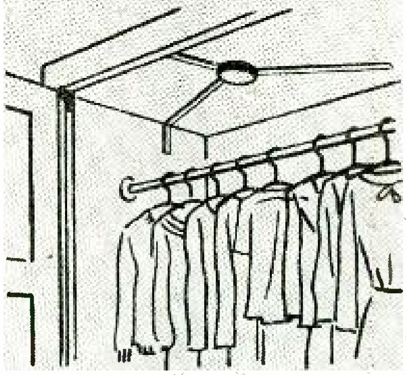

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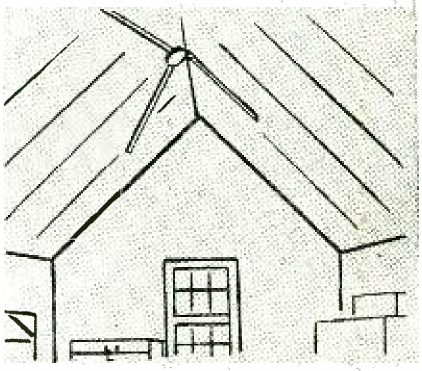

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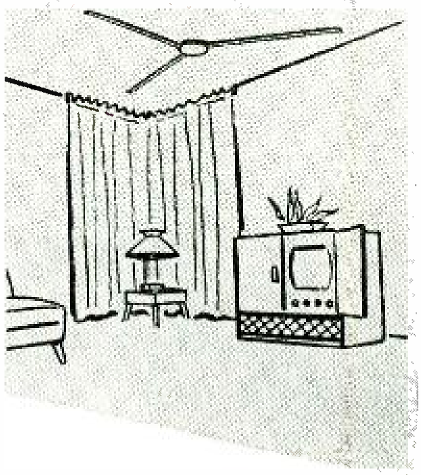

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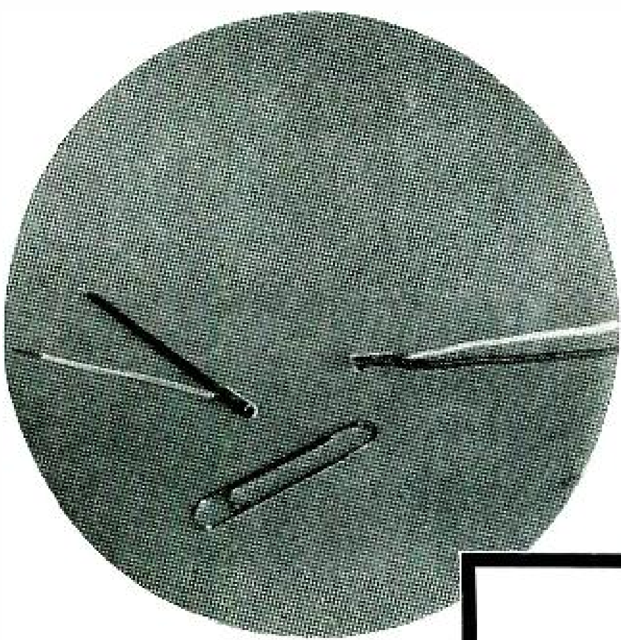


Two of the diminutive type 1N77 photodiodes.

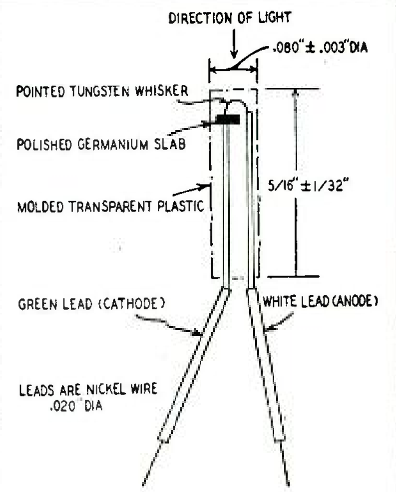


Fig. 1—Details of a 1N77 photodiode.

Subminiature Germanium Photodiodes

They may open many new applications in photoelectricity

By RUFUS P. TURNER

THE relatively large size of photocells and phototubes often hinders miniaturization of photoelectric equipment. Even the *small-sized* phototubes which have made their appearance in recent months are too big for many projected applications. Nor has the situation been improved materially by reducing the area of selenium and copper-oxide photocells, since the internal shunting capacitance of these cells remains high and the frequency response correspondingly poor.

The recent development of the Sylvania type 1N77 germanium photodiode makes available a light-sensitive device of very small proportions. The rod-shaped, molded transparent plastic housing of the 1N77 is only 8/100-inch in diameter and 5/16-inch long. This small over-all size adapts the photodiode especially to subminiature light-sensitive apparatus. The 1N77 may be mounted directly in the tip of a pencil-type light probe for evaluating the illumination of small areas. The sensitive area of the device is approximately *one ten-thousandth of a square centimeter*. The capacitance accordingly is low, of the order of 2 μμf, and the frequency response therefore high—greater than 100 kc. The wide frequency range of the 1N77 makes it suitable for operations involving chopped or modulated light, such as sound reproduction, facsimile, and similar processes in which high-frequency operation is important.

Constructional details

The small size of the 1N77 may be noted from the photograph. Two of the

units are shown beside a paper clip for comparison.

Fig. 1 shows structural details of the 1N77. The photodiode is similar in construction to the simple crystal diode. In the 1N77, a sharply pointed tungsten whisker is placed in firm contact with the polished surface of a processed germanium slab. The assembly is molded in a colorless, transparent plastic, with the diode elements close to one end of the molding. Leads of .020-inch diameter nickel wire, from the germanium and whisker, are brought out of the other end. The extended portions

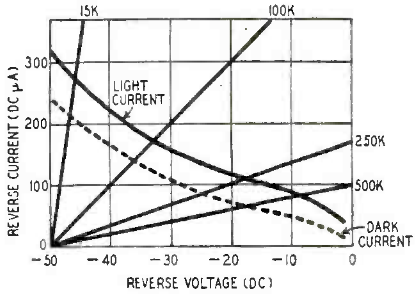


Fig. 2—Static characteristics, 1N77.

of the leads are insulated. For identification the cathode lead which is connected to the germanium slab is covered with green spaghetti wire; the anode lead connected to the whisker is insulated with white spaghetti. The anode lead is approximately 4 inches long, while the cathode lead is approximately 4½ inches.

The 1N77 may be mounted and operated in any position, provided the actuating light rays are allowed to enter the end nearest the diode assembly and perpendicular to the "outside" face of the germanium slab, as shown in Fig. 1.

Operating principle

The photodiode uses an effect long known to workers with germanium diodes—that illumination of the whisker-germanium contact area momentarily changes the conduction characteristics of the diode. When a polarizing voltage is applied to the diode. the current

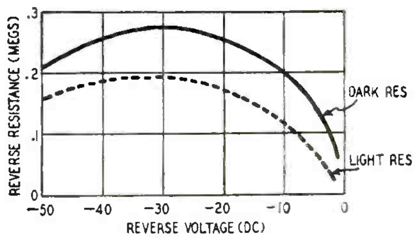


Fig. 3—D.c. resistance characteristics.

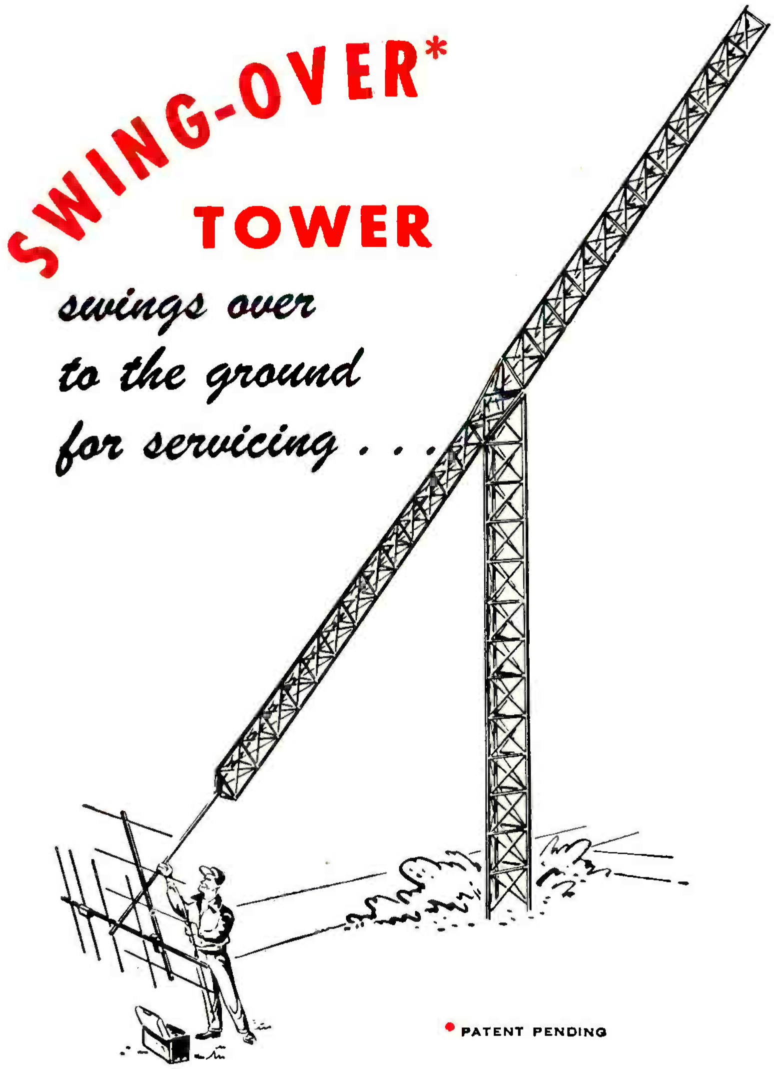
flowing through it increases when the contact area is illuminated. This is the result of a decrease in the diode resistance—a complex effect in the atomic structure of the germanium. Both forward current (anode positive) and reverse current (anode negative) may be increased by means of illumination. However, experimental results indicate that the device works best by using the reverse characteristic. The germanium diode also possesses a small photovoltaic property—that is, in the ab-

the most convenient TV tower ever made

THE TEL-A-RAY

SWING-OVER* TOWER

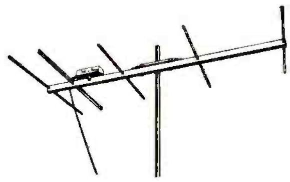
swings over to the ground for servicing . . .



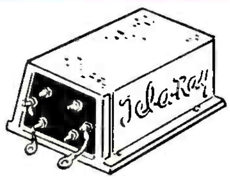
* PATENT PENDING

The biggest new idea in television — the Tel-a-Ray Swing-Over Tower* — swings over to the ground for easy servicing! One man can raise or lower this counterbalanced tower in three minutes!
Model TT1, for ground installations, is 50 feet high when a recommended 10 feet of water pipe is added — can be quickly erected with no guy wires.
Model TT2 is designed for roof tops, reaches up 24 feet with the addition of an eight-foot pipe.
Although light in weight, the Swing-Over Tower is ruggedly built with steel angles and welded construction.
Simple to assemble . . . no machinery necessary . . . low in price.
Write today for information.

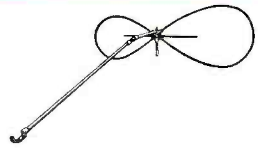
FOR WONDERFUL TV RECEPTION WHEREVER YOU ARE



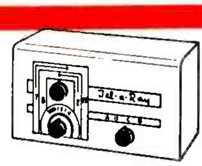
The weatherproof Model T antenna . . . brings in wonderful reception up to 200 miles.



Only low-priced Pre-Amplifier on the market, the TB. Multiplies signal gain . . . holds noise to a minimum.



Butterfly Swivel-Positioned TV and FM antenna . . . designed to give the finest reception in primary areas.



Tel-a-Ray's new Switching Booster (Model PTB1) — one switch changes channels and antennas. Eliminates the need for a separate booster for each antenna . . . for as many as four antennas. Automatic features make this outstanding.

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With the RCA line you get ALL THESE EXTRA BENEFITS, TOO

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You get **TERRIFIC SELLING AIDS** . . . signs, banners, displays, kits, merchandisers that are unique . . . to mark your store as headquarters for RCA Batteries.

You get **RADIO-ENGINEERED BATTERIES** . . . power-packed for *extra* listening hours . . . and built to exacting standards of quality. They represent the combined skills of both battery engineers and radio engineers.

You get a **ROUNDED LINE** to fill virtually every portable and farm radio requirement. Seven popular types will fill about 80% of your needs. You cut down on stocking problems . . . are sure to have the right batteries on hand—at the right time!

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Let us help you make this your banner year for battery sales. Call your RCA Battery Distributor right now. Get set with the *Radio Battery* for the *Radio Trade*...RCA. And *let us help you make more money . . . starting* TODAY.

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You're in the *Radio Business.* So are we.

You're interested in promoting the sale and use of *Radio products.* So are we.

If you prosper, so do we!

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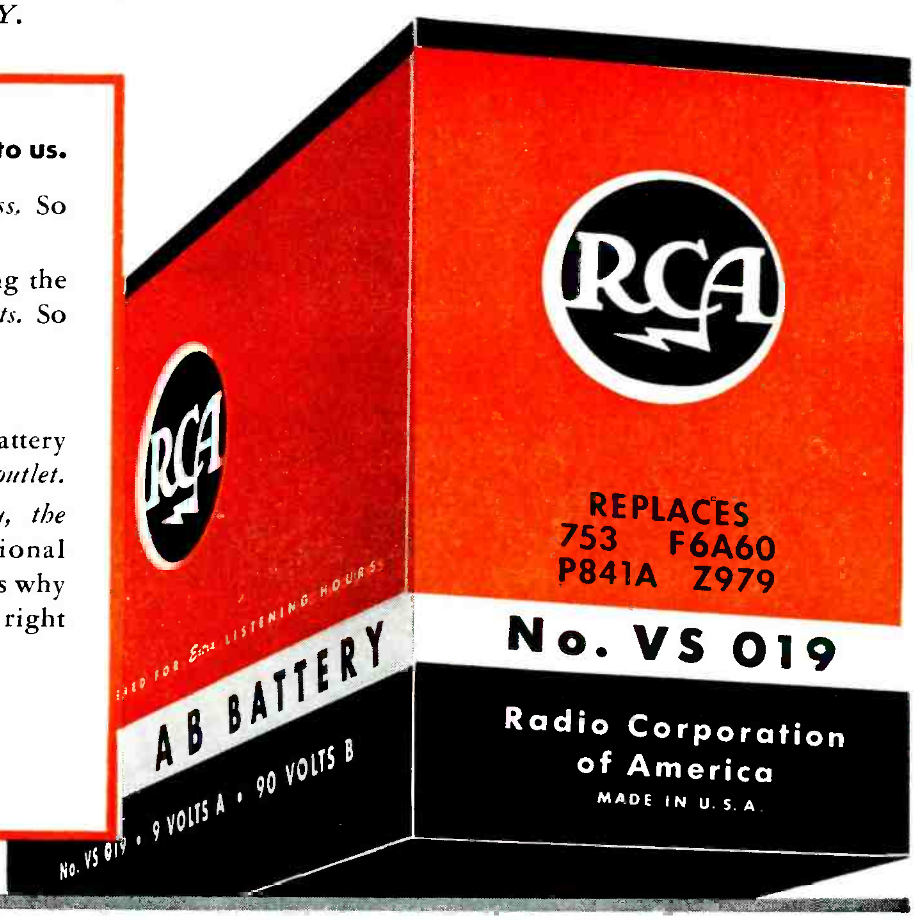
You're a Radio Man.
We're a Radio Company.
Let's prosper together!



RADIO CORPORATION of AMERICA

RADIO BATTERIES — **HARRISON, N. J.**

sence of any polarizing voltage, it will generate a voltage under the influence of illumination, the anode (whisker) becoming positive and the cathode (germanium) negative.

Fig. 2 shows the reverse-voltage–reverse-current curves for the 1N77 operated with various values of load resistance. Fig. 3 shows a typical reverse-resistance curve. Fig. 2 assumes that a circuit similar to the one given in Fig. 4 will be employed; i.e., with photodiode, d.c. voltage, and load resistance connected in series. Fig. 4 illustrates response of the 1N77 circuit to pulsed light at 1,000 cycles.

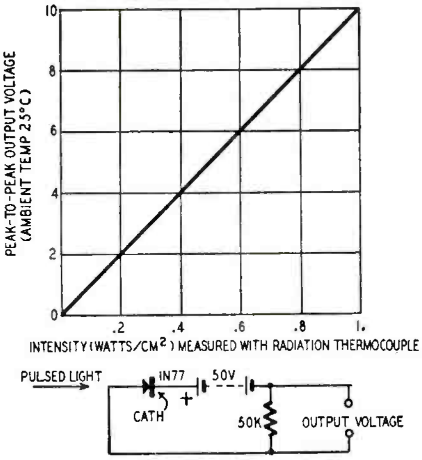


Fig. 4—The output with pulsed input at 1,000 cycles. Circuit at bottom of figure was used to obtain the curves.

In electrical characteristics, the 1N77 is similar to the 1N34 crystal diode, except that the peak reverse voltage of the photodiode is somewhat higher. Special germanium processing makes the reverse resistance of the 1N77 especially sensitive to illumination.

The 1N77 is most sensitive to radiaton in the infra-red and near infra-red regions. The spectral response peak is at 1.7 microns. Response is negligible in the ultra-violet region.

Maximum voltage output is obtained with the higher values of load resistance, while maximum power output results with low load resistance values. In production units, the dark current (as measured with a 50-volt d.c. supply and zero load resistance) is kept below 0.5 ma. In pulsed-light operation (See Fig. 4), the output voltage has the same waveform as that of the applied light.

The actual mechanisms whereby the diode resistance is varied by radiation intensity and also through which current is generated by photovoltaic action in germanium-tungsten point contact devices may be explained only in the complex terms of semiconductor physics. Such an explanation is beyond the scope of this article. The reader who desires a complete exposition of this process is referred to any of the textbooks on the modern theory of semiconductors and electrical conduction in solids.

Higher light intensities are required with the germanium photodiode for a given voltage output than with photocells and phototubes of other types. This is not necessarily a drawback, since sufficient illumination is available at close range in many applications. Such applications include counters, communication and recording devices employing punched tape, sorters, densitometers, turbidity meters, sound-track pickup, etc. Lens systems and filters may be employed to advantage with the 1N77.

Applications

The basic direct-current photodiode circuit is shown in Fig. 4. When this circuit is employed with steady, unmodulated illumination, output voltage may be applied to the input terminals of a d.c. amplifier, which in turn may actuate a rugged relay, counter, or indicating meter.

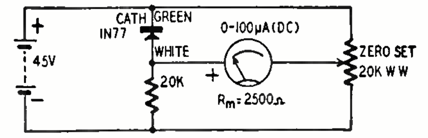


Fig. 5—Bridge type light meter circuit.

Fig. 5 shows a bridge-type light meter employing the 1N77. In this arrangement, the cell is darkened and the potentiometer is adjusted to zero the meter. Illumination then will cause the meter to deflect upscale. If the meter is zeroed, on the other hand, under illumination, interruption or attenuation of the light will produce downscale deflection. If desired, the meter may be removed from the circuit and the output terminals of the bridge circuit connected to the input of a d.c. amplifier.

Fig. 6 shows how the 1N77 may be connected to an a.c. amplifier when the photodiode is operated from pulsed, chopped, or modulated light and more voltage or power is required than the diode alone can furnish. A power-output stage in the amplifier may drive an electromechanical device or reproducer. Possible interrupted light sources for operation of this circuit include shutters, film sound tracks, punched tape, and flasher tubes such as Strobotrons and glow modulators.

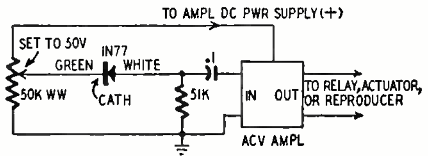


Fig. 6—Amplifier for modulated light.

The 1N77 is adaptable to other conventional circuits in which other types of photocells commonly are specified. When operated within its limits, the germanium photodiode affords the best compromise between size and sensitivity available up to this time.

This photodiode—or even smaller modifications of it—may have future applications not now forseeable. The possibility of building up a relatively fine mosaic out of these units is only one example of the possibilities which may open up entirely new fields not now occupied by phototubes.

—end—

New Devices

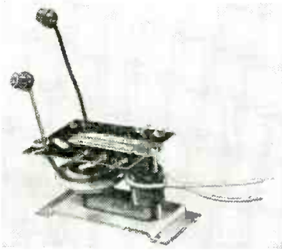
RESONATORS FOR TVI

Motorola, Inc., 4545 W. Augusta Blvd., Chicago 51, Ill., has announced production of precision selector cavity resonators available in several degrees of selectivity depending upon application and frequency separation. These units minimize television interference by highly attenuating spurious and harmonic radiation of transmitter antenna systems of base station two-way radio communications equipment. The cavity resonator, a very high "Q" circuit which can be inserted into a line, makes it possible to use two or more transmitters on the same antenna without mutual interference.

Motorola cavities, designed for the 30-48 mc, 72-76 mc, 122-132 mc, and 132-180 mc communication bands, are compensated for optimum performance over wide temperature ranges. Each unit has an input and output impedance of 50-72 ohms at a 250 watt maximum power rating. They are designed for optimum impedance match and a low voltage standing wave ratio.

TV AUTOTRANSFORMER

RAM Electronics Sales Co., 7 South Buckhout St., Irvington-on-Hudson, New York, has added a new high-efficiency replacement and conversion TV autotransformer to its line of TV parts. The RAM X054 requires less driving power than a true transformer while providing ample high voltage and sweep for tube sizes up to 21-inch rectangular. It features a high-permeability ferrite core and special precision-pattern windings resulting in excellent regulation and linearity. In sets using selenium-rectifier voltage-doubler circuits with 250 volts plate supply, it produces 13.5 kv with a boost voltage of 430; with standard power supplies, 15 kv with 500 volts boost.



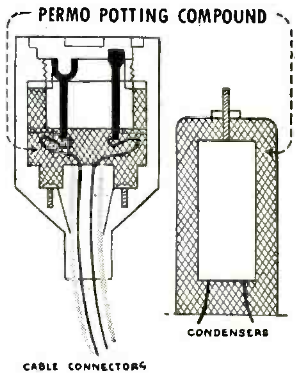
PORTABLE RECORDER

Amplifier Corp. of America, 398 Broadway, New York 13, N. Y., has announced full scale production of the Magnemite, a battery-operated portable tape recorder-playback unit. Weighing only 9¾ lbs. and measuring 11½ x 8½ x 5½ inches, the unit will operate for 100 hours at an operating cost of 2½ cents per hour using self-contained dry batteries. A noiseless and vibrationless spring wound motor will run 15 minutes on a single winding; during operation a light indicator flashes a warning two minutes before rewinding is necessary.

When closed, the Magnemite's two-tone leatherette covered case gives no hint of the function of the unit, which may operate in motion and in any position, including upside down. The high-gain amplifier, requiring no preliminary warm-up, will pick up a normal speaking voice 100 feet from the microphone. A tape speed of 1⅞ inches per second with a frequency response to 3,000 cycles allows two full hours of recording time on a single 5-inch reel of standard ¼-inch wide tape.

SEALING COMPOUNDS

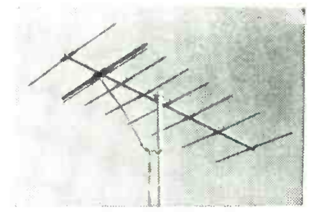
H. V. Hardman Co., Inc., 571 Cortlandt St., Belleville, N. J., announces production of a new line, known as Permo Potting and Sealing Compounds, especially designed for use where high electric insulation and low moisture absorption is required. These compounds are not to be mistaken for ordinary tars as they have a wide temperature tolerance and maintain viscosity at higher temperatures.



8-ELEMENT YAGI

LaPointe Plascomold Corp., Windsor Locks, Conn., has announced the "Long John", a new Vee-D-X single bay antenna for more powerful single channel fringe area reception. This 8-element Yagi (Model LJ) produces 41% more gain than the best 5-element Yagi and is equivalent to any 5-element stacked array. Higher front-to-back ratio eliminates co-channel interference, yet the LJ has the same wide bandwidth as the Vee-D-X JC.

Standard pre-assembled construction, lower cost, installation ease, better appearance, and a re-inforced boom for extra sturdiness on the low channels are some of the features.



U.H.F. SWEEP GENERATOR

Radio Corp. of America, Harrison, N. J., has developed two new u.h.f. sweep generators of particular interest to research workers and engineers engaged in the development of u.h.f. TV receivers, tuners, filters, antennas, etc. The model WR-40A and WR-41A instruments feature continuous tuning from 470 to 890 mc with operation entirely on fundamentals. No beats or harmonics are used. Sweep width is continuously variable from 0 to 45 mc.

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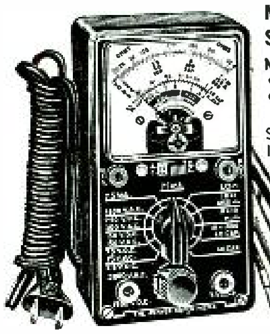

MOST COMPLETE AND COMPACT MULTI-SERVICE INSTRUMENT EVER DESIGNED

Measures:
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- Capacity
- Current
- Reactance
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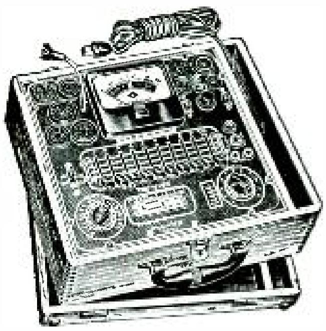
- Inductance

Specifications: D.C. Volts: 0-7.5/75/150/750/-1500 Volts. A.C. Volts: 0-15/150/300/1500/3000 Volts. Resistance: 0-10,000/100,000 ohms. 0-10 Megohms. D.C. Current: 0-7.5/75 Ma. 0-7.5 amps. Capacity: .001 Mfd.—.2 Mfd. .1 Mfd.—20 Mfd. Electrolytic Leakage: Reads quality of electrolytics at 150 Volt test potential. Decibels: -10 Db to +18 Db. +10 Db to +38 Db. +38 Db. to +58 Db. Reactance: 15 ohms—25 K ohms 15 K ohms—2.5 Megohms. Inductance: .5 Henry—50 Henries 30 Henries—10 K Henries. Plus Good-Bad scale for checking the quality of electrolytic condensers.

Handsome round cornered molded bakelite case 3⅛" x 5⅞" x 2¼" complete with all test leads and instructions.

$21.40 NET

Superior's New Model TV-11
TUBE TESTER



Operates on 105-130 Volt 60 Cycles A.C. Hand-rubbed oak cabinet complete with portable cover

$47.50 NET

* Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary. * Uses no combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket. * Free-moving built-in roll chart provides complete data for all tubes. * Phono jack on front panel for plugging in either phones or external amplifier detects microphonic tubes or noise due to faulty elements and loose external connections.

Superior's New Model CA-12
SIGNAL TRACER

Completely Portable—weighs 8 pounds—measures 5½" x 6½" x 9".

Model CA-12 comes complete with all leads and operating instructions

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The well known model CA-12 is the only signal tracer in the low price range including both meter and speaker ! ! !

SPECIFICATIONS: * Comparative Intensity of the signal is read directly on the meter—quality of the signal is heard in the speaker. * Simple to Operate—only one connecting cable—no tuning controls. * Highly Sensitive—uses an improved vacuum-tube voltmeter circuit. * Tube and Resistor Capacity Network are built into the detector probe. * Built-In High Gain Amplifier—Alnico V Speaker.

Superior's New
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THROWS AN ACTUAL BAR PATTERN ON ANY TV RECEIVER SCREEN! !

Two Simple Steps

1. Connect Bar Generator to Antenna Post of any TV Receiver.
2. Plug Line Cord into A. C. Outlet and Throw Switch.

RESULT: A stable never-shifting vertical or horizontal pattern projected on the screen of the TV receiver under test.

Power Supply: 105-125 Volt 60 Cycles. Power Consumption: 20 Watts. Channels: 2-5 on panel, 7-13 by harmonics. Horizontal lines: 4 to 12 (Variable). Vertical lines: 12 (Fixed). Vertical sweep output: 60 Cycles. Horizontal sweep output: 15,750 Cycles.

TV Bar Generator comes complete with shielded leads and detailed operating instructions. Only ....

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SIGNAL GENERATOR

Provides Complete Coverage for A.M.-F.M. and TV Alignment

* Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 240 Megacycles on powerful harmonics. Accuracy and stability assured by use of permeability trimmed Hi-Q coils. * R.F. available or modulated by the internal audio oscillator. * Built in 400 Cycle sine wave audio oscillator used to modulate the R.F. signal also available separately for audio testing of receivers, amplifiers, etc. * Oscillator Circuit: Uses a miniature high frequency type of acorn triode in a Hartley circuit to insure a high degree of stability. By using the same type of triode as a buffer amplifier, complete and positive isolation between the R.F. oscillator and the attenuator is attained. * Attenuator: a 3 step ladder type of attenuator is used. Each step of the attenuator is controlled by a separate attenuator control thus providing intermediate level steps. * Tubes used: 955, as R.F. Oscillator. 955 as Modulated Buffer Amplifier. 6SN7 as Audio Oscillator and Power Rectifier.

The Model 660 comes complete with coaxial cable test lead and instructions.

$42.95 NET

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Please send me the units checked below. I am enclosing the down payment with order and agree to pay the monthly balance as shown. It is understood there will be no carrying, interest or any other charges, provided I send my monthly payments when due. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

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- ☐ MODEL CA-12.......................Total Price $33.95
  $9.95 down payment. Balance $4.00 monthly for 6 months.
- ☐ TELEVISION BAR GENERATOR.......................Total Price $39.95
  $9.95 down payment. Balance $5.00 monthly for 6 months.
- ☐ MODEL 660.......................Total Price $42.95
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- ☐ Ship C.O.D. for the down payment.

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City________________Zone________State________ with amplitude variation of 0.1 db per mc or less throughout the swept range. Maximum output is 0.5 volt across a 50-ohm load. Facilities for matching to 72- or 300-ohm loads are provided.

The WR-40A is a laboratory-type instrument. It has a built-in crystal calibrator and a variable-frequency marker oscillator. Other features include attenuator controls for varying amplitudes of the sweep output, response input, marker pips, and calibrating pips; built-in detector for direct monitoring of the sweep-oscillator output, a front-panel blanking control, and a marker injection system which prevents distortion of the response curve.

The WR-41A has the same sweep-generator mechanism as the WR-40A but does not include the calibrator or marker circuits.

5-INCH OSCILLOSCOPE

Triplett Electrical Instrument Co., Bluffton, Ohio, has replaced the model 3440 with their new model 3441, designed for TV, FM, and industrial testing requirements. An illuminated calibration meter makes it possible to view the percentage of positive and negative peak-to-peak volts in addition to reading peak-to-peak voltage directly in 8 ranges from 0 to 1000 volts. The push-pull horizontal amplifier is flat within ±20% from 20 cycles to 150 kc. and its deflection sensitivity is 0.15 r.m.s. volt inch. The push-pull vertical amplifier is usable beyond 4 mc. Its sensitivity is .01 r.m.s. volt inch with switch in 2-mc position; .02 r.m.s. volt inch with switch in 4-mc position. A high-gain amplifier system is available for tracing audio circuits and checking for noisy components. A phone jack on the panel makes a convenient way to associate the visual pattern with the familiar sounds. Furnished in black suede-finished metal case. 15-11/32 x 11-1/32 x 16 inches. Accessories include coaxial cables, probe, and instructions. A crystal signal-tracing probe is available as an extra accessory.

HI-FI SPEAKERS

Oxford Electric Corp., 3911 South Michigan Ave., Chicago 15, Ill., has announced a number of new high fidelity loudspeakers. Among them are

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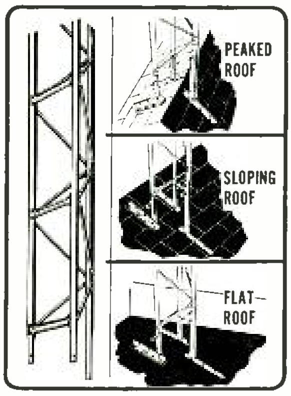
the 8-inch HF8JB, 10-inch HF10JB, and 12-inch HF12J8. These units handle 10 watts maximum, and have 6.8-ounce magnets and 1-inch voice coils. The HF12LN, a 12-inch model, has a 14-ounce magnet, 1½-inch voice coil, and handles 25 watts.

Also included in the line is the C012JB coaxial speaker which has a frequency range of 65 to 15,000 cycles with crossover at 4,000 cycles. The combination handles 10–12 watts. The 12-inch woofer has a 6.8-ounce Alnico V magnet and the 3-inch tweeter has a 1.47-ounce Alnico V magnet.

All the speakers have 8-ohm input impedances and are finished with hammertone lacquer.

TV ANTENNA TOWERS

Channel Master Corp., Ellenville, N.Y., is distributing a new line of steel towers. Available in 10-foot sections, they have a built-in ladder on one side with no obstructions to interfere with easy climbing. The other two sides feature truss construction for added strength. Tower legs are made of steel tubing and are spaced, 8½ inches apart, for greater rigidity and twist-resistance. All tower sections are completely interchangeable, because only one type of section is used. No different top, middle, or bottom sections are required, and base mount and mast brackets fit all sections.

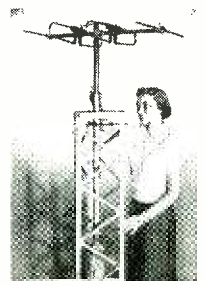


All three tower legs are swaged on one end for easy assembling. Additional sections are merely slipped into each preceding section and fastened. Masts and rotators are mounted internally for greater support and protection.

Also available is a universal base mount which is adaptable for all types of installations—peaked, sloping, and flat surfaces. Special dual-purpose mounting brackets, for use both as mast supports and rotator bearings, are also available with the towers.

ROTATOR ADAPTOR KIT

Alprodco, Inc., Kempton, Ind., and Mineral Wells, Texas, is producing a new antenna rotator adaptor kit de-



signed to make it possible to install any commercial antenna rotator on its antenna towers. The RK-1W kit consists of a pre-drilled adaptor mounting plate which takes any well-known rotator, a 1-foot mast pole to connect the rotator to the antenna, a 24-inch-long bearing for the pole, and a 3-piece assembly which holds the mast bearing securely to the tower. This protects the rotator by permitting the tower to absorb all wind thrust.

—end—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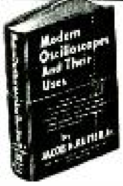

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Now you'll really know how to use the greatest, most versatile service instrument of all—the oscilloscope! MODERN OSCILLOSCOPES AND THEIR USES gives you expert knowledge of 'scopes, helps you work faster, more accurately and more profitably on all sorts of service and laboratory jobs. No involved mathematics or theory! First, the author explains the construction and operation of cathode ray tubes and basic oscilloscope circuits. Then he gets right down to earth in telling exactly how to use a scope for AM, FM and TV service work—from locating receiver troubles to aligning and adjusting the most complicated circuits. Dozens of actual pattern photos plus an unusually descriptive text teach you exactly how to analyze and interpret various patterns.

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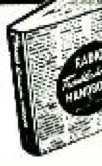

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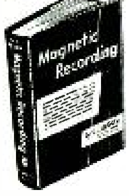

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TUBES OF THE MONTH

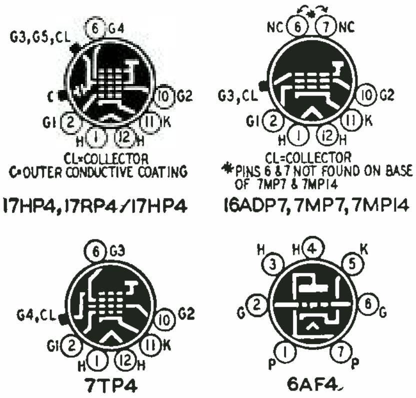
The leading tube manufacturers have produced a bumper crop of new tube types during the last month. These types include cathode-ray tubes for TV, radar, and oscilloscopes; receiving and transmitting tubes, as well as types for industrial and special-purpose applications.

The Rauland Corporation announces the 27QP4, a new 27-inch electrostatically focused and magnetically deflected metal rectangular picture tube. Because it has a 90° deflection angle the tube has a shorter over-all length than a standard 20-inch tube. The picture area is about 390 square inches with a gray filter face plate treated to minimize surface reflections. The tube uses a tilted offset electrostatic gun with an indicator-type ion trap which requires a single-field magnet. The gun design provides for improved detail in the corners as well as in the center of the screen. The 27QP4 can be used as a zero-voltage focus tube or can be focused for maximum sharpness with a low voltage taken from the set's power supply.

Rauland 27QP4 has a 90-degree deflection angle and can be used with zero or low-voltage electrostatic focusing.

RCA is producing two new picture tubes—the 17HP4 and 7TP4.

The 17HP4 is a 17-inch glass rectangular picture tube using a Filterglass faceplate; low-voltage electrostatic focus, and magnetic deflection (65° horizontal). A single-field ion-trap magnet is required. An external conductive bulb coating forms a supplementary filter capacitor. The focusing electrode (grid No. 4) has its own base-pin terminal allowing optimum setting with a potentiometer from the boost voltage to ground. Focusing potential varies from 0 to 350 volts with 14 kv on the ultor. The screen size is 14⅜ by 11¼ inches with slightly curved sides



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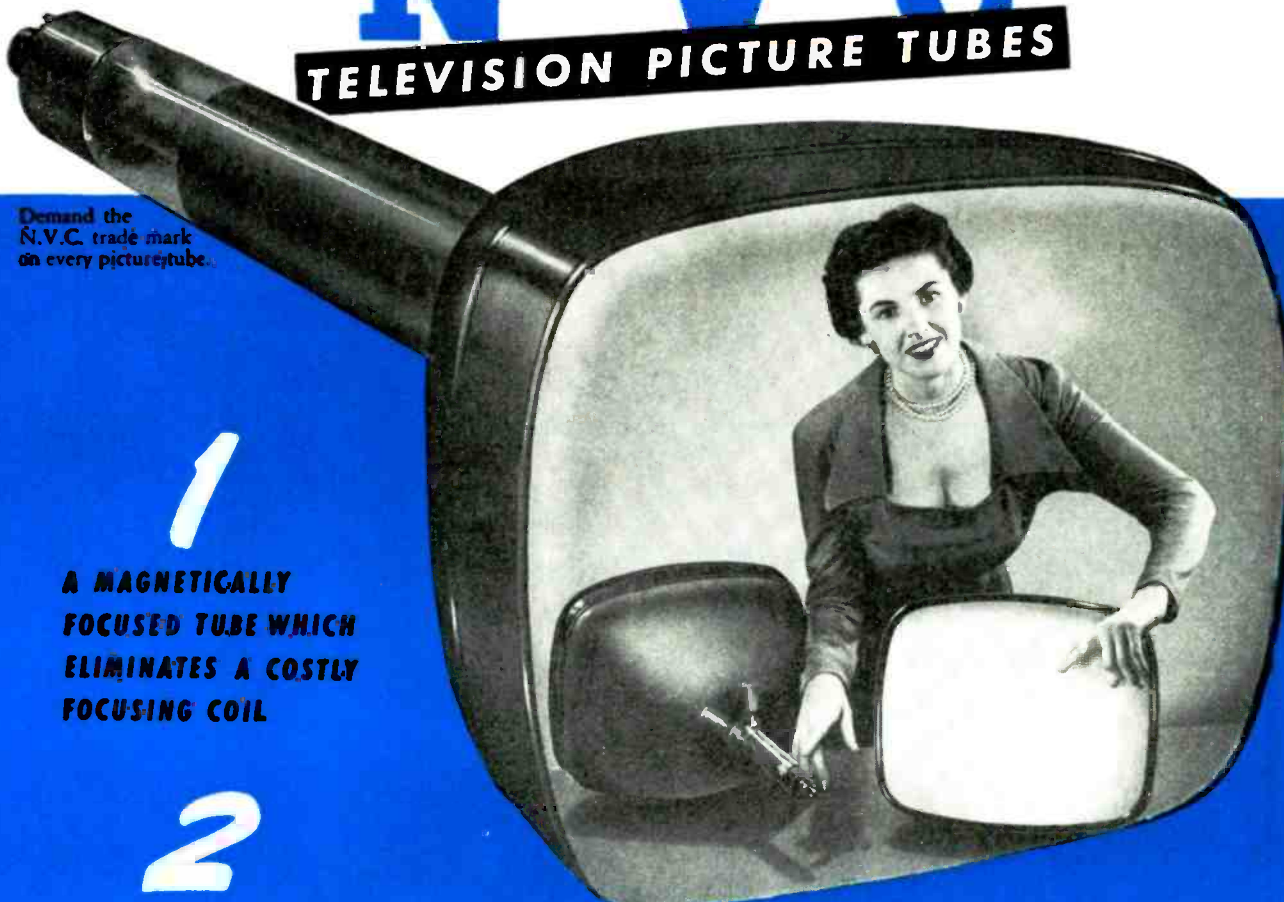

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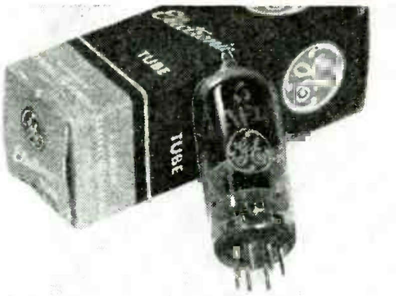
and rounded corners. The over-all length is approximately 19¼ inches. Maximum ultor (collector) voltage is 16,000, maximum focusing-electrode voltage is 500, maximum accelerator anode (grid No. 2) voltage is 500.

The 7TP4 is a 7-inch round tube intended for monitor service in TV broadcast systems. It produces a 5⅜ x 4

The RCA electrostatically focused 17HP4.

inch picture on a metal-backed screen which improves brightness and definition and eliminates the need for a beam-bender. It employs high-voltage electrostatic focusing and 50-degree electromagnetic deflection. Maximum ratings are 12 kv for the ultor, 2 kv on grid 3, and 410 volts on grid 2. Grid 1 voltage for visual extinction of undeflected focused spot is –22 to –52 volts.

The 17RP4/17HP4 and 17VP4 are G-E's new low-voltage electrostatic focused glass rectangular picture tubes. They have cylindrical face plates. The 17RP4/17HP4 is a single type designation used for a tube which can be used as a direct replacement for either the 17RP4 or 17HP4. The manufacturer recommends operating the focusing electrode at zero voltage with respect to the cathode. Slightly sharper focusing may be obtained by applying a potential be-



G-E 6AF4, intended for oscillator duty in u.h.f. TV sets, the tube has dual pins for grid and plate connections.

tween −50 and +300 volts to the focusing electrode. The 17VP4 is mechanically and physically equivalent to the 17LP4.

U.H.F. oscillator

The new General Electric 6AF4 is a 7-pin miniature type triode intended for local oscillator use in ultra-high-frequency reception from 470 to 890 mc. Operating data: plate voltage, 150; plate current, 28 ma; input, 2.5 watts; dissipation, 2.25 watts; heater, 6.3 volts at 0.225 amperes.

Oscilloscope and radar tubes

The 7MP7, 7MP14, and 16ADP7 are new RCA oscillograph tubes employing magnetic focus and deflection and are designed for radar and similar applications where a pulse-modulated signal on grid 1 causes high beam currents. Their gun structure includes a limiting aperture which produces a sharper spot at high beam currents. The 7MP7 and 7MP14 are identical except for the characteristics of their phosphors. The P7 and P14 phosphors are long- and medium-long-persistence types, respectively. Both may be used with Wratten No. 15 (G) yellow filters to suppress the blue fluorescence while observing slow traces or with Wratten 47A (C5) blue filters to suppress the yellow phosphorescence when observing fast traces. They have 6.3-volt, 0.6-amp heaters.

The 7-inch tubes have round glass envelopes 7$\frac{5}{16}$ inches in diameter and are 13⅛ inches long. Typical operating conditions are 4-7 kv on the ultor, 250 volts on grid 2, and bias on grid 1 varying from −27 to −63 volts. The 16ADP7 has a metal shell 16 inches in diameter. Its overall length is 22 inches. Its typical operating conditions are similar to the 7-inch types above except for the ultor voltage which is 12 kv.

Special and industrial types

The RCA 6080 is a low-mu, high-perveance, power, twin triode, similar in characteristics to the 6AS7-G and with pin connections identical to the 6SN7-GT. Smaller in size and mechanically sturdier, it has been designed primarily for use as the regulator tube in stabilized d.c. power-supply units and is useful in projection television scanning applications where high pulsed plate voltages are encountered.

Other special tubes include the u.h.f. triode 5893, the 5822 ignitron, the GL-5727 thyratron and the 6038 ATR tube. These may be described later.

—end—

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VARYING THE BANDWIDTH

By WILBUR HANTZ

COMMUNICATIONS and other high-quality receivers may use several double- or triple-tuned i.f. transformers to obtain a specific selectivity curve. Triple-tuned transformers are excellent, but their cost prevents the average constructor from using them.

You can build your own i.f. channels for any passband within reason from standard commercially available i.f. transformers. The intermediate frequency is not too critical and may be anything from 175 to 2,000 kc.

Several methods may be used to vary the coupling in intermediate-frequency stages. Some receivers use a mechanical arrangement which changes the distance between the primary and secondary windings of the i.f. transformer for different degrees of selectivity, but the mechanical difficulties deter the average home constructor.

Fig. 1 shows a coupling arrangement using two i.f. transformers. Reactance

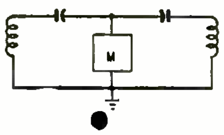

Fig. 1—Setup for varying selectivity.

of coupling component M controls the width of the selectivity curve.

Figs. 2, 3, and 4 show three variable coupling arrangements using two standard output i.f. transformers. In Fig. 2 the coupling component is a tapped inductance connected to a single-pole, five-position switch for selecting the passband. The coupling inductance used here is made by winding a form 2½ inches long and 1 inch in diameter with 50 turns of No. 22 enameled wire, tapped at 9, 16, 23, and 35 turns from ground. The passband of this unit is variable from 7 to 12 kc.

In Fig. 3 the coupling components are from left to right, .003-, .007-, .01-, .03-, and .07-μf capacitors. The passband of this unit is the same as above.

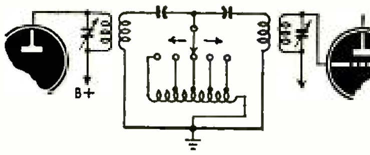

Fig. 2—Reactance using a tapped coil.

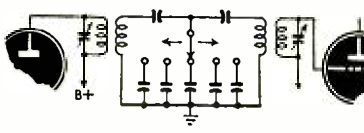

Fig. 3—Selected capacitors may be used.

The coupling in Fig 4 is varied by switching resistors of different values. Resistors present a uniform impedance or coupling factor at all the frequencies within the passband, while the effect of an inductance or capacitance is a little greater at one side or the other.

When resistors are used as the coupling component, they tend to decrease the Q of the coils. A small series resistance is equivalent to a high value of shunt resistance. A medium value, 100 ohms, used in the circuit of Fig. 4 has the same effect as shunting the coil with about 700,000 ohms. This circuit has the advantage of giving both steeper and broader selectivity than the above circuits. The resistors are 5, 15, 25, 50, and 100 ohms.

In Fig. 5, the selectivity is varied by switching another coil in series with either the primary or secondary winding of a single i.f. transformer. An output-type i.f. transformer can be altered slightly to provide two different passbands of 10 or 20 kc.

When the switch is thrown to the sharp position, inductance is added to the secondary winding. In the broad position, the extra coil on the secondary

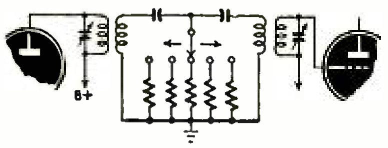

Fig. 4—A symmetrical curve is possible.

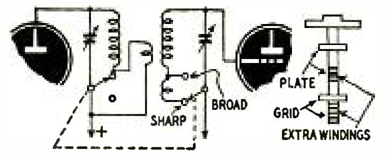

Fig. 5—An alternate 2-position circuit.

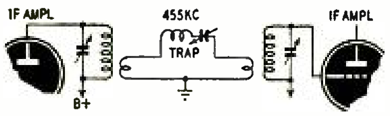

Fig. 6—A circuit of high versatility.

side is removed while inductance is added to the primary winding. The extra windings are 15 turns of No. 30 enameled wire wound in the same direction as the transformer windings.

In Fig. 6 two 455-kc. transformers are used in a bottom coupling arrangement. This circuit is effectively a triple-tuned intermediate transformer and has a straight-sided selectivity curve. As the coupling is low-impedance, the leads between the two transformers can be any convenient length. The wave-trap is tuned to the intermediate frequency. The coupling coils are 15 turns of No. 30 enameled wire close-wound.

The variable-selectivity types should be aligned in the sharp position. All units with the exception of Fig. 6 introduce some loss of gain and may require an additional i.f. stage.

All the information on these coupling arrangements was obtained by oscilloscope measurements. Meissner Ferrocart type 16-5742 output transformers were used. The values given are for a frequency of 455 kc but values for other frequencies can be calculated readily.

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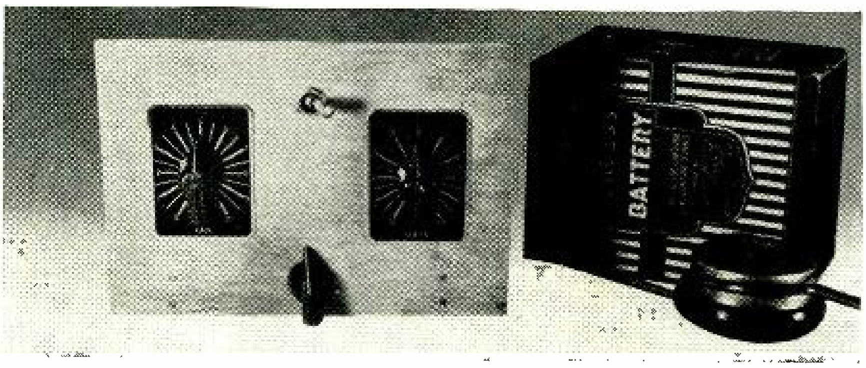

Front-view photograph of the battery-operated, bandswitching novice receiver.

Bandswitching Receiver For The Novice Amateur

By HOMER L. DAVIDSON

THE little "ham novice" receiver described in this article is very simple to build, but will provide shortwave reception for the inexperienced constructor. Only two battery tubes are used in this amateur receiver. One is an r.f. pentode 1N5-GT, which is used as a regenerative detector. The other tube is a 1A5-GT audio power amplifier. The receiver operates from A- and B-batteries only. The plate supply is a small 45-volt B-battery, while the A-battery supply can be a flashlight cell or a No. 6 dry cell. A good pair of magnetic headphones with a resistance of 2,000 ohms or better will work satisfactorily.

The receiver is mounted in a Masonite and plywood cabinet, to be described later in the text. The set has three operating controls: tuning, regeneration, and band-switching.

The frequency range is from 1.8 to 15 mc. A tapped coil and switch provides a simple method of band changing. Switching eliminates the need for plugging coils in and out for different bands. The regeneration control is a tickler which slides in and out of the grid coil. Regeneration is smooth over a wide range, and there are no variable resistors to introduce noise into the regeneration circuit.

Tube line-up

The regenerative detector 1N5-GT requires a filament voltage of 1.5 at .05 ampere and is hooked in parallel with the 1A5-GT. The grid coil of 70 turns is tapped at 20, 40, and 60 turns. (See Fig. 2-a.) These taps were made by winding 20 turns on the coil form and then twisting the wire around in a tight loop for a tap, then continuing the winding. All the taps were made this way. The last ten turns were spaced to about one full inch for the 20-meter band. It is important to mount the grid coil with the 1.8-mc coil tap away from the front panel. Thus the 14-mc coil winding will be nearest to the chassis or front panel. By doing so the regeneration can be varied over all bands.

The band switch is mounted on the right, and the tuning capacitor on the left side of the front panel. The ceramic trimmer is mounted on the chassis between the 1N5-GT tube and the tuning capacitor. Binding posts for antenna and ground connection may be mounted at the rear of the chassis. The grid coil is tuned with a small 140-μμf variable capacitor. The tuning is very sharp and one should be able to learn to fish in shortwave and ham stations. This will come with experience after you've played with the set a bit.

A grid leak and grid capacitor is wired in the lead to the control grid of V1. After the signal passes through the tickler coil, it goes through a small r.f. choke RFC to the .01-μf coupling capacitor. The choke consists of 100 turns of No. 28 enameled wire on a ¼-inch form. The screen grid is kept at a lower potential than the plate by inserting a 470,000-ohm carbon resistor in series with it and the B-battery. A 100,000-ohm carbon resistor is the plate load for the 1N5-GT.

By hooking a coupling capacitor to

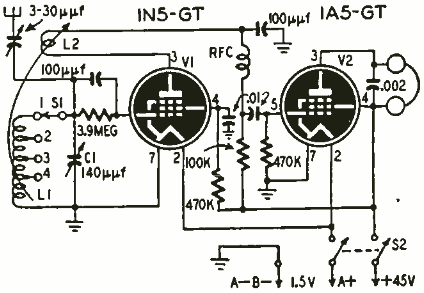

Fig. 1—Diagram of the all-wave 2-tuber.

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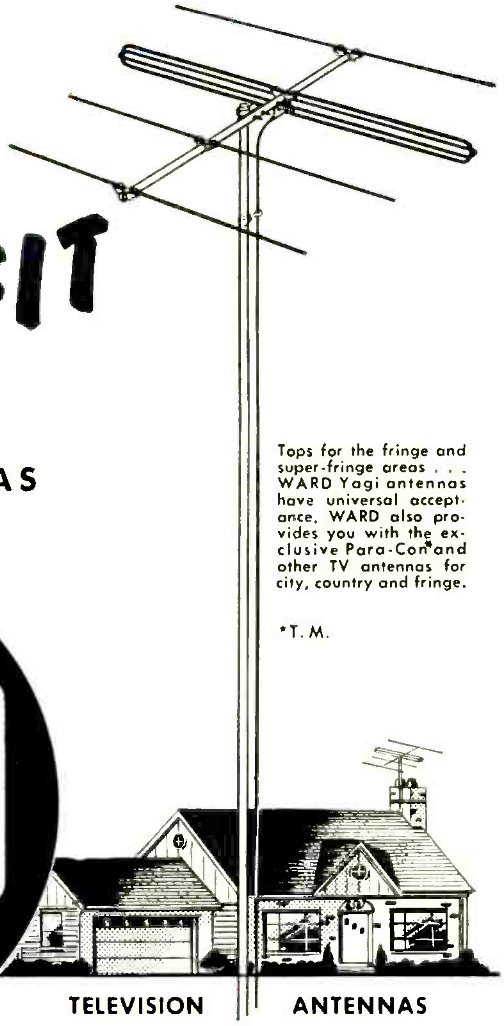

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the plate load, the signal is transferred to the control grid of V2. A 470,000-ohm resistor is tied in as a grid resistor. The plate and screen grid of the 1A5-GT tube are soldered directly to the phone jack pins. A .002-μf paper capacitor is wired across the phones. At first, this was not included and one could vary the regeneration by touching the phone cord. This annoying condition can be easily eliminated with the bypass capacitor as shown in Fig. 1.

The 45-volt B-battery is switched off and on with a d.p.d.t. switch. In one leg of this switch the A-supply is switched simultaneously. A connection common to A- and B-batteries is made to ground. These batteries are external.

The regeneration control L2 contains 40 turns of Litz wire and is wound on

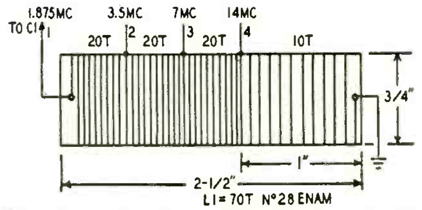


Fig. 2-a—Details on L1, the tuned coil.

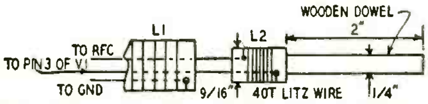


Fig. 2-b—L2 slides inside L1 as shown.

a 9/16-inch coil form. (See Fig. 2-b.) If you can't find a coil form this size, wind paper around a smaller one until it becomes the required diameter. A wooden dowel could be whittled from a larger piece of wood stock, leaving 9/16 inch diameter for the coil form. The Litz wire was taken from an old i.f. transformer and wound tightly around the coil form. Ordinary fine wire (No. 36 or so) will also work well. The form should be as short as possible. Leave about three inches of long leads on the tickler winding so that movement through L1 will be unimpeded.

When the winding is finished, brush on some coil dope for firmness. With a piece of wrapping paper, pad up a ¼-inch-diameter wooden dowel and place it inside this coil. A spot of coil cement at each end will keep it into place. Let it dry overnight. It is best to build your chassis and wind the coils the first night, then start wiring the receiver later.

In operation this tickler coil is adjusted by slowly inserting coil L2 (middle lower knob) into coil L1 until the threshold point of oscillation is reached. The most sensitive reception is at this point. This setting varies, however, with tuning capacitor and range-switch setting. Be careful not to operate the receiver in an oscillating condition (when you can hear whistles as you tune to and away from a station). This ruins the quality of reception. Pull the tickler back and start building up regeneration very slowly again.

Mounting and wiring

A few words should be said about mounting the various components of


CAUTION ON HIGH VOLTS
OFF
6000
1200
300
60
12
3
12A
120
12
1.2
ACV
60 μA
OUTPUT
COM
V-Ω-A
Ω ADJ

the receiver. After all the holes are drilled, mount the larger parts first. Then connect the smaller parts such as capacitors and resistors, when wiring up the receiver. The diameters of holes are shown in Fig. 3 a and b.

The receiver is very simple to wire. Here are a few wiring *don'ts: Do not* use acid-core solder because it will cause corroded, high-resistance joints. Use only rosin-core solder. Don't forget to check the wiring twice before trying

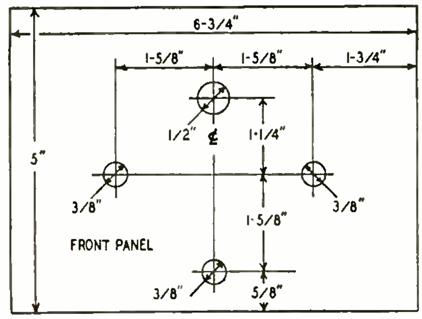


Fig. 3-a—Details of the plywood panel.

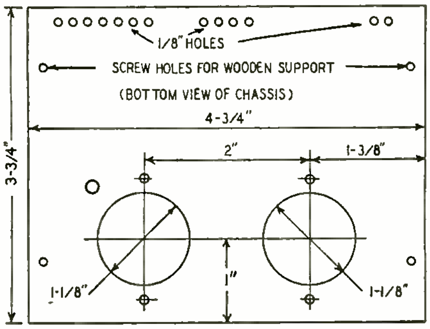
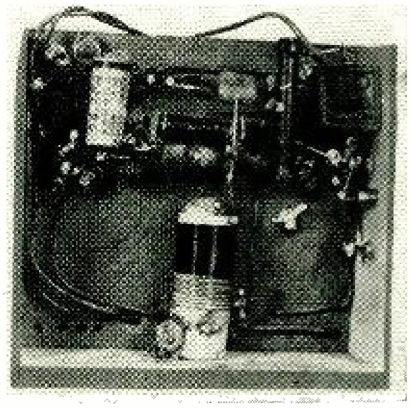


Fig. 3-b—Space chassis holes as shown.

it out. It is very discouraging not to have it work at once. Don't forget to scrape the ends of the Litz wire clean and tin them, because the outside of the wire is enameled. It is also very easy to break the wire while scraping, so be as careful as possible. Use fine emery cloth. Do not use long r.f. lead wires. A neat soldering and wiring job should be done, as long straggling wires are poison to high frequencies. Do not forget to reverse the tickler leads if the receiver fails to oscillate the first time. A proper regenerative condition is indicated by a smooth rushing sound, culminating in a plopping noise as the



Under-chassis photograph of the receiver. The grid coil L1 is shown in the center. Note the tapered section of the winding.

feedback coil, L2, is inserted into the grid coil, L1.

Chassis and front panel

The chassis is made from ¼-inch Masonite. It is 4¾ inches long by 3¾ inches deep. Two small wooden pieces 3¾ inches long and 1 inch high support the chassis; the front panel is screwed tightly or nailed to these wooden strips. All holes were drilled and cut before the chassis was put together. The phone jack holes were drilled in the wooden side support. If the holes are very snug the phone tip jacks may be screwed in and no locknuts are needed.

A piece of mahogany veneer plywood was secured for the front panel. It is 6¾ inches long by 5 inches high. Drill the holes for the tuning capacitor, regeneration control, and S1 control first. Before mounting any parts on the front panel, sand the surface down. Then nail the front panel onto the chassis with four small brads. The panel was not painted but could be shellacked to keep its original color.

The little receiver has two attractive black dial plates with matched red pointer knobs. When operating the receiver, a good 75-foot antenna should be used. Be sure it is as high as possible and clear of all objects. Also use a good ground such as a cold water pipe for best results.

Materials for receiver

Resistors: 1—100,000, 2—470,000 ohms; 1—3.9 megohms, ½ watt.
Capacitors: 1—140 μμf, midget variable; 1—3-30 μμf, ceramic trimmer; 2—100 μμf, mica; 1—.002, 2—.01 μf, paper.
Miscellaneous: 1—1N5-GT and 1A5-GT tube and octal sockets. Coils (see text). 1—single-pole 4-position rotary switch, 1—double-pole single-throw toggle switch. 2—pin jacks, 3—bar knobs, 2—black dial plates, 1—45-volt battery, 1—flashlight cell, 2—binding posts, phones, ¼-inch plywood and masonite board, hardware, solder, and wire.

—end—

Suggested by Leslie Boisen, Indianapolis, Ind.
"Sometimes I wish I had a motor driven antenna!"

PARTS LISTS

Bills of material for most of the pieces of equipment described in RADIO-ELECTRONICS construction articles are on hand at all radio parts jobbers and distributors who sell the magazine. See your dealer for a complete parts list of any of this apparatus you wish to construct.

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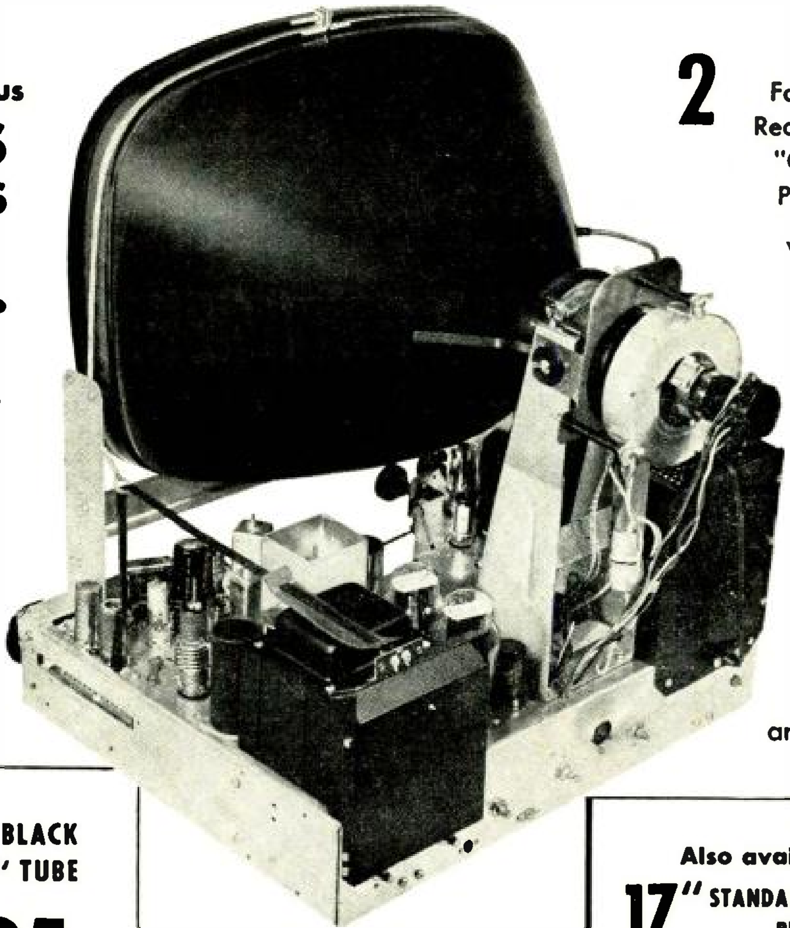

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PUTTING NEW LIFE IN MIDGET SETS

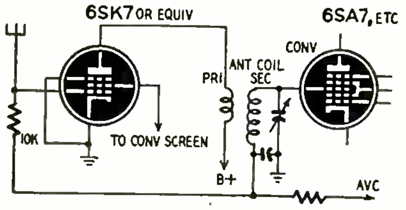
By C. E. COHN

The circuit shown here is a simple way of squeezing a little more performance out of those ordinary 2-gang superhets which do not already have an r.f. stage, and which use an external antenna. It is essentially an r.f. stage with an aperiodic input circuit, and requires only a tube, socket, and one resistor.

Connecting it to the receiver is simple. First, find a suitable place to install the tube socket, as close to the antenna coil as possible, either on the main chassis or on a subchassis. Disconnect the primary of the antenna coil from its present connections, and connect one end to the B-plus and the other end to the plate of the new tube. The screen of the new tube goes to the converter screen terminal. Make the rest of the connections as shown, connecting the bottom end of the grid resistor to the bottom end of the antenna coil secondary to get a.v.c. Any *remote-cutoff* r.f. pentode can be used here.

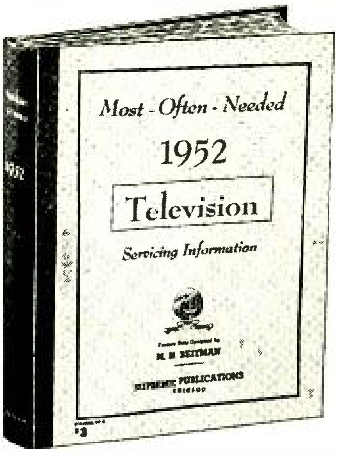
This stage is extremely easy to put in operation, and because of the resistance in the grid circuit, cannot possibly oscillate. There is no cross-modulation that would be caused normally by the use of a remote-cutoff tube. However, it will induce modulation hum into the signal if there is any trace of hum on the chassis. This can be easily eliminated in an a.c. set—with a good ground connection. In a transformerless set, try the plug both ways and use the polarity that gives best operation, since a ground connection is not permissible.

The circuit improves the performance of the set in almost every respect. There is a slight increase in gain and in noise figure, and there is a decided improvement in a.v.c. action. However, the greatest improvement which this set gives is in image rejection. If you tune an ordinary 2-gang superhet across the lower part of the broadcast band from 550 to about 700 kc, you are likely to notice a number of whistles, which are caused by image interference from stations in the upper part of the band. These image stations are so far away from the signal you would think that the antenna tuned circuit could separate them, but in many sets it does not. The effective Q and the selectivity of the mixer circuit are greatly increased,



An untuned r.f. stage improves the set.

New Supreme 1952 TV Manual



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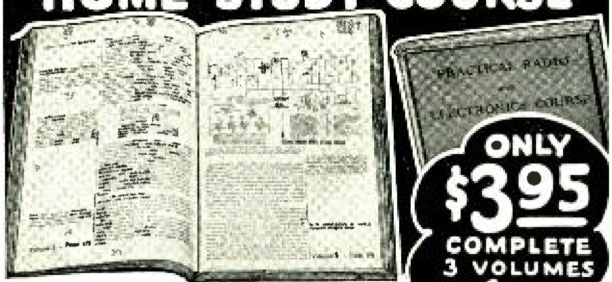

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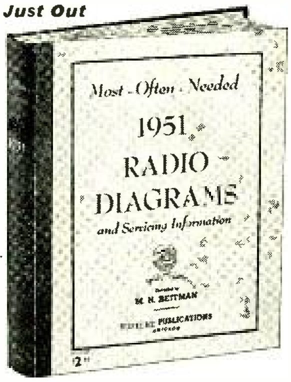

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and the whistles practically disappear.

Replacing the original antenna coil with a matching r.f. coil may give a slight increase in gain. This is especially true if the antenna coil has a low-impedance primary. If the primary winding is high-impedance (a large universal-wound coil) it may be well matched to a pentode plate. Experiment will tell. Even more gain may be obtained (especially at the low-frequency end of the dial) by using a choke (or untuned antenna) coil in place of the grid resistor. This coil should be trimmed till it resonates just beyond the low-frequency end of the band. There is some danger of oscillation with this hookup. Increasing the grid resistor from 10,000 to 50,000 may increase volume.

This circuit can be used in an all-wave set, being fully effective to the highest ranges. In such receivers, the plate and B-plus connections previously made to the antenna winding will now be made to the antenna and ground connections on the bandswitch respectively. In most cases, this circuit gives added performance.

Some commercial sets use an arrangement in which the antenna coil (or built-in loop) is used in the grid circuit of a tuned r.f. stage whose plate is fed through an r.f. choke coil. A .0001-μf capacitor couples the r.f. plate to the control grid of the mixer. A ½-megohm resistor from the mixer grid to the a.v.c. line allows bias control.

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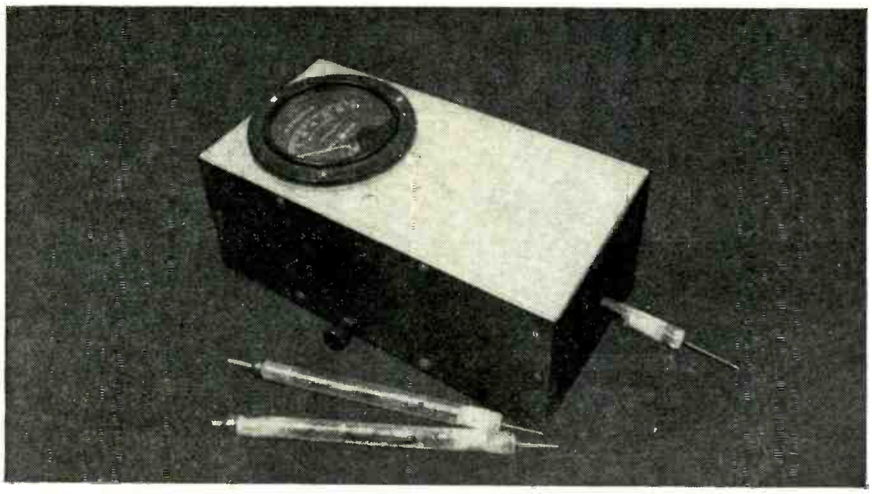


Photo of the trim-looking unit and the associated plug-in multiplier probes.

SENSITIVE R.F. VOLTMETER

By A. STRATMOEN

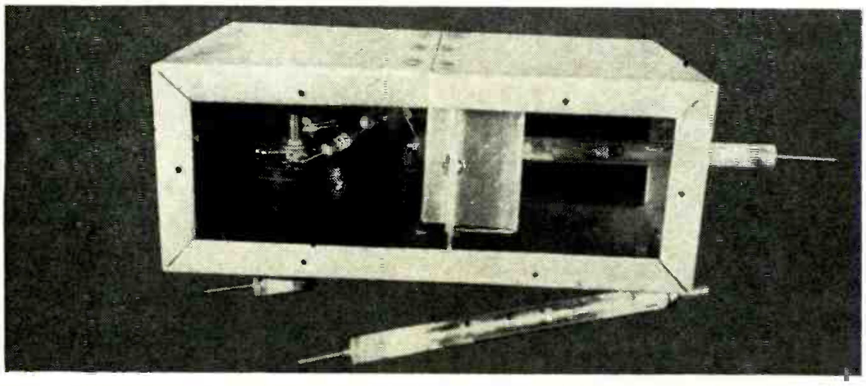
A GOOD vacuum-tube diode type voltmeter costs a good deal of money. It also requires power to operate the diode. The one illustrated can be constructed for about ten dollars and be designed to cover many ranges by increasing the case size and multiplier resistance. It is ready to operate instantly and requires no connection to the power line. It isn't even necessary to have a ground connection as body capacitance is enough to provide a return path. But for safety's sake it is best to ground it, especially if there is high-voltage d.c. around. Where d.c. is present in the circuit an external blocking capacitor is necessary.

Originally built for amateur use, this circuit can be used to measure *relative* values of the voltage (with a more sensitive meter and a higher voltage multiplier) at the plate of horizontal output tubes or high voltage rectifiers in TV sets. The meter should present about the same load as the picture tube and the filter capacitor.

The popular germanium diode probe used for measuring r.f. voltage is usually limited to 30 volts maximum, as more than this might exceed the back voltage rating of the crystal, especially if the waveform is not a sine wave. Some crystal diode rectifiers can be used up to 150 volts, and with a capacitance-type multiplier will safely read almost any voltage.

The unit to be described has been used for quantitative tests on transmitters and open-wire feeder lines to antennas. The illustrations show that the case is used as a three-section shield—two sections around the probe which is also the multiplier, and one around the meter and rectifier assembly. The shield around the probe must have a low capacitance to the resistors or some of the current will pass directly to ground without registering on the meter. The multiplier must be shielded to prevent the sensitive low-voltage end of the multiplier from picking up r.f. both from the source and from the high-voltage end through distributed capacitance. The two-section box shield does this without introducing too much capacitance to ground. The capacitive effect is minimized further by using a fairly large meter current. A 0-1 ma meter is used but the over-all sensitivity is about 450 ohms per volt. This does load the circuit somewhat but for transmitting work this is not undesirable.

The case is constructed of 52S½H aluminum sheet. This alloy combines



View of the inner construction, showing the resistor shielding and the components.

stiffness and workability. For an 8x4x3-inch case, sheeting of .025 gauge is about right. The sides, however, could be heavier since it isn't necessary to bend them. One side is riveted permanently and the other one is fastened with self-tapping screws. Two partitions reinforce the sides, shield the multiplier, and divide the case into three sections. The construction of the inner shields and banana jack support should be completed before assembling the case.

The multiplier resistance for each range may be determined by using an audio-frequency voltage and an accurate a.c. voltmeter. Start with about 450 ohms per volt. The multipliers would be accurate only for sine waves as most voltmeters read r.m.s. values. The multiplier should have at least three resistors, especially for the higher ranges. On the 1,500-volt range the resistors may dissipate a little over 3 watts so the total wattage should be adequate. It is preferable to have the resistors in a multiplier as near identical as possible in wattage and ohmage.

The probe-multipliers are made of Amphenol polystyrene tubing and rods. ¼-inch rods just fit into ⅜-inch tubing, so these sizes are used. A ½-inch length of rod is drilled axially and tapped for the 6–32 thread of standard banana plugs. It is difficult to drill this straight unless the rod is placed in the drill chuck and the drill bit clamped in a vise. This rod is then cemented in the end of a piece of tubing with polystyrene cement and allowed to harden. Then a 1/16-inch hole is drilled alongside the threads for the resistor lead. After the resistor string is made up use a length of 1/16-inch brass welding rod at one end for the probe tip. The resistors should be so spaced that about half of the last one will be inside the inner shield when the probe is plugged in. After making a final check of the multiplier for accuracy, seal the probe end with a section of rod drilled to fit the welding rod, and cement it in place.

The meter illustrated use four probes to give 0-3, 30, 300, and 1,500-volt

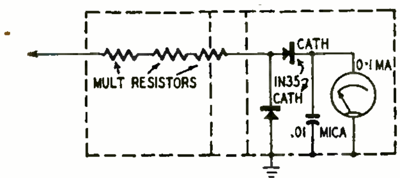


Diagram of the diode-type voltmeter.

ranges. The circuit was selected because it gives linear readings on all but the 3-volt scale, allowing d.c. meter scales to be used. A 1N35 dual crystal (having matched characteristics) is used in preference to the 1N34 types.

Materials for Voltmeter

One 0-1 ma meter, one .01-μf mica capacitor, one 1N35 germanium crystal, some ¼-inch polystyrene rods, several lengths of ⅜-inch polystyrene tubing 5½ inches long, several pieces of brass welding rod, several banana plugs, a jack with insulating washers, three matched 1-watt 5% tolerance resistors (see text), per multiplier-probe, and solder. Several .025-gauge 52S½H aluminum sheets, binding posts, hardware, etc.

—end—

A VISUAL ALARM FOR HARD-OF-HEARING

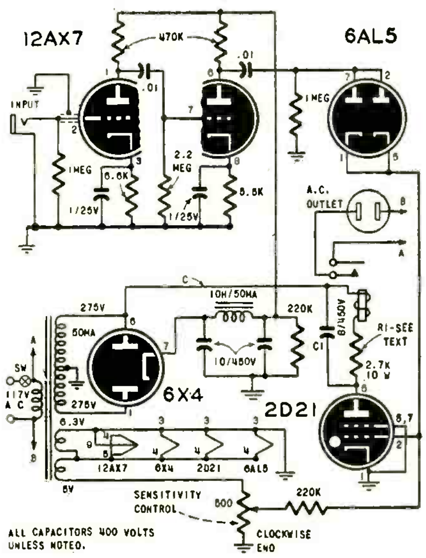
By RICHARD H. HOUSTON

One member of our household is somewhat hard-of-hearing, although not enough so to be considered really deaf. On numerous occasions he is left to hold the fort alone for an evening as general custodian and baby sitter. While not a professional, he enjoys the family TV receiver in true sitter style. Now this is where a problem arises. With the receiver volume at a fairly high level, the telephone bell is not sufficiently loud to attract the sitter's attention if he is absorbed in a TV program. This difficulty caused several evenings of anxiety when a call home produced no response.

Some kind of signal or alarm with more attention-getting power was needed. We considered using a mike, amplifier, and speaker which would make the sound of the phone bell much louder. The baby sitter would hear it, but so would the baby! Some other method would have to be used.

A little thought brought up the idea of using a light as the signal. The following system was developed quickly. A microphone picks up the sound of the telephone bell and an electronic circuit operates a relay, which in turn flashes a light near the TV screen. It works every time.

The control unit shown in the diagram is built in a conventional chassis to be mounted in a wooden cabinet. A two-stage resistance-coupled amplifier raises the voltage from the microphone to a level of 20 volts or more (depending on the mike output). The amplifier output is rectified by the 6AL5, producing a positive voltage at the cathodes. This positive potential is present only when sound is being picked up by the mike.



Schematic of the sound-operated alarm.

The positive voltage from the 6AL5 is applied to the grid of a 2D21 thyratron, causing it to conduct and operate the relay in its plate circuit. The contacts of the relay are in series with the a.c. line and the ac output receptacle. Thus when a sound of sufficient intensity is picked up by the microphone, the relay contacts close and turn on a lamp plugged into the a.c. output receptacle. The lamp is placed so that it could not fail to attract attention, using an extension cord if necessary. (Use a small *Photoflood* lamp—it will be seen anywhere in the room.—*Editor.*)

Most circuits of this type need a source of negative voltage to keep the thyratron from firing during no-signal intervals. A negative-voltage power supply would do the trick, but it would increase the size and cost. Fortunately another source of bias is already at hand, since we may use a.c. voltage as bias. The voltage of the filament windings of the power transformer, reverses polarity at the same time as that of the high-voltage winding. If this low voltage is tied to the control grid so the grid goes negative when the plate goes positive, no arc will occur during this half-cycle. When the grid goes positive, the plate will go negative, and still no plate current will flow. Thus we have an a.c. bias doing essentially the work of a constant negative d.c. bias.

The positive voltage from the 6AL5 rectifier is added to this a.c. bias at the grid of the 2D21. When the positive voltage becomes sufficient to cancel the action of the negative a.c. grid swing, the 2D21 conducts on each half-cycle that its plate is positive, since the grid is no longer negative during this period. Thus, each time the microphone picks up sound of sufficient intensity, the thyratron fires and its plate current closes the relay and energizes the a.c. output receptacle.

Since the plate-current flow through the winding of the relay is a series of pulses, capacitor C1 was added to prevent the relay from chattering. Note the polarity indications on C1. The relay may be any type whose contacts will handle 2 or 3 amps. and which will close on a current of 35 to 50 ma. The value of resistance of R1 is best determined experimentally, but will be roughly 3,000 ohms less the resistance of the relay. Omit R1 if the relay resistance is 3,000 ohms or more.

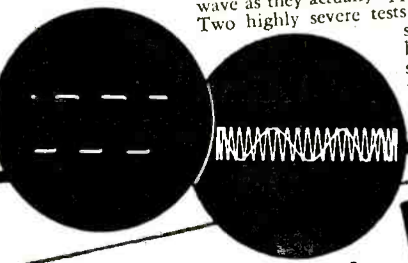
Potentiometer R2 is a sensitivity control. It controls the a.c. bias applied to the grid of the 2D21. The clockwise end of R2 should be grounded. Note that the 5-volt winding is tied in series with the 6.3-volt winding on the power transformer to supply the a.c. bias across the control. This is necessary because 6.3 volts was too low to provide reliable operation. Make sure the two filament windings are in series *adding*, not *bucking*. An a.c. voltmeter will show when the two are adding by indicating a total voltage of about 11.3.

(*Continued on page* 107)

Features OF THE NEW 1952

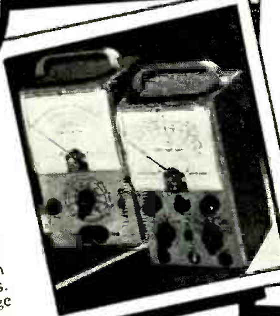
PROOF OF THE NEW 0-7 OSCILLOSCOPE'S OUTSTANDING PERFORMANCE

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.



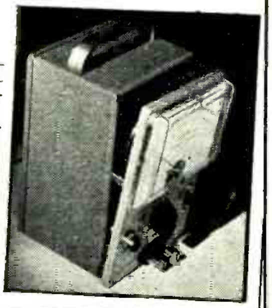
COMPANION VACUUM TUBE VOLTMETERS

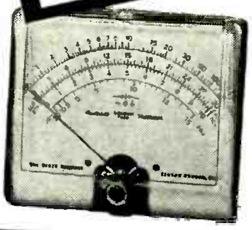
Here are the two NEW 1952 VACUUM TUBE VOLTMETER COMPANION PIECES. Matched instruments of new design to open up the whole field of DC, AC, and resistance measurements for you. The new greatly reduced size combines style, beauty, and compactness — The V-5 and AV-1 have the new panel and cabinet construction 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.

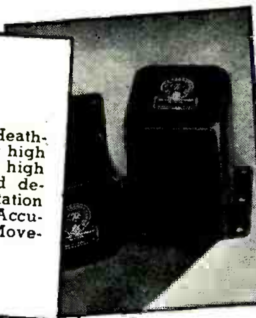




A STATEMENT FROM SIMPSON ELECTRIC CO.

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.

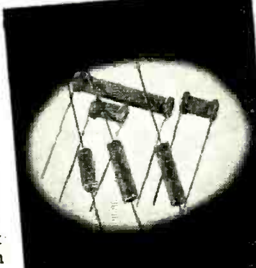
We at Chicago Transformer are proud that our product has contributed to the recognized quality and increasing popularity of Heathkits.

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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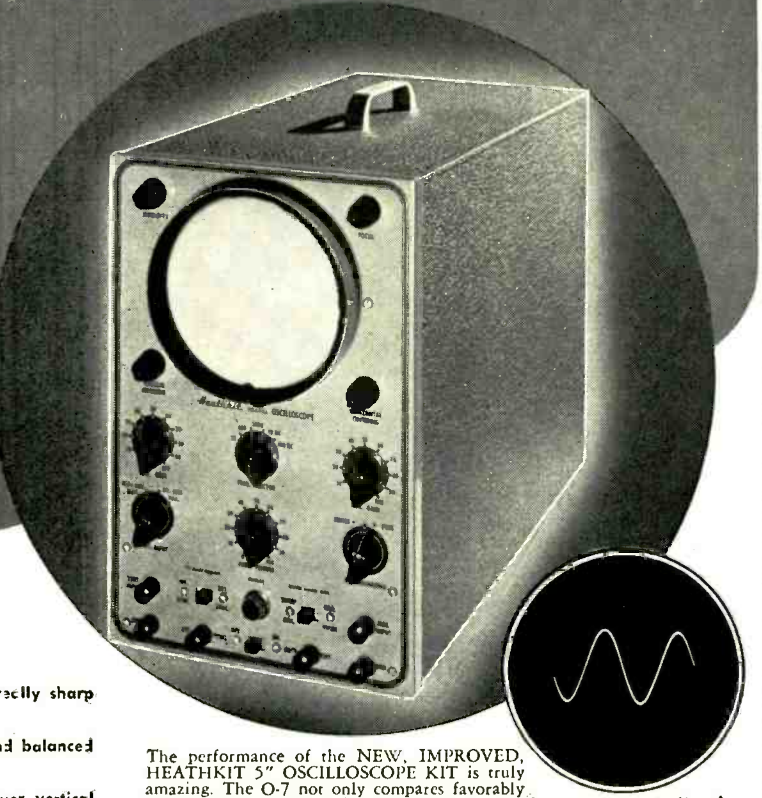
13 E. 40th ST.
NEW YORK CITY (16)
CABLE: ARLAB-N.Y.

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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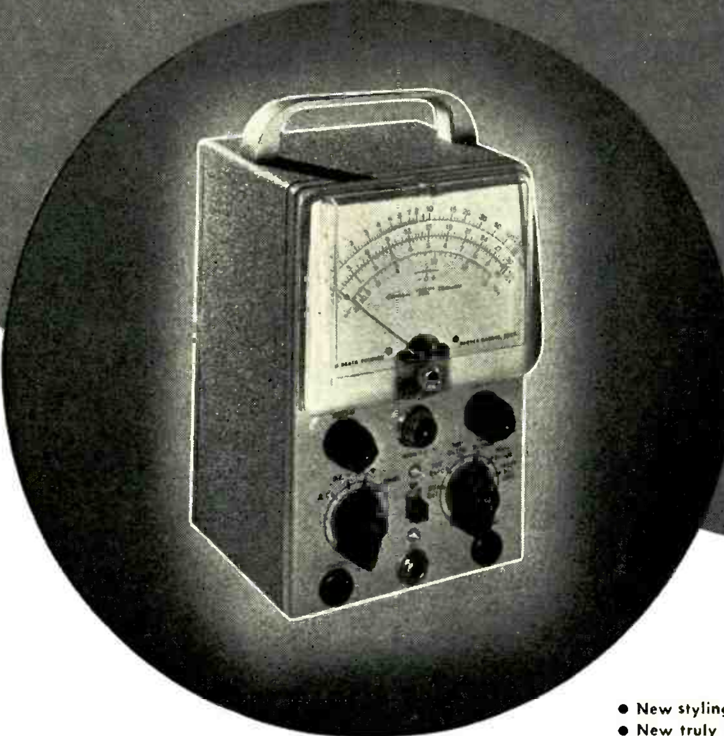
THE *New* 1952

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 7⅜" 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.

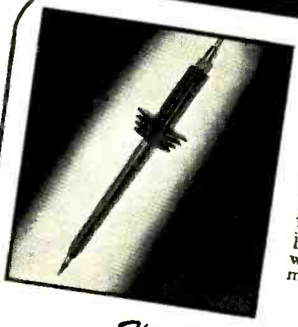
And you can make a tremendous range of measurements — ½V to 1000V AC, ½V to 1000V DC, .1 to over 1 billion ohms, and DB. Has mid-scale zero level marking for quick FM alignment. DB scale in red for easy identification — all other scales a sharp, crisp black for easy reading.

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

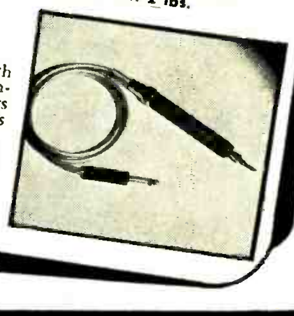
No. 336 High Voltage Probe Kit
Shipping Wt. 2 lbs.

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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Heathkit

SIGNAL GENERATOR KIT

Model SG-6
Shipping Wt. 7 lbs.

$19.50

The new Heathkit Signal Generator Kit has dozens of improvements. Covers the extended range of 160 Kc to 50 megacycles on fundamentals and up to 150 megacycles on useful calibrated harmonics; makes this Heathkit ideal as a marker oscillator for TV. Output level can be conveniently set by means of both step attenuator and continuously variable output controls. Instrument has new miniature HF tubes to easily handle the high frequencies covered.

Uses 6C4 master oscillator and 6C4 sine wave audio oscillator. The kit is transformer operated and a husky selenium rectifier is used in the power supply. All coils are precision wound and checked for calibration making only one adjustment necessary for all bands.

New sine wave audio oscillator provides internal modulation and is also available for external audio testing. Switch provided allows the oscillator to be modulated by an external audio oscillator for fidelity testing of receivers. Comes complete, all tubes, cabinet, test leads, every part. The instruction manual has step-by-step instructions and pictorials. It's easy and fun to build a Heathkit Model SG-6 Signal Generator.

Heathkit

CONDENSER CHECKER KIT

Only

$19.50

Model C-2
Shipping Wt. 6 lbs.

Checks all types of condensers — paper — mica — ceramic — electrolytic. All condenser scales are direct reading and require no charts or multipliers. Covers range of .00001 MFD to 1000 MFD. A Condenser Checker that anyone can read. A leakage test and polarizing voltage for 20 to 500 V provided. Measures power factor of electrolytics between 0% and 50% and reads resistance from 100 ohms to 5 megohms. The magic eye indicator makes testing easy.

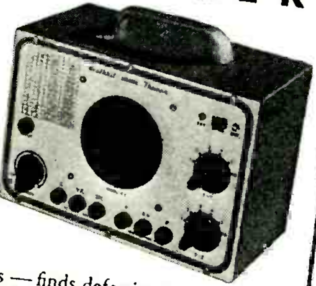
The kit is 110V 60 cycle transformer operated and comes complete with rectifier tube, magic eye tube, cabinet, calibrated panel and all other parts. Has clear detailed instructions for assembly and use.

NEW *Heathkit*

SIGNAL TRACER AND UNIVERSAL TEST SPEAKER KIT

$19.50

Model T-2
Shipping Wt. 7 lbs.



The popular Heathkit Signal Tracer has now been combined with a universal test speaker at no increase in price. The same high quality tracer follows signal from antenna to speaker — locates intermittents — finds defective parts quicker — saves valuable service time — gives greater income per service hour. Works equally well on broadcast, FM, or TV receivers. The test speaker has an assortment of switching ranges to match either push-pull or single output impedances. Also tests microphones, pickups and PA systems. Comes complete: cabinet, 110V 60 cycle power transformer, tubes, test probe, all necessary parts, and detailed instructions for assembly and use.

Heathkit

TUBE CHECKER KIT

Model TC-1
Shipping Wt. 12 lbs.

$29.50

The Tube Checker is a MUST for radio repair men. Often customers want to SEE tubes checked, and a checker like this builds customer confidence. In your repairing, you will have a multitude of tubes to check — quickly. The Heathkit tube checker will serve all these functions — it's good looking (with a polished birch cabinet and an attractive two color panel) — checks 4, 5, 6, 7 prong Octals, Loctals, 7 prong miniatures, 9 prong miniatures, pilot lights, and the Hytron 5 prong types. AND IT'S FAST TO OPERATE — the gear driven, free-running roll chart lists hundreds of tubes, and the smooth acting, simplified switching arrangement gives really rapid set-ups.

The testing arrangement is designed so that you will be able to test new tubes of the future — without even waiting for factory data — protection against obsolescence.

You can give tubes a thorough testing — checks for opens, shorts, each element individually, emission, and for filament continuity. A large BAD-?-GOOD meter scale is in three colors for easy reading and also has a "line-set" mark.

You'll find this tube checker kit a good investment — and it's only $29.50.

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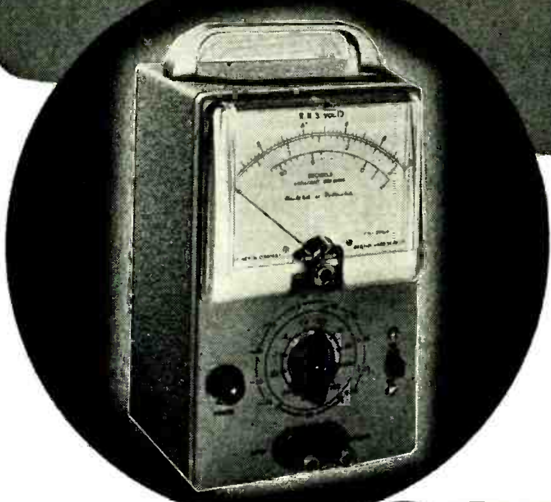
New LABORATORY LINE HEATHKITS

NEW *Heathkit* A.C. VACUUM TUBE VOLTMETER KIT



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.

MODEL AV-1
Shipping weight 5 lbs.

$29.50

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.

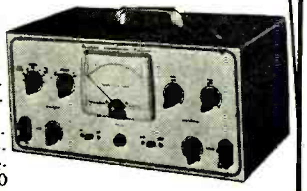
Input impedance is high (1 megohm) for negligible circuit loading. A signal voltage anywhere between 2 and 300V can be fed directly into the instrument and a change in signal voltage between these limits will not affect the meter reading. In addition, input wave shape is not critical (the unit will read 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 which 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

MODEL SQ-1
Shipping wt. 14 lbs.

$29.50

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.

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Heathkit

IMPEDANCE BRIDGE KIT

Model IB-1B
Shipping Wt. 15 lbs.

$69.50

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.

Heathkit LABORATORY

RESISTANCE DECADE KIT

$19.50

Shipping Wt. 4 lbs.

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.

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

$29.50

Model PS-1 ..... Ship. Wt. 20 lbs.

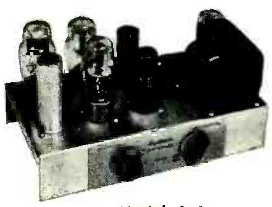
Every experimenter needs a good power supply for electronic setups of all kinds. This unit has been expressly designed to act as a HV supply and a 6.3 V filament voltage source. Voltage control allows selection of HV output desired (continuously variable within limits outlined), and a Volts-Ma switch 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.

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.

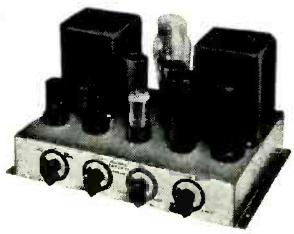
$12.50

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



$33.50

Shipping Wt. 18 lbs.

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.

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. **$35.50**
Shipping Wt. 18 lbs.

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EXPORT AGENT
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13 E. 40th ST.
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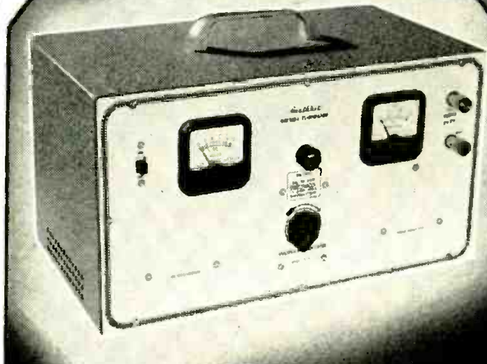
The HEATH COMPANY
. . . BENTON HARBOR 20, MICHIGAN

NEW 1952 *Heathkit*

BATTERY ELIMINATOR KIT



- 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 Amperes 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.

$24.50

Model BE-3
Shipping Wt. 17 lbs.

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 transformer 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.

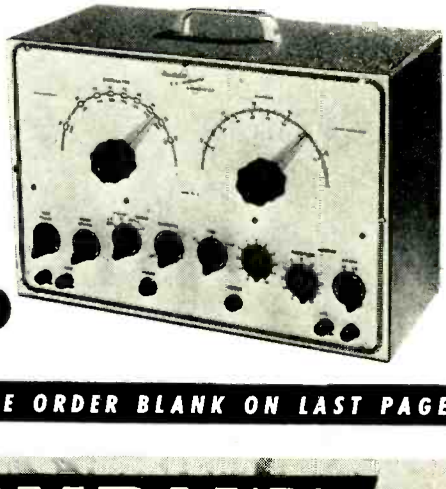
An absorption type frequency marker covers from 20 to 75 Mc. in two ranges — therefore, you have a simple, convenient means of frequency checking of IF's, independent of oscillator calibration.

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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If no a.c. voltmeter is obtainable, you can find the correct connection by determining which of the two possible connections produces the loudest hum in a pair of headphones connected across R2.

Voltage on the plate of the 2D21 must be out of phase with the a.c. bias voltage across R2. That is, plate voltage is positive when grid bias is negative, and vice versa. Set R2 at the extreme counterclockwise position. Be sure no signal is coming from the amplifier 12AX7 tube. Under these conditions, the 2D21 will fire (relay operates and tube glows blue) when the lead C from the relay is connected to one end of the high-voltage winding, but will not fire when the lead is connected to the other end. Leave the lead on the latter connection. Advancing R2 to the extreme clockwise end should now cause the thyratron to fire. In practice, the control is set so that the 2D21 thyratron almost fires, making the unit quite sensitive.

A word about the microphone—almost any high-level output mike will work nicely. We used the transmitter from an otherwise defective sound-powered handset. An old earphone would do the same job, as would a small loudspeaker with an output transformer attached. A carbon mike (old telephone transmitter) would be O.K., but a mike transformer and battery would be necessary. Constant drain on the battery necessitates frequent replacements. Shield the microphone lead.

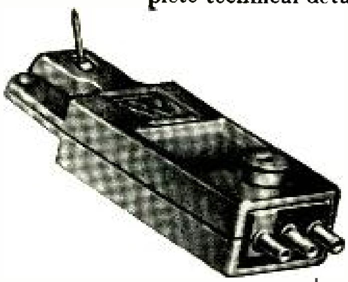
An experimenter who has several large tubes in his junk box, but no miniatures, could build the alarm without additional purchases. A 6SL7 or two 6F5's would replace the 12AX7, with different circuit constants as given in the resistance-coupled amplifier section of a tube handbook. An 884 or a 2050 could replace the 2D21, and a 6X5 would do the same job as the 6X4. A 5Y3, 80, or other such rectifier could be used if an additional 6.3-volt winding were available on the transformer to substitute for the 5-volt winding in the bias circuit.

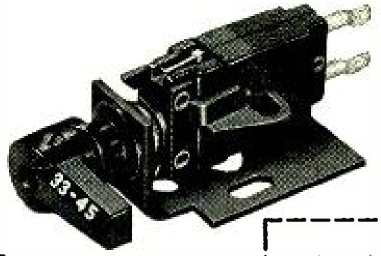
In addition to its function as a telephone alarm, the unit may be used in several other ways. It can be used to signal the ringing of the doorbell, the crying of the baby, or even the arrival of the family car in the garage. Frankly, though, our most enthusiastic user so far is the little two-year-old for whose protection the unit was designed. Does he appreciate our efforts in his behalf? Does he realize the security this little device affords? We wonder—he likes to chatter into the mike and watch the light wink back!

Materials for telephone alarm

Resistors: 1—2.2, 2—1 megohm, ½ watt; 2— 470,000, 2—220,000, 2—5,600 ohms, ½ watt; 1—(Potentiometer) 500 ohms, wire-wound; 1—R1 (see text).
Capacitors: (Paper) 2—0.1 μf, 400 volts; (Electrolytic) 2—10 μf, 450 volts; 1—8 μf, 450 volts; 2—1 μf or larger, 25 volts.
Miscellaneous: Tubes: 1—12AX7, 1—6AL5, 1—2D21, 1—6X4. 4—Tube sockets. 1—A.C. receptacle. 1—Microphone jack. 1—Power transformer, 550 volts c.t., 50 ma; 6.3 volts, 2 amp, 5 volts, 2 amp. 1—Choke, 10 henries, 50 ma or more. 1—Relay, s.p.s.t. normally open contacts (see text). Hookup wire, chassis, hardware, etc.

—end—





EARLY WARNING PLANE DETECTION SYSTEM

Patent No. 2,571,386

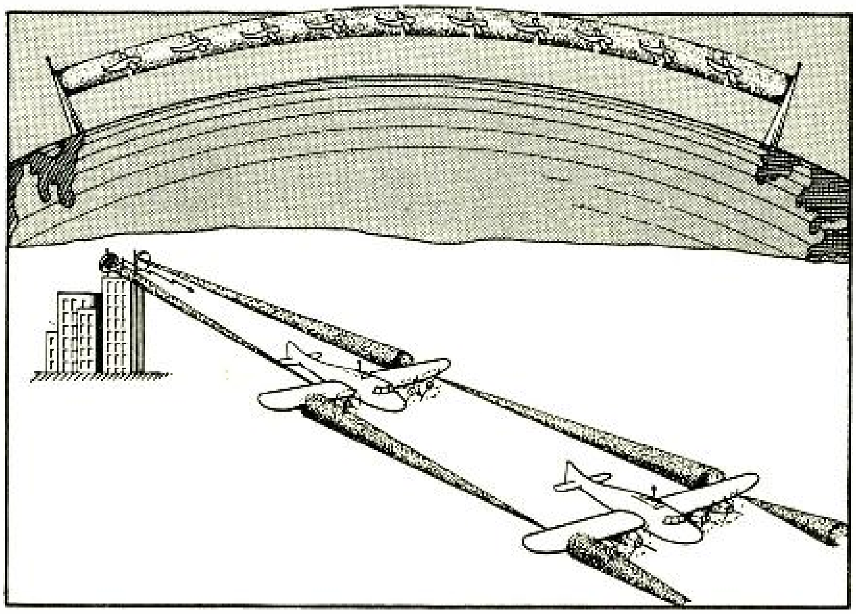
David Sarnoff, New York, N. Y. (assignor to the Radio Corporation of America).

The purpose of this invention is to obtain information on enemy raiders or guided missiles at a sufficiently early moment to permit intercepting raiders, jamming the control signals of guided missiles, sending out counter-aircraft, or otherwise deflecting or destroying the attackers.

It provides a system wherein a number of radio-relay carrying aircraft are to follow each other at regular intervals over a given course (say between Newfoundland and England). They would be kept on the same beam by directive transmitters at the shore stations at each end of the flight course and by directive receivers and transmitters on each plane. Thus a straight line would be maintained over the whole course, though planes near the center of the flight would be out of range of the shore stations. A typical defense setup of this type could consist of a stream of planes in which each would fly about 250 miles behind the other.

Each of these planes would carry radar detection apparatus, and could relay information picked up on the radar equipment immediately to the shore station by way of the other planes in the string, thus warning of attackers much earlier than could any shore-based station.

The patent, which covers six pages of text and seven pages of drawings, suggests a number of other possibilities, such as parasite planes attached to the patrol craft. Should enemy planes or missiles approach, the parasites would be launched to intercept them. The use of Ultrafax and Teleran is also mentioned as means of obtaining more rapid or complete information on given strategic situations, and relaying it to its final destination with the utmost efficiency.



COSMIC RAY ALTIMETER

Patent No. 2,573,823

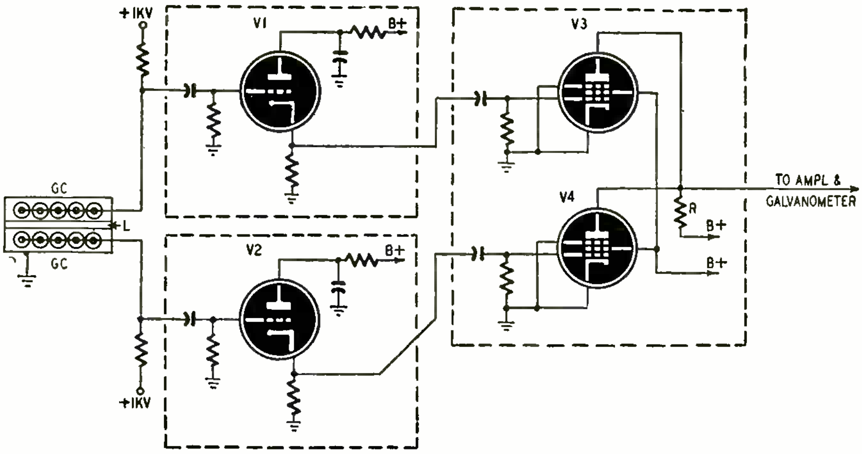
John W. B. Barghausen, Mt. Rainier and James A. Van Allen, Silver Spring, Md.

(Assigned to the U.S. Government as represented by the Secretary of the Navy)

This instrument is effective at heights of 3 to 20 miles above sea level. Geiger counters measure the cosmic ray intensity which increases with height and becomes nearly constant 20 miles up. Results are accurate within 1,000 ft. An ordinary barometric altimeter is unreliable above 3 miles due to the low and nearly constant pressure.

The Geiger counters (GC) are arranged in two groups, one above the other. The groups are separated by a lead barrier (L) about ¾ inch thick. Several counters are used to average out possible error. Each anode is polarized by a positive 1,000-volt source (not shown). The upper group of counters feeds through channel V1 and V3. The lower group is connected through V2 and V4. Tubes V1 and V2, cathode followers, do not reverse the polarity of a signal.

A Geiger counter output consists of negative



pulses. These are fed, as shown, to separate tubes. The negative pulse outputs of these tubes are connected to pentodes V3, V4 which comprise a coincidence stage. If either tube is pulsed, there is practically no change in the plate current through R. For example, if V3 is pulsed negatively, this tube is blocked but there is a rise in plate voltage at V4. Therefore the latter tube passes more current and there is little net change in the voltage drop across R. However, when V3 and V4 are pulsed *simultaneously* both are blocked and a positive pulse is transmitted. The pulse is amplified and indicated on a damped galvanometer to show the average count.

Cosmic rays penetrate the lead barrier at high speed so both groups of counters are energized almost simultaneously. But if other types of radiation are also present they will not register.

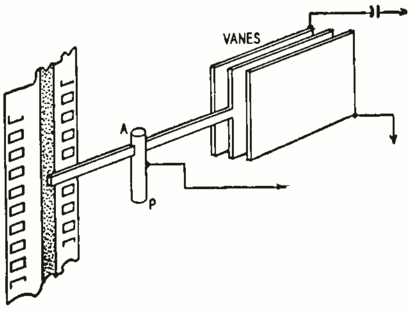
MAGNETIC TAPE REPRODUCER

Patent No. 2,574,708

Michael Rettinger, Encino, Calif.

(Assigned to Radio Corp. of America)

This pickup works capacitively rather than by the conventional magnetic method. The usual reproducer includes a playback winding in which a voltage is induced as the tape moves past. This voltage is proportional to frequency. With the same magnetization, for example, the output voltage is greater at higher frequencies. Therefore an equalizer is needed to restore acoustic balance. The new pickup does not need an equalizer.



An iron armature A is pivoted at P and carries a flat vane at the far end. Two fixed plates are on either side of the movable vane. When a magnetized tape (shown with sprocket holes) moves past A, the armature vibrates. The motion of the center vane produces a varying capacitance proportional to the tape magnetization.

An oscillator-discriminator transforms the capacitance changes to variations of voltage. The present patent does not cover such a circuit. If desired, the capacitance changes may be used to frequency-modulate an oscillator. This produces FM which may be detected in the usual way.

TV SOUND SEPARATOR

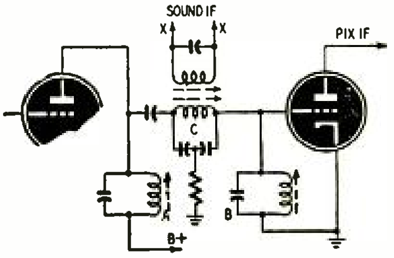
Patent No. 2,574,259

Harold Goldberg, Towson, Md.

(Assigned to Bendix Aviation Corp.)

This network rejects the sound channel while passing a wide video band. Rejection is greater than 40 db at the undesired frequency. The network may be aligned without a sweep generator. The adjustments are not interdependent.

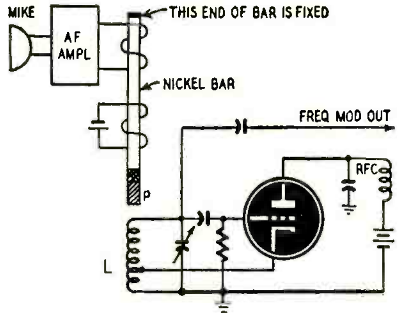
A and B are parallel-resonant circuits. One is tuned slightly higher than the center of the pix i.f., and the other slightly lower. This extends the pix pass-band. C is a bridged-T circuit tuned to the sound channel. When set for null, the bridged-T eliminates the sound from succeeding pix stages. However, this sound energy appears across C and terminals X which feed the sound i.f. strip.



FM GENERATOR

Patent No. 2,574,647
Robert Lorenzen, New York, N. Y.
(Assigned to Electronic Systems Corp.)

Magnetostriction is utilized to modulate frequency in this generator. It seems to be applicable to phone transmitters, sweep generators, etc. The figure shows a single triode employed as an FM oscillator. A bar of nickel or magnetostrictive alloy is shown near or partly within the tank coil (L). One end of the bar is firmly fixed in position. The other end carries an iron slug (P) insulated from the bar. Two windings magnetize the bar. One carries an a.f. signal, the other uses d.c.



The bar shown here will vibrate longitudinally at an a.f. rate in a magnetic field. The d.c. merely biases the bar magnetically for linear operation. As P vibrates into and out of L, the oscillator frequency varies and produces an FM signal.

If desired, capacitance may be controlled instead of inductance. In this case P is then a high dielectric material and is placed between metal plates. When the nickel bar expands, P moves deeper into the capacitor formed by the metal plates, changing the capacitance.

IMPROVED TRANSISTOR

Patent No. 2,570,978
William G. Pfann, Chatham, N. J.
(Assigned to Bell Telephone Laboratories, Inc.)

This transistor is designed for greater gain, higher input impedance and better efficiency. It may be used as an amplifier or oscillator. The germanium crystal is partly N-type and partly P-

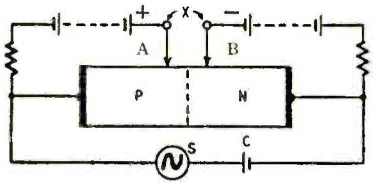


Fig. 1—Transistor used as amplifier.

type as illustrated. Each point contact functions as a combination emitter-collector. A metal plating (shown as a thick line) is used as the base of the transistor. Either separate bases (Fig. 1) or a common element (Fig. 2) may be used.

In Fig. 1, A is biased to emit *holes*. These positive charges pass through the crystal and are collected by B. On the other hand, B is biased to emit *electrons* which are collected at A. An a.c. signal S and a d.c. source C control the output across terminals X. The d.c. aids the passage of holes from P to N and of electrons in the opposite direction. The a.c. signal S modulates the flow of both charges.

Fig. 2 shows a transistor connected as an oscillator. The point contacts are coupled by an LC circuit which determines the oscillating frequency. R may be adjusted to control output amplitude.

In both circuits, the boundary between N and P (dotted line) is photo-sensitive. Light falling on this barrier liberates electron-hole pairs and adds to the output.

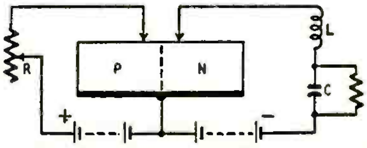


Fig. 2—Transistor oscillator circuit.

—end—

ARTSNY RECEIVES GIFT

The Associated Radio-Television Servicemen of New York (City) received a complete set of Oak Ridge test equipment from that company. The gift, which was on hand and formally accepted at their meeting of January 17, will be of great assistance in their work in the new shop-class-clubroom at 165 East Broadway.

The new headquarters has been fitted up with a stage, benches for spectators and a test bench 40 feet long. A couple of old chassis have been obtained, and more test equipment is expected.

The meeting on January 17 was largely occupied with a discussion of the pending licensing legislation. The bankruptcy of Conlan Electric, which had more than 20,000 contracts, was another of the main topics of discussion. Newspaper reports of statements made by Conlan's legal counsel that the company had lost more than $1,000,000 since going into television, and that the reason for failure was that the rates charged under the contracts were not sufficient to meet the costs of service, attracted special interest.

LONG BEACH ELECTS

Officers of the Long Beach (Cal.) RTA for 1952 are: Fred S. Abrams, president; Les Huckins, vice president; H. L. Brown, secretary; and Clarence Spencer, treasurer.

Elwyn W. Ley was chosen program chairman, and Harry Ward continues as public relations officer, with the assistance of Col. J. C. Hughes and Rod McIntire. Frank Gregson is the new chairman of the membership committee, and Joe Martin was again selected as the association's technical adviser.

A new post, sergeant-at-arms, was created, with Merlyn (Speedy) Cochems at the first incumbent. The past president, Hal Meyers, is handling the job of technical guidance in customer relations. An official photographer, Bob Hayden, was designated.

NESA APPROVES US

We received the following much appreciated letter from the Nebraska Electronic Service Association (NESA) of Lincoln, Nebraska.

"The members of the Nebraska Electronics Service Association very heartily endorse the efforts of RADIO-ELECTRONICS and all its staff for what they are doing for the electronic industry today and also for the information we have received from you in the past."

NESA is now sponsoring a TV service school for the service technicians of the community.

The officers for 1952 are: Eddie Kohl, president; H. M. Tanquary, vice-president; Leslie Ryman, secretary; and Paul Eddy, treasurer.

MOCH PRESIDENT OF TISA

Frank Moch, president of NATESA, has been elected for the fifth time to the presidency of Chicago's Television Installation and Service Association (TISA). Morton Binder was reelected vice president, Reuben Saxner, secretary, and Martin Reese, treasurer.

ST. LOUIS EXPOSÉ

St. Louis has joined the cities making investigations into television service. The Better Business Bureau of that city submitted three sets—two with a defective tube and one with a blown fuse—successively two or three times to different branches of the same service company. The prices for repair ranged from $5.30 (fuse 30 cents, labor $5.00) to $32.60. In all cases where a high charge was made, various resistors and tubes were replaced, but the major charge was for labor in each case. The labor charge tended to run between $20 and $25. In at least one case a repair charge of $30.40 was charged for repairing a set which had been returned a few days before by another branch of the same company, presumably in perfect operating condition.

The Bureau concludes that the "unnecessary replacement of good parts and high labor charges indicate sharp practices or gross incompetence."

Two interesting points stand out in the investigation. One is that all parts listed as having been replaced were replaced in fact. (In many cases, where concerns have been engaged in gyp practices, the bills have been padded with many items not actually supplied.) The other is that the "trivial gimmick" angle is not as applicable in television as in radio repair, since the customer is trained to pay $5.00 for a service call, even when the trouble is a blown fuse.

Otherwise the faults in these receivers might be classified as trivial, in one case consisting of a loose wire, and in others single bad tubes.

UNETHICAL ADS BANNED

The *Courier Journal* and *Louisville Times* of Louisville, Ky., have announced a set of rules which television dealers must abide by to be permitted to advertise in those papers.

Advertisements must contain accurate descriptions, carry the featured price next to illustrations of the featured receiver, use exact illustrations, state whether equipment shown with sets must be paid for separately, state only the actual retail price, state what additional charges are to be made for warranty, tax, service contract, etc., refrain from using such terms as "no money down," without the necessary qualifications regarding trade-ins, and make all guarantees quite clear and specific.

The advertising manager of the two papers states that the code is no pious statement, but that all copy is actually checked to see that it complies. If it does not, it is returned to the advertiser for revision.

CHANGE OF NAME

The Nebraska-Iowa Television & Electronic Service Association has changed its name to Television & Electronics Service Association, according to a recent *NATESA Bulletin.* Jim Husted, secretary-general of NATESA, has been elected to the T&ESA presidency for a second term.

—end—

PRESELECTOR FROM T.R.F. SET

Old t.r.f. broadcast radios which have been dismissed from active service can be used as preselectors for broadcast dx. (Also for short wave if the set has a short-wave switch.) We used a set which had two 6K7's in the r.f. stages and a 6F6 in the audio. The .01-µf capacitor which went from the plate of the detector to the grid of the 6F6 was removed, and a 100-µµf mica capacitor was soldered from the plate of the 6K7 detector to a tie lug. A shielded wire was brought from the tie lug and attached to the antenna post of a broadcast set. The shield was grounded in the t.r.f. preselector and near the antenna of the broadcast set to which it was attached. Both these sets had transformer-type power supplies. If two a.c.-d.c. sets are to be hooked together, polarity must be observed. No feedback was noticed with the sets in their cabinets. If feedback is present, it may be necessary to put wire screen inside the cabinet of the preselector.

With the preselector in operation after midnight when there is little congestion on the band, the results were astounding. Stations all over the country never before heard came in with good signals.—*C. Tierney*

AUDIO AMPLIFIER HINT

If oscillations do not respond to the usual remedies in a high-gain amplifier which does *not* have inverse feedback, try reversing the leads to the primary of the output transformer. If the amplifier has a push-pull output stage, reverse the plate connections to the output transformer and keep these leads isolated as much as possible from grid and plate leads of preceding stages. Shielding these may be necessary.—*John Crouch*

TV CHANNEL INDICATOR

Some TV sets, such as the Motorola VT-71M-A, have only a small dot as the indicator on the channel-selector knob. This makes it difficult to tell which channel is tuned in when viewing from a distance in a dimly lit room.

To solve this problem, I use a piece of cardboard as a pointer. Using the rear circumference of the knob as a guide, I trace the outline on the cardboard, then add a small projection for the pointer. After trimming around the outline and punching out the center for the control shaft, I cement the pointer to the back of the knob so it is directly behind the small indicator dot.—*B. W. Welz*

A KINK FOR D.C. RELAYS

In the small broadcast station where I am employed, several d.c. relays are operated by microphone switches on the control console. Every time a mike was turned off the VU meter kicked and a click could be heard in the audio system. This was probably caused by the inductive kickback current in the relay coil. We cleared up the trouble by shunting a .05-µf capacitor across the coil of each relay.—*Charles Erwin Cohn*

CLEANING VARIABLE CAPACITORS

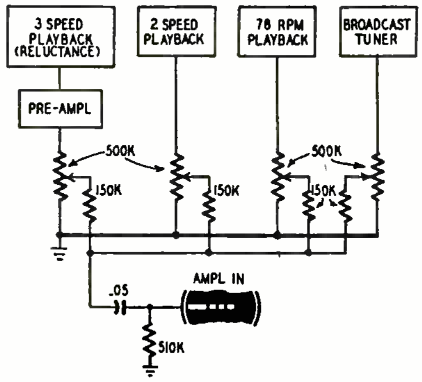
Many of the younger service technicians use carbon tet, compressed air, and other gimmicks to remove dust, metal filings, etc. from between the plates of tuning capacitors. When it comes to stubborn cases which do not respond to these treatments, the youngsters would do well to borrow a trick from an old-timer.

Disconnect the leads from the tuning capacitor, apply 800–1,000 volts a.c. across the plates, and slowly turn the rotor through its range. Arcing in the narrow air gap will quickly burn out any foreign material.

The secondary of an old power transformer is a convenient source of voltage. Connect a 200-ohm, 25-watt resistor or a 25-watt, 115-volt bulb in series with the primary and one side of the power line. This limits the current and keeps the transformer from burning out. When the bulb starts to light, leave the rotor set at this point until the condition clears up as indicated by the lamp going out. Use well-insulated leads and test clips to connect the transformer across the capacitor.—*A. Ivanivsky*

AUDIO MIXING SYSTEM

I am a high-fidelity fan with quite an array of audio equipment which includes a playback amplifier, tuner, and three turntables. We wanted to avoid using a channel-selector switch on the amplifier because of the clicks and pops which usually occur when a switch is thrown, so we used the mixer circuit shown in the diagram.



The volume control at the input of the amplifier was replaced with a 510,000-ohm resistor. The amplifier was then coupled to individual 500,000-ohm volume controls through 150,000-ohm isolating resistors. These resistors introduce some loss into the individual circuits, but they enable me to set the unused controls in any position without noticeably changing the level of the particular channel in use.—*Robert G. Masching*

TRANSFORMER LEAD MARKING

Ordinary pricing tags—such as are used by stores—are useful when replacing multilead transformers. Check each lead when removing the old transformer, and slip a properly marked tag on it. When the new transformer arrives, the job of checking need not be done again. —*Eric Leslie*

QUIETER VOLUME CONTROLS

Standard replacement volume controls have been shrinking in physical size for the past several years. While these controls have a low enough noise level for replacement use in radios, they are noisy in low-level stages of amplifiers and equalizers. Here are some ways to substantially reduce this noise.

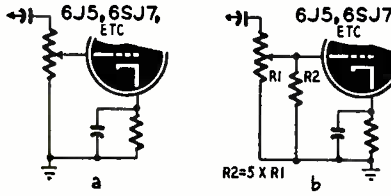


Fig. 1—The circuit at *b* lessens noise.

A large part of volume-control noise is a result of the grid not having any return to ground when the contact passes over an eroded or dirty portion of the control. This is the case in Fig. 1-a. By adding a resistor R2 between grid and ground, a d.c. return for the grid is insured at all times. This resistor should have a resistance about five times the volume-control resistance R1. See Fig. 1-b.

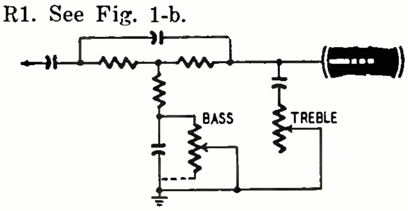


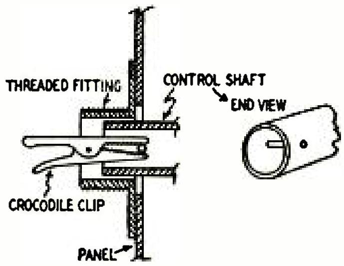
Fig. 2—Quieting tone-control circuits.

Fig. 2 is the basic tone-control circuit used in many tuners and radios. Only two terminals of the bass control are usually wired into the circuit. After a few months the control becomes more noisy. The simple cure is to ground the third terminal as shown by the dashed lines. This establishes a grid return through the potentiometer regardless of variable arm contact irregularities.

The procedure is simple, yet it is a sure cure for this cause of control noise.
—*Edwin Bohr*

ADAPTER FOR TUNING SHAFTS

Many automobile radios have volume, tone, and tuning controls equipped with special fittings designed to be operated through slotted-end flexible shafts. This type of control is difficult to adjust when the control shafts are removed while the set is being serviced.

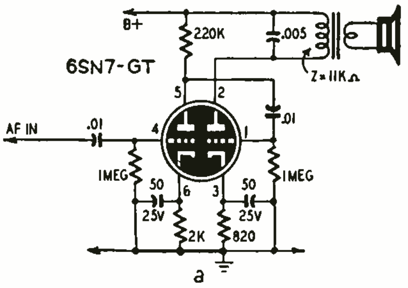


I use thin-nose crocodile clips to simplify adjusting the controls. The drawing shows the type of fitting and the use of the clip as an extension shaft.
—*Nate Silverman*

—end—

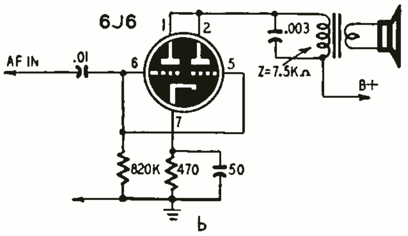
NOVEL OUTPUT STAGES

From time to time, we have seen circuits of small European receivers which

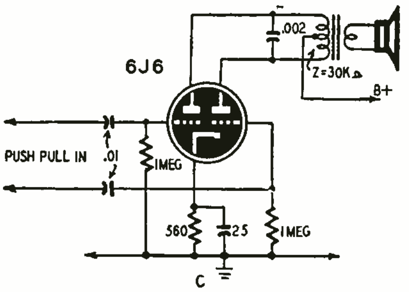


use 6C5's, 6SK7's, and similar voltage amplifier triodes and pentodes driving speakers in the output stage. We haven't seen any claims as to the power delivered, but if they can drive a small speaker, the saving in drain on the B-supply should certainly make them useful in some types of sets.

Three circuits designed for twin-triodes were described in *Radio Ekko*



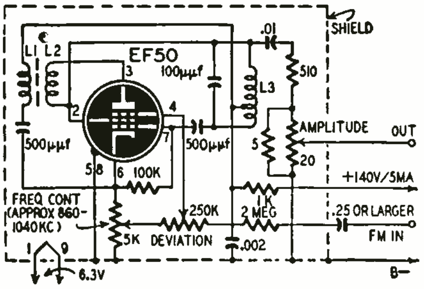
(Denmark). The circuit at *a* shows how a 6SN7-GT may be used as a cascade-coupled amplifier with the second section driving the speaker. The circuits at *b* and *c* are for 6J6's and similar tubes. These show connections for single-ended and push-pull output stages.



WOBBULATED SIG GEN

Most broadcast sets are aligned by peaking the i.f. transformer windings for maximum output. This method is not particularly suited to high-fidelity tuners and some communications receivers. The ideal method is to adjust the tuned circuits for the desired response curve on an oscilloscope. A circuit of a wobbulated oscillator for visual alignment of broadcast sets is described in *Wireless World* (London, England). Its circuit is shown in the diagram.

This circuit, which uses a single EF50 tube as combined oscillator and reactance tube, is a development of a system described by K. C. Johnson in the April and May, 1949, issues of *Wireless World*. The EF50 is obtainable in this country as a surplus tube.



The oscillator circuit consists of L1 and the 500-μμf capacitor in series. Feedback between the grid and plate is developed through the autotransformer L3 which is broadly resonant throughout the tuning range—about 860 to 1040 kc. L2 carries the plate current and is tightly coupled to L1. A change in plate current changes the mutual inductance and shifts the operating frequency. The change in frequency is determined by the ratio of plate current to cathode current. Since changing the voltage on the suppressor causes a large change in plate current without greatly affecting the total cathode current, the oscillator may be frequency-modulated by applying a varying voltage to the suppressor.

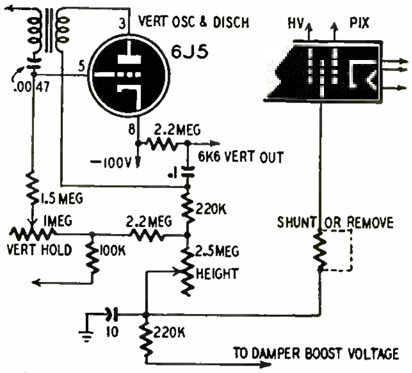
A sawtooth voltage is applied to the suppressor grid to provide the necessary sweep voltage. This is obtained by connecting the FM input terminal to the horizontal deflection amplifier output of the 'scope. The output of the generator is coupled directly to the grid of the mixer tube in the receiver or to the antenna posts through a dummy antenna. The signal for the vertical amplifier of the 'scope may be tapped off the hot end of the volume control. The a.v.c. line should be grounded during alignment.

L1 consists of 30 turns of No. 31 enameled wire close-wound on a 1-inch form. L2 is an identical winding wound in the same direction on top of L1. The cathode and screen-grid connections should be made to corresponding ends of L1 and L2. L3 is 100 turns of No. 31 wire on a 1-inch form with a tap 40 turns from the end which connects to L2. L3 should be mounted at right angles to L1-L2 with the tube or a shield between them to minimize coupling. The unit should be carefully shielded to minimize leakage.

When using the wobbulator, adjust the receiver to a quiet spot around 1000 kc on the dial, then adjust the frequency control until the signal is tuned in. Set the sweep speed of the scope to a fairly low rate so there is no difference between the forward and backward traces.

BEAM KILLER

This circuit modification prevents formation of the intense spot of light that appears in the center of many TV screens immediately after the set is turned off. In most TV sets the picture tube first anode is supplied from some point in the power supply proper. The diagram shows how a popular RCA circuit can be modified so the first anode is supplied directly from the arm of the height control which usually obtains its voltage from the damper-boost circuit. If the original circuit has a resistor in



series with the first anode, remove it.

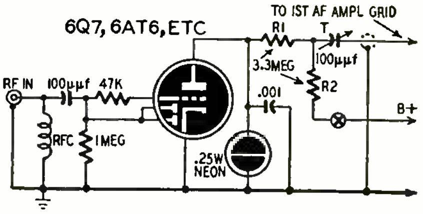
This circuit also aids in eliminating the brown spot seen on kinescope screens after some use. Although the circuit shown is applied to the 630-type set, there is no reason why it cannot be applied in other receivers.—*Wilbur J. Hantz*

(Take care when adding this circuit to sets having large picture tubes, because the boosted voltage may exceed the maximum voltage which may be applied to grid 2. If the voltage exceeds 400, use a voltage divider.—*Editor*)

KEYING MONITOR

A keying monitor must be simple to construct and trouble-free in its operation if it is to become a permanent fixture in the average amateur station. Such a monitor is described in *Short Wave Magazine* (London, England).

The r.f. input terminal of the monitor is coupled loosely to the output of the transmitter. A foot or so of wire or bus bar will work nicely. When the transmitting key is up, the triode section of the tube conducts heavily so the voltage on its plate is too low to permit the neon-tube relaxation oscillator to fire. When the key is closed, the diode section rectifies the incoming r.f. signal and develops sufficient negative voltage to greatly reduce the plate current of the triode. The plate current rises enough to permit the neon lamp to oscillate.

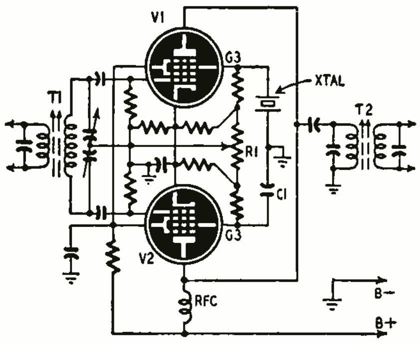


A 6SQ7, 6Q7, 6AT6, or similar tube may be used in the circuit. The output of the monitor is fed directly to the grid of the a.f. power amplifier in the receiver, so the setting of the receiver's volume will not disturb the level of the output from the monitor. Monitor volume is controlled by the 100-μμf trimmer and by the ratio of R1 to R2. Operating voltage may be taken from the receiver. The receiver's standby switch should not disable the a.f. amplifiers when the monitor is used. If the switch is in the negative leg of the power supply, modify the circuit so it is in the r.f. and i.f. B-plus lead.

SELECTIVE I.F. AMPLIFIER

Adequate selectivity is often a major problem in communications receiver design particularly in sets designed for c.w. reception. In most cases, a network of one or more quartz crystals acts as a selective coupler between two i.f. stages. The filter network can be considered as a very high-Q series-resonant circuit tuned to the intermediate frequency.

A different type of crystal-controlled variable-selectivity circuit is described in patent No. 2,533,802 issued to Donald L. Hings, and assigned to Cornell-Dubilier. This method of obtaining a high degree of selectivity is based on the operation of the push-push selective amplifier



shown in the diagram. Transformers T1 and T2 are tuned to the frequency to be passed. This may be the i.f. of a standard receiver. The secondary of T1 is tuned by a split-stator capacitor which provides a balanced input to the push-pull grids of amplifier tubes V1 and V2. The plates of these tubes are connected in parallel.

The injector grid G3 of V1 is connected to ground through a crystal cut to the center frequency of the amplifier. The injector grid of V2 is bypassed to ground through C1, in the injector grid circuit of V2.

If it were not for the crystal in the circuit of V1, the voltages at the plates of V1 and V2 would be equal and 180 degrees out of phase and would cancel each other. However, when a signal to which the crystal is resonant is fed into T1, the crystal oscillates at its natural frequency. The injector grid of V1 becomes sufficiently negative to bias the tube to cutoff or greatly reduce its output. V2 amplifies the signal in a normal manner so the voltage developed across the primary of T2 is the differential of the two plate voltages. The curve of the developed voltage is similar to the response characteristic of a conventional crystal filter, as commonly used in communications receivers.

The selectivity of the circuit can be varied by adjusting the setting of R1 which controls the bias on the injector grids.

V1 and V2 are obviously mixer-type tubes which have two grids that can be used as independent control elements. Such tubes as the 6AS6, the 6SA7, or better, the 6BA7 can probably be used in this circuit. Another feasible tube might appear to be the 6L7, provided that the grid cap on the top is properly shielded.

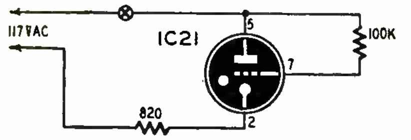
THE SYNCHROSCOPE

The principal component of this small stroboscope is a 1C21 cold-cathode rectifier, used as a moderately strong source of light.

The plate and the cathode of the tube are connected to the a.c. line with about 800 ohms in series to limit the current to about 100 ma.

The starter anode (grid) is connected to the plate through a resistance of about 100,000 ohms.

The tube rectifies the line voltage and gives off a pulse of light during each positive half of the a.c. cycle. Thus one visual pulse per cycle of line frequency is given.



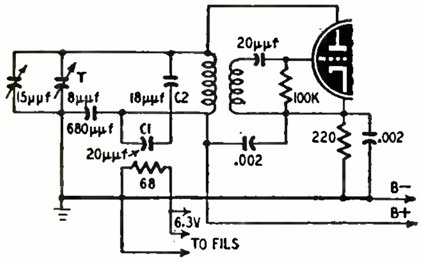
This pulse of light will stroboscopically stop the motion of a synchronous motor or any device that is operating in synchronism with the line frequency. Its ready application in the testing of synchronous motors, electric clocks, phonograph motors, time switches, timing devices, generators, business time machines etc., is apparent.—*Harry Peach and Edward Spierer*

NEW CIRCUITS IN FM SET

If you are an experimenter looking for interesting circuits to try, or are an engineer looking for a chance to develop new circuits, study the circuits of some of the new FM-AM combinations. They are full of interesting tricks.

Two unusual circuits are used in an FM receiver described by J. G. Spencer of the BBC, in *Wireless World* (London, England). The high-frequency oscillator circuit is shown at *a*. (The tube is the triode section of a converter similar to the 6K8.) This is a conventional tuned-plate oscillator with a 68-ohm resistor-heater in contact with the negative-coefficient temperature compensating capacitor, C1, in series with C2 added across the tuned circuit to compensate for the rapid drift which usually occurs during the initial warm-up period. A 1-watt resistor is ok.

—end—



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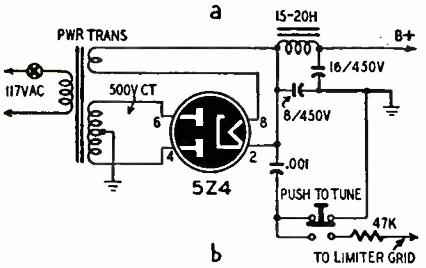
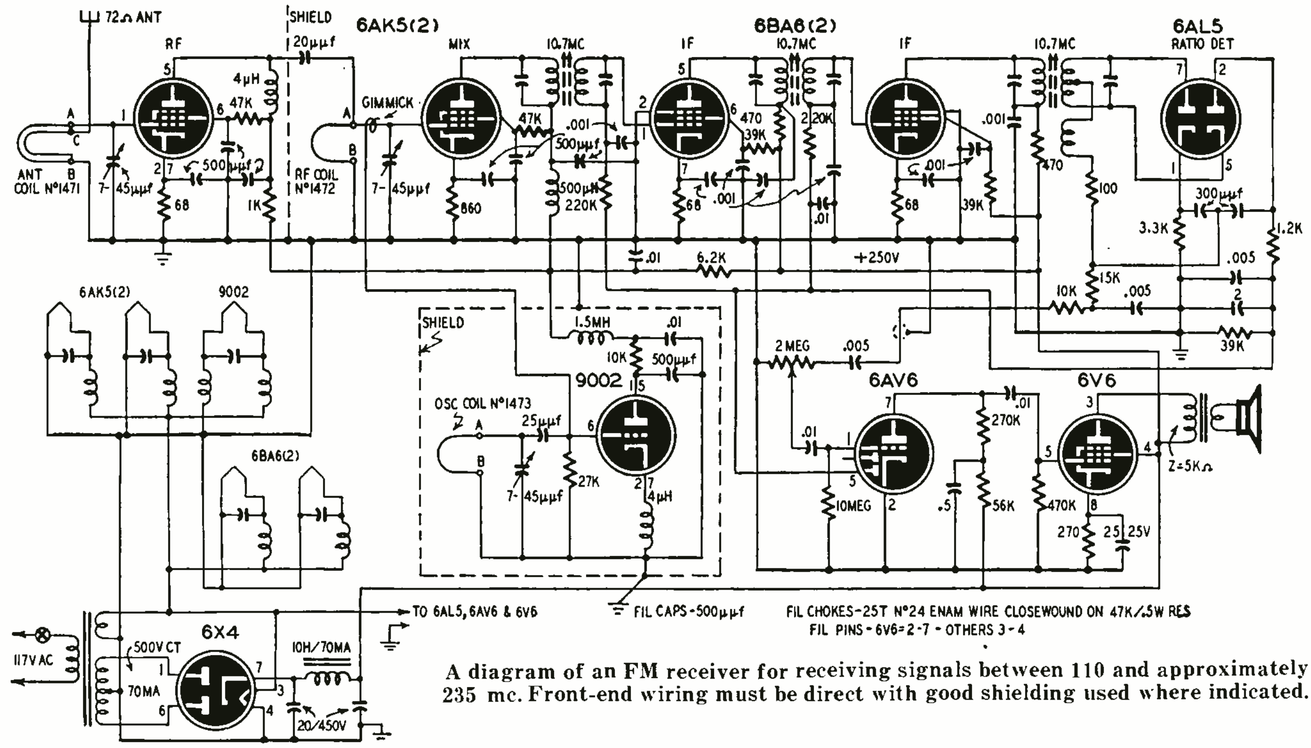


b

NATIONAL EMERGENCY

If you have any scrap iron, steel, copper, bronze, aluminum, lead, zinc or other metal, turn it over to co-operating scrap-collecting agencies. The defense effort needs it more than you do.



A diagram of an FM receiver for receiving signals between 110 and approximately 235 mc. Front-end wiring must be direct with good shielding used where indicated.

150-MC EMERGENCY RECEIVER

? *Please prepare a diagram of a sensitive superhet receiver for receiving the signal from a 156.57-mc police transmitter. Please show how the frequency of this receiver may be shifted to receive another station near 130 mc.—A. R. S., Stockton, Calif.*

A. The diagram can be used for any FM receiver as long as the coils in the tuner section cover the required band. The coils specified are made by J. W. Miller Co. and are suitable for use in the range from 110 to 235 mc. The tuning capacitors specified are for use in the 150-mc range. Other sections of this band can be covered by using larger or smaller tuning capacitors.

Shielding must be used between the r.f. amplifier, mixer, and oscillator circuits to prevent interaction and feedback. The set is designed for spot-frequency work, so the tuning capacitors may be ceramic trimmers. If continuous tuning is desired, a 3-gang tuning capacitor is recommended. In this case, you may have to pad the oscillator circuit to provide proper tracking. The i.f. amplifier may be aligned more sharply than for conventional FM broadcast sets. This provides more gain, so take care to avoid oscillation in the i.f. strip.

PREAMP AND EQUALIZER UNIT

? *I have an old Philco receiver which has a triode-connected 6F6 as a driver for push-pull power amplifiers in a dual-channel audio output system. I like the performance of the audio channel and would like to convert it into an amplifier for high-fidelity music and public-address work.*

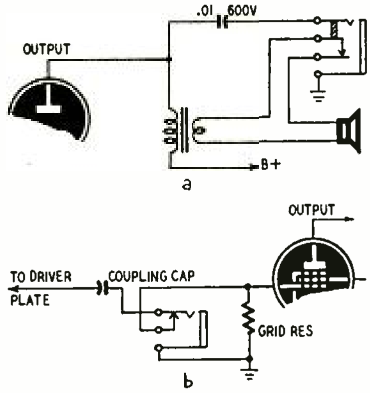
Please draw a circuit of a preamplifier, mixer, and equalizer for two crystal microphones and a crystal pickup. Please include an input circuit for a radio tuner when the mikes and pickup are not being used. I want separate high- and low-frequency tone controls and a simple loudness control.—C. J. M., Broad Channel, N. Y.

A. The diagram shows a 6SJ7 used as mixer and preamplifier for the microphones and pickup. The output of the preamplifier or the input from a tuner is fed through bass and treble controls to cascade-connected 6J5 voltage amplifiers. These two stages provide the required gain while compensating for the insertion losses of the equalizer and the IRC loudness-control circuits.

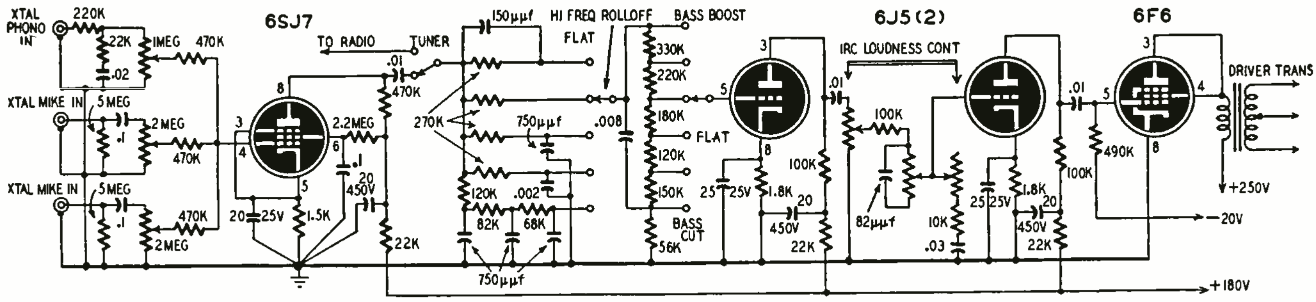
A single 6SN7-GT may be substituted for the pair of 6J5's. The driver and output transformers which you have are probably satisfactory. However, if you replace the driver transformer, be sure to select a unit which supplies a minimum plate load of 10,000 ohms.

ADDING HEADPHONES

? *I would like to add a pair of headphones to my receiver, which has a single 47 in the output stage. The jack must be wired so the speaker is cut out when the phones are plugged in.—J. M., La Grangeville, N. Y.*



A. The phone jack can be installed in the plate or grid circuit of the output tube. The volume will be somewhat greater when the phones are inserted in the plate circuit as shown at *a*, but the



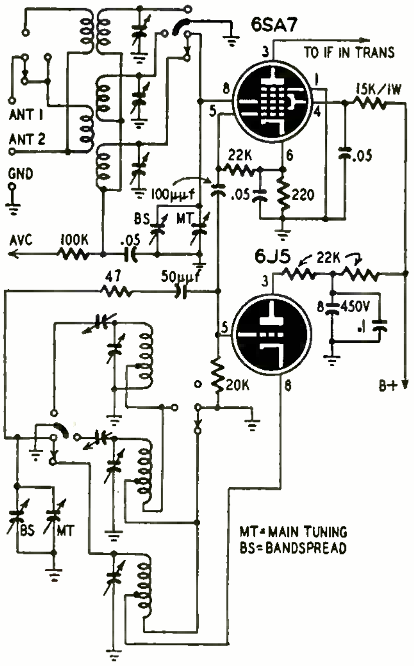
This unit can be used with most amplifiers by omitting the 6F6 and using coax to couple the last 6J5 to the amplifier.

volume obtained with the circuit at *b* is usually adequate for most purposes. These circuits can be used for most sets having single-ended output stages. If the receiver is an a.c.-d.c. model, a .006-µf, 600-volt capacitor should be used between the frame of the jack and ground.

OSCILLATOR-MIXER CIRCUIT

? *I am planning to use parts from a small a.c.-d.c. set (Hallicrafters S-41G) to construct an a.c. receiver. I would like to use a 6SA7 mixer and a 6J5 as a separate oscillator. Please draw a circuit showing how the antenna and oscillator coils of the S-41 can be used in this type of circuit.—A. B., New York, N. Y.*

A. The diagram shows how the coils can be used in the oscillator-mixer circuit. Compare this circuit with the original schematic to determine the proper connections to the coil and band switch.

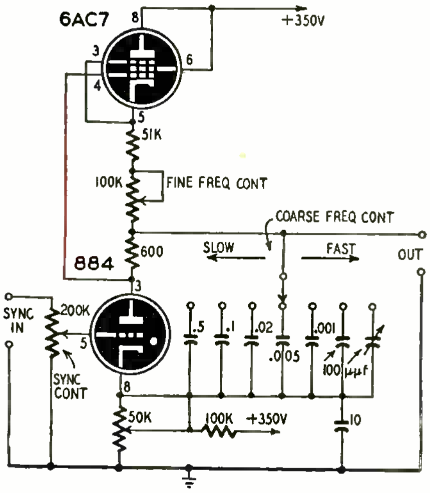


SCOPE SWEEP GENERATOR

? *I am modifying a BC-412 radar indicator so it can be used as an oscilloscope. I have not been able to find a circuit of a sweep generator which has the required linearity. Can you recommend a circuit?—N. C. O., Seattle, Wash.*

A. Having experimented with a number of different oscillators as sweep generators, we believe that the circuit described by Eugene L. Langbergh (*Electronics*, November, 1946) to be more linear and easier to operate than most of the others which we have tried. Tubes and components are not critical.

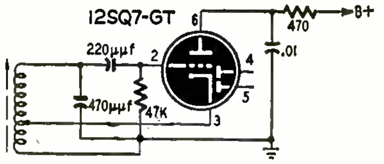
Vary the 50,000-ohm variable resistor for greatest linearity with the generator delivering 8 to 13 volts at its output terminals. Varying the setting of this control causes some shift in calibration of the fine frequency control, so adjust this before calibrating the sweep circuit.



QUERY ON S-38 RECEIVER

? *My Hallicrafters S-38 receiver has a defective b.f.o. circuit. When the shield of the coil is completely on or completely off, I cannot get a beat with incoming signals. However, the unit works properly when the shield is covering about half the coil. I am using a small piece of metal foil wrapped around half the coil as a temporary repair. Can you tell me what is wrong and how I may repair it.—R. L. E., Ambler, Pa.*

A. If the set is properly aligned and you cannot get the b.f.o. to operate properly by adjusting the C. W. PITCH CONTROL, the trouble is probably caused by a change in the value of the 220- or 470-µµf capacitors or the 47,000-ohm grid resistor. Try replacing these components with others known to be of the correct value. The position of these parts is shown on the diagram.



ANTENNA PROBLEM

? *For the last four years, my 75-meter transmitting antenna has been a dipole fed with 75-ohm transmitting-type ribbon line. Up until a week ago, the antenna resonated at 3990 kc and worked out nicely. Overnight, it refused to take a load anywhere in the band. There was no measurable change in the length of the Copperweld flat-top. The feeders checked good with an ohmmeter. Checking the antenna with a grid-dip meter and with a v.f.o., we found that it resonated sharply at 4400 kc. Since there were no changes in the installation or operating conditions, we cannot explain this change. Can you offer any suggestions?—H. R. C., New York, N. Y.*

A. Since all conditions are the same, we suspect that the feeders are the source of the trouble. According to an Amphenol bulletin, the life of ribbon-type lines is not more than 16 months when exposed to sunlight. Deterioration of the polyethylene changes the power factor and characteristic impedance of the line. Since the line is much too old to perform at its best, we believe that replacing it will clear up the trouble.

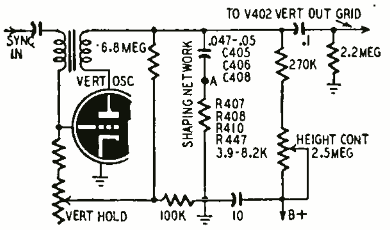
—end—

RETRACE LINES IN ADMIRAL SETS

In weak-signal areas, the best pictures are often obtained by operating the set with contrast reduced and brightness turned up. Under these conditions, several bright retrace lines may be visible in the picture. By feeding a portion of the vertical oscillator voltage to the grid or cathode of the picture tube, the brightness control can be turned up without retrace lines appearing.

On the 20A1, 20B1, 20T1, 20V1, 21A1, 21B1, and similar chassis, connect a 270,000-ohm, ½-watt resistor in series with the lead going from the grid (pin 2) of the picture tube to the junction of the arm of the brightness control and its bypass capacitor (see *b* in the figure). Connect a .05-µf capacitor from the grid of the picture tube to the junction of wave-shaping network shown at *a*.

On the 24D1, -E1, -F1, -G1, and -H1 chassis, connect the 270,000-ohm resistor as shown at *b*. Reverse the connections of the vertical wave-shaping network (R410 and C406) so the capacitor connects to the grid of V402 and the resistor connects to ground. Connect a .05-µf capacitor from the grid of the picture tube to the junction of R410 and capacitor C406 to the wave-shaping network as described in the paragraph above.



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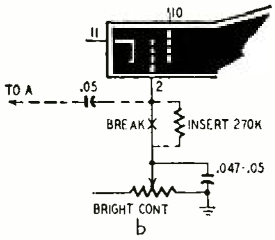


b

Diagrams of typical Admiral vertical oscillator and brightness-control circuits. Pertinent codes used in the models discussed are:

C405—Models 20A1, -B1, -T1, 20V1 and 21A1.
C406—Models 24D1, -E1, -F1, -G1, and 20H1, and 21B1.
C408—Models 20X1, 20Y1 and 20Z1.
R408—Models 20A1, 20B1, and 21A1.
R410—Models 24D1, -E1, -F1, -G1, and 24H1.
R447—Models 20X1, 20Y1, and 20Z1.

To modify the 20X1, 20Y1, and 20Z1, connect the 270,000-ohm resistor as shown at *b* in the illustration. Replace the 3,900-ohm vertical wave-shaping resistor (R447) with an 8,200-ohm, ½-watt unit. Connect a .05-µf capacitor between the grid of the picture tube and the junction of C408 and R447.

In the 30A1, 30B1, and 30D1 chassis, insert a 47,000-ohm, ½-watt resistor in series with the lead from the cathode (pin 11) of the picture tube to the arm of the brightness control and the cathode bypass capacitor C325. Connect a .05-µf capacitor between the cathode of the picture tube and the green lead of the vertical output transformer.—*Admiral Radio & TV Service Bulletin*

BLOWN FUSES IN SENTINELS

Blown fuses may be encountered in the Sentinel models 438, 439, 440, 441, 443, and 446 using chassis marked YA, YB, YC, and YD. Take a look at the 1-inch-long No. 8 self-tapping screw which holds the back to the chassis near the interlock plug. This screw may be long enough to short to one of the filament pins of the 6W4 or 6BY5-G rectifiers. If so, you can eliminate the condition by placing a ⅛-inch washer or washers under the head of the screw. If the set has a 2½-ampere Slo-Blo fuse, replace it with a 3-ampere Slo-Blo unit.

A few chassis have a ½-ampere Slo-Blo fuse in the secondary circuit of the power transformer. If the screw touches the rectifier socket on this type chassis, the ½-ampere fuse will not blow. Check this possibility if the power transformer overheats.—*Sentinel Service Bulletin*

ASTORIA (R. H. MACY) 816

I had difficulty with horizontal sync phase at the 6AL5 phase detector tube. The picture was split down the middle by a gray bar, and the right and left-hand sides of the picture were transposed. This set has no centering controls. I discovered that the feedback capacitor between the horizontal flyback transformer and the phase detector was leaking under load. It checked O.K. in a capacitor checker with 500 volts on it, but when it was in the set, it allowed enough high voltage to leak through to disturb the comparison voltage at the phase detector. Replacing this capacitor corrected the phase shift.—*G. McVity*

HIGH-VOLTAGE FAILURE

When checking TV receivers for lack of high voltage on the picture tube, it is a good idea to check the setting of the horizontal-drive trimmer capacitor. In many new sets, this trimmer has been turned all the way in to eliminate vertical overdrive lines at the left of the picture. When the receiver ages, there is a lack of horizontal drive on the output tube. This results in little or no high voltage. Sometimes, you may find the trimmer completely shorted to ground.—*Wilbur J. Hantz*

EMERSON 664B (CHASSIS 120133B)

If the horizontal sync is unstable and cannot be corrected by changing the sync amplifier and horizontal oscillator tubes, check the plate voltage at pin 5 of the horizontal oscillator tube. If the voltage is incorrect, check the 150,000-ohm resistor R78 in the plate circuit. This resistor sometimes increases to 200,000 ohms or more. Replacing it with a resistor of the correct value restores the set to perfect operation.—*Peter Hickey*

—end—

THE FUND REACHES $9,274.00

HELP - FREDDIE-WALK FUND

Readers from all over the world—from Spain, Italy, Sweden, and Hawaii, to mention a few spots—are still responding enthusiastically to our appeal for funds to "help Freddie walk." Freddie, the young son of radio technician Herschel Thomason, of Magnolia, Arkansas, was born without arms or legs, and contributions from RADIO-ELECTRONICS readers are largely responsible for making available the means by which he will become a useful member of society when he grows older.

This month the "Freddie" fund reaches a grand total of almost $9,300.00. We are particularly pleased to note two "group" contributions from the members of the U.S. Navy. $72.00 was received from the Enlisted Electronic Technicians of the "U.S.S. Midway," who express the hope that "if our contribution was noticed by other men in the fleet it might instigate further contributions from Navy men in our field of work."

And from Gyro & Battery Repair, 9th Division, "U.S.S. Delta" comes $13.70, with the following note attached: "Everything once it is started should have a purpose. Well, about six weeks before Christmas we started putting odd amounts of change in a large glass jug every time we had a cup of coffee. And everyone knows the Navy drinks coffee pot after pot all day. All this money and no reason, but then the newspaper piece about Freddie was pasted up on the jug. I don't know if we drank 1,370 cups of coffee, but here we are . . ."

Also of special note is a contribution of $17.00 from the Young Women's Society of Christian Service of the Methodist Church of Centralia, Pa., collected through the efforts of Mrs. Larry Minnish, Secretary, who writes they all "want to help a little, most of us having little boys, too."

Contributions are still urgently needed; and no contribution is too small for our notice and acknowledgment. Please continue to send them from time to time whenever you are able. *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, N. Y.

FAMILY CIRCLE CONTRIBUTIONS

Balance as of December 19, 1951	$511.50
Miss Ann Albino, New Haven, Conn.	1.00
Mary Krull, Passaic, N. J.	1.00
Mrs. M. J. Pagliaro, Richmond, Calif.	2.00
Mrs. S. Weinzimer, New York City	2.00
FAMILY CIRCLE Contributions received to January 18, 1952	$517.50

RADIO-ELECTRONICS CONTRIBUTIONS

Balance as of December 19, 1951	$8,594.60
Anonymous, No. Hollywood, Calif.	5.00
Anonymous, Palo Alto, Calif.	1.00
Anonymous, Lake Odessa, Mich.	1.00
Walter J. Bluhm, Jamaica Plain, Mass.	5.00
Dominic & Mary Cacciola, Phila., Pa.	1.00
V. L. Daniels, W9IZL, Racine, Wisc.	5.00
Meyer Dumanis, New York City	6.00
Enlisted Electronic Technicians of the U.S.S. Midway, c/o F.P.O., New York City	72.00
William Evans, Jr., McLean, Va.	1.00
A Friend, Knoxville, Tenn.	1.00
Friends of Freddie, Worcester, Mass.	2.00
Lt. Louis J. Frketic, c/o F.P.O., New York City	2.00
Gyro & Battery Repair, 9th Division, U.S.S. Delta, c/o F.P.O., San Francisco, Calif.	13.70
C. T. Haley, Chicago, Ill.	1.00
Johan Jensen, Goteborg, Sweden	1.00
William F. Klein, St. Louis, Mo.	5.00
Harry Khosrofian, Washington, D. C.	1.00
John L. Knoerl, Buffalo, N. Y.	1.00
C. J. Laramie, Marquette, Mich.	2.00
"Merry Christmas from out Texas"	.20
Morris Moses, Baldwin Township, Pittsburgh, Pa.	5.00
Joe Rackey, Milwaukee, Wisc.	1.00
Gray Trembly, Somerville, Mass.	10.00
G. Carrol Utermahlen, W3HVD, Baltimore, Md.	1.00
Mr. & Mrs. David W. Wothe, Green Bay, Wisc.	1.00
Young Women's Society of Christian Service, Centralia Methodist Church, Centralia, Penn.	17.00
RADIO-ELECTRONICS Contributions	$8,756.50
FAMILY CIRCLE Contributions	517.50
TOTAL RECEIPTS to January 18, 1952	$9,274.00

THE PRICES SPEAK FOR THEMSELVES!

RADIO & TV TUBES

At Better Than 50% Off List Price!

STANDARD BRANDS — FULLY GUARANTEED

OZ4	$ .77	6SG7	.94
1A5G9	.94	6SH7	1.04
1A7GT	1.03	6SJ7GT	.77
1B3GT	1.27	6SK7GT	.84
1H5GT	.77	6SL7GT	1.14
1LA6	1.27	6SN7GT	1.04
1LB4	1.27	6SQ7GT	.69
1LC5	1.27	6SS7	.94
1LC6	1.27	6T8	1.39
1LD5	1.27	6U5	.94
1LE3	1.27	6V6GT	.94
1LH4	1.27	6W4GT	.84
1LN5	1.27	6X4	.69
1N5GT	.94	6X5GT	.69
1Q5GT	1.27	7A5	1.04
1R5	.94	7A8	.84
1S4	1.03	7B4	.84
1S5	.84	7B5	.84
1T4	.94	7B6	.84
1T5GT	1.27	7B7	.84
1U4	.94	7C5	.84
1U5	.84	7C6	.84
1X2	1.27	7F7	1.04
3Q4	1.04	7F8	1.54
3Q5GT	1.14	7Q7	.84
3S4	.94	7Y4	.84
3V4	.94	12AH7GT	1.27
5T4	1.16	12AL5	.94
5U4G	.69	12AT6	.69
5V4G	1.14	12AT7	1.39
5W4	.77	12AU7	1.14
5Y3GT	.52	12AX7	1.14
5Y4G	.69	12BA6	.84
6A7	1.04	12BE6	.84
6A8GT	1.04	12J5GT	.69
6AB4	.94	12K7GT	1.04
6AB7	1.56	12SA7GT	.84
6AC7	1.39	12SF5	.94
6AG5	1.27	12SF7	.94
6AG7	1.54	12SG7	.94
6AH6	1.89	12SJ7GT	.77
6AK5	1.89	12SK7GT	.84
6AL5	.94	12SL7GT	1.14
6AL7GT	1.27	12SN7GT	1.04
6AQ5	.94	12SQ7GT	.77
6AQ6	.84	12SR7	1.04
6AQ7GT	1.14	14A7	1.04
6AS7G	3.98	14B6	1.04
6AT6	.69	14Q7	1.04
6AU6	.84	19BG6G	2.94
6AV6	.69	19T8	1.39
6AX5GT	.77	25A6	1.27
6BA6	.84	25L6GT	.84
6BE6	.84	25W4GT	.94
6BG6G	2.32	25Z5	.77
6BC5	.94	25Z6GT	.69
6BH6	.94	35A5	.84
6BQ6GT	1.54	35L6GT	.84
6C4	.77	35W4	.62
6C5GT	.77	35Y4	.84
6C6	1.04	35Z3	.84
6CD6G	2.94	35Z5GT	.62
6D6	1.04	41	.94
6E5	1.04	42	.94
6F5GT	.77	43	.94
6F6GT	.77	45	.94
6H6GT	.84	47	1.39
6J5GT	.69	50A5	1.04
6J6	1.39	50B5	.94
6J7GT	.94	50L6GT	.77
6K6GT	.77	75	.77
6K7GT	1.04	76	.77
6L6G	1.72	77	.94
6N7GT	1.14	78	.94
6Q7GT	.84	80	.61
6SA7GT	.84	117L7GT	1.89
6SC7	.94	117N7GT	1.89
6SF5GT	.84	117Z3	.69
6SF7	.94	117Z6GT	1.14

100 ASSORTED TUBULAR CONDENSERS

All Are Standard Brands
All Are Desirable Sizes

$15.00 Value

Only **$4.69**

100 ASSORTED ½ WATT RESISTORS

Just what you use in Radio & TV Repairs.

$12.00 Value

Only **$3.97**

100 ASSORTED PILOT LIGHTS — $4.83

#44, 46, 47 & 51 ....only

100 ASSORTED SOCKETS — 3.92

Octal, Loctal & Miniature, only

100 ASSORTED KNOBS — 2.97

Screw & Push-on ....only

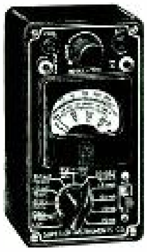
TV CONDENSERS — 85°— C

.05 MFD	2500 Volts	$.27
.1 MFD	2500 Volts	.29
.05 MFD	3000 Volts	.36
.003 MFD	6000 Volts	.28
.01 MFD	6000 Volts	.37
.05 MFD	6000 Volts	.39
.0005 MFD	7500 Volts	.29
.005 MFD	7500 Volts	.32
.003 MFD	7500 Volts	.34
.03 MFD	7500 Volts	.39

Worth 4 times as much, for example the .05-6000V condenser lists for $1.60.

TUBE CARTONS in Lots of 100

SMALL PEANUT	1"x1"x2⅛"	$ .89
LARGE PEANUT	1"x1"x2¾"	.98
GT TYPE	1¼"x1¼"x3⅜"	1.06
SMALL G	1½"x1½"x4½"	1.39
LARGE G	2"x2"x5"	1.59
EXTRA LARGE	2¼"x2¼"x6½"	2.97



SUPERIOR POCKET SIZE VOLT-OHM MILLIAMMETER

SENSITIVITY—1000 ohms PER VOLT
SIX—A.C. VOLTAGE RANGES 0-15/30/150/300/1500/3000 volts
SIX—D.C. VOLTAGE RANGES 0-7.5/15/75/150/750/1500 volts
FOUR—D.C. CURRENT RANGES 0-1.5/15/150 MA 0-1.5 Amps
TWO—RESISTANCE RANGES 0-500 Ohms 0-1 Megohm
PLASTIC CASE—3⅛ x 5⅞ x 2¼"

Complete with batteries, test leads, instructions and factory guaranty. **$14.90**

PM SPEAKERS (ALNICO #5)

Brand New Factory Guaranteed Stock
1 oz. mag. on 3" to 6", heavier mag. on 8" & 12"

3"	$ .98	6"	1.98
4"	1.29	8"	3.97
5"	1.49	12"	6.94

$5.00 SAPPHIRE PHONO NEEDLE	$.58
WEBSTER 3-SPEED CHANGER	24.96
PHONO MOTOR, 78 RPM, complete	3.18
PHONO MOTOR, 78, 45, 33 RPM	4.97
UNIVERSAL PICKUP, 78, 45, 33 RPM	4.63
FAMOUS MAKE CRYSTAL PICKUP	2.44
CRYSTAL CARTRIDGE, popular type	1.42
PHONO AMPLIFIER, incl. 3 tubes	3.87
BROOKS INVERTER, DC to AC, 50 W	8.95
QUALITY STAND MICROPHONE	5.76
GRILL CLOTH, gold, 14" x 13"	.49

LATEST 1952 MODEL RADIOS Complete Ready to Play

DEWALD—ROUND THE WORLD PORTABLE — $39.84
3-Way, A.C.-D.C. & Batteries.
3-Bands, Broadcast, Short Wave, Foreign.
Beautiful leatherette case, whip antenna

STANDARD BRAND RADIO 5-TUBE SUPER, TABLE-MODEL — 14.32
A.C.-D.C. built-in antenna.
Streamlined plastic cabinet in Walnut or Ivory.

STANDARD BRAND RADIO WITH SESSIONS CLOCK — 18.97
Goes ON & OFF automatically.
Style, Quality & Performance

OUTPUT TRANSFORMER (50L6)	$.36
OUTPUT TRANSFORMER (6K6)	.52
UNIVERSAL OUT. TRANS. (any tube)	.89
IF TRANSFORMER, 456KC	.49
IF TRANSFORMER, FM-10.7MC	.58
VARIABLE COND., 2 gang, super	.59
VOL. CONT. L/S, ¼, ½, 1, 2 meg.	.24
VOL. CONT. W/S, ¼, ½, 1, 2 meg.	.47
AC-DC OVAL ANTENNA LOOPS	.19
ANTENNA HANK, 15' on handy spool	.08
RESISTANCE CORD, 150 ohms	.19
6' LINE CORD, complete with plug	.16

CUSTOM-BUILT AUTO RADIOS

FORD..... 1949-50-51	PLYMOUTH 1949-50-51
DODGE...... 49-50-51	CHEVROLET. 49-50-51
STUDEBAKER.. 50-51	HUDSON.. 48-49-50-51
HENRY J........ 51	

All List at $59.95

Your Price . . . (Any Model) Complete ready to install Including Easy Instructions.. **$36.97**

AUTO ANTENNA, fits all cars $2.49

1 POUND ROSIN CORE SOLDER	$.59
UNIVERSAL BALLAST TUBES, (3)	1.18
67½ V. BATTERY, 3⅝" x 2¾" x 1⅜"	1.69
TOGGLE SWITCH, DPDT	.46
SELENIUM RECTIFIER, 75 mills	.59
SELENIUM RECTIFIER, 100 mills	.69
300 OHM TWIN-LEAD WIRE, 100'	1.98
TV POWER TRANSFORMER, 295 ma	6.11
72 OHM CO-AX CABLE WIRE, 100'	4.84
TV TABLE ANTENNA	1.99
TV WINDOW ANTENNA, Gyro Tenna	4.97

BROOKS RADIO & TV CORP., 84 Vesey St., Dept.A, New York 7, N.Y.

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.

MARCH, 1918 ELECTRICAL EXPERIMENTER

President's Speech to World Via Cable and Radio
How U-Boats Send Radio 1,000 Miles, by H. Winfield Secor
A War-Time Suggestion To Radio Amateurs, by Howard S. Pyle, U.S.N.
Women Now Study Wireless
An Exceptional Amateur Radio Station
Visiting Arlington via the Talo Club, by W. J. Howell
The Design and Use of the Wave-Meter, by Morton W. Sterns
"Secret Service" Pocket Radio Receptor, by Harry E. Fuchs
Hy-Tone Tester for Minerals and Code Practice, by Curtis Kissell
The How and Why of Radio Apparatus, by H. Winfield Secor
A Good Substitute for a Practice Buzzer, by Paul G. Watson
An Improved Radiophone Arc Gap, by Seefred Bros.

AUDIO FEEDBACK DESIGN

A number of readers have asked for a list of reference texts to supplement the series of articles which appeared in RADIO-ELECTRONICS between October, 1950, and November, 1951. There is, unfortunately, no book which I would recommend that the average reader buy just for its treatment of negative feedback. If there had been, the series of articles would not have been presented. The books mentioned below are not being condemned when I say this, because they do not claim to deal exclusively with negative feedback, which occupies only the place taken by bread on Falstaff's bill at the inn. Examine these books and decide for yourself whether they contain too much mathematics, and whether the other material in them is what you want.

The following list is not complete. These are only the books in my office, on my desk at home, or remembered from past reading.

1. **Network Analysis and Feedback Amplifier Design**, H. W. Bode: Van Nostrand. Bode knows more about feedback than most of us will ever want to know. This book was planned as a course of lectures to Bell Laboratories engineers and I would say was for "college graduates only."

2. **Radio Engineers Handbook**, F. E. Terman: McGraw-Hill. The handbook seems to me to be a better value for the money than Terman's *Radio Engineering*. Feedback is dealt with in two instances—under circuit theory, pp. 218-

226, and under amplifiers, pp. 395-406. I do not like the "Bode Step" design discussed in the first section, because it seems too complicated for the noncritical audio problems. The treatment, on page 401, of the response peaks is definitely misleading, because the responses shown are only just stable.

3. **Reference Data for Radio Engineers** (3rd Ed.). Federal. This is worth $3.75 of anybody's money. Feedback is discussed on pages 256-261 and (for the long-haired ones) on pages 533-545.

4. **Vacuum Tube Circuits**, L. B. Arguimbau: Wiley. This book contains a very clear discussion of the effect of feedback on the amplifier impedances.

5. **Vacuum tube Amplifiers**, Valley and Wallman: Radiation Lab Series, McGraw Hill. Deals mostly with bandpass amplifiers.

6. **Electronic Instruments**, Companion volume to the above (5). Contains a short discussion of the template method described in the Radio-Electronics series.

7. **Radio Receiver Design, Vol. II (Low Frequency)**, K. R. Sturley: Wiley. This book has a good reputation. Sturley is head of the BBC training department.

In addition to the above books, and a number of others, some of the following articles should help the reader. The *Proceedings of the I.R.E.* paper is a good general survey, with a number of references. The *Wireless Engineer* papers (W.E.) are rather mathematical, the *Wireless World* papers (W.W.) are the easiest reading.

"The Stability Problem in Feedback Amplifiers," W. A. Lynch: *Proc. I.R.E.* Vol. 39, p. 100, September, 1951.

"Audio Amplifier Damping," R. M. Mitchell: *Electronics*, Vol. 24, No. 9. p. 128. September, 1951.

"Relations between Attenuation and Phase in Feedback Amplifier Design," H. W. Bode: *Bell System Technical Journal*, XIX, 421, July, 1940.

"When Negative Feedback Isn't Negative," "Cathode Ray": *W.W.* LV, 189, May, 1949.

"Output Impedance Control," T. Roddam: *W.W.* LVI, 48, February, 1950.

"Negative Feedback: Its Effect on Input Impedance and Distortion," E. Griffiths: *W.W.* LVI, III, March, 1950.

"More About Positive Feedback," T. Roddam: *W.W.* LVI, 242, July, 1950..

"Stabilizing Feedback Amplifiers," T. Roddam, *W. W.*, LVII, 112, March, 1951.

"Negative-Feedback Amplifiers: Conditions for Maximal Flatness," C. F. Brockelsby: *W. E.*, XXVI, 43, February, 1949.

"Feedback Amplifier Design," H. Mayr: *W. E.*, XXVI, 297, September, 1949.

"Feedback Amplifiers and Servo Systems," E. E. Ward: *W. E.*, XXVII, 146, May, 1950.

"Negative-Feedback Amplifiers: Conditions for Critical Damping," J. E. Flood: *W. E.*, XXVII, 201, July, 1950.

"Amplifier of Variable Output Impedance," R. Yorke and K. R. McLachlan: *W. E.*, XXVIII, 222, July, 1951.

"Amplifier Characteristics at Low Frequencies," G. W. Edwards and E. C. Cherry: *Journal of the Institution of Electrical Engineers Proc. W. Section* 15, 204, September, 1940.

"Some Considerations in the Design of Negative-Feedback Amplifiers," W. T. Duerdoth: *J.I.E.E.*, Vol. 97, III, 138, May, 1950.

Finally, for the armchair rather than the desk:

The Human Use of Human Beings, and *Cybernetics*, both by Norbert Wiener: Houghton Mifflin.

Even if you do not agree with Wiener, he will make you think about the implications of feedback in economics and politics. And if you won't take an interest . . .—*George Fletcher Cooper*

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.

RADIO-TV CATALOG

The new 1952 Catalog No. 86 has been issued by Radiolab. Comprising 118 pages, the issue features a wide variety of ham equipment, communications receivers, tubes, test equipment, TV and sound equipment, books, tools, and TV antennas.

Gratis from Radiolab, 1608-14 Grand Ave., Kansas City 8, Mo.

DIAGRAM AID

A four-page bulletin giving tips to the technicians on how to get more efficiency in consulting diagrams has been put out by Supreme Publications. Also included is a list of the various manuals issued by them.

Gratis from Supreme Publications, 3727 W. 13th St., Chicago 23, Ill.

RADIO-TV CATALOG

The 1952 catalog of Edlie Electronics, Inc., features a wide variety of parts, accessories, test equipment, sound units, auto sets, books, and antennas.

Gratis from Edlie Electronics, Inc., 154 Greenwich St., New York 6, N. Y.

WINDOW-SIZE BLOWUP

"Are Servicemen Gyps?" is the title of a blowup of the advertisement on page 17 of this issue, currently being offered to service technicians by Sprague Products Co., for exhibition in their windows.

The text deals with the customer who protests a television repair bill while accepting without comment much larger bills from his garageman, and the complaints from persons in fringe areas who expect excellent reception, or those in better areas who have bought bargain sets and are getting reception that is no bargain. It ends with an exhortation directed at the service technician's customer and is signed by the president of the company.

Available from Sprague Products Co., North Adams, Mass., for 10 cents to cover costs.

METALLIC RECTIFIER BOOKLET

Radio Receptor Co. has issued a 16-page booklet reviewing the background of metallic rectifiers and clarifying the various applications factors with many drawings, diagrams, and charts. It is useful to the engineer with specialized experience as well as to the novice.

Copy gratis from Radio Receptor Company, Inc., Seletron Rectifier Division, 251 West 19th St., New York 11, N. Y.

TUBE SUBSTITUTION GUIDE

The first supplement of Receiving Tube Substitution Guide Book, by H. A. Middleton, is now available. Wiring instructions and illustrations cover 750 tube substitutions in AM-FM-TV receivers. The supplement contains 48 pages, 8½ x 11 inches, and is bound with a heavy cover.

John F. Rider Publisher, Inc., 480 Canal St., New York 13, N. Y., or any of the organization's distributors. Price 99¢.

RIDER HAS NEW FOLDERS

A new TV schematic folder service is announced by John F. Rider Publisher, Inc., with the issuance of the TEK-FILE. Each TEK-FILE (to be issued monthly) is in a box containing a number of folders of alphabetically arranged TV schematics. The makeup of the new service is similar to the Rider Manuals in organization and emphasis on servicing details. Each pack has at least 128 8½ x 11-inch pages.

The files contain factory authorized information, circuit action descriptions, unpacking and installation data, trouble-shooting waveforms, production changes, alignment data, chassis views, and voltage and resistance readings. Included in the pack is an index of manufacturers and model numbers. A TEK-FILE cumulative index is available for dealers from Rider distributors.

LABORATORY INSTRUMENTS

Polarad is issuing its new enlarged catalog on laboratory instruments, including all-band spectrum analyzers, and microwave signal sources.

Available from Polarad Electronics Corp., 100 Metropolitan Avenue, Brooklyn 11, N. Y. Gratis.

REPLACEMENT NEEDLE GUIDE

Recoton is issuing a 17-page replacement needle guide containing handy needle charts and manufacturers' cross index. Punched for binder insert.

Available from Recoton Corp. 25 4th Ave., New York, N. Y. Gratis.

—end—

Douglas Y. Smith, a veteran of almost 25 years of service in the engineering, merchandising, and sales activities of RCA, was promoted to manager of sales operations for the Tube Department, according to an announcement by L. S. Thees, general sales manager of the department. Mr. Smith was most recently plant manager of the Tube Department's Lancaster, Pa., plant. Earl M. Wood, former manager of manufacturing at Lancaster, succeeds Mr. Smith as plant manager.


D. Y. SMITH

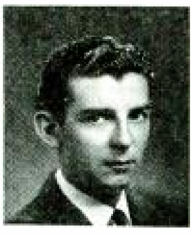
Wickham Harter, sales manager of Mechanical-Electronic Products of the Centralab Division of Globe-Union Inc., Milwaukee, died of a heart ailment in St. Mary's Hospital, Milwaukee, at the age of 58. Mr. Harter was a pioneer sales executive in the radio field and at one time vice-president of Solar Manufacturing Co. He was a member of the Sons of the Revolution and the Princeton Club of New York.


W. HARTER

Floyd J. Van Alstyne was appointed jobber sales manager of Permoflux Corp., Chicago. He will direct the sales of loudspeakers, baffles, headsets, and other jobber items manufactured by Permoflux. Also announced was the appointment of Howard Roth, Eugene Roeske, and George Adams as industrial sales representative, head of the New Transformer Core Division and factory superintendent, respectively. Mr. Roth came to Permoflux from American Steel and Wire; Mr. Roeske from S & C Electric Co.; and Mr. Adams from RCA.


F. J. VAN ALSTYNE

John Giltner Twist, former assistant sales manager of the Capacitor Division of Sangamo Electric Co., was promoted to sales manager of the division at Marion, Ill. William W. Taylor was named sales promotion manager of the division.


W. W. TAYLOR


J. G. TWIST

OPPORTUNITY AD-LETS

Rates—35¢ per word (including name, address and initials). Minimum ad 10 words. Cash must accompany all ads except those placed by accredited agencies. Discount for 6 issues, 10%, for 12 issues, 20%. Misleading or objectionable ads not accepted. Copy for May issue must reach us before March 21, 1952.
Radio-Electronics, 25 W. Broadway, New York 7, N. Y.

RADIO Officers, $7,200-$10,000 annual earnings, top union conditions, 6 months Radio Operating experience US Merchant ships on FCC License since Jan., 1935, can get emergency FCC License to sail at once. Also experienced USN Radiomen with 2d class Radiotelegraph license plus 6 months sea Radio time. Phone, write, wire. American Radio Association, CIO, 5 Beekman St., New York. CO 7-6397.

SPEAKERS REPAIRED at wholesale prices. Guaranteed workmanship. Fast service. Amprite Speaker Service, 70 Vesey St., New York 7, N. Y.

SEND ME A BUCK; I'll send you my book—RAPID RADIO REPAIR. John D. Burke, 88-14 168th Street, Jamaica 3, N. Y.

MINIATURE RADIO, weight 8 oz. with batteries. Write for prices. Also plans all wave radio using hearing aid parts. 25¢. Glen Ecker, 10 East Orange Grove, Pasadena, California.

USED BUT EXCELLENT SNAIDER AUDITORIUM 20x26 Projection TV. List $1495.00. Sacrifice $398.00. Details. Forcier, Essex, Middleton, Mass.

WE REPAIR, EXCHANGE, SELL, ALL TYPES OF electrical instruments, tube checkers and analyzers. Hazleton Instrument Co. (Electric Meter Laboratory), 128 Liberty Street, New York, N. Y. Telephone—BArclay 7-4239.

FIVE ONE-TUBE "LOUDSPEAKER" RADIO CIRCUITS 25¢. Radio Kit price list with each order. Master Kit Company, Post Office Box 206, Belleville, Ontario, Canada.

WANTED RG-8-U, RG-11-U, RG-59-U COAXIAL Cable; any lengths, any quantities. Write: Television Service Co., 249 North 48 St., Lincoln, Nebr.

AMATEURS — RADIO ENGINEERING QUESTIONS answered $1.00. With Schematics $2.50. Henry Twillmann, RR. #1, Chesterfield, Missouri.

TV AND FM ANTENNAS. YAGI, CONICAL, BOW-TIE. Mounts accessories. Lowest prices. Wholesale Supply Co., Lunenburg 2, Mass.

20' TELEVISION TOWER, AMERICA'S FAVORITE "TUFFY" now lists at $29.95 complete with saddle hinged mount. Easy to erect, safe to climb, may be made 40' by telescoping pipe through tower. (Cartoned). Youngstown Steel Towers Co., 1825 Wilson Ave., Youngstown, Ohio.

Personnel notes

. . . **Robert E. Lee** was appointed assistant manager of the cathode-ray tube operations of GENERAL ELECTRIC'S Tube Department at Schenectady, N. Y. He was formerly manager of finance for the department. Other Tube Department promotions include S. Norman Crawford, designing engineer for power electronic equipment; C. Curtis Herskind and Walter R. Kettenring, section engineers.

. . . **Albert A. La Pointe**, vice-president of LA POINTE-PLASCOMOLD CORP., Windsor Locks, Conn., died in West Hartford, Conn.

. . . **John J. Doyle** was appointed manager of power tube sales for the Electronic Tube Division of WESTINGHOUSE at Elmira, N. Y.

. . . **John M. McGuire** joined NATIONAL UNION RADIO CORP. as district manager for the up-state New York territory of the Renewal Sales Division. He previously held a sales position with the General Electric Credit Corp.

. . . **Manfred E. Philip** was appointed controller and director of purchases for TELREX, INC., Asbury Park, N. J. He was formerly with a firm of certified public accountants.

. . . **S. I. Neiman** and **Kenneth C. Prince** were named executive secretary and general counsel, respectively for RADAR-RADIO INDUSTRIES of Chicago, a trade group of radio, television, and parts manufacturers engaged in defense work.

. . . **J. E. O'Donnell** was named to the post of Chicago warehouse manager of the WALTER L. SCHOTT CO., Los Angeles.

. . . **J. A. Myers, Jr.**, and **P. E. Coolbaugh** were appointed departmental sales managers for the CHICAGO TRANSFORMER DIVISION of the ESSEX WIRE CORP. Mr. Myers will be responsible for broadcast and transmission equipment and Mr. Coolbaugh for radio, television, and industrial equipment.

. . . **Thomas M. Blake**, vice-president and treasurer of LITTELFUSE, INC., Chicago, has written a treatise, "Formula for Peace," which he has published in booklet form at his own expense. The booklet is available free upon request from Mr. Blake.

. . . **H. A. Gumz**, production manager of WEBSTER-CHICAGO, was named vice-president of the firm.

. . . **Leon B. Ungar**, vice-president and general manager of UNGAR ELECTRIC TOOLS, INC., was elected chairman of the Los Angeles Council of the West Coast Electronic Manufacturers Association.

. . . **Warren E. Albright**, former manager of the General Materials Division of RCA's Home Instrument Department, was appointed general plant manager of the department.

. . . **H. S. Zebley** joined SNYDER MANUFACTURING Co., Philadelphia, as sales manager of the Military Division. Ben Henig joined Snyder as sales representative of the same division. Mr. Zebley was formerly with Major Distributing Co., and Mr. Henig with U.S. Metal Products Co.

—end—

CONVERSIONS DANGEROUS?

Dear Editor:

No technician has any business making any major changes in a radio or TV. Converting to bigger picture tubes, u.h.f., or color is the manufacturer's business, not the technician's. In a good many cases the manufacturer is wisely shying away from it, yet the technician, with very limited technical and financial resources, steps in and undertakes these conversions. "Television technicians rush in where angels fear to tread," or something to that effect!

Purpose of this letter is to ask you to put a headnote on these conversion articles warning that when, as and if the conversion jobs start coming back a few months or a year from now, the technician may be faced with a choice, either to make good and go bankrupt, or to deny paternity and leave the customer with an orphan on his hands, to work out his own salvation as best he can.

The garageman confines his activities to replacing worn or broken parts with exact duplicates, and if he does make any major changes it is with the authority of, and with parts furnished by, the manufacturer. He believes in "Cobbler stick to your last."

If the television man will do likewise, all will be well. That is, confine his activities to replacing defective parts with exact duplicates. Leave research, radio engineering and experimentation and the headaches and financial losses that go with them, to the manufacturer who has a special department to handle all that and a way of collecting for its maintenance!

CLARENCE J. RICHARDSON

Buffalo, N.Y.

(The above represents the highlights of a carefully written but very long letter, which covered a number of details and brought up supporting arguments for the statements made. Our set conversion specialists will no doubt be interested. Comment is invited. —*Editor*)

BENEFICIAL DISTORTION

Dear Editor:

It has come to my attention recently that my use of the word "distortion" in my November article on the Baldwin Electronic Organ has been misinterpreted (either deliberately or through ignorance) by rival sales organizations, and used for attacks on the Baldwin.

As I clearly stated in that article and the two following ones, the special kind of "distortion" referred to was Baldwin's deliberate changes in the shapes of sawtooth waves, using formant filters. As any technician must have understood, and as anyone who has ever heard the Baldwin knows, the results, far from being deleterious, are a wide variety of tones so like those of a pipe organ and so pleasing in musical quality that it is often hard to believe that there are no pipes!

I know you would not want the magazine quoted incorrectly, especially when it can unfairly harm a high-quality product. I hope you will publish this letter, therefore, to assure anyone who may have been misled that sometimes "distortion"—at least the kind I described—is good, not bad. To misquote a phrase myself, "What's an amplifier's poison may be an electronic organ's meat!"

R. H. DORF

New York, N. Y.

WORST TYPE OF TVI?

Dear Editor:

Your magazine has devoted hundreds of articles to improving and servicing TV receivers. Included among them have been many about television interference. But nobody has yet done anything about the most important television interference problem existing today. All magazines, books, and other sources that cover TV blithely ignore it.

I refer to the nerve-wracking, insanity-producing *audio* whistle heard on all TV sets. I have heard this high-frequency whistle on practically every set I have been near. Cost of a set is no criterion—they all seem to have it.

You may ask, "Is this a special condition?" No, it isn't. About half the people under 30 are affected by it and complain bitterly about it when asked. Many have specifically stated that the whistle is the reason they will not own a set, even though they desire and can afford to. I assume that much business is lost because of this.

I even dislike visiting friends who own a TV set. This is embarrassing because they can't hear the whistle. (They wouldn't have bought the set if they could!) I have asked children about it. They have indicated that they thought the whistle was part of the program. They hear it, of course, but somehow become oblivious to its effects. (Is this the reason why some claim that kids get groggy listening to a TV set?)

The effect caused by this noise is a splitting headache. Prolonged exposure will cause a headache that will last for days. The fact that most people are to a degree deficient in hearing and therefore cannot hear this 15,750-cycle note, is no reason for the rest of us to suffer. I am against TV till this most important difficulty is solved and cured (for new sets and old alike). Can you include an article on this in your magazine? Can any of your readers find a cure?

LEO W. MAKI

Los Angeles, California

LET'S HAVE MORE THEORY

Dear Editor:

Your recent series "Audio Feedback Design" and your articles on electronic brains were very stimulating. Let's have more of this sort of theory—it makes fine material for the technical readers to sink their teeth into. Keep up the good work!

ALLEN BRUCE

Halifax, Nova Scotia

—end—

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#630 TV KIT BUILDER - SET OF INSTRUCTIONS

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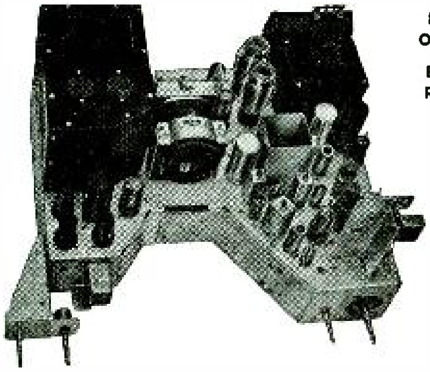

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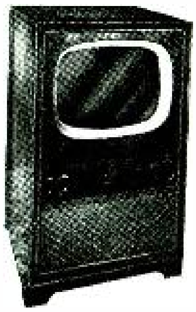

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THE NEW YORKER
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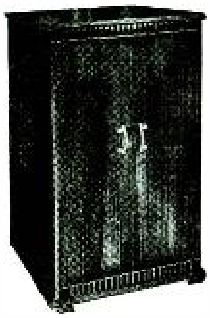
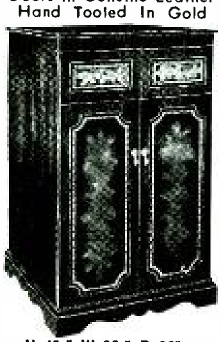


H-42", W-26", D-24"
$96.87

THE WINDSOR
Aristocrat of Cabinets Doors in Genuine Leather Hand Tooled In Gold



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PHYSICAL PRINCIPLES OF WAVE GUIDE TRANSMISSION AND ANTENNA SYSTEMS, by W. H. Watson. Published by Oxford University Press, 114 Fifth Ave., New York 11, N. Y. 6 x 9½ inches, 207 pages. Price $7.00.

This is an advanced text suitable for physicists and theoretical-minded engineers. It deals with v.h.f. exclusively. Rectangular wave guides are covered in detail. There is also material on various antennas, notably the slot radiator. One chapter describes measurements of frequency, power, standing waves, phase, antenna gain, etc.

Through most of the book, matrix algebra is relied upon to discuss wave phenomena. This method entails less work equation-wise than differential equations, but a knowledge of matrices is presupposed.—*IQ*

AMPLIFIERS, by N. H. Crowhurst. Published by Norman Price (Publishers) Ltd., 283, City Road, London, E.C. 1, England. 5½ x 8½ inches, 64 pages. Price three shillings sixpence.

There has been a gap in audio literature between the practical material on audio amplifier construction, installation and use, and the engineering treatises on theory and design. Evidently that gap exists on the other side of the Atlantic, too, for the author describes this work as a book to fill the gap between *theory* and *practice*.

Explanations of such things as load lines, oscillation, and matching are therefore given in greater detail than in the standard engineering work, but with more of a theoretical slant than the average build-this-amplifier type of book.

Negative feedback is excepted from the theoretical approach, and little explanation of the "why" is given. The "how" is dealt with in considerable detail, making a complete and concise compendium of information on what negative feedback will *not* do, what it will do, and what circuit arrangements will supply it.

In spite of its small size, this book contains more easily accessible information on amplifiers than any other this reviewer has seen.—*FS*

RECORD KEEPING FOR SMALL STORES, by Charles H. Welch and Charles H. Sevin. Printed by the U.S. Government Printing Office, Washington, 25, D.C. 6 x 9 inches, 94 pages. Price 65¢.

A book aimed at persuading the small businessman of the necessity of keeping records and training him to do so. Although it is directed to the retailer rather than to the service type of business, and therefore ignores a whole class of records necessary to the owner of a radio or television service business, its style and approach may make it more valuable than many more inclusive bookkeeping texts. For this is by no means a textbook—it is a straightforward how-to-do-it book intended for the practical man.

Can be ordered from the Superintendent of Documents, Government Printing Office. Contains information worth at least the 65¢ it costs.—*FS*

ADVERTISING INDEX

RADIO SCHOOL DIRECTORY

Page 134

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SHORT-WAVE RADIATION PHENOMENA, by August Hund. Published by McGraw-Hill Book Co., Inc., 330 W. 42 St., New York, N. Y. 6 x 9 inches, 1382 pages. Price $20.00, in 2 volumes (not sold separately).

This work is a comprehensive, modern description of h.f. radiation from 30 mc upward. It is a combination handbook, textbook and guide for self-study. Numerous graphs, equations and tables appear throughout both volumes. The author has spared few details of this subject which he knows so well. Most descriptions are rather lengthy.

The first volume is divided into six chapters. The first touches basic fundamentals in theory and calculation. Reference is made to Ampere's and Faraday's laws, Maxwell's equations, vectors, gradients, curl, etc. Many numerical examples are worked out. The treatment is largely descriptive and without rigor.

Succeeding chapters discuss fields of elementary dipoles, propagation, transmission lines and space radiation. A full chapter is devoted to mathematical methods and their application to electromagnetic problems.

The second volume has three chapters and supplementary material. It continues with a discussion of radiation where obstructions are present, diffraction phenomena, wave guides and cavities. A large appendix covers special math functions and their use. It is easy to find a desired subject in the detailed index, which covers 74 pages. —*IQ*

AUDIO AMPLIFIERS AND ASSOCIATED EQUIPMENT, Vol. 3 (AA-3), compiled and published by Howard W. Sams & Co., Inc., 2201 E. 46th St., Indianapolis 5, Ind. 8 1/2 x 11 inches, 362 pages. Price $3.50.

This manual—the third in the Audio Amplifier series—gives clear, concise technical details on 50 audio amplifiers and over 20 AM, FM, and FM-AM tuners produced by leading manufacturers during 1950. Like the two earlier volumes, this book is a compilation of folders which have been published previously in Photofact sets. It includes detailed photographs, drawings, schematics, parts lists, and voltage and resistance charts.

This volume is a good buy for technicians, custom builders, instructors, and audio enthusiasts who desire detailed information on the latest audio equipment.—*RFS*

GUIDE TO BROADCASTING STATIONS (sixth edition, 1951) Published by *Wireless World*, Dorset House, Stamford St., London, S.E. 1. 4 x 5 1/2 inches, 94 pages. Price two shillings twopence postpaid.

A complete listing of European broadcasting stations by frequency and geographical location occupies the first third of this little book. A listing of shortwave stations of the world—first by frequency, then by geographical location—follows. Other material includes a listing of European television stations, with some operating particulars, and a list of European stations operating above 30 mc. Most of these are frequency modulated.

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R-308	12 VDC	100	2C @ 4 Amps	1.85
R-343	12 VDC	100	1C	2.00
R-826	12 VDC	150	2C, 1B	1.55
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
R-417	5.5 ma	5800	2C	2.50
R-563	60/120 VDC	7500	1A	2/3.10
R-213	5/8 VAC 60 Cy.	....	2A	2.50
R-801	115 VAC	....	NONE	1.45
R-589	12 VDC	125	2A	1.30
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
R-121	150 VDC	5000	2A&1C	2.05
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
R-908	6 VDC	15	4A @ 4 Amps	1.50
R-800	12 VDC	150	2C&1A	1.55
R-537	12/24 VDC	150	2C&1B	2.00
R-750	24 VDC	400	1A	1.60
R-367	10/16 VDC	195	2C	2.50
R-335	20/30 VDC	700	2A, 1C	2.00
R-366	30/120 VDC	4850	1C	2.50

STANDARD TELEPHONE RELAYS

STK. NO.	VOLTAGE	OHMAGE	CONTACTS	UNIT PRICE
R-806	115 VAC	900	1A	$2.05
R-161	6 VDC	10	2B&1A	1.10
R-873	6 VDC	12	3C-3A MICALEX	3.00
R-305	12 VDC	50	2A Split Cerm.	1.35
R-360	24 VDC	200	1C	1.50
R-484	24 VDC	200	2A, 1C	1.35
R-337	24/48 VDC	1200	1A, 2B Split	2.65
R-101	24 VDC	1300	2A	2.50
R-868	30/162 VDC	3300	1C	1.90
R-365	52/162 VDC	3300	4C	3.95
R-518	85/125 VDC	6500	1C	3.60
R-918	52/228 VDC	6500	1C	3.60
R-852	52/228 VDC	6500	1C, 1A	3.00
R-341	75/228 VDC	6500	4C @ 4 Amps	3.65
R-633	180/350 VDC	10,000	1C @ 5 Amps	2.90
R-344	72/300 VDC	11,300	3A, 1B	2.45
R-332	100/350 VDC	40,000	2A	3.50
R-664	110 VAC	...	2B&1A/OCT.SOCKET	2.45
R-667	6 VDC	.75	1B/10AMP. 1A/3AMP.	1.45
R-632	6 VDC	12	5A&1C	3.25
R-154	6/12 VDC	200	1A	1.50
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
R-851	52/228 VDC	6500	1C, 1A	3.00
R-591	6 VDC	40	1B&1C	1.35
R-155	12 VDC	100	4A&4B	1.45
R-520	200/300 VDC	14,000	2C	3.45
R-159	6 VDC	50	2A	1.35
R-158	6 VDC	50	4A Cerm.	1.85
R-381	6/8 VDC	100	1A Split	2.50
R-382	6/12 VDC	200	1B Split	2.50
R-153	12 VDC	200	1C&1A	1.55
R-304	12 VDC	200	4A Split Cerm.	2.50
R-383	6/12 VDC	500	1A Split	2.50
R-385	6/12 VDC	500	1B Split	2.50
R-384	6/12 VDC	500	3A Split	3.00
R-576	12 VDC	200	2A	2.50
R-316	24 VDC	200	1C	1.50

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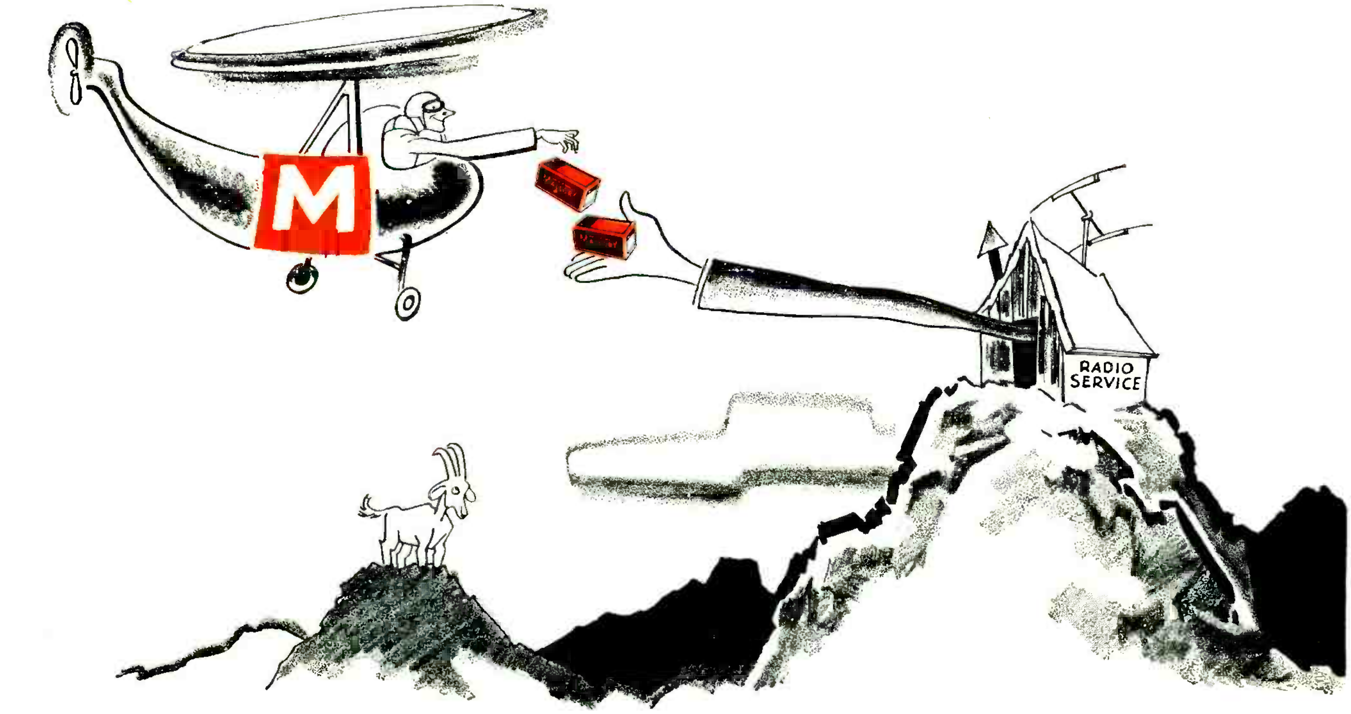

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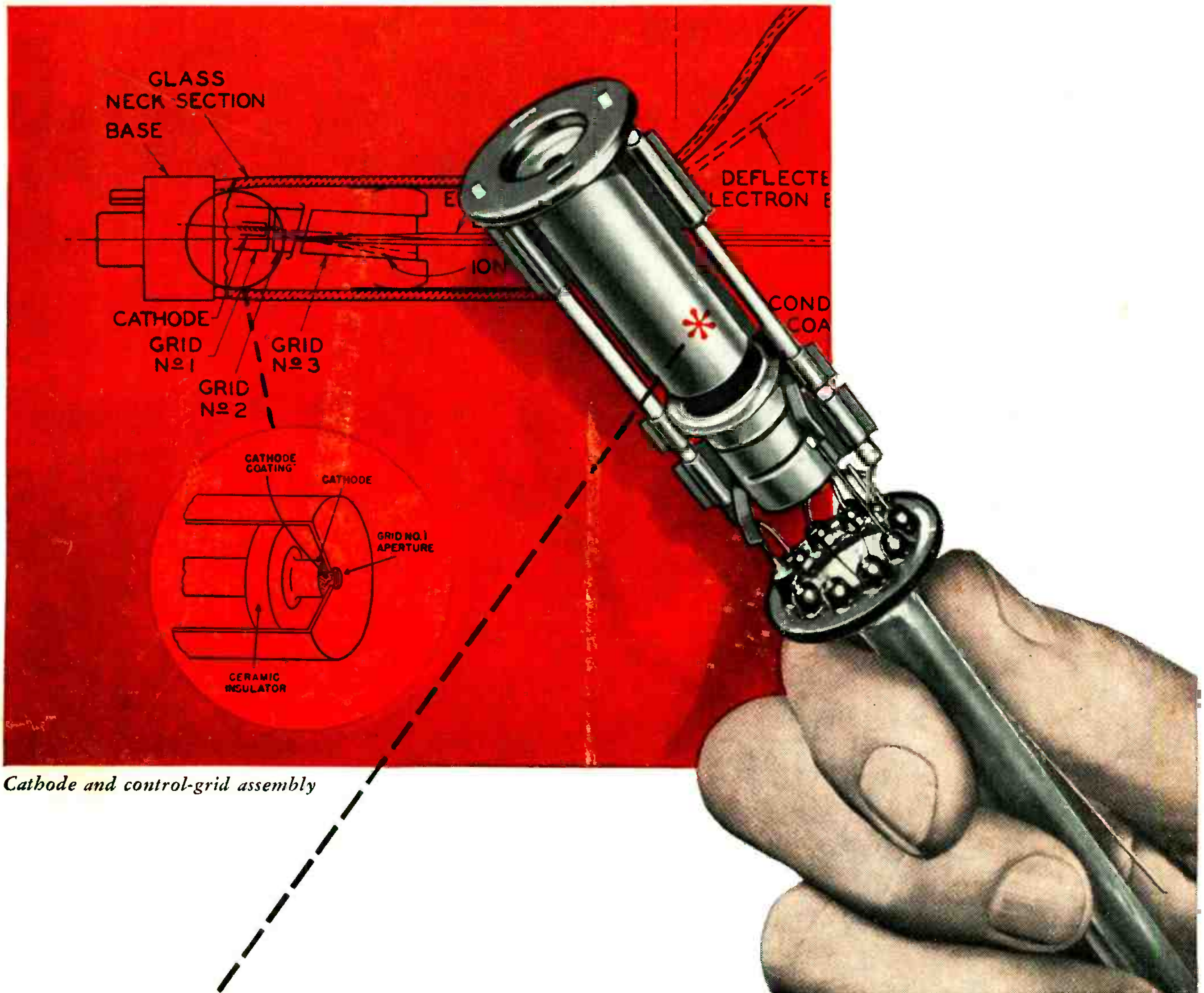

Cathode and control-grid assembly

The gun that looked 100% "perfect" . . . yet never "fired a shot"

The electron gun you see looks perfect, but actually it "never fired a shot." You see, RCA rejected it because the spacing between grid No. 1 and the cathode was out of bounds. Only a 0.001" departure from the design value for this spacing is sufficient cause for gun rejections in RCA factories.

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