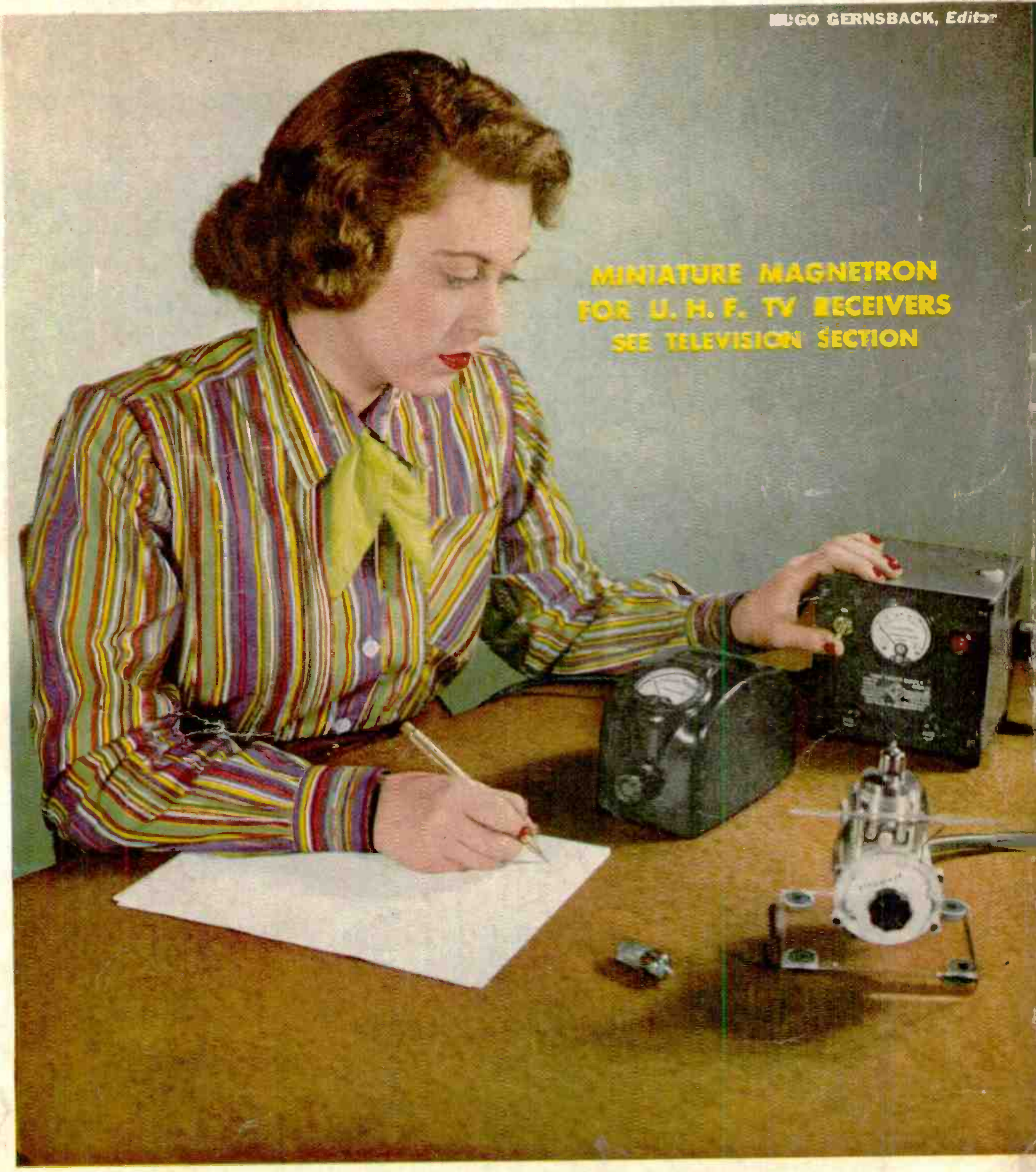
AUGUST 1951

SPECIAL—TV CONVERSIONS

RADIO-ELECTRONICS

LATEST IN TELEVISION • SERVICING • AUDIO



30¢
U.S. and CANADA

In this issue: **More Range for SW Receivers • Improving Table Radios • Versatile Tube Checker**

I Will Show You How to LEARN RADIO-TELEVISION SERVICING OR COMMUNICATIONS by Practicing in Spare Time

YOU PRACTICE RADIO SERVICING

You build the modern Radio shown below as part of my Servicing Course. I send you speaker, tubes, chassis, transformer, loop antenna, everything you see pictured and EVERYTHING you need to build this modern Radio Receiver. Use it to make many tests, get practical experience.

YOU PRACTICE RADIO COMMUNICATIONS

I send you all the parts to build Transmitter shown below as part of my new Communications Course. Conduct actual procedure of Broadcast Operators, practice interesting experiments, learn how to actually put a transmitter on the air.

EXTRA PAY IN ARMY, NAVY, AIR FORCE

Knowing Radio, TV, Electronics can help you get extra rank, extra prestige, more interesting duty at pay up to several times a private's base pay. You are also prepared for good Radio-TV jobs upon leaving service. Mail coupon TODAY.

I TRAINED THESE MEN

"After graduating, worked for servicing shop. Now Chief Engineer of three Police Radio Stations."—S. W. DINWIDDIE, Jacksonville, Illinois.

"While learning, made $5 to $10 a week in spare time. Now have a profitable spare time shop."—L. ARNOLD, Pontiac, Mich.

"I accepted a position as Radio and Television Technician . . . was promoted to manager of Television Service and installation."—L. HAUGER, San Bruno, California.

"Have my own shop. Am authorized serviceman for five manufacturers and do servicing for 7 dealers."—P. MILLER, Maumee, O.

"Four years ago, a bookkeeper on a hand-to-mouth salary, am now a Radio Engineer ABC network."—N. H. WARD, Ridgefield Park, New Jersey.

"When I enrolled, had no idea it would be so easy to learn. Have equipped my shop out of spare time earnings. I am clearing about $40 to $60 a month."—J. D. KNIGHT, Denison, Tex.

I Will Train You at Home with MANY KITS OF PARTS I SEND

Do you want good pay, a job with a bright future and security? Would you like a profitable shop of your own? The fast growing, prosperous RADIO-TELEVISION industry is making these opportunities for you. Radio alone is bigger than ever. 90 million home and auto Radios, 3100 Broadcasting Stations, expanding use of Aviation and Police Radio, Micro-Wave Relay, Two-Way Radio for buses, taxis, etc., are making opportunities for Servicing and Communications Technicians and FCC-Licensed Operators.

Television is TODAY'S Good Job Maker

In 1946 only 6,000 TV sets sold. In 1950 over 5,000,000. By 1954, 25,000,000 TV sets will be in use, according to estimates. Over 100 TV Stations are operating in 35 states. Authorities predict there will be 1,000 TV Stations. This means new jobs, more jobs, good pay for qualified men.

Many Soon Make $10 A Week Extra in Spare Time

Keep your job while training at home. Hundreds I've trained are successful RADIO-TELEVISION TECHNICIANS. Learn Radio-Television principles from illustrated lessons. Get PRACTICAL EXPERIENCE experimenting with circuits common to Radio and Television. Many students make $5, $10 a week extra fixing neighbors' Radios in spare time. Special Booklets start teaching you the day you enroll.

Send Now for 2 Books FREE—Mail Coupon

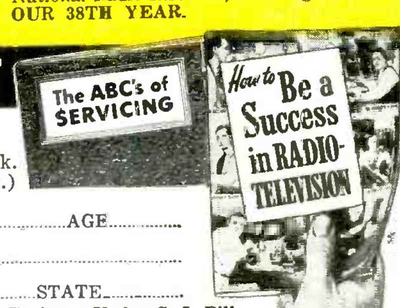
Send for my FREE DOUBLE OFFER. Get actual Servicing lesson. Also get my 64-page book, "How to Be a Success in Radio-Television." Read what my graduates are doing, earning. Send coupon in envelope or paste on postal. J. E. SMITH, President, Dept. 1HF, National Radio Institute, Washington 9, D. C. OUR 38TH YEAR.

NOW! Advanced Television Practice

New, special TV kits furnished to build high-definition SCOPE . . . RF OSCILLATOR with flyback power supply . . . complete TV set . . . many other units. You see pulse, trapezoidal, saw-tooth wave forms. Get valuable PRACTICAL EXPERIENCE locating and correcting TV troubles. Mail coupon for facts, pictures and prices!

A TESTED WAY TO BETTER PAY...MAIL COUPON NOW

Good for Both-FREE



MR. J. E. SMITH, President, Dept. 1HF
National Radio Institute, Washington 9, D. C.
Mail me FREE Lesson and 64-page book. (No salesman will call. Please write plainly.)

NAME...AGE..........

ADDRESS..

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

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RADIO-ELECTRONICS

Incorporating
SHORT WAVE CRAFT* TELEVISION NEWS* RADIO & TELEVISION
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formerly RADIO-CRAFT

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ON THE COVER

Miniature magnetron and tuner, with its power supply and a wavemeter, in a test setup.
Kodachrome original by Avery Slack

August, 1951 RADIO-ELECTRONICS Vol. XXII, No. 11

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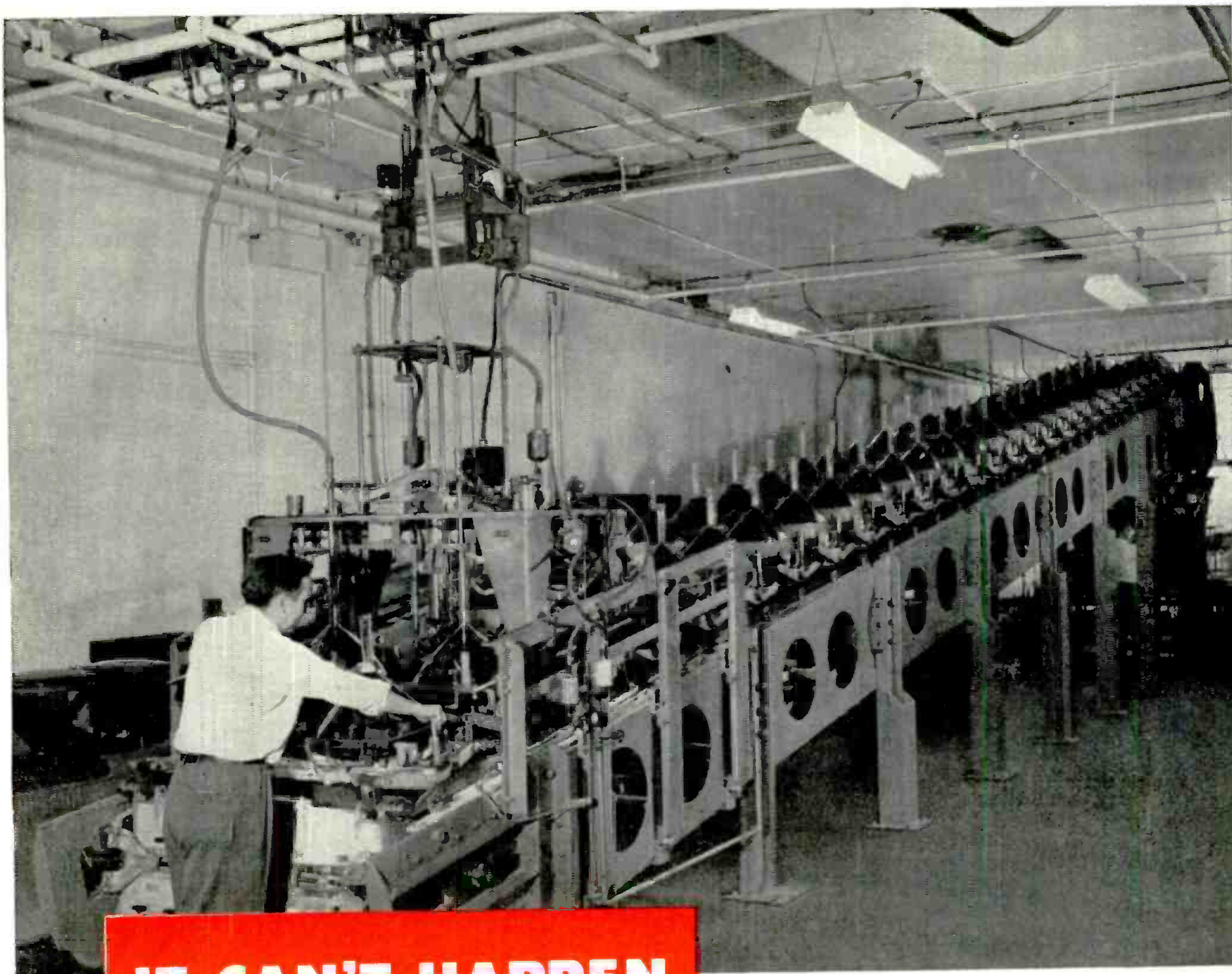


IT CAN'T HAPPEN HERE!

Hytron's unique automatic settling conveyor. Machine dispenses and settles precisely uniform TV picture-tube screens. Automatic dispenser in foreground is an achievement of Hytron mechanical engineering. Vibration-proof chain-link conveyor was constructed for Hytron by Truhner and Boumans, Inc.

NO LIGHT SCREENS . . . NO HEAVY SCREENS . . . NO HOLES . . . NO UNEVENNESS

Another engineering first for you! Hytron's unique, automatic machine for dispensing and settling the screens of TV picture tubes.

What does it mean to you? A guarantee of the most uniform and finest-textured TV screens in the business. No light screens. No heavy screens. No specks from foreign particles. No unevenness.

Automatic dispenser pours exactly the right amount of chemicals into the big bottles as they travel slowly up the ramp. Conveyor's motion is so smooth a nickel standing on edge can ride it! Phosphors fall uniformly out of suspending solution . . . undisturbed — a "must" for perfect screens. Decanting or pouring off of chemical residue, loading, and unloading are equally shock-free. And there's precise electro-mechanical control throughout . . . with human errors barred!

That is why you can pick *any* Hytron picture tube. Depend on it. Any one will give you the finest screen money can buy. Yes, it pays to buy from Hytron . . . the most modern picture-tube plant in the world.

MANUFACTURERS OF RECEIVING TUBES SINCE 1921

HYTRON

RADIO AND ELECTRONICS CORP.

MAIN OFFICE: SALEM, MASSACHUSETTS

HYTRON EASY BUDGET PLAN

The easy way to sell picture tubes. No need to miss that profitable picture tube sale — just because your customer doesn't have the cash. Get the details on this original Hytron service for you.

Fill out and mail this coupon today!

Please rush me details on the Hytron Easy Budget Plan.

Name . . . .
(please print)

Street . . . .

City . . . . *State* . . . .

JUNCTION TRANSISTOR, a radically new type which does away with the cat whisker-like point contacts of the earlier rivals of the vacuum tube, was announced July 5 by Bell Labs.

The junction transistor consists of a tiny rod-shaped piece of germanium, treated so that a thin electrically positive layer is sandwiched between the two electrically negative ends. It derives its name from the two "junctions" between the negative ends and the positive layer. It differs markedly from the earlier type in which point contacts were essential.

The entire rod is encased in a hard plastic bead about 3/16 of an inch in diameter, with wire leads connected to each of the three regions and extended outside. This new form of transistor occupies about 1/400 of a cubic inch, whereas a typical sub-miniature vacuum tube occupies about one-eighth of a cubic inch.

Perhaps the most remarkable feature of these transistors is their ability to operate with exceedingly small power consumption. The best example of this to date is an audio oscillator which requires only 6 microamperes at 0.1 volt from a power supply. This represents 0.6 *microwatt* of power, contrasting sharply with the million or more microwatts required merely to heat the cathode of an ordinary receiving-type vacuum tube.

Power handling capacity, and efficiency are high. The design can readily be varied to permit the required amount of power dissipation up to at least two watts. Further, the static characteristics are so nearly ideal that class-A efficiencies of 48 or 49 out of a possible 50% can be realized. Efficiencies for class-B and class-C operation are correspondingly high, reaching 98%.

The input and output impedances are always positive, whether the transistor is connected as a grounded-emitter, grounded-base or grounded-collector. This permits a great freedom in circuit design and makes possible, by choosing the appropriate connection, a variety of input and output impedances.

Other characteristics of the new junction-type transistor are its relatively low noise figure (1,000 times less than that of its predecessor), and its high gain.

While studies indicate that collector capacitance limits the frequency response at full gain to a few kilocycles, it is possible (by using a suitable impedance mismatch) to maintain the frequency response flat to at least one megacycle while still obtaining a useful amount of gain.

At 1,000 c.p.s., most of the units measured so far have a noise figure between 10 and 20 db. Power gains of the order of 40 to 50 db per stage have been obtained.

The Laboratories also announced that development work on the original "point contact" type of transistor has been so successful that this type will be put into trial use in the Bell System early next year. The Laboratories have made transistors of this original type which are as uniform in performance as vacuum tubes.

MIGHTY MITE is one way of describing the new cobalt-platinum magnet developed by scientists of the G-E Research Laboratory.

G-E cobalt-platinum magnet is at right.

A small cobalt-platinum magnet about the size of a pencil eraser lifts a steel bar 16 times longer and 24 times heavier than that lifted by an Alnico-5 magnet of similar size. The new magnet is not expected to replace Alnico, but will open new fields of use for permanent magnets where high cost is not a factor.

TELEVISION'S fastest growth (outside the United States) is in Latin America. Six stations have gone on the air in the last year—two in Mexico, two in Cuba, and two in Brazil. That's as many as are operating on a regular basis in all of Europe. The United States has 107 stations and 12,500,000 sets. Since the Latin American stations operate on American standards (RCA and G-E built the transmitters) a huge potential market is opening up.

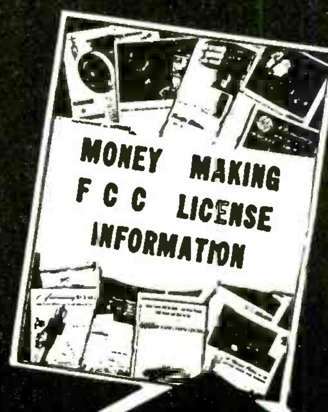
MOVIE companies may play down the role of television because it is competition now, but they are still doing research in the field. Latest is the experimental work in cross-polarization effects, carried out by Twentieth Century Fox with their experimental television relay station KE2XKA.

The Fox people visualized a method of crowding more stations into the u.h.f. spectrum by having co-channel stations in adjacent districts use vertical and horizontally polarized antennas. They tried to find out how weak the received signal could be made, by placing the receiving and transmitting antennas at right angles to each other. A waveguide transmission line fed 7,000-mc signals into a parabaloid reflector.

Results of the experiments carried on for two years showed that signal suppression up to 30 db could be achieved. In many cases the crossed signal dropped below noise level. The conclusion reached was that cross-polarization would be useful in increasing the number of channels available.

Want To Double Your Pay?

How To Pass FCC COMMERCIAL RADIO OPERATOR LICENSE EXAMINATIONS



GET THIS AMAZING NEW BOOKLET FREE!

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!**

Telegram, August 9, 1950, from Chief Engineer, Broadcast Station, Pennsylvania, "Have job opening for one transmitter operator to start immediately, contact me at once."

Letter, August 12, 1950, from Dir. Radio Div. State Highway Patrol, "We have two vacancies in our radio Communication division. Starting pay $200; $250 after six months' satisfactory service. Will you recommend graduates of your school?"

Letter, August 24, 1950, from radio-television sales and service company, Ohio, "We are in need of a good television man. The pay will be good, also good surroundings to work in. Please let us hear from you."

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

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

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., Berginfield, N. J.	1st Phone	38
S/Sgt. Ben H. Davis, 317 North Roosevelt, Lebanon, Ill.	1st Phone	28
Albert Schoel', 110 West 11th St., Escondido, Calif.	2nd Phone	23

CLEVELAND INSTITUTE OF RADIO ELECTRONICS
Desk RE-32, 4900 Euclid Bldg., Cleveland 3, Ohio
(Approved for Veteran Training Under G.I. Bill)

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 274, 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 Genesse Ave., Dayton, Ohio.

Your FCC Ticket is always 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-32—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."

Name..

Address..

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

Paste on penny postcard or send air mail.

PHONEVISION, the television device that would permit a subscriber to see top-flight movies on his TV set by calling the telephone company and paying a dollar a movie, was extremely successful in recent tests, according to E. F. McDonald, president of Zenith Radio Co. It was tried out on 300 selected "average" families in the Chicago area whose sets were provided with the service by telephone connections.

Mr. McDonald said that the take for the three-month period of the test was $6,750, or about $22.50 per family. The "attendance" was about three and one-half times that considered normal for movie theaters.

A jumble of sound and wavering lines greeted regular viewers who tuned in on the channel. Subscribers had a device which automatically cleared the picture and sound when the subscriber indicated to the telephone company that he wanted to see a picture. FCC authorized the tests on an experimental basis.

The "pay-as-you-see" aspect of telecasting is causing widespread discussion. Paying for the right to receive broadcasts or telecasts has no precedent in the U. S. and may face a court test.

TRANSPARENT SCREEN for television picture tubes designed to give greater contrast between light and dark areas, is being developed by the General Electric Co.

Dr. Ferd E. Williams, a G-E scientist, discovered that a transparent screen coated with a film of zinc fluoride mixed with manganese would glow under impact of electrons. The film, which is about one eight-thousandths inch thick, is deposited on a heated glass surface in the presence of hydrogen sulfide.

When looking at the transparent screen the blacks are blacker because the viewer sees through the screen into the dark recesses of the tube. This is in contrast to present picture tubes using phosphor powders, in which the darkest areas appear white or grey.

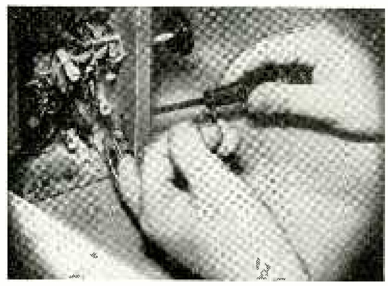
FIRST COMMERCIAL color TV receiver was demonstrated early in June by CBS-Columbia, Inc. (formerly Air King Products), Brooklyn, N. Y., now a subsidiary of CBS. The program, which featured flowers, package goods, and other colorful items (including CBS actress Penny Painter) received considerable favorable notice. A slight tendency to blurring in the fast movement of Miss Painter's red fingertips was evident. No other rapid movement was shown for comparison.

According to D. H. Cogan, president of the firm, CBS system receivers will be able to use tricolor tubes very simply, whenever such tubes can be produced in mass quantity. Pending the development of a suitable tricolor tube, the new receivers will use the disc or drum system. The receiver which was demonstrated receives CBS color as well as standard black-and-white, and can receive CBS color broadcasts in black-and-white as well, if for any reason that should be desired.

—end—

Merchandising and promotion

RCA Tube Department has launched a prestige-building promotion for the service technician. Built around the theme, "Serving the Community", the

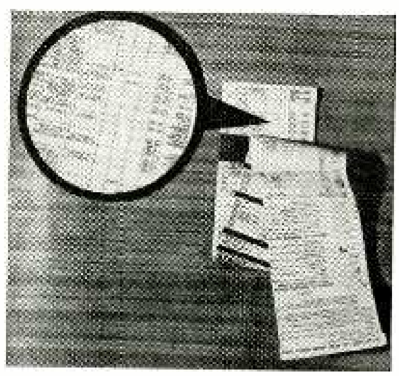


campaign uses striking window and counter displays backed up by direct mail and sales aids.

As part of its promotion campaign, the company is also offering service technicians a set of finger-tip wrenches for working in tight spots. The wrenches are worn on the fingers and used to steady nuts in hard-to-reach corners. The set consists of five wrenches that are adjustable to finger size. They are available from local RCA tube distributors.

Thomas Electronics Inc., Passaic, N. J., TV picture tube manufacturers, are under way on a merchandising and advertising campaign to strengthen their position in the picture tube replacement market. The company is offering a bonus to technicians who buy Thomas tubes, in the form of a certificate which has a cash value when applied to the purchase of test equipment manufactured by the Simpson Electric Co., Chicago.

Jensen Industries, Chicago, developed a "slide-rule" type replacement needle chart for either pocket or counter use. Simple and easy to operate, the chart shows the proper replacement for every



make of phonograph and cartridge. It is not necessary to know the model number of the phonograph or cartridge number. The guide may be obtained from distributors or the company.

Burgess Battery Co., Freeport, Ill., has launched a national promotion on its portable radio batteries. The campaign includes window streamers, counter displays, and direct mail as well as local and national advertising.

La Pointe-Plascomold Corp., Windsor Locks, Conn., held a Television Antenna Seminar for TV service technicians in New York City in June in conjunction with Ben Joseph, its New York representative.

Recoton Corp., New York City, released a simplified reference guide which gives information about replacement needles, cartridges, and other component parts of phonographs.

Raytheon Manufacturing Co.'s Replacement Tube Department, Newton, Mass., announced a new picture tube warranty which eliminates code dating and cuts down "paper work." Tubes are now guaranteed for six months from the date of purchase by the set owner.

The Astatic Corporation, Conneaut, O., published a new Phonograph Cartridge Directory and Replacement Guide. Printed on heavy stock, the directory gives a complete listing of cartridge models of leading manufacturers and illustrations of all Astatic cartridges and needles with complete performance data. Available from the company.

Sylvania Electric Products, Radio Tube Div., is offering service technicians, through distributors, a 40-foot extension and trouble light free with the purchase of three Sylvania TV picture tubes. The offer is effective from July 15th to September 1st. The cord is made of molded soft rubber and includes an on-off switch and two outlets for plugging in radio or TV sets, test equipment or other electrical accessories.

New Plants and Expansions

General Electric Co. broke ground for a new multi-million dollar electronics plant to be built in New Hartford, N. Y.

Aerovox Corp., New Bedford, Mass., acquired Wilkor Products, Inc., Cleveland, Ohio, which manufactures resistors. Wilkor Products will continue to operate in its own plant, but will enter the radio-electronic parts jobbing trade for the first time. Sales will be handled by the Distributor Division of Aerovox.

RCA formally dedicated its new electronic tube plant in Cincinnati on June 11. It will be devoted to the manufacture of miniature tubes for civilian and defense needs.

The Heath Co., Benton Harbor, Mich., acquired considerable property adjoining its present plant. The new site will be used for the expansion of present manufacturing facilities.

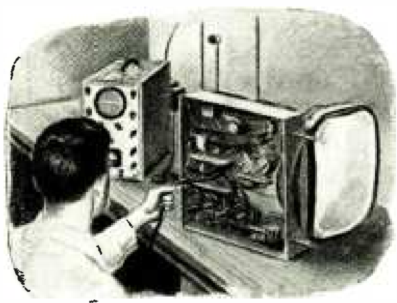
Industrial Development Engineering Associates announced that a new Regency Booster plant in Lawrence, Ind., would be ready for occupancy in October, 1951. This will be the company's fourth plant.

V-M Corp., Benton Harbor, Mich., manufacturer of automatic record changers, acquired a 105-acre site for the erection of a new factory.

Production and Sales

National Broadcasting Co., Division of Plans and Research, announced that as of June 1, there were 12,769,000 television sets in use in the United States. This more than doubled the previous year's figure. New York City led with 2,390,000 followed by Los Angeles with 933,000, Chicago with 930,000 and Philadelphia 858,000.

To Employers who need qualified TV technicians



...here's a quick and easy way to train them

Manufacturers ... service organizations ... dealers ... distributors ... and other employers of skilled TV technicians who feel the manpower pinch should be interested in this advertisement.

A VALUABLE TRAINING TOOL TO MAKE BEST USE OF MANPOWER RESOURCES

Because of the critical shortage of TRAINED and EXPERIENCED TV SERVICEMEN, RCA Institutes offers a highly specialized and practical Home Study Course in TV Servicing, to the working members of the radio-electronics industry.

The object of the RCA Institutes home study course is to train more *good* servicemen and to help make good servicemen *better*. Also to help expand the supply of qualified TV technicians for industry requirements in face of a manpower shortage. The RCA Institutes Home Study Course in TV Servicing provides an effective way to train men now in your employ to use their latent talents to fill positions that require technical training in television.

STUDENTS KEEP JOBS WHILE TRAINING ... STUDY LESSONS AT HOME

Employed men supplement the practical experience they get while actually working on their regular jobs with pre-tested technical knowledge learned from a study of the course at home in their spare time. They become more valuable to you as employees with each lesson studied. You quickly train men on the job to utilize their highest skills and capacities. Reduces the need to go outside in the rapidly shrinking manpower market for hard-to-find qualified men. Several thousands of RCA Service Company's own people have taken this course.

LOW RATES FOR EMPLOYER GROUPS

The cost of the RCA Institutes Home Study Course in Television Servicing has been cut to a minimum. It covers only the cost of preparation, grading and administration. It is offered by RCA Institutes as an economical and beneficial service to the radio-electronics industry at a time when the need for this kind of help is acute.

Employers may enroll any number of their employees. Reduced tuition rates for groups of six or more. Act now to get full benefits of this practical way to improve the over-all efficiency of your organization.

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 men quickly, easily. Mail coupon in envelope or paste on postal card.

RCA INSTITUTES, INC.

A SERVICE OF RADIO CORPORATION of AMERICA
350 WEST FOURTH STREET, NEW YORK 14, N.Y.

MAIL COUPON NOW!

RCA INSTITUTES, INC.
Home Study Department, RE-851
350 West Fourth Street, New York 14, N.Y.

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

Name__________ (Please Print) Title__________

Company__________

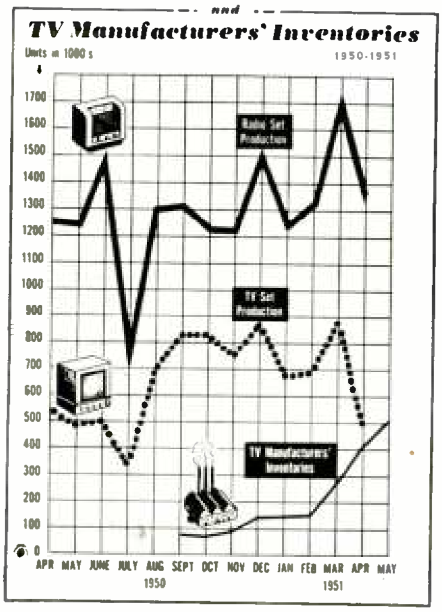
Address__________

City__________ Zone______ State__________

The RTMA reported that radio receiving tube sales, totaling 35,883,627 for the month of April, had dropped from the previous all-time high of March, 1951. A breakdown showed that 22,453,223 tubes were sold to manufacturers, while 9,052,251 were sold for replacements. The balance were sold to exporters, to Government agencies and to manufacturers of electronic devices other than radio and TV sets.

The RTMA further reported that television picture tube sales in April of 278,955 dropped 54% below the March figure. Of this total, 89% were rectangular and 95% were 16 inches or larger.

Radio & Television Set Production — and — TV Manufacturers' Inventories



Business briefs

. . . RCA released full technical details on the design and production of its tri-color TV picture tube to the entire radio-television manufacturing industry (including CBS) at a technical symposium held in New York City late in June.

. . . **Philco Corp.**, as a result of a long-term research program with the Chicago Transformer Division (Essex Wire Corp.), has developed new transformers which, it is stated, save 25% of the copper and silicon steel normally required for transformer manufacture.

. . . **Columbia Broadcasting System and Hytron Radio Electronics Corp.** stockholders approved the proposed merger of the two companies. Lloyd H. Coffin and Bruce A. Coffin of Hytron and David H. Cogan, Air King Products Co. (Hytron subsidiary) became CBS vice presidents. The Hytron name was changed to Hytron Radio & Electronics Co. and Air King to CBS-Columbia, Inc.

. . . **Tel-A-Ray Enterprises, Inc.**, whose antenna plant in Henderson, Ky., was completely destroyed by fire last May, announced that production would probably be resumed some time this fall.

. . . **Sprague Electric Co.**, celebrated its 25th Anniversary in June, with appropriate ceremonies at its plant in North Adams, Mass.

. . . **The Pacific Electronic Exhibit** which will be held in the San Francisco Civic Auditorium August 22-24, reports that booth space has been virtually sold out.

. . . **The West Coast Electronic Manufacturers Assn.** established a "have and want" program at which members exchange needed materials.

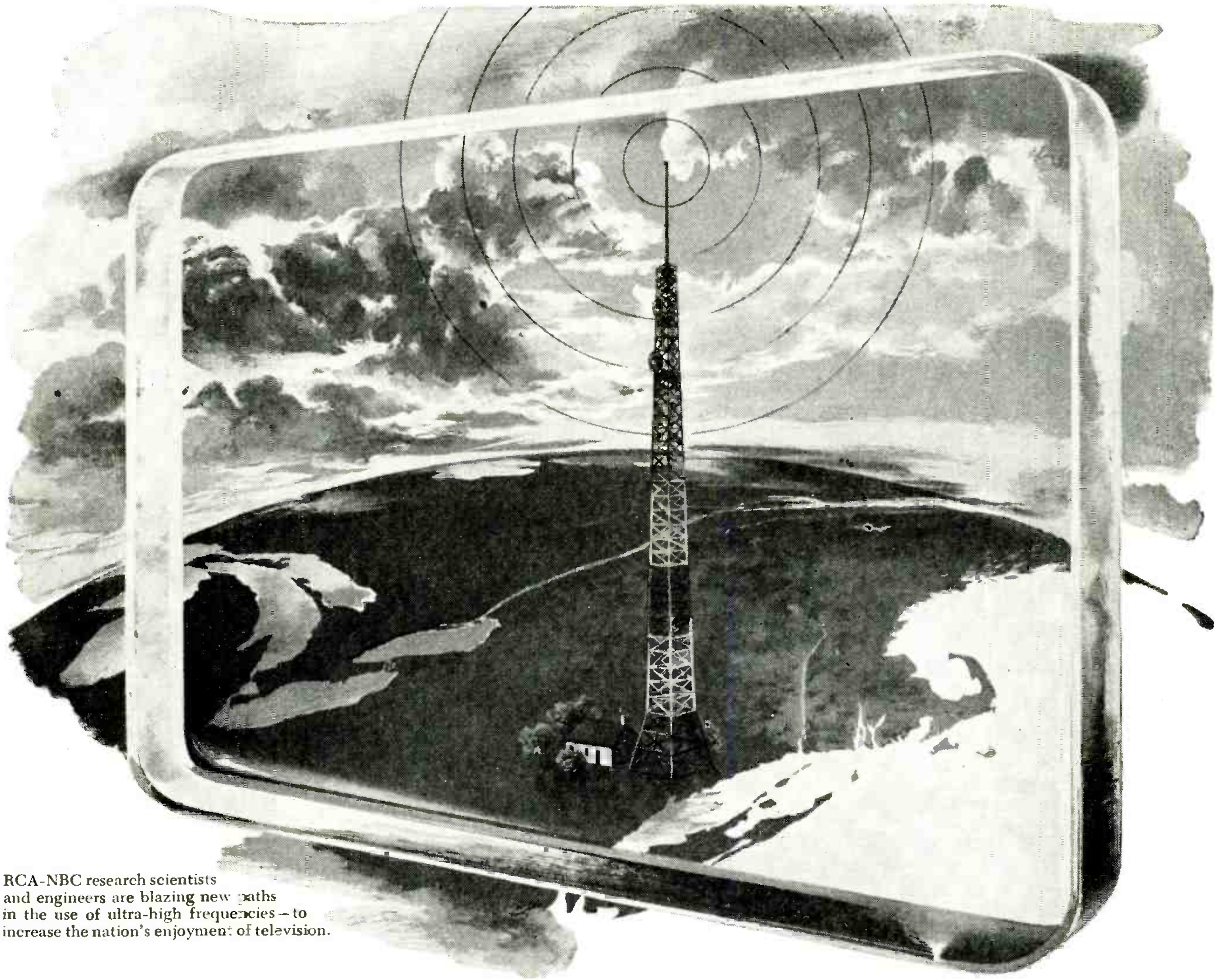
. . . **Brach Manufacturing Co.**, Newark, N. J., announced that one of Chicago's leading home builders had arranged for the installation of Brach's "Mul-tel" antenna system in his "Electronic Homes" development.

. . . **Rinehart & Co., Inc.**, New York City, parent company of Rinehart Books, Inc., publishers of technical books, acquired a substantial interest in A. S. Barnes & Co., one of the oldest publishing firms in the country.

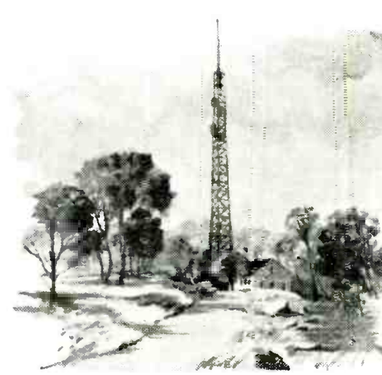
. . . **Telrex, Inc.**, Asbury Park, N. J., manufacturer of antennas, announced that Oak Ridge Products Co., Long Island City, N. Y., and Central Industries, Los Angeles, had signed as licensees under its "Conical-V-Beam" patents.

. . . **Industrial Television Inc.**, Clifton, N. J., published a booklet, "Multivision Antenna System," describing its new multiple antenna system for use in fringe area installations as well as strong signal locations.

—end—



RCA-NBC research scientists and engineers are blazing new paths in the use of ultra-high frequencies—to increase the nation's enjoyment of television.



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Tele-King Production Test Foreman James Adler and Harry R. Ashley, President of EICO, inspecting the use of the EICO Model 425 Oscilloscope and Model 221 Vacuum Tube Voltmeter at one of the important constant-duty alignment positions on the Tele-King television production line, New York City.

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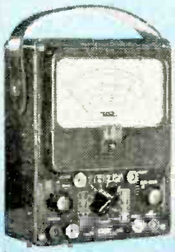

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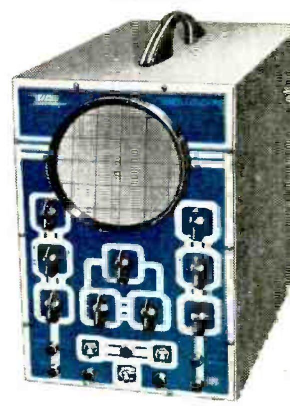

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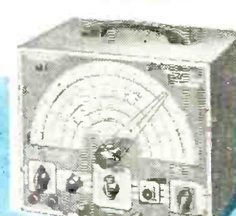

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SERVICE TECHNICIANS' TRIALS

. . . The service technician's life is not a bed of roses . . .

By HUGO GERNSBACK

THE radio and television service technician has never been too popular with the public at large. The most important reason is that the public has always found it difficult to comprehend and appreciate the complexity of the service technician's calling.

The public has never learned that the service technician has only one thing to sell—his time. This is particularly true when he does not supply parts, but reconditions the set so that it will perform once more.

For some obscure reason, people connect radio or television servicing with parts replacements; yet the technician's time spent in locating the trouble never counts with most set owners.

From the service technician's point of view there are only two types of failures when it comes to service radio or television sets.

1. Material failure such as capacitors, tubes, or other components which sometimes fail after they have been installed by the technician.

2. The human factor which is by far the greatest source of trouble from the service technician's point of view. Somehow the public does not mind if a newly repaired watch ceases to function within a few weeks and cheerfully pays another service charge to the watchmaker. But when the radio set fails to operate after a few weeks the service technician feels the full wrath of the customer who now expects free service to put the set into condition again.

Many people think nothing of lugging a defective set from one servicing establishment to another trying to get the cheapest repair estimate. The time which the service technician takes in looking over the receiver to find out what is really wrong—which might take a half hour or more—means nothing to these individuals, who cannot see why the technician should be paid for an estimate, if he does not repair the job.

Then we have the *Guarantee-Waver*. This is the bird whose set has worked satisfactorily for two months and three weeks of the 90-day guarantee and then fails to work. The little matter of the receiver falling down from the table, which caused the failure, seems to be of no importance. The customer insists on having the repair made free *because he has a guarantee!*

Another worthy citizen who would never dream of doing anything dishonest does not hesitate to take three or more weak tubes from the bedroom set and put them in a newly repaired set on which he paid the repair charges. Then he takes the same set back to the shop. Inasmuch as the repair was recently made he expects that the service technician will put it in good shape again, bad tubes and all. Surprisingly, such shady transactions do not bother some people who salve their consciences by cheating the service technician, whom they fancy overcharged on the last repair.

The *Set-Scratcher* is usually a feminine customer who burns up the telephone wires and vents her indignation on the service technician, complaining that his men scratched up the set so badly that she must have a new cabinet. On investigation there is only a small scratch on the side which could not be seen when the console is put back into its accustomed place. The mere fact that the scratch is speedily eliminated does not mollify her in the least. Often it can be pointed out to the customer that it is an old scratch which was there *before* the set was serviced. This, however, never convinces the belligerent customer who really wanted to get a free service job (or a better looking cabinet) and thought she could put one over on the service people. Diplomacy of the highest calibre is in order with such pests, should it be considered desirable to retain their trade.

Let us also consider here a variety of *nuisance customers*. *Suspicious Sue* is one of these odd varieties of *homo sapiens*. She will take a set to a service shop and insist that it be repaired while she is on the premises. She will not leave it unattended. She has been told over the back fence that leaving such a valuable set as hers—vintage 1933—is not safe, with these servicing crooks. She knows that if she does not watch closely he will steal some tubes and take out other parts which are now highly valuable (probably as antiques!) replacing them with inferior ones. So she hangs over the technician's shoulder, not only making a nuisance of herself, but impeding his progress.

Knowing Norbert is another type who proclaims himself to be an engineer. True, he may be a *mechanical* engineer. For that reason he is certain that he knows all about radio's intricacies. He also stays around while the job is being looked over and put into condition, all the while discussing his latest scientific theories, and detracting the service technician so much that it takes three or four times longer to fix the set than if he had been left alone.

The *Amateur Repairman* is another one of these nuisances. He once built a Neutrodyne radio set in the radio boom of 1925 which makes him a radio expert. He recently took the television receiver apart, rewired the job, but alas, something stumped him and the set does not perform. He is not sympathetic to the idea that the receiver has to be practically rebuilt and this will cost, with necessary new parts, $38.00. He cannot for the life of him understand why it should cost more than $5.00 to put it into first-class condition.

The *Parts Putterer* is another nuisance-type who breezes in one day buying a list of parts, then next day brings in the set in which he has installed these parts. He indignantly states that you have sold him "defective" components because after he installed them the radio still does not work. That he put the parts in the wrong place and blew out several tubes in addition, counts for naught with him. All he knows is that you have gypped him and he wants you to repair the set *pronto*, or else.

This catalog of public failure could be extended indefinitely. Does all this mean that the public is downright dishonest? Certainly not. Let us be charitable and class the behavior as ignorance plus un-understanding, with a dash of intolerance towards radio service technicians.

—end—

Television Conversion

Pages 22-31

Information on conversion to big tubes can help your business. Read the articles below.

ARTICLES

Articles on conversion also appeared in January and May, 1951, and others are in preparation for early issues.

Slave Unit Simplifies 7-Inch Conversion Jobs

By WALTER H. BUCHSBAUM*

STATISTICS show that over 500,000 television receivers are in use that have only a 7-inch picture tube. All these sets use electrostatic deflection. The last of these sets were manufactured in 1949 and the early part of 1950, so that by now most of them probably need new picture tubes or repair. This means that the service technician will have a chance to sell the owner a new receiver or else propose conversion to a larger picture tube.

However, converting these receivers is not a simple matter. The 10HP4, the only electrostatically deflected 10-inch tube, is generally not available. To convert a 7-inch electrostatic set to use a magnetic type picture tube, circuits must be added and other changes made.

The anode voltage available from most 7-inch sets is below 5 kv, while the large picture tubes need between 9 and 14 kv. They need nearly 20 watts of B-power for the horizontal flyback, plus extra vertical sweep power. Magnetic-focus types need a PM focus ring or focus coil.

While it might be possible to add the necessary components in some jumbled-up fashion to the original chassis, the simplest and cheapest approach is to design a small subchassis (including its own power supply) and mount it in a convenient spot in the cabinet.

A simple slave system

We shall describe a 5-tube subchassis slave unit for large-screen electromagnetic picture tube conversion. By using only four leads from the subchassis to the old receiver, a simple arrangement is possible. The slave unit contains the vertical output stage, a B-plus supply to provide d.c. for the focus coil, and the horizontal flyback and high-voltage section. Driving voltages for the vertical and horizontal sweeps are taken directly from the main receiver chassis (see Fig. 1). The a.c. leads are connected so that the slave is controlled by the same switch as the main chassis. While the connections shown in Fig. 1 apply only to the Motorola VT71, similar tie points are shown in the Table on page 24 for other 7-inch receivers.

The horizontal driving signal consists of a sawtooth voltage of about 85 volts peak-to-peak applied on the grid of the 6BQ6 output amplifier. This voltage is taken from the output of the electrostatic horizontal deflection amplifier. If it has the wrong polarity the picture will be cut in half by a broad vertical band. Since most 7-inch sets use push-pull output, either plate of the output amplifier may be tried.

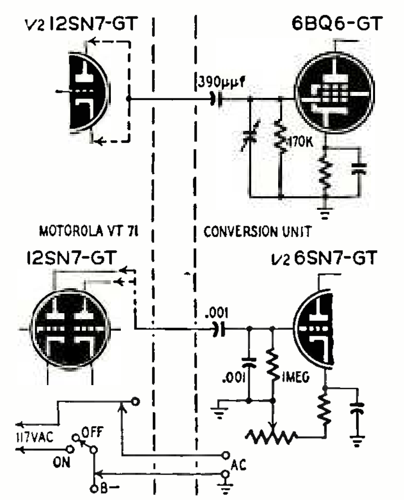


Fig. 1—Connecting the Motorola VT 71.

The Motorola and several others use a step-up transformer for the horizontal output. The sawtooth voltage is then obtained either from the two transformer leads or from the tube elements driving the transformer. In Fig. 1, it was better to connect directly to plate or cathode of the 12SN7-GT output tube; in the Table, the proper transformer leads are shown. The difference in the connections results in different peak voltages, which are adjusted by the width control in the main receiver or the drive trimmer in the slave.

The vertical driving signal is obtained from the vertical output amplifier plates in the main chassis. Wrong polarity will produce an upside-down picture. The two .001-μf capacitors in Fig. 1 act as a capacitive voltage divider, bringing the peak-to-peak voltage on the grid of the 6SN7 to the proper value.

In the unit illustrated a conventional RMA 109 focus coil was used. Its connection and the focus control potentiometer are shown in Fig. 2, the complete diagram of the slave unit. If a PM focus ring were used the focus circuit could be omitted together with C14, a

*Author of Television Servicing, Prentice-Hall 1950.

40-µf electrolytic. For use with the electrostatic focus tube a different circuit is required. If the picture tube uses 3,500 to 4,500 volts focusing potential, this voltage can be obtained from the high-voltage supply in the main receiver chassis. If the latest low-potential focus tube is used, the focusing voltage can be obtained simply by shunting a 1-megohm potentiometer across the B-plus supply.

Fig. 2 shows a high-voltage flyback circuit used for big picture conversions and in many new large-screen receivers. The XO32 (Ram) high-efficiency flyback transformer provides about 13 kv and, together with the 70-degree, ferrite deflection yoke, gives ample sweep for a 20-inch rectangular tube. The usual width coil is omitted here since its function is taken over by the width control on the main chassis. Take care in the physical layout and construction of the high-voltage section. Arcing and corona are the main source of trouble. It is good practice to make sure no grounded metal is closer than ¾ inch to any high-voltage part. Rounded solder connections and possibly a good coating with corona dope or similar material will also help.

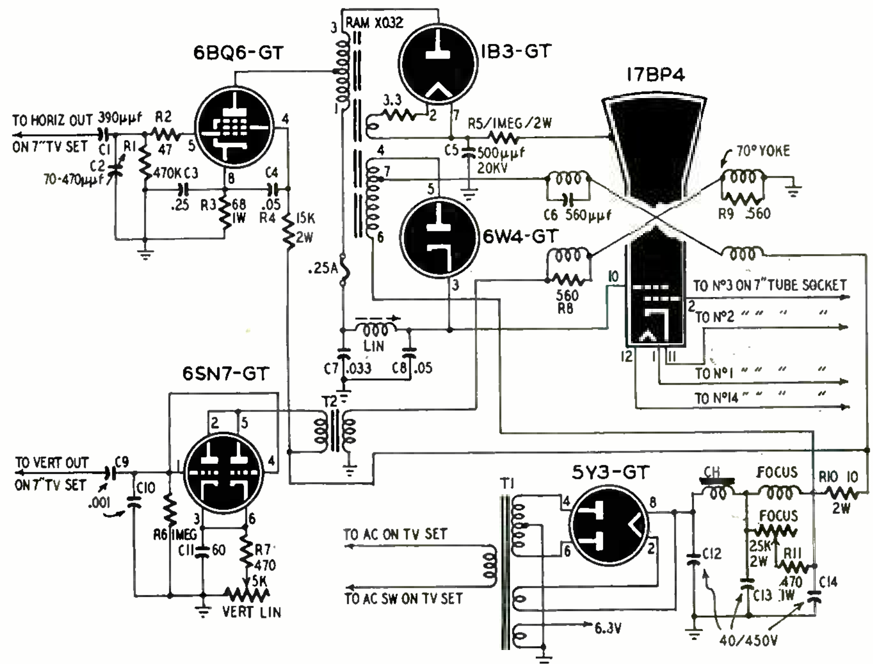


Fig. 2—Conversion unit for 7-inch TV receivers. Nine input leads are required.

Construction data

The unit shown in Fig. 2 and photos, was built on an old a.c. radio chassis. It is 10 x 5 x 1½ inches and already had the power transformer cutout as well as the required tube sockets. Any chassis of similar size will do, provided the layout gives sufficient space to the high-voltage section. Except for this, none of the layout dimensions are critical and the 5Y3-GT rectifier, 6SN7-GT vertical output, and the 6W4-GT damper tube can be located anywhere. The socket for the 6BQ6-GT should be near the flyback transformer, which, in turn, should be near the 1B3-GT high-voltage rectifier.

The photographs of Fig. 3 and 4 show the vertical mounting of the flyback as well as the bakelite strip used for the 1B3-GT socket. C5, the high-voltage capacitor, is mounted on the side of the chassis near the 1B3-GT socket as shown in Fig. 4. The high-voltage cage was bent up from a piece of perforated steel we happened to have around. This shield or cage prevents accidental shock from high-voltage parts and reduces the amount of interference picked up by nearby receivers. The cage could extend to cover the entire unit and could be made of regular window-screen material with suitable supports along the sides. We show the unit without its top cover in all photographs, but in actual practice a perforated top is used to close up the unit. A bottom plate or mounting board prevents access from below.

Three controls are shown in the photographs, although only two potentiometers appear in the diagram. The large potentiometer in Fig. 4 is the focus control and the one next to it is the vertical linearity control. The third control was originally used to adjust the drive on the horizontal-output amplifier, but after the pictures were taken it was found that a trimmer condenser, C2 in Fig. 2, provides more linear control. Location of the controls in the chassis layout is important. They should be accessible from the rear of the set without any difficulty.

To avoid 60-cycle hum pickup, the vertical-output transformer (T2) was mounted at right angles to the power transformer and the choke shown on top of the chassis in Fig. 3. The two electrolytic capacitor cans (C12, C13, C14) are mounted away from the 5Y3 and the power supply to reduce the ambient heat on them and also to act as shields between the horizontal-sweep section and the rest of the unit. These precautions are not always necessary, but they are sound design practice and do not add any cost or labor to the unit.

In a complete installation the yoke and focus coil probably will be mounted in the brackets holding the picture tube in the cabinet. To permit removal of the subchassis without cutting leads, an octal socket and plug-in cable connects the slave to the picture tube. The connections to the tube socket of the new large-screen picture tube are shown in Fig. 5. All 7-inch picture tubes use a 14-prong socket, while all magnetically deflected tubes use a standard 12-prong socket.

To simplify the wiring we connected corresponding elements of the two kinescopes together. This means that whatever system of brightness control or video amplifier coupling is used, it will remain in operation for the new picture tube. Theoretically, the new tube might require more video signal to drive it black than the 7-inch tube, but in actual practice the signal available for the 7-inch tube is just enough for the new kinescope. Experiments with several different 7-inch receivers have failed to show up either poor contrast or poor brightness.

The first anode, pin 10, of the mag-

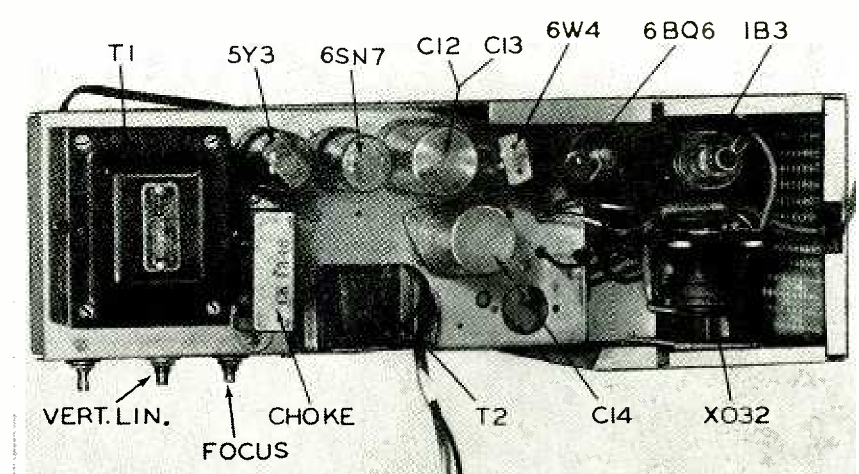


Fig. 3—Note positioning of transformers. A shield (not shown) prevents shock.

netic-deflection picture tube requires about 350 to 450 volts for bright, clear pictures. This voltage is not usually available in many 7-inch sets so this mer capacitor C2. This can be any type trimmer such as used in the r.f. section of many broadcast and short-wave receivers. Its approximate range should

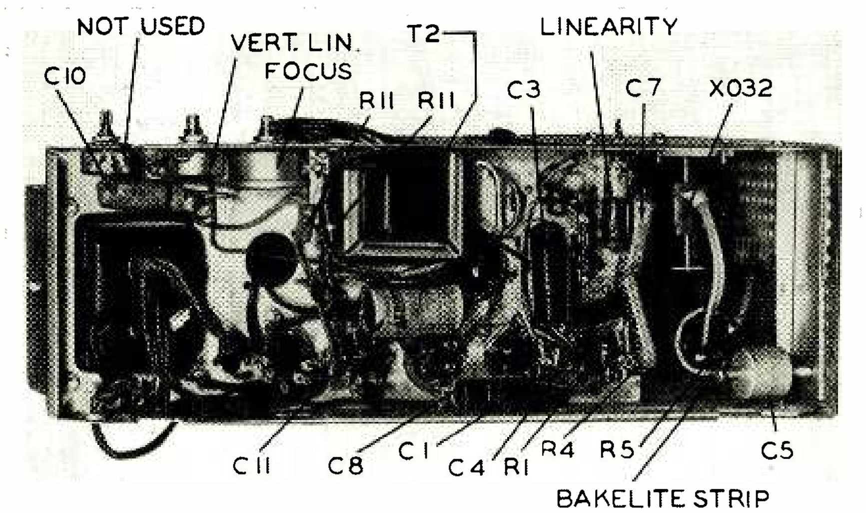


Fig. 4—Location of controls is important. The long chassis simplifies mounting.

lead is brought to the cathode of the 6W4-GT damper tube in the conversion unit where the horizontal-boost voltage adds to the B-plus to give about 450 volts d.c.

In connecting the two kinescope sockets remember that the video signal is applied between grid and cathode and that the stray capacitances of these two leads must be kept at a minimum. Never lace the grid or cathode lead into a tight cable harness. This may result in smeared pictures.

The power transformer T1, as used here, has a 375-volt, center-tapped, 100-ma secondary. The conversion unit will work equally well if the B-plus voltage is only 350 or 325 volts, but the value for R4 may have to be lowered to continue to give about 150 volts at the screen grid of the 6BQ6.

Two separate cans (Fig. 3) were used for C12, C13, and C14, the electrolytic filter capacitors, simply because those were at hand, but triple units are available. C11, the 60-μfs 50-wv capacitor used to bypass the cathode of the vertical-output amplifier, is a small cardboard electrolytic. The only other item deserving special description is the trim-

be from 70 to 470 μμf, but if it is less a small-value mica capacitor can be shunted across it.

After the subchassis is assembled and the wiring complete, check continuity and resistance throughout the B-plus section to avoid shorts due to wiring errors. A quick test run with the power on can be tried, but remember that the current through the 6BQ6-GT will be excessive when no signal appears on the grid.

Bench tryout

Before installing the entire unit in the new cabinet, try out the system on the bench. Set up the new large-screen picture tube with the focus coil and deflection yoke and connect the conversion unit, picture tube, and 7-inch receiver together. Since you do not know the proper sawtooth polarity in advance, the connections to the vertical- and horizontal-sweep amplifiers should be just clipped or hooked on. Center the brightness control and adjust the ion trap until a raster appears. Set the ion trap for maximum brightness. Next, adjust the focus control for best focus.

7-INCH CONVERSION DATA

Manufacturer	Model	Vert. Output	Vert. Connection	Horiz. Output	Horiz. Connection
Admiral	19A1 etc.	6SL7	#2 or 5	6SN7	#2 or 3
Airline	84GSE-3011A	6SL7	"	6SN7	#2 or 5
Airline	94GSE-3015A	6SL7	"	6SN7	"
Automatic	TV-P490	12SN7	"	12SN7	"
Automatic	TV-707, 709	12SN7	"	12SN7	"
Belmont	22A21, etc.	6SN7	"	6SN7	"
Coronado	438965	12SN7	"	Transformer	Green or black
Emerson	600, 639	6SL7	"	Transformer	Either side
Firestone	13G3	6SL7	"	6SN7	#2 or 5
Firestone	13G33	6SL7	"	6SN7	"
Hallicrafters	T54	12SN7	"	12SN7	"
Meck	XA-701	12SN7	"	12SN7	"
Motorola	VT-71, 73	6SL7	"	Transformer	Blue or yellow
Motorola	7VT1, 9VT1	6SL7	"	Transformer	Blue or yellow
National	NC-TV7, etc.	6SN7	"	6SN7	#2 or 5
Philco	48-700	7C5	#2*	7C5	#2*
Raytheon	7DX21, etc.	12SN7	#2 or 5	Transformer	Green or black
Sentinel	400TVM, etc.	6SL7	"	6SN7	#2 or 5
Teletone	TV149	12SN7	"	12SN7	"
Teletone	TV170, etc.	6SN7	"	12SN7	"
Truetone	D-2985	12SN7	"	Transformer	Green or black

* Try either tube

Turn up the contrast control and check the picture. If it appears deformed vertically, adjust the vertical linearity control on the conversion unit as well as the vertical linearity and height control on the 7-inch set. If reducing the height by means of the controls in the TV set results in loss of the vertical sawtooth signal, the value of the capacitor C10 must be changed from a .001-μf to a 500-μμf mica or else C9 should be increased from .001-μf to .002-μf. If the picture appears up-side-down, connect the vertical lead to the other output amplifier plate of the TV set. For this purpose the connections for both polarity signals are given in the Table.

With the vertical section operating properly we turn to the horizontal-sweep and flyback section. First see if the picture really starts at the left side. If it seems that one half of the picture is at the left and the other half at the right with a wide vertical blank space between them, connect the horizontal lead to the alternate point in the TV set as shown in the table. You may observe folding in the middle, a series of bright vertical bars at the left edge of the picture, or a stretching at the right of the screen.

All of these symptoms may be due to too much sawtooth voltage on the grid of the 6BQ6-GT. To cure this, adjust the width and horizontal-linearity controls in the TV set first. Then adjust the trimmer capacitor C2 in the conversion unit. If these different adjustments do not reduce the sawtooth sufficiently, shunt a 470-μμf mica capacitor across C2.

If only a slight nonlinearity exists, adjust the horizontal-linearity coil in the subchassis. Since we are using the horizontal and vertical sawtooth generators and synchronizing circuits of the original 7-inch set, their operation and adjustment will affect the conversion unit. In most 7-inch sets any adjustment of the height or width controls necessitates another setting of the horizontal or vertical hold controls.

Voltages and current should be checked to make sure the unit will not break down after a short run. The screen voltage on the 6BQ6-GT should not exceed 150 volts and the total cathode current through this tube should be less than 100 ma. To measure the current quickly, check the voltage across R3, the 68-ohm cathode resistor. It should be less than 6.8 volts.

Another important check is at the horizontal-linearity coil where the boost voltage is applied to the primary of the flyback transformer. This boost voltage should range between 450 and 600 volts, depending on the B-plus voltage from the power supply. If the 6BQ6-GT draws more than the 100 ma, the boost voltage will be reduced and the voltage across R3 will be more than 6.8 volts. Check the grid bias on the 6BQ6-GT, which should be about minus 18 volts. Adjust the trimmer C2 and the width control in the 7-inch TV set to get proper drive on the 6BQ6-GT. The vertical output tube should draw no more than 15 to 18 ma, depending on the height control and the vertical-linearity control setting.

A final check of proper operation would be to disconnect the center-tap of the power transformer secondary and insert a 0—250-ma d.c. ammeter between that point and the chassis. The total current should not exceed 120 ma, since otherwise the 5Y3-GT rectifier would be overloaded and its life seriously shortened.

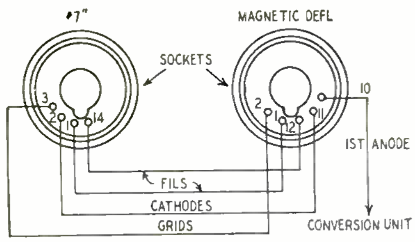


Fig. 5—The socket connections are easy.

We have not mentioned the high voltage and its proper value for the single reason that if all previous measurements check and the tube lights up it will automatically be correct. Depending on the flyback transformer, deflection yoke, 6BQ6-GT and B-plus voltage, the high voltage will range between 12 and 14 kv, sufficient to operate all round and rectangular picture tubes up to 20 inches.

Installation

After the entire unit has been thoroughly checked and been in operation for a while it can be transferred to the cabinet. The picture tube in this case, a 16DP4, was installed in the cabinet first. The bench trial was made with a 17BP4 to demonstrate the unit's ability to sweep a rectangular picture tube. The cabinet used was a consolette sold especially for conversions. Standard brackets mount the deflection yoke on the cross board as shown in Fig. 6

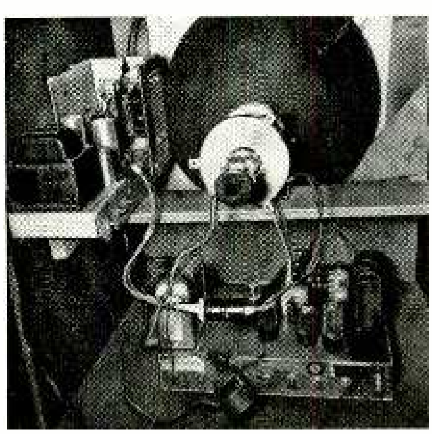


Fig. 6—The final installation. Two brackets mount yoke on the crossboard.

The focus-coil bracket is not yet mounted.

After the picture tube was centered the main chassis without the 7-inch picture tube was mounted in the cabinet. The connections between the main chassis and the conversion unit were soldered in the main chassis beforehand, and leads were brought through existing chassis holes. Finally the conversion unit was mounted as shown in Fig. 6. This location permitted a relatively short high-voltage lead to the picture tube as well as short connections to the deflection yoke and focus coil.

The subchassis is fastened to the side of the cabinet with short wood screws and to the cross beam with a bolt through a hole previously drilled in the chassis. In locating the subchassis inside the cabinet, choose the best ventilated spot. All controls should be easily accessible. Neither the 1B3-GT nor the 5Y3-GT should be mounted sideways since their filament wires might sag and touch the plate. Upside-down mounting is permitted.

After mounting all three major units in the cabinet, another test run and final adjustment should be made. After the back is put on and the set is placed in its final location no one could guess that you have an old 7-inch set instead of a new large-screen TV receiver.

Other uses

This slave unit can be used in other ways which will occur to the constructor. For instance, instead of placing the chassis in the cabinet along with the picture tube, it is possible to place both the new large-screen picture tube and the slave unit at some point remote from the main TV receiver chassis.

The design of the slave unit will readily permit leads up to fifty feet to be used. Thus, the receiver can be attached to the slave unit with a flexible four-wire cable. Programs are tuned in the usual way, and then the portable TV cabinet holding the viewing unit can be taken out into the yard or on the porch for comfortable, leisurely viewing.

There are other ways of using this slave unit. For instance, suppose that two viewing systems are desired. This can easily be done by using one or more of these slave circuits. It is possible to hook up a remote viewing unit which can be switched on or off at will from a central point near the set.

In this case (no drawings are shown because each installation will present its own problems) a general approach would be to set up a control panel which uses multi-contact relays or other means of switching.

If remote control is desired to one or more points it is important to remember that the circuit not be loaded with more than one slave at a time. In addition to stray capacitances which would be introduced, the output power from the TV set may not be great enough to handle more than one unit.

As a final suggestion, it may be desireable to keep the old small-screen tubes and mount them in a small cabinet nearby. The small screen can be used for monitoring purposes if a portable cabinet setup is finally evolved. In any case, trial and error will prove or disprove the feasibility of any special installations without too much effort being involved.

—end—

TV DX REPORTS

Though we will be only about halfway through summer, the TV dx season will come to an abrupt end in August, at least as far as the lower channels are concerned. Sporadic-E skip, having been a little late getting under way in the spring, will probably carry farther into August than the average, but there will be few openings of any magnitude after about the 8th, and practically none after the 15th. Even in the first part of the month there will be nothing to compare with the widespread dx reception of June and July.

Tropospheric propagation will be generally good over most of the country, particularly on the higher channels. High-band dx will tend to improve as the month wears on. It will be most pronounced along our coasts, in the areas near the Great Lakes, and in the lower Mississippi Valley, though signal strengths will be above average most of the time in practically all sections of the country. Tropospheric reception will be best in the hours around sundown, and in the late evening; poorest in midafternoon. The early morning hours are also good, though this period is of little use to most TV dx enthusiasts.

At least one pronounced aurora borealis may be expected by viewers in the northeastern quarter of the country and adjoining Canadian provinces, probably around August 18-20. Another possible aurora period is that between the 5th and 7th. As with other propagation phenomena associated with solar conditions, the best advance indication of coming auroral effects will be the dates of such disturbances in July. Recurrences nearly always follow 27 to 29 days later. The period August 18 to 20 in 1950 produced some of the most widespread auroras in recent times. Unusual propagation effects were observed as far south as Jackson, Mississippi.

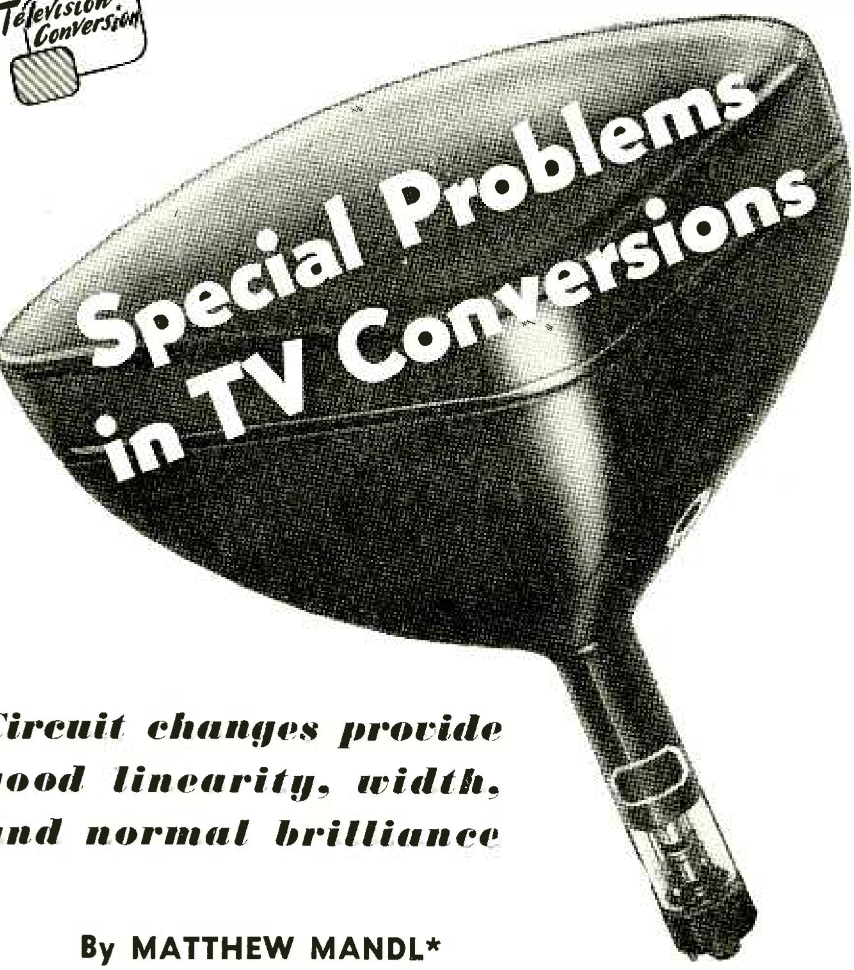
As little is known of a definite nature regarding the effects of aurora on the higher TV frequencies, dx enthusiasts are urged to turn their arrays north during auroral displays and take careful note of the results on all channels. High-gain arrays with a considerable front-to-back ratio are best suited to this type of observation.

Aurora effect is common in the late afternoon or early evening hours, often showing up too early for visual observation, and disappearing before darkness sets in.

—end—

Television Conversion

Special Problems in TV Conversions



Circuit changes provide good linearity, width, and normal brilliance

By MATTHEW MANDL*

TWO major problems arise in converting small-screen television receivers to the larger size: cabinet changes to accommodate the larger tube, and circuit changes to get increased sweep and high voltage. Cabinet and circuit changes have been discussed in previous articles[1] but special problems often arise which require other adjustments for good performance. The differences in circuit design for various receivers are usually enough to revise modification procedure. Good linearity, width, and brilliance are not always achieved immediately.

After conversion, evaluate final results by observing a station test pattern. Full programming schedules have curtailed the transmission of test patterns from many stations, but it is still worth while to wait until a pattern is on the air. Using a station pattern, true linearity, height, width, and shading can be easily ascertained and changes made for best reception.

* Co-author: Television and FM Antenna Guide

Correcting picture "bloom"

Fig. 1 is a photo of a test pattern on a 16-inch receiver converted from a 10-inch tube. Note the expanded circle and the lack of fine detail—typical indications of blooming, or overexpanded sweep. Now, note the ideal test pattern shown in Fig. 2. The inner circle is perfectly round and the sides of the outer circle are visible beyond the black edge of the horizontal wedge. Most test patterns have these two circles. The inner should be seen entirely, the outer should be visible as partial circles at the sides, thus aiding proper horizontal centering of the picture and determining the setting of the width control.

In Fig. 1, where blooming occurs, the outer circle is beyond the edge of the picture tube and the inner circle has expanded beyond top and bottom. Width and height controls cannot bring the picture to proper size because the high-voltage power supply delivers *too little* voltage to the picture-tube 2nd anode. When the 2nd anode voltage is below recommended values, beam velocity is decreased and the beam is more strongly influenced by the magnetic fields of the yoke. It is therefore swept too much and spreads beyond the tube screen.

If the high voltage is too low, a voltage-doubling circuit can be used. Try the suggestions in the following paragraphs first, though. As a final check, the 2nd anode voltage should be such that vertical height and horizontal width controls do not have to be "all on" in order to make the picture fill the mask properly.

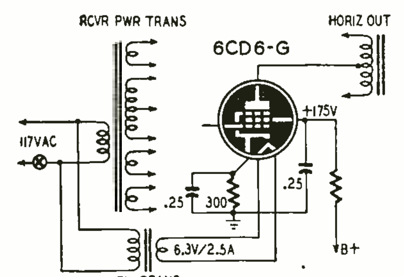


Fig. 3—An extra filament transformer is added when 6CD6-G replaces 6BG6-G.

Adjust the drive control slightly to get additional high voltage. Be careful —too much drive will result in severe horizontal nonlinearity. Use a test pattern to check the amount of drive which can be used before left-side elongation and right-side compression of the pattern occurs.

Increasing screen voltage will increase horizontal output, with resultant increase in sweep width and high voltage. Make a voltmeter check of screen voltage to make sure the tube ratings are not exceeded. Increase voltage by using smaller values of screen-dropping resistors. The maximum rated screen-grid voltage of the 6AU5 is 200. The maximum rating of the 6BG6-G is 350 volts; the 6CD6-G has a screen-grid voltage rating of 175; the 6BQ6 has a screen voltage rating of 200. All these values can be exceeded by 25 volts.

When the 6CD6-G is used as a direct replacement for the 6BG6-G be sure that the extra filament current drawn by the 6CD6-G does not exceed the rating of the power transformer. An extra filament transformer can be used as shown in Fig. 3.

Wire the extra filament transformer into the circuit as shown so that it will be turned on and off with the TV re-

Fig. 1—"Blooming" is caused by low second anode voltage. Note poor detail here.

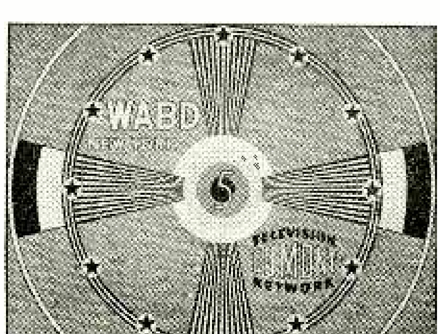


Fig. 2—This drawing shows the ideal received pattern. Details should be crisp.

ceiver. The 6AU5 and other types of miniature horizontal output tubes cannot be replaced by the 6CD6-G unless the socket is rewired. But first other measures should be tried for improving horizontal output. If a 6AU5 or 6BQ6 is replaced by a 6BG6-G, another filament transformer is not necessary.

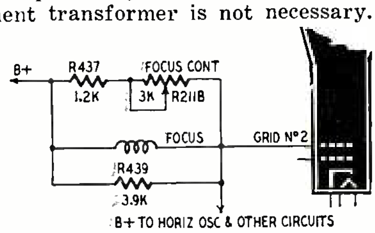


Fig. 4—Increasing focus coil current.

Conversion from a 10- or 12-inch tube to a larger size having 70-degree deflection angle requires a wide-angle yoke, a matching horizontal output transformer, and often a change in width control and focus coil current. Unless replacements are made, it will be difficult to avoid blooming pictures, corner shadows, or insufficient width and height until new components have been installed.

In converting sets in use for several years, change all tubes from the horizontal oscillator through to the deflection coil circuit. Tubes used for a long time have lower output. The installation of a new discharge tube, horizontal output, high-voltage rectifier, and damping tube will give the increased efficiency necessary for the larger size picture tube.

Critical ion trap adjustments

Low brilliancy will be helped by making all these changes. The ion trap must be carefully adjusted. It is surprising how often lack of brilliancy is attributed to circuit defects when more critical adjustment of the ion trap will give the additional brilliance desired. Make sure the coil type ion traps have enough current and the magnet types enough strength to do a good job. If doubtful, substitute a new unit and adjust it carefully for maximum brilliance by slow rotation and forward-back movement. If the ion trap must be placed too close to the focus coil to get maximum brilliancy, it indicates the magnetic field of the ion trap is below normal. Be sure the proper type trap is used for a given picture tube.

Increasing focus-coil current

Focus-coil current can be increased when needed by changing the associated resistor values. A typical focus-coil circuit is shown in Fig. 4 (Admiral 30A1 chassis—10"). A larger R439 shunt resistor instead of the 3.9K shown will cause greater current flow through the focus coil. Several sizes for both R437 and R439 should be tried until the proper focus-coil current is obtained with adequate control by R211B (the focus control). A decreased resistance in this focus network will also provide for an increase in voltage to grid 2 of the picture tube because the network represents a resistance in series with the B-plus supply. The increased voltage to grid 2 is recommended for the larger size tubes, for most of them require about 50 volts more grid 2 voltage than the smaller types.

Increasing height

In many instances the height control of the converted receiver will fill the mask vertically. However, if full height can be reached only by an extreme setting of the height control, poor vertical linearity may result. Height can be increased by increasing the voltage to the plate of the vertical output tube. One method is shown in Fig. 5, where the original B-plus feed (bottom of R1) is removed from the low-voltage power supply source and connected to the voltage-boost system. This is indicated by the heavy line in Fig. 5. The value of R1 can also be halved to get more voltage for the vertical output.

The vertical output tube can be changed to one giving greater output with less drive. If a high enough plate voltage is available, a 6S4 can be used. The 6S4 is a medium-mu triode suitable for vertical-sweep output circuits. It will take a maximum plate voltage of 500, it requires less grid drive for increased output, and it has a low-drain filament (0.6 ampere) so that filament secondaries will not have an increased load when this tube is used.

When a high-efficiency deflection circuit is used in the horizontal output with 70-degree tubes such as the 16GP4, increased vertical output can be achieved using the 6S4 together with a special vertical output transformer such as the RCA 222T1. This, in conjunction with the increased voltage boost gotten with output transformers such as the RCA 218T1 with matching yoke 206D1, will give all the vertical height increase needed without over-extending the range of the height control.

Linearity correction

With proper vertical output, linearity problems will not be too great for the vertical sweep. With horizontal deflection, the more complex circuit and danger of upsetting the many circuit requirements which make for linear sweep will offer difficulties. When measures to increase sweep and high voltage consist of placing capacitors across the horizontal output transformer secondary, linearity will be affected. This holds true when the width coil is removed, or when it is shunted with a capacitor. Such procedures introduce resonant effects and make linearity adjustments more critical. In many of these instances, perfect linearity will be impossible to achieve. Unless the resultant nonlinearity is not too severe (depending on individual tolerance) the foregoing measures for increasing horizontal output should be avoided.

Proper picture masking and linearity depend on adjustments of centering, linearity, drive, and width controls. Since each has some effect on the final result it will be impossible to achieve linearity with the linearity control alone unless the others are also adjusted to correct for the effects secured. Reducing overextended drive will require extending width to compensate for horizontal shrinkage. Adjusting linearity to correct for compressed sides means readjustment of width to bring picture up to mask edges again. Only by such repeated adjustment of the controls will good results be obtained.

Undersize picture

After conversion, an undersize picture could be due to any one or more of the following: Insufficient vertical and horizontal sweep; decreased output from low-voltage power supply; excessive voltage from high-voltage supply.

When the sweep system is not able to take care of the larger screen, width and height controls cannot bring the picture to proper size. If the controls are advanced fully, nonlinearity, fold-over and other overdriven sweep faults become evident.

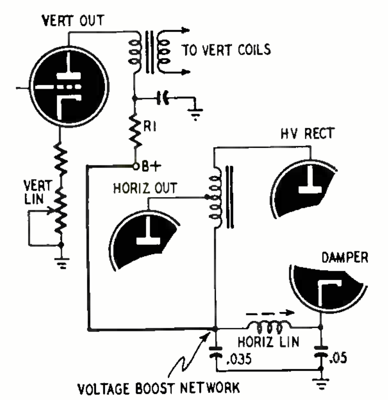


Fig. 5—Increasing height by providing more voltage for vertical output stage.

In some instances a gradual decrease in low-voltage output over the years had been compensated for by increasing height and width controls. After conversion to the larger tube, the additional sweep was lacking because of subnormal voltages to the plates of the sweep systems. The remedy lies in replacing the low-voltage rectifier tubes and checking the filter capacitors to see that their leakage is not placing too severe a load on the power supply.

If the converted high-voltage system delivers more than it should to the picture-tube 2nd anode, the tube's beam velocity will be too high. Consequently the sweep fields of the yoke are less able to sweep the entire face of the tube. Again, as with too small a low-voltage system, an undersize raster results. In both instances, however, picture quality will not be affected, and good linearity can be secured by adjustment of controls. A check of both low- and high-voltage supplies will establish which one is at fault.

[1]Page 50, RADIO-ELECTRONICS, January, 1951; page 24, RADIO-ELECTRONICS, May, 1951.

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Profitable Conversions with Rectangular Tubes

Part I — Advantages and methods of revamping small-screen TV sets with rectangular tubes

By TED CANTOR

CONVERSION is a new and lucrative field open to the television technician. When called to replace a small-screen picture tube or to service an older television set, the technician can grasp the opportunity to explain the advantages of rectangular tube conversion at reasonable cost.

The ratio of height to width on television pictures is 3:4; thus much of the round tube face is wasted. If the whole picture is shown on the tube, it must be brought down to the size of Fig. 1, and much of the tube is unused. If the whole tube face is used, the picture corners are clipped off, as in Fig. 2.

The rectangular tubes therefore make it possible to have a bigger picture on a tube which takes up less cabinet space. The shorter neck of these tubes solves front-to-back problems, but increases the diagonal deflection angle from about 53 to 70 degrees.

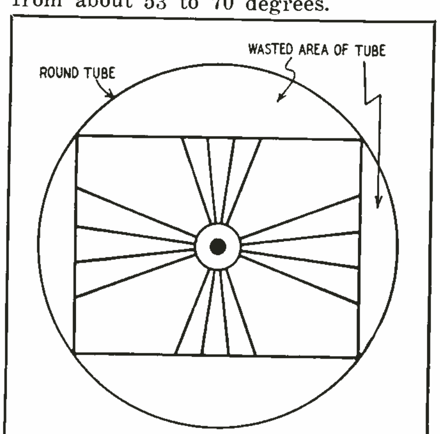

Fig. 1—A round tube wastes picture.

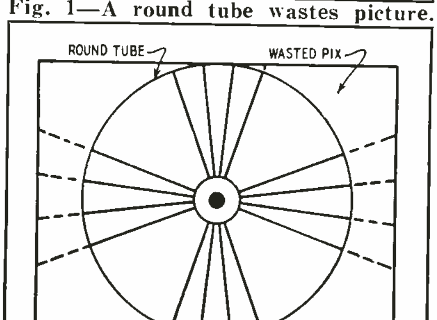

Fig. 2—Picture corners are clipped here.

Modern tubes have other advantages. Besides saving space, they usually have dark filter face plates to increase picture contrast and reduce the effect of ambient light. For these reasons, plus the decisive one of a bigger picture, the technician can show that large-screen conversion is desirable and expedient.

High-efficiency components

Because greater deflection power is required in the 70-degree tubes, and anode voltages of 12 to 16 kv are necessary for good brightness and resolution, new and more efficient components are essential.

High-efficiency flyback transformers, designed around ferrite cores, wound and mounted to reduce distributed capacity to a minimum, are especially important in conversion jobs.

With high-efficiency transformers, yokes, width, and linearity coils, we can get 14 to 16 kv with excellent regulation, linearity, and more than enough sweep for 70-degree tubes, 14 inches to 24 inches in size. See Fig. 3 for comparison of deflection angles.

The 630 horizontal output circuit with a high-efficiency flyback transformer and 70-degree yoke is shown in Fig. 4. Any circuit can be adopted to their use by following the text.

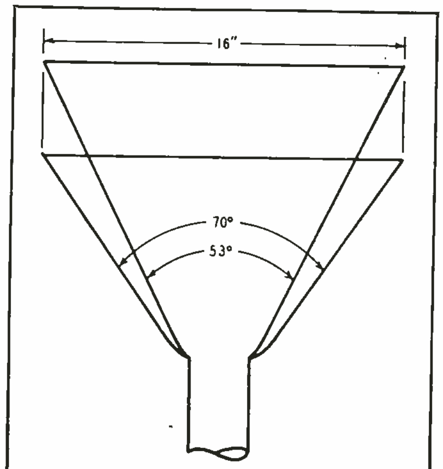

Fig. 3—Comparison of deflection angles.

Replacement of parts

First replace the original flyback transformer and yoke with the high-efficiency units. Original width and linearity coils can be used, unless width and linearity require improvement. Early sets and those using the 211T1 type transformer needed damping resistors shunted from plate to cathode of the 5V4 damper tube. These should be removed as they dissipate considerable amounts of power and are not required with the high-efficiency units.

Focusing

Picture tubes operating at higher anode voltages require a stronger focusing field. Try to increase the focusing current through the original focus coil. Where the focus control is shunted across the focus coil (Fig. 5-a), try removing any shunt resistor across the focus coil and inserting a resistance R in series with the focus control, to pass more current through the coil. Resistor R should be 10 to 100% of the focus control resistance. A smaller value will have little effect in increasing focusing current, and too large a value will cut down the range of the focus control. In some instances, removal of the focus control entirely will provide just enough focusing current.

If the focus control is in series with the focus coil, remove the shunt resistor and any resistor that may be in series with the focus control or focus coil (Fig. 5-b). Caution: Before removing any resistors, check the schematic to make sure the resistors are in the focus circuit only and are not a part of some other circuit network.

If these changes don't provide the proper focusing range, change the focus coil. Coils with a resistance of 200 to 300 ohms may be replaced with RCA type 202D2, JETEC 109 or equivalent which has a resistance of 470 ohms and a somewhat different mounting. Other types of focus coils may be replaced with a permanent magnet focus unit which will not require any wiring. The beam is focused with an adjusting screw or flexible cable and picture centering with a centering handle. The focus unit thus serves a dual purpose. These are available in different sizes, depending on the anode voltages.

If a PM focus unit is available with more flux than required, it can be cut down by adding small pieces of steel, approximately 1/16 inch thick by 1/2 inch square, or steel washers of similar size to the edges of the unit until the picture comes into focus range. To restore the unit to full strength at a later date, remove the steel shunts.

When substituting the PM type, leave the old focus coil wired in the circuit or replace it with a resistor of equivalent wattage and resistance. Complete removal will disturb circuit operating conditions.

The exact wattage rating of an equivalent resistor may be determined by measuring the d.c. voltage across the focus coil. Disconnect the coil and measure its resistance. Then use the formula Watts $= \frac{E^2}{R}$. For example, focus coil voltage is 50 volts, resistance is 200 ohms, $W = \frac{50 \times 50}{200} = 12.5$ watts. With a 100% safety factor a 25-watt resistor is the correct replacement.

Ion trap

The ion trap magnet used on the 10-inch and 12-inch tubes generally will not be satisfactory with the new and larger types. The wrong type ion trap may provide a picture, but it will have inferior brightness or focus, and damage to the tube may result. Consult the chart (RADIO-ELECTRONICS, May, 1951, P. 38) or ask your dealer for the correct ion trap magnet when purchasing your tube. As with the EM focus coil, if an EM ion trap was originally in the set, leave it wired in circuit placing it in any convenient location, or replace it with an equivalent resistor to avoid circuit unbalance.

Width control

The width coil controls width by absorbing power from the flyback transformer. To *decrease* width: (a) use a lower inductance width coil, 50-250 μh; (b) increase the screen resistor of the horizontal output tube; (c) connect the negative side of the high-voltage capacitor to the plate of the damper tube.

To *increase* width: (a) use a larger inductance width coil, 170-610 μh, or remove it entirely; (b) shunt width coil with .001 to .05-μf capacitor; (this will reduce high voltage about 1 kv); (c) use a feedback circuit of two 10-μμf, 1,500-volt capacitors in series from pin 4 of the flyback transformer to the grid of the horizontal output tube, Fig. 6. This will also increase the high voltage approximately 1.5 kv; (d) remove the negative side of the high-voltage capacitor from the plate of the damper tube and return to ground.

Width coil burning indicates the width coil is removing too much power from the circuit. Replace it with a larger inductance. If this increases the width too much, shunt it with a resistor, determining its value experimentally.

Picture tube anode voltage

To increase the high voltage on the picture tube: (a) return the negative side of the high-voltage capacitor to the plate of the damper tube instead of ground. This will raise the high voltage approximately 1.5 kv and decrease the width approximately ½ inch; (b) decrease the size of the screen resistor of the horizontal output tube. Do this carefully as it raises the screen voltage and increases the cathode current, screen, and plate dissipation.

The cathode current may be checked by measuring the cathode voltage and dividing it by the value of the cathode resistor. The maximum cathode current of the 6BQ6 is 100 ma and the screen voltage maximum is 200 volts. The maximum cathode current of the 6BG6-G is 100 ma and the screen voltage maximum is 350 volts. The 6CD6 cathode current is limited to 125 ma (flows through the damper tube), and the screen voltage to 175 volts; (c) use the feedback circuit in Fig. 6.

Linearity control

The linearity coil and capacitors C1 and C2 form a phasing network which controls linearity, Fig. 7. Decreasing the value of the linearity coil to 5 mh and C2 to .02 μf gives a wider range to the control but makes adjustment critical. The value of C1 is not critical and should be left unchanged.

Power supply

With the new transformer, the pulses impressed on the damper tube may cause arcing from the damper tube socket pins to ground. If this occurs, replace the socket with one better insulated. The 5V4 damper tube used in most early sets will work well in conversions.

The 6W4 cannot directly replace the 5V4 unless a separate 6.3-volt heater winding, insulated for 2500 v, is used. The cathode of the damper tube has high-pulse voltages applied to it. If the the common heater supply was used, the 6W4 cathode to heater insulation would break down eventually. The new 6AX4 damper tube has all the advantages of the 6W4 plus double the cathode to heater insulation, permitting it to be used on the common heater supply.

The high-voltage capacitors in the older sets could withstand only 10 kv. To avoid any chance of breaking down this capacitor and perhaps burning out the rectifier tube and flyback transformer, replace it with one designed for 20 kv. When the negative side of the high-voltage capacitor is returned to the plate of the damper tube for increasing the high voltage, it should be mounted on a bakelite strip, keeping the negative terminal at least ⅜ inch away from the chassis and the positive terminal at least 1 inch away from any low-potential points (Fig. 8).

When converting high-voltage circuits using voltage doublers, disconnect one of the 1B3 rectifier sockets, and rewire the other socket.

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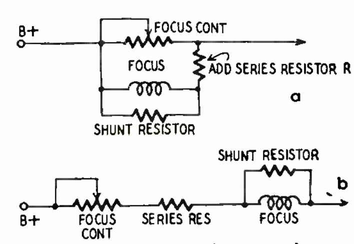


Fig. 5—Focus, (a) shunt: (b) series.

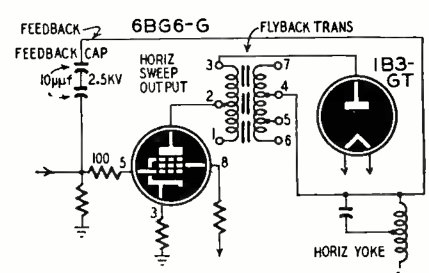


Fig. 6—Feedback circuit increases h.v.

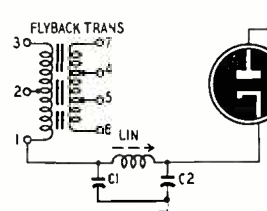


Fig. 7—Linearity control network.

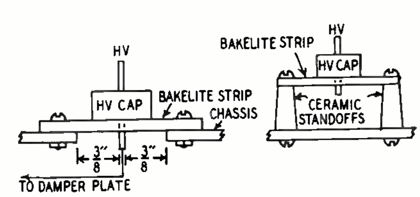


Fig. 8—Mount high-voltage capacitors.

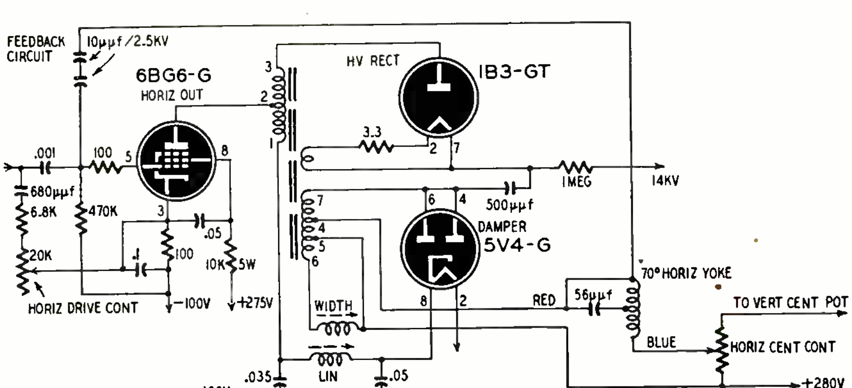


Fig. 4—630 type circuit with high-efficiency fly-back transformer and 70° yoke.

TV Conversion Components

Useful equipment for big-tube installations

The success of any large-screen TV conversion depends on customer satisfaction and on a profit for the technician. When the job is completed, the set must work perfectly and should look as good or better than it did originally. It is up to the service technician to select components and circuits which will provide the most satisfactory conversion. Here is component data. Conversion jobs and techniques are described in other articles in this issue.

DEFLECTION YOKES

Mfr. & Type No.	Defl. Angle (deg.)	Max. Tube Size (inches)	Induct. Horiz. Winding	Induct. Vert. Winding	Core	Comments *
DX DX-Y1	50-62	to 12	8.3 mh	50 mh	Iron wire	4, 10
DX DX-Y2	50-62	to 12	10.3 mh	41.5 mh	Ferrite	5
DX DX-Y3	70	to 17	12.5 mh	48 mh	Ferrite	5
DX DX-Y4	70	to 17	18 mh	41.5 mh	Ferrite	5
DX DX-Y5	70	to 17	25 mh	50 mh	Ferrite	5
DX DX-Y6	70	to 20	30 mh	3 mh	Ferrite	5, 6
DUMONT Y2A1	70	Any	10.5 mh	42 mh	Ferrite	5
DUMONT Y2A2	70	Any	10.5 mh	42 mh	Ferrite	4
DUMONT Y2A3	70	Any	10.5 mh	42 mh	Ferrite	4, 7
DUMONT Y2A5	70	Any	10.5 mh	42 mh	Ferrite	5, 7
G-E RLD-024	70	to 24	15 mh	30 mh	Ferrite	5, 8
G-E RLD-025	70	to 24	15 mh	30 mh	Ferrite	5
MERIT MD-12	53	16	8.3 mh	50 mh		17
MERIT MD-70	70	19	12.5 mh	50 mh	Molded iron	
MERIT MDF-70	70	24	10.3 mh	45 mh	Ferrite	22
MERIT MDF-30	70	24	30 mh	3 mh	Ferrite	22
RAM Y70I08	70	14-16	8.3 mh	50 mh	Iron wire	5
RAM Y70F08	70	14-17	8.3 mh	50 mh	Ferrite	5
RAM Y70F10	70	20-24	10.3 mh	45 mh	Ferrite	5, 9
RAM Y70F14	70	16-20	14 mh	50 mh	Ferrite	5, 9
RCA 201D1	50-57	16	8.3 mh	50 mh	Iron wire	4
RCA 201D3	50-57	16	8.3 mh	50 mh	Iron wire	5
RCA 201D12	50-57	16	8.3 mh	50 mh	Iron wire	11
RCA 207D1	50-57	16	8.3 mh	50 mh	Molded iron	4, 12
RCA 205D1	50-57	12	12.5 mh	50 mh	Molded iron	4, 11, 12
RCA 206D1	66-70	20	10.3 mh	41.5 mh	Ferrite	4
RCA 209D1	66-70	20	13.3 mh	41.0 mh	Ferrite	4
STAND DY-1	53		8.3 mh		Molded iron	10
STAND DY-2	70		8.3 mh		Ferrite	9, 14
TECH 70W-8	70	20	8.3 mh	50 mh	Ferrite	
TECH 70W-14	70	20	14 mh	50 mh	Ferrite	
TECH DH1	63	16	8.3 mh	50 mh	Iron wire	
TECH 1D1	53	12	8.3 mh	50 mh	Iron wire	10
TELR TE-102		16	8.3 mh	50 mh	Flake	
TELR TE-135		20	13.5 mh	50 mh	Ceramic	
TELR TE-104		16-20	10.5 mh	40 mh	Ceramic	
TODD CF70L	66	All[13]	8.3 mh	50 mh	Ferrite	9
TODD CF70L	66	All[13]	10.3 mh	41 mh	Ferrite	9
TODD CF70L	66	All[13]	14 mh	50 mh	Ferrite	9
TODD CF70L	66	All[13]	30 mh	41 mh	Ferrite	9
TODD CF70S	70	16GP4	8.3 mh	50 mh	Ferrite	9, 16
TODD CF70S	70	16GP4	10.3 mh	41 mh	Ferrite	9, 14, 16
TODD CF70S	70	16GP4	14 mh	41 mh	Ferrite	9, 15, 16
TODD CF70S	70	16GP4	30 mh	41 mh	Ferrite	9, 16

FOCUS COILS

Mfr. & Type No.	JETEC-RMA Equiv.	C-R Tube High Volts (kv)	D.c. Res. (ohms)	Current (ma)
G-E RLF-038			1,400	30
MERIT MF-1	106	10	247	
MERIT MF-2	109	14	470	
MERIT MF-3[19]		14	360	
QUAM QF1[20]	106			
QUAM QF2[20]	109			
RCA 202D1	106	to 10	247	75 200
RCA 202D2	109	to 16	470	75 140
STAND FC-10			247	200
STAND FC-11			470	140
TECH 2D1	106	10-12	247	115
TECH 2D2	109	12-16	470	95
TRIAD B-160	23		160	210
TRIAD B-247	24		247	170
TRIAD B-470	25		470	125
TRIAD B-1000	25		1,000	85

WIDTH COILS

Mfr. & Type No.	No. Matching Horiz. Out. Transformer	A.G.C. Winding (Yes-No)	Equiv. RCA—G-E Coil
DUMONT W1A1	H1A1	Yes	
G-E RLD-019	RTO-085	No	
MERIT MWC-1	HOV-6, HOV-7	Yes	7J1[18]
RAM 201R1	XO32	No	201R1
RAM 201R4	XO35	No	201R4
RAM 201R10	XO45	No	
RAM 201R11	XO32, XO35, XO53	Yes	
RCA 201R1	204T3, 211T1, 211T3, 211T5	No	
RCA 206R1	217T1	No	
RCA 208R1	208T1	No	
STAN S-957		No	201R1
STAN S-980		Yes	
TECH 1R4-J	TJ1	No	T77J1
TECH 1R4-AG	11T5	Yes	211T5
TECH 1R4-E	TJ1	Yes	T77J1

MOUNTING SLEEVES

Mfr. & Type No. (sleeve)	Mfr. & Type No. (ring)	Picture Tube
ANCH 16AP4/IC	ANCH 1601I14F	16AP4
ANCH 16GP4/IC	ANCH 1601I14F	16GP4
ANCH 19AP4/IC	ANCH 1901I14F	19AP4
ANCH 24AP4/IC	ANCH 2411I49F	24AP4
ANCH 17CP4/IC	ANCH 17R4F	17CP4, 17GP4

Note: Rubber band supplied with each ring. Each sleeve supplied with snap-on connector for second anode or tube.

TV-TUBE MASKS

Mfr. & Type No.	Size Tube (inches)	Color	Material
TELE 712W	12½" round	Gold	Lucite
TELE 714R	14" rect.	Gold	Lucite
TELE 716R	16" rect.	Gold	Lucite
TELE 716W	16" round	Gold	Lucite
TELE 717R	17" rect.	Gold	Lucite
TELE 719W	19" round	Gold	Lucite
TELE 720W	20" round	Gold	Lucite
TELE 720R	20" rect.	Gold	Lucite
TELE 724W	24" round	Gold	Lucite

LINEARITY COILS

Mfr. & Type No.	RCA–G-E Equiv.	Mfr. & Type No.	RCA–G-E Equiv.
DUMONT W1A1 G-E RLD-016		RCA 201R3 RCA 207R1[2] RCA 209R1[2]	
MERIT MW3-1	77J4-1	TECH 1R3 TECH 1R5[26] TECH 9R1[26]	201R3 201R5 209R1
RAM 201R3 RAM 201R5[26] RAM 201R10	201R3 201R5		

ION TRAPS

Mfr. & Type No.	Single or Double	PM or EM	Field Strength (gauss)
CLAR TV-2 CLAR TV-3	Single Double	PM PM	
DX DX11 DX DX12	Single Single	PM PM	45 55
G-E RET-003 G-E RET-005	Single Double	PM PM	42 35
QUAM 1T1 QUAM 1T2 QUAM 1T3	Double Single Single	PM PM PM	
RCA 203D1 RCA 203D3	Double Double	EM PM	
TECH LIT1 TECH LIT2	Single Double	PM PM	35–45 45

*Footnotes for TV components tables:

1. Has a.g.c. winding which can be left open if not required.
2. Tapped secondary to match yokes from 10 to 80 mh and provide up to 14 kv output.
3. Designed for 20-inch rectangular tube. Will provide 14 to 16 kv with ample sweep for cosine yoke.
4. No built-in R-C network.
5. Complete with built-in R-C network.
6. Especially for 19-inch round and 20-inch rectangular tubes.
7. Designed for autotransformer type flyback transformer.
8. Has focus-coil mounting bracket.
9. Cosine yoke.
10. Equivalent of 201D1.
11. Same as 201D1 with different terminal connections.
12. Same as 201D1 with molded-iron core.
13. Except 16GP4.
14. Equivalent of 206D1.
15. Equivalent of 209D1.
16. Will deflect all tubes but slightly less sensitive than CF70L.
17. Equivalent to 201D1, 201D3, and 201D12.
18. Also used as horizontal linearity coil.
19. For 10- to 12-inch tubes.
20. PM focus magnets with adjustable centering controls.
21. Any 70-degree yoke.
22. Equivalent of 209D1, 206D1, and Y2A.
23. Any voltages applicable to 16-inch, 70-degree tubes.
24. Any voltages suitable for 10- or 12-inch tubes.
25. Any voltages suitable for any 70-degree tubes.
26. Tapped linearity coil.

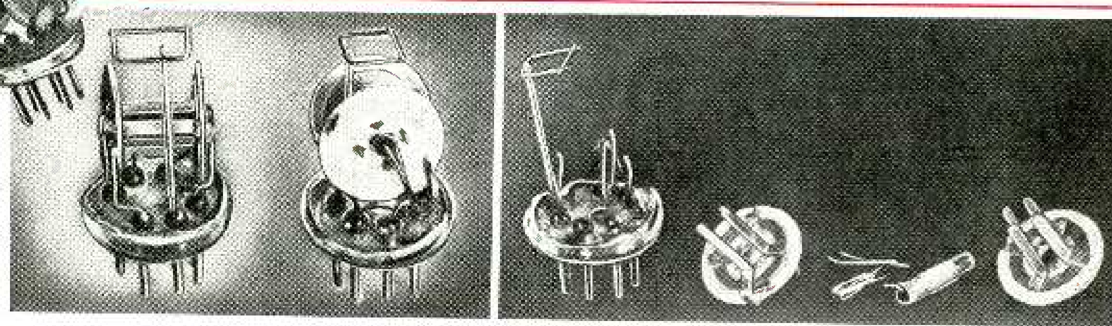
Code	Manufacturer
ANCH	Anchor Industrial Co., 533 Canal St., New York, N. Y.
CLAR	Clarostat Mfg. Co., Inc., Dover, N. H.
DX	DX Radio Products Co., 2300 W. Armitage Ave., Chicago 47, Ill.
DUMONT	Allen B. Du Mont Laboratories, Inc., Electronic Parts Sales, 35 Market St., East Paterson, N. J.
G-E	General Electric Co., Receiver Parts Sales, Bldg. #5, Syracuse, N. Y.
HALL	The Halldorson Co., 4500 Ravenswood Ave., Chicago 40, Ill.
MERIT	Merit Transformer Corp., 4427 N. Clark St., Chicago 40, Ill.
QUAM	Quam-Nichols Co., 33rd Place & Cottage Grove Ave., Chicago 16, Ill.
RAM	Ram Electronic Sales Co., South Buckhout St., Irvington-on-Hudson, N. Y.
RCA	Radio Corp. of America, Tube Dept., Harrison, N. J.
ROOT	Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
STAN	Stanwyck Winding Co., 137 Walsh Ave., Newburgh, N. Y.
STAND	Standard Transformer Corp., 3580 Elston Ave., Chicago 18, Ill.
TECH	Tech Master Products Co., 443 Broadway, New York, N. Y.
TELE	Tele Plastics Co., Div. of Willmax Mfg. Co., 202 Broadway, Brooklyn 11, N. Y.
TELR	Tel-Rad Mfg. Co., Inc., 7th & Madison Sts., Fennimore, Wis.
TODD	Todd-Tran Corp., 156 Gramatan Ave., Mt. Vernon, N. Y.
TRIAD	Triad Transformer Mfg. Co., 254 Sepulveda Blvd., Los Angeles 64, Calif.

HORIZONTAL OUTPUT AND H-V TRANSFORMERS

Mfr. & Type No.	Max kv	Defl. Angle (deg.)	Core	Typical Output Tubes	H.V. Rect. Tubes	Mfr.'s Matching Yoke	Matching RCA–G-E Yoke	Equiv. G-E–RCA Transformer
DX DX-T2[1]	14	70						
DUMONT H1A1	13	70	Ferrite	6BG6-G 6BQ6-GT	1B3-GT 1X2	Y2A1 Y2A2		77J1
G-E RTO-085 (77J1)	15	70	Ferrite	6AV5-GT 6BQ6-GT 6AU5-GT 6BG6-G	1X2-A	RLD-024 RLD-025		
HALL TV-10	9	50	Pow. iron	6BG6-G	1B3-GT		71420 71777	211T1
HALL TV-13	12	50-54	Pow. iron	6BG6-G	1B3-GT		71420 71777	211T3
HALL TV-14 HALL TV-15	14 13.5	65-70 60-65	Pow. iron Pow. iron	6BG6-G 6BG6-G	1B3-GT 1B3-GT		RLD-101 201D1 201D2	77J1 211T5
MERIT HVO-5	14	50-57		6BG6-G	1B3-GT or 1X2-A for all types	MD-12		211T5
MERIT HVO-6	14	70	Ferrite	6BG6-G		MD-12		77J1
MERIT HVO-7	14	70	Ferrite	6BG6-G		MD-70		77J1
MERIT HVO-8	14	70	Air	6BG6-G		MDF-30		74951
RAM XO32	13	70	Ferrite	6BQ6-GT 6CD6-GT 6AU5-GT 6BG6-G	1B3-GT 1X2	Y70I08 Y70F08		
RAM XO35	14.5	70	Ferrite	6BQ6-GT 6CD6-GT 6AU5-GT 6BG6-G	1B3-GT 1X2	Y70F10 Y70F14		
RAM XO45	14.5	70	Ferrite	6BG6-G 6BQ6-GT 6AV5-GT 6AU5-GT 6CD6-GT	1X2 1B3-GT	Y70F30		77J1
RAM XO53[3]	17	70	Ferrite	6BQ6-GT	1B3-GT	Y70F10		
RCA 225T1	16	66	Ferrite	6AU5-GT 6BQ6-GT	1B3-GT	209D1		
RCA 224T1 RCA 223T1	14 14	66 70	Ferrite Ferrite	6BQ6-GT 6AU5-GT 6BQ6-GT	1B3-GT 1B3-GT	209D1 209D1		
RCA 218T1 RCA 217T1 RCA 211T5 RCA 211T3 RCA 211T1 RCA 204T3	14 12 13.5 10 10 10	66-70 50-57 50-57 50-57 50-57 50-57	Pow. iron Pow. iron Pow. iron Pow. iron Pow. iron Pow. iron	6CD6-GT 6AU5-GT 6BG6-G 6BG6-G 6BG6-G 6BG6-G	1B3-GT 1V2 1B3-GT 1B3-GT 1B3-GT 1B3-GT	206D1 205D1 207D1 201D12 201D3 201D1		
ROOT SRJ1	14	70	Ferrite	6BG6-G 6BQ6-GT 6CD6-GT	1B3-GT 1X2		206D1 RLD-024	77J1
ROOT HTA	14.5	70	Ferrite	6AU5-GT 6BQ6-GT 6BG6-G	1B3-GT 1X2		209D1	223T1 224T1
ROOT SX-16	16	70	Ferrite	6AU5-GT 6BQ6-GT	1B3-GT		209D1	225T1
STAN S-999	1.4	70	Ferrite					77J1
STAND A-8119 STAND A-8127 STAND A-8128 STAND A-8129 STAND A-8130	13 10 11 13 14	53 53 53 70 70	Pow. iron Pow. iron Pow. iron Ferrite Ferrite	6BG6-G 6BG6-G 6BG6-G 6BG6-G 6BG6-G	(2) 1B3-GT 1B3-GT 1B3-GT 1B3-GT 1B3-GT	DY-1 DY-1 DY-1 DY-7 DY-7	201D1 201D1 201D1 206D1 206D1	211T5 211T3 77J1
TECH 15T1 TECH 11T5 TECH TJ1	10 12.5 14.5	53 60 70	Ferrite Ferrite Ceramic	6BG6-G 6BG6-G 6CD6-GT	1B3-GT 1B3-GT 1B3-GT	1D1 DH1 70W	201D1 209D1	215T1 211T5 77J1
TODD T-8								77J1
TRIAD D1	14	70	Ferramic H	6BG6-G 6BQ6-GT	1X2 1B3-GT		206D1	77J1
TRIAD D2	14	70	Ferramic H	6BG6-G	1B3-GT 1X2		22	

Miniature Magnetron

for V.H.F. TV Receivers



Left corner, a G-E Z-2061, approximately life size; left, two tubes without envelopes; right, an exploded view.

By FRED SHUNAMAN

A MINIATURE magnetron is almost a contradiction in terms. Usually we think of pulsed transmitting tubes delivering hundreds of kilowatts. A magnetron for an ordinary TV receiver which works with less than 200 volts seems almost unbelievable. Yet such a tube has been constructed. It may be an answer to the problem of finding a local oscillator for TV receivers operating in the 480-890-mc band.

Triodes have been used in that spectrum, but their efficiency drops off sharply at higher frequencies. Cathode, grid, and plate spacings are so small that the tubes are difficult and expensive to make. The Klystron works well at ultra-high frequencies, but is tunable only over limited ranges, and is even more expensive than ultra-high-frequency triodes. So there is definitely an opening for an ultra-high-frequency receiver oscillator. The new magnetron, experimentally designated as the G-E Z-2061, has been designed to fill that opening.

The magnetron has several advantages for such a job, because it is a very simple tube. The Z-2061 is a diode with eight plates connected alternately to two end rings. Manufacturing costs are lower than for the more complex tubes. Tolerances are less rigid, as cathode-grid and grid-plate spacings can be relatively large in a tube that will work well above 1,000 mc.

Magnetron operation

Oscillations in a magnetron are not produced like those in standard vacuum tubes, though there is a similarity between them and Barkhausen-Kurz oscillations. A simple magnetron with a single cylindrical plate can be made to oscillate, but general practice is to split the anode into a number of segments (these are the resonant cavities, or "keyholes" of the high-power radar tubes).

The Z-2061 has eight such segments, or vanes. They form a cylinder 0.18 inch in diameter around a cathode whose diameter is 0.1 inch. These vanes are connected alternately to opposite end rings, forming two interleaving anodes of four vanes each.

The magnet used with this tiny magnetron is actually two horseshoe magnets butted together, S-pole to S-pole and N-pole to N-pole, to form a perfect ring, which is put over the tube and turned to the position at which plate current is minimum.

If this magentron (or any magnetron) is operated as an ordinary diode, plate current will flow to the plate (anode) or plates (Fig. 1-a). But if a strong magnet is placed with its poles at the ends of the cathode, so that we have a magnetic field lengthwise along the cathode, the electrons are deflected from their straight course. Each electron is a minute electric current, and is deflected by a magnetic field according to the well-known right-hand rule. (Imagine the thumb of the right hand to be the cathode, pointing toward the N-pole of the magnetic field. Then the electrons, instead of going in a straight line from cathode to anode, will follow a spiral course in the direction the fingers point, as in Fig. 1-b. Note that the N-pole faces *away* from the reader.)

The strength of the magnetic field can be increased to a point where the electron's path is so curved that it misses the plate altogether (Fig. 1-c), and curves around back to the cathode. The condition of 1-c is called the Hull cutoff point, after A. W. Hull, inventor of the magnetron.

The magnetron oscillator (Fig. 2) is a push-pull circuit. In the Z-2061 there are four push-pull pairs, each consisting of two adjacent anode plates.

The Hull cutoff point may be reached by adjusting the plate voltage (the magnet is a permanent one, so magnetic field strength is fixed). A cloud of electrons is then rotating around the filament. The very outer edge of the cloud just falls short of the anode cylinder which catches the stray outermost electrons. Other electrons may be forced into orbits that take them back to the filament, as in Fig. 1-c. Still others may spiral around the cathode several times before succeeds in reaching either cathode or anode.

How it oscillates

To understand how the magnetron oscillates, remember that each electron has a certain amount of energy or momentum due to the attraction of the positive anode on the negative electron. The magnetic field does not add to or subtract from that energy—it merely changes its direction. It is this energy —taken from the B-supply as in any other oscillator—that is used to maintain r.f. oscillations.

A rapidly moving electron can give up energy in two ways. First: it can hit something, and its energy is turned to heat (watch a rectifier tube when the filter blows and the plate is subjected to a heavy electron bombardment); or it can "push" on something, and lose its kinetic energy.

Second: Imagine an alternating r.f. voltage across the push-pull circuit of Fig. 2. It is easier to consider that we are dealing with oscillations already started than to go over the laborious process of building them up. (Every radioman knows that, given the proper circuit, oscillations cannot be *prevented* from starting.)

To see how oscillations are produced,

all we have to do is to follow two of the electrons in the rotating cloud between cathode and anode. Electron 1 (Fig. 3-a) is so placed in the cloud that it finds itself passing the gaps between the anode vanes just at the point in the r.f. cycle when the vane ahead of it is becoming positive and the one behind it negative. It will be speeded up by the pulling action of the positive plate ahead of it because the plate behind it

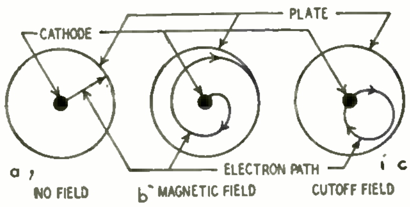


Fig. 1—Effect of the magnetic field.

is relatively much less positive. Since the pushing and pulling by the charges on the anode plates are the reason for its added energy, this electron actually takes energy from *the r.f. circuit*. The extra energy it gets causes it to come round the magnetic bend with more speed than average and plunge into the cathode. An electron which is speeded up by the anodes' r.f. field makes one trip only.

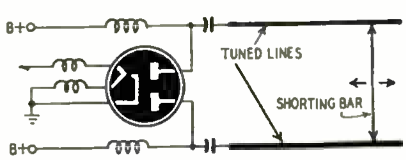


Fig. 2—Practical circuit for the tube.

Electron 2 has no such easy path. Leaving the cathode about half a cycle later, it finds itself approaching the gap between two anode segments while the plate behind it is positive and the plate ahead of it is negative. As it travels its circular course, the plate ahead tries to stop it and the plate behind pulls it back. Pushing ahead against the r.f. field, this electron gives up some of its energy to that field.

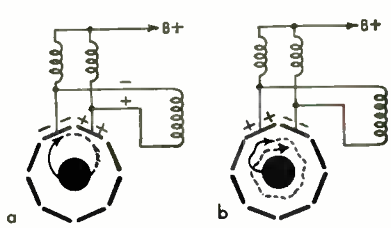


Fig. 3—How oscillations are produced.

This electron, having lost instead of gained bounce, does not get back to the cathode as did its speeded-up friend, but may go round the circle once again or several times before reaching an anode segment or dropping back into the cathode. Fig. 3-b is a diagram of the eccentric path of such an electron traveling under the influence of d.c. plate voltage, r.f. plate voltage, and magnetic field.

Thus the electrons that give up energy to the r.f. circuit—because they travel longer and farther than those that take energy away from it—supply more power than the accelerated ones take away. If the difference is more than enough to supply circuit losses, we have an oscillating circuit. We can think of our electron cloud as a sort of toothed wheel or gear which sweeps by the anode vanes, each tooth imparting energy as it goes by.

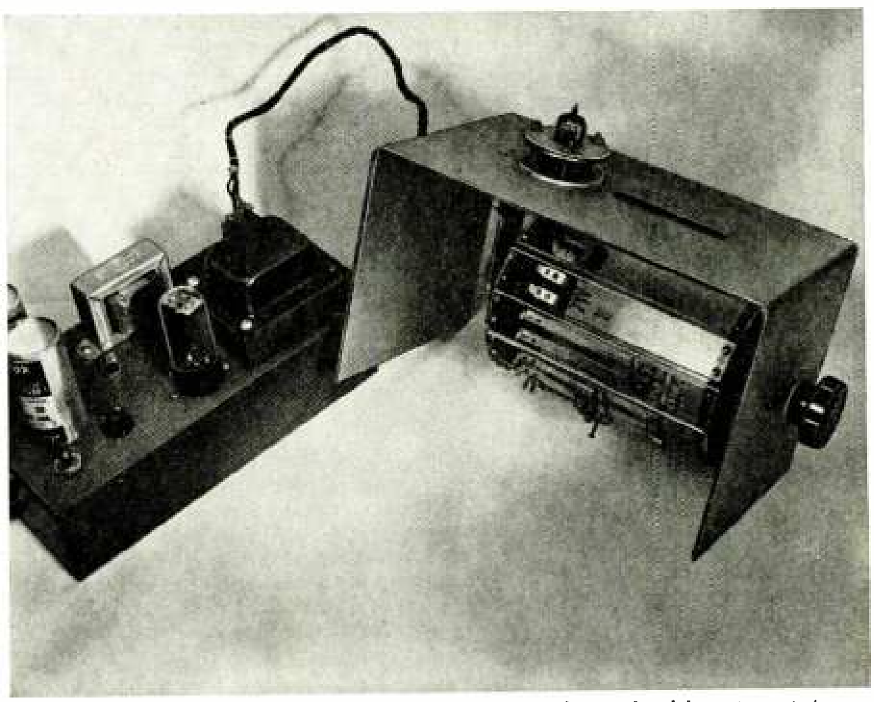
Various methods of tuning—in fact any that are suited for any types of tubes at these frequencies—may be used. A spiral type of tuner is used in the circuit of the cover photo.

Tuning and applications

Lumped constants can be used at lower frequencies (see below.) At higher frequencies, long lines, coaxial tuners or resonant cavities are applicable.

The miniature magnetron was designed as a local oscillator for u.h.f. television receivers. It has other possible applications, most promising of which are an oscillator for small transmitters—such as Citizens band equipment—or r.f. source in a u.h.f. signal generator. For portable use, we might even have a dry-cell version—though there is no report of anyone trying to make one as yet.

—end—

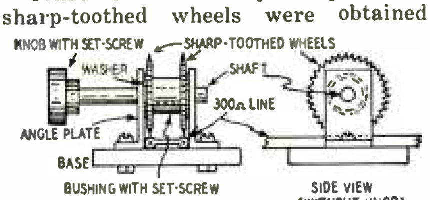


An experimental circuit, in which the magnetron is used with a turret tuner.

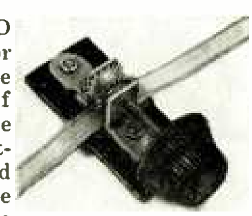
Quick Checker for Stub Lengths

The service-technician can use this adjustable stub to find the length of stub needed in some installations to eliminate ghosts. One end of a 300-ohm line is attached to the antenna terminals of the TV set while the regular antenna is connected. (Use about 44 inches of 300-ohm line, which will match down to channel 2.) The other end is placed under the toothed wheels, so that when the knob is turned, it will pull the wire. Then, as this knob is turned the stub antenna gets shorter. At the same time it is being short-circuited. When the best TV reception is obtained and ghosts are eliminated, the stub is cut and permanently attached.

Construction is very simple. The sharp-toothed wheels were obtained



from a JFD lightning arrestor (where they are used in form of cups). These wheels are flattened out and soldered to the bushing. The washer gives these



wheels the necessary clearance. Insulating material can be substituted for everything except the wheels and the bushing, and any sharptoothed wheels can be used. If nothing suitable is at hand, cut them from spring brass.

In locations where several stations are giving trouble it may be advisable to prepare several stubs, plugging them into the antenna terminals with pin jacks.

Where only one of several stations is weak or troubled with ghosts, it may be found that a stub cut for that station can be left in place without noticeably affecting the stronger stations.—*Hyman Herman*

TV Trouble Lexicon

By JOHN B. LEDBETTER*

This is the concluding article of the series. The author thanks the manufacturers for their help in this listing.

RCA

630-TS. Horizontal distortion. Defective linearity control. Gross misadjustment of linearity control. Defective capacitors C186 (.05 µf) or C188 (.035 µf). (See Fig. 1.).

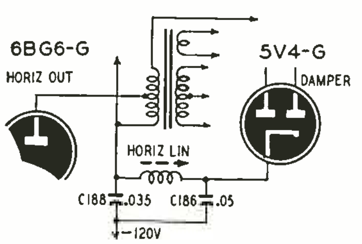


Fig. 1—Horizontal output circuit, 630.

No high voltage. Defective 6SN7-GT horizontal discharge. Check by substitution even though tube tests good.

Microphonic howl. Defective 6J6 oscillator.

Horizontal sync instability (no lock-in action). Improper adjustment of horizontal frequency control at rear of chassis. Adjust for maximum picture stability at either extreme of horizontal hold control. Check lock-in by switching momentarily to another channel and back.

9T240, 9TC240. Poor detail on fine or light parts of picture. Improper setting of focus control. Defective 6AL5 second detector or 12AU7 video amplifier. Misadjustment of video i.f. stages.

No raster. Incorrect ion trap adjustment; magnets reversed (top to bottom or front to back); front magnet improperly oriented. Defective 1B3-GT or 6BG6-G. Shorted 500-µµf h.v. filter capacitor C164. Open 3.3-ohm resistor R187 (1B3-GT filament) or 1-meg anode series resistor R189. Defective 6SN7-GT horizontal oscillator control. Inoperative 5V4-G damper.

No sound (raster and picture normal). Shorted .0047-µf plate bypass capacitor in 6K6-GT audio output.

Picture jitter. Improper adjustment of a.g.c. threshold control R138. If regular sections at left of picture are displaced, change 6BG6-G.

Light vertical line on left of picture. Defective 5V4-G damper. Defective 56-µµf capacitor C169.

*Engineer, WKRC—TV

RAYTHEON

1101. Excessive warmup required for sound and sync to reach normal. Weak selenium or low-voltage rectifier. Decrease in capacitance of low-voltage filter capacitors.

SENTINEL

400, 405. Insufficient height, bright lines or bars at top or bottom of screen. Defective 6SN7 vertical oscillator or 6SL7 vertical amplifier. Open or increased resistance in vertical amplifier plate-dropping resistors (4.7 meg, R23, and R24). Shorted 0.1-µf coupling capacitor C13 or shorted 20-µf cathode bypass capacitor C21 in vertical amplifier.

Insufficient width. Defective 6SN7-GT vertical oscillator or 6SN7-GT horizontal output. Open or increased resistance in horizontal amplifier 100,000-ohm plate-dropping resistors R2 and R5. Open or shorted filter capacitors in medium-h.v. power supply.

No raster, thin white line. Shorted .02-µf vertical oscillator coupling capacitor C11.

No raster, thin vertical line. Defective horizontal oscillator or amplifier tube. Shorted .01-µf horizontal amplifier coupling capacitor. Replace with a 1,200-volt unit. Shorted .0001-µf horizontal oscillator coupling capacitor.

400-TV. Horizontal nonlinearity. Incorrect adjustment of horizontal linearity control. Defective horizontal oscillator or amplifier. Defective .001-µf horizontal sawtooth capacitor C7.

400TV, 405-TVM. No picture. Shorted 0.1-µf screen-grid bypass capacitor in 6Y6-G h.v. oscillator. Replace 33,000-ohm screen resistor when capacitor is replaced.

401, 402, 406, 411. Short life of 6AR5 audio output (glass breakage). Excessive pressure from tube shield; breakage results from heat expansion. Discard shield.

413, 414, 415. Insufficient width. Improper adjustment of width or horizontal drive controls. Open 500-µµf capacitor C73 (6W4 plate to width control). Defective 6BG6-G, 1X2, or 6W4. Leaky .05-µf capacitor C74 or shorted 0.1-µf capacitor C75 (both connected to horizontal linearity coil). Open 250-µµf horizontal oscillator capacitor C59.

STEWART-WARNER

9100E. Intermittent hum (intercarrier type; varies with camera or program changes). Improper adjustment of discriminator stage. Also check picture i.f. alignment.

9100A, B, C, and D. Oscillator slug falls into coil form. (Caused by excessive pressure or too many turns during adjustment). Remove channel coil from turret assembly, lift slug retaining spring aside, and tap coil form until slug moves forward so that its threads can be engaged by the slug-retaining spring.

Binding (tuner unit.) Loosen screw holding tuner to bracket. Reposition tuner and shaft-centering plate so that fine-tuning control rotates freely.

STROMBERG-CARLSON

TV-12. No raster (sound normal). Defective .005-µf h.v. filter capacitor. Open 680,000-ohm, 1-watt resistor in series with 1B3 output and picture-tube anode (if open, also check filter capacitor for breakdown due to removal of load).

TELE-TONE

TV-209, TV-282. Insufficient vertical sweep. Weak 6SN7. Open or shorted 1.5-meg plate-load resistor R65.

No vertical sweep. See above.

Poor damping action (distortion on left side of picture). Defective 5V4-G damper. Defective 56-µµf capacitor across one of the horizontal deflection coils.

No raster, or intermittent raster. Leaky .005-µf 6,000-volt horizontal-sweep coupling capacitor.

WESTINGHOUSE

H-196, H-208, H-217. Short life of 5Z4 (earlier models). Replace with higher-current 5V4-G.

Fuse in horizontal output circuit blown. Gassy 6BG6-G. Excessive load in horizontal output circuit. (Use only a ¼-amp fuse to protect horizontal output transformer.)

Overloading on strong signals. Improper adjustment of a.g.c. control. To adjust, tune receiver to dead channel, turn contrast full on and a.g.c. control fully counterclockwise (maximum sensitivity). Turn a.g.c. clockwise until snow on screen just begins to decrease. Lock in this position.

Insensitivity to weak signals. Improper adjustment of a.g.c. control (see above).

No horizontal sync, horizontal hold control ineffective. Defective 6AQ5 horizontal oscillator or 6AC7 horizontal reactance tube.

Poor vertical sync (earlier models). Replace 12AU7 sync amplifier with a 12AT7.

Insufficient picture width (when line voltage is low). Check deflection yoke; replace if code number is "V" 98, 108, or 118. Replace with one of another code number.

Hum in sound (early models). Ineffective screen filtering on 6AQ5 audio output. Parallel a 30-µf capacitor across original capacitor (C99). (Later models incorporated this change).

—end—

Television Service Clinic

Conducted By MATTHEW MANDL*

A NUMBER of recent letters to the TV Service Clinic have asked about horizontal instability in receivers using the Synchroguide system of horizontal lock. In many cases the hold control setting is very critical and the picture drifts out of synchronization three or more times during an evening's reception. In some instances new tubes were installed without correcting the trouble and often a check of component parts failed to disclose any defects.

In such instances the trouble is that the Synchroguide system needs to be realigned so that the proper phase and frequency relationships are established between the control tube and the oscillator. Then the horizontal hold control will keep the picture in sync for most of its range, though for normal operation sync will be lost at one extreme setting, while at the other setting sync will be lost during change of stations.

With the older type Synchrolock or phase-detector systems realignment was rather simple. With the Synchroguide, the advantage of having only a single dual-purpose tube (6SN7) carries with it the disadvantage that alignment is a rather complex affair. It should not be attempted unless an oscilloscope is available and the service notes for the particular receiver are on hand so that procedures can be followed carefully.

Fig. 1 is a partial schematic of a typical Synchroguide circuit showing the controls involved during adjustment. V1 is the control tube in which the horizontal locking range and hold-control adjustments are to be found. V2 is a blocking oscillator with a resonant stabilizing coil and capacitor. The blocking-oscillator transformer contains the frequency-control slug, while the stabilizing coil contains the phase or waveform adjusting screw.

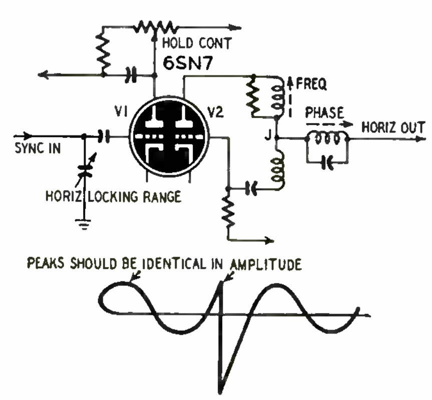


Fig. 1—A typical Synchroguide circuit.

* Co-author: *Television and FM Antenna Guide*, Macmillan, N. Y. C.

Proper adjustment of this system is made by connecting an oscilloscope from point marked J (junction of coils) to ground and adjusting the various controls until the waveform shown is secured. With the Synchroguide it is essential that the broad and narrow peaks of this waveform have identical amplitudes. Connections to the scope must be of low capacitance so that oscillator performance is not upset. The usual shielded-wire type scope connections should be discarded and two rubber- or cotton-covered wires used instead; one for ground connection and the other to the vertical input.

Scope patterns also should be taken of sync separator system output to see that all sync levels are clipped to the same amplitude for stations of different signal strengths. Unequal amplitude sync will tend to make the Synchroguide unstable.

Picture shrinkage

In a Motorola, the bottom of the picture has shrunk until there now is a space of about 1 inch from the bottom of the picture to the mask. I have tried new tubes in the vertical sweep but this does not seem to help. J. S. Hamtramck, Mich.

If the bottom of the picture shrinks (with resultant linearity change as indicated by a flat-bottomed circle in a station pattern) check all capacitors between the vertical oscillator and the grid of the vertical output tube. Do not, however, bridge existing capacitors, but check by direct substitution. If the shrinkage is also accompanied by foldover, check coupling capacitors for leakage.

Also lower the picture by changing vertical position and note if top of picture is affected. Shrinkage at both top and bottom indicates degeneration such as would occur by a decrease in capacitor value across the cathode resistor.

Ineffective contrast control

The contrast control in a Hallicrafter model 603 doesn't give any change in contrast when it is rotated. At full counterclockwise setting I get an intermittent type of interference on the screen. J. B., Cranford, N. J.

The trouble you mention is either in the contrast-control potentiometer (R-123) or in the capacitor which shunts it. Disconnect the leads from the contrast control and check with an ohmmeter to see whether the resistance (2,500 ohms) exists between outer terminals. Also check to see that rotation of the shaft gives a constant change without interruption from the center terminal of the potentiometer to one of the outer terminals. Also substitute a new shunting capacitor for the one now across the contrast control.

Replacing 6AG5's with 6BC5's

Will I get more picture gain by replacing a 6AG5 r.f. amplifier with a 6BC5? Would it also help to change the 6AG5 i.f. amplifier tubes with 6BC5's? L. V., Altoona, Pa.

The 6BC5 can be used as a direct replacement for the 6AG5 tube in the r.f. amplifier, and the higher transconductance of the 6BC5 will result in more gain. With a.g.c. type receivers, however, the difference will most likely be one of less snow effect than contrast except for the very weak stations. When replacing picture i.f. tubes with the 6BC5 *all* the i.f. tubes should be substituted in a stagger-tuned system to avoid distortion of the response curve. Replacing only one or two will shoot the gain up for one section of the response curve above the desired flat top.

Intermittent picture

Picture and raster disappear every once in a while. Sound remains normal during this intermittent condition. I have checked all voltages and tubes, and have even replaced the picture tube, but the trouble still persists. F. R., Cincinnati, Ohio.

Your trouble is probably due to a loose contact in the picture-tube socket, which interrupts the filament current. To check this, watch the tube neck in a darkened room and you will note the filament glow. When the picture brightness fades out, note whether or not the filament glow at the tube neck base dies down. If it does, check for a cold-soldered joint in the tube socket, or for other loose connections in the leads going to the tube socket. Also gently wiggle the tube socket to see if internal contacts are loose.

Transformer matching

In converting to color, I am worried about the match of the RCA 211T1 transformer with the yoke. Will a 211T3 give a better match? A. R., Newark, N. J.

Your present 211T1 transformer is designed to be used with deflecting-yoke type 201D1, 201D3, or 201D12. The 211T3 transformer is a newer tpe, but is also designed to be used with the same deflection yokes previously mentioned. Thus, if the receiver already has one of the yokes listed, replacing the transformer with the 211T3 will not improve impedance match.

—end—

Versatile Tube Checker

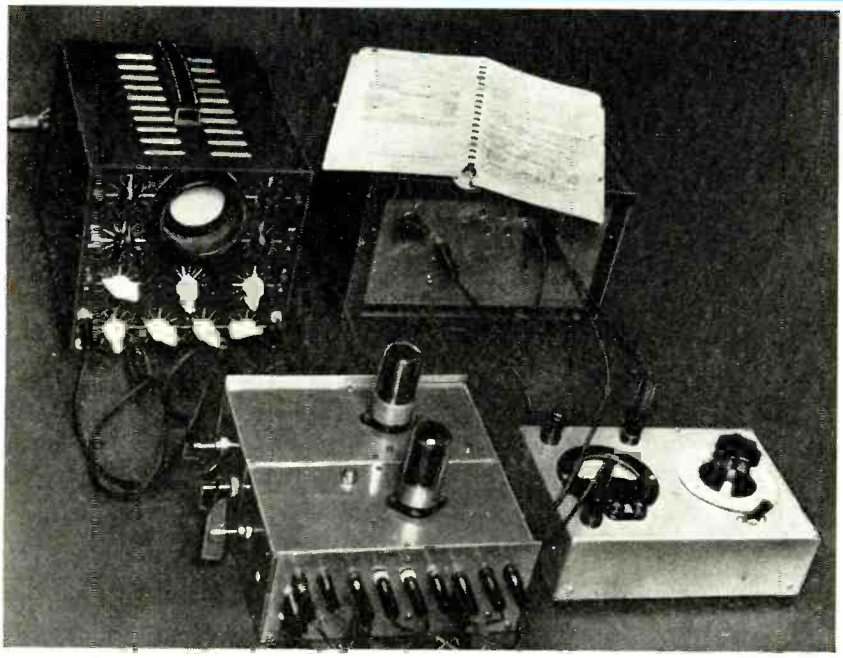


Fig. 1—Using tube checker, characteristics of two tubes show up on scope.

By OTTO VON GUERICKE

BEFORE the days of radar and television the vacuum tube was used for amplifying purposes chiefly, but today it has many other uses. The number of special circuits increases every day.

With television, the service technician, too, has to deal with these special circuits, most of which can be classified under one of the following three groups: relaxation oscillators, pulse shapers, trigger circuits. Only occasionally will he be lucky enough to detect in a tube manual a tube characteristic that fits into the operating conditions of his special problem. This unfortunate situation is, I think, responsible for the general adoption of the trial-and-error method when building such circuits. An expert in this field is often regarded somewhat as a magician.

I have worked out a good number of special circuits and feel that vast practical experience is what counts in this business. That, or a large collection of diagrams. In the latter case, however, you are successful only if you are pedantic even about trifles when copying the diagrams. This can be an expensive game sometimes; say for example you possess a few dozen 6SN7's but the designer unfortunately had a few dozen 6SC7's at his disposal. What now? You either have to spend more money on tubes or give up being the perfect "diagram-slave."

These considerations induced me to seek a method for quick comparison of the tube characteristics which would enable me to compare the behavior of tubes of identical or different type under different operating conditions. As I wanted the new method to be a swift one, too, I discarded all possibilities that involved "read-on-scale—jot down—draw-curve" schemes, and finally arrived at the setup shown in Fig. 1, which records two different tube transfer characteristics simultaneously on one C-R tube screen.

I am now able to find out how a certain characteristic is affected by changes in operating conditions, just by altering the conditions for one tube and keeping constant those for the second tube. Further, I can compare two special conditions as to their merits for my special problem. I can select from different tube types those that fulfill best all requirements of the circuits. On the other hand I can vary the operating conditions of a tube I want to use to replace another type, until the characteristics are identical. There are innumerable other applications.

The curves shown in Figs. 2 show a number of grid-voltage/plate-current transfer characteristics. The grid voltage is varied from +15 to –15 volts.

In Fig. 2-a are curves of the two new 6SN7's (first triode systems) with identical operating conditions. The curves prove to be identical too. This figure shows that choosing a replacement tube which has to possess the same cutoff point and the same steepness of characteristic (important for trigger circuits) becomes an easy and very reliable procedure.

That the setup can be used as a tube checker in the common sense of the word is explained by Fig. 2-b which again shows the 6SN7 curves. One tube, however, now operates with a heater voltage reduced to 4 volts (lower trace). The figure shows further why sufficient cathode emission is so important in power-amplifier stages. The curve of the underheated tube does not differ much from the normally heated one as long as the grid voltage is sufficiently negative, a requisite situation that can be observed when dealing with voltage amplifiers, perhaps, but usually not with power amplifiers.

Fig. 2-c gives the answer to the question: with 100 volts supply voltage available, shall we operate a 6SJ7 as triode or as pentode to get the highest value of mutual conductance? The answer (which in this case could be found

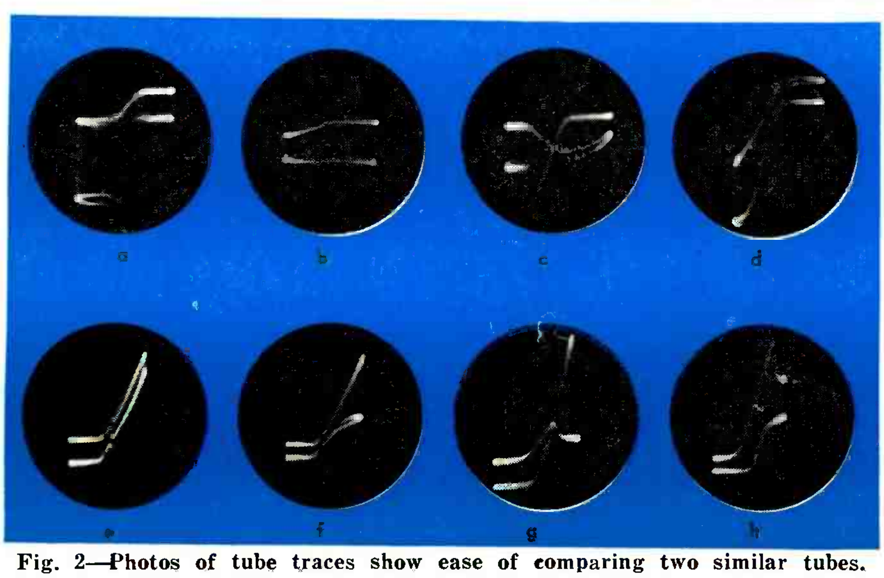


Fig. 2—Photos of tube traces show ease of comparing two similar tubes.

in some tube manuals, too) is that the triode connection (lower trace) is superior to the pentode connection (upper trace).

Now another problem: how can we shift the cutoff point of a 6SJ7 (pentode connection) to less negative values of control grid voltage? Look at Fig. 2-d. The upper trace is for normal operating conditions. The lower curve results if the screen voltage is reduced to 10. We observe that this reduction influences the position of the cutoff point as desired. We also see that while the reduction of screen voltage shortens the useful range of grid swing it does not much affect the mutual conductance of the tube.

Now follow three pictures in which the control effects on the anode current which different grids have are compared to each other. Again 6SJ7's are used for the demonstration. In Fig. 2-e the supply voltage is 200. The upper trace belongs to the normal connection; the lower is produced by a tube in which the first grid is connected to the supply voltage and the screen grid used as the control grid. The lower trace shows a reduced mutual conductance and a cutoff point which is shifted to the right. On the whole, however, the differences of the two traces are not very great. As soon as the supply voltage is reduced to 30 volts, Fig. 2-f the normal arrangement (upper trace) is altogether useless, while with the first grid operating as space charge grid (lower trace) amplification can still be obtained. So by gradually lowering the supply voltage one could find the value at which the space-charge grid arrangement begins to be superior.

The fact that the suppressor grid stops plate current completely if a strong negative bias is applied is demonstrated by Fig. 2-g. The lower trace belongs to the normal connections (100-volts supply) and the upper trace comes from a tube with its first grid grounded and the suppressor grid used as a control grid. It is interesting to note that with more negative values of grid voltage a sharp cutoff point cannot be obtained. On the other hand, if the grid voltage is positive at one point the plate current goes to zero rather abruptly.

As a last example, two different tubes will be compared. We all know that the 6AC7 has a higher mutual conductance than the 6SJ7—that is, we know this for normal values of supply voltage. How things look if the screen-supply voltages are only 50 is indicated in Fig. 2-h, the 6AC7 (upper trace) still proving to have considerably higher value of transconductance than the 6SJ7 (lower trace).

The setup used to obtain the above tube characteristics as shown in Fig. 1 consists of: a scope with a built-in electronic switch to double-trace it. I used the scope described in the July, 1950, issue of RADIO-ELECTRONICS; a voltmeter; a variable voltage power supply; and the circuit shown in Fig. 3. This circuit is built into a chassis which can be seen in Fig. 1. Note the multiple tap plugs. It can be used in all those cases where one is interested in characteristics relating some grid voltage to some electrode current. For the plate-voltage/plate-current curve, however, a slightly different circuit is necessary. Its schematic is shown in Fig. 5.

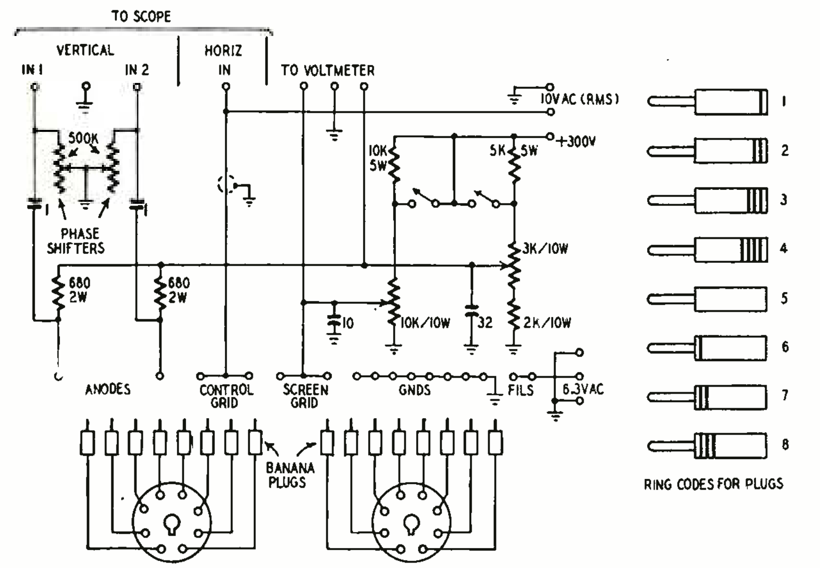


Fig. 3—Versatile tube checker circuit. Multiple plugs give extreme flexibility.

Fig. 4, too, gives a simplified diagram for the circuit of Fig. 3 which I am going to use for explanation. Resistor R must be made small compared to the internal resistance of the tube. The current running through R produces a voltage which is fed to the vertical deflection plates after passing through a phase shifting network. This is necessary because in practice the phase difference between this voltage and the voltage applied to the grid is not, as theory implies, exactly 180 degrees. Only if it is 180 degrees does the tube characteristic appear as a single line on the C-R screen.

The phase correction cannot be fully achieved by the R-C shifting network if the tube curve has been changed a great deal by this phase shift, because in such a case strong harmonics of the 60-cycle a.c. voltage fed to the control grid are produced in the tube. If the curve splits up—see Fig. 3-h, upper right corner, for example—neither of the two parts of the curve may be identified with the tube characteristic. This must be kept in mind. Therefore the variable phase shifters must be altered until the loop is as thin as possible.

As they influence the amplitude, too, the gain of the two scope amplifiers connected between the tubes and the vertical deflection plates in the actual circuit must be altered. It is advisable to start with identical operating conditions for both tubes, to adjust all controls until two equal curves appear on the screen and then to make the changes. If the two tubes to be compared are not identical start with two identical tubes and then replace one of them with the other type.

The circuit in Fig. 3 combines two circuits of the kind described in Fig. 4. The two outputs of this combination are fed to the two vertical inputs of the double-traced scope. Plate and screen voltages can be altered to study different operating conditions. To go from one tube type to the other, in most cases, the socket connections have to be changed. This is done according to a simple principle (see Fig. 3): all terminals which have to be connected to the tube sockets are soldered to jacks. The leads going to the tube sockets are plugged into these jacks with banana plugs of two colors, one for each of the two tube sockets. The plugs are individualized by a code explained in Fig. 3.

So far I have experimented only with octal-base tubes, but other kinds of tube sockets certainly can be added without difficulty, since they are just soldered in parallel to the octal ones.

The experimenter will undoubtedly find many interesting uses for this tube checker. Certainly, its flexibility will enable him to speed up the design of equipment he is experimenting with.

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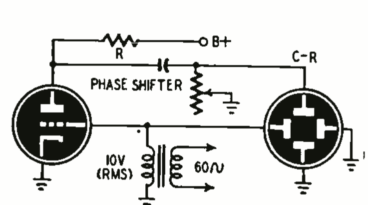


Fig. 4—Schematic for comparing E_g/I_p.

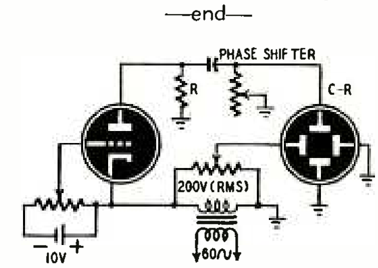


Fig. 5—Schematic for comparing E_p/I_p.

Modern Service Bench Design

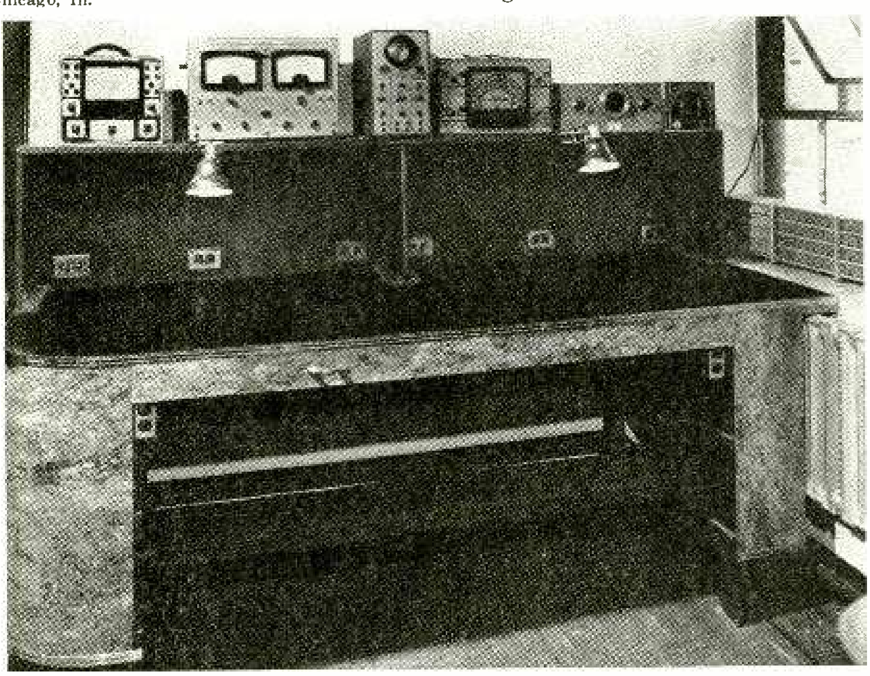
Easy to build and of flexible design, this bench permits efficient servicing

By GEORGE KELLY*

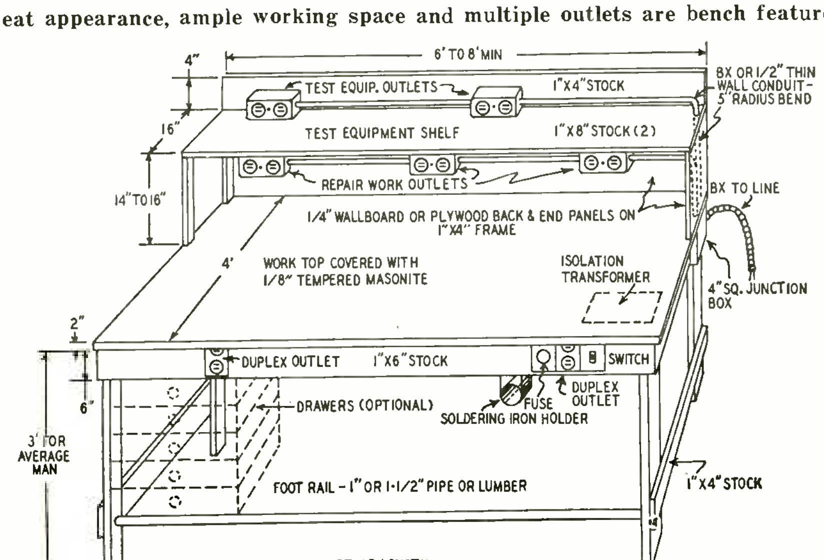
HERE is a useful service bench that will not grow obsolete. It requires a minimum of time to build and wire. While a bench with all test equipment mounted inside a panel has merit, it takes longer to build, and is not as easy to change once built. The type we recommend here is very flexible—in fact, the author's bench is ten years old and still meets today's requirements.

* Head instructor, De Forest's Training, Inc., Chicago, Ill.

The top of the bench (see accompanying diagram) may be built of rough (at least 1-inch) lumber. The legs can be 2 x 4's and should be screw-fastened for solidity. Nail 2 x 4's across the width of the bench for added strength under the work surface. The high, wide shelf holds your test equipment and allows it to be moved when necessary, closer to the unit being serviced. A rugged foot-rail set about six to eight inches above the floor relieves fatigue when one is sitting on a high stool.



Neat appearance, ample working space and multiple outlets are bench features.



Easy-to-follow drawing shows desirable features of the versatile model bench.

Tempered Masonite Presdwood gives the longest service on the working surface. Sharp chassis corners will not mar it badly. A hot soldering iron laid accidently on the surface will cause an unmistakable odor before charring. This type of surface also is very smooth and easy to clean. If you will be doing a great deal of TV servicing, your work surface should be at least 48 inches deep to accommodate large-screen receivers. Frame the edge of the work top with screen molding (called "clover leaf") to stop small parts, screws, etc. from rolling off when dropped.

The bench should be wired (see bench wiring circuit) with number 12 BX or wire enclosed in thin wall conduit. Tap in directly to the service panel on the electric meter so that no other circuits are on the same line or fuse. (This helps keep the bench quiet and free from interference.) Run the line in through a master switch and fuse at the bench, using a fuse of lower ampere rating than that in the electric meter box.

The isolation transformer has a 1-to-1 ratio and makes it possible to work without shock hazard on units where one side of the line connects to the chassis. If you do not care to purchase a commercial isolation transformer, it may be possible for you to make your own, using two heavy-duty transformers with the same ratings. Look through your junk box for these. Depending upon your own setup, transformers of at least 200 watts capacity should be used. Wire them back to back (secondary to secondary).

A small plastic-encased neon light may be plugged in under the test equipment shelf to serve as a pilot light. This cuts down on the work and expense involved with regular panel lights.

The number of outlets depends upon the individual requirements and purse. Be sure to allow for future additions on the test equipment shelf, though.

The layout of outlets is designed to keep the bench work top as clear of wires and leads as possible. Outlets along the back of the shelf are for test equipment; those under the shelf are intended for the receivers being repaired. Outlets on the front apron accommodate the soldering iron, electric drill or vacuum cleaner.

The soldering-iron holder is for the older type iron—keeping it handy and off the bench top. A one-gallon square can may be adapted for the newer pistol-grip irons, if so desired. An inexpensive heat control for the older irons can be fashioned by wiring a 50-or 100-watt light bulb in series with the iron. The shorting switch is opened when you want stand-by heat.

Antenna and ground leads should come in from the ceiling over small awning pulleys. Equip these leads with small alligator clips and counterweight them to pull up out of the way when released. A knot or bead on the line will stop it at the proper height.

A small, unfinished chest of drawers can be added under the bench inside the legs. These drawers can then be suitably compartmented for parts and tools.

The ideas for this bench are adaptable to almost any setup. Your own conditions will govern the size and other factors.

Other features can be built in as they are needed. Perhaps a running time meter could be wired in permanently to one of the outlets. This might help in checking intermittents. Certainly provision should be made for an auto transformer. A Variac is very useful for raising line voltages for temporary overloads to check pesky intermittents.

If the installation is not planned for long-term use, it might be advisable to screw all the joints together, rather than use nails. The model bench can then easily be disassembled.

If long leads from the testing apparatus tend to get tangled use this trick. Either wind the leads around a short length of spring shade roller, or else use the coil-up spring plastic shortener used on ordinary telephones to prevent kinks and snarls in connecting wires.

[Our thanks are due to *D.T.I. News* in which this article originally appeared (Vol. 12, No. 1).—*Editor*]

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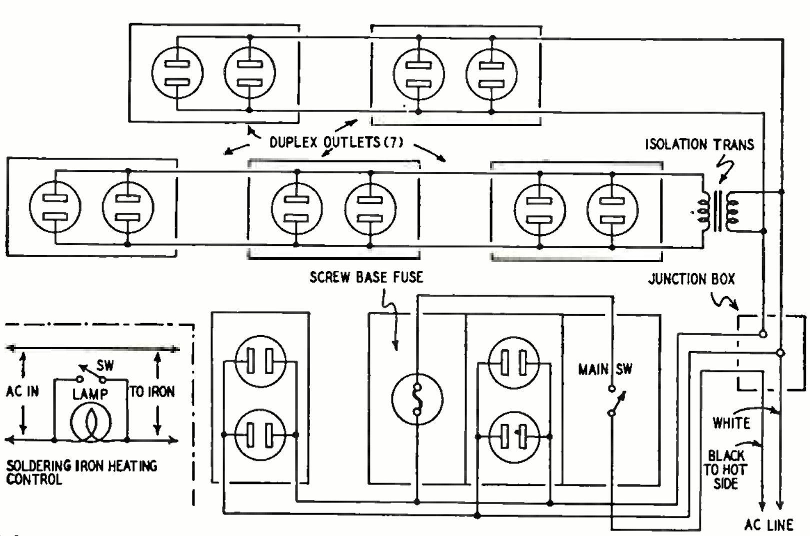


Model bench has simple wiring diagram. Note heating control; isolation unit.

Customer Relations Key to Profits

By JACK BEDFORD

"When a repair job leaves my shop," a radio service technician of my acquaintance told me recently, "I do everything I can to make the customer happy if he brings it back for an adjustment."

Though this dealer's volume was up, his net profit was too low. My analysis of his operation figures revealed the proper balance between labor costs and service charges. Parts were sold at a good mark-up and there was no excess loss from inventory shrinkage. Further analysis revealed that the adjustment expense was too high. Profits were leaking out through the "customer adjustment" account in his shop.

Because his service business had been built on adjustment of all customer complaints quickly it didn't seem advisable to discontinue this policy. While checking on this problem I heard the following conversation with a customer: "Now remember, if this doesn't work exactly right when you get it home don't hesitate to bring it back."

This type of closing remark had been devised to remove all possible doubt in the customer's mind about the policy of the shop or the quality of the workmanship. Closing remarks should do just that, but this one planted a doubt in the customer's mind just before he left the shop with his repaired set.

Half the battle to improve radio service shop operations is to discover the cause of low net profit return. In this particular case the cause lay in the repair man's negative remark. Once discovered this was easily corrected. The following statement was used: "I'm sure you will find your radio works all right now."

Reducing the number of returns and adjustments is a fundamental principle of profitable shop operation. To do this: *Display confidence in your work, and your product!* Your service work will then be sold—not returned.

—end—

Electronics and Music

Part XIV–The why of tone as analyzed by the formant theory of acoustic resonance

By RICHARD H. DORF*

THE most distinctive attribute of any musical instrument is its tone quality. There are other qualities, of course, such as its attack and decay envelope, its frequency range, and so on. But the principal reason for such a great variety of instruments is that each has a certain distinctive tone quality.

Let us look at some of the best known. The trumpet has a brassy sound—it blares obtrusively. Yet the French horn, a member of the brass family, has a muted sort of tone, rather smooth and formal. The saxophone (a reed instrument) is much smoother, with hardly any of the whine effect that can be heard in the upper registers of the oboe, another reed instrument. The stringed instruments of the violin family can sound sharp or relatively smooth according to the player's desire; but the violin and the viola, which belong to the same family, look almost the same, and can cover much of the same frequency range. They are easily told apart because of a marked difference in the way they sound.

This variety in sound qualities accounts for the sustained interest of orchestral and ensemble music. Many people who have heard a little about Tin Pan Alley think that the great composers merely wrote piano scores, then hired arrangers to convert the melodies and harmonies to orchestral form. Nothing could be further from the truth (except in a very few isolated instances), for one of the outstanding characteristics of great ensemble music is the artistic use of the various instrumental tone qualities. Each tone quality and each combination of them conveys quite a different impression to the hearer; and since music is really nothing but a series of impressions, the particular instruments are every bit as important as the melody, harmony, and rhythm. To prove this to yourself listen to someone play a symphony theme on the piano. Your impression of the music will be greatly different (and less favorable) than when an orchestra plays it in all its variety of tone coloration.

* Audio Consultant, New York City

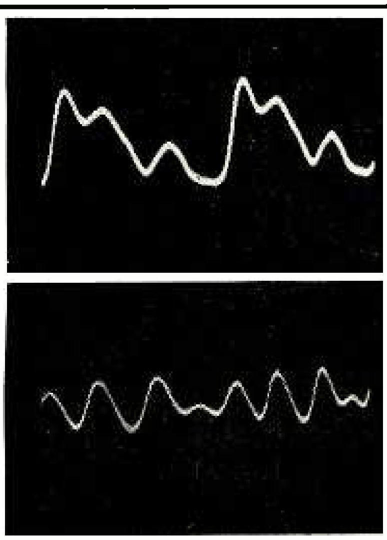


Fig. 1—(top) Choir, A 110, Violoncello, 8'; (bottom) Same, tone A 440.

In electronic musical instruments, tone quality is a prime factor in making an instrument good, passable, or bad. To be more accurate, an organ-like instrument—even a monophonic one (as compared with the multiple "voices" of a large organ)—must be capable of variation in tone color. It follows, therefore, that a circuit capable of producing the notes of the scale but incapable of producing a number of interesting and pleasing tone colors is of little or no value.

There are, as far as tone is concerned, two general types of electronic musical instruments. The first does not try to imitate the tones of ordinary acoustic instruments particularly; the Hammond organ is an example. The second tries to reproduce as closely as possible the traditional tones of the organ, as does the Baldwin organ. There are several other commercial instruments (all of which we shall describe later in this series) which compromise between the two classes—they are imitative to some extent but not entirely.

How musical instruments work

Some of the earliest work done in scientific circles to analyze instrumental sounds was carried on by Helmholtz, who worked on acoustic resonance. Helmholtz developed some of the first wave analyzers with which he analyzed sounds and found what they contained in the way of harmonic structure.

He did this by constructing small enclosures, each of which was acoustically resonant at a certain frequency. We can get roughly the same results by blowing at the edge of a bottle and producing that steamboat-whistle sound. We find that we can change the pitch of the sound by filling the bottle with a liquid and that height or lowness of pitch depends on how full the bottle is. We find that as we fill it more and more the pitch becomes higher and higher. This is a scientific experiment which shows us that a container is acoustically resonant at a certain frequency. The frequency depends on the size of the enclosure. It becomes higher as the enclosure becomes smaller.

The resonance effect is exactly analogous to the electrical resonance we obtain from a coil and capacitor or from a piece of wire or transmission line cut to a certain length.

Acoustically, resonance is not limited to enclosures. If we strike a bar or tube of metal, or a bell, we often get a sound of one pitch because the makeup of the material is such that it can vibrate at a certain optimum rate. A stretched string is also resonant at a frequency depending on its length, physical makeup, and tightness, so that when it is plucked or struck it gives off a certain tone.

Every finite object has at least one resonant frequency. It may not be apparent if the object is very large and heavy, for then the frequency is below audibility. Also the frequency is hard to find if the object is made up of a number of different materials each of which has a different reasonant frequency; then any one of the tones is hard to distinguish. The latter accounts for a standard test of a piece of good crystal glassware; if it gives a clear, sweet tone when struck it is made of high-quality glass, uniform throughout the piece. If it does not, the glass is inferior, because its structure at various places in the piece has varied in manufacture. The variations in the glass compound all have different resonances and the sound is dull because it is a mixture of unrelated tones.

Just as in electrical resonators, mechanical ones have a Q factor—a factor of efficiency. In a lumped electrical tank circuit the amount of pure resistance determines the Q. The more resistance the lower the Q, for then there are current losses which cut down the sharpness of the resonance. Sound losses come from absorbent surfaces. A tone can be produced by blowing into a cardboard milk container, but it will be lower in volume than that obtained from a glass milk bottle. The cardboard sides are not efficient as sound bouncers, for their roughness absorbs some of the sound and the resonance curve flattens out.

Acoustic resonance and Q account for the existence of the bathroom baritone. When you sing in the bathroom two things happen. First, the room itself has a low resonant frequency, which boosts the lower tones of your voice and tends to suppress the higher harmonics which cause unpleasant sound. Second, the bathroom has a high Q; its walls and floor are usually of very hard, smooth tile, so the sound is bounced right back at you instead of being absorbed.

The flute (and many organ pipes—which are nothing but king-size flutes) produce tones because of acoustic resonance. Air is blown across a sharp surface so that the stream is set into agitation. The inside of the flute, having a certain volume and shape, is resonant at a certain frequency. The pitch is varied by opening or stopping up holes which increase or decrease the length of the flute, and thereby its resonant frequency. Reed instruments such as the clarinet, oboe, saxophone, and so on, operate in the same way except that the air stream is agitated by the motion of the reed. Brasses are somewhat similar, with the air vibration produced by the player's lips when he gives the musical equivalent of a "Bronx cheer."

Why tone qualities vary

The only instrument which produces a fairly pure tone—one without a very high harmonic content—is the flute, especially in the lower registers. This is because the agitation of the air stream produced by blowing across the sharp edge at the mouthpiece is fairly constant in character. By the resonance of the flute's air column the stream is caused to vary from minimum to maximum but it never shuts off entirely. The tone consists mostly of the fundamental pitch, though there are harmonics because the air stream does not vary in a real sine manner. This is helped by the fact that the bore of the flute is cylindrical, with the same diameter at all points, so that each section of the air column has the same resonant frequency. The division into sections is by no means arbitrary, since resonance is produced not only by an air column of the wave length of the fundamental, but also by columns with lengths of a quarter wave and even smaller divisions. In this respect, an air column is very like an electrical resonant transmission line.

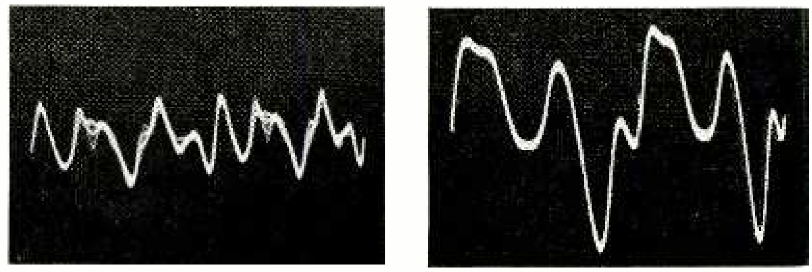


Fig. 2—(left) Choir, A 110, Orch. obe, 8′; (right) Great, A 440, Tuba, 8′.

The reed instruments are entirely different in character from the flute. The reed of a saxaphone or clarinet as affixed to the mouthpiece leaves a slight opening. When blown, the reed is set into vibration against the lay of the mouthpiece. As the opening increases and reduces, the waveform of the air stream that it produces is almost a true sawtooth—gradual rise and sudden drop. Since a sawtooth wave contains an infinite number of harmonics, with the volume of each proportionate to its ordinal number, obviously the harmonic content of a reed instrument is high.

The brasses have the same type of effect, since the lip movements create the same sawtooth shape.

The sawtooth mode of the air stream is produced by pressure variation. At first, with the lips or reed toward closure, a certain amount of air produces great pressure, since it is restrained by the closure. The pressure makes the lips or reed open. As the opening becomes wider, the air pressure becomes less and the opening action it gives becomes less. When the opening is wide enough, by tone control of the player, the reed, or with the trumpet player the lips, spring toward closure, continuing in rapid vibration.

The shape and size of the instrument and the materials of which it is made determine just which of the harmonics originally generated are heard and in what proportion. Thus the basic simple conception of tone quality variation by harmonic content variation accounts for much of the tone difference among the instruments.

Helmholtz's resonators were used many years ago to analyze the tones. The instrument to be tested was played into several resonators in turn; by listening the experimeter could get an idea of which resonators showed resonance and from that he could build up a picture of tone content.

The next step was to discover from a practical standpoint what was responsible for the total tone quality of a given instrument. Helmholtz held the theory that only harmonics of a given fundamental existed in any tone, but research since then has refuted that and developed a *formant* theory which takes into account, so far as is known up to now, all the characteristics of an instrument.

Let us take the case of the clarinet. The air stream is varied in practically sawtooth form by the reed. The length of the air column determines the fundamental resonance and the fundamental note produced. The fact that the bore is conical rather than cylindrical means that different sections of it have different resonances. Therefore for the higher frequencies which are harmonics of the fundamental the column is divided into several parts and certain harmonics find resonances and are emphasized. The material of which the clarinet is made gives a certain Q—we might call it a sound-bounce factor— which determines how much each resonant harmonic is emphasized. This is true because the amount of bounce or absorption is different at different frequencies.

But in addition to all this, the wood body of the instrument has its own resonant frequency because it has a certain mass and makeup. Therefore, every time it is struck by a puff of air the body gives off a damped wavetrain of a period determined by its own resonant frequency, which is usually higher than the highest fundamental note of the instrument.

This is the essence of the formant theory. It refutes Helmholtz, for the formant frequency—the natural reso-

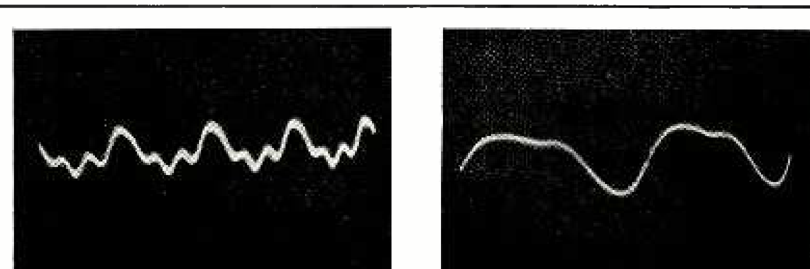


Fig. 3—(left) Great, A 110, Flute, 4′; (right) The same but with Flute A 440.

nant frequency of the instrument body —bears no harmonic relation to the tones of the instrument. In addition to the small damped wave train obtained by shock excitation, the resonance of the body emphasizes the harmonics which fall at and around it.

The explanations we have given here are simplified. The subject is a large one and men have spent years of study on it. Readers who are interested in a deeper study can get much good information from standard texts on acoustics and from issues of the *Journal of the Acoustical Society of America.*

Electronic tone synthesis

Two distinct approaches are used in electronic musical instruments for producing various tone colors. One, gener-

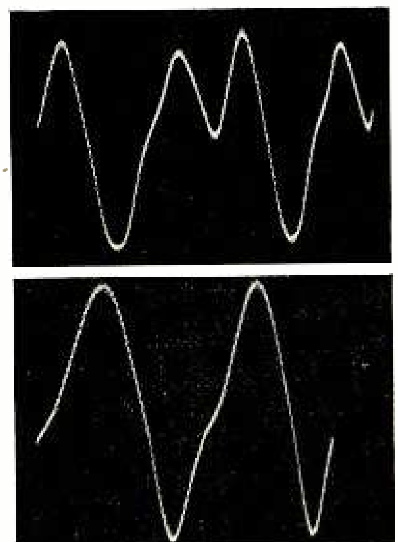


Fig. 4—(top) Great, A 110, Open Diapason, 8′; (bottom) The same, A 440.

ally known as *harmonic synthesis*, constructs specific tone colors by mixing together sine waves corresponding to a fundamental and the desired harmonics. This is done in the Hammond organ, which we shall analyze in next month's article.

The second approach might be called synthesis by analogy and is based on formant theory. It analogizes with electrical components the acoustic properties of the instrument to be imitated. The fundamental tone may be obtained from a sawtooth oscillator which simulates the lip movements or the reed action. One or more resonant circuits may simulate the natural resonance of the instrument body. A set of filters may attenuate and emphasize various parts of the frequency spectrum to correspond with the effects of a conical air-column bore and of a bell at the end of the instrument. The bell, whose prime function is air-coupling, also has resonances which emphasize certain portions of the spectrum. Differentiator circuits may make the wave into a series of sharp pulses to simulate the effect of the horsehairs in a bow, which set a string in motion in a series of sharp jerks.

Fundamentally the difference between the two systems in that the first builds a tone from its ingredients while the second generates a wave containing all possible ingredients and then deletes those not wanted. In actual practice, however, there is another difference. With the second approach, all the notes can be passed through a single set of filters for a particular tone quality. Since the formant frequencies and those of emphasis and attenuation do not vary no matter what fundamental pitch is being produced, the waveform of the finished tone is different from note to note. If a formant frequency for a certain quality is 800 cycles, for instance, then a 200-cycle note will contain a large component of its fourth harmonic. A 400-cycle note would have a large second-harmonic content, while an 800-cycle note of the same instrument or stop would be a pure sine wave (though usually a second, higher, formant takes over at this point). Thus the waveform of the three notes of the same stop would be different; this is the case with actual acoustic instruments and the realism obtained with the system is remarkable.

With harmonic synthesis, as it is used in the Hammond organ, the controls are so set that every note has the same harmonic content. For a given setting, for instance, there may be 50% fundamental, 25% second harmonic, and 25% third harmonic. Then every note of the scale has the same waveform. While this system produces pleasing tones, it does not simulate ordinary instruments (though many of the diapasons can be successfully approximated).

The oscillograms shown in this article were taken from the tones produced on a 3-manual Kilgen organ in an auditorium at Oklahoma Agricultural and Mechanical College, Stillwater, Okla. They were made especially for this article by Professor Hugh Lineback, to whom the writer expresses great appreciation. These photos show how the waveforms of particular stops are altered at different frequencies.

To make these waveform photographs Professor Lineback placed a microphone in front of the organ chamber of a 3-manual Kilgen and recorded the patterns of most of the stops at two pitches two octaves apart, the A just above middle C (440 cycles) and the A two octaves lower down. Comparison of each pair shows clearly how the harmonic content lessens more nearly approaching a sine wave, as the 440-cycle tone comes nearer to its formant (which is different for each stop) and to the upper-frequency limit of the harmonics of the pipe. The legends indicate the organ department (group of pipes and corresponding manual), the frequency, the name of the stop, and the register.

The waveforms of the 8-foot violoncello stop, Fig. 1, are particularly interesting. Notice that at 110 cycles, the main outline of the waveform is a sawtooth. That is so because the violoncello pipes are actually reed pipes—and the characteristic basic reed, as we have said earlier, produces a sawtooth waveform. The sawtooth is modified by the formants of the pipe. The 440-cycle violoncello pattern is considerably simplified from a harmonic standpoint, since the formant frequency is being approached.

The oboe is a true reed. Its sound is rather "buzzy," indicating a complex harmonic structure. That structure is amply illustrated by the oboe patterns, Fig. 2, left. Even without lengthy analysis, it is easy to see from the many undulations and irregularities of the waveform that it is far from a simple sine wave.

The tuba is normally a brass instrument, but in a pipe organ it is approximated by a reed. The tuba waveform, Fig. 2, right, indicates a complex harmonic structure and—even more important—its complexity even at 440 cycles shows that its formant frequency must be rather high.

The flute tones of an organ are produced by flue pipes rather than reeds. It is often supposed that a flute tone is almost a sine wave. The patterns shown here, Fig. 3, refute that to a large extent. As we said early in this series, a sine-wave tone is musically uninteresting. The flute pipes have harmonic output and formants just like the others. The flute pattern for A 110 (it is actually a 220-cycle tone because it is in a 4-foot rank) is obviously well endowed with harmonics, though it is simpler than the brass, reed, and string stops such as the tuba, oboe, and cello. It's formant is not too high, however, for the 440-cycle pattern shown next to the other is beginning to approach sine-wave form.

The diapasons, Fig. 4, are heavy flute-type tones which are the foundation of what most hearers think of as true organ quality. The 110-cycle diapason pattern is relatively simple, showing a large fundamental content, with the second harmonic the predominant one. At 440 cycles, the fundamental is very strong. Though there are some higher harmonics, as evidenced by the slight waveshape irregularity, the wave is very nearly sine. Because of this the diapason is never used as a solo voice, its principal function being to reinforce other organ stops or congregational singing.

Readers who plan to build electronic organs will be interested in comparing the waveforms of their own instruments with these to see on the oscilloscope how close they come to realism. (Of course, stops with the same name on different organs vary somewhat.) Actual analysis of these patterns by inspection is extremely difficult, but clues can be obtained by comparing the patterns with the many harmonic combinations pictured in the new *Encyclopedia on Cathode Ray Tubes and Their Uses*, by Rider and Uslan (John F. Rider Publisher, Inc.). Actual examples of networks which produce realistic tones were given in the Thyratone article (see March and April issues).

(continued next month)

Audio Feedback Design

Part X—Designing a center-tuned, resistance loaded amplifier for 1.6 mc.

By GEORGE FLETCHER COOPER

WHEN I first went out into the world I had the good fortune to fall among a group of network engineers. They introduced me to a concept which has proved useful ever since. Simply, it is this: all problems are network problems; all network problems are low-pass problems.

For instance, why does your wife go through your pockets at night? Because the feedback circuit in Fig. 1 has not been provided with sufficient feedback. A network engineer would see two solutions immediately: (*a*) give your wife all your money ($\beta = 1$), or (*b*) put your pants under the mattress (brute force solution). This application of feedback theory to nonelectrical problems is known as cybernetics.

A more technical aspect of the network engineer's attitude is shown when he is given the problem of matching an antenna to a transmitter. He takes a bridge and measures the impedance between antenna and ground terminals at a number of frequencies in the working band. These figures enable him to say that between those terminals there is a reactance and resistance in series. He designs a circuit to get energy into the resistance and leaves it to the antenna engineer to see that this is radiation resistance and not just straight loss.

This preamble is intended to act as a shock-absorber for the reader who expects this article to be about conventional audio, because I intend to discuss narrow-band bandpass amplifiers, which in general means intermediate-frequency amplifiers. I propose to show, however, that these amplifiers can be designed in complete accordance with the rules we have already discussed in our previous articles, just as though they were audio amplifiers. This is not to say that you can build a radar i.f. amplifier for 60 mc in the same way as you build an audio amplifier. But . . . you can construct a 3-stage amplifier with 20 db feedback for use at, say, 1 mc—without any new design curves!

Why build such an amplifier? Mostly for special applications, such as the time I was receiving strong local station pickup on my lead-in running from the antenna on my roof to my set. (I happen not to like the local station programs.)

The basic amplifier we shall consider is that which is sometimes known as the center-tuned, resistance-loaded amplifier. The plate circuit of each tube contains a parallel network of resistance, inductance, and capacitance. Each circuit is tuned to the center frequency. This type of amplifier is easier to design as a feedback amplifier than the stagger-tuned type in which the plate circuits are tuned to different frequencies. The center-tuned type is also easier to line up, because three or more reference frequencies are needed in the stagger-tuned type. In the latter case the spacing of these frequencies governs the pass characteristic and a good signal generator must be used.

Let us look at the basic element of the circuit. This is shown in Fig. 2, and consists of inductance L in parallel with capacitance C. The admittance of this circuit is $j\omega C + 1/j\omega L$.

Notice that it is easier to use admittance (than reactance) when you deal with parallel circuits. In theoretical work admittances make mathematical

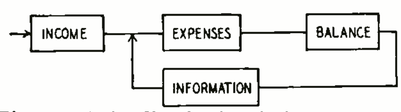


Fig. 1—A feedback circuit in a network engineer's life. Resistance is neglected.

manipulations easier. So we will do some manipulation and see what we can make of this admittance. $Y = j\omega C + 1/j\omega L$. Adding the two over the common denominator $j\omega L$, we have $(1-\omega^2 LC)/j\omega L$. Now let $\omega^2 LC = 1$. This will be the case at the antiresonant frequency ω_o:

$$\omega_o = 2\pi f_o = 1/\sqrt{LC}\,.$$

At this frequency the admittance Y is zero and the circuit of Fig. 2 is tuned to resonance.

At this frequency $1/\omega_o L = \omega_o C$ (the reactance of the coil is equal to that of the capacitor. By using $\omega_o C$ for $1/\omega_o L$, and going through a number of mathematical rearrangements, our expression for Y above comes out

$$Y = \frac{j\omega_o C \left(\frac{\omega^2}{\omega_o^2} - 1\right)}{\omega/\omega_o}$$

Suppose to save space and trouble, we let Ω (capital omega) represent

$$\frac{\omega_o \left(\frac{\omega^2}{\omega_o^2} - 1\right)}{\omega/\omega_o}$$

in our further calculations. The admittance is then simply $Y = j\Omega C$. For a single capacitor, the admittance at a frequency ω is just $Y = j\omega C$.

The reader will be well advised to think about these two equations very carefully. He will see that anything which can be said about a capacitance at a frequency ω can be said about an anti-resonant (parallel) circuit at a "normalized frequency" Ω. For example, 1,000 μμf has an admittance of 1/16,000 ohms at 10 kc. Put 100 μh in parallel, and the anti-resonant frequency is 500 kc. This means that $\omega_o = 2\pi \cdot 500{,}000$ and at this frequency $\omega = \omega_o$

$$\Omega = \omega_o \frac{1^2 - 1}{1} = 0$$

So the admittance is zero, just as the admittance of the capacitor alone is zero at zero frequency. Raising the frequency slightly, to 505 kc:

$$\Omega = 2\pi \cdot 500{,}000 \; \frac{\left(\frac{505}{500}\right)^2 - 1}{\frac{505}{500}}$$

$$= 2\pi \cdot 500{,}000 \; \frac{[\,(1.01)^2 - 1\,]}{1.01}$$

$$= 2\pi \cdot 500{,}000\ [0.02] \text{ approx.}$$

$$= 2\pi \cdot 10{,}000$$

and the admittance, $j\Omega C$, is .0000628, or 1/16,000 ohms. The admittance at 5 Kc from the center frequency is equal to that of the capacitor alone at twice 5 Kc from zero. We shall get the same number if we examine the admittance at 495 kc.

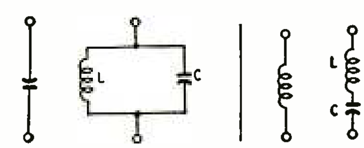


Fig. 2 (left)—This basic reactance circuit is equivalent to capacitance as shown. Admittance = $j\omega C + 1/j\omega L$ Fig. 3 (right)—L and C replace inductance in the band-pass to low-pass equivalence. Impedance = $j\omega L + 1/j\omega C$

Without working out the theory in detail, I propose to state, and the reader can check, that *the admittance of an antiresonant circuit f cycles away from the tuning point is equal to that of the capacitor alone at 2 f cycles away from zero.* To help the reader who wants to check this, the approximation used is $(1 + \lambda)^2 = 1 + 2\lambda$.

We can do the same thing for the series circuit of Fig. 3. Here the impedance is $j\omega L + 1/j\omega C = (1 - \omega^2 LC)/j\omega C$

$$= \frac{j\omega_o L \left(\frac{\omega^2}{\omega_o^2} - 1\right)}{\omega/\omega_o} = j\Omega L$$

with Ω having the same meaning as before.

Let us look at a very simple application of this result. A low-pass filter has been designed in the form shown in Fig. 4-a. It may have been designed by a purely arithmetical process to give a

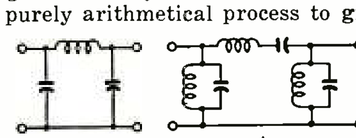


Fig. 4—Substituting Figs. 2 and 3, low-pass filter (a) becomes bandpass (b). Added elements tune to center frequency.

special response: now we want a bandpass filter to give the corresponding performance.

First of all, remember that there is a factor "2" in the low-pass to bandpass transformation. If we want the bandpass filter to work up to f cycles on each side of the center frequency we must make the low-pass filter have a design cutoff of 2f cycles. We have seen: that we can replace a capacitance by an antiresonant circuit with the same capacitance (allowing for the factor "2"; and that we can replace an inductance by a resonant circuit with the same inductance. The bandpass filter is thus obtained by using the circuit shown in Fig. 4-b. The added elements are those which tune the low-pass components to the center frequency. The bandpass problem is just a variant on the low-pass problem.

Now we may look back to the circuit we need for our amplifiers. This is shown in Fig. 5. We can write the admittance of this as $1/R + j\Omega C$ and re-

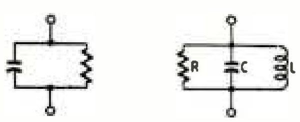


Fig. 5—Plate load; band-pass amplifier.

membering the equations we used in setting up our templates (Part II, November, 1950) we can say that the circuit has a characteristic frequency Ω given by $\Omega CR = 1$. At this frequency, which is most conveniently written $\Omega_0 = 1/CR$, the response is 3 db down. It is at a distance ω_a from the center frequency, and $\omega_a = 1/2CR$.

The low-frequency and bandpass circuit responses are shown together in Fig. 6. This is drawn in the usual "response" form without decibel and logarithmic scales, so that the relationship between the two curves and the usual universal "resonance curve" of the textbooks is made more obvious.

The way in which the factor "2" appears can also be remembered by considering these two curves. It will be seen that for any C-R the total bandwidth is the same. In the low-pass case this means that the band extends from 0 to f: in the bandpass case it extends from $f_0 - f/2$ to $f_0 + f/_2$. There are a number of ways of interpreting this mathematically, but they are all beyond our scope. Perhaps the only thing we need to mention is that the noise energy is the same wherever you put the band.

Notice also that the low-pass case is not simply a bandpass extending from $-f$ to f, centered on zero: this produces an error of 2: the bandwidth 3 db down is the same for low-pass and bandpass, but because there are two sidebands, the audio width is halved in the bandpass case.

One more point to observe: For our purposes, the bandwidth is taken at the 3 db down level. You will find very often in textbooks that the 6 db point is used, but this has no significance for our design technique.

Let us now turn to our specific task, the design of a bandpass amplifier with feedback. We shall take the center frequency to be 1.6 mc, so that $\omega_0 = 2\pi \times 1.6 \times 10^6 = 10^7$, and the bandwidth to be 16 kc (8 kc on either side of the center frequency). From what we have said above, this is really equivalent to designing an audio amplifier to work up to 16 kc. We shall use two 6AK5's and a 6AQ5, since this is a paper design. Let us see what we can do with a 3-stage amplifier.

For the 6AK5 we can rely on having a transconductance of 4,000 μmhos, and we shall be safe in taking an input capacitance of 7 μμf and an output capacitance of 5 μμf. The capacitances of the 6AQ5 are higher, and we must assume about 10 μμf and 15 μμf. The book values are lower than this, but the socket must be taken into account. The optimum load for the 6AQ5 is 5,000 ohms, so that with decoupling the stage gain in the output stage is 20 times. Since in this sort of amplifier we usually apply the feedback from cathode to cathode, the 1st and 3rd stage cathodes will not be decoupled, and the output stage gain is only 10 times.

It is important to notice that the plate circuit of the 6AQ5 should not affect the behaviour—from the stability point of view—of the amplifier since the feedback comes from the cathode. Theoretically we have only two circuits in the feedback loop, and therefore it must be stable, whatever we do. But let

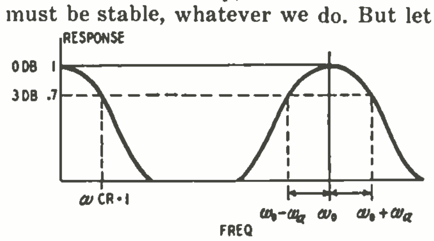


Fig. 6—Low-pass (left); band-pass (right), range $f_0 - f_2$ to $f_0 + f_2$.

us look at the first plate circuit. The total capacitance is made up of the output capacitance of the first tube and the input capacitance of the second tube: this gives us 12 μμf. With wiring, coil capacitance and an allowance for trimming let us increase this to 25 μμf. The bandwidth is 16 kc, so that we can be 3 db down at the band edges if we have

$$2\pi \times 16{,}000 \times 25 \times 10^{-12} \times R = 1$$
$$R = 400{,}000$$

This implies that the Q of the coil must be 100, which is a moderately good coil: let us take this as one circuit. The stage gain, without decoupling, will be about 800 times. Using the templates of Part II, we draw the sideband responses, putting ω_a at 50,000 ($2\pi \times 8000$). Adding another circuit with ω_a at 200,000, we get over-all curves which show that the phase margin for 20 db feedback is 45°, which is a fairly safe value.

At first sight this looks like a reasonable design. The second circuit, for which ω_a = 200,000, has a capacitance of the same order as the first, if we make slightly less generous allowance. It is easy to see that for this circuit $R = 100{,}000$, and without decoupling the stage gain will be 200 times. This means that the total gain is $800 \times 200 \times 10 = 1{,}600{,}000$, or over 120 decibels.

In theory, all we do now is calculate the inductances, and connect a feedback resistor cathode-to-cathode. In practice we have left out a very important factor, the plate-grid capacitance of the tube. Consider the second tube: the impedance in the grid circuit is 400,000 ohms; the plate-grid capacitance is at least 0.02 μμf even without strays. This capacitance has an impedance—at 1.6 mc—of 5 megohms. As a rough approximation

$$\frac{.4\text{ meg}}{5\text{ meg} + .4\text{ meg}} = \frac{4}{54} = \frac{1}{13.5}$$

of the plate swing will be fed back to the grid. I have ignored the phases, because we only want a rough figure for the moment. It is obvious that with nearly one tenth of the plate swing reappearing at the grid, we cannot use a gain of 200 times, so that our design procedure breaks down because it leads us to values which are not practical in this case.

We get round this problem by checking on the grid-plate capacitance first. We know it is 5 megohms, so we can construct a table:

Plate load	Plate-grid feedback ratio	Gain for Gm = 4,000 and no decoupling
100,000	50	200
50,000	100	100
25,000	200	50
20,000	250	40
10,000	500	20

This table is used in conjunction with the required gain, which we haven't mentioned so far. Let us take a figure of 50 db, with 20 db feedback. Without feedback we need 70 db, and the output stage will give us 20 db. By using plate loads of 10,000 ohms in each of the first two stages, giving 26 db gain in each (20 times), we get a gain without feedback of 72 db, which is near enough.

Having fixed R, we can go back and calculate the capacitances. We have, for one stage,

$$2\pi \cdot 16000 \cdot 10{,}000\, C = 1$$
$$C = 1/1000\ \mu f = 1{,}000\ \mu\mu f.$$

For the other stage, with four times the bandwidth,

$$C = 4{,}000\ \mu\mu f$$

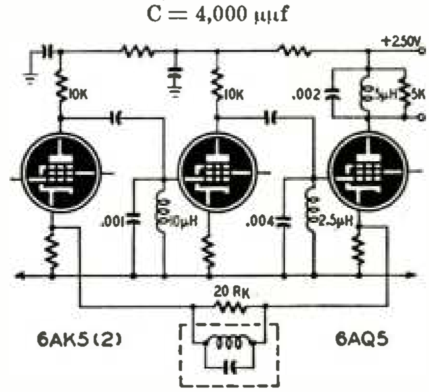


Fig. 7—Essential structure of 3 stage amplifier with a band-pass of 1.6 mc.

Improving Table Radios

Simple changes in the audio end of receivers bring big set tone; low cost and little time needed

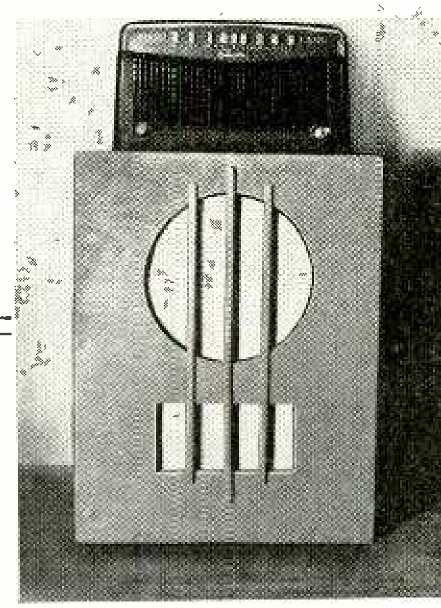
By JOSEPH MARSHALL

EVEN the best commercial radio receivers represent some compromise between the conflicting demands of tuning range, sensitivity, and tonal fidelity. Tonal fidelity suffers most in commercial designs, especially of small, inexpensive table-model receivers. However, it is possible to improve the tonal quality of even the simplest receivers at a relatively low cost in parts and time. The resulting performance will not equal that of expensive high-fidelity systems, but it will show a surprising improvement.

Most of these receivers have a converter, one stage of i.f., a combined diode detector and a.f. amplifier, followed by a beam pentode output stage. Older receivers used vacuum-tube rectifiers; recent models use the simpler selenium type. The diagram in Fig. 1 is of the audio end of such a receiver.

This type of simple superhet is more suitable for modification to higher fidelity than many more elaborate sets, because the r.f. and i.f. system has a pass-band of about 15 kc. This will pass most of the desired high audio frequencies and all of that transmitted on AM broadcasts. Yet it gives a reasonably good attenuation of adjacent channel interference. More elaborate superhets may have a much narrower pass-band with attenuation of high audio frequencies.

The single-ended audio power amplifier may seem unsuited to any effort at higher fidelity. If high power output is needed, it certainly would be; but if used in a small room, it will almost never have to supply more than ¼-watt of electrical power. Even with an inefficient loudspeaker, a single-ended stage can easily produce this much power with little distortion. But there are factors beside power output.



Simple set-up uses baffle for good tone.

The loudspeaker system

The biggest tonal deficiency of table-model receivers lies in the speaker system, especially at low frequencies. Not much can be done with the small speakers and the small enclosures of the receivers as they stand. The solution is an external speaker and baffle.

A good 8-inch speaker is the smallest size from which any low-frequency efficiency can be obtained. Several extended-range 8-inch speakers are available at moderate prices. Aside from a wider response, these speakers usually have a 5- or 7-ounce Alnico V magnet to increase the acoustic efficiency. For the same sound output, the power tube delivers less electrical output and operates at lower output and distortion levels.

Most 8-inch extended-range speakers have a 6- or 8-ohm voice coil, while the receiver probably has a 4-ohm speaker and an output transformer to match. This mismatch is not significant, the bad effects being more than made up by the greater efficiency.

A small bass reflex enclosure using a reflex port half the area of the speaker makes a good baffle. We produced the small enclosure pictured in the photo and diagrammed in Fig 2. The inside dimensions are approximately 16 inches high, 12 inches wide, and 11½ inches deep. The reflex port is 6 x 3 inches in size and is placed 2 or 3 inches below the speaker opening. The enclosure is figured for a cone resonance of 100 cycles, which approximates that of most 8-inch speakers of this type.

The construction is simple. Front and back are of ½-inch, 5-ply plywood, and the bottom, top, and sides are of ¾-inch plywood. Half-inch plywood could be

---

AUDIO FEEDBACK DESIGN *(Continued from facing page)*

The output stage, which has a resistive load of 5,000 ohms, will give a response 3 db down at the band edges if we should now make the total capacitance 2,000 μμf.

We now calculate the inductances which must tune these capacitances to 1.6 mc. They are:

1,000 μμf	10 μh
2,000 μμf	5 μh
4,000 μμf	2.5 μh

With this information, the amplifier design is almost complete. The 6AK5 does not like more than 180 volts on the plate, at 7.7 ma. We can put the 10,000-ohm resistors in the plate-supply leads to drop the voltage, and use the 250-volt line for the 6AQ5. The coils are then connected in the grid circuit, as shown in Fig. 7. The gain from the 1st grid to the 3rd cathode will be about 200 times, which we propose to reduce by a factor of 10. The feedback resistor therefore must be approximately 20 Rk times the cathode resistance.

What more remains to be done? This depends on the design specification. We can compute the stability margin, in the way I have described in Part VI. We can calculate the exact response, using the mu-beta calculator described in Part IX. We can, if needed, put a network in the feedback path to make the response drop more rapidly outside the working band. This network, which corresponds to a capacitance in the ordinary audio amplifier, has been shown dotted in Fig. 7.

The example I have chosen is a very simple one, because the use of feedback in high-frequency amplifiers seems to afflict a lot of people with quite unnecessary feelings of nervousness. As you can see, it is just the same sort of problem you encounter at audio frequencies, except that the screen decoupling, plate decoupling, and band center (or low end at audio) effects can be neglected. In fact, audio amplifiers are really more difficult to design! The next article will deal with a signal generator with very low distortion, but we shall get back to audio again before this series comes to an end.

—end—

used throughout, but since it is difficult to make screws hold in the end grain of ½-inch plywood, some sort of reinforcement would be necessary. So it would be simpler and probably cheaper in the end to use the ¾-inch plywood as specified. Small pieces of such can be obtained, often cut to desired dimension, from lumber yards and carpenter and cabinet shops.

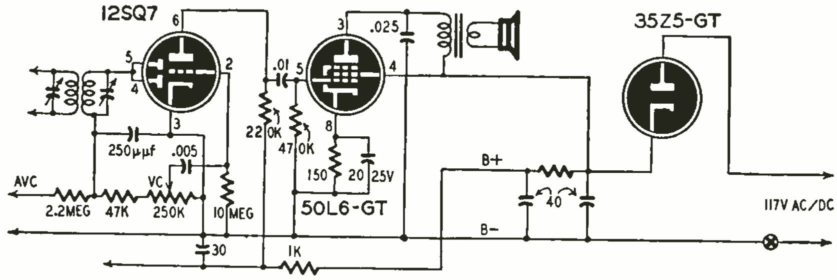


Fig. 1—Audio end of a small receiver. Compare with modified circuit in Fig. 3.

The baffle is put together with 1¼-inch screws. Spread glue or rubber cement thickly on both edges which come together, and pull them together tightly with screws to seal the joints. Fasten an 11 x 11-inch piece of acoustic celotex tile of the perforated type to the inside of the back. Other types of sound insulating material can be used, but this acoustic tile is perfect for the purpose. A ¼-inch hole is drilled somewhere on the back to pass the speaker cable.

This combination of speaker and baffle gives little response below about 80 cycles, but the response between 80 and 8,000 cycles is very smooth and clean. The combination has much less noticeable cavity resonance than larger enclosures of this type. The over-all quality, especially when the baffle is placed in a corner, will compare favorably with that of systems costing many times more . . . and the elusive quality of "presence" will be felt.

The output stage

The biggest remaining inadequacy now is the output transformer, which invariably is very small. A larger transformer could be substituted, but a really good one would have to be large and expensive because of d.c. core saturation. A simpler, cheaper, and in many respects a superior expedient is the use of parallel feed. This was a common practice in earlier radio days, seldom met with nowadays.

Removing the d.c. from the primary reduces core saturation and increases the effective inductance of a transformer. A careful choice of choke, coupling capacitor, and output transformer makes it possible to extend the bass response.

In practice, the change to parallel or shunt feed with the same transformer, especially when the change is supplemented with inverse feedback, results in an almost incredible improvement. Not only is the bass response wider and smoother, but the transient response is improved, transient distortion or hangover is reduced, and definition immeasurably improved.

The change is quite simple. The only extra parts required are a small filter choke—a midget 15-h, 50-ma choke is exactly right—and a 2-µf paper or oil-filled capacitor. The wiring is shown in Fig. 3. The big problem is finding room for the choke and the capacitor on the chassis or inside the cabinet. If necessary to make room, the output transformer could be placed inside the baffle.

This shunt feed can be applied to any audio-output stage, single-ended or push-pull. Use a choke of at least 15 henries, which will carry the current now going through the output transformer primary. (In push-pull circuits, an old output transformer can be used, (with the secondary open) as a center-tapped choke.) A paper capacitor of 2 to 4 µf will usually work with any transformer. (Push-pull circuits would require two of these, one for each output plate circuit.) If desired, various capacitor values may be tried for effect.

Inverse feedback

Most inexpensive table-model receivers do not use negative feedback, but it is simple to add it. Series feedback is the easiest to add, and requires the addition of only one resistor. The 680,000-ohm resistor gives a feedback of about 10% with the plate and grid resistor values given in the diagram. These values will be found in most of the receivers of this type; if the values are lower, the feedback resistor also should be lowered in proportion.

Other changes

The improved bass response of the speaker system, plus the improvement made by parallel feed may be so great at low frequencies that the hum level becomes annoying even when feedback is used. This is true only of receivers which do not use a filter choke, and the cure is to add a midget choke to replace the first filter resistor. When this change is made, the lead to the output tube should be changed from the cathode of the rectifier where it probably was originally, to the output of this choke to apply the benefits of the increased filtering to the output stage.

Now that we have provided a means for enjoying a good bass response, the original .01- or .005-µf coupling capacitor between the a.f. and power output stage should be replaced with an .05- or .1-µf capacitor. Finally, a jack for crystal pickups can be added. The diagram shows a circuit-closing jack. With such a jack, the phono plug when inserted automatically mutes the radio.

Another circuit-closing jack is indicated in the voice-coil circuit; when the external speaker is plugged into this jack, the internal speaker is muted. When the external speaker plug is removed, the radio can be used with the original speaker.

Some receivers have a shunt capacitor across the primary of the output transformer. When shunt feed is added, this capacitor can be disconnected.

Some receivers have a by-pass capacitor across the bias resistor of the power-amplifier tube. This elimination of the bypass results in a degree of current feedback. When series feedback is added, the addition of a bypass capacitor of about 20 µf will give an increased output, and a lower hum level.

These few and simple changes, which can be made by any technician or experimenter at a parts cost of about $12, including the new speaker and wood for the baffle, will improve the receiver almost beyond recognition.

—end—

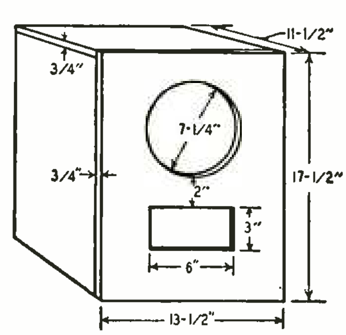


Fig. 2—A small bass reflex enclosure.

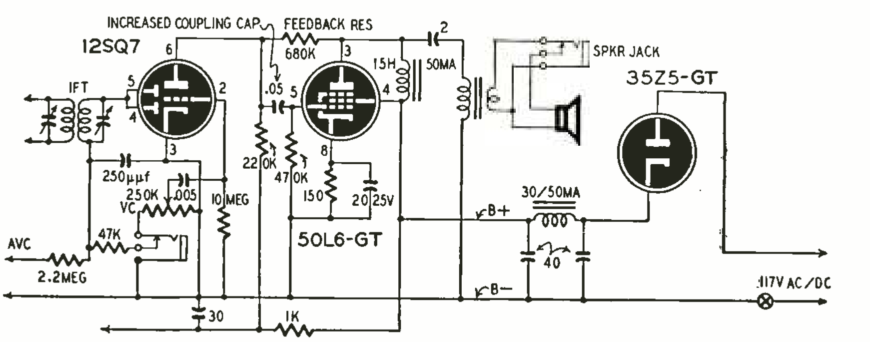


Fig. 3—Changes in the output stage include negative feedback and shunt feed.

How an Electronic Brain Works

Part XI—Beginning the timing and control circuits

By EDMUND C. BERKELEY* and ROBERT A. JENSEN

IN the last three articles, we discussed series of pulses representing information traveling along lines (conductors) in an electronic brain (electronic digital computer). In Part VIII, we told how a series of pulses could be stored in a delay line until they were wanted somewhere else in the computer. In Part IX, we added two series of pulses or binary numbers, 0101 and 1011, in an adder (see Fig. 9 of Part IX). In Part X, we multiplied 1101 by 1011 in a multiplier. To do so we made use of (1) six machine cycles of eight pulse-times each, and (2) five different sets of control pulses.

The questions that arise now are:

1. Where do those series of control pulses for controlling the multiplier come from?

2. How can we obtain them and any other control pulses that we may need or want?

3. If we have two registers storing numbers, how can we take numbers out of those registers, put them into an adder or multiplier, and then store the results?

In this article, we begin the study of the answers to these questions; in other words the study of the timing and control of an electronic computer.

Timing pulse selector

In the operation of the multiplier one of the sets of control pulses which we used was the following:

Cycle	*Pulse Series*
1	0000 0000
2	0000 0001
3	0000 0001
4	0000 0001
5	0000 0001
6	0000 0000

The name of this particular set was the Multiplier Digit Timing Pulse, since it enabled us to select the desired successive digits of the multiplier at the time we wanted each one. Each of the eight-digit binary numbers in the pulse series is read from *right to left*, and the 1 indicates a pulse at the pulse-time corresponding to the position of the 1 and the 0 indicates no pulse at that pulse-time.

We obtain this series of pulses (and also any desired series of timing pulses) with a *Timing Pulse Selector*, an assembly of delay lines, flip-flops, and a single initial pulse. See Fig. 1, a diagram of a Timing Pulse Selector.

In the Timing Pulse Selector, the loop at the left side of Fig. 1 containing the seven-pulse delay line repeats a pulse pattern every eight pulses. If this loop were divided into eight 1-pulse delays, we could choose in every cycle a desired pulse in any one of the eight binary digit positions that we might be interested in. In our particular case, we are interested only in selecting the eight pulse-time in each cycle. So instead of installing seven 1-pulse-time delays (as would be more general), we have installed a single 7-pulse-time delay. A lead from the output of this delay gives us the pulse series for the Reset Timing Pulse for F-F1 and F-F2 in the multiplier of Part IX.

The six 8-pulse-time delay lines (marked 8P) in the loop across the top of the diagram of Fig. 1, enable us to choose the first pulse-time in any one of the six multiplier cycles that we may be interested in. At the start of each successive cycle No. 1, 7, 13, and so on, a pulse appears on line L1. At the start of each cycle No. 2, 8, 14, and so on, a pulse appears on line L2. At the start of each cycle No. 3, 9, 15, and so on, a pulse appears on line L3, and so on.

To construct the desired series of control pulses for the Multiplier Digit Timing Pulse we connect output lines L2, L3, L4, L5 from this loop (through crystal diodes to prevent back signals) to the outgoing line T3. The only times when a pulse is allowed out on L2, L3, L4, and L5 is at the start of cycles 2, 3, 4, and 5, so that we obtain just the timing pulses which we desire, the Multiplier Digit Timing Pulse. Similarly, we can obtain the Readout Digit Timing Pulse on line T4.

*Author: *Giant Brains*, John Wiley and Sons, 1949.

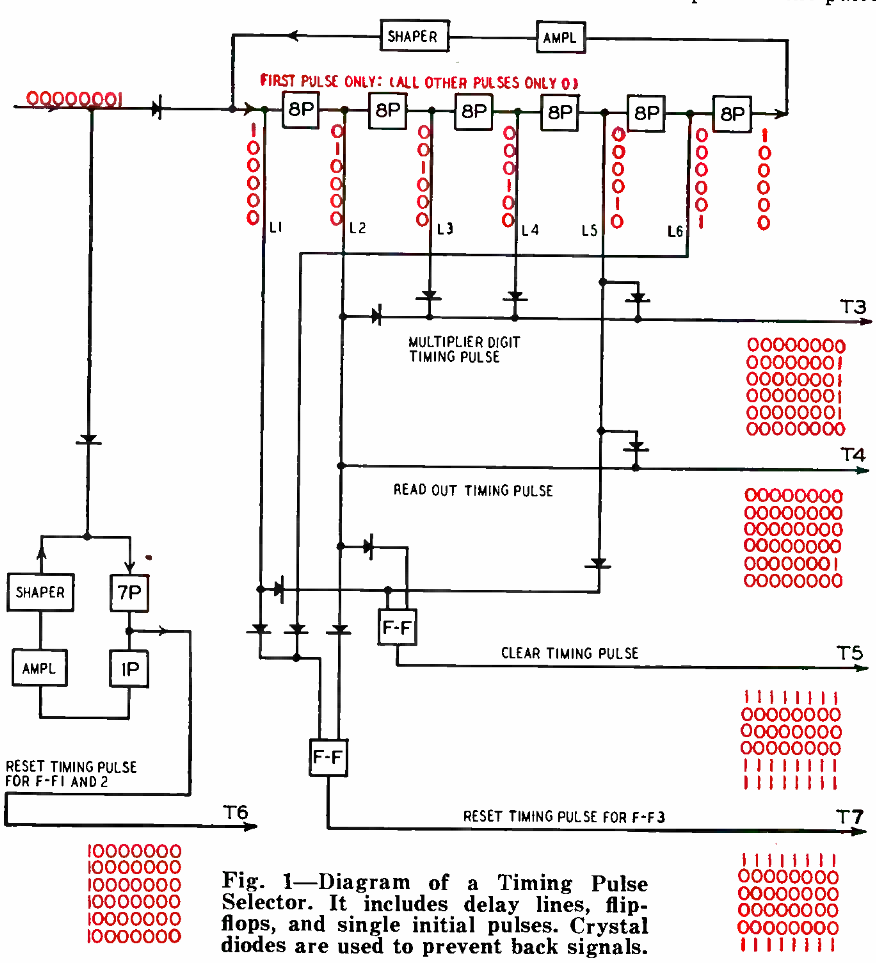


Fig. 1—Diagram of a Timing Pulse Selector. It includes delay lines, flip-flops, and single initial pulses. Crystal diodes are used to prevent back signals.

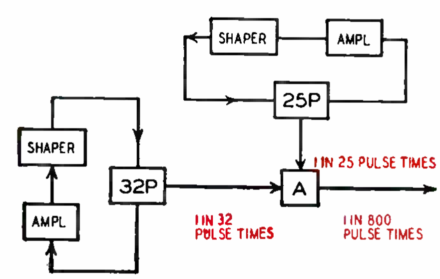


Fig. 2—Two circulating delay line loops.

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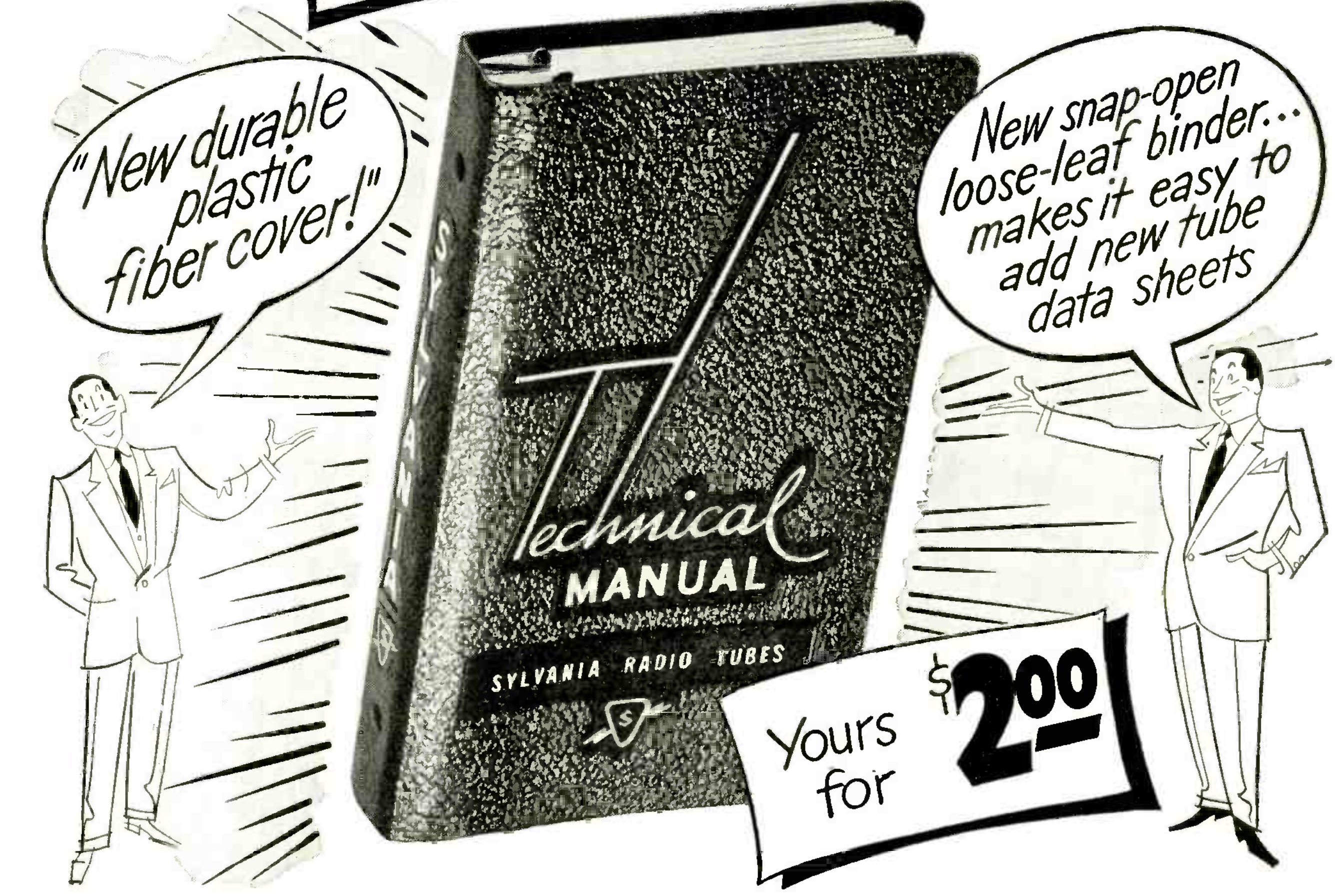

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The Clear Timing Pulse which we need for line T5 into the multiplier of the last article is a series of control pulses as follows:

Cycle	*Pulse Series*
1	1111 1111
2	0000 0000
3	0000 0000
4	0000 0000
5	1111 1111
6	1111 1111

To obtain this configuration of pulses—and the 1111 1111 can be one continuous signal, not necessarily a series of 8 separate positive pulses—we make use of a flip-flop. We need to set the flip-flop at the start of cycle 1 and cycle 5, and reset the flip-flop at the start of cycle 2. This we can do by appropriate connections through crystal diodes from (1) L1 and L5, and (2) L2, respectively. The reason we are using two set pulses and only one reset pulse is that when the machine is turned on, the first set pulse from line L1 is required.

Ordinary electrical delay lines are good for delays of about 50 pulse-times. After that, the pulses become indistinct. To get accurate control pulses at much longer intervals, the type of circuit shown in Fig. 2 may be used. Here there are two circulating delay line loops, one repeating at intervals of every 25 pulse-times and the other repeating at intervals of every 32 pulse-times. These two numbers have no common factor, so the pulses applying for admission to the AND circuit will match each other only once in 25 × 32 times, or once in 800 pulse-times.

We can now assemble some storage registers and some computing facilities, and begin to obtain a whole electronic computer. In Fig. 3 we have drawn a schematic diagram showing:

- a Main Storage, or memory, of 8 registers of eight binary digits each, in a 64 pulse-time delay line;
- a Computing Section, which can add, subtract, or multiply;
- an A-Register, and B-Register, which can take in numbers to be operated on in the Computing Section;
- an Operation Register, which can take in the instruction telling the operation to be performed; these last three are the Computing Section Input Registers;
- and a Result Register, which will hold the result of the operation produced by the Computing Section.

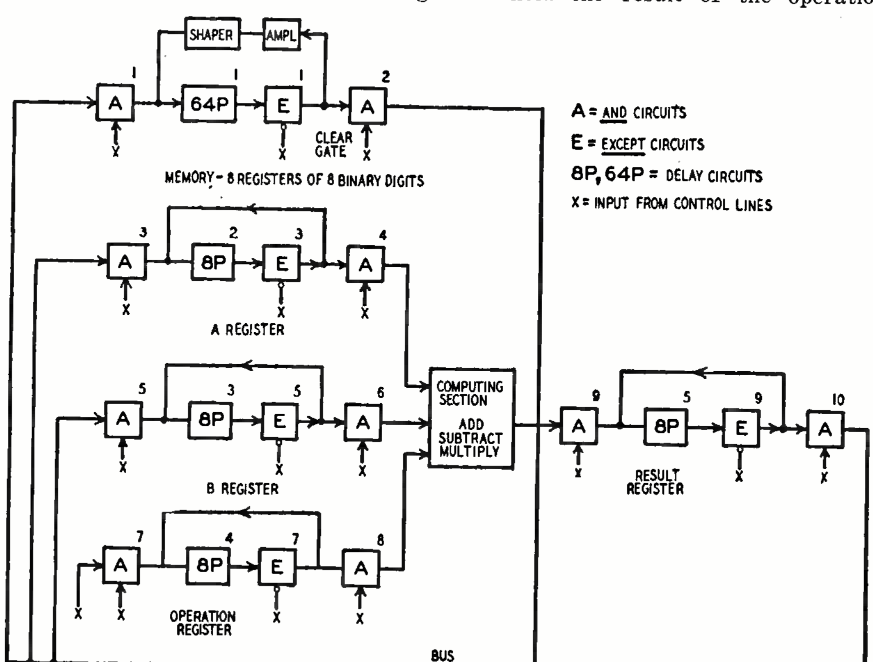

Fig. 3—Storage registers and computing facilities assembled form partial brain.

At the bottom of the diagram is the *bus*, a line along which numbers can travel from any register in the Main Storage to any Computing Section Input Register, and back again from the Computing Section Result Register to a register in Main Storage. Permission to any number to travel on the bus depends on the opening of the AND circuit. The operation of the circuit hinges on the control lines running to the ten AND circuits and the five EXCEPT circuits. These 15 control lines and the 16th line, the input of the Operation Register, all marked as ending with x, lead to controlled timing pulses and signals, and are related to the programming of an electronic computer.

A typical problem

How does this partial schematic of an electronic computer operate? In the Chart we show how this assembly would carry out a typical problem like:

> Take the number in the 2nd register, and the number in the 5th register, multiply them, and put the result in the 7th register.

The Chart lists minor cycles and major cycles. What are they? A minor cycle consists of eight pulse-times, beginning with the first digit of an 8-binary-digit number, and ending with the last one. A major cycle consists of eight minor cycles, a time sufficiently long for all the numbers in the Main Storage to circulate once completely around their loop. In general, to get any desired number out of Main Storage, we have to wait until it comes round the loop and grab it then.

To carry out our problem, the first thing is to get the number in the 2nd register out of Main Storage. This we do by waiting until the 2nd minor cycle comes along; we then open AND circuit No. 2, and let the series of pulses come out into the bus. But there is no way of storing them there, so we simultaneously open AND circuit No. 3, allowing this number to go into the A-Register delay line. This will do us no good unless we clear out of the A-Register any number already there, so we energize EXCEPT circuit No. 3. In this way we succeed in making the transfer we desire. This is step 1.

In step 2, we proceed in almost the same way, and transfer the number in the 5th register, using minor cycle 5. In step 3, we assume that the command for making the computing section multiply is available at minor cycle 8, and transfer it at that time.

Having filled the input of the Computing Section with the information it is going to use, in step 4 (the time is now minor cycle 1 within major cycle 3) we send the numbers and the operation into the computer, and assuming that not more than 6 or 7 minor cycles are necessary for the multiplication, the result comes out into the Result Register at the time major cycle 4, minor cycle 1.

Since the answer is to be stored in the 7th register, we do not have to wait for the next major cycle, but in this same 4th major cycle we can send in the number at the time of minor cycle 7. So at that time we transfer from the Result Register through the bus into the 7th register of Main Storage by opening the appropriate AND circuits, A10, A1, and operating EXCEPT circuit No. 1 to clear out any previous information in this register.

The chief topics remaining to be discussed are function tables, programming, and input and output. These we shall begin in the next article.

(Continued next month)

CHART OF MAJOR AND MINOR CYCLES

Process *Step*	Major *Cycle*	Minor *Cycle*	AND Circuits *Conducting*	EXCEPT Circuits *Inhibiting*
1	1	2	2, 3	3
2	2	5	2, 5	5
3	2	8	7	7
4	3	1	4, 6, 8	—
5	4	1	9	9
6	4	7	10, 1	1

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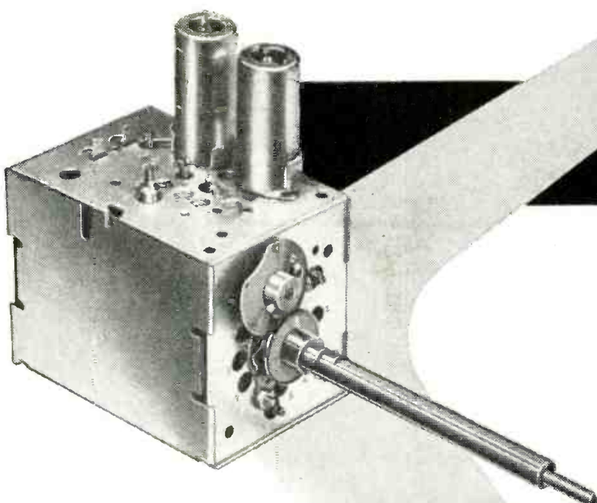

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Johnson at the controls of the modified Sky Buddy. A modulator unit is above.

More Range For The SW Receiver

By STAN JOHNSON, WOLBV

INEXPENSIVE "communications" receivers seldom have either r.f. stages or high-selectivity i.f. stages. Sooner or later the owner wishes the set had these two features—sorely needed to pull in the weak ones and to separate stations in the crowded amateur bands.

The solution is a simple but effective high-gain r.f. stage so designed that it connects to the doublet or balanced input antenna terminals on your receiver, plus a plug-in adapter which makes the i.f. stage regenerative. (Regeneration is the simplest and most effective method of stepping up i.f. selectivity toward the point of single-signal selectivity.) Both units are so designed that they can be added to a receiver without disturbing the original wiring—an important point if you plan to trade in the set at some later date.

The original units were built up for use with an old Sky Buddy. They pep up the receiver to the point where many 10-meter dx signals are readable which can't be heard at all without the r.f. unit. And the high-selectivity i.f. has pulled many a 160-meter phone conversation out of the fire when the going was rough. The Sky Buddy now performs like a hundred-dollar-plus receiver. And best of all, adding the "monkey glands" costs less than $10.00!

The simple r.f. amplifier (Fig. 1) uses a 6AK5, one of the hottest of the small r.f. pentodes and one which has been widely available as surplus. The i.f. unit requires no tube—it uses the i.f. tube already in the set.

The 2½ by 6½-inch panel for the r.f. amplifier carries the tuning capacitor for the r.f. stage, the r.f. gain control, and the regeneration control for the variable-selectivity i.f. stage. All the parts for the r.f. stage are mounted on the panel or on the 2½ by 6-inch chassis which is L-shaped and 2 inches high.

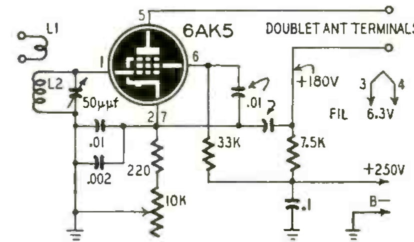
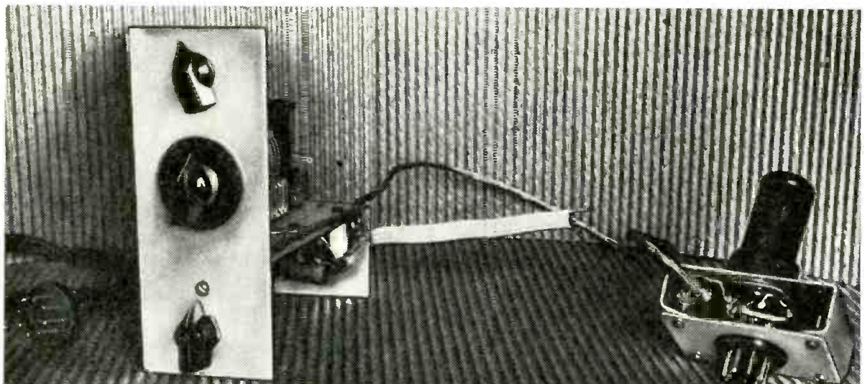


Fig. 1—The 1-tube r.f. amplifier circuit.

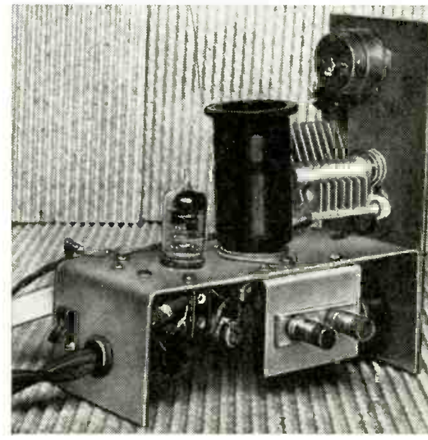
The size of the mounting for the i.f. adapter will depend upon the set in which it will be used. The limiting factor is the space between i.f. cans and other parts, above the chassis of the original set. Very little space is needed for this adapter because the only bulky part—the regeneration control—is on the panel of the r.f. amplifier.

Wiring either of the units is very simple and straightforward—if you are careful to avoid boners. Keep all leads as short as possible in the r.f. unit and bypass to the cathode terminals as shown in the diagram, Fig. 1. Plenty of bypass capacitors stabilize the stage—with the result that the original model was oscillation-free, even on 10 meters.

Obtaining voltage for the r.f. unit may take a bit of ingenuity—unless, of course, it is supplied from a separate power supply rather than from the receiver. The latter method is satisfactory—and a lot cheaper—with any of the sets which have 6.3-volt tubes. Most sets of the communications type



The r.f. unit mounts next to the receiver. The i.f. section plugs into the set.



Arrangement of parts keeps leads short.

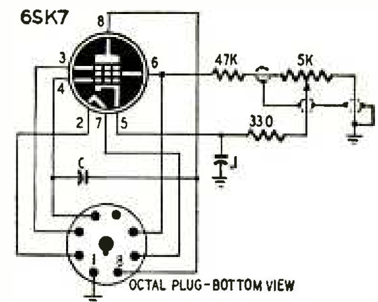
have a socket at the rear of the chassis which allows powering the set from an external source, such as a dynamotor. By studying the circuit diagram of the set, you can work out a method of picking up voltage by plugging into this socket. With the Sky Buddy all that is required is an octal plug.

Picking up operating voltage from a.c.-d.c. sets using 12-volt tubes is harder. On most of the sets, B-plus voltage can be obtained from the screen lead to the audio output tube. B-minus is tougher to find—one fairly easy point is the "set" side of the bypass capacitor which is ordinarily found connected to the external ground terminal of the set, if there is one. Otherwise, look for negative returns, but beware of getting on an a.v.c. line. With an a.c.-d.c. set, of course, heater voltage for the r.f. unit must co. ıe from a separate 6.3-volt filament transformer. Since the plate voltage in an a.c.-d.c. set is usually limited to 115, the dropping resistors in the screen and plate circuits of the r.f. amplifier may be omitted.

As mentioned previously, the output of the r.f. unit simply connects to the doublet antenna terminal on the receiver with a short length of 300-ohm ribbon. Try reversing the connections—gain will be better one way than the other. The r.f. unit is used, of course, to peak up signals which are tuned in on the receiver in the usual way. It is broad enough so that once set for the middle of an amateur band it provides some gain over the entire band—and can be peaked after the desired signal is selected.

In the i.f. section capacitor *C* consists of a lead connected to the grid and another lead connected to the plate contact of the i.f. tube socket. The leads are not connected electrically—they are simply moved close to each other to provide some capacitance. They should be pushed together—or pulled apart—until a point is found at which the stage oscillates—as indicated by a gentle "plop" in the speaker—with the regeneration control approximately half on. The point of highest selectivity comes just before oscillation begins. At this point there is a pronounced single-signal effect on c.w. and very high selectivity on phone.

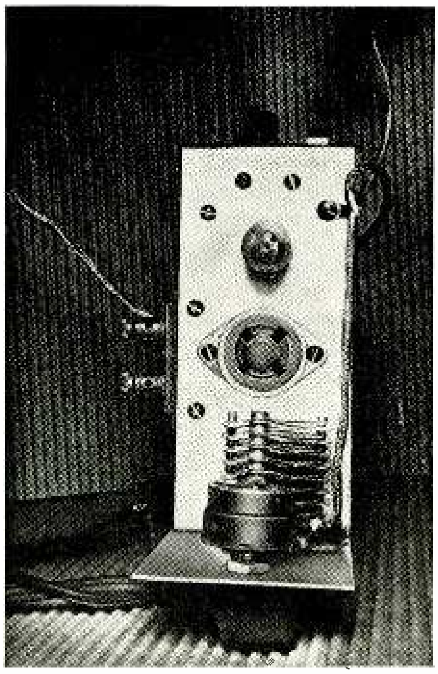
After the adapter is plugged into the i.f. tube socket and everything is working properly it is a good idea to touch up the i.f. alignment. If you don't have a test oscillator the job can be done by tuning the set to a noisy spot on the dial and adjusting the i.f. trimmers for maximum noise.



The adapter greatly aids selectivity.

The adapter shown is for a 6SK7, a tube widely used for the purpose. The wiring will have to be changed somewhat to accommodate other tubes. This is easy to do if the basic idea is kept in mind—all the terminals of the plug (which of course should duplicate the tube in pin arrangement) are connected to corresponding terminals on the socket in the adapter (plate to plate, screen to screen, etc.) with the exception of the cathode. The cathode prong on the plug is left open—and the cathode terminal on the socket returned to ground through the resistors in the adapter. The shield terminal on both socket and plug are used for ground return points.

The only critical thing on the i.f. adapter is the 3-wire lead to the regeneration control. This should be carried by a 2-wire shielded cable, the braid of course acting as ground. The shielding is necessary to avoid picking up interfering signals in the i.f.



Miniature tube points up chassis size.

COIL WINDING DATA

Range	L1	L2
10 meters	5 turns No. 26 close-wound	5 turns No. 26 spaced ⅝ in.
20 meters	6 turns No. 26 close-wound	10 turns No. 26 close-wound
40 meters	7 turns No. 26 close-wound	21 turns No. 26 close-wound
80 meters	12 turns No. 26 close-wound	42 turns No. 26 close-wound
160 meters	30 turns No. 30 close-wound	95 turns No. 30 close-wound

All coils wound on standard 1¼ inch 4-prong coil forms

Bill of Materials

Resistors: 1—220, 1—330, 1—7,500, 1—33,000, 1—47,000 ohms; 1—5,000 ohms, 1—10,000 ohms, potentiometers.

Capacitors: 1—50 μμf, variable, 1—.002 μf, mica, 3—.01, 2—0.1 μf, paper.

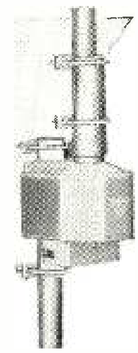
Miscellaneous: 1—6AK5 tube, 2—sockets, chassis, hardware, miscellaneous wiring material.

—end—

2 New Trio Products

TRIO TV ROTATOR AND DIRECTION INDICATOR

TWO HEAVY DUTY MOTORS
For Trouble-free • Two Direction Rotation



Here's the rotator that provides the ultimate in trouble-free dependable operation. Designed to support the heaviest TV arrays — even in 80 M.P.H. winds! This outstanding rotator has undergone extensive tests for three years, standing up under every abuse and temperature extremes.

Here, indeed, is the rotator that abolishes TV callback problems!

Two Heavy Duty Motors

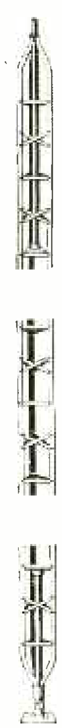
Two 24 volt motors are used — one for clockwise and one for counter-clockwise rotation. Even if children play with the unit and leave it on continuously, a motor cannot burn out since load on a single motor is never on more than 50% of the time!

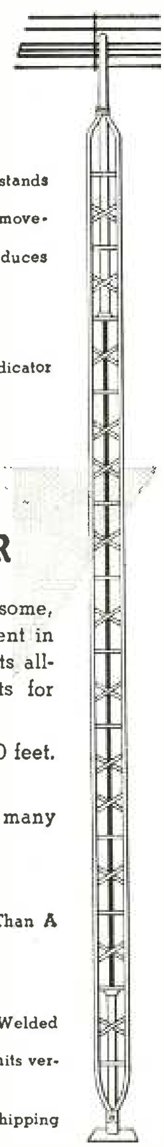
Positive acting electrical stops at both ends of 360° turn eliminates lead damage.

Indicator always shows exact antenna position.

Compare These Features

- Cast TENSALLOY aluminum mast holder withstands 4500 lbs. bending movement.
- 11/16 steel shaft withstands 4500 lbs. bending movement
- Automatic Electro-Mechanical Brake — reduces coasting to minimum
- Can be fastened to any pipe up to 2" OD
- Two direction rotation
- All-aluminum case — no cast zinc!
- Numbered terminal boards on rotator and indicator
- Turns 1 RPM, lifetime lubricated
- Ball-bearing end thrusts on shafts
- Ideal for 10, 6 and 2 meter amateur use





NEW TRIO *All Aluminum* TOWER

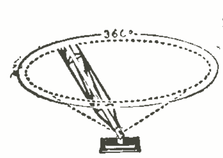
Weighing less than a pound per foot, this sturdy, extremely handsome, all weather-proof triangular tower represents a great refinement in streamlined appearance and installation ease over all others. Its all-aluminum components permit the most flexible arrangements for construction of the *exact* tower needed for *any* installation.

Tower may be raised from horizontal position in heights up to 40 feet. For additional height, sections may be added from *bottom*.

Comes in 5 foot sections, a bottom section, a top section and as many center sections as desired.

FEATURES

- Sturdy, Yet Light In Weight — Less Than A Pound Per Foot
- Forever Rust Proof
- High Quality Extruded Aluminum
- Interchangeable Sections
- Preferred Riveted Construction . . . No Welded Joints
- Dual Swivel Base — 180° and 360° permits vertical or horizontal plane mounting
- Low Installation Cost
- Completely Cartoned For Protection In Shipping — Compact Storage



Dual Swivel Base 180° and 360°

THOMPSON CORPORATION
AFFILIATED WITH TRIO MANUFACTURING CO.
GRIGGSVILLE, ILLINOIS

TRIO YAGIS
Lead the Field . . .

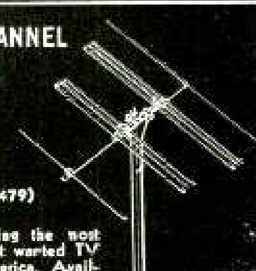
TRIO DOUBLE FOLDED DIPOLE

(Model 304)

Here is the popular TRIO Double Dipole TV Antenna. With 10 db forward gain and a front-to-back ratio of 25 db, it is unexcelled for extreme fringe areas. Available for each of 12 TV channels. Easily stacked for additional gain. Reinforced fittings for extra strength — extra rigidity!

- Exact Impedance Match To 300 ohm Line!
- Sturdy Construction — Light Weight!
- Partially Assembled!

TRIO 2-CHANNEL YAGIS



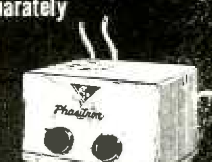
(Models 445 & 479)

Rapidly becoming the most popular — most wanted TV antenna in America. Available for channels 4 and 5, and channels 7 and 9. Provides gain on two channels equal to any two conventional 4-element yagis!

- Full 10 db Gain On 2 Channels!
- Less Weight Per Gain Than Any Other TV Antenna!

TRIO PHASITRON
Now available separately

(Model No. PC-600)



The TRIO PHASITRON, origi ally sold only as part of the TRIO Controlled Pattern TV Antenna System, is now available separately for TV set owners who want to get the very best results from their sets ard erten as or to hams and other experimenters.

PHASITRON acts as a continuously variable tuning stub and will provide an exact impedance match between line and booster and helpful in matching output impedance of booster to set input impedance. Due to exact matching, losses in line become negligible and set performance greatly improved.

May also be used to coordinate input from two or more antennas to provide added balanced output to set. Write for full details.

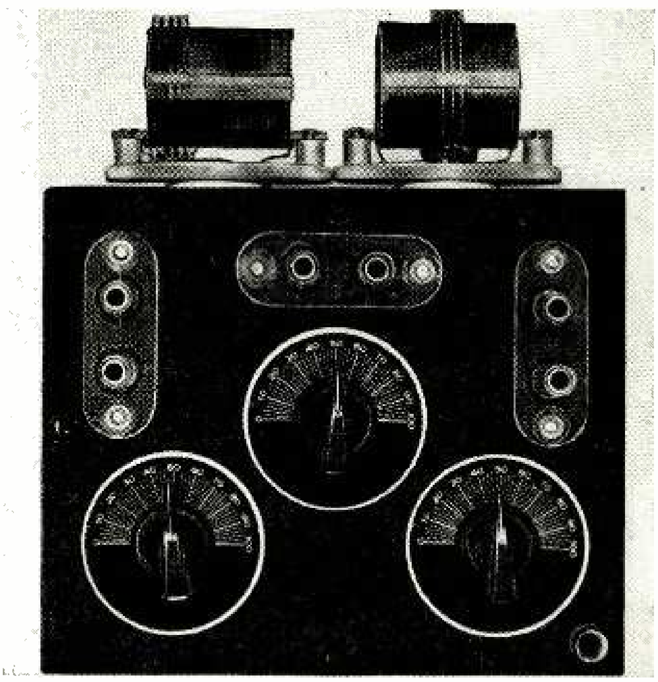
NEW TRIO TV ACCESSORY CONTROL UNIT

(Model No. RY-1)

A handy control unit that hides away inside or in back of the TV set and provides an automatic line switch for booster, rotator, TV lamp or other accessories. By plugging the line cords from these accessories into the TRIO Control Relay Unit, all accessories are turned on with the one switch controlling the TV set. Quickly installed without making any wiring change in set.

Trio MFG. CO.
GRIGGSVILLE, ILLINOIS

Double Coupler Matches All Antennas to Xmtrs



The coupler has a tuned circuit with resonant and π networks.

By HAL BUMBAUGH, W6HI

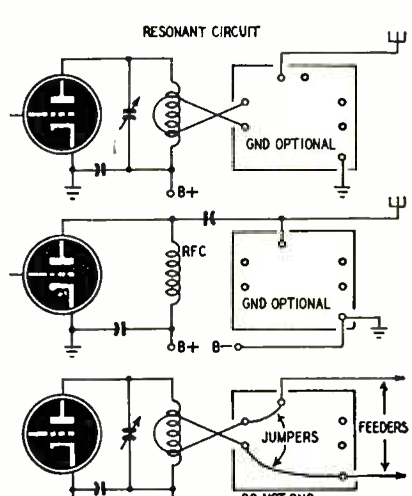
IN PORTABLE and emergency work you sometimes have to operate with anything but the ideal antenna. The little arrangement described here is capable of matching any antenna to any low-power transmitter. It is actually *two* antenna couplers in one box; a tuned circuit with link, and a π network.

The circuit given in Fig. 1 has two principal sections. The left half (left dial on the front panel, the jacks on left side of the panel, and the left one of the two jacks at the top of the panel) represents a tuned circuit—together with the left coil on top of the cabinet. Note here that only one of the coils shown in the photograph is used at any one time—never both coils together, as might be inferred from the photograph.

To return to the circuit. The tuned-circuit section may be used to feed any voltage-fed antenna including the off-center fed type. The ground jack at the lower right-hand corner of the front panel should be tried connected and unconnected to find the arrangement giving the best results. In this part of the circuit a small loop of wire with a flashlight bulb in series will help to tune the circuit for maximum energy. Maximum current in the tuned circuit should be arrived at with the antenna attached.

The π network may be used to couple any random length of wire to any small transmitter—even a transmitter whose final plate coil is the inductor plugged into the socket occupied by the right-hand coil in the photograph.

The most usual connection to this type network is through a coupling capacitor to the plate tank of the transmitter or—if the only inductance is that in the π network—through a capacitor to the plate of the final. Several types of connection for both the voltage feed from a resonant circuit and for the π network are shown in Fig. 2.



Getting it going

In adjusting the π network, if you are unfamiliar with this type of coupling:

First connect the network to the transmitter. Next, with the antenna disconnected, set the capacitor on the antenna end of the inductor (the loading capacitor) at about ¾ full capacity. Apply plate voltage and tune the other capacitor (on the transmitter end of

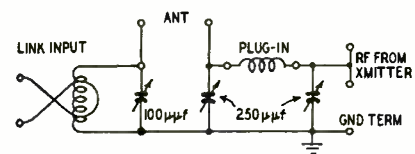


Fig. 1—Circuit of 2-in-1 antenna coupler.

the inductor) quickly to resonance. Resonance in this case should occur with the capacitor at the transmitter end of the inductor at from ¼ to ⅓ full capacity.

If this can't be done there is too much or too little inductance in circuit. Experiment will quickly tell which. After you tune through resonance with the tuning capacitor (the one at the transmitter end of the inductor) at from ¼ to ⅓ full capacity and the loading capacitor at about ¾ full capacity the antenna may be connected.

Again apply plate voltage and tune for a dip with the tuning capacitor. At this point you will find one of three conditions: the plate-current dip is too high, or the setting of the tuning capacitor has been greatly changed, or the plate-current dip is too low.

If the plate current dip is too high the loading capacitor (the one nearest the antenna) should be increased slightly and another attempt made to reach resonance with the tuning capacitor while getting the desired plate-current dip with nearly the original tuning capacitor setting. Several readjust-

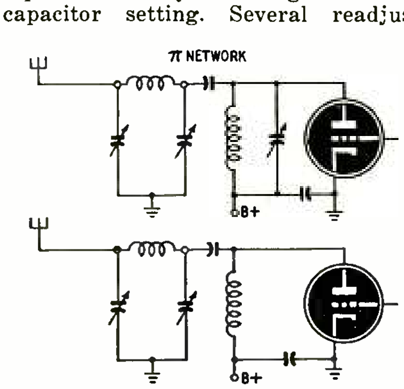


Fig. 2—The network couples any length antenna wire to the transmitter. The final plate inductor is plugged into the coupler. The resonant circuit uses link output as shown. In any case experiment is necessary to achieve maximum power.

CONSISTENTLY DEPENDABLE ROTATORS

TELE-ROTOR

This heavy-duty TELE-ROTOR has no match! It's more powerful . . . will turn any TV antenna array under any weather conditions. Easily installed . . . it is trouble-free in performance. Easiest of all to operate!

MODEL TR-2 . . . rotator with "compass control" cabinet having illuminated "perfect pattern" dial . . . (uses 8 wire cable) $49.95

Give your Customers the Best

You Can't Beat A TELE-ROTOR

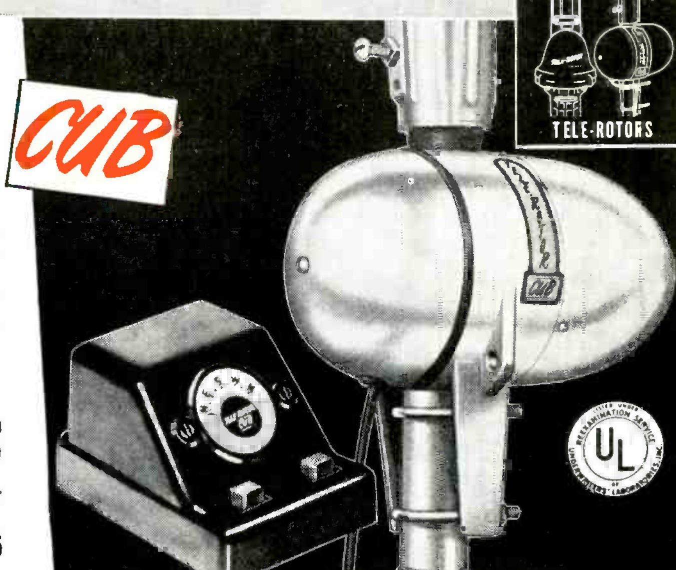
CONSISTENTLY DEPENDABLE ROTATORS

TELE-ROTOR CUB

The new TELE-ROTOR "CUB" is ideal for average installations. The same husky motor as the Heavy-Duty model . . . the "CUB" is the fastest and easiest of all rotators to install. All-In-Line design . . . with true in-line thrust between antenna and mast. The ¾" STEEL shaft rotates on a case hardened steel ball . . . with in-line reamed oilless bearings.

MODEL 502B . . . . . . Rotator with plastic control cabinet having indicating meter for "hairline" tuning. (Uses 5 wire cable) . . . $44.95

MODEL 501B . . . . rotator with control cabinet having end-of-rotation signal. Light flashes every 7.2° showing antenna is turning. (Uses 5 wire cable) $34.95



THE RADIART CORPORATION CLEVELAND 2, OHIO

CORNELL-DUBILIER SOUTH PLAINFIELD, N. J.

ments may be necessary to secure these conditions.

When the plate-current dip is too low the loading capacitance should be slightly decreased and conditions rechecked.

When the final adjustments have been made a quick check on their correctness may be made by disconnecting the antenna and finding a new resonance setting of the tuning capacitor. If this new setting occurs at nearly the same point as with the antenna connected, the network is functioning correctly and is matching the antenna to the transmitter.

When the inductor in the network serves also as the plate tank for the transmitter the coil table will be helpful. Changes in distributed capacities, etc., may require slight changes in the number of turns, but in general those given in the table will be correct.

Tuning the link

Many links, swinging and fixed, are of three turns. Frequently these three turns do not give adequate coupling at the lower frequencies (especially at 80 meters). Our little arrangement may be used to improve the condition in this case by partially tuning the pickup coil or loop and thereby reducing the inductively reactive component with a corresponding increase in effective voltage delivered.

Where a pair of feeders are to be attached to the link the arrangement should be as shown in Fig. 2. Note that no coils are used in either socket—merely two wire jumpers as indicated by the heavy lines. No ground connection should be made with this arrangement, even though the ground post is used to attach one of the feeders. The left-hand capacitor dial may be used for tuning, although frequently it is

Tuner Coil Table

BAND	COIL DIAM.	TURNS	WIRE
80	1½"	33 close-wound	#18 En.
40	1½"	15 close-wound	#18 En.
20	1½"	9 close-wound	#18 En.
10	1½"	5 close-wound	#18 En.

used at full capacity. While this arrangement has been little used by amateurs, it gives superior results to the old method of adding a number of turns to the pickup link to provide more voltage for the lower frequencies.

The capacitor in our tuning unit (250 μμf) is big enough to tune out the reactance of the pickup coil and develop maximum attainable voltage at 80 meters. If much work is to be done at this frequency, a 5-turn pickup coil will be additionally effective. This 5-turn loop also may be used on 40 meters. For higher frequencies no more than three turns should be used in the pickup coil.

—end—

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of Sylvania's big brilliant campaign for Service Dealers

Now begins the second half of Sylvania's greatest and most appealing ad campaign ever offered to Service Dealers.

Featuring 2 famous celebrities, Paulette Goddard and Patrice Munsel, this campaign ties in with big ads soon to appear in the Saturday Evening Post, Look, Life, and Collier's magazine, and is backed by the nation-wide weekly TV show, "Beat the Clock."

Everything included

Here's everything you need for a record harvest of fall service business. You get big, smashing life-like displays of the famous stars. You get counter cards, streamers, direct-mail pieces . . . even radio spot announcements.

Remember, you pay only one cent each for the mailing pieces. All the rest is FREE! So don't let another minute go by without calling your nearest Sylvania distributor . . . or mail the coupon NOW.

SYLVANIA

RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC PRODUCTS; ELECTRONIC TEST EQUIPMENT; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

SYLVANIA ELECTRIC PRODUCTS INC. 1901-1951 50th ANNIVERSARY FIVE DECADES OF PROGRESS

Sylvania Electric Products Inc.
Dept. R-2408B, Emporium, Pa.

Please send me full details about Sylvania's great Fall 1951 Service Dealer Campaign.

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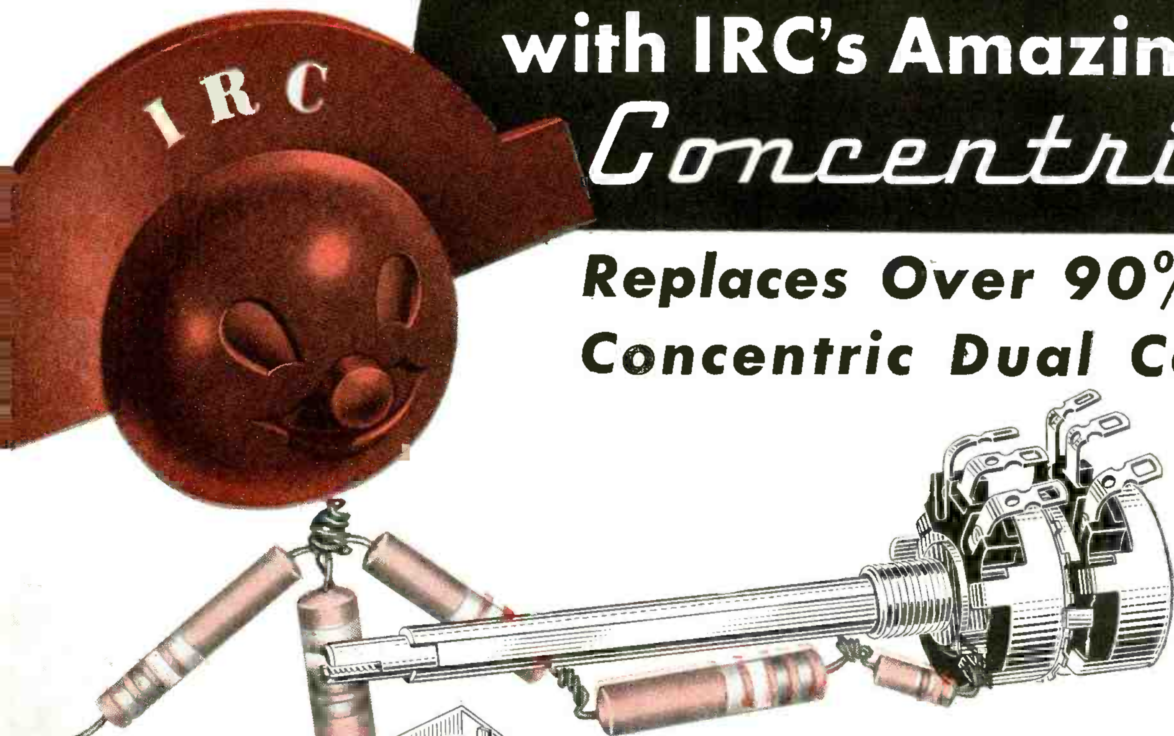
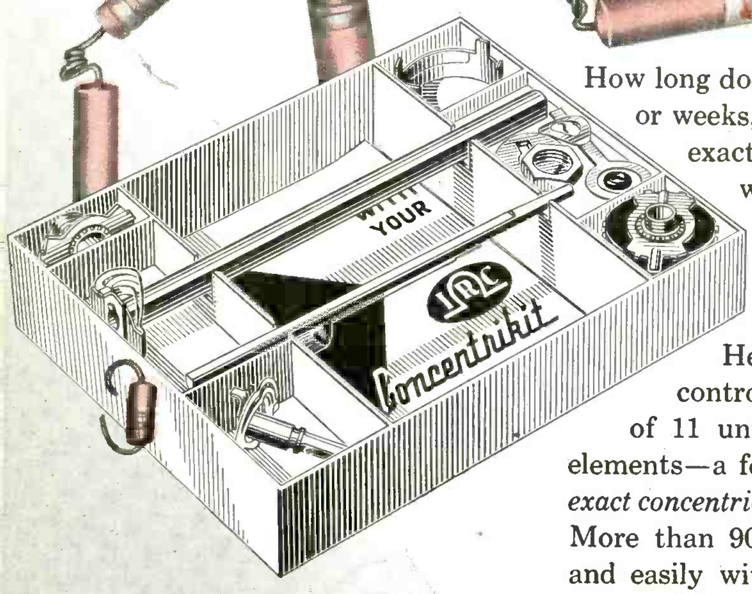
REPLACEMENT CONCENTRICS?

"Roll Your Own" with IRC's Amazing New *Concentrikit*



Replaces Over 90% of ALL Concentric Dual Controls!



How long does it take *you* to get replacement concentrics? Days or weeks, maybe, if you're looking all over the landscape for exact duplicates. *Minutes*—when you "roll your own" with IRC's astonishing new CONCENTRIKIT!

ASSEMBLE ALMOST ALL CONCENTRIC DUALS IN JUST A FEW MINUTES

Here, if we do say so ourselves, is the most sensational control development ever! A handy CONCENTRIKIT of 11 universal parts—a shaft end and a couple of base-elements—a few minutes with ordinary tools—and you have the *exact concentric dual you need* for home or auto radio as well as TV. More than 90% of all concentric duals can be replaced quickly and easily with CONCENTRIKIT! Think what this means in time-and-inventory savings.

EASY, FOOL-PROOF CONCENTRIC REPLACEMENT

Step-by-step instructions, furnished with every CONCENTRIKIT, make concentric dual assembly simple and easy. And IRC's comprehensive new TV Replacement Manual gives full data on concentrics from the earliest home and auto radio sets to modern TV. Be sure to get your copy from your IRC Distributor.

IRC *Concentrikit*

Stock Assortment Covers over 500 TV Models

ONLY **$24.78** DEALER NET COST

This Complete Assortment AND METAL CABINET at Only the Price of the Parts!

	Quantity		Quantity
Complete Concentrikits	4	B19-133X	1
Base Elements		B11-137	3
B11-108	1	B13-137	2
B11-114	1	B13-137X	1
B11-115	1	B18-137XX	1
B11-116	1	B19-137X	1
B17-116	1	B11-139	2
B11-119	1	B13-139	1
B11-120	1	B13-139X	1
B11-121	1	**Inner Shaft Ends**	
B11-123	2	E-187	3
B11-128	2	E-190	1
B11-130	1	E-202	2
B13-130	2	**Sleeve Bushings**	
B13-130X	1	S-4	1
B18-130X	1	S-5	1
B18-132X	1	**Resilient Retainer Rings**	10
B11-133	2	**Switches**	
B13-133	2	76-1	3
B13-133X	1		
B18-133X	1		

With this compact CONCENTRIKIT Stock Assortment on your bench, you're ready for all TV concentric dual requirements. Handsome, durable metal cabinet contains all you need to assemble any of 144 different concentric duals. Parts cover over 500 different TV models . . . RCA, Admiral, Air King, Belmont, Emerson, General Electric, Motorola, Philco, Westinghouse, Zenith, and many more. Order from your IRC Distributor now—or clip coupon for more information. International Resistance Company, 401 N. Broad St., Philadelphia 8, Pa.

This handsome, enamelled all-metal cabinet keeps your CONCENTRIKIT Stock Assortment safe and handy. Four drawers with individual compartments keep parts in order. Cabinets may be stacked with IRC Resist-o-Cabinets for convenience and good looks in the shop. ALL-METAL CABINET IS SUPPLIED AT NO EXTRA CHARGE—You pay only the regular price of the parts—$24.78.

ORDER YOURS TODAY!

IRC

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Wherever the Circuit Says —/\/\/\—

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☐ I'm interested in saving time and inventory investment with CONCENTRIKIT. Send Catalogs DC1B and DC2A with full information on CONCENTRIKIT and Dealer Stock Assortment.

☐ Enclosed find 50c in stamps or coin for my copy of IRC's new TV Replacement Manual.

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LETTER WRITING PASSÉ?

Letter writing is a thing of the past—at least to devotees of a new fad called wirespondence. They exchange their information vocally by taking down what they have to say on a spool of wire, enclose this in a small box, and drop it in the mailbox just as they would a letter. They have even started a world-wide club to integrate their activities.

Correspondence by wire, tape, or even record is not entirely new, and has been carried on for a number of years by a small group of enthusiasts.

Notable among these are such enthusiasts as, for example, "Pop" Gage of Keyport, New Jersey. A retired telephone official, he was forced to remain at home for considerable periods because of ill health coupled with failing eyesight. He used this enforced leisure and, with the help of wire and records, opened up his broken communication lines with the outside world.

One of his closest friends and correspondents is Emile Arsenault of New Bedford, Massachusetts, who is totally blind. Between them the term "wirespondence" is believed to have been invented.

Romance entered into the picture when Emile Arsenault in Massachusetts introduced his neighbor's daughter, by wire to a wirespondent in New York. The two young people began carrying on their own wirespondence after that. A few months later, after one meeting, they were married.

It remained for John Schirmer, an employee in the export department of Webster-Chicago, to put wirespondence on an organized basis. He had occasionally made recordings which he sent to distant friends. When the Russians blockaded Berlin, he began to worry about his mother, who lives there. At the same time, a pilot flying the airlift to Berlin requested a wire recorder from the company, and Schirmer got an idea. He sent along with the ordered equipment a 15-minute recorded message for his mother and requested the pilot to deliver the spool if he could.

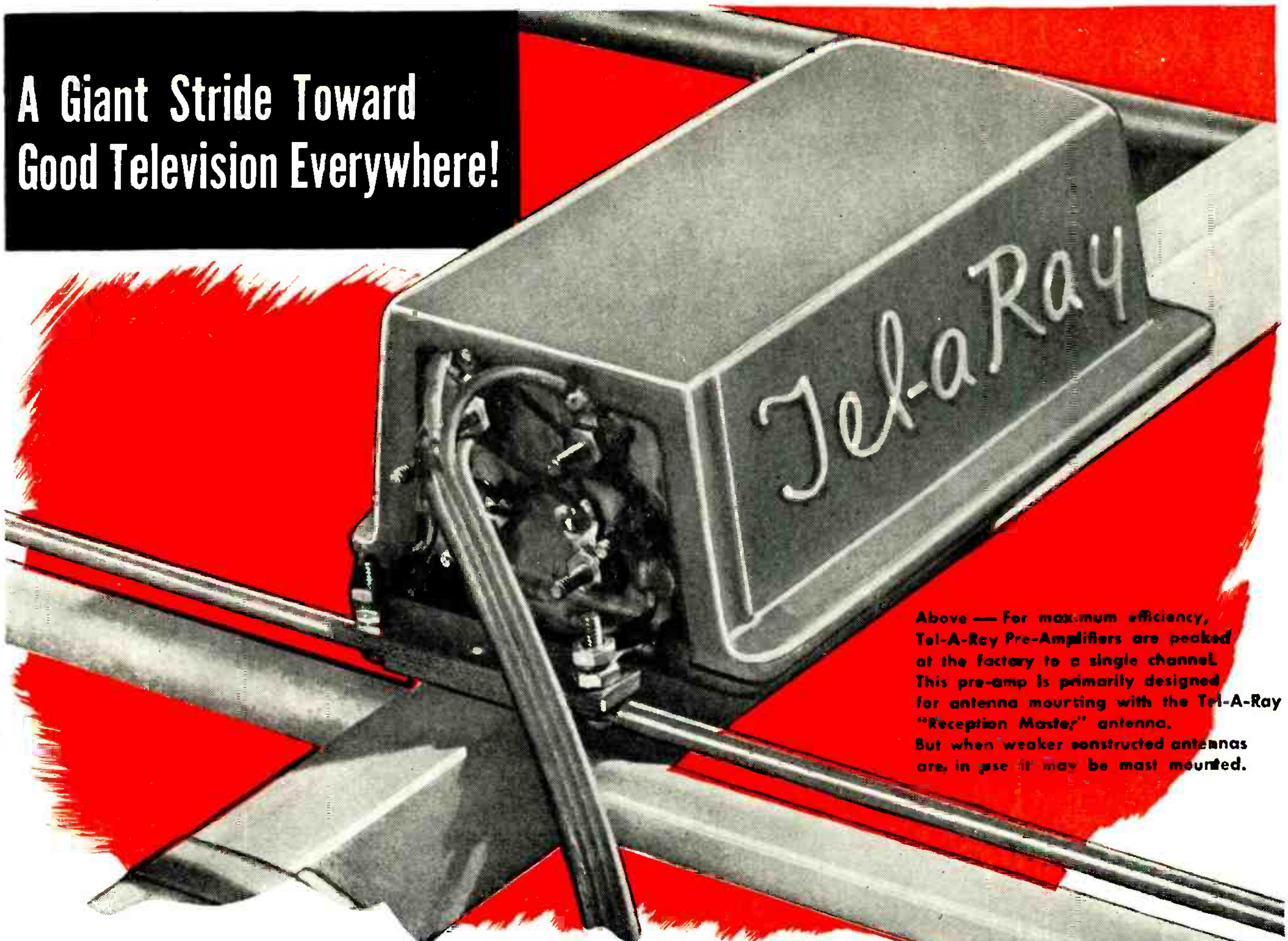
Before long, recordings started moving out of Berlin regularly, and Schirmer began sending the spools to other sections of this country.

Schirmer and his blind friend liked the idea so much that Schirmer approached his employer with the proposal that the firm set up a registration system for wire recorder enthusiasts who would like to correspond with others on mutually interesting subjects. The Wirespondence Club was officially formed, and within three months its membership totalled 830 persons in the United States and 20 other countries. Today the total is near 1,500.

The membership list includes the name and address of each wirespondent, a code number that tells his interests, and also the name of any specific city or country in which he would like to find a wirespondent.

—end—

A Giant Stride Toward Good Television Everywhere!



Above — For maximum efficiency, Tel-A-Ray Pre-Amplifiers are peaked at the factory to a single channel. This pre-amp is primarily designed for antenna mourting with the Tel-A-Ray "Reception Master" antenna. But when weaker constructed antennas are, in use it may be mast mounted.

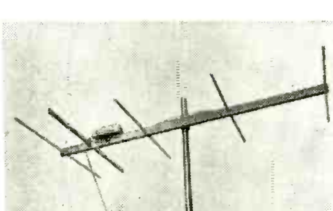
New, Improved TEL-A-RAY PRE-AMPLIFIER

gives clean, sharp reception beyond the fringe areas!

Here is an advance that can help sell many more television sets . . . that is a "must" installation wherever signals are weak and snow is a problem.

The only antenna-mounted device of its kind, the new, improved Tel-A-Ray Pre-Amplifier is now made in separate models for high and low channels . . . with a matched and tuned grid circuit that insures maximum gain and a stable signal. With it, television can now go beyond the fringe areas, and you have the simple, easily installed and economical means of insuring clear, sharp, snow-free television reception in many other locations. It is a tremendous advance with all the bugs worked out of it . . . ready for your use now in bringing good television to many more people.

USE WITH MODEL T OR TD ANTENNA for the best results



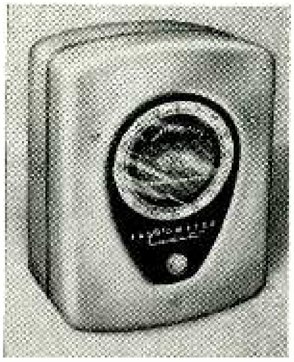
Installation of these famous long distance Tel-A-Ray antennas is the first step in getting clear, snow-free reception. With the Pre-Amplifier, they give up to 300 times gain over dipole.

- **Gives maximum gain in signal.**
- **Insures stability of signal.**
- **Provides for vastly improved signal-to-noise ratio.**
- **Compensates for lead line loss.**
- **Eliminates or greatly reduces snow.**
- **An essential complement to the booster at the set in many locations, and can be used without a booster in numerous cases.**
- **Made of Dural and weather-sealed . . . completely guaranteed against weather damage.**
- **Inexpensive . . . speedily and easily installed to any mast or antenna.**

Tel-a-Ray
ENTERPRISES, INCORPORATED
BOX 332E
HENDERSON, KENTUCKY
TRADE MARK

"FISH-DETECTOR"

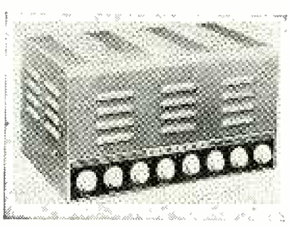
Raytheon Mfg. Co., Waltham, Mass., is manufacturing an accurate, low cost depth sounder or fathometer for use by the small boat owner or fisherman. The Fathometer Cadet covers depth ranges from 1 foot to 160 feet, and sounds 900 times per minute to show the changes in bottom contours and to assure finding fish. It can locate individual tuna.



There are three parts to the complete unit: the indicator, power unit, and projector. The indicator has a single, on-off, sensitivity-control knob. The vibrator is available for 6, 12, 32, or 110 volts d.c. The projector can be installed inside the hull. No holes through the bottom are needed, and drydocking is not necessary. The projector both transmits and receives the supersonic sounding signals generated by the Cadet.

50 WATT AMPLIFIER

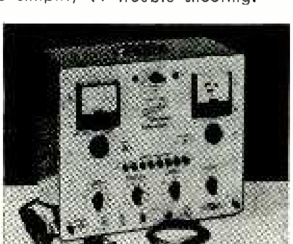
Newcomb Audio Products Co., 6824 Lexington Avenue, Hollywood, Cal., is distributing its amplifier E-50D, a high-powered model providing two separate 25-watt output channels with separate controls for a total of 50 watts audio output power.



The unit is flexible, having inputs for three microphones and one phonograph. There is an amplifier jack on the chassis to permit connecting of another E-50D amplifier. Inverse feedback provides less than 5% distortion on each 25-watt channel.

VIDEO GENERATOR

Hickock Electrical Instrument Co., 10531 Dupont Avenue, Cleveland, Ohio, is now distributing the model 650 Videometer, a crystal-controlled unit, to simplify TV trouble shooting.

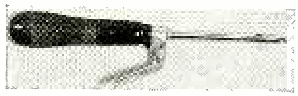


The r.f. output is calibrated in microvolts. The Videometer contains a line-voltage scale for check on line-voltage fluctuation. Horizontal and vertical sawtooth voltages can be substituted for vertical and horizontal oscillator circuits of a TV receiver. Amplitude is sufficient to give full raster deflection.

The model 650 is housed in a strong steel case, and is designed for both on-location and test-bench use. Size, 13 x 16 x 7 inches.

WIRE CUTTER

C & G Sales Co., Columbus, Ohio, is producing a precision wire-cutting tool that snips copper wire up to 18 gauge.

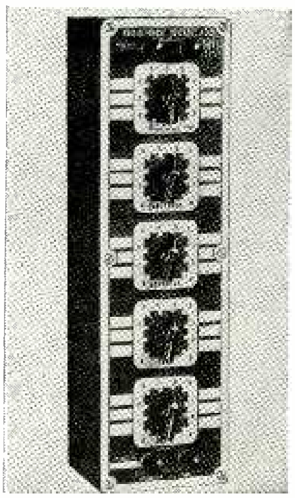


A high-carbon steel tip assures a quick, clean cut. The tip of the tool hooks over the wire to be cut. It can also hold wires during soldering work.

RESISTANCE DECADE

Electronic Instrument Co. Inc., 276 Newport St., Brooklyn, N. Y., is presenting the model 1171 resistance decade box in factory-wired and kit form. It supplies resistance values from 0 to 99,999 ohms with ½% accuracy.

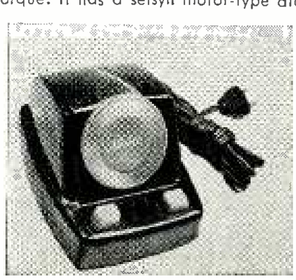
There are five separate switches with 10 positions on each. All integral resistors have ½% accuracy. There is a "comparator" position which with its binding posts permits instant substitution of an actual equivalent component for the resistance value indicated.



The decade is housed in a heavy-gauge steel case and has a three-color panel. Pictorial and schematic instructions are supplied.

ANTENNA ROTATOR

Walco Products, Inc., 60 Franklin St., East Orange, N. J., announces production of the Rotenna, a TV antenna rotator with 50 inch-pounds of starting torque. It has a selsyn motor-type dial indicator which shows the position of the antenna.



The indicator can be calibrated for each location, and small numbers are supplied to be affixed to the dial plate.

Standard equipment includes an outboard support collar to permit distribution of wind stresses over widely separated points on the mast.

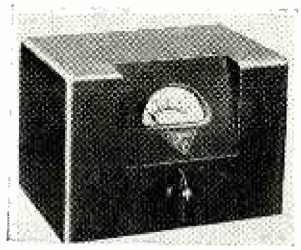
The Rotenna holds masts from 1 inch through 1⅜ inches. A 6-conductor cable is used between the Rotenna and the control indicator.

TV ROTATOR

Trio Mfg. Co., Griggsville, Ill., announces a TV antenna rotator and direction indicator said to support the heaviest TV arrays in winds up to 80 miles per hour.

Two motors are used, one each for clockwise and counterclockwise rotation. A positive-acting electric stop at both ends of a 360-degree turn is incorporated.

The rotator includes a cast aluminum mast holder and a 11/16-inch steel shaft that withstands 4,500 pounds bending pressure, automatic electromechanical brake, all-aluminum case, numbered terminal boards on rotator and indicator, and ball-bearing end thrusts on shafts.



The rotator turns 1 r.p.m. and can be fastened to any pipe up to 2 inches O.D.

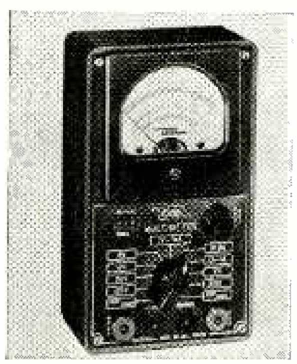
MULTIMETER

Electronic Instrument Co., Inc., 276 Newport St., Brooklyn, N. Y. is introducing in both kit and assembled form model 526, a multimeter with a sensitivity of 1,000 ohms per volt. It has 31 ranges, and a 3½-inch 400-μa meter.

All resistors have 1% accuracy. There are separate jacks for low and high current and voltage positions.

Ranges: Voltages (a.c. and d.c.): 0-1, 5, 10, 50, 100, 500, 5,000, at 1,000 ohms/volt. Resistance (from 0 to 1 megohm): R x 1, R x 10, low ohms. Current (a.c. and d.c.): 0-1 ma, 10 ma, 0.1 ampere, 1 ampere. Db ranges: —20 to + 69 db. D.c. accuracy, ± 3% of full scale. A.c. accuracy, ± 5% of full scale.

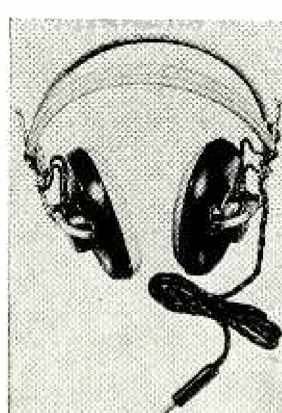
The instrument is housed in a bakelite case with figures and symbols molded in.



Both model 526-K (kit) and model 526 (factory wired) come with battery. Dimensions: 6¼ x 3¾ x 2 inches.

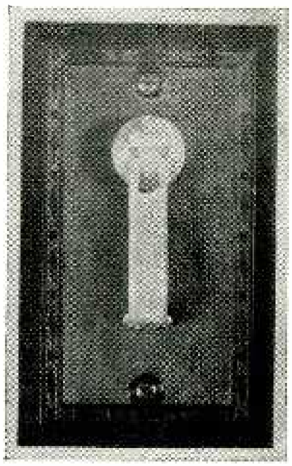
DYNAMIC PHONES

Permoflux Corp., 4900 W. Grand Avenue, Chicago, Ill., is producing dynamic headphones which range in frequency response from 100 to 7,000 cycles for the High Fidelity Series, to 4500 cycles in the Standard Series.



TV WALL PLATE

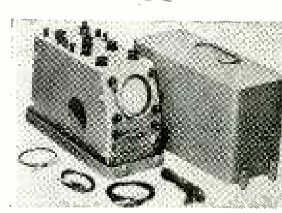
Javex Co., Garland, Texas, is distributing a TV wall plate, WP-2, which enables a TV set to be plugged into or removed from its antenna lead-in. Provision is made for running a plug-in lead to a wall plate in another room. Thus a TV set can be moved from room to room with convenient antenna terminations available.



PORTABLE SCOPE

Hickock Electrical Instrument Co., 10531 Dupont Ave., Cleveland, Ohio, is presenting a portable 3-inch oscilloscope, model 380 Miniscope, which has frequency coverage to 2.5 mc, a sensitivity of 0.1 r.m.s. volts per inch, and a telescopic light shield. There is provision for Z-axis modulation, and direct connection to C-R deflection plates. The unit comes in a portable case, weighs 14 pounds with the cover, and is 6 x 9 x 13 inches.

D.c. range of its vertical amplifiers is 0-1 mc flat (full gain setting). A.c., 5 cycles to 2.5 mc,—3 db. Horizontal amplifiers: 25—100,000 cycles. Sweep circuit oscillator: 3—50,000 cycles. Input impedance: vertical amplifier, a.c., 1.5 megohms shunted by 25 μμf. D.c. 2 megohms shunted by 5,000 μμf. Deflection sensitivity, horizontal and vertical, 0.1 r.m.s. inch.



TUNED TV BOOSTER

Vee-D-X Co., Windsor Locks, Conn, has marketed its Outboard Booster, a unit that attaches to the back panel of a TV set and is preset for a single channel. It provides up to 18 db boost with full 5 mc bandwidth. It has a push-pull cross-neutralized amplifier which prevents oscillation and gives high signal-to-noise ratio.

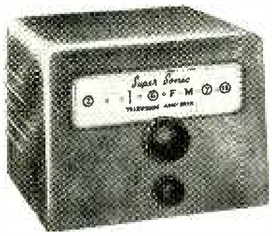
The booster is contained in a metal case measuring 3⅞ x 4⅝ x 2⅜ inches. It turns on and off with the set and cannot be left on accidentally.

All models are preset to specific channels at the factory, and the r.f. assembly can be easily removed as a single unit from the case.

All Specifications given are obtained from manufacturer's data.

TV BOOSTER

Sonic Industries, Inc., 221 W. 17 St., New York, N. Y., announces the model IT 7 Super Sonic television booster. This is a new, improved version of previous models, and comes housed in



a bakelite cabinet. It has high signal-to-noise ratio, according to the manufacturers, with high gain over the full bandwidth.

FM TUNER

Collins Audio Products Co., Inc., Westfield, N. J., is now producing the HF-14 an FM tuner using permeability tuning Precisely tuned with a 4½-inch microammeter. Fourteen tubes are used.

The output is approximately 3 volts, directly into a load ranging from 500 ohms to ½ megohm. The tuner is said to be flat to 15 kc. Minimum distortion is introduced.

A squelch circuit is provided to eliminate the "rush" between stations. When the squelch is off the sensitivity of the tuner is between 5 and 10 microvolts.

The panel is finished in gray crinkle with chrome-plated dial escutcheon. A mahogany cabinet is available if desired.

BRIDGING FUSES

Bussman Mfg. Co., at University and Jefferson, St. Louis, Mo., is manufacturing twin clips which enable new fuses to be bridged across blown pigtail fuses, without cutting or unsoldering pigtails. No soldering iron is needed.

The twin-clips can be rotated around the blown fuse to get maximum clearance against grounding. They are made of spring bronze, nickel plated, and strong clip pressure assures good contact. The holder takes any ¼ x 1¼ inch ordinary or Fusetron fuse.

POTENTIOMETER

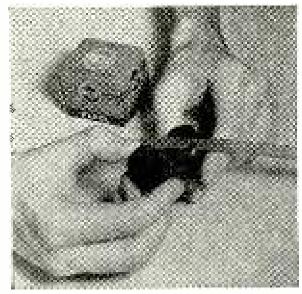
Fairchild Camera and Instrument Corp., 88-06 Van Wyck Blvd., Jamaica, N. Y., announces an addition to its line of precision potentiometers. The type 746 is all-metal construction to retain the tolerances necessary where precision units are used with precision gearing. Up to 20 units can be ganged on a single shaft. Means is provided for phasing each unit without disassembly. Plug-in units are available.

The unit is 1.75 inches in diameter and is custom-built to specifications. Resistances are available up to 100,000 ohms and accuracy of 0.5% linear and

1% nonlinear is guaranteed. The torque is 1.5 ounce-inches, with 1,000,000 cycles service life guaranteed. The case is anodized aluminum.

LIGHTNING ARRESTER

RCA Victor Division of Radio Corporation of America, Camden, N. J., is producing a lightning arrester, 215X1, designed for indoor as well as outdoor use. It will match 300-ohm transmission lines and is attached to the line without cutting and splicing. The unit is approved by Underwriters Laboratories.



CHANNEL CONVERTER

Technical Appliance Corp., Sherburne, N. Y., is manufacturing a channel converter for use with the Tacoplex master antenna system.

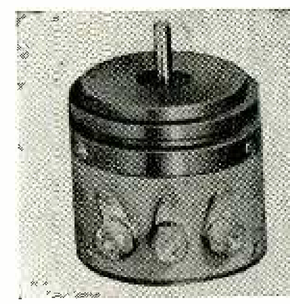
Losses of signal strength at high TV frequencies are overcome with this system. The converter beats the higher channel signals down to a low-band open channel. For example, if channel 13 is operating in a region where the only other channel is 4, the converter, located at the antenna station, converts the channel 13 signal to channel 2 and transmits that signal through the cables. The receiver operator tunes his receiver to channel 2 to pick up the channel 13 signal.

The converting is done with a crystal-controlled oscillator. There is no frequency drift. Power connections are provided from the Tacoplex amplifier chassis for this unit.

LOW TORQUE POT

Helipot Corp., South Pasadena, Cal., has started production of a miniature Tinytorque potentiometer with a starting torque of .005 ounce-inches. The unit measures ⅞ inch in diameter and 25-32 inch back-of-panel, and weighs 0.56 ounces.

It is available in resistances from 1,000 to 100,000 ohms in single section and ganged assemblies with single or double shaft extensions. It has active electrical rotation of 355 degrees, and continuous mechanical rotation without stops. Power rating is ½ watt.



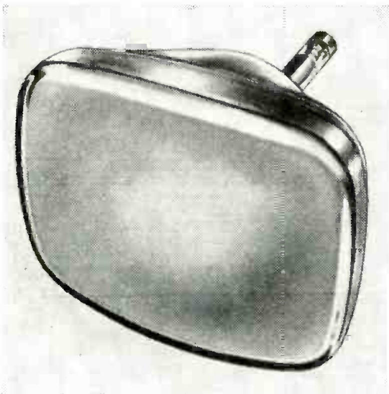
ANTENNA CLIP

Industrial Television Inc., Clifton, N. J., is marketing a device which can be used to make positive connection to standard screw-type antenna posts. It provides a fast, low loss, permanent connection and cannot short the line. The unit looks like a spring clip with copper tips shaped to fit terminal screws.

—end—

NEW TUBES OF THE MONTH

In line with the trend toward saving critical materials new developments in picture tube design are announced by Du Mont and RCA. Both have developed electrostatic-focusing for large-screen tubes. Du Mont has come up with self-focusing Teletron type 17KP4.



Self-focusing Dumont Teletron, 17KP4.

Electrostatic focusing is used in the RCA 17GP4, a 16 kv metal-shell type tube.

Full information is not released as yet because of patent security, but the following data is available. It is an all-glass, rectangular tube employing magnetic deflection and automatic, electrostatic focus. Gray-filter faceplate and external conductive coating are included.

Beam focus is maintained independently of anode potential and variations in line voltage. No external focusing coils or controls are used. The focusing element is not brought out to an external terminal as in other electrostatic-focus types. A standard 5-pin duodecal base is used. The self-focusing Teletron will simplify conversion and replacement problems, and elimination of magnetic focusing will result in savings of critical materials.

Typical operating conditions are: anode voltage, 13,000; grid 2 voltage, 300; grid 1, volts, –33 to –77; heater, 6.3 volts at 0.6 ampere.

Du Mont has also announced two rectangular Teletrons, types 17FP4 and 20GP4, which employ high-voltage electrostatic focus and which are said to give comparable quality to magnetically deflected tubes. Focusing voltages for both tubes are approximately 23% of anode voltages. The tubes are similar to the Du Mont magnetic-focus 17BP4A and 20CP4.

RCA announces three rectangular tubes types 14GP4 (14 kv), 17GP4 (16 kv), and 20GP4 (18 kv), all using high-voltage electrostatic focusing. Each of these tubes has a diagonal deflection angle of 70° and a horizontal deflection angle of 66° and have filter-glass faces. The 17GP4 is the metal-shell type, the others are all-glass.

For other information on these new electrostatic type tubes, see June issue, page 60, and May, page 27. The latter

Twin-miniature triode-pentode

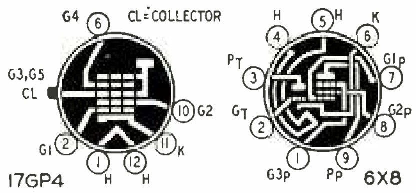
British power pentode KT66

gives circuits for obtaining focusing voltages, which usually run about 23% of the second anode potential. As accelerating voltages go higher, *danger* from X-ray radiation increases. Take care in replacement operations.

National Union is producing the 20HP4, a rectangular, low-voltage, electrostatically focused tube. It has an electron gun designed to be used with a single-magnet external ion trap. It incorporates a filterglass plate for increased contrast. Typical operation is at 14,000 volts maximum. Grid 4 (focus) voltage is 200 volts, which may be varied from 0 to 400 volts.

A miniature type 6X8, containing a medium-mu triode and sharp-cutoff pentode is announced by RCA. It is designed for use as a combined oscillator and mixer, in TV sets using an i.f. of 40 mc. The low capacitance between grid 1 and plate of the pentode mixer unit minimizes feedback problems at 40 mc. Low output capacitance of the mixer permits use of a high-impedance plate circuit with resultant increase in mixer gain.

Tung-Sol is introducing a tube designed for television horizontal frequency damper service, the 6AX4. It is a single, indirectly heated diode with the high-voltage insulation requirement removed from an external transformer and built into the tube. Heater to cathode insulation ratings have been increased from 2,000 to 4,000 volts pulse rating and from 450 to 900 volts d.c. rating.



Basing diagrams of the two new tubes.

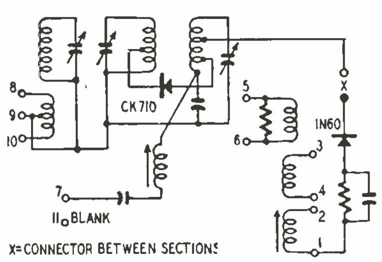
The British KT66 output tube, which came to prominence in this country when the Williamson circuit was introduced, is now available through British Industries Corp. A tetrode, the KT66, is interchangeable with the 6L6, but can be used with higher plate and screen ratings. It is used in the output stage of high-fidelity audio amplifiers, but can also be used as an oscillator up to 30 mc. The 807 most closely resembles this tube except for some slight differences in plate characteristics.

G-E has announced a tube for moderately high-speed digital computers to be used in flip-flop service in binary system calculators. The twin triode GL-5844 directly replaces the 6J6 and uses one-third less heater power. Thus, more than ½ kilowatt of power can be saved in a 600-tube computer.

Tubeless Converter for U.H.F. Inserts as Channel Strip

U.h.f. will not offer the conversion problems to the technician that color—or even the demand for larger tubes—does. Several converters and tuners have already been demonstrated, ready to go into production as soon as u.h.f. stations start broadcasting.

Standard Coil Products Co., who demonstrated a converter unit at Bridgeport, Connecticut, home of NBC's experimental u.h.f. television transmitter offered one solution to the problem.



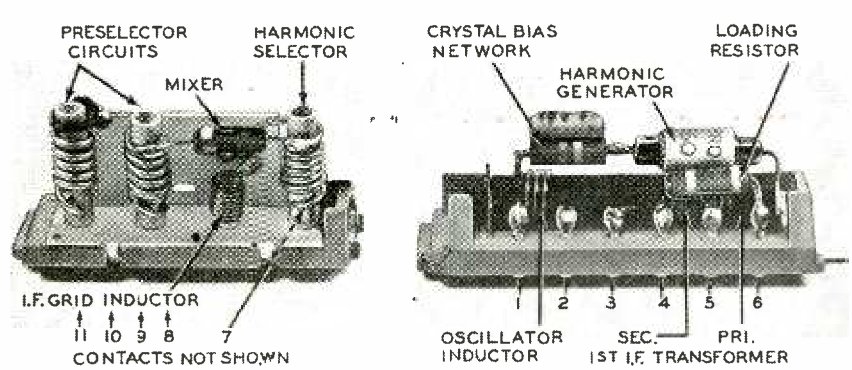
Tubeless converter for u.h.f. television. The point in the schematic marked X is the junction between the two sections.

Standard's device is a tubeless converter which can be inserted directly into Standard's turret tuner as a channel strip. It uses a harmonic of the oscillator in the receiver to beat with the u.h.f. signal, producing an intermediate frequency which is usually in the spectrum between the two present television bands. This new i.f. beats with the fundamental of the receiver oscillator to produce the receiver's regular i.f. The arrangement resembles some of the converters used to permit low-band FM receivers to work in the 100-mc region.

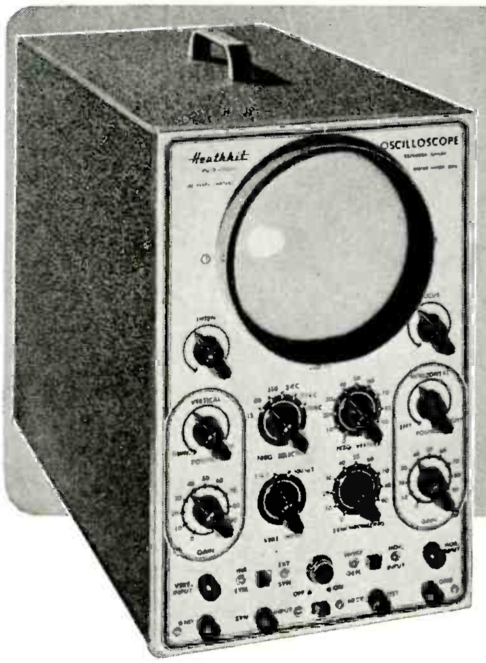
In a press demonstration at Bridgeport, programs from the local u.h.f. station, KC2XAK (RADIO-ELECTRONICS, August, 1950), were received with excellent quality and stability in two locations, one of high signal strength, the other outside Bridgeport where the signal was a little less than moderately strong.

The new converter channel strips can be inserted as easily as a new channel strip for the standard TV channels. The photograph and schematic are self-explanatory. Numbers refer to contacts on the Standard tuner schematic, (July issue, page 33).

Other converters recently announced, notably the Zenith and Westinghouse, are said to use the same principle, and both Crosley and Philco have announced u.h.f. tuners without revealing technical details. —end—



Standard u.h.f. converter plugs into the turret tuner, provides quality reception.



Heathkit MODEL 0-6 . . . PUSH-PULL . . . 5"
OSCILLOSCOPE KIT

The new Heathkit 5" Push-Pull Oscilloscope Kit is again the best buy. No other kit offers half the features — check them.

Measure either AC or DC on this new scope — the first oscilloscope under $100.00 with a DC amplifier.

The vertical amplifier has frequency compensated step attenuator input into a cathode follower stage. The gain control is of the non frequency discriminating type—accurate response at any setting. A push-pull pentode stage feeds the CR tube. New type positioning control has wide range for observing any portion of the trace.

The horizontal amplifiers are direct coupled to the CR tube and may be used as either AC or DC amplifiers. Separate binding posts are provided for AC or DC.

The multivibrator type sweep generator has new frequency compensation for the wide range it covers; 15 cycles to over 100,000 cycles.

The new model 0-6 scope uses 10 tubes in all, including 5" CR tube. Has improved amplifiers for better response useful to 2 megacycles. Tremendous sensitivity .04V RMS per inch horizontal — .09V RMS per inch vertical. Only Heathkit Scopes have all the features.

New husky heavy duty power transformer has 50% more laminations. It runs cool and has the lowest possible magnetic field. A complete eletrostatic shield covers primary and other necessary windings and has lead brought out for proper grounding.

The new filter condenser has separate sections for the vertical and horizontal screen grids and prevents interaction between them. An improved intensity circuit provides almost double previous brilliance and better intensity modulation.

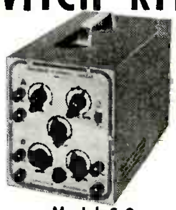
A new synchronization circuit allows the trace to be synchronized with either the positive or negative pulse, an important feature in observing the complex pulses encountered in television servicing.

Model 0-6............ Shipping Wt. 24 lbs.

$39.50

The kit is complete, all tubes, cabinet, transformer, controls, grid screen, tube shield, etc. The instruction manual has complete step-by-step assembly and pictorials of every section. Compare it with all others and you will buy a Heathkit.

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).

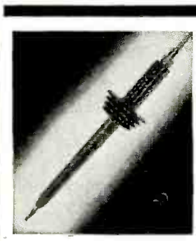
Use the switch to see distortion, phase shift, clipping due to improper bias, both the input and output traces of an amplifier, — as a square wave generator over limited range.

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.

$19.50

Heathkit 30,000V DC PROBE KIT



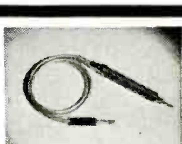
$5.50

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.

No. 336 High Voltage Probe Kit........Shipping Wt. 2 lbs.

Heathkit RF PROBE KIT

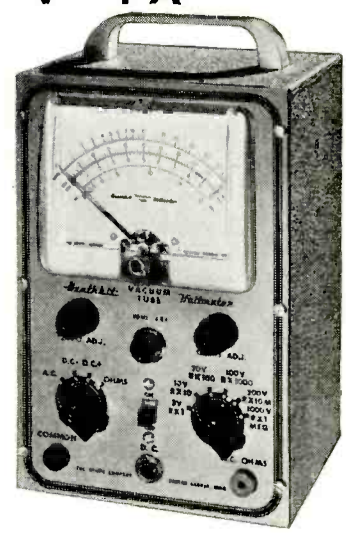
This RF Probe Kit comes complete with probe housing, crystal diode detector, connector, lead and plug and all other parts plus clear assembly instructions. Extends range of Heathkit VTVM to 250 Mc. ± 10%. Works on any 11 megohm input VTVM. Specify No. 309 RF Probe Kit.



Shipping Wt. 1 lb.

$5.50

New MODEL V-4A *Heathkit* VTVM KIT



Model V-4A .....Shipping Wt. 8 lbs.

Note New Low Price

$23.50

The new Heathkit Model V-4A VTVM Kit measures up to 30,000 Volts DC and 250 megacycles when used with accessory probes — think of it, all in one electronic instrument more useful than ever before. The AC Voltmeter is so flat and extended in its response (± 1 db from 20 cycles to 2 megacycles) that it eliminates the need for separate expensive AC VTVM's.

The new 200 microampere, 4½" streamline meter with quality Simpson movement (five times as sensitive as the commonly used 1 MA meter) has a shatter proof plastic meter face for maximum protection. Meter has all the desirable scales and indicates AC volts, DC volts, ohms, db (direct reading), and even has a special zero center marking for quick FM alignment.

There are six complete ranges for each function. Four functions give total of 24 ranges. The 3 volt range allows 33⅓% of the scale for reading 1 volt, as against only 20% of the scale on the 5 volt types.

New ½% ceramic precision resistors are the most accurate commercial type available — you find the same make and quality in the finest laboratory equipment selling for thousands of dollars. The entire voltage divider decade uses these ½% resistors.

Both AC and DC voltmeter measurements use a push-pull electronic voltmeter circuit, and the meter circuit makes the meter burn-out proof. Electronic ohmmeter circuit measures resistance over the amazing range of 1/10 ohm to one billion ohms, all with internal 3 volt battery. Ohmmeter batteries mount on the chassis in snap-in mounting for easy replacement.

Voltage ranges are full scale — 3 Volts, 10 Volts, 30 Volts, 100 Volts, 300 Volts, 1000 Volts. Complete decading coverage without gaps.

The DC probe is isolated for dynamic measurements. Negligible circuit loading. Gets the accurate reading without disturbing the operation of the equipment under test. Kit comes complete: cabinet, transformer, Simpson meter, test leads, complete assembly and instruction manual.

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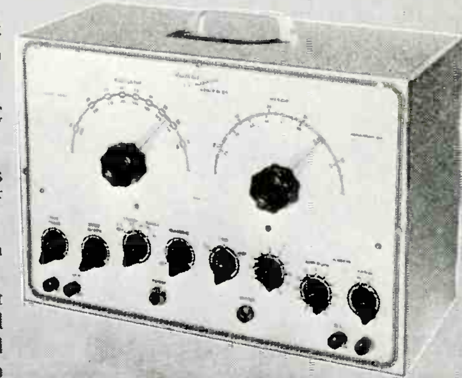
NEW

Heathkit TV 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!

$39.50

Model TS-2
Shipping Wt......20 lbs.

Heathkit SIGNAL GENERATOR KIT

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.

Model SG-6
Shipping Wt.
7 lbs.

$19.50

Heathkit SIGNAL TRACER
and UNIVERSAL TEST SPEAKER KIT

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.

Model T-2
Shipping Wt.......7 lbs.

$19.50

Heathkit CONDENSER CHECKER KIT

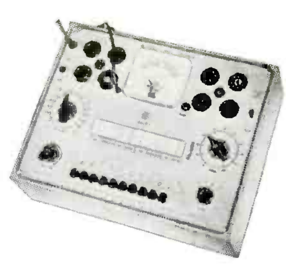
Checks all types of condensers—paper, mica, ceramic, electrolytic. All condenser scales are direct reading and require no charts or multipliers. Covers range of .00001 MFD to 1000 MFD. A Condenser Checker that anyone can read. A leakage test and polarizing voltage for 20 to 500 V provided. Measures power 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.

$19.50

Model C-2 .... Shipping Wt. 6 lbs.

Heathkit TUBE CHECKER KIT



Test your tubes the modern way—dynamically—the simplest, yet fastest and surest method—your Heathkit has a switch for each tube element and measures that element—no chance for open or shorted elements slipping by, all the advantages of the mutual conductance type without the slow cumbersome time consuming setups. Checks for opens, shorts, each element individually, filament and filament tap continuity, and emission.

This Tube Checker has all the features—beautiful 3 color BAD-?-GOOD meter—complete selection of voltages—roller chart listing hundreds of tubes including the new 9 pin miniatures—finest quality Centralab lever switches—high grade birch, counter-type cabinet—continuously variable line adjust control—every feature you need to sell tubes properly. The most modern type tube checker with complete protection against obsolescence. Uses only the best of parts—rugged oversize 110V 60 cycle power transformer, finest of Mallory and Centralab switches and controls, complete set of sockets for all type tubes with blank spare for future types. Fast action, gear driven roller chart quickly locates the setting for any type tube. Simplified switching cuts necessary testing time to a minimum and saves valuable service time. Simple method allows instant setup of new tube types without waiting for factory data. No matter what the arrangement of tube elements is, the Heathkit flexible switching method easily handles it. Order your Heathkit Tube Checker Kit today and see for yourself that Heath again saves you two-thirds and yet retains all the quality. Complete with instructions, all parts, and cabinet.

Model TC-1
Shipping Wt.
12 lbs.

$29.50

NEW *Heathkit* HANDITESTER KIT

A precision portable volt-ohm-milliammeter. Uses only high quality parts—All precision ½% 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 microamp 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.

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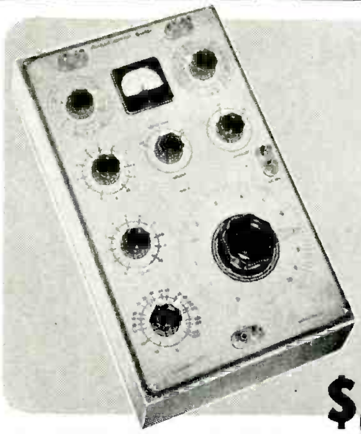


NEW *Heathkit*

IMPEDANCE BRIDGE KIT

This Impedance Bridge Kit is really a favorite with schools, industrial laboratories, and serious experimenters. An invaluable instrument for those doing electrical measurements work. Reads resistance from .01 Ohms to 10 megohms, capacitance from .00001 MFD 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 Wheatsone, Hay, Maxwell, and capacitance comparison circuits for the wide range and types of measurements possible. And it's self powered — has internal battery and General Radio 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, General Radio hummer, Mallory ceramic switches, excellent 200 microamp zero center galvanometer, laboratory type binding posts with standard ¾ inch centers, ½% precision ceramic-body type multiplier resistors, beautiful birch cabinet and ready calibrated panel. (Headphones not included.)

Take the guesswork out of electrical measurements — order your Heathkit Impedance Bridge Kit today — you'll like it.

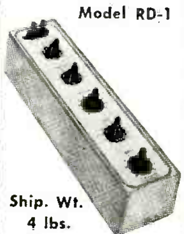
Model IB-1B....Shipping Wt. 15 lbs.

$69.50

Heathkit LABORATORY

RESISTANCE DECADE KIT

Model RD-1



Ship. Wt. 4 lbs.

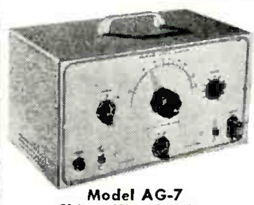
$19.50

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, ½% 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.

NEW *Heathkit* SINE and SQUARE WAVE

AUDIO GENERATOR KIT



Model AG-7
Ship. Wt. 15 lbs.

$34.50

We proudly present the NEW MODEL Sine and Square Wave Audio Generator Kit. Designed with versatility, usefulness, and dependability in mind, the AG-7 gives you the two most needed waveshapes 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 to 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 readily trust the output waveshape.

6 tubes, quality 4 gang tuning condenser, power transformer, metal cased filter condenser, ½% 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.

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	Heathkit VTVM Kit — Model V-4A			Heathkit H.V. Probe Kit — No. 336	
	Heothkit FM Tuner Kit — FM-2			Heothkit R.F. Signol Gen. Kit — Model SG-6	
	Heothkit Broodcost Receiver Kit — Model BR-1			Heothkit Condenser Checker Kit — Model C-2	
	Heothkit Three Bond Receiver Kit - Model AR-1			Heothkit Honditester Kit — Model M-1	
	Heathkit Amplifier Kit — Model A-4			Heathkit Power Supply Kit — Model PS-1	
	Heathkit Amplifier Kit — Model A-6 (or A-6A)			Heathkit Resistance Decade Kit — Model RD-1	
	Heathkit Tube Checker Kit — Model TC-1			Heathkit Impedance Bridge Kit — Model IB-1B	
	Heathkit Audio Generator Kit — Model AG-7				
	Heothkit Battery Eliminator Kit — Model BE-2				
	Heathkit Electronic Switch Kit — Model S-2				
	Heathkit T.V. Alignment Gen. Kit — TS-2				
	Heathkit Signal Tracer Kit — Model T-2				

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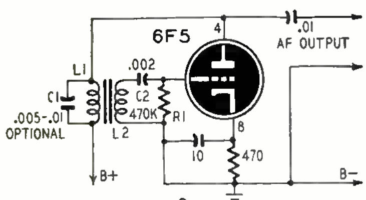
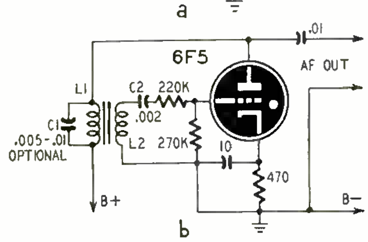
OSCILLATOR DESIGN NOTES

The circuit of a typical a.f. oscillator is shown at *a* in the illustration. Circuits like this may be designed rather haphazardly when they are used as code practice oscillators and for modulating r.f. signal generators. The inherent distortion makes the note easier to listen to over long periods of time. When used in electronic musical instruments and precision a.f. generators, the oscillator must develop a pure sine wave of a precise frequency.



a



b

The characteristics of the triode are not particularly important in this case. Almost any triode can be used. It might be advisable to use a tube such as the 117L7 or 117P7 type. In these tubes, one section is used as a rectifier to supply the B+, the other as triode.

The frequency of the oscillator is determined largely by the inductance of the transformer windings and the value of C1. C1 may be the distributed capacitance of winding L1 or a combination of an external tuning capacitor and the distributed capacitance. If the frequency is too high, increase the value of C1. If it is too low, remove any external capacitance which may be a part of C1. If this does not help, try using L1 as the grid winding and L2 as the tickler. Reverse the connections to one winding if the circuit does not oscillate. If the frequency cannot be made high enough when the circuit is tuned solely by stray capacitance, try another transformer.

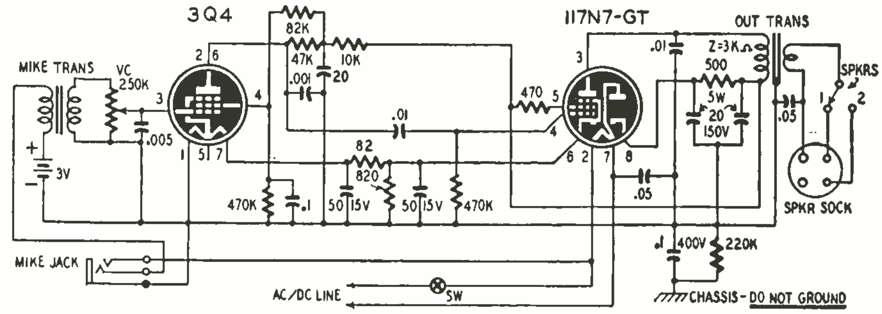
The purity of the tone—freedom from distortion—depends on the amplitude of the voltage fed back to the grid. When the amplitude is too high, the signal distorts. Above a certain point, the feedback may be sufficient to cause the circuit to operate as a blocking oscillator with the on-off frequency determined by the values of R1 and C2. The signal applied to the grid is determined largely by the turns ratio of the transformer. Since it is impractical to change the turns ratio, the circuit can be rearranged as shown at *b*. R1 may be split into two resistors with the grid connected to their junction. The signal applied to the grid is only a fraction of the total voltage developed across L2. For precision adjustments, the two resistors can be replaced by a 500,000-ohm potentiometer with its arm connected to the grid.—*A. Ivanivsky*

2-TUBE PAGING AMPLIFIER USES EXTENSION SPEAKERS

We installed this little paging amplifier in our office with extension speakers in the storeroom and garage. It saves lots of time and energy when it is necessary to call someone to the phone.

The unit is constructed almost entirely from surplus parts. The case is a 5 x 4 x 3-inch jack box. The microphone is a T-17 with a plastic case, and the microphone transformer is a subminiature type. Microphone current is supplied by two miniature flashlight cells connected in series. The 3Q4 is a power amplifier tube but it does a good job as a voltage amplifier for driving the pentode section of the 117N7-GT. Filament voltage for the 3Q4 is tapped off the cathode biasing resistor for the 117N7-GT.

We keep the 117N7-GT heater turned on all day. Plate current does not flow until the mike button is pressed. The frame of the microphone jack—a Mallory SCA-2B or equivalent—is mounted on an insulated bracket approximately 1¼ inch below the chassis so there is no danger of receiving a shock while inserting the microphone plug. One side of the a.c. line is connected directly to the common negative lead. Be sure that the line plug is inserted so this connects to the grounded side of the line.—*E. L. Raynaud*



BATTERY OPERATED FIELD STRENGTH METER

It is important for TV salesmen in weak-signal and fringe areas to know whether the signal in the customer's location is strong enough to provide a satisfactory picture *before* the set is delivered. It is equally important for antenna crews to be able to select the best antenna and align it for maximum signal pickup. A TV field-strength meter can be used to survey the location and obtain answers to these questions before the set is delivered.

This 2-tube, battery-operated TV field-strength meter is described in *The Aerovox Research Worker*. Its circuit is shown in Fig. 1. It consists of a local oscillator—a 957 acorn tube—tunable between 94 and 176 mc, a silicon diode mixer such as a 1N21, 1N22, or 1N23, and an RK62 gas-filled triode as a superregenerative i.f. and second detector. The unit is powered by a small 67.5-volt B-battery and two 1.5-volt cells.

The local oscillator operates above the signal frequency on the low band and below it on the high band. The oscillator and the signal frequencies beat in the mixer to produce a 40-mc i.f. The superregenerative detector will produce almost as much gain and sensitivity as the r.f. and i.f. stages in conventional a.c.-operated field-strength meters.

The input circuit, L1, is untuned to provide for broad-band operation. In extremely remote areas where there are only one or two channels, sensitivity and image rejection can be improved by using a small capacitor to tune the input to the signal frequency.

The instrument is housed in a 6 x 5 x 4-inch metal utility box. The placement of most components is shown in Fig. 2. Wire the unit, then spread or squeeze the turns of L4 so the 957 oscillates smoothly between 94 and 176 mc. Measure the frequency with a grid-dip meter or by inserting a milliammeter in series with the oscillator plate lead and tuning a closely coupled absorption meter until the meter kicks sharply upward. Couple the oscillator and mixer by connecting an insulated lead to the plate end of L4 and wrap it once around the lead between the crystal detector and L1. Remove the meter.

Plug a pair of phones into the phone jack and advance the regeneration control until a "rush" or hiss is heard. This should start at around 200 μa on the tuning meter and should be strong at 1 ma. Connect battery BATT1. The meter should drop to zero. When using the instrument, the regeneration control should be adjusted so the meter reads zero with no signal input.

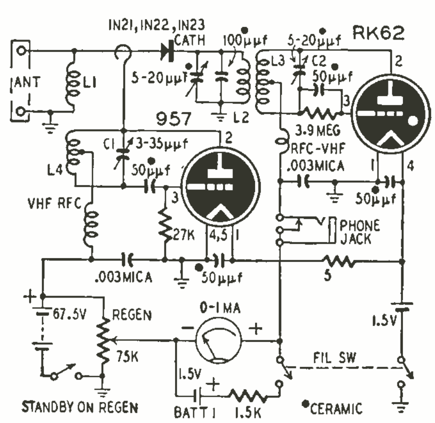


Fig. 1—Superregenerative meter circuit.

Set a signal generator to 40 mc. Tune L3 for maximum deflection. The meter should deflect to at least half scale. Tune L2 for a further increase in the reading.

To calibrate the instrument, connect a 300-ohm antenna to the terminals and close the standby and filament switches. The meter will swing upward when stations are tuned in with C1. Identify the stations by listening to the signal in the phones. Mark the channel number or call letters on the tuning with great care.

Some FM stations will be heard near the dial settings of TV channels 7, 8, and 9. When the local oscillator is tuned between 134 and 148 mc, it beats with FM

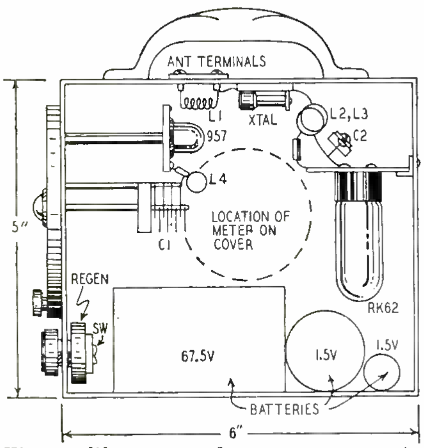


Fig. 2—Placement of meter components.

stations between 94 and 108 mc to produce the 40-mc i.f. needed for detection. After the stations have been identified and the dial carefully calibrated, FM images should not cause trouble.

Because of its sensitivity and portability, amateur radio operators and service technicians will find it useful for identifying and tracking down sources of TVI.

The coils are self-supporting and are wound with No. 14 enameled wire. L1 is 9 turns, ½ inch inside diameter, spaced to 1 inch long. L2 is 3 turns, ½ inch inside diameter, ¼ inch long. L3 is 19 turns, ½ inch inside diamater, 1½ inch long. L4 is 3 turns, ⅜ inch inside diameter, ¼ inch long.

Someone should rectifier

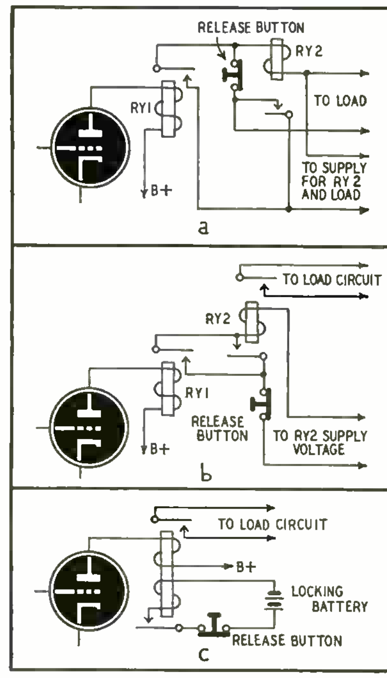
Suggested by Harry A. Nickerson, Boston, Mass.

"Two months ago I planted a Geranium crystal and it has not come up yet!"

SELF-LOCKING RELAYS

A self-locking relay with a mechanical latching and electrical release was described in the December, 1950, issue. Having a yen for control and relay circuits, I worked out three additional locking circuits which can be used and added quite easily to almost any instrument to control current flow.

In each circuit, RY1 is a sensitive relay in the plate circuit of an amplifier, capacitance relay control tube, phototube, etc., and RY2 is the relay which handles the load current. Momentarily closing the contacts of RY1 will close RY2 and cause it to remain closed until the circuit is broken by pressing the release switch.



In the circuit shown at *a*, RY1 will momentarily carry the load current. If this current is large, it may damage the contacts of RY1. In such cases, the circuit may be connected as shown at *b*. Here, RY2 is a double-pole relay having one set of contacts sufficiently heavy to carry the load current and to do the job without arcing.

The circuits at *a* and *b* can be simplified further by using a twin-coil relay connected as shown at *c*. This relay replaces RY1 and RY2. It may be necessary to use a resistive load in the plate circuit of the tube to provide the proper load and put the relay coil in the cathode circuit.—*John W. Sponsler*

IMPROVING SOLDERING IRONS

While soldering a heavy joint on a chassis, I found that my soldering iron was not producing enough heat to do a good job. Removing the tip and knocking off the rust did not help. To provide a more efficient transfer of heat between the tip and barrel, I reversed the tip, lightly filed the part which goes into the barrel, then tinned it thoroughly. When the tip was replaced correctly, the iron worked like a charm. It supplied enough heat for jobs which could not be done before the tip was cleaned and tinned.—*Edwin D. Kennedy*

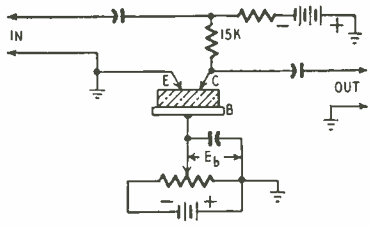
—end—

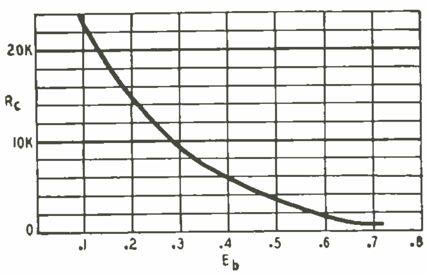
VARIABLE IMPEDANCE

Patent No. 2,544,211

Loy E. Barton, Princeton, N. J.
(Assigned to Radio Corp. of America)

This inventor has discovered that the output impedance of a transistor (between collector and base) can be varied over a wide range by adjusting the base voltage. As shown, impedance varies from approximately 25,000 to 1,000 ohms if the voltage is varied from about 0.08 to 0.7 volts.





The transistor may be used as part of a voltage divider. An r.f. or a.f. signal can be attenuated over a wide range by controlling the base voltage on the transistor. The signal is connected across the entire divider while output is taken between collector and ground (through a capacitor).

VERTICAL SYNC CIRCUIT

Patent No. 2,539,374

Louis L. Pourciau and Richard W. Lee, Pleasantville, N. Y.
(Assigned to General Precision Laboratory, Inc.)

This recent invention deals with improved vertical synchronization. The vertical oscillator at the receiver, Fig. 1, is controlled by a gating tube. This tube is operated by the sync pulse but is immune to noise and interference.

Fig. 2-a shows the conventional vertical blanking signal and 2-b is an enlarged portion of it. The sync pulse interval is marked *A*. The vertical sync pulse, with the remainder of the composite

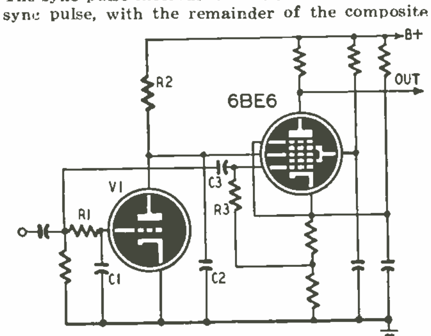


Fig. 1

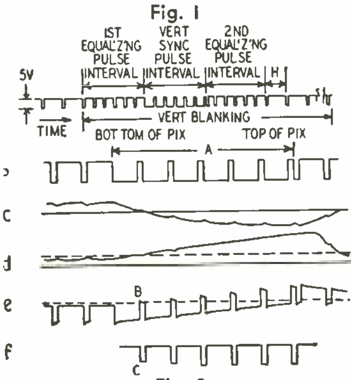


Fig. 2

signal, is fed through a large capacitor to V1 (see Fig. 1). R1-C1 integrates (or averages) the voltage and produces wave shape 2-c. V1 amplifies and reverses the polarity of the input. After further integration (by C2-R2) the curve appears as in 2-d. The dotted line is cutoff level for grid 3 of the 6BE6.

The composite signal is also fed to grid 1 of the 6BE6 through a differentiating network R3-C3. The voltage at grid 1 is shown in 2-e. The dotted line indicates cutoff level of this grid.

Gating tube 6BE6 can conduct only when its grids 1 and 3 are above cutoff. Fig. 2-d shows that grid 3 is unblocked during the vertical sync interval *A*. The first equalizing pulse *B* (Fig. 2-e) raises grid 1 above cutoff and the gating tube conducts. This produces output as shown by the pulses in Fig. 2-f. The first output pulse *C* triggers the vertical oscillator (not shown) and the pulses which follow have no effect. Note that *C* is slightly smaller than the following pulses because *B* is just slightly above cutoff. However, *C* is sufficient to trigger the circuit.

There is little chance of false synchronization with this circuit because the 6BE6 is blocked during the entire field except during the small sync interval. The first pulse during this interval operates the oscillator. A steadier picture and satisfactory interlacing are the results.

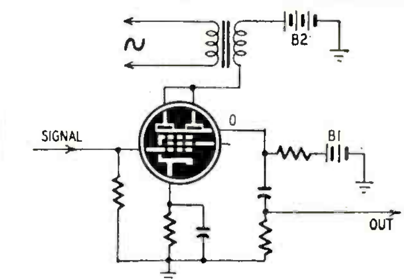
HIGH GAIN PENTODE

Patent No. 2,543,039

Kenneth G. McKay, Summit, N. J.

(Assigned to Bell Telephone Laboratory, Inc.)

This invention makes possible a pentode with a Gm of 50,000 μmhos. It utilizes the property of certain crystals, normally insulators, which become conductive temporarily when bombarded by



electrons, X-rays, or other forms of radiation. A diamond has this property.

The bombardment releases internal electrons in the diamond. If an electric field is applied across the crystal, the freed charges migrate toward the positive surfaces. Impurities in the crystal trap the electrons and form a space charge, if a d.c. field is applied. When a.c. is used alone or superimposed over the d.c., the traps cannot build up and the output current is greatly increased.

The high-gain tube uses diamond crystals D as anodes (one at each side of the tube center). Each may be ¼ inch square and .02 inch thick. Gold is evaporated onto opposite surfaces of each crystal. B1 is the anode supply. B2 supplies extra positive voltage to the far side of the crystals to increase the internal current. The a.c. may be 20 cycles. Electrons from the cathode strike the crystals and release other charges. These move in the same general direction toward the more positive surface of the diamond.

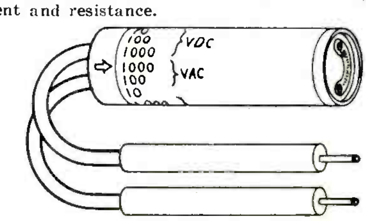
A gain of 10 may easily be obtained in the crystals. Coupled with a tube Gm of 5,000, the over-all effective Gm is 50,000 without increasing undesirable shunt capacitances.

COMPACT MULTIMETER

Patent No. 2,547,248

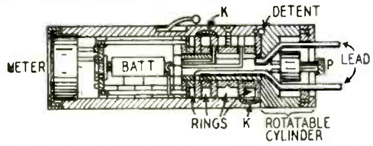
Thomas L. Bartholomew, Baltimore, Md.

This ultra-compact multimeter uses a 1-inch meter and can measure a.c. and d.c. volts, current and resistance.



All components are within a cylindrical housing as shown (Fig. 1). Only the leads protrude. At one end, the meter is visible. At the other end, a rotating head acts as a switch. This end is rotated until the arrow indicates the desired range.

The internal view (Fig. 2) shows how some of the components are arranged. A novel switching method is used. As the rotating cylinder is turned, metal rings press against contacts (such



as K) fixed in the housing. These close the required circuits. The potentiometer and dial P adjust the instrument when used as an ohmmeter. Fuses are connected inside the prods at the end of each lead.

VERSATILE MULTIVIBRATOR

Patent No. 2,540,478
George R. Frost, Great Neck, N. Y.
(Assigned to Bell Telephone Labs., Inc.)

Different waveshapes are generated in different parts of a multivibrator circuit. This versatile MV is equipped with 5 pairs of output terminals and 2 switches. By setting the switches and choosing the proper terminals, any one of 15 different waveforms is conveniently available. Square, triangular, exponential, and other waves are available. In each case a timing circuit determines frequency. The 10,000-ohm resistors may be varied to alter the wave shapes. The tube may be a 6SN7.

The following table shows switch settings and terminals to provide the waveforms of Figs. 2-16.

Output term.	S1 open S2 as shown	S1 closed S2 as shown	S1 open S2 dotted pos.
A	Fig. 2	Fig. 7	Fig. 12
B	3	8	13
C	4	9	14
D	5	10	15
E	6	11	16

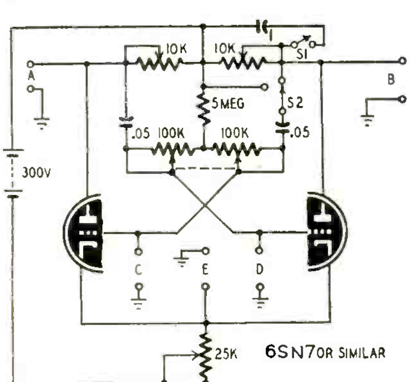


Fig.1

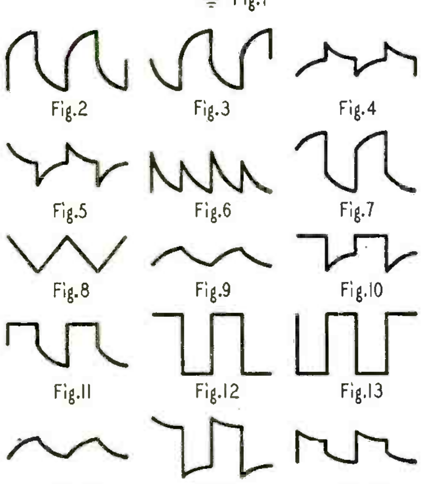
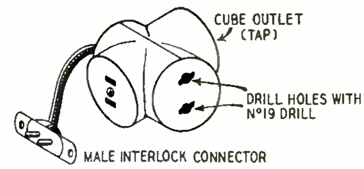


Fig.2 Fig.3 Fig.4
Fig.5 Fig.6 Fig.7
Fig.8 Fig.9 Fig.10
Fig.11 Fig.12 Fig.13
Fig.14 Fig.15 Fig.16

—end—

TV INTERLOCK ADAPTER

It is often difficult to obtain the special interlock plugs used on Philco, Zenith, and some other makes of TV sets. A simple solution to the problem is to drill holes in the center of the slots on a standard plastic cube tap fitted with an extension cord long enough to reach a convenient receptacle. If a polarized connector is needed drill one hole with a No. 19 drill and the other with a No.

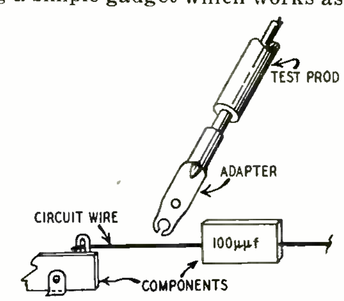


26. Use a No. 19 drill for both if polarity is not important. The holes in the slot are the correct size to fit over the prongs of the male half of the connector.

You can connect the modfied tap to a standard male chassis interlock connector with a few feet of cord (see illustration). Plug the adapter into the female connector on the cabinet back and fit the tap over the terminals over the male half of the interlock. The soldering iron, trouble light, or extension cord can be plugged into the other slots on the tap.—*Elmer C. Carlson*

HANDY ADAPTER FOR TESTING

Many modern electronic devices are made so compact that it is almost impossible to reach some parts of the circuit with standard alligator clips. I have overcome these difficulties by making a simple gadget which works as well.



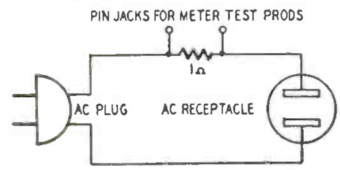
The adapter is made from a contact out of a molded-plate octal socket. Remove the whole contact and make a narrow slit in the eye. Slip it over the end of a test prod or piece of insulated bus bar. When metering circuits, signal tracing, signal injecting, etc., slip the eye over the circuit lead and give the prod a half-turn to hold it in place. The illustration shows how the adapter is used.—*Augustine Mayer*

SIMPLE AUDIO PICKUP

Radio programs may be piped from a receiver to any recorder, amplifier, or public address system through inductive coupling between the output transformer of the set and a magnetic contact microphone connected to the amplifier. Tests have shown the strongest field to be at the top of the transformer. The mike may be suspended within 3 inches of the top of the transformer or mounted directly atop the transformer if it is cushioned with a thin layer of rubber or cork.—*Orren Reynolds*

WATTAGE CHECKER

Some times, it is desirable to know how much current a receiver or other appliance draws from the a.c. line. A quick check on line current will often show up a partial short in a filter capacitor or power transformer. Since most multimeters do not have provisions for measuring alternating current, we use this adapter unit in conjunction with the a.c. voltage range of the meter. The adapter is shown in the diagram and photograph.

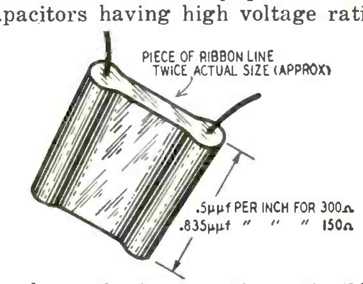


The adapter is simply a 1-ohm wire-wound resistor inserted in series with one side of the power line. Pin jacks are provided so a meter can be connected to measure the voltage drop across the resistor. By using a 1-ohm resistor, an a.c. voltmeter scale can be read directly in amperes without using charts or calibration tables. To find the wattage drain simply square the meter reading since watts equals E^2/R.

The wattage rating of the resistor is determined by the receiver current drain. A 10-watt resistor will handle a little more than 3 amperes. The reactance of a 1-ohm wire-wound resistor at 60 cycles may be neglected.—*W. S. Kemper*

RIBBON-LINE CAPACITOR

Small but fairly precise values of capacitance are often required in the construction of TV boosters and other v.h.f. and u.h.f. equipment. Small capacitors having high voltage ratings



can be made from sections of ribbon-type transmission line. The average 300-ohm ribbon has a capacitance of approximately 0.5 μμf per inch, and 1 inch of 150-ohm ribbon has a capacitance of about 0.835 μμf. The required capacitance can be obtained by cutting the line to the required length. For precise work, cut the line a little long and prune it the exact value required.—*Edwin Bohr*

CRYSTAL ADAPTERS

The pins of FT-241-A and similar crystal holders are too small to fit snugly into sockets designed for holders having larger pins. To adapt these crystals for use in regular sockets, remove pins 2 and 5 from an old 25Z5 or similar tube and slip them over the pins of the crystal holder. They make a perfect fit for most sockets and will not slip off the crystal. They can be crimped for a permanent job.—*Harry Kundrat*

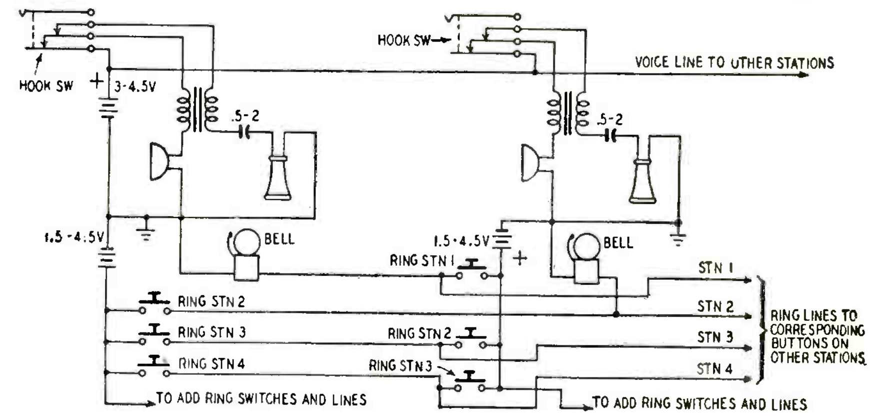
—end—

HOUSE TELEPHONE CIRCUIT FOR SEVERAL PHONES

? *I have a pair of telephones which I want to connect between my house and garage. Each phone is complete with induction coil, switch hook, a bell which works on 1.5 volts d.c., and 10 push-button switches. Please show how these units can be connected. I may want to add other phones to the system so please show how these can be connected.—M. W. New York, N.Y.*

A. We are not sure of the internal connections in the units you have but this circuit should be applicable. Three lines and a common ground are required for the first pair of phones and one additional line for each station you add to the system. Each station is connected in the same manner.

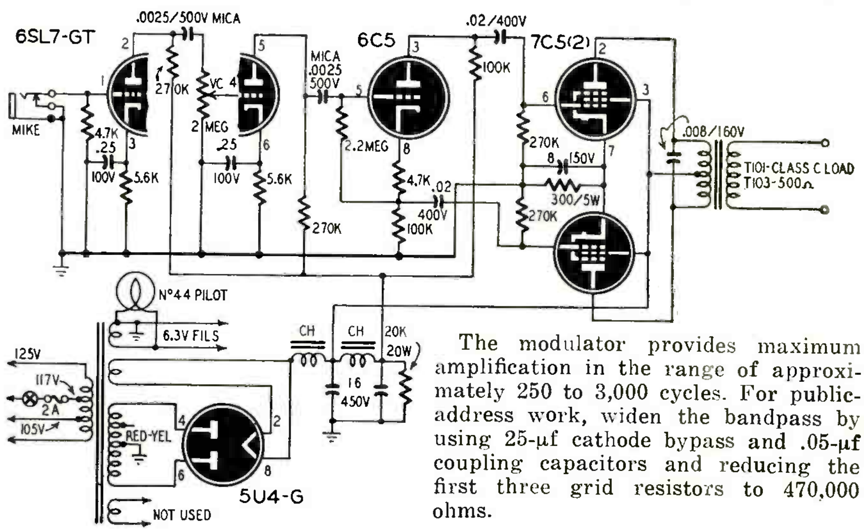
For trouble-free operation use weather-proof wire for the telephone line.



HAMMARLUND FOUR-11 MODULATOR SCHEMATIC

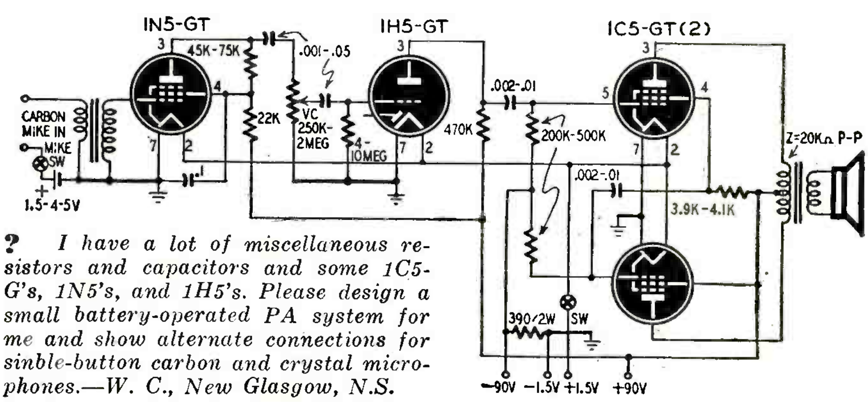
? *I have a kit of parts for constructing a Hammarlund Four-11 modulator but I cannot find a schematic diagram. Please print a circuit of this unit.—N. J. S., Greensboro, N. C.*

A. The diagram of the Four-11 is shown. Some of these units are equipped with 500-ohm output transformers and others have modulation transformers designed for 8,000-ohm class-C loads.



The modulator provides maximum amplification in the range of approximately 250 to 3,000 cycles. For public-address work, widen the bandpass by using 25-μf cathode bypass and .05-μf coupling capacitors and reducing the first three grid resistors to 470,000 ohms.

BATTERY-OPERATED PUBLIC ADDRESS SYSTEM



? *I have a lot of miscellaneous resistors and capacitors and some 1C5-G's, 1N5's, and 1H5's. Please design a small battery-operated PA system for me and show alternate connections for sinble-button carbon and crystal microphones.—W. C., New Glasgow, N.S.*

A. A diagram of a four-tube battery-operated amplifier is shown. The output stage uses push-pull 1C5-GT's connected so the voltage drop across the screen dropping resistor of one is coupled into the control-grid circuit of the other. The value of the screen resistor should be selected to have the signals on the 1C5-GT grids equal. A range of values are given on the noncritical components. The coupling capacitors feeding the push-pull grids should be equal in value.

The inset shows the connections for a single-button carbon microphone. The amplifier should deliver approximately ½ watt. Its gain is sufficient to work from crystal pickups and carbon and high-output crystal microphones. For rough, outdoor use, the carbon mike is recommended.

ANTENNA MATCHING

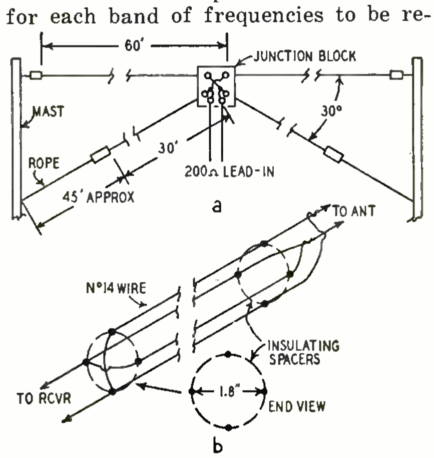
? *I have two 300-ohm Yagis cut for channel 13 and an all-channel conical antenna. Please show how these three antennas can be connected to a single 300-ohm transmission line in a manner that will give greatest gain with proper impedance matching.—F. A. H., Cokeberg, Penn.*

A. It is not advisable to connect Yagi antennas in parallel with all-channel antennas of any type. The antennas are likely to interact and produce reflections or cause serious attenuation on some channels. Use a separate lead-in for the all-channel antenna and stack the Yagis for maximum gain. Space the Yagis 28 inches apart and connect them with ¼-inch tubing spaced 4½ inches on center. Connect a 300-ohm transmission line to the center of the matching section.

DOUBLE-DOUBLET ANTENNA

? *Please give me the dimensions of a doublet antenna which can be used for reception between 2 and 20 mc.—E. E. P., Pittsburgh, Pa.*

A. The efficiency of a standard doublet antenna drops off rapidly for signals below or above the frequency for which the antenna is cut. Therefore, it is advisable to use separate antennas cut for each band of frequencies to be re-



ceived. When this is not practical, a double doublet like the one shown in the diagram may be used. It consists of one dipole cut for 4 mc and the other cut for 8 mc. The impedance curve of this combination antenna does not change as rapidly in the neighborhood of the half-wavelength frequencies as it does for a single doublet. The antenna should be fed with a 200-ohm transmission line. Commercial transmission line is not available with a 200-ohm impedance, so a suitable lead-in can be made by using four No. 14 wires arranged in the form of a square 1.3 inch on each side or spaced equally around the outside of a 1.8-inch circle. The diagonally opposite wires are connected at each end of the line as shown at *b* in the diagram.

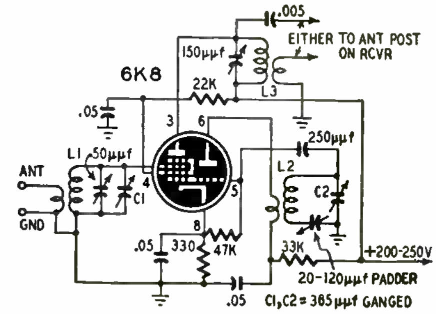
The insulating spacers may be X-shaped members, squares, or circles. The only requirement is that the conductors should be 1.3 inch apart.

LOW-FREQUENCY CONVERTER

? *Please print a circuit of a simple converter which can be used with most receivers for continuous coverage between 200 and 500 kc. I want to use standard 1¼-inch plug-in coil forms and a 2-gang 365-μμf tuning capacitor.* —*S. S., Austin, Minn.*

A. The circuit of the converter is shown in the diagram. Operating voltages can be taken from almost any a.c.-operated broadcast receiver using 6-volt tubes.

The antenna coil L1 consists of 500 turns of No. 32 enameled wire close-wound on a 1¼-inch form. It should be wound in 5 layers of approximately 100 turns each. The primary winding may be omitted and the antenna connected to the top of the secondary through a 100-μμf mica capacitor. If you include the primary, wind approximately 150 turns in 3 layers over the ground end of the secondary.



The oscillator grid coil L2 consists of 110 turns of No. 32 enameled wire close-wound in a single layer. The plate coil is 40 turns of No. 32 wire close-wound over the ground end of the grid coil. Use a thin layer of insulating paper between the grid and plate windings. The oscillator padder is a 20- to 120-μμf unit set to approximately 102 μμf. Adjust its setting for proper tracking. Shunt a 50-μμf miniature tuning capacitor across the antenna winding so it can be peaked at any desired frequency in the tuning range.

Converter coil L3 may be a standard broadcast antenna coil with its primary coupled to the antenna posts of the receiver and its secondary tuned to 1000 kc by the 150-μμf trimmer. The receiver must be tuned to 1000 kc when using the converter.

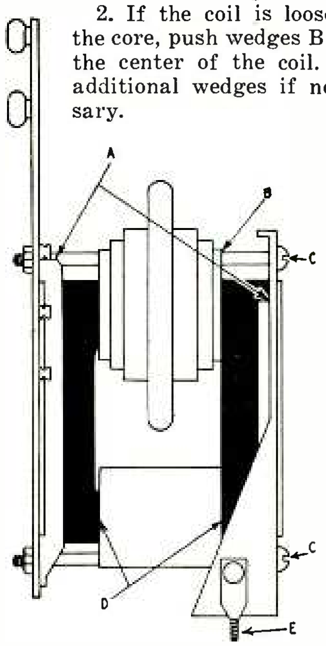
—end—

SENTINEL 419, 420, 423

A steady or intermittent high-frequency squeal in these and similar models is caused by mechanical vibration in the horizontal output transformer. It can be eliminated:

1. Run Glyptal cement between the U-shaped channel brackets and the iron core (point A on the drawing). Then, use gas pliers to squeeze the channel brackets until they touch both sides of the iron core. Do not damage the coil.

2. If the coil is loose on the core, push wedges B into the center of the coil. Use additional wedges if necessary.



3. Tighten screws C which hold the transformer assembly together.

4. Apply Glyptal to the cardboard sleeving D so it is glued to the core.

5. Tighten nuts E.

6. Make sure that all leads are dressed away from the transformer. Be careful with the lead going to the fuse.

7. Screws on high-voltage cage must be tight.—*Sentinel Service Bulletin*

MODULATION HUM

The complaint was an intermittent modulation hum which sometimes occurred when the volume was turned up full and a station was tuned in on the nose. The trouble was eventually traced to the output filter capacitor which also served as r.f. bypass capacitor for the B-plus line. This capacitor developed an internal resistance which was sufficiently high to affect the stability. The trouble was cured by connecting a 0.1-μf paper capacitor between the B-plus line and ground.—*R. G. Young*

ADMIRAL 5F11UL PORTABLE

This was brought into the shop with the complaint that it was very weak on a.c. and almost dead on batteries. In this set, the hinges provide the electrical contact between the receiver circuit and the loop antenna in the plastic lid. This set had been used on the beach for several weeks. The salt air had corroded the hinges and practically opened the circuit between the set and the antenna. Normal operation was restored by cleaning the hinges with carbon tet and coating them lightly with switch lubricant.—*Lawrence J. Miller, Jr.*

RCA MODEL 6K2

When this set was first turned on, full volume could not be obtained without snapping the power switch on and off a few times. Fading was frequent until the set warmed up. The trouble was traced to a bad .01-μf coupling capacitor between the plate of the 6F5 and the grid of the 6F6 output tube. Evidently this capacitor was partly open when the set was cold. Heat probably caused the capacitor and leads to expand and close the circuit. The same type of trouble can occur in capacitors elsewhere in the circuit. Open resistors as well as capacitors are a frequent cause of trouble in sets. This is because the heat dissipation in multitube sets is large.—*Peter Bedrosian*

DU MONT RA-103, -104, -110

Erratic picture framing which required frequent adjustment of the vertical hold and size controls was caused by a defective 30-μf, 450-volt filter capacitor (C-208-A) connected from the B-plus side of the vertical size control to ground. Replacing this capacitor cleared up the trouble.—*Wilbur J. Hantz*

ADMIRAL 20T1 AND 21B1 CHASSIS

A 6BQ6-GT horizontal output is used in all 1950 chassis of the 20T1 and 21B1 series except the 21D1 chassis. A poor connection between the plate-cap lead and the plate cap to the 6BQ6-GT may cause an excessively long warm-up period before the raster appears. Touching a hot soldering iron to the joint inside the plate cap will often help.—*Admiral Television Service Hints*

AIR KING 700-93 CHASSIS

A considerable amount of hum or buzz may be noticed in some of the 700-93 chassis. This can be cured by placing a shield over the glass 6SQ7 if it is the type which has a metal ring base. If not, substitute a metal 6SQ7. —*Air King Service Bulletin*

RCA 9T57, -77, -79, -89

An interference pattern consisting of narrow vertical bars on the left side of the raster may be the result of arcing within the 4.7-μμf capacitor C198 at the plate of the horizontal sweep output tube. This interference may be mistaken for Barkhausen oscillation. Replace this capacitor if none of the usual Barkhausen preventives (adjusting the drive or placing a magnet over the 6BG6-G) work.—*RCA Service Tips*

G-E 801, 802, 803

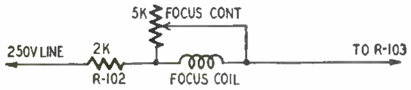
The picture may distort when either the brightness or contrast control is advanced after installing a ceramic horizontal output transformer. This trouble occurs when the lead between pins 2 and 5 of the damper tube and terminal 4 of the transformer is too close to the lead between terminal 5 of the transformer and the *blue* side of the width coil. Dressing the lead from terminal 4 along the top of the chassis eliminates the trouble.—*G-E Radio Service Bulletin*

TUNING INDICATORS

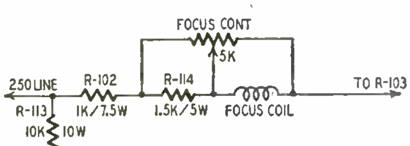
The tuning eye or indicator may fail to close properly when the set is installed in a weak-signal area a considerable distance from the nearest station. This condition can be corrected by substituting a 6E5 tuning-indicator tube. The latter will give a more positive indication because it requires less grid voltage to produce a shadow-angle of zero degrees.—*John L. Johnson*

SENTINEL MODELS 412, 413, 415

The range of the focus control on all series YA, YB, YC, and early YD chassis (the latter have the YD stamped in ink on the back of the chassis) can be increased by duplicating the production changes which were made. The original circuit is shown at *a* and the modified circuit at *b*.



a



b

Series resistor R-102 was changed from 2,000 to 1,000 ohms. A 1,500-ohm, 5-watt resistor has been added in series with the output side of the focus coil, and a 10,000-ohm, 10-watt bleeder resistor has been connected between ground and the output side of R-102. The focus control circuit is rewired so it is across the focus coil and the 1,500-ohm resistor in series with it. The tap on the control is connected to the output side of the focus coil. —*Sentinel Service Bulletin*

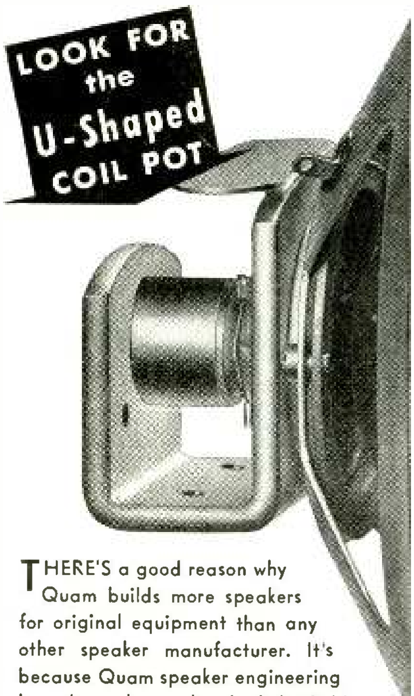
MAJESTIC 4705

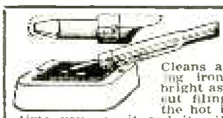
This set would suddenly stop playing after about 15 minutes of operation. Replacing the 50B5 restored the set to normal operation. The old 50B5 was checked and found to be gassy. The cathode of this tube supplied heater voltage for the 1.4-volt in the set. When the set warmed up, the 50B5 cathode current dropped and the oscillator tube stopped functioning because of insufficient filament voltage.—*Manuel E. Silva*

HUM IN A.C.-D.C. SETS

Most a.c.-d.c. sets have the common B-minus lead connected to the chassis through an isolating capacitor. Leakage between the dial light socket and chassis will feed power-line hum into the grid circuits of all tubes in the receiver. This type of hum is hard to isolate, it sounds like a bad filter capacitor. Whenever you run into a bad case of hum, check the dial light socket for faulty insulation or a coating of dust and dirt which will provide a leakage path to the chassis.—*John W. Cook*

—end—





NEW YORK AND LICENSES

Latest news at time of writing indicates that New York will almost certainly have a licensing law. The proposed act will provide for a Commissioner with power to make regulations within the limits granted him by the local law, for technician licenses based on examinations, and for a seven-member advisory committee to consult with the commissioner. This committee would contain representatives of all groups in the industry which are affected by the local law, and their recommendations would require an answer in writing from the Commissioner should he not agree with them.

Television or radio service technicians engaged in business at present would be able to obtain permits to operate for the next two years, after which time all radio technicians would have to be certified as having passed a regular examination.

NEWS FROM LONG BEACH

Apprentice training is an important part of the work of the Long Beach Radio Technicians Association. The photo below shows Richard A. Ward, instructor, and Charles Beeken, an apprentice in his third year of apprenticeship, working together at the service bench.

The latest report from Long Beach praises the cooperation of the Office of Price Stabilization of Los Angeles, stating that at no time have Association members been in trouble for over- or under-charging.

Harry E. Ward sends in a statement of membership of the other chapters of the Southern California group. The San Fernando Valley chapter, he says, has 150 members, Santa Monica a little less than 100, Pomona Valley between 150 and 200, Tri-City less than 200, and the newest chapter, Santa Ana, 75.

The Southern California Association has circulated a list of suggested minimum prices among its membership. There is a sharp difference made between charges for radio and television repairs (based on need for more skilled personnel for television service). A home call, including minor repairs, is listed at $3.50 for radio and $6.00 for a television call. TV bench labor, based on a 1-hour minimum, is $7.50 per hour, while a minimum charge for repairing a.c.-d.c. radios (no time suggested) is $2.50; minimum for a record changer, $17.50. The minimum *labor* charge for a TV antenna installation is $17.50, materials cost being added to this charge.

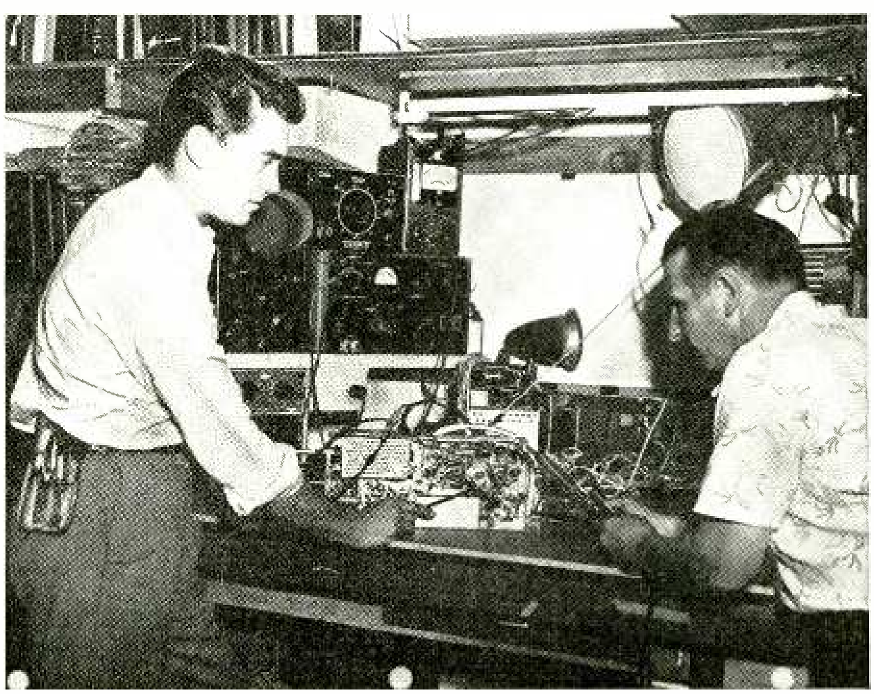
L. A. INVESTIGATES

Los Angeles is one of the latest cities to report an exposé of the radio repair industry. This one differs from previous attempts since the exposers are standing by their guns and bringing the offenders to court. They will have an opportunity to defend themselves. But the proven crooks will no longer have the opportunity to further plunder the set owner and harm the reputation of the industry.

The exposé—actually, investigation—was initiated by the bunco squad of the Los Angeles police department. Warrants for petty theft were sworn against TV repairmen who were found to have charged for parts that were not replaced or for such types of labor as "repairing short in the horizontal speed can," an item which appeared on one bill.

At the time of writing, two of the defendants booked for larceny had been found guilty of petty theft, and another had entered a guilty plea.

Reaction among repairmen has been mixed. Some—including the Radio Technicians Association—feel that the investigation "will be of great help to



Actual work on the bench is stressed in the Long Beach training program.

the public and to the legitimate service technician." Others are not so sure. One, writing to the Los Angeles *Daily News*, which has been sponsoring the investigation editorially, suggests that some honest errors may be punished as crimes, and says "Your articles . . . will only serve to discourage competent men in the industry or men who may be contemplating entering the field."

Still others, dubious about the practice by the police of laying traps for repairmen, say it is suggestive of methods which have never formed a part of American jurisprudence. The response of the television set owner—as judged from the letters printed by the *Daily News*—appears to have been uniformly favorable.

NETSDA PLANS TV SET AWARDS

The National Electronic Technicians and Service Dealers Associations met in Washington, June 3. Main topic of discussion was the proposed Awards for "serviceable" television sets. The organization plans to recognize with an annual award the manufacturer who most imaginatively anticipates the service technicians' problems in the design of his sets. Most efficient servicing is the criterion. The discussion was led by Jack Wheaton, who is head of the Award committee.

Dave Krantz was elected delegate to the Chicago RTMA meeting June 5, and Messrs. Selinger, Burns and Marshall delegates to the Federal Trade Commission meeting in Washington, June 21.

It was decided to hold no further meetings of the organization till September.

The proposed Constitution was read and approved by the delegates, and returned to the group's counsel for processing through the District of Columbia courts.

RTMA MUST COOPERATE

Education and cooperation are the two things the service technician would most appreciate from the set manufacturer. This was the theme of the speech made by Dave Krantz, representing the National Electronic Technicians and Service Dealers Associations at the RTMA Service Committee meeting in Chicago, June 5.

A uniform, over-all training program on u.h.f. and color is needed, he emphasized. This can be carried out successfully only with the full cooperation of the manufacturer, distributor, local educators and the local technicians' groups. The program should be well planned, not the "one-shot" affairs proved relatively ineffective in the past.

In addition to a formal planned program, a more liberal program in supplying technical service bulletins would

OPPORTUNITY FOR WRITERS

RADIO-ELECTRONICS pays good rates for interesting and original articles. Most in demand are stories on communications receivers, television boosters, television test equipment, advanced audio test equipment (distortion meters, etc.) and new slants on television and radio servicing. Send for our Author's Guide

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(*Continued from page* 87)
be helpful. Information and technical data on converting present test equipment for coming developments, and training in the use of the new equipment that will be needed for u.h.f. and color are also necessary to "keep up with the times."

Manufacturers' cooperation was possible along two lines, according to Krantz. The greatest need is fast and efficient replacements, requiring cooperation by the manufacturer and the local distributor. Another important aid to the service technician would be the release of new types of tubes to distributors and service organizations immediately (or before) a chassis is released. Thousands of man-hours are now wasted by the repairman in calls on models for which he has no tubes. Warranty should be 90 days on all parts except the picture tube, which should be six months.

The question of design is so important that NETSDA intends to award "Oscars" to manufacturers who produce chassis best adapted to efficient service. Good design from the service technician's point of view would include:

Clear markings: permanent and far more legible markings on tubes; socket numbering on the chassis; stamping of the chassis' model and code numbers into the chassis itself; frequency markings on the i.f. and discriminator transformer and chassis layouts placed inside cabinets. These are necessary for efficient and rapid servicing. The service technician is grateful for what has been done in this direction by some manufacturers and would like to see all these markings become universal.

Easy access: components and wiring should be so arranged that the technician can get at them. Tubes should not be placed under the chassis, or under a C-R tube or yoke mounting. Speakers should have plugs and fuses be clip-mounted.

Other points making for better servicing are: standardization of couplings for dual controls; standardization of the functional names of controls; standardization of fuse sizes; placing a protective cover on metal picture tubes; and a method of easily removing the safety glass or screen to clean the C-R tube face.

A third type of cooperation, Mr. Krantz concluded, would be to discourage exaggerated advertising statements, especially in regard to the performance of receivers and built-in antennas. Advertisements should stress the need for proper servicing of equipment and not include statements which give the customer the idea that installations of units are so simple that, "all you need is a screwdriver." Such ads make the customer unwilling to pay for the labor involved.

The television service contractors were represented at the meeting by three spokesmen, Al Haas of Philadelphia, Jack Barton of Detroit and Frank Moch of Chicago. Transcripts of their addresses were not received at the time of writing. A friendly atmosphere marked the discussion on the part both of the manufacturers and the service industry at the meeting.

—end—

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.

AUGUST, 1917
ELECTRICAL EXPERIMENTER

Women Radio Operators to Aid Uncle Sam
Bell Telephone Engineers in U. S. Signal Reserve Corps
"Eiffel Tower" Radio Mast on Wheels
Experimental Poulsen Arc, by Raymond F. Yates
20,000-Meter Undamped Radio Receiver, by William Burnett, Jr.
Useful Hints on the Audion, by Frank J. Collins
Converting a Tuning Coil into a Cabinet Tuner, by N. H. Allen
Effect of Water Vapor on the Propagation of Electromagnetic Waves
A Duplex Polarity Potentiometer
A Hand-Feed Arc for the Experimeter, by James Pratt

THE FUND TOPS $8,000.

HELP - FREDDIE-WALK FUND

This month we are happy to present something new in the Help-Freddie-Walk Fund.

We have a letter from Mr. Clarence W. Suedekum of the Suedekum Electronic Supply Company of Cape Girardeau, Mo. He also sent us a check we acknowledged with thanks. Mr. Suedekum writes as follows and the picture on this page gives all the details:

"Herewith our check for $7.50 for the Help-Freddie-Walk Fund, which was collected here in our store in what we feel is a novel collection means. Each month we will be mailing a check for the Fund. We use a quart ice cream container (see picture) and as we have a 'Coke' machine in the store, when we match for cokes the loser has to put a nickel

in the Freddie container. A small amount is frequently dropped in the box by customers who, in getting their change from a purchase, use the pennies, or nickels, or dimes, which they just drop in the box. We cut the story and picture of Freddie from the March issue of RADIO-ELECTRONICS and using Scotch tape put them on the outside of the box to secure the photo and story. If other stores or radio distributors do what we are doing, they will get an appreciable monthly contribution for Freddie. No one misses these small sums, whereas Freddie's expenses just go on and on for years."

If enough of these boxes are placed in radio and other stores around the country the Freddie fund will continue to grow at a healthy rate. We are also pleased to report the following:

$15.50 contributed by employees and friends of Frank C. Nahser, Inc., Chicago, Ill., through Paul J. Steffen.

Please keep up your efforts in behalf of Freddie, who, when he grows up will, we all hope, become a radioman once he has been equipped with his final mechanical legs and arms.

Please send your contributions from time to time—even the smallest donation will be greatly welcome.

Make all checks, money orders, etc., payable to Herschel Thomason. Please address all letters to:

Help-Freddie-Walk Fund
c/o RADIO-ELECTRONICS
25 West Broadway
New York 7, N. Y.

FAMILY CIRCLE MAGAZINE CONTRIBUTIONS

Balance as of May 18, 1951	$379.95
Ethel C. Alexander—Jacksonville, Fla.	1.00
Lucy B. Blaich—Los Angeles, Calif.	2.50
Mr. & Mrs. J. A. Carpenter—Grants Pass, Ore.	5.00
The Finkelsteins—Brooklyn, N. Y.	2.00
Mrs. Marie Gastl—Cincinnati, Ohio	1.00
Catherine T. Haley—Chicago, Ill.	1.00
Mildred Luberman—Brooklyn, N. Y.	1.00
Mrs. P. M. McMinn, Jr.—Culver City, Calif.	2.00
Miss Mary Nichalyco—Skaneateles Falls, N. Y.	2.00
Mrs. Le Ray Teigen—Wanamingo, Minn.	5.00
Mrs. Louis Thame—Cincinnati, Ohio	1.00
L. G. Vualo—Jersey City, N. J.	2.00
Adeline V. Waite—Los Angeles, Calif.	1.00
Carol Weaver—Los Alamos, N. M.	10.00
Mrs. John M. Young—Reading, Pa.	1.00
FAMILY CIRCLE Contributions received up to June 19, 1951	$417.45

RADIO-ELECTRONICS CONTRIBUTIONS

Balance as of May 18, 1951	$7,796.83
Anonymous—Glendale, Calif.	1.00
Anonymous—Rock Island, Ill.	1.00
Anonymous—Holyoke, Mass.	2.00
Anonymous—Kansas City, Mo.	1.00
Anonymous—Gastonia, N. C.	5.00
Anonymous—Bridgewater, Va.	10.00
Employees and Friends of Frank C. Nahser, Inc.—Chicago, Ill.	15.50
Van H. Ferguson—Tallahassee, Fla.	5.00
Firmin F. Fortur, W6VJ—Burbank, Calif.	5.00
H. Gademer—Glen Ridge, N. J.	1.00
Jack's Radio-TV—Indianapolis, Ind.	2.00
R. Johnston—Westmont, Ill.	30.00
H. J. Klick—Cayuga, N. Y.	1.00
E. J. Mahoney—South Orange, N. J.	2.00
National Radio Institute—Washington, D. C.	50.00
Ken Sakamoto—Canada	2.00
David S. Sterrett, USN—Annapolis, Md.	5.00
Suedekum Electronic Supply Company—Cape Girardeau, Mo.	7.50
M. J. Wiegler—Newark, N. J.	2.00
Evan Williams—South Laguna, Calif.	5.00
RADIO-ELECTRONICS contributions	$7,949.83
FAMILY CIRCLE contributions	417.45
Total received to June 19, 1951	$8,367.28

—end—

RADIOMEN HONOR DE FOREST

Twenty prominent radio engineers and business executives, all formerly connected with the de Forest radio companies, organized the de Forest Pioneers, June 14. The group will perpetuate the name of Dr. Lee de Forest, planning to set up offices and scholarships as part of their general activities.

Dr. de Forest, inventor of the three-element Audion, the tube that made radio practical, was unable to attend, but sent a message to his old friends.

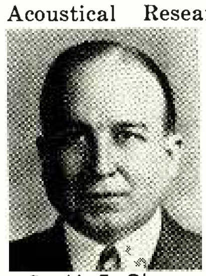
Among those present were Dr. Allen B. Du Mont, head of Allen B. Du Mont Laboratories, Inc., who was formerly chief engineer of the de Forest Radio Co.; Admiral E. W. Stone, president of American Cable and Radio Corp.; Frank Andrea, president of Andrea Radio & Television Corp.; W. J. Barkley, vice-president of Collins Radio Co.; Louis Pacent, president of Pacent Engineering Co.; and Hugo Gernsback, editor and publisher of RADIO-ELECTRONICS.

W. P. Ready

William P. Ready was appointed General Sales Manager of the NATIONAL COMPANY, INC., Malden, Mass. Mr. Ready has been with the company since 1946. His most recent position was television sales manager.

R. R. Hutmacher

Ray R. Hutmacher joined the PERMO-FLUX CORP., Chicago, as sales manager of the Jobber Division. Mr. Hutmacher, who has been associated with the electronics industry for 17 years, was most recently midwestern sales manager of North American Philips Co.



Dr. H. F. Olson

Dr. Harry F. Olson, Director of the Acoustical Research Laboratory of RCA LABORATORIES, Princeton, N. J., was elected president of the Acoustical Society of America for the year 1952. Dr. Olson has been engaged in acoustical research with RCA since 1928 and he has been the Acoustical Laboratory director since 1946. He was a pioneer in the development of directional microphones.

Hugo Gernsback, Editor of RADIO-ELECTRONICS, addressed the Quarter Century Wireless Association Banquet in New York City in June. He amused the gathering with a discourse on "Wireless on Mars" which he originally presented at a Wireless Banquet in the same hall in 1909.

Hobert M. Murdock joined the TURNER COMPANY, Cedar Rapids, Iowa, manufacturer of microphones, television boosters, and electronic equipment, as sales manager. Mr. Murdock has had extensive sales and administrative experience. He was most recently vice-president in charge of sales for Cedar Rapids Engineering.

Personnel Notes

. . . **Dr. Allen B. Du Mont**, president of ALLEN B. DU MONT LABORATORIES, INC., was ranked fourth among America's twelve "most outstanding industrialists" in a poll conducted by Forbes Magazine.

. . . **Richard W. Mitchell**, sales manager of INDUSTRIAL DEVELOPMENT ENGINEERING ASSOCIATES (Regency), was appointed sales manager of Radio Apparatus Corp., both of Indianapolis. He will continue as sales manager of both companies.

. . . **William T. Buschmann** joined SYLVANIA ELECTRIC PRODUCTS, INC., as merchandising co-ordinator for the

Radio Tube and Television Tube Divisions. The company also announced the appointment of William G. Blowers as merchandising supervisor of the Television Picture Tube Division.

. . . Dr. Henry G. Booker and John M. Berkowitz were elected to the Board of Directors of the LaPointe-Plascomold Corp., Windsor Locks, Conn.

. . . Edwin A. Freed, formerly with the Tube Department, RCA, joined the General Instrument Corp., as sales manager of products manufactured at the Elizabeth, N. J., plant. Lee Balengee, formerly of the Elizabeth plant, was transferred to the position of manager of the Chicago Sales Office.

. . . Philo T. Farnsworth, vice president and director of research of Capehart-Farnsworth Corp., Fort Wayne, Ind., received the honorary degree of Doctor of Science from the Indiana Technical College. He was the principal speaker at the school's fifteenth annual commencement exercises.

Robert C. Sprague, president of Sprague Electric Co., was re-elected Chairman of the Board of Directors of the RTMA at its annual conference in Chicago. Glen McDaniel continues as full-time, paid president. John W. Craig of the Crosley Division of Avco Mfg. Co., was elected a new vice-president and chairman of the Set Division. He was re-elected a director. R. E. Carlson, Tung-Sol Lamp Works, was elected a vice-president and chairman of the Tube Division. W. J. Barkeley, Collins Radio Co., A. D. Plamondon, Jr., Indiana Steel Products Co., and Arie Liberman, Talk-A-Phone Co., were re-elected vice-presidents in charge of the Transmitter, Parts, and Amplifier & Sound Equipment Divisions respectively.

—end—

CORRECTIONS

There are errors in the markings of the 6B4-G filament pins in Figs. 4 and 8 of the article "Engineered Amplifier Brings Audio Realism" in the February, 1951 issue. The correct heater connections are to pins 2 and 7 rather than 2 and 6 as shown. Pin numbers for the plate and cathode of the lower half of the push-pull 6SN7-GT (Fig. 4) are reversed. The cathode pin is 6 and the plate is 5.

We thank Mr. Robert L. Howard, of Bloomfield, N. J. for this correction.

There is an error in the mathematical calculations in the article "Variable Power Supply for Shop or Laboratory," on page 43 of the May, 1951, issue. In the last paragraph of the first column, the solution to a problem shows 350 volts at 150 ma to be equivalent to 42.4 watts. The correct answer is, of course, 52.5 watts.

Our attention was also called to the fact that the 25,000-ohm bleeder resistor has a much higher wattage rating than is necessary. The bleeder current is 14 ma and its dissipation is 4.9 watts. Therefore, a 10-watt resistor will provide an adequate safety factor.

We thank an alert reader, R. V. Purcha, of Lorain, Ohio, for calling our attention to these facts.

MORE ON HUSBANDS

Dear Editor:

I just must answer the article by Mrs. Robert Altomare (*page 95, June, Ed.* . . . This much of her article is true—that any wife with a radio bug for a husband can expect his almost complete absorption in it. (She should be glad it isn't something which takes him away from home).

. . . She made me good and mad when she referred to the new rug she wanted; the frail female nailing shingles, etc. Doesn't she realize that all these things don't need to take place at all? I'm not superhuman, just a wife and mother of a small child. But if my husband wants to do something, and make constructive use of his extra hours, who am I to sit around and make a martyr of myself. Seems to me these gals aren't as smart as they could be.

I find I can help my lot by trying to "see" radio. Save some of that eternal ironing for the evening and then do it in the basement (or wherever the shack is). If these radio wives' husbands knew they really wanted to be with them, I'm sure they would make a place for a chair—mine did, and he isn't different from any other man.

I try to read my husband's RADIO-ELECTRONICS, and it does help me to know what he is talking about. Seems to me those gals who talk of quitting, etc., just don't care enough to try . . .

. . . From all this don't think I'm a mechanical wizard . . . I'm not. In fact my dear husband will probably have a relapse when he reads this—he would be the first to say "My XYL? Nope, she sure isn't any radio man . . ."

I just couldn't let that item go unanswered. In articles, radio wives take such a beating it didn't seem fair to let it go by.

MRS. S. RAND

Portland, Ore.

OLD FRIENDS MEET

Dear Editor:

You probably did not expect that the book review in RADIO-ELECTRONICS, February—about the Radio Technical Dictionary by Horst A. C. Krieger—would provide information to re-establish friendly connections, interrupted in the last disastrous months of World War II, between the author and the undersigned writer.

Mr. Krieger informed me in a recent letter that the omission of television terms is due to the fact that most of this edition was compiled four to five years ago. At this time he was with a group of English and German scientists performing tests on captured German V-2 rockets—a job we were engaged in during the past war. Final work of the present edition of said dictionary was done in behalf of Nordwestdeutscher Rundfunk (Northwestern German Broadcasting System) to enable its key technical personnel to get in contact with proceedings achieved in England and the U.S.A. during and after the past war . . .

WILLY FRIEDRICH

Camden, N. J.

—end—

RADIO SCHOOL DIRECTORY

HIGH-FREQUENCY MEASUREMENTS (second edition), by August Hund. Published by McGraw-Hill Book Co., 330 West 42 St., New York, N. Y. 6¼ x 9¼ inches, 676 pages. Price $10.00.

The second edition of this book—one of the two standard texts in the field—has been thoroughly revised "to bring it up to date with the advances of the last eighteen years." Measurements discussed range from low to super-high radio frequencies, covering the spectrum up to 30,000 mc. Chapters on line and antenna determinations and on modulation measurements were completely rewritten, and a larger number of measurement procedures are presented.

PULSE TECHNIQUES, by Sidney Moskowitz and Joseph Racker. Published by Prentice-Hall, Inc., 70 Fifth Avenue, New York, N. Y. 6 x 8½ inches, 300 pages. Price $6.65.

The primary stated purpose of this book is to enable those with electrical engineering background to analyze and design circuits for transmission and utilization of pulses. It may be equally interesting to the engineering student who desires more information on pulses and pulse networks.

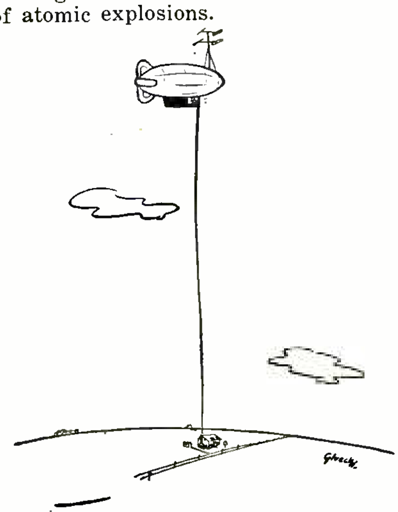
The transient response and the design of pulse networks is fully covered, and considerable space given to pulse amplification and to pulse-shaping and clamping circuits. Coverage of pulse communication systems is much less complete, only one of the standard systems being described rather briefly.

RADIATION MONITORING IN ATOMIC DEFENSE, by Dwight Gray and John Martens. Published by D. Van Nostrand Co., Inc., 250 Fourth Ave., New York, N. Y. 5½ x 8½ inches, 122 pages. Price $2.00.

Material offered is divided into two general sections. Part 1 is background information including atomic theory.

Part 2 covers—in elementary fashion—the basic construction and characteristics of a number of radiation protective devices, and gives instructions for operation and maintenance. Included are geiger counters, ionization chambers, proportional alpha counters, and pocket chambers and dosimeters.

Radiation hazards are discussed, including immediate and lingering effects of atomic explosions.



ADVERTISING INDEX

RADIO SCHOOL DIRECTORY

Page 94

Radio-Electronics does not assmue responsibility for any errors appearing in the above index

HIGH-SPEED COMPUTING DEVICES, by the staff of Engineering Research Associates, Inc. Published by McGraw-Hill Book Co., Inc., 330 West 42 St., New York, N. Y. 6¼ x 9½ inches, 451 pages. Price $6.50.

This volume begins with the elementary circuits used in electronic computing equipment. It covers arithmetic systems with reference to their adaptability to mechanical computers, and discusses present types of computers, beginning with the desk calculator. It devotes a chapter to punched-card systems as well as one to analog computers. Digital computers, of course, receive the main attention of the authors.

Part III of the book covers physical components and methods, including special techniques and equipment which are likely to be more fully used in future computing equipment.

The book is interestingly written and the technical reader who has found previous literature on the subject too general to give him a grasp of actual computing equipment and methods, will find it of value. Numerous diagrams and other illustrative material increase the value of the text.

VACUUM-TUBE VOLTMETERS (second edition) by John F. Rider. (Revised by John F. Rider and Alfred W. Barber). Published by John F. Rider Publisher, Inc., 480 Canal St., New York 13, N. Y. 6 x 8½ inches, 422 pages. Price $4.50.

More than twice as big as the first edition which was published ten years ago, the new *Vacuum-Tube Voltmeters* is expanded and contains a number of new chapters.

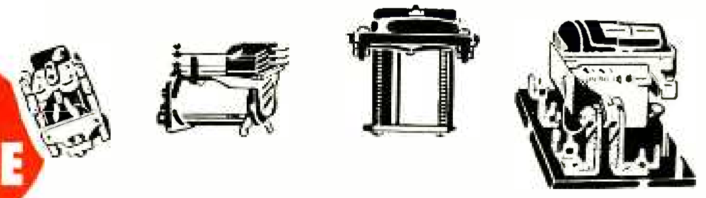
The new chapters are "Probes for R.F. and D.C., Commercial Vacuum-Tube Voltmeters," and "Maintenance and Repair of Vacuum-Tube Voltmeters." The latter chapter devotes 64 pages to this important subject, and amounts almost to a subsection of the book. The chapter on commercial meters is almost as long, and includes 49 pages of diagrams of commercial vacuum tube voltmeters.

The book closes with an extensive bibliography and an index, and questions for student use have been provided at the end of each chapter.

—end—

Suggested by R. W. Glueckstein, Menominee Falls, Wis.
"He's got his set built right into the living room wall!"

RELAYS FOR EVERY PURPOSE



RECENT ADDITIONS TO OUR STOCK OF OVER A MILLION RELAYS . . .

Each relay is brand new, standard make, inspected, individually boxed and fully guaranteed. This is only a partial list. Write or wire us for information on types not shown.

STANDARD DC TELEPHONE RELAYS

Stock No.	Voltage	Ohmage	Contacts	Unit Price
R-868	30/162 VDC	3300	1C	$1.90
R-873	6	12	3C, 3A Micalex	3.00
R-918	52/228 VDC	6500	1C	3.60
R-852	52/228 VDC	6500	1C, 1A	1.55

SHORT TELEPHONE RELAYS

Stock No.	Voltage	Ohmage	Contacts	Unit Price
R-907	24/32 VDC	3500	1C	2.00
R-914	110 VAC	200	3B	2.50
R-908	6 VDC	15	4A @ 4 amps.	1.50

KEYING RELAYS

Stock No.	Voltage	Ohmage	Contacts	Unit Price
R-850	12 VDC	450	1A @ 1.5 amps.	1.50
R-935	28 VDC	1000	1C @ 1.5 amps.	1.65
R-949	2.4 VAC	. . .	1A @ 5 amps.	1.95
R-891	24 VDC	475	1C @ 5 amps.	1.45
R-858	27.5 VDC	250	1A Dbl. Brk.	1.45
R-833	6.5 VDC	1300	2C	3.05
R-960	24 VDC	230	3C @ 15 amps.	2.95
R-828	6/8 VDC	42	1A	1.50
R-855	110 VAC	160	1A Dbl. Brk. @ 15 amps.	3.25
R-948	110 VAC	330	3A @ 15 amps.	3.00
R-924	12 VDC	72	1C Dbl. Brk.	1.65
R-950	2.4 VAC	. . .	1A @ 8 amps.	2.25
R-978	6 VAC	1.7	1A 1B @ 1 5 amps.	1.95
R-979	6 VAC	1.7	2A @ 1.5 amps.	1.95
R-917	18 VAC	31	1A @ 12 amps.	3.25
R-965	24/30 VAC	38	1A 1B @ 1.5 amps.	1.95
R-966	24/30 VAC	38	2A 2B @ 1.5 amps.	2.25
R-937	24/30 VAC	38	2A 3B @ 1.5 amps.	2.40
R-968	24/30 VAC	38	1A 5B @ 1.5 amps.	2.55
R-969	24/30 VAC	38	1A 6B @ 1.5 amps.	2.70
R-974	24/30 VAC	48	1A 1B @ 1.5 amps.	2.25
R-971	24/30 VAC	48	1A 2C @ 1.5 amps.	2.40
R-973	24/30 VAC	48	2A @ 1.5 amps.	2.25
R-970	24/30 VAC	48	2A 1C @ 1.5 amps.	2.40
R-975	24/30 VAC	48	1B 1C @ 1.5 amps.	2.40
R-976	24/30 VAC	48	2C @ 1.5 amps.	2.55
R-977	24/30 VAC	48	3A 1C @ 8 amps.	2.70
R-883	115 VAC	1200	1A 1C 1D	2.00
R-853	6/8 VDC	30	2A @ 10 amps.	1.55
R-875	6/8 VDC	240	1A @ 12 amps.	
			1C @ 1.5 amps.	1.50
R-830	24 VDC	330	2A	1.45
R-832	24 VDC	375 C.T.	1A @ 15 amps.	1.70
R-959	24 VDC	747	2C	1.50
R-929	24 VDC	425	1A Dbl. Brk.	1.25
R-982	12 VDC	24	1A Dbl. Brk.	1.55
R-947	12/24 VDC	320	1C @ 3 amps.	1.25
R-900	24 VDC	95	1A Dbl. Brk. @ 20 amps.	1.55
R-926	24 VDC	95	4C @ 15 amps.	3.55
R-983	24 VDC	265	3A	1.65
R-984	24 VDC	375	1C	1.65
R-878	24 VDC	375	1C Micalex	1.65
R-871	18/24 VDC	2000	2C	1.65
R-936	28 VDC	1000	1C @ 1.5 amps.	1.65
R-829	12/18 VDC	270	1A	1.45
R-905	32 VDC	1500	1C Dbl. Brk. @ 15 amps.	3.25
R-869	115 VDC	600	1A Dbl. Brk.	2.25
R-963	220 VAC	. . .	2C-1A Dbl. Brk.	7.50
R-928	350 MA	1.75	1C @ 6 amps.	1.25
R-953	12 VDC	65	1A @ 100 amps.	4.95
R-955	12 VDC	65	1B @ 100 amps.	4.95
R-954	24 VDC	160	1A @ 100 amps.	4.95
R-876	12 VDC	175	2A 1B	1.60
R-882	24 VDC	300	1A	3.00
R-860	48 VDC	3000	2A @ 1 amp. 230 v	2.60
R-923	24 VDC	1050	2C	2.75
R-958	60 VDC	1550	2A @ 12 amps.	1.50

W-E TYPE "E" RELAYS

Stock No.	Voltage	Ohmage	Contacts	Unit Price
R-910	. . .	6/35/35	2A Split Cont.	$3.50
R-904	. . .	35/175	1A	1.25
R-981	12 VDC	270	2B-2C	1.50
R-870	24 VDC	2600	1A	1.30
R-863	48 VDC	4000	3A	2.00

SLOW ACTING

Stock No.	Voltage	Ohmage	Contacts	Unit Price
R-897	6 VDC	150	1A Slow Break	2.65
R-865	24 VDC	200	1C Slow Break	1.75
R-934	24 VDC	3000	2B Slow Break	2.95
R-962	6 VDC	150	1A Slow Make	2.65

DIFFERENTIAL RELAYS

Stock No.	Voltage	Ohmage	Contacts	Unit Price
R-849	220/250 VDC	8000	2C	3.65

SEALED RELAYS

Stock No.	Voltage	Ohmage	Contacts	Unit Price
R-861	32 VDC	8000	1B	4.00

VOLTAGE REGULATORS

Stock No.	Voltage	Ohmage	Contacts	Unit Price
R-986	6 VDC	. . .	3 Terminal	2.25
R-886	6 VDC	1	with 15 ohm 50 watt	1.95

CONTACTORS

Stock No.	Voltage	Ohmage	Contacts	Unit Price
R-890	24 VDC	60	1A @ 10 amps.	3.45
R-916	24 VDC	80	1A @ 25 amps.	2.95
R-885	24 VDC	120	1A @ 25 amps.	3.00
R-845	220 VAC	. . .	3A	6.95
R-838	90/120 VDC	925	2A	4.50
R-842	115 VDC	925	3A	5.50
R-840	115 VDC	1200	2A—Size 1	5.50
R-843	115 VDC	1200	3A	4.50
R-841	115 VDC	1200	3A-1A (Aux.) Size 2	40.00
R-844	115 VDC	1200	3A-1B (Aux.)	4.50
R-980	24 VDC	6	1A @ 250 amps.	5.50
R-942	24 VDC	80	1A @ 200 amps.	3.95
R-888	115 VAC	32	2A Dbl. Brk. Size 1	7.50
R-903	24 VDC	65	1A @ 200 amps.	5.50
R-938	24 VDC	70	1A @ 200 amps.	5.50
R-939	24 VDC	40	2A @ 200 amps.	7.50
R-854	24 VDC	100	1A @ 50 amps.	4.05
R-933	24 VDC	100	1A @ 50 amps.	4.75
R-881	24 VDC	150	1A	2.50
R-944	115 VAC	40	4A (1B-Remote)	4.50
R-943	115 VAC	100	4A-4B @ 10 amps.	6.75
R-941	14 VDC	12	1A @ 200 amps.	4.05
R-956	28 VDC	160	1A Dbl. Brk. @ 50 amps.	4.05
R-880	18/24 VDC	375 C T	1A Dbl Brk.	2.50
R-889	18/29 VDC	180	1A Dbl. Brk.	2.50
R-899	24 VDC	70	1C @ 50 amp. 1B Aux.	2.50
R-898	28 VDC	8	1A @ 200 amps.	4.50
R-909	24 VDC	11	1A @ 250 amps.	5.50
R-937	24 VDC	150	1A @ 50 amps.	4.75

Stock No.	Voltage	Ohmage	Contacts	Unit Price
R-831	7.5/29 VDC	6.5	1A @ 250 amps.	$5.50
R-925	24 VDC	100	1A @ 50 amps.	4.05
R-940	24 VDC	132	1A @ 200 amps.	5.50
R-879	24 VDC	150	1A @ 50 amps.	3.75
R-874	24 VDC	140	1A Dbl. Brk. @ 25 amps.	2.00
R-945	12 VAC	1	2A @ 30 amps.	3.25
R-946	125 VDC	3200	2A @ 30 amps.	2.75
R-860	115 VAC	175	2A @ 30 amps.	5.95

MIDGET RELAYS

Stock No.	Voltage	Ohmage	Contacts	Unit Price
R-857	24 VDC	260	1D	1.75
R-912	4/5 VDC	20	3A-1C Ceramic	1.45
R-921	6.7 VDC	18	1A Dbl. Brk. @ 10 amps.	1.45
R-922	12 VDC	75	1A Dbl. Brk. @ 10 amps.	1.45
R-893	14 VDC	150	1A, 1C	2.50
R-895	14 VDC	150	2A, 1B, 1C	2.50
R-896	24 VDC	260	2A	2.50
R-894	24 VDC	260	3A, 1C	2.50
R-856	18/24 VDC	300	1B	1.45
R-913	6 VDC	20	3A, 1C Ceramic	1.45
R-915	12 VDC	70	1A Dbl. Brk. @ 10 amps.	2.00
R-834	6 VDC	20	3A, 1C	1.45

SPECIAL RELAYS

Stock No.	Voltage	Ohmage	Contacts	Unit Price
R-846	5/8 VDC	19	1C Coax	6.95
R-920	6 VDC	18	1A @ 25 amps.	1.25
R-931	Min. 1.5 Ma.	150	1C	7.50
R-927	220 VAC	2500	1A @ 5 amps.	15.00
R-951	115 VAC		⅜" Stroke	1.45
R-887	.5 Adj. 1.5 Amp.	40	2 Pole 2 Pos.	27.50
R-932	6 V @ 112 amps 12 V. @ 56 amps. 24 V. @ 28 amps.			4.25
R-930	25/50 VAC	25 ea. coil	2B-1H @ 8 amps. 1A @ 12½ amps.	3.75
R-972	40/50 VAC		1B @ 12½ amps. 1 MBM @ 1½ amps.	3.25
R-256	26 VDC	65	2B-1A @ 1KW	10.95
R-906	40 VDC	600	1A @ 30 amps.	3.95
R-864	24/24 VDC	95/95	1A,1B,1C/1A,1B,1C	5.50
R-847	10/15 VDC	70	4C	4.75
R-964	220 VAC		2A Dbl. Brk. @ 3 KV.	8.95
R-952	24 VDC	175	1A-Grounded	2.95
R-884	12 VDC	670	2A	
	28 VDC	230	12 Pos. Rotary	12.95
R-902	115 VAC		1A @ 25 amps. 440 VAC 1A @ 2 amps 300 VDC 1A @ 5 amps. 115 VAC	
R-866	Adj. from 1 Ma.	6200	1C	87.50
R-957	12 VDC	.5	1B 2 Aux. Cont.	17.50
R-919	6/8 VDC	50	1C	1.50
R-911	40 VDC	200	1C @ 20 amps.	5.2
			1A Mom.	7.9

TYPE 82

Stock No.	Voltage	Ohmage	Descriptive Information	Price
R-809	28 VDC	7	360° Rotation in 12 steps with 7" lg. shaft	$2.4
R-766	28 VDC	4/230	360° Rotation in 12 steps with 2½" lg. shaft and 8-6 Terminal Wafers mounted on 12" x 5" Terminal Board with 63 Screw Terminals plus lugs	4.90

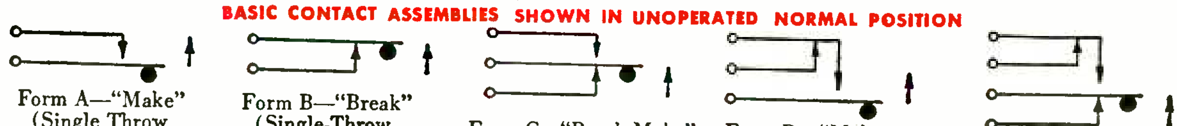
ROTARY RELAYS

Type 76-77 14 VDC—2 Ohm Energizing, 125 Ohms Holding Coil 30° Rotation ¼" Long Shaft.

Stock No.	First Wafer Circuit 1	First Wafer Circuit 2	First Wafer Circuit 3	First Wafer Term*	Second Wafer Circuit 1	Second Wafer Circuit 2	Second Wafer Circuit 3	Second Wafer Circuit 4	Second Wafer Term	Price
R-877	1 NC	1 NC	. . . .	4	1 NO	1 NO	1 NO	SPDT	9	$2.25
R-892	3 NO	. . . .	. . . .	4	SPDT	SPDT	Ceramic		6	2.40
	28 VDC—7 Ohms Energizing, 230 Ohms Holding Coil 30° Rotation ¼" Lg. Shaft									
R-711	SPDT	2 pole reversing	. . . .	8	With Coupling		. . . .	. . . .	. . . .	2.05
R-712	1 NC	1 NC	1 NC	6	. . . .	. . . .	. . . .	. . . .	. . . .	2.05
R-573	2 pole reversing	. . . .	. . . .	5	. . . .	. . . .	. . . .	. . . .	. . . .	2.05
R-901	2 NO-1 NC	. . . .	. . . .	4	SPDT	SPDT	3 NC	. . . .	10	2.25
R-616	1 NC	1 NC	. . . .	4	1 NC	1 NC	1 NC	1 NO	8	2.40

* NOTE: Number of terminals excludes those required for operation of relay.

BASIC CONTACT ASSEMBLIES SHOWN IN UNOPERATED NORMAL POSITION



Form A—"Make" (Single Throw, Normally Open)

Form B—"Break" (Single-Throw, Normally Closed)

Form C—"Break-Make" (Double-Throw)

Form D—"Make-Before-Break"

Form E—"Break-Make-Before-Break"

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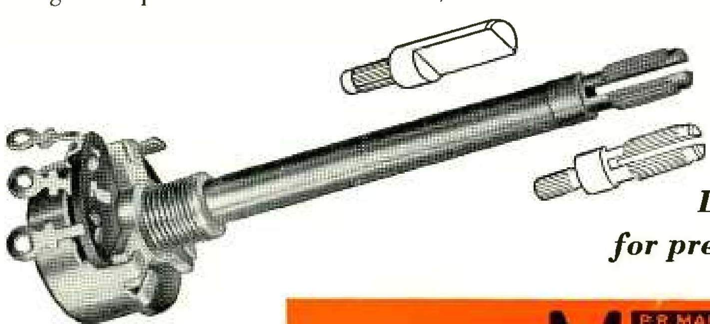

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