NOVEMBER 1951

RADIO-ELECTRONICS

LATEST IN TELEVISION • SERVICING • AUDIO

HUGO GERNSBACK, Editor

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SEE THEORY AND ENGINEERING

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U.S. and
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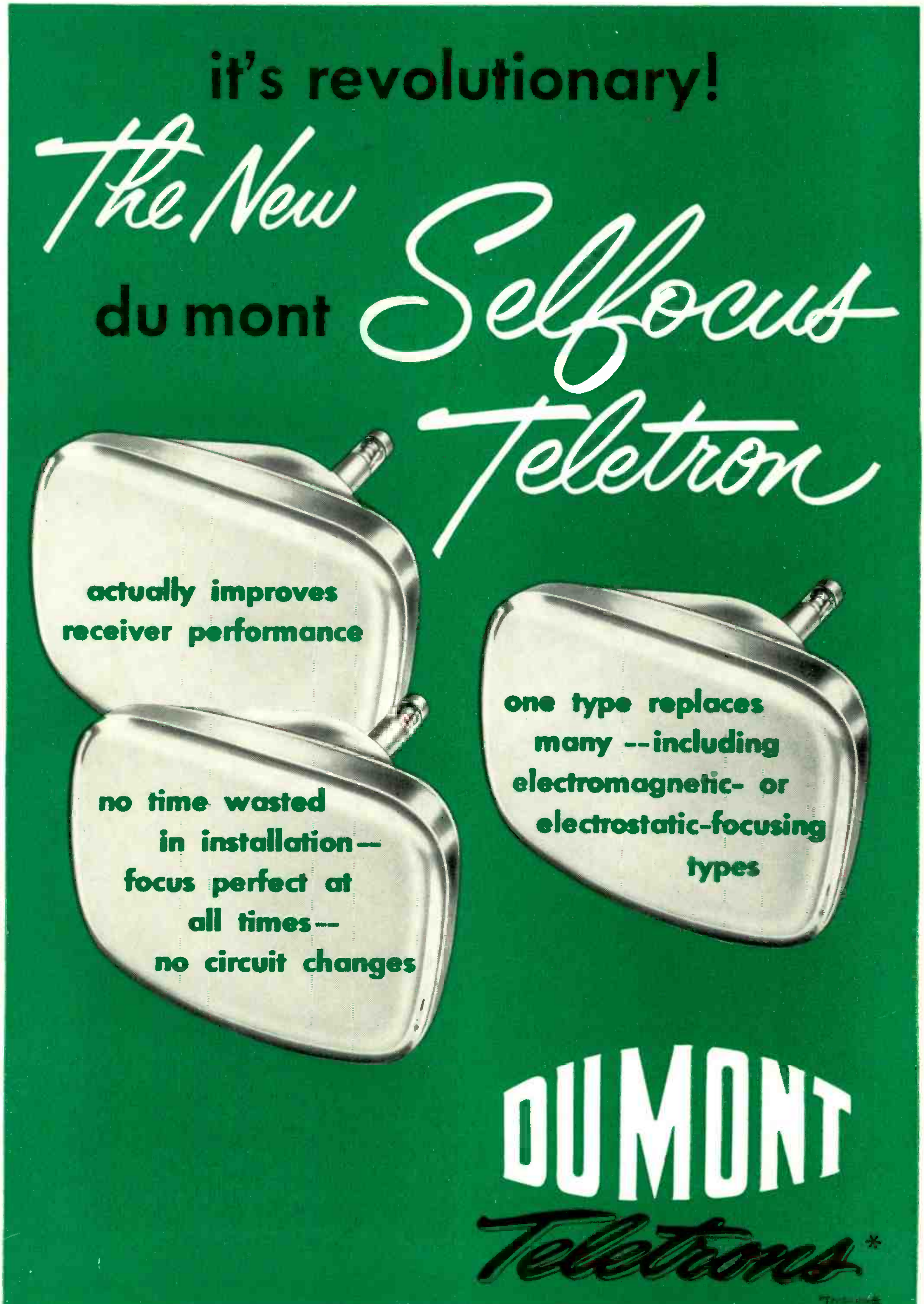
In this issue: **Black-and-White Plus Color Receiver • Revolutionary New Speaker • Filter Facts**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actually improves receiver performance
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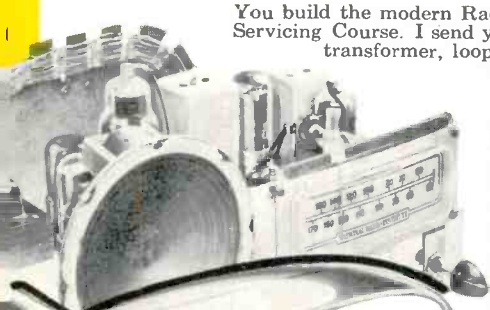
one type replaces many --including electromagnetic- or electrostatic-focusing types
DUMONT
Teletrons*

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

I Will Show You How to Learn RADIO-TELEVISION

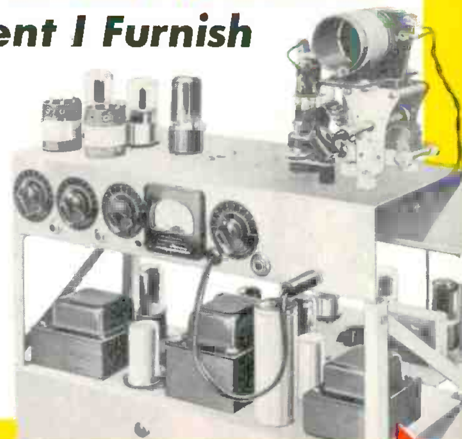
by Practicing at Home in Spare Time

You Practice SERVICING with Equipment I Furnish



You build the modern Radio (at left) as part of my Servicing Course. I send you speaker, tubes, chassis, transformer, loop antenna, everything you need. You use it to make many tests, get practical experience you need to make EXTRA money fixing Radios. I send you many other kits of parts with which you build other circuits common to Radio and Television, some of which are pictured on the next page. All equipment is yours to keep. See and read about them in my FREE 64-PAGE BOOK. Mail card below.

You Practice COMMUNICATIONS with Equipment I Furnish



As part of my Communications Course I send you kits of parts to build the low power broadcasting transmitter shown at the right and many other circuits common to Radio and Television. You use this equipment to get practical experience putting a station "on the air," performing procedures demanded of Broadcast Station operators. I train you for your FCC Commercial Operator's License that puts you in line for good pay in Radio or Television Broadcasting. Mail card below.

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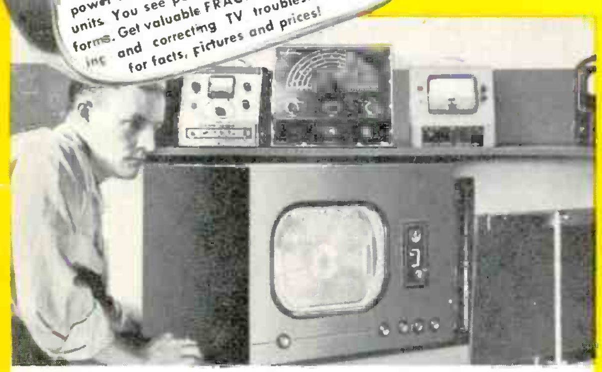

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In 1946 only 6,000 TV sets sold. In 1950 over 5,000,000. By 1954, 25,000,000 TV sets estimated. Over 100 TV Stations now operating. Authorities predict 1,000 TV Stations. This means more jobs, good pay for properly trained men. Mail this Postage-Free card NOW for FREE book and sample lesson.

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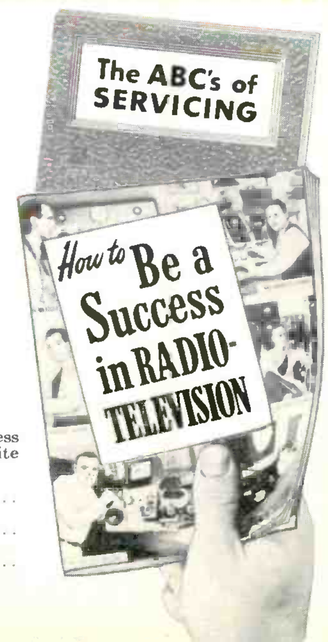
ACT NOW! Send for my DOUBLE OFFER FREE. This card entitles you to Sample Lesson on Servicing; shows how you learn Radio-Television at home. You'll receive my 64-page Book, "How To Be a Success in Radio-Television." Mail card now! No postage needed. J. E. SMITH, President, National Radio Institute, Washington 9, D.C. Our 38th year.



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

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

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IMPORTANT!
See Other Side

Read What Successful NRI Graduates Say:

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

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

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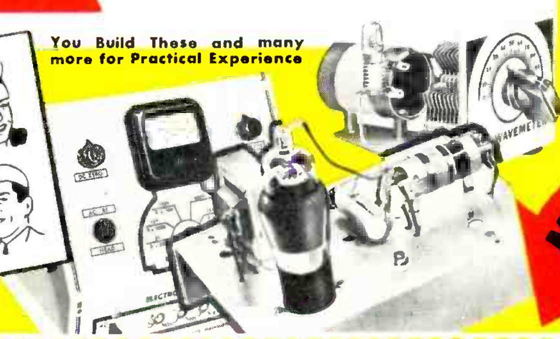

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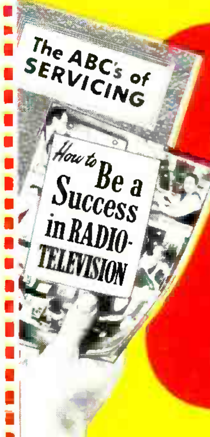

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ON THE COVER: Paul Chirlian, New York University, and the antenna designed by the university's Electrical Engineering College to range from 100 kc to 4,000 mc.
Ektachrome original by Avery Slack

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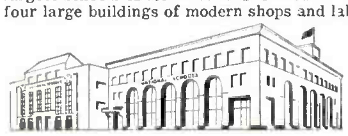

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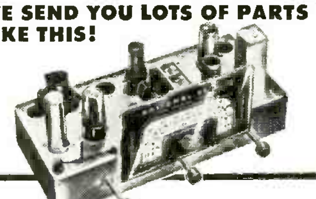

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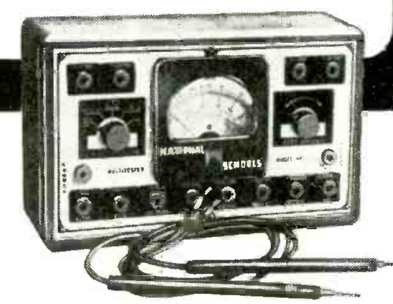

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You get this amazing, new testing instrument—factory-made and tested—complete—ready to use! Simple to operate. Accurate and dependable. An instrument every Radio-TV man needs. Light enough to carry around—so you can use it at home or on service calls.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

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This tremendous business asset—The Raytheon Bond—costs service dealers nothing if they can qualify for it. Better ask your Raytheon Tube Distributor if you can join the ever increasing number of Service Dealers who are reaping the benefits of this priceless Bond.

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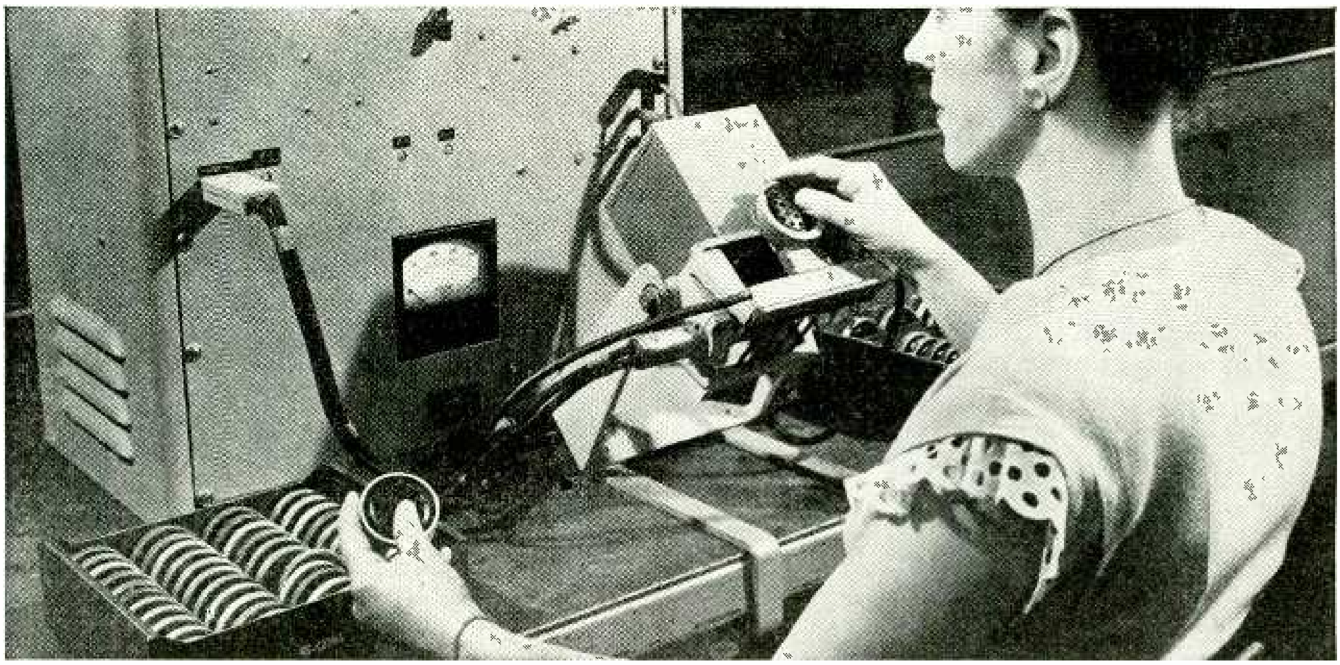
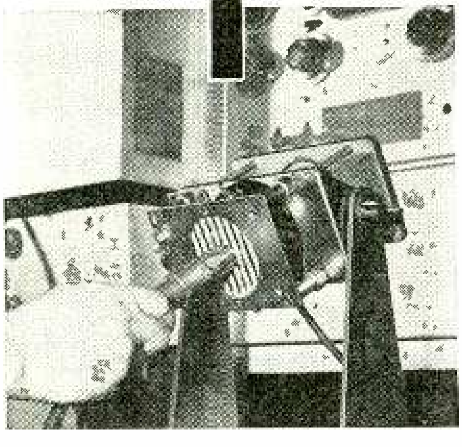


This Western Electric employee mounts a transmitter in the test fixture which is swung down to face an artificial mouth at 45-degree angle, just as transmitters are held in use. More than a million transmitters are tested each year.

This mouth speaks to millions



At Bell Laboratories a scientist employs a condenser microphone to check the sound level from another type of artificial mouth, used in transmitter research.

To serve the changing needs of telephone subscribers millions of telephone sets have to be moved each year. Before being put back into service most of them are returned to the Western Electric Company's Distributing Houses where they receive a thorough checkup.

Western Electric engineers needed a rapid method of testing transmitters over a range of frequencies. At Bell Telephone Laboratories, scientists had just the thing—a technique they had devised for fundamental research on transmitters. In co-operation with these scientists, Western Electric engineers developed the practical tester in the illustration.

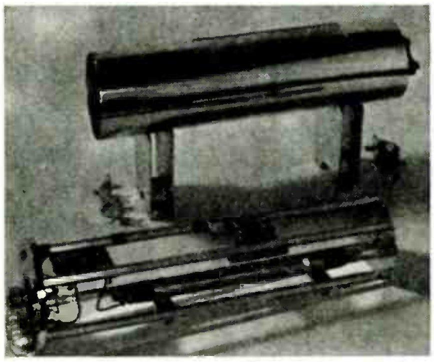
The transmitter is removed from the handset and put in front of an artificial mouth which emits a tone that swings several times per second over a band of frequencies. A signal lamp tells whether the transmitter is good. Each test takes 5 seconds.

This new tester illustrates how Bell Laboratories research and Western Electric manufacturing skill team up to maintain your telephone service high in quality yet low in cost.

BELL TELEPHONE LABORATORIES

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

FM RADIO SNOW GAUGES, developed by the U.S. Weather Bureau and the Corps of Engineers, are now being used to measure the water content of snow fields on mountain tops and other isolated points. The depth of the snow is measured by burying radioactive isotopes of common metals below the ground surface and using a Geiger-Mueller tube to measure the intensity of radiation after passing through the snow. The strength of the radiation is an indication of water content of the snow.



Courtesy Motorola Inc.

The sensing unit (foreground) with its Geiger tube slips into housing (rear).

Since the measuring apparatus is located at remote points, battery-operated FM transmitters are used to transmit the data to a central recording station.

PHONE BOOTH TELEVISION came close to being a reality recently in a New York City pay station. Picking up the receiver to make a call, a would-be telephonist heard voices. Thinking he was interrupting a conversation, he hung up and tried again a few minutes later. The voices were still there, and were apparently following the script of some kind of a play. Within a few minutes the program was identified as that of WABD, channel 5.

A call to an official of the telephone company resulted in repair men being rushed to the scene. The company official stated that while such happenings are rare, they can be caused by a cross-talk between the regular phone lines and those used for the TV broadcast.

NEW TV COLOR TUBE, that can be manufactured at a cost comparable to present black-and-white tubes, was demonstrated by Professor Ernest O. Lawrence of the University of California. Dr. Lawrence is the inventor of the cyclotron and a Nobel prize winner for his work in electronic and atomic physics.

The new tube has a screen built up of phosphor strips which glow alternately in blue, green and red. Before reaching this screen, the electrons pass through a multiple-wire grid which acts both as a accelerating electrode and a deflecting lens. By alternately raising and lowering the voltage on this grid a few hundred volts above and below its steady state, the beam is directed to the desired color.

The phosphor color plate can be produced by silk-screen printing methods with sufficient accuracy and at low cost.

According to the inventor, the new tube can be adapted to receive either CBS or RCA color, as well as black-and-white programs. To receive CBS programs only three additional tubes are needed, plus an adapter somewhat similar to those now sold to make standard receivers compatible with CBS 405-line transmissions. Dr. Lawrence worked with Chromatic Television Laboratories, Inc., a Paramount Pictures subsidiary, in the development of the tube.

SHIPBOARD RADIO OPERATORS who have been drafted into the armed services will be discharged and returned to civilian status if recommendations of the Federal Maritime Administration are followed. The recommendation was made at a recent conference of representatives of the FCC, Maritime Administration, radio-operator unions, Coast Guard, and maritime industry at a meeting called to determine means of easing the shortage of qualified marine radio operators which developed when nearly 300 merchant ships were withdrawn from the "moth-ball fleet."

Proposals were made to alter the FCC regulations to permit employment of men not now eligible for the licenses required for shipboard service. The changes would make available men in two new categories. One group includes men who held limited radiotelegrapher's licenses before 1935 and who would be eligible if they could prove previous shipboard service. The second group includes those men who obtained licenses since 1935 and who operated shipboard radio installations under temporary limited licenses during the war. In both instances, the operators would have to pass a code test.

U.H.F. TELEVISION was advocated by FCC chairman Wayne Coy as being a means of bringing about a nation-wide system of competitive television. Speakink at RCA's one-day u.h.f. seminar in Bridgeport, Conn., Mr. Coy went all out for u.h.f. TV. He said that he is sold on u.h.f. and that he would like to see all TV in the u.h.f. channels.

Mr. Coy pointed out that the "TV freeze" came about when the FCC realized that the existing 12 v.h.f. channels are not sufficient to provide for a competitive TV service in the nation's 168 metropolitan areas with populations of over 50,000. He proposed using the entire band between 480 and 890 mc for u.h.f. TV assignments and asserted that when the freeze is over, two-thirds to three-quarters of all TV station assignments will be in the u.h.f. region. These would make possible the ultimate establishment of nearly 3,000 TV stations in this country.

U.h.f. TV reception was described as excellent. This was based on the fact that the signal from Bridgeport's u.h.f. TV station was as good in New Haven —25 miles away—as that of New Haven's channel 6 station, WNHC-TV.

ELECTRONIC SCALES are now being used to weigh giant electrical transformers and other equipment too massive and heavy to be weighed by ordinary means. The operation of the new scale is based on the use of a resistance-wire strain gage which changes its resistance in proportion to its length.

The gage is connected to the upper part of a gigantic crane hook which supports the object to be weighed. It is cemented to a member on the crane's structure where the weight of the object develops a compression strain which produces an imperceptible reduction in the length of the member. This compression is transmitted to the strain gage which changes its resistance according to the applied force. Electronic circuits convert the change in resistance directly into pounds or tons on the dial of a portable meter.

RADAR FISH PATROL in use by California's Division of Fish and Game is rapidly driving illegal fishing from the coastal waters of that state. Before radar equipment was installed on the commission's four patrol boats, fog and darkness severely handicapped the seagoing wardens whose duty is to prevent commercial fishing inside the 3-mile limit. Under these conditions, standard operating procedure was to stop the patrol boat and listen for other boat engines and watch for lights aboard boats of careless violators.

Now, with radar, the patrol can always spot violators miles away, at any time of day or night. After a few boats were captured and many warned, the word has gotten around that there can be no escape so there are few attempts at fishing inside closed waters. During 1949 and 1950, 25 boats were caught and 284 crewmen arrested. This year's catch is one boat and nine men.

AUDIO FAIR, the third annual convention of the Audio Engineering Society, will be held on November 1, 2, and 3 in the Hotel New Yorker, in New York City. Audio equipment and accessories will be displayed and demonstrated by manufacturers, distributors, and manufacturers' agents. High lights of the Audio Fair will be a series of technical papers delivered by authorities in the field. The tentative lecture program is as follows:

"Problems of Ultra-Speed Recording Techniques," by C. J. LaBel, of Audio Instrument Co.

"Magnetic Recording Equipment for Motion Picture Production," by Bruce Denny and William L. Thayer, of Paramount Pictures, Inc.

"Modern Recording Installation That Emphasizes Tape," by W. O. Summerlin, of Audio-Video Recording Co.

"An Artificial Reverberation Generator," by Lewis S. Goodfriend, of Audio Facilities Corp.

"Magnetic Tape Recording for Instrumentation and Data Storage," by Kenneth B. Boothe, of Audio and Video Products Corp.

"Loudspeaker Enclosures," by Daniel J. Plach and Philip B. Williams, of Jensen Mfg. Co.

"Multiple-Speaker Systems," by Harry F. Olson, of RCA Laboratories.

"Design Principles as Applied to Radio and Loudspeaker Cabinets," by Jeff Markell, New Horizons Furniture.

"New Amplifier Design," by Herbert I. Keroes, of Acro Products Co.

"Industrial Sound Systems," by H. S. Morris, of Altec Lansing.

"Transistors in Audio Use." Speaker from Bell Telephone Laboratories.

"Magnetic Amplifiers for Audio Applications." Speaker from Bureau of Ships, U. S. Navy.

—end—

Courtesy General Electric Co.

Captain Hooker scans the radar screen aboard the 63-foot patrol boat Bonito. Seagoing game and fish warden uses radar to spot violators off California coast.

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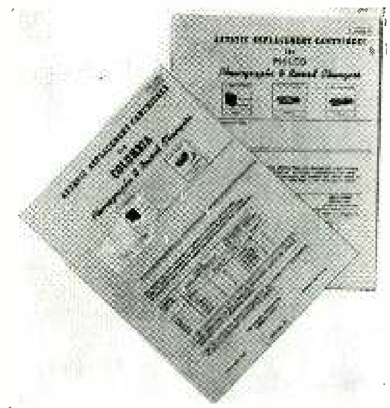
Merchandising and Promotion

Merit Transformer Corp., Chicago, has published a new "TV Replacement Guide and Catalog" which lists all makes and models of TV sets with manufacturers' numbers and Merit replacements. The catalog is available through the company or its distributors. The company also introduced a new conversion and replacement kit for distributors' sales departments, featuring a "Day-Glo" card.

Astatic Corp., Conneaut, Ohio, has issued two new phonograph cartridge

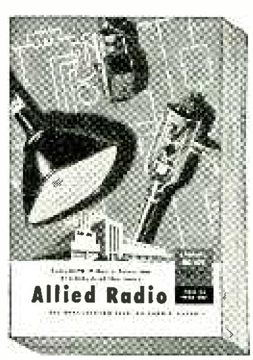


replacement guides. One lists the proper Astatic replacements for Columbia phonographs and record changers, and the other gives similar data on Philco models. Recommended Astatic cartridges and needle types are illustrated and a numerical designation given.

Allen B. Du Mont Laboratories' Cathode-Ray Tube Division advertising manager, Jake Ruiter, outlined the largest and most comprehensive advertising campaign the division has yet undertaken. The campaign will include advertisements in leading trade and service publications as well as extensive use of point-of-sale material for distributors, dealers, and service technicians.

The Division also issued a new pocket-size TV Picture Tube Replacement Selector which indicates the correct replacement type for worn-out Du Mont picture tubes. The circular cardboard indicator is available free through the company and its Teletron distributors.

Allied Radio Corp., Chicago, has published its 1952 catalog. The new 212-page book lists radio, television and



electronic parts, test equipment, P.A. systems and many other items to meet the requirements of the radio-television-electronics field.

Brach Manufacturing Corp., Newark, N. J., is sponsoring a joint advertising campaign with Dynamic Stores over New York's WOR-TV. Built around the theme, "Two Sets for Every Happy Home," the campaign features the Brach two-set coupler.

South River Metal Products, Inc., South River, N. J., has prepared a new catalog on its antenna mounting accessories.

Edwin I. Guthman Co., Inc., Chicago, has published a new booklet illustrating its production facilities. The company is a fabricator of electrical and TV components.

Columbia Wire & Supply Co., Chicago, published a new booklet describing its facilities and products which it manufactures, including all types of electrical insulating wire, cords, cable, wire kits, etc. Columbia is also a national warehouse and distributor for Anaconda Densheath television and radio wire and cable.

Sangamo Electric Co., Springfield, Ill., released its first TV capacitor replacement catalog. The 28-page booklet lists not only Sangamo capacitors but types comparable to them made by other manufacturers. The booklet may be had from the company or its distributors.

Servicing Business

The RCA Service Co., Camden, N. J., added two new protection plans to its full-coverage service contracts. One plan provides protection for the picture tube only; guarantees the tube for one year from the date of purchase by the user. Cost of the plan varies according to the size of the tube. The second plan features complete installation, instructions to the customer and a one-year parts and tube warranty plus one service call during the year. Additional calls are charged at the rate of $3.95 if the set is brought to the RCA Service Company, and $5.95 if it is a home call.

Production and Sales

The RTMA announced that sales of receiving tubes by manufacturers during the month of July dropped to 13,185,567, almost 50% less than the June figure. An analysis of sales showed that 7,117,435 were for new equipment, 4,625,314 were for replacements, and the balance for export and Government agencies.

The RTMA also announced that 89,144 cathode-ray tubes were sold to TV receiver manufacturers during July as compared with 221,759 during June. Of the July total, 99% were rectangular and 16 inches or larger in size.

The NBC-TV Sales Planning and Research Bureau announced that there were 13,271,700 TV sets installed in the United States as of August 1. There were 2,455,000 in New York City, 1,003,000 in Los Angeles, 942,000 in Chicago, 874,000 in Philadelphia, 754,000 in Boston, 526,000 in Detroit, 486,000 in Cleveland, 312,000 in Pittsburgh, and 308,000 in Baltimore.

Show Notes

The Radio Parts & Electronic Equipment Shows, Inc., Board of Directors

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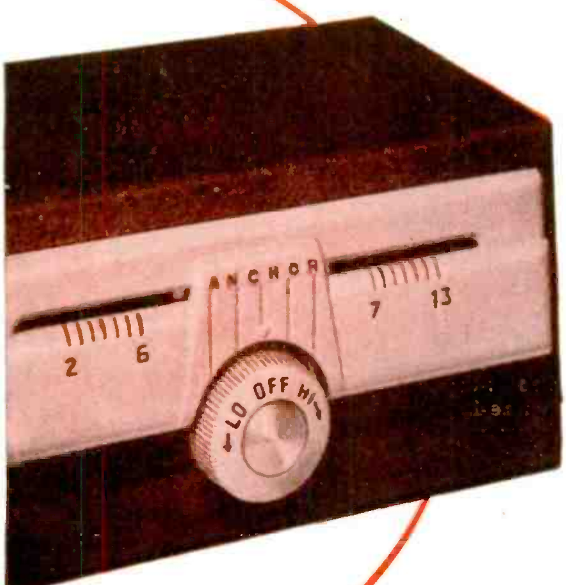

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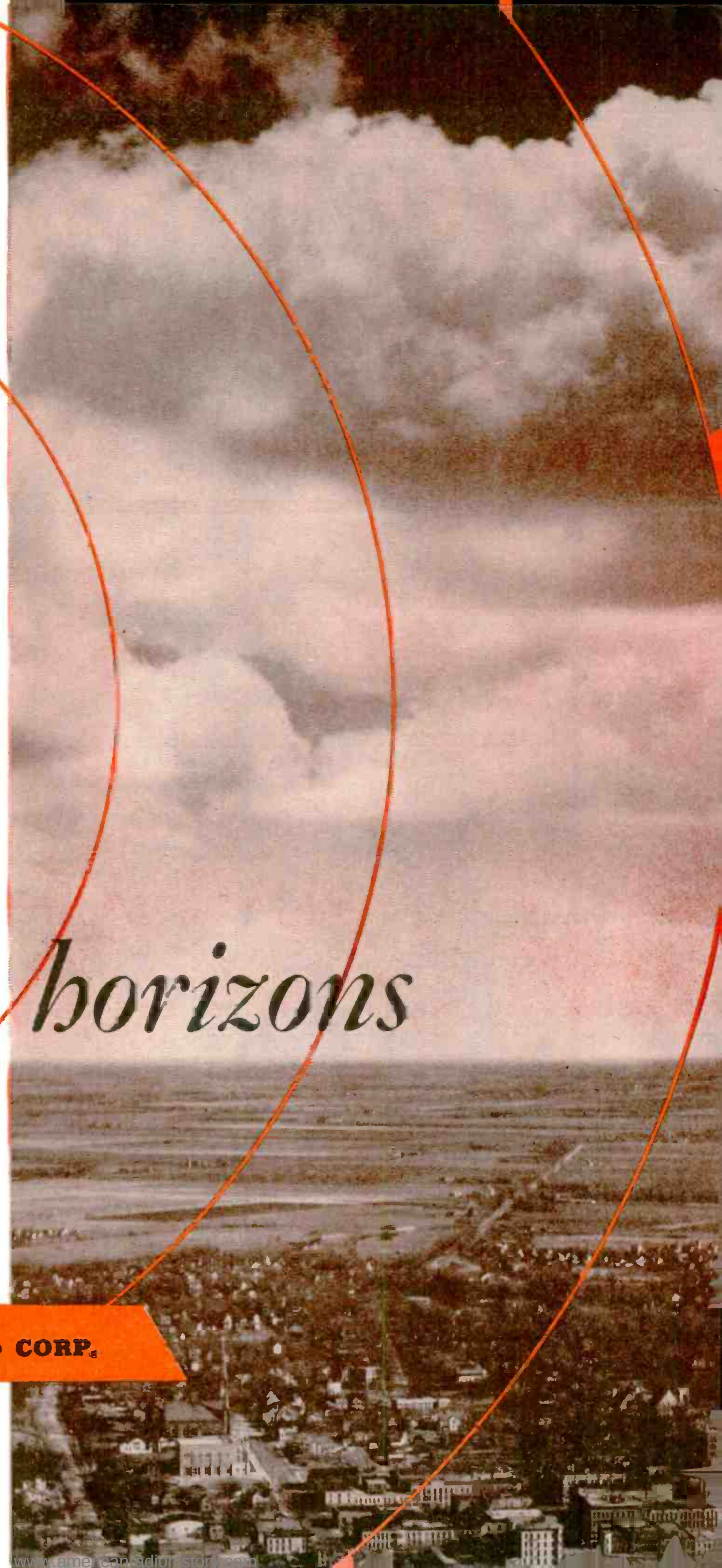

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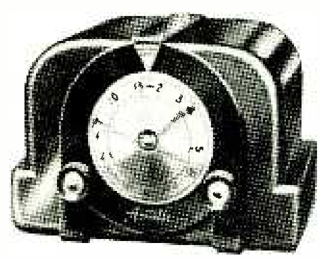

approved a three-point program for basic changes in the future conduct of the show. The board was increased from nine to fourteen members to include seven NEDA members and seven members of cosponsoring manufacturers' associations, including the RTMA, Association of Electronic Parts & Equipment Mfrs., Sales Managers Club, Eastern Division, and West Coast Electronic Mfrs. Association. Other changes in the bylaws provided that at least the first two days of shows be exclusive distributor days and that no individual may serve and no company may be represented on the board for more than two consecutive years. As a result of these changes, the NEDA Board of Directors decided that beginning in 1952, and every year thereafter, there would be an Annual NEDA Convention and Manufacturers' Conference without a trade exhibit.

The Eighth Annual Pacific Electronic Exhibit Show Committee increased its membership to eight. This increase of three members was made to include representatives of the I.R.E. who will cosponsor the show with the West Coast Electronic Manufacturers' Association in 1952.

New Plants and Expansions

The American Phenolic Corp. is erecting its fourth plant on Chicago's west side to permit a greater expansion of AN and RF connector assembly production at the main plant. The new 65,000-square-foot plant will house all synthetic operations.

General Electric Company's Tube Department leased the Garden State Lines bus terminal in Clifton, N. J., for use as its electronic tube warehouse and as headquarters for the department's eastern commercial service operations.

Haydu Brothers, Plainfield, N. J., manufacturer of TV tubes and other electronic products, is adding a new wing to its plant.

Helipot Corp. added a second plant to its facilities in Pasadena, Cal. It comprises 15,000 square feet of floor space with facilities for over 150 employees

The Hi-Lo TV Antenna Corp. constructed an additional plant immediately adjacent to its present plant in Chicago.

Veri-Best Electronics Co. is now in full production in its new plant at Westbury, N. Y. The company plans a new series of electronic products in addition to its current line of TV antennas.

North American Philips Co., Inc., New York City, purchased the capital stock of the A. W. Haydon Co., Waterbury, Conn.

Collins Radio Co., Cedar Rapids, Iowa, has established a Procurement Division which will be headed by Max W. Burrell, former general sales manager.

Electronic Devices, Inc., Brooklyn, N. Y., purchased the Precision Rectifier Corp., which will now operate as the Precision Rectifier Division of Electronic Devices. The division will manufacture selenium rectifiers.

—end—

SUPREME TEST EQUIPMENT AT SPECIAL SAVINGS

THAT FAMOUS QUALITY RECOGNIZED AND PRAISED BY ELECTRONIC TECHNICIANS FOR OVER 24 YEARS
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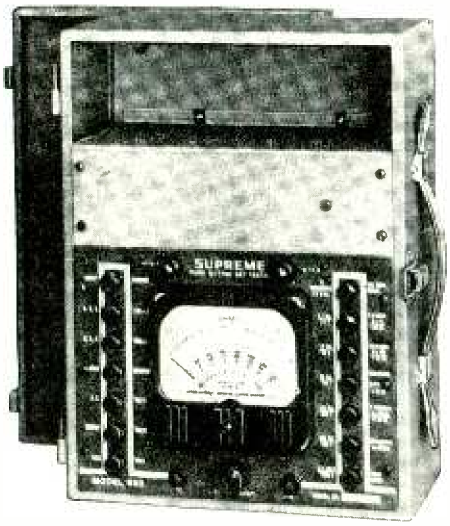

AM - FM - TV MULTI-METER

MEASURES DC VOLTAGE TO 35,000 VOLTS AT 25,000 OHMS PER VOLT! The popular Supreme Model 592 has been extended for television. It now measures up to 35,000 volts DC with input resistance of the high range being 875 megohms. Many VTVMs are below this. Once you have used the Supreme 592, you would not trade it for all the rest. It's simple to operate and gives the user speed he never dreamed of. After test leads are inserted in the two pin jacks, it is not necessary to move them again (except on the 14 ampere and 35,000 volt ranges).

Fifteen DC VOLTAGE ranges—two sensitivities—8 ranges at 25,000 ohms/volt and 7 ranges at 1000 ohms/volt—0/3.5/7/35/140/350/700/1400 volts DC. External extension unit included for 35,000 volt range at 25,000 ohms/volt. Six OHMMETER ranges—0/500/5000/50,000/500,000/5 meg./50 meg. No ranges omitted to confuse operator. All readings are made on easy-to-read single scale by simply adding zeros. Ohmmeter uses standard type batteries—simple, economical replacement. No external power required, even for the 50 megohm range! Six AC VOLTAGE ranges—0/7/35/140/350/700/1400 volts. Temperature compensated double bridge rectifier circuit provides maximum accuracy and protection. Seven DIRECT CURRENT ranges—0/70 microamperes, 0/7/35/140/350 milliamperes, 0/1.4/14 amperes. Six OUTPUT VOLTAGE ranges—0/7/35/140/350/700/1400. No external blocking condenser required when used as output meter in alignment. Four DECIBEL ranges—0 to plus 16, plus 10 to plus 26, plus 26 to plus 36, plus 36 to plus 46 db. All decibel ranges calibrated for direct reading on 500 ohm line. Full-vision, Supreme built, four inch meter with 40 microampere movement and sturdy pointer. Instrument housed in attractive, sturdy, metallic carrying case with leather handle, test lead compartment, and detachable lid. Shipped complete with instruction manual, test leads, batteries, and high voltage extension unit. Approx. dimensions 8½ x 12 x 5 inches. Shipping Weight 13 pounds.

Regular Value $69.90 — YOUR COST DURING THIS SPECIAL OFFER **$36.95**

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CHECKS AM—FM—TV RECEIVING TUBES AND PORTABLE RADIO BATTERIES. The SUPREME Model 616 cannot be beat for efficient bench or counter tube testing. Incorporating that famous tube test circuit and patented regulated neon leakage test, both pioneered and developed by Supreme. Have set tube rejection standards for years. Minimized obsolescence by use of Supreme patented element selector system. Thousands of testers using this circuit have been in use over ten years. Socket facilities for all AM, FM and TV receiving tubes. ILLUMINATED ROLL CHART with hundreds of types listed. TUBE SETTING DATA on future tubes supplied by Supreme as they come into use. Quality test readings for both tubes and batteries on "Replace-Good" scales of beautiful BIG SEVEN INCH FULL VISION METER designed and built by SUPREME. Non-breakable window. Most people can read this meter ten feet away. Also checks portable radio batteries UNDER PROPER LOAD. Tests batteries with rated voltages of 1½, 4½, 6, 45, 67½, 90 volts. Hammerloid finished metallic case with detachable cover. Approx. dimensions 11 x 15 x 6½ inches. Shipping weight 20 pounds.

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SUPREME MODEL 600 is also being made available during this special sale offer. Similar in appearance to Model 616, with all the features listed above plus **31 multi-meter ranges** (1000 ohms/volt).

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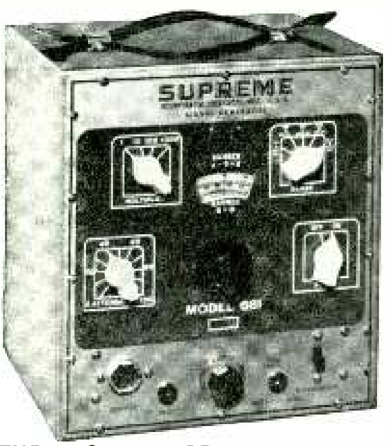
ORDER TODAY—THIS OFFER IS SUBJECT TO WITHDRAWAL IN 60 DAYS, OR BEFORE IF ANY MODEL IS SOLD OUT AND NOT AVAILABLE FOR IMMEDIATE DELIVERY. PRICES APPLY ONLY TO ORDERS FROM INSIDE THE CONTINENTAL U. S. A.



A DEPENDABLE SIGNAL GENERATOR

RF TO 82 MC—400 CYCLE AF—COVERS TV IF MARKERS

Supreme pioneered in the development of all wave signal generators and the Model 661 is the result of many years of development and research to find the most stable circuits and provide the most simple operation. Many circuits were explored and the one used in the 661 was declared the best of all. Many dial arrangements were investigated; many calibration methods checked; many attenuators and modulation methods carefully analyzed. There is no better service oscillator on the market than the Model 661. Only 2 dial scales but 5 bands. All ranges are read simply on two basic scales that are accurately calibrated—even at both ends. Impregnated iron core tuned inductors and air dielectric trimmers provide the maximum frequency stability. Guards against shift due to line voltage fluctuation, aging, temperature and humidity. Continuously variable output in a 4 step ladder attenuator. Double shielding to minimize leakage. Shielded line cord, illuminated hair line dial. RF ranges from 65kc to 82 megacycles (65kc to 20.5 Mc on fundamentals). Audio frequency output, continuously variable from minimum to maximum. Internal modulation of RF signal approximately 50%. Jack provided for external amplitude modulation. Housed in heavy steel case, attractive finish. Complete with instruction manual and shielded connector. Approx. dimensions 9½ x 8¾ x 7½ inches. Shipping weight 15 pounds.

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Mr. Al Goldberg, Assistant Chief Engineer of CBS-Columbia, and Harry R. Ashley, President of EICO, inspecting the use of the EICO Model 221 Vacuum Tube Voltmeter and Model HVP-1 High Voltage Probe at the Sweep Frequency Troubleshooting Position on the CBS-Columbia Color Television production lines.
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Before You buy any higher-priced equipment, be sure You look at the EICO line—in Wired as well as Kit form! Each EICO product is jam-packed with unbelievable value. YOU be the judge—compare, see EICO instruments today — in stock at your local jobber — and SAVE! Write NOW for FREE newest Catalog 11-C.
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Radio-Electronic Giant

... The radio-electronic industry will soon be one of the top three ...

By HUGO GERNSBACK

Sometimes the members of our industry do not realize the giant strides that it has made in recent years.

Dr. Allen B. Du Mont last month stated that more than $7,600,000,000 will have been awarded for radio-electronic contracts by the end of 1951, ranking the industry next to steel and aircraft in importance during the present military buildup.

Military contracts are, however, only a single facet in the new giant industry. At the moment, no accurate statistics as to the total volume of radio-electronic dollar volume can be compiled. The industry is too young and is growing so fast that no sooner have the first set of figures been computed than they are already obsolete. The industry is so huge and goes into so many ramifications—at times overlapping other industries—that it is often difficult to formulate a true overall picture. Take for instance, two of the largest radio-electronic manufacturers in the country, General Electric and Westinghouse, who do not report their radio-electronic sales separately. These concerns manufacture many other items of electrical or other nature, (not radio or electronic) which makes it impossible to get accurate figures. While the radio-electronics industry is now some thirty years old, even the U. S. Department of Commerce still lumps its radio-electronic figures under a heading: "Manufacturing, electrical machinery."

If we estimate that radio and electronic items represent only 15% of the total production of such huge firms as General Electric and Westinghouse in 1950, we can obtain an approximate figure of their radio-electronic dollar volume. If then we add the twenty topmost radio-electronic firms manufacturing radios, television sets, and various electronic items, we find that the income of these firms during 1950 came to around $3,000,000,000. (Three billion dollars.)

This isn't, however, the whole story and does still not give us a correct perspective. The point is that there are hundreds of lesser firms who manufacture all sorts of radio-electronic devices, both for peace and military purposes. Many of these firms are young and have as yet to make their way. New firms spring up in the industry every week and while many manufacture radio-electronic devices exclusively, there are equally as many firms who manufacture other products as well.

The war effort has also blurred the picture somewhat, because it is difficult to disentangle war orders from others throughout the industry. One thing is quite certain: even with no war orders it seems likely that annual non-military sales of the entire radio-electronic industry by 1960 should reach no less than $10,000,000,000.

So much for the dollars and cents aspect of the giant industry. People on the outside sometimes find it difficult to understand that our industry has made such tremendous strides, particularly during the past ten years.

The answer is simple. In nearly every endeavor that one can think of radio-electronics has a part nowadays. There is hardly any household, office, or factory today which is untouched by the magic wand of radio-electronics. This tendency is certain to increase and will keep on increasing during the next few decades.

Indeed, radio-electronics has created a new industrial revolution far greater than any of us realize today. It keeps on eliminating many jobs throughout this country and, indeed, the world at an astonishing rate. Unlike other industrial revolutions, few people get hurt in the process. The workers are simply released for other and more important jobs, which usually pay better. Surprisingly enough, radio-electronics has been a huge factor in not only increasing the prosperity of the country but in a large measure is responsible for higher wages. In our own industry, when radio-electronic workers are eliminated in one branch these same workers, practically without exception, command higher wages on their next jobs. This is true in many of the allied industries as well.

The machine age has now been replaced by the radio-electronic age. Heretofore, men tended the machines. Soon the machines will tend themselves, purely due to the magic of radio-electronics. Modern plants have already begun robotizing. Some plants where formerly hundreds of employees were needed, today require only a handful of engineers to supervise a series of complex procedures. This tendency is now on the march and will continue to expand during the next few decades at an ever-accelerating rate. It would seem that there are few manufactured items which cannot be made successfully in a practically manless plant.

These tendencies will make man freer than he ever was before. The drift toward shorter hours which has been going on for the past 30 years is still in evidence and will continue at an increasing rate, due primarily to radio-electronics and its labor-saving devices.

The new uses for radio-electronics are so astonishing that even men within the industry are hard put to keep track of them. Every day brings new applications which in turn increase the power of the industry. One of the newest huge additions is the electronic computer—the robot mathematician. The manufacture of computers in itself is becoming quite an industry and these computers will be one of the big factors in the automatic factories of the future.

Radio-electronics has successfully invaded other industries such as plastics. Some solid plastics are now made from liquids. Cathode rays, similar to those we use in television, convert liquid raw materials into solid plastics.

Another unsung radio-electronic achievement is the assorting machine, which nowadays is doing almost magical jobs. It would seem impossible that a machine could accurately sort thousands of different unlabeled cans, containing dozens of different foods; nevertheless, this has been done recently in a very striking manner. There is no visible identification on the cans, but then radio-electronics doesn't need any. Before the cans are packed with the various foods *they are magnetized in certain spots in a special code.* The radio-electronic sorter segregates the various cans using the magnetic code on their rims. Then the machine selects the correct label, affixes it and sends it down the conveyor.

Wonders such as these are becoming commonplace in our blasé world—which expects them. Nothing seems impossible today for radio-electronics. It improves our health, it gives us more and purer foods, it gives us more leisure and far greater wealth. It is the key to interplanetary travel—impossible without it. Radio-electronics to future ages will be known as the *Ultimate Emancipator*, for it, and it alone holds the key to man's peace on earth—the final elimination of war.

—end—

CBS-Columbia — First Commercial Color Plus Black-and-White Set

Fig. 1—New receiver looks like standard set, has only one more control. Wheel is invisible and inaudible.

By
I. J. MELMAN,*
E. S. WHITE,*
S. CUKER*

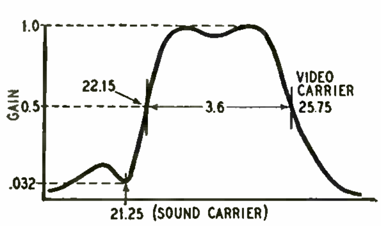


Fig. 2—Video detector output response. Sound carrier is maintained at a level approximately 30 db below video carrier.

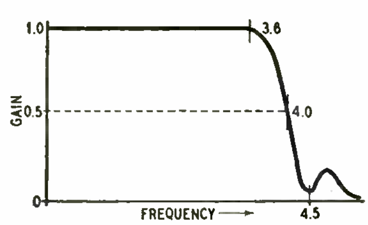


Fig. 3—Response of the combined outputs of video detector and amplifier. Half-power points are near 4 mc on the highs and 30 cycles at the lower end.

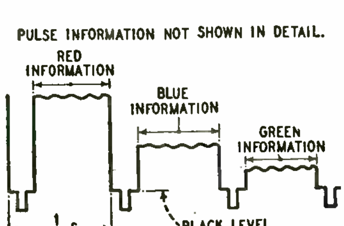


Fig. 4—Signal at video amplifier grid. The amplification of each color must be equal regardless of frequency or level.

A COMPLETELY self-contained television receiver which can receive both black-and-white transmission and CBS color transmission is an important advance in the television field. The console unit shown in Fig. 1 contains—within an exterior no larger than most current black-and-white television models—what the viewing public looks at as a somewhat magical device which reproduces either color or monochrome pictures with the flick of one simple switch.

The dealer and service technician may fear its supposed complexity and wonder about its reliability and serviceability. It should be made quite clear, therefore, that with the exception of the scanning mechanism and its associated 3-tube disc control circuit, the fundamental circuitry in every section of this receiver is already well known to the television industry. Unlike rival color television systems, the CBS color-monochrome receiver uses circuits which have been production- and field-tested for many years. Special consideration has been given in the design of the various sections to bring out the full potentialities of the CBS color system; however, these special considerations represent only refinements of currently "known art."

*CBS-Columbia, Inc., Advanced Development Laboratory

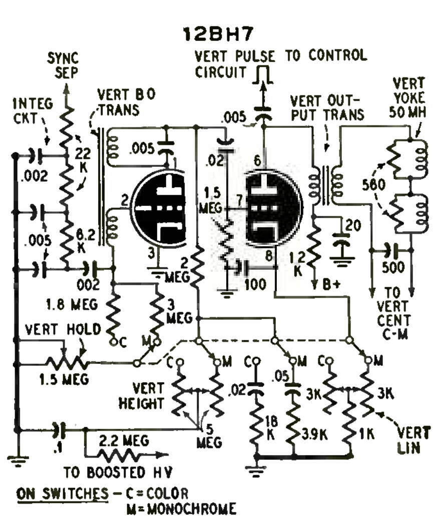


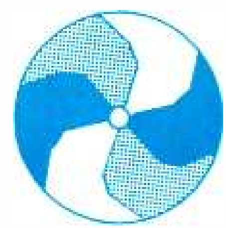
Fig. 5—The vertical sweep circuit, including color-monochrome switching.

It might be suspected that the quality of the monochrome picture produced by this dual-type receiver would be neglected in concentrating upon reproducing a good color picture. As will be shown later in this article, design requirements for a good color picture are more stringent than for a good monochrome picture. Since the same basic circuits are used for both color and monochrome, however, the natural consequence is not only good color, but also very good black-and-white reproduction.

The design and operation of the complete color-monochrome receiver will be discussed under the following headings:

1. Tuner and i.f. amplifier.
2. Video amplifier, d.c. restorer, and intercarrier sound system.
3. Synchronization, sweep, and high-voltage circuits.
4. Disc-control circuit.
5. Scanning disc and motor assembly.

Receives black-and-white at 525 lines or full color at 405 lines, at the flick of a switch, and is completely self-contained. Its design features are described in the article below.



Items 1 and 2 are the same in both the color and monochrome positions; switching of circuit elements between color and monochrome operation is necessary only in 3; 4, and 5 operate only during color reception.

Tuner and i.f. amplifier

Since the r.f. tuner or "front end" is not called upon to perform any unusual function in the color-monochrome receiver, almost any well-designed tuner is suitable. The usual considerations of noise factor, gain, oscillator radiation, spurious responses, etc., are applicable.

In the CBS color system, both the vertical and horizontal scanning frequencies are increased over current standard monochrome scanning frequencies. To retain as much picture information as possible in the color position, a minimum over-all r.f. and i.f. 6-db bandwidth of 3.6 mc is employed. A high-Q accompanying sound trap is capacitively-coupled to the first i.f. amplifier tube grid, so that at the output of the video detector, the sound carrier is attenuated 30 db relative to the pass-band. The over-all relative response at the video-detector output is shown in Fig. 2. Two staggered pairs,[1] with 6CB6 amplifier tubes, are used because of simplicity and cost considerations. Almost any i.f. amplifier interstage coupling arrangement may be used as long as the response obtained is as shown. Overloading and departures from linearity must be avoided.

Video amplifier

A combined video amplifier and video detector response flat out to 3.6 mc is used to retain picture information. The response is shown in Fig. 3. A good low-frequency response, down to 30 cycles, is also desirable.

Although high-frequency peaking often is employed in monochrome television receivers to "crispen up" the picture, its desirability is questionable in color reception. To obtain the proper color balance, as transmitted, the detailed color information in the red, blue, and green fields should be amplified equally regardless of frequency.

The output linearity of the video amplifier is particularly important. Consider the highly simplified signal, shown in Fig. 4, arriving at the input grid of the final video-amplifier tube. The scene depicted is a solid color consisting mainly of red, with some blue and less green components. If the tube characteristics are not linear, the relative amplification of the three fields may be considerably different, resulting in poor color reproduction. Furthermore, this color distortion will be a function of over-all signal level. To avoid this difficulty, an output swing of approximately 100 volts with a maximum of 10% departure from linearity has been designed into the receiver.

D.c. restorer

The theoretically desirable type of d.c. restorer, from the point of view of color fidelity, is highly efficient and has a speed of response of the order of a few lines. The instantaneous position of the video amplitude on the kinescope amplification characteristic will, of course, determine the degree of faithfulness of reproduction of the color. Since this position is determined, in great part, by the value of d.c. component present at that instant, one can ap-

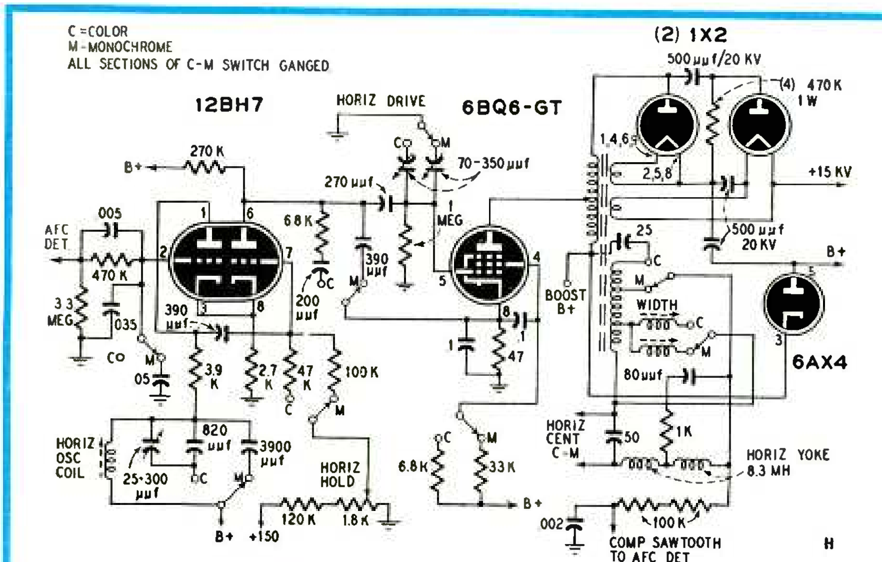


Fig. 6—The receiver's horizontal sweep circuits, with switching for color and monochrome. Note that component values change in the same ratio as sweep rates.

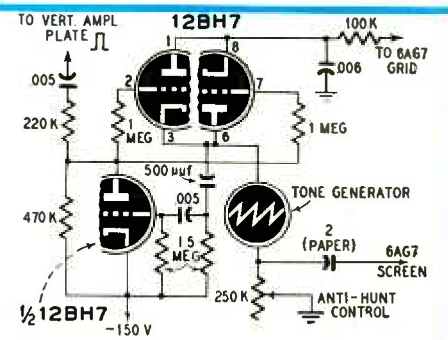


Fig. 9—Source of the control voltage.

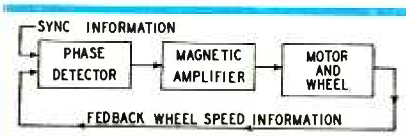


Fig. 7—Disc control circuit diagram. Phase detector and magnetic amplifier schematics appear in Figs. 8 and 9, and the motor photograph in Fig. 13.

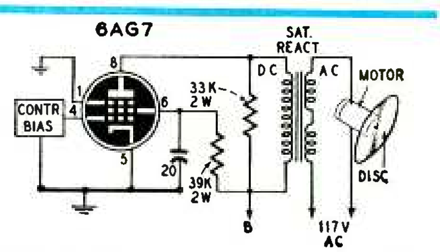


Fig. 8—The magnetic control amplifier.

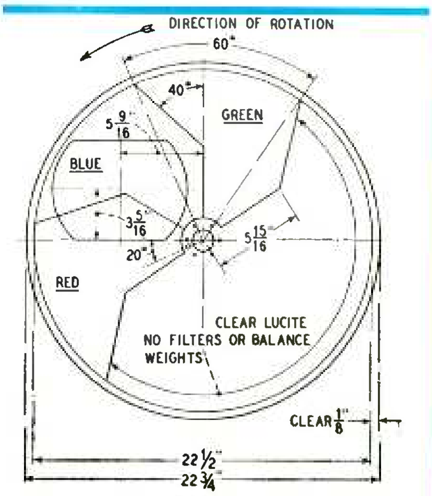


Fig. 10—The two-section color disc.

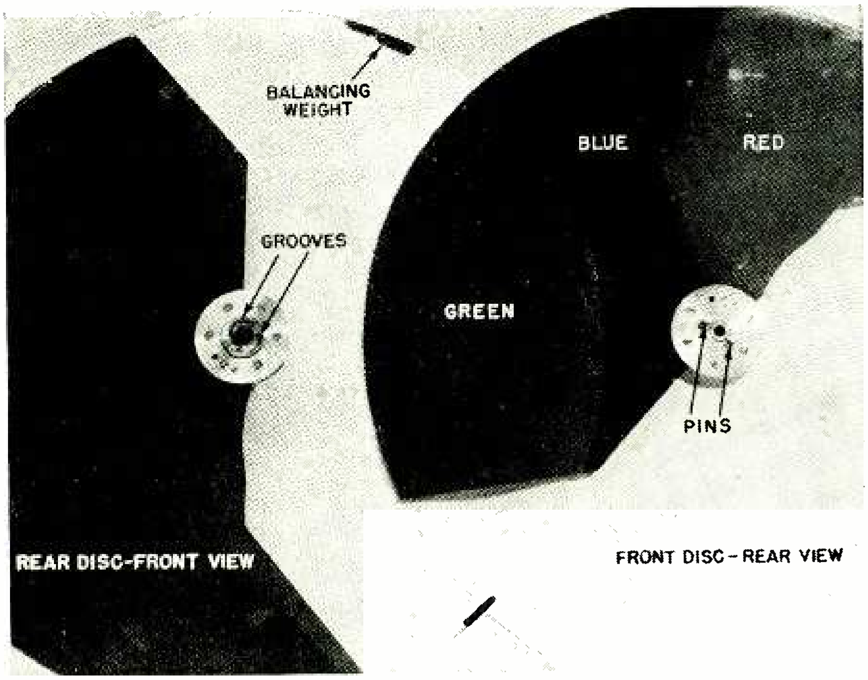


Fig. 11—Some details of the discs and hubs, showing the pins and grooves which reproduce color while in motion but permit black-and-white reception when still.

preciate the reasons for the d.c. restorer requirements stated above.

To meet these requirements at the present time would involve complex and costly circuitry (the simple direct-coupling arrangements employed in current monochrome receivers do not meet these requirements), and so a simple diode d.c. restorer circuit has been used, pending further developments.

Intercarrier sound system

The intercarrier sound system, although not critical, requires more care in its design. In the color position, 144-cycle sync buzz is more readily amplified by the audio system and more accurately reproduced by the loudspeaker than is 60-cycle sync buzz in monochrome reception. Application of well-known principles, however, is sufficient to eliminate any audible buzz.

Most important of these are:

1. The sound carrier should be attenuated at least 26 db relative to the pass-band at the video detector.
2. The video detector should operate with as high a signal level as possible without overloading the last i.f. amplifier stage.
3. Operation of the video amplifier with the composite video signal sync tips close to the cutoff region must be avoided.
4. Picture i.f. amplifier overloading must be prevented.
5. Adequate amplitude modulation rejection must be provided by the ratio detector or by whatever other FM detector and limiting device is used.

Sync, sweep, and high-voltage

The synchronizing circuits require no basic changes to accommodate the vertical sweep at 144 cycles and the horizontal sweep at 29,160 cycles. However, a noteworthy improvement, the double time constant input, is incorporated in the sync circuit of this receiver. This addition to the conventional sync circuit improves the noise immunity of the sync by providing a fast discharge path for the undesirable noise energy stored up in the grid-coupling capacitor, thus preventing the effects of impulse noise bursts from "hanging on."

The problems of converting to color sweep frequencies have been brought to the attention of the public and the industry[2] and still remain a point of interest. To produce the color sweep frequencies of 144 and 29,160 cycles per second, the time constants of the vertical blocking oscillator and the horizontal multivibrator must be switched. The ratios by which the time constants must be decreased are:

$$\text{Vertical: } \frac{144}{60} = 2.4$$

$$\text{Horizontal: } \frac{29{,}160}{15{,}750} = 1.85$$

If the reader checks the circuits shown in Figs. 5 and 6, he will see that the values which are switched are approximately in the ratios of these numbers. It is interesting to note that the higher vertical sweep frequency requires a retrace time of about 40% of that for monochrome, hence the large peaking resistor.

No changes are required in the vertical amplifier stage. Since the vertical output transformer is designed for 60-cycle sweep, it will operate at least as well at 144 cycles. The vertical winding of the yoke will likewise perform well.

The horizontal output and high-voltage circuits merit some special attention in connection with color. Because of the light reduction, it is necessary to raise the high voltage and average beam current. The energy storage in the 53° deflection yoke for the 10RP4 picture tube is insufficient to produce over 10 kv with a single rectifier without excessive retrace time or excessive 6BG6 cathode current. Therefore, a voltage doubler is used to meet the 14 kv, 250 μa requirements. The high voltage could have been obtained with a single rectifier only at the cost of excessive retrace time, or with a high-current horizontal deflection amplifier.

Obviously, the design of the horizontal output transformer would be a function of the sweep frequency. Nevertheless, the same transformer, in conjunction with a single yoke, is called upon to operate satisfactorily in both color and monochrome performance. This is accomplished by a simple autotransformer design with an extra tap for switching the horizontal yoke.

Since the losses go up as frequency squared, a ferrite yoke must be used. Ferrite yokes give increased width and high voltage at 15,750 cycles, and at 29,160 cycles the advantages gained by using a ferrite yoke are even more significant.

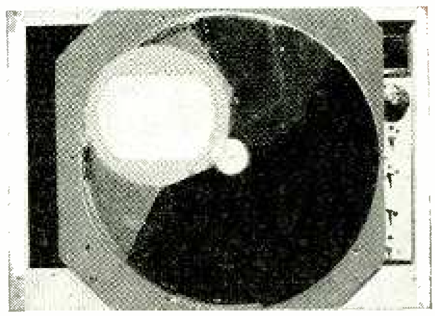


Fig. 12—The black-and-white window.

Disc control circuit

In the CBS field-sequential system the color information is transmitted in the order red-blue-green. To reproduce the color information on the viewer's screen, the color disc must be in exact synchronism with the transmitter. Furthermore, the red field and the red filter on the disc must coincide. The circuit which keeps the disc in step with the transmitter is dubbed the "disc-control circuit."

For the purpose of analysis, the circuit will be divided into several simple circuits whose individual functions are more readily apparent. A block diagram is shown in Fig. 7.

The magnetic amplifier consists of a high-gain pentode whose plate current flows through the d.c. winding of a saturable reactor. The a.c. winding of this reactor is in series with the motor which drives the disc. See Fig. 8. Operation is as follows:

If the control bias becomes less negative, the plate current increases. The increased plate current in the d.c. winding drives the reactor into saturation and hence decreases the a.c. voltage drop across the reactor a.c. winding, thus making a larger share of the line voltage available for the motor. Therefore, a reduction in negative bias at the control tube grid speeds up the motor, and an increase in the negative bias slows down the motor. However, we are *not* interested in varying the speed of the disc; we *are* interested in *keeping its speed constant* at 1,440 r.p.m. This implies that the control bias must be furnished by a circuit which will insure that at every instant the proper control bias is present to keep the motor speed absolutely constant regardless of line voltage or of any line frequency fluctuations.

The phase detector is just such a circuit. Two signals are furnished to the phase detector, one from the vertical output of the receiver which is in sync with the transmitter, and the other one from the disc tone generator. After the two signals are compared by the phase detector, a d.c. output whose magnitude is a function of the relative phase results. A schematic diagram is given in Fig. 9.

By obtaining the proper polarity from the sawtooth tone generator, the phase detector can be made to produce a d.c. correction bias which will keep the color disc exactly in step with the vertical amplifier pulse. Thus the color disc is held in dynamic synchronism by a straightforward electronic control circuit.

Scanning disc and motor

One of the advantages of the field-sequential system for color transmission and reception is that the frequency of color switching is low enough to render it practical to use either electronic, electromechanical, or comparatively simple mechanical devices. The simplest technique thus far used is that of the rotating color disc. The disc is used in the present production receiver. (Other methods have been used or are now in the laboratory stage). The color drum is a mechanical means for obtaining a larger color picture. The tricolor tube is being investigated as a possibility for an electronic field-sequential system. Other mechanical means for converting present 17- and 20-inch black-and-white sets to receive color are under investigation.

To date, the most faithful color reproduction has been obtained with the disc. The discs used in the current receiver are shown in Figs. 10, 11, and 12. The shape of the color segments is determined by:

1. The requirement that the color segment follow the scanning lines vertically down the raster.

2. The position of the center of the disc relative to the raster.

The color-monochrome receiver uses two discs. Each of the discs have three color segments and a 50% clear section. When the selector switch is in *color* position, the color segments of the rotating discs are 180° opposite each other, and the effect is that of a conventional 6-segment disc. When the switch is in *monochrome* position, the discs are in-

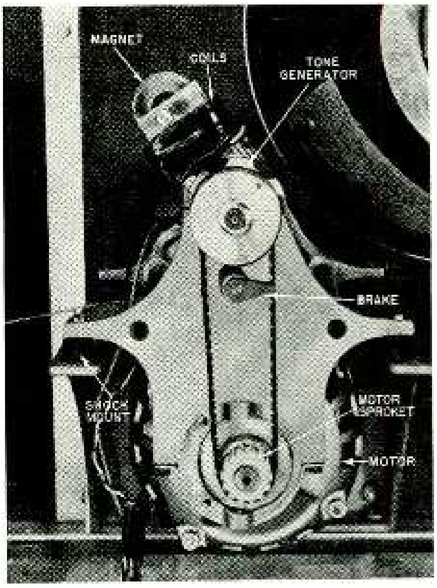


Fig. 13—The motor and motor control.

dexed (as explained later) so that the clear area of each disc is stationary in front of the raster (Fig. 12).

The filters used in these discs may be the red, green, and blue Monsanto "E" filters or the following Eastman Kodak television filters:

Blue—#451, Green—#610, Red—#260

To avoid flicker, the two discs are paired so that the comparative filters for similar color segment areas do not vary more than ±1% for green, ±2.5% for red, and ±3.5% for blue in their color transmission. The discs are statically balanced to within 0.1 inch-ounce.

The rotating disc and motor are generally not discernible by the viewing audience. It has been the experience of the writers, while demonstrating the receiver to various groups, that invariably the question is raised, "Is there a disc in the cabinet?" The audience (including engineers and service technicians) could neither see nor hear the disc about which they had been hearing and reading.

With the proper motor and shock mounting (Figs. 13 and 14), the operation is essentially noiseless. The motor used in this receiver is a split-phase capacitor type which has a torque of 21 inch-ounces. Its speed is 1,748 r.p.m. and it is geared down with belt and sprockets (Fig. 13) to 1,440 r.p.m. The operating voltage of the motor is approximately 85.

The disc shaft is rigidly connected to the front disc. When this disc rotates it pulls the other, or free, disc along with the indexing pins (Fig. 11) which are engaged in the grooves of the "free" disc hub. It takes the discs approximately 20 seconds to reach the operating speed from the off position.

Mounted on the rear of the disc shaft (Fig. 13) is a tone-generator disc. As each pair of arms of this disc passes under the ends of the horseshoe magnet, a sawtooth voltage is generated in the coils. The spacing, the shape of the arms, and the ends of the horseshoe magnet determine the generated waveshape. The sawtooth voltage is then applied to the disc control circuit for comparison with the vertical sweep pulses as explained previously in the section on disc control.

When the selector switch is thrown to *monochrome* position, a mechanical brake (Fig. 13) is applied. This slows down the forward motion of the discs. At the same time, the current through one of the motor windings is reversed. As the driven disc slows down with respect to the free disc, its relative position with respect to the free disc is allowed to change by 120°, where the free disc is again held in position by the indexing pins which ride in the grooves of the free disc hub (Fig. 11). In this position there is 120° of clear area (Fig. 12). When the reverse current in one of the motor windings re-

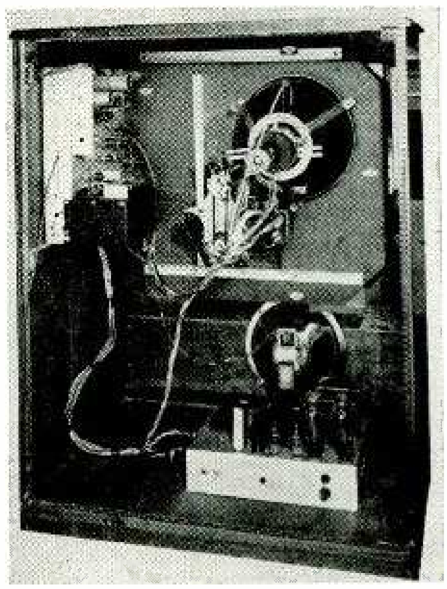


Fig. 14—Rear view, complete receiver.

verses the direction of rotation of the disc, a stop latch on the hub of the free disc moves up against a stop on the mounting assembly and both discs are stopped in the correct position (clear sections in front of raster). When the discs are in the correct position, a microswitch behind the stop latch turns the motor current off. This changeover from color to monochrome takes less than 8 seconds.

A magnifying lens enlarges the 10-inch tube image to the equivalent of a 12½-inch tube.

Acknowledgment is gratefully given to the CBS Engineering Staff, and particularly to Dr. Peter Goldmark, John Christianson, and Al Goldberg who worked closely with the authors in the development of this receiver.

REFERENCES

1 "Vacuum Tube Amplifiers," Valley and Wallman; Chapter 4.

2 "Field Sequential Color Companion," Cohen and Easton; *Electronics*, May 1951.

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Remote Controls For TV Promote Viewer Comfort

electromechanical and electronic systems are used

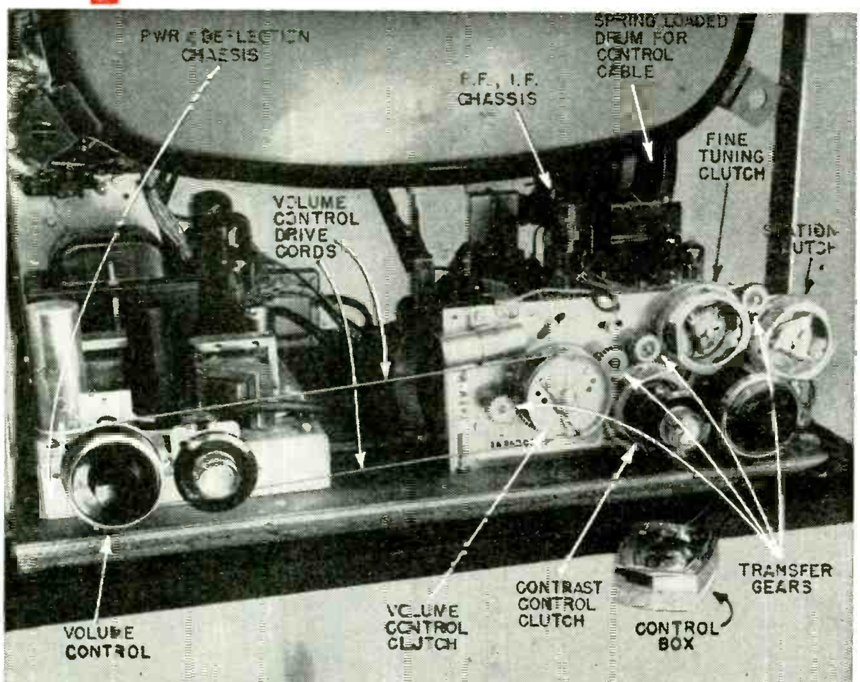


Photo A— Remote control unit on Philco dual-chassis receiver.

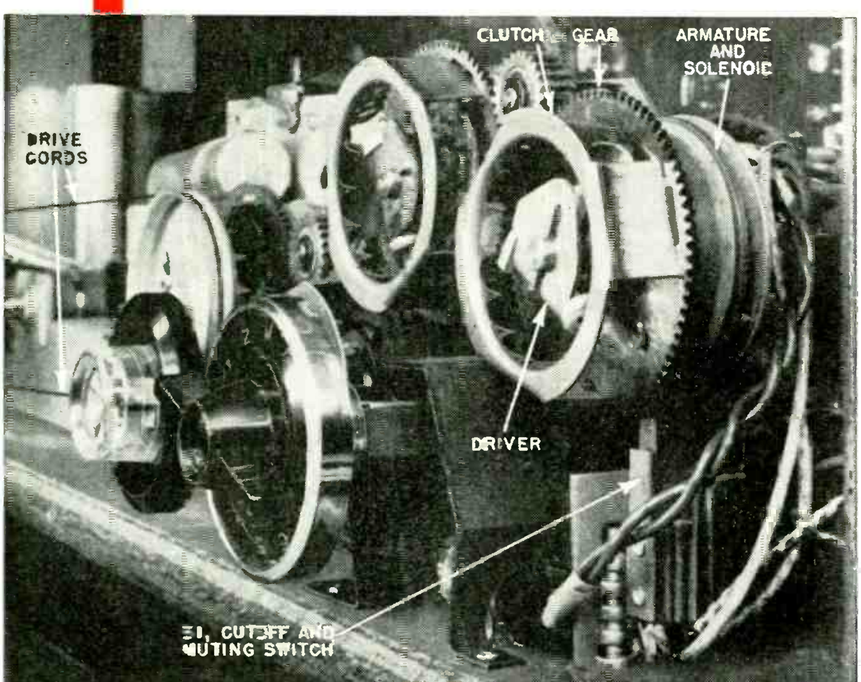


Photo B—Close-up of drive unit of Philco's remote control

By ROBERT F. SCOTT

BUILT-IN and large-screen television installations are usually placed where the screen can be seen clearly by a maximum number of viewers, who may be seated 10 or 15 feet away. If the host sits among his guests, he blocks their view each time he gets up to adjust the volume, tuning, or contrast. If he sits beside the set where he won't block the view of others, he will probably go to bed with a neck cramp from trying to see the screen and with a headache from watching it from too near. One TV owner even sits beside the set and watches the screen in a mirror on the opposite wall.

Some TV set manufacturers have produced remote viewers and remote-control systems which permit control of the set from a convenient viewing spot. Some of the following systems are electronic, others are electromechanical.

Zenith "Lazy Bones"

The Zenith remote-control system, called "Lazy Bones," is optional on the 1951 series H chassis. It consists of a motor-driven tuning mechanism bolted to the rear of the tuner and controlled by two push switches on the end of a 17-foot 3-conductor cable. A schematic of this system is shown in Fig. 1 and a drawing of two views of the mechanical arrangement is shown in Fig. 2.

The essential parts of the system are a low-voltage a.c. motor, step-down transformer, a high-ratio reduction gear, an electromagnetic clutch, and a small control box on the end of the 17-foot cable. The drawings in Fig. 2 show the drive mechanism in the unenergized position. Gear G1 has a D-shaped hole which fits the shaft extension on the rear of the tuner turret. The worm gear G2, mounted in bearings on the armature of the electromagnet EM, is coupled to the motor shaft through a flexible coupling made of rubber tubing or similar material.

Pressure on S1 or S2 applies power to the motor and the electromagnet which is in series with it. When the motor starts, the magnet attracts the armature holding G2 and pulls in until G1 and G2 are meshed. Because of the gear ratio, G1 turns slowly. This slow motion and a heavy detent causes the stations to click in one after the other as long as S1 or S2 is closed. All the operator need do to change channels is press either switch until the detent drops into the right channel. S1 causes the turret to turn clockwise and S2 turns it counterclockwise. No provisions are made for operating any controls other than the channel selector.

Philco control

The Philco RC-1 remote control turns the set on or off, selects any channel, and adjusts volume, contrast, and fine-tuning controls from any distance up to 30 feet from the receiver. The control cable fits on a spring roller reel-up drum. Proper length is pulled out.

Shown schematically in Fig. 3, it consists of four self-centering d.p.d.t. switches on the end of a 30-foot 8-conductor cable, a 24-volt reversible a.c. motor and step-down transformer, and a clutch-gear assembly which turns the shafts of the volume, contrast, station-selector, and fine-tuning controls. Photo A shows the front of one of the recent Philco models with the gear assembly and motor in place. Photo B is a close-up of the gear mechanism.

The major portion of the remote-control mechanism—the clutch-gear-solenoid assembly—is mounted on the r.f.-i.f. chassis. The volume control—on the power and deflection chassis—is coupled to its drive mechanism through a pulley and drive cords (see Photo A). All controls on the set have concentric shafts. Only those controls on the outer shafts are operated by the remote-control system. One gear in the train is driven by a belt from the motor. This belt-driven gear is coupled to the others through small transfer gears. See Photo A.

There are four solenoid-clutch-driver assemblies. The clutch-gear assembly is a one-piece unit which revolves continuously as long as the motor is turning. When the solenoid is excited, the clutch moves back approximately 1/8 inch so one of its cogs engages the toggle on the driver and the shaft starts to turn. A spring returns the armature and clutch to their resting position when the solenoid circuit is opened.

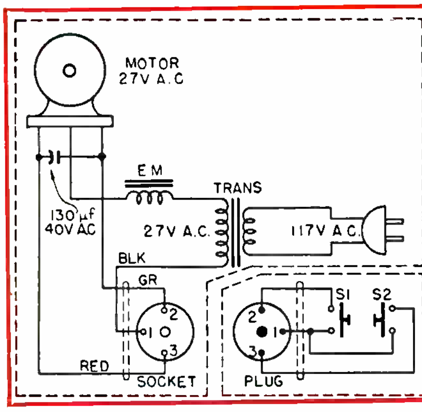
A safety device on all controls except the channel selector is a spring toggle which maintains sufficient pressure to turn the control throughout its range and slips with a audible clicking when the control reaches the end of its range. The channel selector can be rotated continuously so it does not have such a slip-type clutch.

Referring to Fig. 3, we see that throwing any switch on the control box starts the motor and excites the solenoid which transfers the rotary motion to the shaft corresponding to the switch. The switches have a dead center position with a spring return. The rotation can be reversed by sliding the switch in the opposite direction.

The channel-selector mechanism is coupled directly to a normally open cut-off and muting switch S1 placed across the speaker voice coil and the cycling switch S2. Photo C shows the exploded view of the cycling switch and detent assembly and Photo D is the detent and roller assembly which fits over a shaft on the back of the turret tuner.

Operation

When the STATION SELECTOR switch is pressed, the motor and corresponding



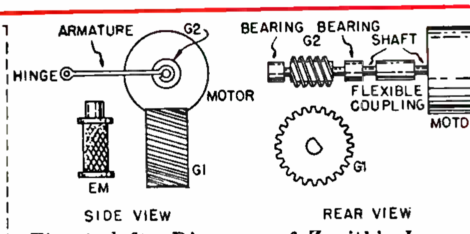
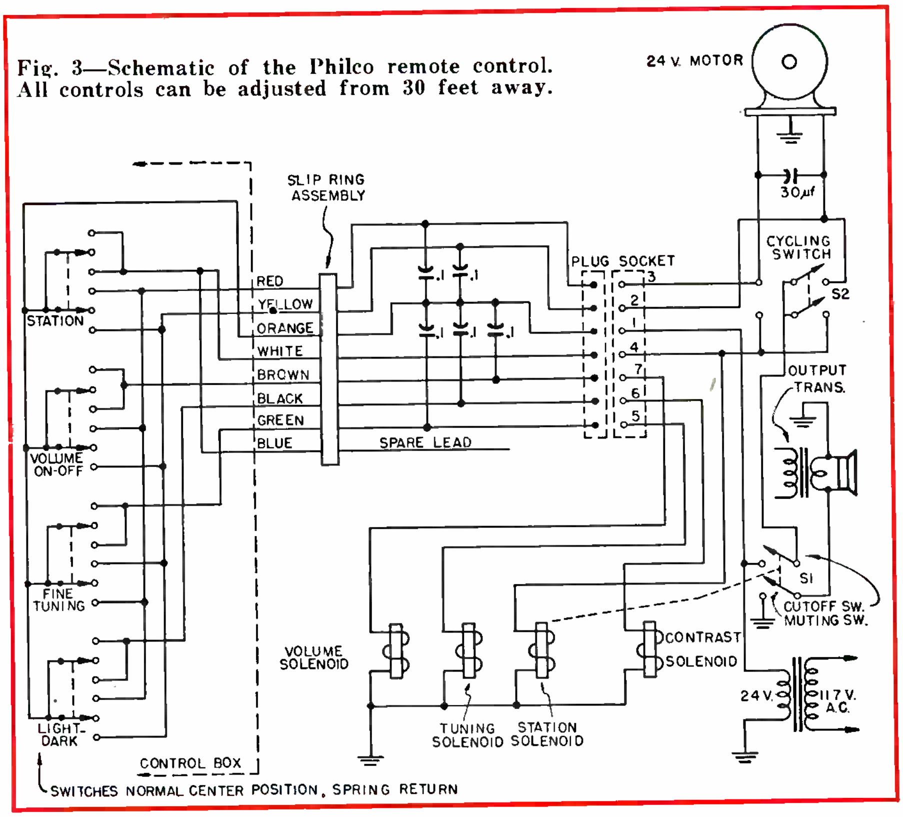


Fig. 1, left—Diagram of Zenith's Lazy Bones remote control. Fig. 2, above—When motor starts, electromagnet EM pulls armature down bringing gear G2 into mesh with drive gear G1 which is mounted on a shaft projecting from the rear of the turret-type tuner. A heavy detent action provides positive tuning.

Fig. 3—Schematic of the Philco remote control. All controls can be adjusted from 30 feet away.



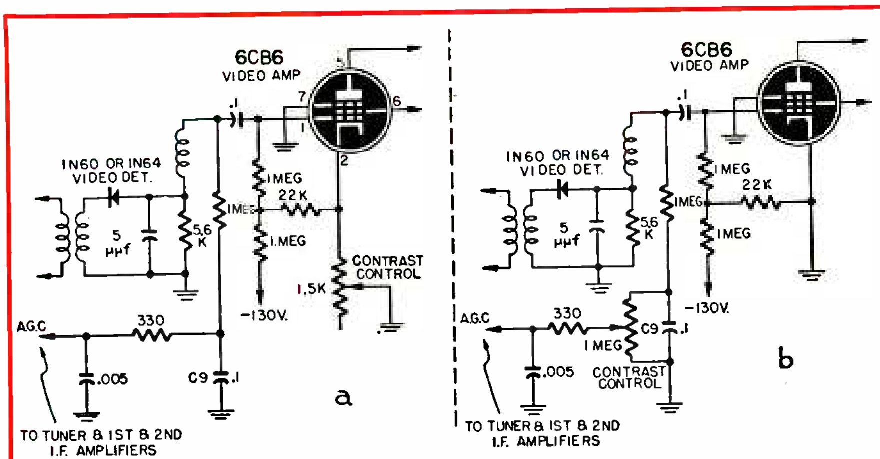
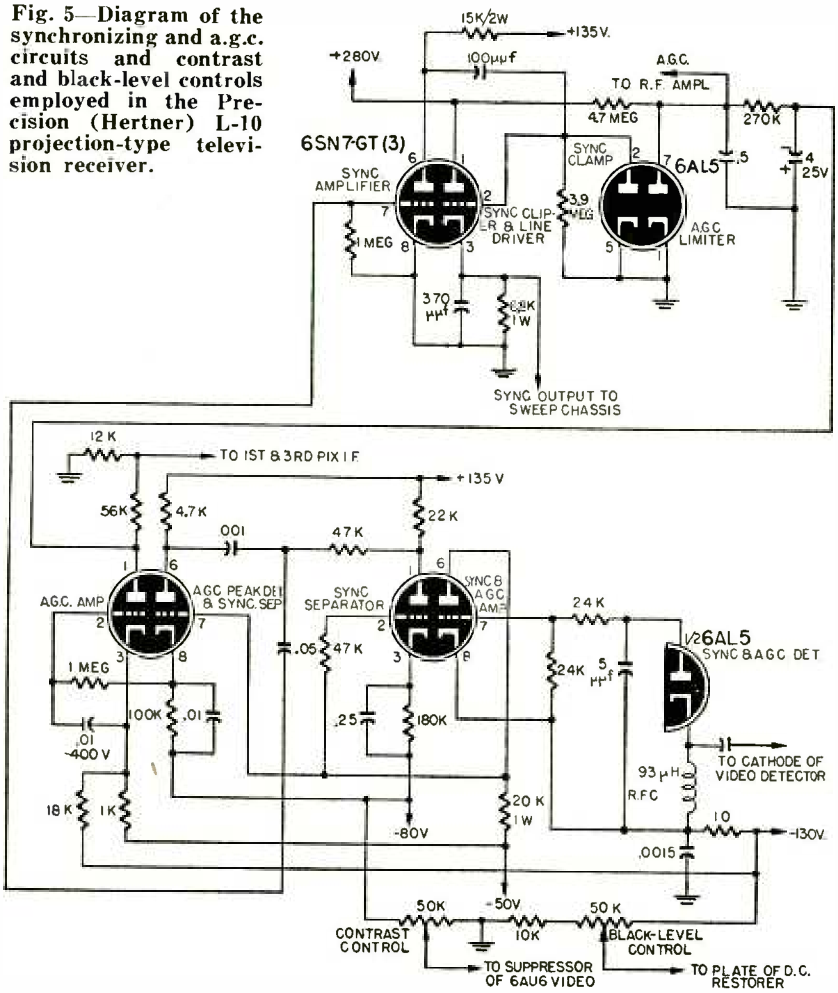


Fig. 4-a—Tele-Tone contrast control; 4-b—as modified for remote control.

solenoid are energized and the turret shaft starts to rotate. The detent rollers (see Photos C and D) are subjected to sideways and upward thrusts by the star wheel on the detent-plate assembly. The centering lever moves sideways to close the cycling switch S2. This switch is in series with the cutoff section of S1 which was closed earlier by the clutch gear as it moved backward to conduct the driver.

These two series-connected switches parallel the STATION SELECTOR in the control box. Therefore, during the time that the detent roller is riding up on the star wheel, the centering lever holds S2 closed.

Fig. 5—Diagram of the synchronizing and a.g.c. circuits and contrast and black-level controls employed in the Precision (Hertner) L-10 projection-type television receiver.



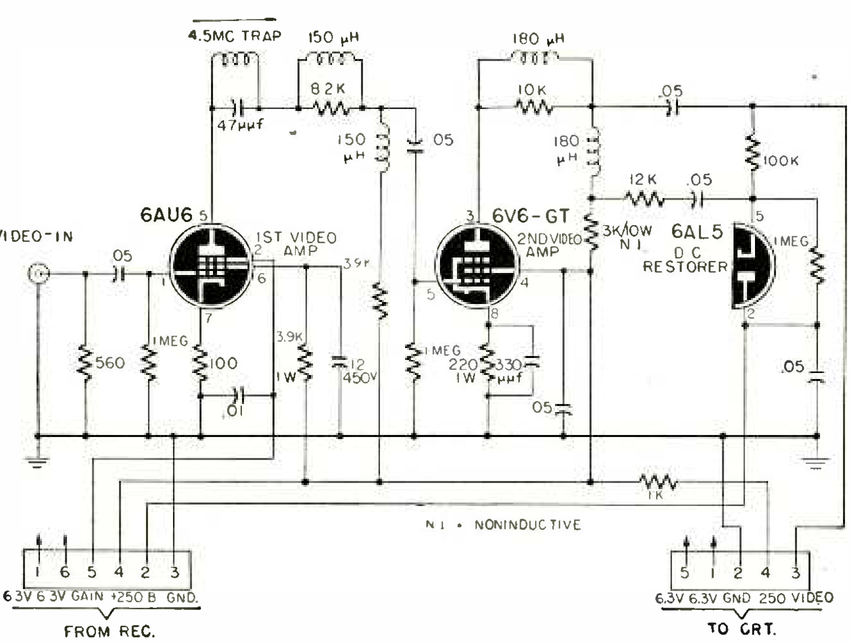


Fig. 6—Video circuit of the L-10. Lead B from the d.c. restorer plate goes to the brightness control. The contrast control varies suppressor bias on the 6AU6.

The cycling switch S2 closes, even on one sharp pulse from the station selector switch. Thus the station selector switch does not have to be held down once the tuner starts to rotate. S2 has two positions, as shown, because the motor rotates in one of two directions, and proper phasing must be maintained. The detent cam throws S2 in one of the two positions, depending on the initial direction of rotation.

The tuner continues to revolve until the detent roller (see Photo D) dips down to the next depression in the star wheel. The centering lever returns to its normal position and opens S2 so all voltage is removed from the motor and solenoid. The armature returns to its resting position and opens S1 which removes the short from across the speaker voice coil.

During manual operation, S2 is closed by rotation of the tuner shaft but the motor and solenoid are not excited because S1—in series with the hot lead from the transformer—is open.

Tele-tone control

Tele-Tone type TAP chassis are used in some remote installations. The tuner is removed from the set and installed in a small control box. The converter and first i.f. transformers have low-impedance secondaries and primaries, respectively, which are link-coupled with 72-ohm coax. The volume-control circuit is brought to the control box through standard 2-conductor shielded cable.

When the TAP chassis is used in a straight console or table model, the contrast control is a 1,500-ohm potentiometer in the cathode return of the 6CB6 video-amplifier stage shown in Fig. 4-a. Since the control is in a signal circuit, it is not practical to extend to the control box for remote-control installations. Therefore, the control is removed from the circuit and the cathode of the video amplifier is returned directly to ground. The modified circuit is Fig. 4-b. The video amplifier operates at full gain as it does with the original contrast control at minimum resistance.

The a.g.c. lead is disconnected from the junction of R14 and C9 and connected to the arm of a 1-megohm potentiometer shunted across C9. Placing the contrast control in a d.c. circuit makes it possible to extend its leads to the control box without disturbing the operation of the circuit.

The Hertner system

An electronic remote-control system is used in the Precision (Hertner) L-10, a projection model which has the tuner, i.f. strips, sync circuits, and audio amplifier on the remote-control or receiver chassis. The 30-kv r.f. power supply, sweep circuits, and video amplifier are all on separate chassis. The tuner and audio amplifier are on subchassis which can be taken off the receiver chassis and mounted in other remote locations.

The tuner, a Standard Coil Products unit, has a converter transformer designed to connect to the first i.f. transformer through a low-impedance link. The connecting cable (standard 90-ohm coax) may be 50 feet long without affecting the performance of the tuner. This system of chassis and subchassis makes possible a large number of physical arrangements which can be adapted to almost any custom installation.

The composite circuit is very much like that of a 630 which has been modified to make it possible to separate the various chassis.

The contrast, black-level, horizontal and vertical hold, volume, and tone controls are on the main chassis. All except the last two are in d.c. circuits which make it possible to extend control leads to any remote point without taking elaborate precautions to avoid signal distortion. The sync and a.g.c. circuits and contrast and black-level controls are shown in Fig. 5.

The video amplifier shown in Fig. 6 prevents the high input capacitance of the 5TP4 from causing a loss in the high-frequency components of the video signal. Contrast is controlled by varying the suppressor voltage on the 6AU6, and the black-level is controlled by adjusting the bias on the plate of the 6AL5 d.c. restorer.

Cascade remote system

The circuit of Cascade's LD-120 remote system is surisingly simple. In this system, *all* voltages and signals are developed on the control chassis—a modified 630—and "piped" into the picture-tube chassis over special cables and lines which may run up to 65 feet.

The second video amplifier (usually a 6K6-GT in the 630) is replaced by a 6V6 followed by a 6Y6 cathode-follower which works into a video line having an impedance of approximately 600 ohms. This video lead is made by stripping the outer conductor from a standard coaxial cable. Although 600 ohms may seem to be unusually high for a long video line, hum and spurious signals which may be picked up do not appear in the picture because the video level is very high at this point. The only precaution is to make sure that the unshielded video line is at least 1/8 inch from any of the others. The video output circuit of the LD-120 is shown in Fig. 7. High voltage (14,000 volts) for the picture tube (a 19-inch round or 20-inch rectangular) is fed to the anode through RG/59-U cable. The hot side of the horizontal deflection circuit is fed to the yoke through a separate lead insulated for 6,000 volts or more. All other voltages are fed to the picture-tube chassis through 8-conductor shielded cable. No. 16 wire is used for the filament lead to prevent excessive voltage drop. The loudspeaker is normally mounted on the control chassis but it can be moved to any convenient point by extending the voice-coil leads.

Many of the circuit innovations shown here can be successfully incorporated into sets of other makes and models. Before trying to use any of these circuits, carefully study the complete schematic of the receiver using the circuit you want to use in your set. Pay particular attention to d.c. operating voltages and to polarity of video and synchronizing signals.

—end—

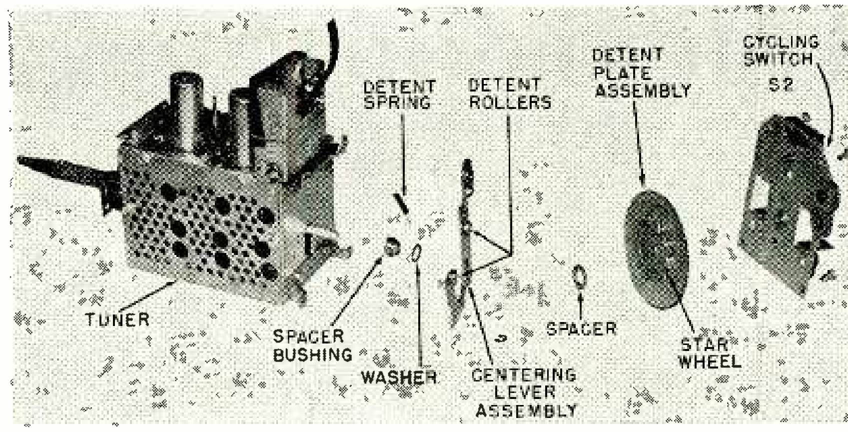


Photo C—Exploded view of the cycling switch and detent assembly used in the Philco RC-1 remote control which is optional equipment for 1951 models.

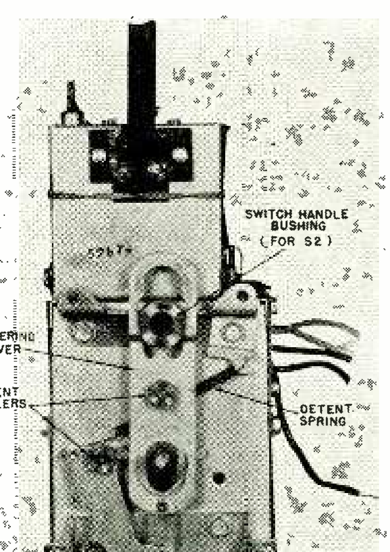


Photo D—Detent rollers and centering lever fitted on back of Philco tuner.

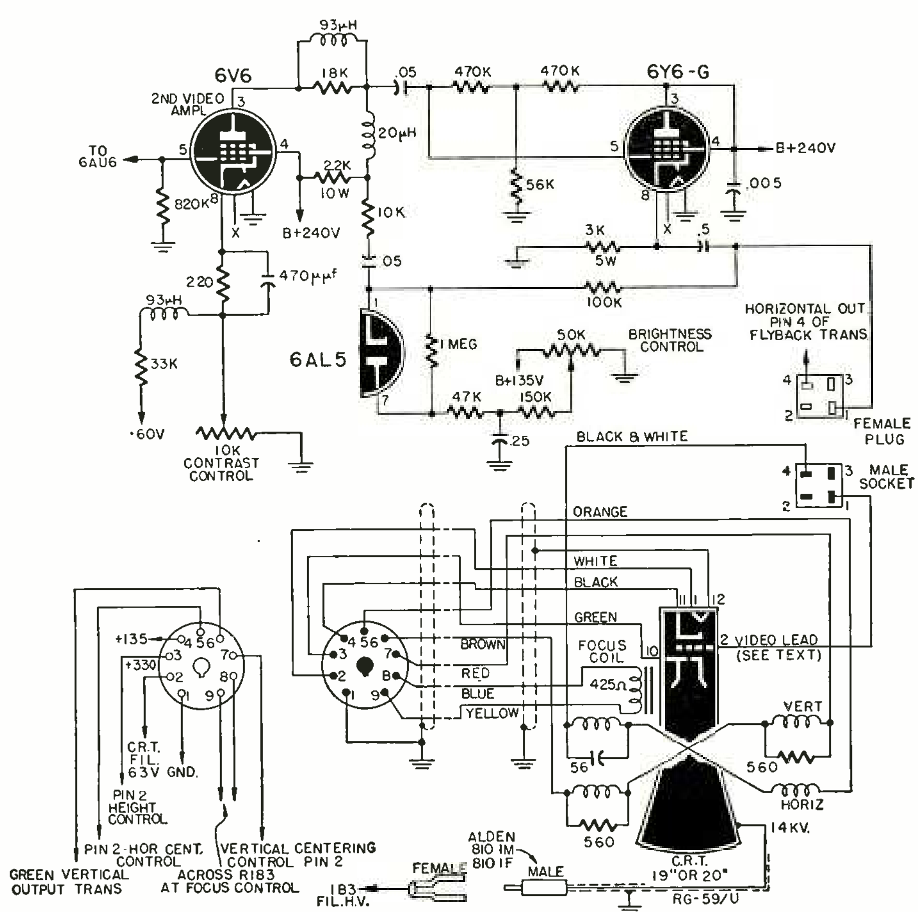


Fig. 7—Video output circuit of the Cascade LD-120. Remote may be 65 feet away.

Television Service Clinic

Conducted by MATTHEW MANDL

A NUMBER of television receivers make use of a sound i.f. of 21.25 megacycles and a picture i.f. of 25.75 megacycles. These sets normally give good service in most signal areas, but use of these i.f.'s sometimes can cause considerable trouble.

A reader in Tucson, Arizona, reports fringe-area reception of channel 5 resulted in finely-spaced horizontal lines which look like thickened horizontal trace lines. Fine tuning adjustment caused such lines to rotate from their horizontal position to vertical. They disappear when the station signal strength increases. A booster or 4.5-mc trap adjustment did not help.

In these receivers the source of trouble is the third harmonic of the video i.f. falling on channel 5 picture carrier frequency:

Channel 5 picture carrier 77.25
Receiver picture i.f.
25.75 X 3 ....77.25

With the slightest deviation of oscillator frequency (such as 25.72 i.f. resultant) heterodyning action can take place between channel 5 picture carrier and the third harmonic of the i.f. which is present because of low-Q circuits and nonlinear mixing systems. The resultant frequencies, if slightly *below* the 15,750 sweep, will produce the effect shown in the photo.

Horizontal lines are due to video i.f.

Varying the fine tuning may change the difference frequency enough to produce a resultant *above* the 15,750 sweep. The interfering lines will then be vertical. If the incoming signal is strong, the visible line structure will be less noticeable.

The 25.75-mc picture i.f. can also produce interference in localities with different station allocations. For instance, a fairly strong channel 10 carrier can ride in on channel 6.

To tune channel 6, the local oscillator in sets using an i.f. of 25.75 will have to generate a frequency of 109 mc. Similarly, to tune channel 10 it would have to generate a frequency of 219 mc.

However, the oscillator for channel 6 produces harmonics as well as the fundamental 109 mc. The second harmonic is 218 mc, which is so close to the channel 10 oscillator frequency (219 mc) that channel 10 will ride into the i.f. system and cause interference on channel 6.

Other such interference problems have arisen and manufacturers have subsequently used 25.5 mc for the picture i.f. and 21 mc for the sound i.f. in their later receivers. Many technicians have realigned such receivers slightly to rid them of this type interference. When this is done the tuner must be tracked to produce the new i.f. frequencies and the i.f. stages must be aligned for proper acceptance of the new resultant. This was done by our Tucson reader. It resulted in complete absence of the interfering lines.

Adjacent channel interference

What can be done to reduce adjacent channel interference in this area? Local stations are strong and spill over when the more distant ones are tuned in. A. D., West Orange, N. J.

When local stations are extremely high in signal strength, not much can be done to reduce adjacent channel interference. Adjacent channel traps can be installed in receivers which do not have them, or additional ones can be put into receivers which have single ones. Poor i.f. alignment will cause adjacent channel spill-over and so will a poorly tracked tuner. A good booster, with its added selectivity, will also help. Also check antenna orientation and use multielement reflectors for better screening from the rear.

Reversed picture

After conversion of an RCA receiver from a 10-inch tube to a 14-inch, the picture appeared reversed in a horizontal direction. Would this be caused by the newly installed yoke? C. H., Cleveland, Ohio.

If you get a reversed picture along the horizontal plane it indicates that you have the two leads to the horizontal coils of the yoke reversed.

Interchange these leads. When the leads are reversed on the horizontal coils, sweep starts from the right and goes to the left instead of vice versa. If you had reversed the vertical-coil leads your picture would have appeared upside-down.

Transformer sing

After conversion of an Admiral to a 14-inch screen everything worked all right except for the presence of a very high-pitched squeal. Evidently the 15,750 sweep is now very audible and I would appreciate suggestions for its reduction. F. S., South Attleboro, Mass.

Your new horizontal output transformer is the offender. Some transformers produce more *singing* than others. If the transformer windings are vibrating, little can be done except boiling the core in a sealing compound. A reduction in the drive-control setting sometimes is helpful; excessive drive aggravates singing. Reduce drive as much as possible, but check horizontal linearity to prevent picture distortion. Also check to see that width is proper.

Reduced picture size

On a G-E model 806 the picture does not fill the screen. There is about ½ inch border all around the picture and I have been unable to fill the mask. G. L., New Brunswick, N. J.

If both height and width controls are unable to bring the picture to full size, one of several things may be wrong, as listed:

1. Defective low-voltage supply. Replace the low-voltage rectifier and check filter capacitors to see that leakage resistance is not draining too much current.
2. Excessive high voltage. This could be caused by a gassy horizontal output tube or high-voltage rectifier. Replace each to see if picture expands.
3. Improper placement of yoke on neck of tube. If yoke is too far back from the flare of the picture tube, the beam cannot sweep fully.

Picture stretch

I have a receiver with excessive stretching of the picture at the left. The outer circle of the test pattern is almost pointed.

I have tried to remedy this condition by replacing the damping tube and adjusting controls, without success. R. S., New York, N. Y.

Normally this condition is caused by an incorrectly adjusted "drive" control which, in conjunction with the horizontal linearity and width controls, must be properly set for a perfectly rounded circle. If adjustment of these controls fails to reduce left-side stretch, the discharge tube should be replaced and a check made of the associated circuit. An incorrect value voltage-boost capacitor in the cathode circuit of the damper tube may also cause this condition.

Defective picture tube

I have a receiver using a 12LP4 tube. When the set is turned on, sound is all right but the picture takes about 15 minutes to come up to proper bright-

ness. During this time the screen has no brilliancy, and as the picture appears it is badly out of focus and double images appear. Eventually focus and brilliancy reach normal levels. I have tried receiver-tube changes but this didn't help. The trap in this receiver is a single-magnet type—could this cause such symptoms? H. P., Birmingham, Ala.

All indications point to a defective picture tube in this receiver. The 12LP4 tube requires a double-magnet type of ion trap, and if this receiver has been in use for any appreciable time with a single-magnet ion trap, damage to the gun structure of the tube has probably occurred. Try a double-magnet ion trap and carefully position it for brightest raster. This may make some difference in performance, though if the damage is extensive, the tube will have to be replaced before you will regain normal operation.

No picture or sound

In an Air-King model A-1000 both sound and picture are missing, but the raster is present. Inasmuch as this is not an intercarrier receiver I suspected the tuner. I replaced all the tubes in the tuner with new ones without result and finally changed the entire tuner but to no avail. Where else could the trouble lie? M. G., Cementon, Pa.

This model receiver has the same circuit as the RCA 630 and the sound take-off is right between the mixer tube and the first i.f. stage. Absence of both picture and sound *usually* indicates tuner trouble. Since you replaced the front end, it is quite possible that you have a bad tube or defective part in *both* the video and the sound section. There is also a bare possibility that there was some defect in the new tuner that you installed.

If the tubes check all right in both these stages, localize the defective stage in the sound i.f., detector, and audio amplifier by signal-tracing methods. Repeat for the video section from the tuner to the picture tube.

Conversion to 20-inch tube

I have a Radio Craftsman receiver, model RC-100-A, using a 16AP4A picture tube. Am I right in assuming that my present high-voltage system would be suitable for the 20CP4 conversion I have in mind? Is changing the yoke the only major conversion item? O. M., Moosup, Conn.

You would need more high voltage for the 20CP4 than your present supply furnishes to get best results. Besides a new yoke, the horizontal output transformer also should be changed for a proper impedance match. The focus coil also will have to be replaced. The 16AP4-A is a 53° deflection tube using a double-magnet ion trap and metal-cone lip, high-voltage connection.

The 20CP4 is a glass tube (70° deflection) and the high-voltage connection is of the cavity type. A single-magnet ion trap is needed.

—end—

Television dx Forecast for November

The between-seasons character of November is reflected in the nature of TV dx conditions that may be expected during the month. Just as in weather, November provides samplings of both summer and winter in its v.h.f. propagation conditions.

Sporadic-E skip is not uncommon at this season, but the openings are usually of short duration and reception is likely to be highly erratic in character. TV dx of this sort will be more prevalent in the lower latitudes. Viewers 500 to 1200 miles from either Mexico City or Havana will be getting occasional looks at the Channel 4 transmissions from these two cities. Stations in the southern parts of this country will be received at similar distances several times in November, with the more northerly stations affected less often. Little dx will be observed on TV channels above 4.

Tropospheric propagation will run the gamut from very good to near the winter minimum, and these variations will follow the weather pattern closely. Parts of the country where November's days are still warm and the nights only moderately cool will be getting good extended-range reception on the lower channels in fair calm weather. High-band tropospheric DX occasionally observed in early fall will be rare after the latter part of October.

Average signal strengths on all channels will deteriorate somewhat, increasing "fringe-area jitters" on the part of TV service technicians. Viewers who have had their first TV experience in the favorable conditions of summer and early fall will be needling their technicians to fix up their snowy reception, and educational as well as technical methods will be required to pacify them. This may be a little trying to a busy man's patience, but it can be good for the booster and high-gain antenna business.

The aurora borealis is likely to provide a show or two for residents of that portion of the U.S.A. above Latitude 40 (approximately Washington to Reno). and we again request that propagation effects observed on the TV frequencies during auroral disturbances be reported in detail for study.

—end—

WOR'S "Television Square" Opens Next Month

Television Square, WOR-TV's new block-square studio, is scheduled to be opened for occupancy about December 1, a month ahead of schedule. The two-story structure—New York's first to be erected solely as a TV studio—runs from Broadway to Columbus Avenue and occupies practically the entire block between 67th and 68th Streets.

The building, which will contain approximately 50,000 square feet of floor space, will enable WOR-TV to place nearly all their production facilities under one roof. Incorporated in the studios are many new design features suggested by competitive engineers from Du Mont, ABC, CBS, and NBC. The live-production facilities consist of two 4,000- and one 6,000-square-foot studios on the first floor. Each is entirely self-contained with its own control room, sponsor's and announcer's booths, and a 400-square-foot rehearsal room. The largest studio has a spectator's balcony seating nearly 250 persons. The studios are adjacent to four dressing rooms for stars and two others which accommodate about twelve performers each. Each studio has access to 5,000-square-foot storage area used for scenery and properties.

The second floor is equipped for filmed productions. There are editing, cutting, and projection rooms, master control, and a small studio for forum and news telecasts.

The roof of the building has clear range to WOR-TV's transmitting tower in North Bergen, N. J., thus making it possible to use microwave relay between studios and transmitter. The entire building is acoustically treated, air-conditioned, and protected against fire.

An ingenious system is devised to discourage gate-crashing and trespassing and to prevent unauthorized persons from entering or leaving except through the main entrance. An indicator board is located at the receptionist's desk. If any door, except the main one—is opened, a light flashes and a buzzer sounds until the door has been closed and locked.

—end—

Underwater TV Spots Submarine's Remains

Underwater television was used by the British Navy to locate and positively identify the wreck of the submarine *Affray* lost with 75 men aboard during a practice dive last April.

The equipment consisted of a portable TV camera equipped with remote controls and sealed in a watertight container. The camera assembly was fitted with powerful lights designed for underwater photography. It was installed on the salvage ship *Reclaim*.

Underwater soundings taken over many square miles of sea located many wrecks which were investigated with the undersea TV equipment. After several weeks of intensive investigation, the search was climaxed when viewers aboard the *Reclaim* were able to read the name *Affray* on the wreckage 250 feet below the English Channel surface.

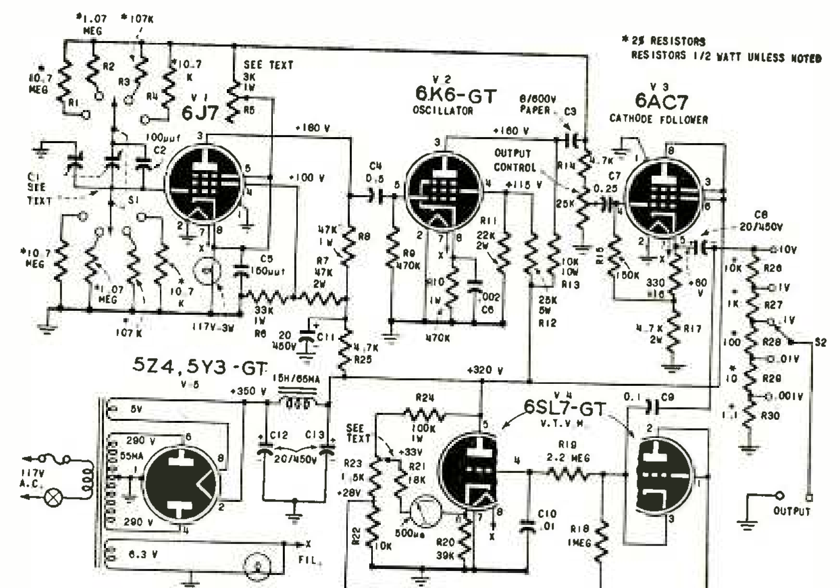
—end—

AUDIO SIGNAL GENERATOR WITH CALIBRATED OUTPUT

By
LAWRENCE FLEMING

ALL audio measurements and testing require a calibrated signal source. Very few audio oscillators are equipped to tell just how many volts or millivolts they are delivering to their terminals, and without knowing this we are in no position to measure, for instance, the gain of an amplifier.

If we want to feed the input of an experimental amplifier, say 10 millivolts at 2,500 cycles, we usually need a regular oscillator plus an auxiliary output meter and a calibrated attenuator. Most amateur, PA, and allied work doesn't require 1% laboratory precision. This instrument does the job with 5 to 10% accuracy, is easy to build, uses standard parts throughout and is completely self-contained. An output meter and attenuator are built into the same case with a conventional resistance-tuned audio oscillator. The output is isolated from the oscillator proper by a cathode-follower stage.

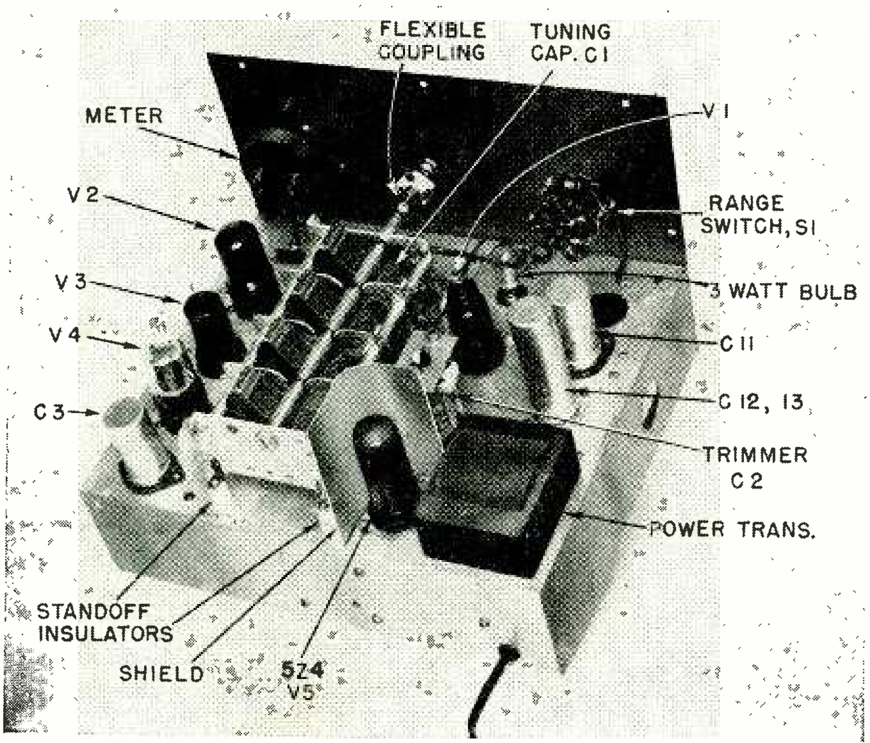


Oscillator is a Wien bridge with wide-range amplifier and calibrated attenuator.

The frequency range is 20 cycles to 200 kc, covered in 4 ranges. The same dial calibration serves for all ranges. The output voltage is variable from 100 microvolts to 10 volts. The output impedance varies with the setting of the attenuator switch, but is always lower than 900 ohms.

General layout

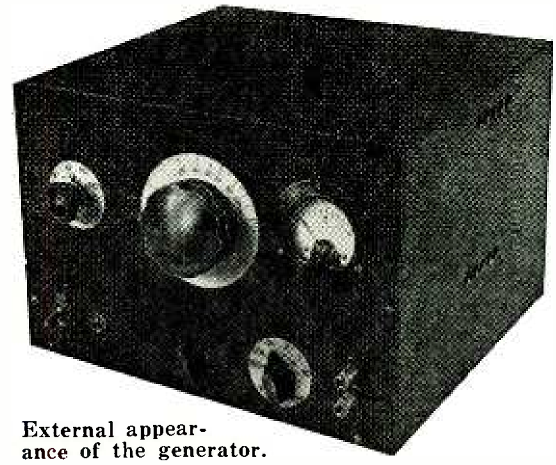
The instrument is built on a standard 10 x 12 x 3-inch chassis, which fits into an 11 x 12 x 8-inch utility box. As shown in the photo, the main tuning capacitor, C_1, is mounted down the middle of the chassis. It is a 4-gang, 365-μμf-per-section unit. The sections are paralleled in pairs, giving in effect a two-gang capacitor having 730 μμf per section. The range selection switch S1 and its associated resistors, as well as the 6J7 tube V_1, are mounted to the left of the tuning capacitor.



Layout of the generator. Variable capacitor must be insulated from chassis.

The power supply occupies the back

An instrument with calibrated output variable from 100 microvolts to 10 volts and frequency range from 20 cycles to 200 kc in four bands.



External appearance of the generator.

left-hand corner of the chassis (filter choke L_1 is under the chassis), and the remaining tubes and the output meter are mounted to the right of the tuning capacitor. V_2 is nearest the panel, and next to V_1. The cathode-follower output stage V_3 is next in line, and the v.t.v.m. tube V_4, for output metering, the rearmost.

Circuit operation

The oscillator is the Wien bridge type and its principal components are the bridge itself, C_1, R_1-R_4 and the two stage amplifier V_1, V_2. With resistors R_1 switched in, the frequency range is 20–200 cycles; with R_2, 200–2,000 cycles; with R_3, 2,000–20,000 cycles; with R_4, 20,000–200,000 cycles. This last range is easy to include and is useful in getting the bugs out of feedback amplifiers, which often oscillate up above 30 or 40 kc.

The amplifier part of the oscillator system has to have wide-range response and low phase-shift, which is the reason for not using screen bypass capacitors. The 6J7 and 6K6 tubes get their screen voltage from voltage dividers R_6, R_7, R_{11}, R_{12} instead. This is the reason too for the large 0.5 µf interstage coupling capacitor C_4 and the very large capacitor C_3 for coupling the output back to the positive and negative feedback networks. C_5 and C_6 are for high-frequency equalization, such as is used in oscilloscope amplifiers.

The negative feedback loop extends from the plate of V_2 through C_3, through feedback potentiometer R_5 to the cathode of the first stage V_1. The 3-watt lamp, which acts as a cathode resistor for V_1 serves also as the automatic amplitude control. If the output voltage rises, the signal voltage fed back across the lamp will rise and the lamp filament will consume some energy. When the filament gets hotter, its average resistance *increases*, so that the negative feedback factor *increases* too and the gain *drops*.

The positive feedback extends from the plate of V_2 through C_3, the Wein bridge, and back to the grid of the tube V_1.

The rotor of the main tuning capacitor C_1 is hot and precautions have to be taken also for stray capacitances and hum pickup. The variable tuning capacitor is mounted on small ceramic standoffs and the dial is connected to it through an insulating coupling. The frame-to-ground capacitance is across the lower section of C_1. The purpose of the 100-µµf air trimmer C_2 is to balance this capacitance, and its normal setting should be about 60% of maximum.

To prevent electrostatic hum pickup in the grid circuit of the 6J7, shielding is necessary. The metal cabinet is sufficient shielding from 60-cycle electrostatic fields orginating outside the chassis. In the chassis the only offender is the rectifier tube V_5. If a glass tube, such as a 5Y3-GT, is employed, a tin baffle shield will be required between the tube and C_1. Use of the metal 5Z4 makes the baffle shield less necessary, but still advisable. A shield was added to the present unit after the photo was taken. All a.c. wiring should be below the chassis, and the 6J7 grid lead, range switch S_1 and its resistors R_1-R_4 all should be above the chassis to assure elimination of hum.

Hum pickup shows up as beats between the oscillator frequency and 60 cycles and its harmonics. Thus when the dial of C_1 is set within a few cycles of 60 or 120 cycles the beats will appear as an oscillation of the output amplitude at the difference frequency. The effect is very noticeable when the instrument is operated with the cabinet removed. Normally the effect is hardly perceptible.

Cathode-follower stage

The normal amplitude of oscillation at the plate of V_2 is about 15 volts. To isolate the oscillator section and provide a lower output impedance, a cathode-follower is used for the output stage. A 6AC7 tube, V_3, operates at about 12 milliamperes plate current and about 60 volts drop across its load resistor R_{17}. Our maximum useable output is about 10 volts. This is fully adequate for all applications of supplying input to an amplifier. For testing speakers, cutting heads, etc., a power amplifier is needed anyway, external to the signal generator.

Potentiometer R_{21} gives continuous control of the signal level to the grid of the output stage, and the step attenuator S_2, R_{26}-R_{30} mounted below the chassis, knocks the output level down in successive steps of 10. This attenuation at the output insures a good signal/hum ratio at low output levels. The step attenuator is a simple voltage divider. The impedance looking back into the output terminals accordingly varies with the attenuator setting, but this disadvantage is outweighed by the gain in simplicity for nearly all practical work.

The choice of the over-all resistance of the divider is controlled by the following considerations: If it is too high, the output impedance on those taps near (but not at) the top will be excessive; if too low, it will load the output stage too much.

Leakage in the electrolytic capacitor C_8 used for output coupling sometimes causes a fraction of a volt of d.c. to appear across the output terminals. This is a difficulty common to most commercial resistance-tuned oscillators, too. Hence it is not advisable to connect the output directly to a grid without an intervening capacitor, since it might upset the bias.

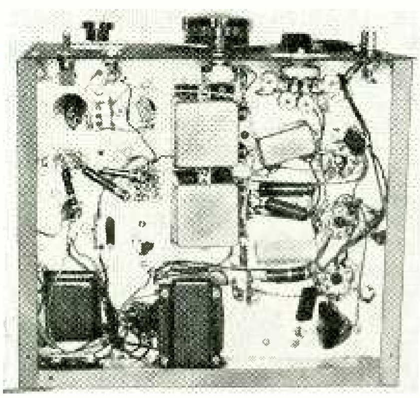
Output metering

The output meter circuit consists of a double triode V_4 with one half used as a half-wave diode rectifier and the other half as a d.c. vacuum-tube voltmeter. It is stable, low in cost and does not load the output circuit enough to cause any distortion due to clipping. No zero adjustment is needed other than the mechanical zero on the 500-microampere d.c. meter.

The diode rectifier works into a 1-megohm load R_{18}. The positive d.c. voltage developed across it is fed through a filter R_{19}, C_{10} to the grid of the other triode section, which operates as a cathode-follower type voltmeter. The full-scale voltage is 10 volts r.m.s. The sensitivity is adjusted by the multiplier resistor R_{21}, and the zero is governed by the ohmage of the voltage divider resistor R_{23}.

An indicating meter of *higher* sensitivity than 500 microamperes full-scale can be used at M merely by increasing the series multiplier R_{21}, but a *less* sensitive movement such as 0-1 milliampere will not work without redesigning the whole circuit. Once calibrated, this v.t.v.m. is quite accurate and stable, because the over-all sensitivity depends only very slightly on tube characteristics. With 10 volts r.m.s. a.c. input to the diode, the rectified d.c. applied to the grid of the triode section is 14.14 volts. This voltage is applied to the meter through an effective resistance made up of multiplier R_{21}, voltage divider resistors R_{23} and R_{24}, and the output impedance of the triode which appears across cathode resistor R_{20}. This last is only a few hundred ohms, whereas the fixed resistors total 28,000 ohms.

The output voltages appearing across the attenuator switch S_2 are 10, 1, 0.1, .01, and .001 volts. The photo showing



An underchassis view of the generator

the front of the panel shows an additional .0001-volt section on S_2. This was added by the author, but in most cases is not necessary. If desired, an additional resistor, 0.11 ohms in value, can be used to give this scale reading. However, great accuracy at this level should not be expected. If used, the resistor is inserted between R30 and ground, and an additional switch section is necessary for S_2.

Calibration and adjustment

When construction is completed, the first thing to check is the d.c. potentials at the various plates, screens, and cathodes, and they should be within about 20% of the values marked on the schematic.

The amplitude of oscillation is controlled by the 110-volt 3-watt lamp bulb and by the negative feedback potentiometer R5. An oscilloscope is necessary, and the first thing to do is to increase R_5 until flat-tops just become noticeable on the sinusoidal output of the oscillator. Then decrease R_5 until the amplitude has dropped to about two-thirds of its former value. If R_5 is too high, overloading and distortion will result; if too low, oscillation will tend to die out. Individual selection or padding of R_6 is necessary because the lamp bulbs vary quite a bit in characteristics.

Incidentally, the interstage coupling capacitor C_4 should be a good one. Leakage here is about the commonest cause of trouble in commercial instruments.

Calibration of the output meter merely consists of connecting a 1,000 ohm-per-volt a.c. meter to the output, setting output control and S_2 for 10 volts, and selecting or padding multiplier R_{21} until meter M reads full scale. The frequency should be low, say 100 cycles. If the meter does not zero properly, adjust the 1,500-ohm divider resistor R_{23} until the electrical zero and mechanical zero coincide. The meter scale is linear.

Trimmer C_2 is best adjusted with the chassis in the cabinet, through a hole in the top of the box. The procedure is merely to adjust C_2 until the output voltage of the oscillator is most nearly the same at both ends of the dial. This obtains on the three lower frequency ranges only. On the 20–200-kilocycle range it is normal for the output voltage to rise 20% or so at the high-frequency end. On the high end of this range, too, the frequency calibration is somewhat dependent on the value of the small capacitor C_5 across the lamp bulb. Ordinarily not much accuracy is required up there, but if it is desired C_5 can be adjusted by beating the output against a signal generator at 200 kc.

Frequency calibration

Barring a serious inaccuracy in the Wein bridge resistors, there is no reason why the dial calibration for one range will not hold precisely for the other ranges. The 200–2,000-cycle range is the most convenient for calibration. The following methods may be used, the easiest requiring the most apparatus and vice versa. The easiest way is to use another audio oscillator which you trust, as a standard. Apply the output of the standard to the horizontal input of an oscilloscope, and the newly-built unit to the vertical plates. Identity of the two frequencies is shown by a circle or ellipse on the screen.

The instrument can be calibrated with Lissajous figures on an oscilloscope screen, using the 60-cycle power frequency as a standard. Frequencies such as 20, 30, 60, 90, 120, and 180 cycles are easy to spot, but frequencies with more complicated ratios to 60 cycles (such as 50 and 200) are more difficult to identify.

A piano that is reasonably well in tune might be used as a standard, but the frequencies are all rather odd values. The lining-up of the oscillator frequency with the piano notes is best done by ear, even if a microphone and a scope are available, because the piano tones have very high harmonic content. Middle C is 261.6, A one octave above middle C is 440, and 2 octaves below it is 110 c.p.s.

Materials for generator:

Resistors: 2—10.7, 2—1.07, 2—0.107 megohms, 2—10,700 ohms, 1—10,000, 1—1,000, 1—1,000, 1—100, 1—10, 1—1.1 ohms, ½ watt, 2% accuracy; 1—300, 2—5,000, 1—10,000, 1—18,000 (see text), 1—39,000, 1—150,000, 1—500,000 ohms, 1—1, 1—2 megohm, ½ watt, 10% accuracy; 1—500, 1—30,000, 1—50,000, 1—100,000 ohms, 1 watt; 1—5,000, 1—22,000, 1—50,000 ohms, 2 watts; 1—25,000 ohms, 5 watts; 1—10,000 ohms, noninductive, 10 watts; Potentiometers; 1—3,000, 1—1,500, 1—25,000 ohms.

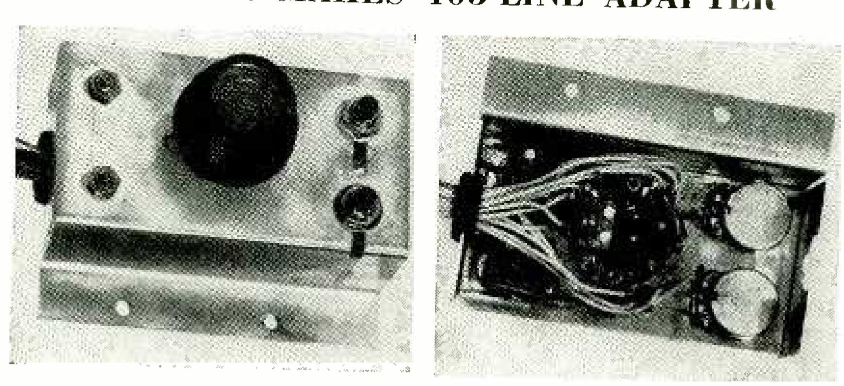
Capacitors (Electrolytic) 2—20 μf, 1—20 μf, 450 volts. (Mica) 1—150 μμf, 1—.002 μf. (Paper) 1—01, 1—.1, 1—.25 μf, 400 volts. 1—.5, 1—8 μf, 600 volts. (Variable) 1—4-gang, 365 μμf per section, 1—100 μμf.

Inductors: 1—15 h, 65 ma choke, (approx. 500 ohms d.c. resistance. 1—power transformer, 600 volts, c.t., 55 ma.

Miscellaneous: Tubes: 1—6J7, 1—6K6-GT, 1—6AC7, 1—6SL7—GT, 1—5Z4 or 5Y3-GT (see text). 1—S1, 2-circuit, 4-position rotary switch, shorting type, 1—S2, 1-circuit, 5-position rotary switch, shorting type, 1—s.p.s.t. toggle switch. 1—6-volt pilot lamp and socket, 1—3-watt, 117-volt lamp, 1—1 ampere fuse and fuse holder, 1—0-500 microampere d.c. meter, 2½-inch diameter, Tube sockets, Chassis. Hardware. Solder. Wire.

—end—

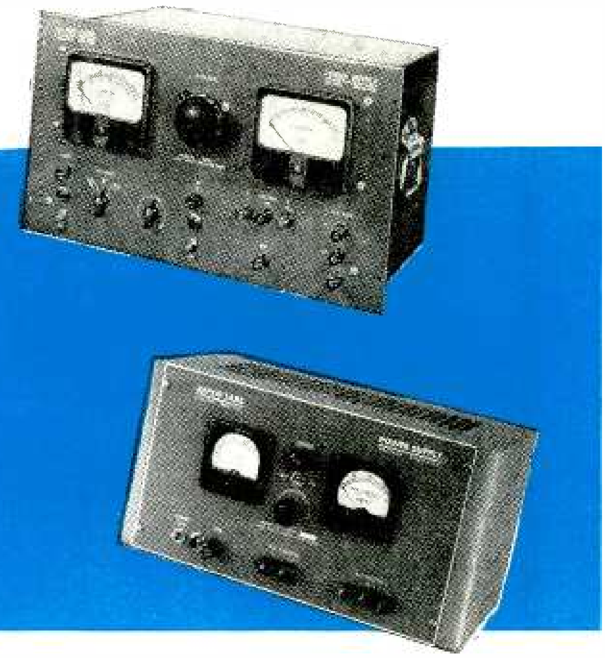
DU MONT MAKES 405-LINE ADAPTER



A number of "color adapters" which make possible black-and-white reception of CBS color broadcasts have been put on the market recently. Du Mont is possibly the first large television manufacturer to produce such an adapter. It is intended for use with standard Du Mont receivers to receive 405-line programs. The front and rear appearance of the unit is well shown by the two photographs. It is attached to a convenient place on the rear of the receiver, and is said to take only one hour for installation.

This adapter will make possible reception of CBS color programs in black-and-white. Adding a color wheel would permit reception in full color.

V-R systems are important in many new developments



FUNDAMENTALS OF VOLTAGE REGULATION

By ALLAN LYTEL

VOLTAGE-REGULATION systems are used to maintain a constant voltage output over a range of varying load requirements. There are two fundamental circuit types: one uses gas-filled tubes and is based upon the ionization of the gas particles; the second utilizes vacuum tubes and is based upon the changing plate resistance.

Gas regulator tubes can maintain a fixed voltage output over a range between 5 and 40 milliamperes. Fig. 1 illustrates the 0D3 (VR-150) gas-filled voltage-regulator tube. A d.c. potential of 180 volts is necessary to ionize the inert gas and start the tube in operation. The tube has a voltage of 150 between plate and cathode after ionization; operating current is 5–40 ma. Fig. 2 shows the operating characteristics of the 0D3. The table shows how this tube compares with two other gas tubes.

How gas tube regulates

A typical gas diode voltage regulator circuit may be seen in Fig. 3. Assume that the d.c. output voltage from the power supply filter tends to rise; this may be because the line voltage increases. As the line voltage increases, the d.c. output from the rectifier will increase and the output voltage across the load would also have a tendency to rise. But the voltage regulator tube will now draw more current which increases the voltage drop across the series resistor R1. This increased voltage drop *decreases* the voltage output to the load.

If the line voltage should drop and the d.c. output from the rectifier circuit tends to decrease, the voltage-regulator tube will draw less current. This decreases the current flow and the voltage drop across resistor R1. This action tends to keep the output voltage constant. The same regulatory action occurs as the current drawn by the load changes. If the output voltage from the regulator circuit tends to decrease

Fig. 1—Cold-cathode gas tube 0D3. The small tube beside it is an 0A2.

because of increased load, the regulator tube draws less current and keeps the output voltage constant.

V-R tubes must have an applied voltage greater than their operating voltage before they will ionize. This voltage occurs during the initial surge when the power supply is turned on. The series resistor R1 also prevents excessive current flow to the regulator tube which would shorten its life. Tubes must operate within their proper range to regulate properly. Less than 5 ma., their regulation action is poor. With more than 40 ma. their life span is shortened.

Several of these tubes may be operated in series to obtain a higher voltage output. Two 0C3's will give a d.c. operating voltage of 210 for instance. Parallel operation is impossible, since one tube will ionize first and reduce the voltage across the second below the ionization potential.

If the regulator tube is removed from its socket, the voltage output from the power supply rises to a higher value than normal, due to the current taken by the operating voltage-regulator tube. In some of these tubes, a jumper is used as an additional safety device, Fig. 4. This jumper is connected in series with the voltage output to the load. If the tube is removed no voltage output can be obtained.

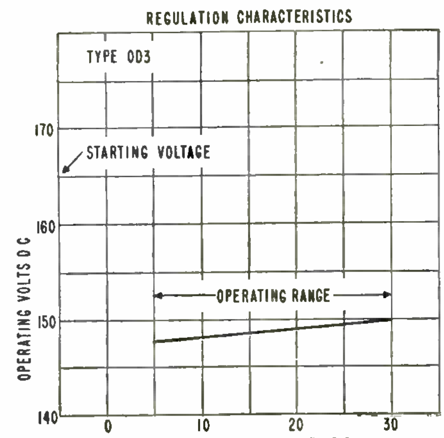


Fig. 2—0D3/VR-150 operating characterestics. Note the operating range.

	0A3/VR-75	0B3/VR-90	0C3/VR-105	0D3/VR-150
D.c. starting supply voltage (min.)	105v	125v	133v	180v
D.c. operating voltage (approx.)	75v	90v	105v	150v
D.c. operating current (min.)	5ma	5ma	5ma	5ma
D.c. operating current (max.)	40ma	40ma	40ma	40ma

Vacuum tube regulators

Where only small currents (up to 40 ma.) need to be regulated, it is possible to use a gas tube. For higher

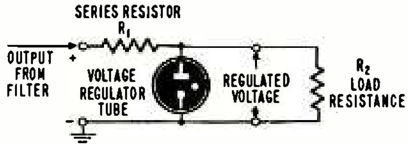


Fig. 3—Gas diode regulator circuit.

currents and better regulation, vacuum tubes are used. Fig. 5 is a simplified circuit demonstrating vacuum tube voltage regulator action.

R2 is the resistance which represents the load; the regulated output voltage appears across it. A voltmeter, V, is placed across the regulated voltage output. The regulation occurs in the element marked R1, a vacuum tube in practice, but here shown as a variable series resistor. A small series resistor

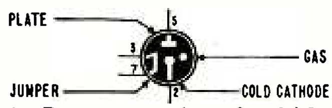


Fig. 4—Base connections for 0A3, 0B3, 0C3 and 0D3. See text for jumper use.

means a small voltage drop, a high series resistor a high voltage drop. An actual variable resistor is not used in the circuit; by means of vacuum tubes' plate resistance the same effect is obtained. The value of this variable resistance changes as the d.c. supply voltage

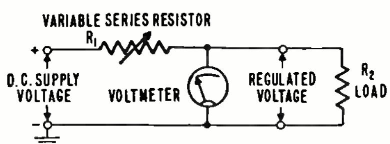


Fig. 5—Simplified vacuum tube regulator circuit where R1 is the tube resistance.

changes. This same variable resistor also changes value when the current drawn by the load changes. This circuit effectively keeps the output voltage constant in spite of changes in the line voltage and changes in the load current.

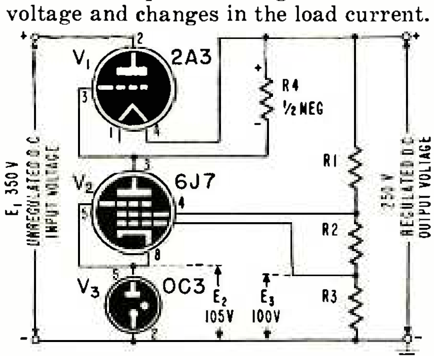


Fig. 6—A simple voltage regulator.

A vacuum tube voltage-regulator circuit shown in Fig. 6 uses two vacuum tubes and one gas tube. V1, a 2A3 power amplifier triode, acts as the series resistance R1 of Fig. 5. The plate resistance of a triode tube can be said to vary as the grid bias varies if other voltages are constant. If the grid voltage is positive, and approximately equal to the plate voltage, the tube conducts heavily and acts like a very low series resistance. A negative grid voltage (less current flow with the same applied voltage), will make the tube act as a higher resistance. If we apply a negative voltage great enough to prevent current flow entirely, the 2A3 acts as a very high resistance.

A 6J7 is used as the voltage amplifier tube V2; it supplies the control voltage for the grid of V1. V3 (0C3) supplies a fixed reference voltage. The output load resistors in series are R1, R2, and R3. R3 is variable.

Tube regulator action (6J7)

The cathode of V2 (6J7) is fixed at a definite value above ground by V3. V2 acts as an amplifier, feeding back the changes in output voltage to the variable resistor, V1. As this resistance changes, the output is held constant.

Assume that the circuit is turned on. The complete path for the current flow for V3 is through V2, R4, and V1 to the positive side of the input voltage. As the 0C3 ionizes, it will have 105 volts from cathode to plate. This is shown as E2 in Fig. 6. The plate voltage of the regulator tube is exactly the same as the cathode voltage of V2.

The grid of V2 is connected to the junction of R2 and R3. Its grid voltage is 100 volts d.c. Since grid bias is the voltage difference between grid and cathode, if the V2 cathode has 105 volts and its grid 100, the bias is –5 volts d.c. This is not enough to cut the tube off but acts as a control voltage.

The suppressor grid of V2 is tied to its cathode; the screen is attached to the bleeder network at the junction of R1 and R2, with between 100 and 250 volts d.c. on it.

The plate voltage of V2 is also the grid voltage of V1. Current for the 6J7 flows through R4 and the 2A3. The current flow through this resistor establishes a potential so that the grid of the 2A3 is more negative than the cathode.

Regulator action (2A3)

The circuit is placed in operation by connecting it to a power supply with an output of 350 volts. Conduction is established through the 3 tubes in the circuit, and current flows through the resistor string R1, R2, and R3. Since the 2A3 is conducting, it appears as a fixed resistance in the circuit and there is a voltage drop from cathode to plate of this tube. This is the reason the output voltage is 250 rather than 350 volts.

Assume now that the input voltage to this circuit increases, (this may be caused by an increase in the applied line voltage). As the output voltage tends to increase, the voltage on the control grid of the 6J7 will also increase. This will decrease the bias on this tube and decrease the voltage difference between E2 and E3. The 6J7 now conducts more heavily, and more current flows through R4. The larger voltage now developed across this resistor increases the bias on the 2A3 tube; this tube conducts less and becomes a higher resistance. More voltage is now dropped across this higher resistance and the output voltage tends to drop.

Assume the input voltage decreases. Less voltage appears across R1, R2, and R3. There will be a decrease in voltage on the grid of the 6J7 which will increase the negative grid bias on this tube (because its cathode is held at a constant potential by V3). Less current flows through R4. A smaller bias voltage is applied to the 2A3 which conducts more readily, becoming a lower resistance. A smaller voltage drop appears across this lower resistance and the output voltage rises. Thus constant voltage output is maintained.

A 6J7 is used for the control tube since it has high gain and small changes in output voltage give close regulation.

V1 must be a tube able to carry large currents since all of the current used in the load flows through this tube. A type 2A3 is used in regulators which supply up to approximately 50 milliamperes. Power amplifier triodes of this type are often used; by means of parallel connections, several tubes may be used and this multiplies the effective current by the number of tubes being used. One control tube of the 6J7 variety can be used with several 2A3 tubes in parallel. A 6Y6-G tube is used in parallel to obtain load currents of up to 250 milliamperes. Other types of control tubes are the 6SF5 triode or the 6AC7 pentode.

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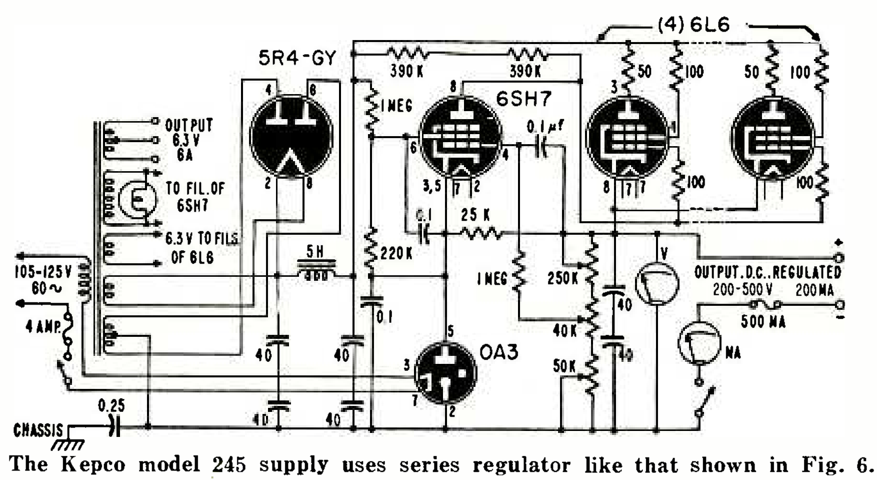
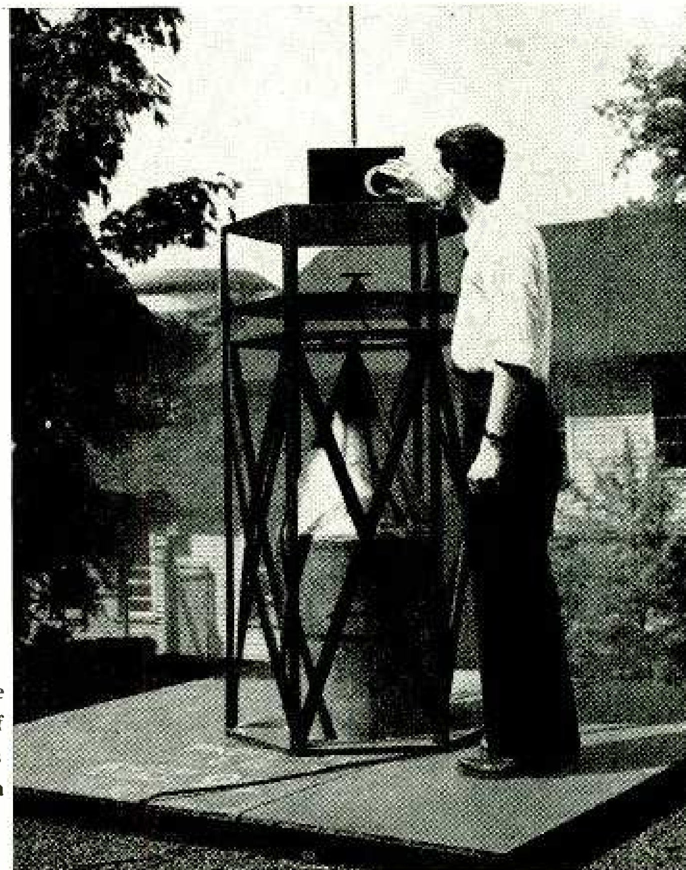


The Kepco model 245 supply uses series regulator like that shown in Fig. 6.

DISCONE—BROADBAND ANTENNA

This antenna, using discones in two of its three switching positions, goes from 100 kilocycles to 4,000 megacycles in only three tuning ranges

By FRED SHUNAMAN



Lester Saporta, one of the designers of the antenna, tunes up the whip section

Courtesy New York University

THE antenna on our cover is possibly unique among its kind both in the size of the job it is able to do and in the special design features that permit it to do that work. It resulted from the need of the Air Force's Air Development Center for an antenna that would cover the almost unbelievable bandwidth of 100 kc to 4000 mc. A research project with the objective of designing such an antenna was let to Camburn, Inc., who sublet it to the College of Engineering of New York University. The resulting antenna is largely the work of two students in that college, Lester Saporta and Paul Chirlian.

Even this antenna does not cover the band in one continuous sweep without switching. But only three switch positions are necessary to work across the whole spectrum. The lower band, from 100 kc to 12 mc, is handled prosaically with a 22-foot whip antenna and tunable loading coil. It is in the upper reaches of its spectrum that the antenna departs from tradition. To cover the extended frequency range, it was necessary to use the peculiar qualities of the *discone.*

The discone antenna is not new. Developed by Armig G. Kandoian of Federal Telephone and Radio Corporation, it was first described by him to the Institute of Radio Engineers in 1945. Its inventor says that it "may be visualized as a radiator intermediate between a conventional dipole and an electromagnetic horn.[1]" The radio technician studying it for the first time may also see it as a combination of transmission line, matching section, and radiator.

It may be difficult to conceive of how an antenna can combine all these features, but the actual operation of the discone is rather easy to understand. Starting with it as a piece of standard coaxial transmission line (for convenience placed at right angles to a vertical feeder, Fig. 1-a) we check the radiation. It is negligible. Now, if we flare the outer conductor out into a sort of horn (Fig. 1-b), it begins to radiate efficiently at frequencies above a certain cutoff point. Our flared coaxial line becomes a radiator with a wide frequency range, but good in one direction only.

Four such "coaxial horns" would make an omnidirectional antenna, though the field pattern would be irregular, because radiation naturally would be best directly ahead of each horn. But there is a simpler and better way to get a perfect omnidirectional pattern. Imagine rotating our "coaxial horn" around the end of its feeder through a complete circle (360 degrees). The inner conductor would, as they say in geometry, "generate" a disc, and the top and bottom of the horn would each "generate" a cone. This would be equivalent to an infinite number of these "horns" or at least such a large number that the central conductors would be close enough together to become a disc. See Fig. 2.

The top half of this antenna merely duplicates the lower half, and can be abandoned, and we have a discone—a horn that presents a mouth in all directions.

Frequency range

The frequency range of the discone is phenomenal. Antenna bandwidth is often rated in terms of the percentage of center frequency at which response is 3 decibels down. The bandwidth of the discone is so great that its useful frequency range is usually stated in terms of octaves rather than percentages. The smaller (upper) antenna in the photograph is used over the region between 600 and 4000 mc, while the big one works over the enormous frequency range of 12 to 600 mc.

A vertically polarized wave is transmitted (or received best) and the bulk of the signal is radiated almost parallel with the earth at the lower end of each antenna's spectrum, the angle tipping slightly upward as the frequency is raised. For greater flattening of the signal area, two or more discones may be stacked one above the other, compressing the radiation pattern into a thin disc which puts most of the power near the earth's surface where it is needed.

At frequencies near cutoff, the inventor states, we can think of the antenna as a dipole. Of course, since we are dealing with the space between two surfaces instead of a conductor, we will have to think in terms of electric fields instead of currents. As the waves move out from the center of the discone, the electrostatic lines of force extend between disc and cone as in Fig. 3. For any given frequency, there is a point where the wave finds it easy to "take off" into space. Our imaginary dipole, then, can be taken as a ring around the cone and one around the disc, on which the ends of the electrostatic lines of force rest at the point where they are being radiated out into space. Cutoff comes at the point where the lines extend from the disc to the extreme lower edge of the cone.

Automatic impedance match

Here is where the matching section feature of this antenna comes in. The discone acts not only as a radiator for a given frequency, but as a matching transformer between the transmission line and that point on the antenna at which that frequency finds conditions suitable for transfer between antenna and space.

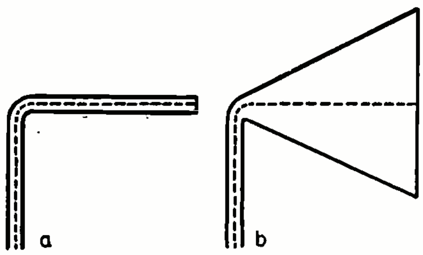


Fig. 1—Evolution of a coaxial horn.

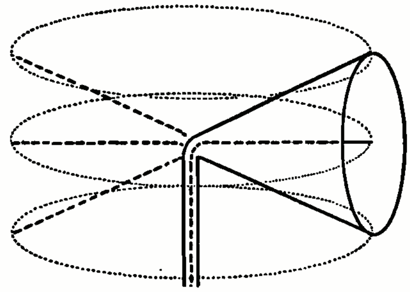


Fig. 2—Discone is derived from horn.

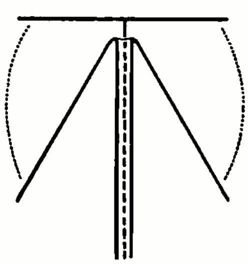


Fig. 3—Electrostatic field on discone.

As a matching transformer, it resembles closely the old delta- or V-match section of the lead-in of a doublet—that section which is fanned out to match line to flat-top. The V-section matches a lower to a higher impedance because of the gradualness with which its impedance increases as it opens. If a 52-ohm line were connected to the terminals of a 300-ohm antenna, waves would be reflected back along the line, and the match would be bad. But if the 52-ohm line opens into a very short section of 53-ohm line, and that into an equally short section of 54-ohm line, and so on out to the 300-ohm points on the antenna, the mismatch at any one point is slight, reflection is minimized, and the match is considered good.

The gradually increasing distance between upper and lower plate of the discone acts as just such a transmission line matching section, increasing gradually in impedance as the space between them increases, down to the point where the wave takes off into space. That again can be considered a matter of matching impedances. At the critical point, the impedance of the antenna for the given frequency is similar to that of space. The impedance just before that (toward the center of the antenna) is lower, and toward the edge is higher. Therefore the wave finds it easier just to depart into space than to stay on the cone.

The critical point moves outward as frequency is lowered, making it necessary to build a bigger antenna for lower frequencies. Kandoian gives the following dimensions for 90 mc (see Fig. 4): A, 9 inches; B, 24 inches; C, 10 inches. For 200 mc, the figures are: A, 4½ inches; B, 12½ inches; and C, 7 inches. Amateurs[2] have found it safe to consider the cutoff frequency that at which the slant height of the cone (D in Fig. 4) is a quarter wavelength.

The larger antenna in the photograph may not seem to be a true discone. The difference is one of detail. The designers found that by making a cylinder out of the lower part of the cone, they could retain most of the advantages of the conical shape while saving a great deal of the space that would otherwise be occupied by the flaring lower edge.

The discone has not come into as common use as its qualities would seem to justify. Possibly its peculiar and novel appearance has prevented is more general acceptance. Search through the standard antenna handbooks turns up very little about it, and that little usually buried in the section on ground-plane antennas. Its vertical polariza-

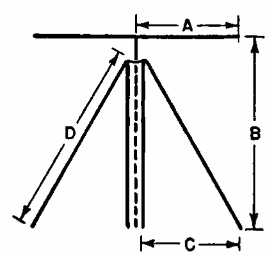


Fig. 4—Discone dimension references.

tion—in the position most convenient for mounting—may keep it out of the television field. Yet it might be the solution to the problem of perfect matching at both high and low frequencies, which might compensate for the difficulties of horizontal mounting. In size, such an antenna could be kept within about 4 feet in height and diameter and it could be built of copper screen on a metal (or insulating) framework, to keep down wind resistance.

The amateurs, as already noted, are beginning to use the discone for v.h.f. and u.h.f. work. As frequencies continue to rise, we may expect to see these antennas more and more often.

[1] Proceedings I.R.E., Waves and Electrons Section, Vol. 1, No. 2, February, 1946.
[2] Discone—40 to 500 Mc Skywire, Joseph M. Boyer, W6UYH, CQ, July, 1949.

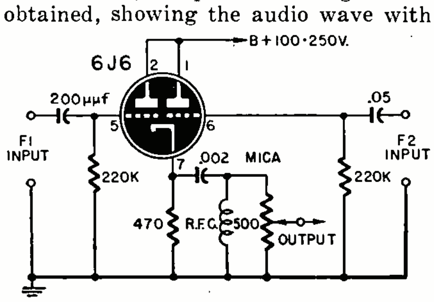
—end—

An Interesting Mixer Circuit

Needing a mixer having special characteristics, we thought of a combination of two cathode followers, tying the cathodes together to deliver the modulated output voltage. The circuit shown was tried and worked nicely at once. A 6J6 tube was used, but equally good results were obtained with 6SN7-GT and 6F8-G tubes. The scheme is extremely simple and involves no critical parts.

A scope was used to see how this works. The F1 input posts were tied to an oscillator working on 200 kc, and the F2 ones to an audio oscillator. Fig. 1 shows the output wave modulated at 60%; the modulation is rather good.

A radio-frequency choke RFC is required to provide a low impedance path for the audio component. When RFC was omitted, the pattern of Fig. 2 was obtained, showing the audio wave with



superposed r.f. This is no modulated wave. The choke must be chosen in accordance with the r.f. range of the mixer.

Fig. 1

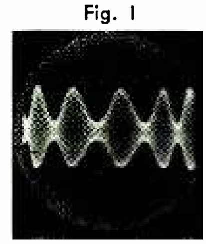
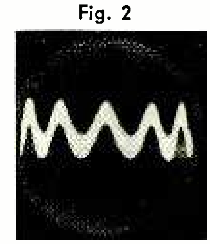


Fig. 2



This circuit features several outstanding advantages:

1—Very low input capacity. As a cathode follower, the amplification of the tube is less than unity, and there is no Miller effect.

2—High input impedance. The grid resistors are of 0.2 to 2 megohms.

3—Low output impedance. A good characteristic for signal generators.

4—High stability. The B-voltage can vary widely without any change in modulation quality. Resistors and capacitors are in no way critical.

5—Economy. Minimum of components.

Alfred Haas

—end—

Magnetic PHENOMENON

Strange action of bismuth in a magnetic field opens up new range of possibilities in future electronic discoveries and applications

By ALVIN B. KAUFMAN

ONE of the most unusual of all magnetic phenomena now open to experimentation is the change of resistance of bismuth wire when placed in magnetic fields of different intensities. This change of resistance is *as high as 100 to 1.*

Bismuth is well known in the laboratory, but because of its limited availability up to now it is not familiar to the average person. The advent of commercially available *ductile* bismuth wire opens up new fields to the experimenter. Last January the Fitzpatrick Electric Supply Company, 444 Irwin St., Muskegon, Mich., offered the market the first ductile bismuth wire and alloys.

Bismuth is a white metal. It is a poor conductor of heat and electricity, approximately 1/80 of copper, and is very diamagnetic in comparison with other metals (*Diamagnetic* means that metal, instead of being attracted to the poles of a magnet, rather is repelled by the magnet. This is opposite in effect to *paramagnetic* material which is attracted to the magnet.—*Editor*). Bismuth is the most diamagnetic metal known, a sphere or bar of it being forcefully repelled by a magnet.

Electrically, bismuth has some fascinating qualities, some highly desirable, some very unsatisfactory. When present in other metals, even in minute quantities, bismuth renders them brittle and decreases their electrical conductivity. Further notable effects are:

a. Resistance change with magnetic field (Gauss effect).

b. Voltage change due to Hall effect.

c. Resistive change with temperature.

d. Highest known thermoelectric potentials.

Possibly the effect most interesting to those concerned with electronics is the change of resistance with a magnetic field, see Table I. Bismuth has a change of resistance of approximately 300% at 18° C when subject to a zero to 35,000-gauss field. At −192° C when subject to the same field, the change is close to 9,000%, or about a 100 to 1 change! Table I shows the proportional values of bismuth resistance for magnetic field values of 0 to 35,000 gauss, and for different temperatures; assuming 100% (or 1 ohm) resistance at 0° C with no field.

The Hall effect, Fig. 1, is the generation of minute output potentials when a flat strip of metal is placed within a magnetic field with its planar surfaces at right angles to the direction of the

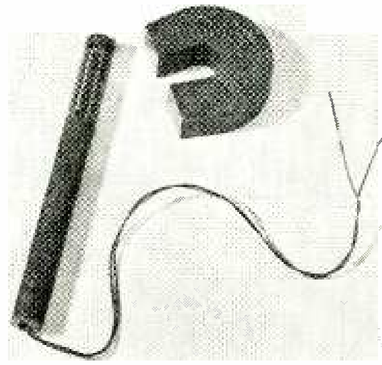


Photo A—The simplest equipment used.

Photo B—Construction of pickup coil.

Table I

H Gauss	−192° C	−135° C	−37° C	0° C	18° C	60° C	100° C
0	0.40	0.60	0.88	1.00	1.08	1.25	1.42
2,000	1.16	0.87	0.96	1.08	1.11	1.26	1.43
4,000	2.32	1.35	1.10	1.18	1.21	1.31	1.46
6,000	4.00	2.06	1.29	1.30	1.32	1.39	1.51
8,000	5.90	2.88	1.50	1.43	1.42	1.46	1.57
10,000	8.60	3.80	1.72	1.57	1.54	1.54	1.62
12,000	10.8	4.76	1.94	1.71	1.67	1.62	1.67
14,000	12.9	5.82	2.16	1.87	1.80	1.70	1.73
16,000	15.2	6.95	2.38	2.02	1.93	1.79	1.80
18,000	17.5	8.15	2.60	2.18	2.06	1.88	1.87
20,000	19.8	9.50	2.81	2.38	2.20	1.97	1.95
25,000	25.5	13.3	3.50	2.73	2.52	2.22	2.10
30,000	30.7	18.2	4.20	3.17	2.86	2.46	2.28
35,000	35.5	20.35	4.95	3.62	3.25	2.69	2.45

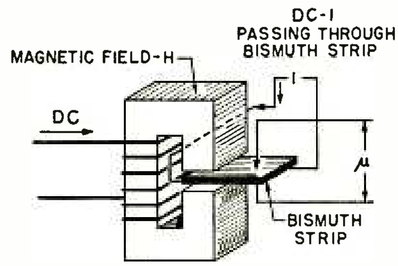


Fig. 1—How Hall effect (generation of voltage at right angles to magnetic field and current) is studied. The Hall effect is extraordinarily strong in this metal.

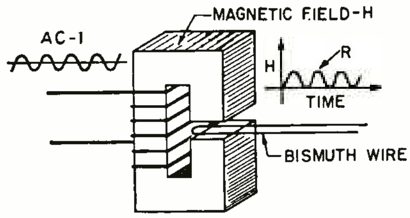


Fig. 2—Idealized illustration, setup to study change in bismuth's resistance as surrounding magnetic field is varied.

field and with a current passed through the length of the strip. The difference of potential μ occurs between the top and bottom surfaces of the strip. Bismuth exhibits this property to an unusual degree, and many physicists have explored the phenomenon. Output microvolts may vary from several microvolts to over 15,000 for a field strength of 4,200 gauss (See Table II). The residual e.m.f is the potential difference caused by the fact that the pickup fingers which pick up the transverse Hall potential cannot possibly be placed at exactly equipotential spots with regard to the longitudinal current (with present techniques). The net Hall e.m.f. was obtained by subtracting column 2 from column 3. A longitudinal current of 1.5 amperes was used with a sprayed .012-cm-thick bismuth film for obtaining the above data.

As a resistance material with a high coefficient of thermal electric resistance change Fitzpatrick bismuth wire is excellent, running 720 ohms/mil foot. In this respect, bismuth is the most negative material known for thermocouples, exceeding all others by over 100%, giving 69 microvolts per degree Centigrade change from 0 to 100° C compared with platinum.

TABLE II

HALL EFFECT IN BISMUTH FOR A SINGLE PICKUP

Field Strength Gauss	Residual e.m.f. (μ Volts)	Residual Hall e.m.f. (μ Volts)	Net Hall e.m.f. (μ Volts)
.08	14.0	15.5	1.5
.10	14.2	15.8	1.6
.25	14.0	16.4	2.4
.30	14.5	19.8	5.3
.50	14.6	22.7	8.1
1.00	14.6	20.6	15.0
1,000.	14.0	1,889.0	1,875.0
2,500.	14.0	7,514.0	7,500.0
4,220.	14.0	15,320.0	15,300.0

The Gauss effect

The Gauss effect is very interesting. Probably the most important characteristic of bismuth wire is its large *increase in resistance* when placed in a magnetic field (Fig. 2). Between the values of 2,000 and 35,000 gauss, its proportionate response is approximately 214% at 18° C. From 300 to 2,000 gauss, the proportionate response is less though sensitive enough for electrical instrumentation.

The gauss fields indicated in tables, Fig. 3, and in the article to this point, are much higher than normally available in amateur laboratories. High field strengths are normally found only in close-gap apparatus. A conventional d.c. motor, for example, generally has a 6,000-gauss field, or about 40,000 lines per square inch. Low- to medium-strength fields are not high enough to give more than a fraction of 1% to several percent change in resistance of the bismuth at normal ambient temperatures.

Simple tests

The author, using the equipment shown in Photo A, about three feet of .011 Fitzpatrick bismuth wire wound on a 24-turn pregrooved ⅜-inch form and an Alnico horseshoe magnet, could deflect the galvanometer on an impedance bridge. The deflection *was not* momentary, as will occur due to generator effect with a coil of copper wire, but permanent until the magnet was removed. The galvanometer deflection was slight, but easily visible. With a stronger field (800-2,800 gauss such as produced by a surplus magnetron magnet), the effect is much greater and more readable in terms of resistance change. The change in resistance is easily visible and possible to read when a more sensitive Wheatstone bridge is used.

In all tests employing a galvanometer for indication, the coil was first disconnected and the magnet brought close to it while the galvanometer was observed to be sure that the magnetic field of the magnet was not directly affecting the galvanometer. It was also noted that the *thermal* effect was much greater than the *magnetic* effect for a ow gauss field. In measuring the change of resistance on a bridge, a change of 0.2% (about .04 ohms, 16-ohm coil) was visibly induced by the horseshoe alnico magnet. This small magnet had about a 200-gauss field. Later a magnetron magnet of 2,800 gauss was used. The same pickup coil with 16.37 ohms ambient resistance increased to 17.20 ohms when placed in this field. This was an increase of 5½%. Putting the fingers on the coil resulted in a thermal resistive change of possibly several times this magnitude.

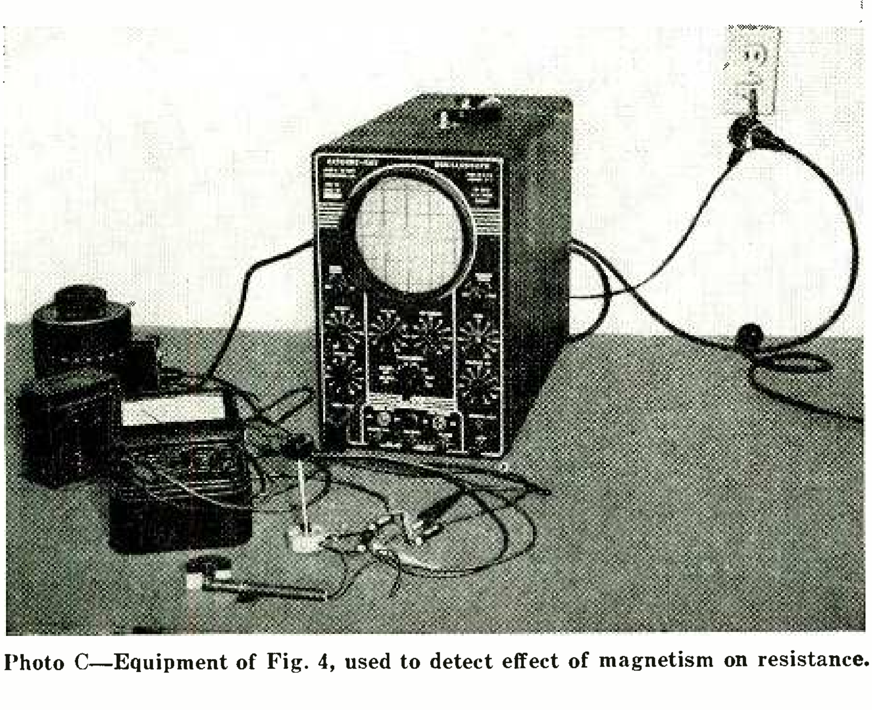


Photo C—Equipment of Fig. 4, used to detect effect of magnetism on resistance.

Measuring errors

It is preferable then, in design, to obtain a strong enough field to reduce any thermal change to a small percentage of the gauss resistive change. Otherwise it is necessary to introduce a thermal compensating coil in series or parallel with the bismuth coil to prevent thermal effects from introducing errors.

It must also be noted that the wire changes electrical resistance with the passage of current due to the resultant thermal I^2R heating. If the current is held to a low value, this effect may be negligible. For higher currents, but below the fusing value, the wire may change its resistance by approximately 50% as indicated in Table III. The .011 wire used for these preliminary experiments ran warm at ½ ampere, and fused at 1½ amperes.

TABLE III

Current (Amperes)	Resistance (Ohms)
0	24.0
.4	25.5
.45	25.75
.5	26
.6	30
.7	32
.8	35

Consideration must be taken when making bridge measurements not to exceed these currents and to allow the bridge to stabilize until the thermal conditions in the coil are completely equalized before making any gauss measurements.

Care in handling

In handling the wire, do not make sharp bends or flex the wire. The wire is not as ductile as copper; it will break after a few bends. After the pickup coil is made, cement the wires in place and connect the bismuth wires to light-gauge, flexible, extension leads (see Photo B). The melting point of bismuth is 520° F, so conventional solder cannot be used. Instead, a low-temperature-melting alloy must be used. The author used Cero-bend, but Woods metal or others of the same class are applicable.

The joint between the bismuth wire and the tinned-copper wire strictly speaking is not a soldered joint, as the Cero-bend does not bond to the copper wire. These low-temperature joints are mechanical. If a soldering iron is used to melt the low-temperature alloy, allow the melted metal to cool before use or its higher-than-500° temperature will cause the bismuth wire to melt. The joint in any case will look dirty and like a very poor cold solder connection.

Noting field intensities

With the fine bare bismuth wire wound into a flat coil or on a rod to form a prod, it may be used directly with a high-sensitivity Wheatstone bridge for exploring the intensity of magnetic fields in many types of magnetically operated apparatus. Coated bismuth wire also may be obtained, and with

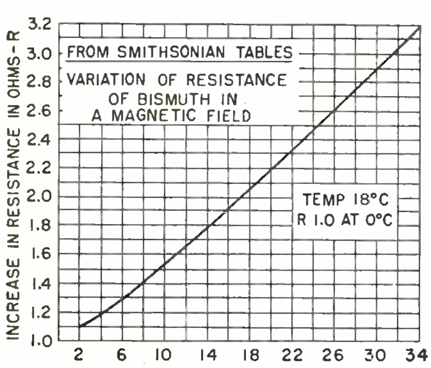


Fig. 3—Gauss effect in strong fields.

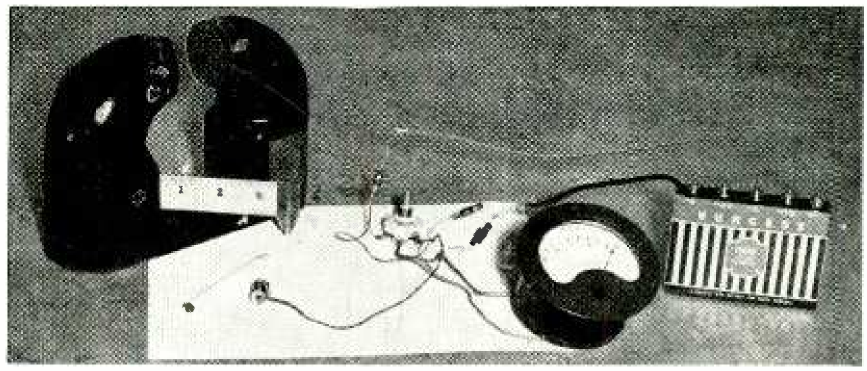


Photo D—This simplified setup follows Fig. 5, with a meter instead of 'scope.

this it is comparatively easy to wind any type of coil. A typical coil wound by the author had an ambient resistance of 60 ohms which increased to 63 ohms when subjected to a 2,800-gauss field from a surplus magnet.

Since the coil resistance will increase directly in proportion to the intensity of the field beginning with about 2,000 gauss (under that the resistance changes are low and not linear), the use of this measurement method apparently is limited to high-intensity fields. Where high-intensity fields are available, the measurement need not be limited to a Wheatstone bridge. The change of resistance may be used to operate electronic control equipment. Slight changes of this high-intensity field by ferrous materials on a person or in material might well be detectable by this means.

Sample experiments

For low-intensity fields where the maximum resistance change might be 0.2%, (in strain gauges, typical carrier or phase sensitive amplifiers) designers might make use of bismuth's peculiar properties. A scope indication of the unbalanced bridge carrier output is shown in Photo C. Here (see Fig. 4 for the schematic) 60-cycle a.c. is fed into a Wheatstone bridge, and the unbalanced output is connected to a 5-inch oscilloscope. After potential is applied to the bridge for several minutes and the four legs resistively thermal-stabilized, the bridge is balanced. The oscilloscope amplifier used supplied enough gain to secure a change in the sine wave amplitude when the bridge balance was upset by placing a 200-gauss magnet next to the bismuth pickup coil. For a.c., the coil must be noninductively wound. A bifilar winding with opposing bucking fields is constructed.

The experimental setup shown in Fig. 5 and Photo D is the simplest circuit for the experimenter to construct. A 50-ohm coil is wound, using coated bismuth wire, and hooked into a bridge circuit as shown. It has extremely high sensitivity, giving as much as half-scale deflection using a surplus magnetron magnet. This circuit is adaptable to measuring and comparing the field strengths of PM or dynamic speakers, TV focus coils or ion traps and probably to many other similar uses.

The bismuth probe is small, about ¼ inch by ½ inch. The coated wire must be handled carefully the same as the bare wire. The insulating coating is easily removable with the use of acetone.

It must be noted that although an analyzer, as the Simpson 260, may be used for the bridge meter, its much higher internal resistance, even if it is used on the 100-microampere scale, will cause the bridge to be comparatively insensitive.

A bridge supply voltage of 7½ volts is optimum when measuring high-intensity fields. For low-intensity PM speaker field measurements, etc., the bridge sensitivity may be increased threefold by raising the bridge voltage to 22½ volts. The bridge supply voltage directly regulates its sensitivity—the higher the supply the greater the sensitivity. The maximum supply is limited by the heating in the bridge arms. With the bismuth wire used, 45 volts input should not be exceeded; higher level causes high thermal temperatures to develop in the coil.

—end—

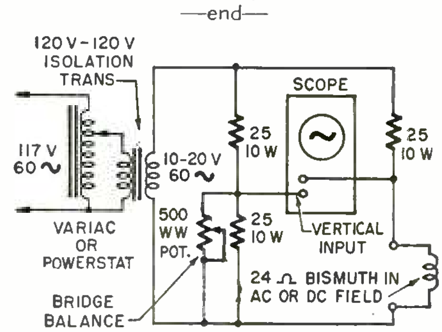
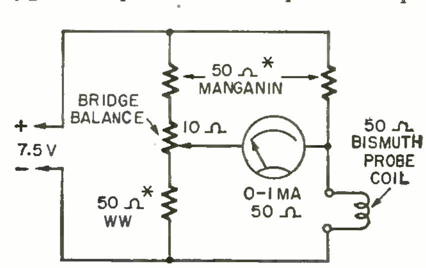


Fig. 4—Experimental setup with 'scope.



* MAY BE 0.5 WATT IRC FOR TEST PURPOSES

Fig. 5—Simplest experimental hookup.

IONOPHONE

The inventor, S. Klein, demonstrates his new and revolutionary loudspeaker.

By E. AISBERG* and M. BONHOMME**

Long the dream of engineers, the inertialess loudspeaker is now reality. It produces sound from electric current with ionized air molecules

JULY 27, 1951 will remain a red-letter day in the memory of two authors of this article. On that day they heard for the first time sounds from a loudspeaker that did *not have a single mechanical part in movement* and was designed on an absolutely new principle.

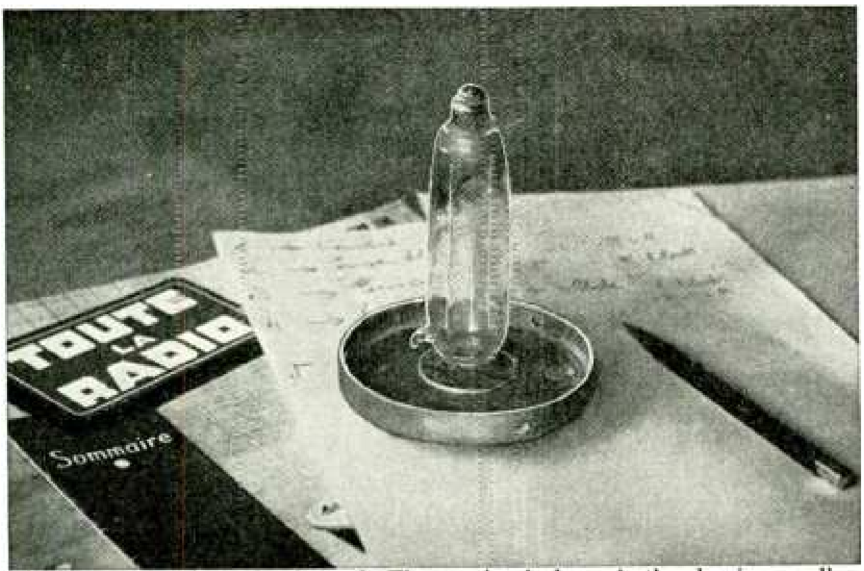
The device is the fruit of years of patient research by S. Klein, a young French physicist, who for years struggled over the problem of producing sounds loud enough to raise his invention above the category of a mere scientific toy. He has succeeded, and at present the biggest French manufacturer of loudspeakers is tooling up for mass production of Ionophones, as the new speakers are called.

Yesterday's dreams make tomorrow's inventions. Electronicians always dislike to use moving parts, and nowhere more than in loudspeakers, where they result in an efficiency of less than 5 per cent and in imperfect fidelity. Why should radio receivers be required to pass the audio frequency currents which have been carefully protected against distortion through a part which—by its very nature—cannot but distort the sounds it engenders?

The best diaphragm has its natural vibration period and enough weight to be a factor, without possessing that ideal rigidity which forms the piston described in manuals on acoustics. In spite of setting the resonant points beyond the limits of the frequencies being reproduced, all diaphragms cause linear and nonlinear distortion, not to mention bad reproduction of transient phenomena.

Inventors have long tried to get rid of the unfortunate diaphragm. One of the earliest attempts was probably Edison's Thermophone. Duddell's singing arc and the talking flame also might be mentioned. Hugo Gernsback, whose ideas seem so fanciful but whose predictions usually come true, called for a speaker without moving parts[1] ten years ago.

*Publisher of *Toute La Radio*
**Chief Editor of *Toute La Radio*



Closeup view of the ionization unit. The opening is down, in the aluminum collar.

[1] *Molecular music* is another subject which as yet has not been exploited at all. Years ago, it was discovered that it is possible to make dynamos sing or talk by merely vibrating the dynamo's molecules. In this case, nothing moves. There are no diaphragms, no loudspeakers, but the entire iron frame of the machine gives forth sounds, speech, or music.

I can visualize, therefore, a future all-steel auditorium giving forth super-music *by energizing the entire auditorium in such a manner that the walls, ceiling, and floor will have their molecules vibrated. Entirely new effects undreamed of today will thus be obtained.*

(From an editorial in *Radio-Craft*, April, 1941.)

This new loudspeaker comes very close to being the fulfilment of that prediction. It is based on the phenomenon of *ionization*. By raising the temperature of certain bodies they can be made to emit ions. Under the influence of intense thermal agitation, not only are electrons torn off but also some molecules, which because of the fact that they have lost electrons, become ionized *positively*. The action becomes complicated because the electrons meet air molecules and tear off further electrons. We therefore have a complex mixture of ions from the emitting substance and ionized molecules from the gases of which the air is composed.

Creation of the Ionophone

The first model was made several years ago. It can be compared to a diode operating in free air. An indirectly heated "cathode" emitted positive ions toward a "plate" which was maintained at a high negative potential. When an alternating audio-frequency voltage was impressed on the direct voltage between the two electrodes, the number of ions in circulation would vary according to the rhythm of the alternating voltage and determine the corresponding movement of the air molecules, which were propagated in the form of sound waves at the audio frequency.

A better model was designed in the form of a triode where the alternating voltage was applied to a sort of cylindrical grid between the emitter and the outer cylindrical shield (Fig. 1).

The sound generated by both these was very weak and the high-voltage d.c. heating required a power in the order of 500 watts. A decisive step forward was made when Klein gave up the indirectly heated cathode and conceived the idea of a self-heating one. That idea was developed in the form of a cylinder of quartz into which a platinum wire was sealed along its axis. The cylinder was then coated with an ion-emitting substance, composed as follows:

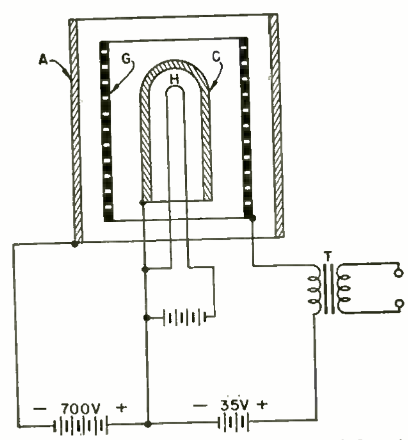


Fig. 1—The developmental model, with heater H, "cathode" C, grid G, and outer shield A at a high negative voltage.

Precipitated platinum	50%
Aluminum phosphate	40%
Graphite	5%
Precipitated iridium	5%

In this formula, the platinum (which is the principal source of ions) reaches a state of extremely fine division, which favors both the emission of ions and the renewal of the emitting surface.

This tube is sealed to the lower end of a short exponential horn (likewise of quartz) which has a double wall inside of which a high vacuum is maintained. The assembly is then placed inside a cylindrical shield, the bottom of which is steatite, so that the emitter is held in place. The mouth of the small quartz horn connects with a large exponential horn of the type ordinarily used for compressed-air public address loudspeakers.

How it operates

A high-frequency (about 400 kc) and high-voltage (10,000 to 12,000) field is set up between the outside cylindrical shielding and the platinum wire which is the axis of the emitter. Through the action of dielectric losses, the quartz surrounding the platinum wire reaches a temperature of 1,000 degrees within one or two minutes.

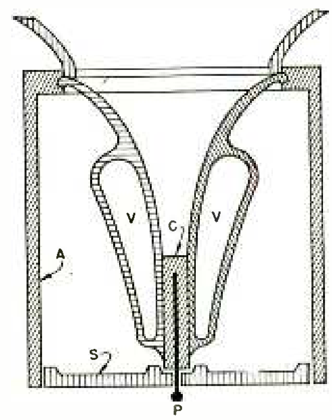
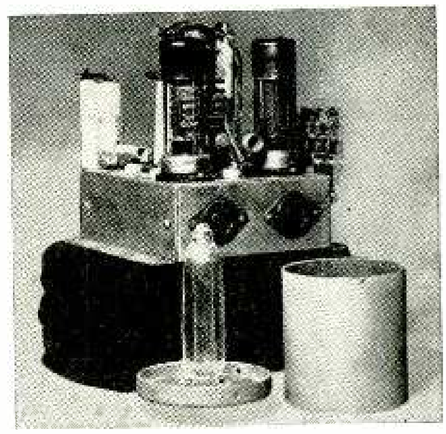


Fig. 2—Idealized cross-section of the speaker. P is the platinum wire, C the quartz cylinder, V the vacuum space in the horn walls and A the outer shield.

The strong field which is established between the platinum wire and the cylindrical shielding produces emissions which also produce heat in leaving the emitter, thereby assisting to maintain a high temperature. The heat is concentrated because the vacuum chamber of the evacuated quartz horn prevents its spread by conduction. Secondarily, the vacuum of this enclosure prevents the passage of electrical charges through the material.

Because of the concentrated effect of heat and the electrical discharge rich in ultraviolet radiation, the emitter releases a flow of ions. The high temperature in the neighborhood rarefies the air; consequently, the molecules are far enough apart to enable the ions leaving the cathode to follow a free course longer than they could in dense, cold air. It is nonetheless true that some air molecules are ionized by collision with ions and electrons coming from the emitter.

In short, we have before us a kind of capacitor whose plates are the coated emitter with its central platinum wire and the exterior shield. Between these plates there is a cloud of ionized particles, which are in a state of agitation because they are in an alternating field which acts on all bodies, whether positively or negatively charged.



The speaker unit with its r.f. exciter.

If we change the strength of the alternating electric field, we also alter the amplitude of the individual oscillations of each of these bodies. Now, *molecular movement* and *heat* are two words to describe the same phenomenon. Therefore, by varying the strength of the electric field, we can obtain corresponding instantaneous variations of temperature.

Nothing is easier to the radioman than to vary the strength of a high-frequency field at a low-frequency rate. The inventor of the Ionophone simply modulated his high-frequency field at audio frequencies. The temperature in the vicinity of the emitter was varied in proportion to the low frequency. This takes us back to Edison's original Thermophone, with the exception that where Edison's heated wire was limited to the lower audio frequencies, the Ionophone reproduces with equal exactitude all frequencies within the audio range. (The old Thermophone produced sound by expansion and contraction of the air surrounding a heated wire, which of course had considerable thermal lag.)

Each variation in temperature produces an expansion of air, followed by a contraction, thereby producing a sound wave. These sound waves spread along the length of the exponential horn without friction and manifest their presence by sounds of the strength, form, and frequency desired.

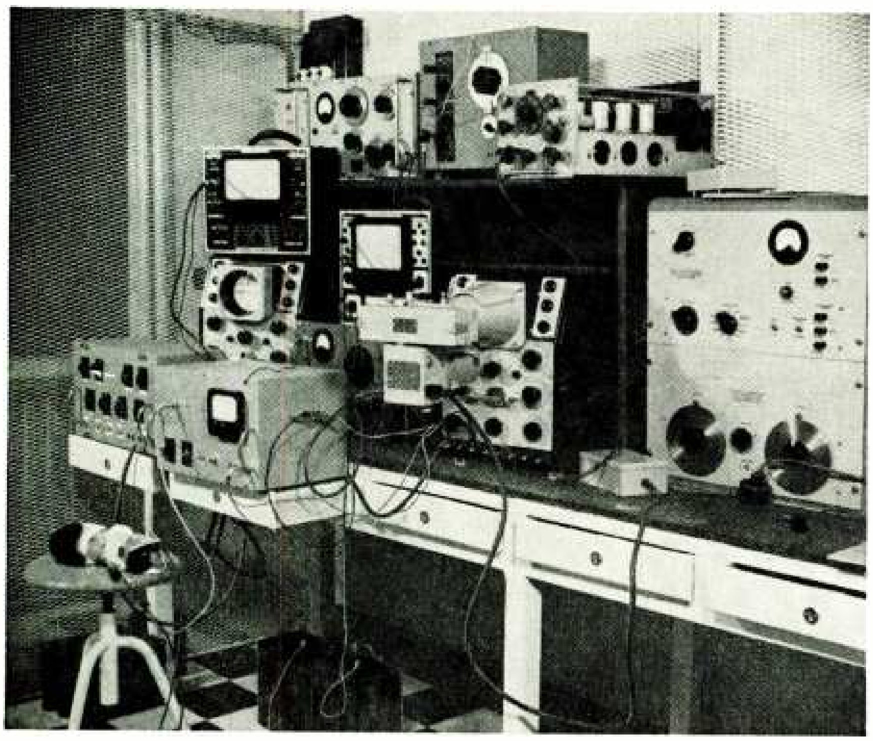
Space does not permit details of the rather special circuits used for the operation of this unconventional loudspeaker, except to point out that while it can be used with present types of radios, it also opens up the possibility of having radio receivers without either audio amplification or detection—the intermediate frequency of the receiver being sufficient to operate the loud speaker.

All these points will be covered in a succeeding article.

—end—

ULTRASONICS AND THERAPY

Medical application of ultrasonics—both in diagnosis and for treatment—has made great strides, especially in Europe, as this article testifies.



Part of the laboratories at the Institut Medical Bunge. Guinea pig, left, is wired up for simultaneous notation of myograms, electro-encephalograms, and cardiograms.

By DR. F. VAN DEN BOSCH*

ULTRASONIC waves are sound waves generated beyond the upper limit of human hearing. They are not electromagnetic waves like radio waves. Generation of heat in tissues by using them is fundamentally different from dielectric heating, for instance. Sound waves are a special kind of elastic wave. They travel in media which have two properties: inertia and elasticity. Sound waves in air are longitudinal waves; they consist of condensations and rarefactions of the air.

The characteristic field terms are pressure, P, and particle velocity V. This gives rise to a kind of Ohms law of acoustics: $\frac{P}{V} = Z$.

Z is (in the case of plane waves) the characteristic impedance of the material and is equal to DV° where D is the density and V° the propagation velocity. Z is a constant of the medium. By measuring the pressure in dynes per square centimeter and the velocity in centimeters per second, Z would have one value for air and another for liquids. The units used are sometimes referred to as "acoustical ohms."

In the study of transmission of acoustic and ultrasonic energy, the characteristic impedances of the material or medium used is important. Reflection of sound waves is a function of reflecting surface and wavelength. When ultrasonic energy is transmitted through two materials the influx of energy into the second medium will be smaller by the amount that reflection is greater in the first medium.

Comparing mechanical energy to analogous electrical circuitry, mass resistance in the mechanical system is analogous to an inductance. Ultrasonic sound energy can be measured by the sound radiation pressure, for which Lord Rayleigh calculated the formula $P = 1/2RD$; D represents energy density, P the measured radiation pressure, and R the ratio of the specific heat constants (the effective value of specific heat depends on frequency).

Ultrasonic waves are sound waves. They are thus absorbed as well as reflected. Absorption depends upon the medium the wave travels in, and attenuation can run in the order of several decibels per meter wavelength. In CO_2 for instance, this value sometimes reaches 300 db per meter, which is extremely large.

Transducer types

Electrical energy is changed into ultrasonic energy by means of transducers. These act as matching devices and permit maximum transfer of energy to the medium, in addition to acting as a converter of one type of energy into another. There are two types of transducers, *magnetostriction* and *piezo-electric.*

Magnetostriction transducers utilize the principle that a rod of iron or other magnetic material undergoes a change of length when magnetized.

Piezo-electricity is based on the fact that if a slice is cut from a quartz crystal and pressures applied on the opposite faces of the slice, then these faces will develop equal and opposite electrical charges. This effect is also reversible: by placing the quartz in an electric field elastic deformations are developed in it. If the field is an alternating one of frequency f, the quartz will be subject to f oscillations along its electric axis.

This principle is used in generating ultrasonic waves. A crystal which will resonate at a desired frequency is chosen. One face of the crystal is fixed, and the other side, S, left free to vibrate when acted on by the electric field. If this face S is in contact with air, water, oil, or any other fluid, waves will be generated in the fluid.

The natural frequency of vibration of the crystal is determined by its dimension parallel to the direction of vibration. Using quartz, frequencies of 5×10^7 c.p.s. may be attained, but if this is the fundamental frequency the plate is only .055 millimeters thick and very fragile. Higher frequencies are attainable by using partial tones or harmonics, and this has the further advantage that a number of different frequencies may be obtained from the same plate although the intensity is less. If the surface of the crystal plate is large compared with the thickness, the partial tones are very nearly harmonic.

The photos on page 48 show different practical forms of quartz transducers. The quartz transducer is in every case the same, the only difference being the special mounting on top of the quartz for specialized applications. Generally speaking, quartz transducers are water-cooled when they have to dissipate a

*Chief of Physical and Electronic Laboratories, Institut Medical Bunge, Berchem-Antwerp, Belgium.

certain amount of power and are hermetically sealed so that they may be used to treat cases under water or in immersion baths. If they use transducers in liquids, operators must take precautions to protect their hands from the ultrasonic vibrations of the liquid. Specially adapted thick rubber gloves are often used.

Ultrasonic generator

The oscillators which drive the transducers are generally of relatively low power compared to other industrial high-frequency generators. They range from the 50-watt type to about 1 kw (output power). The circuit shown is simple to build, efficient in operation, and has the advantage of being self rectifying, thus giving a pulse type of power which presents an advantage in ultrasonic therapy.

The frequency is determined by the tank circuit: the transducer parallels C1, the main tank capacitor. It may be difficult to get stability of the oscillator as such. In this event, adjust the decoupling capacitor C2 between grids and cathodes. Coil RFC 1 is made by winding 16 turns of No. 22 gauge wire on a coil form 1½ inches in diameter and 2 inches long. RFC 2 is 14 turns of No. 12 wire on same size coil form. The rest of the circuit is self-explanatory.

Ultrasonic uses

Among the reported chemical effects of ultrasonic vibration are: The transformation of immiscible liquids such as water and oil into homogeneous, stable emulsions; the dispersion of metals during the process of electrolysis by bombarding the anode with ultrasonic waves; the disintegration of polymerized molecules and acceleration of peptization (convert into colloidal solutions and sols). In contrast to the *dispersive* effect which the waves produce in the case of liquids or hydrosols is the *coagulative* effect which they produce in the case of aerosols (suspensions in gases). Smoke is quickly coagulated into larger particles. These cannot remain in suspension and drop out of the air.

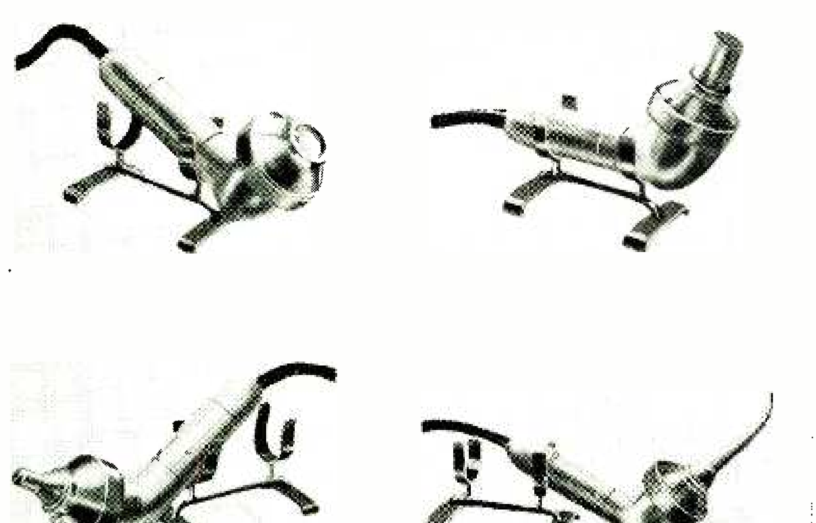
Biological effects

The biological actions of ultrasonic radiation are sometimes astonishing, witness the rupture of small organisms such as protozoa, the tearing-off of the gills of Triturus larvae, the complete disintegration of Arbaciae eggs, and the killing of fish and frogs. Tobacco-mosaic virus can be inactivated and the virulence of certain bacteria diminished. These effects seem to be due to the immense pressure changes which accompany the radiations.

In medical diagnostics ultrasonics undoubtedly will present certain undeniable advantages. For example where ordinary means fail, using ultrasonics it is easy to detect an empty or full organ, such as the projection of the heart, spleen, liver, bladder, kidneys, and the stomach.

By its nature ultrasonics allows the differentiation between a normal and abnormal organ. An enlarged liver can be diagnosed as being an ordinary enlargement—or a tumor, for the tumor will present a different coefficient of absorption than the liver itself. Ultrasonics is probably most useful in this type of field since the basis of medical therapy is correct diagnosis.

Solid objects such as gallstones can be detected by ultrasonics based upon pure reflection phenomena. Kidney and bladder stones are easily detectable, for their size is usually greater than gallstones. Abnormal bone structures can also thus be mapped where the patient's sensitivity to X-ray radiation makes radiography impossible or inadvisable.



Four quartz transducer ultrasonic applicators. The vibrating quartz units in these are identical; their difference is due to the specialized mounts, which make them convenient to apply to different parts of the human body.

Medical therapy

Medical ultrasonic therapy has been extensively used in recent years. Ultrasonic therapy is as yet in its infancy, as the application is varied and results are sometimes contested. Medical practitioners should start ultrasonic therapy with small power so as to avoid injury. To avoid injury to the patient, it is generally accepted that the threshold of pain indicates a maximum limit of power dosage. This should never be exceeded. For deep therapy it is advisable to use the fundamental wavelength, while harmonics are more useful for surface treatment. Since attenuation in tissues is rather large, intensity should be proportional to the depth which it is desired to attain, while the time will be a function of the area to be treated.

Here are some successful cases using ultrasonic therapy which have been reported, mainly in Germany and France. G. Barth and F. Wachsmann (Medical University Clinic Erlangen) have published in *Strahlentherapie 78* (1948) some of their results which follow:

Neuralgia: Patients were neglected cases. No results had been obtained through other methods. Good results were obtained especially with sciatica, with a decrease in the pain noted.

Myalgia: After one to three treatments, pain subsides.

Arthritis: Arthritis, especially of articulations, reacts favorably with ultrasonics.

Infections: Abscess and maxilar empyema generally respond well to ultrasonic treatment.

Prostates: Relief of individual pain.

Carriers of Diphtheria microbe: Among 21 cases treated, only two did not react; it was not possible to eject the microbes *in vitro* even with large intensities.

Malignant tumors: In the cases of small tumors these have disappeared, while in some cases they disappeared to re-form again later on. The authors cannot recommend the use of ultrasonics as a therapy, but they seem of the opinion that results justify further investigation and research.

These results are confirmed by the Röntgenabteilung der Chirurgisches Universitätsklinik Würzburg.

Ulcer therapy

A. Stoltz of the Strahlenabteilung des Medische Klinik, Giessen (*Strahlentherapie* 79-1949;4:641) has experimented with ultrasonic therapy on gastric and duodenal ulcers. 93 persons, sufferers from ulcers (47 ulc. ventr. and 45 ulc. duod.) have been treated. Without special diet or medical therapy, 89 cases felt total relief, after the sixth treat-

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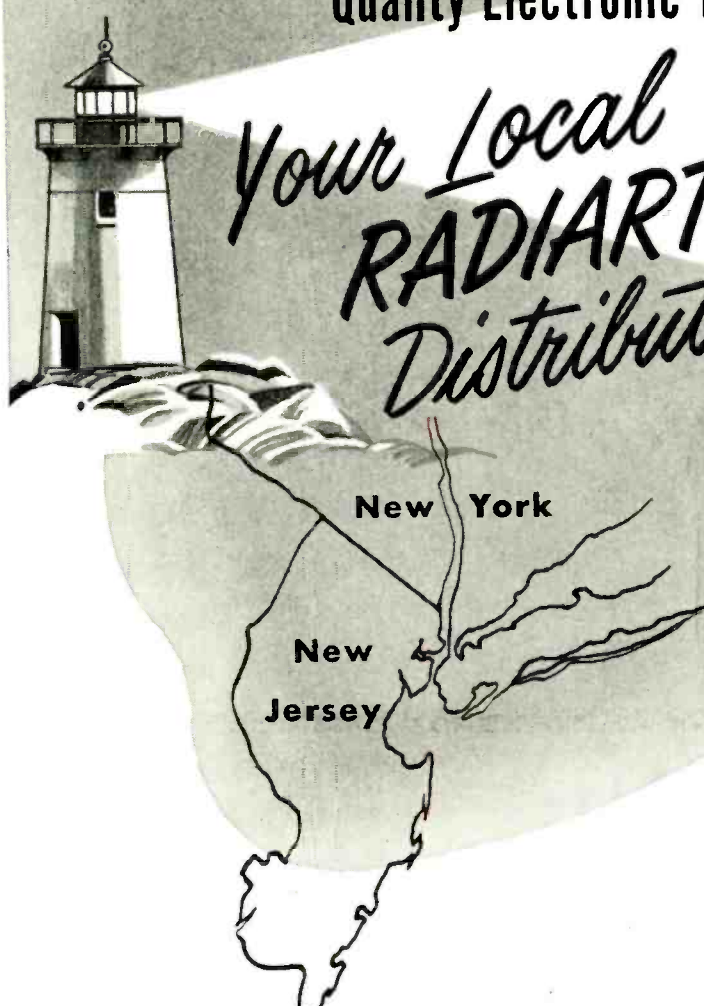

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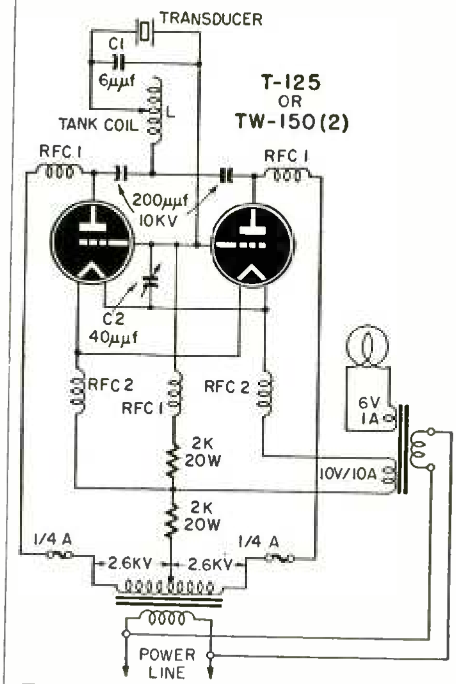
VIBRATORS • AUTO AERIALS • TV ANTENNAS • ROTATORS • POWER SUPPLIES ment. Weight increased and in all cases the ulcers were cured by the end of the treatment. Frequent examinations failed to find hemorrhages as a result of the treatment. Only in 4 cases was a recurrence noted, and there the failures have been explained by other causes.



The schematic of the oscillator used to generate energy for the transducer unit.

Treatment technique: The region marked by X-ray examination was treated with vaseline (to insure good contact) and a vigorous ultrasonic massage was given, each treatment lasting 10 minutes. The first six treatments were given daily, then six treatments every 2 or 3 days, finally 3 to 8 weekly treatments after the disappearance of the symptoms. During and before treatment patients had to drink ¾ to 1 liter hot camomile tea.

These results have been further confirmed by other workers such as Ebert of the *Innere abteilung Stadtkrankenhaus Wolfsburg.*

Asthma therapy

Other interesting results are the cases reported by P. Anstett of Lyon, France (*Lyon Medical*, 1948).

The report deals with sixty cases of asthma treated with ultrasonics, 29 cases without complication (25 cases with bronchitis and emphysema have also reacted favorably); 39 cases were completely cured (observed during 10 months); 13 cases improved to a point of being negligible; 1 case slightly improved; and 1 case resisted treatment. The impression is gained that only the spasmodical fraction is influenced and not the inflammatory fraction. However, this has been improved sometimes with the injection of autovaccin.

Treatment technique: 10 minutes every day, 12 treatments in all, both sides of the sternum at the height of the ganglium stellatum. This treatment used the highest possible and bearable ultrasonic intensity. The effect is immediate as in the case of adrenaline injection. The only complication sometimes is dizziness.

These results have been confirmed by A. Denier and H. Desgrez, and in Germany by W. Bunse and R. Muller of the Poloclinique Medicale Wirzburg.

Conclusions from results

After looking at all the published data on ultrasonic therapy one has to come to the conclusion that efficient and lasting results are obtained only when full advantage is taken of the peculiar characteristics ultrasonics possess. For example, the cases of ulcers treated use the dispersional properties of ultrasonics to effect the cure. The same can be said for asthmatical treatment. Experiments on animals have borne out that ultrasonic therapy will be most beneficial and meet real success if therapists will base their treatments on the fundamental properties of ultrasonic energy, and if when starting, they always use the smallest possible intensities.

On the other hand there seems to be an unlimited field of application in diagnostics. Ultimately ultrasonics will contribute to what is bound to come one day. Complete and rational electronic diagnosis, wherein the site of every ailment will be correctly located and the ailment evaluated by appropriate electronic apparatus. This kind of qualitative and quantitative analysis will give a faultless and unmistakable diagnosis. From the pure physical and electronic angle there is not the slightest reason why this could not be achieved even today. It can be achieved fastest by the fullest co-operation among members of the medical profession.

—end—

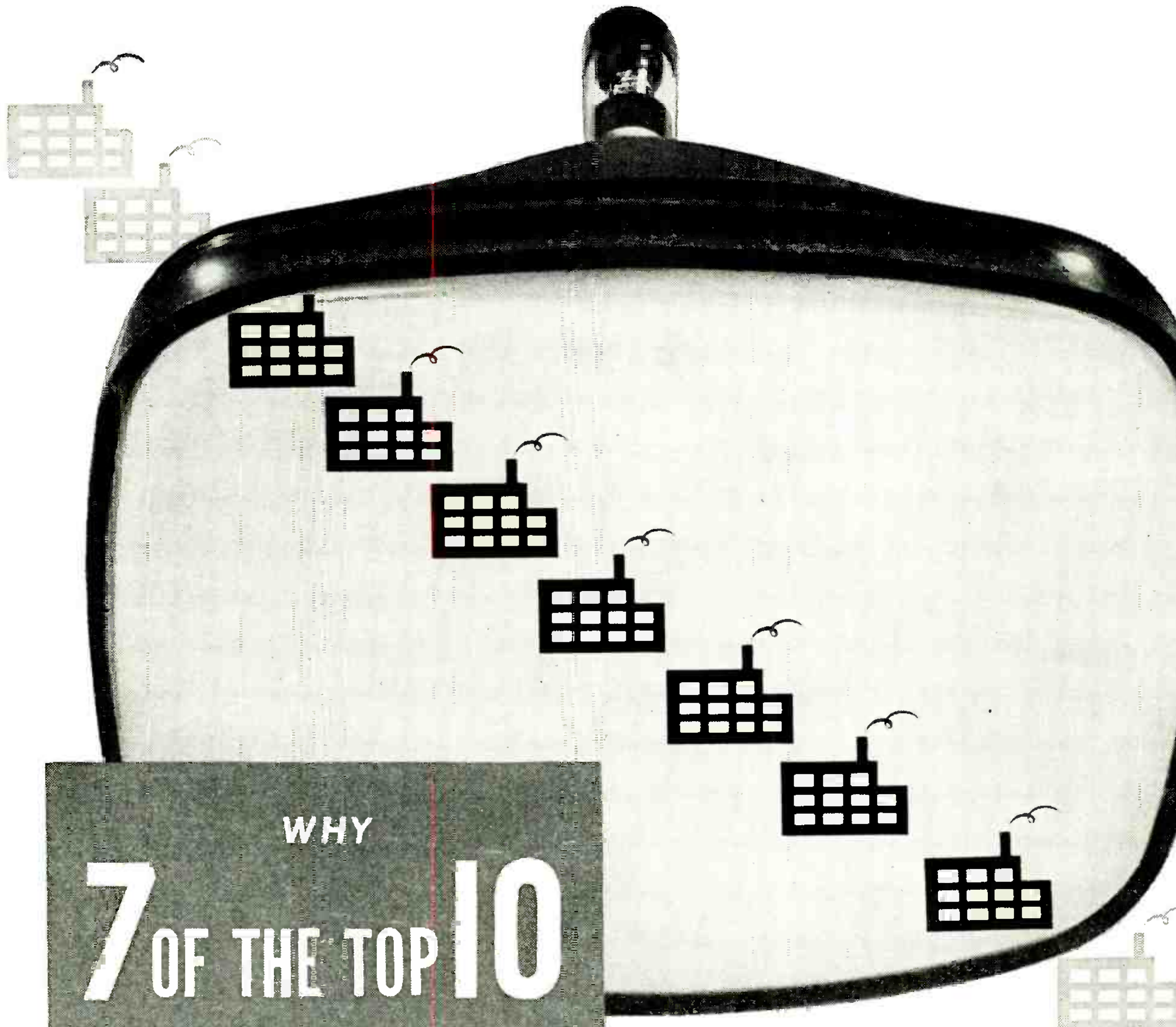
Thunderstorm Recorder?

Thunderstorms are located both in Britain and the U. S. by using networks of radar stations to determine by triangulation the location of the storm. The present American network covers an area with a diameter of 4,000 miles in the Caribbean region.

The British have now worked out a method, however, which uses an automatic recorder to pick up and compute signals received by a single radar. They measure the time interval between reception of a wave from a lightning flash as it travels along the ground and another wave from the same flash as it bounces off the ionosphere high in the sky.

Signal Corps scientists at Fort Monmouth, N. J., have analyzed similar experimental tests conducted for them by University of Florida scientists working under contract with the Army, and declare that the method is not feasible. Wave shapes from lightning patterns were not clear enough to accurately place the thunderstorms, but they used human calculation rather than the automatic recorder developed by the British.

—end—



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BIRDS AND ULTRASONICS

There has been much difference of opinion about the value of ultrasonic "scarecrows," though a number of attempts have been made to use ultrasound to scare birds away from roosting places.

The rather negative results of such attempts have led many to believe that ultrasonics is not the answer to the problem. Therefore, special interest attaches to the following letter, written by a Detroit radio engineer who is also interested in the work of the Audubon Society. It was addressed to Hugo Gernsback, in reply to a request for information on the successful experiments on bird-scaring, of which he had heard.

"The martin-starling experiment we have been working on here in Detroit has been keeping us quite busy checking and re-checking data on the effects of the various frequencies used.

"Inasmuch as this was the spontaneous application of a theory, the equipment used was all standard—oscillator, amplifier, and speakers. No special equipment was developed and therefore no special circuits were involved. The last five years we have recorded on tape some 135 half-hour reels of bird, animal, and insect sounds made throughout Michigan, on the East Coast and in Canada.

"Our findings in this work contributed to the idea of using high frequencies in forcing the movement of concentrations of birds from areas in which they come to roost each night. These concentrations, or flockings, always precede actual migration. Two or more species may gang up in this flocking; therefore the two above-named species of birds make up this particular flock of some hundred thousand individuals. The martins particularly are of inestimable value as insect killers and are protected by Federal law throughout the land. Where they have become a nuisance, however, such as in great concentrations in the middle of residential sections, wholesale killing has been quite generally sanctioned by local authorities—thoughtlessly, of course, as they might as well try to stop a hurricane or flood or any other natural happening.

"We have quite effectively proven that frequencies *varied quite rapidly* from approximately 9,500 to 11,000 cycles per second with substantial level as determined by distance involved, will definitely keep the birds on the wing, forcing them to go elsewhere. With strategically located speakers in the usually small areas involved the entire flock could be discouraged from landing in the area affected. These areas are usually thickly covered with old tall elms.

"We are desirous that this information be made available wherever and to whomever it may be of practical interest, in the hope that the final results may save the lives of countless thousands of one of our most valuable species of birds."—*Ed. G. Boyes*

—end—

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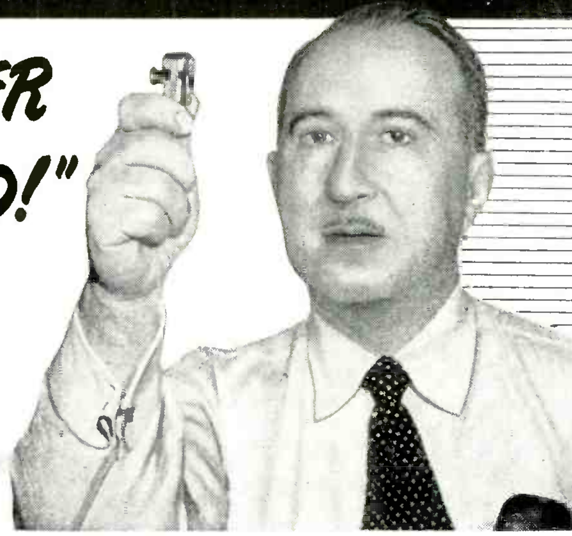

Reports ARNOLD DEUTSCHMANN
***Vice President*, RADIO SHACK Corporation**
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Filter Facts And Faddle

Filters are widely used in radio, video, and audio work. The author shows how to design many of the various types.

By JAMES R. LANGHAM

WE FIRST began fooling with filters 'way back when we had just managed to get our tuner's over-all response up past 10 kc—up into the range where the 10-kc beat-frequency squeals between broadcast stations were coming through very well.

For a long time I was sure I had oscillation in the tuner—I don't know why an r.f. beat frequency didn't occur to me—and I had beat my head against the wall for several evenings in a row trying to de-squeal that little t.r.f. I remember dashing into the bedroom, late one evening, to wake up the XYL and tell her the squeal had disappeared and I hadn't done anything to it. I also remember her remarks. She simmered down after awhile and wondered what I should have wondered straight away: "Do you suppose that could be a beat frequency between stations?"

We didn't immediately jump into filter design. We followed our usual (excuse the expression) engineering technique. We first tried several sections of resistor-capacitor tone control between the tuner and amplifier; we added R-C sections until the highs were sounding muffled and the squeal still came through. Then I remember padding the inside of the boom box (I still thought I liked them then) and even suggesting that we use cotton upholstery padding for grill cloth. It was the XYL who got us started. "Listen," she said. "Why don't you design a filter? I'll build it."

I dug into books then while the XYL played records. I soon decided my books weren't adequate so I called on a friend (hah!) for help. This man was a high-fidelity fan who was also a physics major, and he handed me a book.

There's no question that it's a fine book but it surely wasn't for me. Lordy, I could barely count over ten without taking off my socks—and this book . . .

Around midnight the XYL peeked over my shoulder on her way to bed. "Hmmm," she yawned. "I didn't know you liked mathematics, dear."

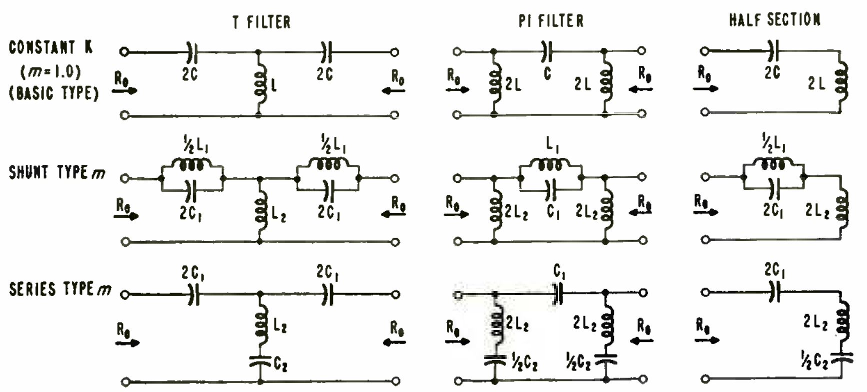
"I find it extremely fascinating," I snarled at her.

Her laugh was silvery and gay, so I added: "—especially with you playing *Pictures At An Exhibition* at a 34-db level."

She trilled a merry goodnight in my direction and went in to bed, yawning loudly and sighing luxuriously as she relaxed. I ground my teeth, made more coffee and tried to think. I couldn't find the information for the mathematics, as the author had done a beautiful job of hiding it. I finally gave up that night but the next day I tried some more. I wasn't curious about how the formulas were derived—I just wanted to know how to work it. After awhile I tried other books, looking for answers. My eyes became bloodshot, the circles underneath them became bags, and my skin took on the tone of a slightly soiled mushroom.

The M business bothered me a great deal because I couldn't find out what it meant. I was very annoyed at myself for not learning how to apply the math I didn't understand. Nowhere could I find any explicit directions about filter design.

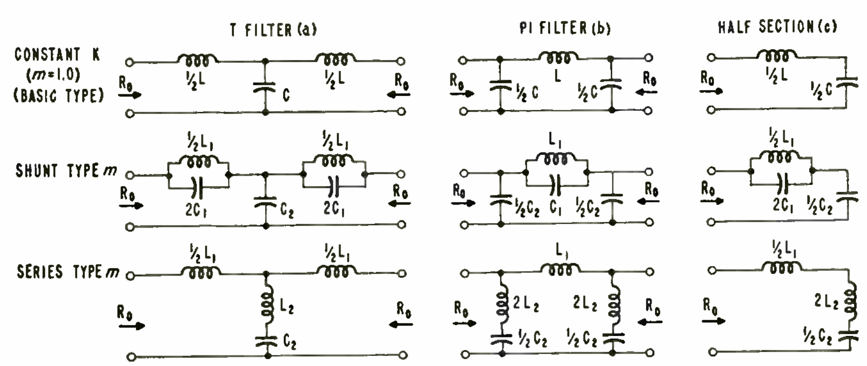
Actually, the design of a simple low-pass (or high-pass) filter is quite easy—now that I know how to do it.



R_0 = OHMS; L, L_1, L_2 = HENRIES; C, C_1, C_2 = μf

FORMULAS: $L = \frac{R_0}{4\pi f_c}$ $\quad C = \frac{10^6}{4\pi f_c R_0}$ $\quad L_1 = \frac{m}{1-m^2} \times 4L$ $\quad C_1 = \frac{C}{m}$ $\quad L_2 = \frac{L}{m}$ $\quad C_2 = \frac{m}{1-m^2} \times 4C$

Fig. 1—Three classes of high-pass filters: T, Pi, Half sections. These can be Constant-*k*, Shunt type *m*, or Series type *m*. Note formulas for their use.



R_0 = OHMS; L, L_1, L_2 = HENRIES; C, C_1, C_2 = μf

FORMULAS: $L = \frac{R_0}{\pi f_c}$ $\quad C = \frac{10^6}{\pi f_c R_0}$ $\quad L_1 = mL$ $\quad C_1 = \frac{1-m^2}{m} \times \frac{C}{4}$ $\quad L_2 = \frac{1-m^2}{m} \times \frac{L}{4}$ $\quad C_2 = mC$

Fig. 2—Low-pass filters also fall into several classes. The math is very easy.

Filter types

The main classes of filters are: T, Pi, and half sections. There are others but they are mostly versions of these doubled or folded. There are also constant-*k* filters and *m*-derived filters: in the *m*-derived category there are shunt and series types.

The T and Pi filters are called that because their configurations look like the Latin letter T and the Greek letter π. The half sections are also called half-tees, half-Pi's, and ladders.

Constant-*k* filters are also called constant *z*, basic type, and *m*=1 filters.

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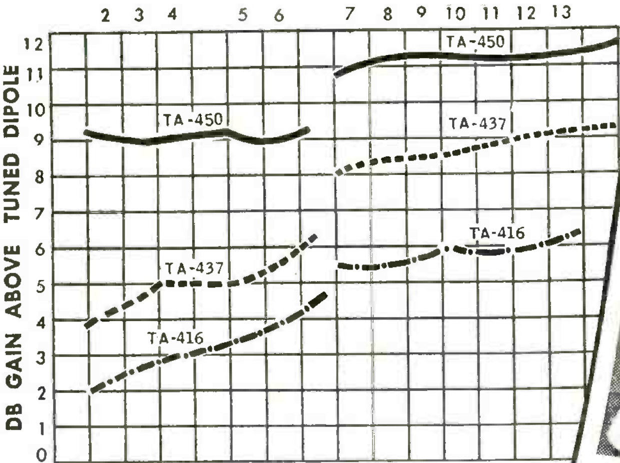

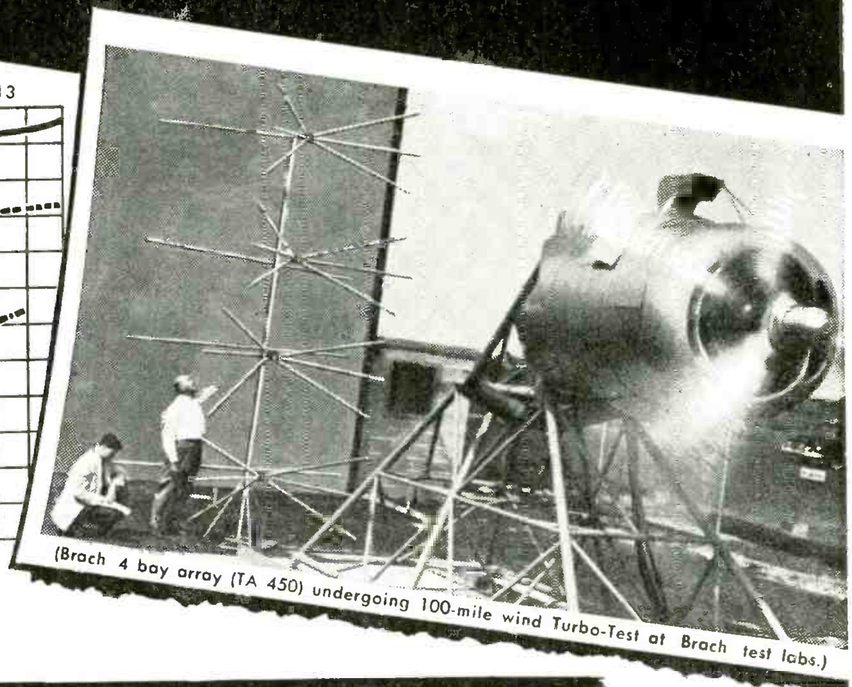

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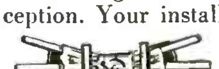

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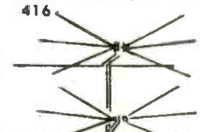

For fringe areas; the 2 bay array Brach TA 437

Brach all channel signal booster 50825. No tuning or switching necessary. Averages 15 DB gain on all channels used to realize maximum TV signals in fringe installation.

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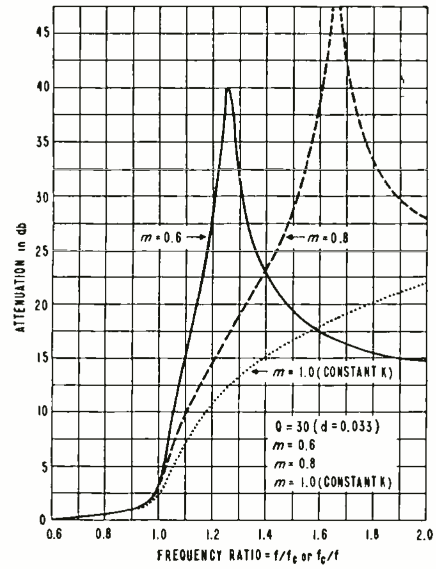

Fig. 3—Characteristics of high and low pass filter sections where Q equals 30.

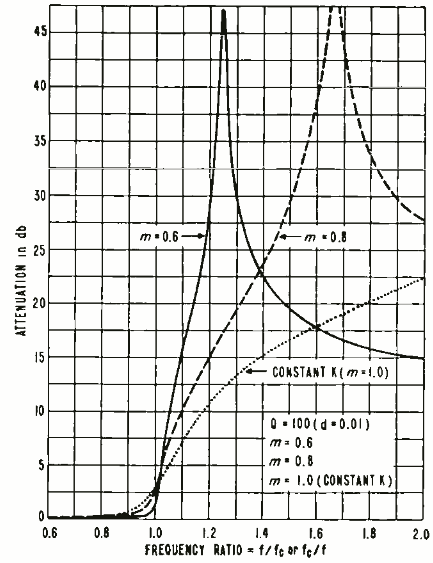

Fig. 4—Same conditions as Fig. 3, but Q is now 100. Note sharp cutoff points

They are fundamental to the evaluation of constants for the *m*-derived filters. The term *m* is best regarded as simply a dimensionless number that is used in filter work. It can be defined as the square root of the quantity one minus the square ratio of cutoff frequency to peak-attenuation frequency, thus: $m=\sqrt{1-(f_c/f_p)^2}$.

In simpler language, *m* is a mumber between zero and one; the closer to one it is, the sharper is the attenuation curve and the closer together are the cutoff and peak-attenuation frequencies. The *m*-derived filters are simply filters using *m* in calculation of the capacity and inductance values.

All of these filters are critical in regard to impedances and resistances across either the input or the output. If you want to use a particular filter on a 500-ohm line, you must design it for that particular impedance or it won't play.

Filters and Q

Now there were two major faults with all those books I struggled with that time long ago: (1) Their constants were all pure reactances without resistive components, which is to say that their Q's were infinite. I was further confused in that the books did not mention Q explicitly either. They used another term, *d*, which they defined badly but which I later discovered to be nothing more than 1/Q. (2) The books had been written for people who study rather than people who just read; and one very important matter, the conversion between T, Pi, and half sections, was buried in a mass of mathematics.

The filter I ended up with that time was about an octave out of kilter. Instead of attenuating the 10-kc whistles, it had a nominal cutoff of 20 kc. I say nominal because the difference between infinite Q and the Q of the filter made for such a sloppy cutoff that I couldn't find it on my 20-to-20,000-cycle oscillator, and I made some silly remarks about the XYL's fabrication which turned out to be very unwise after we both checked the circuit constants on the bridge. With the bad filter design, my headaches, and the XYL's remarks, I was having a pretty unhappy time all around.

The Q's you are likely to encounter around the audio band range from 30 to 100 for the coils and you can stop worrying about the capacitors. Away up in the ridiculous frequencies where they have things like television, I am told conditions are likely to be opposite —the capacitor Q's are the worry items and the coils pretty much forgotten. Down in the high-fidelity band, the coil Q is the circuit Q and there's no nonsense about it.

Practical filters

Fig. 1 shows *high-pass* filters and Fig. 2 illustrates the *low-pass* units. In each case, the formulas are right there too, and about the only item to worry you is grade school arithmetic.

Fig. 3 and 4 show the curves you will get from practical filters. In Fig. 3 are the attenuation characteristics of a basic constant-*k*, an $m=0.6$ and an $m=0.8$ filter with a Q of 30. Fig. 4 is the same except that there the Q is 100. You can see a strong resemblance between the two sets of curves but I'm sure you can also see quite a difference, especially in the cutoff region for the $m=0.6$ filter.

Now the $m=0.6$ filter is about the handiest and the most commonly used type you're likely to need. It makes the best impedance match to any circuit with a critical source impedance, and for this reason it is very often used in two half sections, one at the input end and the other at the output end of a complex, multi-element filter.

Those of you who have delved into this stuff before might be confused as I was in the matter of impedance matching. Just from the name, I thought that a constant-*k* (which I think was called a constant-*z* in that particular book) would be better to use for impedance matching. Not so. Don't regard that name, constant-*k*, as having any more meaning than if it were called George or Terence. For impedance matching, forget names and use the $m = 0.6$ filter.

In the case that started me off, a single $m=0.6$ section is fine, but, as you can see by the curve, the attenuation simmers down once the peak is passed. There are many applications where the attenuation must continue and in one of those cases an $m=0.8$ section is very fine: its peak is farther away and its attenuation is higher except in the cutoff region. The basic constant-*k* type is also popular for providing attenuation at an even greater distance from cutoff. These three types are by far the most useful of all and you can do nearly any filter job quite easily with combinations of these three.

Combining them is quite practicable and it is common to use sections of $m=0.8$, $m=0.6$, and constant-*k* all in the same filter with an $m=0.6$ section split so that half is used at either end for impedance matching. The attenuations are in decibels and merely add arithmetically like apples and pigs.

The values across the bottoms of Figs. 3 and 4 are frequency ratios that permit you to place the curves anywhere you wish to in the band. All the values are referred to the cutoff frequency.

Designing a filter

Now let's do some. Let's assume we want a filter to fit in a 500-ohm speaker line and attenuate a strong 10-kc whistle. In this case a single M=0.6 section will do nicely. The cutoff is sharp and the peak attenuation comes at 1.25 times the cutoff frequency so we can set f_c at 8 kc. A single section should be sufficient, and, because coils are more expensive than capacitors, we'll make it a shunt type Pi section, Fig. 2, shunt type *m*, (b), which uses one inductor and three capacitors.

First we must calculate the L and C as of a constant-*k* filter because the *m*

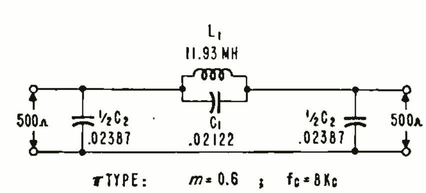

Fig. 5—Shunt Pi low-pass filter designed for *m* of 0.6 and for 8-kc cutoff.

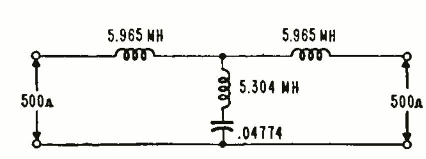

Fig. 6—Characteristics of the series-T filter are similar to those of Fig. 5.

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THE RADIART CORPORATION CLEVELAND 2, OHIO types are derived from these. Using *low-pass* formulas, see Fig. 2:

$$L = \frac{500}{\pi \times 8000} = 0.01989 \text{ h or } 19.89 \text{ mh}$$

$$C = \frac{10^6}{\pi \times 8000 \times 500} = 0.07957 \ \mu f$$

$$L_1 = 0.6 \times 19.89 = 11.93 \text{ mh}$$

$$C_1 = \frac{1 - 0.6^2}{0.6} \times \frac{0.07957}{4} = 0.02122 \ \mu f$$

$$\tfrac{1}{2} C_2 = \tfrac{1}{2} \times 0.6 \times 0.07957 = 0.02387 \ \mu f$$

The filter section is shown in Fig. 5 as a shunt type m. Compare with Fig. 2, and you will see that the center part of the Pi is really a simple tuned circuit resonant at 10 kc. The capacitors on each side true up the impedance match so that the complete section looks like 500 ohms from either side. The transmission characteristic will be like the solid line in either Fig. 3 or Fig. 4, depending on whether the Q of the 11.93-millihenry coil is closer to 30 or to 100.

This particular filter configuration was selected because we preferred using capacitors. If a chap likes to mess around with inductors, he could get exactly the same results for the series type T section shown in Fig. 6.

Suppose now that a single $m = 0.6$ section should not be sufficient. Suppose you wanted about 60 db of attenuation from here on up. You could add an $m = 0.8$ section and, to ensure impedance matching in and out, split the $m = 0.6$ section into halves and use half on each side of the $m = 0.8$ section.

The $m = 0.8$ constants are computed in exactly the same way as were those for the M = 0.6 section:

$$L_1 = 0.8 \times 19.89 = 15.91 \text{ mh}$$

$$C_1 = \frac{1 - 0.8^2}{0.8} \times \frac{0.07957}{4} = 0.008951 \ \mu f$$

$$\tfrac{1}{2} C^2 = \tfrac{1}{2} \times 0.8 \times 0.07957 = 0.03183 \ \mu f$$

Our values for the $m = 0.6$ section are for a full section, and by referring to Fig. 2 shunt type m, (c), we see that we want to use $\tfrac{1}{2}L_1$ and $2C_1$ so we double our reactances in the center of the Pi. This of course does not change the resonant frequency.

A combination of the $m = 0.6$ and the $m = 0.8$ sections provides a lot of attenuation close to cutoff, but, if we wish to maintain a full 60-db blank from here on up, we must add still another section. A constant-k filter will do nicely here and we already have the values of L and C worked out so all we have to do to make a Pi section is halve the capacitance according to Fig. 2 constant-k, (c).

Fig. 7 shows the lineup of filter sections. The sections are combined by adding the parallel capacitors into single units—this is just to save space and expense. If we had formed our filter of T sections we would combine them by adding the reactances of the protruding arms; inductances arithmetically, $L_a + L_b + L_c$ etc., and capacitances by using: $1/C_T = 1/C_1 + 1/C_2$.

Fig. 8 shows the over-all characteristic of our filter. The solid line is the curve for using coils with Q's of 30, while the dotted line shows how the attenuation is with Q's of 100.

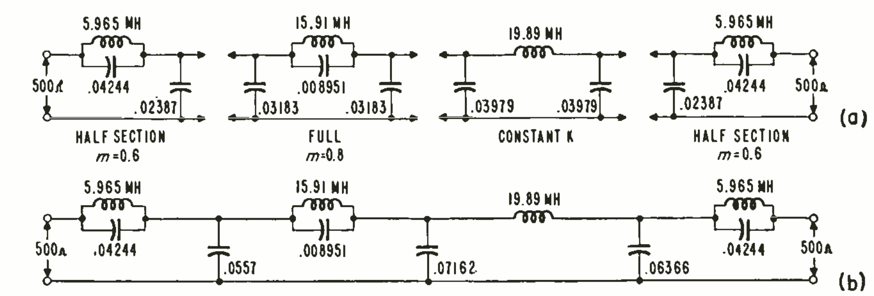

Fig. 7—Design for a low-pass filter, (b) is combined from the elements of (a).

There are other ways of designing filters. One of the more rigorous ways involves the consideration of various resonances and antiresonances or (if you'd like to keep in style) "poles" and "zeroes." If you like doing things the hard way that's fine, but this method will get your filters to come out as you want them and without any great strain.

The design of filters isn't hard (as you can see) but filter building is a cow from another barn. You can buy almost any value of capacitor but the inductors aren't quite so easy to come by. If you are poor you can wind them yourself. Actually coil winding isn't nearly so hard as you might think. You should have a bridge to check the reactances. These can usually be borrowed.

As I look back, I do believe a lot of my filter headaches at first were caused by nothing more than awe for a lot of mathematics that were away beyond me. There's no need for that.

—end—

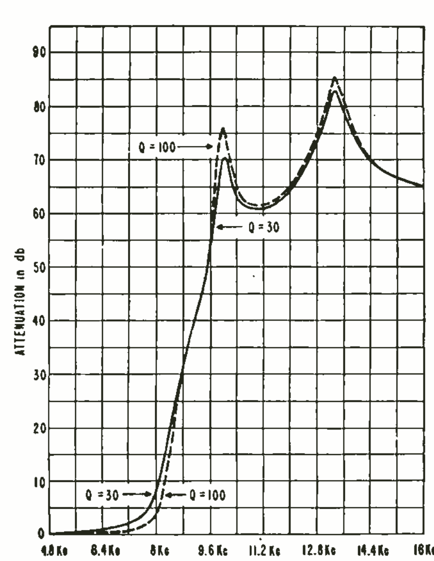

Fig. 8—Curves of filter shown in Fig. 7

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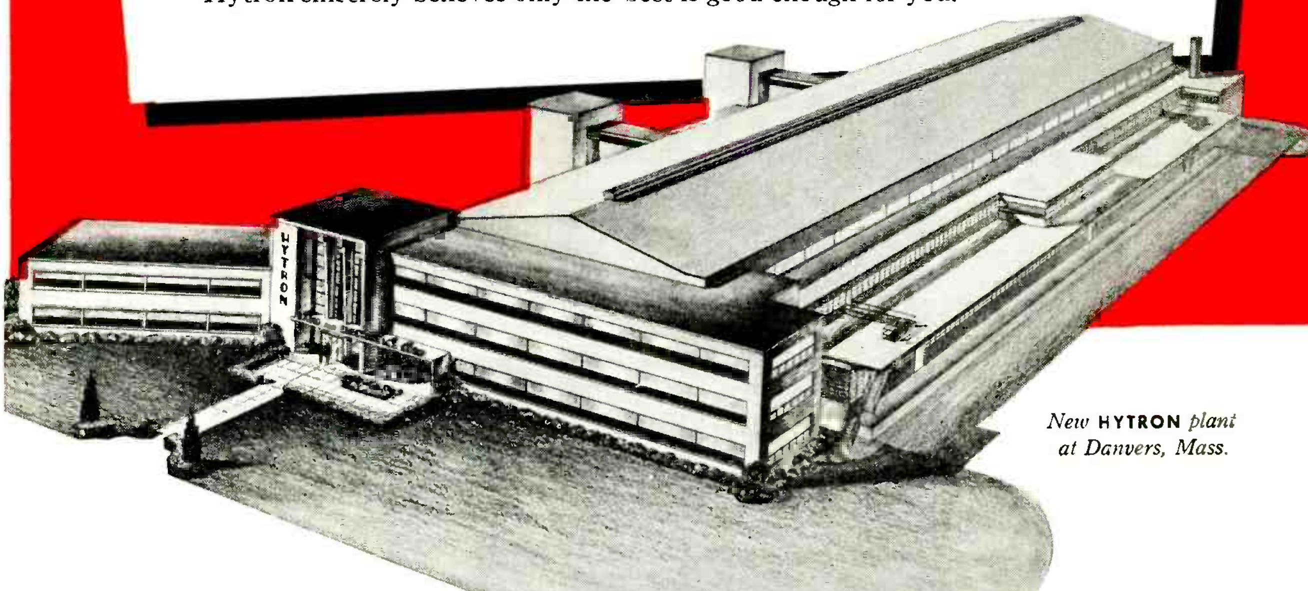

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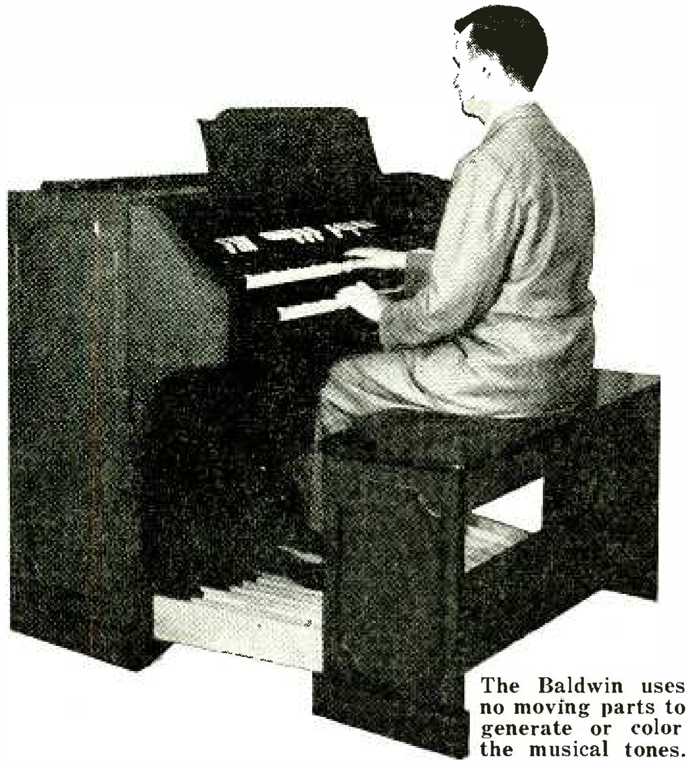

The Baldwin uses no moving parts to generate or color the musical tones.

Part XVII—This and next month's article describe the Baldwin, an instrument of the all-electronic type.

By RICHARD H. DORF

DELIBERATELY introducing distortion in an amplifier is contrary to most audio principles. When the amplifier must transmit music, distortion is especially undesirable. However, when discriminating circuits are used in an instrument which generates musical tones, results may justify altering the fidelity of the amplifier.

The Baldwin electronic organ, built by the Baldwin Piano Company, Cincinnati, uses this principle of tone variation with filters to produce tone coloration almost like that of a true pipe organ. The filters in the Baldwin were designed using the formant principle discussed here two months ago. While no electronic or electrical organ perfectly duplicates a pipe organ, the Baldwin comes so close that most lay hearers are deceived. It is used in a large number of churches. It is also used for serious recital work. Some prominent concert organists and conductors prefer it to the run-of-the-mill pipe organ.

Two Baldwin electronic models are manufactured. Model 5, (photo left) is the smaller one. It has a standard AGO (American Guild of Organists) console, with great pedal and swell manuals and a 32-note radial pedal clavier. Vibrato (frequency-modulation type) effects both manual and pedals and is adjustable. There are 25 stops and two couplers. The console is 52½ inches wide and 29 inches deep.

Model 10 is a newer and larger model, with additional stops and couplers and with pistons to select preset stop combinations. It operates like Model 5. Baldwin has also introduced a new model which operates on the photoelectric principle. In this article we shall discuss the Model 5.

General functioning

The organ is an all-electronic device with no moving parts except keys, pedals, and stop tabs. It generates a series of sawtooth-shaped waves which are passed through fixed filters to modify them and reproduce various tone colors.

Fig. 1 is an over-all block diagram. The generator assembly generates tones. A vibrato oscillator modifies the tone frequencies at the vibrato rate when the vibrato switch is operated. The gen-

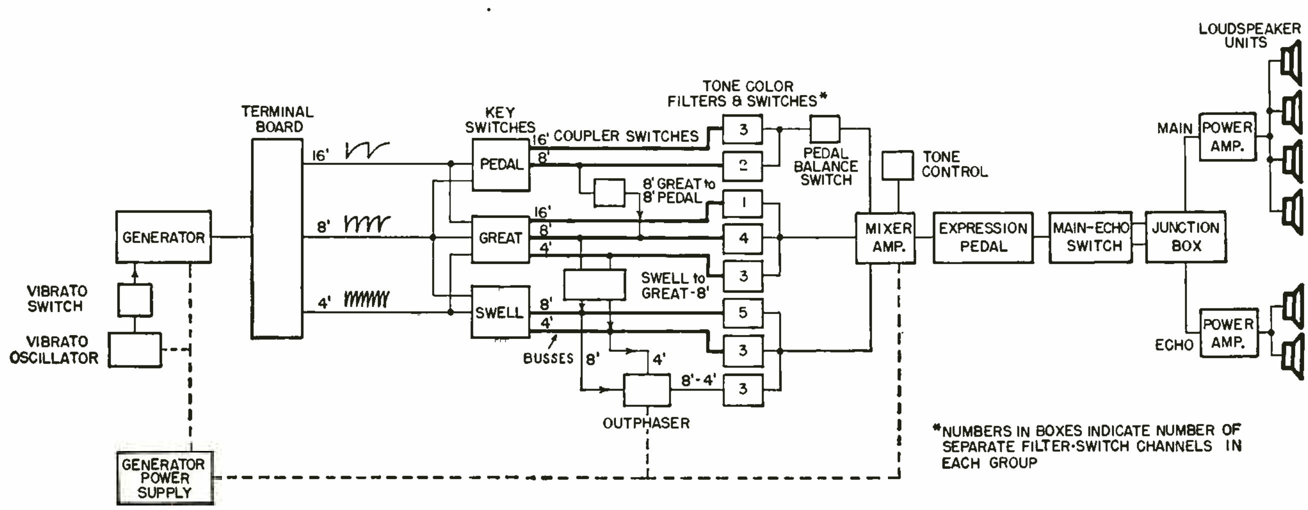

Fig. 1—Block diagram of the Model 5. The heavy horizontal lines near center are the busses referred to in the text.

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Within a single cycle of this oscillation, however, the grid draws so much current through the high-value grid leak that the triode is biased beyond cutoff, and it stops oscillating. The resulting charge on C1 discharges relatively slowly through R1 until the bias becomes less than cutoff value. Then another wave from the top oscillator starts the cycle over. The number of waves from the top oscillator between successive discharges of C1 depends on the time constant of R1 and C1-C2.

Because the Baldwin uses frequency division, the first divider discharges its capacitance once for every two cycles of the top oscillator. The charge and discharge is in the form of the characteristic sawtooth, which is the waveform appearing across C1-C2. The two capacitors are used as a voltage divider, with the output signal voltage taken from the junction. The output, signal 2, is 1/10 of the voltage appearing across the combination and is at a frequency just half that of the top oscillator.

The five divider transformers are all wound on a common core, as can be seen in Fig. 4. Thus, while there is no electrical connection between the dividers, the top-octave signal fed through R2 into the multiple transformer affects them all in the same way. Each divider must, of course, lock at some submultiple of the top octave.

Fig. 5 shows simultaneous waveshapes at various points in the generator circuits. The output of the top-octave oscillator is not very complex, but this is unimportant for the later tone-shaping circuits because the fundamentals are so high that most of the higher-order harmonics would be inaudible anyway. The waveform at the plate of the first blocking oscillator shows the effect of the synchronizing waves supplied from the top oscillator—large pulses of high-frequency oscillation. The grid waveform of the blocking oscillator shows the resulting pulse of grid voltage caused by the grid current, followed by the gradual fall of voltage as the capacitance discharges. The signal 2 output voltage taken from the capacitive voltage divider is a simple sawtooth because of the capacitors' filtering action.

The schematic of Fig. 3 shows for several components a range of values rather than a single one. Components so marked are dependent for their values on the particular note to be generated by the chassis in which they are placed.

Power supply

The power supply diagrammed in Fig. 6 also holds the vibrato oscillator and an extra tone generator for the lowest C of the instrument.

The primary of the power transformer is provided with three taps, one of which is selected in accordance with the average a.c. line voltage in the location. The d.c. power is supplied by the 5Y3-GT rectifier and a filter consisting of choke L and capacitors C2 and C3. The filtered 260-volt line is fed to tubes

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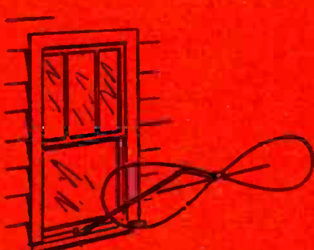

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The Butterfly with the three-way bracket mounting is listed at just $4.95. For the single bay array, the suggested list price is $12.95.

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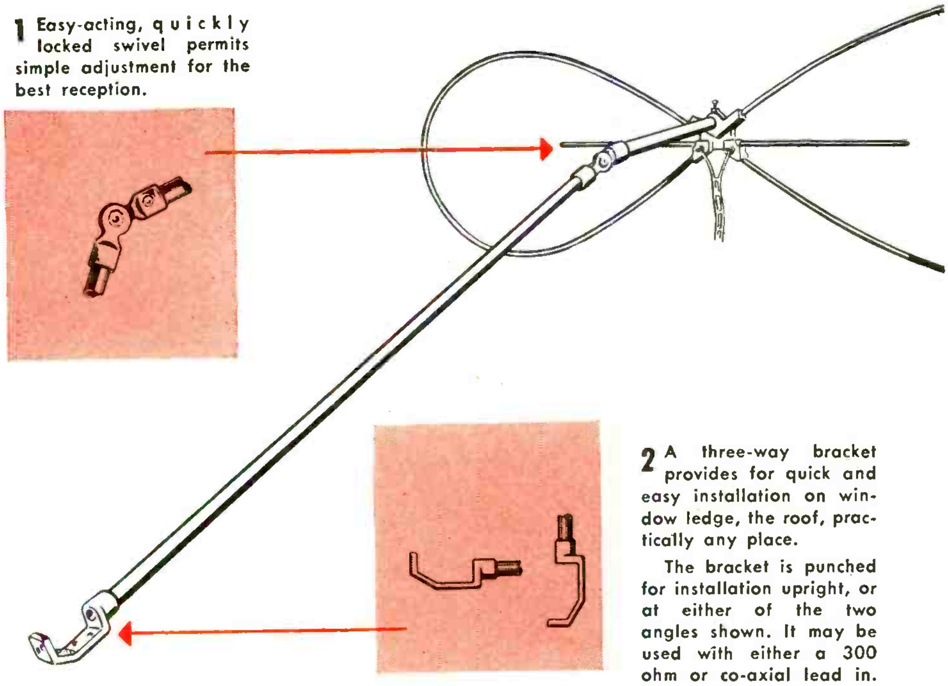


2 A three-way bracket provides for quick and easy installation on window ledge, the roof, practically any place.

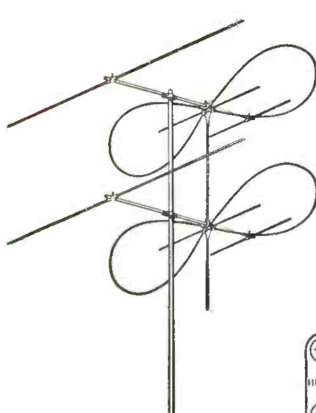
The bracket is punched for installation upright, or at either of the two angles shown. It may be used with either a 300 ohm or co-axial lead in.

Introducing the All-Channel BUTTERFLY Swivel-Positioned ANTENNA . . .

Tel-A-Ray's contributions in the field of long-distance television have been of greatest importance; the area of clear, stable, interference-free TV reception has been tremendously expanded by Tel-A-Ray long-distance antennas and the unique Tel-A-Ray Pre-Amplifier.

Now, Tel-A-Ray announces a brand new development just as important to the improvement of primary TV area reception: the new All-Channel Butterfly Swivel-Positioned Antenna. It can be installed for maximum signal gain right on a window ledge, in the attic, on the roof. It is rugged . . . quality constructed of tough extruded aluminum, guaranteed against wind and weather damage . . . easily adjusted for brilliant television reception.

Never before was a high-gain antenna so fool-proof . . . so flexible and so simple to install and adjust . . . so ideal for use in densely populated metropolitan areas where a number of stations are operating. It comes with a three-position bracket for mounting at right angles, a 30° angle, or upright, with nothing extra to buy . . . or mounted in one, two or four-bay arrays for improved reception in outer service areas and near-station dead spots. Be sure of the best primary area reception by using Tel-A-Ray Butterfly Swivel-Positioned Antenna.



The Butterfly mounted in a two-bay array . . . a low-cost way of getting improved TV reception in outer service areas, or in primary area dead spots.

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in the tonecolor box, where there are additional filter sections.

Resistors R2, R4, and R5 form a voltage divider to supply plate and cathode voltages to the generator chassis. The B-plus, 165 volts, comes from the junction of R2-R4, and the cathode voltage comes from R4-R5. The ratio of 11:1 between the plate and cathode voltages must be maintained exactly to keep the oscillators dividing correctly. C5 provides additional filtering for these two voltages. C4 provides still more cathode filtering.

There are three different filament windings on the power transformer. The first is a 5-volt winding for the 5Y3-GT. The next supplies 6.3-volt power for the 37 tubes (see next paragraph) in the generator assembly. The center-tap of that one is connected to the plus-15-volt line so that the cathodes and heaters of the divider tubes are at the same potential and heater-cathode leakage is minimized. The last furnishes power for the tubes in the tone color box. The center-tap is connected to plus 15 volts to minimize hum, and R10-C1 filters the connection so that no signal from the generators is transferred to the tone-color tubes.

The left section of the 6SN7-GT V1 (Fig. 6), is the blocking oscillator for the lowest C of the instrument. Each tone-generator chassis has three tubes and can put out only six tones, one for each octave of the organ. The C series must have an additional note (there are 7 C's in six octaves), so that each manual will go from C to C. The divider is identical to the others except that it receives synchronizing signals from the plate of the lowest C on the C chassis through a 180,000-ohm resistor rather than through the coupling of a common transformer core. The output tone is obtained as in the other dividers.

V2 is the vibrato oscillator. The feedback circuit includes the transformer T, C6, and R8 and R9. The vibrato frequency is largely controlled by the inductance of T and the combined capacitance of C7 and C8. C8 is selected at the factory as a final frequency adjustment, to fix vibrato rate. The *grids of all the oscillators are grounded through the grid winding of the vibrato transformer.*

The depth (amount of frequency swing) of the vibrato and the on-off control are combined in a 3-position switch in the tone-color box (see Fig. 6). With the switch in the off position, the vibrato oscillator plate is disconnected from the power supply. In the center or medium position, plate current passes through R7 and other components, to the plate of V1. At the same time the second portion of the switch shunts the plate of V2 with 5,600 ohms and 0.15 μf to lower the frequency somewhat to correspond with the lowered amplitude. In the full position, the 5,600-ohm series resistor is bypassed and there is no shunt. R7 is a permanent current-limiting resistor selected at the factory to limit the maximum vibrato amplitude.

(continued next month)

New portable radiotelephone, of less weight but longer range, designed and built by RCA engineers.

Longer range, but lighter weight for the "Take-along Radiophone"

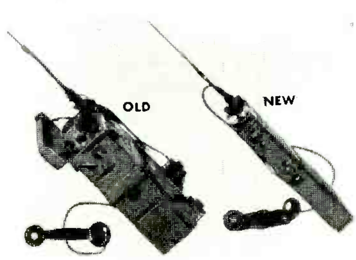
You've read how useful our Armed Forces found their portable radiotelephones. Now this indispensable instrument has become even more efficient.

At the Signal Corps' request, RCA engineers undertook to streamline the older, heavier model—which many a soldier of World War II called "the backie-breakie." Following principles of sub-miniaturization—pioneered at RCA Laboratories—every one of its hundreds of parts was redesigned. Models were built, tested, rebuilt, and finally RCA came up with an instrument weighing only 29 pounds. Its range is double that of the World War II model.

Even more important, under present conditions, RCA was able to beat the most optimistic estimate of the time needed to design such an instrument *by nearly three months.* Signal Corps engineers have called this "A major engineering and production achievement."

* * *

See the latest wonders of radio, television, and electronics at RCA Exhibition Hall, 36 West 49th St., New York. Admission is free. Radio Corporation of America, RCA Building, Radio City, New York 20, N. Y.



Comparison with the older model portable radiotelephone shows how RCA engineers have reduced its size with their new instrument.

RADIO CORPORATION of AMERICA

World Leader in Radio — First in Television

Audio Feedback Design

Part XIII—"Fifty to Five Hundred"—the story of an amplifier which should solve many of the public-address man's problems

By
GEORGE FLETCHER COOPER

THIS is the last article of this series on audio feedback design. Unlike the poet, I propose to end, not with a whimper but a bang. The topic of feedback amplifier design is by no means exhausted, even though the reader and the author may be, and I hope to discuss in some separate articles some special topics which do not fit into the framework of this series. To finish up the series, however, I propose to describe an amplifier which has been designed to act as a general-purpose public-address unit. This is not an amplifier for the home, at least not for my idea of a home; it was designed for use in a sound-distribution network, feeding from 5 to 50 loudspeakers in parallel. The particular merit of the design is its flexibility.

For public address work in which a number of loudspeakers are to be driven from a common audio line we are in rather the same position as the power engineer who provides 60-cycle supply at a number of outlets, to drive the radio and the lamps, the vacuum cleaner and the electric heater. He provides us with a fixed voltage from a low-impedance source, so that the level at one outlet does not depend on the load at another. The nominal level of the 60-cycle supply is 117 volts r.m.s. In distributing speech and music to a number of outlets it is very convenient to follow this example, but to use 50 volts r.m.s. as the nominal level. Loads of down to 50 ohms then can be connected to a 50-watt supply, and loads down to 5 ohms to a 500-watt supply. If 10-watt speakers are used, each is bridged across the line, with a transformer giving a primary impedance of 250 ohms.

The power supply engineer provides a low-impedance source, then monitors the output so that the voltage does not vary more than about 5% as the load is changed. We shall use negative feedback to keep the audio level from varying more than about 20% as the load changes from one loudspeaker to the maximum system load.

Perhaps it is time to explain the title of this particular article. Recently I have had to design a number of public-address systems, of different sizes. Like most ingenious engineers, I am a lazy man, and I decided to design one basic amplifier which could be used as a standard brick in building up any size of public-address system. The standard unit which fitted into the scheme best turned out to be a 100-watt amplifier, using four tubes in the output stage. When operated with only two tubes it is a 50-watt amplifier, the power consumption is halved, and the two tubes which are taken out are not wearing out. When more power is needed, several amplifiers can be connected in parallel without any more precaution than the obvious check of keeping the polarities the same. So far only five have been run in parallel, but there are very few jobs for which more than 500 watts of audio is needed.

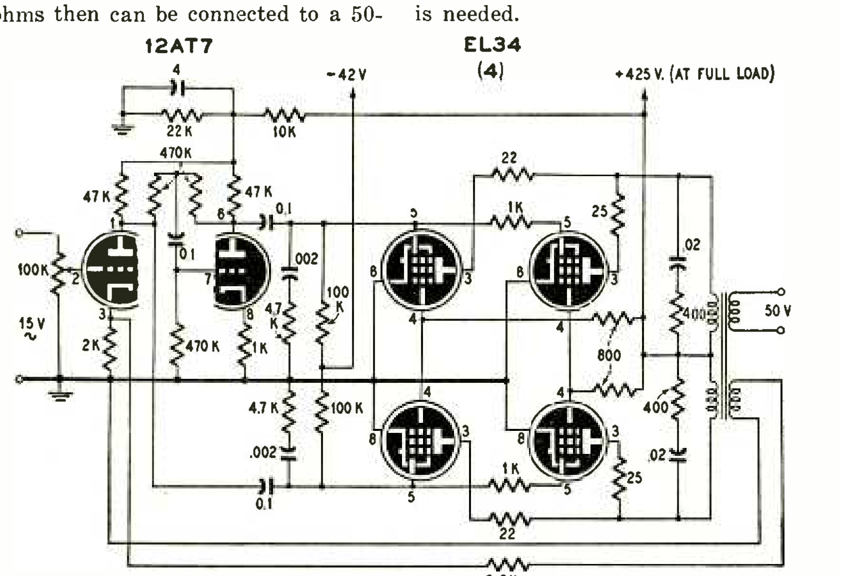


Fig. 1—The amplifier schematic. Feedback is from a special output winding.

This sort of installation is ideal for the ordinary public-address operator, because with 500 watts of amplifier power he either can use it all at the one big show—the county fair, say—or he can put in 200 watts for one job, 100 watts for another, 50 watts in some small hall, and still hold one unit in reserve. The equipment load factor can be kept high, and he never has to use a big amplifier for a small job, where tube wear would eat away his profit.

A "see-saw" circuit

The amplifier circuit is a very simple one, consisting merely of a see-saw phase splitter driving a class-B push-pull output stage. In consequence, the grid input voltage is high, by the usual standards of power amplifiers (we need 15 volts to drive the amplifiers to full power.) This is only a few milliwatts, however, and is easily obtained from a normal 3-stage microphone amplifier. The voltage deliberately was made high so that the long connections used in paralleling amplifiers would not pick up serious amounts of hum and noise. Class B has been getting a bad press lately, and I have read quite a lot about *notch effect*. This is the small step at the crossover point where both sides of the push-pull circuit seem to be cut off. With a bad transformer all sorts of curious effects can occur in the gap, and if the transformer is included in the feedback path, trouble is in store for the designer. A good transformer, which must be symmetrical, seems to prevent all this sort of trouble, and in this amplifier, at any rate, the waveform looks perfectly good until the level is high enough for the peaks to start limiting. I can get the notch effect by using the wrong bias, but so long as I use the values given by the tube maker I have no trouble. Anyone who is suspicious about this might ponder on the number of AM broadcast transmitters which use high-power class B modulators. They do this in Europe, too, where state broadcasting means that low distortion is demanded with all the vigor that any taxpayer puts behind what he considers his rights.

The output tube, which is the key to the amplifier design, is a European type, the Dutch Philips EL34. There just doesn't seem to be any other tube which will do all that this excellent tube will do. It is a 6.3-volt indirectly heated tube, on an octal base, with a transcon-

NEW PARA-CON ANTENNA COMBINES PARABOLIC & CONICAL PRINCIPLES

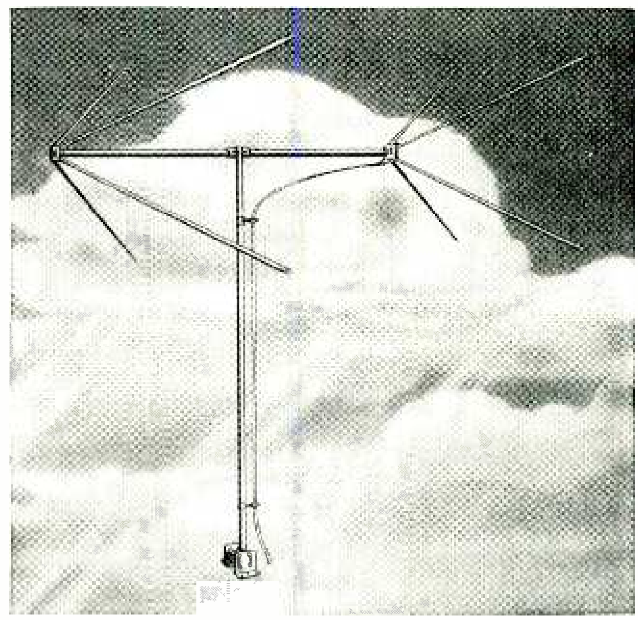
Barbara Lee—Rising TV Star, WEWS Cleveland.

Sight Sells It

After all, people buy TV sets to enjoy the picture. It just makes sense that the antenna bringing in the best picture brings in the best entertainment and the most customer satisfaction. Hook a Para-Con onto any set and you'll agree—it sells on sight.

Solves 9 out of 10 Installation Problems—Challenges Comparison

Two best features are incorporated into one BEST antenna. The praiseworthy features conical type aerials possess for supplying full audio and full video bandwidth reception are used with a parabolic design that gives the Para-Con a concentration of signals. Para-Con is engineered to concentrate the maximum wave energy on the antenna by providing all-around, unmatched performance . . . perfect picture clarity . . . long customer satisfaction.



Any TV Set Performs Better With a Para-Con Antenna

Every set performs better when conditions are better. Install Para-Con when older sets are starving for a stronger signal. Install a Para-Con when any set is being drowned in a sea of local interference. In the majority of set installations, Para-Con makes both old and new sets perform at their peak. To be on the safe side every time, install the sensationally performing new Para-Con antenna and forestall TV troubles at both the reception and the service end.

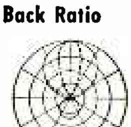
Proved in Thousands Of Installations

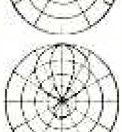
Spectacular success has been achieved in practically every installation. Even in locations far removed and in difficult terrain where other more elaborate arrays were tried and failed, PARA-CON aerials not only bring in brighter, clearer pictures but seize and channel in stations where dependable reception has not been possible with an ordinary antenna. Ward's new PARA-CON Antenna has been field tested in thousands of installations . . . proved far and away better.

Singles Out The Stations

High Front to Back Ratio

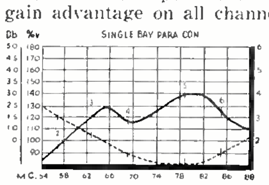
The new Para-Con design achieves an unusual capacity to obtain sharp directivity over all the television spectrum. Para-Con principles afford greater power and less interfering noise on each channel.

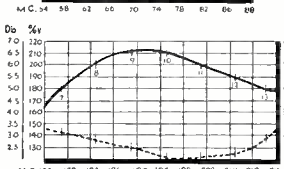




One Antenna Covers All Channels

The Para-Con antenna reaches out and grasps all channels. The Ward Para-Con has an exceptionally low standing wave ratio combined with a spectacular high gain advantage on all channels.





No Ghost Hunts

No more skeletons in your customer's TV closets. Scientifically determined direct impedance matching characteristics eliminate many ghosts. Para-Con's revolutionary design transfers the maximum power from the antenna to the receiver with a minimum of reflections.

Profit-Wise Dealers Prefer Para-Con*

The antenna is one of the most important and critical components of a TV receiver. Nearly 20% of all TV service calls result from faulty antennas. The general all-around, high performance of Ward's Para-Con antenna gives customer satisfaction right from the initial installation. Expensive call-backs due to antennas are slashed. Ruggedly built for long lasting trouble-free service Para-Con withstands winds and weather. Easy to handle and quick to install . . . saves time and expense.

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Parabolic antennas have long been used in special applications for concentrating weak signals onto driven elements. The brilliant results of Ward Para-Con are now setting new performance standards on all channels and in most every area. Ward's Para-Con Antenna is different. It's new. Now it is possible for one antenna to meet and solve many of the local problems of installation and reception.

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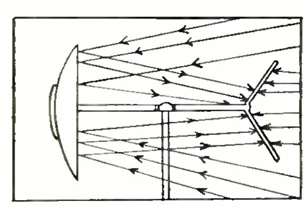
In fringe areas where selection of a number of channels is available, Ward's stacked Para-Con models provide the ideal compromise antenna for maximum results on all bands. Stacked in either two or four bay arrays, the Parabolic design reflectors reach out, gather and concentrate maximum energy on the antenna elements.



Diagramatic sketch showing how parabolic reflectors gather in and concentrate energy on conical elements.

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ductance of 10,000 μmhos and can be run in class B with 0.5 megohm in the grid circuit. The full details are supplied in the appendix. Four of these tubes give a rated power output of 116 watts at 425 volts plate supply, and they can be driven by a single 12AT7. Every other tube seems to need a low-impedance driver stage, or an extravagantly high plate voltage. To us who have to get American tubes in spite of import prohibitions and exchange regulations, it would seem to be simple indeed for an American to get EL34's.

What sort of a performance will this amplifier give? Measured at 10 volts output into a 25-ohm load, the frequency response is flat within ±1 db from 20 to over 10,000 cycles. At 100 watts the distortion is less than 2% at frequencies between 300 and 1,000 cycles. It is not much more even at 75 cycles, but this is not important, because we do not expect high levels at extreme frequencies.

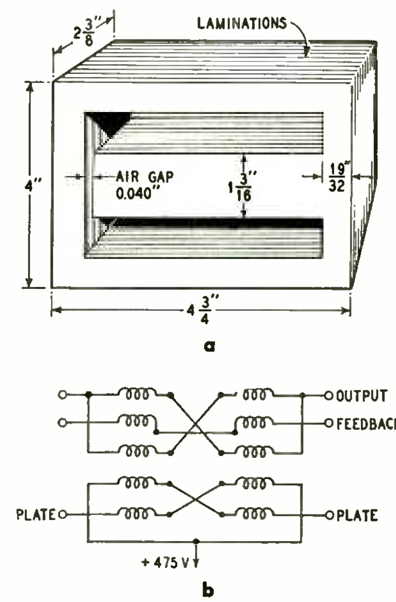
Negative feedback keeps the output impedance low, so that when the load is disconnected the output line voltage rises less than 20%, which is hardly to be detected by a listener.

The circuit diagram is shown in Fig. 1. The input tube a 12AT7 double triode, operates as a see-saw type phase-splitter. The first triode is a normal amplifier, with 47,000-ohm plate load. Cathode bias is provided by a 2,000-ohm cathode resistor together with the 2,000-ohm feedback resistor, making 1,000 ohms in all. This tube drives the lower half of the push-pull stage directly. The second triode is a unity gain amplifier with a large amount of feedback from plate to grid, which gets its input through the first 470,000-ohm resistor. That, at least, is one way of looking at it. Another way of thinking of the circuit is that the grid drive of the second tube is the difference in the plate swings of the two triodes, so that the center point of the two 470,000-ohm resistors acts as the fulcrum of a see-saw. An exact balance of the plate swings is obtained by reducing the left-hand 470,000-ohm resistor slightly, and if you do want to balance the stage closely you can try something of the order of 5 megohms in parallel with this resistor, or some tens of kilohms in series with the right-hand resistor. The second triode drives the upper half of the push-pull stage. The plate-supply voltage, about 250 volts, for the twin triode is derived from the main high-voltage supply of 425-475 volts by a potential divider and decoupling capacitor.

In the power stage all cathodes are grounded. Plate stoppers of 22 ohms are mounted close to each tube, to kill any parasitic oscillations which may otherwise be produced in the wiring. Each push-pull pair has its own 800-ohm common screen resistor, which is not decoupled. The screen voltage comes straight from the high-voltage supply. Feedback is taken from a special winding on the output transformer. With 42 volts bias on the output stage, a drive of 29.5 volts r.m.s. is needed to give full output.

The output transformer

The design of the output transformer is the first and most important stage in the detailed design of the amplifier, once the framework of the amplifier is fixed. In designing this transformer for class B it is imperative to keep the inductances low and the balance between the two sides good. Balanced



TURNS	SIZE NO.	TURNS	SIZE NO.
65	18	65	18
65	30	65	30
65	18	65	18
300	24	300	24
300	24	300	24

c

Fig. 2—The output transformer design.

direct-current polarization cannot be assumed, because we do not want to run into instability if a tube fails. We can make use of our assumption that we do not want high levels at low frequencies, and in designing the transformer I have allowed the rolloff at low frequencies to begin at 125 cycles so that the plate load is almost purely resistive down to 300 cycles, while the response is 6 db down at 60 cycles. In these circumstances the high-frequency response of the transformer alone is good up to beyond 30 kc. The inductance is easily calculated: The optimum plate-to-plate load for two tubes is 4,000 ohms, so that for 4 tubes it will be 2,000 ohms. The inductance is $2{,}000 \cdot 2\pi \cdot 125 =$ 2.54 henries. With the core size shown in Fig. 2, and an air gap of .040 inch, ordinary 14 mil silicon steel laminations, we need 1,200 turns to give an inductance of 2.5 h. The exact core size is not critical, of course, and any core of about the same size may be used. Fig. 2-a is a rough drawing of the core.

The plate windings are put on as four separate windings of 300 turns each, two in each section of a twin former. They are cross-connected as shown in Fig. 2-b. A layer of insulation, rated at 2,000 volts, is then applied. This can be supplemented with an ordinary split screen of copper foil.

Over the plate windings three additional windings are added on each half of the former. These are output, feedback, and output in that order. No. 18 AWG wire is used for the output windings, while 30 AWG is used for the feedback winding. Each of these six coils contain 65 turns. A series-parallel connection of the output windings and series feedback windings provide very close and balanced coupling between the output circuit and the feedback winding. The window cross-section appears in Fig. 2-C.

Although this sort of amplifier is usually considered to be a 2-stage circuit, which must be stable at low frequencies, it must not be forgotten that the signal in one half of the push-pull stage passes through three stages. Adequate low-frequency stability is obtained by choosing the coupling capacitors so that the response is flat to well below the 125 cycles used in the output transformer design. I have used 0.1 μf, which with the 100,000-ohm grid resistors gives a characteristic frequency below 16 cycles per second. This value of capacitance can be reduced to 0.05 μf without danger, and could probably be reduced even more.

High-frequency problems

At the high-frequency end the design presented a lot of difficulties, mainly because of the need for flexibility. An amplifier to work into a normal load is quite straightforward, but if you want to be able to remove the load or to attach a long capacitive cable with no termination the problems of design become much more complicated. Separate responses must be plotted for each possible load condition, and any circuit change must be checked in at least three different plots. To add to the difficulty a really good safety margin seemed to be desirable to meet the special conditions of parallel operation. Two shunt R-C circuits, one in each stage, and duplicated because of the push-pull operation, were found to give satisfactory results. Across each half of the transformer primary a .02-μf capacitor (1,000-volt d.c. wkg. paper tubular) is connected to prevent the load on the output side affecting the high-frequency response. The phase shift produced by this capacitance is brought back to zero in the dangerous region above 25 kc by connecting 400-ohm resistors in series with each capacitor.

An additional pair of high-frequency response control circuits across the interstage circuits of the amplifier, consisting each of a 4,700-ohm resistor in series with .002 μf, was found to be necessary. It would probably be sufficient to combine these into a single 10,000-ohm resistor and .001 μf, leaving out the ground point at the center.

One disadvantage of the stabilizing system used must be noted. At high frequencies all the power can pass into the two 400-ohm resistors across the transformer primary. Any attempt to measure the frequency response at full power will lead to a burn-out here, unless you use unreasonably large resistors. I have used 5-watt wire-wound resistors, which do not even get warm under normal working conditions. The only other resistors with any power in them are the 800-ohm screen resistors, which should be 2-watt types.

The physical layout can follow the circuit diagram. The only precautions are to keep the stages separate, and to keep the plate stopper resistors in the output stage near the tubes. Do not forget that the output line must carry 2 amperes.

Important details

The power supply unit is required to provide 6.3 amp at 6.3 volts for the heaters, a plate supply of about 550 ma at full load, dropping to about 100 ma at no input, with a smoothed voltage of 425 volts at full load. In addition a smoothed grid supply of 42 volts is needed. For the grid supply a germanium, copper oxide, or selenium rectifier may be used, and it is a good idea to take this and the heater supply from one transformer. The grid-bias voltage can be used to operate a relay in the high-voltage supply transformer primary, so that you cannot get plate voltage without bias. More trouble, true, but so is paying for new tubes if the bias supply fails. The bias must be adjusted to 42 volts with a resistor in the bias-rectifier circuit. The high voltage is supplied by a 550–0–550-volt winding and a pair of 5Z3 rectifiers. It is a good idea to make it three 5Z3's, to keep the system working through a failure. A choke input filter, using a single 10-μf capacitor, provides sufficient smoothing, and the regulation is such that the voltage at no load rises to 475 volts.

An additional *continuity of service* precaution is the connection of a second 12AT7 in parallel with the one shown.

When used as a 100-watt amplifier all tubes should be in place, and the load impedance should be 25 ohms. It is, of course, quite in order to work with higher load impedances, but you will not get 100 watts, but only $(50)^2/R$ watts, where R is the load impedance. If you need only 50 watts, pull out two of the EL34 tubes and one of the rectifiers, if you are using three. That is all. If you need 200 watts, connect two amplifiers in parallel, after checking that they are set to have the same gain. The load impedance may then be 12.5 ohms. And so on for higher powers.

It is with some regret that I come to the end of this series of articles. I have endeavored in this series to provide a sound fundamental background for the designer and constructor of feedback circuits, without exceeding the rigid limit of mathematics set by the editor. In sorting out my knowledge I myself have learned quite a lot. I can only hope that the readers have found the series of some value.

Appendix.

Philips EL34 tube: Heater: 6.3 volts, 1.5 amps. a.c. or d.c. Class B operation, 2 tubes:

Common screen resistor	800 ohms		
Bias	— 42 volts		
Grid drive	0	29.5 volts	
Supply voltage	425	425 volts	
Optimum load	4,400 ohms		
Ip	2 x 20	2 x 106 ma	212
I_{g2}	2 x 2.4	2 x 28 ma	56
Power	0	58 watts	
Distortion	—	4.5%	

—end—

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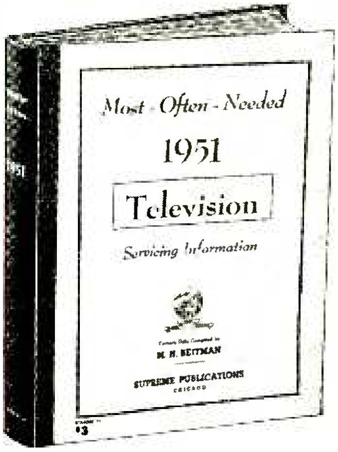

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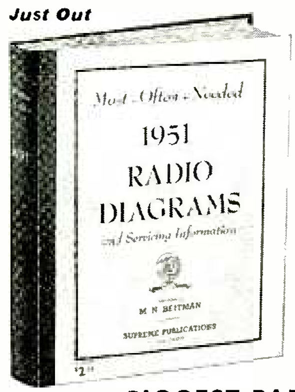

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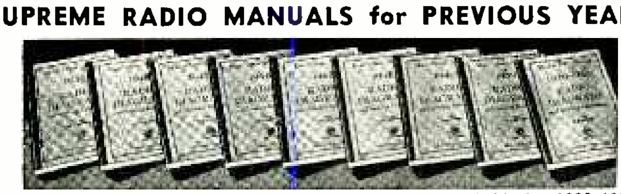

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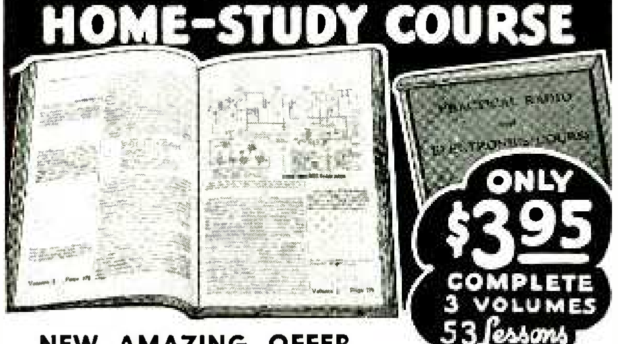

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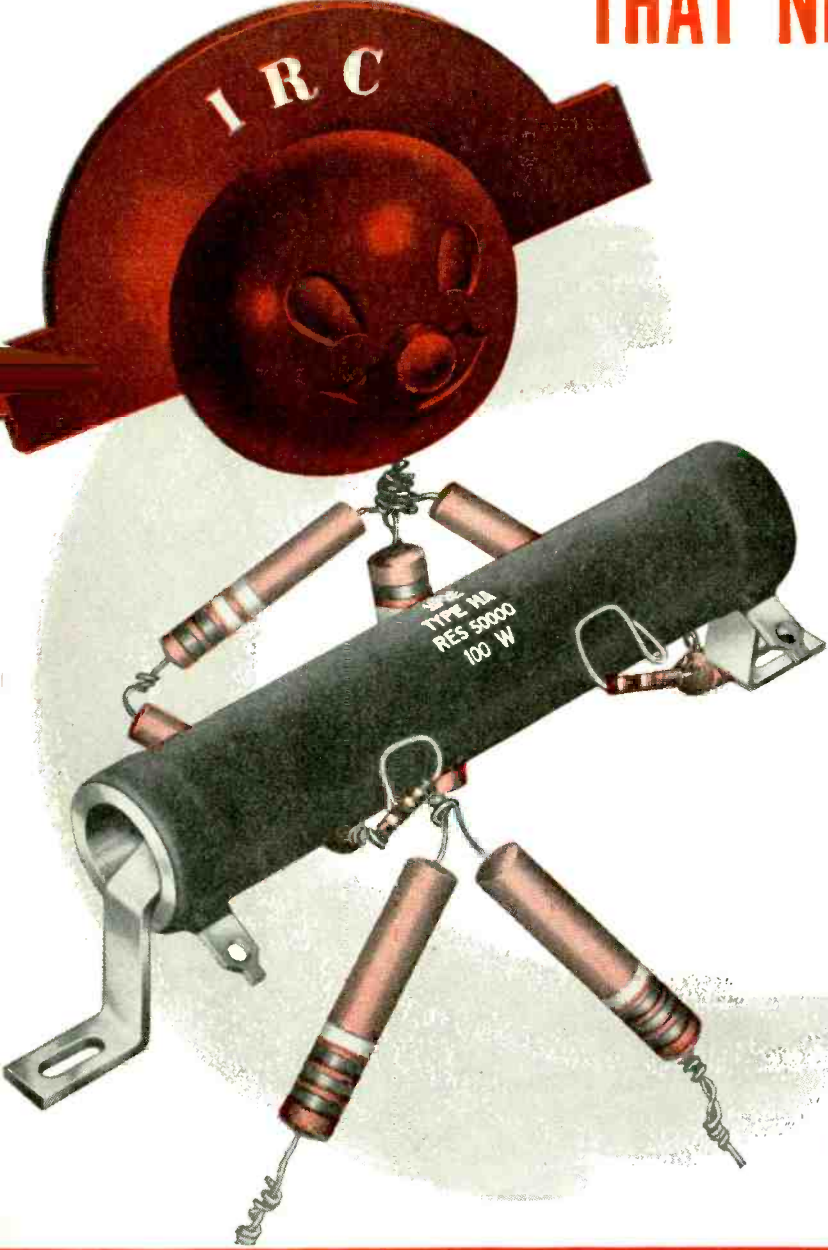

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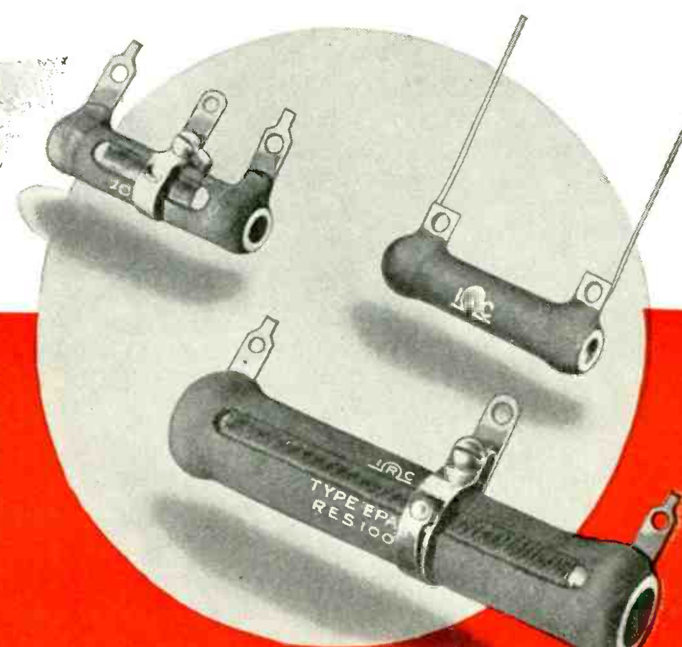

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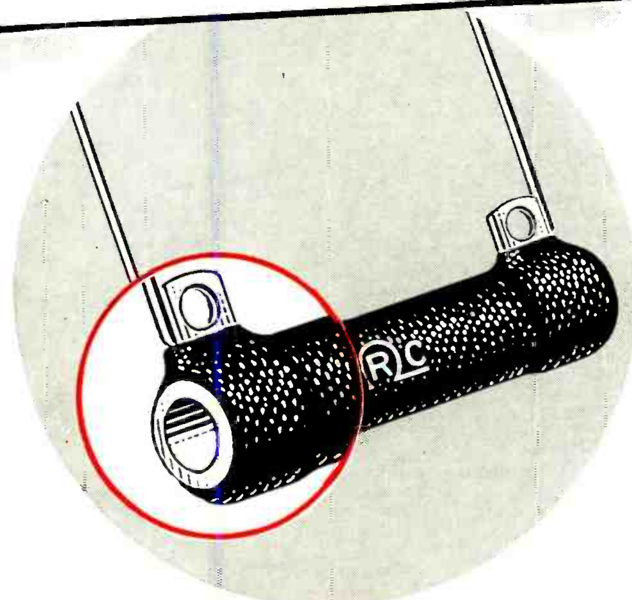

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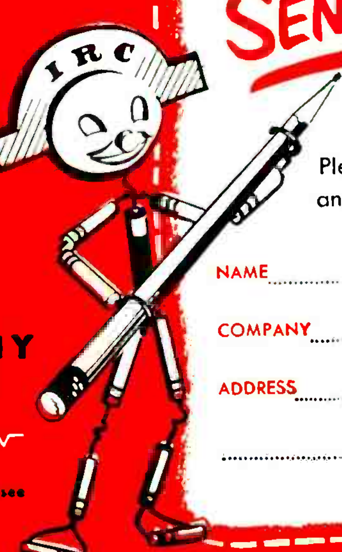

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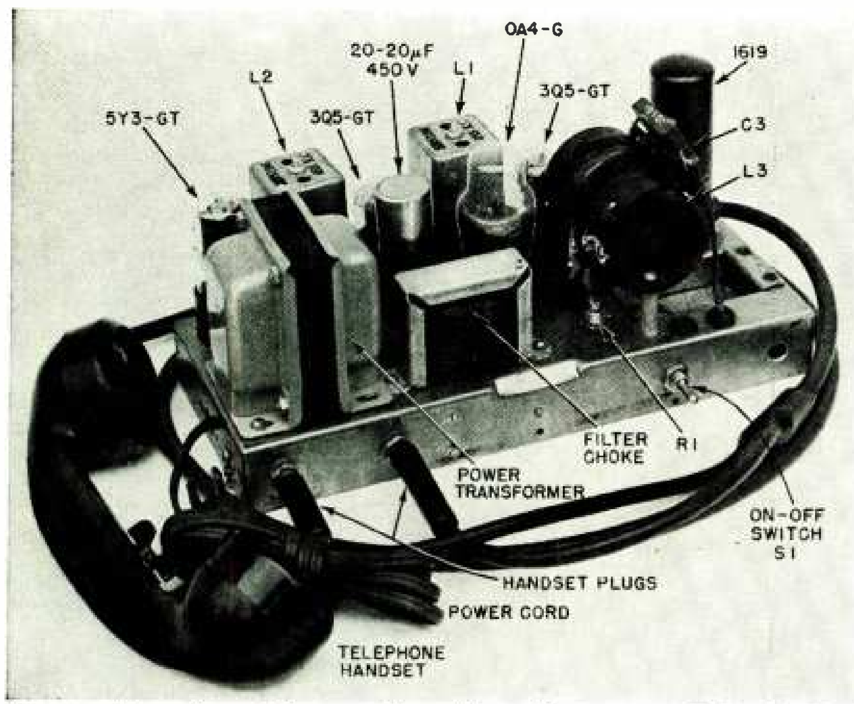


The complete equipment is mounted on this easily transported chassis. Note especially construction and mounting of the oscillation transformer L3.

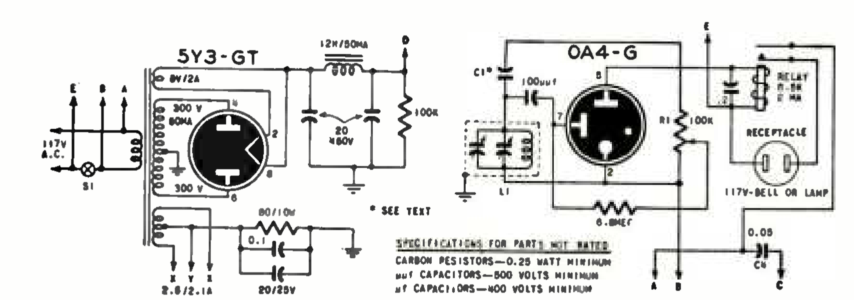


Fig. 1—The alarm or ringing circuit and power supply appear in this diagram.

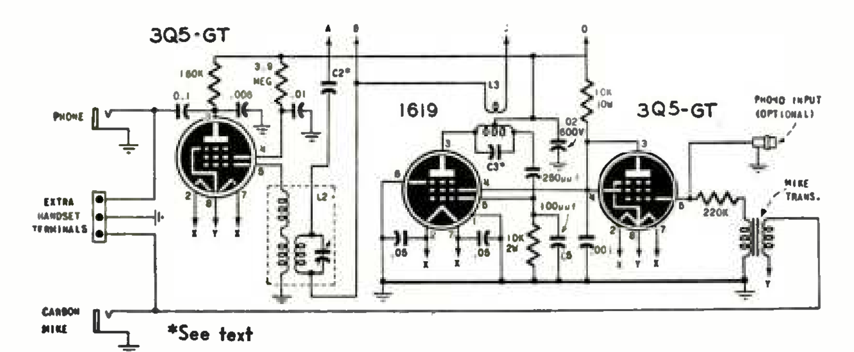


Fig. 2—Transmitter-receiver. Leads with same letter are connected together.

A PORTABLE short-range carrier-current telephone system can be a useful thing to have. Two units were constructed using this principle. Each unit is plugged into a standard power outlet and is then ready for operation without additional connecting wires.

When the power switch is turned on in one unit, an alarm is sounded in the other. Telephone handsets are used and simultaneous operation of receivers and transmitters provides duplex operation. The warmup period for each telephone unit is less than one second because tubes with directly heated cathodes are used. Each unit uses five tubes in a circuit that includes an alarm, a power supply, a receiver, and a modulated transmitter built on a single chassis measuring 11 x 4½ x 5 inches.

Signalling

A type 0A4-G cold-cathode, gas-filled tube operates an alarm relay when a carrier-current signal of a certain frequency is impressed across the series-resonant circuit including C1 and L1. L1 was made from a standard 455 kc i.f. transformer; one of its coils was removed for later use by careful heating to soften the wax. The trimmers provided with the transformer are shunted across the remaining coil to tune the series circuit. (See Fig. 1.)

A sufficient voltage is developed across the coil (when a carrier-current signal of the correct frequency is applied) to initiate a glow discharge between the starter-anode and cathode through the 100-μμf coupling capacitor. The potentiometer R1 is adjusted to provide an a.c. bias so that less r.f. voltage is required for conduction of the tube. When the starter-anode ionizes the gas, conduction from the main anode to the cathode occurs and a current flows through the relay coil.

Since the cathode is so much larger than the anode, a greater flow of electrons can take place toward the anode than toward the cathode with the impressed a.c. so that a rectified voltage is produced for the d.c. relay. The 0.2-μf capacitor shunting the relay coil eliminates relay chatter. The relay contacts can control an alarm bell or signal lamp.

If desired, the relay mechanism itself can serve as a buzzer by merely removing the shunting capacitor. With the contacts in vibration the controlled output should not be used because of the arcing that would result. With S1 in the off position the 0A4-G circuit will signal when a carrier-current signal is present. With S1 on, the 0A4-G circuit is shunted and inoperative. A toggle switch was used by the author, but a micro-switch operated by hanging up the telephone handset could be used.

Power supply

When S1 is turned on, the power transformer is energized and in less than one second the four directly-heated-cathode tubes become operative. The 5Y3-GT acts as a full-wave rectifier. Two plates are connected to the ends of the high-voltage winding as is standard practice. The 20-μf capacitors and 12-henry choke provide adequate smoothing of the direct current for the carrier-current receiver and transmitter. The 100,000-ohm bleeder resistor aids voltage regulation. The 80-ohm carbon resistor connected from the center-tap of the 2.5-volt filament winding to ground carries the current from the cathode circuits of the detector, modulator, and oscillator tubes and develops a small potential of about 2 volts. This acts as grid bias for all three stages and also as a d.c. source in the carbon microphone circuit. This resistor is shunted by two capacitors to prevent audio oscillation and loss of gain.

The receiver

The receiver uses a single 3Q5-GT, see Fig. 2, in a grid-bias detector circuit. The tuning coil L2 was made from a 455-kc i.f. transformer plus the winding removed in making L1. The added winding was slipped next to one of the two coils in the can. Then, the trimmer capacitor was disconnected from the coil closest to the added winding and these two windings were joined in series so that their magnetic fields aid each other.

The trimmer across the primary winding does the tuning. This primary winding was moved closer to the secondary coils for greater transfer of energy. The primary which is connected across the line through C2 resembles the 0A4-G resonant circuit except for the inductive coupling which is necessary to isolate the chassis from the power line. C2 is made of 2 ceramic capacitors, one 240- and one 100-μμf capacitor, paralleled. Detection is accomplished by amplification of the positive half of the received carrier-current signal only. The negative portion of the signal added to the negative bias causes negligible plate current to flow in comparison to the positive signal portion. The audio signal produced in the plate circuit is coupled to the headphone by a 0.1-μf capacitor. The receiver is tuned to the same frequency as the 0A4-G alarm.

The transmitter

The carrier-current transmitter uses a 1619 tube connected as a Hartley oscillator using series feed and a type 3Q5-GT triode-connected modulator. The coil L3 is wound on a form 2 inches in diameter and 2¾ inches in length with 55 turns of No. 26 enameled wire. A tap is provided at about the center for connection to the positive side of the power supply. Two turns of well-insulated hookup wire are wrapped around the center of this winding to couple the generated signal to the power line through C4. The windings are fastened to the form with dope.

Also mounted on the form is the mica capacitor C3 which is chosen to fix the frequency of resonance. C5 shunts the grid-leak resistor and suppresses harmonics that might otherwise interfere with nearby radio and TV receivers. The reactance of a capacitor varies inversely with frequency so that the higher frequencies are shunted to a very much greater extent than the fundamental low-frequency carrier-current signal.

Connected directly to the screen grid of the 1619 tube is the plate of the triode-connected 3Q5-GT tube. The 10,000-ohm dropping resistor applies a voltage to the screen which is fluctuated according to the signal applied to the modulator. The phono input shown is for high impedance sound sources; it is isolated from the microphone transformer by the 220,000-ohm resistor.

The operating frequencies and values for C1, C2, and C3 are included in Table 1. Small ceramic or mica capacitors are suitable for C1 and C2, while mica capacitors of 1,200-volt rating should be used for C3.

Alignment procedure

With both telephone units plugged into nearby electrical outlets the aligning procedure can be started. The first step is to adjust the potentiometers (R1) on each unit with both power switches (S1) turned off. They are set to the position at which a glow discharge of the 0A4-G's and the relays are just about to close.

Next, one unit is turned on and the trimmer shunting L1 of the other unit is adjusted for glow discharge and relay closing. The most sensitive point is found by tuning for the glow to cover as much of the cathode electrode as possible. The procedure is next repeated with opposite units on and off.

Now, with both units on, the receivers of each unit are adjusted for loudest signals from the other transmitter unit. Receiver tuning is done with the L2 trimmers. An audio tone applied to the modulator is a good sound source, and a sensitive a.c. voltmeter across the phone terminals makes a better alignment indicator than the ear. After the initial alignment, the telephone units can be plugged into outlets separated by a greater distance and the process repeated with weaker signals for finer adjustment.

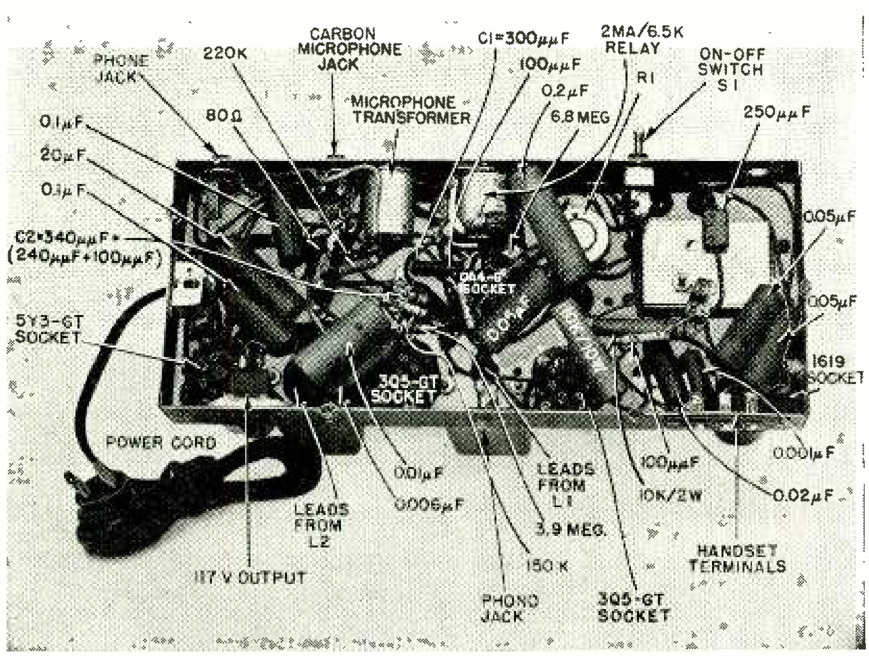
The power-line medium is an unknown variable, since different electrical loads that are connected and disconnected from the line tend to absorb r.f. energy and change the useful range of communication. In most cases it should be possible to use the units satisfactorily for operation between any two locations in the home, or any locations where meters or other bypassing devices do not intervene.

To use more than two of these phones some experimentation would be necessary. A frequency-selector switch might be added, and undoubtedly there would be a question of choosing frequencies that would not interfere with one another.

(In some cases, signals from the transmitter may be strong enough to block the receiver in the same station unit even though their frequencies are 20 kc or more apart. If this happens, it is advisable to install a spring-return type s.p.d.t. send-receive switch in series with the B-plus leads to the transmitter and receiver circuits. The B-plus lead from the power supply connects to the arm of the switch, the normally closed contact to the B-plus lead of the receiver. The normally open contact goes to the B-plus lead to the transmitter. If your handset has a talk-listen switch like that shown in the photo, this switch can be used to control a send-receive relay connected in place of the switch in the B-plus lead.—*Editor*)

TABLE I

Unit	Frequency of Alarm Circuit and Receiver	Frequency of Transmitter	Mica C1 170-215 kc	Mica C2 181-209 kc	Mica C3
1	186 kc	207 kc	300 μμf	340 μμf (240+100)	0.005 μf
2	207 kc	186 kc	300 μμf	340 μμf (240+100)	0.006 μf



Compactness of the equipment and the large number of components mounted on the chassis make for a rather crowded underchassis layout. However, the constructor will be aided by the rather complete callout of components.

Materials for telephone unit

Resistors: 1—.1, 1—.15, 1—.22, 1—3.9, 1—6.8 megohms, ½ watt; 1—10,000 ohm, 2 watt; 1—10,000 ohm, 10 watt; 1—80 ohm, watt; 1—100,000 ohm potentiometer.

Capacitors: (Ceramic) 1—240, 1—100 μμf. (Electrolytic) 1—20 μf, 25 volts; 2—20 μf, 450 volts. (Mica) 2—100, 1—250, 1—300, 1—.005, 1—.006 μf, 1,200 volts. (Paper) 1—.001, 1—.006, 1—.01, 2—.1, 1—.2 μf, 400 volts; 2—.02, 3—.05 μf, 600 volts.

Inductors: 1—choke, 12 h, 50 ma; 1—power transformer, 300-0-300 volts, 50 ma with 2.5- and 5-volt windings. 1—mike transformer, for carbon mike. 2—i.f. transformers, 455 kc.

Miscellaneous: Tubes: 1—0A4-G, 1—5Y3-GT, 1—1619, 2—3Q5-GT, and sockets for same. 1—Relay, 2 ma, 6,500-ohm coil, s.p.s.t., contacts heavy enough to control lamp or bell 1—s.p.s.t. toggle switch. 1—coil form, 2-inch diameter, 2¾-inches long. 1—Phone jack. 1—Mike jack. 1—Phono jack. 1—terminal strip, 3—terminals. Chassis. Hardware. Wire.

—end—

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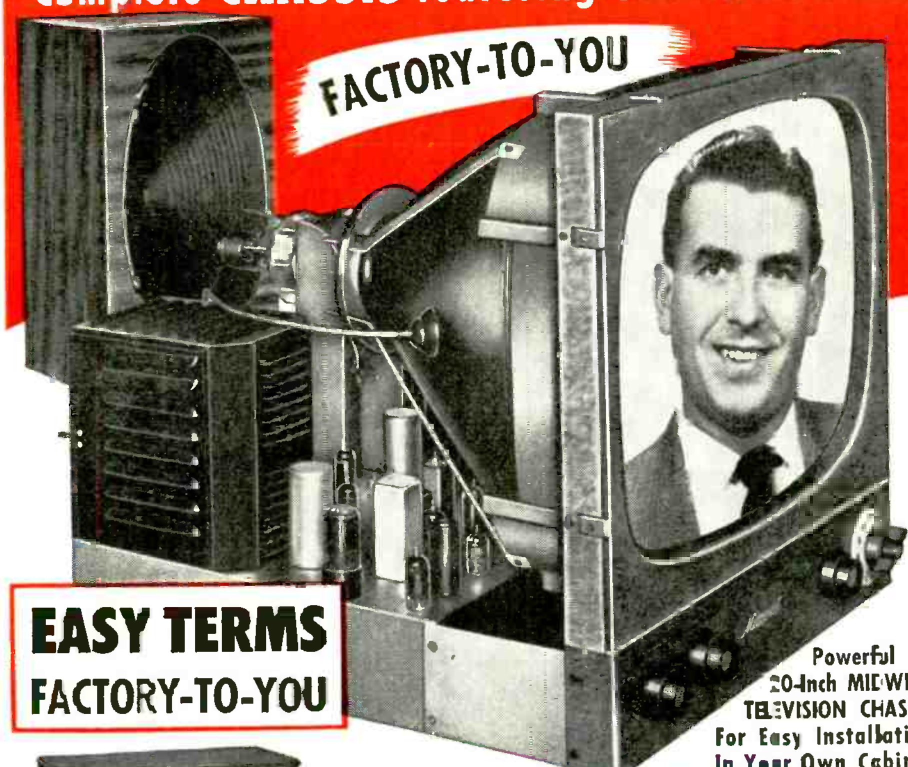

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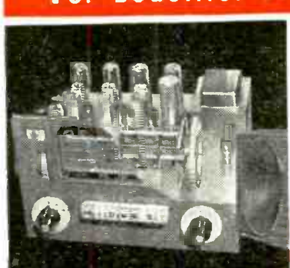

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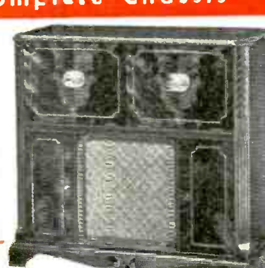

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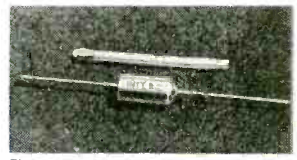
New Devices

SEALED RECTIFIERS

International Rectifier Corp., 6809 S. Victoria Ave., Los Angeles 43, has developed a new line of hermetically sealed selenium rectifiers. They are assembled in half-wave cartridges with current ratings from 300 μa up to 60 ma. The individual cartridges accommodate up to 400 cell elements with d.c. voltage ratings up to 8,000 volts per cartridge. By connecting a number of cartridges in series, voltages up to 250,000 have been obtained.



The assembly is rugged and impervious to the effects of outside atmosphere. The units are capable of withstanding 100 G's of acceleration, and are ideally suited for airborne applications. They can be operated in ambient temperatures up to 100° C. Outside diameters vary from 3/16-inch up to 1¼-inches, depending upon current rating.

These rectifiers are designed for applications such as air-borne radar components, guided missiles, bias supplies, inverse peak clippers, oscilloscope power supplies, solenoid power supplies, modulators, etc.

BROADBAND TV BOOSTER

Electro-Voice, Inc., Buchanan, Mich., announces the new model 3002 Tune-O-Matic two-stage broad-band automatic self-tuning TV booster, for fringe and intermediate areas. It uses two type 6BK7 tubes (one on the high bands and one on the low) in an exclusive low-noise circuit, and provides uniformly high usable gain with very low internal noise, on all channels, 2-13.

Tuning is automatic—no booster dials to turn—and it is turned on or off by the TV receiver switch.

The all-electronic circuit is a.c.-powered and has high stability, insuring long, trouble-free service.

The booster is finished in baked lacquer copper tone. It is 6⅞x3⅛x3⅝-inches and weighs 1 pound 13 ounces. It has rubber grommet feet to protect polished surfaces.

VIDEO AMPLIFIER

Polaroid Electronics Corp., 100 Metropolitan Avenue, Brooklyn 11, N. Y., announces a new, improved wide-band video amplifier, model V-2. It has a flat amplitude response ± 1.5 db from below 10 cycles to 20 megacycles.

It is designed for use as an oscilloscope deflection amplifier for the measurement and viewing of pulses of extremely short duration and rise time. It is a tool for laboratory and industrial use to extend the amplitude range of vacuum-tube voltmeters and signal generators. Its extended low-frequency responses permit accurate analysis of television signals. Sixty-cycle square waves are passed with less than 5% tilt.

4-WAY SWITCH

JFD Manufacturing Co., Inc., 6101 Sixteenth Ave., Brooklyn 4, N. Y., is producing a new four-way antenna switch. The new accessory supplies swift, low-loss switching facilities in any TV installation, local or remote, where up to four antennas are used. A constant-impedance rotary switch with low-loss-resistance silver-to-silver contacts provides maximum energy transfer. The new JFD accessory is housed in a compact bakelite case.

TEST PROD ADAPTER

United Technical Laboratories, Morristown, N. J., announce a new test prod adapter specially designed for use with standard R.T.M.A. test points or the phonograph needle type so that any point in miniaturized or other compact electronic circuits may be conveniently contacted by a self-holding prod.

The new *Klipzon* type L Longie adapter provides a slender, insulated point for reaching into crowded circuits without danger of shorts, shock, or accidental disconect. A unique self-holding point permits measurements with both hands free for circuit adjustment, soldering, or other work.

Klipzon type L adapters, which are about 3 inches long and are available in red and black, clip onto wires ranging from the finest to No. 12 AWG. Prod points are made of nonmagnetic alloy steel and are needle sharp for easy piercing of insulation, protective coatings, and fungus. The adapters are easily slipped onto standard test prods.

BASIC CHASSIS

Alden Products Company, 117 North Main St., Brockton 64, Mass., has designed a new basic chassis on which most circuit elements can be laid out and easily fabricated as unit subassemblies.

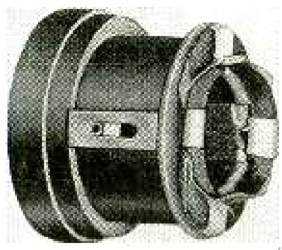
Heart of the chassis is the terminal mounting board system whereby tube sockets and all associated circuitry are mounted and interwired as an individual subassembly for mounting in basic chassis. Mounted on both sides of the chassis, terminal boards are instantly accessible for inspection or removal. Hundreds of prepunched holes on the terminal boards permit an almost unlimited number of circuit patterns to be wired without modification of any sort. Alden miniature terminals staked into holes as per optimum pattern hold components firmly for soldering without time-consuming wrap-around of leads.

The simplified production methods made possible by the new chassis speed up production. When an electronic design is ready to go into production, the schematic is divided into functional blocks of circuitry. These blocks can readily be laid out on the standard components of the Alden basic chassis. Costly intermediate steps of housing design, modification of the prototype, tooling, ordering of special connectors, plugs, etc., are eliminated. On the production line, terminal boards, front panel, back connectors, and cabling are all wired as subassemblies, resulting in increased production efficiency.

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

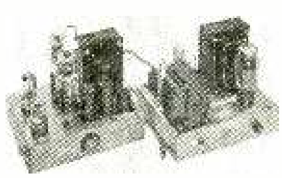
DEFLECTION YOKE

Cleveland Electronics, Inc., 6612 Euclid Avenue, Cleveland 3, Ohio, has designed a deflection yoke with anastigmatically corrected coils to provide a sharper focus over the entire picture area. Insulated against high temperature throughout with materials to withstand temperatures up to 90 degrees Celsius. Quadruple Formvar wire insulation used on all horizontal coils for maximum protection against high voltage. Easily installed with a floating type cage nut that permits rapid and accurate adjustment.



WILLIAMSON COMPONENTS

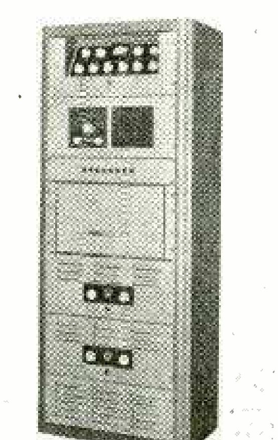
Standard Transformer Corp., 3580 Elston Ave., Chicago 18, announces Stancor components for the famous Williamson amplifier, designed to make high-fidelity audio available at low cost. The new Stancor components include a high-fidelity output transformer A-8054, power transformer PC8412, and filter choke C-1411.



Tests made by an independent testing laboratory on a unit built from standard stock parts show zero db frequency response from 20 cycles to 50 kc at the 8-watt level, remaining unchanged at the low level of 0.5 watts. Intermodulation distortion measures 3% at 8 watts output. Total harmonic distortion at 1,000 cycles is extremely low and may be considered nonexistent below the 10-watt power level, the tests showed.

RACK ASSEMBLIES

Newcomb Audio Products Co., 6824 Lexington Ave., Hollywood 38, Cal., offers basic elements for custom, cabinet-type rack systems. Designed for flexibility, these assemblies enable the engineer to install PA equipment to meet individual requirements. All standard Newcomb amplifiers are available mounted in panels, as well as a record changer, radio, intercom amplifier, and other special equipment. Mounting holes are RMA standard 1¼- and ½-inch spacings. Panel mounting holes are tapped in ⅛-inch stock. Fully ventilated rear door provides easy accessibility. Entire cabinet is a welded assembly with dark grey hammertone finish, and has provision in rear for nine ½-inch conduits. A removable terminal-strip mounting plate is included near conduit inlets. Dimensions are 59½- x 23- x 16-inches.



PICK-UP STICK

Hytron Radio and Electronics Co., Salem, Mass., has brought out an in-

teresting and useful novelty in the form of a pencil with an adhesive wax tip in place of the eraser. This special wax tip picks up screws, nuts, etc., dropped into inaccessible spots in radio chassis. It also holds head of screw in those impossible-to-reach spots while starting nuts. Just a slight pressure of the special wax tip does the trick. The Pick-Up Stick doubles in brass as a pencil too.

CHIMNEY MOUNT

The Radiart Corporation, Cleveland 2, Ohio, announces the development of an entirely new idea in chimney mounts for TV antennas. Known as the Spee-Dee chimney mount, it is swiftly installed without the usual nuts and bolts for tightening the straps around the chimney. A slip-proof aluminum ratchet

lock winds up the straps and locks them tightly in place.

Use with masts up to 1¾ inch O.D. is made possible by the large U-bolt.

JUNIOR VOLTOHMYST

RCA, Harrison, N. J. announce the latest addition to RCA's Blue Ribbon test equipment line, the new WV-77A Junior VoltOhmyst meter, measuring a.c. volts, d.c. volts, and resistance in five different ranges. The all-electronic meter features a high-impedance diode tube as a signal rectifier, an electronic bridge circuit similar to

the one used in RCA's Senior VoltOhmyst meter, a 200-microampere movement, and carbon-film multiplier resistors.

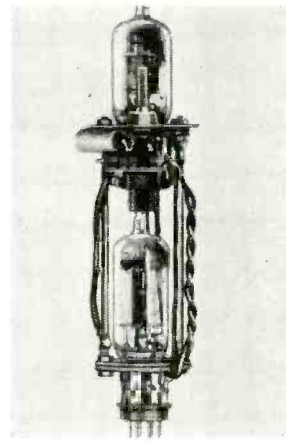
PIC TUBE TESTER

Oak Ridge Products, 37-01 Vernon Blvd., Long Island City 1, N. Y., announces the *Cathette*, a tester for checking C-R tubes in the television set under high-voltage operating conditions.

This compact tester measures only 5½x3⅞x2¼ inches. It checks all magnetic and electrostatic focused tubes and has a large full-scale meter, calibrated with GOOD-BAD scales.

SIGNAL BOOSTER

The Grayburne Corporation, 103 Lafayette St., New York 13, N. Y., has produced a new TV i.f. signal booster specifically designed for use in near-fringe as well as metropolitan or suburban areas where a moderate increase in signal will produce satisfactory results on "those weak stations" present in every TV locality.

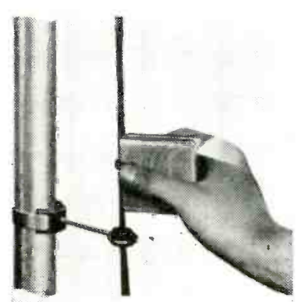


By increasing video and audio signals approximately 25%, the booster can often change unsatisfactory pictures into pleasing TV reception at nominal cost.

Designated the model TSB-1, the new booster is a complete i.f. stage ready for insertion in the receiver circuit in a matter of minutes. No external cabinet to house the unit is needed, and no on-off or channel switches are required.

BREAK LOCATOR

Easy-Up Tower Co., Racine, Wis., has introduced a testing device for quickly locating breaks in 300-ohm twin line. Sold under the trade name *Twin-Test*, it indicates the exact location of the break by a light. Twin line can be tested while connected to any type of antenna, whether open- or closed-circuit.



C-R TUBE TESTER

Trojan Electronics, 3706 North Halsteod St., Chicago, has developed a new tube tester which enables the television service technician to determine the condition of a picture tube without removing it from the chassis.

The model 601 will check all the more commonly used direct-view tubes made since 1946. Condition of the tube is indicated by the fractional milliampere reading of the meter.

The tester is designed for durability. Its meter is protected with a 5-ma fuse, and it is light in weight (just under 3 pounds).

ALL-CHANNEL AMPLIFIER

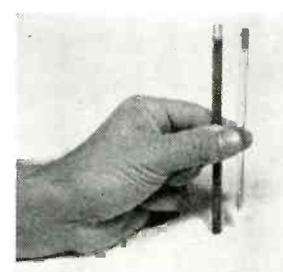
Blonder-Tongue Laboratories, 38 N. Second Ave., Mt. Vernon, N. Y., has just introduced a new type commercial TV amplifier.

Their new unit, called the Commercial Antensifier, is a 4-tube, 4-stage TV signal amplifier that will suppy a gain of 30 db on all channels simultaneously. Operation is automatic, without any tuning or adjustment whatever.

This unit can be used with the Blonder-Tongue, and every other master antenna distribution system, to overcome line losses at any point in the system. In weak signal areas, it can be used as a preamplifier for the distribution system.

TV SERVICE TOOLS

Insuline Corporation of America, 36-02 35th Ave., Long Island City 1, N. Y., has placed on the market two new tools designed to speed up television and radio servicing operations. The first is the No. 6247 dual-bladed Kleer aligner. This is a rod of low-loss transparent plastic, 4½ inches long and

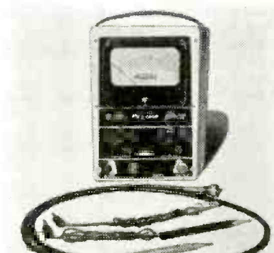


7/32 inch in diameter, fitted with corrosion-proof steel blades .018 inch and .025 inch thick, respectively.

The second of these instruments is the No. 6249 tuning wand, which is a brown phenolic rod 4¾ inches long and ¼ inch in diameter. One end contains a molded powdered iron core having a permeability tolerance of 2% and a Q tolerance of 10%; the other end of the rod contains a silver-plated brass core.

V.T. VOLTMETER

Precise Development Corp., Oceanside, N. Y., has commenced delivering its new vacuum-tube voltmeter, the model 909. It has six voltage ranges for both a.c. and d.c., five for resistance, and one decibel range. Ranges are:
Volts: 0-5-25-50-250-500-1,000.
Ohms: .01 to 1 billion in five ranges.
Db: —20 to +55.



The voltmeter is available in kit or factory-wired form. The instrument measures 9½ x 6 x 5 inches and its shipping weight is 10 pounds.

—end—

Converting the Mark II

By

LOUIS H. HIPPE, W6APQ

Minor changes improve the equipment. The author increased the output on phone with speech amplification and plate modulation

THE No. 19 Mark II radio set is one of the most beautifully engineered and built pieces of radio equipment to be offered to date on the surplus market. Designed to operate in combat tanks, its construction is rugged enough to stand up under almost any amateur use. In addition, its size makes it ideally suited to portable or mobile use. As for versatility, it is actually two complete ham stations in one. Set A covers the 3.5- and 7-mc bands. Set B is a high-frequency transceiver that operates on 235 mc. Both sets are tuned by variable-frequency oscillators, which adds to their usefulness.

For phone operation set A employs low-level grid modulation. The oscillator is modulated in set B.

We used the rig on 75-meter phone for several months without modifications. Reports indicated that unless we shouted into the microphone the resultant modulation was insufficient to kick the 807 final anywhere near a useable level. W6ABM suggested we use the intercom amplifier in the rig as a pre-amp to increase the output of the modulator. The changes are very simple and the changeover can be made in three easy steps.

1. Reverse the leads to prongs 3 and 1 on power socket PL2A, on lower left corner of front panel.
2. Disconnect the center wire of the shielded lead from the microphone input transformer T3A, leaving the shield connected to ground. To the center wire of the shielded line just disconnected, solder another length of shielded wire which is in turn to be connected to the secondary of the intercom output transformer. This is the tap on the left front of T6A having the white lead soldered to it.

   It is not necessary to disconnect the white wire from T6A, once the new shielded wire is soldered to this terminal the output of the intercom will drive the grid of V3A and thus modulate the 807 final stage.
3. Resistor R23D (22,000 ohms), located on the grid cap of V1F can be left as is or it may be shorted out, whichever seems to give the best results.

The above will give added kick to the grid of the 807 and set A may be used according to operating instructions without having to shout into the microphone.

Plate modulation

However, on phone operation input to the 807 is only 5 watts as compared to the 30 watts input on c.w. By converting to plate modulation the power input for phone operation can be brought up to the level of that possible for c.w. This, too is a simple operation and can be completed in an evening. We do this by using the output of the intercom as a modulator for the 807 plate. Make all changes as described in 1 and 3 above. After these are completed, continue as follows:

4. Replace the 6V6-G (V8B) with a 6L6. (V8B is the tube at the left rear as you face the set from the front top.)
5. Replace R39A, the cathode resistor of V8B, with a 500-ohm, 10-watt resistor bypassed with a 4-μf, 50-volt electrolytic capacitor.
6. Disconnect the plate of the 6L6 (V8B) from the primary of T6A.
7. Use a 10-watt modulation transformer (Hadley S-588-D, Peerless M2103X, or equivalent, provided it is physically small) to couple the output of V8B (the 6L6) to the plate circuit of the 807 final. Use the *entire* primary winding of the modulation transformer. Connect one side of the primary to the plate of the 6L6 (V8B). Leave the other side of the primary floating until step 8 is completed.
8. Break the 500-volt lead to the plate coil of the 807 final amplifier. Connect the 807 plate coil to one of the secondary leads on the modulation transformer. The other lead from the secondary *and* the remaining wire across from it on the *primary* side are both connected to the 500-volt lead to the power supply.
9. Replace C33B with an .002-μf, 1,500-volt paper capacitor. (C33B is connected from the lower end of the 807 plate-tank coil to ground.)
10. Short out the *two bottom pins on the contacts nearest to the back of the set on the* MCW—CW—PHONE *switch*. See Photo A. This increases the power input on phone to 30 watts.
11. Change resistor R8F (from grid of V8B to ground) to 470,000 ohms, ½ watt.
12. Use set in normal manner. Be sure the ALL switch is in the ON position to place the former intercom amplifier in operation as the modulator.

The screen of the 807 is not modulated. To do this would entail further modifications if you work c.w. Lack of screen modulation does not seem to affect the modulation quality, however, as reports on the air indicate.

Finding sufficient room to mount the plate-modulation transformer may seem to be a hopeless task. However, you can find sufficient space by shifting the shield located between the 807 and transformer T6A. Move it back against the side of T6A and swing the small transformer T2A back so the edge of its mounting bracket can slip under the edge of T6A. Its opposite mounting bracket is fastened to the chassis by a bolt through the extra hole drilled in the chassis. Location of the modulation transformer is shown in Photo B on next page.

Since with plate modulation the former speech input transformer T3A is no longer needed, it can be removed to provide room for a stand-by input transformer for use with other equipment you might build. Remove the tubes in the receiver section opposite the transformer. With a long, thin screwdriver carefully reach back between the variable tuning capacitor and remove the two screws that hold T3A to the chassis shield. You may have to remove the screws that hold this shield

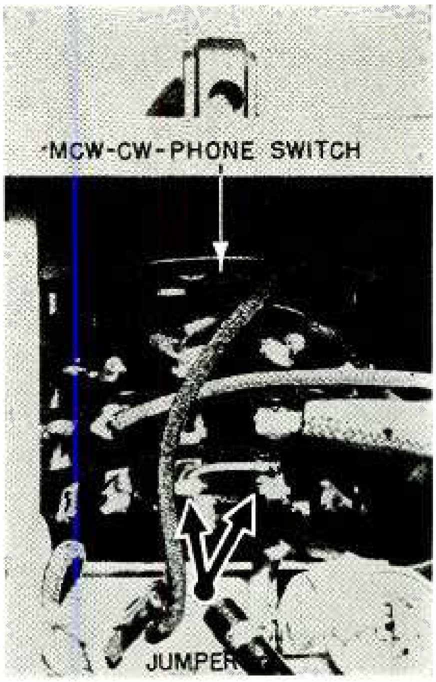


Photo A—Underside, MCW-CW-PHONE switch. Install jumper as shown.

in place so that it may be raised to permit removal of the transformer.

A.C. operation

If you build an a.c. power pack for the unit, either you must provide 12-volts d.c. for the heaters and relays or you can cut loose the filaments so that a.c. may be used on them, thus reducing the d.c. drain so a lighter d.c. source can be used for the relays. The relays *must* be operated from d.c. Surplus selenium rectifiers solve this problem nicely. Note that the filament and relay circuits can be operated on 6 volts by reconnecting them in parallel instead of series and series parallel as they are hooked up at present.

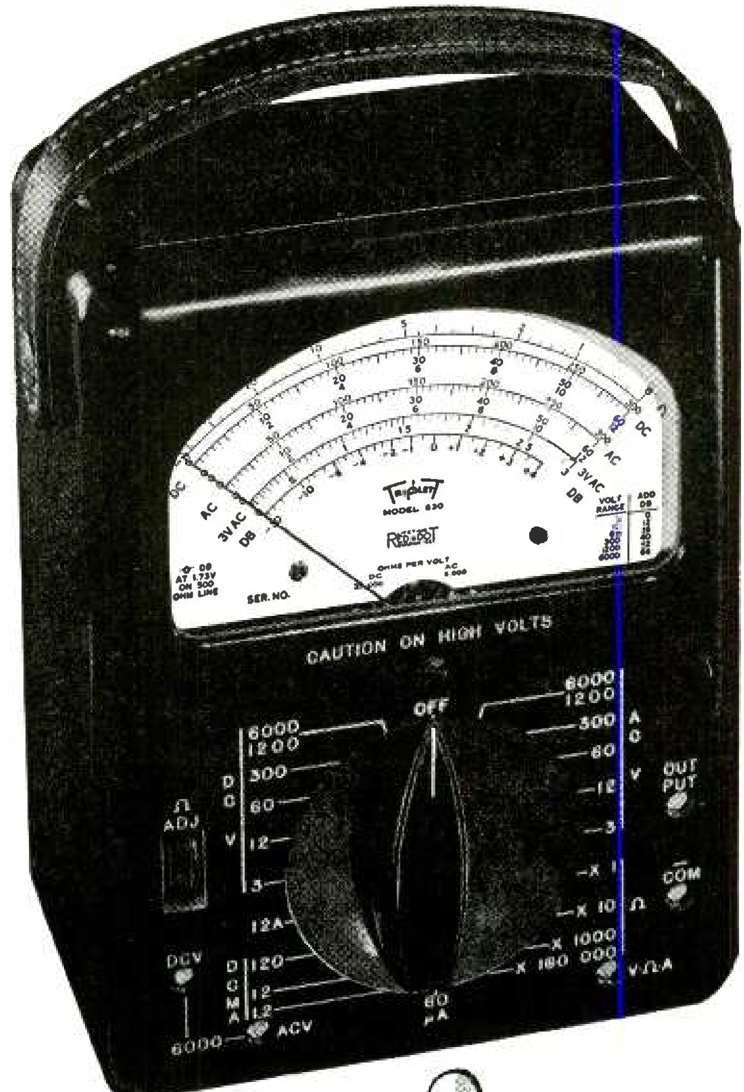
The voltage which supplies the 807 screen, speech amplifier, and receiver is fairly critical. The voltage on the high-voltage section should not run over 600; the voltage for the low-voltage section should read not less than 300. These readings should be made at the voltage divider with the power pack under full load. If the low-voltage reading is too low, downward modulation will result. This is indicated by the down kick of the panel meter in AE position or the glow of ½ watt neon bulb.

The power supply is connected in the conventional manner but should be capable of delivering 250 ma. Be sure the components used are capable of handling the total load without overload or excessive voltage drop.

Mobile operation

If the set is intended for mobile operation, the first three steps of the conversion are all that is necessary. This limits the set to 5 watts input which is about the limit of the capabilities of the

Photo B—Shield and transformer T2A are moved back to make room for transformer needed for plate modulation.


CAUTION ON HIGH VOLTS
OFF
MODEL 630
SER. NO.
ADJ
DCV
ACV
OUT PUT
COM

dynamotor for phone operation. The 500-volt section is rated at only 65 ma; the 275-volt section at 125 ma. If you use the dynamotor after conversion to plate modulation, be sure the resistor placed in the cathode of V8B (step 5 above) does not fall below the specified value otherwise the 6L6 will draw so much current that the dynamotor will overheat. The low-voltage section of the dynamotor is well filtered (32 μf) but the high-voltage section is not. The 0.1-μf capacitor, C33A, is much too small. This probably explains why the c.w. note is rough. Heavier filtering helps to clear up this as well as help remove carrier hum.

Putting the B set on 2 meters

The versatility of the Mark II can be increased by further conversion of the B set for 2-meter operation. This is an even simpler conversion than the one just described for the A set. The conversion is simplest when following these steps:

1. Remove the present coil from the transceiver. (Note its connections carefully before removal.)
2. Wind a 5-turn coil, ⅜ inch inside diameter, with No. 10 antenna wire. Space the coil to a length of 11/16 inch.
3. Solder the new coil in the transceiver, using the *same connections as on the previous coil.*
4. The transceiver is now on two meters and may be operated exactly the same as before conversion. Be sure and check with 2-meter stations for band-edge limits on the tuning dial. Adjustments can be made by stretching or squeezing the coil. See Photo C.

The low-voltage (300-volt) tap from the power supply also feeds the four tubes in the transceiver. If the plate voltage falls below 275 the sensitivity of the B set receiver will suffer and a reduction in output when transmitting will result.

Antennas for the Mark II

A 123-foot off-center fed Hertz or Marconi works best on 75. Use a transmitting-type variable capacitor (about 80 μμf) in series with the antenna lead. Set capacitor to half capacitance and peak the circuit with the variometer.

The 2-meter antenna used at W6APQ is a commercial 5-element Yagi fed with 52-ohm coax and coupled directly into the transceiver through the connector provided on set B.

—end—

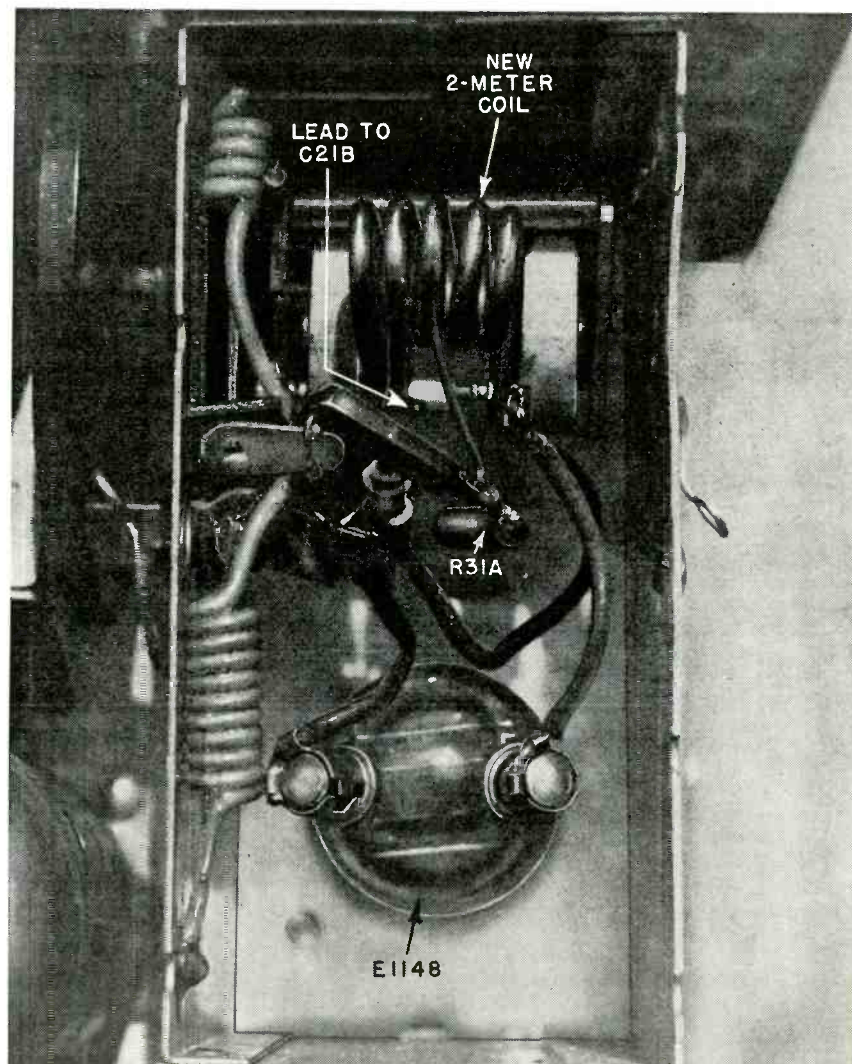


Photo C—V.h.f. compartment showing the location of the coil used for 2 meters.

Your Tape Recordings Are Not Negotiable!

If you cut your own records or make tapes from radio broadcasts with your own recorder, don't try to sell them! The Metropolitan Opera Association and Columbia Records got a New York dealer into a lot of trouble because of that. The dealer tuned in the opera every Saturday afternoon, cut a master plate from the broadcast, stamped out a lot of records and sold them cheap, without paying royalties and without much overhead.

The Metropolitan Opera Association didn't like it because it was a poor recording job and made the opera sound bad.

Columbia Records didn't like it because they had exclusive rights to record the Metropolitan operas and the exclusive right to use the Metropolitan name on records. They had to have expensive special performances to record an opera.

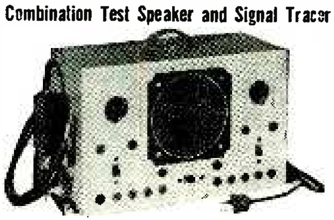
The pirate recorder made a good case in court and almost got away with it. The copyright on all the operas expired long ago; anyone can perform *Lohengrin* or *Tannhauser* or *Carmen* or almost anything else the Metropolitan does without paying any royalty. So he claimed that he had not violated any copyright law.

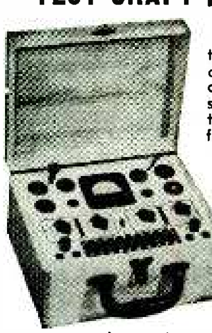
The pirate said that he wasn't competing with the Metropolitan, as he wasn't trying to run a rival opera or steal customers from them, so they had no grounds to complain. And he hadn't stolen anything from Columbia; competition is legal in this country, and a business rival has no right to sue you if you are able to produce cheaper than he can. As far as this particular dealer was concerned, it was simply a matter of free enterprise.

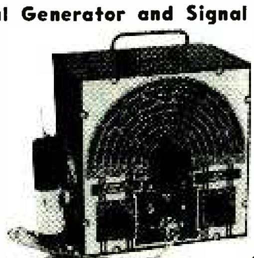
Paul Whiteman once sued RCA for using some of his music without paying him, but the court said that Whiteman and RCA were not in the same business (Whiteman is a musician and RCA a manufacturer) and dismissed the action.

That argument was used here, but it didn't work this time. The New York Supreme Court said that the Metropolitan program had been "misappropriated and one doesn't have to be in competition with a thief to stop him from stealing the product of your expenditure and industry." The answer to this was that when a program is broadcast, it is published and abandoned; interpretive ideas are not subject to copyright; the Metropolitan didn't own the score, and by spreading the program all over the country by radio where anyone could listen to it free, they lost all exclusive right to that program. But the court wasn't having any. They laid down the law that a radio performance doesn't endanger a performer's ownership of the material used and it is against the law to copy a radio show and then sell records of it even if you give credit to the show.—*Francis George*

—end—







Universal Tester For Field Use

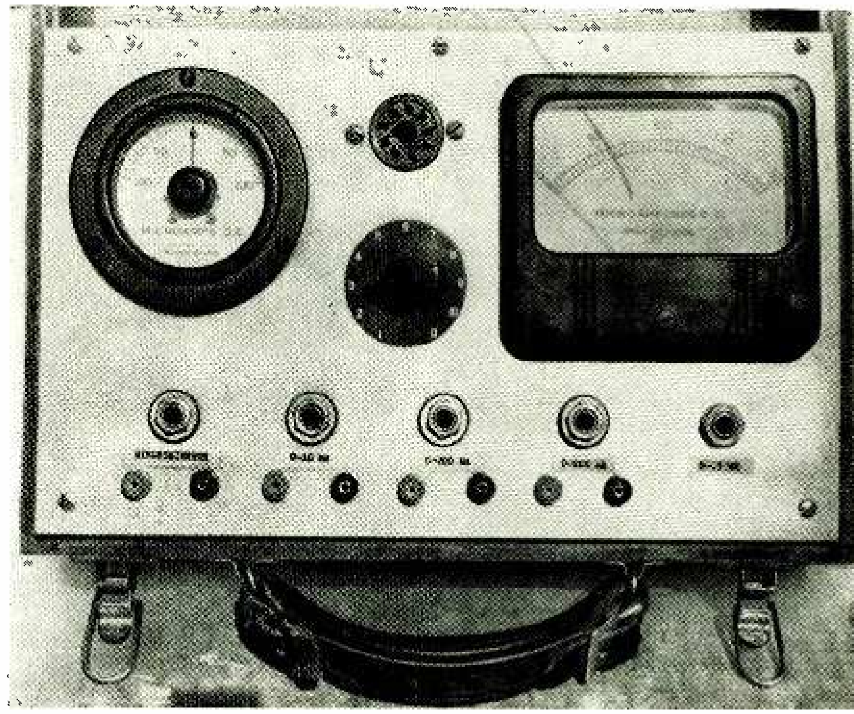


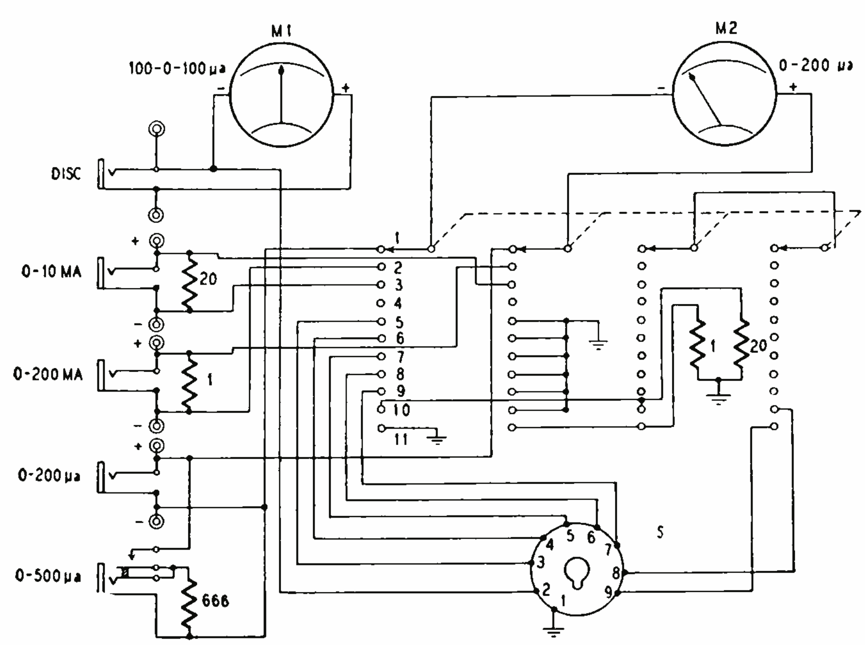
Photo of the tester. Provisions are made for multiconductor test cable and test leads with phone or tip type plugs. All jacks are insulated from the metal panel.

By LYMAN E. GRAY

A communication technician does most of his work in the field. His test equipment is necessarily limited. One way to overcome this disadvantage is to carry spare units; the defective unit can go back to the shop for repairs. This method is not often economical.

Some manufacturers supply special test apparatus for their equipment. Unfortunately, such test apparatus seldom can be used with other manufacturers' products.

This simple meter was designed for flexible field use. It has few parts and can check alignment and operation of most communication sets. A crystal-controlled frequency meter is necessary too. (The Link 2051 frequency meter, a dual-channel battery-operated unit, is ideal. It supplies a crystal-controlled signal for receiver alignment and also can be used to check carrier frequency, radiated power and frequency swing of the modulator in FM equipment.



Schematic of the tester designed for Link FMTR ED7A and similar 2-way sets.

The instrument shown in the diagram and photograph is designed especially for testing Link FMTR ED7A equipment, but it can be used with other types as well. The 9-pin socket shown between the meters is used for connections to the circuits in the FMTR ED7A. Test leads fitted with phone plugs or standard pin tips are used when testing other types of equipment. The main advantage of this test set is that discriminator voltage and limiter grid currents can be metered simultaneously. This is an important feature when checking equipment in the field and also when complete realignment is necessary.

Two meters are used. M1 is a zero-center 100-0-100 microammeter used to measure discriminator voltage. We used a meter of this type to eliminate the need for a polarity-reversing switch. M2 is a standard 200-μa instrument. The need for a polarity-reversing switch is eliminated here by using two test cables, one of which has connections to one plug reversed.

A 3-circuit, 11-position switch is used for switching M2. The meter ranges and functions corresponding to switch positions are given in the table. Positions 5 through 11 are used for metering circuits in type FMTR ED7A equipment.

Switch Position	Range and Function
1	0-200 μa and 0-500 μa (0.5 ma)
2	0-200 ma
3	0-10 ma
4	Not used
5	First limiter grid current
6	Second limiter grid current
7	First doubler grid current
8	Quadrupler grid current
9	Second doubler grid current
10	Power amplifier grid current
11	Power amplifier plate current

The meter used for M2 has an internal resistance of 1,000 ohms so the current shunts were constructed accordingly. When using a meter having a lower resistance, compute the values of shunts from the formula:

$$R_{shunt} = \frac{R_{meter}}{N-1}$$

where N is the factor by which the basic meter range is to be multiplied. Thus, if you have a 100-microampere meter and want to make it read 1 milliampere, N is 10 and N−1 is 9. So the shunt required is 1/9 the resistance of the meter.

If the resistance is near 1,000 ohms, simply put a resistor in series to bring the total resistance up to the proper value.

Materials for test set

Resistors: (For 1,000-ohm meter) 2—1, 2—20, 1—666 ohms, 5% or smaller tolerance.
Meters: 1—100-0-100 μa, d.c.; 1—200 μa, 1,000 ohms, d.c.
Miscellaneous: 1—9-Pin socket (Amphenol 77M1P9 or equivalent). 4—Tip jacks, black; 4—tip jacks, red. 4—Phone jacks, open-circuit type; 1—phone jack with separate make-contact springs (Utah-Carter type 103, Mallory type 703, or equivalent). 1—Switch, rotary, 4 circuits, 11 positions. Insulating washers for jacks, hookup wire, panel, carrying case, etc.

—end—

A-Bomb Position Locator

Radiation lampshade is a new device civil defense authorities may use to quickly and accurately determine the exact position of an atomic blast within a given target area. Such data is required immediately after the explosion to enable rescue workers to proceed with the greatest efficiency.

Developed by the Mohawk Association of Scientists and Engineers, in co-operation with Schenectady, N. Y. civil defense authorities, the instrument will determine the height as well as ground-zero—the point directly under the burst. The instrument resembles a standard lampshade approximately 12 inches in diameter at the bottom and somewhat smaller at the top. It is made of metal and is painted white inside and out. On its inside surface is a grid consisting of numbered vertical and lettered horizontal lines. A pointed brass rod projects upward inside the "shade."

Courtesy General Electric Co.

Heat generated by an atomic blast within a few miles of the device will scorch the painted inside surface. Since heat radiation travels in straight lines, it casts shadows of objects in its path in the same way that light rays cast shadows. The upper edge of the device and the pointed rod will cast shadows which appear as unscorched areas on the calibrated grid.

The lampshade will be inspected immediately after an atomic explosion. Shadows on the grid will indicate the direction and elevation of the blast. It is planned to install the devices so there will be at least four within one or two miles of any blast that may occur in a target area. By taking the readings of two or more indicators, a headquarters unit can, by triangulation, determine the elevation and ground-zero of the blast.

Crystal Quartz in U.S.A.

Quartz crystals of electronic quality have been discovered in appreciable quantity in the United States. Formerly we were dependent chiefly on Brazil for these important items. The new source of crystal quartz is on a high mesa in the Gosiute Indian reservation in Utah.

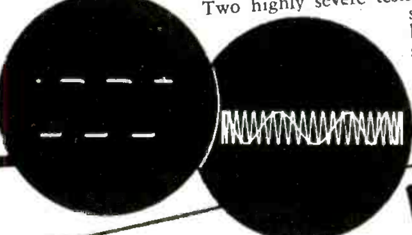
Preparations are being made by a Western mining company to excavate the quartz, the Indians to receive 10% of the company's profits. The U.S. Government (General Services Administration) has ordered the full output for the next year.

—end—

Features OF THE NEW 1952 Heathkits

PROOF OF THE NEW O-7 OSCILLOSCOPE'S OUTSTANDING PERFORMANCE

Below are actual, unretouched photographs showing the outstanding frequency response characteristics of the NEW 1952 HEATHKIT OSCILLOSCOPE MODEL O-7. To the left is a 10 KC square wave — to the right a 4 MC sine wave as they actually appear on the screen. Two highly severe tests to make on any scope (only the best of scopes will show traces like these) — and the O-7 really comes through.

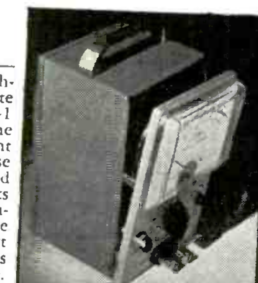


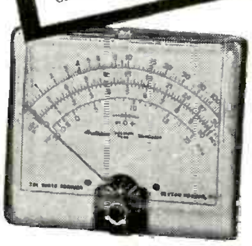
COMPANION VACUUM TUBE VOLTMETERS

Here are the two NEW 1952 VACUUM TUBE VOLTMETER COMPANION PIECES. Matched instruments of new design to open up the whole field of DC, AC, and resistance measurements for you. The new greatly reduced size combines style, beauty, and compactness — The V-5 and AV-1 have the new panel and cabinet construction as shown on the right. A tremendous pair of voltmeters. Small in size but virtual giants in the range of measurements they make.

NEW STYLE AND BEAUTY

Style that's modern, yet functional — that's the trend of today — and Heathkits are right up to the minute. Note the cut showing the new V-5 and AV-1 cabinet and panel construction. The front panel and rear cover slide right over the recessed flange of the case thereby eliminating sharp edges and pointed corners. The voltmeter kits aren't "shelf" or "mounted" instruments — they're moved about on the bench a lot and thus the new compact size and specially designed cabinets — Another 1952 Heathkit feature.

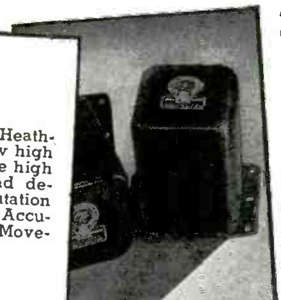




A STATEMENT FROM SIMPSON ELECTRIC CO.

In choosing Simpson Meters for their Heathkit VTVM, the Heath Co. has set a new high standard of kit meter quality. The same high quality of material, workmanship and design that has given Simpson the reputation for building "Instruments That Stay Accurate" is found in the Heathkit Meter Movement.

SIGNED
SIMPSON ELECTRIC CO.



A STATEMENT FROM CHICAGO TRANSFORMER

It is indeed gratifying to note the outstanding sales records you are building with your Heathkits.

This sales success is readily understandable, since we are cognizant of the high quality standards you have established for your component suppliers.

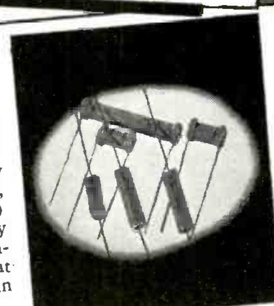
We at Chicago Transformer are proud that our product has contributed to the recognized quality and increasing popularity of Heathkits.

CHICAGO TRANSFORMER DIVISION
Essex Wire Corporation

L. S. RACINE
Vice-President and Sales Manager

HEATHKIT PRECISION RESISTORS

Where exact resistance values are required for instrument accuracy, the Heath Co. has spared no effort in supplying the finest resistors available. Precision resistors as manufactured by Continental Carbon Inc., and Wilcor Corp., meet the rigorous JAN (Joint Army-Navy) specifications and are small in size, extremely non-inductive, highly stable, have a low temperature coefficient, and can be held to great accuracy. You'll find quality components in Heathkits.



COLLEGES USE HEATHKITS

Colleges and Universities throughout the country are using Heathkits in their electrical engineering, radio, and physics laboratories — Heathkits are the answer to good test equipment at low cost, plus being rugged, dependable, and accurate. Trade schools are having their students build Heathkits to obtain a first hand working knowledge of test equipment and to get the practical experience gained by construction. Heathkits fill school needs.

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THE *New* 1952

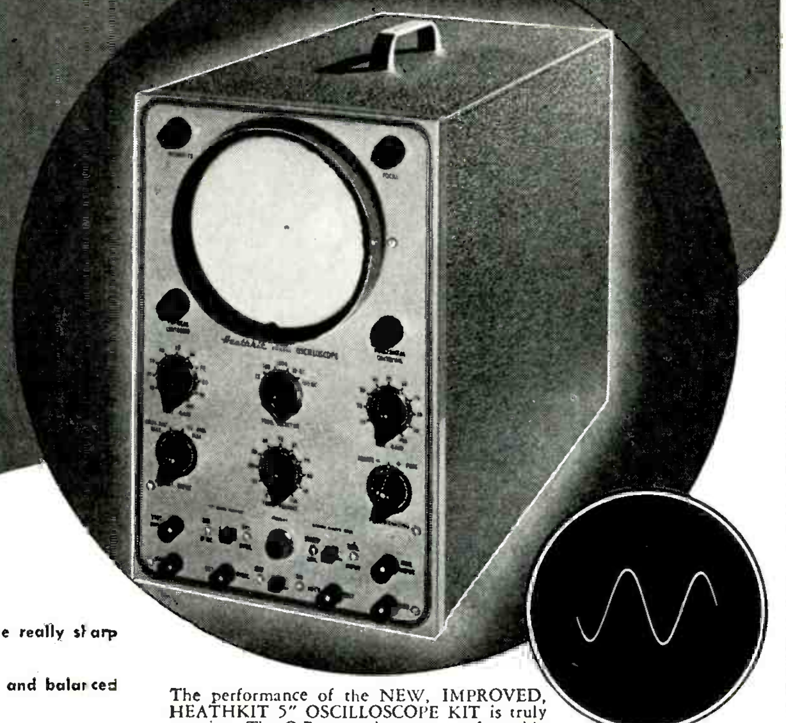
Heathkit

OSCILLOSCOPE KIT

MODEL O-7

SHIPPING WEIGHT 24 LBS.

$43.50



Features

- New "spot shape" control for spot adjustment — to give really sharp focusing.
- A total of ten tubes including CR tube and five miniatures.
- Cascaded vertical amplifiers followed by phase splitter and balanced push-pull deflection amplifiers.
- Greatly reduced retrace time.
- Step attenuated — frequency compensated — cathode follower vertical input.
- Low impedance vertical gain control for minimum distortion.
- New mounting of phase splitter and deflection amplifier tubes near CR tube base.
- Greatly simplified wiring layout.
- Increased frequency response — useful to 5 Mc.
- Tremendous sensitivity .03V RMS per inch Vertical — .6V RMS per inch Horizontal.
- Dual control in vernier sweep frequency circuit — smoother acting.
- Positive or negative peak internal synchronization.

The performance of the NEW, IMPROVED, HEATHKIT 5" OSCILLOSCOPE KIT is truly amazing. The O-7 not only compares favorably with equipment costing 4 and 5 times as much, but in many cases literally surpasses the really expensive equipment. The new, and carefully engineered circuit incorporates the best in electronic design — and a multitude of excellent features all contribute to the outstanding performance of the new scope.

The VERTICAL CHANNEL has a step attenuated, frequency compensated vertical input which feeds a cathode follower stage — this accomplishes improved frequency response, presents a high impedance input, and places the vertical gain control in a low impedance circuit for minimum distortion. Following the cathode follower stage is a twin triode — cascaded amplifiers to contribute to the scope's extremely high sensitivity. Next comes a phase splitter stage which properly drives the push-pull, hi-gain, deflection amplifiers (whose plates are directly coupled to the vertical deflection plates). This fine tube lineup and circuitry give a sensitivity of .03V per inch RMS vertical and useful frequency response to 5 Mc.

The HORIZONTAL CHANNEL consists of a triode phase splitter with a dual potentiometer (horizontal gain control) in its plate and cathode circuits for smooth, proper driving of the push-pull horizontal deflection amplifiers. As in the vertical channel, horizontal deflection amplifier plates are direct coupled to the CR tube horizontal deflection plates (for improved frequency response).

The WIDE-RANGE SWEEP GENERATOR circuit incorporates a twin triode multivibrator stage for producing a good saw-tooth sweep frequency (with faster retrace time). Has both coarse and vernier sweep frequency controls.

And the scope has internal synchronization which operates on either positive or negative peaks of the input signal — both high and low voltage rectifiers — Z axis modulation (intensity modulation) — new spot shape (astigmatism) control for spot adjustment — provisions for external synchronization — vertical centering and horizontal centering controls, wide range focus control — and an intensity control for giving plenty of trace brilliance.

The Model O-7 EVEN HAS GREAT NEW MECHANICAL FEATURES — A special extra-wide CR tube mounting bracket is provided so that the vertical cascade amplifier, vertical phase splitter, vertical deflection amplifier, and horizontal deflection amplifier can mount near the base of the CR tube. This permits close connection between the above stages and to the deflection plates; distributed wiring capacity is greatly reduced, thereby affording increased high frequency response.

The power transformer is specially designed so as to keep its electrostatic and electromagnetic fields to a minimum — also has an internal shield with external ground lead.

You'll like the complete instructions showing all details for easily building the kit — includes pictorials, step-by-step construction procedure, numerous sketches, schematic, circuit description. All necessary components included — transformer, cabinet, all tubes (including CR tube), completely punched and formed chassis—nothing else to buy.

NEW INEXPENSIVE *Heathkit*

ELECTRONIC SWITCH KIT

The companion piece to a scope — Feed two different signals into the switch, connect its output to a scope, and you can observe both signals — each as an individual trace. Gain of each input is easily set (gain A and gain B controls), the switching frequency is simple to adjust (coarse and fine frequency controls) and the traces can be superimposed for comparison or separated for individual study (position control).

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

The kit is complete; all tubes, switches, cabinet, power transformer and all other parts, plus a clear detailed construction manual.

Model S-2
Shipping Wt. 11 lbs.

Only

$19.50

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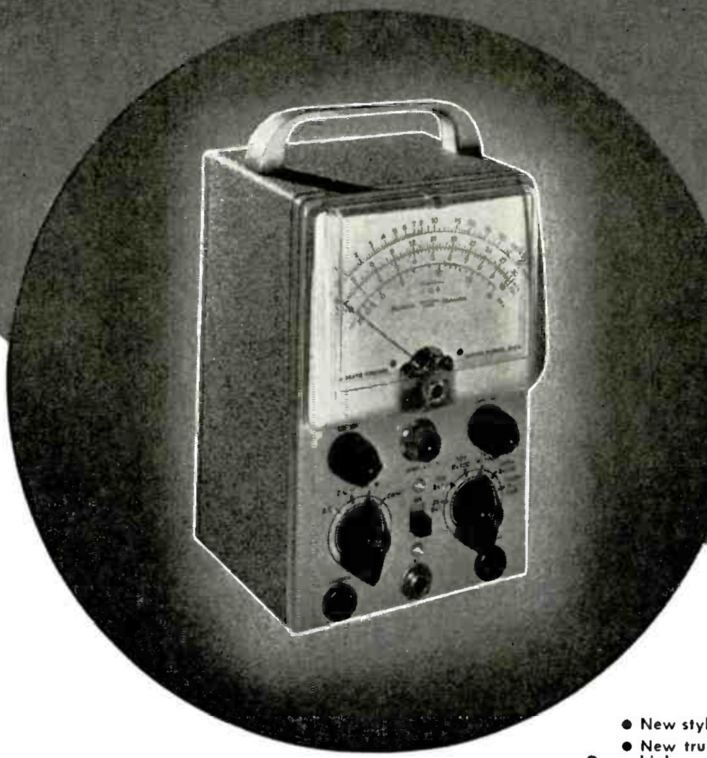


THE *New* 1952 *Heathkit* VTVM KIT

MODEL V-5
SHIPPING WT. 5 LBS.

$24.50

Features

- New styling, — formed case for beauty.
- New truly compact size. Cabinet 4⅛" deep by 4-11/16" wide by 7⅜" high.
- Quality 200 microamp meter.
- New ohms battery holding clamp and spring clip — assurance of good electrical contact.
- Highest quality precision resistors in multiplier circuit.
- Calibrates on both AC and DC for maximum accuracy.
- Terrific coverage — reads from ½V to 1000V AC, ½V to 1000V DC, and .1 to over 1 billion ohms resistance.
- Large, clearly marked meter scales indicate ohms, AC Volts, DC Volts, and DB — has zero set mark for FM alignment.
- New styling presents attractive and professional appearance.

A real beauty — you'll have only highest praise for this NEW MODEL VACUUM TUBE VOLTMETER. Truly a beautiful little instrument — and it's more compact than any of our previous models. Note the new rounded edges on the front panel and rear cover. The size is greatly reduced to occupy a minimum of space on your workbench — yet the meter remains the same large size with plainly marked scales.

A set of specially designed control mounting brackets permit calibration to be performed with greatest ease — also makes for ease in wiring. New battery mounting clamp holds ohms battery tightly into place, and base spring clip insures a good connection to the ohms string of resistors.

The circuitry employs two vacuum tubes — A duo diode operating when AC voltage measurements are taken, and a twin triode in the circuit at all times. The cathode balancing circuit of the twin triode assures sensitive measurements, and yet offers complete protection to the meter movement. Makes the meter burn-out proof in a properly constructed instrument.

Quality components are used throughout —1% precision resistors in the multiplier circuit—conservatively rated power transformer—Simpson meter movement — excellent positive detent, smooth acting switches — sturdy cabinet, etc.

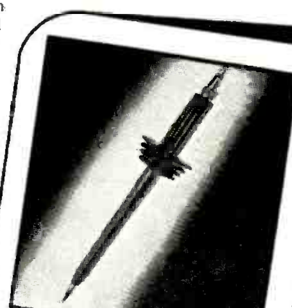
And you can make a tremendous range of measurements — ½V to 1000V AC, ½V to 1000V DC, .1 to over 1 billion ohms, and DB. Has mid-scale zero level marking for quick FM alignment. DB scale in red for easy identification — all other scales a sharp, crisp black for for easy reading.

A four position selector switch allows operator to rapidly set the instrument for type or reading desired—positions include ACV, DC+V, DC—V, and Ohms. DC— position allows negative voltage to be rapidly taken. Zero adjust and ohms adjust controls are conveniently located on front panel.

Enjoy the numerous advantages of using a VTVM. Its high input impedance doesn't "load" circuits under test — therefore, assures more accurate and dependable readings in high impedance circuits such as resistance coupled amplifiers, AVC circuits, etc. Note the 30,000 VDC probe kit and the RF probe kit — available at low extra cost and specially designed for use with this instrument. With these two probes, you can make DC voltage measurements up to 30,000V, or make RF measurements — added usefulness to an already highly useful instrument.

The instruction manual is absolutely complete — contains a host of figures, pictorials, schematic, detailed step-by-step instructions, and circuit description. These clear, detailed instructions make assembly a cinch.

And every part is included — meter, all controls, pilot light, switches, test leads, cabinet, instruction manual, etc.



Heathkit 30,000V DC PROBE KIT

A new 30,000 V DC Probe Kit to handle high voltages with safety. For TV service work and all other high voltage applications. Sleek looking — Two color molded plastic — Red body and guard — jet black handle. Comes with connector, cable, and PL55 type plug. Plugs into Heathkit VTVM so that 300V scale is conveniently multiplied by 100. Can be used with any standard 11 megohm VTVM.

$5.50

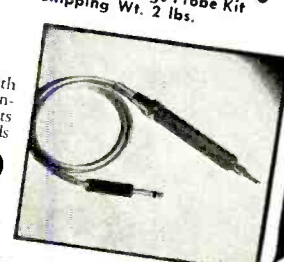
No. 336 High Voltage Probe Kit
Shipping Wt. 2 lbs.

Heathkit RF PROBE KIT

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

$5.50

Ship. Wt. 1 lb.



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Heathkit SIGNAL GENERATOR KIT

Model SG-6
Shipping Wt. 7 lbs.

The new Heathkit Signal Generator Kit has dozens of improvements. Covers the extended range of 160 Kc to 50 megacycles on fundamentals and up to 150 megacycles on useful calibrated harmonics; makes this Heathkit ideal as a marker oscillator for TV. Output level can be conveniently set by means of both step attenuator and continuously variable output controls. Instrument has new miniature HF tubes to easily handle the high frequencies covered.

Uses 6C4 master oscillator and 6C4 sine wave audio oscillator. The kit is transformer operated and a husky selenium rectifier is used in the power supply. All coils are precision wound and checked for calibration making only one adjustment necessary for all bands.

New sine wave audio oscillator provides internal modulation and is also available for external audio testing. Switch provided allows the oscillator to be modulated by an external audio oscillator for fidelity testing of receivers. Comes complete, all tubes, cabinet, test leads, every part. The instruction manual has step-by-step instructions and pictorials. It's easy and fun to build a Heathkit Model SG-6 Signal Generator.

Heathkit CONDENSER CHECKER KIT

Only

$19.50

Model C-2
Shipping Wt. 6 lbs.

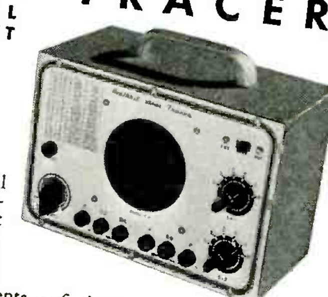
Checks all types of condensers — paper — mica — ceramic — electrolytic. All condenser scales are direct reading and require no charts or multipliers. Covers range of .00001 MFD to 1000 MFD. A Condenser Checker that anyone can read. A leakage test and polarizing voltage for 20 to 500 V provided. Measures power factor of electrolytics between 0% and 50% and reads resistance from 100 ohms to 5 megohms. The magic eye indicator makes testing easy.

The kit is 110V 60 cycle transformer operated and comes complete with rectifier tube, magic eye tube, cabinet, calibrated panel and all other parts. Has clear detailed instructions for assembly and use.

NEW *Heathkit* SIGNAL TRACER AND UNIVERSAL TEST SPEAKER KIT

$19.50

Model T-2
Shipping Wt. 7 lbs.



The popular Heathkit Signal Tracer has now been combined with a universal test speaker at no increase in price. The same high quality tracer follows signal from antenna to speaker — locates intermittents — finds defective parts quicker — saves valuable service time — gives greater income per service hour. Works equally well on broadcast, FM, or TV receivers. The test speaker has an assortment of switching ranges to match either push-pull or single output impedances. Also tests microphones, pickups and PA systems. Comes complete: cabinet, 110V 60 cycle power transformer, tubes, test probe, all necessary parts, and detailed instructions for assembly and use.

Heathkit TUBE CHECKER KIT

Model TC-1
Shipping Wt. 12 lbs.

$29.50

The Tube Checker is a MUST for radio repair men. Often customers want to SEE tubes checked, and a checker like this builds customer confidence. In your repairing, you will have a multitude of tubes to check — quickly. The Heathkit tube checker will serve all these functions — it's good looking (with a polished birch cabinet and an attractive two color panel) — checks 4, 5, 6, 7 prong Octals, Loctals, 7 prong miniatures, 9 prong miniatures, pilot lights, and the Hytron 5 prong types. AND IT'S FAST TO OPERATE — the gear driven, free-running roll chart lists hundreds of tubes, and the smooth acting, simplified switching arrangement gives really rapid set-ups.

The testing arrangement is designed so that you will be able to test new tubes of the future — without even waiting for factory data — protection against obsolescence.

You can give tubes a thorough testing — checks for opens, shorts, each element individually, emission, and for filament continuity. A large BAD-?-GOOD meter scale is in three colors for easy reading and also has a "line-set" mark.

You'll find this tube checker kit a good investment — and it's only $29.50.

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New LABORATORY LINE HEATHKITS

NEW *Heathkit* A.C. VACUUM TUBE VOLTMETER KIT

Now — as a Heathkit — at a price anyone can afford, an AC VTVM. A new kit to make possible those sensitive AC measurements required by audio enthusiasts, laboratories, and experimentors. Here is the kit that the audio men have been looking for. Its tremendous range of coverage makes possible measurements of audio amplifier frequency response — gain or loss of audio stages — characteristics of audio filters and attenuators — hum investigation — and literally a multitude of others. Ten ranges consisting of full scale .01, .03, .1, .3 1, 3, 10, 30, 100, 300 volts RMS assure easy and more accurate readings. Ten ranges on DB provide for measurements from −52 to +52 DB. Frequency response within 1 DB from 20 cycles to 50 KC.

The ingenious circuitry incorporates precision multiplier resistors for accuracy, two amplifier stages using miniature tubes, a unique bridge rectifier meter circuit, quality Simpson meter with 200 microampere movement, and a clean layout of parts for easy wiring. A high degree of inverse feedback provides for stability and linearity.

Simple operation is accomplished by the use of only one control, a range switch which changes the voltage ranges in multiples of 1 and 3, and DB ranges in steps of 10.

The instrument is extremely compact, cabinet size — 4⅛" deep x 4-11/16" wide x 7⅜" high, and the newly designed cabinet makes this the companion piece to the VTVM. For audio work, this kit is a natural.

MODEL AV-1
Shipping weight 5 lbs.

$29.50

NEW *Heathkit* AUDIO FREQUENCY METER KIT

MODEL AF-1
Shipping weight 12 lbs.

$34.50

A NEW Heathkit Audio Frequency Meter — the ideal instrument for determining frequencies from 20 cycles to 100 KC. Set the selector switch to the proper range — feed the signal into the input terminals — and read the frequency from the meter — completely simple to operate, and yet dependable results.

Quality Simpson 200 microampere meter has two plainly marked scales (0-100 0-300. These scales, read in conjunction with the seven position selector switch, give full scale readings of 100, 300, 1000, 3000, 10,000, 30,000, and 100,000 cycles. Convenient ranges for fast and easy readings.

For greatest accuracy, the 1-3-10 ratio of ranges is maintained and each range has individual calibrating control.

Input impedance is high (1 megohm) for negligible circuit loading. A signal voltage anywhere between 2 and 300V can be fed directly into the instrument and a change in signal voltage between these limits will not affect the meter reading. In addition, input wave shape is not critical (the unit will read the frequency of either sine wave or square wave input).

The tube complement consists of a 6SJ7 amplifier and clipper, 6V6 amplifier and clipper, 6H6 meter pulse rectifier, 6X5 power supply rectifier, and OD3/VR150 voltage regulator.

Construction is simple, and quality components are used throughout.

NEW *Heathkit* INTERMODULATION ANALYZER KIT

Intermodulation testing of audio equipment is rapidly being accepted by more and more engineers and audio experts as the best way to determine the characteristics of audio amplifiers, recording systems, networks, etc. — shows up those undesirable characteristics which contribute to listening fatigue when all other methods fail.

The Heathkit Intermodulation Analyzer supplies a choice of two high frequencies (3000 cycles and a higher frequency) and one low frequency (60 cycles). Both 1:1 or 4:1 ratios of low to high frequencies can be set up for IM testing, and the ratios are easily set by means of a panel control and the instrument's own VTVM. An output level control supplies the mixed signal at the desired level with an output impedance of two thousand ohms. The Analyzer section has input level control and proper filter circuits feeding the instrument's VTVM to read intermodulation directly on full scale ranges of 30%, 10% and 3%. Built-in power supply furnishes all necessary voltages for operating the instrument.

You won't want to be without this new and efficient means of testing

MODEL IM-1
Shipping wt. 18 lbs.

$39.50

NEW *Heathkit* SQUARE WAVE GENERATOR KIT

The new Heathkit Square Wave Generator Kit with its 100 KC square wave opens an entirely new field of audio testing. Square wave testing over this wide range will quickly show high and low frequency response characteristics of circuits — permit easy adjustment of high frequency compensating networks used in vidio amplifiers — identify ringing in circuits — demonstrate transformer characteristics, etc.

The circuitry consists of a multivibrator stage, a clipping and squaring stage, and a cathode follower output stage. The power supply is transformer operated and utilizes a full wave rectifier tube with 2 sections of LC filtering.

As a multivibrator cannot be accurately calibrated, a provision is provided to allow the instrument to be accurately synchronized with an accurate external source when extreme accuracy is required.

The low impedance output is continuously variable between 0 and 25 volts and operation is simple. You'll really appreciate the wide range of this instrument, 10 cycles to 100 kilocycles — continuously variable. Kit is complete with all parts and instruction manual, and is easy to build.

MODEL SQ-1
Shipping wt. 14 lbs.

$29.50

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Heathkit
IMPEDANCE BRIDGE KIT

This Impedance Bridge Kit is really a favorite with schools, industrial laboratories, and serious experimenters. An invaluable instrument for those doing electrical measurements work. Reads resistance from .01 Ohms to 10 meg., capacitance from .00001 to 100 MFD, inductance from 10 microhenries to 100 henries, dissipation factor from .002 to 1, and storage factor from 1 to 1000. And you don't have to worry about selecting the proper bridge circuit for the various measurements — the instrument automatically makes the correct circuit when you set up for taking the measurement you want. Bridge utilizes Wheatstone, Hay, Maxwell, and capacitance comparison circuits for the wide range and types of measurements possible. And it's self powered — has internal battery and 1000 cycle hummer. No external generator required — has provisions for external generator if measurements at other than 1000 cycles are desired. Kit utilizes only highest quality parts, General Radio main calibrated control. Mallory ceramic switches, excellent 200 microamp zero center galvanometer, laboratory type binding posts with standard ¾ inch centers, 1% precision ceramic-body type multiplier resistors, beautiful birch cabinet and ready calibrated panel. (Headphones not included.)

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

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

$69.50

Heathkit LABORATORY
RESISTANCE DECADE KIT

$19.50

Shipping Wt. 4 lbs.

An indispensable piece of laboratory equipment — the Heathkit Resistance Decade Kit gives you resistance settings from 1 to 99,999 ohms IN ONE OHM STEPS. For greatest accuracy, 1% precision ceramic-body type resistors and highest quality ceramic wafer switches are used.

Designed to match the Impedance Bridge above, the Resistance Decade Kit has a beautiful birch cabinet and attractive panel. It's easy to build, and comes complete with all parts and construction manual.

Heathkit LABORATORY
POWER SUPPLY KITS

Limits:

No load	Variable	150-400V DC
25 MA	Variable	30-310V DC
50 MA	Variable	25-250V DC

Higher loads: Voltage drops off proportionally

Every experimenter needs a good power supply for electronic setups of all kinds. This unit has been expressly designed to act as a HV supply and a 6.3 V filament voltage source. Voltage control allows selection of HV output desired (continuously variable within limits outlined), and a Volts-Ma switch provides choice of output metering. A large plainly marked and direct reading meter scale indicates either DC voltage output in Volts or DC current output in Ma. (Range of meter 0-500V D.C., 0-200 Ma. D.C.). Instrument has convenient stand-by position and pilot light.

$29.50

Model PS-1.....Ship. Wt. 20 lbs.

Comes with power transformer, filament transformer, meter, 5Y3 rectifier, two 1619 control tubes, completely punched and formed chassis, panel, cabinet, detailed construction manual, and all other parts to make the kit complete.

Heathkit
ECONOMY . . . 6 WATT
AMPLIFIER KIT

Model A-4
Ship. Wt. 8 lbs.

$12.50

No. 304 12 inch speaker . . . $6.95

This fine Heathkit Amplifier was designed to give quality reproduction and yet remain low in price. Has two preamp stages, phase inverter stage, and push-pull beam power output. Comes complete with six tubes, quality output transformer (to 3-4 ohm voice coil), husky cased power transformer and all other parts. Has tone and volume controls. Instruction manual has pictorial for easy assembly. Six watts output with response flat ± 1½ db from 50 to 15,000 cycles. A quality amplifier kit at a low price. Better build one.

Heathkit HIGH FIDELITY . . . 20 WATT
AMPLIFIER KIT

Our latest and finest amplifier — the model A-6 (or A-6A) is capable of a full 20 Watts of high fidelity output — good faithful reproduction made possible through careful circuit design and the use of only highest quality components. Frequency response within ± 1 db from 20-20,000 cycles. Distortion at 3 db below maximum power output (at 1000 cycles) is only .8%. The power transformer is rugged and conservatively rated and will deliver full plate and filament supply with ease. The output transformer was selected because of its exceptionally good frequency response and wide range of output impedances (4-8-16-150-600 ohms). Both are Chicago Transformers in drawn steel case for shielding and maximum protection to windings. The unit has dual tone controls to set the output for the tonal quality desired — treble control attentuates up to 15 db at 10,000 cycles — bass control gives bass boost up to 10 db at 50 cycles.

$33.50

Shipping Wt. 18 lbs.

Tube complement consists of 5U4G rectifier, 6SJ7 voltage amplifier, 6SN7 amplifier and phase splitter, and two 6L6's in push-pull output. Comes complete with all parts and detailed construction manual. (Speaker not included.)

MODEL A-6: For tuner and crystal phono inputs. Has two position selector switch for convenient switching to type of input desired.

MODEL A-6A: Features an added 6SJ7 stage (preamplifier) for operating from variable reluctance cartridge phono pickup, mike input, and either tuner or standard crystal phono pickup. A three position selector switch provides flexible switching.

Shipping Wt. 18 lbs. **$35.50**

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NEW 1952 *Heathkit*

BATTERY ELIMINATOR KIT

$24.50

Model BE-3
Shipping Wt. 17 lbs.

- Can be used as battery charger.
- Continuously variable output 0 - 8 Volts — not switch type.
- Heavy duty Mallory 17 disk type magnesium copper sulfide rectifier.
- Automatic overload relay for maximum protection. Self-resetting type.
- Ideal for battery, aircraft and marine radios.
- Dual Volt and Ammeters read both voltage and amperage continually — no switching.

The new Heathkit Model 3E-2 incorporates the best. Continuously variable output control is of the variable transformer type with smooth wiper type contacts.

There are no switches or steps and voltage between 0 and 8 Volts is available at 10 Amperes continuous and 15 Amperes intermittent. Maximum safety from overloads and shorts provided by automatic overload relay which resets itself when overload is removed.

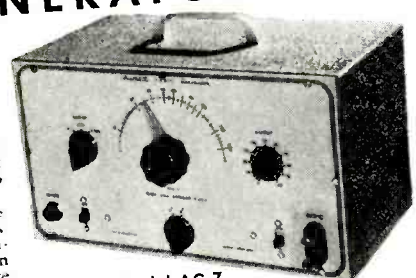
The new rectifier is a 17 plate Mallory magnesium copper sulfide type. This is the most rugged type available for long trouble-free use.

Output is continuously metered by both a 0 - 10 Volt Voltmeter and a 0 - 15 Amp Ammeter. Shorted vibrators indicated instantly by ammeter.

Equip now for all types of service — aircraft — marine — auto and battery radios — this inexpensive instrument vastly increases service possibilities — better be ready when the customer walks in.

NEW *Heathkit*

SINE AND SQUARE WAVE AUDIO GENERATOR KIT



Model AG-7
Shipping Wt. 15 lbs.

$34.50

Designed with versatility, usefulness, and dependability in mind, the AG-7 gives you the two most needed wave shapes right at your fingertips — the sine wave and the square wave.

The range switch and plainly calibrated frequency scale give rapid and easy frequency selection, and the output control permits setting the output to any desired level.

A high-low impedance switch sets the instrument for either high or low impedance output — on high to connect a high impedance load, and on low to work into a low impedance transformer with negligible DC resistance.

Coverage is from 20 to 20,000 cycles, and distortion is at a minimum — you can really trust the output wave shape.

Six tubes, quality 4 gang tuning condenser, power transformer, metal cased filter condenser, 1% precision resistors in the frequency determining circuit, and all other parts come with the kit — plus, a complete construction manual — A tremendous kit, and the price is truly low.

THE NEW *Heathkit*

HANDITESTER KIT

A precision portable volt-ohm milliammeter. Uses only high quality parts — All precision 1% resistors, three deck switch for trouble-free mounting of parts, specially designed battery mounting bracket, smooth acting ohm adjust control, beautiful molded bakelite case, 400 micro-amp meter movement, etc.

DC and AC voltage ranges 10 - 30 - 300 - 1000 - 5000V. Ohms range 0 - 3000 and 0 - 300,000. Range Milliamperes 0 - 10 Ma, 0 - 100 Ma. Easily assembled from complete instructions and pictorial diagrams.

$13.50

Model M-1
Shipping Wt. 3 lbs.

NEW *Heathkit*

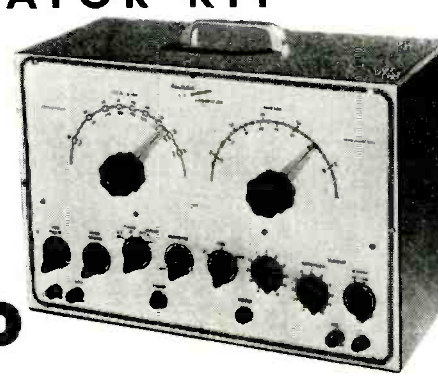
T.V. ALIGNMENT GENERATOR KIT

A few auto radio repair jobs will pay for the Heathkit Battery Eliminator Kit. It's fast for service. The voltage can be lowered to find sticky vibrators or raised to ferret out intermittents. Provides variable DC voltage 5 to 7½ Volts at 10 Amps. continuous or 15 Amps. intermittent.

Also serves as storage battery charger. A well filtered, rugged power supply uses heavy duty selenium rectifier, a husky choke, and a 4000 MFD electrolytic condenser for clean DC. 0 - 15V voltmeter indicates output which is variable in eight steps. Better be equipped for all types of service — it means more income.

Model TS-2
Shipping Wt. 20 lbs.

$39.50



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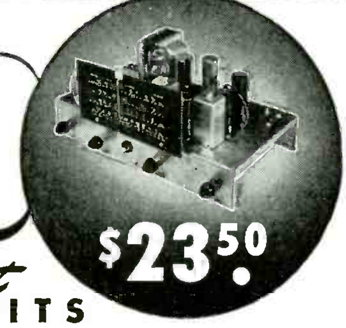
Heathkit RECEIVER & TUNER KITS for AM and FM

$19.50

Model BR-1 Broadcast Model Kit covers 550 to 1600 Kc. Shipping Wt. 10 lbs.

Model AR-1 3 Band Receiver Kit covers 550 Kc. to over 20 Mc. continuous. Extremely high sensitivity. Shipping Wt. 10 lbs.



$23.50

TWO HIGH QUALITY *Heathkit* SUPERHETRODYNE RECEIVER KITS

Two excellent Heathkits. Ideal for schools, replacement of worn out receivers, amateur and custom installations.

Both are transformer operated quality units. The best of materials used throughout — six inch calibrated slide rule dial — quality power output transformers — dual iron core shielded. I.F. coils — metal cased filter condenser. The chassis has phono input jacks, 110 Volt output for phono motor and there is a phono-radio switch on panel. A large metal panel simplifying installation in used console cabinets is included. Comes complete with tubes and instruction manual incorporating pictorials and step-by-step instructions (less speaker and cabinet). The three band model has simple coil turret which is assembled separately for ease of construction.

Model FM-2
Ship. Wt. 9 lbs.

$22.50

TRUE FM FROM *Heathkit* FM TUNER KIT

The Heathkit FM Tuner Model FM-2 was designed for best tonal reproduction. The circuit incorporates the most desirable FM features — true FM.

Utilizes 8 tubes: 7E5 Oscillator, 6SH7 mixer, two 6SH7 IF amplifiers, 6SH7 limiter, two 7C4 diodes as discriminator, and 6X5 rectifier.

The instrument is transformer operated making it safe for connection to any type receiver or amplifier. Has ready wound and adjusted RF coils, and 2 stages of 10.7 Mc IF (including limiter). A calibrated six inch slide rule dial has vernier drive for easy tuning. All parts and complete construction manual furnished.

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	Heathkit VTVM Kit — Model V-5			Heathkit R.F. Signal Gen. Kit — Model SG-6	
	Heathkit FM Tuner Kit — FM-2			Heathkit Condenser Checker Kit — Model C-2	
	Heathkit Broadcast Receiver Kit — Model BR-1			Heathkit Handitester Kit — Model M-1	
	Heathkit Three Band Receiver Kit—Model AR-1			Heathkit Power Supply Kit — Model PS-1	
	Heathkit Amplifier Kit — Model A-4			Heathkit Resistance Decade Kit — Model RD-1	
	Heathkit Amplifier Kit — Model A-6 (or A-6A)			Heathkit Impedance Bridge Kit — Model IB-1B	
	Heathkit Tube Checker Kit — Model TC-1			Heathkit A.C. VTVM-KIT — Model AV-1	
	Heathkit Audio Generator Kit — Model AG-7			Heathkit Intermodul. Analyzer Kit—Model IM-1	
	Heathkit Battery Eliminator Kit — Model BE-2			Heathkit Audio Freq. Meter Kit — Model AF-1	
	Heathkit Electronic Switch Kit — Model S-2			Heathkit Square Wave Gen. Kit — Model SQ-1	
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	Heathkit R.F. Probe Kit — No. 309				

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SIDEBAND GENERATOR

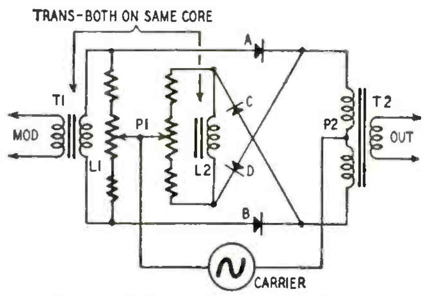
Patent No. 2,545,250
Kurt E. Appert, San Francisco, Calif.
(Assigned to Lenkurt Electric Co., Inc.)

This circuit mixes two signals, for example a.f. modulation with an r.f. carrier. Both signals are balanced out and do not appear, only the sidebands remain. No tubes are needed in this circuit.

The carrier is connected between P1 and P2. It divides equally and flows in opposite directions through the windings of the T2 primary. Thus the carrier is balanced out. Modulation is fed to T1 which has 2 secondaries, L1 and L2. Each is shunted by a center-tapped resistor.

The carrier voltage is made much larger than the modulation. Therefore the conductivity of the four rectifiers is determined solely by the carrier.

During one-half cycle of the carrier, while P1



is positive and P2 negative, *A* and *B* are biased for full conduction while *C* and *D* are blocked. During this period L1 delivers its voltage to T2 but L2 is effectively isolated. During the next half-cycle, L2 delivers its voltage to T2 while *A* and *B* are blocked by the large negative voltage on their anodes.

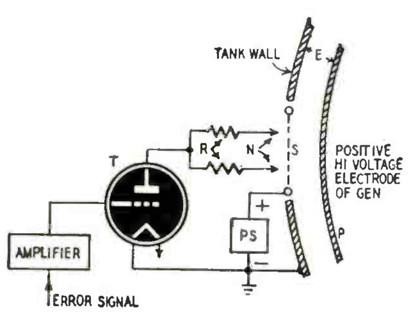
Modulation voltage is thus transmitted to T2 but it is reversed rapidly (at the carrier rate). Therefore the audio envelope has simultaneous positive and negative components, and the modulation (like the carrier) is cancelled out.

Sidebands are generated because of the nonlinearity of the rectifiers. These are available at the output terminals.

HIGH-VOLTAGE REGULATOR

Patent No. 2,548,452
Clarence M. Turner, Stony Brook, N. Y.
(Assigned to United States of America as represented by U. S. Atomic Energy Committee)

It is difficult to regulate the output of an electrostatic generator like the Van de Graaff because of the high voltages involved. This invention permits control without a direct connection to the hot terminal. There are no moving parts.



Resistors R act as load resistors and stabilize corona discharge from the end of needles N.

Metal needles N are fixed near a screen S. The screen substitutes for part of the tank wall of the generator. As usual, the wall is the grounded negative terminal. The power supply PS is sufficient to generate a corona discharge between N and S. This discharge is formed when electrons are drawn from the points N under influence of the positive screen.

The elements N, S, and P act as a triode. Some electrons pass through S and continue on to P. This flow loads the generator and lowers its output voltage E.

An amplified error-signal controls tube T and therefore determines the emission from N. This signal may be a small fraction of the generator output. If E rises for any reason, there is a greater error-signal and a more intense corona discharge. The increased flow between S and P reduces the generator output to normal.

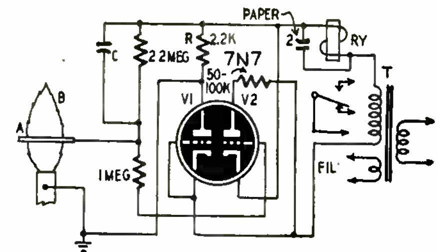
GAS FLAME PROTECTION

Patent No. 2,528,589
George P. Frick, Wayne, Pa.
(Assigned to Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.)

This invention automatically shuts off a gas supply if the flame goes out. Its operation is based on the conductivity of a flame.

Winding T of the power transformer feeds rectifier V1. Rectified voltage appears across R, and half-waves of current flow *downward* through relay RY. Load resistor R is shunted by a 2.2-megohm resistor and a flame B in series. When the flame is on, its conductivity completes a voltage divider across R and C becomes charged. When the flame goes out, there is infinite resistance between electrode A and ground. There is no voltage division in this case and C loses its charge.

Grid and cathode of triode V2 are across C (through a grid resistor). When the flame is on, the voltage from C biases the triode beyond cutoff, and the only relay current is due to the half-waves flowing *downward*. When the flame goes out, there is no charge on C, and V2 conducts to send half-waves of current *upward* through RY. Since both alternations of the a.c. pass through the relay there is no average d.c. component to energize it. The a.c. is bypassed by a 2-µf capacitor across RY. The relay contacts control the gas



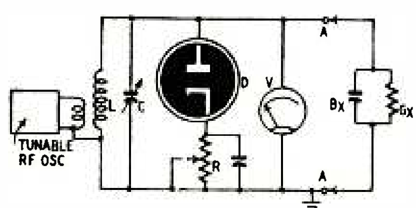
feed to the flame so that gas flows only in the *energized* position. This external control circuit is not illustrated here.

CONDUCTANCE METER

Patent No. 2,547,650
William A. McCool, Hyattsville, Md.
(assigned to Boonton Radio Corp.)

Measuring conductance and susceptance at any desired r.f. this device is applicable to coils, transmission lines, transformers and similar equipment.

With terminals A left open, the oscillator is set to the desired frequency. Then the secondary circuit is resonated by means of C. Meter V shows



when resonance occurs and measures the voltage across the secondary. D is a diode rectifier of the 6H6 type.

When the unknown network (shown here as Gx, Bx) is added, the secondary is detuned and shunted. Resonance may be re-established by varying C. The difference in scale reading of C shows the value of Bx. If the first reading is the higher one, then Bx is a capacitor. Otherwise it is an inductor. C may be calibrated in terms of capacitance (or inductance) across A so Bx can be read directly.

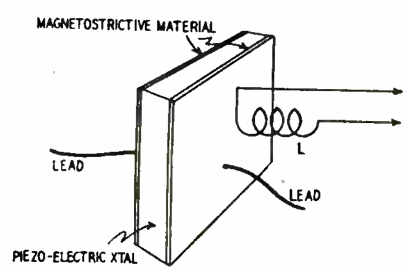
Gx shunts the secondary so the second maximum of V is lower than the first. The original maximum can be restored by increasing R. This control may be calibrated in terms of resistance across A. Then Gx is found directly by reading the dial.

FREQUENCY CONTROL

Patent No. 2,551,848
Billy E. Parker, Quincy, Ill.

This control varies the physical dimensions of a quartz plate. The opposite surfaces of the quartz are coated with a thin layer of nickel or other magnetostrictive material. External connections are made by leads soldered to the metal surfaces.

A crystal may be used to control the frequency of an oscillator or as a filter element. However, if a coil L is added near the nickel layers, current through L sets up a magnetic field which expands or contracts the nickel. As a result the dimensions of the quartz plate also vary to alter the resonant frequency.



LINEAR SINGLE-SWEEP

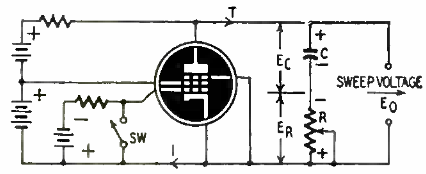
Patent No. 2,539,007
Lourens Blok and George Philip Roszbach, Eindhoven, Netherlands.
(assigned to Hartford Nat'l Bank)

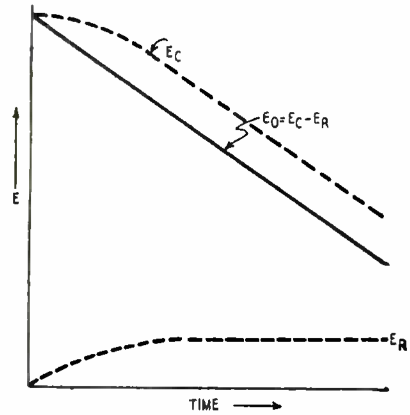
A single-sweep time base such as needed to display a transient signal on a scope is provided by this circuit. It is not easy to attain linearity when such a sweep is very rapid. Compensation is added here to obtain a sweep which is rapid and linear.

A single-sweep is often generated by discharging a capacitor through a pentode. Normally the tube is blocked, and when the bias is removed the discharge current flows through it. Although a pentode tends to pass constant current, it is found that the current actually rises *gradually* from zero to its final value. This is due to the fact that when bias is removed, the grid does not reach cathode potential instantaneously.

The new circuit (see diagram) has a variable resistor R (about 120 ohms) in series with the usual capacitor C. Normally the tube is blocked (SW open). When SW is closed, the bias is removed and the sweep starts. SW may be closed manually as shown, or electronically by the transient to be observed. In either case C discharges through R and the tube.

The discharge current (I) increases gradually before reaching its steady value. Therefore E_R (which is proportional to I) has the shape shown in the figure. Since I is the current withdrawn from the capacitor during discharge, E_C will





decay as shown by the curve. If R is correctly chosen, the rise in E_R will be similar to the decay of E_C.

The sweep voltage is the difference between E_C and E_R. It is shown by the straight line E_O which indicates a linear sweep.

POWER FACTOR METER

Patent No. 2,543,640

Noval P. Millar, Danvers, Mass. and Russell A. Warner, Schenectady, N. Y.

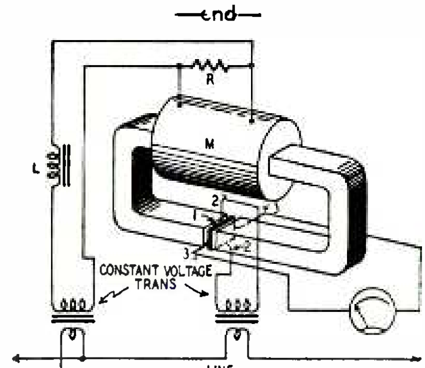
(assigned to General Electric Co.)

The *Hall effect* is utilized in this instrument to measure power factor in an a.c. line. If current flows through a plate of germanium while in a magnetic field, the germanium generates a potential difference. The voltage will be perpendicular to both the current and the field, and will be proportional to their product.

M is an electromagnet supplied with a.c. through a phase-shifter. L and R produce a 90° shift. The Hall plate (1) is fixed between the magnet pole pieces. Current flows through the plate by means of conductors (2). The generated voltage is available from leads (3) and is measured by the galvanometer.

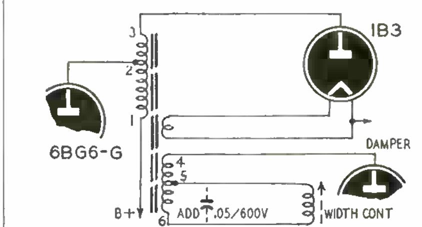
Because of the phase shifter, the field is 90° out of phase with the current to the germanium, under conditions of unity power factor in the line. The product of two vectors with 90° phase difference is zero. Therefore the meter shows a reading of zero-center if the power factor is unity. As the factor lags or leads, the needle will deflect in one direction or the other. The meter may be calibrated in terms of power factor.

—end—



INCREASING PICTURE WIDTH

If the width control of a TV set cannot be adjusted so the picture completely fills the screen, or if the set has no width control, the picture width can be extended to a satisfactory degree by



connecting a .05-μf, 600-volt capacitor across terminals 5 and 6 of the horizontal output transformer.—*L. H. Casto*

ADMIRAL 24-TUBE CHASSIS

Strong 60-cycle hum in the 24D1, 24E1, 24F1, 24G1, and 24H1 chassis is generally caused by one of the following, and can be corrected easily:

(1) The cold side of the volume control may be connected to the grounded heater lug of the first a.f. amplifier tube instead of to the grounded cathode lug on the same socket. Make sure that the volume control grounds to the cathode lug.

(2) The a.c. leads to the switch on the volume control may be too close to the grid lead of the first a.f. tube. Dress the a.c. leads well away from the grid lead. Later production models have a retaining lug to keep the a.c. leads dressed against the chassis.

(3) The coupling capacitor between the volume control and first a.f. grid may be reversed.—*Admiral Radio & TV Service Bulletin*

HALLICRAFTERS T-54

Failure of sound and video circuits is sometimes caused by a short in the .02-μf capacitor between ground and the plate of the 25L6-GT audio output tube. The short circuit reduces the plate voltages to the point where the video circuits are inoperative. Replace this capacitor with a .02-μf, 600-volt unit.

To improve the sensitivity of this set, remove the 10,000-ohm resistor between the plate and screen grid of the 6AG5 r.f. amplifier.—*Wilbur J. Hantz*

EMERSON 650D, 654DF, AND 654F

If the set does not work and several of the tubes do not light, check the filament-dropping resistors. These usually go bad after the set has been in service for about a year. After repairing the set, check the line voltage at the outlet supplying the receiver.

Do not confuse models 650D and 654D (chassis 120123-B) and 650F and 654F (chassis 120138-B)—transformerless types—with the 650 and 654 (chassis 120118-B) which have power transformers.—*Wilbur J. Hantz*

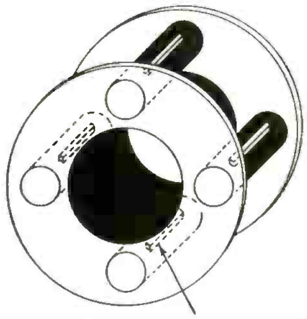
AIRLINE MODEL 62-901

If you find the 6A7 screen bypass capacitor C31 shorted, check the screen-dropping resistor R21 to make sure that its value has not changed from 30,000 ohms. This set will not track properly if the value has changed.—*Clarence J. Tabor*

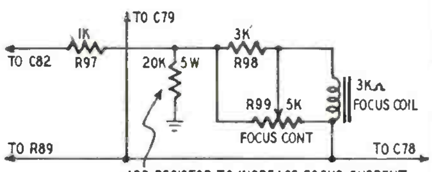
PIX TUBES FOR SENTINEL 420TV

The Sentinel model 420TV was originally shipped with a 16-inch rectangular picture tube bearing the manufacturer's part number 57E5 or 57E6. When exact replacements are not available, 16TP4 or 16RP4 tubes can be used as replacements.

After installing the 16TP4 or 16RP4, set the horizontal drive control as described on page 4 of the service manual for this model. If neck-shadow is present, remove it by adjusting the four mounting screws on the focus-coil mounting assembly. Adjust the focus control for proper focus.



a



b

If focus improves but is not perfect when the control is in the full *counter clockwise* position, the focus magnet is too strong. Correct this by placing four ¾ x ⅛ x 1/16-inch steel strips around the focus magnet as shown in the drawing at *a*. If these shunts do not bring proper focus within the range of the control, use additional shunts.

If you must turn the focus control *clockwise* for improved focus but perfect focus is not attained before the control reaches the full clockwise position, the focus magnet is too weak. Connect a 20,000-ohm, 5-watt resistor between ground and the junction of resistors R97, R98, and R99 as shown in the partial schematic at *b*.—*Sentinel Service Dept.*

CARE OF FOCUSING MAGNETS

The PM and EM-PM type focus magnet assemblies used in many TV sets can be permanently damaged by improper handling or storage. A slight jar or striking with a metal tool may cause the unit to lose its magnetism and affect its ability to properly focus the electron beam on the screen of the picture tube.

Always use a brass or nonmetallic screwdriver when making adjustments on the unit. When storing, do not leave them in contact with each other or with any metal material such as tools, other components, or shelving. Do not store them where they will be subjected to severe mechanical shock or vibration.—*Stromberg-Carlson Service Dept.*

—end—

TWO DYNAMIC NOISE SUPPRESSORS FOR HI-FI MUSIC FANS

A number of dynamic noise-suppressor circuits have been published—some of them have been incorporated in commercial audio equipment. Until a short while ago, constructors were unable to duplicate the published circuits without winding special high-Q inductors or having them made to order.

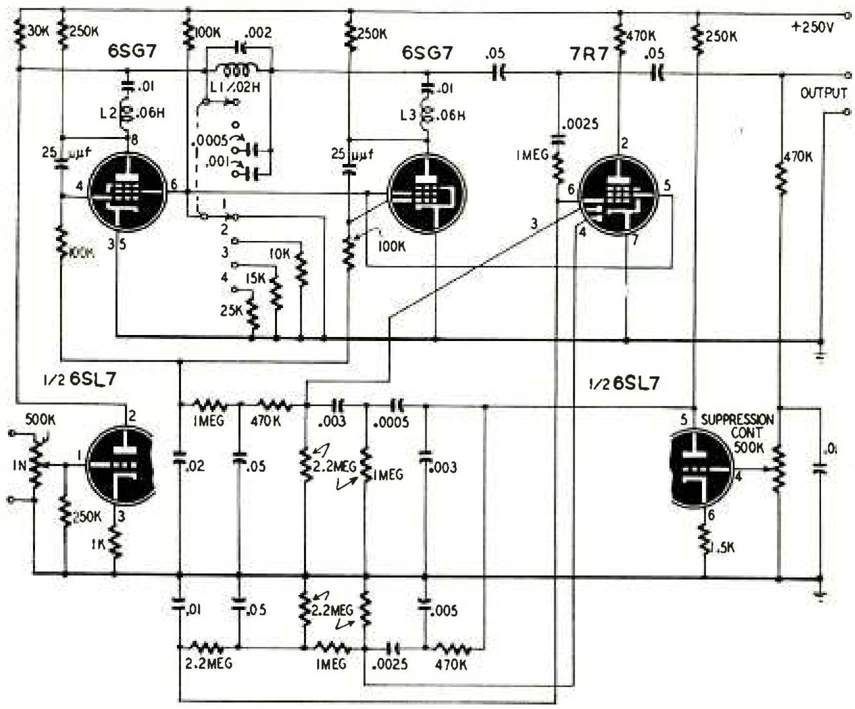


Fig.1—A 4-tube noise suppressor. Frequency response is variable in four steps.

A four-tube dynamic noise suppressor and a two-tube dynamic scratch suppressor are described in *UTC Circuits*, published by United Transformer Company. The noise suppressor, Fig. 1, is controlled by a four-position switch and the suppression control. It is similar to the circuit shown in Fig. 1 of the article "Noise Reduction in A.F. Circuit" in the May, 1948, issue of RADIO-CRAFT. When the switch is in position 1, the gate section is cut out and the circuit response is flat within 1 db from 20 cycles to 20 kc. The remaining switch positions provide different degrees of high- and low-frequency suppression which are determined somewhat by the strength of the input signal. The suppression control varies the suppression between limits determined by the switch setting. Inductors L1, L2, and L3 are .02, .06, and .06 henry, respectively. These three inductors are made by UTC in a special potted unit called the LS-8.

The variable low-pass scratch suppressor is shown in Fig. 2. It is basically a two-section, constant-K filter with variable capacitance elements C1 and C2 connected between grid and cathode of cathode-followers V2-a and V2-b.

The incoming signal is amplified by V1-a. The amplified signal passes through the low-pass filter to the output terminals. A part of the signal developed by V1-a is fed to the diode rectifier V1-b which develops a bias voltage for the grids of the variable-capacitance tubes V2-a and V2-b. The bias voltage varies in accordance with the average signal level. When the bias increases, the effective capacitance of C1 and C2 varies and changes the cutoff frequency of the filter. The response of the filter is 3 db down at 3,500 cycles for a weak input signal and 9,000 cycles for a strong one.

The suppression control is a 250,000-ohm dual potentiometer with linear resistance elements. Connections to the left- and right-hand terminals are made as shown so the output level remains constant at all settings of the control.

Inductors L1 and L2, 0.8 and 2.4 henries, respectively, are combined in one unit in UTC's CG-50.

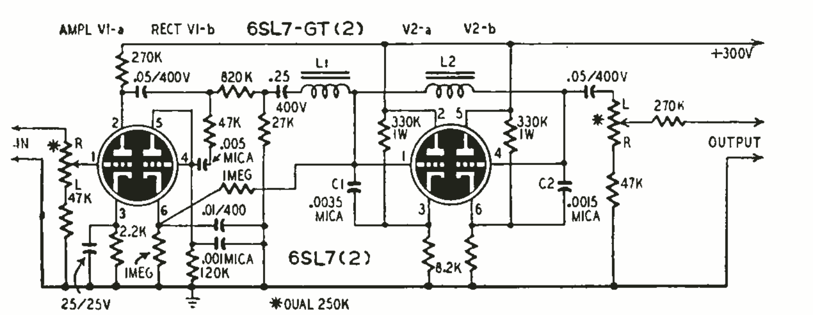


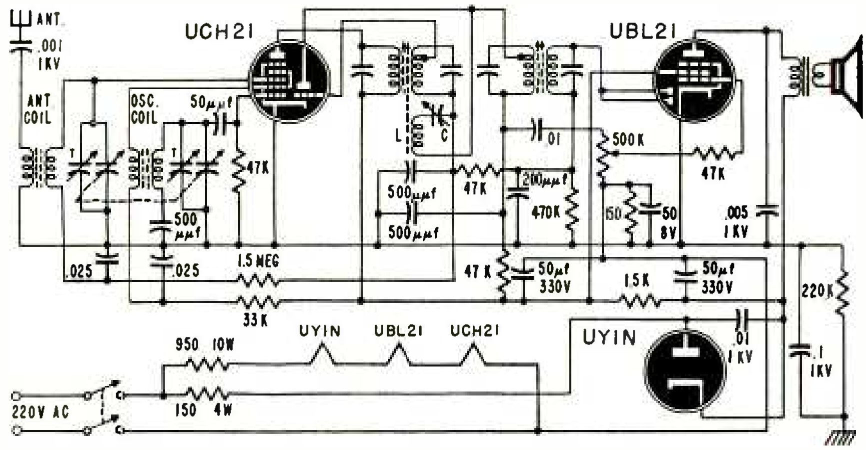
Fig. 2—This simplified suppressor circuit makes an effective scratch filter.

NOVEL 3-TUBE SUPERHETERODYNE FROM AUSTRIA

A glance at the circuit of this 3-tube superhet receiver will show that it is rather unusual when compared to typical American circuits. This set was described in *Radiotechnik* (Vienna, Austria).

The receiver uses a UCH21 triode-heptode, UBL21 duodiode-power amplifier, and a UY1N half-wave rectifier. In most European circuits, the grid. The trimmer capacitor C serves as a blocking capacitor as well as a means of tuning the trap (neutralizing) circuit.

The UBL21 is the second detector and power amplifier tube. The output section is a beam power amplifier having comparatively high sensitivity. With 100, 180, or 200 volts on plate and screen, grid bias is 5.3, 10, or 13 volts



UCH21 is connected with the heptode section working as a mixer and the triode as the high-frequency oscillator in a converter circuit similar to that which we commonly use with a 6K8. In this circuit, the heptode section is used as a pentagrid converter and the triode section as a *neutralized i.f. amplifier*.

The triode section of the UCH21 is neutralized to prevent oscillation. Inductive neutralization is used. The inductance of L is paralleled by the grid-plate capacitance of the triode to form a parallel-resonant circuit tuned to the intermediate frequency. The high impedance of the tuned circuit prevents the flow of current from plate back to respectively.

The UY1N is a half-wave rectifier tube having a 20-volt heater. In other respects, it is very much like the 35Z3 and similar American types.

This circuit can be used as the basis for a number of interesting experimental circuits. For example, you may try a 6X8 as the converter and i.f. amplifier, a germanium diode as the second detector, a sensitive power amplifier tube as the output stage, and a selenium rectifier in the power supply circuit. Note that this set operates from a 220-volt line. It might be advisable to use a voltage doubler type power supply to obtain comparable plate and screen voltages.

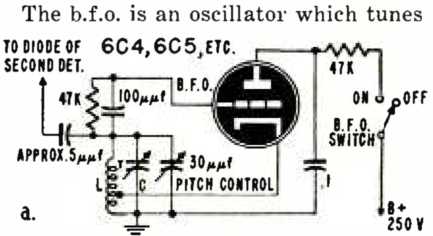
SIMPLE SHORTWAVE RECEIVER CONVERSIONS

There are a number of home-type all-wave receivers which compare favorably with communications sets in selectivity and sensitivity. Such sets can be converted for amateur use by adding a b.f.o. and S-meter. The b.f.o. circuit shown at *a* and the S-meter at *b* can be added to most receivers without making any changes in the original wiring. These circuits were described in an article on an 11-tube communications receiver in *La Radio Professionnelle* (Paris, France).

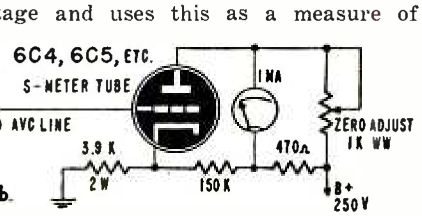
Both circuits are designed to use a medium-mu triode such as a 6C4 or 6C5. You can conserve space by using the separate triodes of a 6SN7-GT or a 12AU7.

The b.f.o. is an oscillator which tunes over a range of 10 or 15 kc on each side of the receiver's intermediate frequency. The coil L may be one winding of an i.f. transformer designed for a frequency equal to the receiver's i.f. with a 30-turn cathode winding close to the ground end of the i.f. coil. No. 28 or 30 wire may be used for the cathode winding. Reverse the connections to this winding if the circuit does not oscillate. C is the usual i.f. tuning capacitor. Its value should be adjusted so the circuit oscillates at the receiver's i.f. when the pitch control is set at midrange. Shield the entire b.f.o. circuit and use minimum coupling to the second detector.

The S-meter circuit is a triode v.t.v.m. which measures the a.v.c. voltage and uses this as a measure of



a.



b.

signal strength. The meter should be adjusted to zero with the antenna posts grounded and the sensitivity control turned to maximum.

The conversion can be completed by installing a switch which grounds the a.v.c. line when the b.f.o. is turned on to receive c.w. This switch is connected between ground and the grid returns on the grid side of the a.v.c. isolating resistor.

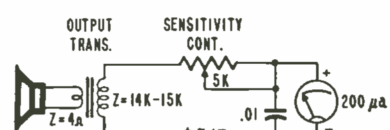
A bandspread capacitor is another desirable feature. A good approximation is a 15- or 20-μμf variable connected across the high-frequency oscillator trimmer in the receiver. Fitted with a knob, it will act as the bandspread tuner. The set should be aligned with it in the half-in position, which should be clearly marked, so that stations will come in at the same point on the main tuning dial.

A noise limiter is often used in communications receivers. One may be added, using the circuits shown in the June, 1951, issue of RADIO-ELECTRONICS.

A.F. OUTPUT METER

An output meter like that shown in the diagram is a handy piece of equipment to have on the aligning bench of a busy radio service shop. The average service technician uses the a.c. volts or output range of a multimeter, thus tying up the instrument so it cannot be used for more essential work.

This instrument, described in *Popular Radio* (Stockholm, Sweden) works without being connected to the set. Sound is picked up by a microphone—a small loudspeaker—and fed through a rectifier to a 200-μa d.c. meter. An output transformer having a turns ratio of 60 to 1 provides a high output voltage. A transformer designed to match a 4-ohm voice coil to a 14,000- or 15,000-ohm plate should work nicely. The rectifier may be a germanium diode or an instrument rectifier.



When aligning sets, the output meter is placed in front of the speaker on the set. The volume control and the 5,000-ohm sensitivity control are adjusted for a low reading on the meter. Receiver circuits are then aligned for maximum swing on the meter.

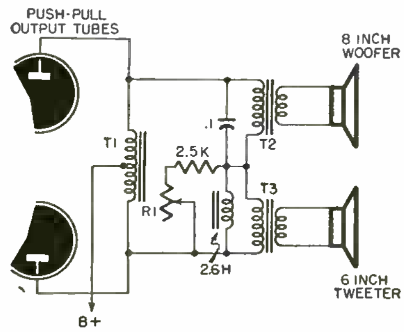
When working with audio circuits and filters, the volume control or input to the circuit and the sensitivity control on the output meter are adjusted so the meter reads zero db. Changes in volume level can then be read directly from the meter which is calibrated in decibels.

The meter is calibrated with zero db at the 80-μa point. Above zero db, +2, +4, +6, and +8 db are at 100, 126, 159, and 200 μa respectively, on the meter. Below zero db, 63, 50, 35, and 25 μa are marked –2, –4, –7, and –10 db respectively.

—end—

NOVEL CROSSOVER NETWORK

I find that the circuit shown is an acceptable substitute for the more expensive dividing or crossover networks used with most high-fidelity reproducing systems. It is particularly useful in small receivers which do not have sufficient baffling to warrant the ex-

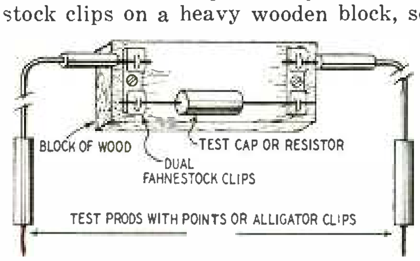


pense of a more elaborate system. The crossover frequency is approximately 400 cycles.

T1 is the regular output transformer of the receiver or amplifier. Its secondary is not used. T2 and T3 are small output transformers. The primary impedance of each is equal to the plate-to-plate load impedance of the output tubes. R1 serves as a tone control by cutting the highs fed to the tweeter. I use a 500,000-ohm unit, but probably a lower value will work better.—*G. Borchert*

SUBSTITUTION BLOCK

This little gadget is as handy as it is simple to construct. I find it lots easier to use than a decade box. The component leads are clamped firmly to Fahnestock clips on a heavy wooden block, so



there is little danger of short-circuits or an accidental shock. If test leads are fitted with alligator clips, the setup can be used when trying different components in experimental circuits. Any capacitor, resistor, or other two-terminal device can then be inserted for test or substitution.—*M. J. Kolo*

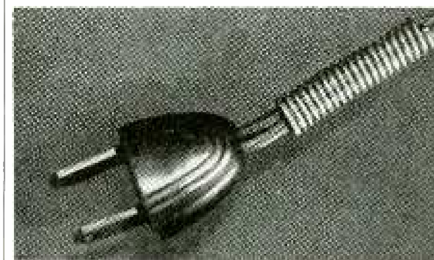
TOM THUMB 3-WAY SET

The customer reported that severe distortion appeared in the set after he had installed five new 1.5-volt A-cells. The distortion sounded like that produced by improper bias or a bad coupling capacitor. Examination showed that the new cells had been inserted incorrectly. The trouble cleared up when the cells were properly installed.

Bias for the various stages is obtained by returning the grids to points on the series-connected filament string. Reversing the polarity of one or more cells will cause severe distortion as will one or two bad or low cells.—*David Gnessin*

HANDY SOLDER SUPPLY

Forgetting to take along a supply of solder when going on a service call or running out of solder just when you need it most, can be prevented by wrapping a foot or two of wire solder around one end of the soldering-iron cord as shown in the photo. Here, it is out of the way, yet always available when needed. —*Louis H. Yates*



DEFECTIVE TUBES ARE USEFUL

Frequently amateurs and radio experimenters are called on to repair a small a.c.-d.c. set for a friend or relative. Usually, the trouble is a burned-out tube as indicated by the complaint, "the set won't light".

To quickly locate the tube with the open filament, make a collection of different types of tubes which have good filaments but are otherwise defective. Snip off all the pins except those for the heater. Now, when you get a set to repair, you can quickly find the defective tube by substituting a dummy.

I have also found the dummy tubes handy substitutes for line-dropping resistors in experimental a.c.-d.c. circuits. For example, I built a code oscillator using a 35Z5-GT and 50L6-GT. I didn't have a resistor which could be used in series with the heaters so I wired in an extra socket and inserted a dummy 35Z5-GT.—*C. Tierney*

LINE FILTERS IN A.C. SETS

Many a.c. receivers have filter capacitors—usually about 0.1 μf—connected from the chassis to one or both sides of the a.c. power line. Although these capacitors are effective in removing stray line noises, they have the disadvantage of reducing the line-isolating capabilities of the power transformer. The current passed by these capacitors is not sufficient to damage any of the set's components but it can give you a healthy jolt if you happen to get between the chassis and a good ground. You can avoid it by removing one capacitor and connecting the other across the line.—*Charles Erwin Cohn*

CARRIER-CURRENT NOTES

Recently, I constructed the carrier-current relay described in the September, 1950 issue. While experimenting with it, I found that it will not work if a receiver or other device having a by-pass capacitor across its line cord is plugged into the power line. The capacitor short-circuits the line for r.f. so the relay will not work. The same applies to most carrier-current or wired-wireless devices.—*Walter R. Sherman*

—end—

A CRYSTAL-CONTROLLED MARINE TRANSMITTER

? *Please print a circuit of a 4-channel, 100-watt phone-c.w. transmitter for use in a small fishing launch. The transmitter should have a single control which can be used to select one of four frequencies in the 2–3-mc range while simultaneously switching in the correct power-amplifier tuning and antenna-loading capacitors. Power is supplied by a 12-volt dynamotor which delivers 600 to 625 volts at 225 ma. When using phone, I want to control the dynamotor with a switch on the T-17 microphone. Separate send-receive and dynamotor switches must be used for c.w. operation.—E. N., Port Arkansas, Texas.*

A. The circuit of the transmitter is shown. By using a Pierce crystal oscillater and a Pi-type antenna coupler, tuning adjustments are limited to a single stage. The 6Y6-G clamp-tube prevents excessive dissipation in the final under key-up conditions.

The modulator is an 815 driven by a triode-connected 6F6 which is excited directly by a T-17 or similar carbon microphone. Microphone excitation voltage is tapped off the cathode resistor for the 6F6. Modulator bias is developed across a resistor in series with the negative leg of the high-voltage supply.

RY1 is the dynamotor starting relay. It has heavy contacts capable of carrying 40 amp or more and is controlled through dynamotor switch S1. When the switch is in the position shown, the dynamotor is stopped and started by the switch on the mike. When it is in the opposite position, RY1 closes and starts the relay.

RY2 makes and breaks the high-voltage supply circuit. The contacts should be wide-spaced and insulated for 1 kv or more. We recommend that you use a d.p.s.t. relay with two sets of contacts in series. When S2 is in the c.w. position, this relay closes when the c.w. send-receive switch S3 is in the send position. RY2 is controlled by the microphone switch when using radiotelephony. RY3 is a 12-volt antenna change-over relay having auxiliary contacts for muting the receiver while transmitting.

The parasitic suppressors in the plate circuits of the 829 are 10 turns of No. 18 enameled wire wound around a 100-ohm, 2-watt resistor. The power-amplifier tank and antenna loading coil consists of approximately 15 turns of No. 12 wire spaced to 3 inches on a 2½-inch form. The winding should be tapped every three turns. A shorting strap is adjusted to the point where the inductance is optimum for the four channels. Sections of the channel selector select the proper preset variable capacitors connected across the ends of the coil.

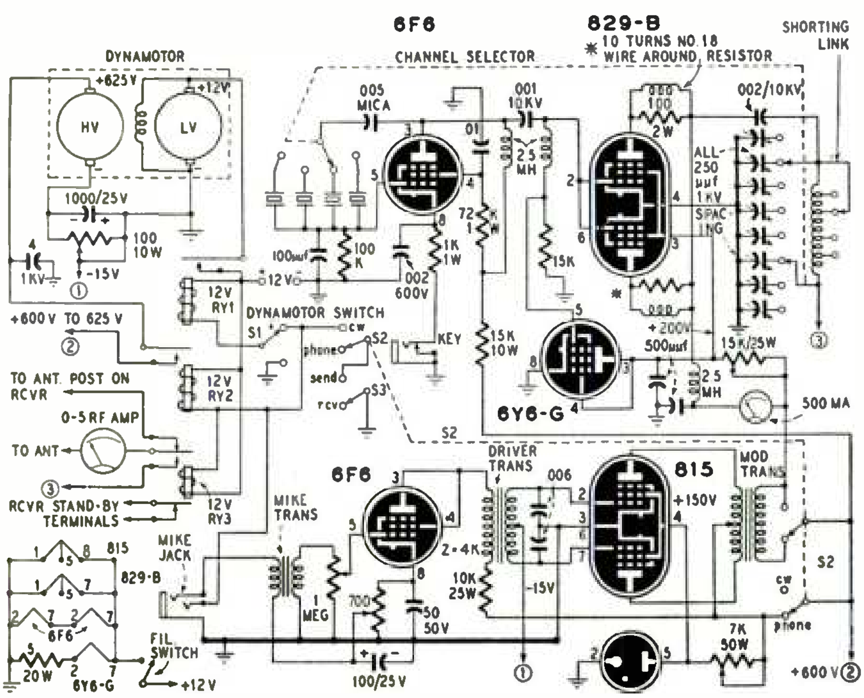
The coil winding data given for the loading coil is typical for most whip-type antennas. However, it may be necessary to use considerably more turns with some antennas, depending on their length.

TV LEAD-IN PROBLEM

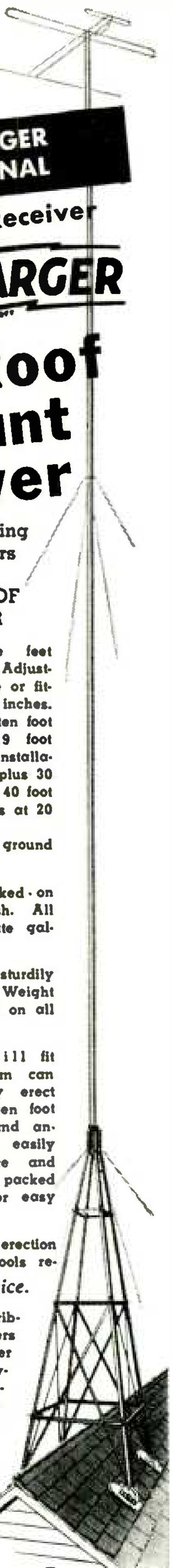
? *I have a run of over 500 feet between my TV antenna and the receiver. I want to use No. 18 wire in an open-wire line. What spacing shall I use for a 300-ohm line?—R. R., Hartford, Conn.*

A. For a 300-ohm line, the spacing is 0.3 inch for No. 18 wire, 0.5 inch for No. 12, and 0.6 inch for No. 10. Such spacings are too small to maintain with any degree of accuracy, particularly when using No. 18 wire on a 500-foot run.

Why not use a 600-ohm open-wire line and match it to the receiver and antenna through 425-ohm quarter-wave stubs? The 600-ohm line can be made from No. 18 wire spaced 3 inches on



NOTE-POINTS HAVING THE SAME NUMBER ARE CONNECTED TOGETHER



centers. The quarter-wavelength matching stubs may be No. 12 wire spaced 1½ inches, or ¼-inch tubing or rod spaced 4½ inches.

The length of the matching stubs is calculated from the formula:

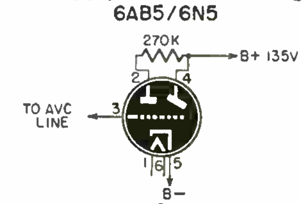
$$L = 246 \times V/f,$$

where L is the length of the stub in feet, V is the velocity factor (approximately 0.975 for open-wire lines), and f is frequency in megacycles. If the antenna is cut for a single channel, substitute for f the center frequency of that channel. For an all-channel antenna, use the average of the frequencies of the highest and lowest local channels or use the center frequency of the weakest local channel.

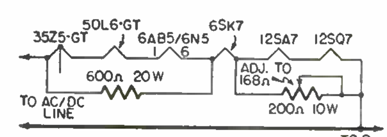
ADDING A TUNING INDICATOR

? *Please show me how to connect an electron-ray tuning indicator tube to an a.c.-d.c. receiver which uses a 35Z5-GT, 50L6-GT, 12SQ7, 12SA7, and 12SK7. I would like to use either a 6AF6-G or a 6AB5/6N5.—C. M., Maracaibo, Venezuela*

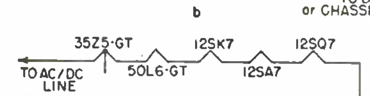
A. Your set requires approximately 120 volts across the series-connected heater string for proper operation. If you use the set on a.c. only, then you can connect the indicator tube as shown at *a* and supply its heater voltage from



a



b



c

a small 6.3-volt, 1-ampere filament transformer. If the set is used on d.c., you may substitute a 6SK7 for the 12SK7 and connect the heater of the 6AB5/6N5 in the filament string as shown at *b*. The 6SK7 draws 300 ma, so resistors must be shunted around the sections of the string which contain the 150-ma tubes. The drawing at *c* shows the heater circuit of the average 5-tube receiver using the tubes you have listed or their equivalents. If a 35L6 can be used for the 50L6, the 6AB5 can be inserted without other changes.

Some receivers develop considerably more a.v.c. voltage than others for a given signal input to the antenna, therefore allowance must be made for individual receiver peculiarities.

In this circuit, –10 volts must be applied to the grid of the 6AB5 for zero shadow angle. Therefore, it may be necessary to add a cathode biasing resistor. A resistor of approximately 2,000 ohms will be about right.

—end—

RTMA ANSWERS TECHNICIANS

The Radio-Television Manufacturers Association's Service Committee met September 18 at New York. Delegates of several radio-TV service technicians' and TV contractors' associations were also present. The committee made a formal reply to the proposals made by the service technicians' representatives at the committee's Chicago meeting (RADIO-ELECTRONICS. Aug. 1951, page 87 and Sept. 1951, page 119).

On the question of design the RTMA committee stated that the majority of member manufacturers were in favor of, and had already complied with, requests such as stamping model and serial numbers on the chassis, providing tube layouts in each set, providing protective covers on metal picture tubes, engineering sets with servicing in view, and that practically all their other members had "set wheels in motion" in that direction. The committee did not quite see its way clear, however, to promise that such problems as tubes and fuses placed under the chassis would be settled immediately.

Even after it was pointed out by service delegates present that large manuufacturers had marketed receivers with removable safety glass, so that the face of the picture tube could be cleaned, the committee insisted that the underwriters have not approved the practice.

The "more liberal program" in supplying service notes was "economically unfeasible" the committee stated. Krantz of Philadelphia, representing NETSDA, pointed out that much of the present distribution of service data is wasted, going into the hands of dealers and distributors who neither understood nor used the data, and that if such data were in the hands of the active service technician it would result in an increase in components sales probably sufficient to cover the cost of distributing the service data. The service technician, it was pointed out, would naturally prefer to use the correct replacement part, which could be installed without difficulty, if he had the information which would permit him to order it. This point evoked considerable interest, and it is felt that future policies of RTMA members may favor wider data distribution than envisaged by the committee's statement.

It appeared that the manufacturers had not been able to make progress on the proposal for an effective training program on u.h.f. and color, for technicians to whom these fields are new, as requested at the June meeting. Instead, some progress had been made in a plan to have a television technician's training course included in the curriculum of 2,500 vocational schools.

Service technician representatives attending the meeting expressed the feeling that while much asked for at the Chicago meeting had not materialized, considerable progress had been made. The very fact that manufacturers and service technicians are at last working together for their mutual benefit is a great step forward, they pointed out.

NETSDA MEETS IN PHILLY

The first fall meeting of the National Electronic Technicians and Service Dealers Associations (NETSDA) was held September 9, in Philadelphia. Delegates from fifteen member Chapters were present. Delegations from the Radio and Television Servicemen's Association of Pittsburgh, Inc. and the Television Contractors Association of Philadelphia were also present as guests.

The delegation headed by David Van Nest of Trenton presented application for membership to NETSDA, which was voted on and accepted, making the Trenton Radio and Television Servicemen's Association the sixteenth Chapter in NETSDA.

Dave Krantz then reported on the Chicago June meeting of the RTMA service committee, which he had attended as representative of NETSDA, and informed the delegates of the coming meeting in New York, to which a representative was also invited. Krantz and Max Liebowitz were elected to attend that meeting. (See P. 113.)

Delegates then voted to add to NETSDA's Industry Relations Committee Max Leibowitz of New York and Dave Krantz of Philadelphia to assist Norman Selinger, vice-president of NETSDA, in Washington, D. C. in making a representation to the Federal Trade Commission on September 26th. NETSDA will join with other service groups in making this representation.

NETSDA voted unanimously approving Sylvania's action regarding its advertising policy in regard to *Look* Magazine and suggested that other members of the electronic manufacturing industry follow Sylvania in the protest to *Look* Magazine, thus assisting the electronic Servicing profession. (See R. 116.)

A committee was appointed under the chairmanship of Mr. James Daly of the Philadelphia Radio Servicemen's Association to formulate a national code of ethics for NETSDA.

The next meeting was set for October 7, at New York City.

MARYLAND'S TECHNICIANS FACE LICENSING PROBLEM

Some Maryland believers in the value of licensing to the service industry have recently been inclined to admit that even a good thing can be carried to absurdity. Cause of the opinion was a "Notice to the Public" recently issued by the Electrical Administrative Board of Baltimore County, Maryland (Baltimore County surrounds the city on three sides, but Baltimore proper is not part of it).

The notice read:

It is illegal to perform or have performed any electrical repairs, installations, or electrically operated apparatus including television and radio, except by a person holding an electrician's license as set forth in the 1949 Acts of the General Assembly of Maryland. Persons violating this law will be prosecuted. . . .

Shortly thereafter, a meeting was held by the board, before a surprisingly large body (more than 200) of interested radio-TV service technicians, radio amateurs, and experimenters. The board's chairman, Louis E. Susemihl, a local electrical contractor, declared that his business had improved 25 per cent since these new rulings had gone into effect. He continued by urging radio and TV service technicians to obtain their licenses.

To obtain one of these licenses, however, it is necessary to have worked for a master electrician for a period of at least two years, and to pay various fees and pass an examination. This would limit licensing to a very small group of the persons now working in the field of electronics as it is generally accepted.

High points of the meeting included several questions as to the fitness of the board members to pass on the qualifications of electronics technicians whose skills are quite different from those of electricians.

As a result of the meeting, a second meeting was held between the board and representatives of a combine of radio amateur clubs. James F. Gordon and Willis Jones, of Bendix Radio Division of Bendix Aviation Corporation, Towson, Maryland, announced after the meeting that the board had agreed to interpret the rulings in such a way as to eliminate the requirement for radio amateurs and radio broadcasting station operators to hold County Electrician's Licenses. This was not exactly a victory, since these classes of operators are protected in their rights by the Federal Government, and no doubt the board had learned that fact.

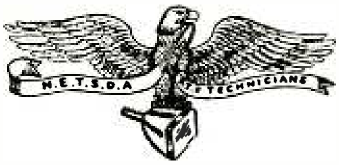
At the present time, according to Paul D. Rockwell, principal engineer at Bendix Radio Division and president of the Chesapeake Amateur Radio Club, there are some indications that the entire set of rules and regulations may be changed, but the ruling continues to require electrician's licenses for radio and television repairmen.

PITTSBURGH'S CREDIT UNION

The Radio and Television Servicemen's Association of Pittsburgh, Inc., applied for membership in the Federation of Radio Servicemen's Association of Pennsylvania.

Pittsburgh is believed to be the first association in the country to set up a Federal Credit Union. This was done to help the small shop owners and the independent service technicians to obtain additional financing for their business and the purchasing of test equipment.

NETSDA ADOPTS EMBLEM



Above is the new emblem of the National Electronic Technicians and Service Dealers Associations, adopted in Washington last spring. It will be supplied to all chapters in the form of mats and decals.

RADIO-TV EMPLOYMENT PROSPECTS ARE GOOD

The U.S. Labor Department predicts strong demand for skilled electronic technicians throughout the early 1950's. Chief demand will be in the fields of home radio and television servicing and in manufacturing and servicing military, industrial, and household electronic equipment. The prediction, which appears in an "Occupational Outlook Handbook" issued by the Department in co-operation with the Veterans Administration, continues to state that service work will increase with the increase of automatic control and automatically operated appliances and equipment. Such control is predominantly electronic.

One note of warning was sounded: The radio service shop owners who do not intend to go into television may have to prepare to go out of business, according to the report.

ETHICS AND WARRANTIES DISCUSSED IN JERSEY

The Television Contractors Association of New Jersey made business ethics and parts warranties the subjects of discussion at an August meeting at the American Legion Home in East Orange.

President Gus Friedman pointed out that the problem of parts warranties is becoming a serious matter, and that in some cases warranties on some components were on the point of expiration when the equipment containing them reached the customer, thus creating a difficult situation for contractor, dealer, and distributor.

The Association advertises in two Newark Sunday newspapers, asking TV service contract holders to make any legitimate complaints to the association's grievance committee, so that any instances of dishonesty or incompetence may be investigated and rectified.

SYLVANIA CANCELS *LOOK*

Among the indignant responses to the *Look* article, "Pop Is a Moral Slacker," was one that came from Sylvania Electric Products, Inc. Sylvania had been running its well-known series of ads promoting the skill and reliability of the radio service technician in that magazine, and by coincidence part of the article describing "radio repair experts" as crooks and cheats appeared on the same page.

Although no part of the television industry would deny that the servicing field includes some dishonest individuals, this article stated that "America's radio repair experts and garage mechanics, *almost to a man*, have cheated the set owners and car drivers. *In nearly every* case, though they did diagnose and repair the trouble, they gave it a fancy name and charged a fancy price."

Sylvania felt that such an article did not fairly represent the service technician and that *Look* in publishing it had acted in a manner harmful to the service industry. To make the protest more impressive, all future Sylvania advertising in *Look* was cancelled. (Italics ours.—*Editor*)

SPECIAL OFFER!

Save up to $2.50 over regular rates.

SPECIAL
LOW RATES

3 YEARS $5.50
2 YEARS $4.00
1 YEAR $2.50

REGULAR RATES
3 Years $8.00
2 Years $6.00
1 Year $3.50

Save up to 15c a copy over the newsstand price!

RADIO • TELEVISION • AUDIO

Don't miss these features scheduled for publication in the near future!

- CONVERTERS FOR UHF TV
- DESIGNING CROSSOVER NETWORKS
- NEW LIFE FOR OLD RADIOS
- ESSENTIAL FACTORS FOR HIGH QUALITY AUDIO
- TIPS ON INDOOR TV ANTENNAS
- MORE ON COLOR AND UHF TV

By such top flight technical writers as Mandl, Frye, Berkeley, Turner, Langham, Ledbetter, Dorf and others.

A SUBSCRIPTION NOW WILL INCLUDE THE BIG 50¢ JANUARY SPECIAL TELEVISION ISSUE!

RADIO — ELECTRONICS

BAR WESTERN UNION?

A "good possibility" that Western Union might be prevented from continuing in the television service field was stated to exist by Frank Moch of Chicago, president of the National Alliance of Television and Electronic Service Associations, in a bulletin issued to the association's membership in late summer.

The bulletin refers to the FTC (Federal Trade Commission) investigation into radio-television industry practices, and says that the FTC is especially interested in:

1. Forced sales of parts warranties.
2. Failure to stock replacements.
3. Use by distributors and manufacturers of off-brand tubes and parts.
4. Charge by distributors and manufacturers of shipping costs in cases where parts are back-ordered.
5. Misrepresentation in advertising.
6. Failure of distributors and manufacturers to co-operate in the supplying of service data.
7. Copies of written parts warranties issued by distributors and manufacturers.

The bulletin then goes on to state:

"You will undoubtedly be interested to know that the Western Union attempt to enter the service field is also being investigated, and we believe a very good possibility exists that Western Union will eventually be barred from the service field."

NEW STATE ASSOCIATION

A new State federation came into being with the formation of the Texas Electronic Association June 3, 1951. It was founded at a meeting at Austin, at which delegates from the Dallas Radio Sales and Service Association, the Texas Electronic Technicians Association of Houston, the San Antonio Radio and Television Association, and the Texas Radio Service Association of Austin were present. Representatives from Fort Worth, Galveston, and Lockhart also attended the meeting.

Two earlier meetings, at which the proposed setup was thoroughly discussed, had been held.

The charter permanent officers are: president, Frank J. Humpola, Houston; vice-president, Forrest Baker, San Antonio; secretary, Luther Bradley, Dallas; and treasurer, J. D. Huff. T. P. Robinson of Dallas was appointed public relations representative.

Object of the association is to unify and bring together the programs of the local groups into a co-operative effort, to advance the cause of the radio and television technicians of Texas, and to provide a means for watching for any proposed legislation that would affect the welfare of these technical men.

In a communication after the date of the meeting, the Fort Worth group notified the secretary of the completion of their own local organization and their intention to apply for membership in the Texas Electronic Association at the next meeting, which was to be held in September. It was anticipated that other associations would join then.

SOUTH JERSEY SEEKS MEMBERS

Membership Committee of the Allied Television Technicians Association of South Jersey has designed a program to extend its membership drive to all of South Jersey.

Present officers are Rodger Haines, president, Paul Matlack, vice-president; Bob Blazer, secretary; and Gordon Laney, treasurer. At the last meeting a nominating committee was appointed to select the list of candidates for election of officers for the October meeting.

Paul Matlack, vice-president of the Association, has just received the contract for the Inter-Communication System on the New Jersey Super Highway.

TRENTON, N. J. NOMINATES

At its recent election the following officers were chosen: George Owens, president; Francis Wolf, vice-president; Charles Redman, secretary; while David Van Nest was elected delegate to the NETSDA. Trenton's delegates were requested to present application for membership to NETSDA. The Trenton association will also co-operate with other groups in New Jersey State in meeting and discussing State problems.

WASHINGTON, D. C., REPORT

Under supervision of J. T. Burns, president, and Norman Selinger, vice-president, we are preparing a new and complete series of technical lectures and business forms. Membership Committee is contemplating a drive to obtain membership from all service organizations in Washington, D. C. A committee will investigate all licensing bills that are being presented in the various municipalities and states as an aid in formulating a licensing bill for Washington, D. C.

Joe Burns, president of the Television Associates, is also Chairman of the Membership Committee for NETSDA and is kept busy meeting delegates from numerous associations and answering mail from others who are interested either in forming an association or obtaining membership in NETSDA.

ARTSNY GETS CLUBROOM

ARTSNY has obtained a new club room consisting of 3,000 square feet. In addition to being a club room, it will have a complete Service Clinic and offices at 5 Rutgers Street, New York City.

A large group of ARTSNY members, with the Association's backing, now have a large ad in the classified telephone directory.

ITHACA AIDS CAUSE

Ben De Young of the Ithaca RSA has all the members helping him on a fund raising campaign for a cause close to his heart—The Cerebral Palsy Fund. The Program Committee has developed new educational and business training lectures that will be presented to the membership at its meetings.

—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.

IN NOVEMBER, 1917 ELECTRICAL EXPERIMENTER

Seeing Wireless Signals

Microphones in Trench Warfare, by H. Gernsback

Something New in Microphones

New Radio Submarine to Foil U-Boats

Construction of a Laboratory Vacuum Pump by Raymond Francis Yates

First Woman Radio Operator

Development of Aircraft Radio in the Navy by Benjamin F. Miessner

Efficiency in Radio Transmitting Circuits by Bayard Shumate

Locating Underground Ores by Electricity

—end—

THE FUND TOPS $8,700.

HELP - FREDDIE-WALK FUND

We are happy to inform our readers that the Freddie Fund last month reached a grand total of $8,672.62.

As a number of our readers know by this time, little Freddie was born completely legless and armless. There are not even any vestiges of limbs on his body. He is the three-year-old son of Herschel Thomason, well-known Arkansas radio technician.

We were exceptionally pleased to receive a letter from Mr. Herbert F. Dengler, Radio Engineer, Voice of America, Munich, Germany. He not only enclosed his own check for $5.00 as a contribution, but also forwarded a check for $10.00 as well from the members of the German technical staff of the Voice of America Receiving Station at Munich, Germany. Ten dollars may not seem like a large sum of money to Americans, but coming from Germany it means a very fine contribution. We take this opportunity to thank the staff of the Voice of America.

We are also pleased to report a special contribution of $3.80 from the Beginners' Class (5-6-year-olds) of the 9th Street Methodist Church, Decatur, Alabama, collected by Mrs. J. D. Sims. Our readers will also be interested in a very important four-page article in *Look* magazine, issue of October 9th. It contains many excellent photographs of Freddie. Do not miss it.

Please send your further contributions from time to time—even the smallest amount will be highly welcome. Make all checks, money orders, etc., payable to Herschel Thomason, and please address all letters to

HELP-FREDDIE-WALK FUND
c/o RADIO-ELECTRONICS
25 WEST BROADWAY
New York 7, New York

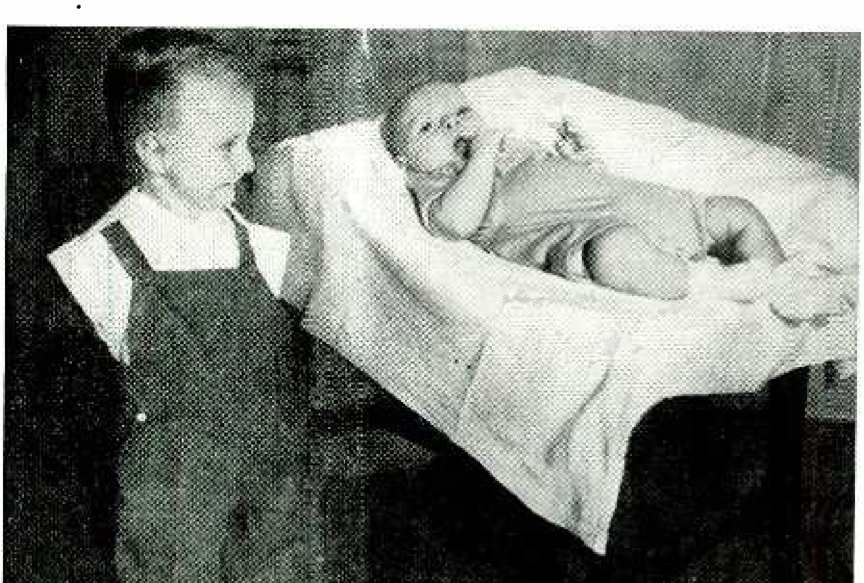
FAMILY CIRCLE CONTRIBUTIONS

Balance as of August 20, 1951	$434.70
Mrs. I. U. Ballard, Wilmington, Calif.	1.00
Miss Norma Cole, Orange, Mass.	5.00
Mrs. Donald Newton, El Cajon, Calif.	1.00
Mary Anne & Tom Rooney, Baltimore, Md.	2.00
Mrs. J. D. Sims and the Beginners' Class of the 9th Street Methodist Church, Decatur, Alabama	3.80
Mrs. Dail C. West, Miami, Oklahoma	10.00
FAMILY CIRCLE contributions received up to September 18, 1951.	$457.50

RADIO-ELECTRONICS CONTRIBUTIONS

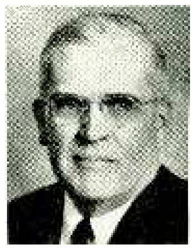
Balance as of August 20, 1951	$8,118.93
Anonymous, Glendale, Calif.	1.00
Anonymous, Stratford, Conn.	5.00
Anonymous, Atlanta, Ga.	5.00
Anonymous, Oak Lawn, Ill.	1.00
Anonymous, Short Hills, N. J.	1.00
Anonymous, New York, N. Y.	2.00
Anonymous, East Pittsburgh, Pa.	1.00
Anonymous, Seattle, Washington	10.00
Joe Anso, Seaside, Calif.	1.00
Bradway Locker Plant, New Castle, Ind.	5.00
James J. Cassidy, So. Boston, Mass.	3.00
Charles Cerami, Newark, N. J.	1.00
Richard A. Davis, Collingswood, N. J.	10.00
H. F. Dengler, Munich, Germany	5.00
Harold Eagen, Philadelphia, Pa.	10.00
W. A. Gilmartin, San Francisco, Calif.	5.00
Herbert Goldstein, New York, N. Y.	5.00
Hurst Radio Service, Trenton, Neb.	10.00
E. G. Kohl, Richmond Hill, N. Y.	3.00
Aurora Mares, Seaside, Calif.	1.00
Ray Mares, Seaside, Calif.	1.00
Pfc. John Martindale, c/o P.M., N.Y.C.	10.00
Members of the German technical staff of "Voice of America" Receiving Station, Munich, Germany	10.00
Stephen Nester, Keyport, N. J.	5.00
Charles Prichard, Gerard, Ill.	5.00
H. B. Scroogs, Baltimore, Md.	1.00
Robert B. Sheehan, Williamstown, Mass.	5.00
W4RTI, Birmingham, Ala.	10.00
RADIO-ELECTRONICS Contributions	$8,250.93
FAMILY CIRCLE Contributions	457.50
TOTAL RECEIPTS TO September 18, 1951	$8,708.43

—end—



Three-year-old Freddie gazes admiringly at the addition to the Thomason family.

Dr. Charles B. Jolliffe was elected to the newly created position of vice-president and technical director of RCA. Dr. E. W. Engstrom was elected vice-president in charge of RCA Labo-



Dr. C. B. Jolliffe

Dr. E. W. Engstrom

ratories Division. Dr. Jolliffe previously was executive vice-president of the RCA Laboratories Division. Dr. Engstrom was previously vice-president in charge of research of the RCA Laboratories Division.

Julius Fine was appointed commercial products sales manager of both Ward Products and Workshop Associates, Electronic Divisions of the Gabriel Co. He will direct all distributor

J. Fine

K. S. Brock

sales. The company also announced the appointment of Kenneth S. Brock as advertising and sales promotion manager for the two divisions. Mr. Fine is currently sales manager of Ward Products. Mr. Brock was previously commercial sales manager for Workshop Associates. Both Mr. Fine and Mr. Brock will maintain their headquarters at the general offices of the Gabriel Company in Cleveland, O. There will be no change in the policies of either division as a result of these promotions.

Charles A. Hansen of the Jensen Manufacturing Co., Chicago, was elected president of the Board of Directors of the Radio Parts & Electronic Equipment Shows, Inc. Sam L. Baraf, United Transformer Co., was elected vice-president; W. D. Jenkins, Radio Supply Co., Richmond Va., secretary, and Lew W. Howard, Triad Transformer Manufacturing Co., Los Angeles, treasurer.

John W. Craig of the Crosley Division, Avco Manufacturing Corp., was reappointed chairman of the RTMA FM Policy Committee. Other RTMA Committee appointments include: Leslie E. Woods, Raytheon Manufacturing Co., as chairman of the RTMA Industrial Relations Committee; Harvey Stephens, International Resistance Co., vice-chairman; John B. Swan, Philco Corp., as chairman of the Traffic Committee; W. L. Fogelson, P. R. Mallory & Co., Inc., vice-chairman; A. M. Freeman, RCA Victor Division, as chairman of the Tax Committee; J. B. Elliot, RCA Victor Division, as chairman of the Sports Broadcasting Committee; and Frank W. Mansfield, Sylvania Electric Products Inc., as chairman of the Industry Statistics Committee.

George Wedemeyer, WEDEMEYER ELECTRONIC SUPPLY Co., Ann Arbor, Mich., was elected president of the National Electronic Distributors Association. Other officers are: Harry D. Stark, Stark Radio Supply Co., Minneapolis, secretary; H. E. Ruble, SREPCO, Inc., Dayton, treasurer; W. D. Jenkins, Radio Supply Co., Richmond, Va., first vice-president; and Byron C. Deadman, Northern Radio & Television Co., Green Bay, Wisc., second vice-president.

Barton K. Wickstrum was elected to the post of vice-president and director of sales of SYLVANIA ELECTRIC PRODUCTS, INC. Mr. Wickstrum, who had been general sales manager of Sylvania's Lighting Division since 1946, succeeds Robert H. Bishop, who resigned from the company.

B. K. Wickstrum

Dr. Edward U. Condon was appointed director of research and development of CORNING GLASS WORKS. Dr. Condon, one of the country's outstanding physicists, was previously director of the National Bureau of Standards.

. . . **George C. Mercer**, former purchasing agent of P. R. MALLORY & Co., INC, Indianapolis, Ind., was promoted to the position of director of purchasing. W. J. Topmiller, Jr., former assistant purchasing agent, succeeds Mr. Mercer as purchasing agent.

. . . **E. W. Olson** was appointed to the newly created position of sales promotion manager for component products of WEBSTER-CHICAGO CORP. He was previously field promotional representative for the company. H. R. Letzter continues as the company's sales promotion manager for all products.

. . . **Howard Rowland** was named chief research engineer of The WORKSHOP ASSOCIATES, division of The Gabriel Co., Needham Heights, Mass. He was the division's chief electrical engineer.

. . . **George Siegel** was promoted to the position of sales promotion manager of JOHN F. RIDER, Publisher, Inc., New York City. Mr. Siegel has been with the Rider Advertising and Sales Departments for the past five years.

. . . **Max Cohn**, president of SOUTH RIVER METAL PRODUCTS Co., INC., South River, N. J., will supervise the company's Sales Department in addition to his duties as general manager.

—end—

MOST POPULAR RADIO & TV TUBES

At Better Than 50% Off List Price!

STANDARD BRANDS—FULLY GUARANTEED

0Z4	$ .77	6SG7	.94
1A5G9	.94	6SH7	1.04
1A7GT	1.03	6SJ7GT	.77
1B3GT	1.27	6SK7GT	.84
1H5GT	.77	6SL7GT	1.14
1LA6	1.27	6SN7GT	1.04
1LB4	1.27	6SQ7GT	.69
1LC5	1.27	6SS7	.94
1LC6	1.27	6T8	1.39
1LD5	1.27	6U5	.94
1LE3	1.27	6V6GT	.94
1LH4	1.27	6W4GT	.84
1LN5	1.27	6X4	.69
1N5GT	.94	6X5GT	.69
1Q5GT	1.27	7A5	1.04
IR5	.94	7A8	.84
1S4	1.03	7B4	.84
1S5	.84	7B5	.84
1T4	.94	7B6	.84
1T5GT	1.27	787	.84
1U4	.94	7C5	.84
1U5	.84	7C6	.84
1X2	1.27	7F7	1.04
3Q4	1.04	7F8	1.54
3Q5GT	1.14	7Q7	.84
3S4	.94	7Y4	.84
3V4	.94	12AH7GT	1.27
5T4	1.16	12AL5	.94
5U4G	.69	12AT6	.69
5V4G	1.14	12AT7	1.39
5W4	.77	12AU7	1.14
5Y3GT	.52	12AX7	1.14
5Y4G	.69	12BA6	.84
6A7	1.04	12BE6	.84
6A8GT	1.04	12J5GT	.69
6A84	.94	12K7GT	1.04
6A87	1.56	12SA7GT	.84
6AC7	1.39	12SF5	.94
6AG5	1.27	12SF7	.94
6AG7	1.54	12SG7	.94
6AH6	1.89	12SJ7GT	.77
6AK5	1.89	12SK7GT	.84
6AL5	.94	12SL7GT	1.14
6AL7GT	1.27	12SN7GT	1.04
6AQ5	.94	12SQ7GT	.77
6AQ6	.84	12SR7	1.04
6AQ7GT	1.14	14A7	1.04
6AS7G	3.98	14B6	1.04
6AT6	.69	14Q7	1.04
6AU6	.84	19BG6G	2.94
6AV6	.69	19T8	1.39
6AX5GT	.77	25A6	1.27
6BA6	.84	25L6GT	.84
6BE6	.84	25W4GT	.94
6BG6G	2.32	25Z5	.77
6BC5	.94	25Z6GT	.69
6BH6	.94	35A5	.84
6BQ6GT	1.54	35L6GT	.84
6C4	.77	35W4	.62
6C5GT	.77	35Y4	.84
6C6	1.04	35Z3	.84
6CD6G	2.94	35Z5GT	.62
6D6	1.04	41	.94
6E5	1.04	42	.94
6F5GT	.77	43	.94
6F6GT	.77	45	.94
6H6GT	.84	47	1.39
6J5GT	.69	50A5	1.04
6J6	1.39	50B5	.94
6J7GT	.94	50L6GT	.77
6K6GT	.77	75	.77
6K7GT	1.04	76	.77
6L6G	1.72	77	.94
6N7GT	1.14	78	.94
6Q7GT	.84	80	.61
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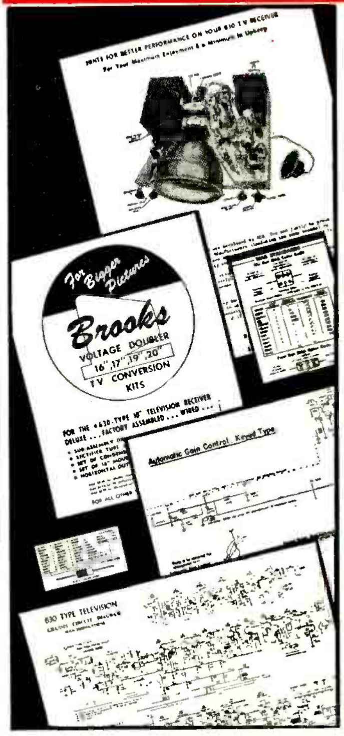

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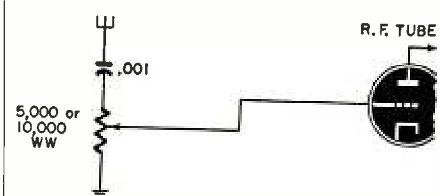
HINTS ON SYNCHRODYNE

Dear Editor:

Thanks for forwarding me the correspondence from readers who have been having difficulties with the Synchrodyne. The most common appears to be squealing. Some possible causes are:

1. Due to insufficient shielding or common coupling in a power supply or in the tuning gang, the r.f. stage is included in a positive feedback loop and the whistles are caused by oscillation in the r.f. or r.f. plus demodulator circuit. To check this try the untuned input circuit shown below.



2. Some American 6J8-G tubes may be different in construction from the Australian ones. North American Philips should be able to supply an ECH35, or alternatively you could use more turns on the triode grid oscillator coil together with lower values for the anode and grid resistors between the r.f. and demodulator tubes.

3. Insufficient signal from the r.f. will not give enough sync signal. Is the r.f. stage defective? Check tube and a.v.c. voltages.

4. The potentiometer giving the synchronizing signal may have a high-resistance contact and this combined with excessive shielding may bypass too much of the sync voltage.

JOHN WM. STRAEDE
Victoria, Australia

MULTIPLE 405-LINE TV!

Dear Editor:

Recently while adjusting my television receiver, a 630 model by Philmore, CBS started to transmit color. By adjusting the synchrolock control at rear, I received the CBS color picture in black-and-white.

But, best of all, I received not one picture but four! One in each quarter of a 17-inch picture tube. Now each member of our family has an individual picture when Columbia transmits a color program!

JOHN CODY
Bronx, N. Y.

SOME NOTES ON THE YAGI

Dear Editor:

We have been reading with interest the answers to the many questions which appear in the Question Box each month. You are definitely providing a much-needed service to your readers.

The July, August, and September issues contained articles of particular interest to our company. Vee-D-X, as you are probably aware, has made certain contributions to the television antenna market.

In the July issue a question was asked relative to the matching of a channel 13 Yagi antenna with a conical. Vee-D-

See page 116

X markets a divider network known as the MM-2 Mighty Match. This device will provide the desired isolation of the two antennas. When connected to a single transmission line with an MM-2 installed, the conical will not pass high-channel signals to the transmission line. The MM-2 will present no insertion loss and will prevent detuning effect of the two antennas. A minimum separation of 36 inches is recommended between the two antennas.

Your July and September issues answered questions relative to the stacking of four and eight Yagi antennas. Vee-D-X markets such harness kits for use with our antennas which will provide either vertical or horizontal stacking of four Yagis. We have constructed and experimented with the stacking of eight Yagi antennas. This array, as pointed out in your article, provided extremely sharp patterns and due to its massive size is not recommended. Such harness kits are not available.

It has been our experience that regardless of the number of antennas stacked, the band-width of the array will not change from that of a single Yagi. We have found that six-element Yagis with a band-width of 5 mc may be multistacked and still maintain their band-width.

We hope that this information is received in the spirit in which it was given; that is, to assist you in compiling information.

THE LA POINTE-PLASCOMOLD CORP.
F. A. Hess, Sales Manager
Windsor Locks, Conn.

UNPAID ETHICAL SERVICE

Dear Editor:

I have just read Walter R. Rogers' article, "Ethical Service Pays," in the September issue, and agree with his conclusions.

But what got me was the lad working after hours and at a rate of only $1.50 for replacing a capacitor and alignment too. I guess that explains why he works at night—he couldn't make a living by day giving away work at that price. Standard rates here allow at least $2.50 for capacitor installation, plus cost of the unit at list price. Alignment would be added to that.

I believe an item featuring low charges such as this example is as bad as too high charges, and only adds to the confusion of the repair man following the middle of the road and who is managing to keep his business on a paying basis at fair prices. What will the average technician think after reading of a man who can render repairs such as the article listed—for $1.50?

J. W. ESSEX
Industrial Sound, Reg'd
Bridgewater, Nova Scotia

(Mr. Essex has an important point here. Many shops which operate till 10 every night could close at a decent hour if the owners would only charge what their work is worth. They'd probably increase their prestige thereby and so get more business, too!—*Editor*)

—end—

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FUNDAMENTALS OF ELECTRICAL ENGINEERING, by Fred H. Pumphrey. Published by Prentice-Hall, Inc., 70 Fifth Ave., New York, N. Y. 5¾ x 8¾ inches, 668 pages. Price $7.65

This book is designed for those taking a full-year's course in basic electrical engineering. Similar in many respects to existing books on the subject, the author departs from the usual treatment by trying to make the reader understand electrical principles through simple explanation and the use of illustrative examples. The book has the further advantage that numerous additional topics such as non-linear resistors (varistors), stabilized amplifiers and electronic instruments have been added.

A good working knowledge of algebra and calculus on a college level is required. Considerable material is devoted to power engineering, not always of interest to those in the communications field. Evidently intended as a book requiring supplementary classroom instruction, the section on vacuum tubes particularly calls for additional reading and guidance.—*MC*

AUDEL'S TELEVISION SERVICE MANUAL, by E. P. Anderson. Published by Theo. Audel Co., 49 W. 23 St., New York 10, N. Y. 5 x 6⅝ inches, 396 pages. Price $2.00.

Although this book is titled a TV Service Manual, only 3 chapters are directly concerned with servicing. Actually it covers the whole range of TV reception from placement of TV receivers in the home, through adjustment of receiver controls and antenna installation to a discussion of color TV conversion methods.

Despite the fact that some material is dated (notably the chapter on TV receiver fundamentals and the inclusion of an obsolete map of proposed coaxial and microwave TV network routes) or has appeared in manufacturers' literature previously, the book will be useful to students and beginners who wish a practical introduction to television.

A comprehensive glossary and index also are included.—*MHG*

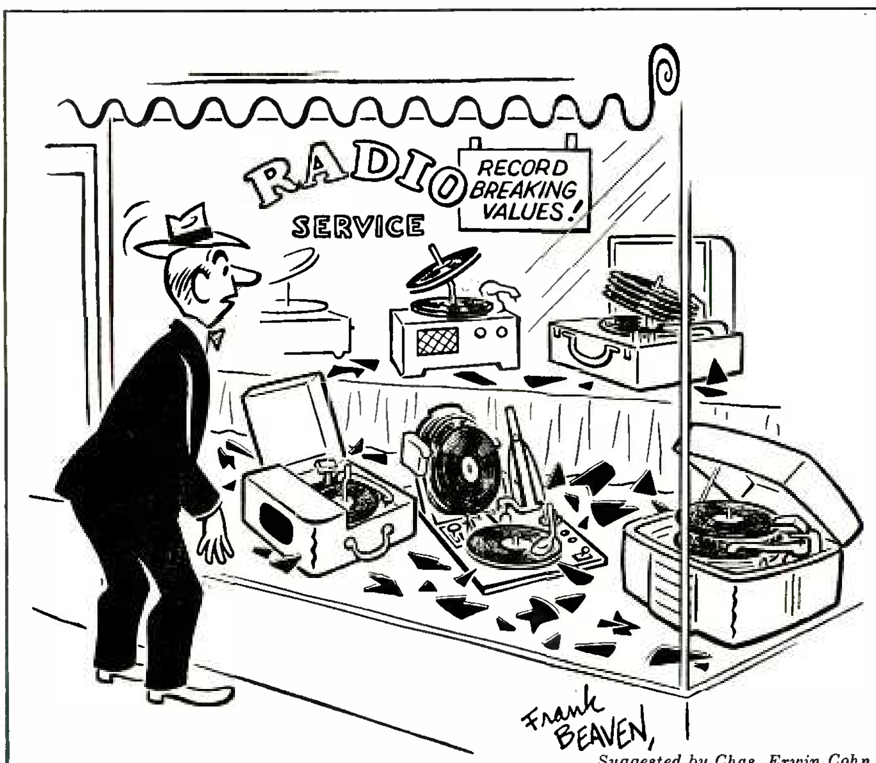
AUTOMOTIVE MANUAL—ELECTRICAL-RADIO WIRING DIAGRAMS. Published by the E. I. Electrical Press, Hinsdale, Ill. 8½ x 11 inches, 87 pages. Price $2.00.

The main objective in preparing this manual, according to its foreword, was to supply electrical wiring diagrams and radio schematics for leading automobiles in use since World War II. It was originally compiled for the use of students in the E-I Electrical School.

The book consists of wiring diagrams of automobiles and schematics of their radios. Since there are cases where several models may use the same radio, the pages of wiring diagrams are more numerous than those of radio schematics. However, no less than seven schematics of various Ford-Lincoln-Mercury radios appear, and 12 of General Motors radios. In all, diagrams of radios used in cars of 11 manufacturers are printed, as well as electrical wiring diagrams of the cars.—*FS*

CONVERTING TO LARGE PICTURE TUBES. Published by the American Distributing Co., 1810 Winchester Street, Baltimore, Md. 8½ X 11 inches, 42 pages, 1951. Price $1.50.

This manual covers the conversion of 16 TV sets, including Admiral, Crosley, G-E, and RCA. It is written in notebook style with instructions printed as Step 1, Step 2, etc. Steps of mechanical change are listed in greater detail than



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Radio-Electronics does not assume responsibility for any errors appearing in above index.

the necessary electronic changes although these are likewise included. An introductory chapter covers fundamental problems in changing over to large picture tubes. Photographs and drawings included make this a helpful book for the service technician.

RADIO VALVE DATA. **Compiled by *Wireless World*. Published by Iliffe & Sons Ltd., London (American agent: British Book Centre, 122 East 55th St., New York 22, N. Y.). 8½ x 11 inches, 80 pages. Price 80 cents.**

This British radio tube manual covers 2,000 British and American tubes, including cathode-ray tubes. It is divided into sections according to functions (tetrodes, output tubes, frequency changers, etc.) and further subdivided into brands (for British tubes) and American tubes. Listing is alphabetical and numerical under these subheadings, and British tubes are further divided into obsolete, replacement and current types.

Complete characteristics are given, as well as basing diagrams (obtained from a table which economizes space but is a bit complex to operate).—*FS*

TELEVISION PRINCIPLES, **by Robert B. Dome. Published by McGraw-Hill Book Co., Inc., 330 West 42 St., New York, N. Y. 6 x 9½ inches, 291 pages. Price $5.50.**

Written primarily for radio engineers by an author recognized by engineers as an authority in the field, this book differs considerably from others with similar titles. Possibly the most striking is brevity. The book contains fewer pages than most of its type. Surprisingly, the explanations seem as clear and complete as some of their more verbose parallels.

Mathematics is rather freely used in explaining circuit action. However, most of it is simple algebra (though the author went into calculus in at least one chapter) and the mathematics, like the text, is so organized as to be most easily understood.—*FS*

TIME BASES (second edition) **by O. S. Puckle. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. 5¾ x 8¾ inches, 387 pages. Price $5.00**

A time base is a means of measuring time. Performed in a crude way by the sun dial, more accurate divisions of time can be obtained by a modern watch. For splitting time up into millionths of a second, electronic means are required.

Time base circuits form a necessary part of electronic equipment—oscilloscopes, television, radar, photography, computers, to mention just a few of the more obvious applications. Now appearing in its second edition, this book covers the design and development of time base scanning generators. Thoroughly familiar with his subject, the author has searched the field carefully and painstakingly and has produced an exhaustive (but not exhausting) book. Encyclopedic in content (and well indexed) it is a mighty tool for those using time base circuits.—*MC*

—end—

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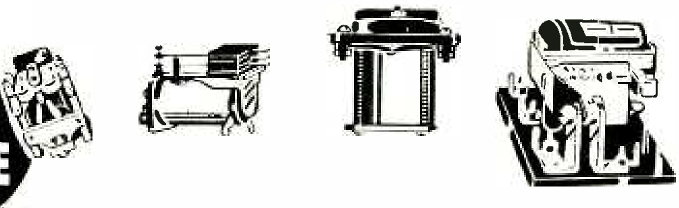

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STANDARD DC TELEPHONE RELAYS

Stock No.	D.C. Voltage	Ohmage	Contacts	Unit Price
R-806	115*	900	1A	$2.05
R-161	6	10	2B & 1A	1.10
R-100	24	600	2A & 1C	2.45
R-518	85/125	6500	1C	3.60
R-633	180/350	10,000	1C & 5 Amps.	2.90
			Oct. Skt.	2.45
R-667	6	.75	1B/10 Amps.	
			1A/3 Amps.	1.45
R-632	6	12	5A & 1C	1.25
R-154	6/12	200	1A	1.50
R-517	12	250	2A	1.50
R-116	85	3000	1B	3.05
R-631	100/125	3300	2A	1.90
R-545	110/250	7000	1C	2.45
R-124	300	12,000	1A	1.55
R-160	6	12	3C & 3A	1.30
R-591	6	40	1B & 1C	1.35
R-155	12	100	4A & 4B	1.45
R-520	200/300	14,000	2C	3.45
R-159	6	50	2A	1.35
R-158	6	50	4A	1.35
R-576	12	200	2A	1.55
R-153	12	200	1C & 1A	1.55

SHORT TELEPHONE RELAYS

Stock No.	D.C. Voltage	Ohmage	Contacts	Unit Price
R-635	12	100	1C & 1A	$1.35
R-618	12	170	1E	1.35
R-826	12	150	2C, 1B	1.55
R-770	24	150	1A/10 Amps.	1.45
R-771	24	200	1A/10 Amps.	1.45
R-603	18/24	400	2A	1.55
R-575	24	500	2C	2.40
R-764	48	1000	2C & 2A	2.00
R-563	60/120	7500	1A	1.70
R-801	115*	——	None	1.45
R-213	5/8*	——	2A	3.10
R-589	12	125	2A	1.30
R-113	12	150	4A	1.55
R-689	12/24	255	1C	1.55
R-799	24	500	None	1.00
R-115	24	500	1C	1.70
R-110	24/32	3500	1C	1.70
R-121	150	5000	2A & 1C	2.05
R-634	150/250	6000	1A & 1B	2.45
R-800	12	150	2C & 1A	1.55
R-537	12/24	150	2C & 1B	2.00
R-750	24	400	1A	1.60

CONTACTORS

Stock No.	D.C. Voltage	Ohmage	Contacts	Unit Price
R-188	24	200	1A/75 Amps.	$3.70
R-183	24	60	1A/50 Amps.	3.45
R-187	24	100	1A/50 Amps.	3.70
R-554	24	85	2A/100 Amps.	5.90
R-788	100*	——	3B & 2A	5.45
R-682	115*	35	5A/10 Amps.	6.10
R-767	24*	20	2A/10 Amps.	4.95
R-180	12	25	1A/50 Amps.	4.05
R-657	24	50	4A/100 Amps.	6.95
R-265	24	60	1A/100 Amps.	3.45
R-535	24	70	1A/100 Amps.	4.80
R-556	24	70	1A/100 Amps.	4.80
R-557	24	100	1A/50 Amps.	3.85
R-178	24	100	1A/100 Amps.	4.80
R-727	10	20	1A/20 Amps.	2.00
R-608	24	125	1A/200 Amps.	2.80
R-184	28	50	1A/100 Amps.	4.90
R-719	24	10	1A/200 Amps.	4.95
R-182	28	80	1A/25 Amps.	2.40
R-244	75*	265	1A/20 Amps.	2.20
R-659	12	7.2	2A/20 Amps.	1.70
R-552	24	70	4A/50 Amps.	5.35
R-185	24	100	1A/50 Amps.	3.45
R-186	24	132	1A/50 Amps.	4.35
R-817	24	150	1A/50 Amps.	3.45
R-534	14	45	1A/30 Amps.	2.05
R-223	28	150	1A/40 Amps./48 VDC.	1.70
R-680	6	3	1A/50 Amps.	3.90
R-677	6	3.5	1A/50 Amps.	3.90
R-532	6	15	1A/50 Amps.	3.90
R-676	12	16	1A/50 Amps. 1AUX/25A	3.90

ROTARY RELAYS

Stock No.	D.C. Voltage	Ohmage	Contacts	Unit Price
R-709	6/8	1	12 Pos. 3 Wafer	$3.90
R-197	9/16	70	2C	2.05
R-713	9/14	125	1C & 1A	2.05
R-616	28	7	5B & 1A	2.40
R-712	24	200	2B	2.05
R-711	24	200	2C & 1B	2.05
R-573	28	200	1C & 1B	2.05
R-766	24	230	12 Pos. 8 Deck	4.90
R-809	28	7	1B & 12 Pos.W/ 7" Shaft for Wafers.	2.45

DIFFERENTIAL RELAYS

Stock No.	D.C. Voltage	Ohmage	Contacts	Unit Price
R-208	120	2000	2C/3 Amps.	$2.45
R-209	220/250	8000	1C/3 Amps.	3.10

SEALED RELAYS

Stock No.	D.C. Voltage	Ohmage	Contacts	Unit Price
R-658	6	35	2C/Octal Plug	$3.45
R-125	24	300	2C/Octal Plug	3.45
R-261	12/24	1900	1C/5 Pin Plug	3.75
R-673	48/150	7500	1C/5 Amps.	2.80

VOLTAGE REGULATORS

Stock No.	D.C. Voltage	Ohmage	Contacts	Unit Price
R-745	6	2	1A/10 Amps.	$1.05
R-780	24	350	1C/6 Amps.	1.05
R-509	6/12	35	1B/2 Amps.	1.05

SPECIAL RELAYS

Stock No.	D.C. Voltage	Ohmage	Contacts	Unit Price
R-503	12/32	100	3A, 2C	$13.50
R-749	600	——	Max. 28 Amps.	7.45
R-804	550*	——	1B/38 Amps.	4.35
R-250	115*	——	Adj. Cir. Bk.-.04-.16A	17.50
R-579	220*	——	1B	8.70
R-294	27.5	200	1B	5.35
R-686	115*	——	2C	6.10
R-246	115*	——	1B	11.20
R-246A	115*	——	1A	11.20
R-611	24*	——	1A/30 Amps.	5.35
R-283	12	125	1C/10 Amps.	4.35
R-614	18/24	60	1A/15 Amps.	4.35
R-245	12	25	4" Micalex Lever	3.20
R-527	6/12	50/50	In Series	1.20
R-544	12/24	60/60	1C	2.05
R-255	——	——	1A	3.50
R-669	75*	400 Cy.	1B, 1A	1.20

KEYING RELAYS

Stock No.	D.C. Voltage	Ohmage	Contacts	Unit Price
R-714	9/14	65	2C/5 Amps.	$1.55
R-850	12	450	1A/1.5 Amps.	1.50
R-721	18/21	290	2C/5 Amps.	1.55
R-694	24	300	1A/5 Amps.	1.50
R-935	28	1000	1C/1.5 Amps	1.65
R-949	2.4*	60 Cy.	1A/5 Amps.	1.95
R-704	2/6	.25	2B/5 Amps.	1.35
R-173	2/6	2	1A	3.00
R-280	6/8	77	1A Dble. Brk.	2.45
R-647	6/12	15	1B/20 Amps.	1.45
R-273	20	160	2A/15A Dble. Brk.	3.55
R-169	24	200	1A	2.45
R-570	24	230	1B Dble. Brk.	2.70
R-960	24	230	3C/15 Amps.	2.95
R-529	24/48	1020	2C	3.10
R-715	24	——	2C Ceramic	3.70
R-584	6	20	1A Dble. Brk.	1.30
R-192	12	44	3C/10 Amps.	1.70
R-204	12	66	2A	1.45
R-224	12	85	1A	1.45
R-221	18/24	5000	1A	2.00
R-205	24	260	2C	1.55
R-891	24	475	1C/5 Amps.	1.45
R-536	27	230	2C	1.55
R-858	27.5	250	1A Dble. Brk.	1.45
R-833	6.5	1300	2C	3.05
R-220	75	5000	1C	1.50
R-828	6/8	42	1A	1.50
R-627	115*	——	1B Dble. Brk.	3.10
R-734	24	150	3C/10 Amps.	1.30
R-598	28	185	2C	1.30
R-622	20/30	200	3A & 2C/10 Amps.	1.45
R-274	24*	——	2A	1.55
R-855	110*	60Cy160	1A Dble. Brk/15A	3.25
R-277	12	30	2C-D Break Cera	2.20

MIDGET RELAYS

Stock No.	D.C. Voltage	Ohmage	Contacts	Unit Price
R-572	24	256	1C	$1.25
R-857	24	260	1 Make Before Make	1.75
R-912	4/5	20	3A-1C Ceramic	2.50
R-291	6	5	1A	1.25
R-921	6.7	18	1A Dbl.Brk.@10 Amp.	1.45
R-738	12	60	3A	1.20
R-922	12	75	1A Dbl.Brk.@10 Amp.	1.45
R-144	12	228	1A	1.45
R-145	18/24	250	2A Ceramic	1.45
R-298	21	300	1A	1.25
R-296	21	300	1A	1.25
R-586	21	300	1A & 1C	1.25
R-137	24	300	1C	1.45
R-142	24	400	2C	1.50
R-785	24	200	2C/10 Amps.	2.00
R-607	24*	——	1A	1.20
R-606	24*	——	1A & 1B	1.20
R-605	24*	——	3A	1.20
R-728	6	30	1A	1.25
R-149	6/8	45	1B	1.50
R-732	12	120	1A	1.45
R-281	12	126	2A	1.25
R-818	18/24	300	1B	1.30
R-135	24	250	1B	1.45
R-133	24	300	None	.75
R-138	24	300	4A	1.45
R-132	24	300	2C	1.50
R-731	24	300	2C	1.55
R-292	24	350	1C	1.25
R-626	24	400	1A/5 Amps.	1.55
R-786	60	1300	2C	2.00
R-588	90/125	6500	4C	2.70
R-755	24	300	1A	1.45
R-150	6	30	1A	1.50
R-893	14	150	1A, 1C	2.50
R-895	14	150	2A, 1B, 1C	2.50

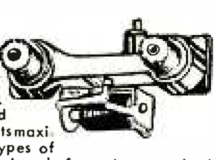
SPECIAL RELAYS—Cont'd

Stock No.	D.C. Voltage	Ohmage	Contacts	Unit Price
R-660	6	——	⅝" Stroke	$1.20
R-651	24	100	Solenoid Valve	3.10
R-295	12	275	Annunciator Drop	2.70
R-230	5/8	2	2A, 1C	2.70
R-813	12	12	Wafer	5.35
R-275	12	750	1A, 1B, 1C	3.45
R-716	24	70	2A/5 Amps.	1.80
R-620	6/12	35	2C, 1A	1.30
R-629	9/14	40	1C/10 Amps.	1.55
R-720	24	50	2C Ceramic	1.70
R-500	12	10/10	2C/6 Amps.	3.55
R-816	12	10/15	2C/6 Amps.	3.55
R-524	21**	——	————	1.20
R-566	115*	Coil Only		1.00
R-710	——	150	Coil Only	.75

*AC. **AC/DC.

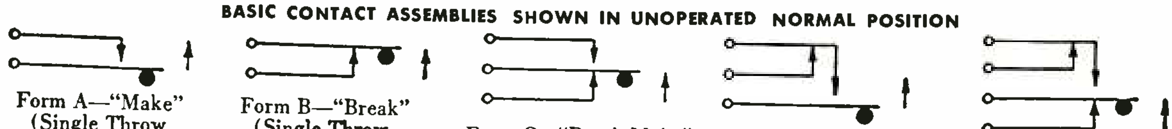
SPECIAL!

CO-AXIAL RELAY



D153766 SPDT, 6 VDC. 19 Ohm coil. Designed to accammodate 75 watts maximum. Perfect for all types of antenna switching. Designed for using standard 83-1SP coaxial fittings. Part of RAX-1 equipment. No. R-846—**$6.95** Ea.

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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In Volume Controls, too...
fast, sure fit
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In a survey of hundreds of servicemen, the importance of fast, sure installation was emphasized time after time in connection with volume controls. If you want a control that lets you do the job fast . . . and do it right . . .

Make Sure! Make it Mallory!

When you use the Mallory Midgetrol*, you get a combination of features that can't be matched.

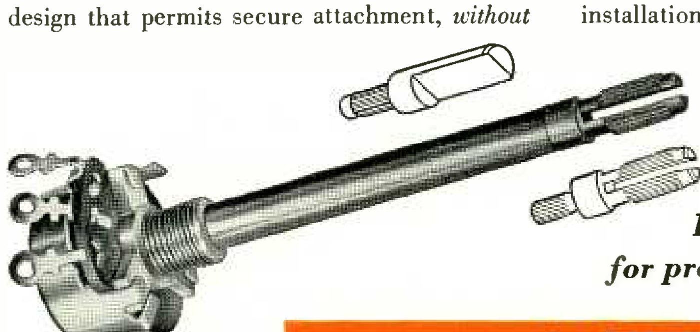
First, you get a *permanently fixed, tubular brass shaft* that can be adapted for split-knurl or flatted type knobs in a few seconds by inserting one of the steel shaft ends supplied in every package. This means utmost convenience without sacrificing the stability of permanent, two-point shaft suspension.

Second, you get the convenience of AC switch design that permits secure attachment, *without removing the control housing*. Positive indexing assures proper position.

Third, you get exceptionally accurate resistance values and taper curves.

Fourth, you can be sure of years of quiet, satisfactory service life through extremes of humidity and temperature.

Make it Mallory and make sure! Ask your distributor to show you the time-proved Mallory Midgetrol with the new features that make installation faster and simpler than ever.



Single Section Control Illustrated

Dualconcentric Mallory Midgetrols can be made up easily by combining factory-assembled front and rear sections of desired resistance values. Ask your Mallory Distributor for details!

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