HUGO GERNSBACK, *Editor*

RADIO CRAFT

DUAL FM-AM TRANSMITTER

SEE PAGE 27

In this issue—

A Carrier-Current Transmitter

Straightening Plastic Cabinets

Superior Rotary Antenna Array

OCT
1947

25¢
CANADA 30¢

RADIO-ELECTRONICS IN ALL ITS PHASES

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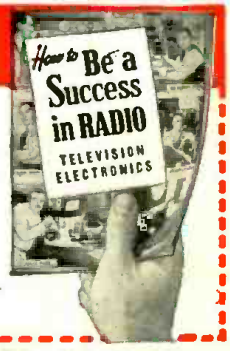

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SYLVANIA NEWS
RADIO SERVICE EDITION

OCT. *Prepared by* SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa. 1947

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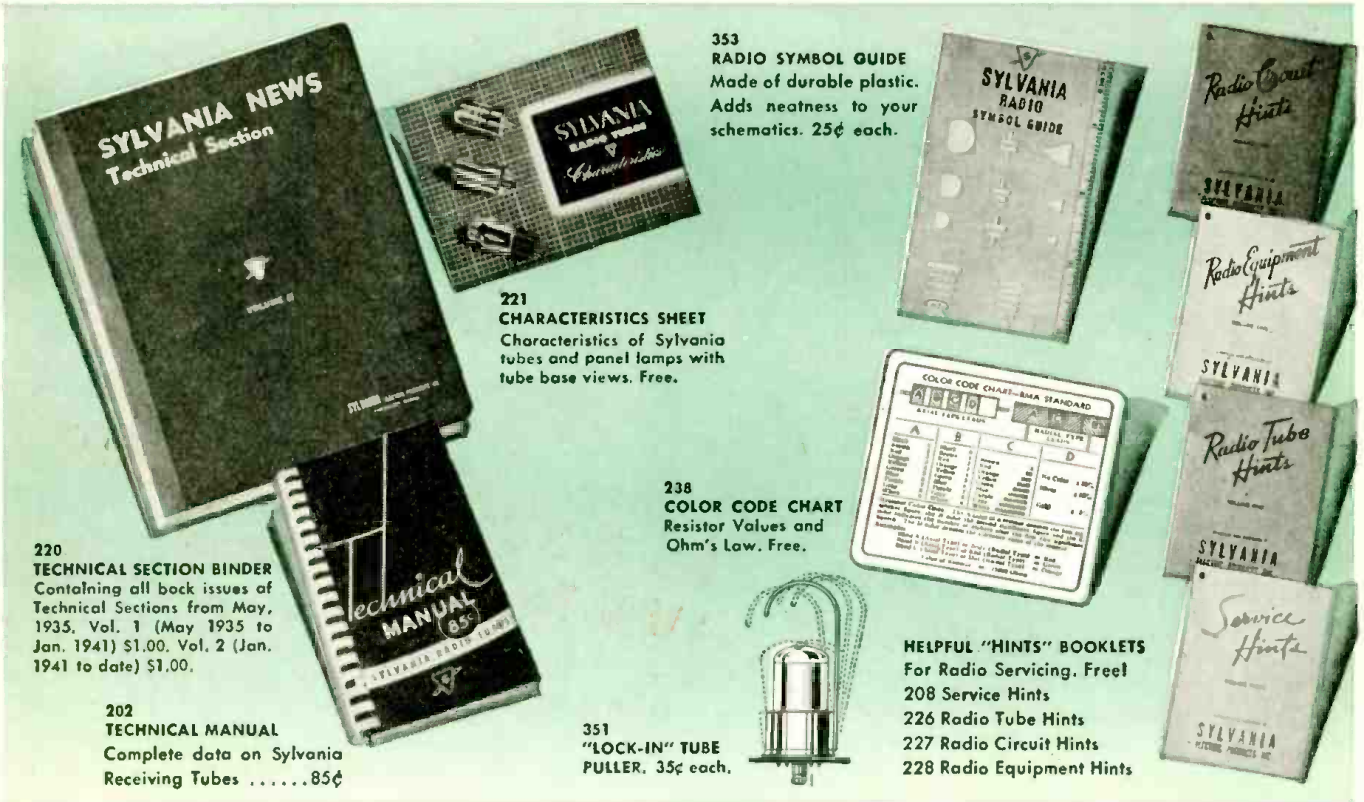

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220
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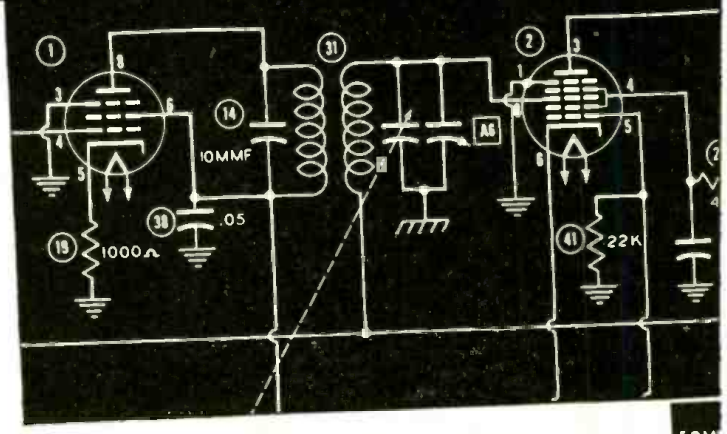

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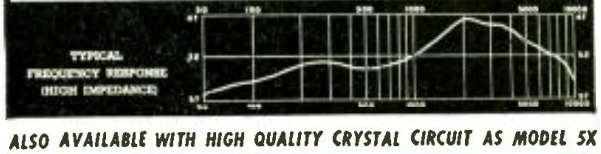
EFFECTIVE OUTPUT LEVEL: 52 db below 1 volt/dyne/sq. c. m. at high impedance.
FREQUENCY RESPONSE: Flat within ±5 db from 50-9000 c. p. s.
OUTPUT IMPEDANCE: 50, 200, 500, ohms, high.
DIRECTIONAL CHARACTERISTICS: Semi-directional. Non-directional when tilted back 90°.
DIAPHRAGM: Highest quality, corrosive resistant aluminum.
MAGNETIC CIRCUIT: Employs highest quality Alnico V magnet. Highly shielded output transformer excludes all hum pickup.
CASE: Tenite. With 90° tilting head. Rubber tilt brake holds in any position.
FINISH: Choice of yellow, green, ivory, orange.
MOUNTING: ⅝"—27 standard coupler.
CABLE: 20 ft. removable, shielded, single conductor, with connector.
DIMENSIONS: 4¼" long x 2⅞" wide x 4⅝" high.
WEIGHT: 17 ounces.



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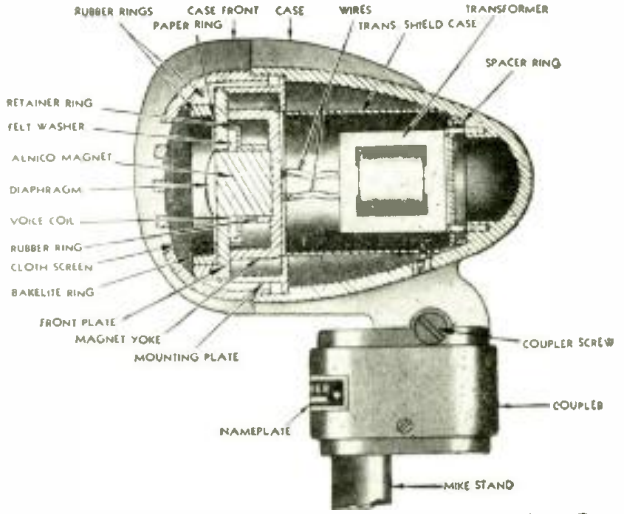

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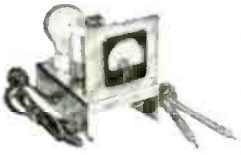

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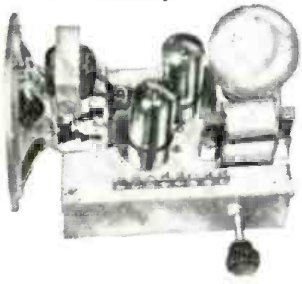

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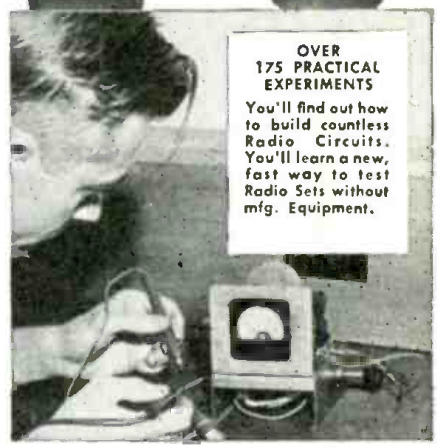

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1	D13-137X	1.0 meg.	B
1	D13-139	2.0 meg.	A

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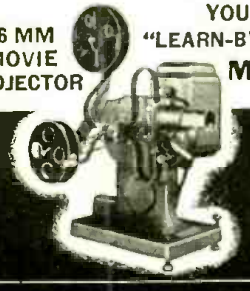

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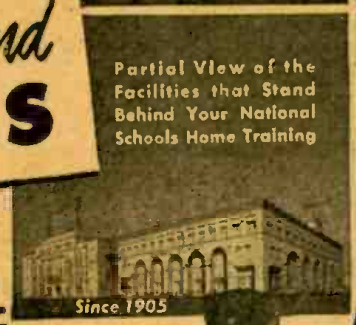
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OCTOBER • 1947

RADIO CRAFT
AND POPULAR ELECTRONICS
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RADIO & TELEVISION

In An Early Issue:

SELLING HOME RECEIVERS
TUBE TESTER MULTIMETER
A 4-TUBE FM RECEIVER

On the Cover:

Harry D. Hooton, W3KPX and the AM-FM transmitter which he is now describing in RADIO-CRAFT.

Chromatone by Alex Schomburg

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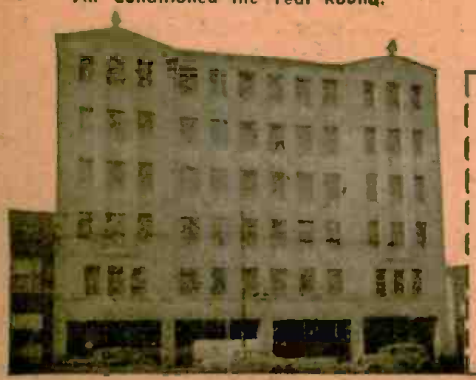

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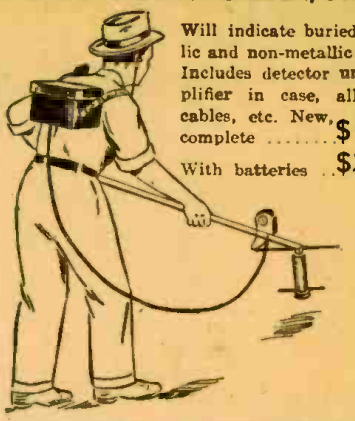

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Power Pair—Use 2 for FW 1900V CT at 350MA pri 117V 60 cycle—3 Taps. EA Transf is cased 950V NCT. Per pair..... $10.00

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10 mf 600DC	.85
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1MF 600V	.35
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.002 mf 15000V Sangamo	$20.00
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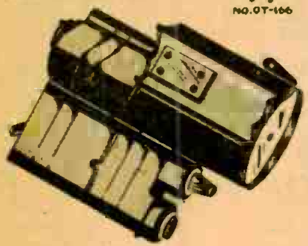

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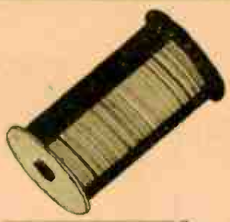

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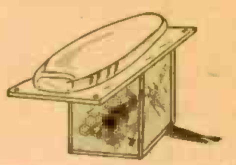

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Oscillator assembly 76 to 300 MC with acorn tube socket mounted on condenser. 1.95
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955	.65	9006	.89
9002	.89	50B5	.89
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.05-.05-.05, 300 VDC, in round can. Approx. 1" x 1".

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FOR SALE—Hickok new tube tester, 532P. Cost $121. Has latest tube chart, new condition. $100. C. F. Chandler, 426 Larklin St., San Francisco, Calif.

FOR SALE—New tubes in cartons 60% off list; 6—1C6, 6—1D7, 6—1D8, 6—1E4, 6—1E7, 3—1G6, 6—1LD5, 6—6AC7, 6—6B8, 6—6C8, 6—6SD7, 6—6SH7, 6—6SJ7, 3—6SR7, 6—7A4, 6—7A5, 6—7A6, 6—7E6, 3—7E7, 6—7H7, 3—7J7, 3—7N7, 3—7Y4, 3—12A5, 3—12A6, 6—12A8, 6—12H6, 6—12J5, 3—12SC7, 6—12SF5, 6—12SJ7, 6—12SL7, 12—14A7, 12—14B6, 24—14H7, 12—39/44, 12—50Y6. Southern Radio Service, Thomasville, Ga.

FOR SALE—Complete 100 watt CW rig 20-40-80 meters 6V6-6V6-P.P. 807 in Bud cabinet; also VFO duplicate 1947 Handbook. Want ART-13 or Meissner 150-B. Gus J. Guillot, W5HHB, Route 4, Box 278A, Beaumont, Texas.

FOR SALE—Hallicrafters S-38 in A-1 condition, $40. Power supply, 500-750v at 300 ma, $60. David Brese, 209 W. Wyandot, Upper Sandusky, Ohio.

URGENTLY NEEDED—AC 8W3 10 meter band spread coils, 60 series. Will trade general coverage 20 and 40 or pay cash. Frank Bou, W3ESX, c/o Bot. Dept., U. of Penna., 38th and Woodland Ave., Philadelphia 4, Pa.

WILL TRADE—BC-375E transmitter, complete with tubes, tuning units, dynamotor and mike. Want signal generator or good usable test equipment. James D. Bell, 515 N. Pelham, Jacksonville, Ala.

WANTED—Telefunken receiver, any model providing it will operate on 110v, 60 cycles a-c. Good shape but may be less tubes. All letters on Telefunken or other all wave foreign receiver will be answered. David F. Thomas, Proctorville, Ohio.

FOR SALE—Instructograph, tapes & new 600-1000 cycle oscillator; Thordarson CHT 75 watt mod. transformer, T-11-M-75; RCA Aero dynamic microphone, 250 ohm imp; several bugs and other transmitting equipment. What do you need? W. A. Zuehlke, W8WBK, RFD #7, Box 356, Akron 3, Ohio.

FOR SALE—2 meter transmitter, 2 meter mobile, and receiver, also power supply, 1250v, 500 ma. and other transmitting equipment. B. F. Leyton, 3306 Arch St., Little Rock, Ark.

SELL OR TRADE—BC-222 walkie-talkie without battery but with adaptor and 110v a-c power unit; 28 to 52 mc frequency in good condition. $30 or will trade for good V.O.M. Jim Lewis, 422 First St., Manistee, Mich.

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WILL TRADE—B.C. 221M frequency meter, spare crystal; RCA AVR 100A lightplane receiver, receives broadcast, marker beacon, range stations, provision for loop. Uses portable batteries. Want B.C. 348, S-40 or similar receiver or signal generator. William Brown, 586 Jamestown St., Philadelphia 28, Pa.

FOR SALE—HQ129-X complete with speaker, new. Morris Silberberg, 2175 Morris Ave., Bronx 53, N. Y.

WANTED—Hallicrafters SX9 receiver, white panel preferred. State price and condition. Matthew Healey, 681 Harris Ave., Providence 9, R. I.

FOR SALE—New BC610E Hallicrafters transmitter complete, in perfect condition. All inquiries answered. J. M. Buzzard, Terrace View Lane, Galena Road, Peoria 4, Ill.

WILL TRADE—Portable car radio and beach portable both with new batteries, $7.95; gas model kit with engine and all accessories, $55, also stamp collection. Want good ham receiver. Phillip Brand, 462 Fordham, Bay Village, Ohio.

FOR SALE—S-20R Sky Champion in excellent condition, 2 years old; also 10 meter pre-selector using an 1852 as in 1944 Amateurs Handbook. Both $55. Roy Benson, 120 Broadway, Arlington 74, Mass.

FOR SALE—BC 603, 10 tube, push button 20 to 28 mc hi sensitivity receiver in excellent condition, $15. V. Johannes, 1541 Metropolitan Ave., Bronx 62, N. Y.

SELL OR TRADE—SX-25 receiver with matching speaker, like new; brand new instructograph S2; 10 tapes. Want Riders, Sams Photo Facts, test equipment. What have you? F. E. Vaughn, Box 540, Eugene, Ore.

SELL OR TRADE—Wilcox CW3 receiver new, 5, 6-10 mc. fixed frequency, less crystal. Want Hallicrafters S40-A, RME-84, National NC-46. Charles Matzinger, 3630 22nd St., San Francisco 14, Calif.

WANTED—Jensen bass reflex speaker with 500 ohm input impedance. Give catalog number, price and condition in first letter. Have for sale, Abbott prewar TR-4 transceiver now on 2 meters, complete with tubes, mike and Mallory vibropack, $40, or will trade for Millen exciter. Allen L. Stratton, W2RTM, RD #1, Ballston Lake, N. Y.

FOR SALE—Latest RME 45-B, slightly used; factory inspected, accurately aligned, ready for use with speaker, $169. Markley, 1260 Second Ave., San Francisco 22, Calif.

FOR SALE—National communications receiver with speaker, like new; NC-100, five bands, 200-400 kc and 1.3 to 30 mc. continuous; mechanical bandspread; S meter calibrated to 40 db above S9, etc. $150 plus crating & freight charge. Carl Lorman, 24705 Hackett Dr., Euclid 17, Ohio.

FOR SALE—BC 312-G receiver complete and ready to operate, 110v, 60c a-c, has crystal phasing, $55. L. H. Rice, 510 Louisiana Ave., Chester, W. Va.

WANTED—Hallicrafters E-200; Precision signal generator; good vibrator tester late model. 25B8 tubes; Riders manuals 10, 11 and 12. Saxton's Radio & Electric Service, Route 1, Pontiac, Ill.

FOR SALE—Abbott DK3 transceiver complete with headset, less batteries. Used very little, $22. Wm. E. Myers, R-1, Pierson, Mich.

SELL OR TRADE—1500 V.D.C. 500 ma. and 500v. 200 ma. power supplies on one rack chassis. R.F. chassis 6L6-807-PP T-40's, needs neut cond. Want National 1-10, NC-101X, HQ-120X, oscilloscope or what have you. All inquiries answered. Albert H. Renfro, 103 E. Maple St., Johnson City, Tenn.

FOR SALE—R44/ARR-5 airforce version of Hallicrafters S36-A. Covers old and new f-m bands also a-m stations from 43 to 144 mc. Never used. In original packaging, $100, with a-c power supply. J. L. Andrews, Jr., Box 406, El Campo, Texas.

SELL OR TRADE—12v—10 amp supply from 110v, $25, or Husky 6 volt supply from 110v. National NC44 receiver with speaker, $50, or good signal generator. W3PFD, 907 14th St., Beaver Falls, Pa.

FOR SALE—Hallicrafters S-19 sky buddy, receiver $28 or will trade for A-C Instructograph, continental code in new condition. Marvin J. Hayostek, Lakefield, Minn.

SELL OR TRADE—2 Gang variable condenser 5" pm speaker; tubes 6Q7, 6V6GT, 12SK7, 50L6, 12SQ7, $4.50 or 6C5. 2525 and code practice set. Bobby Peek c/o Warren Wilson Junior College, Swannanoa, N. Carolina.

FOR SALE—Power transformer, (3x3x4") 390V-140 mil with two 6v. fil., $3.50. Power pack with above transformer wired for two 6x5's, uses two C.D. 16mfd. 450V can filters (6-8/8 x 9x3½"), $5.95. H. S. Wyeth, 1923 Belmont Ave., Chicago 13, Ill.

SELL OR TRADE—PR-15 receiver in good condition. Want Hi-Fi—am & fm tuner. Murray Brown, 149 S. 4th St., Brooklyn 11, N. Y.

FOR SALE—Superior tube tester with instructions, good as new, $17.50; new Radio-Automatic phono in portable case, $78; New E.C.A. radio single player phono in tan portable case, $44; 5 new 6v d-c-120v a-c vibrator transformers, 250v, 100 ma. when using 6Z5 tube & 294 vibrator transformers, $2.35 ea. May trade—what have you? Guaranteed Radio Service, 106 E. Main St., Independence, Kans.

WILL TRADE—Receiving tubes 9002, 9003, 1H5, 1N5, 184 and others; also radio service books, machinist's tools. Want good signal generator, V.T.V.M. or Riders manuals. Angelo F. DiMuccio, 37½ Laurel Hill Ave., Bridgeton, R. I.

FOR SALE—Hammarlund super-pro Sp 400X including speaker and power supply. Used only few months, $100. R. B. Horn, 645 Henderson Ave., San Luis Obispo, Calif.

POSITION WANTED—Radio television serviceman, 2½ years' experience on radio, phonographs and electrical appliances. Would prefer vicinity of New York. T. P. Orlando, 2202 Glebe Ave., Bronx 61, N. Y.

FOR SALE—Transceiver transmitter with tubes, in case, less mike and antenna; transceiver receiver not in case but with good words on UHF in range, operates on 110 voltage, no power supply, $30.50. Ellison Radio Service, Centertown, Ky.

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RADIO GADGETS

Fortunes Are Still To Be Made in Successful Radio Ideas

By HUGO GERNSBACK

WE hear continuously from many of our readers who come up with unusual radio ideas on which they seek our advice. Hardly a week goes by that a number of such letters do not pass across our desk.

There is, indeed, a good deal of money in radio gadgets, i.e., adjuncts to radio receivers. These gadgets are auxiliary items, performing some useful function in connection with radio receivers. They may or may not be electrical.

For the man who has little money, but who has original ideas, a successful business frequently springs from such a simple idea.

Consider that in this country there are now over 65 million radio sets. While the radio receiver performs the primary function of disseminating programs, that is by no means all it can do. The manufacturer who builds radio sets is interested only in supplying a receiver for listening purposes. Yet many radio set owners could very well have other effective uses for their receivers.

A parallel might be cited with the home or business telephone. Hundreds of gadgets have been invented as auxiliaries to the telephone, indeed many concerns have and are now making money from such devices. There is, for instance, a rubber device that clamps on to the telephone handset that enables you to place the handset on your shoulder while carrying on a conversation. The oval rubber block holds it in place so you have both hands free to write with and hold on to the writing paper. Another very widely-used gadget mutes your voice so that when you talk into the mouthpiece a person sitting near you cannot hear what you say. Such a device is often necessary in business when you do not wish to reveal to persons in the same room what information you are giving over the phone.

Another gadget for names and telephone numbers slides out of sight underneath the telephone set. When pulled out, the device gives you an alphabetic list of names and numbers. We could continue this catalog of similar phone gadgets, many of them highly successful, even though frowned upon by the telephone company.

There are many parallel opportunities in radio but, strange to say, radio technicians and inventors have hardly begun to exploit this great potential and most lucrative field.

Let us begin with the most obvious one. There is an urgent demand for a device for near-deaf persons and those hard of hearing who wish to enjoy their radio programs. The same is true for those who do not wish the set turned on too loud thus disturbing others in the same room. This is particularly the case in bedrooms. The wife or husband may wish to listen to a radio program while the other is sleeping. For this purpose, a few radio manufacturers have equipped a receiver with a device such that a headphone or earphone can be connected to the set; but only a very few radio set manufacturers provide such a facility. It should be almost universal. For bedrooms there is also a pillow receiver that is placed inside or underneath the pillow so that one person may listen to a radio program without disturbing others in the same room. This is a particularly useful gadget not only for the home but hospitals as well.

The trouble with these items is that unless you know something about radio or call in a serviceman, you cannot connect such an earpiece to the radio set. That is probably the reason why these items are not sold in far larger quantities, as they deserve.

A much simpler gadget is needed, one that *anybody* can attach to *any* existing radio receiver without jacks and without making special connections. It will take a little ingenuity to solve this, but we believe it can be done.

We can think of one simple solution. A person hard-of-hearing could use a simple low-cost stethoscope, similar to those used by physicians. At one end would be earplugs and at the other a large diaphragm to catch the sound vibrations. Merely by placing this close to the loudspeaker by means of a simple attachment, a person so equipped could readily hear a program. This is a simple solution and does not require any electrical parts whatever. Even by turning down the radio set to a low volume, the near-deaf person still hears very well. We know, because we tried it. There may be other and better solutions.

In the early '30's several manufacturers designed a few radio toys which were highly successful at the time. Among them was a dancing figure which was placed on top of the radio receiver. A simple microphone placed near the loudspeaker energized a small electromagnet inside the dancer who then jigged in unison with the radio's sound waves. The trouble with this toy was that it was much too expensive. Something of a similar nature that would sell around $2.00 could very well make a little fortune for its maker. Indeed, it is not even necessary that the toy be electrical in nature. If you place your hand on the top of any radio, when turned on, you will feel the vibrations induced by the loudspeaker. Twenty-two years ago the writer described in one of his former radio magazines a dancing toy in which small figures, whose legs were three stiff bristles, danced slowly but effectively on top of a metal diaphragm, which was also the loudspeaker. That was long before we had such efficient and powerful loudspeakers as we have today. The same idea is still good: small dancing figures can be made to go through their motions right on top of any radio set. A simple metal guard will keep the dancing figures from falling over the side of the receiver. Such a toy could be sold at a good profit for $1.00. Other similar ideas *(Continued on page 82)*

RADIO-ELECTRONICS

Items Interesting to

AUTOMATIC STEERING of road vehicles by electronic means is proposed in a patent (No. 2,424,288) issued last month.

The inventor, Victor Severy of Atlanta, Georgia, proposes to make motor vehicles automatically steerable by turning the job over to a photocell that will follow paint stripes running down the middle of the driving lane instead of along its side. From one side, underneath the vehicle, he throws a beam of light from a lamp with a reflector. This beam, thrown back to the photocell on the opposite side, actuates the steering mechanism whenever the vehicle tends to drift off course. A second set, with lamp and photocell placed opposite to the first, takes care of deviations in the opposite direction.

FM RECEIVER with only 3 tubes (plus rectifier) was announced to the public last month by Frank E. Shopen, WØWQE, general manager and chief engineer of KOAD, Omaha, Nebraska. The little set has been known for some time to the residents of Omaha and a large number are operating in that area.

The set is a superregenerator, and therefore lacks many of the advantages of a standard FM receiver. It cannot be expected to have either the quality nor the discrimination against unwanted stations that may be obtained from a good superheterodyne.

Mr. Shopen states that he constructed the receiver as a stop-gap until quantities of FM receivers should become available. Most of the users, having become acquainted with the high-fidelity characteristics of FM, would then very likely obtain sets which could reproduce FM in all its excellence.

Complete construction details of this receiver will appear in an early issue of RADIO-CRAFT.

A CAUTION given last month by the FCC to broadcasters warned that some stations have signed contracts that practically delegate to advertising agencies control of the station during certain programs.

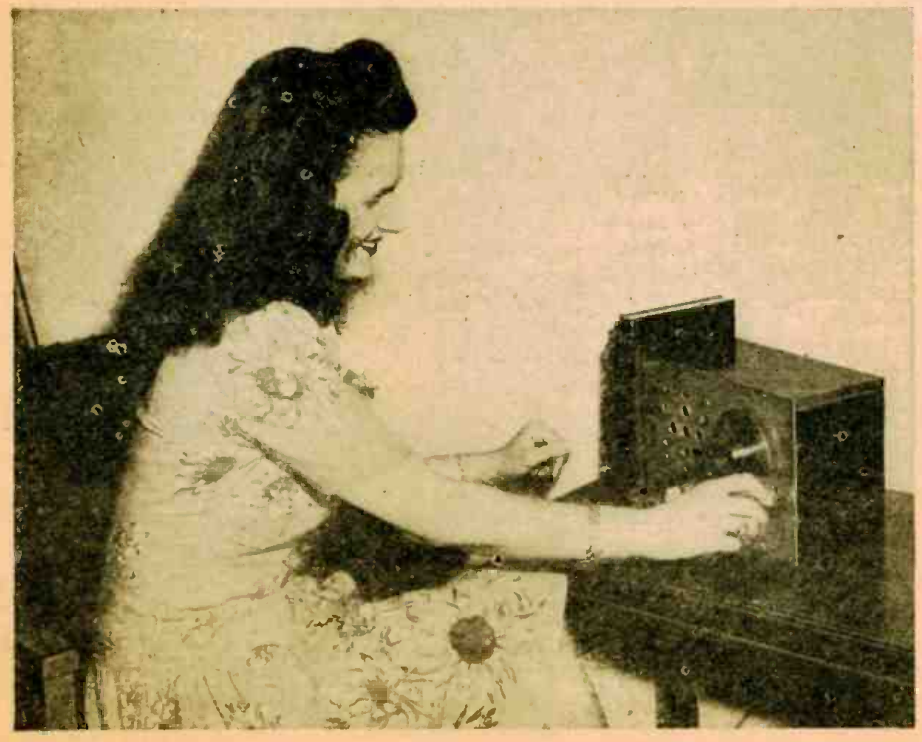
In some instances, it was stated, contracts were entered into in which the agency was sold a block of time. The agency then sublet the time to various sponsors, arranged shows, and in at least one case used its own studios to produce the program.

No contract, the Commission warned, may delegate to others the station's responsibility for what it puts on the air.

BRITISH AMATEURS will not be permitted to act as United Nations radio aids, it was reported from London last month. The amateurs were to handle bulletins from UN destined for the public of all nations, as described in June RADIO-CRAFT.

The General Post Office has invoked a regulation which forbids any form of message transmission for the benefit of third parties, and will make no exception for United Nations traffic.

The matter will be brought up in the British Parliament where attention will be drawn to the present anomalous position of radio enthusiasts in England who technically are not even allowed to transmit SOS messages which they may have picked up.



The little F. M. radio. Quality is good, but of course not equal to that of larger receivers

SPECTROGRAPHY with the aid of a photocell extends the range of spectrographs far into the infra-red, Drs. Richard C. Nelson, R. J. Cashman, and Wallace R. Wilson of Northwestern University stated last month.

The new spectrograph developed by them is a combination of mirrors mounted on a heavy steel base. It breaks down infra-red light into separate wave lengths, just as a prism splits white light into its various component colors.

A photoelectric cell detects these individual wavelengths and converts the light energy into electrical energy which is recorded on a graph.

The scientists said that the new infrared spectrograph almost doubles the range of atom-emitted light on which exact measurements can be made. With this spectrograph, which will give valuable information about the nature of the atom, observations that once took a month can now be made in an hour, they declared.

AMATEUR RADIO has organized to render even more effective aid in disasters than it has in the past, it was announced from Hartford last month by the American Radio Relay League.

A National Emergency Coordinator will in the future fly to any point where natural forces or man-made catastrophe have caused breakdown of the regular communications system. There he will facilitate the orderly integration of a complete emergency communications system, including spotting of portable self-powered "walkie-talkies" for short-haul traffic, the establishment at agency relief centers of radio stations powered by gas-engine generators and, if necessary, request of the Federal Communications Commission a special order clearing amateur channels exclusively for disaster communication, it was stated.

Assisted by local emergency coordinators, he will establish liaison with local officials of the American Red Cross, other relief organizations and protective services to handle their messages directing relief operations and keeping the outside world informed of the status of the emergency.

The first National Emergency Coordinator, Albert E. Hayes, Jr., W3LVY, was formerly an engineer with the Bendix Radio Corporation. He is a graduate of the Massachusetts Institute of Technology, a member of the Institute of Radio Engineers, and has been particularly active professionally in the electronic patent field.

MONTHLY REVIEW

the Radio Technician

RADIO GAS DETECTORS that *hear* and *see* the gases they detect were described last month.

The "seeing eye" detector is intended to detect carbon monoxide in airplanes. Patent 2,425,059 on the device has been awarded to William F. Fagen of Chicago, assignor to the Stewart-Warner Corporation.

A continuous sample of the air supplied to the plane's cabin is passed through a tube which contains a gel that turns dark blue in the presence of carbon monoxide. A light beam that passes through the gel in its normal state is dimmed, hence fails to excite the photocell on which it is directed. The change in current, suitably stepped up, operates a relay and gives warning.

Another instrument to analyze mixtures of gases was described at the recent Kansas City meeting of the American Chemical Society by Carl E. Crouthamel and Harvey Diehl of Iowa State College. The device analyzes mixtures of 2 gases by measuring the speed of sound waves that pass through a gas-filled tube. An audio-frequency oscillator sends waves at 1,000 to 3,000 cycles per second through a brass tube filled with the gas mixture. A sensitive microphone at the opposite end of the tube picks up the sound waves, analyzes them, and records the result on a meter.

FM BROADCASTS over a distance of 110 miles were demonstrated to delegates attending the International Telecommunications Conference at Atlantic City, N. J. The broadcasts originated at W2XEA-W2XMN at Alpine, N. J., and were transmitted to a receiving station at the Seaview Country Club, 7 miles from Atlantic City. A short section of high-fidelity wire line connected the receiving station to WBAB-FM in Atlantic City, from which the program was broadcast for the benefit of the delegates.

The tower at Alpine is 350 feet high, and the height of ground above sea level 850 feet. Distance of the horizon from the top of the Alpine tower is 37 miles. Thus the transmissions were sent over a distance 3 times the traditional line-of-sight range. The towers at Seaview are 120 feet high.

These results were not unexpected. The Alpine station's regular range approximates 90 miles (to rural receiving locations). The demonstration for the Telecommunications Conference was to break the superstition that FM and other high-frequency stations are limited to approximate line-of-sight ranges.

TRAIN TELEPHONE SERVICE between moving trains was inaugurated last month on trains between New York and Washington. Passengers on the Pennsylvania's Congressional Limited and the B. & O.'s Royal Blue simply call long distance in the usual manner to talk to any person connected in the regular telephone system.

The system is an extension of the automobile service now available in many American cities. The operator who answers the passenger's call is at the nearest automobile radiotelephone station, and the call is handled like any other mobile traffic.

Charges for long-distance calls are based on the standard person-to-person rates. Local calls are being charged for at a special rate which varies from 30 to 40 cents. Local calls are those made to areas within a zone of roughly 25 miles from any of the local radiotelephone exchanges, which are located at Newark, Philadelphia, Baltimore, and Washington.

PRIVATE BROADCASTERS were cracked down on by the FCC in Southern Indiana last month. As a result several so-called "carrier-current radio stations" used to broadcast Sunday church services have been shut down. Carrier current has been used for private broadcasting systems, especially in colleges, but it appears that the stations in question were radiating far more power than permitted by the regulations.

One station, "LQW," of Columbus, Ind., operating over power lines, was transmitting so much energy that its emissions interfered with standard broadcast stations. Other relatively high-powered "carrier-current" stations have been operating in the area to an extent that caused one radio inspector to brand Southern Indiana as a "hotbed of illicit radio activity."

Two churches in Bedford, Indiana, have been making plans with a local radio engineer for the installation of carrier equipment to broadcast services to their parishioners. Work has been temporarily suspended while the legality of their plans is discussed with the FCC.

FIVE MILLION RADIOS are now in operation in the Soviet Union, according to a last month's dispatch from Moscow. Another 600,000 sets will be installed this year according to the government plan, it was further reported.

JAMES G. HARBOARD, Lieutenant General (retired) of the United States Army and former president and chairman of the Board of the Radio Corporation of America, died August 20 at his home in Rye, New York. He was 81.

General Harboard was born in Bloomington, Illinois, March 21, 1866. He spent the greater part of his youth in Kansas and attended Kansas State Agricultural College. In 1889 he enlisted in the Army. During the war with Spain, he rose from lieutenant to major in the 2nd U. S. Volunteers. In 1902 he was sent to the Philippines, with the regular Army rank of captain, and was appointed colonel the following year. At the outbreak of the First World War, he was selected by General Pershing as his chief of staff and served with distinction as commander of the 2nd Division and head of the Service of Supplies, rising to the rank of brigadier general.

General Harboard applied for retirement from the Army in 1922 to become president of RCA. He held that position until 1930, when he was elected chairman of the board. Ill health forced his retirement from that office a few months ago. He remained honorary chairman and a member of the Board of Directors until his death.

PLOUGHING BY RADIO

THIS BRITISH RADIO-CONTROLLED TRACTOR PLOUGH STARTS, STOPS, MAKES RIGHT AND LEFT TURNS AND CHANGES SPEED

By S. P. OSBORNE and R. W. DUNN*

RADIO control of aircraft, ships, and land vehicles has been developed hitherto almost exclusively for military or naval purposes, except of course in case of models. Last summer however, a well-known firm of British tractor manufacturers (Tractors Limited) conceived the idea of applying radio control to the more peaceful pursuit of farming and with the co-operation of Britain's Ministry of Supply and the Royal Aircraft Establishment the first successful radio-controlled tractor was demonstrated to the press. To the best of our knowledge this demonstration was the first in history in which ploughing was done by remote control.

The writers and their colleagues had been instructed by the Ministry of Supply to assist the firm with technical advice and supervise installation of equipment lent by the Royal Aircraft Establishment. The outfit was purely experimental. The object was to find out if it was possible to perform the tricky operation of ploughing by remote control with any reasonable degree of success. If so, it would probably be worth further development to produce a really flexible and reliable control system.

*Royal Aircraft Establishment (Britian)

The tractor used was a lightweight model powered by a 7-horsepower engine. It is normally driven rather in the manner of a motordriven lawn mower. There were 3 controls, the throttle, the turn-selection lever, and the forward and reverse selection lever.

It was decided, for the initial experiment, to omit automatic control for reversing, since this can be regarded as a refinement; but the other 2 controls must be selected and operated in co-ordination.

To turn the tractor the engine layshaft is disconnected from one or other of the 2 driving wheels by dog-clutches. Consequently any attempt to turn at full throttle results in an extremely rapid and uncontrollable rate of turn. The diameter of the turning circle is approximately the length of the tractor under these conditions.

A preliminary survey showed that the following requirements could be met:

1. Start and go straight at full throttle (about 4 miles per hour).
2. Do slow left and slow right turns at reduced throttle, with plough raised (about 1 m.p.h.).
3. Straight and reduced throttle with plough raised, as the result of demanding a turn.
4. Reversion to straight and full throttle with plough lowered.
5. Stop.
6. Provision for cutting out the plough-raising mechanism when other implements are attached to the tractor.

These requirements were all that could be met with the available equipment and with the existing dog-clutch arrangement incorporated in the tractor's turn mechanism. Servo systems were used for operating the throttle and turn controls, providing 3 possible servomotor positions. For example, servo "off" gave throttle closed, servo at mid-stroke gave half throttle, and servo fully opened gave full throttle. X in Fig. 1 shows the extreme position of the servomotor, and Y the half-throttle position.

Similar conditions were set up for the left, straight, and right positions of the dog-clutches. A separate, but much larger, servomotor was used to raise the plough.

Coordinated selection of the 3 servomotors—which operated from a compressed air supply at 80 pounds per square inch effected by 2 relay boxes, one of which (turn selection) was arranged specially for the tractor control. Inconing radio signals energized sensitive relays in the receiver. These in turn energized one or more of the above-mentioned relays in the main relay box, which contained 5 relays operating air valves in the pneumatic system. One valve (left turn) was reversed in that the air was turned off when the relay was energized; the reason for this will be explained later.

The sequence of operation and coordination of throttle position with turns were all produced by 4 combinations of 2 sensitive relays (X1 and X2) in the radio receiver:

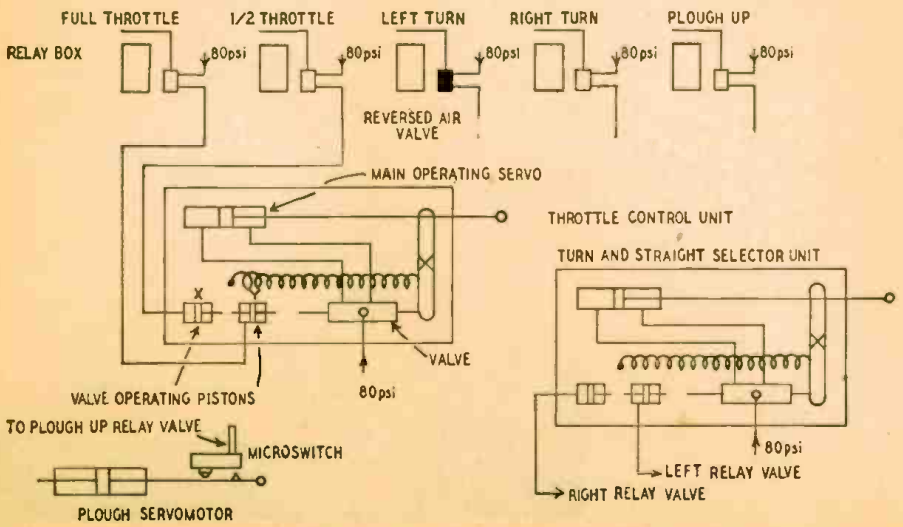


Fig. 1—Pneumatic hookup of the system. The lines represent metal tubes or rods, not wires.

This picture shows the transmitting equipment for the radio plough.

The radio-controlled plough in actual operation, turning a furrow.

Item	*Executive Signal (relays A and B)*	*Condition set up*
1.	X1 and X2 not energized	Stop.
2.	X1 and X2 together	Start, straight, and full throttle.
3.	X1 alone	Right turn plus ½ throttle with delay until plough is fully up.
4.	X2 alone	Left turn plus ½ throttle with delay until plough is fully up.
5.	X1 + X2 (following X1 or X2 alone)	Straight plus ½ throttle.

The piping and wiring diagrams (Figs. 1 and 2) show quite clearly how the above conditions were met. The only points which need clarifying are that the delay in getting from full to half throttle when a turn was demanded was produced by feeding from T.L. (turn left) contacts through a microswitch located on the plough-raising mechanism and thence to half-throttle relay.

T.L. relay, once energized, was locked in electrically and could be unlocked only by switching off the radio transmission momentarily. Reversal of the left-turn relay-operated air valve meant that with X1 + X2 energized neither left- nor right-turn relays were energized; but since air was fed through the left-turn valve to the turn-selection servomotor, this took up a "servo control" position, which was "straight."

T.L. relay was slugged to a 500-milliseconds delay so that any momentary hiatus in radio transmission would not be interpreted as a demand for a turn.

The following example of the sequence of operation may help the reader to follow the system more easily:

1. X1 + X2	=	Full throttle plus straight plus plough down.
2. Demand left turn	=	X2 energized, X1 off.
	=	Left-turn relay energized plus T relay energized.
	=	Air off left-turn valve.
	=	Left turn selected.
also 3. T energized	=	T.L. energized and locked in.
	=	T.L. change-over contacts cancel full throttle in favor of half throttle via plough-up microswitch.
	=	Left turn at half throttle.
Later 4. X1 + X2 together	=	Straight but T.L. still locked.
	=	Straight plus half throttle plus plough up

Thus to get *straight plus half throttle plus plough down*, transmission must be stopped for about ½ second in order to unlock T.L. and so revert to condition 1 above.

The signal adopted was conveyance on the radio-frequency carrier wave of audio tones. Since the number of functions required was small, only 2 tones were used, giving 3 possible executive signals—a fourth obtained by complete lack of any tone was used as the "stop" signal.

The 2 tones used were 1,700 and 2,500 cycles per second. Both tones transmitted simultaneously were arranged to set up the initial conditions of straight and full throttle. Cancellation of one tone resulted in a demand for a left or right turn, according to which tone was cancelled. The transmitting and receiving equipment used was of normal design; the carrier frequency used was 5 megacycles per second, which corresponds to a wave length of about 60 meters. The transmitter power was in the region of 30 watts, amplitude modulation being used. The depth of modulation was kept within the limits required for minimum distortion of the modulation envelope and was determined by the type of transmitter and receiver used and the number of tones transmitted simultaneously.

Since, in the case described, only a single or a double tone was used, the modulator consisted simply of 2 audio-

(Continued on page 54)

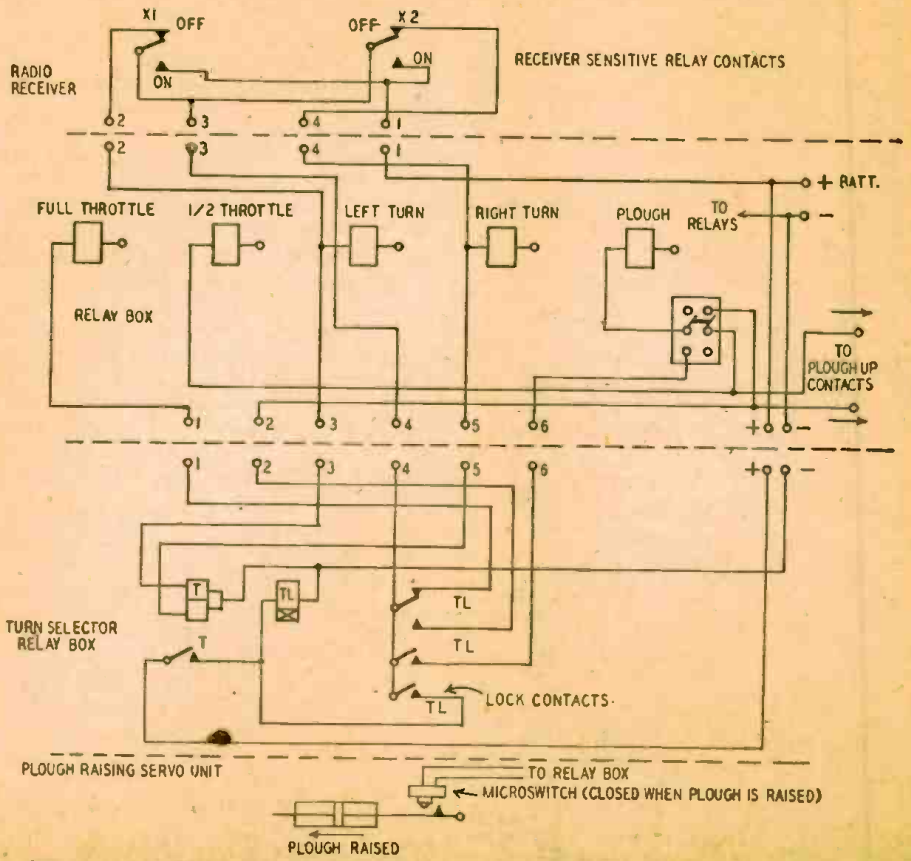


Fig. 2—Hookup of the electric relays. Portion above the dashed line is in the receiver.

FIELD STRENGTH METER

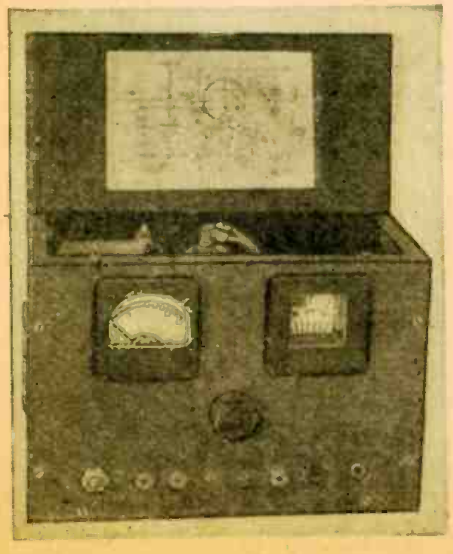
This inexpensive and useful two-function instrument should be a valuable addition to any amateur radio station's equipment

By GEORGE E. ROUSH

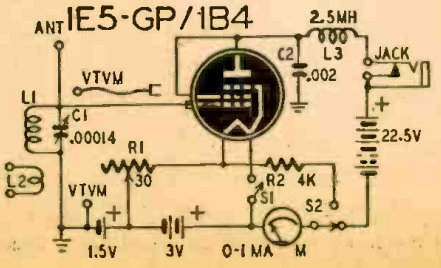
A CIRCUIT design which incorporates novel features into a well-known and reliable circuit results in this unit for the amateur station. It will aid in improving the efficiency of the station at lowest possible cash outlay. Next to the indispensable volt-ohm-milliammeter, the field-strength meter and simple wave meter shown in the photograph will fill the greatest need around the station.

A vacuum-tube voltmeter is desirable for checking the automatic gain control voltage of the station receiver but otherwise is not an absolutely essential part of the equipment. The unit was therefore designed also to measure those automatic gain control voltages for which a limited range only is required.

As shown in the diagram, the circuit comprises a 1E5 or a 1B4 tube with the screen connected to the plate. It operates as a biased-grid detector. The tube filament circuit is completed by a 3-volt battery connected in series with a rheostat R1 to drop the voltage to the proper value and a toggle switch S1 which opens and closes the filament circuit and thus serves as the OFF-ON control for the entire unit. A rotary FUNCTION switch S2 when thrown to the CALIBRATE position (uppermost as seen in the schematic diagram) connects the meter M in series with the multiplier resistor R2 across the filament terminals of the tube. The 4,000-ohm multiplier provides a reading of 0.5 ma (half-scale) when the filament voltage is the rated 2 volts. When switch S2 is thrown to the OPERATE (lower) position, the meter is connected into the plate circuit and will indicate the intensity of any signal applied to the grid.



Front view and schematic of the combined vacuum-tube voltmeter and field-strength meter.



R. f. signals are applied to the grid by means of either an antenna or a primary coil coupled to a tuned circuit. Low alternating-current potentials are applied directly to the grid by means of a pair of tip jacks switched into the circuit by interchanging grid caps. A pair of headphones plugged into the plate circuit will allow the unit to be used as a phone monitor.

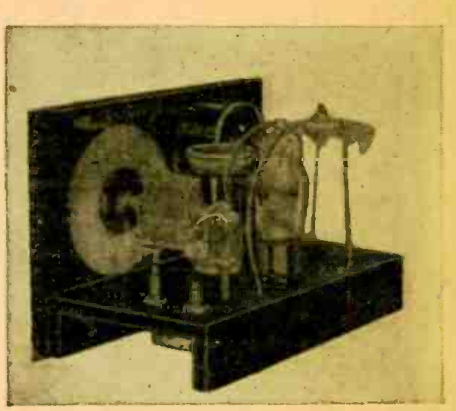
Construction and wiring

The unit is built on a U-shaped steel chassis mounted in a 9 x 6 x 5-inch cabinet. The lid is hinged for easy access when changing coils, adjusting the filament voltage, etc. The front panel is laid out around a Triplett 227-A meter and matching Millen disc dial. The dial is coupled to the tuning capacitor which is mounted on studs fastened near the center of the chassis. The tip jacks are mounted on a line between the ON-OFF switch located in the lower left-hand corner and the jack in the lower right. The plate battery is mounted on top of the chassis behind the meter; the filament and bias batteries are located beneath it on the underside. The tube and coil sockets are located on a line between the meter and the tuning capacitor. The FUNCTION switch and the filament rheostat (both of which are screw driver controlled) are mounted on the right-hand side of the chassis alongside the tuning capacitor. The antenna post, a feed-through insulator with a wing nut, is mounted on the back of the cabinet. A Fahnestock clip is mounted on the inside terminal of the insulator so that the lead to the capacitor can be broken and the chassis readily removed from the cabinet.

The coils are wound on 1½-inch forms, using No. 20 double-cotton-covered wire. The coils are not at all critical and the following table will serve as a basis:

Range (Megacycles)	Number of Turns	
	Tank (L1)	Link (L2)
1.5— 3.5	50	16
3.5— 7.0	15	5
7.0—14.0	4*	2

*Spaced to occupy ¾ inch, all others close-wound.



How the instrument looks out of its cabinet.

Before operating the unit, 2 preliminary adjustments are made. The OFF-ON switch S1 is thrown to the ON position and the filament voltage is first adjusted to 2 volts by throwing S2 to the CALIBRATE position (the upper position in the schematic diagram) and adjusting the rheostat R1 so that the pointer of the meter indicates 0.5 ma. The FUNCTION switch is returned to OPERATE. The pointer of the meter will now indicate about 0.05 milliampere at no signal. The zero-adjusting screw on the face of the meter is adjusted so that the pointer is at the zero mark. Switch S2 is again thrown to CALIBRATE and the reading noted for future reference, preferably by drawing a red line directly on the meter scale. The filament voltage will still be 2 volts, and the meter will indicate zero for conditions of no signal.

With the meter as now adjusted, the meter pointer will rest off-scale when the unit is turned OFF, which feature will serve as a ready check on the condition of the plate and the bias batteries. If after the filament voltage is adjusted to the proper value, the pointer of the meter does not indicate zero at no signal, the plate and bias bat-

(Continued on page 75)

A Useful Tube

Cathode-ray indicator 6AL7-GT can be used in several new ways

By ERIC LESLIE

SERVICEMEN and experimenters will find many uses for the new General Electric FM/AM tuning indicator tube, the 6AL7-GT. This is a cathode-ray tube, with a fluorescent screen at its end on which the pattern appears. This pattern may be made to take various forms in different types of FM and AM receivers and in test instruments. The tube can be useful in any application where it is desired to balance two voltages, or to compare one voltage with a reference voltage. A brief description of the 6AL7-GT was given in the January, 1947, RADIO-CRAFT.

As in other cathode-ray tubes, a cathode emits electrons toward a positively charged target which glows where struck by the electrons. The target is divided into 2 parts, causing the fluorescence to appear as 2 rectangles. Control electrodes vary the size of the rectangles, one electrode usually being maintained at a fixed voltage and the other varied by the voltage to be indicated or studied. A space-charge grid controls the speed of the electrons moving from cathode to anode. By increasing its negative bias with respect to the cathode, the effect of the control electrodes is made greater and the sensitivity of the tube is increased.

Several patterns produced by different circuit combinations are shown in Fig. 1. The simplest indicating circuit for FM receivers is shown in Fig. 2. If desired, the space-charge grid may be returned to cathode rather than ground, the result being a reduction in deflection sensitivity.

Since the voltage output of a discriminator is zero both when no station is tuned in and when a station is tuned in exactly, the pattern (top of Fig. 1) is the same for off-channel and on-tune. This disadvantage can be eliminated in receivers which have a squelch circuit by connecting the space-charge grid to the squelch voltage source, as shown in Fig. 3. A negative voltage of 6 cuts off all electron flow to the target, and there is no fluorescence in the off-channel position. As a station is tuned in, the pattern follows the sequence of the second row of Fig. 1.

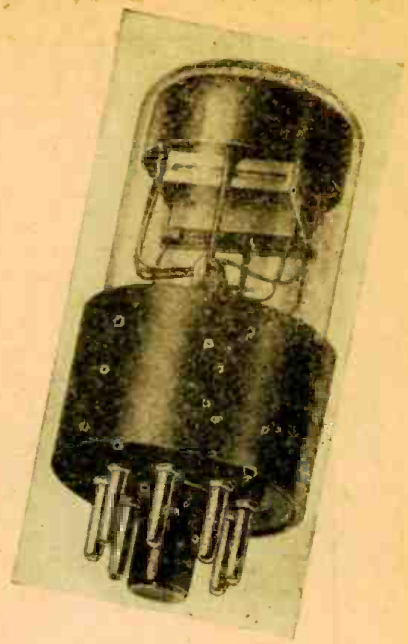
If squelch voltage is not available, the circuit of Fig. 4 may be used. The varying voltage from the limiter causes the off-channel and on-tune patterns to differ as shown in the third row of Fig. 1.

The tube may also be used as an AM tuning indicator. The circuit is then very simple. All deflection electrodes and the space-charge grid are tied together and attached to the a.v.c. voltage source. As the station is tuned in, the 2 fluorescent rectangles become narrower, somewhat in the manner of the shadow tuning indicators which once were popular. The bottom row of Fig. 1 illustrates this. See also Fig. 5.

The 6AL7-GT is a 6.3-volt tube, with a filament current of 0.15 ampere. The target voltage may fall between 220 and 365 volts, 315 being considered typical.

CONTROL VOLTAGE SOURCE	SIGNAL	CIRCUIT (SEE FIGURE)	OFF CHANNEL (−)	ON CHANNEL OFF TUNE (−)	ON TUNE	ON CHANNEL OFF TUNE (+)	OFF CHANNEL (+)
DISCRIMINATOR	FM	5 AND 6					
DISCRIMINATOR AND SQUELCH	FM	7					
DISCRIMINATOR AND LIMITER	FM	8					
AVC	AM	8					

Fig. 1—Types of tuning patterns produced by the four circuit arrangements shown at right.



More information on the tube's characteristics is given in G-E's technical data sheet ET-T27OA. Further interesting information on the tube and its applications appears in the General Electric *Electronic Tube Engineering Bulletin ET-B14*, which supplied much of the material on which this article is based.

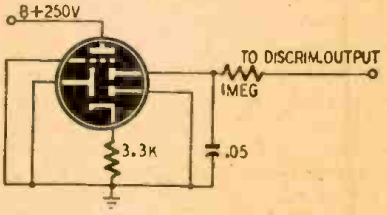


Fig. 2—The simplest hookup for the new tube.

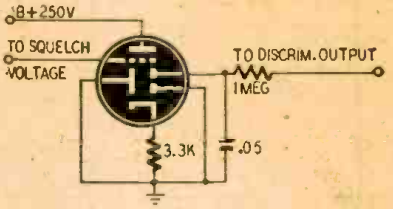


Fig. 3—This circuit has no off-tune pattern.

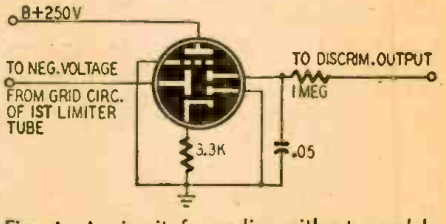


Fig. 4—A circuit for radios without squelch.

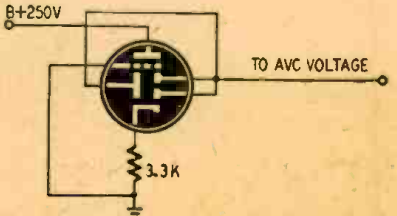
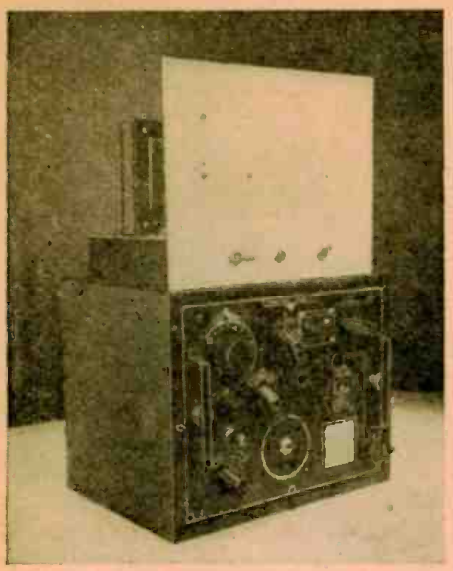


Fig. 5—Hookup for an AM tuning indicator.

Carrier Radiophone



The power pack sits above the transmitter.

Part I — Transmitter section, constructed from a Navy surplus plug-in tuning unit

By BOB WHITE

RADIO communication and carrier-current communication are very similar. Both use radio-frequency energy generated by a transmitter, and both use receivers which convert the r.f. signals into sound. The difference between the two is the medium used to link the transmitter with the receiver. Radio communication employs an aerial to radiate r.f. energy through space to the receiving aerial. Carrier-current or wired-wireless communication uses an electric power line or some other metallic circuit to transport the signal from the transmitter to the receiver(s).

Because of the FCC's ruling limiting the radiation of r.f. energy, it is advisable to use a frequency below 200 kilocycles where radiation is not great. Since most public-utilities carrier-current systems operate below 160 kilocycles, it is therefore necessary to operate on a frequency between 160 and 200 kilocycles.

The distance covered by this system will depend upon your location. In large cities where the line is heavily loaded, you may be able to cover only a few blocks. In rural districts, communication up to many miles may be possible. The distance covered will be dependent largely also upon the time of day because of the changing load on the power line at different hours.

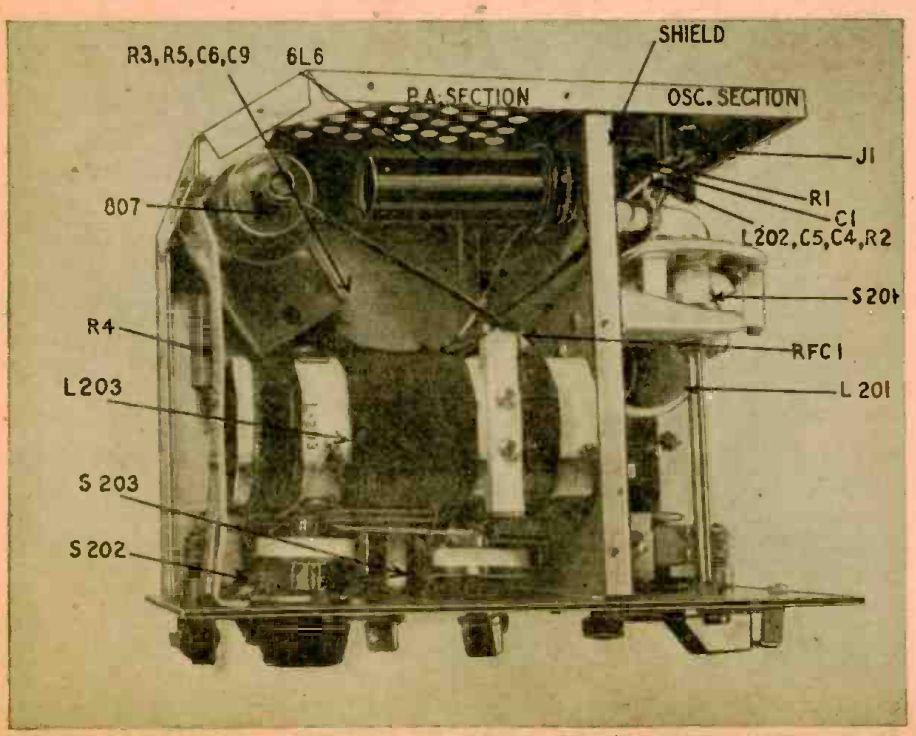
Transmitter construction

The surplus plug-in tuning unit Type CAY-47150, range A, around which this transmitter is built, is one of several coil units numbered A through F which cover frequencies from 350 to 9,050 kilocycles. Each unit contains a master oscillator coil, power amplifier coil, and an antenna tuning coil. These plug-in tuning units were designed to be plugged into the front of the GP-7 Navy transmitter to operate over a wide range of frequencies. The higher-frequency units have large variable tuning condensers; the low-frequency units, which are suitable for carrier-current service, have no tuning condensers but incorporate a small revolving coil within the main coil to tune the circuit by the variometer principle. The range A variometer tuning unit, which tunes 350 to 800 kilocycles, can be converted easily to tune 160 to 270 kilocycles without altering the coils. The Type CAY-47150, range A, must be used for the carrier-current transmitter. These units are inexpensive, and are obtainable at radio stores carrying war surplus supplies.

After buying the unit, remove the following parts from the larger section which is labeled P.A.: the .00072-µf, 5,000-volt condenser, the tapped coil L204, the 5-position selector switch S-204, the 5 x 2-inch plate having 2 contacts, and the ⅞ x 2-inch plate having 1 contact. Nothing need be removed from the smaller section labeled M.O. The various parts in the unit are clearly labeled and can be easily recognized.

Study the wiring of the unit carefully and compare it with the diagram of the transmitter, Fig. 1. Note that the 2 mica condensers C2 and C3 in the M.O. (master oscillator) section, which are connected in series, have to be connected in parallel to lower the tuning range frequency. If desired these 2 condensers can be removed and replaced by a single mica condenser having a capacitance of .0075 µf. Condenser C7 in the P.A. (power amplifier) section can consist of either an additional .004-µf, 3,500-volt, mica condenser used in parallel with the .0011-µf, mica condenser included with the unit or a single .005-µf, 2,500-volt, mica condenser installed in place of the .0011-µf condenser included with the unit.

Drill a hole in the partition separating the M.O. section from the P.A. section for the octal socket of the 6L6 tube. Note that the 6L6 oscillator tube must be metal because it is mounted in the P.A. section. Drill 3 additional holes in the partition for the filament wires, B-power wires, and the r.f. wire. Mount rubber grommets in these holes for the wires to pass through. Drill a hole in the back of the case on the M.O. side



The transmitter, top view. Call-out lettering refers to the schematic on opposite page.

for the jack J1. Enlarge the hole left after the removal of the ANT. TUNING STEP switch S-204 and mount the jeweled pilot lamp bracket in it. Mount jack J2 on the front panel in the hole left by the removal of the ANT. TUNING control and antenna tuning coil L204. Remove the mounting bracket from the switch S-204. This has a hole in it just the right size for the 5-prong socket of the 807 tube. Mount the bracket and 807 tube socket on the diagonal part of the back of the chassis as illustrated in the pictures.

Wiring the transmitter is very simple. The diagram shows the shield separating the M.O. section from the P.A. section and thus differentiates clearly in which section the various parts and wires are located. The coils need not be altered, but the original wiring scheme of the unit must be revised.

The inner chassis has a U-shaped shield which fits over it. Although the unit was designed to be removed from the steel carrying case while in use, the case may be left on if holes are drilled in the back opposite the jack strip. Wires running from the jack strip in the back to the power supply can be soldered to the jacks easily.

An alternate transmitter

Although it is most probable that you will be able to procure a tuning unit, the availability of war surplus items is unpredictable; therefore, it may be advisable to include some suggestions on building without this tuning unit.

The transmitter can be constructed on a small metal chassis measuring approximately 10 x 9 x 2 inches. All parts included with the unit can be purchased with the exception of the oscillator coil L201 and the power amplifier coil L203. These coils will have to be constructed.

Sketches of both coils showing the dimensions and general arrangement of the windings are given. The coils in the tuning unit are wound on ceramic forms. All windings are wound in the same direction with No. 14 cotton-covered enameled wire. The M.O. coil L201 (Fig. 2) has 54 turns on winding A. The top of winding A is connected to position 5 of selector switch S-201, a tap located 7 turns from the top is connected to position 4, a tap at the 18th turn to position 3, a tap at the 27th turn to position 2, and a tap at the 35th turn to position 1. The bottom end of winding A is connected through the front rotating shaft to the revolving coil located inside of the large form. The revolving coil has a single winding divided into 2 sections C and D, 8 turns each. The other end of the rotating coil is brought out through the back shaft and connected to winding B and also to the cathode of the 6L6 tube. Winding B consists of 15 turns; the bottom of this winding is connected through jack J1 to the chassis. The P.A. coil L203, Fig. 3, has 3 fixed windings and two rotating coils. The rotating coils are identical to L201. Winding E consists of 15 turns; one end of this winding is connected to the 807 plate, the other end to the selector arm of P.A. TUNING STEP switch S-203. Position 1 of this switch is connected to the beginning of winding F, position 2 to a tap 6 turns, position 3 to a tap at the 20th turn, and position 4 to a tap 30 turns from the beginning. The total number of turns on winding F is 57. The end of winding F is connected through the front shaft to the rotating coil marked P.A. TUNING.

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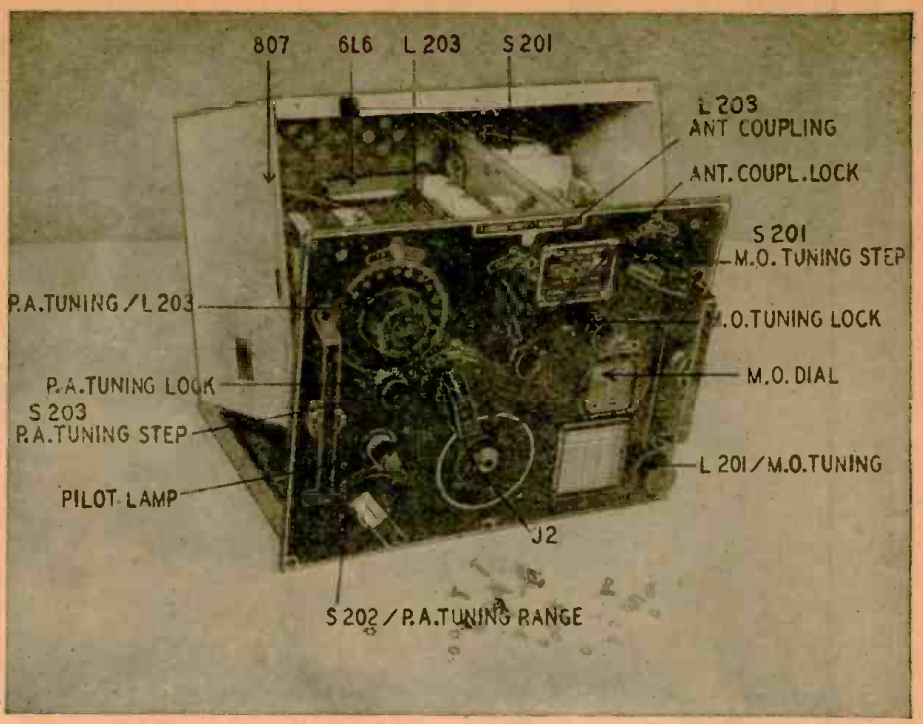


Front view. The unit lends itself well to construction of a carrier-current transmitter.

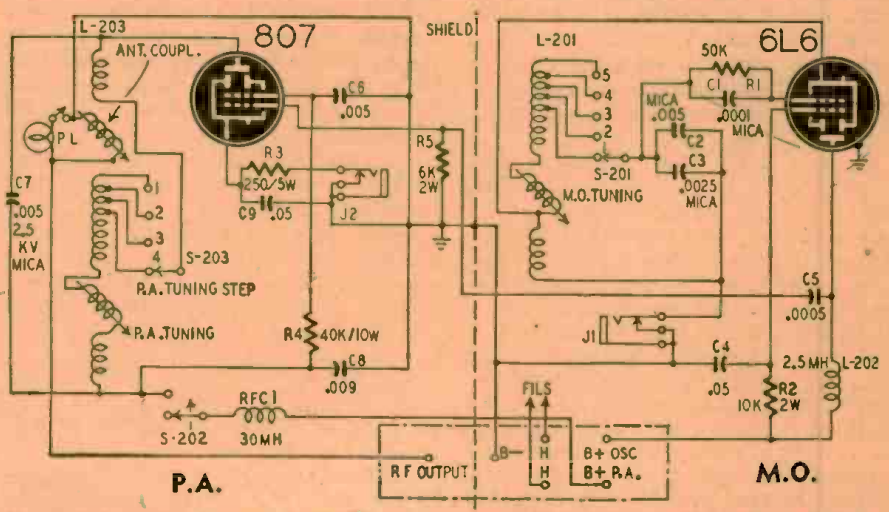


Fig. 1—Schematic of master oscillator and power amplifier. Coils are those shown below.

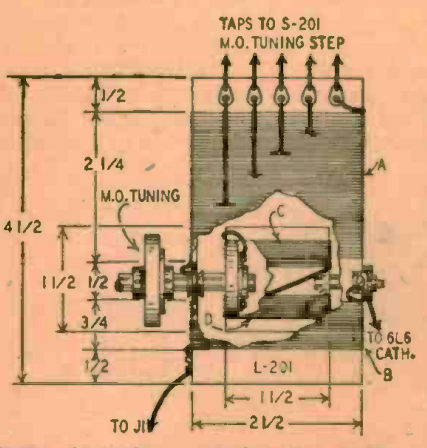


Fig. 2—Coil L-201 in the master oscillator.

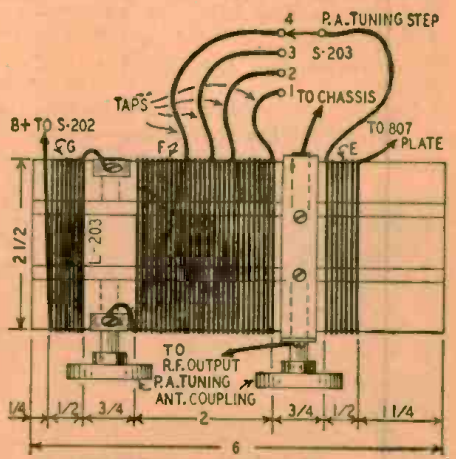
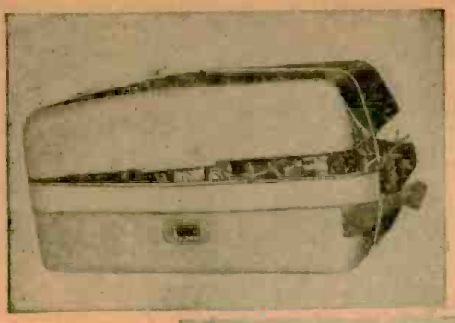


Fig. 3—L-203 is the power amplifier coil.



Plastic Cabinet Straightening

Photos 1 and 2—The cabinet before repair work had been started. Sides were warped and door would not close.

By MAX ALTH

OF all broadcast radio sets, the midget portable gets the most abuse. Not only is it dropped and banged against obstacles as it is carried along, but because of its small size it is stuffed into suitcases along with tennis racquets, shoes, and such. As a result, the set usually suffers as much from cabinet warpage and breakage as it does from circuit breakdown.

Photos 1 and 2 show a typical set after some years of faithful service. The front door containing the antenna no longer springs open when it is released because the casement is warped. It has to be pulled open. The leatheroid covering of the door has been gradually torn away. The latch no longer holds the two halves of the cabinet together and has been supplanted by a piece of string. The handle has long since disappeared and has been replaced with a length of garter. The back of the set has developed a hump like that of a camel, and the speaker louvres also have warped out of shape.

The chassis and batteries were removed, the garter cut away, and the unit prepared for the straightening process.

A heat lamp—in this case a G.E. 250-watt infra-red heat reflector — was screwed into a goose-neck lamp holder and directed onto the portion of the cabinet to be straightened, as shown in Photo 3. We found 6 inches to be about the right distance for the lamp. Bringing the lamp too close will cause little ripples to form on the plastic surface. Keeping it too far away tends to slow the process down interminably and to heat and soften the entire cabinet. Ideally the process should take about 10 minutes.

As a first step, the lamp was directed so that one of the rear sides was heated. It bulged, and then the side was compressed against the table top, beneath a small flat board. The pressure was applied by hand. The lamp was removed, and the plastic gave gradually beneath the pressure. When the plastic cooled, it held its correct shape.

The louvres were first heated in the same manner (Photo 3), then the vertical dips were straightened out with a small piece of wood. Then a block of wood was placed beneath the louvres, on the outside (the side opposite the speaker), and the block of wood and cabinet were placed face down on the table. Blocks of wood were then placed on the other side of the louvres and pressure supplied by an old speaker (Photo 4). Results were fair. Small strips of wood should have been cut to fit the spaces between the louvres so that they would not warp in one plane while being compressed and straightened in another.

Even support necessary

Which brings up an important point. Be sure that all heated surfaces are supported, otherwise a side or top will collapse when it softens. Don't heat any surface more than necessary, and see that the compression surfaces are smooth, otherwise the plastic will bear its imprint. Also make certain that compression of one warped side does not tend to warp another. That is, don't prop or support one side or surface of the case against another. Do not overstretch or overcompress. Shrinkage on

(Continued on page 58)

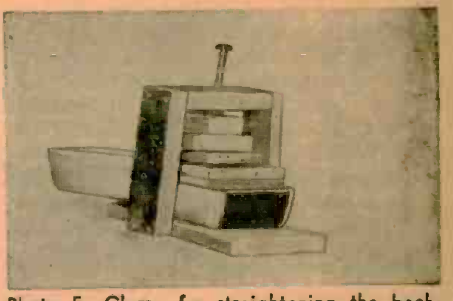


Photo 5—Clamp for straightening the back.

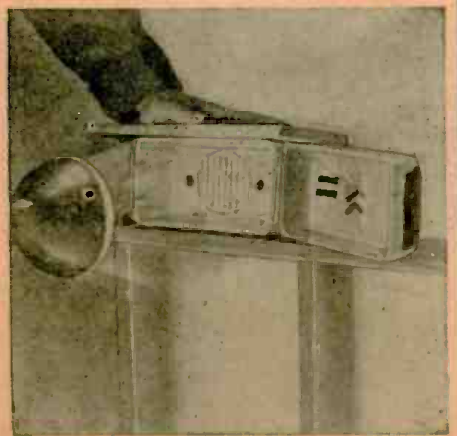


Photo 3—Heat and pressure flatten the back.

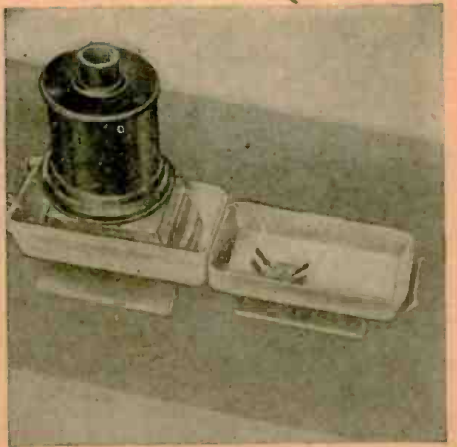


Photo 4—How the louvres were straightened.

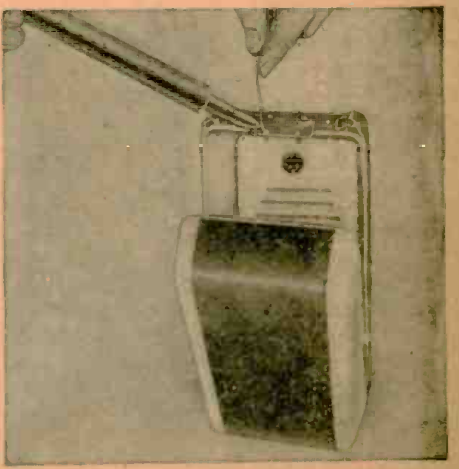
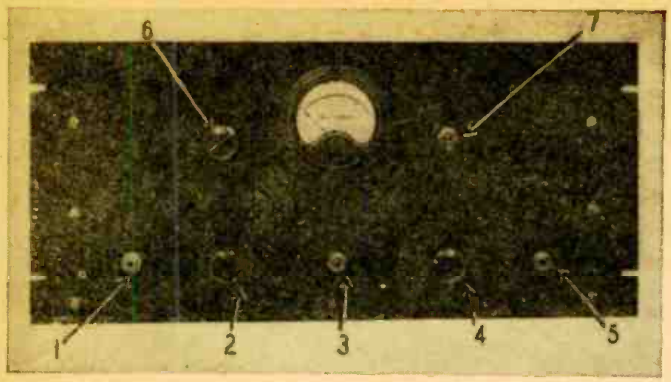
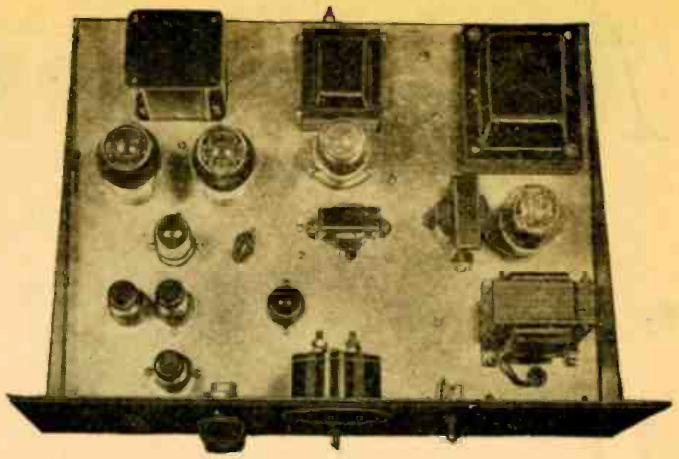


Photo 6—The new latch bolts are soldered in.





Above—Front view of the unit. Numbers are explained in the text. Right—Top view. Some changes were made since the photo was taken.

250-Watt FM-AM Transmitter

PART IV—The speech amplifier circuits

By HARRY D. HOOTON, W3KPX

PRECEDING articles in this series described the FM and radio-frequency circuits of the W3KPX FM-AM transmitter. In this installment we shall discuss the design and construction of the AM speech amplifier and the class-B modulator stages.

The audio-frequency response of this speech amplifier is practically flat over and beyond the two extremes of the male and female voice range. Peak compression or so-called "automatic modulation control" is used to raise the average modulation percentage level and signal intelligibility. This feature is particularly desirable when working through heavy interference or on extremely long distance communication. Inverse feedback in the push-pull 6F6G driver stage reduces the plate-to-plate impedance of the pentodes to a value which compares favorably with triodes, and reduces any inherent distortion to a minimum. The class-B modulator tubes are the time-tested Taylor TZ-40's which simplify bias problems and supply more than sufficient audio power to modulate 100% the 250-watt input to the final r.f. amplifier. The speech amplifier consists of a 6SJ7 pentode microphone input amplifier, a 6SQ7 compression amplifier and rectifier, a 6L7 compressor and audio amplifier, a 6C5 audio amplifier and class-A driver, and a pair of 6F6-G's as drivers for the class-B TZ-40's. As shown in the schematic (Fig. 1), all stages are resistance-capacitance coupled up to the 6C5 grid; transformer coupling is used between the 6C5 plate and the push-pull grids of the two 6F6-G's to simplify phase-inversion problems. The rectifier for the speech amplifier power supply is a 5Z3 with a condenser input filter system.

As the photographs show, the speech amplifier proper, 2 power supplies, and a percentage modulation indicator are built up on a standard 17 x 13 x 3-inch steel chassis and a 19 x 8¾-inch, black ripple-finish steel panel. The controls shown on the bottom front of the panel, left to right, are as follows: 1. microphone jack; 2. speech input "gain" control; 3. control switch for percentage modulation indicator; 4. control knob for percentage modulation indicator; and 5. monitoring jack for headphones. The knob at the upper left 6 is the compression control, and the 0-1 d.c. milliammeter is the percentage modulation indicator. The toggle switch at the upper right (7) controls primary power to the 2 power supply units.

The top view shows the 6SJ7 tube near the front panel; the 6SQ7 is the left one of the 2 tubes shown close together; the tube shown at the right in the group is a 6SB7Y which has been superseded by a 6L7, as shown in the schematic, Fig. 1. The small glass tube is a 6C5-GT; however, it is recommended that a 6C5 metal tube be used in this position instead of the glass type shown. When this speech amplifier was de-

(Continued on page 70)

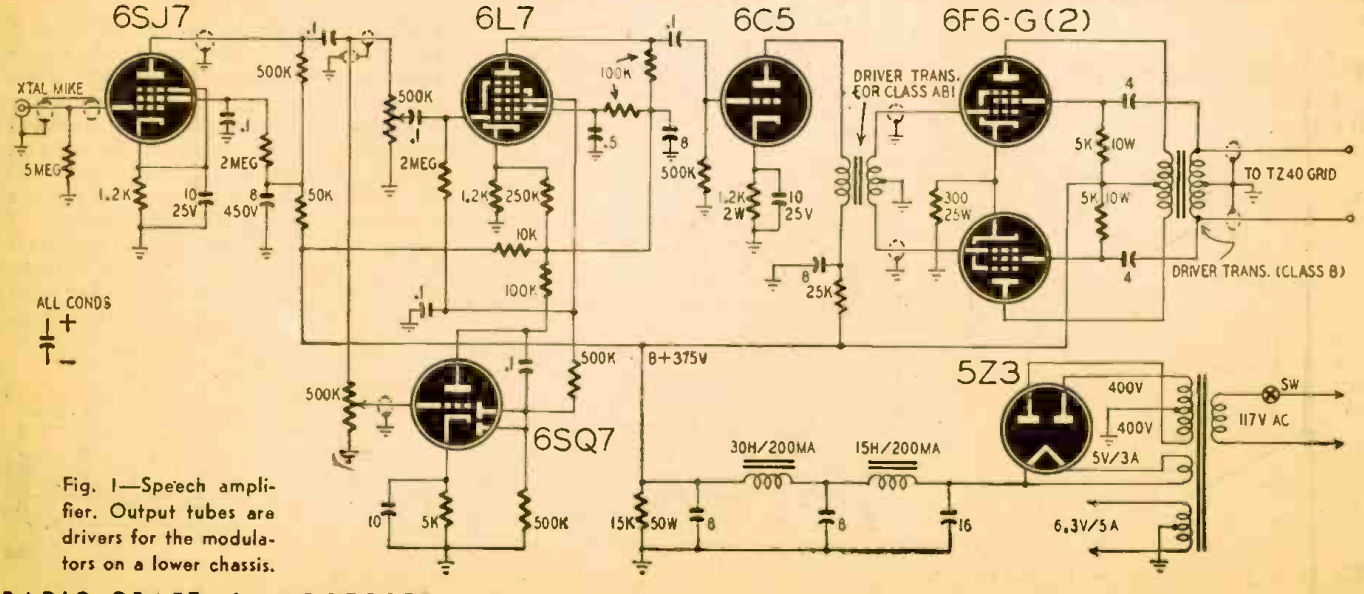


Fig. 1—Speech amplifier. Output tubes are drivers for the modulators on a lower chassis.

Magnetism—

Part I—A modern view of permanent magnet theory

By A. C. SHANEY

THE subject of magnetism is very old (the compass appears to have been invented over 4,000 years ago), yet it remains one of the least understood of phenomena. It was not until the twelfth century A.D. that European scholars tried to fathom its secrets, though the magnet or lodestone had been known to them for centuries, and mention of it is found in legends dating several centuries B.C.

In Europe as in Asia the magnet found its almost exclusive use as a means for determining direction. This unfortunately caused its poles to be given geographical names (north and south). This clumsy terminology has been an obstacle to the student. We will therefore rename the poles arbitrarily, calling the north (N) pole the *positive pole* and the south (S) pole the *negative pole*. To avoid confusion with electrical signs, magnetic pole signs will be circled

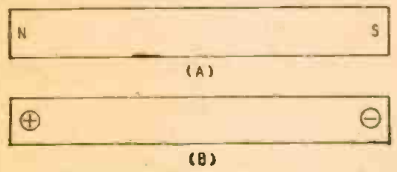


Fig. 1—Illustrating the new magnet markings.

in drawings, as shown in Fig. 1, and put inside parenthesis in text. This is one of a few new concepts we will introduce in an attempt to present magnetic phenomena more clearly to technicians and experimenters who may be interested in contributing to the art of magnetic recording.

New magnetic concepts

Probably nearly every reader (including the author) was first introduced to the mysteries of magnetism via the old familiar bar magnet. When, in 1820, Sir Humphry Davy magnetized a bit of soft iron by running a current of electricity around it, he produced the first bar electromagnet. For an unobstructed understanding of magnetic recording it is suggested that the reader temporarily forget Davy's bar magnet and how it was made. To help forget, try this experiment:

1. Disassemble an old transformer made with E-1 laminations.
2. Stack all the E's together.
3. Slip a coil of wire (about 100 turns of No. 20 R.W.G.) over the center leg.
4. Place a steel bar across all 3 legs as in Fig. 2.
5. Apply 6 or more volts d.c. to the coil for a few seconds.
6. Pull the steel bar away from the laminations.
7. Examine the polarity of this bar magnet with a compass and by sprinkling powdered iron on a sheet of paper placed over the magnet.

Your examination will show that you have made a magnet with like poles at both ends! The powdered-iron pattern will look like Fig. 3-b instead of the usual magnetic field pattern of Fig. 3-a.

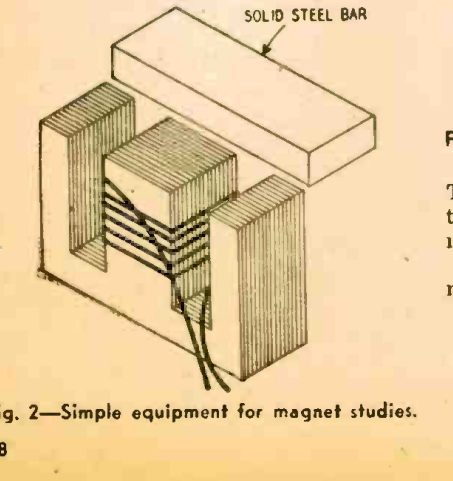


Fig. 2—Simple equipment for magnet studies.

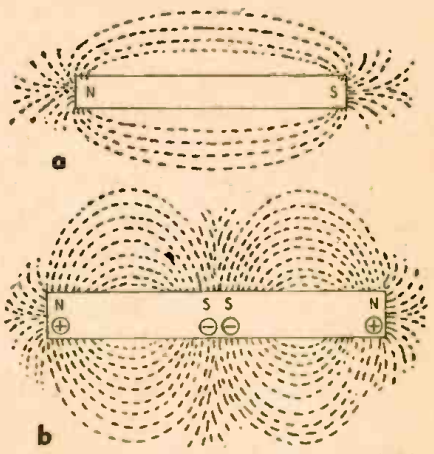


Fig. 3—Two types of permanent magnet fields.

This unusual type of magnet is one of the cornerstones of modern magnetic recording processes.

Two important things should be remembered about this magnet:

1. It was formed *without* passing an electric current around it.
2. Its polarity resembles that of 2 common bar magnets which have been physically joined at like poles.

If this twin magnet be bent into the familiar horseshoe form, it *will not* exhibit usual magnetic properties at its terminal poles.

This magnetic characteristic resembles the effect produced by connecting 2 similar batteries back to back and

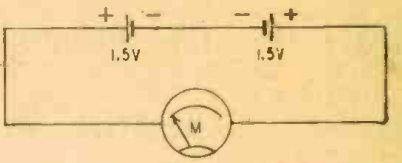


Fig. 4—Electric analog of multipole magnet.

measuring "no voltage" across their outermost terminals (Fig. 4).

If we should pass some current around the flat surfaces of a hard steel disc (Fig. 5-a) about 1 inch in diameter

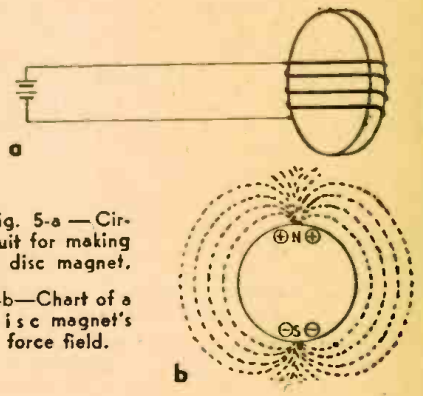


Fig. 5-a—Circuit for making a disc magnet.

5-b—Chart of a disc magnet's force field.

and ¼ inch thick, we would have a short cylinder magnetized *in the direction of its diameter* (Fig. 5-b). (You should have forgotten about ordinary bar magnets by now.) If a hole is drilled through its center, a shaft inserted and the wheel rolled on a small hard steel rod or rail (Fig. 6), the rail will become weakly magnetized at the points of polar contact. This passage of magnetic induction from one magnet into a magnetizable substance by contact (or near contact) and the retention of the mag-

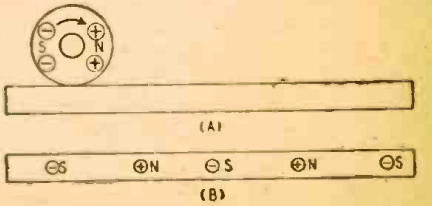


Fig. 6—Magnetization of a strip of steel.

netism by the latter is known as *transference*. Susceptibility to transference determines the degree of interference to be expected when a turn of magnetically recorded wire comes in direct contact with an adjacent wire.

We now have a rail (a magnetic signal carrier) which has been magnetized (modulated by a magneto-mechanical modulator). We can expose or view (detect) these magnetic modulations in a number of ways. A small compass may be used to explore the magnetic field around the rail; or finely powdered iron may be sprinkled on the rail to find its magnetic nodes; an electromagnetic detector (a soft iron horseshoe-shaped rod which passes through a multiturn coil connected to a sensitive galvanometer and whose ends are separated by a distance equal to half the circumference of the magnetic disc), as illustrated in Fig. 7 may be moved along, and in contact with, the rail; or the rail may be moved against the detector. In any case a voltage will be produced in the coil and indicated by the galvanometer.

This electromagnetic detection process may be reversed by applying a variable voltage to the coil while the

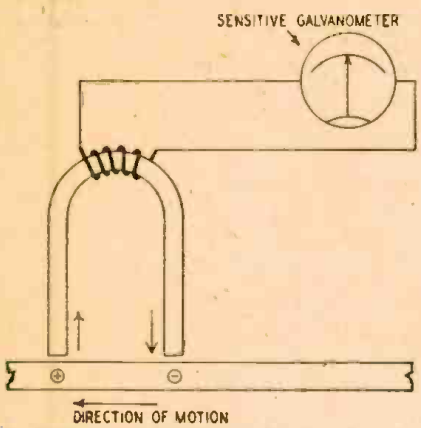


Fig. 7—Simple magnetic modulation detector.

carrier (rail) is moved laterally. The rail will be magnetically modulated as suggested in Fig. 2.

We now have covered the 3 basic elements required to record or transmit intelligence via magnetic media:

1. Magnetic modulator (impresses magnetic modulation on a magnetic carrier);
2. Magnetic carrier (carries the magnetic modulation);
3. Magnetic detector (detects magnetic modulation in the carrier).

As the construction, application, and operation of these basic elements play indispensable roles in the final processes of magnetic recording it becomes important to be able to design these elements for optimum performance. Since they are all primarily magnetic devices, designing them naturally calls for the use of magnetic terms. It is therefore important for a full understanding of the process, to become familiar with applicable magnetic terminology, bearing in mind the very special applications to which it will be applied.

Familiarity with academic magnetic terms may be gained by referring to one of a number of text books on magnetism. (Also see *"Coils, Cores and Magnets"* RADIO-CRAFT, October and November, 1946.) For the radio technician and experimenter, it may be easier to understand magnetic phenomena by referring frequently to electrical analogies.

Interpretation of technical descriptions requires an understanding of carefully chosen units and standards to which the names of famous scientists have been applied (for example, fundamental electrical units were named after scientists like Count Alessandro *Volta*, Georg Simon *Ohm*, André Marie *Ampére*, James *Watt*, and others).

The fundamental units of and formulas relating to magnetic phenomena as developed by physicists are usually expressed in the metric (also called the centimeter-gram-second or c.g.s) system, which has been internationally employed. Interpretation and application of this information is made difficult for English-speaking students accustomed to the clumsier inch-ounce-second or foot-pound-hour system. Conversion into standard English units are helpful. See Tables I and II.

In magnetics, as in other physical sciences, a fundamental force — Gilbert (after William Gilbert)—is required to produce a quantity—Maxwell (after James Clerk Maxwell)—in a given medium. The ability of the medium to help or hinder the flow of the quantity determines its reluctivity (magnetic resistance) or permeability (magnetic conductance).

When the force Gilbert is simply related to lineal length of the magnetic circuit (1 Gilbert per centimeter), we have a unit of magnetizing force per unit of length called an oersted (after Hans Christian Oersted). Similarly, when the quantity maxwell is simply related to cross-sectional area (1 maxwell per square centimeter), we have a unit of magnetic quantity per unit of area—a gauss (after Karl F. Gauss).

The familiar Ohm's Law of electricity now can be compared with its magnetic equivalent as follows:

$$R = \frac{E}{I} \qquad R = \frac{H}{B}$$

Where R = resistance in ohms, E = electromotive force in volts, I = current in amperes.

Where R = reluctivity, H = magnetomotive force in oersteds, B = magnetic flux in gauss.

Similarly, the conductivity of electrical and magnetic circuits may be approximately compared as follows:

$$G = \frac{E}{I} \qquad M = \frac{B}{H}$$

Where G = conductance in mhos, E = electromotive force in volts, I = current in amperes.

Where M = permeability, B = magnetomotive force in oersteds, H = magnetic flux in gauss.

(Continued on page 79)

TABLE I

MAGNETIC FLUX DENSITY CONVERSION RELATIONS

		Lines per square in. B″	Kilolines per square in. B″	Lines per square centimeter B	Gausses B	Kilogausses B
1 line per square inch	B″	1	.001	.155	.155	.000155
1 kiloline per square inch	B″	1,000	1	155	155	.155
1 line per square centimeter	B	6.45	.00645	1	1	.001
1 gauss	B	6.45	.00645	1	1	.001
1 kilogauss	B	6.450	6.45	1,000	1,000	1

TABLE II

MAGNETOMOTIVE FORCE CONVERSION RELATIONS

		Ampere turns per inch H″	Ampere turns per centimeter	Gilberts per centimeter H	Oersteds H
1 ampere turn per inch	H″	1	.394	.495	.495
1 ampere turn per centimeter		2.54	1	1.255	1.255
1 gilbert per centimeter	H	2.02	.796	1	1
1 oersted	H	2.02	.796	1	1

10-Meter Converter Requires No Tuning

By DANIEL SCHULMAN AND NATHAN G. DORFMAN*

FOR the many surplus short-wave receivers now on the market as well as many commercial and home receivers that do not tune down to the 10-meter ham band, a converter is greatly needed. Many types of converters have been designed to extend the frequency range of receivers to this band. Usual practice is to attach to the input an additional unit which includes an additional mixer and oscillator stage and thus convert the receiver to a double superheterodyne. This method necessitates another tuning dial and the attendant difficulty of mounting the converter where it can be reached for tuning.

The converter here described eliminates difficulties caused by an extra tuning dial and calibration of the unit. It is a more easily manipulated device with excellent calibration and extreme ease of construction. There is no tuning of the converter. The receiver is tuned in the normal fashion and the calibration of the band will be as good as that of the receiver being used. It can be readily zero-beat to center frequency by the receiver itself without use of the external frequency meters.

The converter uses a 6SA7 pentagrid tube as a fixed 16-mc oscillator. The receiver acts as a variable-frequency i.f. and will tune the 10-meter band at beat frequencies in its 12-mc region. Assume a 28-mc signal is being received at the antenna input section of the converter. The local oscillator of the converter combines with this signal and produces 2 beat notes of 12 mc and 44 mc, respectively, which are the arithmetical sum and difference of the original frequencies. The plate circuit is slug-tuned to resonate at 12 mc. The 44-mc signal is therefore attenuated to zero and the 12-mc signal is passed on to the receiver. The receiver being tuned to 12 mc is now receiving the 28-mc signal. The entire ham band extending from 27 to 30 mc can be tuned in by tuning the receiver from 11 to 14 mc.

The limit of the tuning range of the converter is dependent on the band pass of the antenna input section and on that of the plate circuit. These cover between 27 and 30 mc in the antenna section and 11 to 14 mc in the plate or output section. To secure maximum conversion transconductance the plate circuit is slug-tuned to a broad resonance peak, before coupling to the receiver. Coupling to the receiver is greater than unity to assist band pass and transfer efficiency. The image rejection with a 12-mc i.f. is high in this type of converter, as the images are 24 mc apart. An r.f. stage therefore is not needed. The receiver usually has sufficient gain to compensate for the lack of such a stage in the converter.

Circuit analysis

The antenna circuit (Fig. 1) consisting of T1, C1, and C2 is of high Q and band-spread tuned to cover from 27 to 30 mc. L1 consists of 2 turns of No. 25 enameled wire and is wound over the ground side of the grid coil L2, serving as the antenna coil. The bottom side of this antenna coil is shown as

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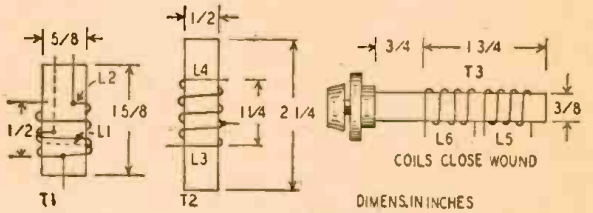


Fig. 2—Dimensions of coil forms. Winding data appears in the text.

*Thor Electronics, Chicago, Ill.

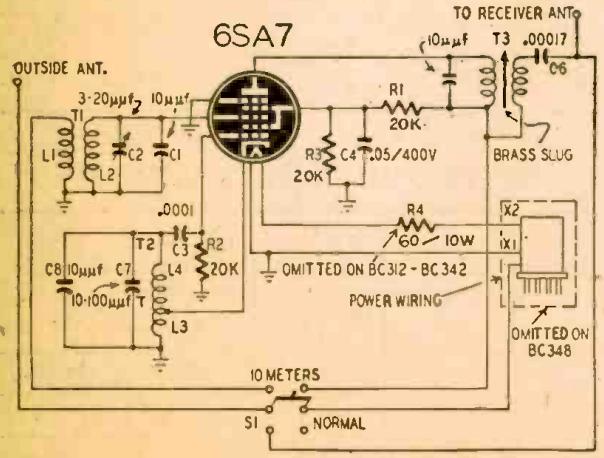
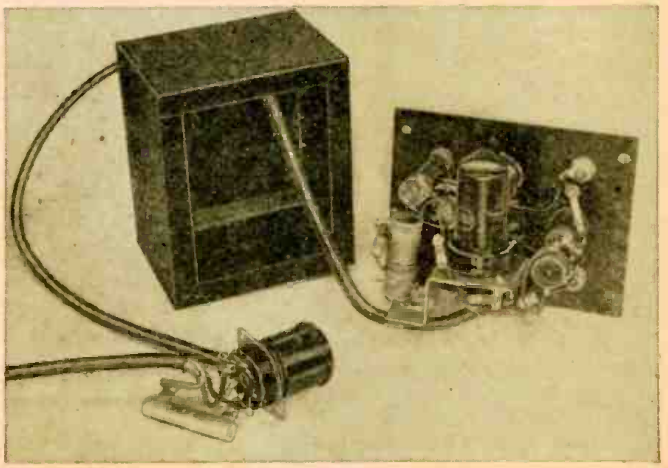


Fig. 1—The 10-meter converter circuit shows some unusual features.



A rear view of the converter. All parts are mounted on the panel.

HOUSEWIVES and TELEVISION

By S. HELLER

"PRACTICALLY anyone can assemble this receiver," states an advertisement in the New York *Times*, offering television kits for sale. "Housewives can build this set. . . ."

The copywriter probably has in mind the following cozy scene:

Three ladies are seated before a workbench in a neat basement. They are assembling television receivers with quiet skill. Mrs. David Sarnou is probably the most efficient worker in the group. She wields a soldering iron with each hand, operating with a power factor of 0.95. Occasionally, a slight fatigue causes her to close her eyes, but she continues working just the same. After a while, Mrs. Sarnou looks up.

"Well, girls," she comments with a happy smile, "I've just finished my 7-tube FM section. In fifty minutes more, I should have the 13-tube video circuit completed."

"Good for you," says Mrs. Lee de Woods, who is deftly mounting an i.f. can on the chassis of her set. Mrs. de Woods glances rapidly and expertly at her schematic, which is lying on a chair 15 feet away.

"Do you know, girls," she remarks, "a casual glance at the diagram inclines me to believe that our video amplifiers are not flat beyond 3 megacycles."

"You're wonderful!" says Mrs. Armsweak, wife of Major Armsweak, admiringly. "I could never detect such a flaw if the diagram was more than 10 feet away."

In this way, chatting lightly about video topics, the ladies continue their work; and before the morning is over, they have finished assembling, testing, and adjusting their television receivers. In the afternoon, they attend to their shopping, and, after supper, the three women start work on color television sets, which they complete before bedtime.

That's the way the copywriter visualizes it.

On the other hand, we would like to present *our* version of what may be expected when Mrs. John Q. Public assembles a television receiver.

The scene is the kitchen of Mrs. Susie Hockfleisch. Near Mrs. Hockfleisch are housewives Catherine Tittleberry and Emily Vanderstupe. They are busily assembling television receivers on the kitchen table.

"Don't you just love these color-coded wires?" says Mrs. Hockfleisch. "I'm going to tie bow-knots in them, to make them look prettier."

"Drat this soldering iron," exclaims Mrs. Vanderstupe. "That's the second time I burned my nose on it." She frowns meditatively. Suddenly a glow lights up her face.

"I've got it, girls, I've got it!" she cries.

The other women look up eagerly. "What is it, Mrs. V.?" asks Mrs. Hockfleisch.

"Why should we solder on these wires, when we can just as easily *glue* them into place?"

"What a brain," says Mrs. Tittle-

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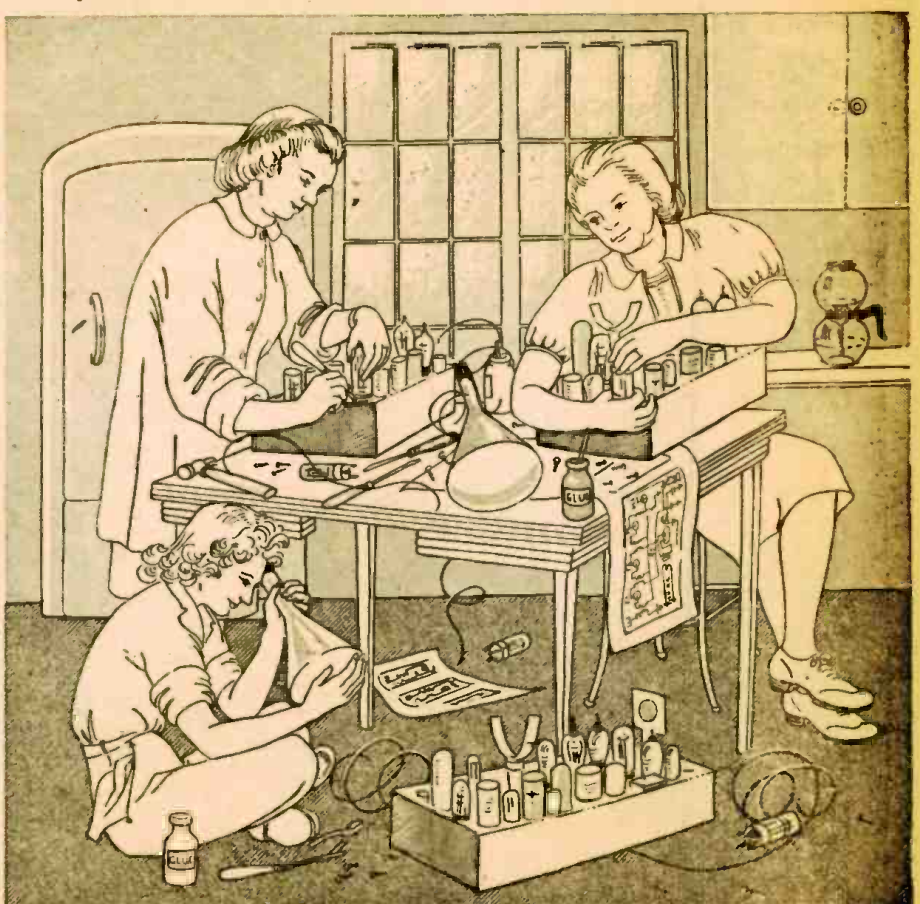


"Vanderstupe's suggestion is immediately carried into action. The irons are discarded . . ."

Radio Set and Service Review

NATIONAL NC-173

New receiver goes down to 5½ meters

THE NC-173 is a new addition to the National line of communications receivers. Its calibrated 6-meter band is a new feature in all-wave receivers and will be welcomed by hams and listeners who have relied on "rush-boxes" and converters for 6-meter reception. An efficient 13-tube superheterodyne circuit is used with continuous coverage from 0.54 to 31.0 megacycles in 4 tuning ranges. A fifth range covers from 48 to 56 mc, encompassing the 6-meter amateur band (50 to 54 mc). The tuning ranges are:

Band	Range (Mc)
A	50 to 54
B	12 to 31
C	4.3 to 12
D	1.6 to 4.3
E	0.54 to 1.6

The designers have followed the current trends of "dressing up" communications sets so that they present a pleasing appearance in almost any surroundings. The chassis is fully enclosed in a metal cabinet finished in a soft gray with white lettering on all controls. The knobs are gray plastic with chrome trim. The S-meter and tuning dials are white translucent plastic illuminated from the rear. The overall dimensions are 19½ inches wide by 13 inches deep by 10 inches high. The 6-inch PM speaker is in a matching cabinet.

The main tuning dial has 5 scales, one for each band between 540 kc and 31 mc and a linear logging scale calibrated from 0 to 200.

The band-spread dial has 6 scales. Five are calibrated directly in megacycles for the 5 amateur bands, and the sixth is a logging scale. Band-spread is adequate on all bands. On the band-spread logging scale, 175 divisions cover the 3.5- to 4-mc band, 123 divisions 7 to 7.3 mc, 144 for 14.0 to 14.4 mc, 128 for 27.16 to 29.7 mc, and 77 divisions for 50 to 54 mc.

The tuning controls have 2-inch knobs on flywheel-weighted shafts for easy tuning. Other front-panel controls are: b.f.o. switch, b.f.o. pitch, tone, a.f. gain, antenna trimmer, send-receive, a.v.c. band and switches, r.f. gain, a.n.l., crystal phasing, and crystal selectivity. Jacks are provided for phono input and headphones.

The circuit

The set has a 6S7 r.f. amplifier, 6SA7 first detector, 6J5 local oscillator, two 6SG7 i.f. amplifiers, 6H6 second detector and a.v.c. rectifier, 6AC7 a.v.c. amplifier, 6SJ7 a.f. amplifier, 6V6-GT audio output, OD3/VR-150 voltage regulator, 6H6 a.n.l., 6SJ7 b.f.o., and a 5Y3-GT rectifier.

The input of the receiver is designed for either a single-wire or doublet antenna. Separate primary windings are used on all bands. The band-switch wafers have shorting sections that short and ground all unused coils. No limit stop is used on the switch so it can be rotated through 360 degrees in either direction. The r.f. stage uses a high-frequency, variable-mu pentode. The antenna coils are resistance-capacitance coupled to it through a 0.001-μf coupling condenser and a 100,000-ohm grid resistor. A small variable air trimmer is connected in parallel with the main r.f. tuning condenser to permit the amplifier to be peaked from the front panel. Inductive-capacitive coupling is used between the r.f. and first detector stages on band B, and straight inductive coupling on all other bands.

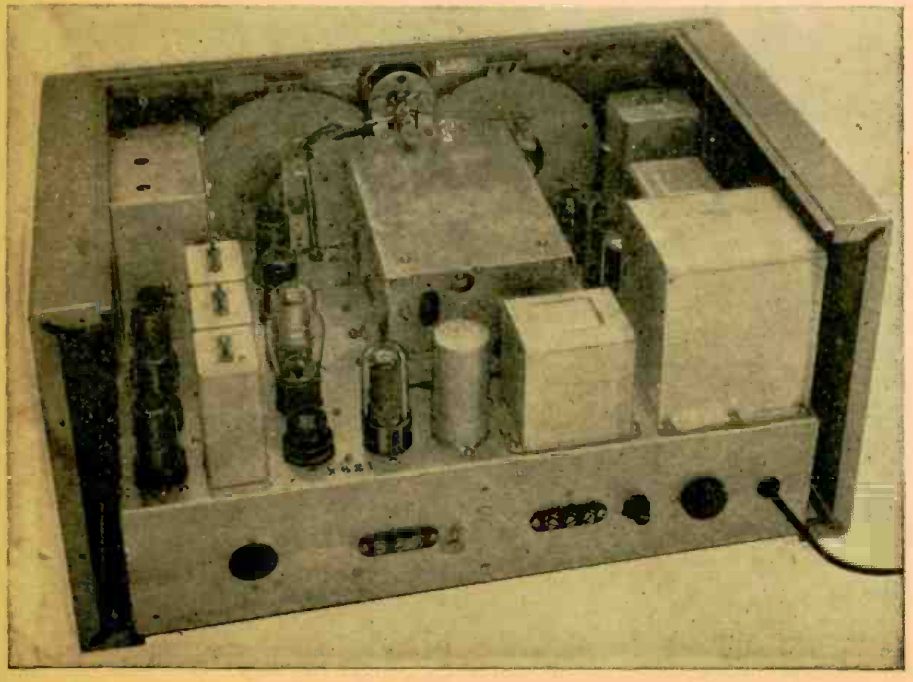
The local oscillator is a modified tuned-plate Hartley circuit with its grid coupled directly to the No. 1 grid of the 6SA7. Electronically stabilized voltage on the plate reduces frequency drift.

The crystal filter between the first detector and i.f. amplifier has 5 degrees of selectivity varying from broad to very sharp. The first 2 positions are suitable for phone reception and the others for c.w. The phasing control balances out heterodynes and aids in reducing interchannel interference. The i.f. amplifiers have high-C circuits in the transformers for increased selectivity. Ample gain is provided by the 6SG7's. A part of the signal is taken from the grid of the second i. f. amplifier, amplified by the 6AC7, and rectified by one diode of the 6H6 second detector-a.v.c. rectifier tube. This voltage is used for a.v.c. of the 6SG7 a.f. and i.f. tubes.

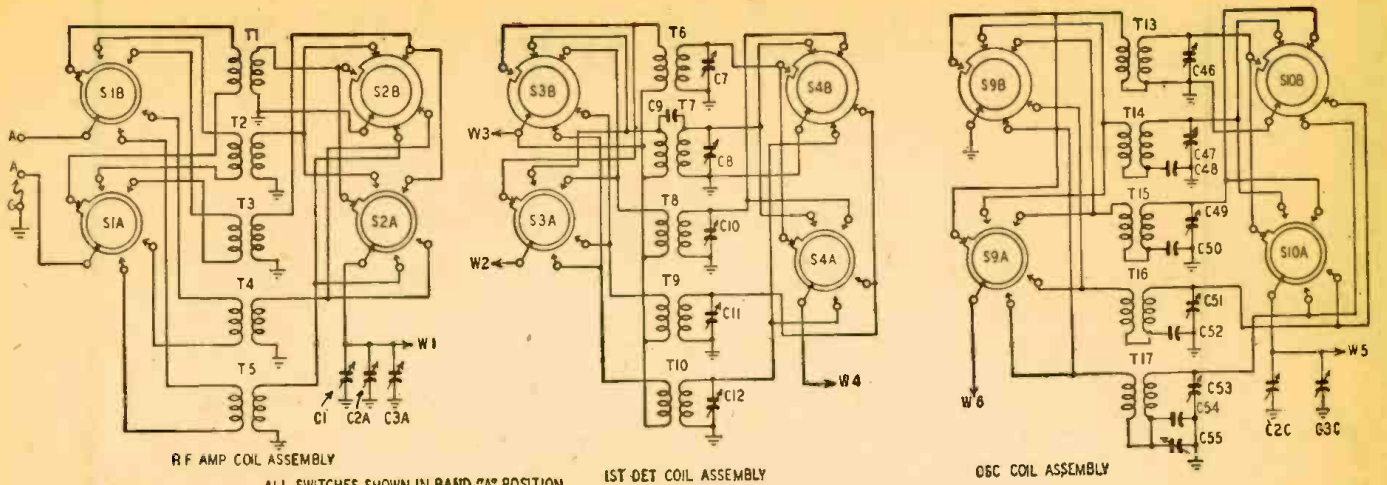
The output of the electron-coupled b.f.o. is capacitance-coupled to the second detector plate. The b.f.o. does not interact with the S-meter or a.v.c. This allows some a.v.c. action when receiving c.w. signals.

A 6H6 series noise limiter between the detector diode load and 6SJ7 first audio effectively reduces noise pulses. A variable control is used to adjust the threshold of limiting action.

The 6SJ7 a.f. amplifier is resistance-



Rear-chassis view. Socket at left is for accessory connections, at right, for battery.



Coil and switch assemblies of NC-173. All terminals are coded to points on schematic below.

coupled to the power amplifier. A resistance-capacitance tone control is connected between the 6SJ7 plate and ground. When a pickup or other a. f. voltage sources is plugged into the phono jack, the a.f. line from the second detector is broken and the external signal coupled to the 6SJ7 grid.

The phone jack is connected across the 8-ohm tap on the output transformer. The speaker is silenced when phones are plugged in. Higher headphone volume may be obtained by switching the phone jack connections across the 500-ohm tap. These taps are connected to a terminal strip at the rear of the set.

The S-meter is in the a.v.c. diode circuit where its sensitivity is controlled by the setting of the r.f. gain control. The first half of its scale is calibrated in S-units with S9 at midscale. The remainder of the scale is calibrated in 5-db steps to 40 db above S9 at full scale.

The set is wired to operate from 110- to 120-volt, 50- to 60-cycle a.c., but may be used on 220- to 240-volt, 50- to 60-cycle lines by making a few minor changes in the connections to the dual primary of the power transformer. The a.c. line is fused with a 2-ampere fuse in an extractor post on the rear of the

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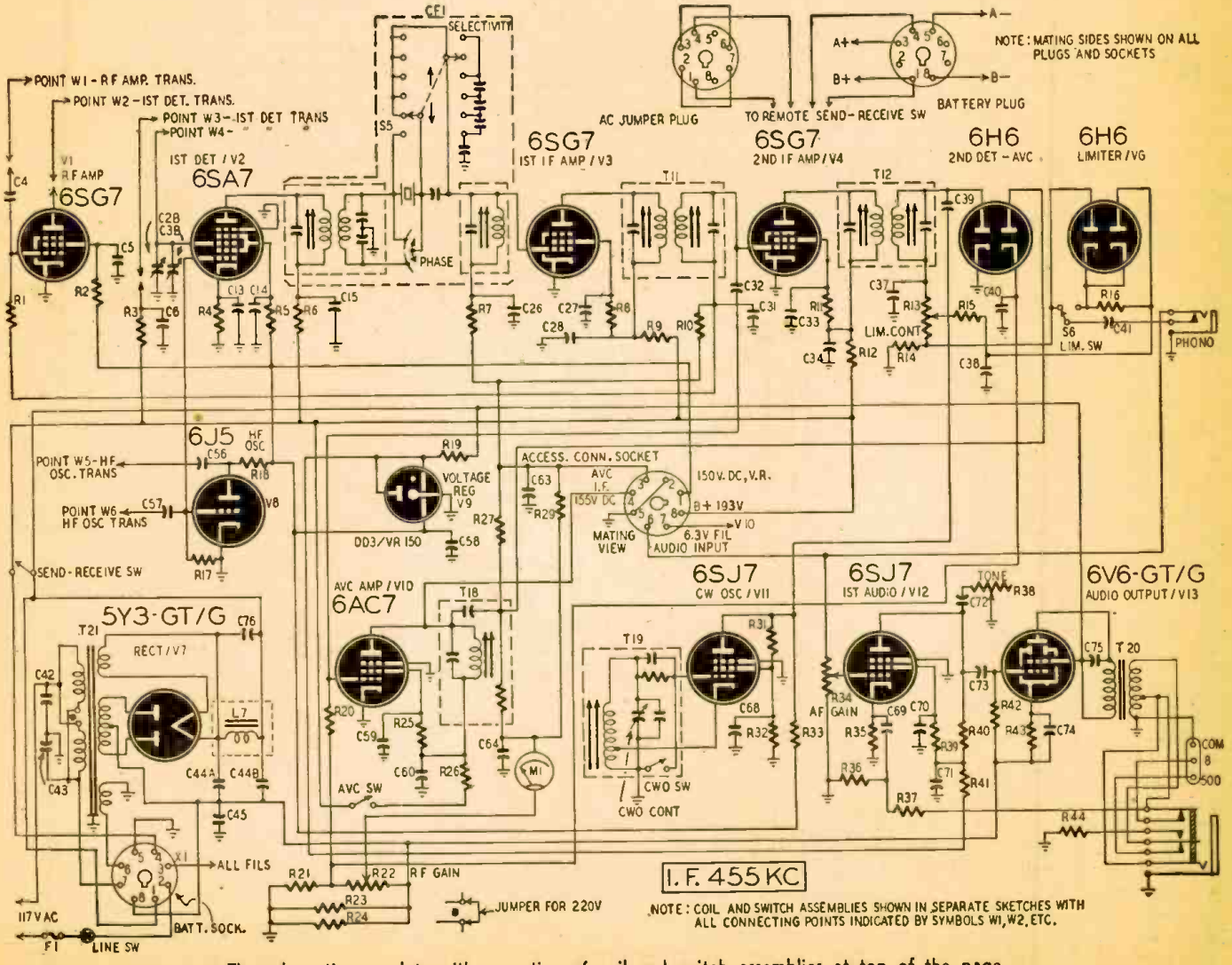


The schematic complete with exception of coil and switch assemblies at top of the page.

Shortwave Rotary Antenna

This 10-meter array has a better radiation angle and front-to-back signal ratio

By CARL V. HAYS, W6RTP

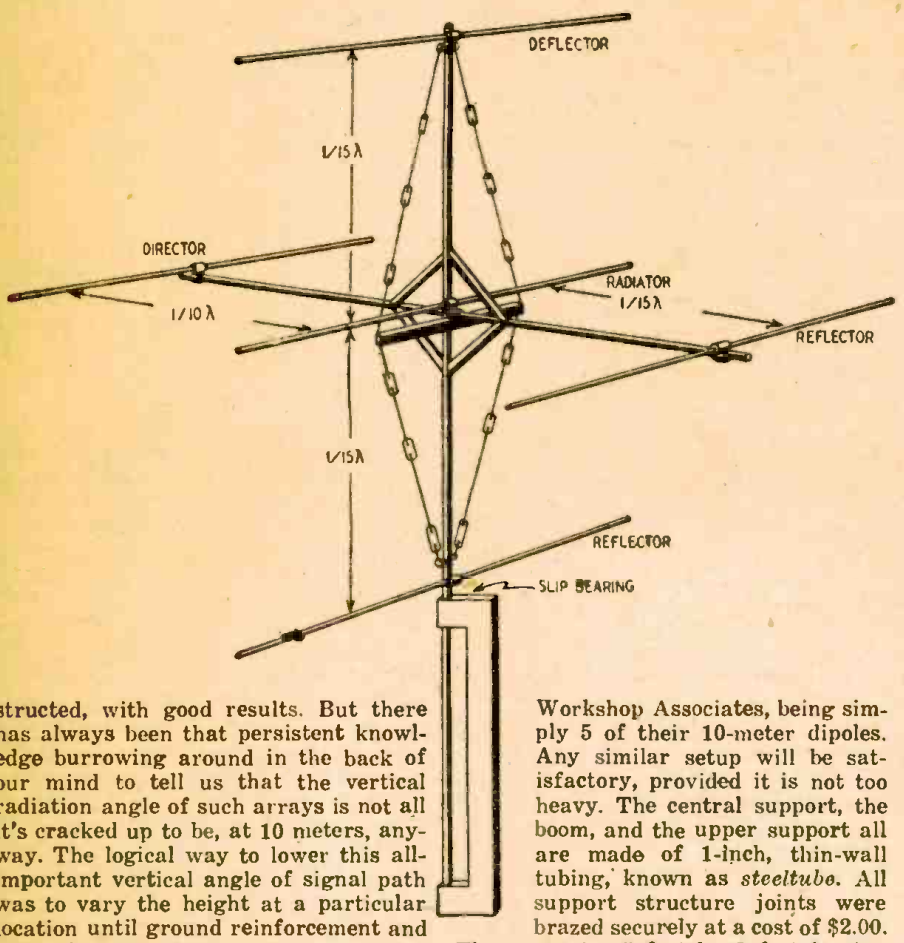
AS with most active amateurs having rather limited pocketbooks, W6RTP has more or less concentrated on low-power rigs, using any available cash in a search for the most effective antenna system.

The common varieties of 3- and 4-element, 10-meter beams have been constructed, with good results. But there has always been that persistent knowledge burrowing around in the back of our mind to tell us that the vertical radiation angle of such arrays is not all it's cracked up to be, at 10 meters, anyway. The logical way to lower this all-important vertical angle of signal path was to vary the height at a particular location until ground reinforcement and other factors all give results as close to the ideal as possible for the frequency, but mechanical considerations limited height to some 25 feet or so.

Daunted but not stumped, we dragged out the *Handbook*, several antenna manuals, and the ever-trustworthy Terman and Henney. After considerable head-scratching over charts and formulas, an array was evolved that appeared to be mechanically practical and in addition, on paper at least, a decided step in the right direction in the elusive search for more and better dx. In the short time this beam has been in use at W6RTP, it has more than justified our hopes, so hence this article.

The entire array weighs approximately 20 pounds, is very strong, can be rotated very easily and cheaply, and outperforms any other system so far tried.

The array pictured uses ready-made elements of aluminum, made by the Workshop Associates, being simply 5 of their 10-meter dipoles. Any similar setup will be satisfactory, provided it is not too heavy. The central support, the boom, and the upper support all are made of 1-inch, thin-wall tubing, known as *steeltube*. All support structure joints were brazed securely at a cost of $2.00. The array is 15 feet by 8 feet in size, light but surprisingly strong and rigid after the addition of shipmast type trussing, as shown in the illustration. Light turnbuckles in each mast-supporting wire serve to true and cinch the supporting framework securely.



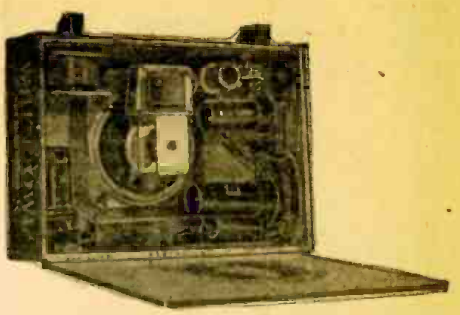
The array itself is a conventional close-spaced 3-element affair, with an additional reflector directly above and below the antenna proper, spaced 5 feet from the radiator itself. These 2 elements produce a highly improved vertical pattern; their addition to a simple in-line array raised the dx signal reports by several db, indicating a very definite lowering of the vertical directivity angle toward something approaching the theoretical ideal for 10-meter work. Reception, much to our surprise, was greatly improved, the European and South African stations in particular being much stronger than ever before. China, the Philippines, and others came in several S points better than on any other beam ever tried.

The front-to-back ratio evidently is the same, except on what apparently are high vertical-angle signals, as for a conventional 3-element antenna. These signals seem to be attenuated terrifically when the array is rotated on reception, even the strongest ones dropping to almost inaudible levels when the back of the beam is on them. Some 10- and 40-mile checks on ground wave gave rather startling reports of front-to-back ratio on transmitting. W6DAX gave us a front-to-back report of S9 plus 15 db, and S3½, respectively, a ratio of nearly 4 to 1 or about 48 db! At the same time the side radiation report was S2, certainly not too bad a discrimination pattern for so compact a system, and far and away better than we have been able to achieve with any other beam. An open line that gave indication of some radiating on its own account was used. Possibly even better results could be obtained with a nonradiating feed system, such as co-axial line.

Dx possibilities of systems based on such a design can be judged from the fact that on one occasion, at about noon PST, which is not a good time for Pacific dx, J9KC on Kwajalein was heard calling CQ, at about S6; a quick look over the band showed no one calling him in return, so we fired up the 60-watt rig and gave a shout. Dave came right back with a Q5, S7-8 report, raising it to S9 some minutes later, his signals averaging S6 all this time, running some 600 watts to a BC-610 rig, and using a good antenna system. The comparative reports and powers involved give a fair idea of what low-angle directivity can do. Incidentally, I heard no other W6 contacts made with J9KC until much later in the day, something else to point up the antenna's possibilities, since Dave called CQ W6 several times after our contact, and Kwajalein isn't too common dx to warrant passing up, even by the dx kings. All of our State-side contacts so far have run S9 or better, even hard-to-hook New Hampshire giv-

(Continued on page 69)

"Scotch Receiver" Includes a Lamp



Parts layout can be seen in this photograph. The lamp socket is placed below the speaker.

By HOMER L. DAVIDSON

THE "Scotch" receiver is a small a.c.-d.c. broadcast set and also a desk lamp. It is ideal for a young boy's den or as a project for a radio beginner who is interested in constructing small receivers.

A 12SK7 pentode is used as the regenerative detector but a 12SJ7 or any 12-volt triode would do. In the audio section a 12A6 beam-power output tube drives a 4-inch PM speaker. The rectifier is another 12SK7 pentode, although any triode or diode will work nicely if it draws the same filament current (150 milliamperes).

Practically any tube line-up will do if certain things are considered. Be sure the vacuum tubes draw the same heater current. Then add the heater voltages

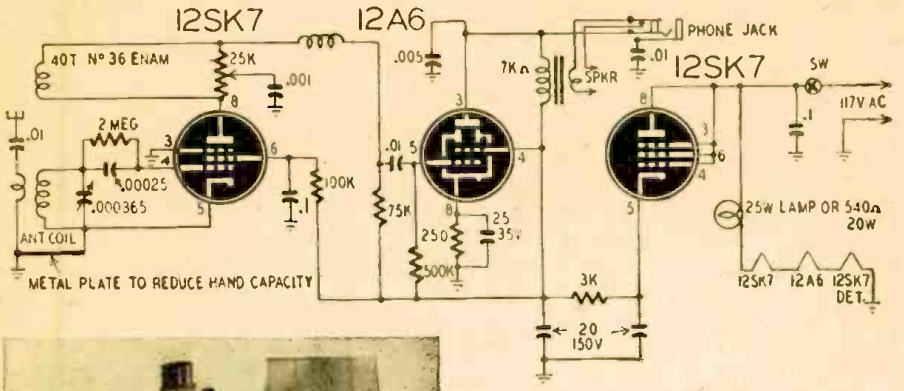


Fig. 1—Note that the 12A6 grid resistor must be grounded, not connected to B-plus.

together and subtract this total voltage from the a.c. power-line voltage, which in most cases is 110 to 117 a.c. By using Ohm's law formula (R = E/I) the dropping-voltage resistance can be determined.

If you want to use the ordinary lamp bulb as the dropping resistance, as in this receiver, here are a few interesting values. A 25-watt bulb has an internal resistance of 480 ohms, a 30-watt-bulb resistance is 400 ohms, a 40-watt-bulb resistance is 300 ohms, a 50-watt-bulb resistance is 240 ohms, and a 60-watt-bulb resistance is 200 ohms. All of the above resistance readings are approximate and are taken when using 110 volts as a standard a.c. line voltage.

Regenerative feedback

The receiver covers the entire broadcast band and has sufficient volume for a small room when tuned to a local station. A 365-μμf variable condenser of the midget variety is used with a regular antenna coil from a broadcast receiver. For the regenerative feedback coil wind approximately 40 turns of No. 36 enamel wire over the grid winding at the ground end. First place a layer of paper over this grid winding and then wind on the ticker. If there is too much regeneration, remove a few turns at a time until the control works smoothly. A 25,000-ohm potentiometer is used for the regeneration control.

To prevent r.f. from getting into the power supply, an r.f. choke is put in the plate circuit. This r.f. choke consists of 30 turns of No. 36 enameled wire scramble-wound on a ¼-inch wood dowell.

It is best to use a 75-foot antenna with the "Scotch" receiver. On local stations a 20-foot indoor antenna works out rather nicely, and no external ground is required. For distant stations the headphones are plugged in. During the daytime only stations within 100 miles are available, but at dusk broadcast stations from all over the States break through.

The output circuit

The power tube is a beam-power pentode 12A6. It is sufficient to drive a 4-inch PM speaker on local stations. If more volume is desired, another audio stage could be added. When quiet listening is required, a pair of earphones is plugged into a closed-circuit jack. Many broadcast stations will then be heard that are not audible over the small speaker. The jack is mounted in the rear of the receiver, and is in the plate circuit of the 12A6 as shown in Fig. 1.

The rectifier

Another 12SK7 pentode is used as a diode rectifier to change the a.c. from the power line to usable d.c. voltage. All grids of the 12SK7 vacuum tube are wired directly to the plate. The d.c. is filtered with a dual electrolytic condenser and a 3,000-ohm, 1-watt resistor. The original set was built in a period of scarcity; today it would be better to use a regular rectifier, like the 35Z4 or the 35Z5.

All the parts are mounted in a cigar box. A small 2 x 4½-inch metal strip is placed ahead of the variable tuning condenser and regeneration control, eliminating hand capacitance. The major parts are mounted first, then smaller components are mounted and soldered in place. One of the photographs shows the interior mountings and wiring. The other illustrates the stripped-down portion of the lamp, with lamp shade, brass shell, and bulb removed.

The cabinet can be finished with enamel paint or wallpaper finish. The addition of a pair of dial plates would make it a very ornamental set for the shack, den or bedroom.

RADAR FOR RECEIVERS?

A new radio audience measuring device needs only pass the listener's front door to learn whether his radio is turned on, an Oklahoma inventor claims.

The inventor, Hal Phillips of Oklahoma City, is an employee of the local station, KTOK. He says that his instrument need only be installed in a suitable mobile unit and driven down the road. Passing a house, it will tell not only whether the radio is on or not, but to what station it is tuned to at the moment.

The Radio Use Computer, as the inventor calls it, will then record the time and location automatically.

Photo 1—Fitting the new pin-jack terminals.

Photo 2—Terminals all in place and labelled.

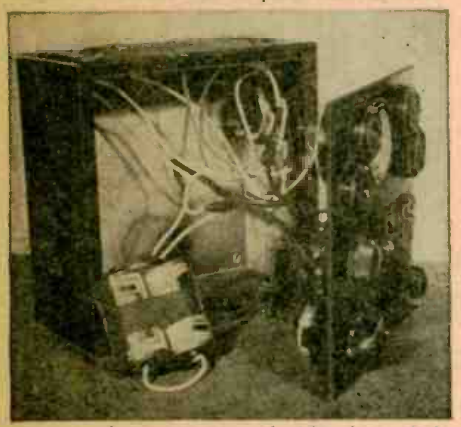


Photo 3—Some new internal wiring is needed.

Photo 4—Jumpers restore original circuit.

Old Tube Tester Is Still Useful

By HARRY F. LEEPER

AN outdated tube tester need not be discarded by the serviceman because it will not test all the modern tubes.

A little time spent in rewiring will make it possible to use the meter as a milliammeter, a continuity meter, and an ohmmeter of limited range, plus the original use of testing certain types of tubes.

The accompanying illustrations and diagrams show such rewiring of a typical tube tester.

It will be noted in Fig. 1 that the leads of the milliammeter were broken or opened and the wires from the meter were brought out direct to the terminals marked 1 and 2 on Fig. 2. The original wires to the tube testing equipment were connected to terminals 3 and 4.

Photo 1 shows the tester case and pin jack terminals for these wires as well as two additional pin jacks marked 5 and 6 for use with the ohmmeter.

Photo 2 shows these terminal jacks in place, labeled with stamped metal tape.

The internal connections made to these terminals and the batteries and resistors for the ohmmeter circuit are shown in Photo 3.

To test tubes it is necessary only to connect two jumper leads from terminals 1 and 2 to terminals 3 and 4. See photo 4. To use the milliammeter only, test leads are plugged into terminals 1 and 2.

In arranging the ohmmeter circuit it was necessary to calculate the resistances required. The meter used on this particular tester registers 5 milliamperes full scale, and two 1.5-volt flashlight batteries were connected in series to give 3 volts.

Using Ohm's Law, ($R = E/I$) 3v/0.005 amp = 600 ohms.

Since less resistance would be needed when the battery voltage drops off, a 400-ohm fixed resistor was used in series with a variable resistor (an old volume control) which could be varied from zero to 250 ohms.

The circuit inside the case was arranged as shown in Fig. 2.

To adjust the zero setting, leads were connected as in Photo 5. Terminal 1 is connected to terminal 5 and test prods to 2 and 6. Prods are shorted and the control varied until the meter reads full scale or 5 milliamperes.

A cardboard scale was made and pasted on top of the case as may be seen in this photo and Photo 6.

From the above we found it required 600 ohms resistance to allow 5 milliamperes to flow in the circuit. Suppose the meter with an unknown resistance under test reads 4 milliamperes. (The meter illustrated is graduated in milliamperes from 1 to 5. On other meters it may be necessary to calibrate and mark the dial face.)

(Continued on page 56)

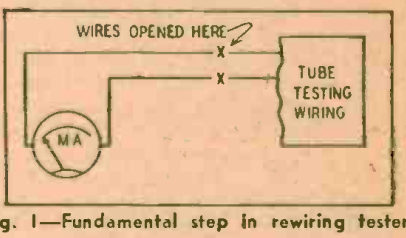


Fig. 1—Fundamental step in rewiring tester.

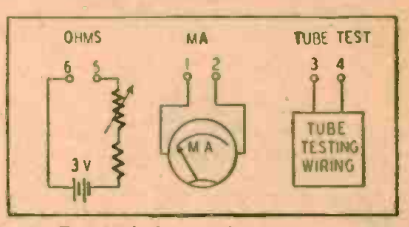


Fig. 2—Terminals for an ohmmeter are added.

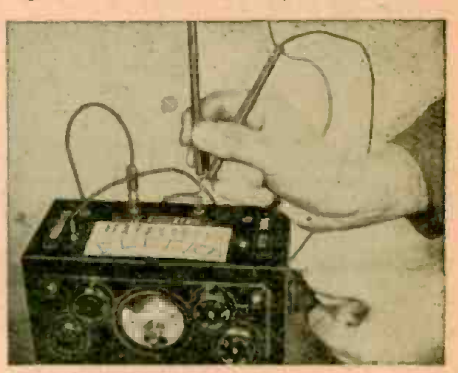


Photo 5—How the ohmmeter circuit is zeroed.

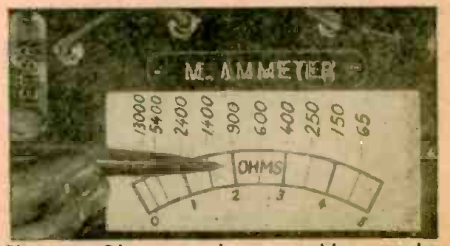
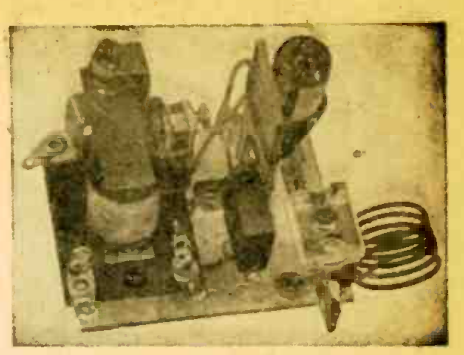


Photo 6—Ohmmeter chart resembles a scale.

Thyratron Receiver For Remote Control

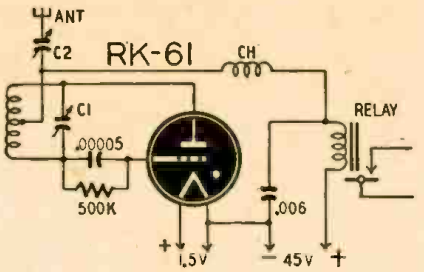
By EDWIN BOHR



THE possibilities of radio control have been long neglected by radio experimenters. Although radio-control systems have reached a fair degree of perfection and reliability, an unlimited field is still open for further research and development. Radio-control receivers are made as small, lightweight, and simple as possible. A high-frequency superregenerative receiver has the obvious advantage of sensitivity while filling the above requirements. For these reasons a superregenerative detector employing a trigger-action gas triode is nearly always used in simple radio-control receivers.

The radio constructed by the author was mounted on 3/16-inch lucite. The RK-61 tube, coil, and other components, were wired to a terminal strip riveted to the lucite. Not shown in the picture, a choke is connected to the center tap of the tuning coil. This choke adds little to the set's sensitivity, but allows the tuning trimmer to be adjusted for a lower frequency before the radio ceases superregenerating. The detector is loaded to the correct operating current by adjusting the antenna coupling condenser. This condenser should be connected to the plate side of the coil for proper operation. The relay was built from parts furnished in kit form, although a completely assembled unit could have been purchased.

Of utmost importance is the correct adjustment of both the relay and receiver so that the relay contacts close and open with the turning on and off



of an unmodulated carrier. This is best accomplished by first connecting a milliammeter in the plate circuit and tuning the receiver to the transmitter frequency. With the transmitter off the antenna loading condenser should be manipulated until the receiver plate current is about 1.8 ma or 2 ma; but when the transmitter is on, the meter should dip to between 0.8 ma and 1.1 ma. The antenna trimmer is adjusted with the aid of an ultra-high-frequency alignment tool. The relay's hairspring is then tightened until the armature lets go at 1.1 ma and pulls down at 2 ma. Though these procedures are relatively simple, they nevertheless require common sense and patience.

Almost any electrical equipment can be controlled at a distance with this apparatus. For example, the small relay could actuate a larger relay which in turn, could open garage doors and turn on lights. The remote receiver is also suitable for use in model airplanes. With the addition of a stepping relay many other uses suggest themselves. Experimenters should find many uses for this simple circuit and perhaps develop better techniques.

Parts List

50-μμf silver mica condenser
0.006-μf mica condenser
C-1—30-μμf ceramic trimmer
C-2—30-μμf ceramic trimmer
500K resistor
L-1—4-6 turns, ¾-inch diameter, spaced ¾-inch long, of No. 16 wire
Choke—35 turns, closely wound on ¼-inch lucite rod, of No. 32 wire
Relay—R.C.H. type 11-A
(Coil winding given for 50 mc.)

A CATHODE FOLLOWER

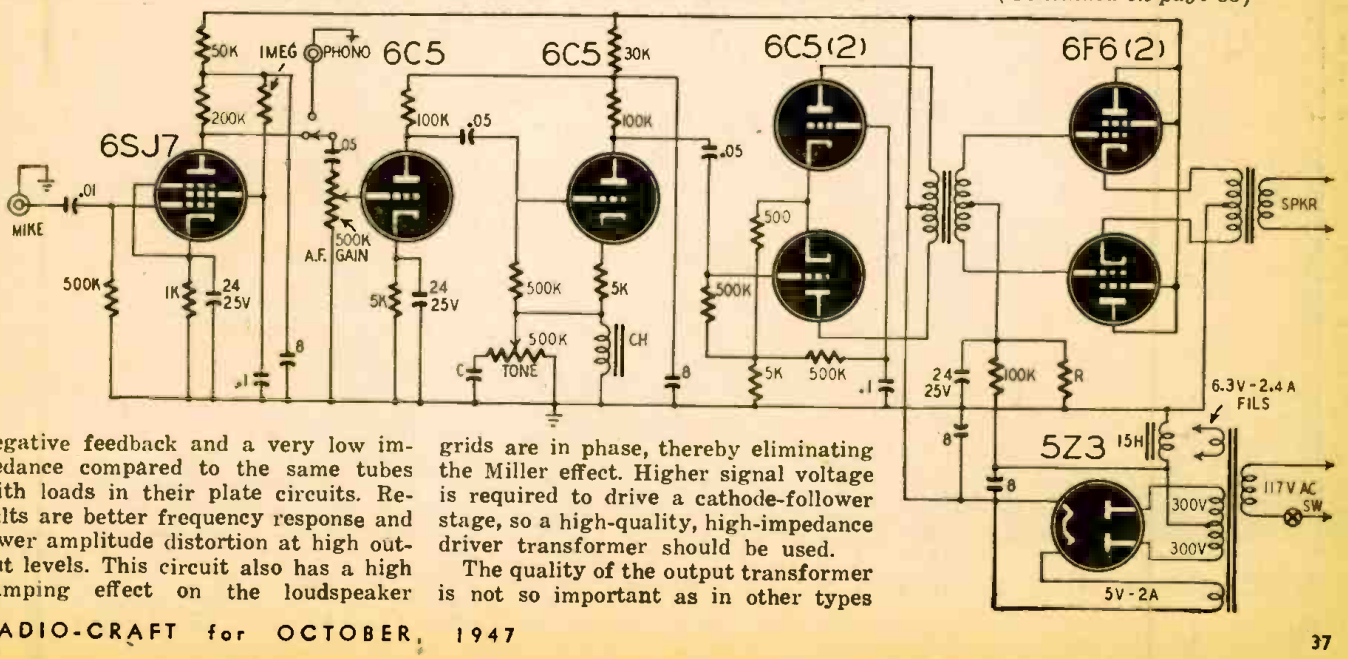
By ROBERT M. CROOKER

IN the design of an output stage, the cathode follower has some interesting characteristics. The entire load is between ground and cathode, giving 100% negative feedback and a very low impedance compared to the same tubes with loads in their plate circuits. Results are better frequency response and lower amplitude distortion at high output levels. This circuit also has a high damping effect on the loudspeaker which tends to overcome resonance effects, which may be very troublesome at certain frequencies.

The input to this stage has very high impedance, as there is no signal voltage on the plates and the cathodes and the grids are in phase, thereby eliminating the Miller effect. Higher signal voltage is required to drive a cathode-follower stage, so a high-quality, high-impedance driver transformer should be used.

The quality of the output transformer is not so important as in other types of output circuits. Mine is a Hammond 463, a 3,000-ohm center-tapped primary with secondary taps at 1, 2, 4, 6, and 10 ohms. The current-carrying capacity of the primary is 70 ma. The driver is

(Continued on page 83)

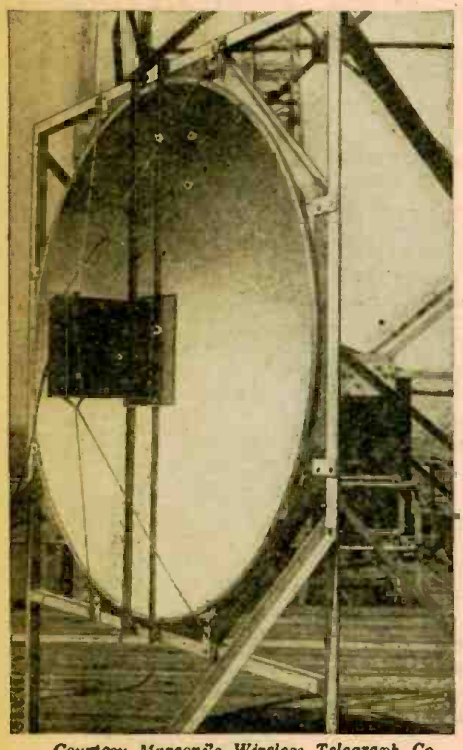


Transatlantic News

By Major Ralph W. Hallows

RADIO-CRAFT EUROPEAN CORRESPONDENT

IT is intended that within about 5 years the majority of the inhabitants of Great Britain shall have television broadcasting services available in their homes. This will be accomplished in the first instance by providing chains of transmitters linked by relays to the London station. The problem of installing a nation-wide television service presents fewer difficulties here than in the United States. First, this country is far smaller, stretching only some 600 miles from north to south, and having nowhere a greater east to west extent than about 300 miles. Second, the overwhelming majority of our people live within easy v.h.f. range—say 35 miles—of a comparatively small number of big towns. About one-third the population have their homes within 35 miles of London and thus are already within range of existing installations. Install similar transmitters in or near a further score of the big towns and not less than 90% of our population can be served.



Courtesy Marconi's Wireless Telegraph Co.

The BBC experimental sound-vision antenna.

Work is now going forward on the first two of the provincial transmitting plants, one of which will be erected in the Birmingham area and the other probably near Manchester.

These transmitters are considerably more powerful than the one now in use at the Alexandra Palace near London. Their output will probably be between 30 and 40 kilowatts, and they are expected to have reliable service areas with an average radius of 45 miles. One special feature of them is the larger band width for which they are designed. London now radiates modulation frequencies up to 2.7 mc; the new transmitters, capable of dealing with frequencies of 3.5 mc or more, are likely to provide the clearest images yet attained in television. One can foresee some headaches for the designers of television receivers in the future; to produce in a moderately priced receiver r.f. and i.f. circuits with a response curve 5.4 mc wide is already no mean task and to do justice to the new transmissions this will have to be increased to 7-8 mc.

An interesting test was made recently of receiving and retransmitting apparatus designed to act as the radio link for relaying television transmissions. The distance covered was actually 73 miles. The transmission originated at Ascot race course, 21 miles southwest of London, whence it was sent to the Alexandra Palace by BBC's O.B. (outside broadcast) trucks. From the Alexandra Palace it was broadcast in the ordinary way, being picked up at Chelmsford, 28 miles to the northeast, and then being relayed by a Marconi link transmitter to Colchester, a further 24 miles to the northeast. The images as finally received were extraordinarily good and appeared to have suffered scarcely at all, despite the number of radio circuits by which they had been handled on their journey. The most stringent of all tests is to be made shortly. Transmissions that have reached Colchester will be relayed back again to Chelmsford, where they will be displayed on a television screen placed beside one on which the same picture received direct from London will be seen.

The Marconi relay link transmitters contain many novel and interesting features. For vision a carrier power of 5 watts and a carrier frequency of 510 mc are used. Frequency modulation is employed because through the use of limiters a constant output level is obtainable at the receiver end. The vision transmitter antenna is of the horn type, mounted on a 40-foot mast. The sound channel is also frequency-modulated, and the carrier power is only 100 milliwatts. The sound transmitting antenna is a modified Yagi, with a reflector which is a section of a cylinder, and 8 directors. At the receiving end, a paraboloid serves as antenna for both sound and vision channels. A small rectangular case placed at its focal point contains a stub which enables the impedance of the paraboloid to be matched with that of a co-axial transmission line leading to the receiver.

New television antenna

Speaking of v.h.f. receiving antennas brings to mind a useful type recently brought out by one of our manufacturers who specializes in the field. Two of its most valuable features are that reception is independent of the angle of polarization of the incoming signal wave and that it is directional, having sharp minima at right angles to its plane. This antenna takes the form of a half-wave dipole with its arms bent downward at an angle of 45 degrees from the horizontal, so that it is shaped like a wide inverted V. It was designed originally as an indoor antenna for television reception, being so shaped that it could be fitted up in an attic close under the roof. Used in that way it gives excellent results in localities where signal strength is good. It is not in some ways so efficient a collector as the normal half-wave dipole. Our television transmissions are vertically polarized and if the signal arrives with vertical polarization, the inverted V an-

(Continued on page 76)

Fox Photos

Horn antennas transmit the vision signals.

Courtesy of Science Illustrated

Captain Bjorn Arnold Rorholt, Los Angeles, Calif.
c/o Norwegian Embossy
Washington, D. C.

Dear OM,

I have the answers to the questions regarding the radio equipment on the Kon-Tiki; I will first put the question as sent to them and then their reply.

1 – Q, Have you tried generator GN58 for receiver?
A, No.
2 – Q, How many batteries did you take?
A, All. 41 six volts and 30 forty-five volts.
3 – Q, Is there any difference in output between generator and battery operation?
A, Not tried yet.
4 – Q, Are you using 6995 KC crystal from the ten meter rig?
A, Yes, but ten meter rig in use too.
5 – Q, Have you removed last audio valve in 173 Receiver?
A, Tried, but receiver then too weak.
6 – Q, What kind of antenna do you normally use?
A, L antenna
7 – Q, Have you tried balloon or kite supported antennas?
A, Both tried.
8 – Q, Have you tried voice modulation since shortly after leaving Peru?
A, Yes, results not good.
9 – Q, Do you use mark two transmitter?
A, Yes, and then very good.
10 – Q, How does the NC-173 stand up under conditions on board?
A, Excellent.
11 – Q, How many hours can you operate the transmitter on one set of batteries?
A, High tension batteries very long life but long articles kill our heater batteries.

In case you did not hear me yesterday their heater batteries are used but Raaby tells me that they make 1½ volt units from their 45 volt batteries and then use four of these for six volts and thus get about four days service from each set. They have about five sets left so are O.K. for sometime yet.

"Pen" sends his vy 73 to you as do I and I hope to work you again soon. I am anxious to meet the boys but I am also going to miss these daily contacts with the raft.

I hope Knut, and Torstein keep up their radio and get on the air when they get back to Norway for I would enjoy very much keeping up our friendship via amateur radio.

Again VY73 to you Pronto and hope to cul.

Very Sincerely,

HAL—W6EVM

NC-173

Frequency coverage from 540 KC to 31 mc plus the 48-56 mc range. Calibrated amateur bond spread on 6, 10-11, 20, 40 and 80 meter bands.

Amateur Net....NC-173 (with speaker) $189.50

National NC EST 1914

The press of the entire country has carried stories concerning the day-to-day activities of the 6 young Norwegian scientists, members of the Kon-Tiki Expedition, who set out on a raft to drift more than 5000 miles across the Pacific Ocean.

Very little mention has been made, however, of the battery-powered transmitter and model NC-173 receiver which allowed the Expedition to dispatch over 500 messages and 30,000 words.

These figures furnish one more proof that a National receiver in the hands of a good operator makes an unbeatable combination.

National Company, Inc.
Dept. No. 75
Malden, Mass.
U.S.A.

MAKERS OF LIFETIME RADIO EQUIPMENT

WORLD-WIDE STATION LIST

Edited by ELMER R. FULLER

SEVERAL times a month readers ask us how to send reception reports to shortwave broadcast stations, and more particularly, how to get verifications back from them!

Here is the dope as we have it. Most stations will answer SWL reports with a verification card or letter; a few will not, particularly the Mexican and Russian stations. I have heard that the Mexicans reply once in a while but they are not to be relied upon. The BBC is very good about verifications. Reports should include the time and program heard, information as to readability and volume, frequency and anything else that will make the report worth while to them. They use these reports in determining the time and frequencies to use in their transmissions. Reports on the BBC should be sent to the British Broadcasting Corporation, 630 Fifth Avenue, New York City 20. Reports on the Australian stations may be sent to the Australian News & Information Bureau, at the same address.

Other station reports may be sent directly to the station, *and should include an international reply coupon for return postage.* These coupons may be purchased from your postmaster for 9 cents each. Please remember one thing, that they should be inclosed with your report and *not pasted or cemented to it.* I hope that this information may help you to better results from your station reports.

Charlie Sutton in Toledo, Ohio, sends us a card to say that reception called dx out his way just isn't during the past summer months, but he expects better results this fall as he will have a new receiver, Hammarlund HQ129X; and he has an RME DB20 preselector to use with it, so we should have some fine reports from Toledo before long now. Stathis Linardos of New York City reports that COBZ on 9.03 mc is on the air from 0800 to 2400 daily, and Ankara, Turkey, (TAP), is on 9.15 mc from 1300 to 1400. XGOY in Chungking, China, transmits from 0945 to 1145 on 9.64 mc. VLG in Melbourne is heard on 9.58 mc from 1300 to 1500. Opal Watkins of Ellijay, Ga., reports several hams, among them OX3GG working a W9 and calling CQ; ZL1CD working with W6ELW; KG6SA working W6RED; F3WT calling W1ENU; VO6R working W2SLV, and F8NP working HH5PA, all on 20-meter phone.

Richard Adams, VE6DA of Duchess, Alberta, reports the Swiss being heard from 2030 to 2230 on 9.535 mc, 1730 to 2230 on 11.865, and from 2030 to 2230 on 15.315 mc. Adams uses a six-tube Victor receiver. He also reports hearing Pitcairn Island which comes in at present with fair volume even on the east coast. The call is VR6RR, and if a proper and useful report is made, I think you will be rewarded with a verification from this catch. This is the greatest dx obtainable here on the east coast.

For those of you who are new in this game, HCJB in Quito, Ecuador, is always a safe bet for receiving, and may be heard any evening. They will verify when a good report is sent to them, and it will be worth your time to listen for them. They are heard on 9.96 mc from 0545 to 0845 and 1200 to 2230; 12.45 mc from 0600 to 1000 and 1400 to 2330, and on 15.11 mc from 0500 to 1200, and 1330 to 2230. Reports are greatly appreciated.

VLA7 directed to the American east coast is now being heard from Australia on 17.8 mc from 2000 to 2115.

And so until next month best of luck, and plenty of fine business dx. Correspondence may be sent to me in care of RADIO-CRAFT, 25 West Broadway, New York City 7.

All Times are Eastern Standard.

Freq.	Station	Location and Schedule
11.70	CKRX	WINNIPEG, CANADA; 1000 to 2000
11.720	OTC	LEOPOLDVILLE, BELGIAN CONGO; 0530 to 0730
11.730	WRUL	BOSTON, MASSACHUSETTS; Caribbean beam, 1715 to 1745; 1830 to 0100
11.730	KGEX	SAN FRANCISCO, CALIFORNIA; Philippine beam, 0400 to 1100
11.740	COCY	HAVANA, CUBA; 0630 to 0100
11.740	CE1174	SANTIAGO, CHILE; 1700 to 2400
11.740	HVJ	VATICAN CITY; 0015 to 0025; 0830 to 0900; 1100 to 1145
11.750	GSD	LONDON, ENGLAND; 1215 to 1600; 1615 to 1200
11.770	KCBR	DELANO, CALIFORNIA; South American beam, 1600 to 2200
11.770	VLA4	MELBOURNE, AUSTRALIA; 1100 to 1200; 1530 to 1830; 2345 to 0045
11.780	HP5G	PANAMA CITY, PANAMA; 0745 to 1000; 1200 to 2230
11.780		MOSCOW, U.S.S.R.; 0900 to 1000; 2000 to 2130; 2200 to 0100
11.790	WLWO	CINCINNATI, OHIO; South American beam, 1700 to 2100; 2115 to 2215
11.790	KNBX	DIXON, CALIFORNIA; Chinese beam, 0400 to 1100
11.180	KCBF	DELANO, CALIFORNIA; Alaskan beam, 2400 to 0315
11.810	WOOW	NEW YORK CITY; European beam, 0500 to 0715
11.810	WGEA	SCHENECTADY, NEW YORK; Brazilian beam, 1700 to 2100
11.820	GSN	LONDON, ENGLAND; 2300 to 0030; 0100 to 0500; 1030 to 1430; 1700 to 2030
11.830	WCBN	NEW YORK CITY; Caribbean beam, 1715 to 1745; Mexican beam, 1800 to 0100
11.830		MOSCOW, U.S.S.R.; 2200 to 0600; 0730 to 0845; 1100 to 1600
11.830	CXA19	MONTEVIDEO, URUGUAY; 0600 to 2200
11.830		CONSTANTINE, ALGERIA; 0030 to 0300; 1200 to 1800
11.840	VLC7	SHEPPARTON, AUSTRALIA; 0800 to 0915
11.840		PARIS, FRANCE; 0000 to 0045; 0100 to 0145; 0454 to 0615; 1045 to 1130; 1315 to 1730; 1830 to 2345
11.870	WBOS	BOSTON, MASSACHUSETTS; European beam, 0500 to 0715
11.880		MOSCOW, U.S.S.R.; 2200 to 0600; 0720 to 1900
11.880	LRR	ROSARIO, ARGENTINA; 0600 to 1800
11.880		MOSCOW, U.S.S.R.; 2200 to 0230
11.890	KWIX	SAN FRANCISCO, CALIFORNIA; Japanese-Chinese beam, 0400 to 0900
11.900	KWID	SAN FRANCISCO, CALIFORNIA; South Pacific beam, 0200 to 0630
11.900	XGDY	CHUNGKING, CHINA; 0500 to 0630; 1045 to 1145
11.900	CXA10	MONTEVIDEO, URUGUAY; 1830 to 2115
11.930	GVX	LONDON, ENGLAND; 0515 to 0530; 0600 to 0630; 0700 to 0730; 0745 to 0900
11.960	HEK4	BERNE, SWITZERLAND; 1645 to 1715 except Saturdays
11.970	FZI	BRAZZAVILLE, FRENCH EQUATORIAL AFRICA; 0000 to 0230; 0445 to 0800; 0930 to 1030; 1100 to 2020
11.990	CSX	LISBON, PORTUGAL, 0800 to 1000
12.000	CE1180	SANTIAGO, CHILE; 0600 to 0800; 1600 to 2300
12.080		MOSCOW, U.S.S.R.; 0800 to 1100

Suggested by:
W. J. Corbett,
Winchester, N. H.

"So this is the table model radio you ordered! And it's only large enough for Junior to eat from."

Freq.	Station	Location and Schedule
12.090	GRF	LONDON, ENGLAND; 2300 to 1615; 1700 to 2030
12.210		VIENNA, AUSTRIA; 1145 to 2030
12.250	WXFD	ADAK, ALASKA; 1800 to 0100
12.260	TFJ	REIKJAVIK, ICELAND; Sundays, 0900 to 0930
12.440	HCJB	QUITO, ECUADOR; 0600 to 1000; 1400 to 2330; Sundays, 0700 to 1630; 1700 to 2200
13.050	WNRI	NEW YORK CITY; European beam, 0600 to 1800
13.050	KCBR	SAN FRANCISCO, CALIFORNIA; Oriental beam, 2215 to 0100
14.560	WNRX	NEW YORK CITY; European beam, 0600 to 1800
15.000	WWV	WASHINGTON, D.C.; U.S. Bureau of Standards; frequency, time, and musical pitch; broadcasts continuously day and night.
15.110	GWG	LONDON, ENGLAND; 0000 to 0400; 0600 to 1015; 1100 to 1315; 1500 to 1600
15.110	HCJB	QUITO, ECUADOR; 0500 to 1200; 1330 to 2230
15.120	HVJ	VATICAN CITY; 0830 to 0930; 1100 to 1145
15.130	WLWRI	CINCINNATI, OHIO; European beam, 0645 to 1500; North African beam, 1515 to 1630
15.130	KGEI	SAN FRANCISCO, CALIFORNIA; Alaskan-Chinese beam, 1700 to 1945
15.130	KGEI	SAN FRANCISCO, CALIFORNIA; Southwest Pacific beam, 0115 to 0845
15.140	GSF	LONDON, ENGLAND; 2300 to 0400; 0600 to 0815; 0830 to 1745
15.150	WRCA	NEW YORK CITY; European beam, 1115 to 1630; Brazilian beam, 1700 to 1845
15.150	KCBA	DELANO, CALIFORNIA; Alaskan beam, 2400 to 0315
15.150	KCBR	DELANO, CALIFORNIA; Philippine beam, 0400 to 1100
15.150	SBT	STOCKHOLM, SWEDEN; 0130 to 0215; 0600 to 0700; 1000 to 1315
15.160	JZK	TOKYO, JAPAN; 1730 to 1815
15.170	TGWA	GUATEMALA CITY, GUATEMALA; 1200 to 2000
15.180	GSD	LONDON, ENGLAND; 2300 to 1200; 1230 to 1745
15.190	CKCX	MONTREAL, CANADA; 0800 to 1200
15.190	TAQ	ANKARA, TURKEY; 0000 to 0200; 0415 to 0730
15.200	WOOC	NEW YORK CITY; European beam, 0900 to 1815
15.210	WBOS	BOSTON, MASSACHUSETTS; European beam, 0915 to 1245; 1300 to 1545; South American beam, 1600 to 2200

(Continued on page 56)

Now YOU CAN HAVE IMPROVED No-DRIFT FM *in the Sensational New 1948*

MIDWEST RADIOS

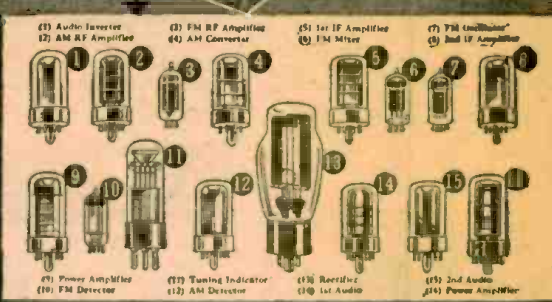
NEW SERIES 16* SUPER DELUXE AM-FM CHASSIS

Here is the finest radio Midwest has ever produced in its 28 years of manufacturing—a world-ranging, 5-band radio with improved Midwest No-Drift FM . . . plus Standard Broadcast and 3 short wave bands, Television Audio Switch-over, and Color-Ray Tone Selection. The Series 16* Super De Luxe Chassis is a powerful, magnificently-toned radio that challenges comparison for performance, sensitivity, selectivity, and advanced engineering features. Supplied with satin stripe copper finish panel—ready to mount in your present cabinet. Send today for the FREE 1948 Midwest Radio Catalog. Buy your radio direct from the manufacturer on Easy Terms and 30 Days Trial and SAVE!

30 DAYS TRIAL

LOW FACTORY-TO-YOU PRICES

EASY TERMS



A COMPLETE LINE OF FINE RADIOS AND RADIO-PHONOGRAPHS . . . *Available in Separate Chassis Like the Powerful Series 16* AM-FM Model above, or in beautiful Radio-Phonograph Consoles like this:*

Scores of NEW Features such as the Exclusive MIDWEST TRI-MAGNADYNE COIL SYSTEM and COLOR-RAY TONE SELECTION

SYMPHONY GRAND AM-FM RADIO-PHONOGRAPH CONSOLE *with NEW Intermix AUTOMATIC RECORD CHANGER*

Our Finest! A superbly beautiful musical instrument . . . a masterpiece of furniture design and radio engineering that offers the sensational Midwest NO-DRIFT FM, Automatic Intermix Record-Changer, Exclusive Color-Ray Tone Selection, World-ranging 5-Band Reception, Television Audio Switch-Over, and many more new and exclusive features.

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FILL IN COUPON AND MAIL TODAY OR JUST SEND YOUR NAME AND ADDRESS ON A POSTCARD

MIDWEST RADIO CORP.
Dept. 38-K, 909 Broadway
Cincinnati 2, Ohio

Gentlemen: Please send me your new FREE catalog and details of your liberal 30 Days Trial.

Name.....

Address.....

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

MIDWEST RADIO CORP.

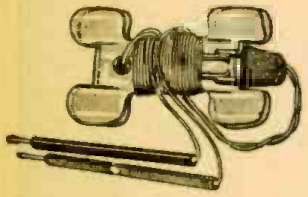
Dept. 38-K • 909 BROADWAY • CINCINNATI 2, OHIO

NEW RADIO·ELECTRONIC DEVICES

UNIVERSAL TESTER

Star Fuse Company, Inc.
New York, N. Y.

The Suretest universal tester is designed for voltage and continuity testing. It consists of a reel-like plastic frame, 6-foot vinyl-covered test leads, and a pair of test prods. Both prods have built-in 100,000-ohm resistors. The red, or positive, prod contains a built-in neon lamp that is viewed through holes in its barrel. The other end of the test leads terminate in a standard attachment plug.



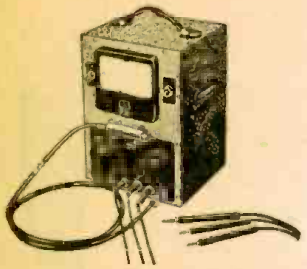
Since each prod is protected by a resistor, high and low voltages may be checked safely. Insert the plug in the short-circuited socket in the end of the frame. With the ends of the leads shorted, the lamp will indicate presence of voltages between 75 and 600 volts.

For continuity testing, the plug is inserted in a 117-volt outlet.—RADIO-CRAFT

ELECTRONIC MULTIMETER

Sylvania Electric Products Inc.
New York, N. Y.

The Type 134 Polymeter is a complete electronic multimeter including a balanced amplifier circuit practically independent of line voltage and normal amplifier tube changes; preset factory adjustments permitting correct zero setting for all ranges through 1 front panel adjustment; convenient range switch for correct multiplier values; 5 jacks for plug-in test-lead readings of a.c. volts, d.c. volts, ohms, amperes, and milliamperes.



Measurement ranges of the Polymeter include: d.c. volts, 0-3, 0-10, 0-30, 0-100, 0-300, 0-1,000; a.c. volts, a.f., 20-15,000 c.p.s., 0-3, 0-10, 0-30, 0-100, 0-300; r.f. volts, 10 kc-300 mc, 0-3, 0-10, 0-30, 0-100, 0-300; d.c., 0-3 ma, 0-10 ma, 0-30 ma, 0-100 ma, 0-300 ma, 0-1,000 ma, 0-10 amperes; resistance, 0-1,000 ohms, 0-10,000 ohms, 0-100,000 ohms, 0-1 megohm, 0-10 megohms and 0-1,000 megohms.

The unit includes a midget probe utilizing the Type 1247 proximity-fuse-type tube.

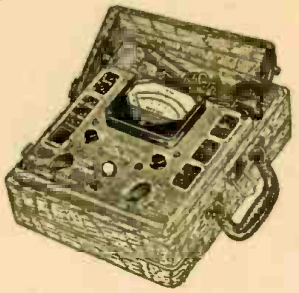
The instrument cabinet measures approximately 10 inches high, 18 inches wide and 6⅞ inches deep, weighs 16 pounds, and is rated at 30 watts input at 105-125 volts, 50-60 cycles a.c.—RADIO-CRAFT

ELECTRONIC ANALYZER

Weston Electrical Instrument Corp.
Newark, N. J.

The Model 769 analyzer embodies within one instrument a high-frequency vacuum-tube voltmeter, an electronic volt-ohmmeter, and a 10,000-ohm-per-volt d.c. and 1,000-ohm-per-volt a.c. multimeter.

The v.t.v.m. is stable over wide variations in line voltage and covers a frequency range of 50 cycles to 300 mc without accessories or adapters, at ranges of 3/12/30/120 volts. Accuracy is 5% up to 150 mc, and 12% from 150 mc to 300 mc, direct reading. A corrective curve reduces this to 8% on the 150- to 300-mc range. The 3½ inch long by ¾ inch diameter r.f. probe is equipped with a flexible cable for plugging into the front panel. Input resistance is 5 megohms; capacity, 5 μμf. The electronic volt-ohmmeter covers ranges from 3 to 1,200 volts, and 2,000 ohms to 2,000 megohms full scale, with stability uninfluenced by line-voltage variations.—RADIO-CRAFT



FREQUENCY METER

The Daven Company
Newark, N. J.

The Model 838 frequency meter is a direct-reading instrument designed to measure frequencies between 20 and 100,000 c.p.s. The accuracy on all ranges is ±2% of the top frequency of the range in use. Indication is substantially independent of variations in input voltages between 0.5 and 150 r.m.s.

A large illuminated meter is used. A

jack has been provided for connection to an external recording milliammeter for making continuous graphic frequency recordings.—RADIO-CRAFT

5-WATT AMPLIFIER

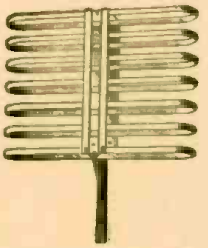
Mark Simpson Mfg. Co., Inc.
Long Island City, N. Y.

The Masco MAP-105 is a self-contained, lightweight, 5-watt musical instrument amplifier. It has 2 inputs for mike or instrument, an 8-inch PM speaker, and a 2-tone fabricoid carrying case. It is designed for use as an instrument amplifier and will meet the needs of small halls and entertainment spots.—RADIO-CRAFT

FM ANTENNA

The Rauland Corp.
Chicago, Ill.

The Model 150 antenna is designed specifically for use on the 88- to 108-mc FM band. It has an omni-directional pickup pattern, requiring no special orientation.



Sensitivity of the antenna is high, being rated at 3 decibels over a conventional dipole.

The unit is of aluminum construction, and its design offers low wind resistance.—RADIO-CRAFT

MULTITESTER

Bradshaw Instructions Co.
Brooklyn, N. Y.

The Model 10 Range Master multitester is interesting in that it incor-

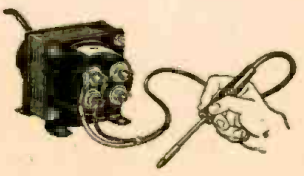
porates a special 1-volt a.c. range for alignment work. Also included are 3 alternating-current ranges, the largest of which reads to 15 amperes. The others have maximums of 0.15 and 1.5 amps, respectively.

Other ranges are 0-10-100-500-1,000 vols a.c. and d.c., milliampere ranges 0-1-10-100 d.c., and 3 resistance ranges to 1 megohm. Three capacitance ranges measure capacitors from 0.001 to 10 microfarads.—RADIO-CRAFT

MIDGET SOLDERING IRON

Industrial Heating Division
General Electric Co.,
Schenectady, N. Y.

The new Midget soldering iron is 8 inches long and weighs only 1¾ ounces, without the cord. It is rated at 25 watts, 6 volts, and uses a 115- to 6-volt step-down transformer. A transformer providing 4 taps for variable heat is available.



The Calrod heating element is built into the tip of the iron to within ½ inch of the working surface. Available tips are ⅛ and ¼ inch in diameter.—RADIO-CRAFT

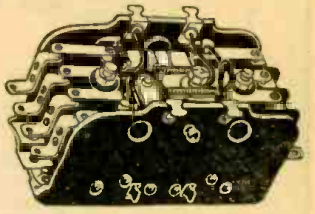
3-POSITION RELAY

Sigma Instructions, Inc.
Boston, Mass.

The new Type 6FX8A 3-position or null-indicating polarized relay is designed for use in relay-terminated control circuits and servo mechanisms.

When the coil is provided with 2 opposed windings for use in a push-pull output circuit, minimum differential power requirements are approximately .005 watt per contact pole, and operation is unaffected by variations in stand-by current. With a single-wound coil, about .0025 watt is needed per contact pole.

The armature has snap-action centering or detent, and does not move gradually with increasing coil current.



About 25 grams of force at the contacts are available from an input of .005 watt, and a similar amount for holding the central or null position, with input balanced or zero. The magnetic circuit being polarized, these forces increase directly with current up to nearly 200 grams. Contacts, which may be ganged in double-break or paralleled-pair arrangement, are rated at 5 amp 110 v a.c. Open or hermetically sealed types are offered.—RADIO-CRAFT

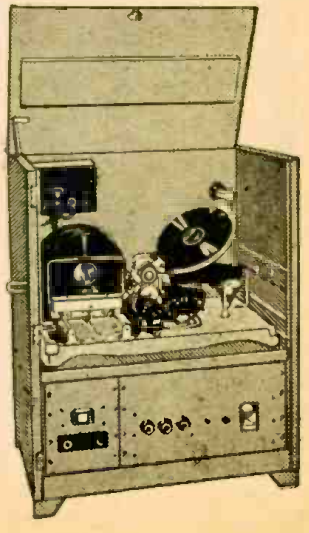
SOUND SYSTEM

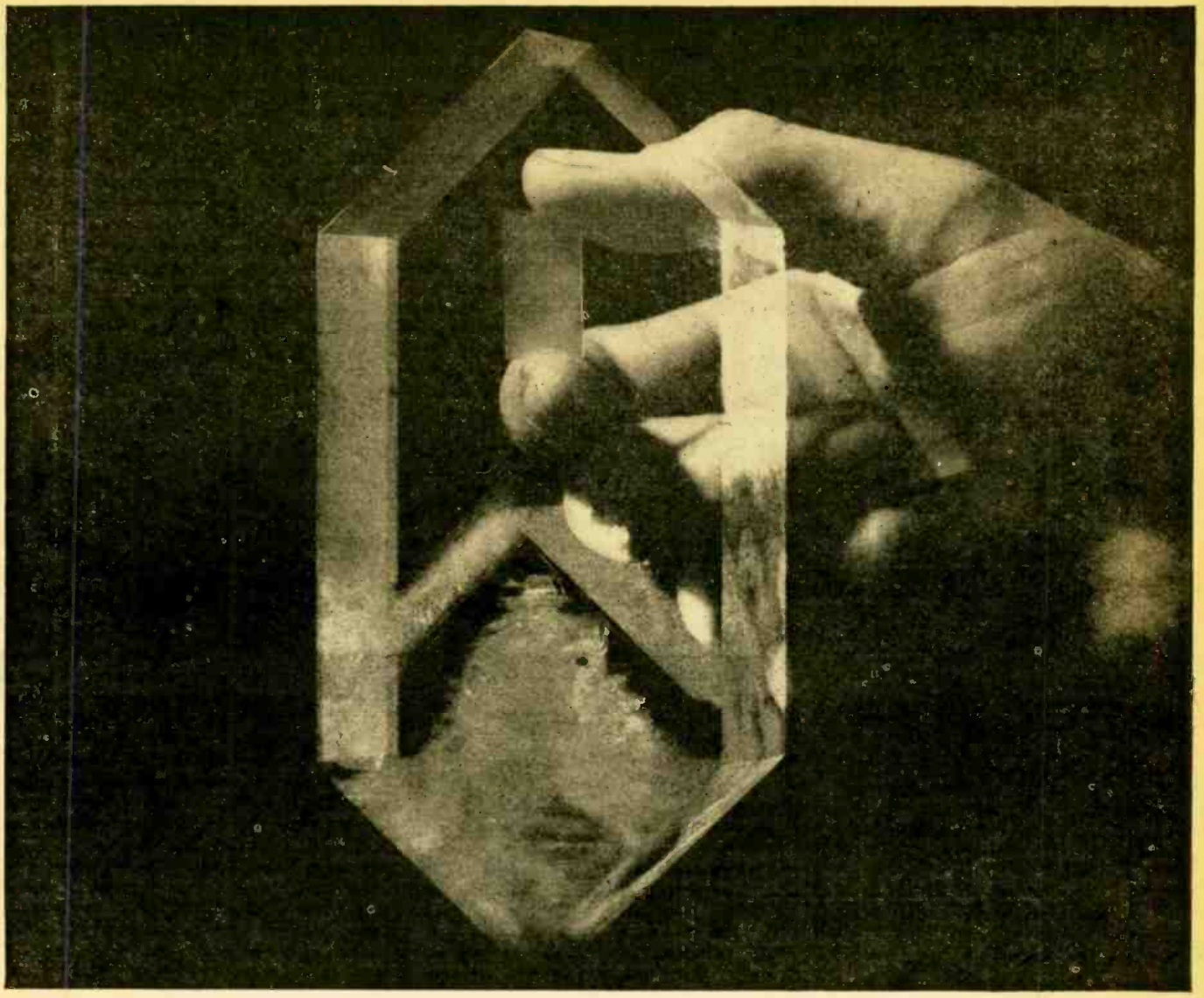
Eastern Amplifier Corp.
New York, N. Y.

The Robomat is a combination radio, automatic phonograph, and paging system with a power output of 90 watts, designed for use in skating rinks, swimming pools, churches, schools, and other institutions.

It includes a microphone for instantaneous paging and a sensitive built-in AM radio.

The record changer is heavy duty and automatic. It stacks 20 records and plays both sides, or a total of 40 discs. This record changer can be operated for continuous periods on either a planned program, such as 1 record every 3 minutes, or on a continuously operating program. A timing device is incorporated in the Robomat, so it will turn itself on and off for any pre-adjusted time.—RADIO-CRAFT





A CRYSTAL THAT GREW FROM A SEED . . . *The large crystal in the foreground is an EDT (Ethylene Diamine Tartrate) crystal. It started from a seed (a piece of mother crystal) and in three months grew in a slowly cooling solution to the size shown. The small plate is cut from a large crystal, then gold-plated for electrical connection and mounted in vacuum. Cultivated EDT crystals can do the same job as quartz in separating the nearly 500 conversations carried by a coaxial circuit.*

Crystals for Conversations

AT WAR'S END, the Bell System began to build many more Long Distance coaxial circuits. Hundreds of telephone calls can be carried by each of these because of electric wave filters, which guide each conversation along its assigned frequency channel. Key to these filters was their frequency-sensitive plates of quartz.

But there was not enough suitable quartz available to build all the filters needed. Bell Telephone Laboratories scientists met the emergency with cultivated crystals. Years of research enabled them to write the prescription at once—a crystal which is grown in a laboratory, and which replaces quartz in these channel filters.

Now Western Electric, manufacturing unit of the Bell System, is growing crystals by the thousands. Many more Long Distance telephone circuits, in urgent demand, can be built, because the scientists of Bell Telephone Laboratories had studied the physics and chemistry of artificial crystals.

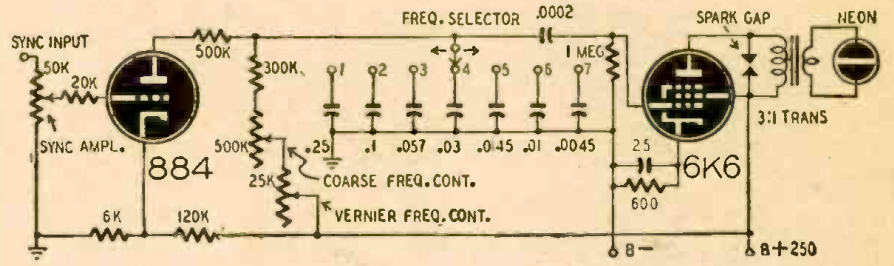
BELL TELEPHONE LABORATORIES

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

RADIO-ELECTRONIC CIRCUITS

SIMPLE STROBOSCOPE

A stroboscope is useful in studying machinery in rapid motion and has applications in home workshops, laboratories, and industry. It can be used for measuring the speed of rotating or reciprocating machine parts. The circuit of a simple stroboscope, presented in *Electronics*, uses an 884 relaxation oscillator, a 6K6 tube, and a neon lamp.



The 884 generates saw-tooth waves at frequencies determined by the settings of the frequency selector and coarse and vernier frequency controls. Frequency ranges are 15 to 30, 30 to 60, 60 to 120, 120 to 240, 180 to 400, 360 to 650, and 650 to 1400 cycles as the frequency range selector is rotated through positions 1 to 7. The 884 may be synchronized with an external signal source connected to the sync input terminal. Strength of the sync injection voltage is controlled by the sync amplitude control.

The 200-μμf condenser and 1-megohm resistor form a differentiating network to convert saw-tooth waves to sharp pulses that are applied to the grid of the 6K6. The plate of this tube is coupled to the neon lamp through a 3:1 step-down transformer. A small adjustable spark gap across the primary protects the transformer against voltage breakdown should the neon lamp be disconnected. The lamp is a 2- or 3-watt unit without built-in limiting resistor. The controls can be calibrated directly in frequency by using an oscilloscope and a known standard such as an accurate audio oscillator or the power-line frequency.

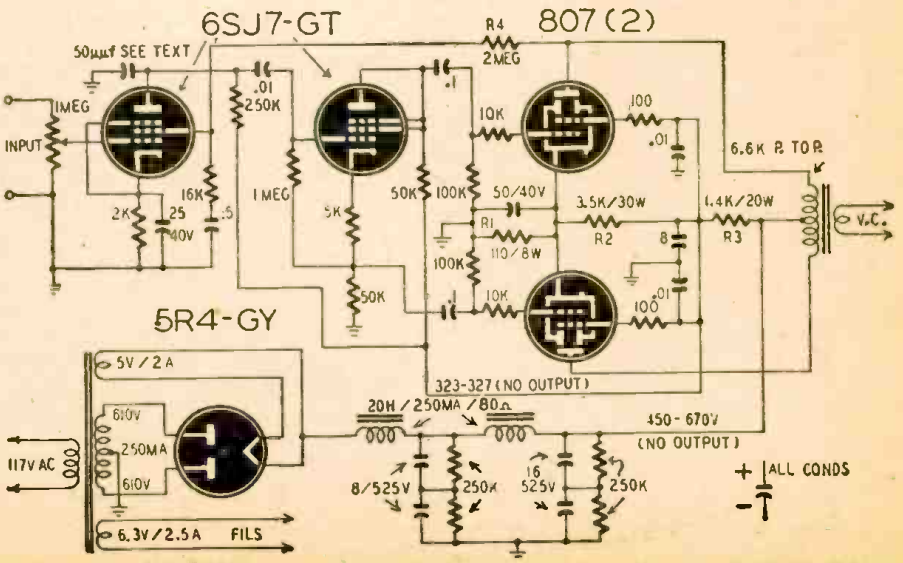
If the blades of a rapidly turning electric fan are lighted by the neon lamp, they will appear motionless as the frequency controls are varied. A number of interesting effects will be noted when a disc, with a single stripe radiating from its center, is placed on a phonograph turntable and lighted by the lamp. The stripe will appear as one or more spokes on the disc as the speed of the motor or frequency of the stroboscope is varied.

30-45-WATT AUDIO AMPLIFIER

Transmitting-type power amplifier tubes such as 807's or 1625's may be used in medium-power audio amplifiers and modulators in place of more commonly used 6L6's. The 807's deliver equal power with less distortion. The circuit of a 30-watt amplifier, described in *Radiotronics* (Australia), can be converted to deliver 45 watts with minor changes in component values.

The 6SJ7-GT voltage amplifier sup-

(Continued on page 78)



MONEY BACK GUARANTEE —We believe units offered for sale by mail order should be sold only on a "Money-Back-If-Not-Satisfied" basis. We carefully check the design calibration and value of all items advertised by us and unhesitatingly offer all merchandise subject to a return for credit or refund. You, the customer, are the sole judge as to value of the item or items you have purchased.

The New KT-30 CHANNEL ANALYZER

The Ultimate in Signal Tracing Includes . . .

METER—For direct reading of signal intensity.

SPEAKER—For listening to the signal.

PHONE—For checking distortion and listening to the signal in low-gain channels.

Comparative signal intensities indicated directly on the meter as Probe follows the signal. A special 4½" P.M. speaker with oversize Alnico V magnet is used for quality checks. Many previously designed Signal Tracers were unable to measure and check low signal intensities. This disadvantage has now been overcome for the Model KT-30 incorporates a special circuit which permits the meter to be put across the output of the Signal Tracer. To accomplish this it is necessary only to flip a front panel switch. This results in additional gain and sensitivity permitting measurement of low signal intensities. An earphone provided with the unit permits listening to the signal in low-gain channels. Incidentally, insertion of the phone automatically cuts out the speaker.

$29.95 NET

Complete with detector probe, test leads, self-contained batteries and earphone. Heavy gauge crystalline cabinet.

The New Model 650-A *A. C. Operated* SIGNAL GENERATOR

- Operates on 110-120 Volts 50 to 60 Cycles A.C.
- R.F. Frequencies from 100 Kc. to 35 Mc. on Fundamentals in 5 bands by front panel switch manipulation. One additional band provides Harmonics from 30 to 105 Mc.
- Audio Modulating Frequency —400 Cycles Pure Sine Wave. Distortion less than 3%.
- Attenuation: Features a newly designed 3-step ladder type of attenuator (T pad). The first step provides lowest output and can be multiplied by 10 and by 100 by turning the multiplier switch.
- Hartley Excited Oscillator Electron coupled to a Buffer Amplifier. Frequency stability is assured by modulating the amplifier stage.

Complete with coaxial cable, test leads and instructions. Heavy gauge grey crystalline cabinet with beautiful two tone etched front panel. Size 9½" x 10" x 6".

$39.95 NET

The New Model 670 SUPER METER

A Combination Volt-Ohm-milliammeter plus Capacity Reactance, Inductance and Decibel Measurements

D.C. VOLTS: 0 to 7.5/15/75/150/750/1500/7500.
A.C. VOLTS: 0 to 15/30/150/300/1500/3000 Volts.
OUTPUT VOLTS: 0 to 15/30/150/300/1500/3000.
D.C. CURRENT: 0 to 1.5/15/150 Ma.; 0 to 1.5 Amps.
RESISTANCE: 0 to 500/100,000 ohms 0 to 10 Megohms.
CAPACITY: .001 to .2 Mfd., .1 to 4 Mfd. (Quality test for electrolytics).
REACTANCE: 700 to 27,000 Ohms; 13,000 Ohms to 3 Megohms.
INDUCTANCE: 1.75 to 70 Henries; 35 to 8,000 Henries.
DECIBELS: —10 to +18, +10 to +38, +30 to +58. The Model 670 comes housed in a rugged, crackle-finished steel cabinet complete with test leads and operating instructions. Size 5½" x 7½" x 3".

$28.40 NET

The New Model CA-11 SIGNAL TRACER

Simple to operate . . . because signal intensity readings are indicated *directly on the meter!*

- ★ SIMPLE TO OPERATE —only 1 connecting cable —NO TUNING CONTROLS.
- ★ HIGHLY SENSITIVE—uses an improved Vacuum Tube Voltmeter circuit.
- ★ Tube and resistor-capacity network are built into the Detector Probe.
- ★ COMPLETELY PORTABLE — weighs 5 lbs. and measures 5"x6"x7".
- ★ Comparative Signal Intensity readings are indicated directly on the meter as the Detector Probe is moved to follow the Signal from Antenna to Speaker.

★ Provision is made for insertion of phones. The Model CA-11 comes housed in a beautiful hand-rubbed wooden cabinet. Complete with Probe, test leads and instructions.

$18.75 NET

The New Model 450 TUBE TESTER

Speedy operation — assured by the newly designed rotary selector switch which replaces the usual snap, toggle, or lever action switches.

SPECIFICATIONS

• Tests all tubes up to 117 volts. • Tests shorts and leakages up to 3 Megohms in all tubes. • Tests both plates in rectifiers. • New type line voltage adjuster. • Tests individual sections such as diodes, triodes, pentodes, etc., in multi-purpose tubes. • Noise Test-detects microphonic tubes or noise due to faulty elements and loose internal connections. • Uses a 4½" square rugged meter. • Works on 90 to 125 volts 60 cycles A.C.

EXTRA SERVICE—May be used as an extremely sensitive condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute.

$39.50 NET

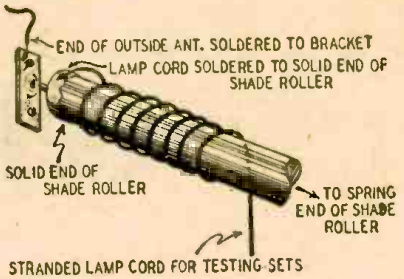
GENERAL ELECTRONIC DISTRIBUTING CO.

DEPT. RC-10, 98 PARK PLACE, NEW YORK 7, N. Y.

TRY THIS ONE

ANTENNA LEAD ROLLER

To keep my antenna lead-in off the service bench when not in use I use the kink described.



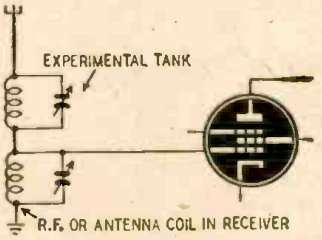
Select a discarded shade roller, with spring in good condition. Use a small awl to punch a series of holes in the roller to locate the end of the spring. Saw off the solid portion 1 or 2 inches beyond the end of the spring, and replace the metal spindle and cap from the discarded end. Make sure the metal spindle makes good contact with the cap. Wind a length of flexible lead-in wire around the roller and solder one end to the cap.

Mount a pair of shade brackets at a convenient place above the bench and connect the antenna to the bracket at the solid end of the roller. When the spring is wound tightly, the lead-in may be pulled out to any length or rolled up at will.

OSCAR E. MALECH,
San Francisco, Calif.

CALIBRATING TANK COILS

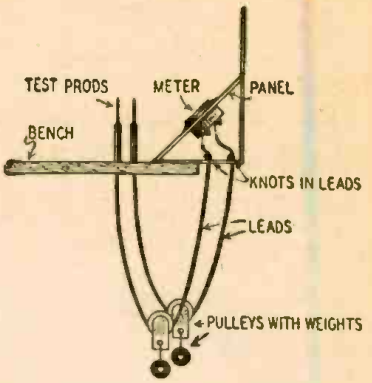
To determine the frequency range of a variable tank circuit in which component values are unknown, insert the coil and condenser combination in series with the antenna lead of an all-wave receiver. If the range of the tank falls within one of the bands of the receiver, it becomes a series wave trap. Tune in a signal on the radio and adjust the tank until the signal fades to a minimum. At this point, the resonant frequency of the tank is equal to that of the receiver and can be read directly off the tuning dial. In this way it is possible to determine the tuning limits of any coil and condenser combination.



AL HAUSER,
W. Lafayette, Ind.

PROTECTING TEST LEADS

Test leads left lying on the work bench have often been burned and otherwise damaged. I now have a system that protects leads not in use. The meter is mounted on a sloping panel, and permanent test leads brought out behind the panel and passed through 2 small holes in the top of the bench. Knots that cannot pass through the holes are made in the leads to protect the meter and connections against strain. The leads are brought up through holes in the front surface of the bench after weighted pulleys have been placed on them as shown. These holes are large enough to permit the leads to slide without binding but will not pass the prods.



CARL E. PORTER,
Bronx, N. Y.

(This system is also handy for antenna and ground leads.—*Editor*)

SPEAKER CONE SHIELD

As soon as a radio is removed from its cabinet for servicing, cover the front of the speaker with an oil-silk or pliofilm dish cover. These are obtainable from 5 & 10-cent stores in a number of sizes that can be used on speakers up to about 15 inches in diameter. The covers prevent the cone from being damaged by tools or other instruments on the bench and keep dust and metal filings from lodging between the voice coil and the pole piece.

HARLEM RADIO CLUB,
New York, N. Y.

FIELD STRENGTH METER

Useful for u.h.f. and v.h.f. work, this field strength meter consists of a modified half-wave folded dipole mounted on a lightweight wooden frame. A plastic cup of bakelite (headphone case) in the center of the T houses the condenser and crystal diodes and supports the antenna at the center. The ends of the dipole are supported on stand-off insulators.

Full-wave rectifiers double the sensitivity of the instrument, making it possible to use d.c. milliammeters with ranges as high as 10 ma. The folded dipole tunes broadly, and tuning is unnecessary when covering any u.h.f. or v.h.f. band.

JAMES R. WHEELER, W9ECI,
Oshkosh, Wisconsin.

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Save up to 80%

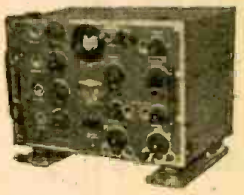
ALL STANDARD BRANDS - ALL IN CARTONS

Type	Price	Type	Price	Type	Price
*0Z4	1.10	6J5GT	.62	12K7GT	.67
1ASGT	.75	6J6	1.32	*12K8	1.10
1A7GT	.90	*6J7	.90	12Q7GT	.62
1B5/25S	.90	6K5GT	.95	12SA7GT	.90
1C5GT	.90	6K6GT	.67	*12SC7	.90
1G4GT	.90	*6K7	.75	12SF5GT	.75
1H4G	.90	6K8GT	.90	*12SF7	.90
1H5GT	.75	6L5G	.75	*12SG7	.90
1L4	1.10	6L6G	1.32	*12SH7	.90
1LA4	1.60	*6L7	1.10	12SJ7GT	.75
1LA6	1.60	6N7GT	1.10	12SK7GT	.75
1LB4	1.60	6P5GT	.90	12SL7GT	1.10
1LC5	1.60	*6Q7	.90	12SN7GT	.90
1LC6	1.60	*6R7	1.10	12SQ7GT	.75
1LD5	1.60	6SA7GT	.75	*12SR7	.90
1LH4	1.60	*6SB7Y	1.32	12Z3	.57
1LN5	1.60	*6SC7	.90	14A7/12B7	1.32
1N5GT	.90	6SD7GT	1.32	14H7	1.32
1Q5GT	1.10	6SF5GT	.90	14Q7	1.10
1R5	1.10	*6SF7	.90	14R7	1.10
1S4	1.10	*6SG7	.90	24A	.67
1S5	1.10	6SH7GT	.90	25L6GT	.75
1T4	1.10	6SJ7GT	.75	25Z5	.67
1T5GT	1.10	6SK7GT	.75	25Z6GT	.67
1U4	.90	6SL7GT	1.10	26	.52
1V	.62	6SN7GT	.90	27	.47
2A3	1.32	6SQ7GT	.75	30	.90
2A6	1.10	*6SR7	.75	32L7GT	1.60
3Q4	1.10	*6SS7	.67	35/51	.67
3Q5GT	1.10	*6ST7	1.10	35A5	.90
3S4	1.10	6U5/6G5	.90	35B5	.90
3V4	1.10	6U7G	.67	35L6GT	.67
*5T4	1.32	*6V6	1.32	35W4	.57
5U4G	.67	6V6GT	.75	35Z3	.90
5V4G	1.10	6X5GT	.67	35Z4GT	.55
5W4GT	.62	6Y6G	1.10	35Z5GT	.57
5X4G	.75	7A4	.90	36	.67
5Y3GT	.47	7A5	.90	37	.57
5Y4G	.52	7A6	.90	38	.75
5Z3	.75	7A7	.90	39/44	.67
*5Z4	.90	7A8	.90	41	.57
6A6	.10	7B5	.90	42	.57
6A7	.67	7B6	.90	43	.90
*6A8	.90	7B7	.90	45	.55
*6AB7/1853	1.32	7B8	.90	45Z3	.75
6AC5GT	.90	7C5	.90	45Z5GT	.75
*6AC7/1852	1.32	7C6	.90	46	1.10
6AD7G	1.10	7C7	.90	47	.75
6AF6G	1.10	7C8	.90	50B5	.90
6AG5	1.60	7E5	.90	50L6GT	.75
*6AG7	1.60	7E6	.90	50Y6GT	.75
6AK5	.90	7E7	1.10	53	1.10
6AL5	.90	7F7	1.10	55	.75
6AQ5	.90	7F8	1.32	56	.55
6AQ7GT	1.10	7G7/1232	1.32	57	.62
6AT6	.75	7H7	1.32	70L7GT	1.95
6B4G	1.32	7J7	1.32	71A	.62
6B7	.90	7K7	1.32	75	.57
*6B8	1.32	7L7	1.32	76	.62
6BA6	.90	7N7	1.32	77	.62
6BE6	.90	7Q7	.90	78	.62
6C4	.75	7V7	1.60	80	.47
*6C5	.75	7Y4	.90	81	1.32
6C6	.67	*12A6	1.32	82	.90
6C8G	1.10	12A8GT	.67	83	.90
6D6	.67	12AT6	.75	84/6Z4	.75
6D8G	1.10	12BA6	.90	85	.62
6E5	.75	12BE6	.90	89	.27
*6F6	.75	*12C8	1.32	117L7/M7GT	1.95
6F8G	.90	*12H6	.75	117N7GT	1.60
6G6G	.90	12J5GT	.67	117P7GT	1.60
*6H6	.75	12J7GT	.75	117Z6GT	1.10

*—Metal Types | *—Metal Types | *—Metal Types

'Hot Radio Values' AT SUN RADIO

100 WATT BENDIX TRANSMITTER TA12



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Four separate output tanks.

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Extra set of coils $1.95

HAM AND POLICE SUPERHET TUNER

Brand New. Complete with 7V7 (1 Stage T.R.F.), 7Q7 (1st IF & Osc.), 7V7 (2nd IF), 7F7 (Audio) and 7V7 (BFO). Frequency 2.4 to 16.3 mc. Filament voltage required 6.3 AC or DC —2.1 amp. Plate voltage required 135V DC-30MA. Only 4½ x 9½ x 3¾" and weighs only 6½ lbs. Ideal for Ham and Police **$14.95**

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$1.79

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Brand new General Electric 2" round panel meters 0-300.

$2.97

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. . . Brand New. Mixes 10 and 12" records.

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Wood Base for above $3.49

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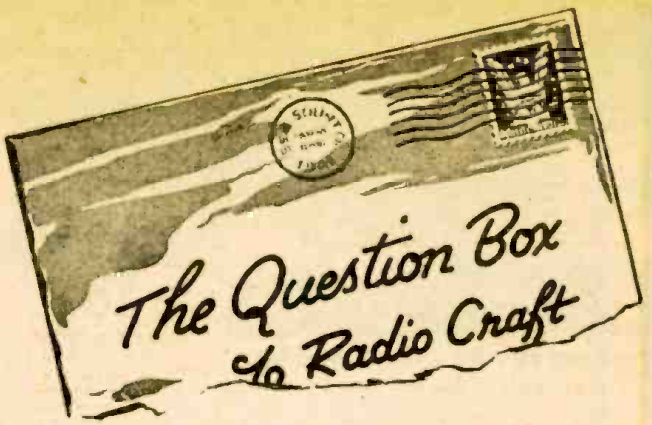
OF WASHINGTON, D. C.

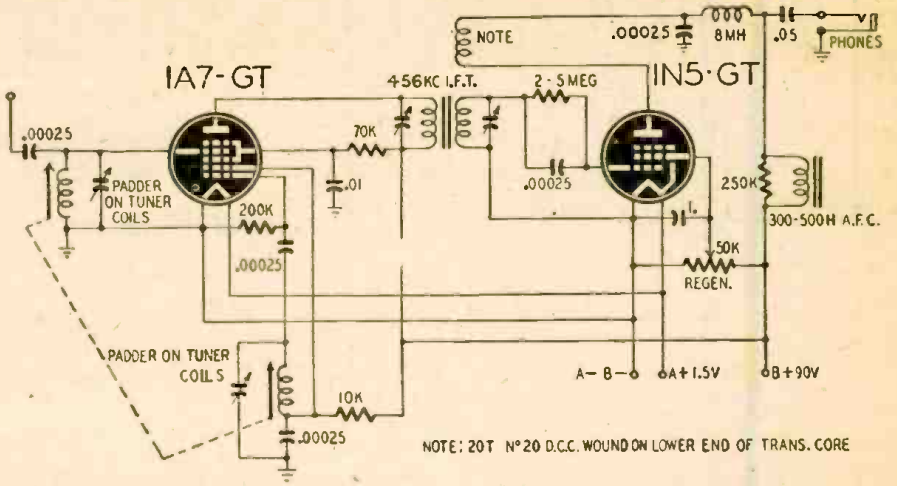
938 F STREET, N. W. WASH. 4, D. C.



? TWO-TUBE SUPERHET

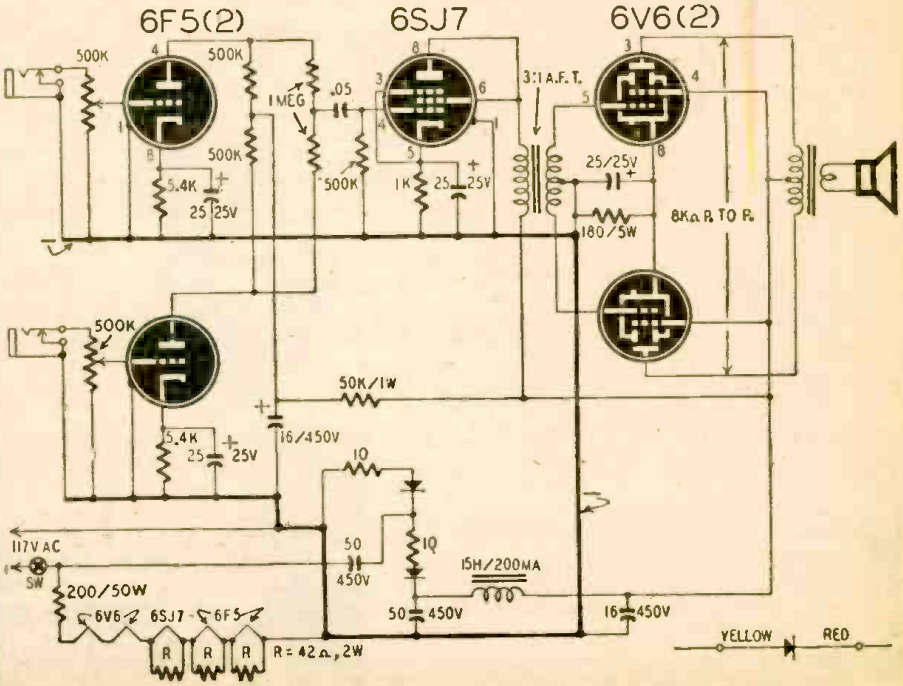
I have a 2-circuit permeability tuner for a superhet and would like a diagram showing how this may be used in a 2-tube battery radio. If possible, I would like to use a 1A7-GT and a 1N5-GT.—J.C., Hollywood, Calif.

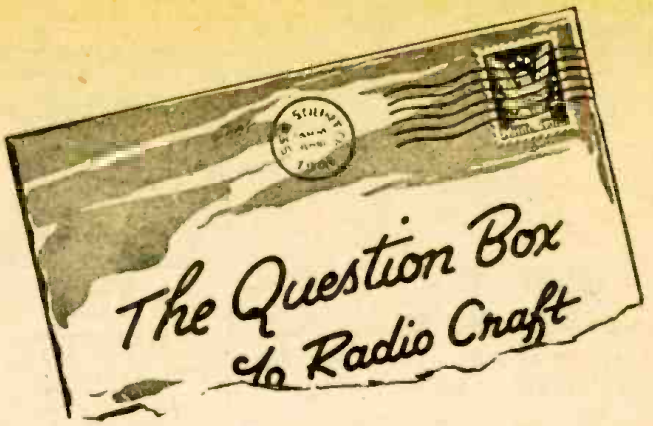
A. This superhet uses a conventional permeability-tuned, oscillator-mixer circuit feeding into a 1N5-GT regenerative detector. The regenerative winding consists of 20 turns of No. 20 d.c.c wire, wound at the lower end of the i.f. transformer core.



? PHONO AMPLIFIER

I would like to have a diagram of a phono amplifier having two input stages with 6F5's and a 6SJ7 transformer coupled to push-pull 6V6's. I want to use selenium rectifiers in a voltage doubler circuit.—H.S., Woodbury, N. J. *(Continued on page 78)*





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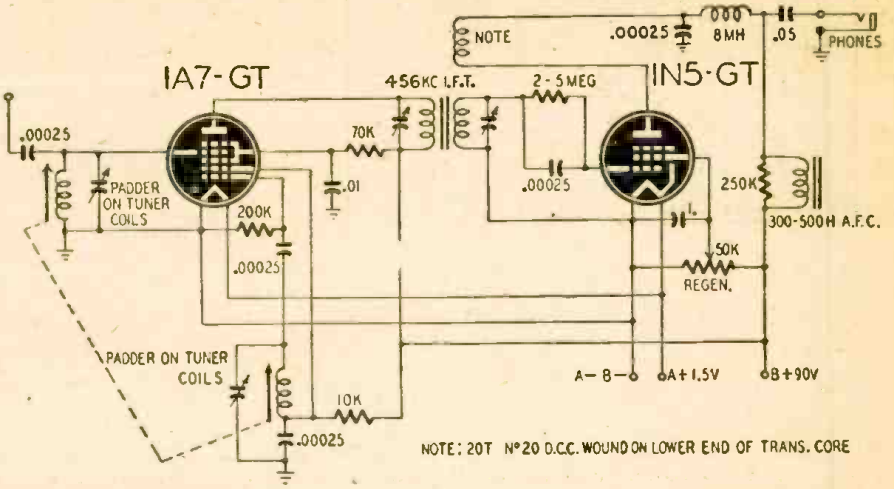

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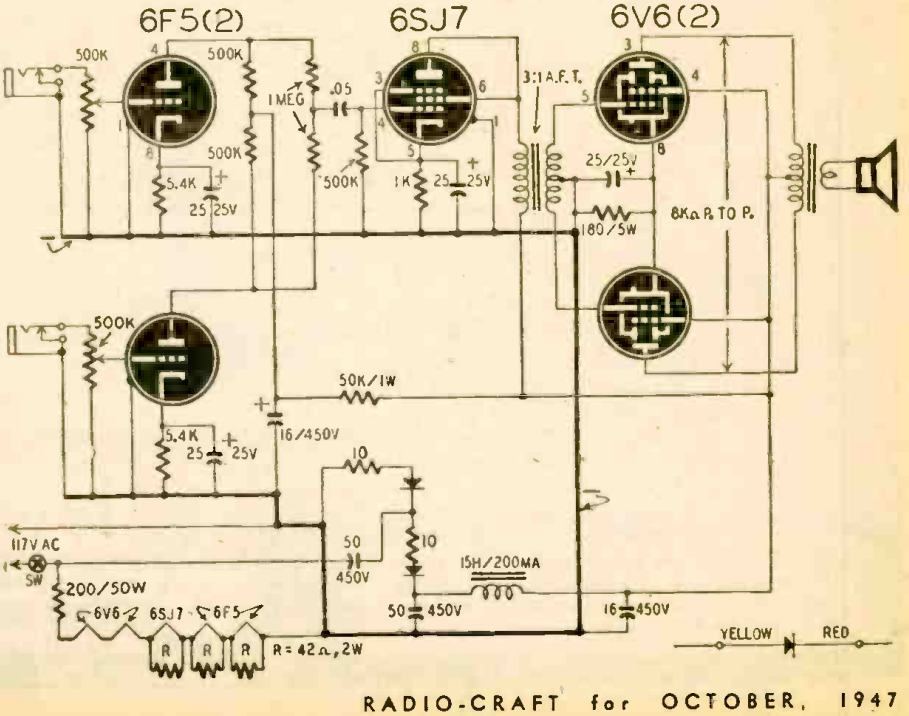

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1B5/25S	.90	6K5GT	.95	12SA7GT	.90
1C5GT	.90	6K6GT	.67	*12SC7	.90
1G4GT	.90	*6K7	.75	12SF5GT	.75
1H4G	.90	6K8GT	.90	*12SF7	.90
1H5GT	.75	6L5G	.75	*12SG7	.90
1L4	1.10	6L6G	1.32	*12SH7	.90
1LA4	1.60	*6L7	1.10	12SJ7GT	.75
1LA6	1.60	6N7GT	1.10	12SK7GT	.75
1LB4	1.60	6P5GT	.90	12SL7GT	1.10
1LC5	1.60	*6Q7	.90	12SN7GT	.90
1LC6	1.60	*6R7	1.10	12SQ7GT	.75
1LD5	1.60	6SA7GT	.75	*12SR7	.90
1LH4	1.60	*6SB7Y	1.32	12Z3	.57
1LN5	1.60	*6SC7	.90	14A7/12B7	1.32
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1Q5GT	1.10	6SF5GT	.90	14Q7	1.10
1R5	1.10	*6SF7	.90	14R7	1.10
1S4	1.10	*6SG7	.90	24A	.67
1S5	1.10	6SH7GT	.90	25L6GT	.75
1T4	1.10	6SJ7GT	.75	25Z5	.67
1T5GT	1.10	6SK7GT	.75	25Z6GT	.67
1U4	.90	6SL7GT	1.10	26	.52
1V	.62	6SN7GT	.90	27	.47
2A3	1.32	6SQ7GT	.75	30	.90
2A6	1.10	*6SR7	.75	32L7GT	1.60
3Q4	1.10	*6SS7	.67	35/51	.67
3Q5GT	1.10	*6ST7	1.10	35A5	.90
3S4	1.10	6U5/6G5	.90	35B5	.90
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5X4G	.75	7A4	.90	36	.67
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5Y4G	.52	7A6	.90	38	.75
5Z3	.75	7A7	.90	39/44	.67
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6A6	.10	7B5	.90	42	.57
6A7	.67	7B6	.90	43	.90
*6A8	.90	7B7	.90	45	.55
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*6AC7/1852	1.32	7C6	.90	46	1.10
6AD7G	1.10	7C7	.90	47	.75
6AF6G	1.10	7C8	.90	50B5	.90
6AG5	1.60	7E5	.90	50L6GT	.75
*6AG7	1.60	7E6	.90	50Y6GT	.75
6AK5	.90	7E7	1.10	53	1.10
6AL5	.90	7F7	1.10	55	.75
6AQ5	.90	7F8	1.32	56	.55
6AQ7GT	1.10	7G7/1232	1.32	57	.62
6AT6	.75	7H7	1.32	70L7GT	1.95
6B4G	1.32	7J7	1.32	71A	.62
6B7	.90	7K7	1.32	75	.57
*6B8	1.32	7L7	1.32	76	.62
6BA6	.90	7N7	1.32	77	.62
6BE6	.90	7Q7	.90	78	.62
6C4	.75	7V7	1.60	80	.47
*6C5	.75	7Y4	.90	81	1.32
6C6	.67	*12A6	1.32	82	.90
6C8G	1.10	12A8GT	.67	83	.90
6D6	.67	12AT6	.75	84/6Z4	.75
6D8G	1.10	12BA6	.90	85	.62
6E5	.75	12BE6	.90	89	.27
*6F6	.75	*12C8	1.32	117L7/M7GT	1.95
6F8G	.90	*12H6	.75	117N7GT	1.60
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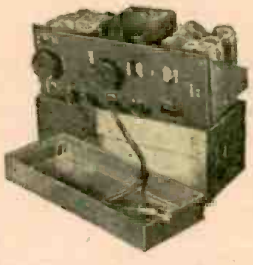

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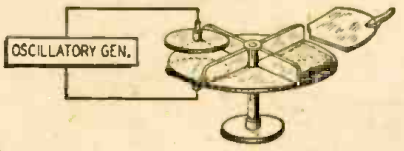
New Radio-Electronic Patents

By I. QUEEN

H.F. BAKING APPARATUS

Vernon W. Sherman, Summit, N. J.
(assignor to Federal Tel. & Radio Corp.)
Patent No. 2,413,003

When high-frequency heating is used to bake or toast, it is found that the outer surface of the food product does not form the usual crust. This is due to the fact that heating of a substance depends upon the dielectric properties and since the dough is uniform throughout it is heated to the same degree.

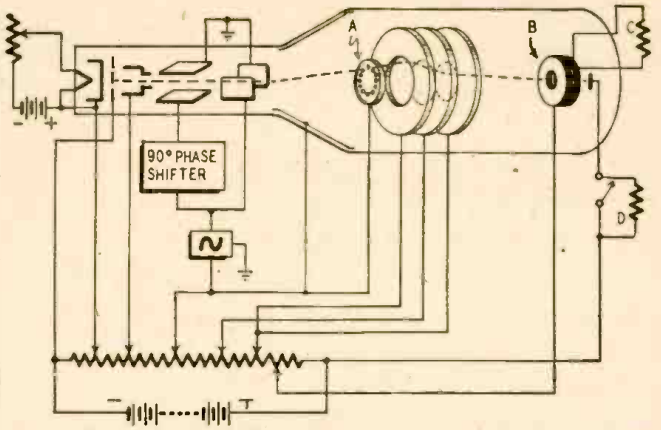


From the standpoint of appearance and handling, it is desirable that the cake, bread, or other food product form an outer crust as usual. This can be accomplished by adding electrodes made of glass, plastic, or similar material. These have dielectric properties which cause them to be heated more than the dough products placed between the electrodes. The dough surface which contacts them receives more heat directly from the electrodes and consequently the desired crust forms.

FREQUENCY MULTIPLIER

Jan A. Rajchman, Philadelphia, Pa.
Patent No. 2,405,519

It is very difficult to obtain a frequency multiplication factor greater than 3 or 4 in conventional electronic circuits. The invention described here discloses a means of obtaining a very high multiplication ratio so that very high frequencies are obtained from crystal-controlled oscillators.



A special cathode-ray tube is used as shown in the figure. The beam-forming and focusing arrangements are conventional except that the fundamental frequency supplies to the two sets of deflecting plates are 90 degrees out of phase but of the same frequency. Such an arrangement results in a continuous circular sweep of the electron beam. In passing through the perforated disc A the beam is interrupted. The three electrostatic-focusing plates then deflect the beam so that it passes through a cavity resonator B which is tuned to the desired high frequency. As each pulse of electrons passes through the cavity, the latter is set into oscillation, and the output is obtained at C. The electrons are collected at a plate and are returned to the tube cathode.

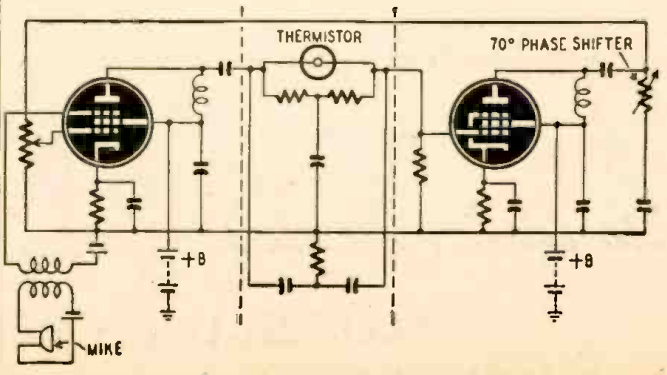
This circuit can be used to obtain a stabilized frequency of 10,000 mc by applying 100 mc to the deflecting plates and passing the beam through a plate provided with 100 apertures.

THERMISTOR FM TRANSMITTER

William G. Shepherd
(Assigned to Bell Telephone Laboratories)
Patent No. 2,407,293

One of the difficulties of FM transmission is that of providing sufficiently large modulation swings without using a number of frequency multipliers. This inventor successfully uses a thermistor to achieve the desired result. The basic circuit includes two vacuum tubes coupled by a double-T network. Among the properties of the network are: suppression of a single frequency (determined by its R-C constants) and change of phase on either side of this frequency.

In order to generate oscillations, the output of the second tube must be in phase with the input to the first. The two tubes themselves account for 360-degree phase shift, and the output R-C network is adjusted for 70 degrees. Therefore the circuit oscillates at whichever frequency corresponds to a phase shift of 290 degrees within the network. Since the only variable is the thermistor, its resistance controls the frequency of oscillation.



In an FM transmitter, the frequency varies with the strength of modulating signal. In this case, the audio is delivered to the suppressor of the first tube, and the output actuates the thermistor. The resistance of the thermistor changes with its temperature, and in turn, with the current flowing through it. Therefore the instantaneous frequency depends upon the sound level at that instant.

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PLOUGHING BY RADIO

(Continued from page 21)

frequency oscillators, the outputs of which were applied to the modulator valves either singly or together by switching the tone oscillator outputs.

The transmitter, as previously stated, may be any ordinary amplitude-modulated master-oscillator type. The actual transmitter used in the test was a Bendix Model TA-12B aircraft equipment together with a type MP-28B power supply which included the modulator.

The receiver was a superheterodyne, and care had been taken to ensure that little distortion of the audio tone was present. This was assured by the use of delayed automatic gain control applied to the mixer and 1 of the 2 intermediate-frequency amplifiers only; thus, non-linear amplification or modulation rise was to a large extent avoided. Post-detector automatic gain control was used to keep the output voltage constant for all values of input above the automatic gain control delay voltage.

The output of the radio receiver was connected to 2 tubes in parallel in whose anode circuits were connected 2 relays X1 and X2. The grid circuit of each tube consisted fundamentally of a resonant circuit whose resonant frequency corresponded to the tone frequency. A rectifier was connected across each filter. The valves were normally in a non-conducting condition so that when no anode current is flowing the relays will not be operated. The circuit appears in Fig. 3.

On the arrival of a tone, or both tones, each filter had applied to it either or both of these tones, but only the desired tone was accepted. The rectified output of the filter was applied to the grid of the relay tube and thus set up conditions which produced anode current and so operated the relay (or relays).

The control circuit actuated by the receiver relays is shown in full in Figs. 1 and 2.

Some Illustrations

To give a clearer idea of the tractor and its control equipment 2 close-up views are shown.

The complete experimental equipment can be seen in the photos: transmitting set in the foreground, and the tractor running with plough raised in the background. The items of control equipment on the tractor itself are as follows:

1. The receiver, with flexible rod aerial;
2. The turn-selector relay box on the left of the receivers;
3. To the right of the receiver, and in the following order, are the main relay box, the throttle control unit, and the directional control unit;
4. Behind the above items can be seen the batteries and the compressed-air (high-pressure) bottle and reducing valve. In both photographs the large plough-raising ram servometer is clearly visible.

Speaking purely from the technical viewpoint, the ability to control a tractor, or for that matter simultaneous

(Continued on page 64)

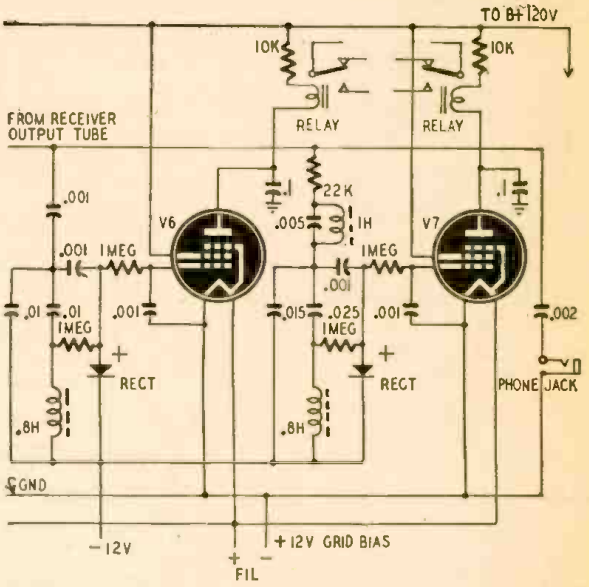

Fig. 3—Receiver's output stage shows resonant circuits and relays.

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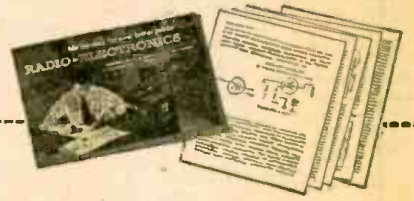

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(Continued from page 40)

15.210	KGEI	SAN FRANCISCO, CALIFORNIA; Guam-Philippine beam, 0400 to 0900
15.220	JTL3	TOKYO, JAPAN; 1800 to 0230
15.230	VLG6	MELBOURNE, AUSTRALIA; 2100 to 2300
15.230		MOSCOW, U.S.S.R.; 2200 to 2400; 0530 to 0830; 0915 to 0930; 1030 to 1330
15.250	WLWK	CINCINNATI, OHIO; European beam, 1430 to 1630; South American-Central American beam, 1700 to 0100
15.270	WCBN	NEW YORK CITY; European beam, 0600 to 1645
15.270	WCRC	NEW YORK CITY; South American beam, 1700 to 2300
15.280	WNRE	NEW YORK CITY; European beam, 0500 to 1815
15.260	GSI	LONDON, ENGLAND; 0400 to 0430; 1030 to 1400
15.290	KWIX	SAN FRANCISCO, CALIFORNIA; Japanese-Chinese beam, 1730 to 2200
15.290	WRUL	BOSTON, MASSACHUSETTS; European beam, 0600 to 1400
15.290	VUO3	DELHI, INDIA; 2245 to 0030; 0130 to 0145; 0200 to 0400; 0445 to 0815
15.300	GWR	LONDON, ENGLAND; 0600 to 0900; 1045 to 1330; 1400 to 1430; 1700 to 1800
15.310	GSP	LONDON, ENGLAND; 2345 to 0030; 0100 to 0500; 0600 to 0815; 1200 to 1315; 1615 to 1845
15.310	VLC4	SHEPPARTON, AUSTRALIA; 2045 to 2145; 0010 to 0045; 1730 to 1800; 1900 to 1915; 2200 to 2225
15.310	HER6	BERNE, SWITZERLAND; Saturdays, 1000 to 1200
15.320		MOSCOW, U.S.S.R.; 2200 to 2300; 0000 to 0500; 0530 to 0800; 0830 to 1100
15.330	WGEO	SCHENECTADY, NEW YORK; European beam, 0600 to 1645
15.330	KNBX	DIXON, CALIFORNIA; South American beam, 1700 to 2200; Japanese-Chinese beam, 2215 to 0345
15.340		MOSCOW, U.S.S.R.; 2200 to 0800; 1000 to 1100
15.350	WRUS	BOSTON, MASSACHUSETTS; European beam, 0500 to 0715; 1030 to 1815; Mexican beam, 1830 to 0100
15.350		PARIS, FRANCE; 0700 to 0900
15.350	WRUA	BOSTON, MASSACHUSETTS; North African beam, 0500 to 0745; 1030 to 1815; Central American beam, 1830 to 0100
15.450	GRD	LONDON, ENGLAND; 0100 to 0500; 0600 to 0700; 1700 to 1845
15.590	FZI	BRAZZAVILLE, FRENCH EQUATORIAL AFRICA; 0445 to 0800; 0930 to 1030
17.440	HVJ	VATICAN CITY; 0715 to 0845
17.530	FZI	BRAZZAVILLE, FRENCH EQUATORIAL AFRICA; 0000 to 0130; 0445 to 0745; 1100 to 1700
17.700	GVP	LONDON, ENGLAND; 0600 to 1115; 1200 to 1600
17.710	GRA	LONDON, ENGLAND; 0600 to 0815
17.730	GVQ	LONDON, ENGLAND; 0100 to 0500; 0800 to 1215
17.750	WRUW	BOSTON, MASSACHUSETTS; European beam, 0600 to 1400; Caribbean beam, 1715 to 1745
17.760	KWID	SAN FRANCISCO, CALIFORNIA; South American beam, 1600 to 2300
17.760		PARIS, FRANCE; 0700 to 0900; 1100 to 1230
17.770	OTC	LEOPOLDVILLE, BELGIAN CONGO; 0500 to 0930; 1130 to 1645
17.770	WOOW	NEW YORK CITY; European beam, 1700 to 1815
17.780	WNBI	NEW YORK CITY; European beam, 0500 to 1630; South American beam, 1645 to 2300
17.780	KCBR	DELANO, CALIFORNIA; Japanese-Chinese beam, 2330 to 0345
17.790	GSG	LONDON, ENGLAND; 0500 to 1030

OLD TUBE TESTER

(Continued from page 36)

Then R = E/I, or 3/0.004 = 750 ohms. 750 minus the 600 in the instrument equals 150 ohms. Thus, 150 ohms was placed above the 4-milliampere mark and other calibrations were made accordingly.

In use, as shown in Photo 6, a jumper lead is connected from terminals 1 to 5 and test leads placed in jacks 2 and 6, with probes on the ends of these leads across the resistor under test. In this test the meter indicated somewhat below the 2-milliampere mark. Transferred to the cardboard scale as in the photo this would mean around 1,000 ohms.

While these readings may not be as accurate as those taken on a precision meter, a tester such as this one will find many uses as an auxiliary unit in checking radios and appliances.

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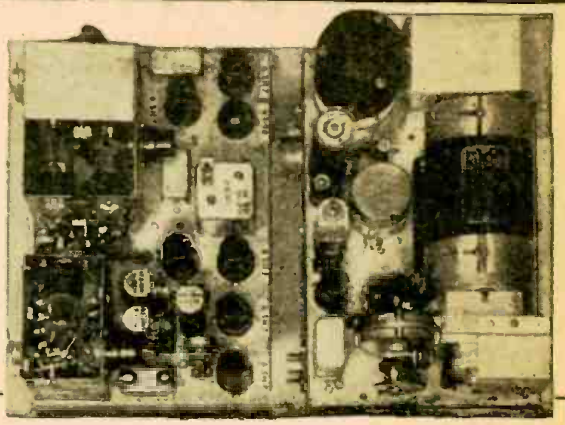

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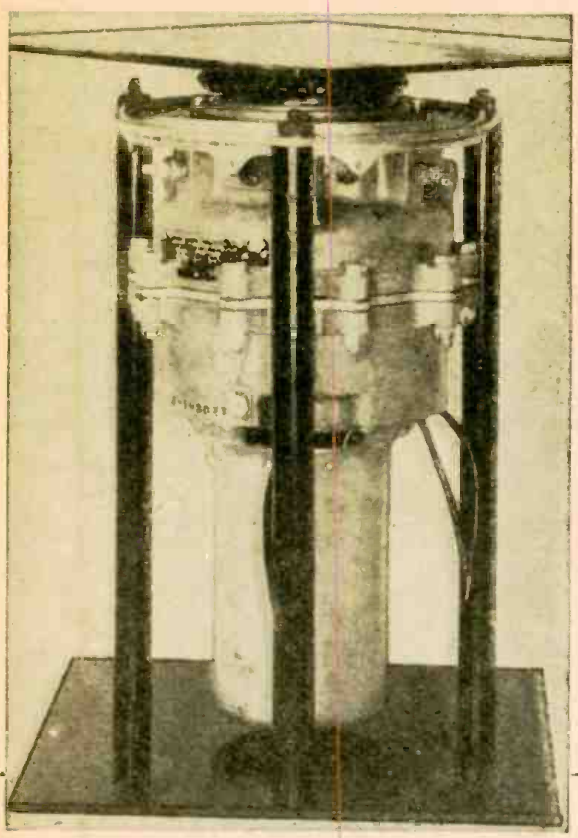

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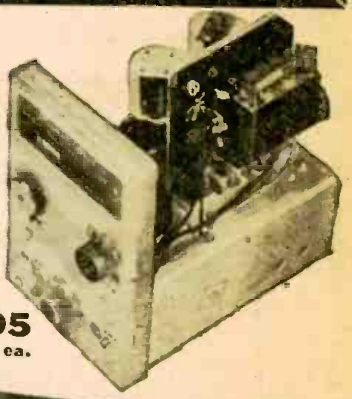

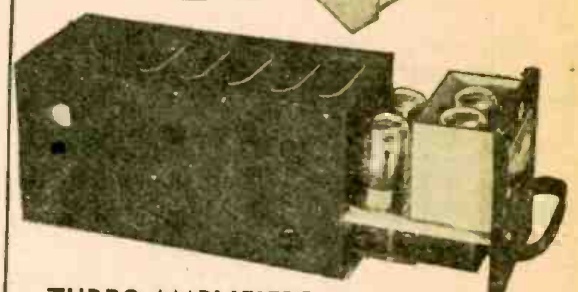

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PLASTIC CABINET

(Continued from page 26)

cooling is less than 1/32 inch, although the plastic acts rubbery when soft.

The humped back was straightened with the homemade clamp arrangement shown in Photo 5; it is crude but effective—2 parallel pieces of wood with a nut and bolt provided the pressure.

Nothing could be done to repair the torn leatheroid on the door without going to the trouble of recovering the entire door, so it was merely glued smooth to prevent further fraying. The torn leatheroid can be reglued with any model-airplane or speaker cement. Apply carefully in the correct amount, and only to the surfaces to be bonded. The acetone solvent in this cement *will dissolve the surface of the leatheroid.*

Non-plastic repairs

A new handle was made from an old camera handle. However, any strip of leather will do. Simply cut to proper

Photo 7—The cabinet looks almost like new.

width and length, and have a shoemaker sew or rivet an overlap at each end.

A new latch was made from a small piece of spring brass, 4 bolts, and 2 nuts. A piece 1½ x 1¼ inches was cut, and 4 holes were drilled near each of the corners. Corresponding holes were drilled in the straightened cabinet. The old latch was removed, and the strip placed equidistant across the top of the two halves of the cabinet. See Photo 6. Nuts and bolts are used to fasten the new latch to the front half of the cabinet, while bolts are soldered in the other 2 holes. The bolts are then filed slightly to remove their threads. The natural spring of the brass keeps the 2 bolts in their holes and the halves of the cabinet together. To open, pull up the strip of brass. The finished job is shown in Photo 7.

Not all plastic cabinets will respond to this heat and pressure treatment, but the kind that warps usually does.

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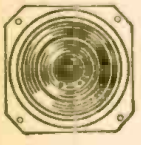

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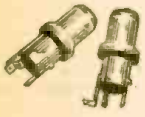

COILS

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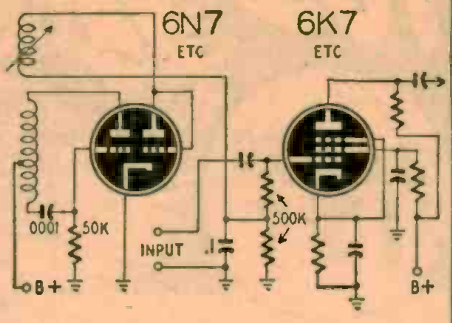
The electronic volume control shares neither of these disadvantages and lends itself with versatility to a number of unusual applications.

The basic principle of the control is placing a variable negative voltage upon the control grid of a variable-mu tube



such as a 6D6, 6K7, or 7B7. This can be done readily (as shown in Fig. 1) with a radio-frequency oscillator variably coupled to a diode rectifier, the output of which controls the variable-mu tube.

In applications such as electronic musical instruments, where both hands are occupied, a foot pedal or similar installation may be arranged to vary coupling between the coils.

A very interesting application of the electronic volume control is in the remote control of radio or public address volume. The system consists of a small 1-tube radio-frequency oscillator as the remote control device and a 3- or 4-tube single-frequency receiver to supply the control voltage to the controlled device. A small superhet can be used if the a.v.c. is disconnected.—*Glen Southworth.*

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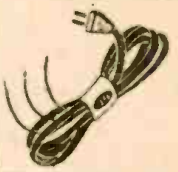

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10-METER CONVERTER

(Continued from page 30)

being grounded, but may be ungrounded and brought to the front panel for use as a double input. L2 on the same ⅝-inch form consists of 8 turns of No. 16 tinned copper wire. It is tuned by the variable condenser C2. To obtain band spread between 27 and 30 mc it may be necessary to shunt the variable condenser with a 10-μμf Ceramicon or adjust the coil spacing until the desired result is obtained.

T2 is the oscillator coil arranged as a modified Hartley. It consists of L3 and L4 (one winding) on a ½-inch form. The full coil has 20 turns of No. 20 enameled wire and is tapped at 6 turns from the ground end. C7 controls the adjustment of the fixed oscillator frequency and is a 100-μμf padder which is adjustable through a hole in the front panel. R2 is a 20,000-ohm resistor, that value being chosen for optimum oscillator grid current. R1 and R3 are the screen-dropping voltage divider resistors, and C4 acts as the screen by-pass. These values were selected to attain proper screen voltages from a variation of 50 to 250 volts that may be encountered by tapping power from the B-plus supplies of various receivers.

The plate coil is a special brass slug-tuned coil T3. (This is actually the R compensation coil from the control head of an Army mine detector. [See figure on page 676, July, 1946, RADIO-CRAFT.] These are available in many places as surplus, but if not obtainable a coil may be constructed as described below.) The brass slug reduces inductance when inserted into the coil. With the slug all the way in, resonance occurs in the 14-mc region. With the slug all the way out, resonance occurs in the 11-mc region. The circuit has a low Q, which is desirable, as it will not be necessary to manipulate this control while tuning the receiver. A 12-mc, air-tuned condenser circuit may be substituted for the slug-tuning arrangement used here. Coupling from the plate to the receiver then can be a 10-μμf condenser. The brass slug-tuned coils are then constructed of No. 18 d.c.c. wire on a ⅜-inch form. Both the coils have 24 turns and are tight-coupled by adjacent winding. Dimensions of coil forms are given in Fig. 2.

The output coupling condenser C6 is of the value needed to allow trimming adjustment of those receivers that have an antenna trimmer on the front panel, and will be correct for most receivers. To simplify the switching in the converter and to prevent the converter from loading the antenna input to the re-

ceiver when normal input is desired, the bottom of the output coil is connected to B+. This is effectively ground at radio frequency, and when S-1 is opened to restore the antenna directly to the receiver, the output does not shunt the antenna to chassis. S-1 is therefore the band-change switch. It is a double-pole, double-throw switch arranged so that B+ and antenna circuits are connected to the converter in one position, while in the other position the B+ is removed and the outside antenna connects through the converter to the receiver antenna post with minimum attenuation. The antenna may be left connected to the converter at all times, and the converter permanently connected to the receiver.

Power supply connections

Power for operation of the 6SA7 converter tube is taken from the receiver to which it is attached by a cable with a tube base and socket fitted to the end which can be plugged into an i.f. stage of the set. The i.f. tube is then refitted into the adapter. As all sets have different arrangements for filament supply and B+ at the i.f. socket, different ways to arrange cable wiring are required. The figures show typical arrangements for use with some of the commonest Army and Navy sets. For the BC-312 and BC-342 the 12-volt filament supply

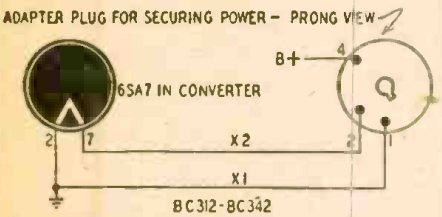


Fig. 3—Connections for BC-312 and BC-342.

is arranged as shown in Fig. 3. For those sets which use a 28-volt filament supply, it is necessary to employ a 60-ohm filament-dropping resistor. Sets which are wired with a 6.3-volt filament with the center tap to ground will have to have an extra wire in the cable to carry the other ungrounded side, or the center tap will have to be ungrounded. For use with the BC-348 the screen supply of the i.f.—usually tapped for the converter—is much too low. Using this set, it is necessary to wire directly to the power supply terminal.

The entire unit can be housed in a standard commercial metal box 5 x 4 x 3 inches. All parts are mounted on the front panel, with the tube socket mounted on a bracket which allows it to lay parallel to the panel. Keep the input and output coils at right angles because of the lack of shielding between them. A hole should be drilled in the front or side of the box to allow the oscillator frequency to be set.

Lining up the converter

Calibration and adjustment of the converter is very simple. Hook the converter to the antenna post on the receiver with a short length of shielded, low-capacity cable. Plug the power cable

(Continued on page 65)

PLOUGHING BY RADIO
(Continued from page 54)

control of several tractors, by automatic radio-directed devices presents little difficulty. It would appear that there is a wide field for improvement and ingenuity in agricultural machinery and farming techniques but quite how far it is possible to go in the matter of "armchair control" is debatable.

If the engineer and scientist can devise equipment which is easily serviced and thoroughly reliable in operation, there is a fair chance of automatic control being a marketable feature. The limitations of simple radio control lie mainly in the ability of the controller to see the object he is controlling; once the object is out of view there is no certainty as to precisely what it is doing, nor of the response to executive signals.

Much of this objection is overcome by ensuring that the equipment is reliable and by arranging the circuits so that undesirable conditions are prohibited—for example a failure in the reception of signals should definitely stop the machine and not leave it running more or less out of control. Prohibitions of this kind are simple and very necessary.

One line of attack very well might be an arrangement wherein a master tractor, carrying the controller, is fitted with the transmitter; the controller then operates a set of slave tractors all of which are in his immediate vicinity.

Colorfax, new color facsimile equipment introduced by Finch Telecommunications, uses ordinary colored pencils to trace its picture. Pencils, in magnetic cylinders, revolve around an axis drawing horizontal lines on the paper. A scanner working through color filters transmits current to each cylinder in proportion to the color strength of the copy scanned, thereby regulating the pencil pressure and reproducing the original in its own colors.

10-METER CONVERTER

(Continued from page 63)

into the set. The receiver is first used to adjust the oscillator. Tune the receiver to 16 mc. Adjust the padder on converter through the hole in the panel until it comes in on the receiver at 16 mc. If the receiver does not have an S-meter or a beat-frequency oscillator, raise the gain control until the noise level cuts out. Locating the oscillator signal on the receiver is easy, as it is strong. Since this adjustment is quickly and easily made, the calibration of the unit can be readily checked and reset in case of drift. When the frequency has been set up, tune the receiver to the band that covers from 11 to 14 mc and tune in a 10-meter signal. Adjust the input and output controls on the converter to peak intensity. All peak indications will be broad, so that a peak indication set somewhere in the middle of the band will hold true for all stations. For very weak signals a slight adjustment may help occasionally. Generally, the only control to be varied will be the normal receiver tuning. New frequency readings of the dial can be made easily by simply adding 16 to the dial reading. The 16 has already been established by previous calibration, making the new calibration accuracy of the same order.

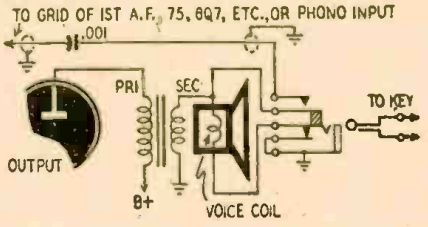
Certain precautions should be taken to prevent the break-through of strong stations operating on the intermediate frequency used. Proper shielding of the antenna lead to the receiver from the converter will reduce stray pickup and minimize interference. Good grounding of the cable at both ends is important. If the interfering signal is very strong, the oscillator frequency can be readjusted to shift the station outside the band so that no interference is experienced.

A converter such as the one described can be made small and compact and easy to mount on the side of the receiver. It is simple and inexpensive to construct and requires no additional power supply. Since all adjustments are preset and do not require constant resetting, it makes a very useful device for extending the frequency range of your receiver.

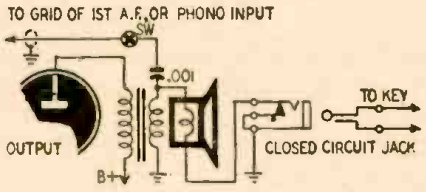
CODE OSCILLATOR

The audio system of the average radio can be used as a code practice oscillator by feeding some of the output voltage of one stage back to the input of a preceding stage. A simple way to do this is to feed some of the voice coil voltage, in proper phase, back to the grid of the first a.f stage through a 0.001-μf condenser.

The circuit is keyed in the voice coil leads, since the capacity of the keying leads is sufficient to sustain oscillation if the feedback circuit is keyed.



If a two-circuit jack and condenser are used as shown above, it closes the feedback circuit and opens one of the voice coil leads when the key plug is inserted. The circuit will be completed as the key is closed. If this type jack is not available, a closed-circuit jack and a low-capacity switch may be installed



(second figure). Pitch and volume are controlled by the setting of the volume control and the capacity of the condenser.

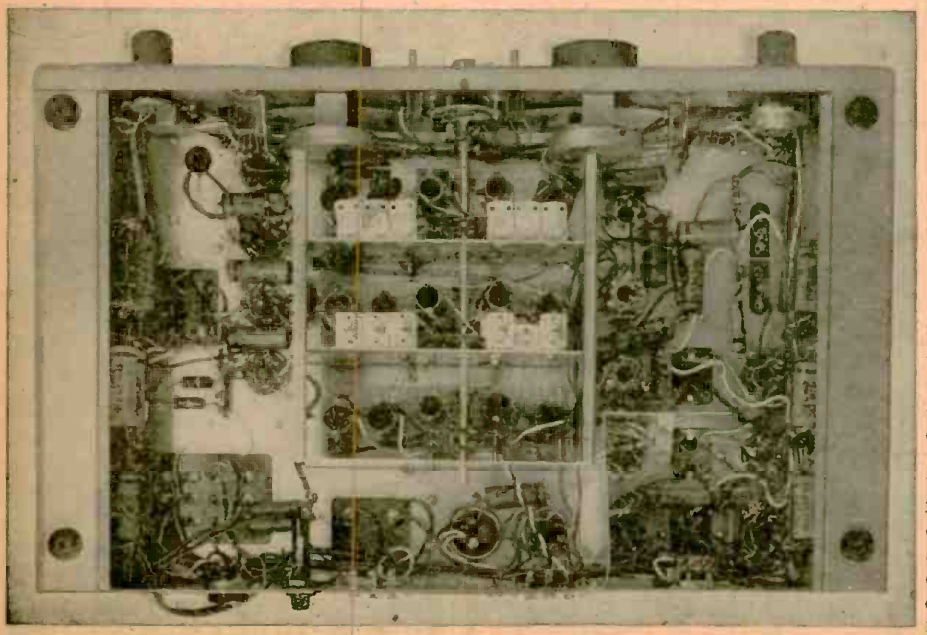
JOSEPH SILVER,
Philadelphia, Penn.

(Other feedback circuits can be used. In radios with output transformers on the speaker, it is often possible to connect to one of the voice-coil terminals and back to the phono input.—*Editor)*

RADIO SET AND SERVICE REVIEW

(Continued from page 33)

chassis. A tuned filter is used at the output of the 5Y3-GT rectifier. An OD3 voltage regulator delivers regulated voltage to the local oscillator, r.f. amplifier and first detector screen grids and to the b.f.o. Battery power may be used for portable or emergency operation by using a 6-volt storage battery and a 135- to 250-volt B-battery. Connections are made to a special socket at the rear. All receiver functions are normal with battery operation.



Under-chassis view of the National NC-173. Note placement of trimmers along the center.

An accessory-connector socket provides a convenient connecting point for such accessories as FM adaptors, crystal calibrators, converters, and other equipment that may require power from the receiver. The a.v.c. line is tied to one of the terminals so that control voltage may be applied to a converter or preselector, or the a.v.c. systems of 2 receivers can be tied together for diversity reception. One terminal on the socket parallels the phono input jack so a.f. signals may be supplied from the rear. In this event, a dummy phone plug should be inserted in the phono jack.

The NC-173 was tested in a very poor receiving location in downtown Manhattan. It proved to be highly sensitive and selective enough to provide single-signal reception of phone or c.w. signals. The antenna trimmer works wonders in bringing a weak signal out of the S5 to S8 noise level common to this location.

The cabinet provides good electrical shielding, making it impossible to pick up any but the strongest of local stations without some type of antenna. The receiver is also remarkably quiet without an antenna, even with both the gain controls in the "wide open" position.

The set is remarkably stable both thermally and electrically in spite of the fact that all components above the chassis, including the tuning condensers, are too hot to touch after about 5 hours of operation. The completely shielded cabinet is almost airtight, thus preventing a free flow of air required for cooler operation.—*R.F.S.*

TECHNOTES

. . . PHILCO 37-61

Intermittent reception on strong signals may be caused by a shorted voice coil due to a warped speaker.

Re-center the cone or replace the entire speaker.

WELTZ C. HANKS,
Crowley, La.

. . . . FORD (PHILCO) 1940-41

If severe static is encountered when traveling over rough roads, use shielding braid to bond the r.f. and i.f. shield cans together and connect them directly to the case—not the chassis—of the set. This cures the trouble every time; even when the cans are tied firmly to the chassis.

EDGAR CAMPBELL,
New Market, Tenn.

. . . . MOTORBOATING MIDGETS

Motorboating on the low end of the dial is a common complaint on midgets and portables using loop antennas. This is often caused by feedback from the i.f. stage to the loop. Align the set.

If a glass tube is used in the i.f. stage, replace it with a metal equivalent. As a last resort, try retuning the i.f. to about 435 kc. This will do the trick in most cases.

JOHN R. SIMPSON,
Gainsville, Fla.

. . . . STROMBERG-CARLSON 1101-H

A number of these sets were returned to our store for pilot light replacements shortly after being placed in service. Investigation showed a 5-tube circuit with a 35Z5 rectifier using dual 40-μf condensers. We replaced the input filter with a 16- or 20-μf unit with very little sacrifice in plate voltage (2 to 4 volts) and negligible increase in hum.

LAWRENCE N. DUNCAN,
McMechen, W. Va.

. . . . PHILCO MODEL 42-380

If the power supply is shorted and the bias resistors overheat, look for a filament-to-cathode short in the 6X5 rectifier tube which operates with one side of its filament grounded.

LEONARD L. SMYLIE,
Vallejo, Calif.

SW ROTARY ANTENNA

(Continued from page 34)

ing a nice report of S9 plus 10 db for a solid 40-minute QSO, on Saturday, of all madhouse days possibly the worst on the crowded 10-meter band.

It would be a very good idea, especially if the same type of split-center elements are used, to incorporate either tuning stubs at the middle of each element of the array, or better yet, to tune them by means of 100 μμf variable condensers, as suggested and used by W6DAX on his 4-element array. Flexible rubber tubing, or plastic tubing, secured to the condenser shafts will permit tuning in a moment to an almost perfect degree, with no trouble from lop-sided elements. With such a system, one man and a field-strength meter can get more out of a beam than half a dozen could using the conventional sliding-end elements, and without the necessity of continually swinging the array back and forth during the tuning process. Tuning and element lengths, incidentally, of the 5-element system described appear to be almost identical with conventional systems. Loading was easily accomplished with a four-turn link in the center of a split-tank final.

The impedance of the system is a moot question. We figured 4 ohms would come fairly close, and wanting to try it out as soon as possible, we used 300-ohm Twin-Lead to a quarter-wave matching section consisting of paralleled, 6-foot, 72-ohm Twin-Lead. Two sections, giving a stub impedance of some 37.5 ohms paralleled, seemed to work out nicely with the 300-ohm feed line, but a tuned stub of course would be the proper method of securing a really efficient match in a duplicate installation.

For the ham who already has a 3- or 4-element job, and wishes to get that power down to an optimum angle in the quickest and easiest way this stunt of adding top and bottom reflectors is recommended. It may be useful as well to those who may be hunting for design data on the construction of an entirely new system. Its performance at the author's station, under all conditions, has definitely shown the 5-element job to outperform any other system tried, without giving us the major headache of trying to support a heavy, awkward structure of impossible dimensions on top of an average dwelling.

INTERFERENCE SUPPRESSOR?

In my radio shop, fluorescent lamps cause serious interference on my a.c.-d.c. radio. I have reduced and even eliminated the noise by plugging in my amplifier, which has a fairly heavy power transformer, with the B-plus off. In fact, any power transformer that may be lying around will reduce or kill interference by simply plugging it into the line.

E. M. CORTEZ,
San Pablo City, Philippines

Investigations on use of radar for inland navigation are being made in Canada by a special vessel commissioned by the Canadian National Research Council.

250-WATT TRANSMITTER

(Continued from page 27)

signed, the metal type was not available. The 2 large glass tubes are the 6F6-G's. The square transformer between the two 6F6-G's and the rear of the chassis is the driver transformer for the TZ-40 modulators. The 5Z4 rectifier, the filter chokes, and power transformer for the speech amplifier power supply are shown grouped at the right of the chassis.

The small power transformer and Type 80 rectifier at the rear center of the chassis are components of a 200-volt d.c. bias supply for the final r.f. amplifier. The small pointer knob formerly controlled a bias potentiometer and switch and has no circuit function in the final design. The 6H6 tube, shown slightly to the left of the 0-1 d.c. milliammeter, is a rectifier for the percentage modulation indicator.

Construction of the speech amplifier and modulator is more or less conventional and quite simple. Unless the builder has had considerable experience with high-gain audio amplifiers, it is suggested that he adhere strictly to the design and layout as shown. No troubles from hum or instability were experienced. However, as the speech amplifier is included as a part of the complete rack assembly, it was found necessary to use a metal shield plate over the open bottom of the chassis to prevent stray r.f. voltage from entering the 6SJ7 and 6L7 input circuits. In some installations, the use of a 2.5-millihenry r.f. choke in series with the 6SJ7 control grid may be required to prevent r.f.. from reaching the input circuit. The r.f. choke, however, should *not* be used unless it is absolutely necessary, as its windings may pick up 60-cycle hum. R.f. feedback into the speech amplifier can be minimized by shielding the bottom of the chassis and by good ground connections between the various chassis in the rack. At this time a word of caution is not amiss: *Do not depend upon the panel mounting screws for ground connection.* This is extremely dangerous as there is always a possibility of the r.f. panel having a potential difference of 1,700-2,000 volts to ground if the panel screws do not make a good connection between the panel and chassis and the cabinet. The various chassis should be connected together with flexible metal braid to which heavy duty lugs have been soldered. The lugs should be attached to the chassis with nuts and bolts; and the entire assembly, including the metal cabinet, should be connected to a good ground, such as a water system. All leads shown enclosed in dotted lines are loosely shielded by means of flexible metal braid tubing. The tubing should be grounded to the speech amplifier chassis. Keep all wiring between stages short and direct; all leads carrying 60 cycles a.c., such as the heater wiring, should be twisted together and dressed close to the metal chassis to restrict their external fields.

(Continued on page 74)

HOUSEWIVES AND TELEVISION

(Continued from page 31)

berry reverently. Mrs. Hockfleisch nods approval. Vanderstupe's suggestion is immediately carried into action. The irons are discarded, and placed in the refrigerator to cool off.

Mrs. Tittleberry fingers an i.f. can. "Does anyone know where this resistor goes?" she asks hesitantly.

Mrs. Hockfleisch laughs heartily. "Resistor, indeed!" she cries. "Why, you silly, that's no resistor—that's a *condenser!*"

Helping each other in this way, the women continue their work. Mrs Hockfleisch wires up her set carefully, making sure there is no clash of colors. Tittleberry carefully attaches the power line cord to the oscillator coil. Vanderstope has gotten some bread crumbs into the tuning condenser, and is busy prying the plates apart with a can opener to get the particles out.

So the time goes pleasantly by. Occasionally the murmur of conversation is drowned out by the shattering of a cathode-ray tube. When the walls have stopped shaking, the women continue where they left off, while tenants in the floors above and below pick pieces of glass out of their eyeteeth.

In the evening, the ladies put aside their glue pots, can openers, and other tools. Vanderstupe and Tittleberry depart for their respective homes. Mrs. H. eagerly awaits her husband, Montmorency Hockfleisch, greeting him proudly when he arrives.

"You'll never believe it, Montmorency, but I'm building a television set," she exclaims.

"Got supper?" asks Mr. Hockfleisch brusquely. He's had a hard day at the office. He's due for a harder night at home.

The salad is garnished with cathode-ray tube particles. The beef stew is filled with half-watt resistors.

Mrs. H. is overjoyed at finding these missing components. Mr. H., however, scarcely shares her pleasure. His sullen apathy flares into hot anger when he bites into a 10-μf, 450-v condenser.

"Holy smoke, this is too much!" shouts Hockfleisch.

His overburdened mind gives way.

Rushing into the living room, where his wife has been playing the phonograph to drown out his anguished cries, he jumps into the automatic record changer while it is changing records, and is never seen again.

Television did it, gentle reader.

Keep it away from housewives, is our moral.

CARRIER RADIOPHONE

(Continued from page 25)

The other end of the rotating coil is connected through the back shaft to winding G, which consists of 15 turns. The end of winding G is connected to B+ through switch S-202. Windings E, F, and G are wound in 2 layers. The ANT. COUPLING rotating coil is *not* connected into the plate circuit; it has one side grounded and the other connected to the r.f. output jack. The 6-volt pilot lamp (r.f. indicator) is connected directly across this winding.

The M.O. and P.A. coils can be constructed by rewinding a commercial transmitting coil. Such a coil is manufactured by E. F. Johnson Co. under the numbers 661 for 20 meters, 662 for 40 meters, and 663 for 80 meters. The revolving ANT. COUPLING coil may be replaced by a fixed winding of about 16 turns located between windings E and F. The exact number of turns and the placement of the windings is not critical.

If you prefer, the rotating coils may be eliminated entirely. In the construction of P.A. coil L203, the ANT. COUPLING may be replaced by a fixed winding of about 16 turns located between windings E and F, the P.A. TUNING coil would be eliminated and coils G and F joined directly together. The M.O. coil L201 would have windings A and B joined together in one continuous winding, and rotating coils C and D would be eliminated. The P.A. coil then would have to be tuned by a variable condenser together with C7 across it; the M.O. coil also would be tuned with a variable condenser together with C2 and C3 across it. These condensers would each have a capacitance of about 350 μμf.

Place a shield between the oscillator and power amplifier stages.

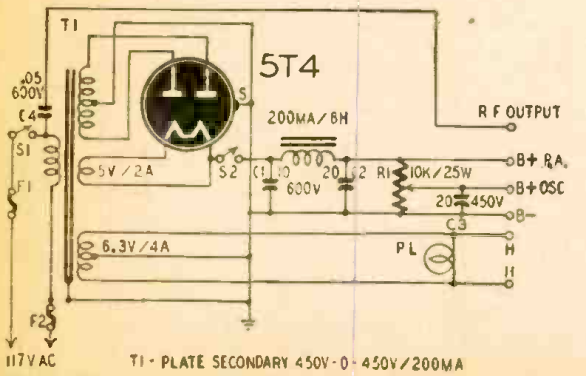


Fig. 4—The power supply. High voltage should be 450-450, 200 ma.

Power supply

The power supply can be constructed on either a metal or wooden chassis about 10 x 6 x 2 inches. See Fig. 4. Mount the transformer, choke, tube *(Continued on page 72)*

CARRIER RADIOPHONE

(Continued from page 71)

and bleeder resistor R1 apart so as to provide good radiation of the heat generated. Use rubber grommets for all through-the-chassis wires. Place a fuse in both leads from the power line!

Switch S-1 is the main power switch; switch S-2 is the standby B-power switch. When the power supply is connected to an outlet, *make sure the chassis of the transmitter is not hot in respect to any grounded objects.*

The adjustable tap of the bleeder resistor should be set so that the oscillator is supplied with about 250 volts. This adjustment must be made with the oscillator load connected because the voltage drops when a load is applied. Do not try to move the tap when the screw adjustment is tight or when the power supply is on.

The power supply is designed to operate the transmitter as well as a 10-watt modulator.

Operating instructions

Switch S-201 (M.O. TUNING STEP A) roughly adjusts the frequency of the oscillator. M.O. TUNING B operates a revolving coil within L-201; it changes the frequency of the oscillator by aiding or opposing the inductance of the fixed winding. Switch S-202, which is labeled C-P.A. TUNING RANGE, turns off the B-supply voltage to the 807 tube. P.A. TUNING STEP D operates a selector switch which roughly tunes the plate tank coil by adding and subtracting turns. P.A. TUNING E rotates a coil inside of the plate tank coil; this control tunes the coil L-203 to the exact desired frequency. ANT. COUPLING H rotates the coupling coil and determines the amount of r.f. energy delivered to the power line.

Test the transmitter with the case and shield removed. If the 6L6 stage is oscillating, a neon lamp will glow when it is placed near grid or plate leads of the oscillator. The plate and screen current, as measured with a d.c. milliammeter connected through jack J1, should be about 50 milliamperes with 250 volts applied to the 6L6 if the tube is oscillating. The plate current will be about 100 milliamperes if the tube does not oscillate.

To tune the final amplifier to the frequency of the oscillator, turn on the final stage switch S-202, turn the ANT. COUPLING H to about 5, and connect the pilot lamp output indicator. Turn P.A. TUNING STEP D to each of the four positions. At one position the pilot lamp should glow. Adjust the P.A. TUNING E so that the pilot lamp is brightest. Do not advance the ANT. COUPLING control too high or you may burn out the pilot lamp.

Calibration

To stay within the recommended limits of 160 to 200 kilocycles, you should determine to what frequency the oscillator is tuned with different set-

(Continued on opposite page)

MARKING TERMINALS

To mark terminals either on strips or tube sockets, I use white ink for lettering and coat it with clear nail polish or lacquer for a durable protective covering. An Artgum eraser is useful in removing any dirt or oil film from the surface before the ink is applied.

R. E. BLAYLOCK,
Little Rock, Ark.

tings of the vernier dial M.O. TUNING B and selector switch M.O. TUNING STEP A. This can be done with sufficient accuracy if a broadcast receiver with true calibration is available. Several harmonics from the transmitter will fall within the broadcast band. By noting the frequencies of these harmonics with each setting of M.O. TUNING B, it will be possible to calculate the frequency of the transmitter. Since the harmonics are integral multiples of the fundamental, the difference between two adjacent harmonics will equal the frequency of the fundamental. The range of the transmitter will be about 160 to 270 kilocycles. Before calibrating, replace the shield and case. This is important because the frequency will certainly shift when the shields are put in place.

When you choose the frequency on which to operate, keep in mind these harmonics that fall on the broadcast band. Adjust your frequency so the harmonics will fall between broadcast stations where they will not cause any interference with broadcast reception in neighboring receivers. Also, keep the ANT. COUPLING H at the lowest setting that will maintain communication. Signal strength may often be increased by connecting an .05-uf condenser between chassis and the grounded side of the line.

Provisions are made for cathode keying through jack J2 on the front panel.

The second part of this article will describe the construction of an inexpensive 10-watt modulator for carrier-current phone operation and a simple carrier-current receiver, which can be used in conjunction with this transmitter. It will appear in an early issue.

AIR DRYER

Crystal pickup cartridges, paper condensers, phonograph records, and other parts easily damaged by moisture or mold, particularly in humid climates, can be preserved for long periods by placing them in a cabinet having a circulating draft of warm air. Install a 8- to 10-watt electric heater unit, like those designed for use in incubators, in the bottom of the cabinet. The continuous circulation of warm air will prevent moisture from condensing on any surface in the cabinet. Use 2 units in parallel if the air is too cold, and in series if the air is too hot.

Electric lamps may be used, but they are less efficient and require more power.

R. DEL VALLE SARROGA,
Santurce, Puerto Rico

250-WATT TRANSMITTER

(*Continued from page 70*)

Before placing the speech amplifier in the transmitter rack or connecting it to the TZ-40 modulators, test it with an audio-frequency signal. The simplest test is to connect a PM dynamic speaker having an output transformer with a primary impedance of from 5,000 to 10,000 ohms across the secondary winding of the class-B driver transformer and to feed an audio signal into the microphone jack. Better results will be obtained if a record player, using a crystal pickup cartridge, is used to supply the audio test signal. When using a record player, however, it is necessary to connect a 10,000-to 20,000-ohm fixed resistor across the output leads from the crystal cartridge for tone compensation; otherwise the reproduction will sound tinny, and a false impression of the audio-frequency response characteristics of the amplifier will be obtained. The microphone has entirely different characteristics, and the tinny effect will not be present.

As mentioned above, inverse feedback is employed in the 6F6-G class-A driver stage. As the schematic (Fig. 1), shows, the feedback circuit is composed of two 4-μf, 600-volt d.c., *oil-filled* capacitors and two 5,000-ohm, 10-watt fixed resistors. The 2 resistors are connected in series between the two 6F6-G screen grids, with the center junction connected to the center tap on the driver transformer primary and B-plus. A 4-μf capacitor is connected from each TZ-40 grid to a screen grid of the push-pull 6F6-G tubes. The exact connection will depend upon the direction of the 2 windings of the driver transformer. *Do not, under any circumstances, connect the driver transformer to the TZ-40's, with plate voltage on the modulator tubes, until the correct phasing of the feedback circuit has been established.* With the loudspeaker connected to the driver transformer secondary, as described above, and with the audio gain and compression controls in the OFF position, reverse the connections of the 4-μf capacitors and the secondary winding. In one position the 6F6-G's will oscillate at about 300 cycles and the tone will be heard in the loudspeaker; a reversal of the connections will stop the oscillations. *The position in which no oscillations are heard is the correct one for inverse feedback action.* If this precaution is not observed, the oscillations may be strong enough to drive the plate current of the TZ-40's sky high and damage the modulator tubes or the modulator transformer.

It will be found that the speech amplifier gain control for average voice range microphones, such as the Turner 22-X, will run about three-fourths of the way up for proper excitation to the TZ-40's.

The next installment of this series will deal with the modulator, adjustment of the compression circuit, the modulation percentage indicator and the monitor.

FIELD STRENGTH METER

(Continued from page 22)

teries have changed value and should be checked and replaced, if necessary.

To operate the unit as a field-strength meter, a short length of stiff wire or tubing is connected to the antenna post. The signal is tuned in with the TUNING control coupled to capacitor C1. The unit is of course most sensitive at resonance; but if the signal is too strong, relative measurements may be made at an off-resonant point. If

There is very little under-chassis wiring.

the signal does not give a large enough deflection, a longer antenna may be connected in series with a capacitor and the case grounded. The series capacitor is necessary to prevent serious detuning. This is often necessary when the unit is used as a monitor at some distance from the transmitter, or a doublet antenna may be connected to the primary winding.

Also a frequency meter

By using an accurately calibrated receiver as a standard the unit can be calibrated as a wave meter, for which purpose the same antenna must always be used. The unit is particularly handy when building a transmitter. The primary winding is included for this reason. A twisted-pair feeder is connected to the tip jacks and a coil connected to its free ends is coupled to the circuit under test.

When using the unit as a vacuum-tube voltmeter, be certain that a d.c. path for the grid bias is provided by the circuit under test.

A filament transformer, a potentiometer, and an a.c. voltmeter are used to calibrate the unit as a vacuum-tube voltmeter with a basic range of about 5 volts. A graph of a.c. *vs.* d.c. voltages reading can be plotted, or the meter scale can be calibrated directly. The range and sensitivity of the unit are sufficient for all practical problems. The range may be increased if desired with a high-resistance voltage divider of the correct size for the range required.

TRANSATLANTIC NEWS

(Continued from page 38)

tenna shows a mid-point voltage about 6 db less than that of a vertical half-wave dipole. But the metallic parts of buildings, such as gutters, water pipes, and electric wiring conduits, often completely change the polarization of the incoming signal by re-radiation. Further, the polarization of a v.h.f. signal may vary from time to time, as it does at my home. The relative inefficiency of the inverted V is thus largely offset by its indifference to the polarization of the signals with which it is dealing. Mounted on a 40-foot mast out of doors, or attached to a pole clamped to a chimney, it gives satisfactory and constant results. Its directional qualities are of real value in eliminating ghosts and interference which would otherwise be caused by man-made static. Television and other v.h.f. enthusiasts may find an antenna of this type well worth trying.

New Swedish broadcasters

Sweden is soon to have 2 of the world's most powerful short-wave broadcasting stations. The transmitters are now being manufactured in England. They are scheduled for delivery within the next 12 months, and both stations should come into operation early in 1949. They will be situated at Hörby, near Malmö, in the extreme south of the country. One is to be used for omnidirectional broadcasts, and the other will have a new type of antenna system so designed that the transmissions can be beamed in any direction.

Radar and coal

Nearly all the coal used by London's electricity and gas generating stations is transported by sea from the great mining areas in the northeast of England. The ships carrying it steam close to the coast through the North Sea which, in winter, is liable to be blanketed by very dense fogs. Until recently there was nothing for it but to lie to until the fog cleared away. It was indeed fortunate that before the terrible coal crisis of last winter some of these ships had been fitted to use the Decca navigational aid system; otherwise our homes would have been even colder and darker than they were! Nearly all the ships are now using it. It will undoubtedly be of great assistance in enabling coal transport by sea to continue in all weathers during the shortage which is bound to occur in the coming winter. Readers are no doubt familiar with the Decca system, which is different from either Gee or Loran, though like both of these it uses lanes composed of hyperbolic lines. It has proved peculiarly satisfactory for use at sea; and at the recent international meeting in New York on radio aids to navigation, the U.S.A. and Britain jointly put forward a resolution, which was accepted unanimously, that its adoption should be world-wide.

Olympia radio show

The Radio Exhibition, which is to be held at Olympia, London, from October 1 to 11, will be the first in 9 years. The 1939 show was wiped out by the outbreak of the war on September 3 of that year, and since the end of the war labor and material supply conditions have been too chaotic to justify anything like a Radiolympia. Things have settled down a little now, and this year's show should be particularly interesting. The intention of the organizers is to run it on entirely new lines. Many people feel that the reforms suggested are long overdue. In the past the exhibition was of far too popular a nature: it concerned itself too much with the entertainment side of broadcasting and too little with technical radio developments. It was by no means unusual to find a stand staffed entirely by salesmen, with no one available to give intelligent answers to queries about the technicalities of the exhibits. This year there is to be a big change. It is realized that hundreds of thousands of men and women received radio and radar training in the armed forces and that they are interested now in the wider aspects of radio. For that reason the show has been thrown open to manufacturers of all kinds of electronic equipment and is no longer confined to apparatus used for broadcast reception. Among the radio exhibitors will be the General Post Office (which conducts our telephone and telegraph services), the Police, Cable and Wireless, the Ministry of Civil Aviation, and 23 firms specializing in electronic and communications equipment.

Meteors and radar

For some time now a continual radar watch on meteors has been maintained at the experimental station of Manchester University. One of the most important features of these observations is that they detect meteors arriving in daylight, which cannot be seen by the eye. This summer a completely unexpected phenomenon has been observed: during the months of May, June, and July the earth passed through a very dense stream of meteors, which reached it on its daylight side and would have passed undetected but for radar. The meteors were counted and the figures are surprising. During the showers of meteors which we see by night at certain times of the year the number of arrivals seldom average more than 20 an hour, though it may rise to 40 to 50 an hour at peak periods. These daylight meteors never fell below 20 to 30 an hour during the whole 3 months, and there were many periods during which 80 to 90 an hour were recorded.

SELENIUM RECTIFIER

When replacing a rectifier tube with the new selenium rectifier disc, mount the unit and the small resistor that it is often necessary to use with it in a tube base with the required connections soldered directly to the base pins.

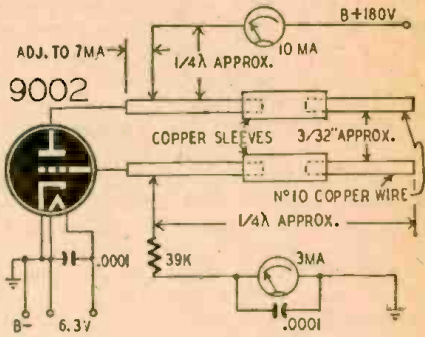
AL GOODELL,
College Station, Texas

watts, substitute a power transformer with a high-voltage secondary delivering 855 volts each side of center at 250 ma. The output transformer should be rated at 45 watts or more, with a plate-to-plate impedance of 10,000. Change R1 to 134 ohms, 8 watts; R2 to 2750 ohms, 40 watts; R3 to 2950 ohms, 40 watts; and R4 to 3 megohms.

Twelve-volt tubes (1625's and 12SJ7's) can be used in these circuits with proper changes in the filament supply.

600-MC OSCILLATOR

The steady climb toward higher communication frequencies requires that new design and construction techniques be applied to receiving and transmitting equipment. A simple oscillator operating up to about 600 mc is useful in investigating u.h.f. and v.h.f. characteristics and techniques.



This 600-mc, long-lines oscillator circuit using a 9002-u.h.f. triode was shown in the *RCA Guide for Transmitting tubes*. The plate and grid lines consist of short pieces of No. 10 bare copper wire with tight-fitting copper sleeves for tuning adjustments. Each line is about 5 inches long for 600 mc. They are parallel and about 3/32 inch apart.

The grid leak is clipped to its line about ¼ wave length from the open end. The grid current at this point should be about 1.5 ma. The plate tap is adjusted for 7 ma plate current. A hairpin loop above and parallel to the lines makes a good output coupling device. Power output is about 0.5 watt.

THE QUESTION BOX

(Continued from page 48)

A. In this circuit, a pair of 150- or 200-ma selenium rectifiers is suggested to carry the current drawn by the amplifier. The input circuits have separate volume controls. A master control may be used in the grid circuit of the 6SJ7 by replacing the 500,000-ohm fixed resistor in this circuit with a 500,000 variable resistor with the arm connected to the grid.

With the filaments supplied through a dropping resistor, it is necessary to shunt the 6SJ7 and 6F5's with 42-ohm, 2-watt resistors. You may connect the filaments in parallel and supply the voltage from a 6.3-volt, 2-ampere filament transformer. The heavy line on the diagram indicates a common negative bus that is insulated from the chassis.

NEW RADIO-ELECTRONIC CIRCUITS

(Continued from page 41)

plies enough gain to drive the class-AB1 807's to full output with less than 0.25-volt input. The output transformer should be able to handle at least 30 watts and have a plate-to-plate impedance of 6,600 ohms. The halves of its primary should be closely coupled to prevent phase shift in the feedback loop between one side of the primary and the screen grid of the 6SJ7-GT. Perfectly balanced transformers are almost unobtainable, so a 50-μμf bypass is in the 6SJ7 plate circuit to prevent parasitics at high volume levels. The amplification is down only 1.5 db at 10,000 cycles. If a greater reduction of highs is desired, increase the value of bypass. When output is viewed on a 'scope, parasitics will be indicated by widening of the trace for a portion of the cycle.

The output tubes are operated with semi-fixed bias, a part of the bias being developed by the bleeder current flowing through R1, and the remaining portion by the cathode current of the 807's.

For 30 watts output, use values in the diagram. To increase power to 45

MAGNETISM

(Continued from page 29)

The magnetic carrier

Although many factors are to be considered in the design and manufacture of magnetic tapes or wires for recording purposes, the most important are the *residual induction* and *coercive force* of the material. These 2 characteristics are best understood by examining the material's so-called *hysteresis loop* (which is nothing more than a visual indication of the lagging of magnetic induction—flux—behind the magnetizing force which produces the magnetism in the material). See Fig. 8.

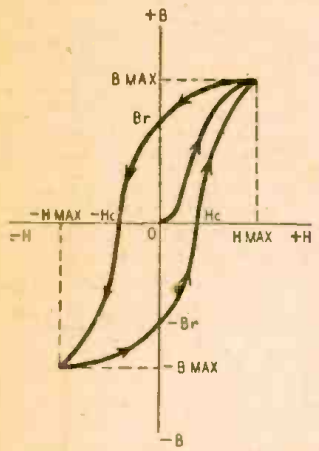


Fig. 8—Magnetic hysteresis, or B-H, curve.

The horizontal axis *H* represents the value of the magnetizing force per unit length applied—positive and negative. The vertical axis *B* represents the amount of flux per unit area induced in the material. Measurement begins with the material completely demagnetized (at O intersection of lines *H* and *B*). The magnetizing force is increased to a positive value beyond which further increases in magnetizing force produce no increase in the magnetism of the material. This registers a curve from O to *B* max on the chart. Then the magnetizing force is reduced to zero. However, a certain amount of induced magnetism *remains in the material*—as represented by the intersection of the return curve from *B* max to *B* at *Br*. This *Br* value

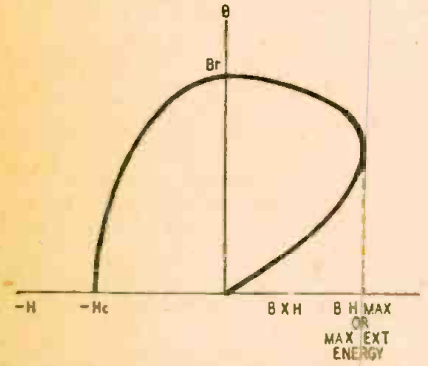


Fig. 9—The important demagnetization loop.

represents the peak residual magnetism the material will retain without demagnetizing influence. From this point, the

(Continued on page 80)

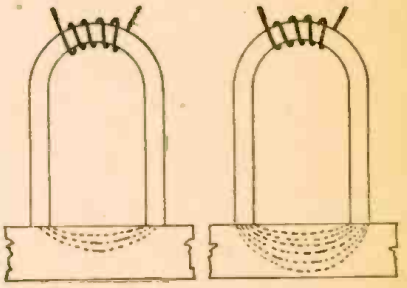
MAGNETISM

(Continued from page 79)

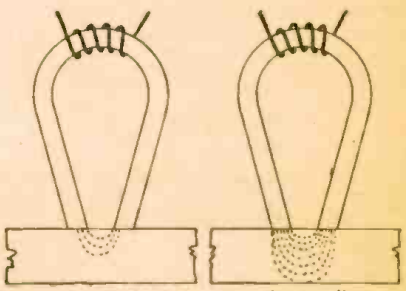
magnetizing force is changed in direction and increased to a negative saturation. This describes a curve from *Br* to an intersection with the *H* line at—*Hc* and on to a negative *B* max. Again the magnetizing force is reduced to zero, producing the curve from negative *B* max to negative *Br*. Re-establishment of positive magnetizing force carries the curve from negative *Br* to positive *B* max. Repetition of this magnetization and demagnetization process will result in the establishment of the complete symmetric loop about point O—the hysteresis loop.

Demagnetization curve

Most of the information required about a material is gained in the segment of the hysteresis loop (*Br to Hc*) known as the demagnetization curve (Fig. 9). As explained, the value marked on the *B* line at point *Br* indicates the maximum residual induction. The value marked on the negative side of the *H* line at *Hc* indicates the demagnetization force per unit length required to reduce the residual magnetism to zero. This is known as the *coercive force* of the material. Furthermore, it can be shown that the product of the flux density *B* and the unit demagnetizing force *H* represents the amount of magnetic energy that each cubic centimeter of the material is capable of supplying. In actual units, *B* x *H* divided



Figs. 10-a and 10-b—Patterns with large gap.



Figs. 10-c, 10-d—Same signals, smaller gap.

by 8 π equals ergs per cubic centimeter. In normal practice, however, only the product of *B* x *H* is quoted.

The variation of *B* x *H* between *Br* and *Hc* is shown on the right side of the demagnetization curve. From a practical standpoint, it can be shown that a magnetic wire or tape *designed to operate at a point on the demagnetization curve corresponding to the maximum value of B x H* will supply the

maximum amount of flux per unit volume of the material.

Other important characteristics of magnetic signal carriers include factors which influence transference, *penetration*, and *self-demagnetization*.

Transference, as previously indicated, is the property of transferring magnetic induction from one magnet to another by contact or near-contact. The degree of transference depends upon the magnetomotive force exerted by the modulator, the depth of magnetic penetration, and subsequent self-demagnetization. Both of the latter functions are dependent upon the thickness of the carrier, the air gap in the modulator, and the recorded wave length.

If we could stop the magnetic modulating process instantaneously and examine the magnetic fields produced within the carrier during the peak energy transfer period of a weak and strong signal fed into 2 modulators, one with a relatively large gap and the other with a smaller one, the magnetic field within the carrier probably would resemble Fig. 10.

Fig. 10-a shows the small degree of penetration obtained with a large gap and low signal (magnetomotive energy). Fig. 10-b indicates the deeper penetration obtained with a larger signal. A further increase of signal energy would saturate the carrier. Fig. 10-c shows the shorter effective magnetic field generated in the carrier by the small gap. As the gaps become smaller and smaller the induced magnetic fields become shorter and shorter until the magnetic isolation between pole pieces decreases to a point where a magnetic short takes place so that no energy is subsequently available for excitation of the magnetic detector. This is a form of *self-demagnetization*. This is roughly equivalent to decreasing the insulation between plates of a condenser until the leakage becomes so high that virtually no charge remains in the condenser. Self-discharge in an electrical sense is approximately analogous to self-demagnetization in a magnetic sense).

Other factors which influence the design and application of magnetic modulators (recording heads), magnetic detectors (playback heads), magnetic demodulators (obliterating heads), and their interrelation with the magnetic carrier (wire or ribbon) will be discussed in a succeeding article *Elements of Magnetic Recording* scheduled to appear in the November issue of RADIO-CRAFT.

Comments from readers will be welcomed by the author. Address all correspondence care of RADIO-CRAFT.

A Chinese Radio Exhibition will be held in Nanking in May, 1948, the Chinese Amateur Radio League announces. Amateur organizations all over the world are invited to contribute or loan station photographs and any other items which might be of interest in such an exhibition.

RADIO GADGETS

(Continued from page 17)

utilizing the natural vibrations of an operating radio set can be evolved with a little ingenuity. Specialty stores, department stores, radio stores and other outlets are always ready to buy such gadgets; every parent of young children is a potential buyer.

Radio sets, as we all know, give out a considerable amount of heat. To the best of our knowledge, such heat effects have not been used for any radio gadget.

Last spring at the Chicago Radio Show we gave away a booklet wherein the trade was treated to a collection of humorous radio ideas. Purely fanciful, they still contained the germs of ideas for successful gadgets. We mention only two of these which made effective use of the heat in radio sets. The first one was called the "Humidoradio." The idea here is to have a small flat tank placed just above the radio tubes. The little tank contains water, while a small pipe leads into the top cigar compartment. As the water evaporates, the cigars are humidified.

Another idea, the "Warmeradio," also a humorous one, was to seal the radio hermetically so no heat could escape. Two holes were fashioned in the top of the receiver. You placed your baby's milk bottles into the openings to keep them hot!

It would seem that some clever designer could make better use of the surplus heat generated by the radio tubes for other and more practical purposes. We can think of moving figures for toy purposes, revolving colored discs or globes to amuse Junior, and dozens of other similar ideas. Low-price gadgets of this type, if well made and reliable in performance, are always in demand.

To the best of our knowledge, neon tubes have so far not been harnessed to radio sets for visual effects. These colorful tubes use very little current and produce exceedingly beautiful effects. We can make small glass figurines, which glow softly in green, red, and other colors in the dark. It is a simple matter to connect such a device in the audio circuit of your radio so that the figures or illuminated devices would glow in unison with the music. If produced in quantities, such an item can be made reasonably cheap; it will find a ready sale not only for home use but in stores which sell radio sets, etc.

We now come to another branch of radio gadgets. These are in the servicing field. In this magazine we describe from time to time a number of such ideas, particularly pocket radio servicing probes. There is always a good market for these, especially those that can be sold at low prices. Servicemen require them and will buy if the item is priced right and works well.

At the present time there is an abundance of war surplus material, much of which can be bought at low cost and which can be used by the manufacturer of servicing gadgets of this

type. Any new device that will make it easier for the radio serviceman to service his sets — provided such an item is low enough in cost—will find an excellent market.

Fortunes are still to be made in radio gadgets of the types we have discussed here. This country with its superabundance of radio sets should be an inspiration to all inventors and designers. The potential market for such devices is incredibly large.

A CATHODE FOLLOWER

(Continued from page 37)

a Hammond 434.

In the circuit, the resistor *R* is chosen to give the -22 volts bias required for the 6F6 tubes, measured from cathode to driver-transformer secondary center tap.

The driver stage has two 6C5 tubes in push-pull and is also a phase inverter with direct cathode coupling.

The single-tube 6C5 stage has a frequency-compensating circuit consisting of *C* and *CH*. The tone control gives separate bass and treble boost. The values of *C* and *CH* should be arrived at by experiment in order to give best results with other parts used. I used .01 µf. for *C* and 30 henrys for *CH*. The choke should be mounted where the least hum is induced in it from the power transformer and filter choke, as it is especially susceptible to such hum pickup.

The remaining 6C5 and 6SJ7 stages are standard and give ample gain for phono and microphone.—*Robert M. Crooker.*

Radio Thirty-Five Years Ago

In Gernsback Publications

HUGO GERNSBACK

Founder

Modern Electrics	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Radio-Craft	1929
Short-Wave Craft	1930
Wireless Association of America	1908

Some of the larger libraries in the country still have copies of ELECTRICAL EXPERIMENTER on file for interested readers.

From October, 1913, ELECTRICAL EXPERIMENTER:

How to Build a Magnetic Hysteresis Detector, by *H. Winfield Secor.*

Sound-Operated Electric Dancer

"Electro" Audion Detector Used at University of Michigan Radio Laboratory.

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The Radio Detectometer

The Poulsen Motor Tikker

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Music by Wireless Now

Hudson Valley Wireless Association

New Chicago Wireless Station

Wireless Telegraphy at State Fair

Amateur Installs Wireless 'Phone.

Communications

PROGRESS OF TELEVISION IN ENGLAND

As a television engineer, I find your magazine interesting and useful. It gives me the American agle on electronice in general. Your treatment of television seems a little odd. It is regarded as quite commonplace here after 10 years of successful daily broadcasting (excluding that little interval of hate!) Your articles and advertisements hailing it as one of the *coming* wonders of the age seem a trifle out of date.

To give you an idea of the size of our television industry, there had been granted as of February of this year 50,000 television receiving licenses. Assuming a few unlicensed receivers, the number must be a little above that.

(Major Hallows, the BBC and the British assistant Postmaster-General give figures between 15,000 and 25,000. —*Editor*)

The price of receivers is well below that of American models. The cheapest is a tuned radio-frequency set, giving television sound but no broadcast radio. It uses a 7-inch tube and costs $140 plus purchase tax. A superheterodyne model with a 10-inch tube retails at $200, and a console model with a 15-inch tube costs $320.

As a serviceman, may I give a note of comfort to those of my profession on your side of the pond? I expect many of you are viewing the advent of television with something akin to apprehension, wondering about the expensive test gear you will have to buy. Forget it, brothers! The man who makes and sells test gear will do his best to convince you that masses of elaborate apparatus are absolutely necessary. I do all my work with a multirange volt-ampere-ohmmeter and a "megger." Very rarely indeed do I use a 'scope.

The vision receiver and the sound receiver are just plain receivers and normal service methods apply. The 2 time bases, line and focus, can give rise to only a few faults, all of which proclaim their nature on the screen: nonlinearity, low amplitude, no scan, etc.

Voltage, current, and resistance checks will locate most faults rapidly, and the effect of any change is seen immediately on the screen. Another point —don't let the high voltage frighten you. The current present is so small that the shock is considerably less violent than from the plugs of an automobile.

JOHN W. TURNER
London, England

(Possibly the great difference in television in the two countries is a difference in the state of opinion. In the U. S. there are at present about 75,000 sets in operation, 9 stations broadcasting regular programs. About 10,000 sets a month are manufactured. Television will not have actually arrived till it is common in every town and city in the country. That day is not far off, as evidenced by the fact one of the larger manufacturers is beginning to produce at the rate of 250,000 sets per year. —*Editor*)

THREE VOTES ON RADIO-ELECTRONIC CIRCUITS

Dear Editor:

I am dismayed and disheartened by your latest RADIO-ELECTRONIC CIRCUITS. Instead of the broad, idea-filled items which I have used from time to time as the basis for useful construction, there appeared a group of articles which, as far as I could see, are of no help to me other than to show me how to improve (?) some circuits.

I might welcome such material if it were printed separately as articles. But as replacements for such a perfectly good series as the ELECTRONIC CIRCUITS has come to be, the newer stuff lacks quality. I hope the previous department will be resumed.

(Perhaps you can place these newer items in the RADIO-ELECTRONICS MONTHLY REVIEW department?)

ISIDOR UGELOW
Bronx, N. Y.

Dear Editor:

I find the new articles under the heading RADIO-ELECTRONIC CIRCUITS very interesting. These articles give a very good explanation of the various circuits' operation, as well as how they can be adapted for use. I believe a person can obtain excellent instruction from articles of this nature and that reading them is time well spent.

I hope the change is approved by the readers and adopted as a permanent feature of the magazine.

SAMUEL TASHBY
Portland, Oregon

"It's for you!"

Dear Editor:

May I suggest you alternate the procedure used in the RADIO-ELECTRONIC CIRCUITS department in the August issue of RADIO-CRAFT with that formerly used? The contents of the August issue were excellent and highly informative.

DUANE E. MROHS
Flint, Michigan

DX ON A 2-METER BEAM

Dear Editor:

You may be interested in some reports of work from the tower pictured and described in the August issue. I have been on the air on 2 meters, with the 32-element beam, last year's super-regenerative receiver, and a 2-meter transmitter with the 815 in the final running about 40 watts.

Results were beyond expectation. During one evening I worked 10 Massachusetts, 7 Connecticut and 6 Rhode Island stations in 4 hours, the beam pointing northeast. Pointing it south (at 11 pm) I immediately began to work New Jersey and Pennsylvania stations. Then came the great thrill of the evening. W3KUX, Washington, D. C.!

During the entire evening of 7 hours I did not hear a single report of QRM on the transmissions from W2BAV. This would seem ample proof of the power gain of the 32-element beam, if further proof were needed after that evening's work. All reception was on the little rush box.

Later I got a card from W4JHC, J. Ira Carlton, Buckroe Beach, Va. "Heard you on 2 meters calling CQ DX South." So we are getting down to the 4th district!

BILL HOISINGTON, W2BAV
Rye, N. Y.

CORRECTION

In the circuit of the Traveller's 2-Tuber, page 37 of the August, 1947, issue, the filament connections of the 3A8 should be reversed so that the No. 2 pin is grounded. This permits the pentode section of the tube to operate without bias while the triode section is biased by the voltage drop across half of the filament. The filament of this tube is center-tapped for series or parallel operation. The center tap and suppressor grid are connected to an internal shield and pin No. 1. This is left floating in this circuit.

We thank Mr. R. F. Klatt of Cleveland Heights, Ohio, for calling this to our attention.

SOLDERING KINK

Sometimes, when building compact radios or other equipment, it is hard to find sufficient space to solder ground leads from condensers or resistors to the chassis. I drill a small hole in the chassis and pass the lead through it and solder from the other side. This avoids working among cramped components, permits easy placement of parts, and facilitates unsoldering when necessary.

BERNARD GORDON,
Chicago, Ill.

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RADIO SCHOOL DIRECTORY
(See Page 88)

BOOK REVIEWS

THE ELECTRON MICROSCOPE, by E. F. Burton and W. H. Kohl. Published by Reinhold Publishing Corporation. Stiff cloth covers, 6 x 9¼ inches, 325 pages. Price $4.00.

The authors of this book were members of the Toronto group who pioneered the electron microscope; hence they know their subject from the embryo. Unlike other works on the subject, this is addressed mainly to the non-technical reader, who is warned, however, that "more than a superficial interest and a great deal of patience" will be required to understand the subject.

Starting with light optics, the action of a microscope is very clearly explained. Light itself is then studied and electron optics compared with light optics. Focussing of electron beams leads naturally to the electron microscope.

The simple presentation and complete illustrations enhance rather than detract from the scientific accuracy and thoroughness of the work, which is adapted to the needs of any person of whatever technical standing who is unfamiliar with the action of the electron microscope and wants to know more about it.

KLYSTRON TUBES, by A. E. Harrison. Published by the McGraw-Hill Book Co. Stiff cloth covers, 6 x 9 inches, 271 pages. Price $3.50.

Written to supply more complete information on the operation of Klystrons than was made available in the older *Klystron Technical Manual*, this book has maintained the simple and clear style of the older work, while introducing a great deal of mathematical material. The book is so written however that the text can be followed by a reader who may not understand the mathematics involved.

Beginning with construction and operational theory, the book deals with reflex oscillators, multiple-resonator tubes, cascade amplifiers, frequency multipliers, frequency, phase, pulse and amplitude modulation and a number of other subjects.

Most useful to the engineer interested in high-frequency tubes, the book may also be read with profit by the general radioman who wishes to know how and why Klystrons operate.

THE ATOMIC STORY, by John W. Campbell. Published by Henry Holt & Co. Stiff cloth covers, 5¾ by 8½ inches, 280 pages. Illustrated. Price $3.00.

Mr. Campbell presents the atomic story in an easily read form, beginning with first approaches to the electron. The action of electrons in vacuum tubes is simply explained. Then come early discoveries in atomic action, leading up to the discovery of the nucleus. Operation of the mass spectrograph and electroscope is explained clearly and illustrations are given where necessary.

The construction of the atom is explained and illustrated so that the average reader can understand it. Then the author goes into the splitting of the atom and the action of the cyclotron.

Uranium chain reaction leading up to the making of the atomic bomb is then discussed. Next, the reader learns about the construction and action of the uranium pile. The production of plutonium, the separation of U-235, and the essential parts of an atomic bomb follow.

Closing chapters deal with the various effects of atomic bombs, atomic strategy and tactics, atomic energy and its promise for the future.—*H.W.S.*

"I think the dial cord is too tight!" *Suggested by E. V. Schwartz, Los Angeles, Calif.*

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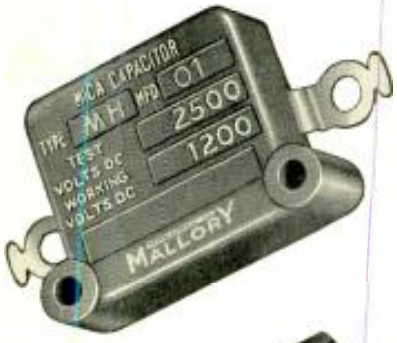

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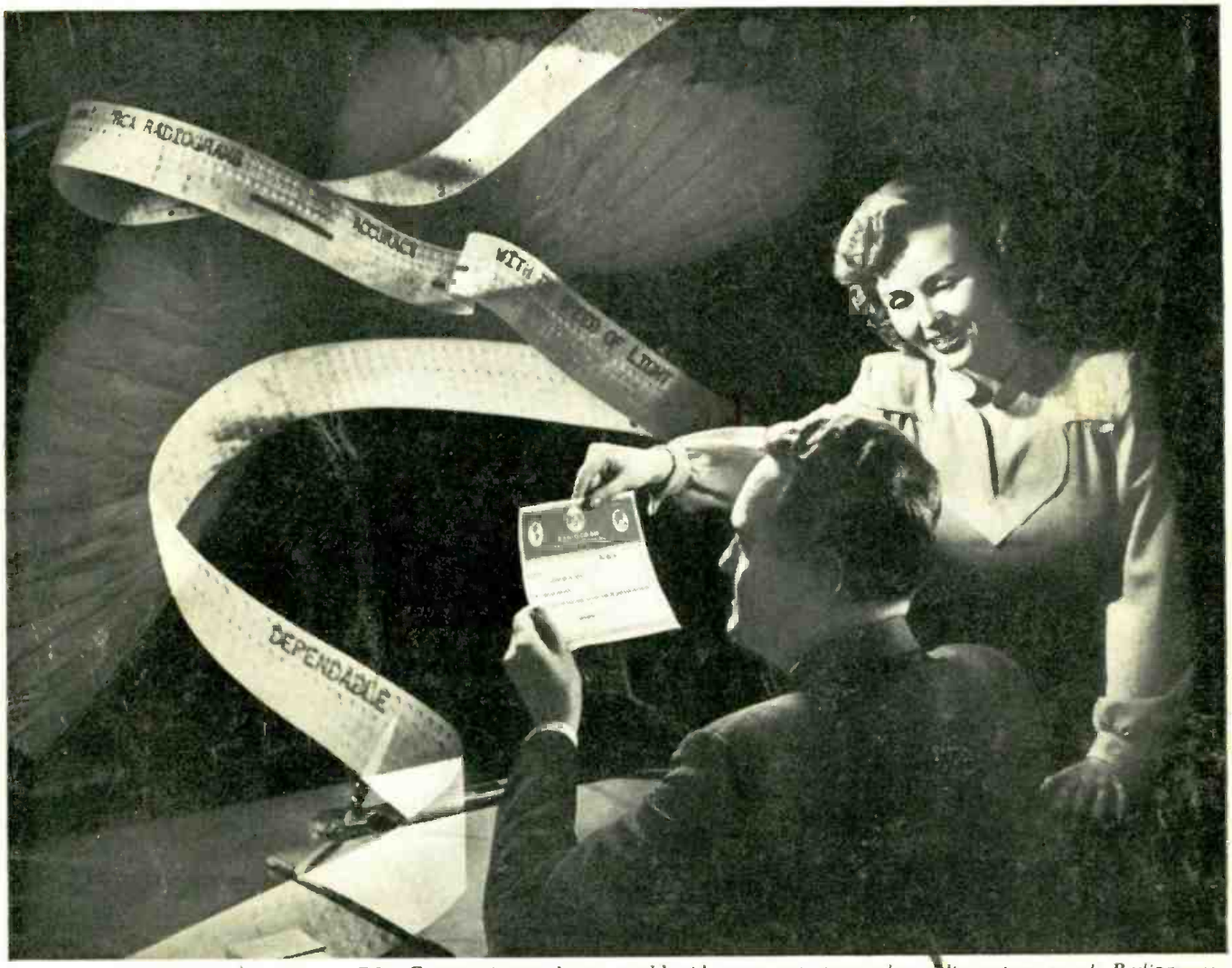

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