HUGO GERNSBACK, *Editor*

RADIO CRAFT

IN THIS ISSUE

A 1-Kw Radio-Frequency Heater

Record Player for FM Receiver

PULSE CODE MODULATION STOPS RELAY LOSSES

SEE PAGE 28

FEB 1948

30¢

CANADA 35¢

RADIO-ELECTRONICS IN ALL ITS PHASES

Laboratory Tests Prove

that FEATURE for FEATURE

AIR KING

Portable WIRE RECORDER

PHONO-COMBINATION

Tops all Competition!

Compare these features:

- ***A record player too!*** Plays 10"—12" records! Records from phonograph! Has Fidelitone permanent needle.
- ***5 Tubes exclusive with Air King!*** ...5 tube amplifier (including rectifier) guarantees finest fidelity.
- ***Has radio attachment!*** At no extra cost there's a cable attached to record on wire from radio without use of microphone. This assures original high fidelity. Can also dub in voice (through mike) while recording from radio.
- ***Practical, compact carrying case!*** Housed in sturdy wooden luggage-type carrying case.
- ***Console features in portable case!*** Has the superior engineering qualities of a console wire recorder including automatic shut-off (motor shuts off automatically after wire rewinds) ... safety lock that prevents accidental erasures ... visual-tone indicator to maintain recording level ... highly sensitive microphone with table stand makes it ideal for conference use ... few simple controls, most easy to operate!
- ***Price is complete ... includes these extras!*** Two spools of wire ... cord for radio recording ... microphone table stand.

$129.50

Including Federal Tax.
(Slightly higher west of Rockies)

See Your AIR KING Distributor Today!

MODEL 750

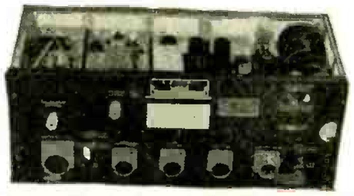
AIR KING PRODUCTS CO., Inc., Brooklyn 32, N. Y.

AIR KING RADIO

Division of HYTRON RADIO & ELECTRONICS CORP.

The Royalty of Radio Since 1920

War Surplus Bargains Sold As Used Unless Otherwise Specified!



RADIO ALTIMETER APN/1

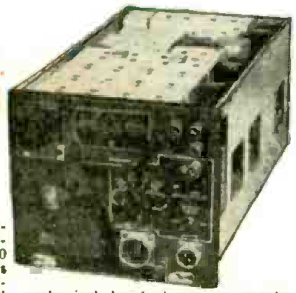
A complete 460 mc. radio receiver and transmitter which can be converted for ham or commercial use. Tubes used and included: 4-12SH7, 3-12SJ7, 2-6H6, 1-VR150, 2-955, 2-9004. Other components such as relays, 24 V dynamotor, transformers, pots, condensers, etc., make this a buy on which you can not go wrong. Complete as shown in aluminum case 18'x7'x7¼.

$8.95

NAVY CRV-46151 AIRCRAFT RADIO RECEIVER

INCLUDING CASE

$19.50



Four bands, including broadcast (195-9,050 KC). Circuit is six-tube superheterodyne with mechanical band change or remote operated electrical band change. Remote band change and tuning controls included, making this set readily adaptable to mobile ham use. Powered from self-contained 24 V. DC dynamotor.

The sets are complete with tubes, mounting rack and remote controls.

AIRCRAFT TRANSMITTER BC-457A or BC-458A

Ideal to make over for master oscillator. Priced complete with tubes. Has built-in crystal for dial calibration. Used but in good condition. 5.3-7 MC or 4-5.3 MC FREE Mounting Rack with order of two or more.

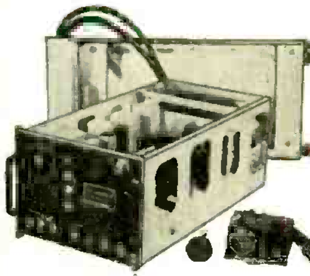
$3.95

INTERPHONE AMPLIFIER RL-9

Convert to high fidelity phone Amp. or speech Amp. Complete with tubes and dynamotor, for 24 V. DC operation. Used but in good condition.

SPECIAL PRICE **$1.75**

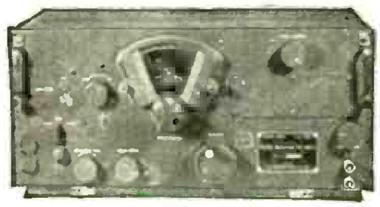
ARC-4 TRANSMITTER & REC.



INCLUDING CASE

$17.95

Operates on any of its 4 predetermined crystal controlled frequencies in the range of 140 MC. Complete with tubes, remote control, junction box, shock mounting base and connecting plugs. This unit is ideal for amateur UHF or mobile telephone. Operates from self-contained 24 V DC dynamotor. 12 V available upon request.



BC-348 Communications Receiver

Excellent selectivity, sensitivity and stability makes this the most outstanding of any receiver yet available from government surplus. This Receiver will give outstanding performance wherever used. Built to withstand vibration and features gear driven 100-1 ratio vernier tuning control. Six bands—500 Kc. and 1.5-18 Mc. Two stages RF, 3 stages IF, BFO, crystal filter manual or AVC. Complete with tubes and 24 V. DC dynamotor. Easily converted to 110V AC operation.

BC-348, 110 V. AC power supply. Including simple conversion instructions $8.95

$69.50

BRAND NEW SCR-625 MINE DETECTORS

ATTENTION, PROSPECTORS, MINERS, OIL COMPANIES, PLUMBERS, ETC.

Used by the Army to detect buried metallic mines. Its private use suggests the location of underground or underwater pipes, cables and ore-bearing rock, the location of metallic fragments in scrap materials, logs, etc., and the screening of personnel in plants for carrying of metallic objects. New, complete in original overseas packing container. Originally sold by War Assets for $166.00. The U. S. Forestry Service has recommended procedure for using the SCR-625 Mine Detector to find concealed metal in tree logs and other timber products.

$79.50

R-5/ARN-7 RECEIVER

Three bands 200 to 1750 KC. Complete with 17 tubes required. This set is ideal for conversion to home broadcast Receiver addition to ham shack, etc. Reported sold for many times the price when brand new. A Receiver that would be hard to pick up at this price. ONLY **$31.50**

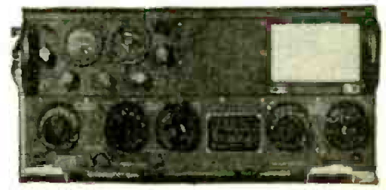
PRICES F.O.B. INDIANAPOLIS

NEW WILLARD RECHARGEABLE STORAGE BATTERIES

New 6 Volt battery in spill-proof clear plastic case, housed in metal case for easy mounting. Applicable for a wide range of uses where battery power is needed. Shipped dry. Uses standard battery electrolyte available everywhere.

Price, each	$4.00
In lots of ten, each	$3.35
Without metal case	$3.00
In lots of ten, each	$2.95

AN/ART B COLLINS

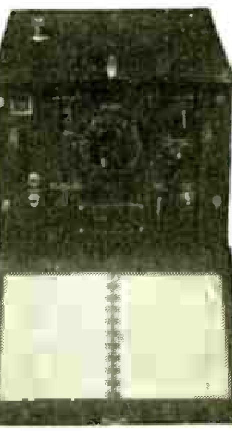


AUTO TUNE TRANSMITTER

A modern, compact, lightweight, high-powered transmitter. For frequency range 2-18 1 Mc. on any of its 11 auto tune crystal controlled or master channels. These units removed from planes. Checked and guaranteed. Weight. 67 lbs.

$134.50

WITH DYNAMOTOR UNIT & CONTROL HEAD



BC-221 FREQUENCY METER

Covers 125-20,000 Kc. Battery or 110 V. AC vibrapack operated. Beautiful equipment.

$49.95

OXYGEN TANKS

These oxygen tanks, removed from surplus aircraft, have a capacity of 500 lbs. pressure. Type D2, with complete regulator assembly. Size of tank 22"x5".

$6.95

TERMS: CASH WITH ORDER

AMERICAN SURPLUS PRODUCTS CO.
537 N. CAPITOL AVE.
INDIANAPOLIS, IND.

TERMS: CASH WITH ORDER

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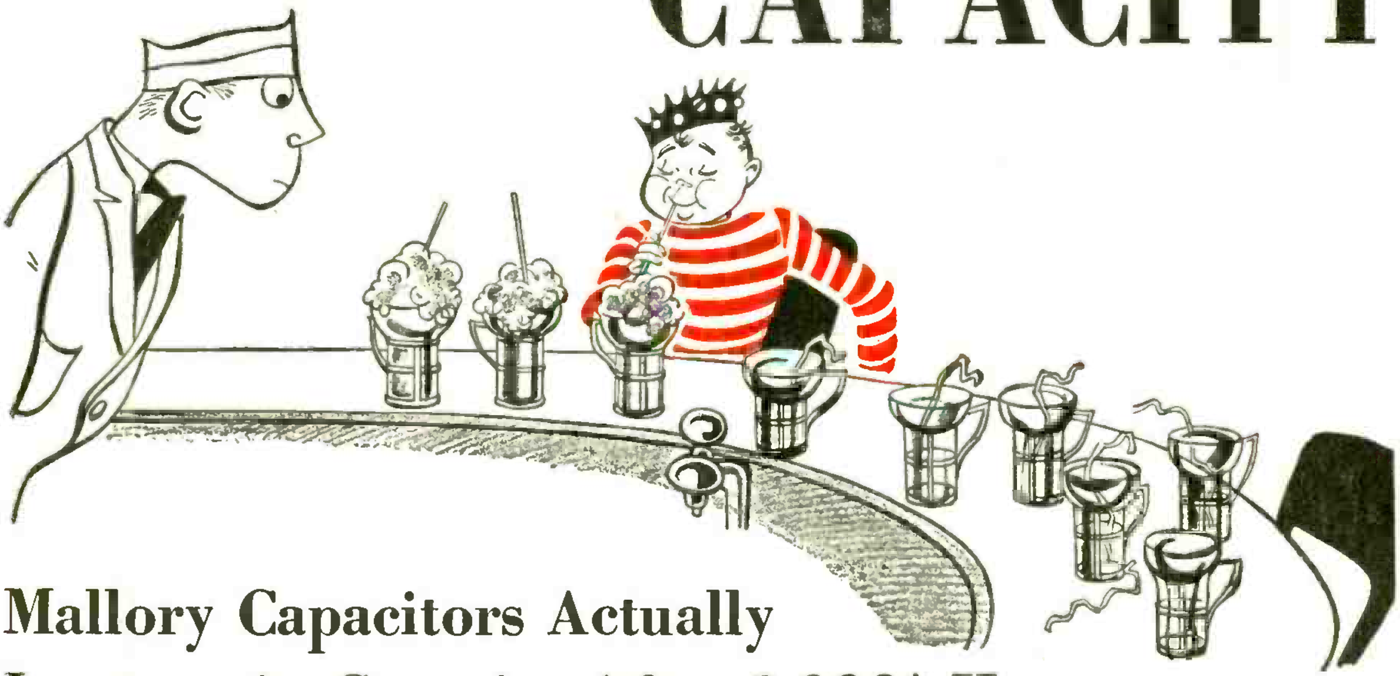
Sustained CAPACITY



Mallory Capacitors Actually Increase in Capacity After 2,000* Hours

Install Mallory FP Capacitors with the knowledge that they will last in a "hot set" with temperatures up around 185° F.—they will last on the shelf or in an inactive set without needing reaging—and they will last without loss of capacity.

Mallory is never satisfied to produce parts that just get by. In all Mallory Parts you will find a generous margin in *your* favor. Mallory capacitors will operate at 185° F. —that's 35° hotter than R. M. A. requirements.

Their RF impedance—their ability to withstand ripple current, are other plus values that make Mallory capacitors popular with radio service men, as well as with manufacturers of radio equipment.

THE MALLORY "GOOD SERVICE FOR GOOD BUSINESS" PLAN

will increase business and profits in your shop.

A unique follow-up file makes it easy to keep customers.

You tie in with Mallory acceptance to develop new business—ask your distributor about it.

***2,000 HOURS OF OPERATION**

An actual test of Mallory capacitors operated in an oven at 185°F. and 450 volts DC, plus 10 volts of 120 cycle ripple, showed them still going strong and with increased capacity at the end of 2,000 hours. Typical results:

At Start of Test		*After 2,000 Hours*	
Capacity	*Resistance*	*Capacity*	*Resistance*
20.9 mmf	6.16 ohms	23.5 mmf	6.5 ohms
20.1 mmf	6.5 ohms	23.4 mmf	6.55 ohms

BUY MALLORY ASSURED QUALITY AT REGULAR PRICE LEVELS

P. R. MALLORY & CO. Inc.

MALLORY

CAPACITORS . . . CONTROLS . . . VIBRATORS . . .
SWITCHES . . . RESISTORS . . . RECTIFIERS . . .
VIBRAPACK* POWER SUPPLIES . . . FILTERS

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FEBRUARY • 1948

RADIO CRAFT

AND POPULAR ELECTRONICS

Incorporating
SHORT WAVE CRAFT — TELEVISION NEWS — RADIO & TELEVISION

In An Early Issue

Electronic Instrument Pickup
A Capacity-Operated Relay
De Luxe Amateur Transmitter

On the Cover:

Dr. R. W. Sears of Bell Telephone Laboratories with the pulse modulation coding tube he developed.

Chromatone by Alex Schomburg from photo by Warren Z. Illes.

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ESSE Specials!

Do not fail to closely examine this list of bargains. We believe that every item listed below is a sensational value that soon can never be repeated. All equipment advertised herein is unconditionally guaranteed to the customer's satisfaction to this extent: Return any item advertised within five days after delivery for full refund except transportation charges (both ways).

Below are listed surplus radio and electronic supplies that are too numerous to picture. Every ham and operator is familiar with these items. See our previous ads for pictures and more complete descriptions.

RECTIFIER RA-63-A
Battery charger or rectifier, or power supply units. 110 V. 60 cy. input; 12 V. 8 amp. output. Brand new $19.75

ARB (CRV-46151) AIRCRAFT RADIO RECEIVER
6 tube, 4 band, superheterodyne rec. with built-in dynamotor. Designed for reception of MCW, (tone or voice) or CW within the frequency range 195 Kc. to 9.05 Mc. We bought a carload of these in order to sell them at this price $19.50

BC-221 FREQUENCY METER
Covers 125-20,000 Kc. Battery or 110 V. AC, vibra-packed operated. A beautiful instrument $49.95

T-17-B CARBON MICROPHONES
Handmike, Brand new $1.00

HS-33 HEADPHONES
600 ohm. (Used) .... .75

HEADPHONE EXT. CORD .... .50

PE-103 DYNAMOTOR, New.... 8.95

IF AMPLIFIER STRIP
19 Mc. containing 5 WE 7-17A tubes $3.95

INTERVALOMETER
Electronic timing device. Was used for releasing bombs at intervals. Ideal for darkroom timer, model train controller. (Contains relays, switches, pilot light, resistors, knobs, etc.) $2.25

WILLARD LEAD ACID CELLS (Brand New)
2 V. (dry-chgd.) $1.00
6 V. (dry-chgd.) $3.00
6V. (in metal carrying case) (dry chgd.) $4.00
(add electrolyte specific gravity 1.265—drugstore).

LANDING LIGHTS—AIRCRAFT
24 V. retractable, 600 watts $3.95

BC-348 COMMUNICATIONS REC.
The finest of all surplus receivers $69.50

BC-348 110 V. Power Supply ... 8.95

SCR-625 MINE DETECTOR
(Brand New). The most sensitive mine detector on the surplus market. For miners, treasure hunters, plumbers, etc. $79.50

AN/PRS-1 MINE DETECTOR
(Brand New). A very dependable detector. Only $14.95

TURBO AMPLIFIERS
Use for parts or small phono amplifier, shipped complete with the following tubes: 2—7C5's, 1—7Y4, 1—7F7. Our greatest bargain, ea. $1.65

BC-375 GE MOPA XMTR.
The most famous of all surplus transmitters. Was used by the Army bombers and ground stations during the War. Frequency range is covered by means of plug-in tuning units as shown below. Each tuning unit has its own oscillator and power amplifier coils and condensers, and antenna tuning circuits all designed to operate at top efficiency within its particular frequency range. Transmitter and accessories are finished in black crackle, and the milliammeter, voltmeter, and RF ammeter are mounted on the front panel. FREQUENCY RANGE: 200-500 Kc. and 1500-12,500 Kc. (Will operate on 10 and 20 meter band with slight modification.) OSCILLATOR: self-excited, thermo-compensated, and hand calibrated. POWER AMPLIFIER: neutralized class "C" stage, using 211 tube, and equipped with antenna coupling circuit which matches practically any length antenna. MODULATOR: Class "B"—uses two 211 tubes. POWER SUPPLY: Dynamotor which furnishes 1000 V. at 350 Ma. Conversion instructions and diagram for 110 V. AC furnished upon request for $1.00.

PRICES: As follows—
Transmitter only **$19.50**
Tuning units TU-5B, TU-6B, TU-7B, TU-8B, TU-9B, TU-10B, TU-26B, choice **$3.75**
Dynamotor PE-73C **$4.95**
Antenna tuning unit (BC-306A) **$4.95**

BC-357 MARKER BEACON RECEIVER
Ideal for controlling remote circuits and model aircraft, boats, etc. Operates about 75 Mc. Signal easily altered to 2-meter band. Tubes used and included: 12C8, and 12SQ7. Also sensitive relay. Circuit diagram inside case. Size, 5⅜ x 3⅜ x 5¼". For 24V DC operation.......... **$2.95**

RADIO ALTIMETER INDICATOR 1-152-AM
Includes 3DP1, 2X2, and 3 type 6AG5 tubes. Powered by 110 V 400 cy. **$8.75**

T-39/APQ-9 RADAR TRANSMITTER
Contains many excellent parts for the VHF experimenter such as a cavity oscillator using 2—RCA 8012 tubes rated at full output to 500 Mc. Tubes are forced air-cooled by 24 V. DC motor, which is easily converted for 110 V. AC operation. Other valuable parts such as a pair of 807's, 2—6AC7's, 1—931, and 1—6AG7 tubes, ceramic switch, potentiometers gears, revolution counter, etc. **$12.50**

APN-1 RADIO ALTIMETER
A complete 460 Mc. radio rec. and trans. which can be converted for ham or commercial use. Tubes used and included: 4—12SH7, 3—12SJ7, 2—6H6, 1—VR150, 2—955, 2—9004. Other components such as relays, 24 V. dynamotor, transformers, pots, condensers, etc., make this a buy on which you cannot go wrong. Complete in aluminum case 18 x 7 x 7¼" **$8.95**

INTERPHONE AMPLIFIER
We've sold thousands of these. Every ham and experimenter could use several at our low price. Type AM-26/AIC with 28 V. DC dynamotor. Contains 2—12A6, and 2—12J7 tubes. Easily converted for phonograph or inter-communication amplifier. A steal.......... **$1.75**

BC-966-A IFF
Approximately 2-meter operation, 14 tube, 350 V. DC dynamotor, 12 V. DC input. Contains voltage regulators and many other fine parts. Worth much more than our price for parts................ **$4.75**

DETROLA AIRCRAFT RECEIVER
If you want a good 28V. DC operated 200-400 Kc. aircraft receiver—just don't pass up this bargain. A few left at ea... **$4.75**

THE WAR ON SERVICEMEN

New Pressure Continues Against Radio Servicemen . . .

By HUGO GERNSBACK

HERE is a little story which will be of interest to every reader of this magazine. I give it to you the way it was related to me:

Not so long ago a certain household called up the Service Department of the Telephone Company complaining that very frequently their phone went dead. Whenever this happened no outgoing calls could be made nor could incoming calls be received.

The woman of the household reported this a number of times. The 'phone company promptly sent over a serviceman. He took the telephone instrument apart, checked the ringer box, but could find nothing wrong.

It appears that the trouble occurred only in the evening—never during the day. Several other servicemen investigated the case, but the subscriber continued to complain until the case began to be a nuisance at the central 'phone office.

The record indicated that no less than four servicemen had gone to the subscriber, that everything had been checked carefully, yet the 'phone continued to go dead in the evening.

Finally one of the best troubleshooters was assigned to the case. After he had studied the complaint records he decided to make his call in the evening to ascertain the cause of the trouble. At the subscriber's home instead of looking at the 'phone instrument itself—which he knew was O.K. because the instrument had been checked several times already—he proceeded to make a careful inspection of the wiring.

He traced the line from the incoming house shaft through the hall to the apartment entrance of the subscriber, then followed each foot of wire through the hall and living room. Next he noted that the wire went into a room the door of which was closed. He asked the lady of the household if he could enter the room. She assented providing he would make no noise, because her husband was asleep on the couch. The telephone man promised this and noiselessly kept on tracing the wire. Inside the den the wire ran alongside the door frame. About five feet from the floor the troubleshooter was amazed to find a pin which had been stuck into the phone line, thereby neatly shortcircuiting the wires! He removed the pin, tiptoed out of the room, went to the phone, dialed and got the operator.

He then turned to the lady of the house and smilingly told her that the cause of the trouble had finally been located: Someone in the household, he emphasized meaningly, evidently had a reason for shortcircuiting the line every night at a certain time. He then departed.

Verbal fireworks immediately flared. The outraged wife promptly awoke her husband and asked the reason for shortcircuiting the phone at night. The explanation was simple:

The lord and master—a harried broker—had a number of children and there were always dozens of calls when he took his nap. The 'phone bell next to his den kept ringing practically uninterruptedly with the family clomping back and forward noisily through the hall whenever the phone rang. So he thought up the simple device of shortcircuiting the line and getting some quiet into the household—and a reduced phone bill. This solved the problem until the "gimmick" was discovered by the 'phone engineer.

Why do I tell this story? For a very simple reason. When it comes to servicing any technical device—be it a telephone, an automobile, or a radio—a serviceman goes through a certain well defined procedure. When failure occurs the technical serviceman will look for certain things first. That is his instinctive routine.

When, however, someone maliciously gimmicks a device—be it a 'phone, an automobile, or a radio—then we have a horse of a different spectrum.

Very often an investigator (who should know better) when he wishes to test servicemen—"fixes" a utility in a devious manner—*which to him is obvious.* But since that *is not a normal failure of the device,* no matter how intelligent the serviceman is he will not look for a "planted" gimmick, but goes on looking for a normal failure.

Frequently such a dodge is used for publicity articles in order to show up the various servicing trades. This is an old trick and has been done for generations. Every once in a while it turns up to the discomfiture of some particular servicing industry. The latest one occurred in New York recently when Lyle Van made a survey for Station WOR, the key station of the Mutual Network. On its face the survey indicated—according to the *New York Post*—that many radio repairmen are still chiselers.

Says the *Post,* and we quote verbatim:

> It seems WOR sent out a $60 battery-operated portable Jefferson-Travis set, in perfect condition *except for a short circuit in plain view in back of the set.* (The italics are ours.—R.C.) This could have been repaired in less than a minute with a screwdriver.
>
> So what happened? The set was brought by Irwin Rosten, *Radio Daily* reporter, to two dozen repair shops. Not a single shop would give an estimate of charges while Rosten waited. Every shop insisted the set needed a thorough examination lasting hours, so, Rosten had to leave the set. Each shop claimed the set needed new condensers, or transformers, or oscillators, tubes, wiring, alignment, etc. Charges ranged from $9.50 to $15. Not a single shop told the truth: that the set had a short circuit in the antenna loop.
>
> Not only that, but the trips to the 24 shops resulted in the set being ruined, thanks to tampering by the repairmen.
>
> I note that a Radio Serviceman's Association of New York has just been formed. It hopes to investigate complaints by customers. Recently, City Councilman Stanley Isaacs proposed licensing of *(Continued on page* 68)

STRATOVISION will take to the air again early in 1948, Westinghouse engineers announced last month. In the second stage of the Stratovision experiments television programs will be broadcast from planes flying at an altitude of 30,000 feet.

Although Stratovision was proposed some years ago (it was described in RADIO-CRAFT, October, 1945) further experiments have been carried out practically without publicity. The 1948 experiments, however, will be on Television Channel 6 and will be participated in by thousands of television receiver owners.

RADIO-ELECTRONICS

ISOTOPES, used for various types of study and to cure disease, will from now on supply the world with its standard of length, the Bureau of Standards revealed last month. The new unit is the length of a wave of green radiation transmitted by mercury 198, an isotope transmuted from gold by neutron bombardment.

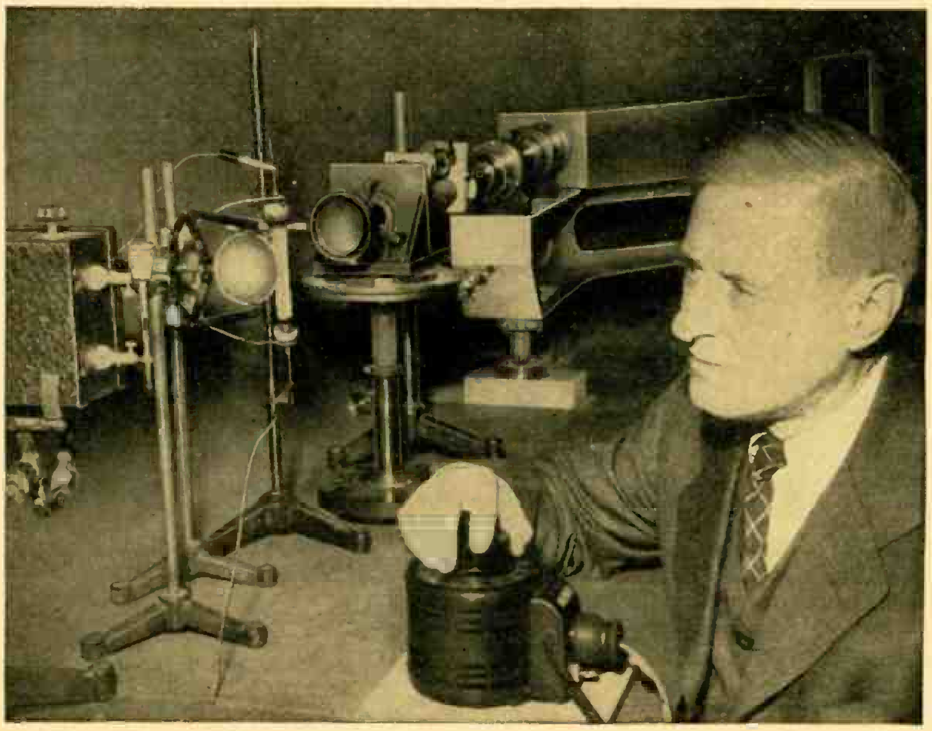
Legally the standard of length for most of the world is the distance between 2 lines on a platinum-iridium "metre" bar at the International Bureau of Weights and Measures in France. Two lines traced on a bar are a rather crude instrumentality for precise measurements, and the red line of cadmium has been used for many years wherever extreme precision has been needed. However, the cadmium standard also has serious disadvantages. First, there is a fine structure in the red radiation which prevents the line from being as sharp as desirable and thus limits the possible precision. Second, the cadmium standard requires excitation in a furnace, which entails unwanted broadening of the spectral line because of relatively high temperature.

The green line of mercury 198 has none of the disadvantages of either the meter bar or the red line of cadmium. The normal human eye is far more sensitive to green than to red, an important consideration in visual adjustment of the interferometer with which lengths are measured and compared. All other characteristics desirable in a light wave standard—such as ability to be reproduced, absolute sharpness of the wavelength, intensity of the spectral line, life and ease of maintenance—are possessed to a greater extent by mercury 198.

INTERFERENCE to British television programs from American FM broadcasts has become so severe that changes in American program schedules have been made, it was revealed last month. Commander E. F. McDonald, president of the Zenith Radio Corporation, asked for and received permission from the FCC to change temporarily the broadcasting hours of his station WEFM to avoid interference with the London television station between the hours of 3:00 and 4:00 p.m. Greenwich Time.

The interference, first noticed early this week, is caused by long-range skip transmissions from the Zenith 45.1-mc FM transmitter. McDonald suggested that it is a temporary condition brought about by sunspot activity, now at the highest point ever recorded, and will not recur again as a serious problem at such extreme distances for 11 years, when sunspots will again reach maximum.

Effective immediately and continuing until the sunspot activity wanes in a matter of days or weeks, WEFM will begin broadcasting at 10:00 a.m. Chicago time (4:00 p.m. London time), and continuing until midnight.


Dr. Wm. F. Meggers adjusts equipment for mercury 198 and cadmium wavelength comparison.

LARGE-SCREEN television by a "double-take" method was demonstrated at the recent annual "clinic" of the Television Broadcasters Association. A moving-picture camera photographed the images on the screen of a standard television receiver, and after a development process which took only 66 seconds, the film was projected with regular moving-picture equipment. The resulting pictures were clear.

Engineers of the Eastman Kodak Co. read to the meeting a paper describing the methods by which development time was reduced to 66 seconds. Inclusion of sound, they reported, was the important difference between this and other rapid-development methods.

TELEVISION may be a "shock absorber" for the national economy four times as great as radio was after the first World War, Frank Mullen, executive vice-president of the National Broadcasting Co. stated last month.

While radio now has an annual turnover of more than $1,500,000,000, he expects that television will account for more than $6,000,000,000 annually, with a tremendous cushioning effect on employment and business as a whole.

RADIO SERVICEMEN were defended last month by Robert W. Damrach, production director of WEBR, Buffalo, rebutting statements made by a New York reporter who checked several New York service shops with a radio which had been "gimmicked" by shorting its loop antenna (see Editorial, page 17).

The radio serviceman, Damrach pointed out, would first check voltages in the set. Finding everything normal, next step might be to test the tubes. The particular "gimmick" which was introduced into the set was a shorted antenna, something which would be exceedingly rare in bona-fide repair work, and a serviceman would be likely to spend a great deal of time before finding it. A fair charge for the service might be an hour's labor charge which would probably run about $2.50, Mr. Damrach believed.

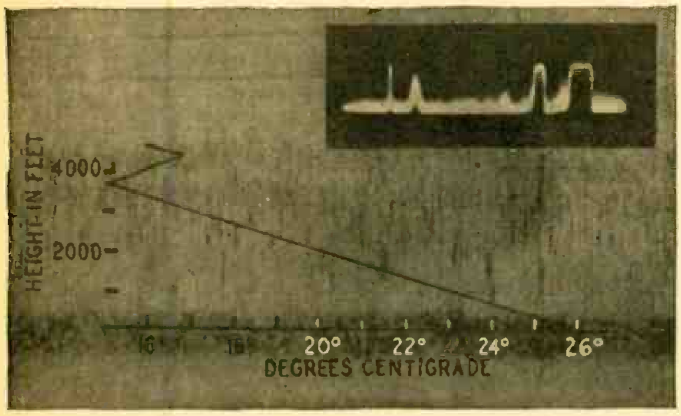
THE EDISON MEDAL for 1947 has been awarded to Dr. Joseph Slepian, the American Institute of Electrical Engineers announced last month. Dr. Slepian, who is associate director of the Westinghouse Research Laboratories, was given the medal "for his practical and theoretical contributions to power systems through circuit analysis, arc control and current interruption" He is the inventor of the ignitron, highest-powered of all electronic tubes, and pioneered in the development of circuit breakers and lightning arrestors.

Last year's recipient of the Edison Medal was Dr. Lee de Forest.

MONTHLY REVIEW

RADAR REFLECTIONS from the apparently empty air at heights between 900 and 5,000 feet have been detected with 1.25-centimeter radar equipment at various times for the past 3 years, it was revealed last month by Herbert B. Brooks, William B. Gould and Raymond Wexler of Evans Signal Laboratory, United States Signal Corps. The inexplicable reflections have been termed "angels" by radar operators.

Angels appear to be more common in summer than winter, the Signal Corps engineers report, but have been reported in all seasons and weather conditions.



The two belts of angels are seen just below the 4,000-foot level. The insert shows how they appear on the cathode-ray tube screen.

As a means of studying the reflections, Mr. H. B. Brooks of Evans Signal Laboratory devised a means of recording the video signals from a radar receiver on a modified facsimile receiver, obtaining a vertical cross section of the atmosphere (time *vs* altitude) as a situation passes through the radar beam. Prior to these recordings it had been assumed that angels always appeared at random altitudes from very close to the ground up to perhaps 9000 feet. The recordings revealed that on certain days a large percentage of angels appeared to stratify at definite altitudes.

An analysis of the records of angels made on 7 days between 5 August and 4 September, 1947, by Mr. R. Wexler of Evans Signal Laboratory, indicates that on 4 days they occurred in double layers with scattered reflections between and below the layers. On 2 of these 4 days there were irregular intervals during which only one layer was evident. On the remaining 3 days only scattered angels were observed, with no concentration at any particular level.

On the 4 days during which double strata were observed, radiosonde flights at Belmar and Lakehurst (New Jersey) revealed atmospheric inversions, the base and top of which roughly agreed with the levels at which the two layers were observed. Typical is the Lakehurst sounding of 5 August, 1947, which shows an inversion based at 3800 feet, top at 4700 feet (see figure). On approximately the same scale is shown the record of the reflections. The broad blackened base is the main pulse about 900 feet in width. Time goes from right to left beginning at 14:22 EST, ending 14:35 EST. Between 900 feet and 3200 feet are scattered angels spaced more or less at random. The 2 layers exist between 3200 and 3900 feet and between 4100 and 4800 feet. Between the two layers, coincident with the inversion, reflections are few in number and randomly spaced. The layer appears, therefore, to be located just above and just below the temperature inversion.

Two theories are offered concerning angels: first, that they are reflections from dielectric discontinuities in the atmosphere; second, angels are reflections from dust specks in the air.

For the detection of dielectric discontinuities in the atmosphere to a maximum range of 9000 yards, it may be shown theoretically that a discontinuity of 0.1 millibar in vapor pressure or 0.30 degrees centrigrade in temperature could be detected by the 1.25 cm radar. Such a discontinuity would have to take place over distances small compared to the wavelength. It is not known whether or not such discontinuities occur in the open atmosphere over distances of less than 1 cm. Sharp temperature or moisture discontinuities occurring over normal distances of 50 or more meters theoretically cannot be detected by the radar.

It appears improbable that the concentration and size of dust particles theoretically required for detection by radar would be normally present in the atmosphere.

JOHN V. L. HOGAN, one of America's first radio inventors, was presented the Armstrong Medal of the Radio Club of America at its 1947 annual dinner meeting. Mr. Hogan was honored as the inventor of the rectifier heterodyne receiving system, continuous-process facsimile, and single-control tuning. His record as a pioneer of high-fidelity and founder of the country's first high-fidelity station, which became WQXR, was also cited.

INFRA-RED LIGHT was used as a means of newspaper communication for the first time last month when a Chicago reporter used "black-light" communications equipment to send a story to his city editor.

The reporter, Larry Wolters, who is the radio editor of his paper, used the "talking lamp" first developed during the last war by Westinghouse engineers, and described in RADIO-CRAFT, October, 1946.

The "lamp" is a special caesium-vapor tube capable of following audio modulation with efficiencies approaching 100% up to at least 3,000 cycles per second.

The modulated infra-red rays were picked up by a phototube on the roof of the newspaper building, three-quarters of a mile away.


How the beam-of-black-light signal was received at the offices of the Chicago Tribune.

Constructing a Radio-Frequency Heater

This 1-kilowatt dielectric unit is suitable for experimental use or the small laboratory

By RICHARD C. KLEINBERGER*

HIGH-FREQUENCY dielectric heating as in instrument of industrial production has made tremendous strides in the past six or seven years. Much experimental work has been done and much has been written about it, so that almost everyone who is in any way involved in electronics has some familiarity with the subject. Many who may be interested in r.f. heating have done no actual experimental work because of the initial expense involved. The purpose of this article is to describe a dielectric heater having an output of 1 kilowatt that was built by the author for experimental purposes during his spare time and represents a cash outlay of about $350. Comparable units bought commercially sell for $1,500 to $1,800.

*Consulting Engineer, White Plains, N. Y.

Fig. 1 shows the complete circuit diagram for the unit. The r.f. portion is a straightforward Hartley circuit using an Amperex 234-R forced-air-cooled tube. Figs. 2 and 3 show 2 views of the r.f. portion and the arrangement of the various components. The resemblance between this type of equipment and a radio transmitter is marked. At the left in Fig. 2 can be seen the plate blocking condenser, oscillator tube, filament bypass condensers, and grid blocking condenser. In the center is the oscillator tank coil and vacuum condenser, and above—mounted on the panel shield—is the grid bias resistor. The variable condenser shown is part of the load-matching network, about which more will be said later. The blower for cooling the tube is mounted under the chassis and may be seen to the extreme right in Fig. 3. With the constants shown in the circuit diagram, the oscillator will deliver power at a frequency of about 27 mc. R.f. connections are made with ¾-inch copper strip. Braid should not be used, as the losses are high.

The main power transformer delivers 2,800 volts either side of center tap at 1 amp. This is rectified through a pair of 872-A/872 mercury-vapor rectifier tubes. No filter is used, but a bleeder resistor of 200,000 ohms is connected across the output of the rectifier. This is to insure that the plate blocking and plate bypass condensers will be discharged when the power is turned off. Transformers for the rectifier and oscillator tube filaments have the ratings indicated on the circuit diagram. The 3 transformers were built to order from specifications. All other components in the unit are standard stock items, as indicated.

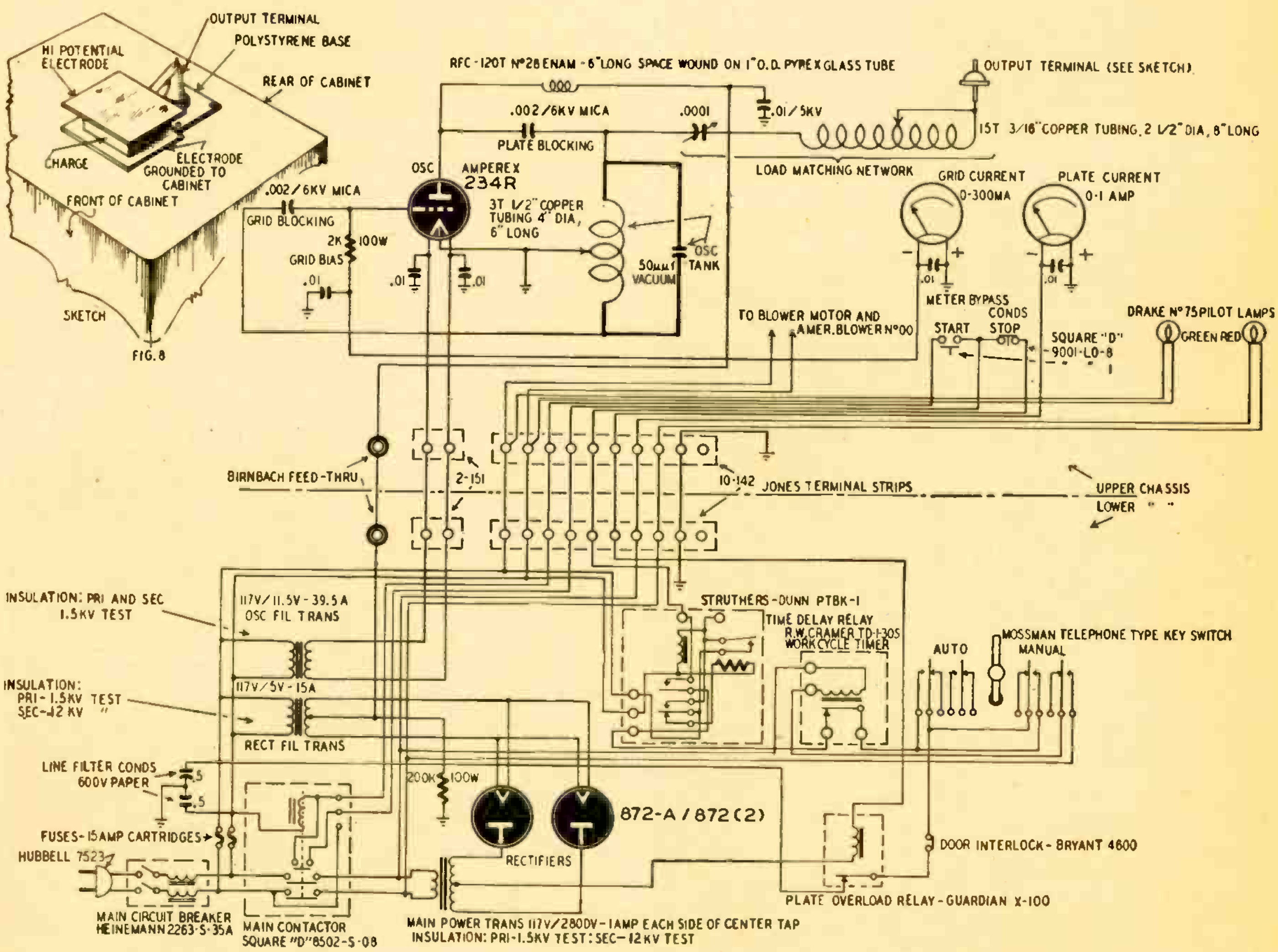


Fig. 1—The schematic. Designations of non-radio parts are included for the constructor's convenience. Transformers are made to order.

The following control items are provided: a main switch and circuit-breaker combination, main contactor, START and STOP push buttons, red and green pilot lamps, plate and grid current meters, thermal time-delay relay, work-cycle timer, plate overload relay, and AUTOMATIC-MANUAL key switch. To start, close the main circuit breaker. This causes the rectifier and oscillator tube filaments to light, the blower to operate, the green pilot lamp to light, and the thermal element of the time-delay relay to heat. After about 30 seconds the time-delay relay will operate. The purpose of the time delay is to make it impossible to apply the high voltage until after the tube filaments have had sufficient time to warm up. The next step is to push the START button. This actuates the main contactor, which causes the red pilot lamp to light and applies the high voltage to the oscillator tube. Also, if the key switch is in the AUTOMATIC position, the work-cycle timer will commence operating. If the switch is in the MANUAL position, the timer will not operate.

Work-cycle timer

A word about the work-cycle timer is in order. This is a motor-driven, normally closed relay whose contacts are connected in series with the main contactor solenoid. It may be set to any desired time within the range of the instrument. At the end of this time the contacts open automatically, releasing the main contactor and thus shutting off the power. In many electronic heating applications it is desirable to have such automatic timing of the work cycle. When the key switch is in the MANUAL position, the timer motor is cut out so that the timer contacts remain closed. To shut off the high voltage it is necessary to push the STOP button.

Figs. 4 and 5 are views of the power supply and control devices. The construction is conventional and requires little comment. Referring to Fig. 4, mounted on the rear of the panel may be seen (from top to bottom) the main circuit-breaker, the work-cycle timer, and the AUTOMATIC-MANUAL switch. Directly below the switch is a fuse block, with two 15-ampere cartridge fuses. These are to protect the control circuits, as may be seen on the circuit diagram. Below this are two ½-µf., 600-volt paper condensers, which constitute a filter to protect the power line against radio-frequency surges. A portion of the time-delay relay can be seen on the base of the chassis just below the work-cycle timer.

The main power transformer is in the background at the rear of the chassis. Immediately adjacent are the 2 rectifier tubes. In the foreground at the left is the rectifier filament transformer, and at the right the oscillator filament transformer. In ordering this latter item it should be specified that it be of the *high-reactance* type, to limit the inrush of current when the tube filament is cold.

General construction

Figs. 6 and 7 are front and rear views of the assembled unit. The resemblance to an amateur radio transmitter is very striking; in fact amateur components were used wherever possible. The cabinet is a Par-Metal No. DL-3513 having a panel space of 35 x 19 inches, set in a No. RT-410 roller truck. The lower chassis contains the power supply and the control devices. The upper chassis is the r.f. portion of the unit. Both chassis are 17 x 13 x 4-inch cadmium-plated steel. Both front panels are 17½ x 19 inches, black wrinkle finish. Each chassis is attached to its respective panel by means of 2 No. SB-713 steel mounting brackets. The cabinet as supplied had a door on the top. This was not desirable, so holes were drilled and brass straps fashioned and attached to the inside of the cabinet so that the door could not be opened. A square hole, 3¼ x 3¼ inches, was cut in the center rear of the cabinet top, and a piece of polystyrene of 4 x 4 x ⅜ inches mounted over it. Through the center of this was cut a hole to accommodate the large Birnbach feed-through shown in the photographs. This is the output terminal.

The ham will find himself quite familiar with the power supply and oscillator circuits. The very necessary relays and controls are the only parts of the equipment with which he has not had experience, but these features involve no technical problems.

Referring to Fig. 6, the components shown on the panels are as follows:

(Continued on following page)

Fig. 2—Radio-frequency section, rear view.

Fig. 3, left—Another view of the r.f. portion of the dielectric heater.

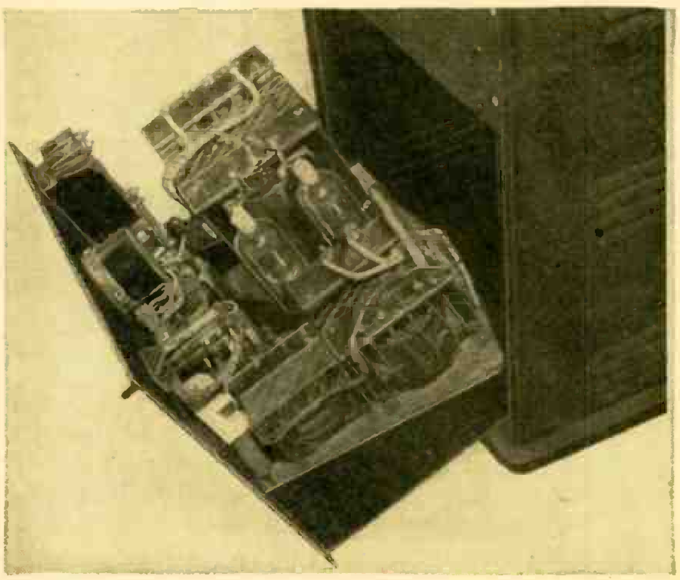


Fig. 4, below—The power supply section, drawn out of the lower part of its metal case. Components are identified in the text.

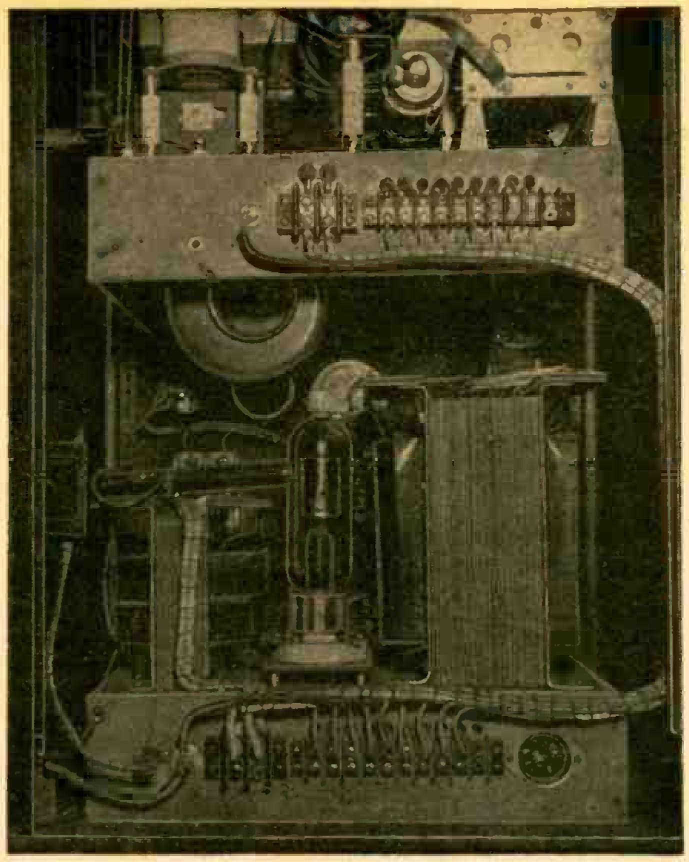


Fig. 5—Power transformer and blower are well shown in this view.

From the left at the top, the green indicator light, the start button, stop button, and red indicator light. In the next row are the grid and plate current meters. In the center of the panel is the power control knob. This operates the variable condenser of the load-matching network. A mechanical problem was presented here that required solving. For reasons of panel symmetry it was desirable to have this knob located in the position shown. However, for electrical reasons it was desirable to have the condenser located at the edge of the chassis, as can be seen from Figs. 2, 3, and 7. Therefore, it was necessary to resort to a bevel gear drive arrangement. Part of this can be seen in Fig. 2. Four small brass rods, some ½ x ⅛-inch brass strip, a ¼-inch insulated shaft coupling, and some incidental hardware were obtained, and the drive was homemade. The strip was used to make supporting brackets. The insulated shaft coupling is necessary as the entire condenser is hot to ground.

On the lower panel, at the left, is the main switch and circuit-breaker, in the center is the work-cycle timer, directly under it is the reset button for the plate overload relay, and to the right is the AUTOMATIC-MANUAL switch.

Fig. 7 shows clearly how the two chassis look when mounted in place in the cabinet. The r.f. choke is shown at the upper left in the photograph. It is a homemade affair, mounted on standoffs on the inside of the cabinet. A 1-inch (outside diameter) pyrex glass tube, 9 inches long, was fitted with straps to mount on the standoffs, and 120 turns of No. 28 enamel wire, space-wound the diameter of the wire, were wound on the tube. The winding length was about 6 inches. Also shown in this photograph is the inductor of the load-matching network, mounted directly in the cabinet, under the top. The cabling arrangement for connecting the terminal boards of the two chassis is also shown. At the extreme right of the lower chassis is shown the Hubbell twist-lock male receptacle, with which the power cord engages. Mounted on the lower door-jamb is seen the door safety interlock. With the rear door of the cabinet open, it is impossible to apply the high voltage.

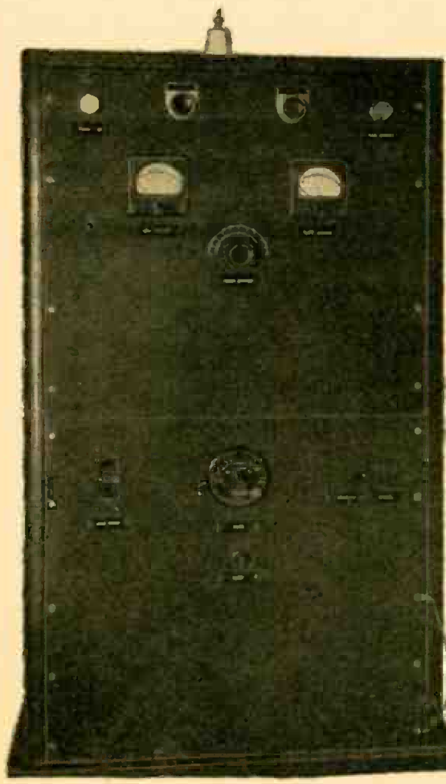


Fig. 6—Front view of the complete equipment.

Load-matching network

To those who have had experience only with communication apparatus the load-matching network previously referred to may seem somewhat strange. However, the impedance of a dielectric-heating load differs considerably from that of an antenna. This impedance must be matched to the electronic generator to effect a satisfactory transfer of energy to the work. Then again, with an experimental unit, a wide variety of loads will be encountered. The network described is sufficiently flexible to accommodate the range of load impedances likely to be encountered.

When everything has been assembled and connected the first step is to condition the rectifier tubes. Close the main circuit breaker and allow the filaments to burn for about 15 minutes. This will evaporate any mercury that may have been deposited on the tube filaments. Next the grid adjustment should be made. Set the cathode tap on the tank coil one-third of the way from the grid end of the coil. Close the rear door and push the START button. This applies the high voltage to the oscillator tube; and, if everything is in order, the unit will oscillate. This can be determined by noting if a reading appears on the grid-current meter. If no reading appears, something is wrong, and all connections should be checked. When everything is in order, the grid current should be 100 milliamperes at no load. If the reading differs from this, the position of the tank coil tap should be changed until it is correct. When this has been accomplished, the unit is ready.

Fig. 8 shows a typical arrangement for heating an experimental load. An electrode is fashioned from copper or brass to overhang the charge a small amount, such as ¼ or ⅜ inch, as shown. This is the high-potential electrode. The grounded electrode may be a brass or copper plate, bolted or otherwise connected to the cabinet. It is usually desirable to insert a thermometer in the charge so that the change in temperature may be observed during the heating cycle.

The only remaining step is to tune the generator to match the load impedance. With no load on the unit, the plate current will be about 0.13 amp. Set the tap on the network inductance at about the mid-point of the coil. Apply the power and vary the tuning condenser until the plate ammeter reads 0.6 amp.

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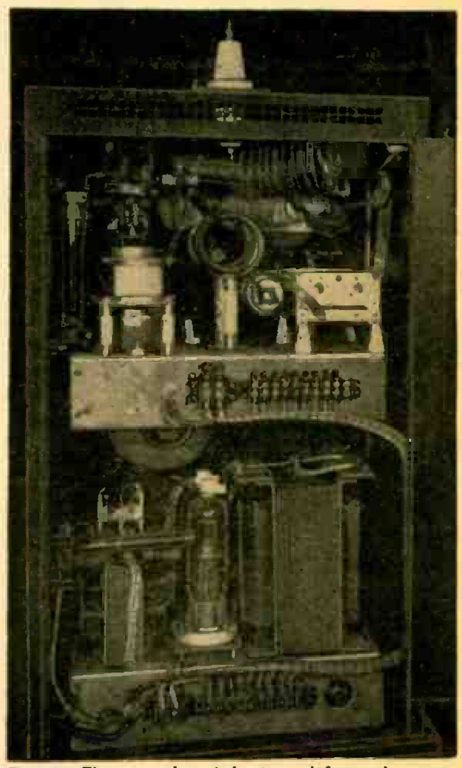
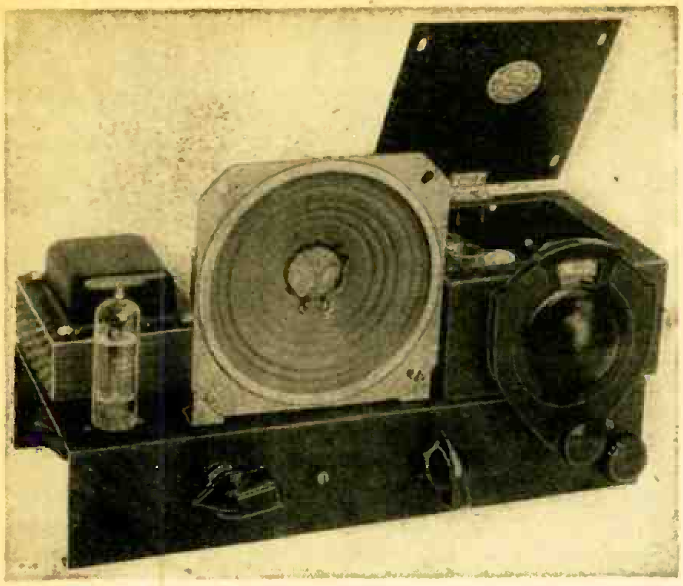
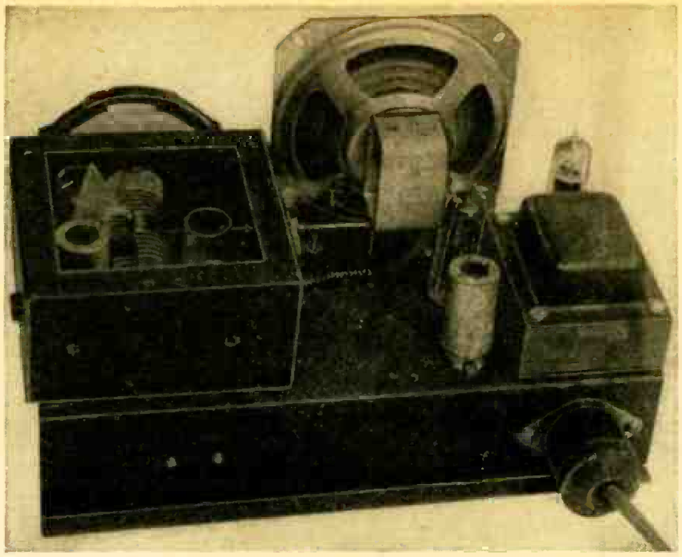


Fig. 7—The complete job viewed from the rear.





Front and rear views of the v.h.f. receiver.

1-10 Meter Receiver

By I. QUEEN, W2OUX

EXCEPT for certain commercial and amateur receivers, short-wave sets are ordinarily designed for wave lengths down to about 15 meters. Until a few years ago this range was sufficient to pick up practically anything which interested most experimenters, amateurs, and broadcast listeners. Since then many radio services have migrated to still shorter wave lengths.

Industries such as the motion picture, public utility, telephone (mobile), transportation, and broadcast (studio-to-tranmitter) have been assigned channels at higher frequencies. The new 2-, 6-, and 10-11-meter bands have reached peak popularity. Many hams operate there, often to the exclusion of other bands. Music-lovers and general listeners are especially interested in the FM band near 3 meters, which provides educational as well as entertainment programs of high quality. FM stations may be found in many rural districts as well as in the more populated centers. Then, of course, there are the sound channels (also FM) of the television stations which may be picked up by those who do not yet own TV receivers but wish to *hear* what is going on.

A compact and very effective receiver has been built to receive these interesting signals between 2 and 12 meters. Plug-in coils are wound for those bands which are of especial interest. Four sets of coils (r.f. plus detector) are enough for this purpose. Five tubes (including rectifier) are used to provide ample power to a 4-inch speaker in most signals.

To be equally effective on FM, AM, and c.w. signals, the detector stage can be adjusted to oscillate or not as desired. The oscillations may be continuous for unmodulated signals or interrupted for superregeneration. That notorious defect of a superregenerator, *radiation*, is eliminated by adding an r.f. amplifier and by complete shielding. As might be expected, the preamplifier also increases sensitivity and selectivity and makes tuning less critical, regardless of type and length of antenna.

Now for the set itself. The power supply and audio stages are conventional except that new-type miniature tubes are used throughout for higher efficiency and compactness. The chassis measures 10 x 4½ x 2 inches, and is made of crackle-finished steel. All audio and power equipment is mounted within an area slightly greater than half the total chassis (4½ x 5¾ inches). This leaves plenty of room for detector and r.f. portions. The speaker is mounted near the center of the chassis between the r.f. and a.f. sections as shown in the photos.

All wiring is done below the main chassis. No panel is used since all controls can be conveniently mounted on the vertical front of the chassis itself. (When completed, it would be well to add a speaker baffle which could also serve as panel.)

Details of construction

The audio and power supply may be completed first. A shell-type transformer was chosen to keep the height down to that of the miniature tubes. The filter choke and speaker transformer are mounted beneath the chassis together with the filter condensers. The power supply delivers about 240 volts at 40 ma. After completion the audio may be tested with a microphone or pickup. It should have very high gain. The R-C circuit between the 6AK5 and 6AQ5 is a conventional filter for de-emphasis of FM broadcasts. If desired, a switch may be provided for putting it in or out of the circuit; or it may be omit-

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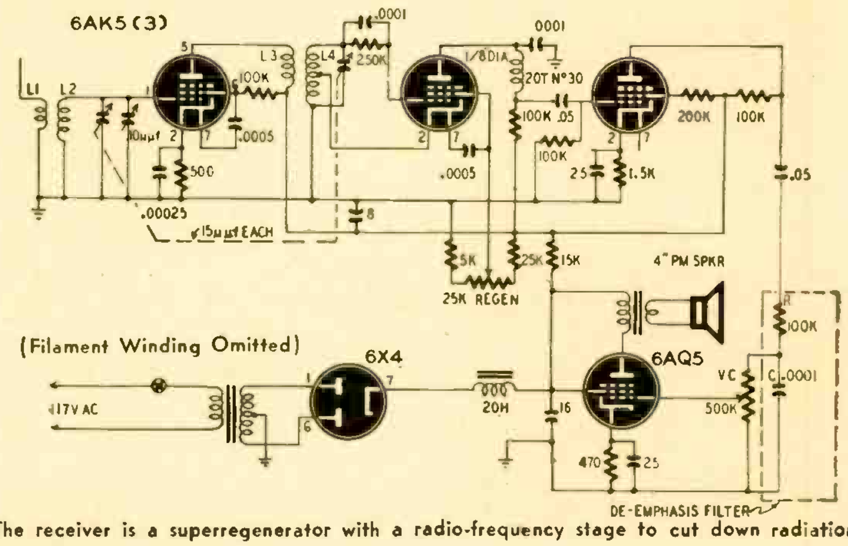


The receiver is a superregenerator with a radio-frequency stage to cut down radiation.

Sunspots and Radio

The Sun's magnetic storms are important to listeners on earth

By HARLAN TRUE STETSON

Dr. Harlan True Stetson is a Research Associate of the Massachusetts Institute of Technology and Director of its Cosmic Terrestrial Research Laboratory at Needham, Mass.

WITH sunspots staging what is probably their greatest activity for three centuries, radio communications are experiencing abnormal transmission conditions. Frequencies in the 50-megacycle band have been crossing continents and oceans with unheard-of clarity. All this comes about with the increase in ionizing radiation from the sun concomitant with a peak of solar activity which certainly has not been rivaled since 1778.

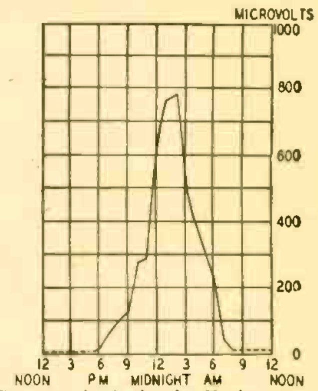
It is common knowledge that the ultraviolet radiation from the sun augments the electron densities in the upper layers of the ionosphere from which dx transmission is reflected. The prediction of communication frequencies depends upon the time of the day, the season of the year, and—equally important—the sunspot cycle of 10 to 11 years' duration.

Every hour on the hour records are made at more than 50 ionospheric stations in various parts of the world. A variable-frequency pulse surges to the ionosphere and back until the critical frequency is reached, when the wave breaks through to outer space. How the average critical frequencies between 9.00 am and 3.00 pm respond to sunspots, both at the E- and F-layers of the ionosphere, is depicted in Fig. 1. From these critical frequencies it is simple arithmetic to calculate the electrons per cubic centimeter at these levels.

How well a radio wave is received over a long-distance path depends upon: (1) how well it is reflected by the ionized layer concerned; and (2) how much of the wave is attenuated through absorption in the lower ionized layers through which the wave passes twice in its flight upward and return from the reflecting layer. Waves of broadcast frequencies are turned back from the E-layer at a fairly constant height of about 110 kilometers. The shorter waves from 1,500 to 30,000 kilocycles depend more upon the F-layer, 200 kilometers high, for their reflection. Waves reflected from the F-layer must pass twice through the E-layer and suffer absorption, depending upon the number of ions or the electron density in this lower layer.

To trace the many vagaries that influence radio reception was the primary reason for the establishment of a Laboratory for Cosmic Terrestrial Research at Needham, Massachusetts, associated with the Massachusetts Institute of Technology. Here 7 recorders are constantly at work with automatic pens of potentiometer recorders geared to special receiving sets, crystal-controlled, that receive waves at different frequencies over different paths from distant stations. More than 20 years' records, covering 2 sunspot cycles, have accumulated on the reception of WBBM, Chicago, in the broadcast band; and the years are accumulating for which records have been received from WWV, the National Bureau of Standards standard-frequency transmitter, sending out waves on 5, 10, and 15 megacycles continuously 24 hours in the day.

With the growing interest in the higher-frequency FM and television, waves too short to be reflected from the usual ionospheric ceilings are recorded by way of tropospheric reception, the troposphere being that lower layer in the ionosphere, underlying the stratosphere, in which all our weather is made. In these records close correspondence between meteorological changes and radio reception has been found.



From Sunspots in Action *by Harlan True Stetson (Ronald Press Co.)*

Fig. 2—Changes in signal strength of WBBM, Chicago, at Needham, Mass., December, 1941.

After Pearl Harbor in December, 1941, WBBM broadcast on 780 kc 24 hours in the day to inform the world of the latest developments in war news. This gave us the opportunity to record WBBM's variation in field strength 24 hours continuously. The results of this reception are shown in Fig. 2. It will be observed that during the daylight hours waves at this frequency were so heavily absorbed as to be scarcely receptible at Needham over the 851-mile path. After sundown, near 6 pm, with the recombination of ions in the lower layers, reception begins to increase rapidly, rising from near zero to nearly 800 microvolts at the receiver by 2 am, and thereafter diminishing and fading out after sunrise about 8 am. This is a clear demonstration of the diurnal variation due to changes in the ionization of the upper

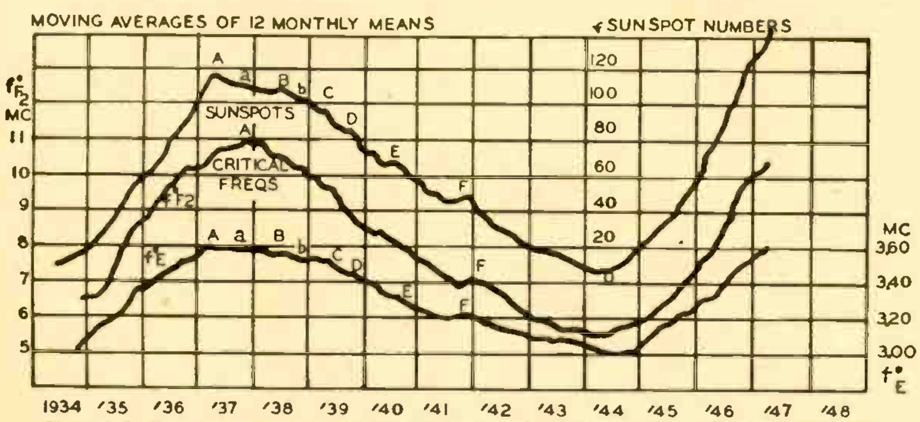


Fig. 1—Sunspot periods vs. critical radio frequencies (values averaged 9-15 hours EST).

atmosphere, chiefly in the E-layer which is responsible for this long-distance reception at broadcast frequencies.

If we confine our attention to broadcast reception from WBBM until 9 pm, we shall discover a marked seasonal variation. In Fig. 3 a field of 500 microvolts at the receiver in January falls to nearly 150 microvolts in June, rising again with the advent of winter. This is easily explained by the increased absorption caused by heavy ionization of the lower layers due to the long summer days and high altitudes of the sun. Here we deal with night E ionization.

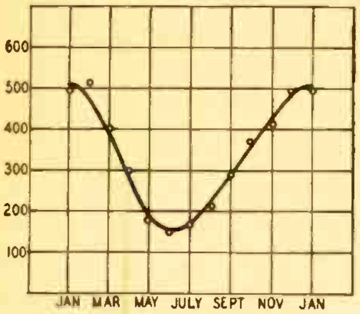
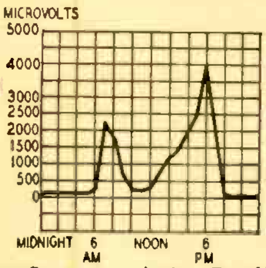


Fig. 3—Field variations, reception at 9 pm.



From Sunspots in Action, *Ronald Press Co.*

Fig. 4—Daily variation, WWV's 5-mc signal.

In Fig. 4 we have a record of a single day's reception on December 10, 1945, from the 24-hour recorder of WWV, the National Bureau of Standards standard-frequency signal on the 5-mc frequency. Low reception during the night hours is followed by an abrupt increase following sunrise with a field of about 2,300 microvolts, as the increasing number of ions in the F2-layer produces better reflection of the waves in the 60-meter band. Thereafter, as the sun attains higher altitudes with more penetrating radiations, ionization builds up in the lower E-layer, increasing the absorption and therefore the attenuation of these waves, causing a drop in field intensities until the noon hour. With the declining sun in the afternoon recombination of the ions in the E-layer diminishes the absorption, and field intensities again rise until about 6 pm. Thereafter, following sunset, recombination sets in again in the ionized F-layer. Poorer reflection results, and field intensities drop rapidly toward the low night values. This curvé, typical of the winter months of 1945, can change materially with the sunspot cycle.

With the increase in sunspots in 1946 the ionizing power of the ultraviolet light of the sun increases enormously. During the daylight hours more and more ions are created in both the F2- and the E-layers and slower recombination of the E-layer during the night hours makes for higher values of field reception. The characteristic change from summer to winter is clearly shown in Fig. 5 where from January, 1945, to June, 1945, we have the expected metamorphosis of the wintertime pattern to the summertime pattern; with the subsequent return to the wintertime pattern in December, 1945, and January, 1946. If one traces the pattern from January, 1946, onward, it can be seen that by early March in 1946 the diurnal reception curve has already gone over into the summer pattern with high night values from WWV and low daytime values due to heavy E-layer absorption.

Now comes the surprise! The summertime pattern of 1946 did not return to the wintertime pattern even though shorter days and longer nights brought decreasing solar altitudes with the progress of the season. The reason for this nonreturn to the winter pattern at the end of 1946, which, as shown in Fig. 6, persists throughout the spring and summer of 1947, is to be explained on the basis of the sudden rise in sunspots which took place during the year 1946 and carried over until 1947. The marked rise in the sunspot curve is shown in Fig. 7. Experience with previous sunspot cycles tells us that the ultraviolet radiation from the sun is about twice as great at sunspot maximum as at sunspot minimum. It is believed, therefore, that the increasing ionization of the sun accompanying the rapid rise in sunspots more than offset the shortening days of winter and the lower solar altitudes which normally bring about the winter pattern.

We are now nearly at the peak of the present sunspot cycle and we may anticipate that before 1948 is over the intensity of the ultraviolet ionizing radiation from the sun will start again to diminish, with a return of this ionizing radiation of sunlight to more nearly normal values. As the sunspot cycle fades, we shall anticipate a return of WWV's 5-mc field-intensity pattern to the winter type. Should this happen in the winter of 1948 we may surmise that we are definitely past the current maximum.

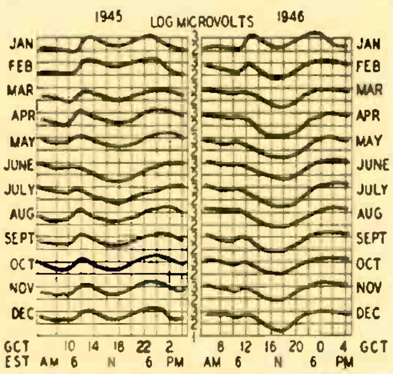


Fig. 5—Monthly diurnal variation, WWV, 5 mc.

All this goes to show how important sunspots are to the radio listener and to communication engineers. Critical frequencies alone may tell us what are the maximum usable frequencies; unfortunately, critical frequency data alone do not make allowance for the attenuation of the waves which may be introduced by the ionization of the atmosphere at lower levels. For this reason radio engineers are becoming more and more interested in recorded field intensities at different frequencies over different paths as a means of improving predictions.

It must be understood that at least 2 different types of interruptions to radio may come about through solar disturbances. One of these is attributable to the radiation of the sun in the extreme ultraviolet end of the spectrum. Such an effect is observed almost immediately, since it takes only 8 minutes for light to travel from the sun to the earth. Occasionally solar explosions accompanying sunspots take place, causing ultraviolet flares on the solar surface akin to an atomic bomb explosion. These flares may result in a momentary blackout of radio communications on all frequencies. Such interruptions, from the records obtained at the Cosmic Terrestrial Research Laboratory, may last from 15 minutes to an hour or more. These fadeouts, to which attention was originally called by Dr. J. H. Dellinger of the National Bureau of Standards, have sometimes been called Dellinger effects. They occur only on the side of the earth exposed to the sun's rays.

Another effect, more far-reaching and of longer duration, is attributed to electrified particles emitted from the sun in the region of sunspots. It is believed that from these gigantic solar whirlwinds particles are shot earthward which, when reaching the earth's atmosphere, so heavily ionize it as to disrupt the radio ceilings over the entire earth. They are of sufficient intensity to cause gorgeous displays of the aurora, or northern lights, which then blaze with great brilliancy, like neon lights advertising an electric show, from 200 to 400 miles aloft. It is then that rivers of electrons start flowing in invisible space, inducing even in the earth itself electric currents that interfere with telegraph lines and teletypes, garbling messages as though a thousand gremlins were let loose on the teletype keys.

One effect of these electrified particles is to create such heavy ionization in the lower atmosphere of the earth as to absorb radio waves and kill communications. These disturbances may last not only for hours but sometimes for days. Long-continued observations at the Cosmic Terrestrial Research Laboratory have shown that in general the appearance of sunspots affects first the highest of the radio ceilings, the F-layer. Shortwave communication by way of this F-layer is therefore the first to be seri-

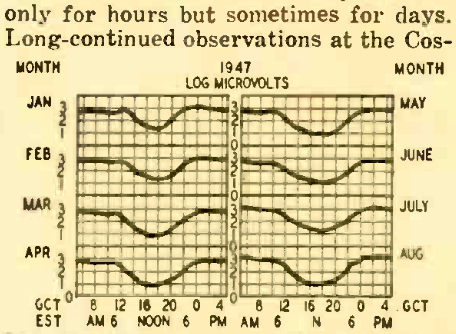
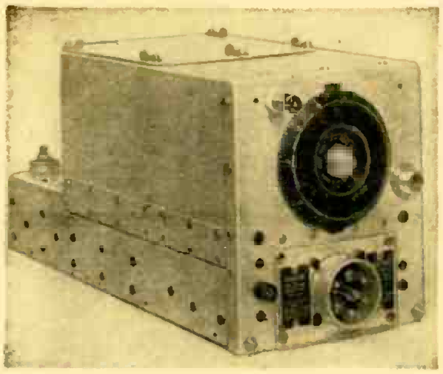


Fig. 6—Mean diurnal variation, Jan.-Aug. 1947.

(Continued on page 72)

BC-946 AS B.C. RECEIVER



The BC-946 is usually obtained in this form.

This little aircraft unit can be converted into a home radio of unusual selectivity and sensitivity

By LYNN G. HERBERT

DOES your family feel like the shoemaker's children who had no shoes when they start listening to that 4-tube table model blooper? Then here is your chance at the expense of a few bucks and a dozen soldering-iron burns to have them bragging to all the neighbors about the fine radio you "made" for them.

It all comes from Uncle Sam's release of the SCR-274-N, out of which you will need the broadcast range receiver, BC-946. For a very modest hunk of capital you get 1 r.f., 2 iron-core i.f.'s, and beam power output similar to the 6V6.

Since you will want to keep the cost down, you will probably put in a 50Y6 as a rectifier in series with the six 12.6-volt, 0.15-amp tubes. The 50Y6 is used as a voltage doubler. The young'un can get between the chassis and a radiator safely without being electrified, for the chassis is connected to the radiator through a 100-watt projection lamp to trade a few electrons for the plate supply. If you don't like that idea, stick to the conventional a.c.-d.c. hookup. If you use the projection lamp, it will light up with the wrong plug insertion. The average family will need about an hour's training on the subject. All this assumes that you live in an average house with 3-wire distribution system of 220-110 volts a. c. with grounded neutral. If it is some odd arrangement, better put a condenser to ground.

The first thing you will want to do after your purchase is to rip the bottom cover off and poke around inside to see what parts you can take out to put in something else. The way the wiring is laid out will frighten you—strictly G.I. Now that you have had a look, pull out the tubes and remove the 2 upper shield covers. To get the inner one off, loosen the screws holding the first two i.f. transformers, and pull them off their plugs. If you own a double-jointed screw driver, you can spend twice the time getting those 2 screws out and not remove the i.f.'s.

Drill into the end of the tuning control gear about ½ inch with a 3/16-inch drill. Due to the movement of the assembly during drilling, you get a nice tapered hole and can file a brass rod or the end of a volume control shaft down to fit. The other end will fit any old knob from the junk-box.

Unplug the tuning coil assembly for elbow room, and take off the front plug and its various cans. Pry the inner connector out carefully, for it is used with the rear one as a speaker plug. Block up this hole with a piece of sheet aluminum and drill the ⅜-inch volume control hole in it. Now you can pull off the 3-µf can on the front. Remove the 239-kc b.f.o. can and the adjacent output transformer (ES-691027) behind it in the back corner of the under-chassis space. Now remove the r.f. hash choke L14 and the dynamotor socket beneath it. Unscrew the dynamotor shock mounts. The 50Y6 replaces the socket. Remove the components of the b.f.o.—R14, 15, 16, 17, and C26. To remove C29 and C31, remove the screws attaching choke L15. Throw R10 in the junk-box. During the conversion you will most likely have to remove the screws of cans of condensers to get at various components. A socket on the power supply plugs into the jack (J2) on the back of the receiver chassis.

The large capacitances of the rectifier filter condensers may alarm you, but all the peak currents used by the 12A6 during loud passages or bass notes must come from them. A heat shield might be placed between the filter condensers and the rectifier tube to lower the operating temperature of the condensers. If so, it should have a large area so as to dissipate the heat well. The resulting ripple level was very low in my set.

The audio could possibly use more gain to drive the 12A6 to full output, but it was more than ample with the 8-inch speaker in the exponential horn used here. The inverse feedback network with a 150,000-ohm resistor and .001 condenser adds a little woof to the response and trims down the harmonic distortion. The cathode bypass of the 12A6 is intentionally small to boost the high frequencies from about 4,000 cycles up. You might want this boost to start in at a lower frequency, so try values of about 0.5 µf. The 30-µf condenser from the 12A6 cathode is moved over to the cathode of the 12R7.

Automatic volume control is applied to the r.f., i.f., and mixer stages. The

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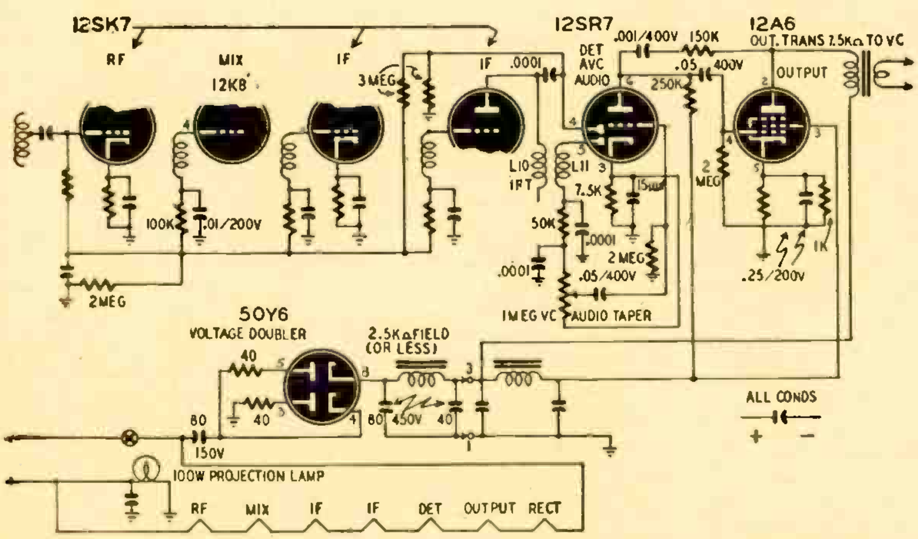
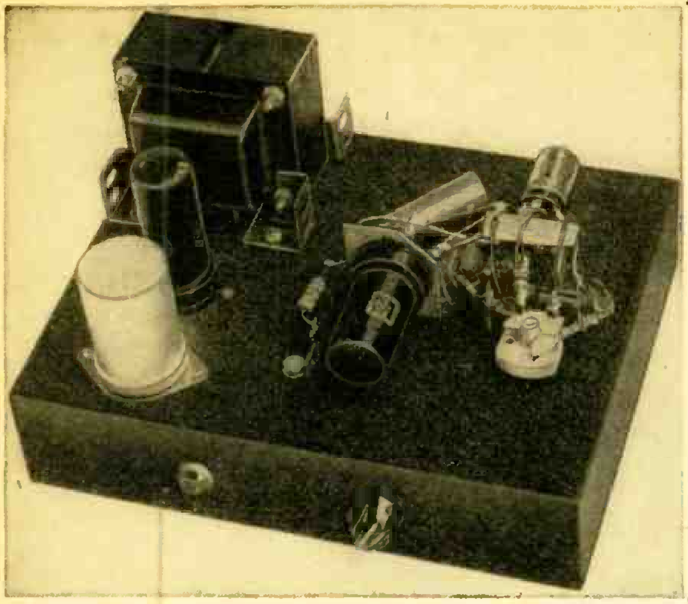
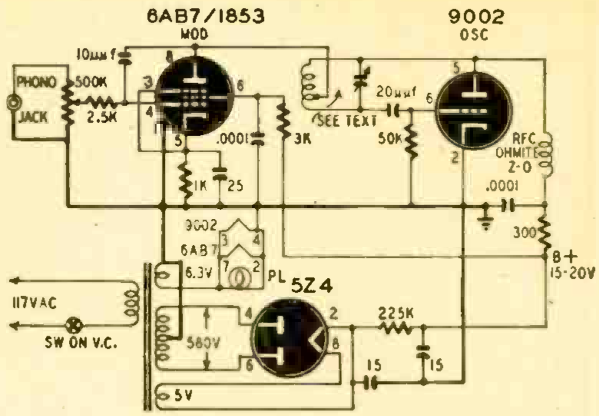


Schematic showing all changed circuits. A complete diagram is usually sold with the set.





Schematic and photograph of the FM wireless record player. Note that all grounds are led to one point (behind small variable condenser). These points are important in high-frequency work, and successful operation may depend on them.

RADIO RECORD PLAYER FOR YOUR FM RECEIVER

By RICHARD H. DORF

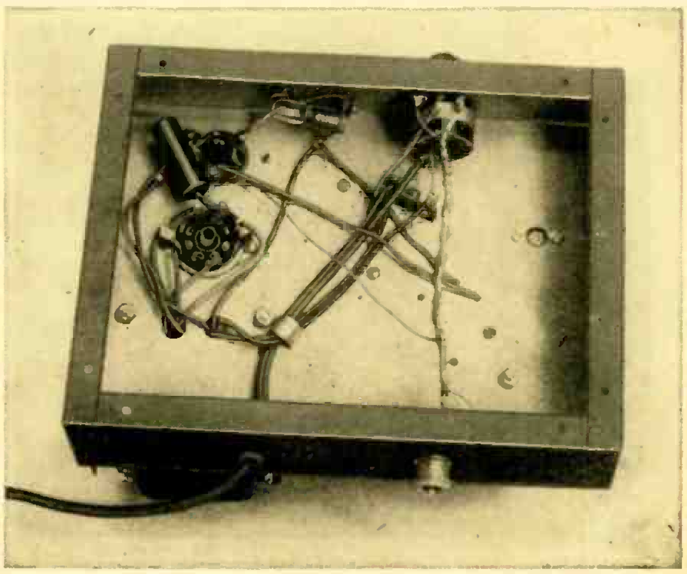
FOR many years phonograph oscillators have been very useful and popular. They are, in effect, miniature broadcast stations, and make it possible to locate the pickup-turntable unit anywhere in the room. Unlike ordinary portable phonographs, the reproduced frequency range need not be restricted by the small speaker which fits into the phonograph case. Played through the family radio receiver, records are usually enhanced in quality.

Not the least of the wireless record player's advantages is comfort and convenience. The small player can easily be put on a coffee table or an end table, so that the operator need not get up from his seat to change records. If space is scarce, the phonograph can be stored in a closet when not in use.

The common phonograph oscillator which works in the standard broadcast band is subject to most of the usual disadvantages of AM transmission and reception. It is often difficult, especially in large cities, to find a place on the dial where there are no whistles or "monkey chatter." This is particularly true at night. Unless the oscillator puts out a substantial signal, interference may be heard; and if it *does* put out a substantial signal, the neighbors and the FCC may be heard! In addition, most AM receivers do not have particularly good audio-frequency response or distortion ratings. Further, an amplitude-modulated oscillator can never be modulated 100%, so receiver volume must be turned up more than usual, admitting any hum and extraneous noise that may be lurking in the vicinity—including carrier hum.

There is a cure for these problems. Any critic who has ever listened to a good FM broadcast knows that there is little or no interference, that most FM receivers have good a.f. characteristics, and that FM tone has that something which, for lack of a better term, we call "presence." It is a quality no AM broadcast can produce—a feeling that the speaker or musician is right in the room with you.

So—why not a frequency-modulated phono oscillator? The FM oscillator described here has practically no frequency discrimination or distortion in itself and, received on a good FM receiver, its sound quality is limited only by the a.f. system of the receiver. It produces satisfactory results with a signal just about strong enough to operate the receiver's limiter.



Bottom view of the oscillator. Most of the wiring is on top.

There is no cross talk with broadcast stations, no monkey chatter. It is *not* necessary to find a quiet spot on the dial, since, as long as the oscillator signal is at least twice as strong as that of a station on or near its frequency, that station will be completely blanked out. The signal strength is great enough to produce this effect at distances up to at least 30 feet. At substantially greater distances, the oscillator cannot be heard; you are safe from the neighbors and the FCC.

FM receiver production is in its stride now; more and more homes are FM-equipped. With this phono oscillator you will have a miniature FM station, capable of high-quality reproduction.

The FM oscillator is shown in the photograph. As the schematic diagram reveals, its construction is simple. It is built on a standard 7 x 9 x 2-inch metal chassis and has its own a.c. power supply.

The oscillator is an ultraudion. This is probably the simplest type of v.h.f. oscillator, and its stability is entirely adequate. The 9002 tube is suitable because

(Continued on page 71)

Pulse Code Modulation

Radiophone signals can be relayed a large number of times without deterioration by this new system

By FRED SHUNAMAN

RADIOTELEPHONY got its start on the sea and in the air, where the connecting lines of the older line telephony could not be strung. Recent events like the opening of the New York-Boston microwave circuit indicate that it is preparing to take over on land as well. The future will see towers on hilltops beaming or funnelling signals to other towers on the far horizon as well as the familiar complex webs of wires stretching endlessly on multi-crossbarred poles or buried co-axial cable lines.

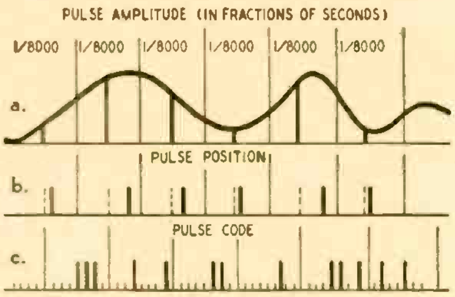


Fig. 1—Pulse modulation, 3 typical systems.

Two stumbling-blocks have hampered the advance of radio in commercial telephony. One is the difficulty of transmitting a large number of messages at the same time on one channel, as can be done easily over *multiplex* wire circuits and coaxial cable. The other is destruction of the signal by atmospherics, electrical interference or distortion introduced by transmitting, relaying and receiving apparatus. To reach great distance on the ultra-high frequencies available for commercial telephone use, many relays are necessary. The number of times a signal can be relayed depends on the amount of extraneous material it picks up on the way. After a large number of relay steps, the voice content of the message may be lost—buried under a mass of atmospherics and electrical noise.

Pulse Code Modulation, a development of Bell Telephone Laboratories, undertakes to solve these two problems simultaneously. Like earlier forms of *pulse modulation*, it makes no attempt to put the whole signal wave on the air. Instead, small *samples* of the signal wave are taken at evenly-spaced intervals. These samples, which register the signal voltage, are transmitted as pulses. They build up at the receiving end substantially the same signal wave as the one at the transmitter.

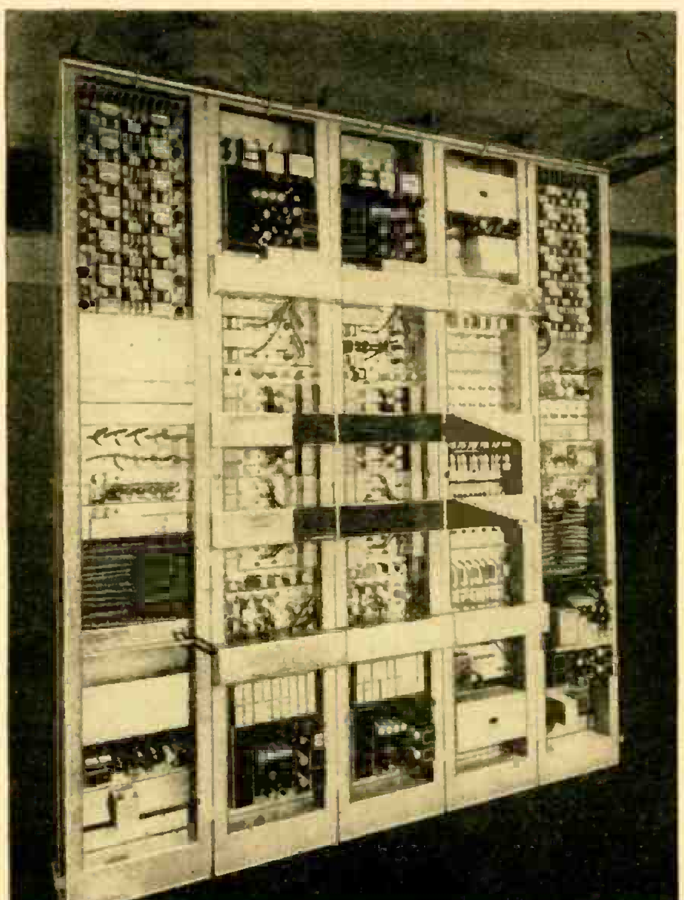


Fig. 2—Rear view of the Bell Laboratories experimental equipment.

To follow exactly the frequency of the sampled transmission, the sampling rate must be at least twice as great as the highest frequency transmitted. Samples are taken 8,000 times per second to transmit telephone conversations which are filtered to remove all frequencies above 3,400 cycles. If the sampling drops below this 2-1 ratio confusion between a sampled frequency and the difference between it and the sampling frequency arises; a sampling frequency of 8,000 would be unable to distinguish between 6,000 and 2,000 cycles (RADIO-CRAFT, March, 1946).

Sampling solves the problem of multiplexing, for the samples can be taken in a much shorter time than the 1/8,000 second allotted. In the present Bell Laboratories experimental set-up, 12 conversations can be sampled in that time. Thus 12 transmissions can be sampled in turn and carried on the same frequency, each one "sharing time" in the 1/8,000 second interval. Circuits at the receiving end unscramble the multiplexed signals and distribute them to their proper channels.

Older forms of pulse modulation attempted to solve the twin problems of multiplexing and multiple relaying. Successful in the former, they did not succeed in getting rid of the cumulative effects outside of interference and noise generated in the radio equipment itself. *Pulse Amplitude Modulation* (Fig. 1-a) was least successful. Static or interference can falsify the message carried by any one pulse, distorting the received signal as in any other form of AM. *Pulse Position Modulation* (Fig. 1-b)—more like FM than AM—was more successful. Instead of varying in amplitude with the signal, modulation caused the pulses to be made earlier or later than their unmodulated position in the center of the time channel. Since all pulses are clipped to uniform amplitude in the receiver, amplitude modulation introduced by noise voltages has no effect. Unfortunately interference or fading may destroy all but the leading edge of one pulse and all but the trailing edge of another, thus varying their relative position, and so distortion does creep in.

Pulse Code Modulation (PCM) (Fig. 1-c) also uses samples to tell its story at the receiving end, but instead of carrying its information by changing the position of pulses, each sampled voltage sends its own *code character* to the receiver or relay station, where it is either *decoded* to produce an exact replica of the sample, or *regenerated* to repair damage caused in transmission, and sent out again as a perfect code group, which can be regenerated and relayed an indefinite number of times.

This advantage is gained at the cost of complication in the transmitting and receiving circuits. Fig. 2 is the rear view of a panel which houses the equipment

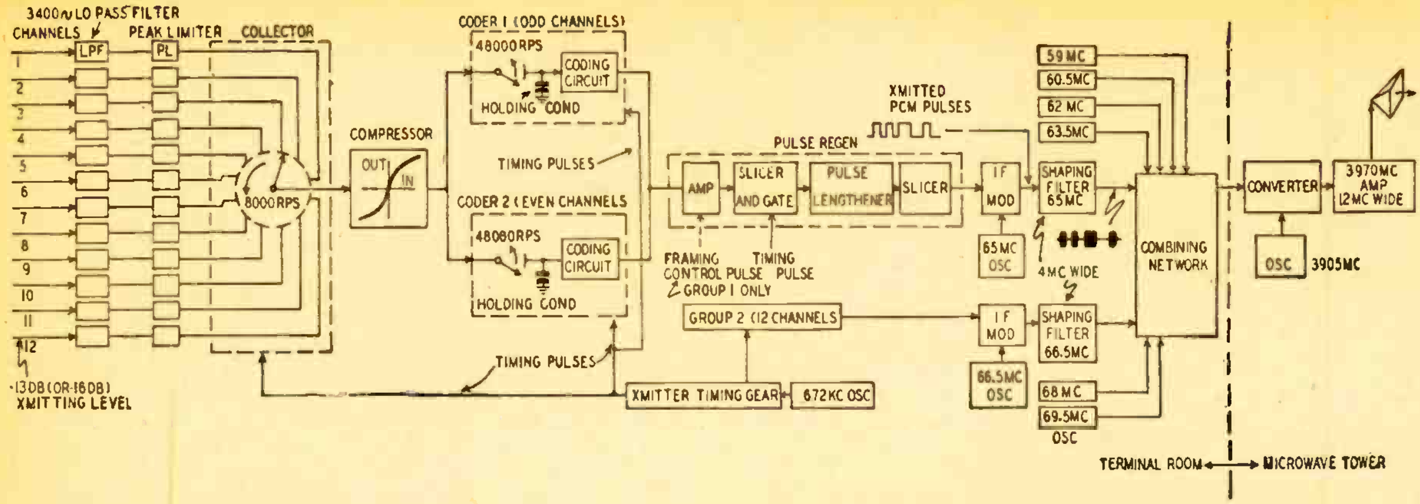


Fig. 3—The complete transmitting apparatus for one experimental circuit, indicating also how additional circuits may be accommodated.

for 2 12-channel circuits, with some auxiliary equipment which might be used for 8 more. Together with old circuit features, such as electronic switches, expanders, clippers (or slicers) we find some new components and ideas. Among these are the *coder* (shown on the cover) *quantizing circuits* and *decoders*. Parts of the circuit resemble older pulse modulation equipment (see *PPM — New Technique*, RADIO-CRAFT, February, 1946). Voice signals from each of the 12 channels of a circuit are passed through filters and limiters (Fig. 3) then are sampled by an electronic switch which contacts each channel 8,000 times per second. Each sample is then put through the compressor, from which it goes to another pair of switching circuits which route the samples from even-numbered circuits through one coder and those from the odd-numbered channels through the other. This is done so the holding capacitors have time to discharge completely between signals, and thus prevents interference (crosstalk) between channels. After coding the signals are amplified, then go through a *slicer* and *gate*, which clip them off to an even amplitude and permit only very narrow pulses to pass in the exact positions required by the pulse code. These exactly positioned pulses are then lengthened by a following circuit to make them easier to transmit than the former very narrow (0.4-microsecond) pulses.

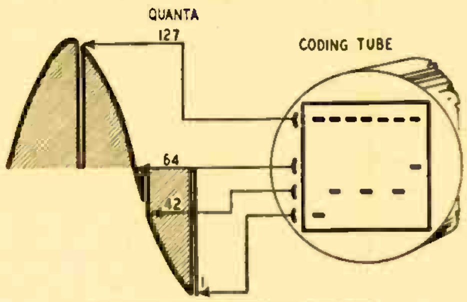
A second slicer again evens the pulses and they pass to an i.f. modulator working on a frequency in the neighborhood of 65 mc. The square pulses go through a *shaping filter* to produce rounded pulses more suitable for radio transmission. A converter at 3905 mc beats with the i.f. and the sum frequency of 3970 mc is further amplified and fed to the horn or parabolic radiators of the antenna system.

Besides multiplexing in time, a number of channels divided in frequency may be transmitted by the same broadband transmitter, as shown in Fig. 3. It is expected that a complete system will be able to carry 8 such channels, or 96 telephone conversations, simultaneously.

Signals follow an equally complex course at the receiving end (Fig. 4). The multiplex signals are first converted back to the 65-kc intermediate frequency, detected and fed to the input slicer, which cuts them down to even amplitude. A switching circuit then divides the odd and even channels and sends them to the two decoders, after another gating and slicing. After decoding, odd and even channels are again combined and amplified, expanded to restore the original form before compressing, and distributed back on their 12 lines in the inverse process of sampling. The holding condensers reduce the amplification needed in the subsequent audio amplification of voice signals which reproduce those supplied to the transmitter, and a 3,400-cycle filter cuts off any high-note noise or distortion products which may have been introduced into the signal in the various circuits.

The pulse code

The code system is simple, and somewhat resembles a telegraph code in which only dashes appear. Each code



1	2	4	8	16	32	64		QUA.
—	—	—	—	—	—	—		127
						—		64
	—		—		—			42
—								1

Fig. 5—How audio wave is sampled and coded.

group is made up of seven spaces, and the code characters are made by filling some of these spaces with dashes and leaving others blank. By combining dashes and blanks as many ways as possible in the 7 allotted spaces, 128 different characters or code groups can be formed.

Samples taken at various points on

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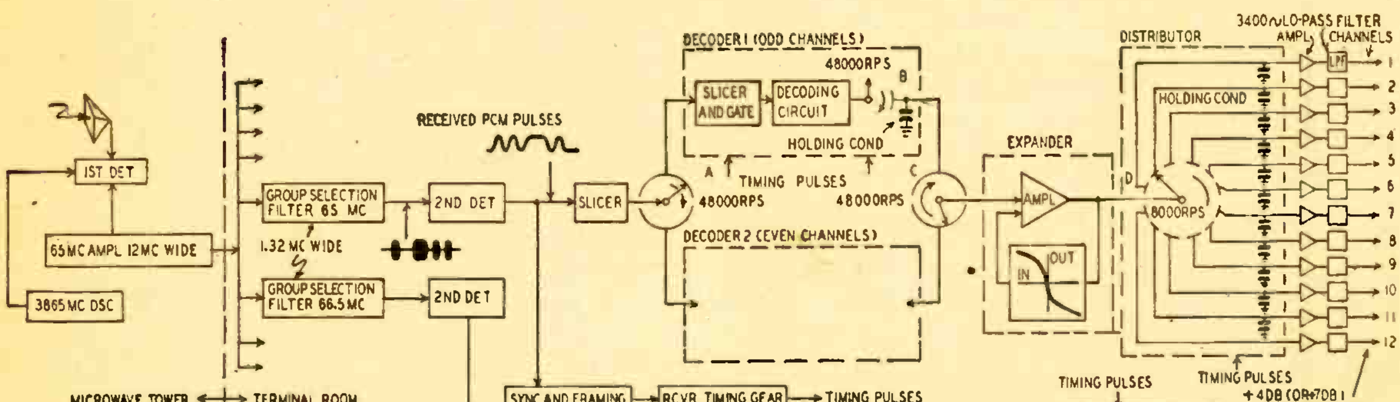

Fig. 4—The experimental receiver, with decoding equipment for one 12-channel group, and indicating parts common to several circuits.

the audio voltage wave produce their own code groups, as shown in Fig. 5. Each of the dashes is given a code value corresponding to its position in the frame. Thus a dash in the first position has a value of 1, in the last position of 64, and a code group composed of a dash in the first and last position, with nothing in the 5 spaces between, would have a value of 65.

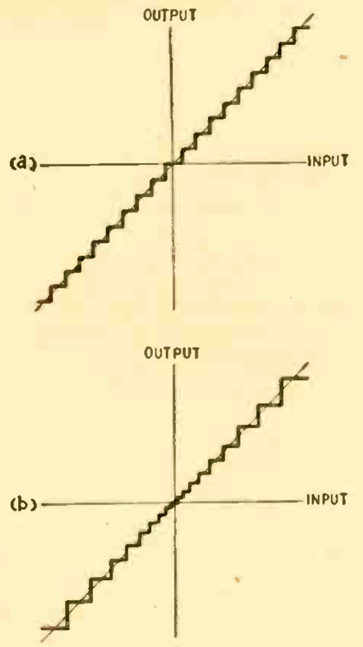

Fig. 6—Breakup of voltage into quanta steps.

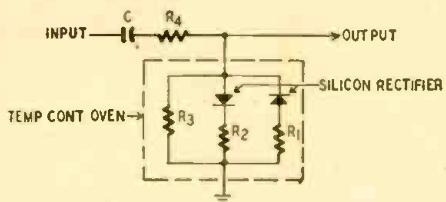

Fig. 7—Circuit of the compressor or expandor.

Samples can then be taken only at 128 points or steps over the amplitude range. These steps (Fig. 6-a) are close enough together to reproduce voice excellently. A system with a larger number of steps has been used for music transmission. Each of these steps or quanta has its own code number, ranging from 1 to 127 in the system now used. The code number 64 represents zero signal, and low-level negative or positive swing is represented by numbers just below and above 64. High-level signal swings are represented by numbers near zero and 128.

The signal compressor

In *quantizing*, or dividing the signal voltage into a series of steps, equal steps seemed to the ear to be too far apart for weak signals and appeared to be closer together as voltages increased. Instead of evenly-spaced steps like those of Fig. 6-a, what was needed was a series more like that of 6-b, in which more steps are available for low-level signals. Such a division is made by inserting a *compressor* in the circuit just before coding.

The compressor (Fig. 7) uses metal rectifiers, whose resistance is large to low currents but decreases as the current through them increases (RADIO-CRAFT, August, 1947, page 37). Two silicon rectifiers poled in opposite directions are shunted across the input to the coder. To make all compressors uniform, small padding resistors are connected in series with each rectifier and a large resistor is shunted across the unit. These resistors are adjusted till the compressor matches a standard unit. The compressor's d.c. resistance then ranges from about 6,000 ohms for very weak signals to only about 190 ohms at full-load peak.

The compressor is shunted across the coder input circuit, so that stronger signals are attenuated more than weak ones. The effect is as if the quantizing steps were farther apart for strong signals and closer together for weak ones (Fig. 6-b).

The *expandor* in the receiver circuit (Fig. 7) is an identical unit. It is placed in the feedback path of an amplifier, so that its effect on the signal is exactly opposite to that of the pre-coding compressor. Since the two units are identical, the signal from the expandor-amplifier has exactly the same form as it had before compressing.

Coding tube and circuits

The actual coding is done by the special cathode-ray tube shown on our cover. It consists (Fig. 8) of an ordinary electron gun, horizontal and vertical deflecting plates and three elements which work together to code the signals. Each channel is sampled once in 1/8,000 second, and there are 6 channels for each coder, so the horizontal beam sweeps from left to right 48,000 times per second. It is blanked out on the return trace.

Voltage samples from the compressor are applied to the vertical deflecting plates. The electron beam may be swept across the tube at any point between the horizontal axis (no signal) and the top or bottom (maximum positive or negative signal).

The code is produced by the *aperture plate* and *quantizing grid*. The aperture plate, shown behind its quantizing grid in Fig. 9, has a number of vertical slots so placed that a narrow electron beam sweeping horizontally across it sends spurts of electrons through it to produce code characters like those of Fig. 5. A beam focused between the top pair quantizing grid wires (maximum positive signal) passes through 7 slots in the aperture plate, producing evenly-spaced pulses (code 1-1-1-1-1-1-1). One wire (step) below, the beam would pass through the aperture plate in all positions but the first, and the code would be 0-1-1-1-1-1-1. There are 128 steps separated by the wires of the quantizing grid, each with a different combination of marks and spaces. The lowest step (maximum negative signal), for example, produces the code 1-0-0-0-0-0-0.

The *quantizing grid* is very important. It holds the beam in a straight horizontal line and prevents it from straying up or down during a horizontal sweep. To so control the beam, a *quantizing bias* is picked up from the circuit which blanks out the electron beam on each return sweep. This bias pushes the beam up against the grid wire just above the sweep path selected for it by the signal. As electrons from the beam strike the grid, it emits secondary electrons. These are picked up by the *collector* and returned as a *quantizing feedback* to the vertical deflecting circuit.

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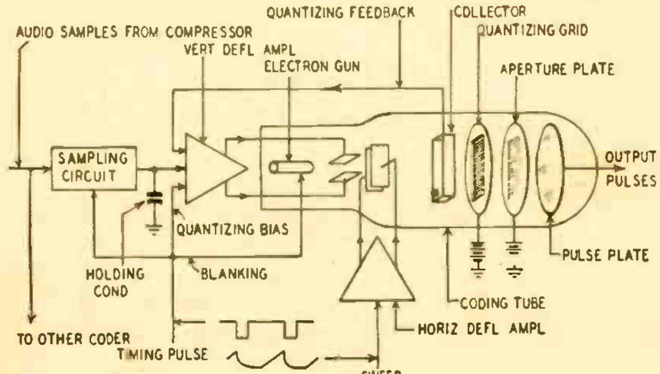

Fig. 8—The coding tube, most important feature of the system.

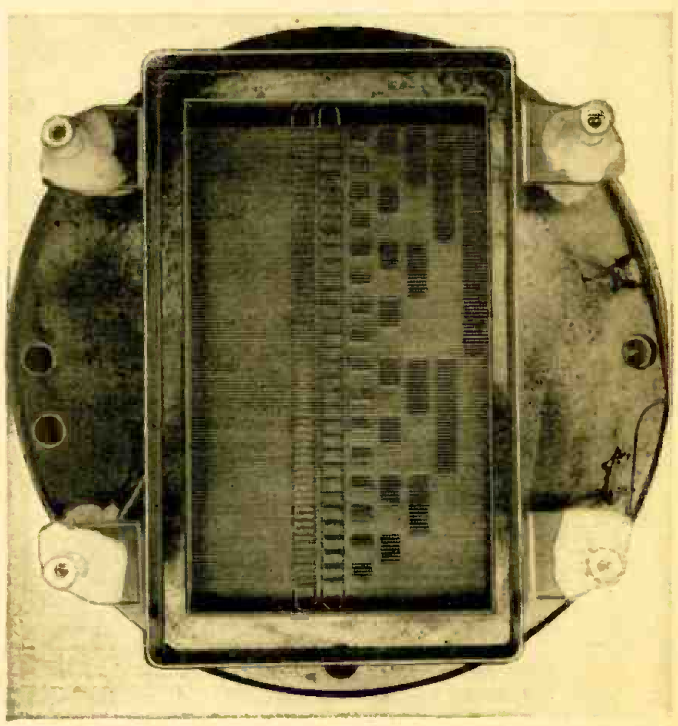

Fig. 9—End view of the aperture plate through the quantizing grid.

MAGNETIC RECORDING

Part IV—The electronic section of a modern magnetic recording and playback apparatus

By A. C. SHANEY*

9-tube amplifier is housed in this long-playing recorder-reproducer.

IT MAY be predicted safely that the major developments contributing most toward the improvement of magnetic tape recording will be in the discovery of new and improved magnetic tape manufacturing techniques.

It is equally safe to predict that tape recording will gain supremacy over magnetic wire recording. The major advantages offered by magnetic tape recording include:

1. It is virtually impossible to tangle tape.
2. Tape offers unlimited editing facilities. Sections may be spliced with ordinary Scotch tape.
3. Magnetic tape decreases the possibility of magnetic cross transference.
4. Magnetic tape may be operated at a considerably reduced speed.
5. Mechanical problems in handling magnetic tape are relatively simple when compared to the mechanics of feeding a hair-thin wire at a constant speed.
6. There is every indication that magnetic tape will be reduced substantially in price as demand increases. The same cannot be said for the comparatively expensive process of drawing the equivalent of A.W.G. No. 28 stainless steel wire.
7. Speed for speed, magnetic tape is far superior to wire. At present, tape traveling at 4 inches per second can easily equal the response of wire traveling at 24 inches per second.
8. Magnetic wire produces an appreciable variation in high-frequency amplitude level due to the twisting of the wire on its axis. This cannot happen with magnetic tape.
9. Most magnetic tape machines provide a high speed forward and reverse shuttling. Most wire recorders, on the contrary, do not offer this desirable feature, and the lack may make it necessary to play through a

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*Chief Engineer, Amplifier Corp. of America

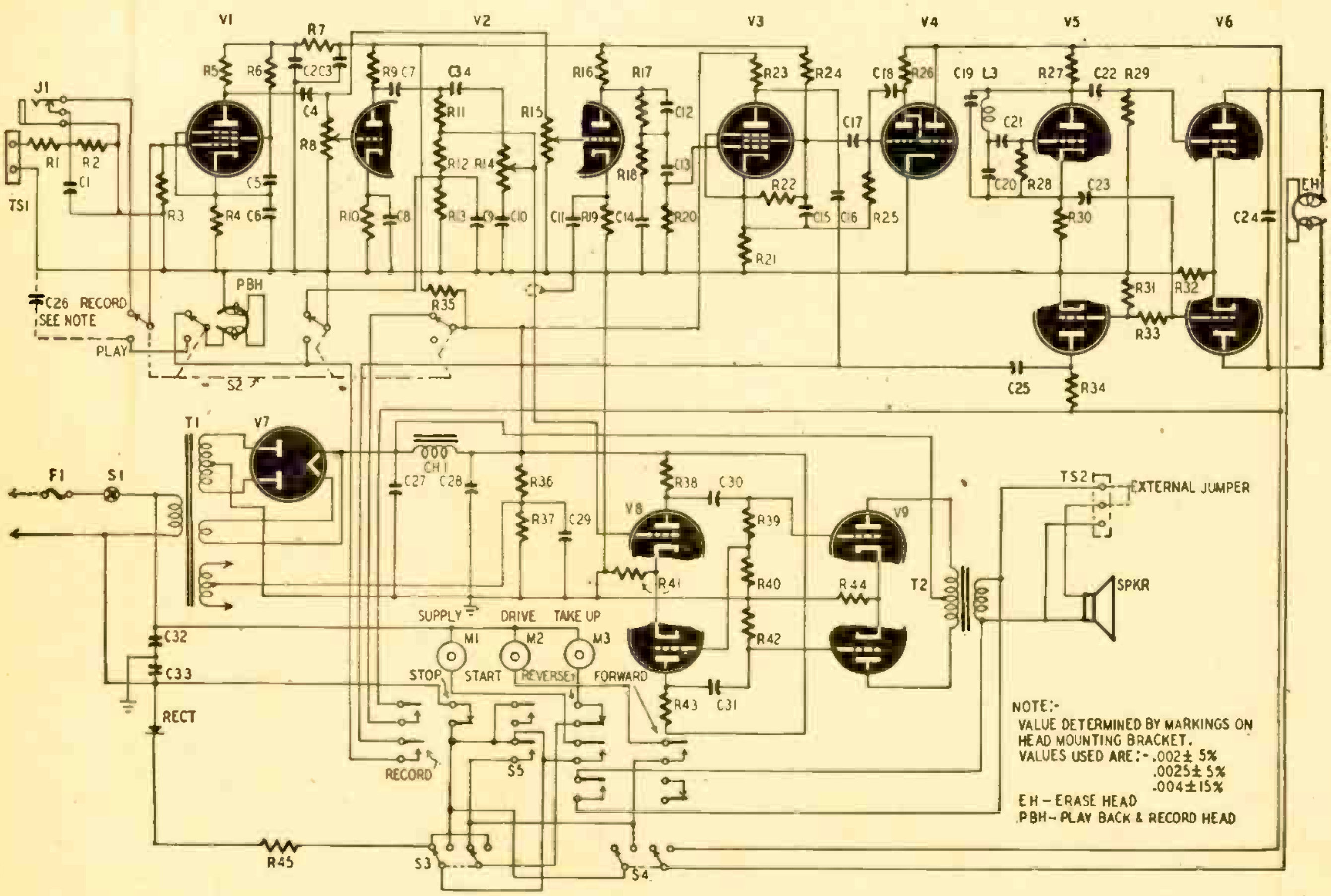


Fig. 1—Schematic of the complete recording and playback amplifiers and erasing circuits. Circuit breakdowns appear in Figs. 2 and 3.

Radio Set and Service Review

The Collins Model 75A-1 Uses several new principles

By R. F. SCOTT, W2PW6

THE Collins amateur-band receiver, Model 75A-1, embodies several features new to amateur receiver design. It is the first of its type to use *permeability tuning* and *double conversion.* These features do much to provide image-free reception and rock-like stability from a cold start—even on 10 meters.

It is a 14-tube receiver with six tuning ranges; one for each amateur band (80, 40, 20, 15, 11 and 10 meters). A well-calibrated mechanical bandspread system and highly stable oscillators provide reset ability to within *a few cycles* on any band. Tuning ranges of the bands are: 80 meters, 3.2 to 4.2 mc; 40 meters, 6.8 to 7.8 mc; 20 meters, 14 to 15 mc; 15 meters, 20.8 to 21.8 mc; 11 meters, 26.0 to 28.0 mc and 10 meters, 28 to 30 mc.

The main dial is of the slide-rule type, with a scale for each band. Each scale is divided into 100-kc points. The circular vernier dial has 2 scales. The lower scale is divided into 1-kc points for use on 80, 40, 20 and 15 meter bands. The upper scale is used on the 11 and 10 meter bands and is marked in 2-kc divisions. The proper scales of both dials are lighted by operation of the band switch. Exact frequencies, in megacycles, are read by adding the settings of the two dials. If, for example, the band switch is set at 80 meters, the pointer on the main dial is between 3.3 and 3.4 mc and the vernier on 45, you find the frequency by adding the direct reading of the vernier dial to 3.3 mc. The frequency is 3.345 mc.

The hair-line of the vernier dial is adjustable 2 divisions each side of center position to compensate for variations in calibration that may arise with aging. WWV, on 15 mc, can be used for checking the calibration of the receiver and for setting the position of the vernier indicator.

Double conversion

The block diagram and the chart at the bottom of the schematic diagram will make it easier to understand the tuning system. The block diagram shows 5 circuits ganged to the tuning control. Six circuits are ganged to this control but one was omitted for simplicity. These circuits are permeability tuned with powdered iron cores connected to a movable platform linked to the tuning shaft.

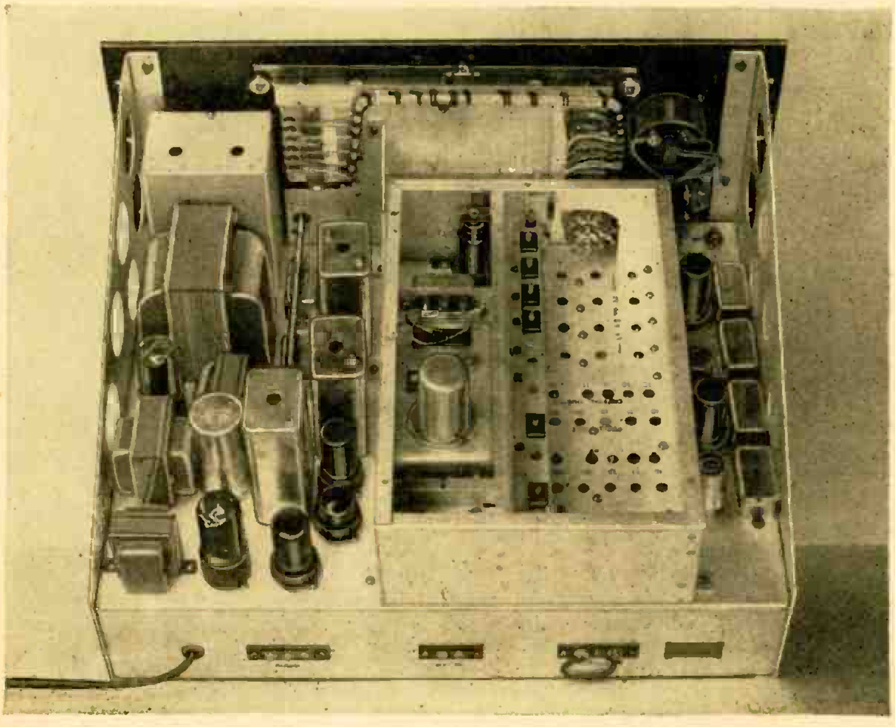
When the set is tuned to a particular band, proper antenna and r.f. coils and crystal are selected. The incoming signal is amplified by the r.f. stage and mixed with the signal from the crystal oscillator at the plate of the first mixer. Tuned circuits in the output of the mixer resonate at a frequency equal to the *difference* between the signal and oscillator frequencies.

Oscillator crystals for the 4 lower frequency bands are chosen so the difference frequency is 2.5 mc at the low ends of the tuning range and 1.5 mc at the high ends. For example: A 5.7-mc crystal is used on the 80 meter band. It beats with 3.2-mc signal to produce a 2.5-mc difference frequency. A 4.2-mc signal beats with the crystal to produce a 1.5-mc difference frequency. The high-frequency i.f. transformers are variable between 1.5 and 2.5 mc and their tuning slugs are ganged with those of the r.f. and antenna coils. In this way, the i.f. transformers are always tuned to the difference frequency. The comparatively high i.f. places the image repeat point well away from the signal frequency thus increasing the image ratio.

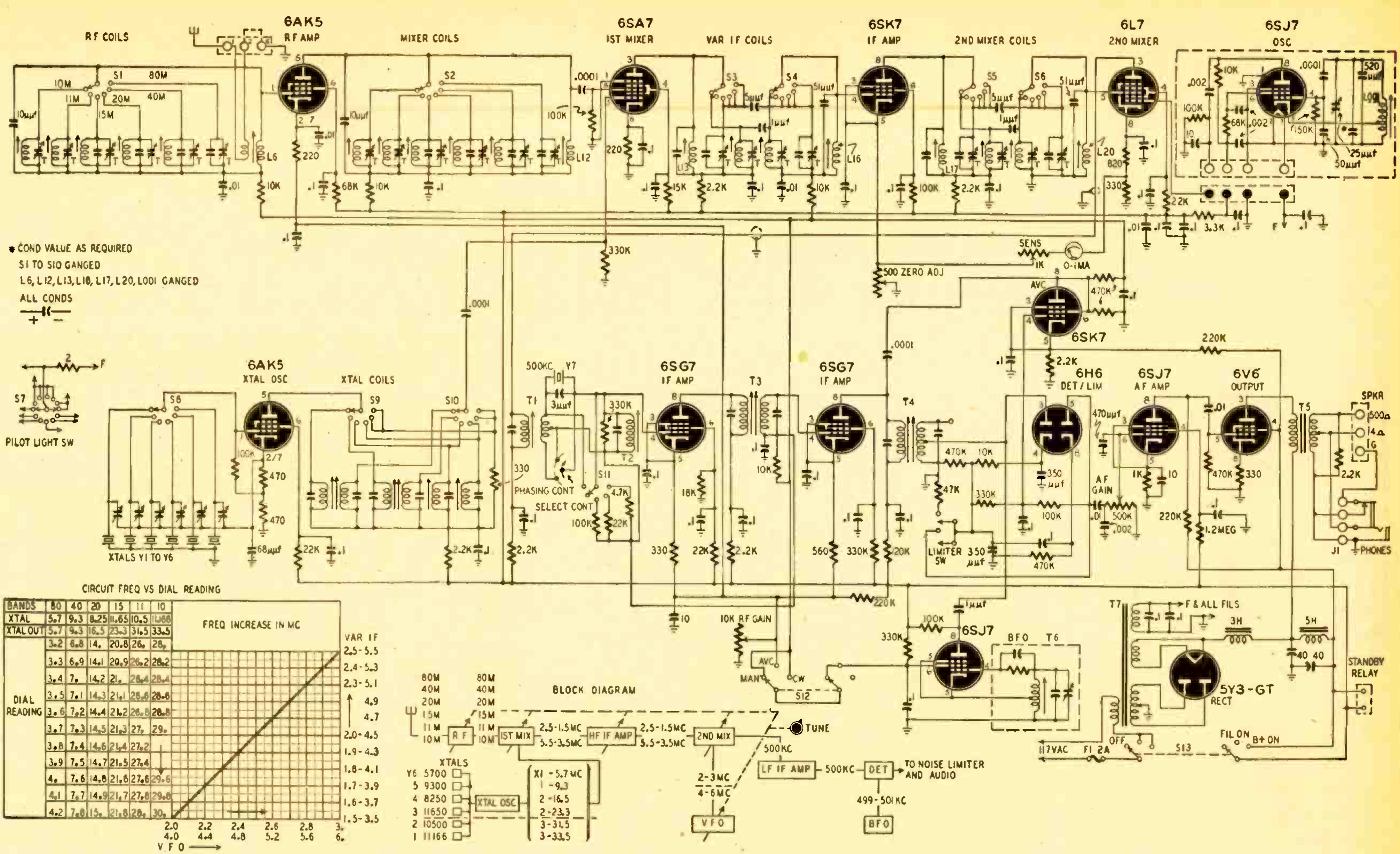
The variable i.f. beats with a signal from the v.f.o. to produce a 500-kc output in the output of the second mixer. The v.f.o. is variable from 2 to 3 mc to provide a constant 500-kc difference between its frequency and that of the variable i.f. The second mixer is followed by two conventional i.f. amplifiers fixed-tuned resonating at 500 kc.

The same tuning principles are used on other bands. Note that crystal fundamentals are used on the 80 and 40-meter bands. On 20 and 15 meters, the *second harmonics* of the crystal oscillator produce heterodynes in the range of the variable i.f. amplifier. The *third harmonics* of crystal frequencies are used to produce beat frequencies between 5.5 and 3.5 mc for signals on 10 and 11 meters. Shifting to a higher variable i.f. eliminates image response on these bands. When the variable i.f. is in

(*Continued on page* 74)



Rear view of the receiver. All tuning components are contained in the center compartment.



CIRCUIT FREQ VS DIAL READING

BANDS	80	40	20	15	11	10
XTAL	5.7	9.3	8.25	11.65	10.5	11.166
XTAL OUT	5.7	9.3	16.5	23.3	31.5	33.5
DIAL READING	3.2	6.8	14.	20.8	26.	28.
	3.3	6.9	14.1	20.9	26.2	28.2
	3.4	7.	14.2	21.	26.4	28.4
	3.5	7.1	14.3	21.1	26.6	28.6
	3.6	7.2	14.4	21.2	26.8	28.8
	3.7	7.3	14.5	21.3	27.	29.
	3.8	7.4	14.6	21.4	27.2	
	3.9	7.5	14.7	21.5	27.4	
	4.	7.6	14.8	21.6	27.6	29.6
	4.1	7.7	14.9	21.7	27.8	29.8
	4.2	7.8	15.	21.8	28.	30.

The Collins Model 75A-1, a 14-tube receiver, is designed solely for use on the amateur bands. Among a number of interesting features, it uses fixed crystal-controlled oscillators, and tunes by varying the intermediate frequencies.

Signal Tracer Is Hand-Size

By CHARLES W. CARRUTHERS

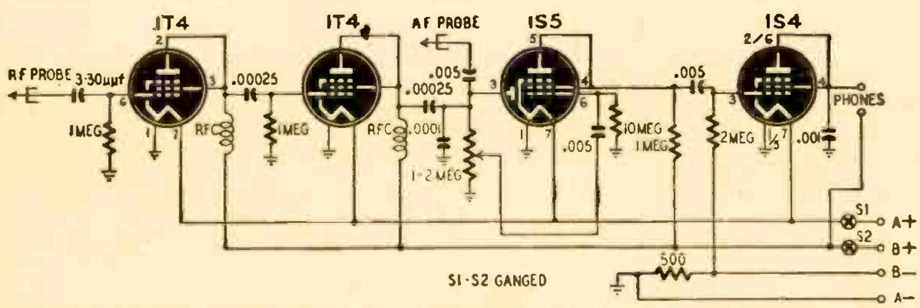
THIS practical signal tracer fits in the palm of your hand. It is not limited to the service bench, either! Batteries make it a very handy instrument for work in the field and reduce the problems of hum and the hot chassis of a.c.-d.c. instruments.

Making the unit so small that one can hold it in one's hand without tiring has a real advantage from the electrical standpoint. One can do away with special test leads and use very short unshielded probes mounted on the signal tracer itself. This makes it a simple matter to keep the r.f. input capacitance low and still have enough signal available at the grid of the first tube to keep the signal-to-noise ratio high.

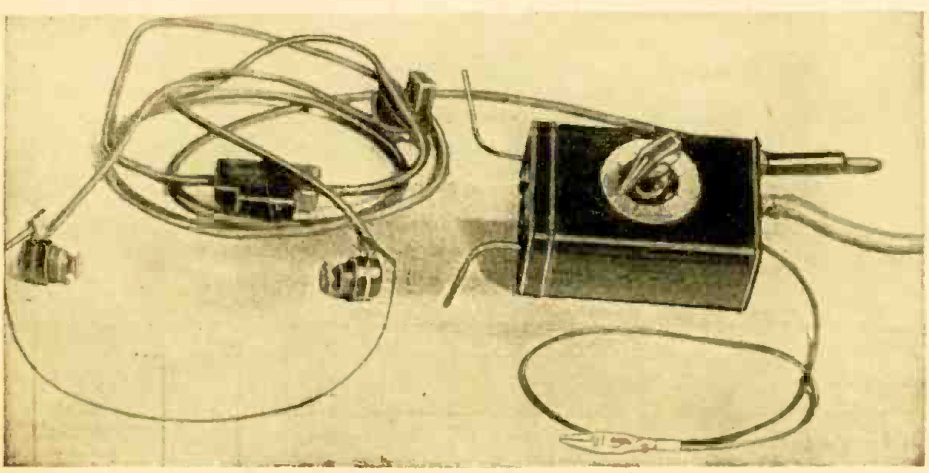
It was designed to fulfill the following specifications:

1. Sufficient r.f. sensitivity to be able to pick up the signal at the antenna coil before any amplification has taken place.
2. Small enough coupling capacitance so that it will not load or detune the circuit under test to a degree that will interfere with normal operation.
3. Sufficient audio gain to permit the checking of the lowest audio levels normally encountered.
4. Definite separation between r.f. and audio signals. The r.f. probe must not pass audio, and the audio section must not pass r.f.
5. Power supply with an extremely low hum level and of a type that will permit direct connection from the tracer ground to any receiver chassis. The a.c.-d.c. type of power supply, which would require blocking condensers, and constant care to keep both receiver and tracer chassis on the same side of the line, is *definitely* not suitable.
6. Size as small as possible without sacrifice of efficiency.
7. Headphones rather than a speaker. This will cause less confusion when checking a receiver that is operating with low volume or distortion. The headphones also help to mask the sound coming from the receiver speaker, so that a check of quality and volume level may be made at any particular stage without interference from the receiver output.
8. A volume control. This is necessary to adjust the volume to a comfortable listening level and at the same time helps in making a comparison of signal levels.

The addition of tuned circuits would not only increase the size of the instrument and add to the number of controls, but would not provide any very great gain in usefulness. The selectivity of the circuit under test, if it is not loaded by the test equipment, is great enough to identify the frequency.



Schematic diagram. Batteries are self-contained. Note that the 1S4 is connected as a triode.


The complete equipment. R.f. and a.f. prods project from one end—phone cord from the other.

A practical instrument

The circuit diagram shows an attempt to meet the foregoing specifications. There are no trick circuits here—no squeezing the last bit of gain out of the tubes. Input resistances are kept low to minimize the chances of oscillation due to feedback among closely-spaced parts. It is a simple 2-stage, untuned r.f. amplifier, detector, and 2-stage audio amplifier, with headphones to take the place of a speaker.

An r.f. probe is coupled to the first 1T4 grid by a 3-30-μμf trimmer (set to minimum capacitance under normal conditions). A 1-megohm resistor returns the grid to ground. All tubes have their screens connected to their plates at the socket. This was done to simplify the wiring, but does improve the operation to some extent. Chokes in the plate circuits of both r.f. stages improve the gain. (The increased r.f. impedance of the chokes over that of resistors and their lower d.c. resistance give them considerable advantage in low-voltage circuits.) A 100-250-μμf condenser couples the plate of the first tube to the grid of the second. Another condenser of the same value is used to couple the plate of the second tube to the diode detector plate. The second r.f. grid is also returned to ground by a 1-megohm resistor.

The audio probe connects to the diode plate end of the volume control through a .005-μf blocking condenser. The variable tap on the volume control is connected through a .005-μf condenser to the first audio grid, which is returned to ground through a 10-megohm resistor. A 2-megohm resistor connects to the negative side of a 500-ohm resistor that is in series with a B− lead. Output of the 1S4 is through a pair of headphones shunted by a .001-μf condenser. A 2-pole switch on the back of the volume control breaks both B+ and A+ leads. The power supply is obtained from 1½-volt A- and 67½-volt B-batteries, of the size commonly used in the new personal portables.

Construction pointers

The original unit was constructed in a small tinned-metal can—a spice can from the pantry shelf. The tube sockets and components are mounted on a narrow chassis soldered to the inside of the can cover. Long connecting leads are left to run to the volume control, which is mounted on the inside of the can. These leads may be hooked up before the unit is assembled, then folded back

(*Continued on page* 79)

Simple Bridges For Inductance Checks

By R. G. YOUNG

SURPRISINGLY few radiomen have inductance bridges. This may be because many books and articles refer to the subject of inductance measurement as one beset with such complicated calculations and "corrections" as to make it seem far too difficult.

Such statements may be true of precision laboratory measurements, but laboratory accuracy is seldom needed in radio service work. For measurements of moderate accuracy the bridges described are quite satisfactory. They are constructed quite simply from standard parts.

No attempt is made to measure coil losses. Such measurements are usually not required, and are often meaningless unless made under actual working conditions.

The bridges described do not depend for accurate balance upon purity or constancy of wave form of the exciting oscillator.

Inductances, for our purposes, can be roughly divided into 3 categories:

1. R.F. coils from 20 µh to 4,000 µh;
2. Air-cored chokes from 4,000 µh to 2 henries;
3. Iron-cored chokes from 2 to 2,000 henries. Measurement outside these limits is hardly practicable with simple apparatus.

Category 1 coils are most easily measured with the Owen bridge shown in Fig. 1. This bridge has the great advantage, for low inductances, that the settings of the loss-cancelling devices R2 and C2 do not affect the setting of the measuring resistance R3, making balancing extremely easy.

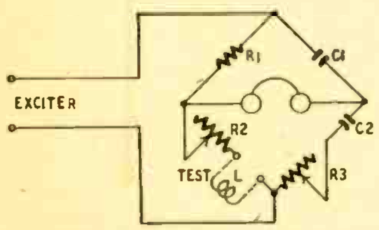


Fig. 1—Owen bridge for small inductances.

Simple Owen bridge

Fig. 2 shows a practical form of this bridge. Some comment is necessary on the components used. The R resistors controlled by S1 must be non-inductive. Carbon types can be used. The condensers must also be noninductive.

S2 gives a coarse adjustment of loss cancellation and R2 a fine adjustment. A difficulty arises with R2, as non-inductive resistors of low ohmage are too expensive for a simple device of the kind described. Fortunately S2 can be manipulated to keep R2 low. As a further check, R2 can be fitted, if desired, with a scale of inductance values obtained by first measuring its own inductance by setting S to B and operating S2, balancing in each case with the test terminals shorted. This will give 3 points on R2. From these points a scale can be constructed to show its inductance values, which can then be subtracted from the reading of R3.

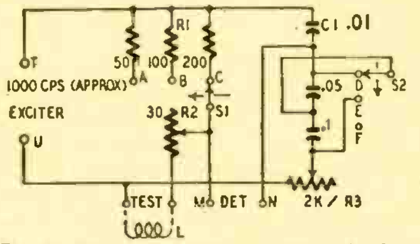


Fig. 2—Practical circuit using Owen bridge.

To give an idea of magnitude of error, the writer's instrument has a 30-ohm rheostat with an inductance of about 50 µh, full scale.

R3 need not be especially noninductive, as slight inductance in it will not affect reading perceptibly.

The formula covering measurements with this bridge is:

L (µh) = R1 R3 C1 (values in ohms and microfarads).

This means that if R3 is calibrated in ohms with S on B, R3 will read µh directly. A will then give µh/2 scale and C a µh × 2 scale.

In Fig. 1 a pair of phones is shown directly in circuit as an indicator. In practice, the output of this bridge is so low that an amplifier is necessary. A suitable form for this bridge is shown in Fig. 3, but almost any 2-tube amplifier could be used, if desired.

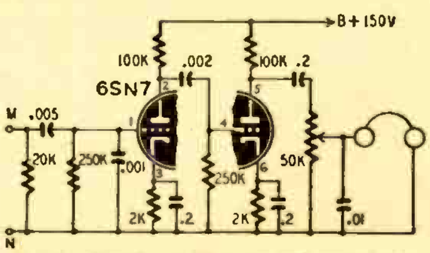


Fig. 3—Good amplifier for instrument use.

A Maxwell bridge

Category 2 coils are not easily measured on Owen bridges without a multiplicity of condensers. The Maxwell bridge shown in Fig. 4 is better.

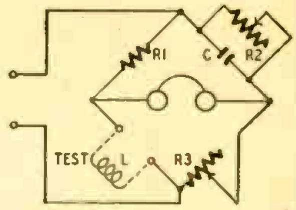


Fig. 4—Maxwell bridge, fundamental circuit.

Again: L (µh) = R1 R3 C1 (ohms, microhenries). In this case, R2 is used for loss cancellation.

This bridge is also suitable for category 3 inductances, but an added complication arises. No balance will be obtained, due to the iron core, if a 1,000-cycle exciter is used.

A simple way out is to change the frequency used to about 300 cycles. This gives a good balance without getting too far away from the region of maximum ear sensitivity. Fig. 5 shows a suitable form of exciter. If this is used with category 2 and 3 coils, no amplifier will be necessary with normally sensitive headphones, excepting with category 1.

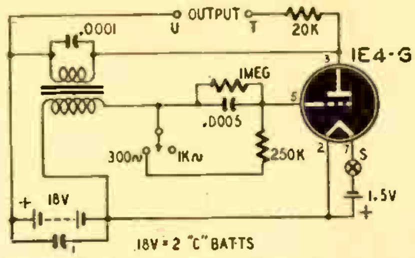


Fig. 5—Exciter supplies 300 or 1,000 cycles.

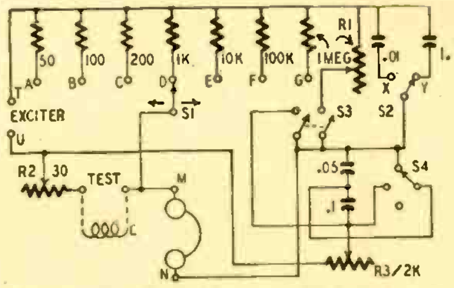


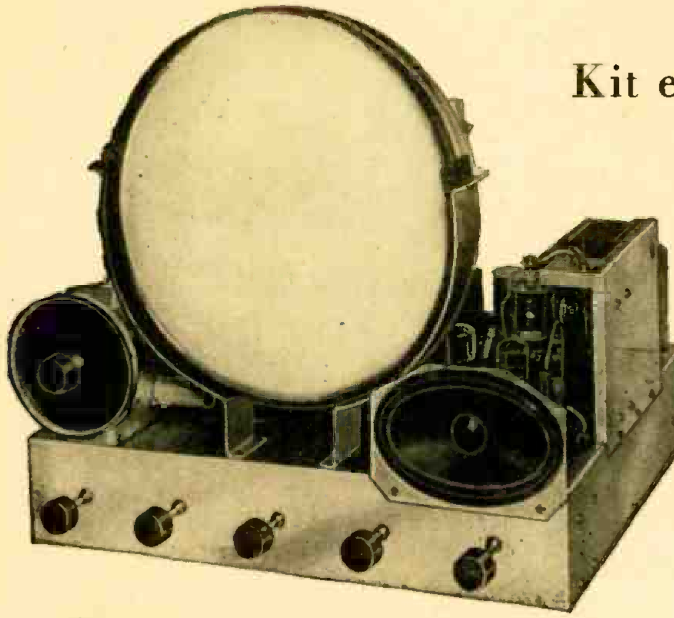
Fig. 6—Practical wide-range bridge circuit.

A bridge incorporating 1, 2, and 3 is shown in Fig. 6. The values given are those found by the writer to give optimum balance conditions and may be used as an actual working design. Some form of table or scale is absolutely essential if this bridge is to be used; the one shown is the type found most readable and convenient for everyday use. R3 is then calibrated in ohms.

Category	Range	INDUCTANCE WHEN R3=2,000 Ω	S1	S2	S3
1.	÷ 2 µh	1,000 µh	A	X	Open
	× 1 µh	2,000 µh	B	X	Open
1,000 cycles	× 2 µh	4,000 µh	C	X	Open
2.	× 10 µh	20 mh	D	X	Closed
	×100 µh	200 mh	E	X	Closed
1,000 cycles	× 1 mh	2 h	F	X	Closed
3.	× 10 mh	20 h	E	Y	Closed
	×100 mh	200 h	F	Y	Closed
300 cycles	× 1 h	2,000 h	G	Y	Closed

Designing Televisers

Kit equipment engineering problems



One of the latest receivers designed by Transvision.

DESIGNING a television receiver even for conventional requirements is, of course, a challenging and stimulating problem. But when nontechnical considerations, without the compensating factor of relaxed quality standards, are also present to restrict the engineer, he is definitely up against a situation that taxes his ingenuity to the limit.

This is precisely the dilemma that the Transvision Corporation found itself in by undertaking design of a kit for laymen. Offhand the assignment might appear to be insurmountable, particularly in light of such "unsporting" conditions as alignment procedure that dispenses with test equipment. A resourceful use of simple expedients nevertheless transformed this ostensibly hopeless task into one that seems almost prosaic. Naturally, certain minor concessions to engineering rigor could not be avoided. The most important of these concerns the r.f. plate, which is constructed and pretuned before shipment, because of the critical alignment procedure it demands.

The routine service of punching out the chassis is also furnished, but the installation of all remaining components is left exclusively to the constructor. He is supplied, furthermore, with every last item that an efficient television system requires for its optimum performance, including such ultimates as a handsome front panel, a 7-inch *Lectrovision* picture tube, and a sensitive single dipole antenna.

Thus, by following plainly written instructions and clearly drawn diagrams, even the inexperienced builder finds himself smoothly guided, step by step and stage by stage, from rudimentary beginnings to the successful completion of an imposing, modern receiver. When he is finished, he possesses an instrument that physically is 18 inches wide, 18 inches high, and 15 inches long. Electrically it has a band pass of 3½ mc. The viewing area of 25 square inches not only will comfortably entertain a minimum of 15 people, but the definition and clarity of the pictures themselves have already won considerable praise. Postwar television in general may be described as having attained a status equivalent to that of home movies.

Partial prefabrication makes assembly problems much easier.

The tube lineup in the r.f. section is a 6AC7 mixer and a 6C4 local oscillator. Despite compactness, it is capable of surprising gain. In the video i.f. section there are 3 stages, each using a 6AC7. The audio intelligence is picked off of the second i.f. transformer by a trap tuned to 21.9 mc, and fed into a sound i.f. stage that uses another 6AC7.

A 6SQ7 demodulator-amplifier and a 6V6 power amplifier comprise the audio section. Video detection and amplification are handled by a 6H6 and 6AG7.

The synchronization separator is still another 6AC7, and it fires a 6N7 multivibrator in both the vertical and horizontal sweep circuits. The 6SN7's that follow are push-pull amplifiers.

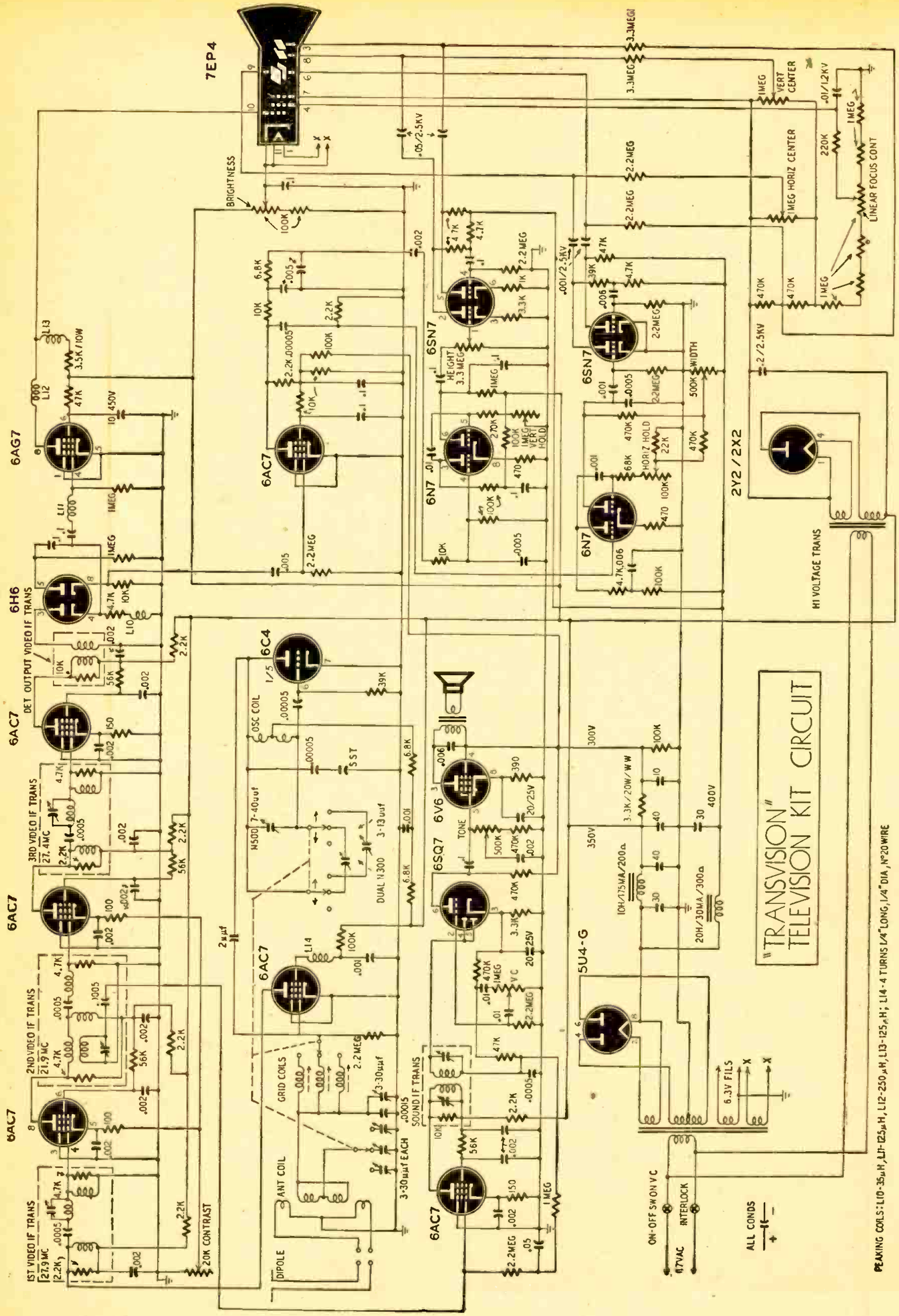
Low-voltage rectification employs a 5U4G, while a 2X2 (or 2Y2) rectifies the high voltages. The picture tube is a type 7EP4.

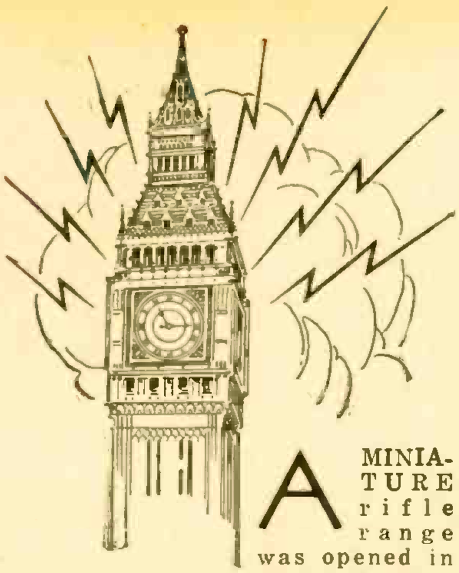
Perhaps the most striking feature of the i.f. section is the system of fixed, double-tuned trap coupling. This method not only obviates the need for a signal generator, but in spite of the high intermediate frequency it affords satisfactory gain over a 3½-mc band pass that is obtained by heavy damping. The only tuning the constructor has to do is to adjust trimmers in the trap circuits. In the second i.f. can, for example, the 21.9-mc trap is simply to be adjusted for maximum audio output, while the 2 remaining trimmers are set for greatest brightness.

The selection of a relatively high intermediate frequency was dictated by image considerations. This choice happily fixes the various image frequencies in channels that, for the present, are inactive, thereby evading this irksome problem despite the inherently poor image rejection power of television receivers in general. Incidentally, even when one makes the reasonable assumption that inevitably these idle frequencies will be used, the situation is not necessarily insecure. Measurements have intimated that, at these high image frequencies, conventional tubes such as the 6AC7 becomes inoperative and in this curious manner introduce acceptable rejection properties.

A noteworthy wiring precaution that preserves i.f. gain at its highest possible level is the use of a single ground for each i.f. stage. This common ground is a lug securely fastened to the appropriate socket under the No. 1 pin. Spuri-

(Continued on page 67)


"TRANSVISION"
TELEVISION KIT CIRCUIT
7EP4
6AG7
6H6
6AC7
6AC7
6AC7
6AC7
6AC7
6AC7
6C4
6SN7
6SN7
6N7
6N7
6V6
6SQ7
5U4-G
2Y2 / 2X2
1ST VIDEO IF TRANS 27.9MC
2ND VIDEO IF TRANS 21.9MC
3RD VIDEO IF TRANS 27.4MC
DET OUTPUT VIDEO IF TRANS
SOUND IF TRANS
OSC COIL
GRID COILS
ANT COIL
DIPOLE
BRIGHTNESS
20K CONTRAST
HEIGHT 3.3 MEG
1MEG VERT HOLD
HORIZ HOLD
WIDTH
TONE
1MEG VERT CENTER
1MEG HORIZ CENTER
LINEAR FOCUS CONT
HI VOLTAGE TRANS
6.3V FILS
ON-OFF SW ON VC
INTERLOCK
117VAC
ALL CONDS
10H/175MA/200Ω
20H/30MA/300Ω
3.3K/20W/WW
DUAL N300
3-30µµf EACH
PEAKING COILS: L10-35µH, L11-125µH, L12-250µH, L13-125µH; L14-4 TURNS 1/4" DIA, 1/4" LONG, N°20 WIRE



Transatlantic News

By Major Ralph W. Hallows

RADIO-CRAFT EUROPEAN CORRESPONDENT

A MINIATURE rifle range was opened in London the other day by Sir Ian Fraser, M.P., who fired the first 2 shots blindfold. Despite this handicap, both were only a small fraction of an inch outside the bull's-eye. He was followed by the chairman of the National Smallbore Rifle Association, who, also blindfolded, scored a bull's-eye with his very first shot. The .22-caliber rifle range for the blind is the outcome of work by P. B. Nye, chief research engineer of St. Dunstan's training center for the blind, who was no doubt inspired by modern blind-landing systems used in aviation.

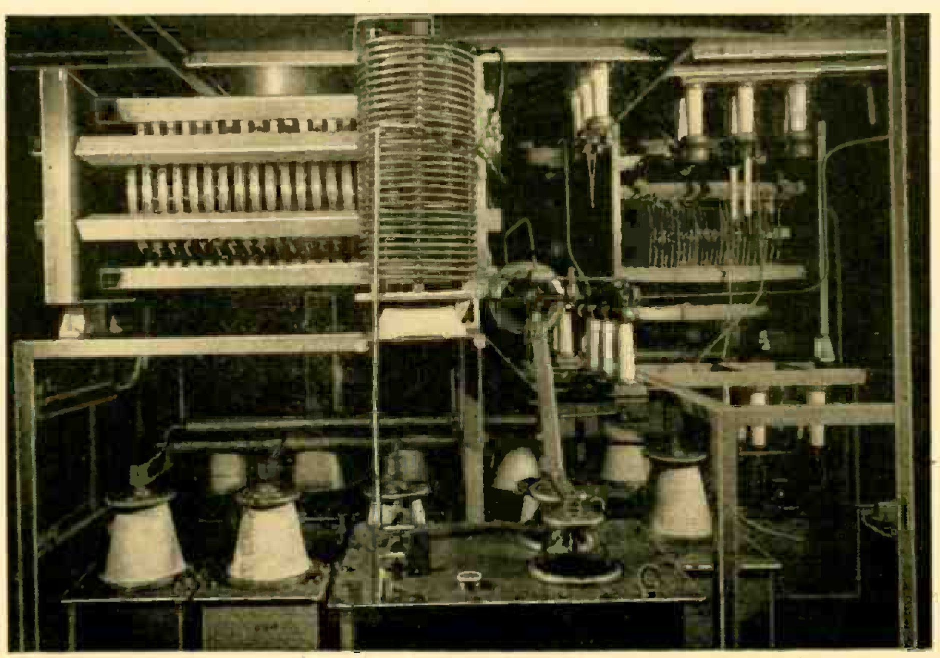
The rifle is a standard .22-caliber weapon, the muzzle end of which passes through a metal ring 2½ inches in diameter. One purpose served by this ring is to ensure that, even if the trigger is pressed inadvertently, no bullet can fail to hit the back-stop at the far end of the range. Imagine now that you are a blind or blindfolded shooter. As you pick up the rifle you hear a sustained note from a loudspeaker. The farther the rifle is sighted from the center of the target, the higher is the pitch of the note. When your aim is "dead on," the loudspeaker is silent. It is rather reminiscent of the old t.r.f.—plus tickler radio method of tuning in a station by finding the silent point between squeals —and the principle is much the same. Move the rifle until the null point is reached and it is right on the correct line of sight.

Hams who have blind training centers in their localities may care to work out similar apparatus for them. The circuits used have not been published, but if readers would like to have them, I will do my best to obtain all the details.

N. Y. police stop London Tele!

International incident? In a way, yes. But it's not going to lead to a fight, or even an exchange of diplomatic broadsides. For some time we have been experiencing what is known as the "Harris Tweed effect" on our televisers. It is clearly due to interference of some kind and certain investigators have just claimed to have tracked the cause down to the police radio transmissions in New York! Whether they are right or wrong is not yet known, but I do know that in the present conditions of near-maximum sunspot activity all kinds of queer v.h.f. reception effects at normally impossible ranges are being reported continually.

It used to be believed that the limit range of transmissions made on frequencies of 30 mc and above was not very much greater than the horizon as viewed from the top of the transmitting antenna. We know now that even in normal conditions it is a good deal beyond that. Further, experience has proved that under the abnormal conditions which accompany a sunspot maximum freak reflection of v.h.f. transmissions may occur from superionized patches in the upper atmosphere. In such circumstances radiations of the order of 5-10 meters may span distances of thousands of miles. I have certainly heard such American transmissions here on more than one occasion and it is therefore not impossible that our Harris Tweed effect is, sometimes at any rate, due to the U. S. police radio.



Part of the BBC transmitter at Ottringham, near Hull, England, described in this article.

The television spy

V.h.f. reception at ranges beyond the quasi-visual is a reminder of a remarkable use made of the French television broadcasts during the war by the British Intelligence Service. It has not until now been permitted to mention it. When the Germans occupied France in 1940, they kept the French television system going, using it chiefly for anti-Allied propaganda purposes. Believing that it was quite unreceivable by the Allies, they regularly used the Paris station to work up feeling against us by broadcasting horror pictures of the devastation wrought by British and American bombing from the air. The British Intelligence Service assigned the well-known radio expert G. T. Kelsey the task of devising apparatus to pick up the broadcasts. At a range of 180 miles strong interference from home radar stations made the problem a difficult one; but by employing a curtain array of 32 dipoles suspended between 150-ft. masts Kelsey was successful. For the last 2 years of the war all the Paris television broadcasts were monitored and the R.A.F. authorities received invaluable information, in the form of actual televised film pictures, of the extent of the damage that they had done. Even the best of secret agents on the spot could not have supplied a tenth of the detailed information thus obligingly sent out by the enemy!

The audio-frequency range

At a recent meeting of the Royal Society of Arts in London, Sir Ernest Fisk stated that Electrical and Musical Industries, a leading phonograph company, had devised successful methods of recording up to 20,000 cycles on wax discs. Other speakers, including Sir Malcolm Sargent, the great orchestral conductor, expressed the belief that it would ultimately be found that real high-fidelity reproduction could never be obtained unless frequencies far beyond the actual audible range were faithfully dealt

(Continued on page 62)

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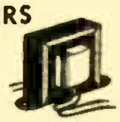

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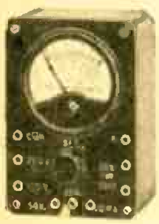
MODEL 312

Volt-Ohm – Milliammeter



An economy pocket meter featuring a 2" moving vane meter.
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Ohms. 100,000;
mfd. .05-15.
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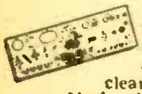

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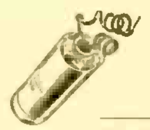

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Mfd.	Volts	List Price	Net Each	Per 100
.01	600	30c	10c	$ 9.15
.02	600	30c	11c	$ 9.95
.05	600	40c	14c	$12.95
.1	600	45c	16c	$14.95

Quantity Prices not assorted.

WORLD-WIDE STATION LIST

Edited by ELMER R. FULLER

THIS month we wish to be a little different. Instead of giving you the good reports first, we will air complaints we receive. First, the difficulty several are having with our time tables. Some have to spend a little time figuring from Eastern Standard to GMT, and then back to local time. And then someone finds that his time is off a half hour instead of an hour from our standards. Well, I am not the one to solve this problem; but it seems that there must be some solution to it. At any rate, we are attempting to use the 24-hour clock on EST. It works this way, midnight is 0000 or 2400 hours; 1 am is 0100; 1:15 am is 0115; noon is 1200; 3 pm is 1500. Several have asked to have this explained again, and this should make it clear to all of our readers. Elsewhere on this page, you will find a chart that will serve as a guide when properly filled in to readily convert EST and GMT to your local time.

Another complaint comes from your editor. Time still needs stressing. Even though there seems to be lots of it, yet we do not have enough. In your reports please state the *schedule* of the transmitters; or if you do not know the schedule, during what time you heard the station. Merely reporting a station as heard is like taking your pants to the cleaners, and then forgetting to go back to pick them up when ready. If you have any doubt about the identity of a station, state this on your report. Perhaps we can help you to identify it, and then again, it may be a mystery to us, so we start looking for it also. Be sure that your report carries time heard if possible, in our system of 24-hour EST.

With that off our chest, lets turn to the reports received for this month. They were good. Gil Harris up in North Adams, Massachusetts sent us 3 reports in the past few weeks. Every one of them was a good one. Gil reports that the station heard on 10.970 mc is PZR in Paramaribo, Surinam and has been heard very fine business at 1700. He also reports hearing a station near 17.840 mc which he thinks is Radio Eireann at Athlone, Eire. They were giving the news in English until 1350 with the sign off at 1353, Brussels, Belgium came on at 1350 warming up their transmitter for the sign-on at 1355 hours. This station is on 17.840 mc, and may be heard on regular schedule 0600 to 0700, 1100 to 1200, and 1230 to 1500 hours, but this is very irregular, and they may be heard signing on or off at other hours, as Gil reports them doing.

Gil also gives us a 0900-hours view of the 25-meter band. The following have the news in English at that hour; 11.780 mc, Saigon, Indo-China; 11.830 mc, XGOA, Nanking, China; 11.840 mc, VLC7, Shepparton, Australia; 11.730 mc, KGEX, and 11.790 mc, KNBA in San Francisco; and 11.650 mc, XTPA, in Canton, China. How many of these can you pull in well enough to identify? All-India Radio is heard to East Asia on 11.870 mc from 0930 to 0942. An Australian heard on 11.760 mc from 0720 to 0800, may be VLC10.

GMT	EST	Local	GMT	EST	Local
5	0/24		17	12	
6	1		18	13	
7	2		19	14	
8	3		20	15	
9	4		21	16	
10	5		22	17	
11	6		23	18	
12	7		24/0	19	
13	8		1	20	
14	9		2	21	
15	10		3	22	
16	11		4	23	

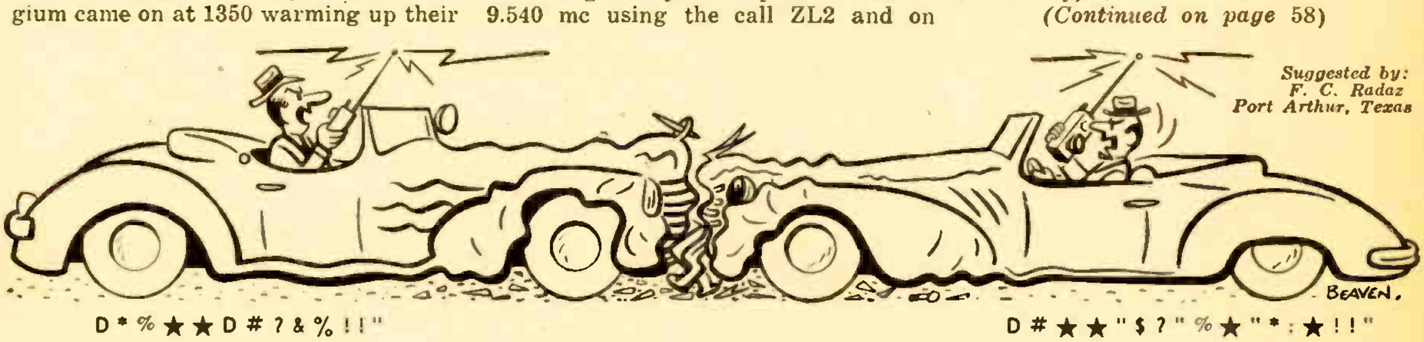
Another report from my old friend, J. B. Yates in Amityyille, New York, didn't have any news on short wave other than the fm and television reception in the New York City area. From *Radio & Hobbies* of Australia, we learn that the New Zealand stations have been heard testing, and that they will soon be on the air. This was some time ago, but I have received no report of them being heard in the U. S. as yet. Has anyone heard these newcomers on the air, either on regular transmissions or testing? They are reported to be on 9.540 mc using the call ZL2 and on 11.780 mc using the call ZL3. Any information regarding these or other New Zealanders will be greatly appreciated.

John Winkler reports hearing a station on 7.217 megacycles at 1600 using Latin and Italian. Test transmissions were being made. No information here regarding this. Johnny also reports hearing FGY in Dakar, French West Africa on 7.210 mc, at 1205. Complete schedule of this station is not known here, as it has been off the air for some time, and has only recently returned. OTC in Leopoldville, Belgian Congo is another old-timer who has been giving us pretty constant reception for several years. They are now heard on 9.740 mc from 1300 to 2015.

Received a report from a newcomer this past month. He is Charles C. Edwards of Peabody, Massachusetts. Charley sticks to the ham bands almost exclusively; and I think that we are going to have some real news on these bands for our readers. He uses an HRO-5 receiver for most of his work. He uses a home-made QSL card and it sure gets results for him. In one year he sent out 2410 reports and received replies to about 1200 of them. During the past month he has received California, Connecticut, Massachusetts, Nevada, Oklahoma, Oregon, Washington, and England on 6-meter amateur phone. This is certainly dx for this band, and the kind we like to have reported. During the same period of time, Mr. Edwards received 58 countries on 10-meter phone and 49 countries on 20-meter phone. To date he has heard on 6-meter phone, 2 countries; on 10-meter phone, 69 countries with 32 verified; on 11-meter phone, 3 countries with 1 verified; on 20-meter phone, 87 countries with 54 verified; and on 40-meter phone, 3 countries heard.

If you have any good recent photographs of your receiving station, with or without yourself, we would like to receive them. There is a possibility that they may be used in an early issue. This was done before the war, and will be resumed in the near future. Send all correspondence to Shortwave Editor; RADIO-CRAFT; 25 West Broadway; New York City, 7.

(*Continued on page* 58)



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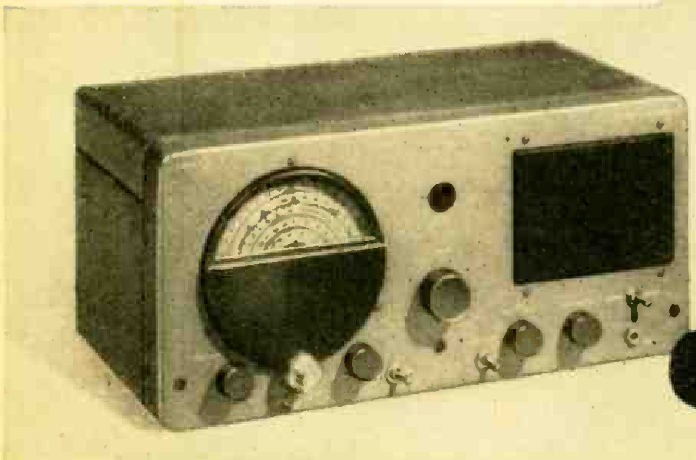

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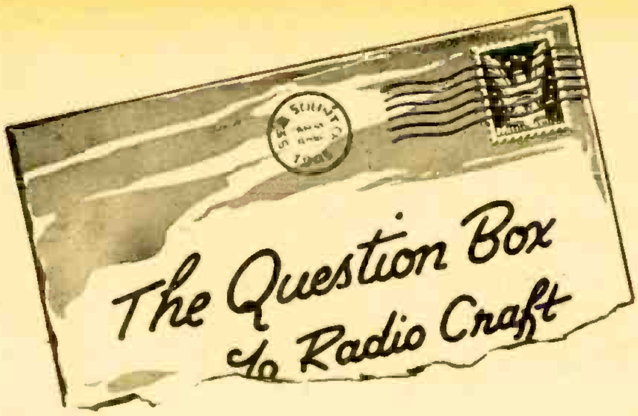


Question Box queries will be answered by mail and those of general interest will be printed in the magazine. A fee of 50c will be charged for simple questions requiring no schematics. Write for estimate on questions that may require diagrams or considerable research. Six to 8 weeks is required to draw up answers involving large schematics.

? HAM BAND PRESELECTOR

Please print a diagram of a 2-stage preselector using 1851's and covering from 200 meters to 10 meters. I have a 2-gang, 140-μμf variable and a 2-gang, 35-μμf variable that I would like to use. Please show some method of tracking one of the stages and an r.f. gain control.—D.Y.S., Grosse Point Farms, Mich.

A. Here is a 2-stage preselector that uses ganged tuning on the main and band-spread tuning condensers. An r.f. gain control has been included in the cathode circuits of the tubes. The band-spread condensers may be omitted without impairing the operation of the unit, since r.f. stages tend to tune rather broadly. L2 is used with a 100-μμf variable condenser, mounted on the panel, to peak the first r.f. stage.

Shields should be used over the r.f. coils and on the plate and grid leads as shown. A grounded baffle or shield should be used between C1 and C2 and between C3 and C4 if the unit oscillates at high-gain settings.

The coils are wound on 1½-inch plug-in forms. Six-prong forms are used for the first r.f. coils and 4-prong forms for the second.

COIL DATA

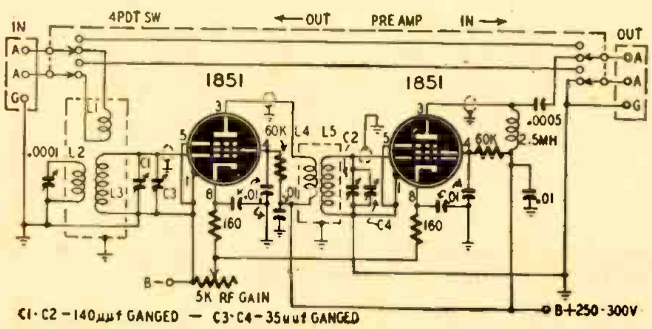
(200 to 80 meters)
L1—15 turns close-wound 5/32 inch below L3
L2—32 turns interwound with L3
L3—50 turns No. 20 s.s.c.

(80 to 40 meters)
L1— 7 turns close-wound ⅛ inch below L3
L2—14 turns interwound with L3
L3—24 turns No. 18 s.s.c.

(40 to 20 meters)
L1— 6 turns close-wound ¼ inch below L3
L2— 8 turns interwound with L3
L3—11 turns No. 18 s.s.c.

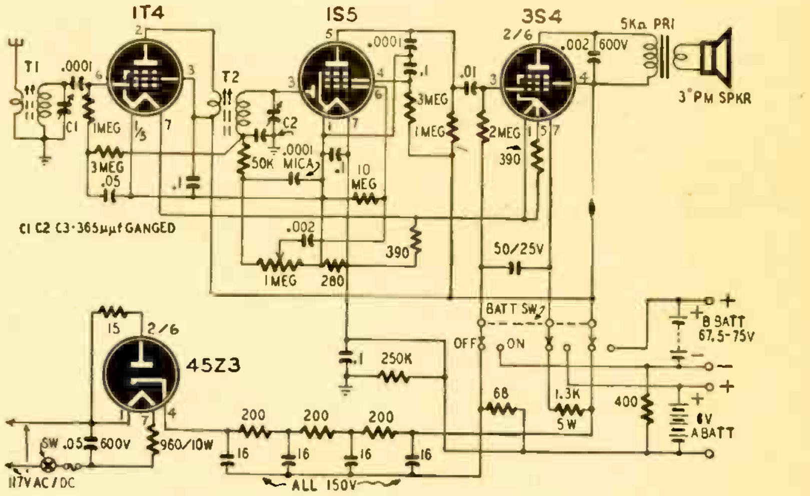
(20 to 10 meters)
L1— 4 turns close-wound ⅛ inch below L3
L2— 4 turns interwound with L3
L3— 5 turns No. 18 s.s.c.

No. 26 s.s.c. is used for winding L1 and L2 on all bands. L4 is wound the same as L2 and L5 the same as L3 for each band.



? 3-WAY PORTABLE

I would like to have a diagram of a 3-way t.r.f. portable radio using a 1T4, 1S5, and 3S4, and a 45Z3. I have a pair of iron core r.f. coils and a 2-gang, 365-μμf tuning condenser that I would like to use.—A.P., Atlantic City, N. J.



This 4-tube, 3-way portable uses 1 r.f. stage, a diode detector and 2 stages of audio.

A. A diagram of the receiver you specify is shown. A small amount of a.v.c. voltage is applied to the first stage to prevent overloading on strong signals. The output is sufficient to drive a 3- to 5-inch speaker. (All resistors are ¼-watt and condensers rated at 200 volts unless specified otherwise.)

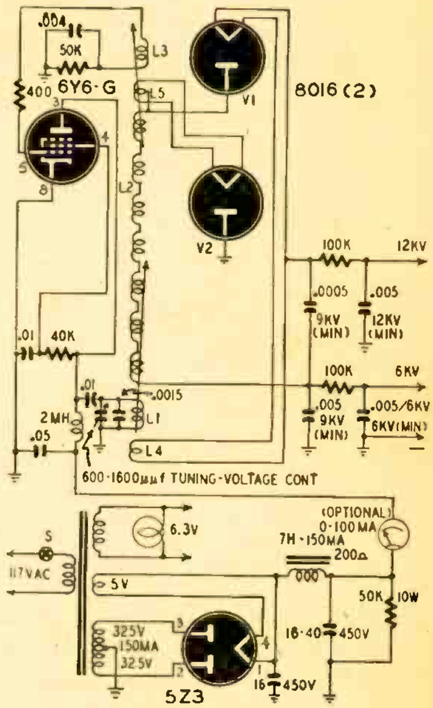
? R.F. POWER SUPPLY

I would like to have a diagram of a 12-kv r.f. power supply using a 6Y6 oscillator and a pair of 8016's as voltage doublers. Is it possible to tap the supply to give 6,000 volts simultaneously?—A.J.L., Brooklyn, N. Y.

A. Data and a circuit for construction of a 12-kv r.f. power supply are given.

The high-voltage coil L2 should give ample voltage output. If the voltage is higher than can be used, the heater winding L1 may be tapped down on L2 one or more pies, or you may remove some turns from L2. The latter method will increase the natural

(Continued on page 78)



Left — Preselector for ham bands. Right—12-kv r.f. power supply using a voltage doubler. Intermediate voltage is also provided.

ted altogether. Without it FM broadcasts will contain very strong high frequencies which result in very crisp speech, and loud rendition of violins and other instruments whose output contains strong high-frequency components.

The r.f. section is assembled within a 3 x 3½-inch area so that an auxiliary 4 x 4-inch steel chassis may be placed around it for shielding. The small chassis has 4 sides and mounting flanges to screw it down to the main chassis, but no bottom. A hinged cover completes the shielding at the top. Both coils and the r.f. and detector tubes as well as the tuning condenser are within the shield.

A double-gang 15-μμf condenser tunes the set. To simplify tracking problems a small 10-μμf variable shunts the r.f. condenser. Trimmer may be seen mounted below the chassis at the right side.

Making the coils

Detector and r.f. coils are wound on 5-prong, Amphenol, ¾-inch-diameter polystyrene forms with No. 22 enameled wire. Detector coils are tapped at approximately center. Each coil has a separate primary winding because this is a more flexible arrangement.

Very short leads are important at these frequencies. The location of tubes and coil sockets has a lot to do with this. We have placed the r.f. coil and tube to the right of the ganged condenser, and the other coil and tubes to the left. This gives good isolation of the stages. Note that the coils are in front of the tubes. The front section of

1—10 METER RECEIVER

(Continued from page 23)

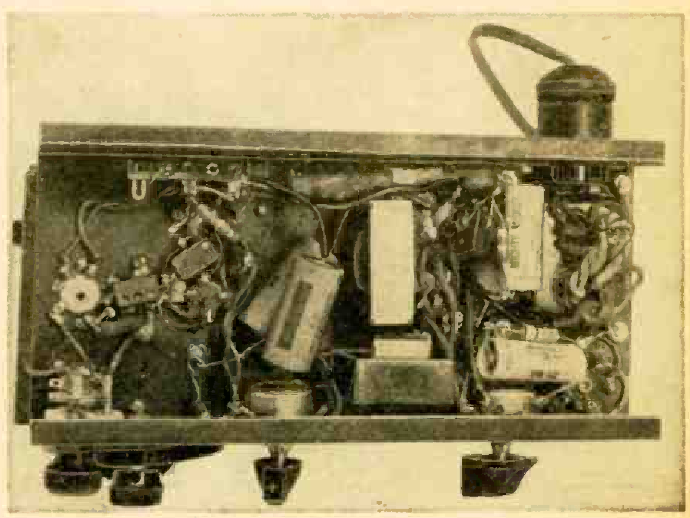
the ganged condenser tunes the r.f.

The 4 bands covered are listed in the coil table. Above 80 mc it was found necessary to use a special procedure in winding coils. At these high frequencies a single turn or two would have had to be used. To get a reasonable number of turns these coils are wound *within* coil forms and have a ¼-inch diameter. The primaries and all other secondaries are wound *over* the forms.

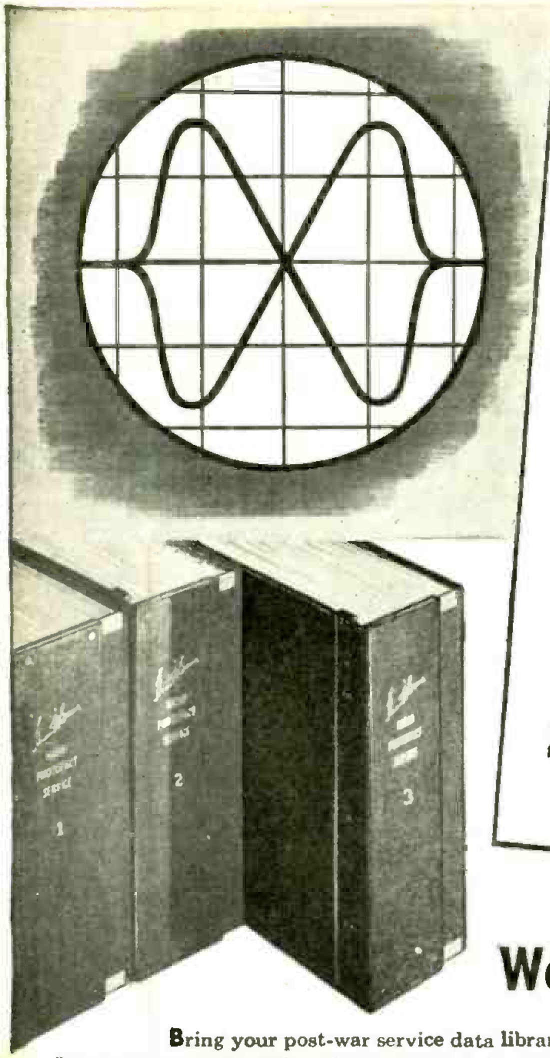
The coils wound over the forms should give no unusual trouble but the ¼-inch coils are best made as follows: Wind them (as specified in the coil table) around a dowel or pencil, remove, then tin the leads, leaving a length of about ¾ inch. The detector coils will require an added tap lead near the center. Now these air-wound coils are inserted (vertically) directly into the coil sockets and the correct frequency range obtained by compressing or expanding the turns. When this is done, the coils are removed from the sockets and placed permanently in the coil forms. Arrange and space the leads to fit the pins of the coil form, then force the coil slightly into a pencil or dowel, thus giving it a long handle by which it may be lowered into the form. A slight twist of the pencil disengages it.

Soldering to the pins of a polystyrene form for the first time is not an easy matter. The polystyrene softens with heat and the whole coil form can be ruined unless soldering is very carefully done. After several tries we finally hit upon the following as the best method. Place the form upside down in

(Continued on page 63)



Bottom view of the set.



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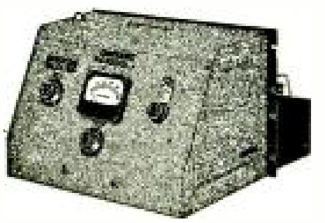
The Type 125 capacitance bridge is useful in measuring interelectrode capacitances in vacuum tubes, provides a range of 0 to 100μμf through the use of 5 multiplier ranges and measurement at 465 kc. Direct capacitance accuracy of 1% and direct conductance accuracy of 10% are provided when calibrated with standards of equal accuracy.



The bridge consists of 3 separate sections including r.f. signal generator and power supply; r.f. amplifier, detector, and vacuum-tube voltmeter and associated switches, controls and a 500-μa meter indicating bridge balance. Ground-to-lead or jig capacitance may be tuned out when combined values do not exceed 25μμf. Special tube-tester adapters are available for measurements with or without base shield or metal shell connected to tube element or ground.

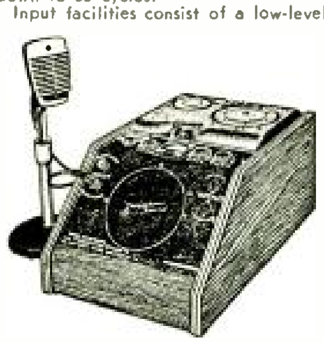
The bridge is rated at 45 watts, 110-120 volts, 50-60 cycles a.c.; weighs 50 pounds; and measures 18 inches long and 12¼ inches high. Tube complement includes 5Y3G, 7A6, 7B4, 0C3, and two 7A7's.—RADIO-CRAFT

WIRE RECORDER

Electronic Sound Engineering Co.
Chicago, Ill.

The Polyphonic Sound wire recorder is specifically designed for use in the home, broadcasting and recording studio, the school or church. The built-in 6-inch speaker, with a range up to 10,000 cycles, has a special diaphragm to insure smooth reproduction of high frequencies. A 15-inch, dual-channel auxiliary speaker is available. This speaker connects with a jack on the front panel and carries the lower range down to 50 cycles.

Input facilities consist of a low-level



input for a microphone and a front-panel input arrangement for high-level sound from radio or record player. The microphone has a response of 60 to 10,000 cycles. Standard equipment includes a 15-minute spool.—RADIO-CRAFT

SPOTLIGHT SOLDERING GUN

Weller Mfg. Co.
Easton, Penna.

A new soldering tool with a handy spotlight tip has just been announced. The small spotlight, placed between the terminals of the loop tip, keeps the work always in plain sight, even when the tip is flexed to suit a job, the light goes on when the trigger switch is pressed to heat the gun. Five-second heating makes the tool ideal for intermittent duty.

The tool draws 100 watts from 110-

volt, 60-cycle lines. Two models are available—one with a single heat of 100 watts; the other has a dual heat control, with 100 watts normal heat and a 35% instantaneous reserve heat.—RADIO-CRAFT

AUDIO FREQUENCY METER

Barker & Williamson, Inc.
Upper Darby, Penna.

The Model 300 audio-frequency meter offers an accurate means of making direct measurements of unknown audio frequencies up to 30,000 cycles. Among other applications, the instrument is useful for checking audio oscillators or tone generators. Six frequency ranges

cover from 0-100, 300, 1,000 3,000, 10,000, and 30,000 cycles, respectively.

Sensitivity is a minimum of 0.5 volt input. The frequency meter will operate on any wave form with peak ratios of less than 8 to 1. A 3-inch fan-type meter with 2 scales provides easy visibility. The power requirement is 110 v, 60 cycles, 50 voltamperes. The unit is in a black crackle-finished steel cabinet with carrying handle and rubber feet. Dimensions are 13¾X7¼X9½ inches, and the weight is 10½ pounds.—RADIO-CRAFT

SILVER PLATE COMPOUND

General Cement Mfg. Co.
Rockford, Ill.

The new Silver Plate Compound is used for plating worn contacts, and newly made contacts and for replating worn silver plating on all types of metals. The compound comes in bottles.

Carbon Control Cleaner is another new product of the same manufacturer. It cleans carbon controls without the set being removed from the cabinet. The chemical removes oxidation and coats the contacts to minimize future trouble. An applicator comes with each bottle.—RADIO-CRAFT.

TEST BENCH

Radio Tube Division
Sylvania Electric Products
New York, N. Y.

Providing ample area for benchwork, the new fixture includes sloping panel for permanent mounting of meters, prod test outlets, tube testers and other tools. Suitably proportioned drawers for dust proof storage of oscilloscopes, vacuum tube voltmeters and other valuable test instruments are provided.

The seven-foot bench top is covered with durable linoleum for improved appearance and protection of delicate equipment and components. Four shallow drawers provide out-of-sight storage for frequently used components, push-back wire and small hand tools. Knee-hole and recessed base design permit working close to the bench with drawers handy while working in

either standing or sitting position. Sloping panel tends to eliminate glare from instrument dials and accidental damage to mounted and portable equipment.

The test bench is available in knock-down, unpainted form.—RADIO-CRAFT

MULTIMETER

Triplett Electrical Instrument Co.
Bluffton, Ohio

The Model 66-HH volt-ohm-milliammeter is a compact multirange instrument with a 3-inch meter with red and black scale markings. Voltage ranges, a.c. and d.c., are 0-10-50-250-1,000-5,000 volts at 1,000 ohms per volt. Direct-current ranges are 0-10-100-500 ma. Two resistance ranges are provided for measurements up to 400,000 ohms. —RADIO-CRAFT

HEARING AID HELP

Beltone Hearing Aid Co.
Chicago, Illinois

The Selectometer is designed to enable a deafened person to choose his own hearing aid. It allows the fitter the opportunity of testing the hard-of-hearing person with more than 140 different combinations of acoustical gain, power output, and frequency response so that the person being fitted actually selects for himself the precise com-

bination of tubes, receivers, and electronic circuits with which he hears best.—RADIO-CRAFT

SIGNAL TRACER

Feiler Engineering Co.
Chicago, Illinois

The model TS-5 Pocket Stethoscope signal tracer is comparable in performance to bench-type models TS-2 and TS-3. It has the extra advantage of

being small and light enough to take out on the job. Size: 4⅛ inches wide, 2⅜ inches deep and 8¾ inches high. Weight only 3½ lbs. complete.

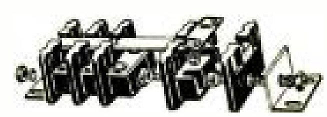
Stethoscopes contain their own PM dynamic speakers but provisions are also made for headphone operation. Any standard type volt-ohm miliammeter may be plugged into convenient jacks to make an effective r.f. vacuum tube voltmeter. The Model TS-5 instrument operates on 115 volts a.c.—RADIO-CRAFT

TERMINAL BLOCK KIT

Curtis Development & Mfg. Co.
Chicago, Illinois

A new terminal block kit expressly designed for experimental work and maintenance operations. Any number of terminals, from one to fourteen, can be quickly and inexpensively produced. These terminal blocks are similar to factory built blocks and equally substantial.

This individual "build up" feature is suited for electrical engineers and others doing experimental work who



need "one of a kind" part or parts in small quantities for their projects.

Kit No. 200 contains necessary molded sections, terminals and screw assemblies, and Kit No. 201 has a balanced supply of end brackets, partitions, threaded rods, screws, nuts and washers.—RADIO-CRAFT

DYNAMIC MICROPHONE

Electro-Voice, Inc.
Buchanan, Michigan

A new high fidelity moving-coil dynamic microphone, the E-V 635 is omnidirectional below 2000 cycles, becoming directional at higher frequencies. Wide frequency range (60-13,000 cycles plus or minus 2.5 db) conforms to modern FM as well as AM standards. Response is substantially flat out to 13 kc. Output is —53 db. Recessed

impedance-selector switch in the microphone stud permits ready choice of 50 or 250 ohms impedance in the one microphone.—RADIO-CRAFT

PULSE CODE MODULATION

(Continued from page 30)

The quantizing feedback is considerably stronger than the quantizing bias, and forces the beam downward. The result is that the beam travels across the tube with its upper edge against the wire just above its path, and resists any force tending to make it move down or up.

The electrons which go through the slots in the aperture plate are picked up by the *pulse plate* and delivered as code groups of pulses to the amplifiers, gating and slicing circuits which work them over into perfect shape and time them exactly for the transmitter, which sends them into space as perfect code groups of exactly uniform amplitude and spacing.

The receiver circuits

Detecting — or decoding — PCM impulses is harder than demodulating any other form of pulse transmission. Pulse amplitude signals can be treated like any other form of amplitude modulation —greater input voltages produce comparatively greater output signals. Neither is it hard to make the output of a detector increase or decrease as a pulse moves toward or away from a zero-signal position. But PCM sends out an apparently random combination of impulses, whose position apparently cannot so easily be resolved into variations of output in a detector circuit.

The randomness of PCM signals is only apparent. A pulse may have any value from 1 to 64 according to its position (Fig. 5) and combinations of pulses which form a code character may have values from 1 to 127. These numbers become actual quantities of electricity in the detector circuit.

The decoder is constructed around a condenser which is given a charge by each pulse in the code group. Its rate of discharge is timed so that exactly half its charge leaks off during each pulse interval. Thus, if the code group 1-0-0-0-0-0-0 is received, the condenser is charged in position 1, drops to half charge in position 2, then through ¼, ⅛, 1/16, 1/32 and 1/64 charge in succeeding positions till at the instant of output it is a pulse of 1/128 its original value (1 quantum). A pulse received in position 2 would reach the output with 1/64 its original value (2 quanta) and in the last position would be interpreted by the output circuit as ½, or 64 quanta. The decoder reverses the coding process and puts out for each code group the same number of quanta as the signal which produced it. Fig. 10 shows quanta of 64, 1 and 82.

Other interesting circuits

There are other circuits, which cannot be described in what is actually a short summary of the pulse coding process. Many of these are very interesting, such as the electronic sampling switches, diodes or triodes whose near-infinite resistance drops to near zero for part of a microsecond when triggered by a sharp signal from a pulse transformer. The synchronizing circuit which in effect steals a digit of one of the pulse groups to use as a signal which keeps the receiver in step with the transmitter is another very important and interesting circuit. Timing oscillators, slicers and gates all are needed to open and close circuits, time and shape the pulse, and possibly most important of all are the regenerating circuits which build up new and fresh code groups from the beaten-up signals which arrive from the last relay station and send them on their way in exactly the form they left the first transmitter. This is the feature which may make PCM the universal form of modulation on future commercial microwave communication circuits.

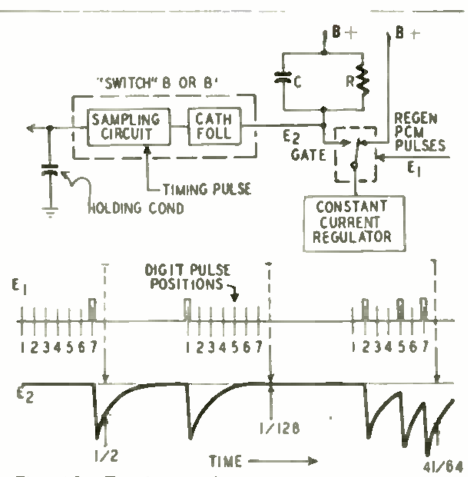
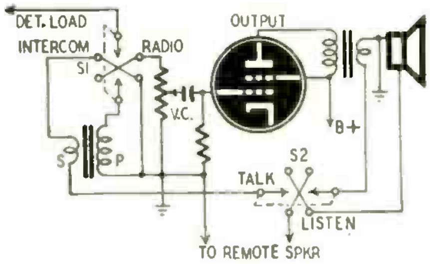


Fig. 10—Turning code signals back to quanta.

RADIO-ELECTRONIC CIRCUITS

RADIO-INTERCOM

Here is a scheme that I use to convert small radios into two-way intercom units without altering the performance of the radio. The input lead to the volume control is broken, and a d.p.d.t. radio-intercom switch and an output transformer, with high-impedance primary, are connected as shown. One side of the speaker voice coil is grounded and the other side opened, and leads run to



a d.p.d.t. talk-listen switch. Other leads are run to terminals for connections to the remote speaker line.

The remote speaker can be used as an extension speaker on the radio by leaving S1 in RADIO position and throwing S2 to TALK.

H. T. NIEMANN,
San Jose, Calif.

(A *low-impedance* line-to-voice coil transformer should be used on the remote speaker for best results.—*Editor)*

SENSITIVE SIGNAL TRACER

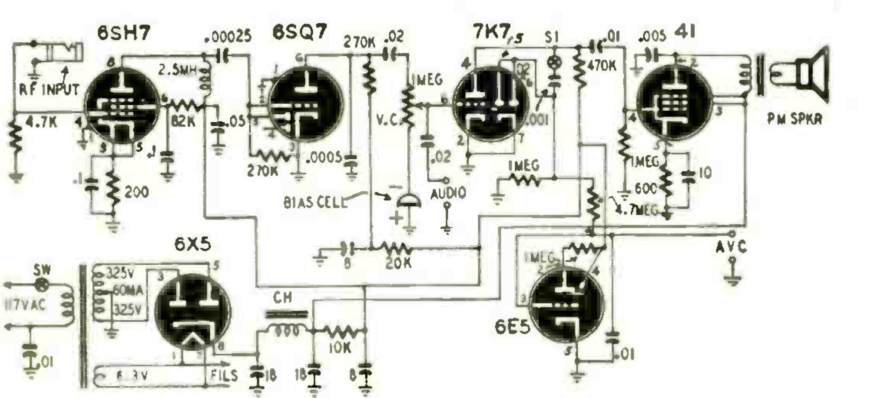
A high-gain 6SH7 r.f. amplifier followed by a 6SQ7 and 7K7 as cascade a.f. amplifiers are used in this simple signal tracer. A 6E5 electron-ray tube is used for visual signal strength indications. Separate probes are used for r.f. and a.f. tracing.

The r.f. probe is built into a case made from a fiber hexagonal neutralizing wrench. The probe tip is a phone tip built up to the proper diameter with a bushing and solder, and inserted in one end of the case. A 25- or 50-μμf ceramic condenser is connected between the tip and a shielded lead which enters the case at the other end. I use a 36-inch length of shielded lead-in from an automobile radio antenna. The cable selected has low-loss insulation and a capacitance of less than 1 μμf per foot. The cable is fitted with a standard phone plug that inserts into a jack on the tracer panel. This type of fitting allows the cable to turn freely and prevents its twisting.

The audio test prod is a simple shielded lead terminating in a standard test prod at one end and phone tips at the other. For audio signal tracing, ground the B-minus lead of the set under test to the chassis of the tracer. Open S1 to disconnect the tuning indicator when tracing audio distortion. The diode rectifier for the indicator causes some distortion of audio signals.

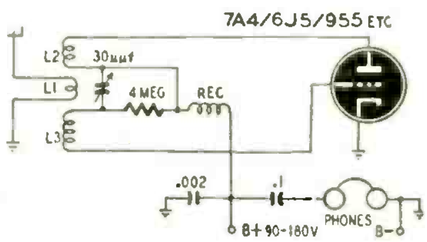
There are a pair of tip jacks in the indicator circuit, so it may be used to check the a.v.c. action of a receiver.

HAROLD R. NEWELL,
Bradford, N. H.



1-TUBER FOR V.H.F.

The circuit of my 1-tube 112- and 144-mc receiver is slightly different from those commonly used. You can use a 6J5, 7A4, 955, or similar tubes.

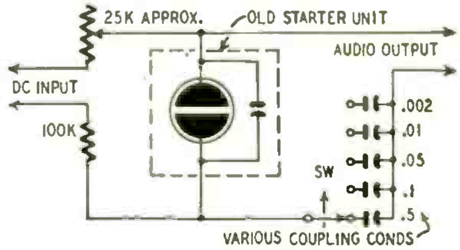


The coils are wound on a ½-inch low-loss form with No. 14 wire. The antenna coil L1 has 3 turns, and L2 and L3 have 6 turns each. This coil is for 112 mc. For 144 mc L1 has 2 turns, and L2 and L3 have 4 turns each. Adjust the turns and spacing between coils for best results.

MICHAEL SHERBA,
Hampton, Ont., Canada

SIMPLE OSCILLATOR

This audio oscillator can be constructed from a starter unit from a fluorescent light and a few parts from the junkbox. Its operation is the same as that of a neon-lamp oscillator. The tone is controlled by selecting one of the condensers in the output circuit. I use 350 volts d.c. input, but much lower voltages



can be used. The output of the unit is sufficient to drive a small speaker or a pair of headphones.

A small neon lamp can be used instead of the fluorescent starter, of course.

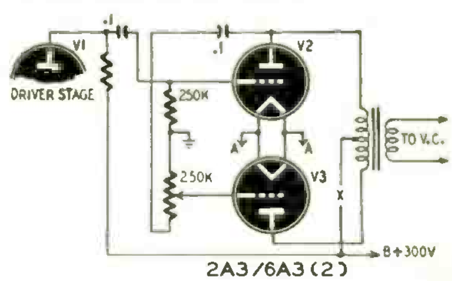
W. F. WENDT,
Napa, Calif.

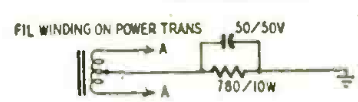
NOVEL PHASE INVERTER

When push-pull tubes are used, their grids must be fed with signals of equal amplitude 180 degrees out of phase. One of the more common methods of providing the out-of-phase signal is to use a transformer with split or center-tapped secondary. A number of phase inverter circuits have been developed to eliminate the coupling transformer. An interesting circuit of this type appeared in *Practical Wireless* (England).

The original circuit used a pair of push-pull PX4's but has been adapted to use 2A3's, 6A3's, or equivalents. Other triodes, tetrodes, or pentodes can be used if plate, screen, and bias voltages are correctly adjusted.

The grid of V2 is resistance-coupled to the plate of V1 in the conventional manner. A 250,000-ohm variable resistor is connected between the plate of V2 and ground with its movable arm connected





to the grid of V3. This control must be set so the signal on the grid of V3 is equal to that of V2. Balance the signals on the grids by connecting a 50-ohm resistor in the B-plus lead at "X" and connect an oscilloscope or headphones across it. Apply a steady tone, about 400 cycles, to the input of the amplifier or to the grid of V1 and vary the control until there is no sound in the phones or no pattern on the scope.

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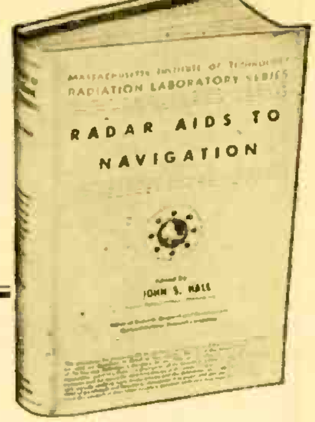

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TRY THIS ONE

SAVING A POWER SUPPLY

Sometimes, when there is high leakage between the high-voltage and filament windings of a transformer, it is cheaper and easier to install a small filament transformer than to replace the entire unit.

Mount a filament transformer with a rating suitable for the current drawn by the filaments on the chassis or elsewhere in the cabinet, disconnect the filaments from the set's power transformer, and connect the primary to the line on the set side of the ON-OFF switch.

Leakage in a transformer usually being from the high-voltage winding or the rectifier filament winding to the filament circuit, this method will be effective in most cases. The old filament winding remains as additional insulation between the secondary and the rectifier filament winding.

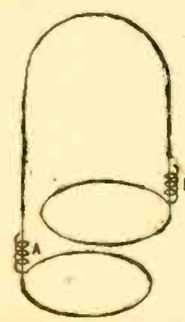
Where the leakage is between primary and secondary (as checked with a high-range ohmmeter) the entire power transformer must be replaced.

T. H. NIO
Bandoeng, Java

HANDY TUBE PULLER

Very often a serviceman has to remove a loctal or GT-type tube from a set and is unable to do so because the set is too compact or the tube too hot to handle. I have constructed a simple tube puller that solves this problem nicely.

A 16-inch length of No. 18 piano wire is bent to the shape shown in the illustration. Wrap the wire around a loctal or GT-type tube to determine the size of the loops.

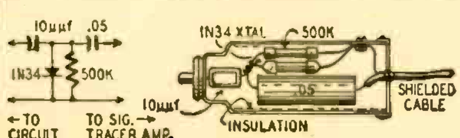


To use, push the loops down to the top of the tube base. An upward pull tightens the loops on the tube so it can be removed easily. There is little danger of tube breakage since pressure is equal on all sides. Remove the tube from the puller by grasping the spirals, A, with one hand and twisting the tube with the other. It comes out easily.

RALPH BLOOM,
Brooklyn, N. Y.

DUTCH TRACER PROBE

A 1N34 is used in this efficient signal tracer as a probe-detector. The crystal diode, a 500,000-ohm resistor, a 10-μμf mica condenser, and a .05-μf condenser are mounted in the shell of a discarded metal tube and connected to an audio amplifier through a shielded cable.

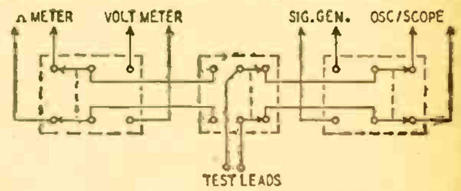


Its sensitivity is high as compared with a vacuum-tube diode. It can be used as a detector when using a 'scope and frequency-modulated test oscillator for viewing band-pass curves. It is particularly useful when servicing sets with high intermediate frequencies.

JAC. WIGMAN, JR.,
Radio-Peeters,
Amsterdam, Holland

TEST LEAD SWITCHING

For those fortunate with more than one test instrument, here is a kink to keep unused test leads out of the way and avoid changing them from one instrument to another as the need requires. Mount the instruments close together on a shelf or panel. Mount 3



double-pole, double-throw switches on a 3 x 6-inch panel near the instruments. Connect short leads to the instruments and wire them to the switches as shown. The only disadvantage is that no two instruments can be used at the same time.

NICK CARTER,
Neptune, N. J.

SUBSTITUTE V.T.V.M.

A high-resistance voltmeter having a sensitivity of 20,000 ohms per volt or more can be used with negligible detuning for emergency measurements on r.f.-carrying circuits. Connect a r.f. choke having low distributed capacitance to the end of the probe to be connected to the r.f. circuit. If the proper inductance is chosen for the frequency in use, little detuning will be noticed. This is an excellent means of checking a.v.c. voltages at the grids of r.f. tubes in receiver circuits.

This system will not work on the a.c. ranges of the tester, but can be used for measuring d.c. voltages present in r.f. circuits.

G. N. CARTER,
Nanaimo, British Columbia.

RECORDING-LEVEL METER

My recording-level meter burned out and a replacement was unavailable. I noticed that the output transformer of the amplifier had a tapped secondary. By experiment, I found that a 50-ma a.c. meter connected across the 30-ohm tap worked well. I connected a 0.25-μf condenser across the terminals to provide damping. An average reading of 20 ma is a good recording level for my cutter.

This can be used also as a cheap recording meter for amateur purposes.

PAUL F. DAWSON, Jr.
Orchard Park, N. Y.

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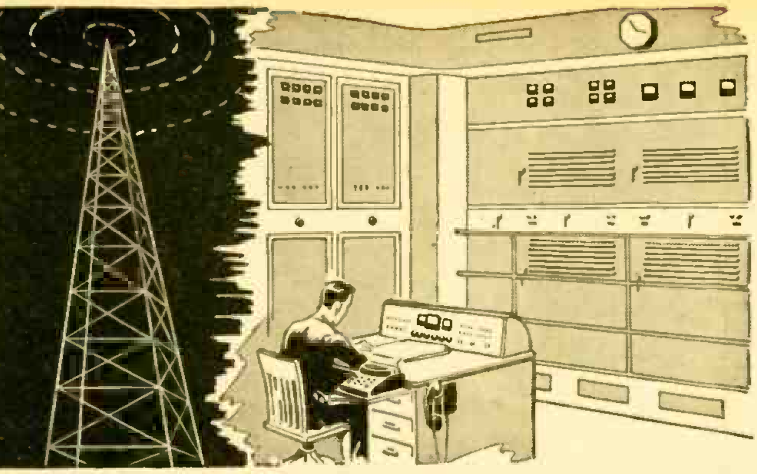

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More than ever before an FCC Commercial Operator License is a sure passport to many of the better paying jobs in this New World of Electronics.

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"I have taken the first class phone license examination and received my first class ticket last Saturday May 31. In closing I must say yours is an excellent radio course, and I really appreciate your help and the fine service you have rendered me."
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"I passed the FCC examination in radiotelephone 2nd class, at Detroit on June 3rd, and I want to thank you for your ready assistance as my instructor on Section I of Nilson's Master Course."
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"I have had my 1st class radiotelephone license since March of this year, and plan to continue with your course since I find it a great help in studying transmitters."
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FREE BOOKLET—Tells you the Government requirements for all classes of FCC COMMERCIAL licenses. (Does not cover Amateur License examinations). Use coupon below for Booklet B.

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A complete course covering the technical fundamentals of radio-electronics, for the radioman who wants a general review. Includes preparation for Broadcast station employment.

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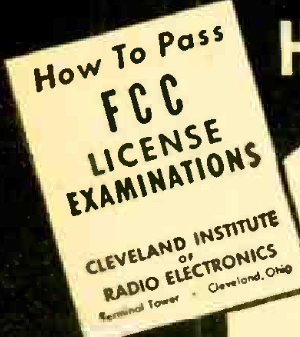

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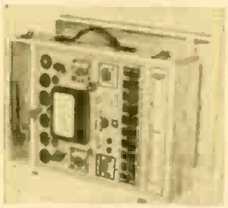
RT-1579 consists of a three stage (cascade 6SJ7's and 6F6 output stage) high gain, high fidelity amplifier with 60 cycle, 110V power supply on the same 13½x14½ chassis, which is protected by a substantial steel cover over tubes and parts. Made by Western Electric with typical quality components such as a husky power transformer and oil condensers, this unit is obviously intended to give years of trouble-free service with no more need for repairs than a telephone. Disconnecting one wire each, from the special input and output filters, will result in as high a fidelity amplifier as can be obtained. Your cost with tubes, diagram and parts list included—$14.95.
We also offer the **RT-1579** with a Raytheon Magnetic Voltage Regulator already installed beneath the cover. Imagine an amplifier complete with tubes, built to Western Electric quality standards, and immune to line voltage variations besides, making it perfectly suited for the most difficult industrial, circus, carnival, or commercial installations, offered for a total price of only $19.95, our price for both units.



1948 MODEL MUTUAL CONDUCTANCE TUBE TESTER $49.95

No possibility of good tubes reading "Bad" or bad tubes reading "Good" as on dynamic conductance testers or other ordinary emission testers. Attractive panel and case equal to any on the market in appearance . . . Large 4½" meter . . . Calibrated micromho scale as well as a Bad-Good scale . . . Front panel fuse . . . Individual sockets for all tube base types—voltages from .75 volts to 117 volts and complete switching flexibility allow all present and future tubes to be tested regardless of location of elements on tube base . . . Indicates gas content and detects shorts or opens on each individual section of all loctal, octal and miniature tubes including cold cathode magic eye and voltage regulator tubes as well as all ballast resistors. Name of the nationally known manufacturer withheld because of special price offer.
Model "C"—Sloping front counter case.......................................$49.95
Model "P"—Handsome hand-rubbed portable case.......................................54.95
Built-in roll chart with either of above $5.00 extra.

$9.95 TAKES ALL THREE BIG BARGAINS

1. AUDIO AMPLIFIER Undreamed of value. Uses 6V6's. Has 4 microphone inputs brought to jacks at rear panel. Various output impedances available at rear panel connections. Steel case with chrome handles. 9" long x 9" high x 6" deep. Tubes included. New in original carton. Shipping weight 15 lbs. **SUPER SPECIAL**—$4.95 while supply lasts.

2. RADIO HEADSETS Latest supersensitive type with rubber earpieces. Every pair guaranteed perfect. $.59 per pair **OR 3 PAIRS FOR $1.00.**

3. HOME WORKSHOP AT BARGAIN PRICE
Accurate and precise 2 speed guaranteed hobby lathe, the essential machine for the home workshop. Sturdy enough for light production work or factory standby service. Supplied with 56" of belting for connecting to any available electric motor or power take-off, such as on a jeep or tractor. Also included in this unbelievable offer are such accessories as a ½" drill chuck with specially hardened tool steel jaws, a 4" electric furnace high speed grinding wheel, a cotton buffing wheel with a large supply of buffing compound, and a 4" steel wire scratch brush. Your cost $6.00. Sole export agent. Distributor inquiries invited.

NO C. O. D.'s—ORDER NOW—DON'T DELAY

RT1463 7 tube amplifiers containing 3-7F7, 1-7Y4, 3-7N7, 4 potentiometers, numerous resistors, filter and bypass condensers, filter chokes, power and audio transformers, and six sensitive plate relays. A military development that provided amazing stepless control proportional to correction required for ailerons, rudder and elevator, in the original application. A control amplifier of the ordinary type would deflect the rudder by some arbitrary amount when the ship was blown off the course to port or starboard. The result would either be that the correction was insufficient and the plane continued off course, or the correction would be too great, starting a series of tackings and would greatly increase fuel consumption and elapsed time in reaching the objective. This phenomenal unit, with its 3 amplifiers and six 5000 ohm relays in bridge circuits, will accurately control any 3 operations, related or unrelated, in minutely adjustable uniquely quantitative variations in either forward or reverse directions. 9"x7"x8" black crackle aluminum case. Brand new in original carton, $12.95, or used $9.95.

AT LAST YOU CAN AFFORD A LABORATORY STANDARD MICRO VOLTER

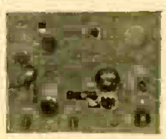
The famous Measurements Corp. Model 78B, 5 Tube Laboratory Standard Signal Generator (that sold new, FOB Boonton, N. J., for $310.00 net), is available in perfect condition for 25 to 60 cycle, 115 V AC operation. Until now this is the sort of top-flight lab equipment that discriminating buyers have only vainly hoped would be released at a bargain price. Worth every cent the manufacturer asks, but available FOB Buffalo while our limited supply lasts for only $79.95.
Such companies as Admiral Corp. and John Meck, Inc., have ordered from us and repeated many times on these 78 generators for use in their labs and production line testing.
"REMEMBER THAT A STANDARD IS ONLY AS RELIABLE AS ITS MAKER."

Model 78-B Standard Signal Generator. Two Frequency Bands between 15 and 250 megacycles.

GENERAL ELECTRIC RT-1248 15-TUBE TRANSMITTER-RECEIVER

TERRIFIC POWER—(20 watts) on any two instantly selected, easily pre-adjusted frequencies from 435 to 500 Mc. Transmitter uses 5 tubes including a Western Electric 316 A as final. Receiver uses 10 tubes including 955's, as first detector and oscillator, and 3—7H7's as IF's, with 4 slug-tuned 40 Mc. IF transformers, plus a 7H7, 7E6's and 7F7's. In addition unit contains 8 relays designed to operate any sort of external equipment when actuated by a received signal from a similar set elsewhere. Originally designed for 12 volt operation, power supply is not included, as it is a cinch for any amateur to connect this unit for 110V AC, using any supply capable of 400V DC at 135 MA. The ideal unit for use in mobile or stationary service in the Citizen's Radio Telephone Band where no license is necessary. Instructions and diagrams supplied for running the RT-1248 transmitter on either code or voice in AM or FM transmission or reception, for use as a mobile public address system, as on 80 to 110 Mc. FM broadcast receiver, as a Facsimile transmitter or receiver, as an amateur television transmitter or receiver, for remote control relay hookups, for Geiger-Mueller counter applications. It sells for only $29.95 or two for $53.90. If desired for marine or mobile use, the dynamotor which will work on either 12 or 24V DC and supply all power for the set is only $15.00 additional.

SCR-284 TRANSMITTER-RECEIVER — This medium power transmitter and the accompanying 7-tube very sensitive receiver are naturals for 80 or 40 meter operation (phone or CW), on either fixed stations or mobile applications. These units are brand new and come complete with 17 tubes, key, microphone, 200 KC calibrating crystal and instructions and diagrams for use with up to 100 watts input to the final stage on 40 or 80 meters for either phone or CW, using vehicle or 110 Volt power supply. Your cost $39.95



5" "SO" RADAR P.P.I. SCOPE, complete with 9 tubes including 807 tube in final power stage that provides deflecting current for magnetic yokes. Selsyn motor and self-contained 110 V. power supply designed to run on the AC supply on LST and PT boats. Various ranges from 2 to 80 miles. The most satisfactory scope available for navigational radar or panoramic television applications.—$39.95. "SO" Radar ECHO BOXES. The perfect calibrated cavity wavemeter—$10.00. LORAN INDICATOR OSCILLOSCOPES, including 26 tubes with 5" scope tube. Govt. instruction manual supplied with each of these—$39.95.

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BC 221

BC-221 FREQUENCY METERS with calibrating Crystal and calibration charts. A precision frequency standard that is useful for innumerable applications for laboratory technician, service man, amateur, and experimenter at the give away price of only $36.95.

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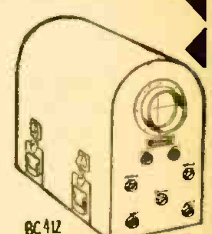
THE FOLLOWING DESIRABLE ITEMS AT SACRIFICE PRICES TO MAKE ROOM IN OUR WAREHOUSE FOR INCOMING STOCK

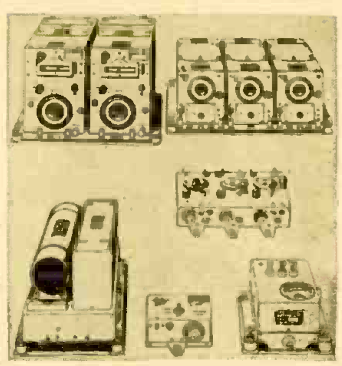
947A ONE KILOWATT HIGH FREQUENCY TRANSMITTER. This relay-controlled transmitter includes a 115V, 60 cycle power supply, protected by 8 magnetic circuit breakers, that alone is worth more than the price we are asking for the whole rig, even on today's surplus market. On the front panel are six 3½" GE or Weston meters, including 250 MA, 50 MA, 1000 MA, 150 V AC and 1500 V DC at 1000 ohms per volt for screens and plate. The rack-type 21" x 15" x 36" unit contains six amplifier and rectifier tubes aggregating over $60.00 at WAA current wholesale prices. Western Electric's price to the government was $1500.00. Shipping weight 500 lbs. Your cost at close-out price as is. Formerly $69.95, now only.............................$39.95

BC-412 5" RADAR OSCILLOSCOPE. Easily converted to a first class lab. scope or to an excellent home television receiver using the instructions in the August 1947 RADIO NEWS. Furnished with a brand new 5BP4 tube for the television application or a brand new 5BP1 for the scope application. Specify your choice. Sold at close-out price as is. Formerly $59.95, now $29.95



BC 412

5 INCH RECEIVER INDICATOR SCOPE. This unit, originally sold by Western Electric for $2500.00 includes a 13 tube receiver with 7 IF stages; 2 tube multivibrator sweep generator; 2 tube sweep amplifier; video amplifier; pedestal impulse and sweep generator, and 115 volt, 60 cycle supply with 2 x 2 for high voltage. Equipped with more than 15 tubes of the 43 originally used and including a brand new scope tube in original carton. Makes a wonderful laboratory instrument and is better adapted for television than any other war surplus item. Reduced close-out price as is. Formerly $69.95, now $39.95



SCR-274N COMMAND SET

The greatest radio equipment value in history

A mountain of valuable equipment that includes 3 receivers covering 190 to 550 KC; 3 to 6 MC; and 6 to 9.1 MC. These receivers use plug-in coils, and consequently can be changed to any frequencies desired without conversion. Also included are two Tuning Control Boxes; 1 Antenna Coupling Box; four 28 V. Dynamotors (easily converted to 110 V. operation); two 40-Watt Transmitters including crystals, and Preamplifier and Modulator. 29 tubes supplied in all. Only a limited quantity available, so get your order in fast. Removed from unused aircraft and in guaranteed electrical condition. A super value at $29.95, including crank type tuning knobs for receivers. Without these knobs the receivers can't be tuned, and are only useful for parts. Don't buy without knobs!

BUFFALO RADIO SUPPLY, 219-221 Genesee St., Dept. 2 C, BUFFALO 3, N. Y.

Cable Address: BUFRAD

MAGNETIC RECORDING

(Continued from page 31)

whole hour's recording in order to hear a selection at the end of the wire roll.

10. It is comparatively simple to splice magnetic tape so that the actual splice cannot be heard. On the other hand, a knotted splice on wire invariably can be heard because the build-up in the knot pushes the wire away from the recording or playback head.

Advanced recording theory—

Many technicians have experienced difficulty in grasping the full significance of all of the elements involved in the actual magnetization of the tape itself. The explanation that the tape is magnetized with a magnetic pattern similar to the sound wave picked up by the microphone is oversimplified. The difficulty lies in the analysis of the magnetic recorded pattern, which in turn is usually tied to the technician's concept of either a bar or horseshoe magnet.

Those RADIO-CRAFT readers who have a casual knowledge of the nature of the mosaic of an iconoscope and who have a little knowledge of the variable-density method of motion picture sound recording, will find it extremely simple to grasp a down-to-earth explanation of the elements involved in recording on magnetic tape.

Magnetic tape should be viewed as a specially treated paper base coated with very fine particles of special magnetic material held in a suitable binder. Each magnetic particle becomes a magnetic island similar to the silver globule in the iconoscope. If each magnetic island is viewed as an extremely small sphere, we can begin to evaluate the importance of particle size, binder, dispersion, and smoothness upon the over-all performance of the magnetic recording-reproducing process.

Before discussing the effects of these factors, it might be desirable to learn how some early German tape was made. The actual magnetic material used was a magnetic ferric oxide obtained by the reaction of ferrous sulphate, ammonia, and ammonium nitrate which produced a very finely divided black magnetic iron oxide, which was subsequently crystallized out of solution. This black oxide was then further oxidized at 230° C. for 6 hours in a specially constructed agitated dryer utilizing air pressure to pr duce the red ferric oxide which has t' same crystal structure as the magnet oxide, and therefore possesses magnet properties. Each of the minute crysta was about 1 micron (1/40,000 inch) size. This material was then suitab fixed with a special plastic binder a deposited on the tape.

As previously indicated (see Nove ber, 1947, issue of RADIO-CRAFT), wher 5,000-cycle signal is recorded on ta moving at a speed of 4 inches per s ond, it will have a total wave length 8/10,000 inch. The distance between t maximum and minimum magnetic r corded phase will be ½ wave length 4/10,000 inch. For ideal recording res lution, the magnetic particle size shou be at least 10 times smaller, whi brings us back to a particle size of a proximately 1/40,000 inch (or 1 micron Smaller particle sizes will of course no harm.

In fact, the smaller the particle, t easier it is to obtain proper dispersi during application. Obviously, the m uniform the particles are in size, t smoother will be the coating. A smo coating assures negligible variations distance between the magnetized p ticles and the pickup head. Significa variations in this distance will increa the amplitude variations at high f quencies.

The effect of particle size upon pl back quality is analogous to the parti size of metallic silver in variable de ity sound on film recording. (Incident ly, another important analogy betw magnetic recording and variable dens sound on film recording is the effect slit width—and magnetic gap lengt upon the resolution of the playback s tem.)

The nature of the binder is obviou important. It is desirable to utiliz binder which will keep the magne particles permanently fastened to paper base. Inasmuch as magnetic t must be in actual contact with both recording head during recording the playback head during playback, actual friction between the eleme could scrape magnetic material off tape if an improper binder is used. T binding material, itself, has been highly perfected that tape may now

(Continued on page 76)

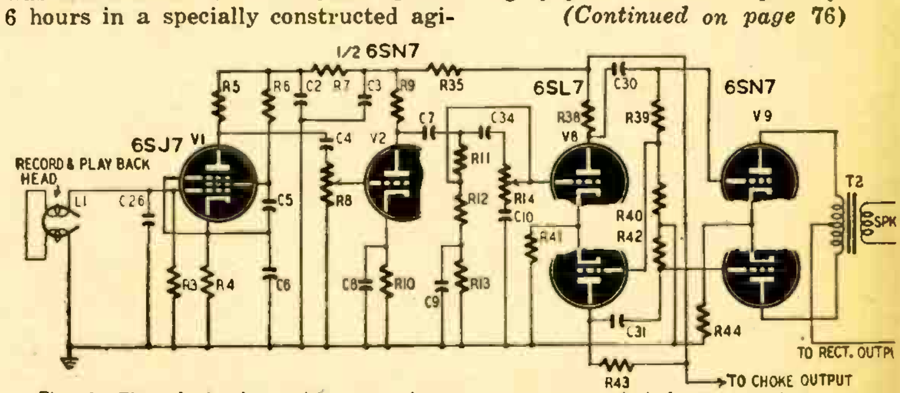


Fig. 2—The playback amplifier is a low-power unit intended for monitoring purpose

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BUY THE PROGRESSIVE UNIT WAY!

Our prices for radio kits and parts have always been amazingly low. NOW, mass sales have made possible even further drastic reductions through our revolutionary PROGRESSIVE UNIT plan.
The Progressive Radio Kit, for instance—earlier reduced from $19.75 to $14.75—can now be purchased at a cost of two kits for $28.15 and three kits for only $41.50!
Buy the PROGRESSIVE UNIT way and save $$$$$$$! See below for our Progressive prices on individual items.

Progressive AMPLIFIER KIT

This newest Progressive Kit, designed by a former Western Electric engineer, comes to you complete with all parts, tubes and a 12" P.M. speaker, enabling you to build a newly-designed, high-fidelity, humless amplifier. Kit includes beautiful aluminum custom-punched chassis, etched tone and volume control plates. Ideal amplifier for television kit or set, FM tuner, AM tuner, microphone, phonograph, wire and instantaneous recorders. Electrify your musical instruments by connecting them to the Progressive amplifier by means of a contact mike. Can be readily modified to match the GE reluctance pick-up. Separate mike and phono input. Regulated power supply maintains constant voltage supply. DC heater supply, whether amplifier is used on AC or DC, provides humless operation by eliminating cathode heater leakage hum. Contains degenerative feedback for improved frequency response, balanced phase inversion and push-pull beam power output. Every stage thoroughly decoupled to improve low-frequency response and prevent motorboating. Tone and volume controls completely variable. Seven-tube performance. Uses two selenium rectifiers, 2 beam power amplifiers, 1 high-mu pentode mike amplifier, 1 twin-triode phase inverter and 1 voltage regulator tube.

PROGRESSIVE UNIT PRICES ON AMPLIFIER KIT
1 Kit $25.75 2 Kits $49.50 3 Kits $69.00

IDEAL AMPLIFIER FOR YOUR TELEVISION KIT

BUILD 15 RADIOS $14.75

COMPLETE KIT Only...

ABSOLUTELY NO KNOWLEDGE OF RADIO NECESSARY

YOU NEED NO ADDITIONAL PARTS

THE PROGRESSIVE RADIO KIT is the ONLY COMPLETE KIT. Contains everything you need. Instruction Book, Metal Chassis, Tubes, Condensers, Resistors and all radio parts. The 36-page book written by expert radio instructors teaches you to build radios in a professional manner. You start with one-tube receivers, then build two-tube receivers. then three-tube receivers. (The three-tube receivers are equal to four-tube receivers because of the addition of a selenium rectifier.) You then construct a powerful public address system which will permit you to address large audiences. Then you make three different transmitters so you can get a real thrill out of being on the air. Before you are done with this kit, you will have built 11 receivers, 1 Public Address System and 3 transmitters.

Special FREE OFFER

Electrical and Radio Tester sent absolutely FREE with each Progressive Radio Kit. PLUS FREE membership in Progressive Radio Club. Entitles you to free expert advice in consultation service with licensed radio technicians. Write for further information or ORDER your KIT NOW!

PROGRESSIVE UNIT PRICES ON RADIO KIT....		
	1 Kit	$14.75
	2 Kits	28.15
	3 Kits	41.50

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No Surplus—All Parts Guaranteed Brand New!

ELECTROLYTIC CONDENSERS

20-20 mfd. 150 W.V.DC.
Regular Price 75c
Buy 1 for 30c and save 45c
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Buy 1 for 45c and save 60c. Buy 4 for $1.70 and save $2.50. Buy 7 for $2.80 save $4.55. Buy 10 for $3.80 save $6.70. 10-10 mfd. 450 W.V.DC. Reg. Price $1.25. Buy 1 for 65c save 60c. Buy 2 for $1.24 save $1.26. Buy 3 for $1.74 save $2.01.

12" ALNICO SLUG SPEAKER

Regular price $8.00
Buy 1 for $5.60 and save $2.40
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Buy 3 for $15.95 and save $8.05
(No more than 3 to a customer)

ANTENNA AND RF COIL SET

(broadcast Band) Reg. Price $1.00
Buy 1 set for 59c and save 41c
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PROGRESSIVE RADIO TOOL KIT

A Progressive Electronics Special.

Contains 55 watt 110/120 volt soldering iron, radioman's combination long nose pliers and cutters, amber handle screw driver, Polystyrene alignment tool.
Regular price $4.95
Buy 1 kit for $3.25 and save $1.70
Buy 2 kits for $6.10 and save $3.80
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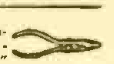

Radioman's Combination LONG NOSE PLIERS and CUTTERS 6" exceptional quality. Hydryzed for extra toughness. Diamond-tested cutters. Regular price $1.95
Buy 1 for $1.45 and save $ .50
Buy 2 for $2.70 and save $1.20
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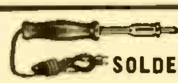

Famous Make **SOLDERING IRON**

55 watts 110/120 volts.
Regular price $2.50
Buy 1 for $1.90 and save 60c
Buy 2 for $3.60 and save $1.40
Buy 3 for $5.10 and save $2.40

CONDENSER KIT

50 paper tubular condensers. Values from .002 mfd. to .1 mfd., 400 v.dc to 600 v.dc.
Regular Price $5.00
Buy 1 kit for $1.95 and save $3.05
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Buy 3 kits for $5.55 and save $9.45

RESISTOR KIT

100 carbon resistors, ½ watt, RMA color coded, values from 330 ohms to 2.2 megohms.
Regular price $5.00.
Buy 1 kit for $1.50 and save $3.50
Buy 2 kits for $2.80 and save $7.20
Buy 3 kits for $3.90 and save $11.10

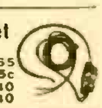
VARIABLE CONDENSER

(420-420 mfd.)
Regular Price $1.80
Buy 1 for $1.45 and save 35c
Buy 2 for $2.60 and save $1.00
Buy 3 for $3.60 and save $1.80

SELENIUM RECTIFIERS

Regular price $1.10
Buy 1 for 79c and save 31c
Buy 2 for $1.54 and save 66c
Buy 3 for $2.25 and save $1.05

PHONES—Single Head Set



1000 Ohms, DC. Reg. Price $1.65
Buy 1 for $1.10 and save 55c
Buy 2 for $1.90 and save $1.40
Buy 3 for $2.55 and save $2.40

PROGRESSIVE ELECTRONICS CO.

DEPT. RC-10

497 UNION AVE., BROOKLYN 11, N. Y.

TECHNOTES

. . . . EMERSON FV433 AND FV426

I have had several of these models in for repair. Complaint was distortion when used on a.c. but O.K. on batteries. The trouble is in the a.c. jack on the set. After some use, the jack contacts do not open. Satisfactory operation is restored by reshaping the contacts.

JAMES MOUDRY,
Cicero, Ill.

. . . . SETCHELL CARLSON 416

Hum in this model can often be traced to the socket of the 12SQ7. The leads from the switch and other components are grounded to a lug riveted to the socket. Very often this lug makes poor contact with the chassis. Solder a wire between the lug and the metal case of the volume control to clear up the trouble.

HAVEN R. WHANGER,
Steubenville, Ohio

. . . . TRANSFORMER REPAIRS

When half of the secondary of an auto radio vibrator transformer opens, the voltage usually drops to a value too low for satisfactory operation. An emergency repair can usually be effected by paralleling the plates of the rectifier tube thus reducing its internal resistance. Connect the open side of the buffer condenser to ground. Additional input filter capacity may be used to add a few volts to the output and increase the filtering.

ARTHUR S. SIMON,
Miami Beach, Fla.

. . . . PHILCO MODEL CT-11

Hum and vibrator noise in these models has been traced to corrosion between the socket rivets and the chassis. A separate ground between the shield of the 75 and ground cures troubles from this source.

HART WEBBER,
Red Bank, N. J.

. . . . TUNABLE HUM

I have had no end of trouble with tubes like the 35Z3, 35Y4 and others when they are used in the field of a loop antenna. They often create an r.f. disturbance similar to tunable hum even when they test perfect. I have known new tubes to have this trouble.

A shield around the offending tube often cures the trouble. Be sure that the shield is grounded or makes contact with the metal shell around the base.

CLIFFORD PENNISTON,
Argyle, Wisconsin

HERSHEL'S HAM HEAVEN . . .

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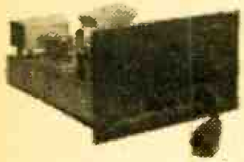
BC-620-A RECEIVER AND TRANSMITTER



ONLY **$9.95**

F-200

Radio set BC-620-A is a portable low power frequency modulation set capable of dependable communication. Frequency range 21-27 MC. Either of 2 Xtal controlled pre-set frequencies may be chosen by throwing the channel switch. The change from receiving to transmitting is made by pressing a button on the hand-set microphone. The fact that this equipment incorporates the latest FM circuit makes it adaptable to uses in locations where noise levels are extremely high. Power requirements for receiver are as follows: "A" supply—1.5V at 7 amps. "B" supply—90V at 25 milliamperes. Transmitter 7.5V. "A" at .3 amps and 150V. "B" at 45 milliamperes. This equipment is used depot stock, is in good condition and comes complete with the following tubes: (1)VT 177 or 1LH4, (1)VT 178 or 1LC6, (4)VT 179 or 1LN5, (2)VT 182 or 3B7/1291, (1)VT 183 or 1R4/1294, (4)VT 185 or 3D6/1299.

BN IFF TRANSMITTER AND RECEIVER

$9.95

F-227

This set can be used as a TELEVISION RECEIVER. This being made possible by the wide band 30MC IF channel and video amplifier. Now being sold at the lowest price in the country. Diagrams furnished, less tubes and power transformer. Weight 100 lbs.

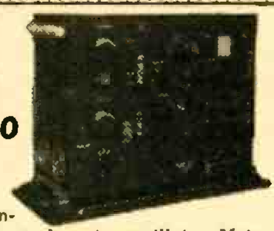
BC-733-D RADIO RECEIVER

$5.95

F-225

A part of aircraft blind landing equipment manufactured by W.E. Operates on any one of its pre-determined Xtal controlled frequencies in the range of 108-120 MC. Contains 10 tubes, three of which are W.E. 717A's, and Xtals. Ideal receiver for conversion to 144MC ham band or mobile telephone bands. For 24 VDC operation. 14½ x 7 x 4⅝". Complete with tubes.

BC-223 TRANSMITTER



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F-301

4 Xtal controlled freq. and master oscillator. Meters for osc., ant., and total current. Uses 46 speech amplifiers. 2-46 modulators, 801 each as oscillator and power amplifier. Practically no conversion necessary: plug in crystal mike and connect power supply and it's ready to operate. Brand new with one tuning unit and circuit. Diagrams. (Less tubes)

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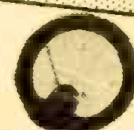

Type D041, 0-1 ma meter scale graduation 0-5 DC Kilo V. and 0-10 ma. BC.

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F-232

5 GANG VARIABLE CONDENSER

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F-243

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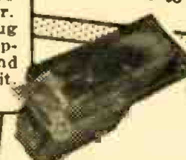

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F-222

Complete line of GE photo flash tubes in stock.

12,000,000 lumens light output—stops all action. Ignition coil included on back of bulb. 10,000 flashes. Diagrams furnished.

McELLROY TG 10 KEYER

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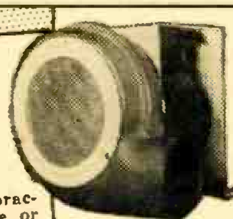
F-300

Makes excellent code practice machine, using tape or key. Variable words-per-minute adjustment. Clean-quick keying, using photocell. Operates on 110V 60cy. Slightly used but in excellent condition. Price does not include tubes.

SQUIRREL CAGE BLOWER



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F-258

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3BP1	1.95
5BP1	2.95
5FP7	1.95
7BP7	2.95
9LP7	3.95
VR150	.69
955	.44
9001	.44
9002	.44
9004	.44
9006	.44
50B5	.89
35W4	.69
872A	1.95
RK60	.95
1T4	.44
3Q4	.44
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VT127A	2.95

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(Continued from page 40)

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Location	Station	Freq.	Schedule
ALASKA	WXFD	12.250	1800 to 0100
ALBANIA			
Tirana	ZAA	7.850	1400 to 1800
ALGERIA			
Algiers		6.040	1230 to 1800
Algiers		9.540	1230 to 1700
Algiers		11.830	0030 to 0300; 1200 to 1800
ANDORRA		5.980	0500 to 1900
ANGOLA			
Benguela	CR6RB	9.160	1330 to 1430
Louanda	CR6RA	9.470	0115 to 0230; 0630 to 0745; 1400 to 1530
ARGENTINA			
Buenos Aires	LRSI	5.980	1800 to 2300
Buenos Aires	LRY1	6.090	0545 to 0715; 1800 to 2100
Buenos Aires	LRY1	9.680	1600 to 1630
Rosario	LRR	11.880	0600 to 1800
AUSTRALIA			
Brisbane	VLQ2	7.210	0230 to 0830
Brisbane	VLQ	7.240	1500 to 1900
Melbourne	VLQ	9.580	1100 to 1200
Melbourne	VLG3	11.710	0100 to 0145; 0230 to 0345
Melbourne	VLG6	15.230	2100 to 2300
Perth	VLW7	9.520	0530 to 1030; 1700 to 2045
Shepparton	VLC8	7.280	1015 to 1045
Shepparton	VLR	9.540	1620 to 1900; 2045 to 0220
Shepparton	VLC6	9.610	0830 to 1200
Shepparton	VLB2	9.680	0900 to 1100
Shepparton	VLC7	11.840	0800 to 0915
Shepparton	VLC4	15.310	N. American beam, 2045 to 2145; 0010 to 1145; Asiatic beam, 1730 to 1800; Philippine beam, 1900 to 1915
AUSTRIA			
Vienna		7.160	0000 to 0200; 0600 to 0800; 1000 to 2030
Vienna		9.820	2345 to 2030
Vienna		12.210	1145 to 2030
AZORES			
Ponta del Gada		4.040	1700 to 1900
Ponta del Gada		11.090	1500 to 1600
BELGIAN CONGO			
Leopoldville	OTC	9.380	0000 to 0200; 1045 to 1600
Leopoldville	OTC	9.740	1300 to 2015
Leopoldville	OTC	11.720	0530 to 0730
Leopoldville	OTC	17.770	0500 to 0930; 1130 to 1215
BOLIVIA			
Cochabamba	CP40	6.510	1930 to 2200
La Paz	CP49	6.770	0700 to 0900; 1100 to 1200; 1730 to 2100
BORNEO			
Balikpapan		9.120	0700 to 0935
Belem	PRC5	4.860	0600 to 1100; 1530 to 2000
Fortaleza	PRE9	6.100	1530 to 2100
Rio de Janeiro	ZYC8	9.610	1500 to 2200
Rio de Janeiro	PRL7	9.720	0430 to 0600; 1415 to 1445; 1500 to 2100
Rio de Janeiro	PSH	10.220	1700 to 1800
Rio de Janeiro	PRL8	11.720	heard at 0500
Sao Paulo	ZYB7	6.090	1600 to 1950
BRITISH GUIANA			
Georgetown	ZFY	6.000	0545 to 0745; 0945 to 1145; 1415 to 1945
BRITISH SOMALILAND			
Hargeisa		7.130	0800 to 1030; 1200 to 1300
BRITISH WEST INDIES			
Jamaica	ZQI	3.480	1600 to 2200
BURMA			
Rangoon		6.040	0030 to 0230; 0645 to 0830; 2100 to 2145
CANADA			
Calgary	CFYP	6.030	0730 to 0100
Edmonton	CJCA	9.540	0815 to 0200
Montreal	CFCX	6.000	0700 to 2315
Montreal	CBFW	6.090	0730 to 1945; 2000 to 2400
Montreal	CKLO	9.630	1600 to 1800
Montreal	CKCX	15.190	0800 to 1200
Montreal	CKNC	17.820	0830 to 1500
Toronto	CFRX	6.070	0600 to 2345
Vancouver	CKFX	6.080	0930 to 0300
Vancouver	CBRX	6.160	0900 to 0200
Winnipeg	CJRO	6.150	2200 to 0300
Winnipeg	CKRX	11.720	1000 to 2000
CANAL ZONE			
Quarry Heights		2.390	0530 to 0700; 1000 to 2305
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CEYLON			
Colombo		3.390	0600 to 1200
Colombo		6.070	0715 to 1200; 1930 to 0545
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Santiago	CE1174	11.740	1700 to 2400
Santiago	CE1180	12.000	0600 to 0800; 1600 to 2300
CHINA			
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Chungking	XGOY	9.650	0630 to 1030
Chungking	XGOA	9.730	0900 to 1030
Chungking	XGOY	11.900	0500 to 0630; 1045 to 1145
Foochow	XGOL	10.000	0400 to 1000
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Shanghai	XGRS	11.690	0300 to 0930; 1830 to 2400
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Bogota	HJCX	6.020	0700 to 0800; 1400 to 2315
Bogota	HJCD	6.160	0700 to 0800; 1600 to 2330
Bogota	HJCT	6.200	1000 to 1400; 1800 to 2315
Bogota	HJCF	6.240	1700 to 2300

(Continued on page 60)

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Havana	CDBQ	9.230	0800 to 1200; 2000 to 2200
Havana	COCX	9.270	0700 to 0030
Havana	COBC	9.380	0700 to 2400
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Havana	COCY	11.740	0630 to 0100
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Willemstad	PJCI	7.250	1130 to 1230; 1630 to 2130
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Copenhagen	OZF	9.520	1330 to 1800
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Ciudad Trujillo	HIIN	6.240	1600 to 2230
Ciudad Trujillo	HIIZ	6.310	1600 to 2255
Monsignor Nouel	HI2T	6.480	1600 to 2400
Santiago	HIIA	6.190	1600 to 1800
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Ciudad Cuenca	HC5EH	3.930	1800 to 2230
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Quito	HCJB	12.440	0600 to 1000; 1400 to 2330; Sundays, 0700 to 1630; 1700 to 2200
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London	GRW	6.150	1445 to 1500; 1900 t 2215; 2330 to 2345
London	GRM	7.120	1145 to 1215; 1445 t 1515
London	GSW	7.230	0100 to 0115; 0130 t 0330; 0600 to 0645; 070 to 0730; 0745 to 0900 1045 to 1130; 1230 t 1430; 1530 to 1715
London	GWI	7.250	
London	GSU	7.260	0030 to 0200; 0630 t 0645; 0700 to 0800; 081 to 0900; 1045 to 1300 1330 to 1700; 2345 to 240
London	GRJ	7.320	0000 to 0015; 0645 t 0700; 1045 to 1815
London	GSC	9.580	1100 to 1315; 1330 t 1415; 1430 to 1530; 161 to 2300; 2345 to 0030
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London	GRH	9.820	1215 to 1600; 1700 t 2300
London	GRG	11.680	0600 to 0645; 0700 t 0900; 1000 to 1130; 114 to 1200; 1230 to 1430
London	GVW	11.700	0000 to 0715; 0830 t 1015; 1130 to 1600; 180 to 2230; 2300 to 0030
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London	GSG	17.790	New Zealand beam, 050 to 1030
London	GSV	17.810	0100 to 0400; 0500 to 143
London	GRQ	18.020	0100 to 0500; 0830 t 0845; 0900 to 1430
London	GVO	18.080	1030 to 1245; 1300 to 150
London	GSH	21.470	0500 to 1215
London	GSJ	21.530	Indian beam, 0500 to 081
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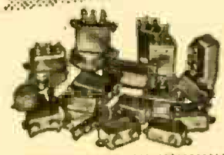

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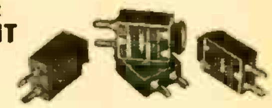

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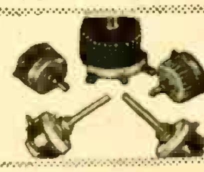

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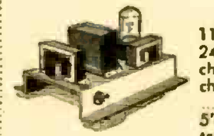

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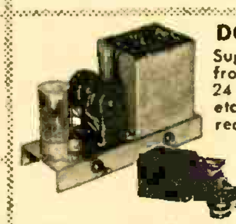

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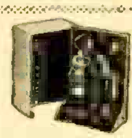

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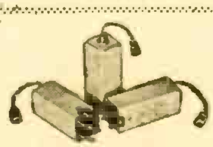

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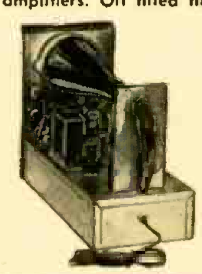

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TRANSATLANTIC NEWS

(Continued from page 38)

with. At first sight this appears paradoxical: why bother about reproducing sounds that the ear cannot hear? But everyone with a sensitive and musical ear admits that there is something lacking even in reproduction reputed to bring out all frequencies in the normal audible range up to, say, 16,000 cycles. Possibly the very high inaudible harmonics of certain instruments in an orchestra beat together and produce audible sounds corresponding to the difference between these frequencies. Such beat frequencies are necessary for genuinely faithful reproduction and they cannot of course be there unless the ultra-audio frequencies which give rise to them are reproduced.

That seems quite likely, but it is also certain that the ordinary radio listener will never develop any real enthusiasm for the very high audio frequencies until we have found some means of eliminating harmonic distortion from our loudspeakers. Second-harmonic and third-harmonic distortion are most distressing to the ear. The only way to reduce their effects in the ordinary broadcast receiver of today is to turn the tone-control knob well toward the "mellow" position—thus cutting out all frequencies above about 4,000!

Parallel transmitters for power

It is now possible for the first time to describe a remarkable new system of obtaining very large power outputs for broadcasting by linking several similar transmitters together, which was developed during the war by the BBC. It became urgently necessary to install a 400-500-kw station, both to ensure coverage of the whole country in case existing transmitters were damaged by enemy bombing and to conduct news services for enemy-occupied European countries. The only transmitters available were several 150-kw units. These units could be "pepped up" to 200 kw and it was decided to devise means of combining the outputs of two of them to produce a transmitter with a power output in the region of 400 kw from the common antenna system. Results were so entirely satisfactory that 4 units were later teamed up on a site near Hull on the northeast coast to form an 800-kw transmitter for the European services. Today the BBC has adopted the linked-unit system as standard for the new medium- and long-wave stations.

Many difficulties had to be overcome. It is simple to match the carrier frequencies of 2 or more units by driving them from a common oscillator; but it is another matter to ensure that the output r.f. voltages are equal *and in phase*, as they must be. Further, the phase and amplitude of the modulation in the outputs must be made and kept precisely the same. Another thorny problem was that of the breakdown of one of the units; unless automatic safety devices could be provided, the transmitters remaining alive would be working into an incorrect load impedance and would feed r.f. power into the dead unit. These snags were overcome. A variable phase-shifting network is inserted in the low-power circuits between the common crystal drive and the drive input of each unit. When phasing-up, each unit's output is run up to full power on a test load. A signal derived from a transformer in the test load is applied to one pair of plates of a c.r. tube, a reference signal taken from the common drive being applied to the other pair. The phase shifter is then adjusted until the trace becomes a straight line at 45° to the vertical. An a.f. line-up follows. When all units have been dealt with, they are switched to the antenna bus-bar through a combining unit set to the correct load impedance, the main high-voltage supply being off. When all is ready, a ganged switch applied the high voltage to all units simultaneously. Should any unit break down when the team is in operation a drive-suppressor comes automatically into action and cuts the high voltage supply to all transmitters. Nor can they be restarted until the dead unit has been disconnected from the antenna bus-bar and the combining unit set to the new correct load impedance. One of the strong points of the system is that even complete breakdown of one transmitter causes only a momentary break in the program.

1—10 METER RECEIVER

(*Continued from page* 44)

a bowl of water, leaving only the pins exposed. The iron can be applied directly to the pins without damaging the polystyrene, which is under water.

After the leads are soldered, there is still a chance to make slight changes in frequency range by displacing the turns. After everything is satisfactory the turns are kept in place by applying Amphenol 912 coil dope, but don't use too much. This dope softens the polystyrene and ruins the appearance of the coil form when too much is used. We found a few drops at 3 or 4 places around each turn sufficient. Don't try to cover the entire winding. The dope can be used to tighten coil pins loosened by too much heat from a soldering iron. Apply a drop or two where the pin enters the polystyrene.

Less trouble will be experienced if the detector stage is completed and made to operate alone first, and the r.f. amplifier tackled afterward. The primary of the detector winding is used as temporary antenna coil.

The r.f. grid coils are wound to slightly less inductance than the corresponding detector coils so that the r.f. trimmer can be used for resonating.

Superregeneration

When operating properly, the set should give no sign of oscillation when the regeneration control is at minimum. As the control is turned up there should be a short interval of continuous oscillation and finally (when the control is turned up still further) the hiss of superregeneration should be heard. If no superregeneration can be obtained, it may be necessary to increase the screen voltage to the detector or to readjust the feedback by changing the tap on the detector coil. The lower frequency bands will probably give no trouble in this respect.

There is a possibility that the r.f. stage may oscillate. This will also prevent the superregeneration from taking place. This is checked by removing the first 6AK5 or shorting out its grid coil. Make sure that the tube shields are in place and that all bypass condensers are well soldered with short leads. Of course the antenna should be connected when making these tests. The antenna is plugged into a banana jack at the right of the r.f. shield.

Miniature tubes should be inserted carefully in new sockets. These tubes are not too rugged since they have very thin pins which enter directly into the tube envelope. When too much force is used, the pins may bend and crack the tube. If a defective miniature tube is available, it is a good idea to insert it several times into the socket to "work it in."

Operating the receiver

Although numerous mobile telephone, police, and aircraft messages may be picked up throughout the range of 2-12

(*Continued on page* 64)

1—10 METER RECEIVER

(Continued from page 63)

meters, the most interesting transmissions will probably be the amateurs and the FM broadcasts. This is especially true of the 10-11-meter ham bands which are consistently hot. Long-distance signals are heard much of the time on these bands, even with a short, simple antenna.

C.w. signals may often be heard. To receive them, back down the regeneration control until the superregeneration hiss just disappears. For loudest volume reduce this control still further until the detector is just above the point of oscillation. The control may cause a slight change in tuning so both may have to be adjusted. For weak phone stations, superregeneration must be used. The hiss will die down as a station is tuned in. The stronger phone stations come in better on a non-oscillating detector with plenty of regeneration.

More than a dozen stations can be heard at this location (Brooklyn) on the new 88-108-mc FM band. Although this is essentially a local band, one FM station picked up here is located at White Plains, 30 miles away. Others in New Jersey and Long Island are also heard regularly with a straight-wire antenna. These weaker stations are heard with a superregenerating detector.

Four or 5 of the local FM stations come in with very good signal strength. It is found that such loud stations are heard best with the detector in a non-oscillating condition. The regeneration control, however, should be turned up to just under the point of oscillation. The listener who is accustomed to AM broadcasts only will be pleasantly surprised at the clarity of speech and music and the wide dynamic range of the FM transmissions. Although this simple set cannot compete with more elaborate receivers using multi-tube amplifiers, discriminators, and cascade limiters, many of the FM stations heard have far better fidelity and tone than the local AM stations picked up on a superheterodyne.

COIL DATA

All coils wound with No. 22 enameled wire—detector secondaries are center-tapped—

	Band 1 L_1	L_2	*26-34 mc.* L_3	L_4
turns	6½	3	7½	3
height	3/8	1/8	3/8	1/8
	Band 2		*42-56 mc.*	
turns	3	2	4	2
height	1/4	1/16	1/4	1/16
	Band 3		*85-110 mc.*	
turns	4*	2	3*	2
height	5/16	1/16	1/4	1/16
	Band 4		*120-150 mc.*	
turns	3*	1½	2*	1
height	1/4	1/16	3/16	1/16

* ¼-inch diameter coils placed within coil forms—all others are wound outside the ¾-inch forms.

BC-946 as B.C. RECEIVER
(Continued from page 26)

delay is about 0.5 second for the good bass response of this set. Both diode plates are used to avoid loading the last i.f. transformer and to keep the impedance-to-load-resistance ratio low. One of these plates is for the separate a.v.c. system and has a small voltage delay from the cathode bias of the first audio amplifier. The diode which was originally grounded is used for the a.v.c., with two 3-megohm resistors and a .0001-μf condenser, as shown in the schematic. The condenser was salvaged from beat-frequency oscillator components. The a.v.c. kicks in at the right point and will hold all but the most rapidly fading stations at a constant level. The cathode resistor causes the grids of the tubes operated by the a.v.c. to have a lower resistance to ground.

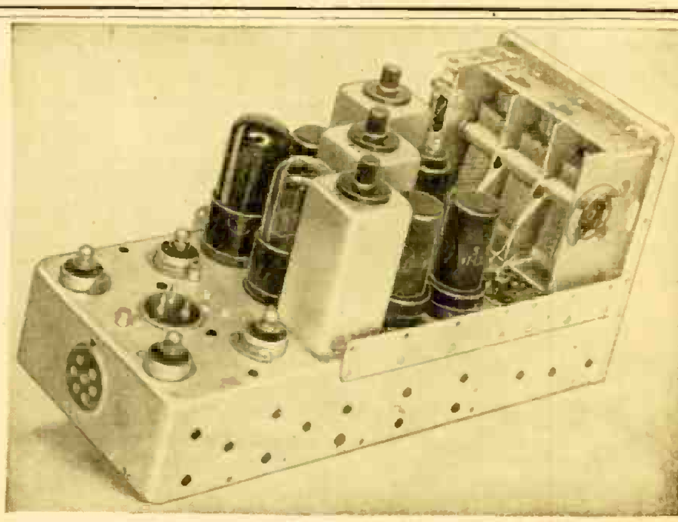
It might be well to note that all the 115-v a.c. lines run down one side of the chassis, and the audio line to the volume control down the other. To reduce electrostatic hum pickup, the heaters of the tubes are nearer ground potential as they are nearer the front end of the set.

The i.f. selectivity may be broadened for better high-frequency audio response. After aligning the trimmers for maximum signal, each one may be turned a little out of alignment, turning the first to the right, the second to the left, and so on. This will of course increase interference from adjacent channels and lessen the sensitivity.

You are faced with a dilemma in the alignment of the set. You can either tune the entire broadcast band, and as a result have the low-frequency calibration off by 20 kc, or lose the range from about 1530 up. If you prefer to have the entire broadcast band and lack a signal generator, set the main tuning condenser for its highest frequency point and adjust the oscillator trimmer C4e until you get the end of the broadcast band or the beginning of the police band. It may be advisable to do this at night if there are no near-by stations at the extreme high end. Then the mixer trimmer and the antenna trimmer are adjusted for maximum output. Now comes the dirty work. Remove the tuning indicator dial and file off the little key on the shaft. Tune the set to a known station at about 1500 kc or just below and move the dial about 3 degrees past the original pin and lock it to that station's correct frequency.

Set the oscillator padder for minimum capacitance. This will cause the set to be calibrated for the high frequencies and will read higher than the true frequency for the low end. If you are partial to the low end of the band, lock the dial nut with the dial set properly at a low-frequency station.

Don't be alarmed if the performance of this set is better than that commercial communications set you paid $70 for.



Rear view of set. The i.f. transformers and coils under the chassis are all plug-in, and may be removed after holding screws at corners are taken out. Several methods of mounting the power pack may be adopted, from mounting it on rear of the chassis to making a separate pack and plugging into Jack 2.

New Radio-Electronic Patents

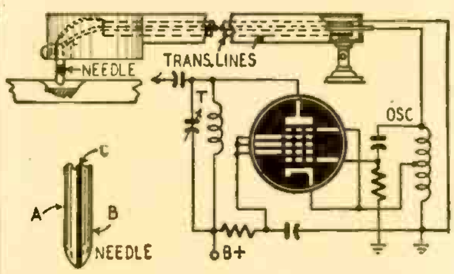
By I. QUEEN

ELECTROSTATIC PICKUP

Charles M. Sinnett, Westmont, N. J.
(Assigned to Radio Corp. of America)
Patent No. 2,423,208

An electrostatic pickup patent has been issued to an inventor who has already done considerable work in this field. The present invention is an improvement over previous types of electrostatic phonograph pickups.

As shown in the figure, the needle itself forms the variable capacitance. It is made of 2 conducting portions separated by a dielectric. One



portion is very thin and therefore can vibrate much more freely than the other. As the needle follows a modulated record groove the audio vibrations cause the dielectric to be compressed and released alternately at the same audio rate. This varies the capacitance between the 2 conducting portions of the needle which are connected across an oscillator tank circuit (by transmission lines through the pickup arm.)

The varying capacitance causes frequency modulation of the r.f. oscillations. The output circuit T is slightly mistuned so that the midpoint of its resonance curve slope corresponds to the unmodulated r.f. oscillation. As the latter is raised and lowered (by the needle vibrations) the output amplitude also varies. This amplitude-modulated r.f. can be detected, amplified, and reproduced as usual.

One form of special needle is shown in the enlarged illustration. Dimensions may be approximately as follows:

A .012 inch
B .005 inch
C .003 inch

The conductive portions may be of some very hard alloy such as steel or tungsten. The dielectric may be made of rubber or mica, or other suitable material.

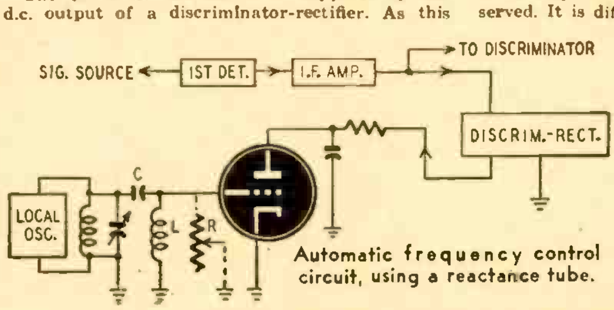
REACTANCE TUBE

Murray G. Crosby, Riverhead, N. Y.
(Assigned to Radio Corp. of America)
Patent No. 2,422,082

Oscillator frequencies are conveniently controlled by reactance tubes. This patent describes a simplified a.f.c. receiver.

The basic principle is simple. The oscillator tank is shunted by a reactance in series with a variable resistance. As the latter is decreased, the reactance has a greater effect in changing the frequency. The actual circuit uses a triode tube whose input is connected in series with C, the reactance. Coil L is a choke which merely completes the grid-to-ground circuit while maintaining the r.f. circuit through the triode's internal resistance.

The plate of the triode is supplied by the d.c. output of a discriminator-rectifier. As this voltage becomes lower, the tube input resistance becomes greater. The frequency of the local oscillator then becomes more nearly that value which is determined by the tank inself. As the plate voltage rises, the tube input resistance (shown dotted) becomes lower. C is then practically in parallel with the tank and causes the frequency to drop. This control can be used to retune a receiver which is slightly off resonance.



Automatic frequency control circuit, using a reactance tube.

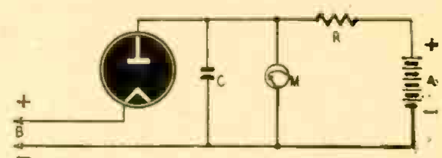
MINIMUM VOLTAGE MEASUREMENT

John R. Boykin, Baltimore, Md.
(Assigned to Westinghouse Elec. Corp.)
Patent No. 2,425,987

Vacuum-tube voltmeters are usually peak-reading instruments calibrated in terms of r.m.s. Their deflection is proportional to the peak of a unidirectional, fluctuating voltage applied during any short interval. Sometimes it is necessary to know the minimum value of a fluctuating voltage. The circuit described here can be used for this purpose.

A rectifier is used with a condenser input R-C filter. This type of filter causes the condenser voltage to rise to the peak applied value when the rectifier resistance is negligible. In this circuit R and M have resistances much larger than the resistance of the rectifier.

The voltage applied to the rectifier is composed of two parts: A, a known steady potential from a battery or regulated power supply, and B, the fluctuating voltage to be measured. They are connected with opposing polarity so that the input voltage is actually A minus B. It is clear that the meter will tend to deflect to the peak



of A minus B. This occurs when B is a minimum.

To illustrate, consider an A voltage of 150, with B fluctuating between 20 and 50 volts. The meter will read the peak, 130 volts. If a 0-150 voltmeter is used (because A is 150), and if the calibrated scale is reversed (with zero at the left) the meter reads 150-130, or 20 volts, the minimum value of B.

In effect, the instrument is a peak-reading voltmeter which measures the *peak difference* between the two voltages.

If it is not convenient to use a reversed scale, the same measurement can still be made. In this case the result is calculated from A minus P, where P is the peak voltage indicated on the meter. The minimum or through voltage will again be 150 minus 130, or 20 volts, the peak difference between the two voltages.

SELENIUM OVERLOAD INDICATOR

George H. Shoemaker, Brooklyn, N. Y.
Patent No. 2,384,200

Selenium rectifiers are widely used because of their long life when temperature limits are observed. It is difficult, however, to determine when the ratings are being exceeded.

To safeguard the rectifier, a simple thermocouple is used to measure the temperature. The couple is composed of constantan and copper wires twisted together and fused to the selenium where a small area has been left without an outer layer of alloy. A meter is connected to the thermocouple to indicate the temperature of the selenium, and indicate the danger point.

DESIGNING TELEVISERS

(Continued from page 36)

ous voltages that frequently reduce gain are thus effectively eliminated.

Although essentially the video circuits are straightforward, excellent response is obtained by the use of low resistance in the detector circuits and a carefully designed series-shunt peaking arrangement in both the input and output of the section.

The audio signal is demodulated by slope detection, and ample volume is provided by the 2 stages of amplification that follow.

The salient feature of the synchronization separator is the exceedingly low voltages employed, a provision that affords maximum limiting.

Because of the latitude present in sweep design, it is always interesting to note what considerations guided final circuit decisions. The primary one, of course, is the selection of an impulse generator. Greater flexibility is possible in the vertical section because of its lower frequency, and consequently the advantages of a multivibrator can be utilized. The problem of stability, however, must be considered more cautiously in horizontal design. Initial plans tentatively called for another multivibrator in the horizontal section. Surprisingly enough, the only instability that actually materialized appeared to be intimately connected with interference, such as ignition disturbances. Investigation soon focused attention upon the long time constant of the capacity-grid-leak arrangement which originally coupled the differentiating network to the 6N7 multivibrator. At any rate, a direct connection from differentiator to grid, together with a further lowering of the differentiator time constant, reduced the problem to such negligible proportions that the multivibrator proved completely acceptable.

A common expedient used in the rectifier circuits to provide the kinescope with an extra 350 volts deserves a word of comment. Generally, the low side of the high-voltage rectifier is returned directly to ground. But since this procedure has the disadvantage of losing the potential available in the low-voltage section, it appeared sensible to connect the 2 rectifier circuits in series. As a precaution against noise pickup, the low side of the high-voltage supply was tied to a 350-volt terminal point safely distant from the r.f. unit.

Although simplicity in design was generally favored as preferable for kits, compromises inconsistent with a full exploitation of modern television techniques were studiously avoided. At the same time, the convenience of inexperienced constructors was borne in mind faithfully, and the resulting chassis layout is so commodious that people with no previous electronic experience whatever have succeeded in wiring the set. Moreover, they are spared the vexing inconvenience of depending helplessly upon the repairman to perform the minor rear chassis adjustments that sporadically confront all television receivers. One example is the holding controls, which must be touched up whenever a gradual change of interelectrode capacitances makes the picture flutter. The kit builder is more than competent to meet such contingencies himself, easily and quickly, while experience has disclosed that the owner of a store-bought model must contend with an annoying succession of calls upon the repairman.

A final consideration that demands special attention in the kit field concerns adequate protection against the high voltages present. For the under surface of the chassis, an interlock switch and a bottom plate are provided, while for the top surface a ceramic cap insulates the connection to the anode of the 2X2. The last protective measure is the use of bakelite shafts attached to all controls with high-voltage connections.

WAR ON SERVICEMEN

(Continued from page 17)

radio technicians. Whether the repairmen will clean their own house or whether the city will have to do it, I don't know. But something should be done, and quickly.

This practice of planting a gimmick is decidedly unfair to the serviceman. While the short circuit may be "in plain view in back of the set," this in normal servicing procedure would naturally not be looked for and it probably would take even a very intelligent serviceman a long time to locate it for the simple reason that *it was not a natural inherent failure of the set but was a "plant"*.

Such "plants" are vicious, unfair, and certainly do not do much to the credit of the investigator's ingenuity. The fair way would be to take a set which has failed normally and have a serviceman ascertain the trouble. *Then* take this set to various servicemen and get an estimate.

There would at least be some fairness to such a procedure and it would make sense. "Planted" gimmicks on the other hand do not make sense, simply because they cannot be discovered quickly by routine testing—they are not expected.

Even when you take a set, which has failed in a natural manner, to two dozen different servicemen, the chances are that you may get 24 different prices. You can also shop around among 24 different dentists for a special inlay in one of your teeth and get a number of variable prices. This, is not an indictment either against the dentist or the servicemen. *In the end you always get what you pay for.*

There is the dentist who will beat every price in town and the same thing holds true of servicemen.

In a complex device such as a radio set where a good deal of labor and material go into repair work it would be a miracle if all prices came out uniform.

RADIO-CRAFT certainly does not hold any brief for the chiseling serviceman—of whom we are sorry to say there still exists a certain percentage in every locality. We stated so recently on this page*. In that article it was pointed out that a small minority of servicemen, who abuse their calling, makes all the mischief. RADIO-CRAFT always has maintained that while this small minority gives radio servicing a black eye, the dishonest serviceman seldom stays long in business, because he can only live off perpetual new customers. But no matter where he is located, sooner or later, such a serviceman will be found out and will be eliminated.

All in all, despite many detractors, the servicing industry on the whole IS sound. For convincing proof we refer investigators and doubters to a comprehensive article which appeared, with facts and figures, in our August, 1946, issue, entitled: "Serviceman are honest."

**Should Servicemen be Licensed?*, December, 1947, issue.

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 the February, 1914, issue ELECTRICAL EXPERIMENTER:

The Radioson Detector, by *H. Gernsback*

An Efficient Transmitting Loose Coupler

An Extra Large Amateur Aerial

The Goldschmidt Radio Tower at Tuckerton

A Novel Oscillation Transformer

Increasing Your Transmitting Power

An Efficient Loose Coupler, by *Eugene Dynner*

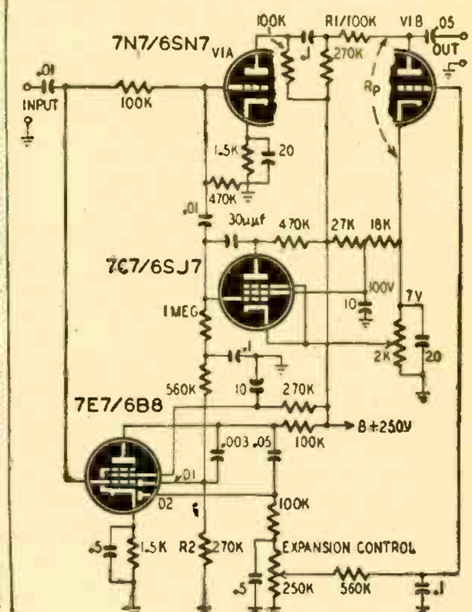
Wireless at Columbia University

Radio Time Station

Canadian Radio Law

SCRATCH SUPPRESSOR

Surface noise and scratch are constant bugaboos of high-quality phonograph reproduction. Filters, tone controls, and suppressors have been developed to combat this interference. In most instances, however, there must be some kind of compromise—either attenuating the signal in the scratch frequency range or reproducing the signal at a level where it overrides scratch. A new electronic scratch suppressor and volume expander combination, described in *Audio Engineering*, can be connected between a *high-level* pickup and the amplifier input circuit. It is basically an electronic tone control producing high-frequency attenuation when the high-frequency component of the signal is comparatively small.



This 3-tube unit can be operated from the power supply of the average a.c. amplifier or from a separate supply.

The input signal is amplified by V1A and resistance-capacitance-coupled to the plate of V1B. This triode is connected so its internal plate resistance R_p, and the 100,000-ohm resistor R1 are in series across the output of V1A. The output voltage of the unit is proportional to the ratio of R_p/R_p+R1.

The 7C7 is connected to the grid of V1A so that it acts as a variable capacitance reactance shunting the input circuit. The effective capacitance of the tube is controlled by its effective grid bias. Operating bias is taken from a tap on the 2,000-ohm resistor in the cathode circuit of V1B.

A pentode amplifier 7E7 is connected to the input circuit. Its plate is connected to one of its diodes D1 through a .003-μf condenser that attenuates the lows and passes the highs to the diode. The diode load resistor R2 is in series with the grid leak of the 7C7 and a 560,000-ohm-resistor — 0.1-μf-condenser time delay network. When no highs are in the applied signal, the voltage developed across R2 biases the 7C7 so that its capacitance reactance is low, thus shunting high-frequency scratch and surface noise from the grid of V1A. When high notes come through, the bias varies to increase the capacitance reactance, permitting the highs to be amplified.

The remaining diode of the 7E7 is coupled to the plate through a .05-µf condenser. This diode is loaded by a 100,000-ohm resistor in series with a 250,000-ohm expansion control. The signal developed across the control is applied to the grid of V1B through a time-delay circuit (560,000-ohm resistor and 0.1-µf condenser) that controls the attack time. The 0.5-µf condenser across the control determines the release time. On loud passages, the bias is increased on V1B, increasing its plate resistance and making a greater signal available at the output terminals.

The position of the tap on the cathode resistor of V2B sets the operating point of the 7C7. Set this by turning the arm of the control to the ground end. Apply a 5,000-cycle, 0.3-volt signal to the input and measure the signal at the output terminals. Adjust this control to reduce the output 10 db.

RADIO RECORD PLAYER

(Continued from page 27)

of its low interelectrode capacitances. The 6AB7/1853 is a very simple reactance-tube modulator. In the usual applications, these modulators work at fairly low frequencies, depending on doublers and triplers to reach the 88-108-mc band. In this unit the modulator acts directly at the output frequency. It has been stripped of all unnecessary parts so that it will not impair oscillator efficiency. As a result, there is a certain amount of AM, but it has no effect on reproduction. With a high-output crystal pickup connected to the input receptacle, almost a full 150-kc swing can be obtained from average records.

The power transformer, filter condensers, and rectifier are mounted at the left of the chassis in the usual manner. But the oscillator and modulator components are mounted above the chassis. This makes the unit easier to adjust and allows the coil to radiate freely. The oscillator and modulator tube sockets are mounted vertically on small angle brackets. The sockets and the oscillator tank are all within a 3½-inch-diameter circle so that long leads, which introduce large losses at these frequencies, are not necessary.

In constructing the oscillator, first assemble the power supply. The power transformer may be any one that can be found in the junk-box. Any full-wave rectifier tube will do. The filter condensers can be of any value between 12 and 40 µf.

Next, the other 2 tubes and the tuning condenser should be mounted. The tuning condenser is a miniature air padder (Bud LC-2076) with all but 2 rotor and 2 stator plates removed. It has a screw driver tuning adjustment. It is mounted face down so that it can be tuned through a hole from under the chassis. Only sufficient room should be allowed between tube sockets and con-

(Continued on page 80)

SUNSPOTS AND RADIO

(Continued from page 25)

ously interrupted. About a day after the greatest damage has been done to the F-layer, the lower E-layer is seriously damaged, causing interference in receiving radio programs on the broadcast band. After the disturbance on the sun is past, the upper, or F-layer is the first to recover. The lower, or E-layer may stay disturbed for several days, and broadcast reception may take a week or even more to return to its normal values after so extensive a catastrophe.

We must understand, of course, that all this applies to long-distance reception. It is only when one is concerned with radio waves coming from stations 100 to 1,000 miles distant that the sky waves of radio are utilized. If you live in the suburbs of New York, Chicago, or any other large city, you usually receive your favorite newscast, music, or entertainment program from one of the near-by stations. In this case sunspots may pass unnoticed, as it is the ground wave that passes directly from the broadcast station to your antenna that is responsible for your enjoyment of the program.

One must be careful not to generalize too widely or to say that under all circumstances sunspots make for poor radio reception and a clear sun makes for good reception. It all depends on the communication path involved, the length of the radio waves employed or their frequency, and whether or not you are beyond the radius of the ground wave when you tune in your program. It is in the case of long-distance radio, involving transcontinental and transoceanic communication, that distances are great enough to be concerned with sky-wave transmission. If we can anticipate the number of sunspots in any future year, we can estimate the best long-distance communication frequencies. It is for this reason that world-wide communication companies are so intimately concerned with cosmic effects on sky-wave propagation, conditions that are quite beyond man's control.

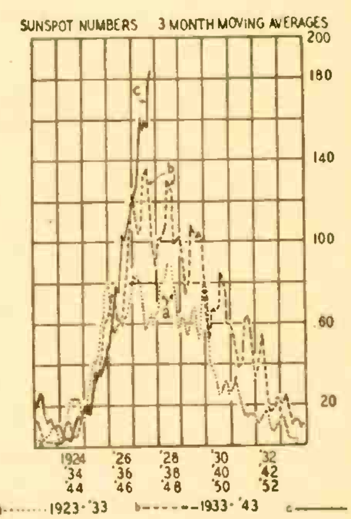


Fig. 7—Sunspot cycles of the last 3 decades.

A TWO-BAND PORTABLE

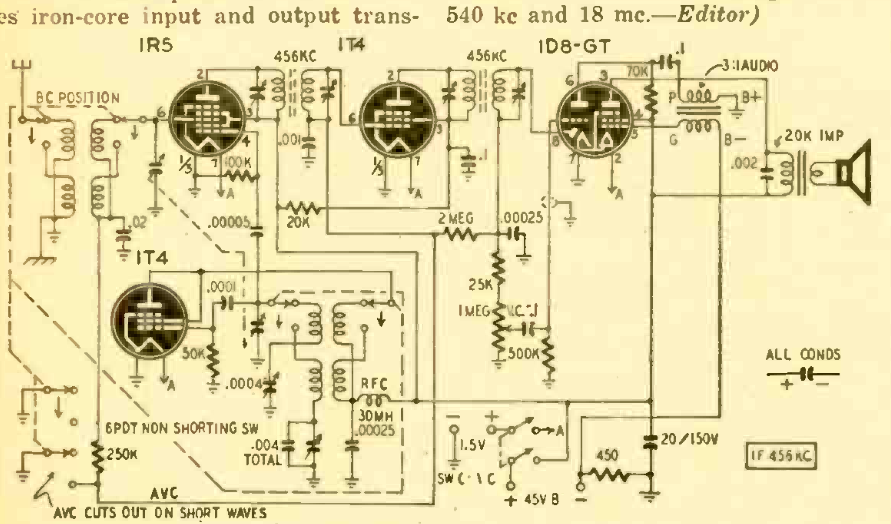
This 2-band portable receiver is handy for vacation trips or as a stand-by set for a shortwave listener. It is a 4-tuber with 6-tube performance, using a pair of standard 2-band tuning coils to cover the broadcast and 5.8- to 19-mc bands.

The band-change switch is a 6-pole, 2-position, nonshorting rotary unit. Two of its sections ground the a.v.c. system when the set is tuned to the short-wave band. A 1T4 is used as a local oscillator with the 1R5 connected as a mixer. It is unusual to find a separate oscillator in a set of this size. I find that it works better on short waves, particularly when the B-supply is limited to 45 volts.

The 1T4 i.f. amplifier is standard and uses iron-core input and output transformers. The balance of the circuit is designed around a 1D8, diode-triode—power-amplifier pentode. The diode section is the second detector and a.v.c. rectifier. The triode section is a voltage amplifier shunt-fed transformer-coupled to the power amplifier section. A small 3:1 interstage transformer is used. The shunt-fed triode plate circuit seems to give better quality. Bias for the power amplifier is from the voltage drop across the 450-ohm resistor between the B-minus lead and the chassis.

JAMES CHARLES SOUKUP,
Chicago, Ill.

(This set may be converted to a portable amateur receiver by using 3-band coils for continuous coverage between 540 kc and 18 mc.—*Editor)*



RADIO SET AND SERVICE REVIEW

(Continued from page 32)

the high range, the signals beat with the *second* harmonics of the v.f.o. to produce the 500-kc difference frequency for working into the fixed i.f. amplifiers.

The circuit

The primary of the antenna coil, L6, is designed for most efficient operation with a 300-ohm antenna or transmission line. Incoming signals appear on the grid of the 6AK5 pentode r.f. amplifier. They are amplified and impedance coupled to the signal grid of the 6SA7 mixer through L12 in the 6AK5 plate circuit. Here the signal beats with the harmonics or fundamental of the crystal oscillator to produce frequencies in the range of the variable i.f. amplifier (2.5 to 1.5 mc or 5.5 to 3.5 mc) depending on the position of the band switch. A variable i.f. transformer, L13 and L16, is used between the 6SA7 and the 6SK7 high-frequency i.f. amplifier. The tuning slugs of the transformer are ganged to the tuning control so the transformer is always resonated to the 6SA7 output frequency.

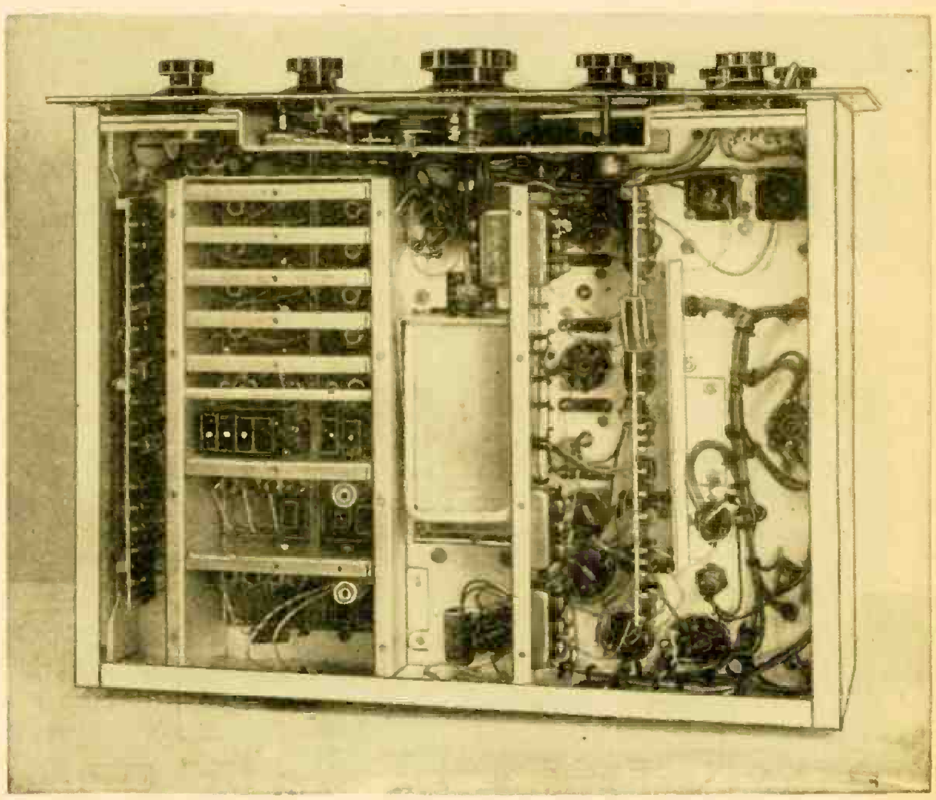
The signal from the 6SK7 is applied to the No. 3 grid of the 6L7 second mixer. Signals from the 6SJ7 permeability-tuned v.f.o. beat with the high-frequency i.f. and produce the 500-kc fixed i.f.

The 500-kc output of the 6L7 feeds through a crystal filter into a conventional-stage high-gain i.f. amplifier using a pair of 6SG7's. The filter is between the output of the mixer and the grid of the first i.f. stage. Unwanted signals are rejected with the phasing control. Selectivity of the filter is controlled by varying the amount of resistance in the circuit. When the 4700-ohm resistor is in the circuit, the Q of the filter is highest and its selectivity is greatest.

A part of the signal from the plate of the second i.f. stage is applied to the plate of the 6SJ7 a.v.c. tube through a 100-μμf condenser. When the signal is great enough to drive the plate more positive than the cathode, the tube conducts, developing a voltage across the 470,000-ohm resistor between the plate and ground. The grid of the 6SJ7 is connected to a positive point on the detector load resistor. This voltage aids in cancelling the delay bias on the cathode so full a.v.c. is developed across the 470,000-ohm plate resistor. Control voltage is taken from the plate through a.v.c. filters and applied to the r.f. and variable i.f. amplifiers and to the second fixed i.f. amplifier.

A 6H6 second detector and noise limiter follow the 500-kc i.f. stage. The detector diode works into a high impedance load that effectively clips all negative audio peaks above the 35% modulation level. The other diode of the 6H6 is a series noise limiter designed to clip positive audio peaks at the 35% modulation level. Limiter operating voltages are taken from the detector load resistor so all signals are clipped at the same level regardless of the carrier strength.

The b.f.o. circuit is conventional. Its frequency is variable 1,000 cycles either side of the i.f. center frequency by a control on the panel. Voltage from the b.f.o. is injected at the detector plate.



Under-chassis view of the receiver. Crystals can be seen in the compartment left of center.

The audio amplifier and power supply are conventional. The output tube develops about 2.5 watts into 400- or 500-ohm loads. A phone jack is provided. The headphone circuit is designed for 500-ohm phones but high-impedance phones work well.

The illuminated S-meter is connected between the cathodes of the variable i.f. amplifier and the second mixer. Sensitivity and zero-set controls are provided for correcting the meter for different antennas and receiving conditions. The meter is calibrated to S9 at half scale and to 60 db above S9 at full scale.

The antenna, r.f., variable i.f. and variable oscillator circuits are tuned by powdered iron slugs which are moved through the cores of L6, L12, L13, L16, L17, L20 and L001. These inductors, except L001, are tuned to the 80-meter band with a semi-variable condenser combination consisting of a fixed condenser and a trimmer. When the set is tuned to other bands, parallel-tuned circuits are connected across the 80-meter inductors to raise the effective resonant frequency to the frequency of the band in use. In each case, the 80-meter inductors are the only ones varied by the tuning controls. In the rear-view photograph, the cover has been removed to show the oscillator shielding compartments. The permeability-tuned v.f.o. is in the center of the set. The movable platform supporting the tuning slugs is just to the right of the shield between the compartments.

Performance

The electrical stability of this set is far superior to any we have seen. Checking the calibration of the set by tuning in signals of known accuracy from a crystal-controlled oscillator, it was possible in all cases to hit the frequency right on the nose just by reading the dial of the set. If there is *any* receiver that will satisfy FCC requirements for frequency - measuring equipment for amateur stations, the Collins 75A-1 is one that will do the job. The set was tuned to zero beat with WWV on 15 mc less than 1 minute after it had been turned on. After being on five hours, only a very low audio note was audible in phones or on the external speaker. While the set was in this condition, it was subjected to mechanical shock without any detectable change in frequency.

U.H.F. SWEEP GENERATOR

Courtesy Vision Research Laboratories

A service instrument for modern use, this sweep signal generator covers a range from 5 to 100 mc and 170 to 216 mc in 4 ranges, with sweep variable from 500 kc to 10 mc.

MAGNETIC RECORDING

(Continued from page 54)

used for more than 1,000 plays without any appreciable reduction in volume level.

If the dispersion is not homogeneous, a characteristic clumping takes place. This deposits an uneven coating and also prevents the formation of a smooth series of magnetic islands on the tape. When clumping occurs, pronounced level variations are noticed at the high frequencies.

Surface smoothness is one of the most important characteristics required for low background noise. Surface smoothness is obviously a function of particle size and dispersion.

Electrical circuits

Fig. 1 shows the complete schematic circuit of the modern tape recorder-reproducer. To simplify tracing the recording - playback circuits, this schematic has been broken down into 2 parts; the recording and erase circuit, and the playback amplifier. The simple power supply used to furnish plate and heater voltages for all of the tubes is shown in Fig. 1. The approximate specifications for the power transformer (T1) follow:

- Primary: 117 volts, 50/60 cycles
- High-voltage secondary: 325-0-325 volts, 100 ma
- Rectifier filament: 5 volts, 2 amperes
- Heater circuit: 6.3 volts, 4 amperes

Two voltages are taken from the power supply: one directly from the rectifier output which delivers approximately 360 volts at 20 ma and the other from the output of the filter circuit (labeled choke output) which delivers approximately 350 volts at 75 ma. The output ripple at this point is less than 0.2 volt.

The playback amplifier is indicated in Fig. 2. This circuit is fairly conventional in design, with the exception of the special post (post-recording) equalizer, consisting of C7, R12, R13, and C9. The network composed of R11, C34, R14 and C10 provides a variable high-frequency attenuating and accentuating control so the over-all response of the unit may be adjusted to the listener's preference. Note that the playback head is resonated with condenser C26 for additional low-frequency boost.

The playback amplifier is more in the nature of a monitor than a high-fidelity playback unit. If an external amplifier and loudspeaker is to be used, it should be tapped in at the input grid of the 6SL7. In fact, if a single-pole, double-throw switch is used to connect the center of R14 either to the 6SL7 for the monitor amplifier or to an external amplifier, a perfect switching arrangement will be provided.

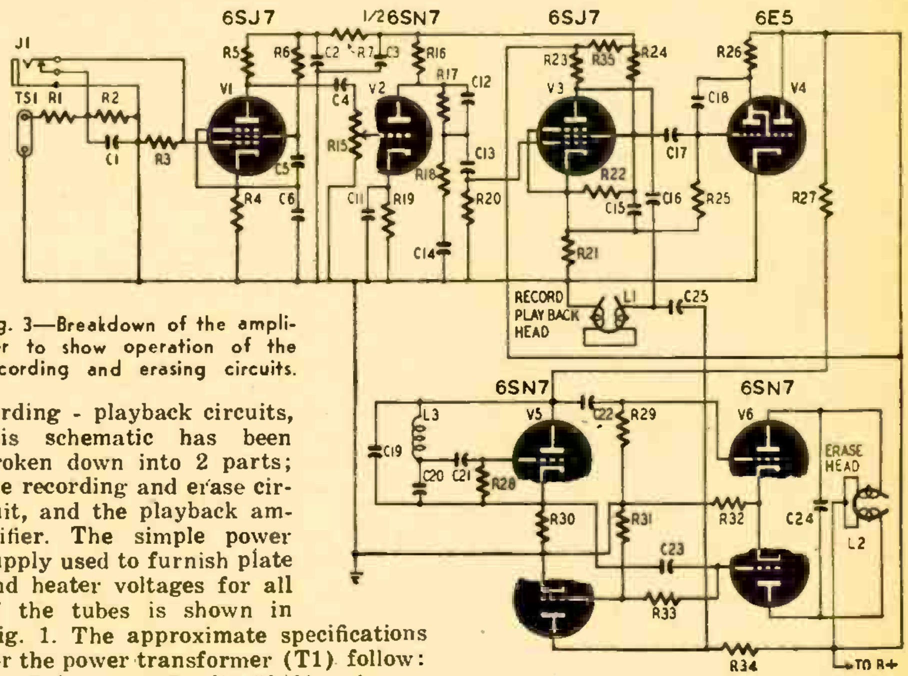


Fig. 3—Breakdown of the amplifier to show operation of the recording and erasing circuits.

Because of the exceptionally high gain of the amplifier, it is extremely important that unusual precautions be taken to avoid excessive hum pickup. Take extreme care in the grounding circuits of the input stage. Note also that only one-half of V2 is utilized in the playback amplifier. The other triode section of the 6SN7 (V2) is utilized in the recording amplifier, which is illustrated in Fig. 3.

The recording and erase amplifier circuits are the most complex, as they include a low-power recording amplifier, an electron-tube overload indicator, a supersonic bias oscillator, an isolating amplifier, and a supersonic power amplifier for erasing. It will be noted that 2 inputs are provided: one high gain which connects directly into the control grid of the 6SJ7 (V1) for microphone use, and the other through a dropping and compensating network into the same grid for high-level input (such as from a radio tuner). A special pre-equalizer circuit composed of R17, R18, C14, C12, C13, and R20 is utilized to provide a response curve which simulates the overload characteristic curve of the tape. One triode of V5 is employed as a 30-kc oscillator and inverter, which in turn feeds the erase amplifier V6, which is connected to the push-pull erase coil. The other triode of V5 is the isolating amplifier which feeds supersonic bias voltage to the recording head. Both the supersonic voltage and audio signal voltage are mixed into the recording heads through C25 and C16, respectively.

All of the electrical and mechanical recording equipment is housed in the central portion of the cabinet shown in the photograph at the head of the article, which illustrates a long playing tape recorder-reproducer capable of recording and playing back eight-hour programs.

Interior views of this unit will be shown in the concluding article of this series, which will also discuss the supersonic biasing, electronic erasing and the tape-handling mechanism.

In the meantime, the writer will be glad to answer questions addressed to him in care of this magazine. To insure speedy replies, please include a postage prepaid self-addressed envelope.

PARTS LIST

RESISTORS

(All units ½ watt except where noted.)

CIRCUIT SYMBOL	DESCRIPTION
R1	470K
R2	22K
R3	470K
R4	1800-ohms
R5	220K
R6	1 meg
R7	22K
R8	1-meg potentiometer
R9	27K
R10	1K
R11	220K
R12	68K
R13	1 meg
R14	1-meg potentiometer
R15	1-meg potentiometer
R16	27K
R17	33K
R18	8200 ohms
R19	1K
R20	1 meg
R21	270 ohms
R22	27K
R23	47K
R24	33K, 1 watt
R25	1 meg
R26	1 meg
R27	27K
R28	100K
R29	100K

(Continued on page 78)

MAGNETIC RECORDING
(Continued from page 77)

R30——27K
R31——47K
R32——680 ohms
R33——100K
R34——15K, 1 w
R35——2200 ohms
R36——470K
R37——68K
R38——27K, 1 w
R39——470K
R40——22K
R41——680 ohms
R42——470K
R43——27K, 1 w
R44——680 ohms
R45——100 ohms, 10 w

CAPACITORS
(600-volt working except where noted.)

C1——.0005µf
C2, 3, 6——3 x 20-µf, 450-v electrolytic
C4——.02µf
C5——.1µf
C7——.02µf
C8——.05µf
C9——.002µf
C10——.002µf
C11——.05µf
C12——.0025µf
C13——.01µf
C14——.05µf
C15——.02µf
C16——.1µf
C17——.1µf
C18——.0001µf
C19——.001µf
C20——.01µf
C21——.01µf
C22——.001µf
C23——.001µf
C24——.0005µf
C25——.0005µf
C26——Values determined by head
C27, 28——2 x 20-µf, 450-v electrolytic
C29——.01µf
C30——.01µf
C31——.01µf
C32——.02µf
C33——.02µf
C34——.001µf

TUBES

V1——6SJ7
V2——6SN7
V3——6SJ7
V4——6E5
V5——6SN7
V6——6SN7
V7——5V3
V8——6SL7
V9——6SN7

MISCELLANEOUS

T1——Power transformer
T2——Output transformer
CH1——10H, 75 ma
J1——Jack (microphone)
TS1——Radio input
TS2——External speaker
SPK——8-inch permanent magnet
M1, 2, 3——115-v a.c. synchronous motor
SW1——Toggle s.p.s.t.
SW2——Rotary 4Zp.d.t.
SW3——Reverse-limit d.p.d.t.
SW4——Forward-limit d.p.d.t.
SW5——5 push-buttons
F1——Glass-type 2, amp
L1——Record-playback head
L2——Erase head
L3——50 mh.
Rectifier——Federal No. 403D2625

QUESTION BOX
(Continued from page 42)

frequency above the present value of about 290 to 300 kc.

The coil mounting and winding will depend on the materials that you use and your ingenuity in applying them. Remember that *a supply of this type is dangerous!* The final coil must be well insulated. High-voltage leads should have gradual bends and also should be insulated against corona discharge.

Construction of the coils is shown in Fig. 2. Coils are wound as follows: L1—32 turns, approximate, of No. 28 d.c.c. magnet wire. L2—1,400 turns of 3/44 Litz wire wound in 7 pies of 200 turns each and 5 turns per layer in each pie. L3—approximately 55 turns No. 32 enamel. The number of turns may be varied to obtain proper grid excitation for the 6Y6. For L4 and L3 use No. 24 d.c.c. wire and wind a fractional turn or so to get 1.25 volt at 0.2 ampere for the filament of each 8016.

The spacing of the windings from each other may have to be varied for best results, but the order in which they are shown should remain the same.

SIGNAL TRACER

(Continued from page 34)

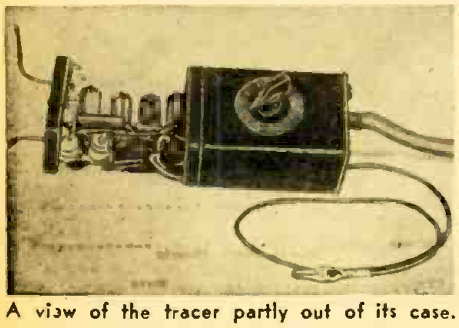
as cover and chassis are slid into place.

A similar procedure is followed for the battery and headphone jack leads. The battery leads should be shielded by running them in a length of shield braid soldered to the can. The audio and r.f. probes are the easiest of all to construct. They are made from heavy tinned-copper wire so bent as to make it easy to reach into the more inaccessible corners of a receiver chassis. The r.f. probe is soldered directly to one terminal of the trimmer and brought through the can cover with an insulating rubber grommet. Outside the can the probe is covered with spaghetti to within ¼-inch of the end to avoid shorting out any of the receiver wiring. The audio probe is similar in construction except that it is soldered to an insulated terminal strip mounted inside the can cover. Both terminal strip and trimmer should be securely mounted to support the probes. The probes must be kept short to prevent unwanted pickup. It must be remembered that they are merely terminals and not antennas. A word of caution about the audio probe blocking condenser. Be sure it is of high enough voltage rating to stand any voltage that might be encountered.

A convenient length of wire with an alligator clip on one end is fastened to the can to provide a common connection between the tracer and the radio chassis. All parts must be chosen for size. The smallest wattage ratings in resistors and other parts are permissible in most cases, as the power is small. The new midget volume controls and r.f. chokes are good.

The signal tracer—if properly constructed—should be able to pick up a signal directly from the grid of the first r.f. or mixer stage. If the capacitance has been kept low enough, there should be no necessity for retuning the dial while checking r.f. stages. The relatively low impedance of the audio probe circuit may load the grid circuits of some first audio amplifiers. But I have yet to experience this difficulty.

In conclusion, all that you have to do is flip the switch and touch the r.f. probe from point to point, following the signal from stage to stage. The audio probe is ready with a twist of the wrist as soon as you have passed the detector. Now and then it will be necessary to turn the volume control down as you approach the receiver output.



A view of the tracer partly out of its case.

ONE television receiver is equal to at least 5½ radio receivers in terms of spectator appeal, says Huber Hoge, advertising agent for U. S. Television. A survey shows that on an average weekday evening 30% of the radios in an area are in use, but that 52% of the teleceivers in the same area are operating. Further, each television receiver has an average of 6.26 persons watching it, while the average audience per radio set is 2.5.

RADIO RECORD PLAYER

(Continued from page 71)

denser to mount the other components.

Now all the wiring may be done, except the connection between the modulator plate and the tank coil. Use good-quality components and see that they are rigidly mounted. Any loose or swinging part will cause microphonics. Use small chassis terminals where necessary. All ground connections in the oscillator-modulator circuit should be made with heavy copper wire *to a common point*. Do not rely on soldering to the chassis. At 100 mc these points may spell the difference between success and failure.

The next step is making the coil. Use copper (or silver-plated) wire, No. 14 or larger. It is absolutely essential that the coil be as rigid as possible. It consists of 3 turns with an inside diameter of ¾ inch. The one shown was made by winding the wire over the bakelite shell of a standard phone plug, then slipping it off. The turns should be pulled out so that coil length is about 1 inch. Leave about 1¼ inches of extra wire at each end of the coil.

Now connect the coil directly to the tuning condenser. No coil form or other support is necessary. Using heavy wire—No. 14 or better—connect the modulator plate to the coil about ½ turn up from its grid end. This wire, like all the connections, should be short and direct. Do not try for orderly appearance in v.h.f. equipment—just connect everything from point to point.

Now insert all the tubes and apply power. Check filament voltages. Place a 1,000-ohm-per-volt meter across the high voltage and adjust the power-supply filter resistor until output is between 15 and 20 volts. With the transformer used in the model, 225,000 ohms gave an output of 18 volts.

Next comes the question of whether the oscillator is oscillating. Disconnect the lead which carries high voltage to the oscillator modulator. Insert a 0-10-ma meter. Open the tuning condenser about ¼ of its range, and turn on the power. If the unit is oscillating, the meter needle will rise slowly, suddenly pause, then continue up a slight distance. To check, put a finger near or on one end of the coil. If current changes when the finger is applied and removed, the oscillator is percolating merrily.

If no oscillation is found, check tubes and connections; then remove the modulator plate connection from the coil and try again. If oscillation is now observed, check all modulator connections (including grid and cathode). If there are still no results, try moving the modulator plate tap to a slightly different spot on the coil.

Setting the frequency may be the longest process of all, unless the reader is luckier than the writer. With power on, tap the coil lightly with a neutralizing tool or pencil and slowly tune the receiver over the band until a twanging sound is heard. If results are nil, change the setting of the oscillator tuning condenser and repeat. If you still have no luck, try squeezing and expanding the coil. Eventually, the oscillator will be located between 88 and 108 mc.

With the coil and condenser specified, the unit will not quite cover the entire FM band. So select the portion which is most free from signals in your locality, and, by adjusting the condenser and squeezing the coil, set the oscillator to some even-numbered dial division for easy location in the future. Use an insulated screw driver to adjust the condenser—it's hot at both r.f. and d.c.

After frequency has been set, you will notice that the oscillator is very microphonic. This is principally because the coil twangs like any piece of similar metal. To make it more rigid in the model, a plexiglass strip about 1/8 inch wide was cut to the length of the coil and glued to it with Duco cement.

The phonograph connector is on the rear apron of the chassis. Connect a crystal pickup to it and play a record. Volume may be adjusted with the potentiometer mounted on the front chassis apron. Most inexpensive crystal pickups will produce enough output to modulate the oscillator almost completely. This can be checked by listening first to an FM station, then to a record.

If a low-level pickup or microphone is to be used, a preamplifier stage will be necessary. Any ordinary resistance-coupled triode or pentode is suitable, depending on the gain needed. It can be mounted easily on the chassis.

It may prove useful to experiment with the value of plate voltage. This can be done by substituting different values for the power-supply filter resistor. Experiment shows, however, that much higher voltages will not be successful. Whatever voltage produces loudest receiver output is best.

The volume control actually controls frequency swing or deviation. If input from pickup or preamplifier is high, it will be found that increasing the control too much causes distortion.

Any of the usual equalization circuits may be used at the input. Pre-emphasis of highs may be desirable, since FM receivers incorporate de-emphasis.

Any article on phono oscillators—even FM oscillators—should end with the following solemn warning! Unless you have enough surplus income to pay a heavy fine or enough spare time to permit you to waste some of it behind bars, DON'T USE AN ANTENNA!

COMMUNICATIONS

LICENSES—PRO AND CON

Dear Editor:

Why is it that the licensing of radio servicemen pops up every so often? Just who is back of this anyway? Why always pick on the radio man? What about the automobile mechanic, watch repairman, or refrigerator serviceman? Many a high-priced watch, good car, or refrigerator have been ruined by the so-called tinker. As a radio serviceman for many years, I have heard more complaints along this line than I have heard in regard to gyp radio servicing. It seems to me that, if the radio service profession kept its mouth shut along this line and let things take their own course, all would be well. Every time the public sees an article on licensing radio servicemen they get the idea we are a bunch of crooks out to give them a raw deal and charge 3 times as much as we should for our work.

It is no wonder our profession is the poorest paid of any in the world. Show me another trade that exposes their wholesale prices like we do. Anyone can write for a catalog, and open circulars by the dozen are sent through the mails for everyone to see. Mail-order houses sell tubes for less than we can buy them and then you expect us to charge a fair retail price without the public squawking. To top this off, every so often the bogieman jumps out and labels us as dishonest by yelling "License them!"

It's we and not the people who are making the fuss. I have to hide the December issue of RADIO-CRAFT for fear one of my customers will see the article and begin to wonder for just how much he is going to be taken. If you, who are always ballyhooing about licensing radio servicing, turned your thoughts to publishing articles in leading magazines on how the public should go about selecting reliable repairmen and get behind manufacturers to form service organizations such as Philco has, it would be a great help to us and the public. You always have and always will have crooks in service professions. No amount of licensing is going to clean up the situation.

This is still a free country where the public can take their servicing wherever they want, and it isn't our fault if they don't want to patronize reliable shops. I have seen people get taken and go right back for more. That's the gambling instinct in man, and it is also what keeps this the free country that it is today. No one has been seriously hurt but ourselves.

ALEX JOHNS,
Johns Radio Shop,
Dubuque, Iowa

Dear Editor:

Why all this fuss about controls? Who is going to be hurt? The sooner they control the radio servicing industry the better for all concerned. I am 40 years old—made my living all my life in radio.

I have attended shows, bought books and equipment, and maintained a complete stock of quality parts and tubes. I have worked long hours and given my community honest and—as far as my capabilities permitted—efficient workmanship.

In return I've been called a robber, a gyp, and every uncomplimentary name under the sun. Not by the 10,000 old customers on my books, but by the shopper who had been patronizing the fellows in a chain-store basement. I have spent hours putting a set back together after it was mutilated, and you know I didn't get paid for it. I have tried to defend my charges for quality parts when compared with fly-by-night competitive worse-than-surplus junk.

Who fears controls? Not the fellows who conduct their affairs honestly. Not the fellow who can pass the tests. Don't try to kid an old-timer, son! Controls will encourage the good men in the industry, will elevate the radio technician and his profession to a level consistent with the effort he must spend to be worthy of the name serviceman. Free enterprise?—you bet I'm all for it. Let any doctor practice who has passed through his internship and is qualified and ethical—but clear out the quacks!

Ed. Crawford,
Crawford Radio Service,
Hibbing, Minnesota

NOVA SCOTIAN OPINION

Dear Editor:

Permit me a few minutes of your time to express my appreciation to you for the publication of a fine magazine. Although working for a newspaper, I am an ardent radio fan, and during the recent differences in international opinion served with the RCAF in the Radio Division as a technician. I buy practically every radio magazine published, and find Radio-Craft the best in its line. I also note that in Canada we pay 35c now, and believe me, if the price were again raised, I would still buy the magazine. I have every copy of Radio-Craft for the past number of years, and credit the magazine with keeping me up-to-date on the ever-changing field of radio-electronics. Please accept my sincere thanks for your smart publication.

J. F. MacLeod,
Sydney, Nova Scotia

LIKES CONSTRUCTION

Dear Editor:

I speak for 10 or 15 friends here in St. Louis who have a superficial knowledge of radio but not too much practical experience.

We like stories on building small receivers, amplifiers, phono oscillators, etc., also instructive articles on design of receiving and sound equipment. Since the hams have their own specialized magazines, I think you would do well to consider the many who have not the time, money, or equipment to go in for transmitters, television, or other more advanced aspects of the field.

(Continued on page 84)

We are interested in wire-recording setups. Will you print some circuits soon? Also good high-fidelity amplifier circuits and some tuners.

Chas. Sheldon,
Kirkwood, Missouri

LICENSES NOT NEEDED

Dear Editor:

In reply to your recent editorial "Should Servicemen Be Licensed?" I would like to answer that they should not. For one thing, licensing often gets into the hands of state and city administrations, so that getting a license may depend on one's politics. For another, examinations test theory. An applicant may know the whole theory of radio and yet, if he has had no servicing experience, he can do more damage in a few minutes than can be repaired in several hours.

Our Association has been functioning for several years with very good results. An applicant must have 2 years' experience in a repair shop and own or have access to the necessary test equipment specified in the Association's By-laws. He must be examined and pay an initiation fee before he can become a member, and must pay dues and attend monthly meetings thereafter.

We have the cooperation of our local supply houses, which we find very helpful. I think if this method of solving the servicemen's problems could be adopted throughout the country, it would help curb many abuses and weed incompetent persons out of the service field.

Scott Adams,
President,
Radio Technicians Association,
Huntington, West Virginia

BASICALLY NEW THINGS

Dear Editor:

Your magazine was recommended to me by a friend when I first started studying electronics about 12 years ago. I have read several other periodicals along with Radio-Craft and can truthfully say that in my eyes there is and has been no better magazine. Most of those I have seen do not satisfy me like the Radio-Craft I have known for the past 12 years.

Concerning your editorial policy, I admire your clear, frank, forthright honesty in whatever subject you deal with. I imagine it pinches in places always to follow that policy, but I admire you for it and earnestly hope you will continue to follow it in the future.

I like technical articles dealing with basic principles in electronics and always read with intense interest any article that describes something basically new. The electret you described some time back stuck in my mind and I have been hoping you would have more to say about it.

I am also delighted to see that Mr. Shaney is back with us again. I am confident he knows his business and his articles are written so I can understand and profit by them.

Van Burtis Spitler,
Findlay, Ohio

RADIO-FREQUENCY HEATER

(Continued from page 22)

This represents full load. If this point cannot be reached, try a different tap on the coil and proceed as before until the maximum plate current, not to exceed 0.6 amp, is reached. In some settings it may be found that a greater current than this will be drawn. In this case the plate overload relay will trip, cutting off the power. In such a case the coil tap must be changed again until the optimum setting is found. For most experimental work it will probably be desirable to have the key switch in the MANUAL position.

Some interesting and enlightening results may be obtained from this device. It is to be noted particularly that a mass of material will heat uniformly throughout, regardless of its thickness. This is in sharp contrast to what takes place in conventional heating, where thermal conduction must be depended upon to conduct the heat from the surface inward. It may readily be appreciated how important this feature becomes in various industrial applications. It is not uncommon for the time required for a given process to be reduced from several hours to a few minutes. Typical applications of this form of treatment are preheating of plastic preforms, setting of plywood, twist-setting of textiles, sealing of plastic sheeting and sterilizing of packaged cereals.

BOOK REVIEWS

TELEVISION TECHNIQUES, by Hoyland Bettinger. (With drawings by the author.) Published by Harper & Brothers. Stiff cloth covers, 6 x 8½ inches, 237 pages. Price $5.00.

Working on the principle that "the basic factors of television showmanship are not new, but are as old as the arts from which they are derived," the author proceeds—after a brief introductory chapter to put the reader at ease with the electronic principles of television—to relate his subject to these older arts.

He deals first with the medium, indicating the limitations as well as possibilities of both sight and sound as transmitted on the television carrier. A long and well-illustrated chapter on pictorial composition and continuity is then followed by one on the video or actual camera technique and another on audio technique. Other chapters deal with television writing, directing and producing, staging the play, the use of film and moving-picture techniques in television programs, and television lighting.

The presentation is directed to the nontechnical user of television or worker in the television field: to the writer, sponsor, advertising agent, studio crew, motion picture field unit, and performers.

FLUORESCENT LIGHTING MANUAL (Second Edition). By Charles L. Amick. Published by McGraw-Hill Book Co. Stiff cloth covers, 6 x 9 inches, 318 pages. Price $4.00.

Written by a member of the General Electric Lamp Department, this is a complete and up-to-date treatise on fluorescent lighting. It covers not only the elementary subjects expected in a practical manual written in language simple enough for the average installation man, but deals also with illumination problems from the viewpoint of the engineer, discusses fluorescent lighting design, and devotes a chapter to lighting economics.

A historical sketch and discussion of modern lamps and auxiliary equipment present the fluorescent lamp to the person previously unfamiliar with the subject. Operating hints, installation, and service suggestions are more interesting to the electrician actively engaged in installing lamps; and several chapters on selection and design, color quality and fluorescent applications are useful to the illumination engineer.

SUNSPOTS IN ACTION, by Harlan True Stetson, Ph.D., with a foreword by Sir Edward V. Appleton. Published by the Ronald Press Co. Stiff cloth covers, 6 x 8½ inches, 252 pages. Price $3.50.

The importance of sunspots in radio is apparent to all who have noted the great increase in maximum usable frequencies during the present period of maximum sunspot activity. Reports of reception of American FM stations have been received in Australia; the Atlantic Ocean has been spanned by amateur communication signals on 6 meters and Chicago FM or New York police radio interference mars the images on London television screens. The radioman is very much interested in sunspots as a factor in radio propagation conditions.

Four chapters of Dr. Stetson's work deal with radio, covering the subjects of the effect of sunspots on communications, their importance as a factor in radio predictions, the effect of moonlight on radio, and the recent sunspot maximum's part in the recent FCC actions in regard to FM and other frequency allocations.

Suggested by James Eastcott, Hamilton, Ontario, Canada.

"This set used too many acorn tubes!"

Advertising Index

RADIO SCHOOL DIRECTORY

(See Page 86)

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 Model 88-A *COMBINATION*

SIGNAL GENERATOR AND SIGNAL TRACER

We're prepared for the demand we know will be created by this long overdue combination of the two units which have always been used together. The ultimate in signal tracing procedure is achieved by the Model 88, for the use of this model, enables you to use either the broadcast signal itself or the signal injected by the Signal Generator. This is especially useful of course when servicing "dead" or "intermittent" receivers. The Model 88 you will find is the greatest time-saver ever provided for by combining a full range Signal Generator and Signal Tracer into one unit the set up time for interconnecting, etc., is entirely eliminated.

Signal Generator Specifications:

★ Frequency Range: 150 Kilocycles to 50 Megacycles.

★ The R.F. Signal Frequency is kept completely constant at all output levels. This is accomplished by use of a special grid loaded circuit which provides a constant load on the oscillatory circuit. A grounded plate oscillator is used for additional frequency stability.

★ Modulation is accomplished by Grid-blocking action which has proven to be equally effective for alignment of amplitude and frequency modulation as well as for television receivers.

★ Positive action attenuator provides effective output control at all times.

★ R.F. is obtainable separately or modulated by the Audio Frequency.

Signal Tracer Specifications:

★ Uses the new Sylvania 1N34 Germanium crystal Diode which combined with a resistance-capacity network provides a frequency range of 300 cycles to 50 Megacycles.

★ Simple to Operate—Clips directly on to receiver chassis, no tuning controls.

★ Provision is made for insertion of phones of any impedance, a standard Volt-Ohm Milliammeter or Oscilloscope.

The Model 88 comes complete with all test leads and operating instructions.

ONLY .... **$28.85 NET**

The New Model 777 — 20,000 OHMS PER VOLT!!

SET TESTER

TUBE TESTER SPECIFICATIONS:

- Tests all tubes including 4, 5, 6, 7, 7L, Octals, Loctals, Television, Magic Eye, Thyratrons, Single Ended, Floating Filament, Mercury Vapor Rectifiers, New Miniatures, etc. Also Pilot Lights.
- Tests by the well-established emission method for tube quality, directly read on the scale of the meter.
- Tests leakages and shorts of any one element against all elements in all tubes.
- Tests both plates in rectifiers.
- Tests individual sections such as diodes, triodes, pentodes, etc., in multi-purpose tubes.
- New type line voltage adjuster.

V.O.M. SPECIFICATIONS:

- D.C. VOLTS: (at 20,000 Ohms Per Volt)
  0 to 7.5/15/75/150/750/1,500 Volts
- A.C. VOLTS: (At 10,000 Ohms Per Volt)
  0 to 15/30/150/300/1,500/3,000 Volts
- D.C. CURRENT:
  0 to 1.5/15/150 Ma. 0 to 1.5 Amperes
- RESISTANCE:
  0 to 5,000/50,000/500,000 Ohms 0 to 50 Megohms
- DECIBELS: (Based on zero decibels equals .006 Watts into a 500-Ohm line.)
  —10 to + 18 db., + 10 to + 38 db., + 30 to + 58 db.

Model 777 operates on 90-120 Volts 60 cycles A.C. Housed in beautiful hand-rubbed cabinet. Complete with test leads, tubes, charts and detailed operating instructions. Size 13" x 12½" x 6".

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