HUGO GERNSBACK, Editor

In this Issue—
Two New FM Tuners
Audio-Frequency Wattmeter

RADIO CRAFT

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1947

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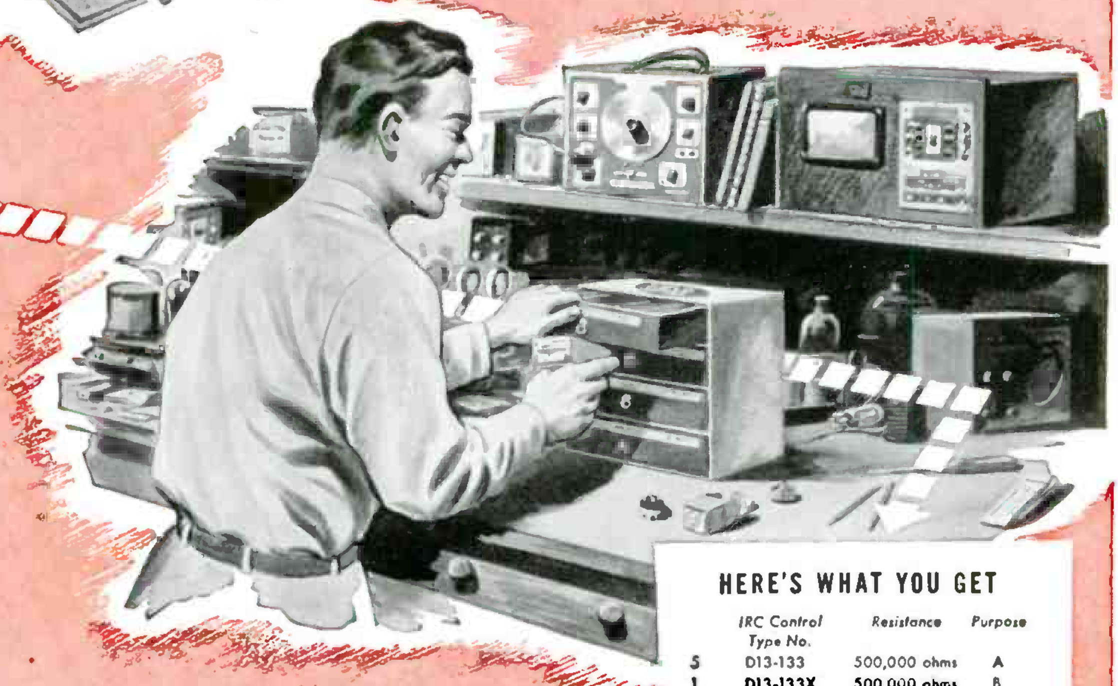
RADIO-ELECTRONICS IN ALL ITS PHASES

This New IRC JUNIOR Control Cabinet Belongs on Your Bench



Here's one selection of 9 "hot-number" controls, switches and shafts you'll use every day! The new IRC Junior Control Cabinet contains 9 of the most-used ½, 1 and 2 meg. type D controls with the added adaptability of the tap-in shaft feature—plus 4 switches and 4 special shafts.

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

Purpose: A-Tone or Audio Circuit control; B-Topped for tone compensation.

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3	#41	S.P.S.T.
1	#42	D.P.S.T.

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3 Type "E" with universal knurl for special type push on knobs.

1 Type "H" with universal groove for many Delco, RCA, Sears-Roebuck and Westinghouse models.

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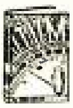

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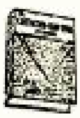

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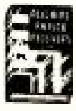

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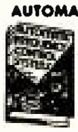

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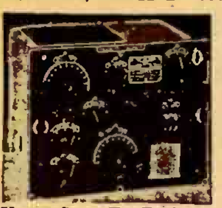

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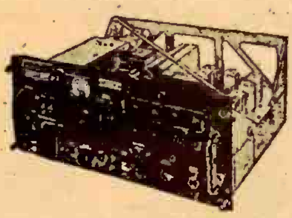

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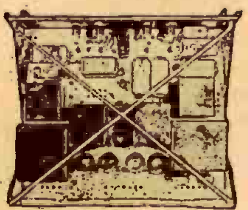

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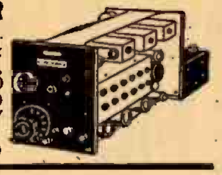

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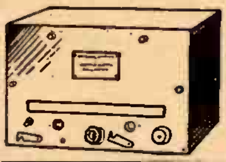

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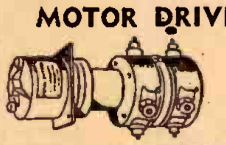

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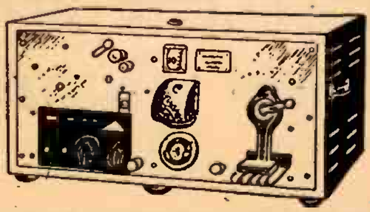

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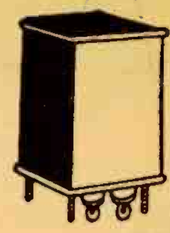

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On the Cover:

Manufacture of FM tubes. The young lady is assembling the parts of a 19T8.

Chromatone by Alex Schomburg from General Electric photo.

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Dr. Lee de Forest

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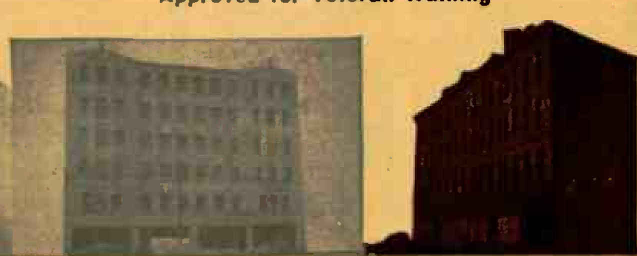

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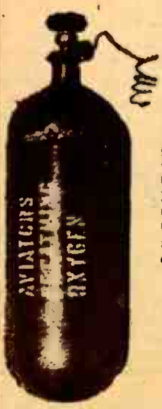

Aviators' oxygen breathing bottles. Withstands 500 lbs. pressure. Non-shatterable. Choice of two above types A or B.

$6.95

BC-1158 TRANSMITTER AND MODULATOR

Made by Bendix for airborne operation. Designed for remote control. Power source 28 V. DC input. (not included). Operates in any place in the 53-60 Mc. and 80-88 Mc. frequency band. Is crystal controlled (crystals not included). Has RF stages, amplifier and driver section, contains 4-815's and 10-12SN7 tubes, 1-0/150 DC milliamp Weston meter which can be switched to various circuits. Has exhaust fan for ventilation. Can easily be converted to operate on several frequency bands. Size 12" x 8" x 18". 45 lbs. Limited quantity $27.50

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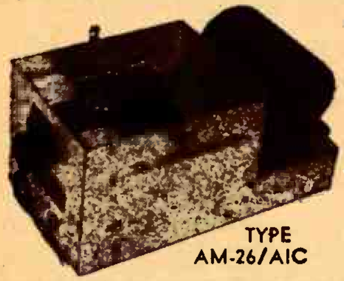
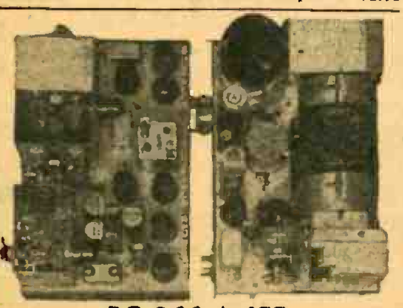


TYPE AM-26/AIC

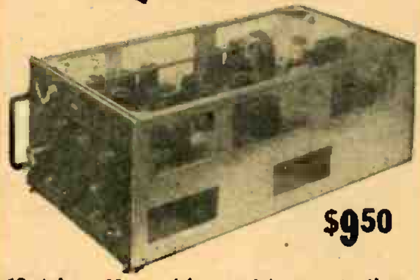
with 28 V. DC dynamotor. Contains 2-12A6 and 2-12J7 tubes. Easily converted for phonograph or inter-communication amplifier $1.75



BC-966-A IFF

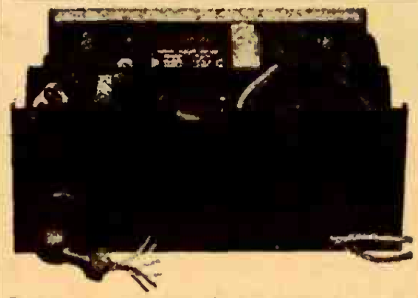
Approximately 2 meter frequency operation. 14 tubes, 350V. DC dynamotor, 12 V. DC input. Contains voltage regulators and many other fine parts. Worth more for parts than price asked $4.75

APQ-13 RECEIVER



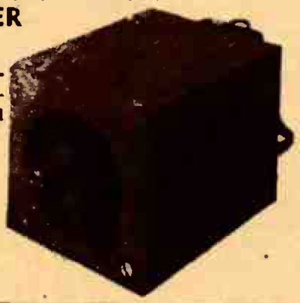
$9.50

17 tubes, 13 precision resistors, potentiometers, condensers, transformer, knob, switches, pilot light, fuses.



Dynamotor unit MG-1A for SCR-552 transmitter & receiver $3.75

DETROLA AIRCRAFT RECEIVER



28 V. DC operated, 200-400 Kc. Good condition.

$3.75

APN-1 RADIO ALTIMETER

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 cannot go wrong. Complete as shown in aluminum case 18" x 7" x 7¼" $8.95

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).

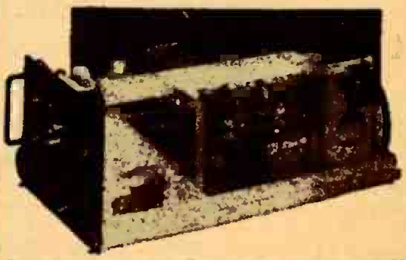
BC-357 MARKER BEACON RECEIVER

Ideal for controlling remote circuits for model aircraft, boats, etc. Operates from 75 Mc. Signal easily altered to 2 meter band. Tubes used and included: 12C8 and 12SQ7. Also sensitive relay. Circuit diagram included inside case. Size, 5⅝" x 3⅜" x 5¼" For 24 V. DC operation $1.95

IF AMPLIFIER STRIP

19 Mc. contains 5 Western Electric 7-17A tubes $3.95

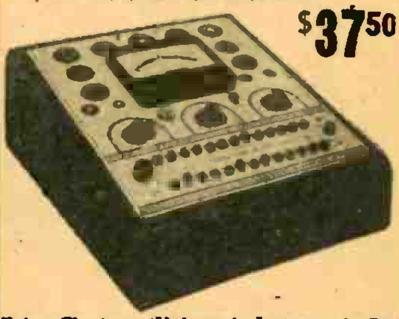
T-39/APQ-9 RADAR TRANSMITTER



Contains many excellent parts for the VHV 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, 1-931 and 1-6AG7 tubes; ceramic switch, potentiometers, gears, revolution counter, etc. $12.50

TUBE CHECKER

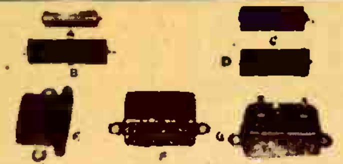
$37.50



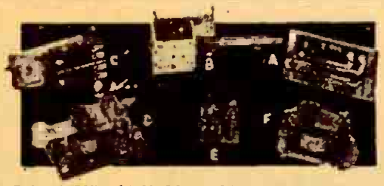
Tube Checker (Universal Instrument Co.) Counter model 501. Tests all tubes in use today. Brand new with manual and factory guaranteed.

(A) Lapp 800 lb. safe working load insulators .... $ .95

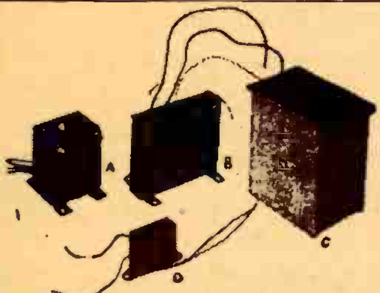
(B) Lapp heavy duty insulators with strap mounts 1.65



A—Condenser, .14 Mfd. 50 V. (metal clad) (New) .... 100—$2.50
B—Condenser, 16 Mfd. 150 V. (filter condenser) (New) .... .20
C—Condenser, .05 Mfd. 400 V. (New) .... .05
D—Condenser, .1 Mfd. 400 V. (New) .... .05
E—Condenser, .3 Mfd. 50 V. DC (Bathtub) (New) .05
F—Condenser, 3 x .1 Mfd. 400 V. DC (Bathtub) (New) .... .05
G Condenser (Aerovox), .02 Mfd. 600 V. .... .05



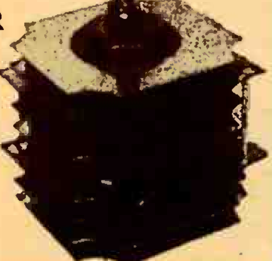
A—Relay (RBM) 110 V. 60 cy. AC operated DPST (New) .... $ .75
B—Relay, 110 V. 6 cy. AC plunge type for door interlock (New) .... .85
C—Relay (Clare), 50 V. .0045 amp. 11,300 ohms with 2 micro-switches. (New) .... .75
D—Relay (Leach), type 1253-DEW, 24 V. DC 160 ohms DPST (New) .... .50
E—Relay, 6 meg. 5000 ohm DC resistance SPDT .85
F—Relay (Leach), type 1127-FR 110 V. 60 cy. DPST (New) .... .75



A—Filament Transformer, 110 V. 60 cy. pri.; Sec. 5 V. and 6 V. Center Tapped (cased) (New) .95
B—Transformer 110 V.-30 V. (New) Made by Esse for beam motor 4.95
C—Power transformer completely cased. 110 V. 60 cy. pri.; Sec. has 600 V. CT 105 Ma. Also 5 V. at 3 amp. plus 2.5 V. at 5 amp. and a 6.3 winding. (New) 1.85
D—Transformer for Selsyn beam indicators 1.95

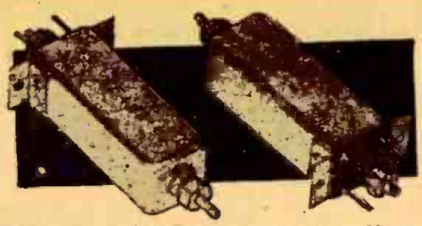
ARR—1 Receiver, 334-358 Mc. Ideal for mobile receiver or concerter on 2 or 6 meter band. Contains 4-954 type acorn tubes, connectors, etc., $4.95.

RECTOX RECTIFIER

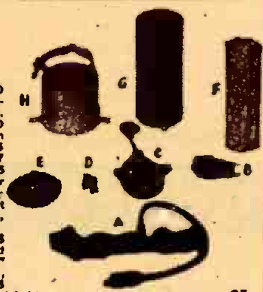


32 V. AC Input, 24 V. DC output, 5 amps. (New)

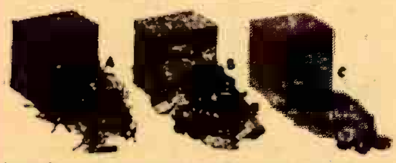
$3.75



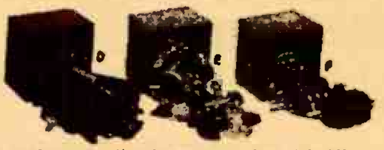
IF Transformer, 19.2 Mc. .... .20 ea.



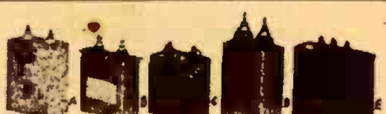
A—Throat Mikes 7 for $1.00
B—Jeweled Pilot Assembly, Candelabra, screw base for 110 V. lamp. Mounts in 1" hole. (New) .25
C—Telegraph Key J-37 (New) ..... .35
D — Phone Jacks for PL-55 Plug .07½
E—National Velvet Vernier dial drive, 6-2 reduction ratio .... .75
F — Ceramic grooved coil forms, 5" length, 2" diameter, 30 grooves .. .15
G—Millin 807 tube shields .... .25
H—813 tube shields .... .35



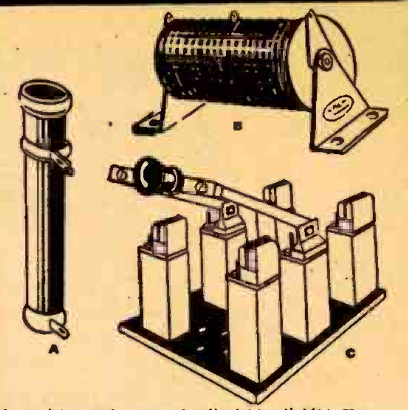
A—Resistor kit composed of 150 or more assorted wattages. Containing various resistors of up to 10 megohms. Many with gold bands. An honest-to-goodness bargain .... Box 2.65
B—Condenser Kit. Contains assortment of 25 various condensers including 2-2Mfd. 600 V. filters, 1-1000 Mfd. 15 V. filter 4-1 Mfd. 400 V. paper by-pass, 3-3 gang midget trimmers, etc. 2.65
C—Hardware Kit containing about 5 lbs. of radio hardware, including nuts, bolts, washers, shafts, gears, grommets, lugs, screws, spacers. It is a gold-mine of invaluable parts 1.95



D—Resistor mounting lugs and terminal strip kit. Assorted sizes and shapes. Many, Many, Many 1.00
E—Tube Socket Kit. 25 or more assorted sockets having various usable sizes 1.50
F—Switch Kit containing assortment of 10 rotary and toggle switches 1.25

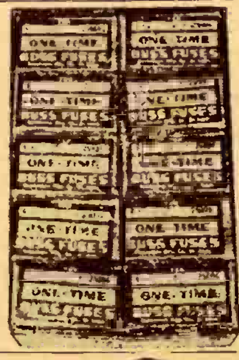


A—Condenser (Solar) 10 Mfd. 1000 V. (New).. 2.00
B—Condenser (GE Pyranol) 8 Mfd. 1000 V. DC. (New) 1.75
C—Condenser (Chi. Ind. Cond. Corp.) 4 Mfd. 2000 V. (New) 2.50
D—Condenser (Cornell-Dubilier) 1 Mfd. 4000 V. (New) 3.00
E—Condenser (Chi. Ind. Cond. Corp.) Dual 8.5 Mfd. 1000 V. (New) 3.50

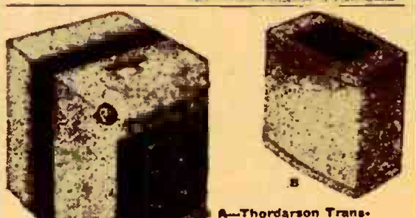


A—Resistor. Wire wound adjustable divider resistor. 100 watt, 5,000 ohms (New) ...... .40 ea.
B—SL-Selenium Rectifier. 110 V. AC input; 110 V. DC output. .75 amp. rating $1.35
C—Antenna Switches. Double pole, double throw. Size 8" x 4" x 2" (New) 2.00
Same as above except SPST, size 8" x 4" x 2" (New) 1.00

FUSES



Cartridge type, packed 10 to a box.
6 Amp. 250 V. Non-renewable
3 Amp. 250 V. non-renewable
Box .40
30 Amp. 250 V. Renewable
3 Amp. 250 V. Renewable
Box .75
Buss fuses type 3AG, 10 amp. glass fuses, .02 ea.
per hundred $1.35



A—Thordarson Transformer type T-4592D Pri. 220 V. 60 cy.; Sec. 530 V. Center Tapped 4.95
B—Filament Transformer GE 7467173 110 V. 60 cy.. Sec. 6.3 V. at 13 amps and 6.3 V. at 1.2 amp. 2.95

WIRE

A—3 stranded conductors inside of a shield, about 30" long .... each .10
B—2 conductors of stranded wire, each strand about 8 gauge rubber covered, twisted & cloth braid outer-cover .... .07 ft.
C—Heavy duty rubber covered, 2 stranded conductors flexible. Ideal for 110 V. AC power leads to heavy electrical machinery .... .10 ft.
D—3 conductors of 20 enameled cotton covered wire, color coded, completely shielded, moisture & fungus proof. Ideal for intercom work. 50 ft. & 250 ft. rolls .... .03 ft.
E—4 strands of braided wire, each rubber covered and color coded, one strand being shielded, cotton and cambric outer wrapping.... .05 ft.
F—Same as above, except the complete cable shielded .... .07½ ft.
Minimum wire order 100 feet. May be assortment of above wire.

F—Condenser, .25 Mfd. 400 V. (New) .... .05
G—Condenser, .125 Mfd. 400 V. (metal cased) dual condenser (New) .... .05
H—Condenser, 1.75 Mfd. 50 V. (New) .... .05
I—Condenser, .5 Mfd. 600 V. (metal cased) (New) .05
J—Condenser (GE Pyranol), 2 Mfd. 600 V. (New) .50

K—Condenser, 2 Mfd. 600 V. (Aerovox) (New) .35
L—Condenser, 4 Mfd. 600 V. DC (GE Pyranol) (New) .... .50
M—Condenser, 4 Mfd. 300 V. (New) .... .35
N—Condenser, 30 Mfd. 330 V. AC (GE Pyranol) (New) 3.00

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Indianapolis 4, Ind.

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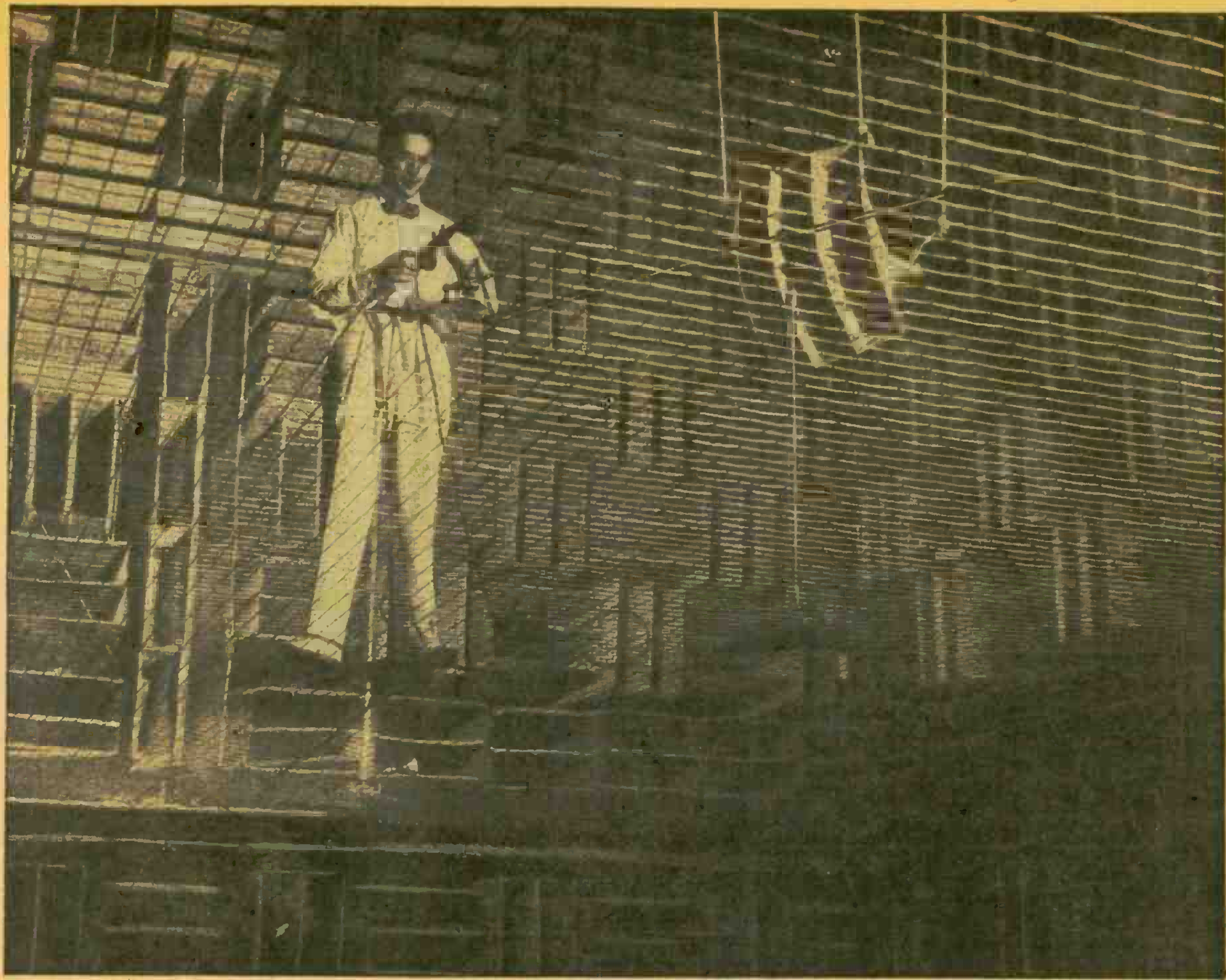
CASH REQUIRED WITH ALL ORDERS
Orders Shipped F.O.B. Collect



A telephone listens to a loud speaker in the new "free field" acoustic test room at Bell Telephone Laboratories. The sound-transparent "floor" is built of steel cables.

Test-tube for Sound

This giant "test-tube" is actually an echoless sound room at Bell Telephone Laboratories. Here engineers seek new facts about sound which will help them make telephone service still better and more dependable.

Bell scientists know a great deal about what happens to sound in electrical systems. This new room will give them a powerful tool to find out more about what happens to sound in the air.

In an ordinary living room, most of the sound addressed to you comes by way of reflections. At 10 feet less than 10% reaches you directly.

Sound that *bounces* at you from walls, ceilings, furniture, and your body is all right for hearing—but it poses questions for scientists who would study it uncontaminated by reflections.

The Bell Laboratories "test-tube" gives telephone people the chance to produce pure sound and analyze it reliably with respect to intensity, pitch, and direction. The entire room is lined with glass wool, contained in wire-mesh cases, wedge-shaped to give maximum absorbing area. Sound bounces along the sloping surfaces, sifts into the soft glass wool, and is gradually stifled.

This is one more example of Bell Laboratories' constant work to learn more about everything which can extend and improve telephone service.

BELL TELEPHONE LABORATORIES

Exploring and inventing, devising and perfecting for continued improvements and economies in telephone service.

Should Servicemen Be Licensed?

Service-Licensing, or Self-Policing — Which Will It Be?

By Hugo Gernsback

RADIO-CRAFT has pointed out for many years that sooner or later, either national, state, or local licensing of radio servicemen would have to be viewed realistically by servicemen.

In past years much pressure has been put on by various authorities to license servicemen for a variety of reasons. Chief among these reasons are:

1. Danger to radio owners (such as electric shocks) from errors of diagnosis and repair of radio sets.
2. Fire hazard due to faulty repairing.
3. Abuses of many kinds by servicemen in their repair work.

These are the main and perhaps overall reasons. There are others.*

Last October the New York City Administration through its City Councilman Stanley M. Isaacs called for mandatory licensing of all radio technicians and radio repairmen in New York City. The Board of Directors of the *Radio Manufacturers Association* immediately adopted a unanimous resolution opposing this proposed licensing of radio servicemen.

The *Radio Manufacturers* made it clear that it does not deny that abuses exist in the radio servicing and repair field, abuses which the licensing regulations might correct. These, according to the Association, involve "exorbitant" fees and poor workmanship. The RMA points out that only a small minority of the radio servicing trade are guilty of such abuses. But the industry feels, according to spokesmen, that "bureaucratic regulation" is not the final answer to the subject. The resolution also stressed that there was no intention of criticising the New York Municipal Administration in any way. It is rather the implications of general licensing that are feared.

The Association rightly feels that if New York sets a precedent in licensing radio servicemen, it is almost certain that other cities throughout the country will soon enact similar measures. The Association is convinced that it would be far better that the servicing industry police itself to do away with present abuses. The Board also pointed out that such initial steps for self-policing are now being taken. As an example, they call attention to a forthcoming experimental clinic for radio repairmen in Philadelphia.

RADIO-CRAFT has pointed out many times in the past that the servicemen themselves can do a great deal to ward off unfavorable legislation and licensing if they would themselves form either a national servicing league, or as this seems to be difficult to achieve at present, that servicemen in all cities should certainly have local Associations to do the policing.

It is true that a few such associations exist in some cities, but there are far too few of them and they cannot be said to exist on a nation-wide scale. It would seem that unless such a nation-wide movement soon gets under way, either stringent federal or state legislation will result. This is certain to prove a great handicap to the servicing industry. Usually when such controls are applied, the individual serviceman particularly, loses much of his freedom. Other new factors will also be injected which in many ways are bound to handicap him. We all know that most of the servicing abuses are perpetrated by a small minority of irresponsible individuals, but it is precisely this minority who give the servicing industry its bad name. It is unfortunate that human nature is such that satisfactory work is seldom praised to the skies, but let one serious abuse come along and instantly the entire servicing industry is blamed.

The country would be best served at the present time by the establishment of local associations. These would issue to each member a shield for display in his place of business, stating that he is a member of the association and licensed by it under a serial number. The local association would make it its business to ascertain that all representative servicemen are properly enrolled. Then by running educational advertisements in the local newspapers the public would quickly learn to patronize only "association men".

It would then be a simple matter to trace those servicemen who abuse the trade, and sufficient pressure could be brought by the association on such non-members to make it almost impossible for the minority, wild-cat servicemen to make a living.

None of this is new. It has been proposed in various ways before, but the unfortunate part is that so far little or nothing has been done about it. There are already certain areas in this country where servicemen are even now subject to restrictive measures, as for instance Madison, Wisconsin, which has an ordinance for "licensing radio and electronic servicemen". Special legislation on the subject has been drafted in Baltimore, Los Angeles, Orlando, Fla., although as far as has been ascertained none has been enacted into law.

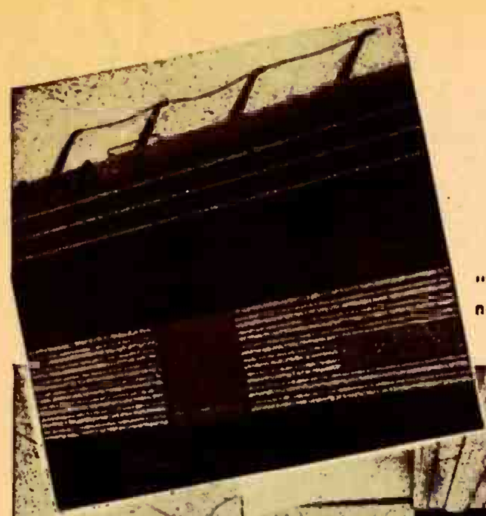
It has often been said, and rightly so, that many people feel that licensing is a threat to the freedom of enterprise and freedom for the individual service man. Indeed, many believe this to be so. But we might also point out that numerous other services are licensed such as plumbers, electricians, and scores of others. They do not appear to be very much down-trodden.

It is quite true that licensing always imposes certain restrictions on the licensee, yet in many trades licenses are distinctly necessary and often essential to the welfare of the community.

RADIO-CRAFT does, however, believe that at the present

(Continued on page 78)

*See also article "Licensing Problems and the Serviceman" by H. W. Schendel, November, 1946, issue RADIO-CRAFT.



RADIO-ELECTRONICS

"Train of the Future" dining car. Speaker is near stairs to "Astra-Dome." Left—the antenna on top of observation car.

RADIO AND RAILROADS are at last getting together. Proof is in the design of "The Train of the Future" revolutionary new General Motors exhibit now touring the country on the principal railroads.

The train has loudspeakers in all cars and in the *Astra-Domes*, a special feature of the new trains. Astra-Domes are "upstairs" sections of the car, raised above the standard roof and enclosed in heavy shatterproof glass. The loudspeakers are connected with radio, recording, and PA apparatus for reproduction of radio programs, wire recordings, or direct voice.

"The Train of the Future" has a complete intercar telephone system, linking all cars and the locomotive. At present it is proposed that use of this system be limited to the crew, but there is no reason why its service should not be extended, if it is found expedient, to permit passengers to call the diner or the sleeping-car porter, for instance.

A second telephone circuit permits connection by means of plug-in lines while the train is standing at a station. When the train is in motion, passengers may still talk to their friends in any part of the world provided with regular line telephones, with automobiles or other trains equipped with mobile radio,

(Continued on page 79)

A MODEL "RADIO TUBE" made of rubber, with "electrons" in the form of bronze balls tests electronic designs in a single day that would require 3 months otherwise, Westinghouse revealed last month. The new model, it is stated, is helping to develop new tubes for television and high-frequency radio.

The experimental model "vacuum tube" in use. The model looks something like a game table.

It consists of a very thin sheet of rubber stretched across a frame about the size of a small dining room table. BB-shot-sized bronze balls simulate electrons; hills and valleys in the rubber simulate electrical voltage; and wooden blocks act as tube elements.

Proper arrangement of the hills and valleys direct a ball and control its velocity. Measuring the time it takes for the ball to roll from one part of the table to another, enables engineers to calculate the speed of actual electrons in a tube. This determines the electrical voltage needed for that part of the tube.

To find the proper spacing and optimum shape of tube elements wooden reproductions of various shapes and sizes of cathodes, grids or anodes are used. They help research men to find the arrangement that gives the best focusing of electrons.

The model, which can produce approximate replicas of most kinds of tubes, permits checking the internal design of a tube in one day compared to three months by the old mathematical trial and error method.

MAX PLANCK, world-f ous physicist and originator of the quantum theory, died October 3, at the age of 89.

Planck is regarded as one of the great scientists of the present generation and one of the scientific immortals of all time. His quantum theory has contributed to the advance of science in the same measure as Newton's discovery of the laws of gravitation or Copernicus' theory of the solar system.

He made his fundamental discovery that radiant energy is not continuous, but comes in small bundles, whose energy content varies with the frequency of the radiation, in 1900. In his own words "Radiant heat is not a continuous flow and indefinitely divisible. . . . It must be defined as a discontinuous mass, made up of units all of which are similar to one another."

These quanta, which he referred to as "the pennies of the atomic world," are so small as to be unobservable in studies of large-scale phenomena, but are of great importance in the study of atomic phenomena, and especially of the physics of the atomic nucleus.

FM STATIONS are losing money, is the concensus of a survey reported last month by the FM Association. Profits were reported by only 8% and 6% said they were breaking even, while 86% were operating at a loss.

Prospects for the future appear to be good, with 25% reporting increasing business and practically all the rest at least holding their own.

MONTHLY REVIEW

AN "ATOMIC PILE" in model form has been built by General Electric engineers to demonstrate the principles of atomic energy production, reports from that company stated last month.

The model is not full scale, and is quite schematic. At the left is the atomic "pile" where matter is transformed into energy by the splitting of uranium or another fissionable element. In his left hand Dr. Kenneth H. Kingdon, one of the first physicists to isolate Uranium 235 from the natural element, holds a rod of this "fuel" material, while the striped rods projecting horizontally represent the control rods which would prevent the process from running away. A heat-exchanging fluid would be pumped through the pile, thence to the heat exchanger on the right, where water would be turned to steam. This would then be used to drive turbines in the customary way.

The heat exchanger step is needed because anything entering the pile would become dangerously radioactive, and thus steam could not be brought directly from it.

MOST POWERFUL RADIO broadcast station in the world will shortly be erected at Geneva, Switzerland, by the United Nations, it was reported on good authority to RADIO-CRAFT last month. The power will be 1,000 kilowatts.

This station will operate on 250 kc (1200 meters) and has been designed to blanket all of Europe. Located strategically in Switzerland, it is certain to reach practically every radio receiver on that continent. Europe has a very large number of crystal receivers. These normally cannot receive signals farther than from 25 to 50 miles. It is expected that every crystal set in Europe will be able to receive the new U. N. broadcast station signals.

DIAMONDS are more useful as detectors of certain types of atomic radiation than the standard Geiger-Muller counter, the National Bureau of Standards revealed last month.

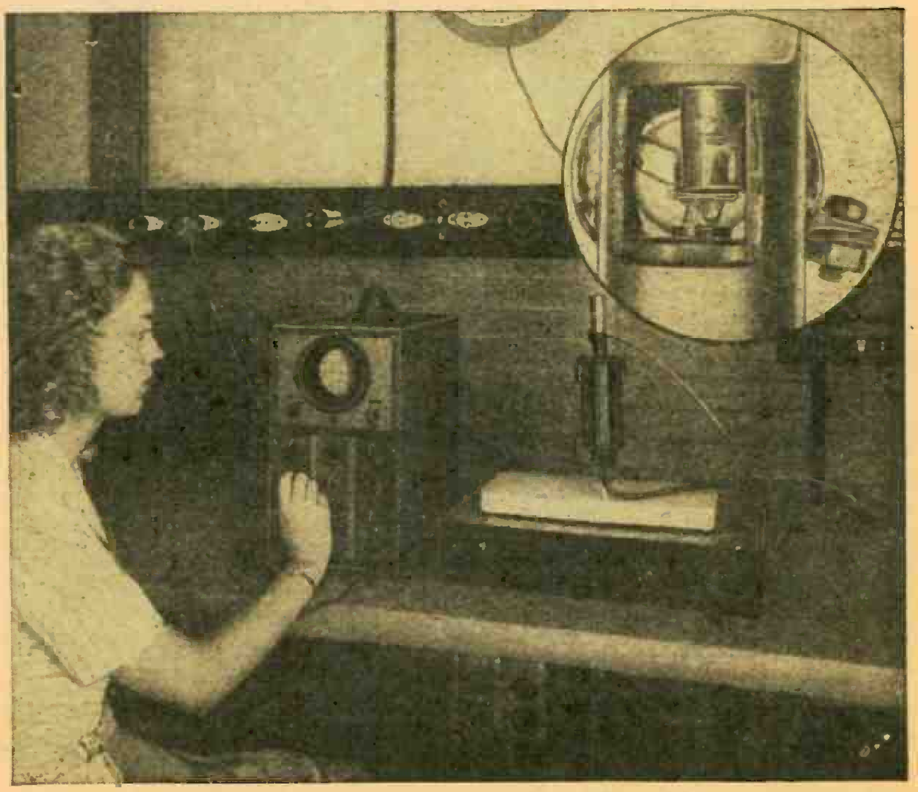
To use a diamond as a counter, it is clamped between two small brass electrodes maintained at a difference in potential of about 1000 volts. When a source of gamma radiation is brought within range of the diamond, pulses of current occur across the electrodes, which after amplification may be detected and counted on any suitable indicating device, such as an oscilloscope, a current meter, a set of headphones, or a loudspeaker. In apparatus assembled at the Bureau, primary amplification is effected with minimum loss of original intensity through the use of a triode very close to the diamond in

(*Continued on page 89*)

HEARING AIDS can be made universally applicable, instead of being individually prescribed, Dr. S. Smith Stevens of the Harvard Psycho-Acoustic Laboratories affirmed last month. A tentative set of specifications for the universal hearing aid includes:

1. Even frequency response, with no sharp peaks or valleys. Lower cut-off should be between 200 and 400 cycles and upper cut-off between 3,000 and 4,000 cycles.
2. Steadily rising characteristic of 3-4 decibels per octave throughout the range.
3. Limit to maximum acoustic output.
4. Sufficient sensitivity and freedom from internal noise to render intelligible to a normal ear speech delivered to the instrument at a level not more than 10 db above the threshold of intelligibility of the same ear.
5. Acoustic gain sufficient for the user. Individuals vary so widely that possibly 3 models with different amounts of gain may have to be designed.
6. Effective volume control with range of at least 40 db.
7. Stability and freedom from squeals and oscillation at maximum gain setting.

MAJOR GENERAL INGLES, wartime head of the Signal Corps, was elected president of RCA Communications, Inc., at a directors' meeting held early this fall. General Ingles is also a director of RCA Communications and of the Radio Corporation of America. Major General George L. Van Deusen, who during the war was chief of the Engineering and Technical Service of the Office of the Chief Signal Officer at Washington, D. C., succeeds General Ingles as President of RCA Institutes.



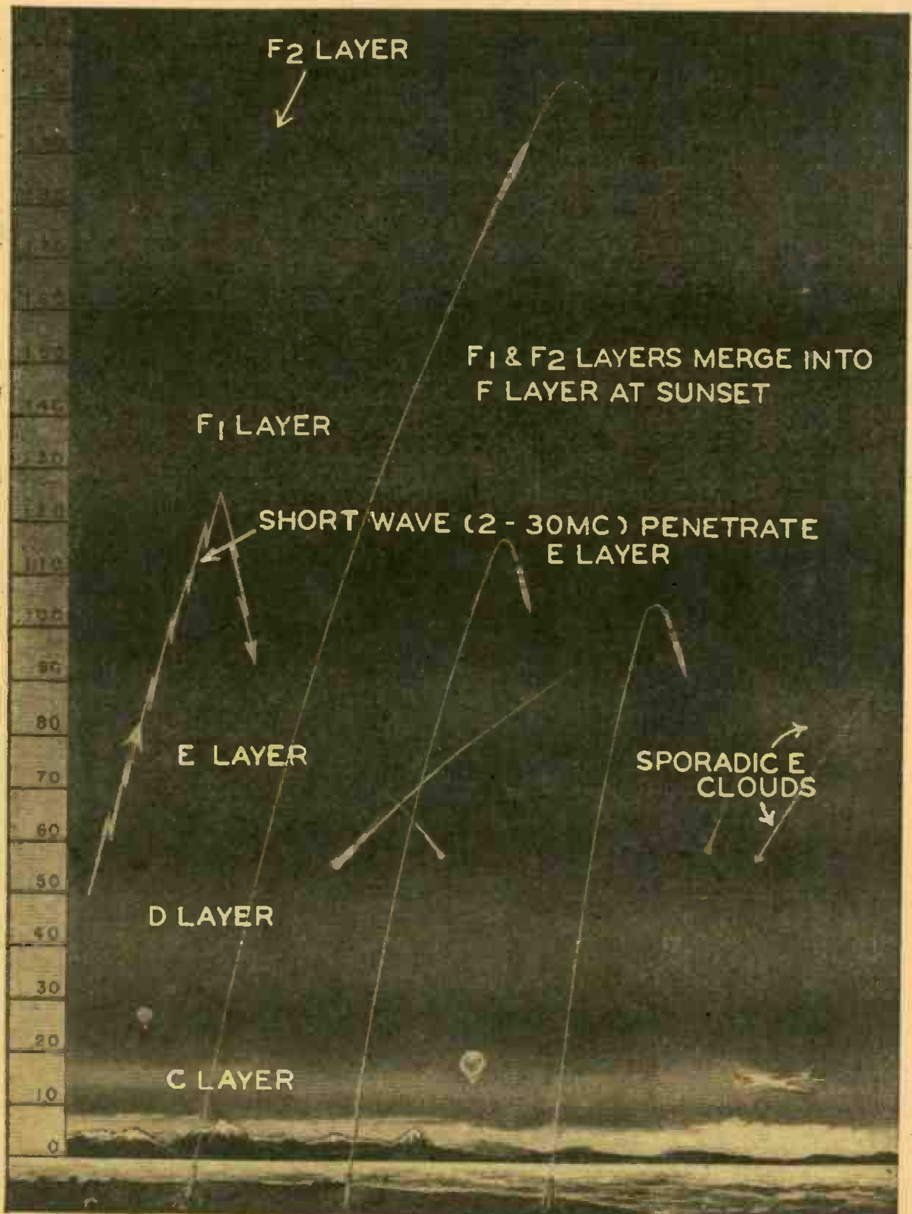
The diamond radiation counter in use. Enlarged insert shows diamond between its electrodes.

How to Use
RADIO PROPAGATION PREDICTIONS

By FRED SHUNAMAN

OLD-TIMERS remember when the best radio wave was the longest one. The long wave was *reliable.* It maintained the same strength day and night at all times of the year, and the strength dropped off steadily with increasing distance from the transmitter. Short waves—roughly those under 1000 meters—were "unreliable." They varied in strength with the time of day and the season and showed other "unpredictable" vagaries.

The reliability of the long waves was obtained at the cost of high power. With the coming of broadcasting, it was found that a station of a few hundred watts could be heard (when conditions were good, such as on a cold winter night) farther than a long-wave station of many kilowatts. Then the amateurs started to work at even higher frequencies, first on 150 meters (2 mc), then 80 (3.5 mc), later 40 and 20 (7 and 14 mc). At each increase of frequency they were able to transmit farther with less power.



The various layers of the atmosphere. Though all affect radio transmission at certain frequencies, F-layer reflections are most important for long-distance communication. Scale at left in miles.

But other and more disquieting discoveries were made. A station which pounded in with ear-splitting volume one night might simply not be there at all the next. Amateurs found they were not able to communicate with old friends in the next state, but were being received solid several thousand miles away. Thus was "skip distance" discovered. One point was clear: if some way could be found to figure out these high frequencies, a new era in low-power, long-distance communication would open up. Scientists, amateurs, and communications companies set out to learn more about these mysterious waves.

First, the scientists Kenelly and Heaviside suggested that the upper parts of the atmosphere were *ionized*—that the ultraviolet rays of the sun break up the atoms in these upper regions where the air is so thin as to resemble a poorly exhausted vacuum tube—into negative electrons and positive

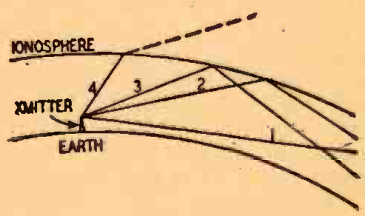


Fig. 1—Long waves follow path 1, shorter ones, 2 or 3, and very short waves, path 4.

ions. These upper regions of the atmosphere, they said, were filled with a partly conductive material, something like the interior of a gas-filled vacuum tube. This ionized layer reflected radio waves of high frequencies back to earth, but lower-frequency waves were merely absorbed by it. The higher the frequency, the farther the waves penetrated the layer; thus the greater the distance at which the reflected wave reached the earth (Fig. 1). Above a certain *critical frequency*, the waves keep right on through the layer and are lost to earth entirely.

In 1923 the English scientist Appleton proved the existence of the Kenelly-Heaviside layer by beaming radio waves straight up and measuring the time the reflected waves took to return. He found that the higher-frequency waves took longer to come back, proving that higher frequencies penetrate farther into the layer.

Height of the layer as measured by this earliest radar was about 70 miles. But as frequencies were raised toward 3 mc, the echoes suddenly disappeared—to return from a distance of more than 150 miles. Obviously there were *two* reflecting layers. Above 8 mc a *double echo* was noted, as if the higher layer were split in two.

The lower layer is now called the E-layer, and the higher one—or two—the F1- and F2-layers. The F2-layer is the most important one to long-distance, high-frequency communication. The E-layer is more important in daylight and at frequencies below 4 mc, though at times its effects may be felt up to 20 mc. Below these layers are the C- and D-layers, whose effects on radio waves have been little studied, but which are beginning to be considered important at certain frequencies.

The Bureau of Standards at Washington has been one of the leading explorers of the ionosphere, and began in the late '30's to issue rough predictions of the probable ranges at various frequencies. The predictions were very approximate, and covered only four periods—summer and winter noon and midnight.

The demand for reliable radio communication during World War II made much more detailed and accurate knowledge of ionosphere conditions necessary. Numerous stations were established at widely scattered points, and continuous records were made and transmitted to Washington for interpretation and correlation with those from other stations. These stations now number 58, and gather ionospheric data from all parts of the earth. The Central Radio Propagation Laboratory (CRPL) of the Bureau of Standards uses this information to issue monthly predictions of usable radio frequencies. These are put out in the form of monthly booklets, 3 months in advance. They contain maps and charts showing the maximum usable frequency for communication between any 2 points on the earth's surface at any time of day. The booklets are entitled *Basic Radio Propagation Predictions* and are used in connection with another publication, *Instructions for the Use of Basic Radio Propagation Predictions* (Bureau of Standards Circular 465), which contains further maps, charts, nomographs, and instructions for use with the *Predictions*.

The *Predictions* consist of a series of charts of the ionosphere. Fig. 2 is one of them. The maps show the *maximum usable frequencies* (muf) for points at 4000 kilometers away from any point on the earth at any given time of day. Points on the same latitude do not have the same ionospheric conditions at the same time of day throughout the world. Therefore it is necessary to have 3 sets of charts. The western (W) chart includes South America, all the United States but the northwestern tip, most of Canada, the Atlantic Ocean and a bit of Africa. The eastern (E) chart is applicable to Asia and Australia, and the intermediate (I) to Europe, Africa, northwest Canada, Alaska, and a belt of the Pacific.

Predictions not easy to apply

The *Predictions* are not particularly easy to use. It is often necessary to use 2 charts in conjunction, checking them against a third when the E-layer may affect results. A further difficulty is that radio waves follow great-circle paths, while the charts are square Mercator projections. This difficulty is solved with a great-circle chart in the *Instructions*. To use the *Predictions*, put a piece of tracing paper over the map of the world in the *Instructions* (Fig. 3). Mark the points between which communication is to be established. Also trace the equator line on the tracing paper. Then place the tracing paper on the great-circle chart (Fig. 4) with the equator lines coinciding, and slide it back and forth until one of the curved lines on this chart connects the 2 points. Draw the great-circle path between them along that line. Put the tracing paper on the correct ionosphere chart with the local station on the vertical line marking the local time of desired communication.

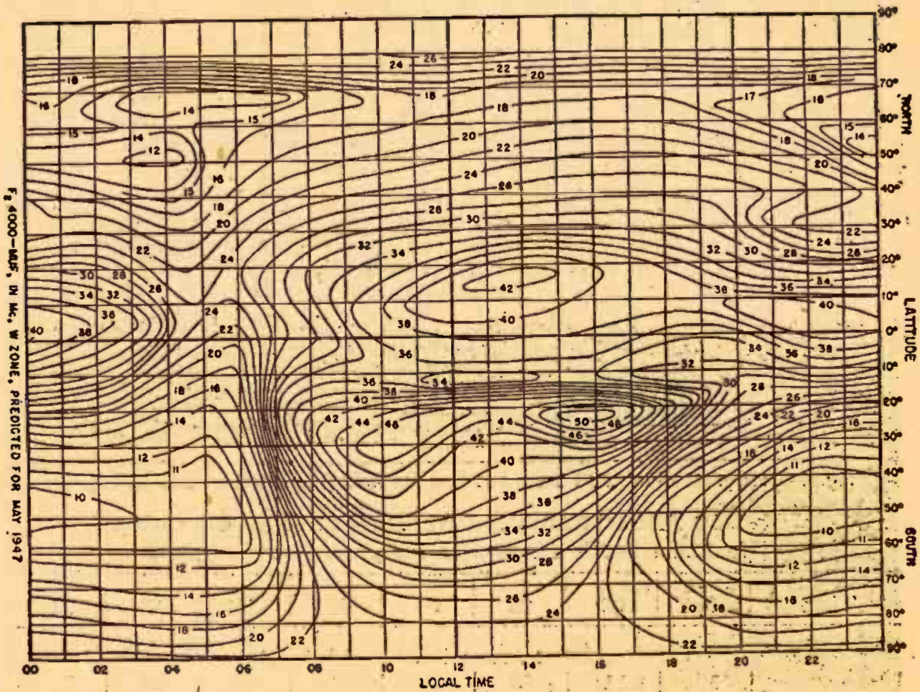


Fig. 2—One of the ionosphere charts. There are six of these F2 and one E-layer chart.

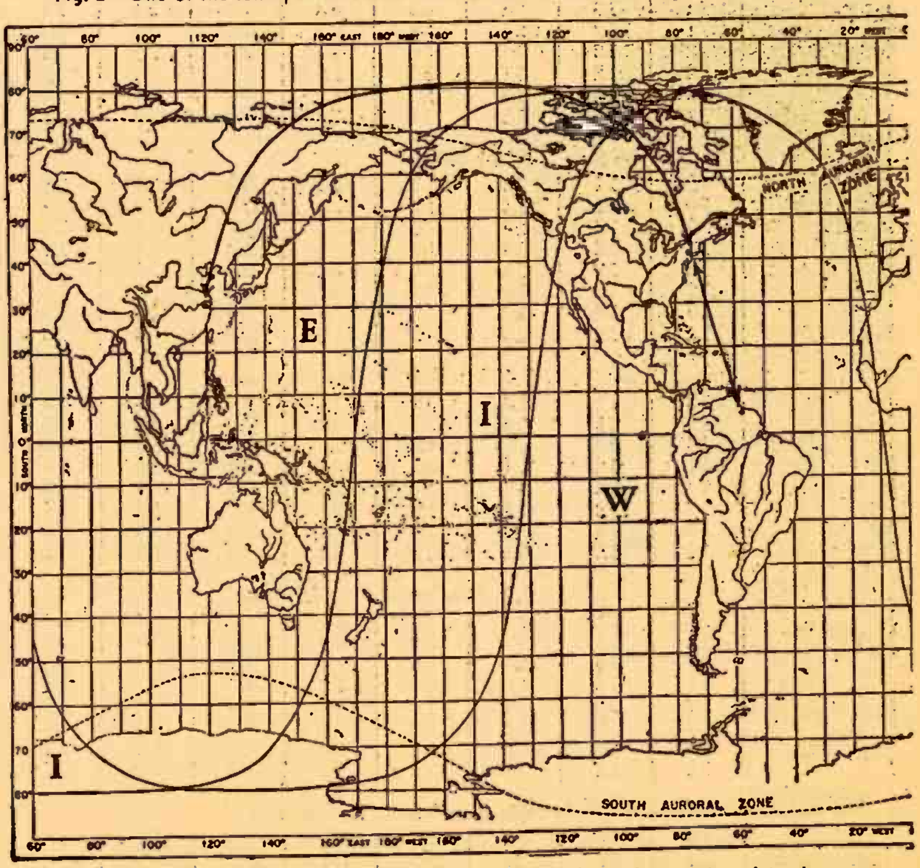


Fig. 3—Part of the world map, showing the two great-circle paths mentioned in the text.

Finding the correct frequency now depends on whether the distance is more or less than 4000 km (2500 miles).

If the distance is exactly 4000 miles, the problem may be relatively simple. The mid-point of the great-circle path is located and the maximum usable frequency (muf) read direct from the F2 4000 chart for the given zone. For example, suppose contact is to be made between New York and Georgetown, British Guiana, a distance of approximately 4000 km. The tracing paper is placed over the world map and the 2 points, as well as the equator, are marked on it. Then the paper is placed over the great-circle chart and moved back and forth till a great circle joins the 2 points. The path between the two is drawn, as well as the *mid-point* of that path.

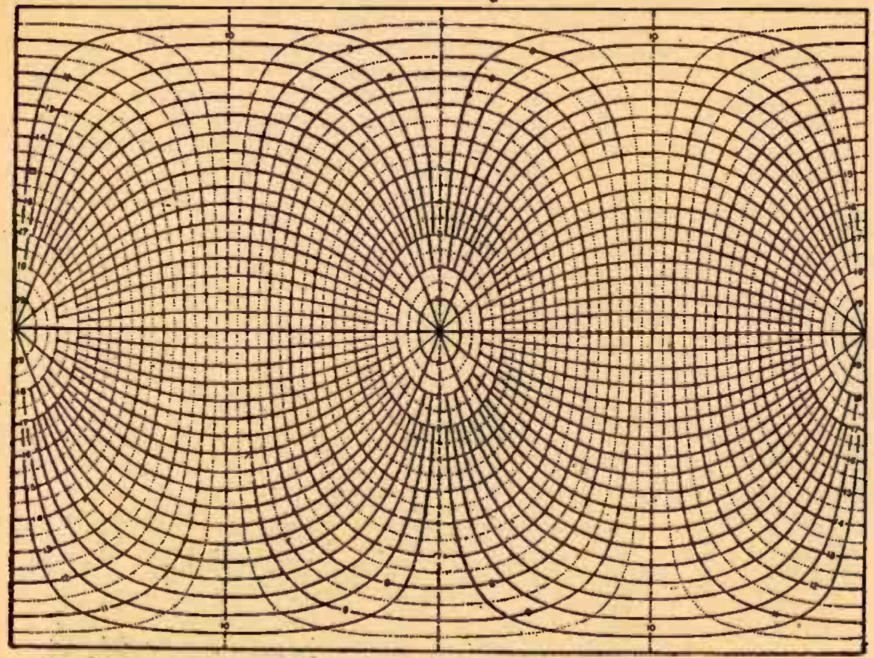


Fig. 4—This great circle chart is used to find the radio transmission paths on Fig. 3.

RADIO PROPAGATION CHART — DECEMBER 1947
(Maximum usable frequencies are given in megacycles)

Time	00	03	06	09	12	15	18	21
			2,500 miles		4,000 km			
N	12	11	13	20	35	34	20	13
NE	11	11	12	32	40	34	19	11
E	14	13	24	43	40	36	24	15
SE	11	12	24	34	35	29	18	13
S	12	12	14	36	34	30	24	16
SW	12	12	11	32	35	32	25	16
W	15	14	13	22	41	40	36	24
NW	11	11	11	13	37	39	33	18
N								
			5,000 miles		8,000 km			
N	12	11	13	16	16	16	16	13
NE	10	11	12	32	32	10	10	9
E	9	13	24	48	38	24	18	12
SE	11	12	24	34	35	29	18	13
S	12	12	14	36	34	38	24	16
SW	12	12	11	32	35	32	25	16
W	15	14	12	8	38	40	36	24
NW	11	10	10	9	10	26	33	18
			7,500 miles		12,000 km			
N	12	11	13	12	12	12	12	13
NE	11	11	12	27	16	10	11	11
E	14	13	24	29	30	28	24	15
SE	11	12	24	33	32	29	18	13
S	12	12	14	24	26	26	24	16
SW	12	12	11	25	28	32	25	16
W	15	14	13	22	26	30	26	24
NW	11	11	11	10	11	16	33	18
			10,000 miles		16,000 km			
N	12	11	13	20	33	20	20	13
NE	11	11	12	31	28	26	19	1
E	14	13	24	35	30	32	27	15
SE	11	12	18	19	22	22	18	13
S	12	12	14	16	16	16	16	16
SW	12	12	11	18	18	19	19	16
W	15	14	13	22	26	30	31	24
NW	11	11	11	13	22	18	33	18
			12,500 miles		20,000 km			
M.u.f.	14	14	24	30	30	26	26	18
Direction	E	W	E	NE	NE	NW	NW	NW

The tracing paper is then placed over the F2, 4000 W map with the equator lines again coinciding and the New York point on the hour meridian of the time desired. The muf of the *mid-point* is read. For example, in December 1947, the muf of the mid-point of the great-circle path between New York and Georgetown is 21 mc for 6 am, 34 mc for 12 noon, and 21 mc for 6 p.m.

Since unpredictable conditions may cause the predictions to be in error, a frequency 15% *lower* than the muf is taken as the *optimum working frequency* (owf). Thus all muf's are multiplied by 0.85 for actual working frequency.

If the distance is greater than 4000 km, 2 points 2000 km from each end of the path are taken instead of the mid-point. The tracing paper is placed over the map as before and both points, as well as the equator, marked. The meridian of Greenwich may be drawn also, as a time reference. It is usually easier to use it for great distances than the local time of either of the 2 stations at the ends of the path. The great-circle chart is again used to find the actual radio path between the 2 points. Instead of marking the mid-point of the path, *control points* 2000 km from the ends of the path are marked. (Experience has shown that muf's at great distances are little different than at 4000 km.) The maximum usable frequency for each of these points is found (on the appropriate chart) and the lower of the two taken as the muf for the entire path.

For example, communication between New York and Shanghai is desired. Drawing the path and control points, the muf's for the New York control point are found to be 28, 12, and 12 mc for 0600, 1200, and 1800 GMT, respectively. At the Shanghai end, using the F2 4000 E chart (not shown) all 3 muf's are found to be 12 mc. The muf for the whole distance is then 12 mc for the given times, and the owf 10.2 mc.

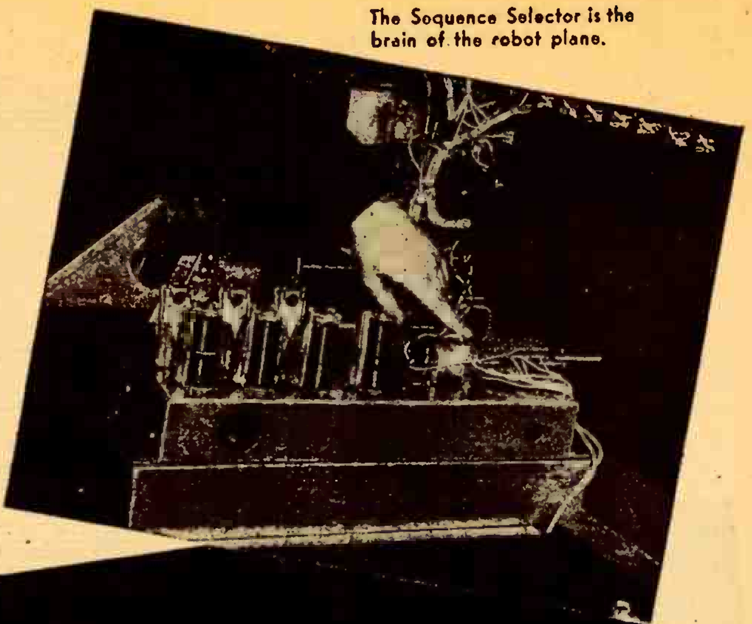
For distances less than 4000 km a little more work must be done. The muf is first found exactly as for the 4000 km. Then the muf of the mid-point is found on the F2 0 chart, which shows the critical frequencies for waves projected directly up from the sending station. Since the distance is between 0 and 4000 km, it might be expected that its muf would be between these two. And so it is, but in a way that does not vary directly with distance. A nomograph is provided in the *Instructions* for distances less than 4000 km. A straightedge is placed between the muf at 0 and that at 4000 km, and the correct frequency is read where the straightedge intersects the line representing the dis-

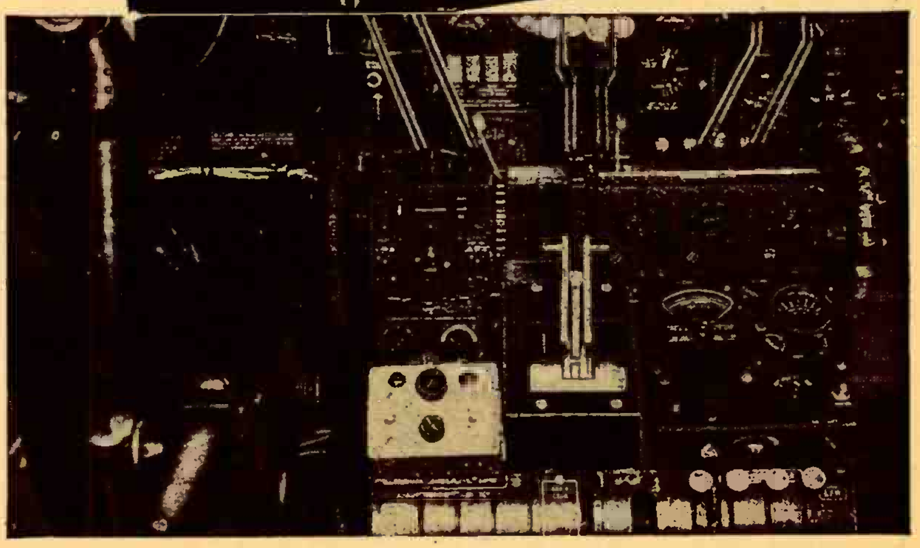
(Continued on page 86)

RADIO PILOTED OCEAN FLIGHT

By JAMES A. NILAND*

The Soquence Selector is the brain of the robot plane.





Center—The Automatic Flight Controller (rear) with Capt. Roman J. Whiting, navigator; Capt. Thomas J. Wells, test pilot; and Mr. James L. Anast, chief of the automatic flight branch at Clinton County Air Field. Bottom—Cockpit of the automatically-controlled C-54 plane.

A BIG four engined U. S. Air Force C-54 was rolled out of the hangar at Stephenville, Newfoundland. Fourteen men, called an emergency crew, climbed aboard. Once inside, the pilot, Colonel Jam s M. Gillespie, started the engines, taxied the plane to the runway and pointed it into take-off position. Stepping away from the controls, he pushed a button. The button was marked "Brise Norton."

Ten hours and fifteen minutes later the wh:els of the plane touched down on the landing strip at Brise Norton, England. *Not once during the 2,400-mile flight across the Atlantic did any member of the emergency crew touch the controls.* The trip was entirely a radio-controlled automatic flight. Eighteen days later the robot Skymaster returned in the same manner when Gillespie pushed a button marked "Stephenville."

As easy as push-button radio tuning, automat:c flight is now a reality. Accomplished by an electronic brain that stores information given to it before the flight begins, the brain reads the flight instruments, listens to the radio signals, measures distances and air speed and carries out for the pilot and his cr.w all the functions necessary to conduct a point-to-point flight from one airfield to another.

The original idea for automatic flight cannot be credited to any one individual, but to a group of Air Force officers. Chief amongst them were Colonel Ben S. Kelsey and Captain Harry S. Breedlove. It was not Colonel Kelsey's original intention to provide pilotless flight. He rather intended to provide methods for accomplishing many routine functions of monitoring the complete flight and making decisions concerning navigation and changes in flight plan.

As the project developed, it was found that more and more pilot duties could be made automatic, until finally they had eliminated almost entirely the need for a pilot.

The devices which control the All-Weather C-54 are not standard. Most of them have been specially constructed for their specific purpose and only one automatic unit of this type exists. It has been popularly misconstrued as a drone plane operated by a mother plane.

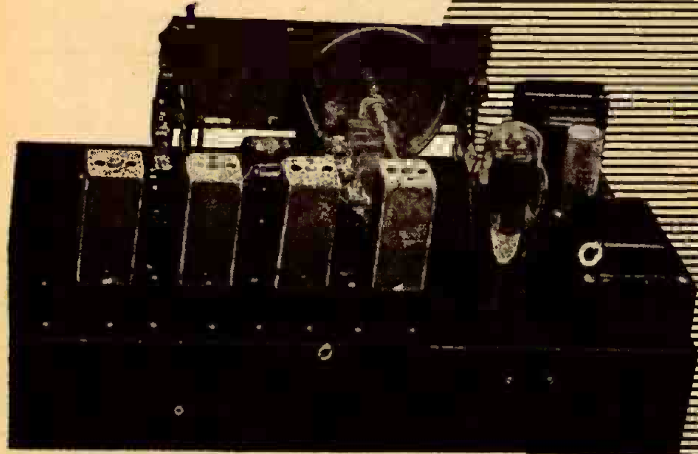
(*Continued on page* 74)

*Project Officer, New York Field Office United States Air Forces

FOR THE CONSTRUCTOR

FM Tuners

5 and 7 Tube



A receiver built on the same lines as Fig. 2, but with an r.f. stage and tube detector.

By EDWIN BOHR

AN FM tuner is often a more convenient and inexpensive solution to the problem of getting FM reception than a complete FM receiver. Most radiomen already have reasonably good AM receivers or amplifiers which can supply the audio amplification and often the power supply.

Before a tuner is added to existing equipment the extra current requirements and audio switching arrangements must be considered. Unless your present radio or amplifier power pack has a large reserve of power, it will be better to build a separate pack for the tuner. In some cases it may be found convenient to switch off the AM r.f. and i.f. stages while the FM tuner is on. This may release sufficient power for the tuner, especially if it is small.

The audio output usually can be fed into the receiver's phono input jack. Where there is no phono jack, one can be installed, the method varying according to the set. (See RADIO-CRAFT December, 1946.) If both phonograph and FM are to be used, a switch will have to be provided to change from one to the other. (The AM receiver must be in PHONO position for both FM and phonograph reproduction.)

A survey of the amplifier's tone quality and power-handling abilities also is wise. Unless the amplifier is to be rebuilt completely the circuit should be left as it is. Adding negative feedback and other circuit modifications may result in lower gain or upset the original design factors. Unless you are sure of what you are doing, replacement of the output transformer and speaker should be the only attempt at extending the range of the system. If the survey shows original components to be of good quality, they should be retained. Should the amplifier not be capable of delivering sufficient power at low distortion, there is not much hope that true FM quality can be obtained.

Construction of a frequency-modulation tuner and the design of its associated circuits is in many ways similar to a comparable high-frequency AM receiver. An FM receiver must contain a detector whose voltage is proportional to frequency changes of the carrier but relatively insensitive to amplitude variations. Also an FM circuit has limiter stages to remove amplitude variations before they reach the detector. The i.f. amplifiers of an FM receiver must be capable of accommodating a wide band. If they do not have a flat top, the gain

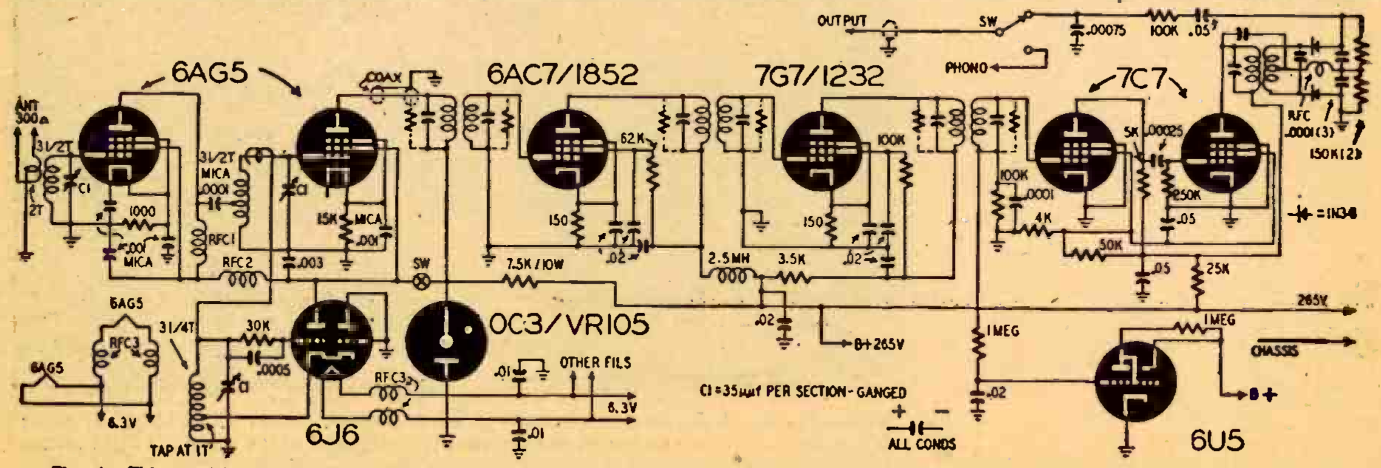


Fig. 1—This sensitive tuner may be used to receive signals at distances near or beyond the limits of the ordinary FM broadcast range.

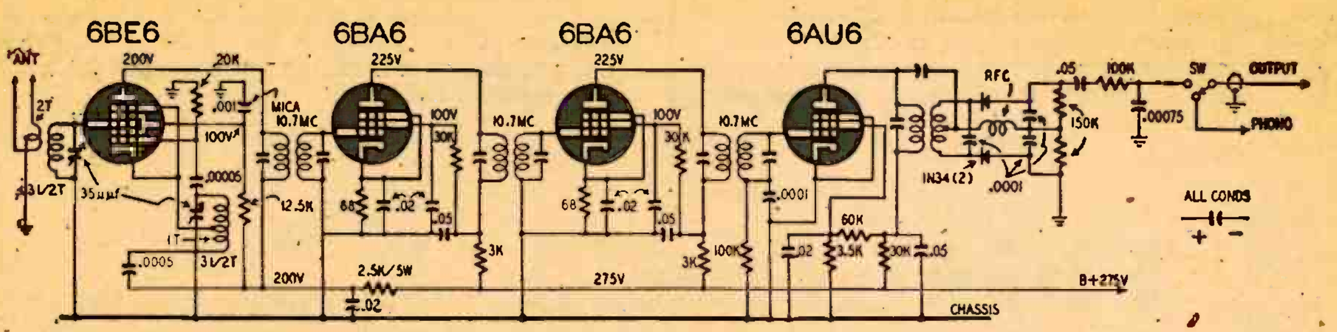


Fig. 2—This can be either a 5-tube tuner with a 6AL5 detector, or may be hooked up as a 4-tuber with the germanium crystal detector.

of the stages falls as the carrier frequency deviates from the frequency to which the i.f. is tuned. This produces amplitude modulation.

The circuit

Since the objective was to get best possible results, the set was a rather ambitious one, containing an r.f. stage, 2 i.f.'s, and 2 limiters. (See Fig. 1.) The constructor who requires a simpler tuner may construct a set along the lines of Fig. 2, which will cut his number of tubes to 4, though the circuits are those of a 5-tube tuner. Two i.f.'s are found advisable, and eliminating one of them to save another tube would not be a good idea unless the constructor lives close to the stations he expects to receive. One of the photographs shows a receiver built with the circuit of Fig. 2, with the addition of an r.f. stage and the use of a 6AL5 detector instead of the germanium crystals.

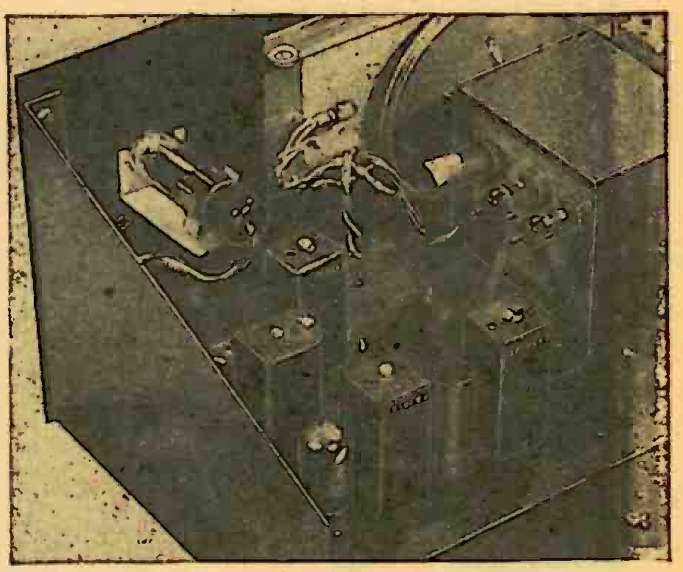
Since the features of the small tuner follow in general those of the larger one, the latter will be described in complete detail. Seven tubes are contained in the tuner circuit, Fig. 1. First are a 6AG5 r.f. amplifier, 6AG5 mixer, 6J6 oscillator. (These 3 tubes comprise the radio-frequency section and are mounted upon an upright chassis affixed directly to the tuning condenser to secure short grid leads.) A 6AC7 first i.f., 7G7 second i.f., and two 7C7's as limiters are employed in the intermediate stages.

The 6AC7 is still one of the highest-gain tubes in the tube manual, and its gain is put to good use in the first stage. Because of the 6AC7's high gain, it is necessary to pay careful attention to decoupling and other precautionary measures. Two of Sylvania's 1N34 germanium diodes are used in the discriminator. (A 1N35 balanced pair would of course be better.) Besides being convenient to wire in the circuit, these diodes have the added advantages of long life and no filament current requirements.. The r.f. assembly is mounted upon its separate chassis secured to the tuning condenser. It obtains its power from a plug which connects to a power socket on the chassis. The output from the 6AG5 mixer is fed through a short length of co-axial cable to a low-loss microphone connector also on the chassis located near the first i.f. transformer. With this type of construction the entire tuning unit may be removed without disturbing the remainder of the radio.

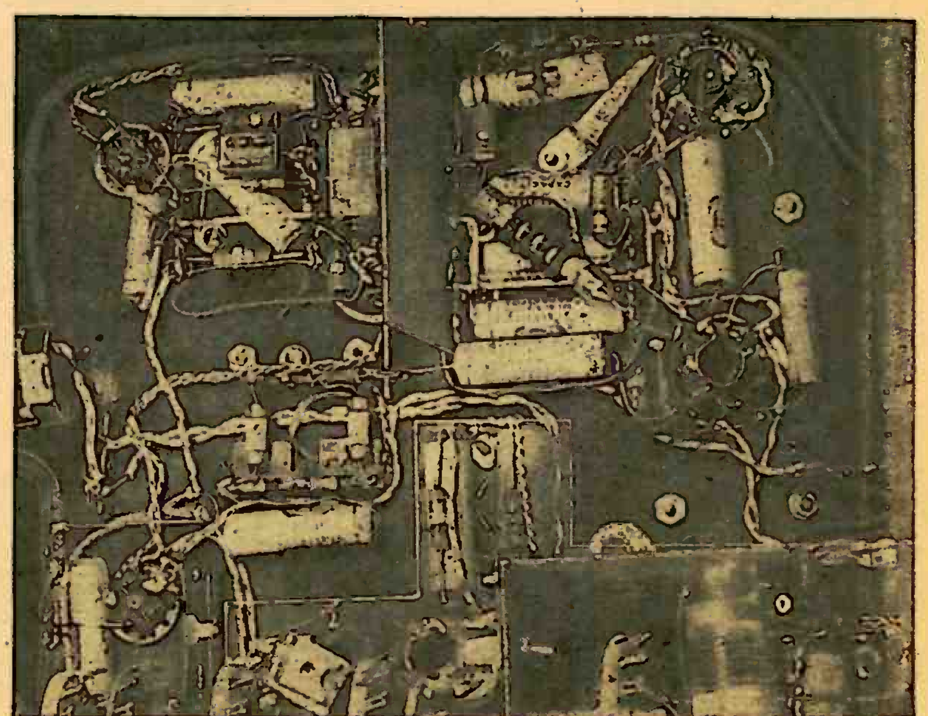
Cathode injection was originally used in the mixer stage, but this was rejected later because tuning of the mixer coil had too great an effect upon oscillator tuning. Inductive coupling was used also between the r.f. stage and mixer originally. However, the present system is much more successful. From the diagram it will be noted that one half of a 6J6 is used for the oscillator. The 6J6 was found necessary because a 6C4 would not oscillate strongly enough with the available 105 volts unless the cathode was tapped very far up the oscillator coil, which made for unstable operation. The 105 volts for the r.f. section preferably should be regulated with an OC3/VR-105 to prevent frequency shift with changes in line voltage. Unless it is regulated, detuning due to the turning on of an electric heater or similar appliance will cause the signal to be severely distorted, necessitating retuning to the station.

The r.f. coils are ½ inch in diameter

(Continued on page 81)

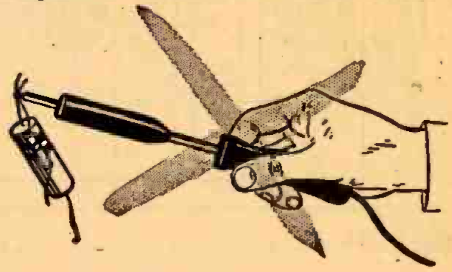


Above is the "FM corner" of the author's large FM-AM receiver.



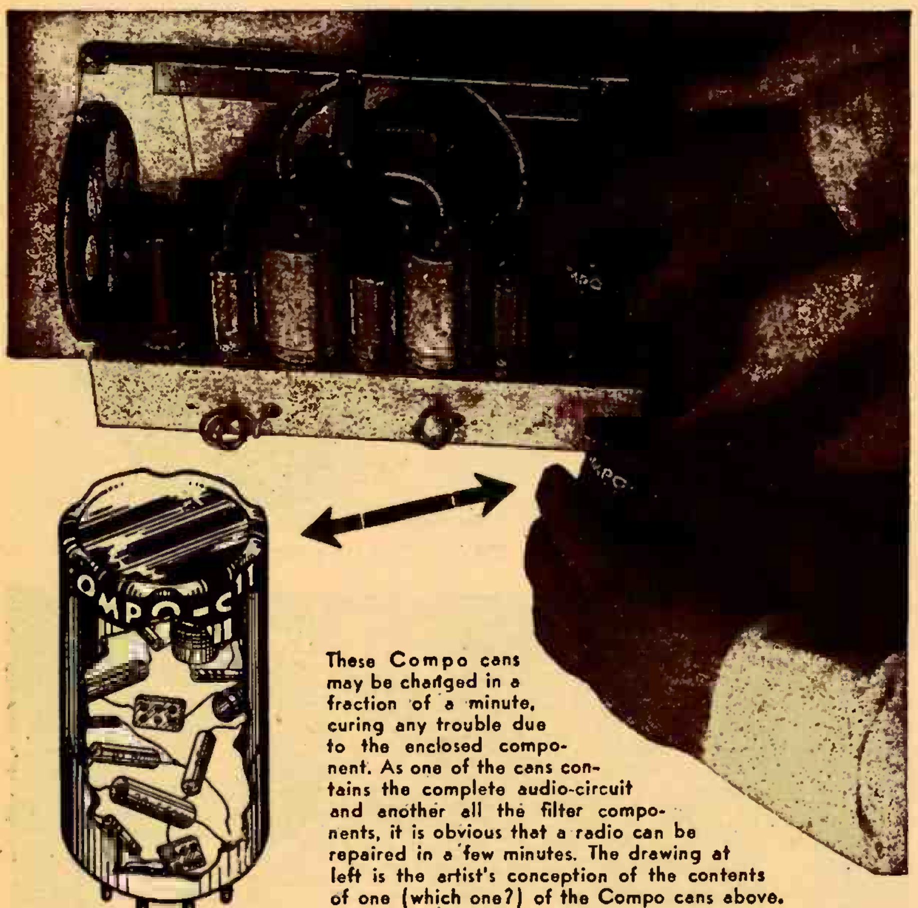
Under-chassis view of the FM area. The partly blanked out section is part of the AM section.

Here is an authoritative article on the much-discussed Cosmo Compo radio, written by the man who invented it. This receiver, which is already being sold in metropolitan department stores, has been hailed by some non-technical writers as a means of emancipating the radio owner from the repairman. Read what the inventor, himself a former radio serviceman, has to say on that subject.



This Radio Services Itself

By ROBERTO BRENTA



These Compo cans may be changed in a fraction of a minute, curing any trouble due to the enclosed component. As one of the cans contains the complete audio-circuit and another all the filter components, it is obvious that a radio can be repaired in a few minutes. The drawing at left is the artist's conception of the contents of one (which one?) of the Compo cans above.

BEFORE anyone can honestly call himself a radio repairman he must have a thorough knowledge of radio electronics. He must be familiar with all types of radio receivers. He must have the proper tools and equipment to give proper service.

For many years many complex problems have faced the radio repairman from the time he puts a radio receiver on his bench till he returns it to its owner in playing condition. It is not uncommon for him to find himself on the short end of a deal. When all the time, energy and materials that go into the repairing of a radio are considered, there is always the chance that he will not make any profit and may lose money. That may sound strange to the layman, but is recognized by the repairman as an everyday possibility. For example, the customer doesn't realize that the breakdown that occurs several days after his set has been fixed has absolutely nothing to do with the original trouble. He insists that the repairman did a poor job and is responsible for putting the set right without further cost. In some cases the cost of additional parts that are needed plus the added time spent in repair exceeds the price of the original estimate.

A serviceman's dream

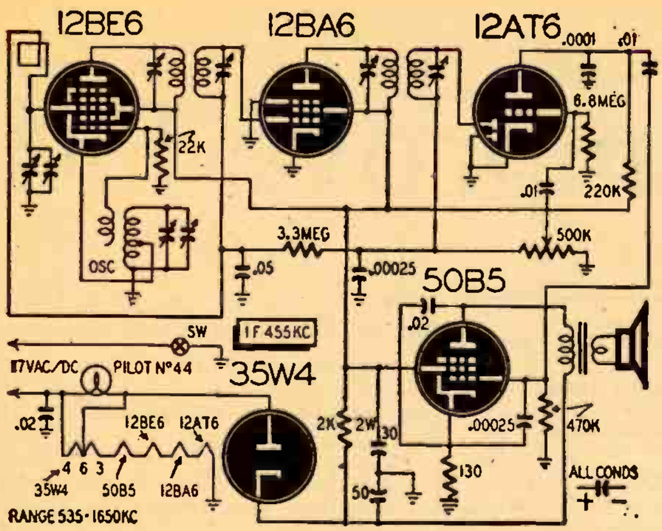
This among other things prompted me to try to find a suitable answer to the problem. During my years studying engineering in the Navy as a radio technician, I had little time to work on the idea. We worked night and day building and repairing radios of all types. Sometimes we had plenty of tools and materials—at others we lacked almost all the proper parts and replacements. Most serious of all, we were understaffed because of the lack of trained technicians. When a component was unobtainable we either had to improvise or scrap an entire unit or set.

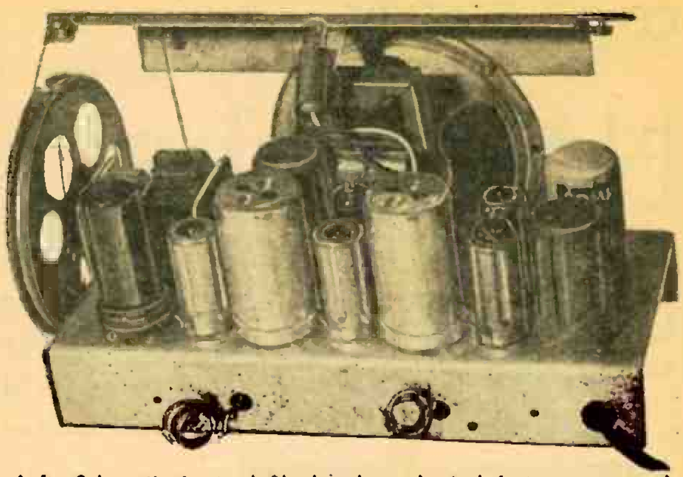
I began to think again about my old plan to simplify radio receivers. Seeing all the waste proved to me that the time was ripe for a radio that would eliminate the complexities of hundreds of parts and wires and reduce the repairman's problems by expediting the work.

When the war in Europe ended I was stationed in Guam in the Pacific. With the cessation of hostilities in the West our job lessened daily. I began to get a few hours for myself each day and used the time for experiments. I wanted to find a way to reduce unnecessary waste. I wanted to find a way to utilize the cast-off parts and units that were deteriorating from lack of use. It struck me that if I took several parts, or better still, a complete circuit and tied the parts together in a single replaceable unit, I would have the answer I was looking for. From the beginning I toyed with the idea of segregating into sections a conventional 5-tube circuit.

The first experimental set gave me quite a bit of trouble because of the long grid leads. This was eliminated by re-arranging the socket positions. I realized then that with further engineering effort such a radio was a practical possibility.

Another big problem was the size of the filters, resisters and condensers. It was impossible to squeeze those components into a unit of practical size. I





Left—Schematic is standard, though mechanical features are novel. Above—Rear view of the plug-in receiver illustrated below.

then considered the use of miniature components, which was the answer to the problem of reducing the size to fit the containers.

There was always something to slow up my progress. After solving the difficulties of putting r.f. components into cans, I ran into trouble with audio quality. This was solved by special attention to matching the output transformer, output tube and speaker, and by using a 50B5 output tube.

The Compo receiver

In brief, I have succeeded in developing a compact AM receiver in which all the elements of a superhet circuit have been made plug-in. Oscillator and i.f. units are pretuned and there is sufficient tolerance to make interchangeability of units quite practical. All the normal under-chassis resistors and capacitors are included in their respective cans, leaving nothing underneath but the filament wiring. Volume control will be plug-in eventually.

The present model consists of 5 vacuum tubes: 12BE6, 12AT6, 50B5, 35W4. In addition, there are 6 *component tubes* which are color-coded and numbered. The oscillator section includes a specially designed oscillator coil with the coupling from the coil to the grid and the grid resistor. The first and second intermediate frequency transformers are in two separate cans or containers. Also in these containers are the automatic volume control line and first audio grid input. Then there is the power supply consisting of a filter and filter resistor.

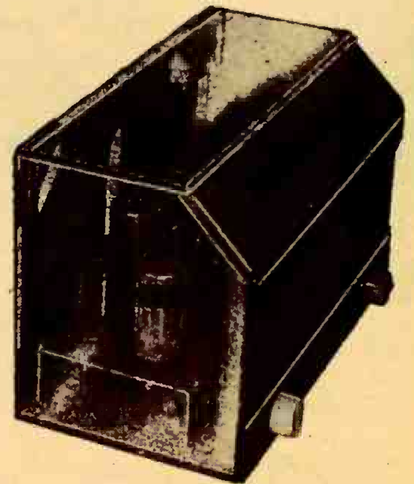
Included in the Compo cans are the following parts: Oscillator is in a green can numbered 114; the 1st i.f. is in a blue can numbered 115; the second i.f. is in a black can numbered 116; the a.v.c. is housed in a yellow can numbered 117; the audio output is in a brown can numbered 118; the filter is in a red can numbered 119. There is also a 35W4 rectifier, 12BE6 converter mixer, 12BA6 i.f. amplifier, 50B5 power output and a 12AT6 detector and 1st audio.

A test has been going on in the laboratory since June 9th. A Compo receiver has been in operation 24 hours a day without interruption under normal operating conditions. So far, the set has been working perfectly and without any signs of difficulty.

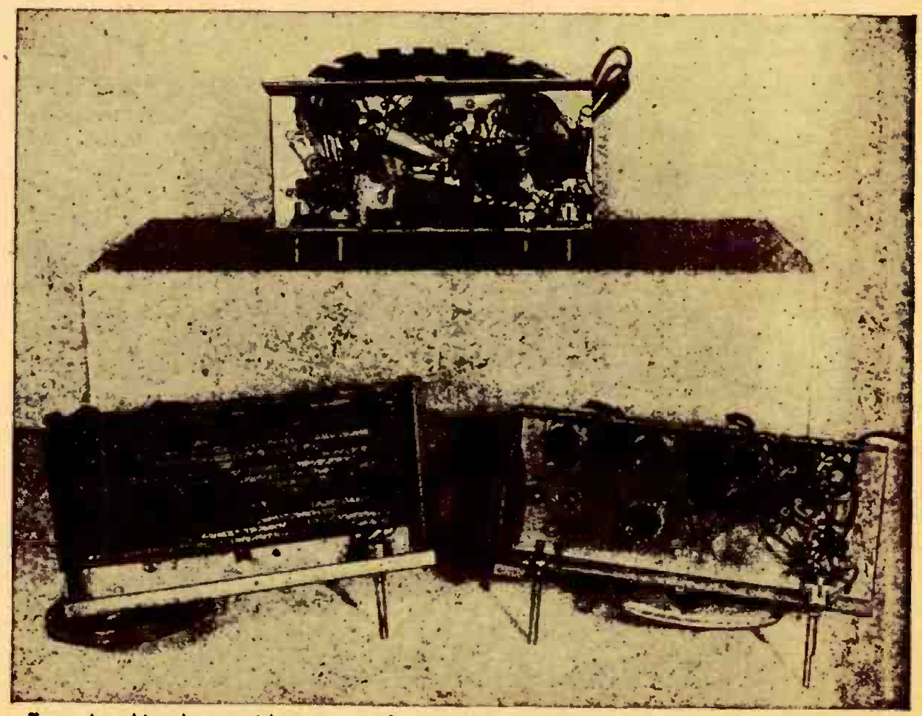
A plug-in amplifier

Using the same principles, a 40-watt experimental amplifier has also been developed. In this case, I have worked out the amplifier so that all the condensers and resistors are wired on a plug-in fibre panel. If anything goes wrong all that has to be done is to remove the entire unit and replace it with a completely new working part. The part that has gone bad can then be repaired and used as a spare.

The Compo system could well be extended to include not only receivers and public address systems, but to cover many types of electronic devices. It would be particularly valuable in commercial and industrial equipment where the time lost in repairing a piece of equipment is more valuable than the price of the parts. A stock of replacement units might in such cases save costly delays, or even the cost of complete standby equipment.



This is a glass-enclosed demonstration model.



Top—An old-style set with its maze of under-chassis wiring and dangling components. Lower right—Present Compo receiver. Lower left—Stamped-wiring Compo receiver of the future.

New Tubes Improve FM

SUCCESSFUL circuits for FM depend on tubes which work well at frequencies near 100 mc. Among the new tubes designed to improve FM reception are the 19T8, assembly of which is illustrated on our cover

An assembly operation on the new FM tubes.

this month. Its 6.3-volt counterpart, the 6T8, and the 12AT7 are other tubes especially designed for FM, and were announced at the same time by the General Electric Co.

The 19T8 and similar tubes are designed for high frequencies.

The new tube consists of 3 sections, one of which contains a triode, while the other two have 2 diodes and 1 diode respectively. Shields around the diodes are identical in appearance with the triode plate, giving the appearance of a triple-triode tube.

Operating skill in assembling tubes takes on new importance with the increasing complexity of these multielement, high-frequency units. The size of the tube is decreased though the number of elements in it is increased. The person whose skillful fingers put together the various parts of the tube becomes an important factor in FM progress. Economical production demands that these complex tubes be constructed to rigid specifications with a minimum of rejected tubes.

The 19T8 is identical to the 6T8 tube except for the difference in filament voltage, which is 18.9 at 0.15 amp in the 19T8 and 6.3 volts at 0.45 amp in the 6T8. Designed for use as a combined AM and FM detector and audio-frequency amplifier, it contains 3 high-perveance diodes and a high-mu triode in the same envelope. One of the diodes has a separate cathode connection.

TABLE I

Direct Interelectrode Capacitances:*	
Triode Grid to Plate	2.4 μμf
Triode Input	1.5 μμf
Triode Output	1.1 μμf
Grid to Each Diode Plate (Max)	0.03 μμf
Number 1 and Number 3 Diode Input (Each)	3.8 μμf
Number 2 Diode input	2.2 μμf

*Approximate values without external shield

Small size, internal isolation and shielding and low interelectrode capacitances adapt the tube to high-frequency operation. Its diameter is ⅞ inch and the height of the glass envelope is 1 15/16 inches, the over-all height with prongs being 2 13/16 inches. Internal capacitances are given in Table 1. Typical operating characteristics are given in Table 2. The tube has the new 9-pin base.

TABLE II—CHARACTERISTICS AND TYPICAL OPERATION

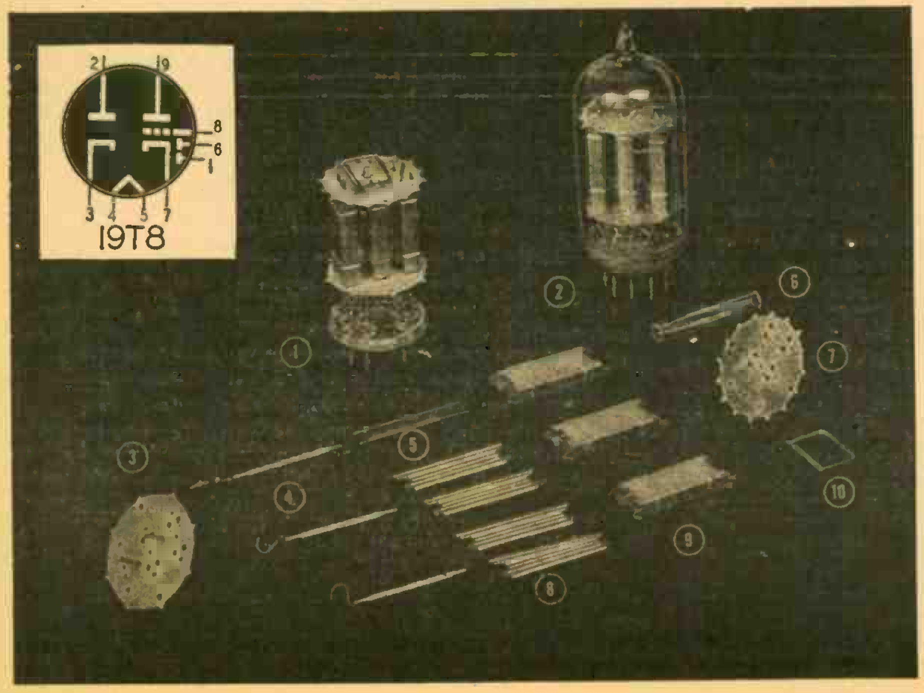
CLASS A AMPLIFIER: TRIODE UNIT

Plate Voltage	100	250	Volts
Grid Bias Voltage	—1	—3.0	Volts
Plate Current	0.8	1.0	Ampere
Amplification Factor	70	70	
Transconductance	1300	1200	Micromhos

DIODE UNIT: EACH UNIT

Average Diode Current with 5 Volts D-C Applied	20	Milliamperes

Note: In a ratio-detector circuit for FM, it is recommended that diodes number 2 and number 3 be used.



An excellent idea of its internal construction is given in the exploded view photograph, in which 1 is a completely assembled tube without the glass envelope and 2 is the completed tube. The top mica separator is shown at 3, the cathodes at 4, and the triode grid at 5. The plates marked 8 are anodes for the diodes (in one case a shield), while those marked 9 are the plate of the triode circuit and shields for the 2 diode sections. A glass tube containing filaments appears at 6, the bottom separator at 7, and a piece holding the getter strip at 10.

Announced at the same time as the 19T8, the 12AT7 is a miniature twin triode designed for use as a grounded-grid, radio-frequency amplifier or as a frequency converter at frequencies below approximately 300 mc. A center-tapped heater permits operation of the tube from either a 6.3 or 12.6-volt heater supply.

CRYSTAL OSCILLATORS—A FEW TESTS

By W. E. ANDERSON, VE3AAZ

THE harmonic-generating crystal oscillator undeniably has advantages for the amateur (especially the higher-frequency) bands. A number of such arrangements have been advanced—notably the tritet with the crystal between grid and cathode, and other types with the crystal between grid and ground. All have either a coil or an r.f. choke tuned with a variable condenser in the cathode circuit. The tritet in particular has come in for considerable criticism because of its high crystal currents as well as instability. Unfortunately some of the better published material on the subject gives figures for crystal current when the tuning is "on the nose," generally ignoring what goes on when controls are detuned and crystal current multiplies many times. The important parasitic problem is often ignored.

A number of tests were run to ascertain just what could be expected in a typical circuit without endeavoring to create a "laboratory atmosphere" where circuits always seem to work better than in the average ham shack.

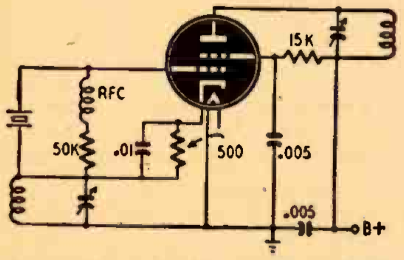


Fig. 1—Standard tritet oscillator circuit.

Fig. 1 is the tritet circuit. About the only variations encountered in this circuit relate to the grid bias. Sometimes the control grid is returned via the grid leak to ground rather than to the cathode, and occasionally cathode bias is omitted entirely. The arrangement shown seems to provide the lowest crystal current for a given output. Inclusion of cathode bias lowers both crystal current and output, but increases the activity, and sometimes the parasitics!

Tables I and II show the results of tests of various common tubes. These tests were run with 40-meter crystals and at a plate potential of approximately 350 volts with a 15,000-ohm series resistor to the screen providing a screen potential averaging 200 volts. With circuits set up for 80-meter crystals, parasitics were almost entirely absent.

The "X" in Table I indicates that while output may be obtainable it is either all or partially parasitic oscillation, as output persists after the crystal is removed. These parasitics appear to arise from the presence of either suppressor grids or beam-forming plates which are internally connected to the cathode, which is itself tuned near the 2nd-harmonic frequency—This includes all tubes tried except the 59, 89, 802, and RK25. This can be deduced from the fact that (excepting the 89) these last-mentioned will "take off" if their suppressor is externally tied to the cathode. The heater also enters the picture. Making the heater float with respect to ground generally detunes and sometimes removes the parasitic, but the output is markedly lower and crystal current higher then.

Parasitic action is also discouraged to a degree by a heavy load on the stage. Many amateurs who previously had no trouble when driving triode tubes from their oscillators now experience difficulties when exciting 807's or similar tetrodes which require much less driving power.

Crystal current is also a function of the load. The tuned-plate crystal grid oscillator TPXG has its highest crystal current unloaded, while with the tritet the crystal current increases with load. Therefore the designations of low, moderate, etc., in the tables are intended for comparative purposes only. For instance, a very heavily loaded 6F6 tritet might burn out a crystal while a heavily loaded 6L6 TPXG might not. The tables attempt to show the least favorable conditions that would likely obtain, both with respect to crystal current and parasitic activity.

Reducing the cathode L-C ratio will weaken the parasitics, but high ratios are required for good multiplying action, especially if endeavoring to obtain 4th-harmonic output. CAUTION: The cathode circuit should not be tuned near the crystal frequency as very high crystal current will result—regardless of tube used. As the cathode condenser is generally chosen large enough for use with 80-meter crystals, on the other bands tuning should be confined to half capacity and less.

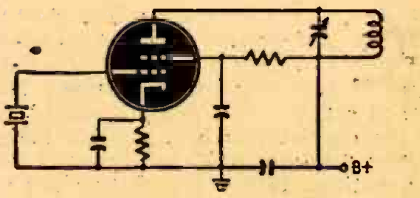


Fig. 2—Tuned-plate crystal-grid oscillator.

Table III details suitable cathode coils derived from the tests—these to be used with a 250-μμf variable condenser. Output L-C ratios appear to be relatively noncritical if extremes are avoided.

Turning now to the grid-ground crystal connection of Fig. 3, the parasitic situation still remains serious. Briefly, with all but the 59, 89, 802, and RK25, it was again found that the settings that provide best output of the low-order

(Continued on page 90)

TABLE III—CATHODE COILS

1½-inch diameter forms

Meters	Turns, coil	Spaced to
80	12	1¼-in. length
40	6	1-in. length
20	4	1-in. length

TABLE I—TRITET OPERATION

Tube	2nd	3rd	4th	Crystal Current Controls Detuned	Remarks
6F6	X	Fair	Poor	Moderate	....
6F6G	X	Fair	Poor	Moderate	....
6V6	X	Fair	Poor	High	....
6V6G	Good	Fair	Poor	High	No cathode bias
6V6GT	X	Fair	Poor	High	....
6L6	Good	Good	Fair	High	Shell tied to B+
6L6G	X	Good	Fair	High	....
RK49	X	Good	Fair	High	....
59	Good	Fair	Poor-Nil	Low	....
89	Good	Fair	Poor-Nil	Low	....
802	Good	Fair	Poor	Low	....
RK25	Good	Fair	Poor	Low	....
807	X	X	X	High	Abso. unmanage.
RK39	X	X	X	High	Abso. unmanage.

TABLE II—FUNDAMENTAL OPERATION

Tube	Crystal Current TPXG	Crystal Current Tritet	Remarks
6F6	Low	Moderate	Shell grounded, otherwise dangerous
6F6G	Low	Moderate	
6V6	Low	Moderate	Shell grounded, otherwise dangerous
6V6G	Moderate	High	
6V6GT	Moderate	Dangerous	
6L6	Moderate	Dangerous	Shell grounded or returned to B+
6L6G	High	Dangerous	
RK49	High	Dangerous	
59	Low	Low	
89	Low	Low	
802	Low	Low	
RK25	Low	Low	
807	Moderate	Dangerous	
RK39	Moderate	Dangerous	

A Two-Tube FM Converter

◀ Meck tuner measures 7½ x 4½ x 4½ inches.

CHEAPEST and smallest of all the FM tuners or converters offered to date, the Meck FM converter uses only 2 tubes—either a 14F8 and a 35W4 or a 7F8 and a 6H6. Yet the converter is by no means simple. The 2 triodes which compose the 14F8 constitute both a superheterodyne and superregenerative detector.

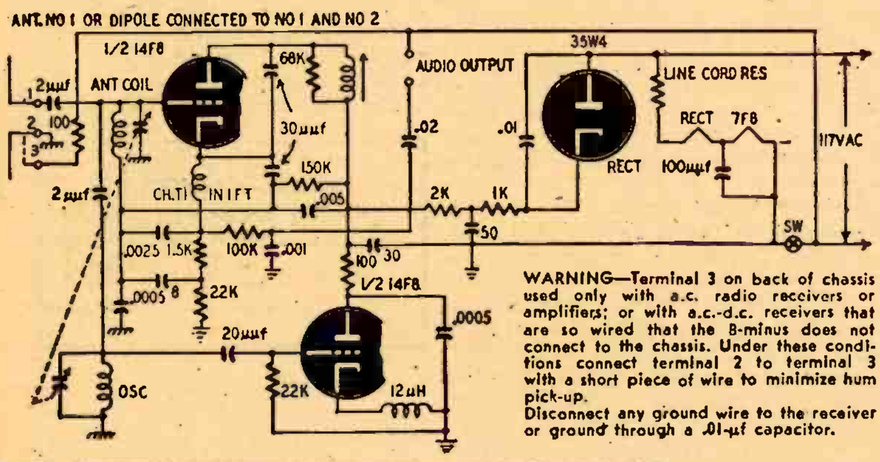
The action as explained by the instructions supplied to servicemen is as follows: In addition to serving as a converter-oscillator in the superheterodyne circuit, one section (pins 1, 3, and 4) of the 14F8 double triode functions as a superregenerative detector and i.f. amplifier. The quench oscillation supplied by this section is at the intermediate frequency, hence little energy is radiated from the antenna.

Pins 5, 6, and 8 comprise the other triode of the 14F8, which is used as the local oscillator for normal superheterodyne action. *Slope detection* is used, with the receiver tuned slightly to one side of the selectivity curve.

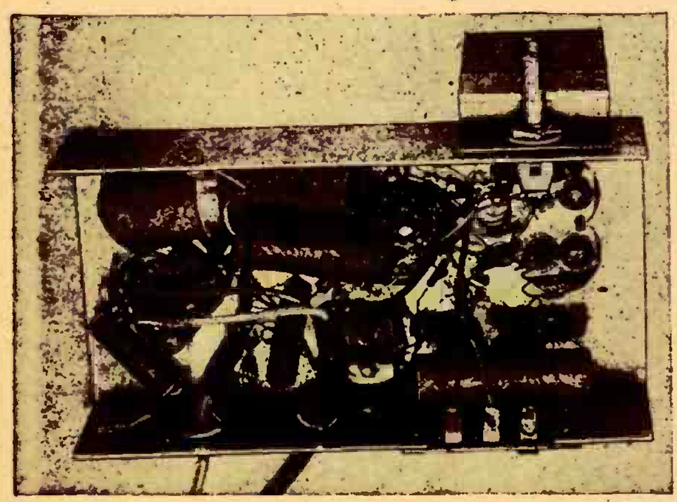
The superregenerative circuit has the added feature of automatic regeneration control. The .0025-µf condenser and 1,500-ohm resistor in the cathode circuit, together with the 150,000-ohm resistor and .005-µf condenser in the plate circuit of the superregenerating triode section, act to set the quench pulse width and average grid repetition rate and control regeneration automatically.

As might well be expected, neither in sensitivity nor quality does this small set equal the larger FM tuners and converters which have been put on the market at higher prices. At a considerable distance from FM stations, difficulty was experienced in bringing in any but the strongest stations satisfactorily. Tuning is accompanied with the familiar superregenerative rush, which disappears when a carrier is tuned in. Quality is subject to the limitations both of slope detection and superregeneration. A certain amount of hum was also noted. This increased considerably when

(*Continued on page 88*)



WARNING—Terminal 3 on back of chassis used only with a.c. radio receivers or amplifiers; or with a.c.-d.c. receivers that are so wired that the B-minus does not connect to the chassis. Under these conditions connect terminal 2 to terminal 3 with a short piece of wire to minimize hum pick-up.
Disconnect any ground wire to the receiver or ground through a .01-µf capacitor.



Schematic diagram (above) bottom and rear-chassis views of the Meck FM tuner. High-frequency coils are below variable condenser.

A. F. Wattmeter Tests Speakers

By I. QUEEN

IT is more difficult to judge sound level from a loudspeaker than it is to estimate sensitivity, band width, or other characteristics of a receiver. Accurate *measurement* of acoustic power is beyond the reach of servicemen, since it requires laboratory equipment. Therefore the output of a radio receiver or audio amplifier is usually specified in terms of the electrical power it can deliver to its speaker. The efficiency of the speaker itself is not taken into account.

Direct measurement of power at audio frequencies also is difficult and there are few instruments available for this purpose. This means that public address and radio technicians have to rely upon indirect measurements which involve some calculation. A common method is to connect a suitable voltmeter across an amplifier resistive load R and find the power by the formula $\frac{\text{volts}^2}{\text{ohms}} = \text{watts}$. An alternative method is to connect an ammeter in series with the load. The equation is then $I^2R = W$.

If a number of measurements are to be made, say with different inputs and adjustments, the calculations take a lot of time and become bothersome.

The instrument described here is a *direct-reading a.f. wattmeter*. It is designed to operate across a low impedance such as the secondary of a speaker output transformer. The usual impedance values, 4, 8 and 16 ohms are provided. Intermediate values lead to slight errors which may be disregarded. When the impedance switch is turned to 8 ohms, the panel meter reads directly in watts. It is a 0-200 microammeter which, as connected here, reads 0-20.0 watts. At 4 ohms and at 16 ohms, the indications are "× 2" and "÷ 2" scales, respectively. This corresponds to the fact that low-impedance voice coils are made to handle less audio power. The meter has its greatest power-handling capacity on high-impedance voice coils, which are more commonly used in large amplifiers.

The wattmeter operates on a very simple principle. A 6SQ7 tube is adjusted as a square-law rectifier so that the plate meter reads in direct proportion to the square of the input voltage. Power dissipated in the grid resistor is also proportional to the input voltage squared. Therefore, the meter can be calibrated to read watts. When properly chosen, the meter is direct-reading.

In addition to the wattmeter circuit, an auxiliary transitron oscillator and a monitor PM speaker have been included for convenience in testing amplifiers.

The schematic (Fig. 1) shows that the instrument is easy to build. The calibrations are easily made, also. To keep the tube characteristic within its square-law portion, plate and grid voltages must be kept low. These voltages may be adjusted over a limited range and are not critical. The plate voltage is about 120 and the grid bias about 2.2 volts. Plate current should be less than 1 ma, so it is preferable to use a 500-microampere or an even more sensitive meter. Choice will depend upon the scale desired. For example, a 0-50- or a 0-5-watt scale is obtained when a 0-500 microammeter is used. In this particular instrument we used a 0-200 microammeter, thus obtaining a direct-reading 0-20.0 watt scale. If any other type of meter is used, the circuit and calibration will be slightly different from that described here.

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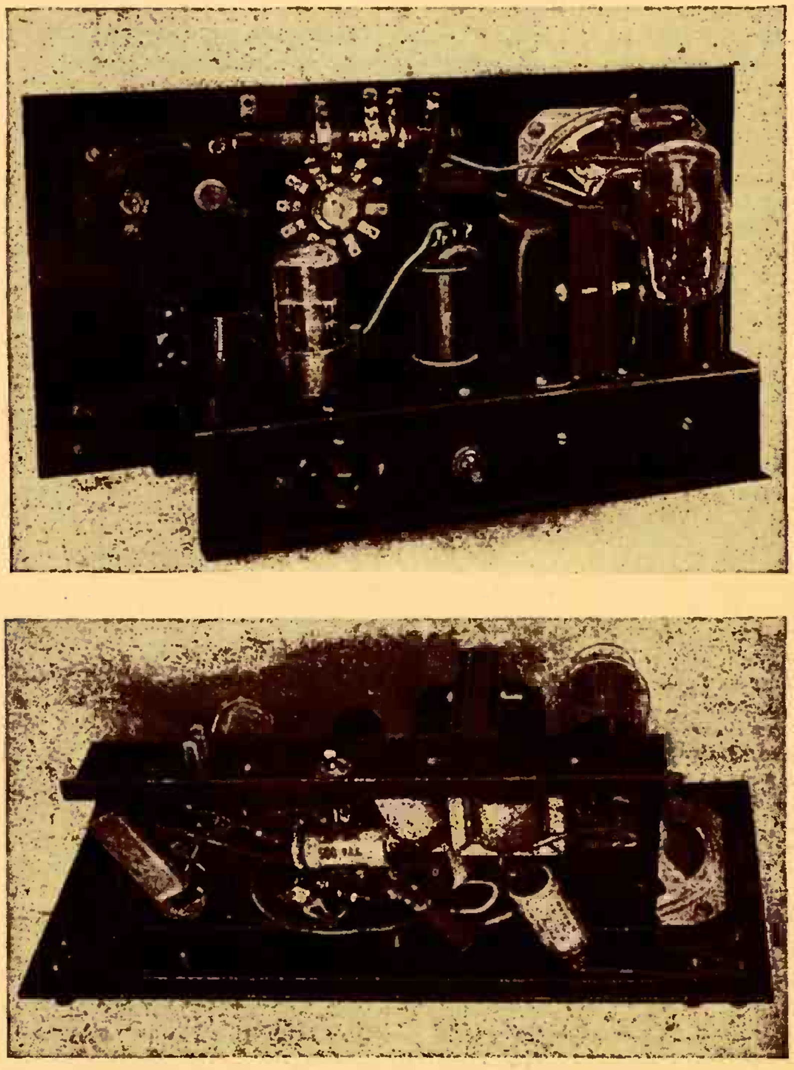


Rear and underchassis views of the wattmeter. (Front view is at top of page.) The load resistor is above switch, which must be a heavy-current-carrying type.

FM and Television Design

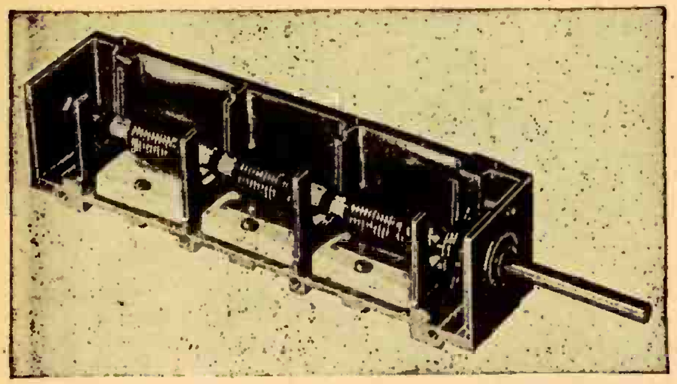


Fig. 1—The Mallory-Ware Inductuner is continuously variable.

PART II—Special circuits and tuning equipment used for very high frequencies

By MILTON S. KIVER

IN the previous article we considered chiefly modification in tubes and their associated circuits in high-frequency receiver design. Now let us note the changes that have occurred in tuning circuits and why these revised circuits are better adapted to deal with the problems of very high frequencies.

In the tuning the high-frequency input circuits of television and FM receivers, the conventional coil and variable condenser combination leaves much to be desired. A variable condenser increases the minimum capacitance across a coil, thereby lowering the L-C ratio and with it the gain. As we tune across a band the capacitance changes, causing the gain to vary over the band. Undesirable coupling occurs between the several sections of a gang condenser. The results are instability, microphonics, and ability of the oscillator voltage to reach the antenna and reradiate to other sets in the vicinity, producing interference.

Coil-condenser coupling between circuits tends to reduce the ability of the various tuned circuits to reject undesired signals. Therefore the present trend among receiver designers has been to use some form of variable-inductance tuning. Coil tuning permits each coil to be used as a separate unit, completely shielded and isolated from similar units. With a variable coil, the fixed capacitance can be kept at a minimum and maximum gain obtained. Variation of inductance produces less variation in Q, and the overall gain and selectivity of the receiver is more constant.

Several types of variable-inductance tuners have made their appearance on the market. These include the *Inductuner, Guillotine tuner, co-axial-line tuner, permeability tuner and quarter-wave lines*. Let us examine each, in turn.

Inductuner: The Inductuner is a wide-range tuner, capable of continuous tuning from 44 to 220 mc. Because of this wide coverage it can encompass the low- and high-frequency television bands and the FM band. It was designed originally by Paul Ware and currently is being manufactured by the P. R. Mallory Company. The unit, with cover removed, is shown in Fig. 1.

It consists of 3 separate variable-inductance units on a common shaft. The coils are wound on ceramic forms, with movable trolley sliders for making continuous contact along the coil. A stop mechanism limits the rotation to 10 turns. Each coil is thus tunable for 10 turns, permitting an inductance variation from 0.02 to 1 microhenry. This represents an inductance change of 1-50,

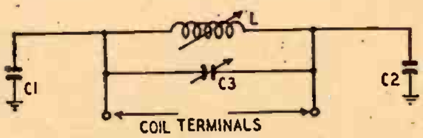


Fig. 2—Equivalent circuit of the Inductuner.

and accounts for the extremely wide band coverage.

The equivalent electrical circuit of the Inductuner, shown in Fig. 2, reveals that 3 capacitances are present. C1 and C2 are stray capacitances from the ends of the coil to ground; C3 is across the coil and consists of 2 parts:

1. A fixed portion representing the interelement stray capacitance,
2. A variable portion which is the distributed capacitance of the winding.

The wiring and interelectrode capacitances, plus whatever additional capacitance might be needed to cover the desired tuning band, are also across the coil. Since the Inductuner has 3 separate windings, it is capable of serving 3 stages. The usual 3 circuits so controlled are the r.f., mixer, and oscillator stages, although the amount of inductance required for each circuit may vary.

To achieve such variation, each winding can be modified to serve its particular purpose. Thus, the r.f. and mixer input coils can be used without modification since these cover the same range. The oscillator coil, being above or below the incoming signal, could be altered to the circuit shown in Fig. 3. The oscillator section of the Inductuner is connected in series with a small external inductance. These 2 coils are then shunted by a fixed inductance and a small trimmer capacitor. The shunt coil raises the frequency of that section of the Inductuner and permits the oscillator to function above the incoming signal. If the oscillator is to operate below the signal, the shunt coil is omitted. The end coil provides the highest frequency of the combination when the inductor trolley has completely short-circuited its own section. The usefulness of the end inductor is that it provides a better Q characteristic than if the variable coil were run out to its limit in order to reach the highest frequency.

The circuit of Fig. 3 is adjusted at its high end with the end inductor and at the low end with the trimmer capacitor. Inductuners are extensively employed in DuMont television receivers.

Guillotine Tuner: The guillotine tuner, used in G.E. FM receivers, consists of 2 identical brass frames which form a 2-turn inductance when connected at their open ends. (See Fig. 4.) To vary the inductance of the 2 turns, a brass blade is inserted between the frames. The effect of the brass blade is twofold: it acts as a shorted turn, reducing the inductance of the unit; at the same time the blade shields the 2 turns from each

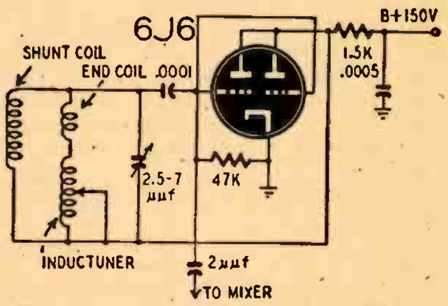


Fig. 3—Inductuner high-frequency oscillator.

other, reducing their mutual coupling. The highest frequency of the tuner is reached when the brass blade is lowered as far down as it will go between the frames. The resonant frequency is lowest when the blade is raised to its topmost point. Slots are cut in the brass blade to produce the desired tuning curve.

In G.E. receivers, the guillotine tuner covers the old and the new FM bands and 2 or more short-wave bands. The low-frequency ranges are tuned by adding shunt capacitance and by inserting series inductances in the guillotine circuit. The entire tuner is enclosed in a metal box which shields the unit and keeps dust out. The blades of the tuner are raised and lowered by a plastic elevator which is attached to a windlass. Within the same shielded case are coils for the standard AM broadcast frequencies. These are permeability-tuned, their iron cores being raised and lowered by the same assembly.

Note the difference in the method of tuning between the standard AM bands and the other channels. In the guillotine tuner, the inductance of the frames

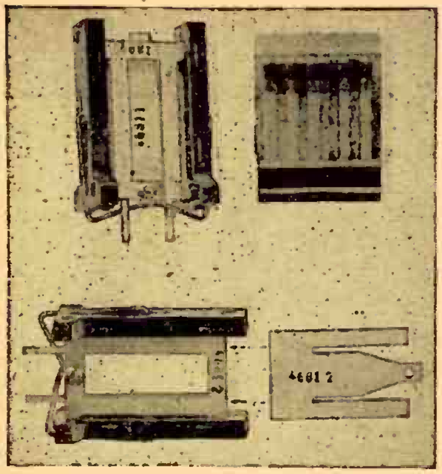


Fig. 4—The Guillotine tuner and its parts. Note the book of matches for size comparison.

decreases as the brass blade is lowered. In the permeability-tuned AM units, the inductance increases when its cores are lowered into the coils.

Co-axial-Line Tuner: FM sets manufactured by Motorola are tuned with co-axial-line tuners. To understand the operation of these units, the reader should be familiar with the following facts concerning transmission lines.

A transmission line, whether of the co-axial type, the twisted-wire type, or the parallel-wire line, contains distributed capacitance, inductance, and re-

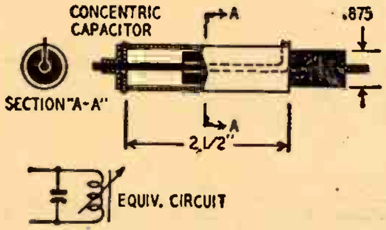


Fig. 5—Design of the co-axial line tuner.

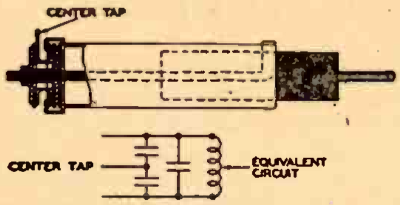


Fig. 6—The tuner with a double capacitance.

sistance. By combining these 3 components, we can cause the line to resonate at different frequencies like a conventional coil and condenser tuning combination. It is the *length* of the transmission line which determines the resonant frequency, because the length of the line determines the amount of reactance and resistance in the circuit.

In the transmission-line tuner used by Motorola, a co-axial cable was chosen because of the effectiveness of a grounded outer conductor in confining all the r.f. energy within the cable. The shielding can be made so effective that removal of the antenna causes the signal to disappear completely. Fig. 5 is a cross-section view of the permeability-tuned co-axial cable. It contains an outer conductor, an inner conductor and, between the two, a powdered-iron core. The ratio of the diameter of the outer to inner conductor is approximately 10 to 1, this value having been found to give maximum impedance. The iron core is mounted on a threaded rod so that its position within the line can be varied. Moving the core into the line increases the line inductance.

To have the tuner track accurately with the other co-axial tuners, an inexpensive silver-mica capacitor is constructed on the closed end of the co-axial line. (See Fig. 5.) In the circuit, a Colpitts oscillator required a dual concentric condenser. Its construction can be seen in Fig. 6. The circuits are aligned at the high-frequency end by adjusting the capacitance and at the low-frequency end by adjusting the initial position of the iron cores. The movable iron cores of each co-axial tuner are mechanically ganged and moved in unison.

The adaptation of the co-axial tuner

(*Continued on page* 68)

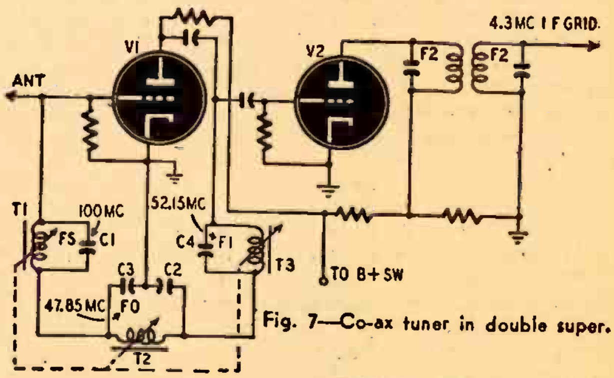
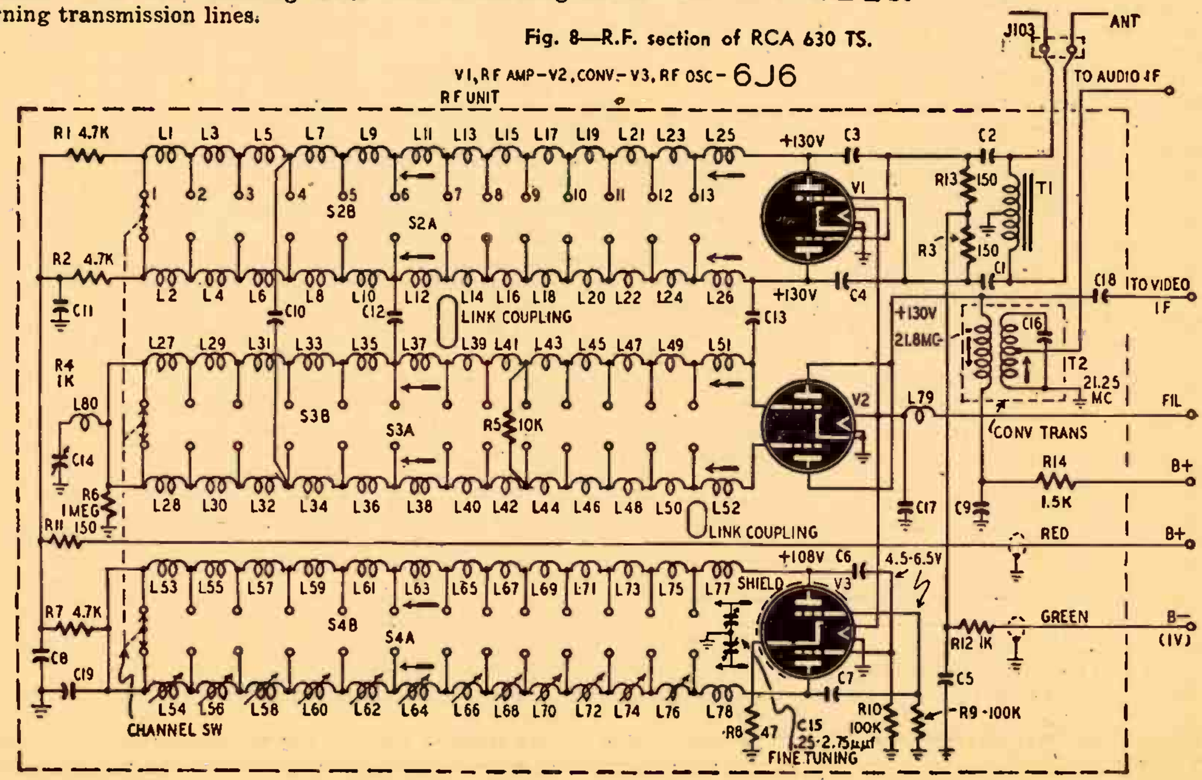


Fig. 7—Co-ax tuner in double super.

Fig. 8—R.F. section of RCA 630 TS.



HIGH-RANGE OHMMETER HAS EXPANDED SCALE

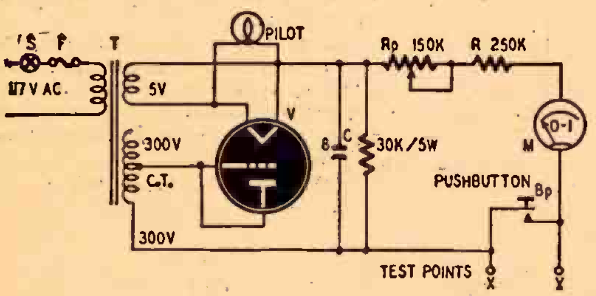
By L. WALTNER

AN OHMMETER that will read high values of resistance, say from 10,000 ohms to 10 or more megohms, is ever needed in the service shop. Such values of resistance are already quite common in modern receivers and are likely to become more so.

The resistance meter found in most service shops, built around a milliammeter of 0-1 ma, is supposed to read up to 1 megohm. This instrument is not linear, and there is serious crowding of markings from about 30,000 ohms upward, so that readings become uncertain and may actually fall far from the real value.

The ultimate value of 1 megohm, up to which the meter is supposed to read, looks on the instrument like infinity. An open resistor of 1 megohm and one in good condition will give almost identical readings.

An ohmmeter that will give good readings between 10,000 ohms and 10 megohms can be constructed easily and cheaply. It will be of great help, not only for testing resistors, but also for finding leakage through defective dielectrics and for testing electrolytic condensers.



Resistors up to 10 megohms are measured accurately with this circuit.

The circuit

The ohmmeter meeting the above specification requires nothing more than an old power transformer, a tube with quick heating filament, and a 0-1 milliammeter, besides the usual hardware. The wiring diagram (Fig. 1) shows the simplicity of the hookup. T is an old power transformer with filament winding for the tube. Half the secondary is left unconnected, provided of course that the other half will supply a voltage of not less than 300. The rectifier tube V may be a directly heated triode, such as a 71, an 80, or other rectifier. C is an electrolytic capacitor of 8µf and 450 volts working voltage. Very little filtering is required, as the remaining a.c. ripple has no perceptible influence on the reading of the meter. Rp is a carbon-type potentiometer of 150,000 ohms, and R is a fixed resistor of 250,000 ohms.

The 150,000-ohm potentiometer is used to adjust the pointer to zero resistance. To do this easily, a bell-push (Bp) for short circuiting the test prods is provided. When the ohmmeter is to be used, the switch is closed, the bell-push is pressed, and the potentiometer adjusted for maximum reading, 1 ma on the scale of the instrument.

One word of caution: There is voltage on the points of the test prods and the operator should use care in handling them. Test prods of high-quality insulating material must be used. The instrument is so sensitive that inferior test prods of poor cables will give a reading of several megohms when touched by the hands. Current will flow through the prods and the body of the operator. However, no inconvenience is caused by the high voltage, since the current is limited to a maximum of 1 ma which is not likely to do any harm.

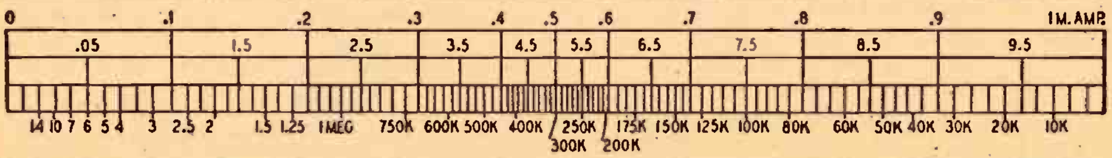
Calibration

The next point to be considered is the calibration of the instrument. To avoid spoiling the dial of the meter with untidy pencil markings, a separate scale can be drawn. A numerical table with dial readings placed side by side with the corresponding resistance values is not altogether satisfactory. It is a slow and uncertain process to interpolate between readings, and errors in computation are frequent. Much better is a double scale showing dial numbers and ohmic values one above the other, as it is sufficient to compare the setting of the pointer with the scale to ascertain the value of the resistor under test. This scale can be straight, like the scale of a slide rule, and if pasted horizontally underneath the meter, works very well.

Actual calibration can be made with good resistors of known value. When several resistors of the silver-tipped type and of identical value are tested one after another, a mean value of sufficient accuracy for practical purposes is obtained.

The instrument can be calibrated by computation also. As it is going to read from 10,000 ohms upward, the internal resistance of the meter can be neglected. In the hypothetical case of the transformer giving an exact 300 volts, the sum of Rp plus R would have to be exactly 300,000 ohms, if a 0-1 ma meter is used. By placing another resistor of 300,000 ohms between the test prods the total resistance in the circuit is doubled, ½ ma flows, and the pointer on the instrument stops exactly on the marking 0.5. It follows that the 300,000 mark falls in midscale. The lower half of the scale will have to cover the values of say 10,000,000 ohms to 300,000 ohms, or the large difference of 9,700,000 ohms, whereas the upper half takes care of only 10,000 to 300,000, or 290,000 ohms. Serious crowding at the left and right ends of the meter will result.

(Continued on page 80)

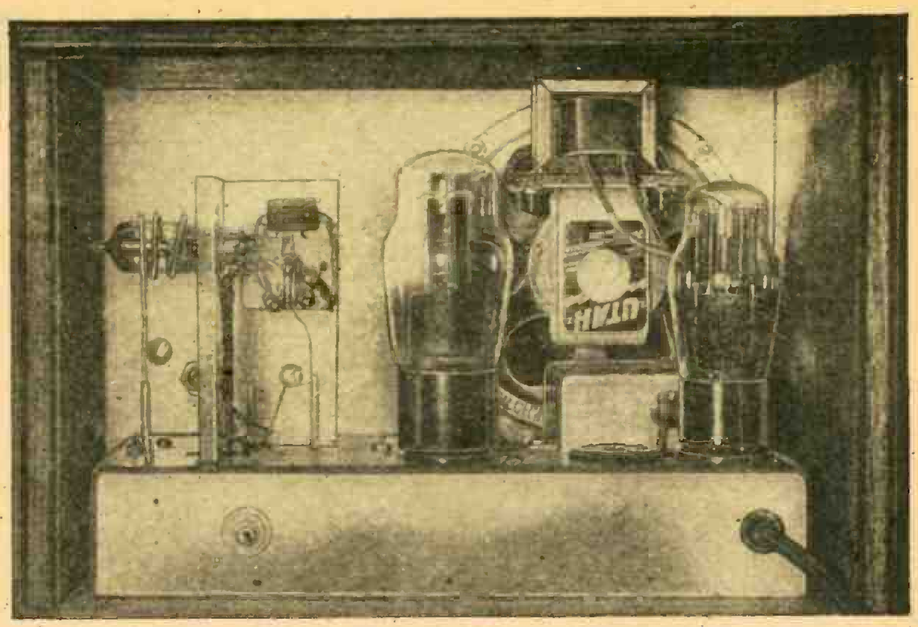


By exaggerating the scale, readings at the normally crowded ends become easier to interpret. The milliammeter scale is at the top.

"Super-R" FM Receiver

This 4-tube FM set may also be used as a tuner

By E. E. SHOPEN



The high-frequency detector circuit (at left) is very clearly seen in this photograph.

THE midget FM receiver has been dubbed a "blooper," since that is the nickname given to the superregenerative circuit which is used. The circuit is neither new nor unusual—it was discovered by Major Edwin H. Armstrong a few decades ago. It has simply been adapted to reception of FM broadcast signals. (The superregenerative circuit will respond to both AM and FM signals.) Good signal strength is required from the FM station or the quality of reception will suffer.

All parts for the set are easily obtainable, and many hams will find that they have most of them on hand. The set uses 4 tubes: a 9002, a 25Z5, a 6SF5, and a 43. Other tube combinations could be used, but these tubes are available and therefore recommended.

The 9002 is especially important, since it is very sensitive at FM frequencies. To keep losses down a polystyrene socket must be used with it. All leads in the 9002 circuit should be kept very short. The other tube circuits are conventional and can be wired in the usual manner. Condenser C1 must be ruggedly mounted (Pilot claims the heavy copper-plate condenser in the Pilotuner prevents drifting) and kept as far from the chassis as convenient. It must be insulated from the chassis, of course. Coil L is mounted directly on the condenser.

The 9002 tube is mounted close to the condenser and coil to keep the leads short. The mechanical coupling between condenser and dial is made through an insulated coupling; and the shaft from the coupling to the dial is a bakelite rod, thus eliminating hand capacitance.

The set pictured uses lucite to support the tuning condenser. Bakelite could be used as well. Even tempered Presdwood would do if given a few coats of shellac or lacquer.

Since all superregenerative sets are critical in antenna coupling, a noncritical system was devised. Three or 4 turns of wire from the antenna lead-in are wrapped around the glass envelope of the 9002 tube. Plenty of coupling is obtained and any length of antenna can be used, although a piece of wire about 2 feet long is usually adequate. It has been found that a single-turn coil loosely coupled to L is usually more satisfactory than the antenna connection just described. The coupling is critical, however and too much will keep the detector from superregenerating. The loop-type coupling has the advantage that a standard doublet or other receiving-type antenna can be used. Both methods are shown in the diagram.

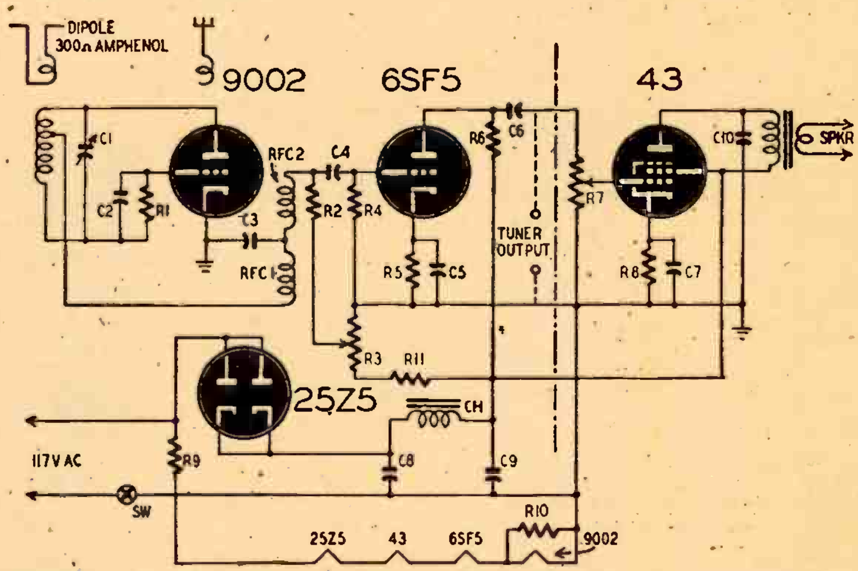
This receiver will re-radiate slightly, and may cause interference to other FM receivers. For this reason the antenna should be kept as short as possible. An r.f. stage ahead of the detector virtually eliminates the re-radiation.

Any convenient chassis layout can be used. A vernier tuning dial is recommended. The regeneration control is not critical. The set is quite stable and does not drift.

Condenser C1 should be about 10 μμf. Hammarlund and Bud each make a 15-μμf condenser consisting of 2 rotor plates and 1 stator. If 1 rotor plate is removed and the coil dimensions are adhered to, the set will tune from 86 to 112 megacycles.

If only an FM tuner is required, the 43 may be omitted and output terminals installed as shown by the dotted lines. Output will be greater than in most FM tuners because of the 6SF5 audio tube in the tuner.

(Continued on page 75)



Schematic of the 4-tube superregenerator, showing the alternative antenna arrangements.

L—4 turns No. 14 ½-inch inside diameter spaced to ¾-inch. Tap is 1¾ turns from plate end
C1—See text
C2—50 μμf mica
C3—.001 to .004 (See note 1)
C4, C6, C10—.01 μf
C5—0.5μf
C7—20 μf, 25 volt
C8, C9—30 μf, 150 volts
R1—10 megohms
R2—50,000-ohm, 1 watt
R3—50,000-ohm potentiometer (regeneration control)
R4—½ megohm
R5—6,000 ohms
R6, 11—100,000 ohms
R7—250,000-ohm volume control with switch
R8—500 ohms, 1 watt
R9—200-ohm line cord resistor
R10—25 ohms, 2 watts
RFC1—25 turns No. 26 to 30 cotton-covered on ¼-inch, close-wound
RFC2—2½- to 80-μh choke
CH—Filter choke or speaker field
Note 1: C3 is critical; experiment for best results.

MAGNETIC RECORDING

Part III of a series, the first two parts of which were headed Magnetism. This part deals with recorder design. Next will be construction of a practical tape recorder

By A. C. SHANEY *

Courtesy Brush Development Corp.
Fig. 1—The Mail-A-Voice uses magnetic discs.

ONE of the most important elements in any magnetic recording process is the magnetic carrier (the material upon which the magnetic modulations are impressed or recorded). Magnetic carriers which have been used successfully to date include metallic ribbon and wire, nonmagnetic ribbon and wire plated with special magnetic coatings, and magnetically coated and impregnated paper and plastic tapes. Early experimenters successfully applied magnetic modulation to a magnetically coated cylinder. A magnetic recorder and playback device which is now available (Fig. 1) utilizes magnetically coated thin paper discs. This list is merely suggestive and by no means exhausts all the possibilities. For example, it should be both economical and practical to coat or impregnate magnetically plastic or cotton fiber thread or other artificial fiber.

The actual magnetic properties of the magnetic carrier determine, to a considerable degree, the over-all performance characteristics of the recording and playback system. They also play an important determinative factor in the design of all other essential elements and auxiliary components used in both the magnetic recording and playback processes.

Many early and highly qualified technicians experimenting with magnetic recording failed to evaluate properly all effects which were normal functions of carrier characteristics, and as a result came to erroneous conclusions. For example, it was believed (during 1932) that it was necessary to run a magnetic carrier at a speed of 393.7 inches per second to obtain a frequency response up to 5,000 cycles. As a result, it was fallaciously concluded that the necessity for the high speed "restricts the application of this recording method to reproduction in the speech range." Today in contrast, a commercially available unit (Fig. 2) is capable of recording and reproducing up to 5,000 cycles with a carrier speed of 4 inches per second—*a reduction in carrier speed of nearly 100 times* without affecting frequency response, attaining, at the same time, many other desirable improvements in noise reduction, increased dynamic range, and lower distortion! Nine thousand cycles has been recorded and played back at a carrier speed of 7½ inches per second, and 12,500 cycles has been attained at a tape speed of 15 inches per second. (Magnetically coated paper tape was used to attain the indicated results.)

The rate of progress in the art of magnetic recording can be measured by the carrier speed of the magnetic medium employed. Slow speeds (with desired frequency response) indicate greater economy of the magnetic medium and longer playing time for a given length and cost of material.

Progress in this respect has been little short of phenomenal. For example, in 1932 118,000 feet of wire was required for a 1-hour program reproducing up to 5,000 cycles. In 1943 the same program quality and duration could be maintained with 11,000 feet of wire. By 1946, it took only 1,250 feet of coated tape to duplicate the same program!

All students of radio have been correctly impressed with the idea that the rate of radio wave propagation (radio carrier speed) is constant (300,000,000 meters per second). As a result, it is simple to calculate wave length—the distance through which current will travel within one cycle—from the following well-known formula.

$$\lambda = \frac{k}{f} \quad (1)$$

when λ = wavelength, f = frequency, and k = carrier speed (186,000 miles per second or 300,000,000 meters per second).

In magnetic recording, the carrier speed is not a fixed and unvarying constant. In fact, as previously explained, there is a strong tendency to continually decrease its speed without affecting over-all response. As a result, the magnetically recorded wavelength of a given frequency will be a function of the magnetic carrier speed and can be found from this simple expression:

$$\lambda = \frac{s}{f} \quad (2)$$

when s = magnetic carrier lineal speed.

Thus a 5,000-cycle signal when magnetically recorded on a tape running 7½ inches per second will have a wave length of 1.5 thousandths of an inch. Similarly, a 5,000-cycle signal recorded at a carrier speed of 4 inches will have a wave length of 8 ten-thousandths of an inch.

When it is realized that each complete wave length has 4 phases (see Fig. 3), evidently each phase of 8 ten-thousandths of an inch wave length will be only 2 ten-thousandths of an inch

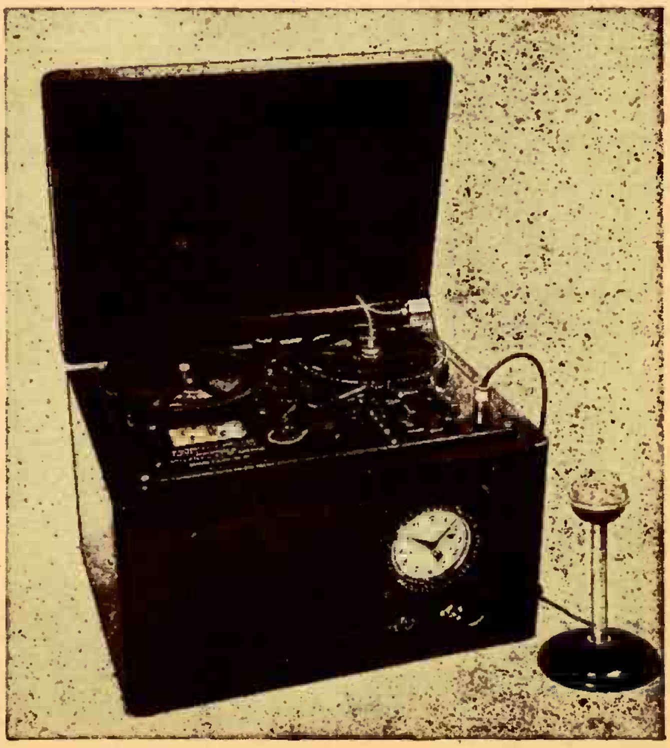


Fig. 2—This machine records 12,500 cycles.
Courtesy Amplifier Corp. of America

*Chief Engineer, Amplifier Corp. of America.

long (approximately 5 microns). We begin to get an idea of the minute dimensions involved in attempting high-frequency magnetic recording on slow-moving media.

Carrier speed stability

A casual examination of the formula (2) relating wave length to speed and frequency indicates that if the magnetic wave length is constant (and it is, if a fixed frequency has been recorded at a constant speed) the reproduced frequency will be directly proportional to lineal speed. If the lineal speed of the magnetic medium should vary for any reason whatsoever, the reproduced frequency will similarly vary. This produces a noticeable variation of frequency when sustained tones are reproduced and resembles the turntable "wow" common to disc recording and reproducing systems which do not employ absolutely constant-speed turntables. To minimize any instantaneous speed variations, it is important to avoid eccentricities in any of the driving members involved in pulling the magnetic medium past the playback head. A correctly designed flywheel should be used to smooth out cyclic pulls common to "constant speed" synchronous motors. A correctly designed capstan drive and flywheel is illustrated in Fig. 4.

The load applied to the driving motor should be constant. Bent reels or spools which scrape either the recording medium or adjacent surfaces are the most common cause of frequency variations in a properly designed mechanism. An idea of the desired constancy of linear speed may be gained from the already established data which indicates that an average listener can detect frequency deviations in the order of 3/10 of 1% (3 parts in 1,000) within the frequency range of 400 to 5,000 cycles. Therefore, instantaneous lineal speed variations should be no greater than ± 0.1% (which allows a variation of 2 parts in 1,000).

Magnetic carrier compliance

Early experimenters who attempted to increase the high-frequency response of magnetic recording systems by increasing wire speeds were bothered by pronounced variations in signal level mainly caused by wire "flutter."

A stiff wire travelling at high speed will tend to assume some natural period of vibration dependent upon its thickness, tautness, and the distance between its supports. Flutter (a transverse vibration) produces a minute frequency variation "wow" (because a slight change in lineal speed takes place), but more important, it introduces a varying pressure against the recording head which in turn changes the air gaps between the magnetic medium and its pickup head. These minute variations produce appreciable high-frequency level fluctuations characteristic of flutter. Steel tapes travelling at high speeds are similarly afflicted. Paper and plastic tapes,—because of their increased compliance and slow speeds—are more easily passed by the pickup head with negligible flutter effects. On the other hand, their increased compliance makes it necessary to use pressure fingers to keep the tape pressed, at a relatively fixed pressure, against the recording and playback heads.

Dimensional stability

When discussing lineal speed stability and its relation to "wow," it was assumed that a magnetically recorded fixed-frequency signal would maintain a fixed wave length. This is true as *long as the wire or tape doesn't stretch.* If stretching does take place, because of temperature and humidity changes between the recording and playback process (and it may, because of the tensions or pull applied to the medium during recording, rewinding, and playback), we then have a new variable to consider.

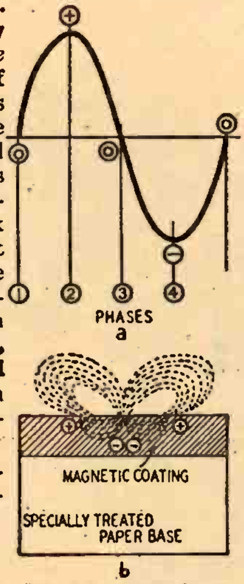


Fig. 3-a—Four phases of sine wave. 3-b—Enlarged cross section of paper tape to show internal and external magnetic flux lines.

A simple transposition of formula (2) produces

$$s = \lambda f \quad (3)$$

which indicates that if the speed remains constant, the reproduced frequency is inversely proportional to wave length. In other words, if the magnetic medium stretches the wave length increases and reproduced frequency decreases! This effect will not be noticeable as long as the "stretch" or dimensional stability is within ± 0.1%. Plastic tapes and thin wires naturally will have some tendency to stretch. The paper base used for coated tape is made of carefully selected material and treated by prestretching for improved dimensional stability.

As expected, one of the most important elements in magnetic recording and playback is the actual magnetic and physical properties of the magnetic carrier. In a magnetic coated medium, the coating itself, and not the base, plays the most important role in the process.

Some of the more critical factors which determine the efficiency, noise, response, constancy of output, overload characteristics, and velocity of the carrier include it coercivity, remnance, particle size, binder, dispersion, chemical composition, surface smoothness, and coating thickness.

Each of these characteristics has a profound influence upon the over-all characteristics and performance of the recording and playback system.

A brief discussion of these factors together with the design details of a suitable magnetic recording amplifier will be covered in the next issue.

Two transpositional errors occurred in the October installment of this series. In comparing the conductivity of electric and magnetic circuits, the formulae should have been:

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

G = conductance in mhos
E = e.m.f. (volts)
I = current (amps)

μ = permeability
H = magnetomotive force (oersteds)
B = magnetic flux (gausses)

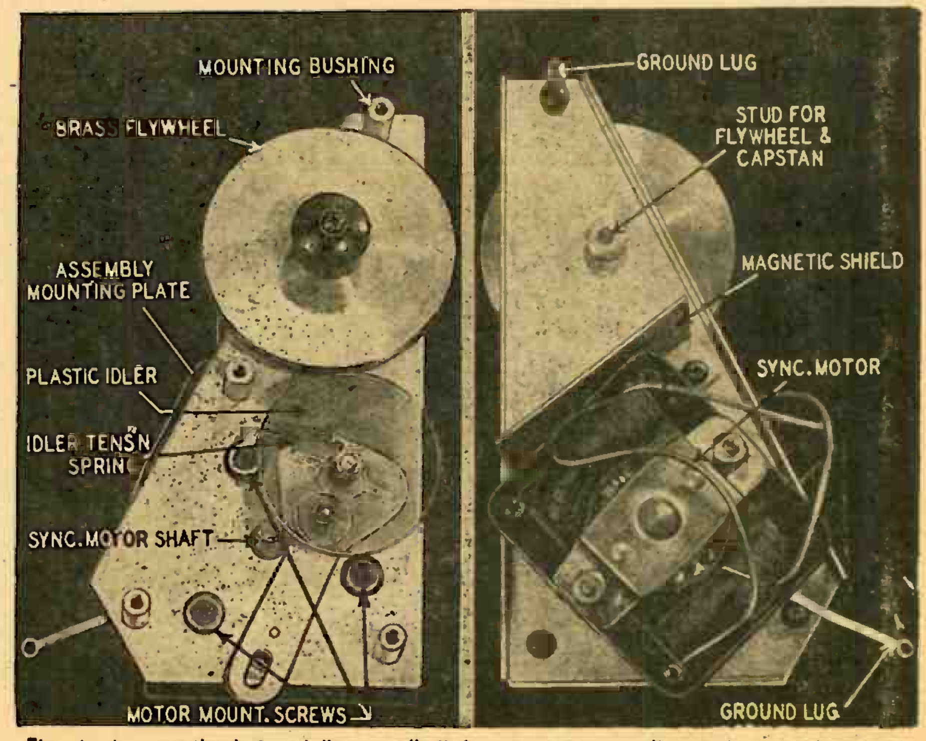


Fig. 4—A correctly designed "tape puller" for magnetic recording and playback devices.

WORLD-WIDE STATION LIST

Edited by ELMER R. FULLER

Elmer R. Fuller, Shortwave Editor of RADIO-CRAFT, is recording shortwave broadcast stations with the help of his Panadaptor, at his observation post in Cortland, N. Y.

WHAT has happened to the dx? This is the poorest month in half a year. Several reports were received, but they contained no dx to speak of.

Reports were received from one of our old observers who has not been heard from in several years, Ed Lendzicszek of Easthampton, Massachusetts. Ed was an observer before the war, and one of our best observers. Welcome back Ed, and may you have plenty of good dx to report to us soon! Others reporting this month were Charles Luckett of Roselle, New Jersey; Gilbert Harris of North Adams, Massachusetts; Charles Sutton, of Toledo, Ohio; Charles Fuller, of Cortland, New York; the Australian News Agency of New York City; the British Broadcasting Corporation of New York City; the Canadian Broadcasting Corporation; and the United States Department of State, Washington, D. C.

HHCN of Port-au-Prince, Haiti is being heard regularly on 5.660 megacycles; reported heard on the east coast at 1900. DSB has been heard from Hamburg on 17.550 megacycles calling PPS2 at Rio de Janeiro, Brazil. This communication was heard at 1338.

Ten-meter ham phone has been very active. F8US, F8MX, F8TU, F9EH, PAXZ, PAVH have been heard by Gil Harris in North Adams, Massachusetts. Heard here by your editor on ten are several from England, Scotland, Ireland, Brazil, Colombia, Peru, Argentina, France, Germany, the Netherlands, and Australia.

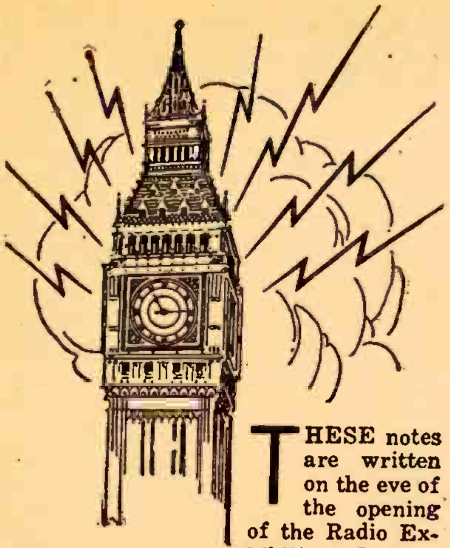
A new station is being heard on 10.970 megacycles from 1730 to 2030. They sign off with Dutch music. Does anyone know who it is? It was first reported to us by Gil Harris.

Berne, Switzerland is being heard from 2030 to 2200 on 6.350 megacycles and 9.650 megacycles. A woman is generally the announcer, although a man is heard occasionally making the announcements. FZI is reported to be using 9.430 megacycles evenings with the programs generally in English. The sign-off is at 2130 with chimes.

All schedules Eastern Standard 24-hour time.

Freq.	Station	Location and Schedule
7.230	GSW	LONDON, ENGLAND; 0100 to 0115; 0130 to 0330; 0600 to 0645; 0700 to 0730; 0745 to 0900; 1045 to 1130; 1 30 to 1430; 1530 to 1715
7.240	VLQ	BRISBANE, AUSTRALIA; 1500 to 1900
7.250	PJCI	WILLEMSTAD, CURACAO: 1130 to 1200 1630 to 2130
7.250	GWI	LONDON, ENGLAND
7.260	GSU	LONDON, ENGLAND; 2345 to 2400; 0030 to 0200; 0680 to 0645; 0700 to 0800; 0815 to 0900; 1045 to 1300; 1330 to 1700
7.260	JVW	TOKYO, JAPAN: 1500 to 0830
7.270	VUD8	DELHI, IND A: 0600 to 0700; 1115 to 1315; 1830 to 1915; 2100 to 2200
7.280	VLC8	SHEPPARTON, AUSTRALIA; 1015 to 1045
7.280	JLW	TOKYO, JAPAN: 0200 to 0800
7.290	VUD3	DELHI, INDIA; 0500 to 1010; 1730 to 1825; 2040 to 2245
7.290	ZOY	ACCRA, GOLD COAST: 1045 to 1300
7.290		ATHENS, GREECE; 1430 to 1530
7.290		MUNICH I, MUNICH, GERMANY: Balkan beam, 1200 to 1700
7.300		MOSCOW, U.S.S.R.: 1300 to 1800; 1815 to 2100
7.310	YSN	SAN SALVADOR, SALVADOR; 1300 to 1500; 1000 to 2300
7.320	GRJ	LONDON, ENGLAND: 0000 to 0015; 0645 to 6700; 1045 to 1815
7.380	HEK3	BERNE, SWITZERLAND: 1000 to 1045; 1510 to 1530
7.570	EAJ43	SANTA CRUZ, CANARY ISLANDS; 0630 to 0800; 1100 to 1200; 1230 to 1800
7.640	KU5Q	GUAM; 0400 to 1200
7.850	ZAA	TIRANA, ALBANIA; 1400 to 1800
7.860	SUX	CAIRO, EGYPT; 1200 to 1600
7.950		ALICANTE, SPAIN; 0730 to 0930; 1530 to 1800
8.030	FXE	BEIRUT, LEBANON: 0015 to 0115; 0525 to 0830; 1000 to 1600
8.560	AFN	MUNICH, GERMANY; 0400 to 1200
8.700	COCO	HAVANA, CUBA; 0700 to 2330
8.720	COJK	CAMAGUEY, CUBA: 2000 to 0030
8.830	COCQ	HAVANA, CUBA: 0530 to 0030
8.950	COKG	SANTIAGO, CUBA: 1830 to 2325
9.030	COBZ	HAVANA, CUBA: 0700 to 0100
9.080	CNR3	RABAT, MOROCCO: 0100 to 0330; 1300 to 1700
9.120		BALIKPAPAN, BORNEO: 0700 to 0935
9.160	CR6RB	BENGUELA, ANGOLA; 1330 to 1430
9.180	HEF4	BERNE, SWITZERLAND
9.210	HI2G	CIUDAD TRUJILLO, DOMINICAN REPUBLIC: 0530 to 0830; 1300 to 1530; 1700 to 1845; 1930 to 2230
9.230	COBQ	HAVANA, CUBA; 0800 to 1200; 2000 to 2200
9.270	COCX	HAVANA, CUBA: 0700 to 0030
9.360		CETINJE, YUGOSLAVIA
9.370	EAQ	MAD⁻ID, SPAIN; 1500 to 1700; 1830 to 2100
9.380	COBC	HAVANA, CUBA: 0700 to 2400
9.380	DTC	LEOPOLDVILLE, BELGIAN CONGO: 00.0 to 0200; 1045 to 1600
9.420		BELGRADE, YUG⁻SLAVIA: 0000 to 1230; 1630 to 0845; 1000 to 1045; 1110 to 1125
9.340	HBL	GENEVA, SWITZERLAND; 1300 to 1500
9.440	FZI	BRAZZAVILLE, FRENCH EQUATORIAL AFRICA; 0000 to 0130; 1100 to 2020
9.460	TAP	ANKARA, TURKEY; 1000 to 1615
9.470	CR6RA	LOUANDA, ANGOLA: 0115 to 0230; 0630 to 0745; 1400 to 1530
9.480		MOSCOW, U.S.S.R.: 1500 to 1700; 1830 to 2100; 0000 to 0100; 0530 to 0815; 1100 to 1130
9.490	KNBI	DIXON, CALIF.; Japanese-Chinese beam, 0400 to 1000
9.500	XEWW	MEXICO CITY, MEXICO: 0800 to 0200
9.500	OIX2	LAHTI, FINLAND: 1100 to 1800
9.510	JLG2	TOKYO, JAPAN: 0300 to 0830
9.520	VLW7	PERTH, AUSTRALIA; 0530 to 1030; 1700 to 2045
9.520	ZRG	JOHANNESBURG, SOUTH AFRICA; 0300 to 0700
9.520	OZF	COPENHAGEN, DENMARK; 1330 to 1800
9.520	JLU2	TOKYO, JAPAN: 0600 to 1200
9.530	WGEO	SCHENECTADY, NEW YORK: South American beam, 1900 to 2400
9.530	SBU	STOCKHOLM, SWEDEN: 0130 to 0145; 1330 to 1700; 2000 to 2100
9.540	VLR	MELBOURNE, AUSTRALIA; 1620 to 1900; 2045 to 0220
9.540	LKJ	OSLO, NORWAY: 0200 to 0230; 0445 to 1700
9.540		MUNICH IV, MUNICH, GERMANY; East European beam, 1200 to 1700
9.540	CJCA	EDMONTON, CANADA; (815 to 0200
9.560		SINGAPORE, MALAYA; 0315 to 0515; 0530 to 1100
9.550	XETT	MEXICO CITY, MEXICO: 0700 to 0100
9.550		PARIS, FRANCE; 0130 to 0145; 0530 to 0615; 0630 to 0800; 0915 to 0930; 1145 to 1615; 1630 to 1730; 1745 to 1830
9.540		ALGIERS, ALGERIA: 1230 to 1700
9.560		KOMSOMOLSK, U.S.R.R.: 0100 to 0930; 1100 to 1400; 1545 to 1650; 1700 to 1830
9.570	KWID	SAN FRANCISCO, CALIF.: Chinese beam, 0700 to 1000
9.570	WRUW	BOSTON, MASSACHUSETTS; South American beam, 1800 to 1900; 2000 to 2200

(Continued on page 64)



Transatlantic News

By Major Ralph W. Hallows

RADIO-CRAFT EUROPEAN CORRESPONDENT

THESE notes are written on the eve of the opening of the Radio Exhibition. I have been privileged to have had a preview of most of the television sets, radio sets, and radio equipment to be seen there. Television has a district of its own at the show—Television Ave., in which a score of manufacturers are showing more than 30 types of receivers. Most of them I know are keenly interested in discovering whether the man in the street is most concerned with cheapness (which means a small image and mediocre fidelity in speech and music reproduction), or with the large image and high-quality sound reproduction, which naturally mean considerable increase in cost.

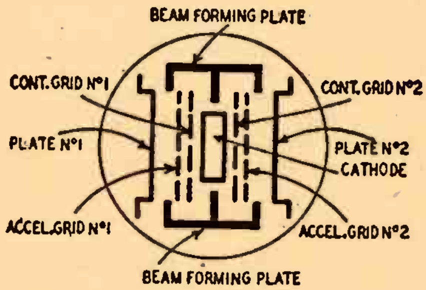
Certainly in 1938 sets priced at about the equivalent of $100 met with a very poor demand. People had no use for their 3-inch images. With us the sound accompanying television is a genuine high-fidelity transmission. Those who had heard what a good receiver could do with this speech and music were not attracted by the audio performance of the cheap set. Though there will always be some who do not much mind what they see and hear, so long as it is television, I have long believed that for some years to come television's best chance of success lies in the luxury or semiluxury market. I think that the manufacturer most likely to succeed is the one who offers a receiver showing an image not less than 8 x 5 inches and providing high-grade sound reproduction. Such a televisor will cost with us from $350 upwards, but I am sure demand won't be lacking. The most expensive receiver in the show, by the way, is the Baird "Grosvenor" model, priced at about $6,000! This set displays a picture 22 inches by 19 inches on a flat screen. The radio portion has elaborate tuning arrangements and 11 wave bands are covered. There is also an autochange phonograph, fitted with a recording unit.

The latest published figures show that there are now 23,000 television receivers in use in England. The increase during the past six months has been at the rate of about a thousand a month, which means that manufacturers' output has been absorbed just about as quickly as it came to the market. That is a gratifying sign, and one hopes that the public will continue to do the same thing when production is stepped up this autumn.

Better receivers demanded

By all the rules at least 8,000,000 to 10,000,000 sets should be in urgent need of replacement. The biggest market always had been for the smaller and cheaper receivers. It seemed to be just a case of handing these out as fast as possible and scooping in the profits.

But things didn't work out like that. In the war years people had formed the habit of making the old set do, and servicemen had become increasingly clever at keeping veteran receivers alive. Sets which would normally have been on the scrap heap long before were still functioning and their owners looked forward to replacing them with the wondrous products of wartime technical advances. It had been dinned into them by the lay press that mass-production methods developed during the war years would smash the prices of high-grade sets. But that didn't happen. The cheaper sets offered were often not much better in performance than their counterparts of seven years previously. If you wanted something markedly better than the old receiver it cost quite a bit more. Well, the public did—and still does—want something better. Hence it goes for the more expensive receiver when it can afford its price, and continues to make out with the old set when it can't.



Elements of new Sargrove all-purpose tube.

Weather ship radio

Under the terms of the international agreement Britain is responsible for 2 of the 13 floating meterological stations now permanently maintained in the North Atlantic. To provide the ships on duty and their reliefs, 4 corvettes have been converted and fitted with special radio and radar apparatus. All carry radio-sonde balloons, which rise to heights of 40,000 feet when liberated. The balloons are fitted with miniature radio transmitters, which send out continuous records of the barometric pressure, the temperature, and the degree of humidity. This is done in an ingenious way. Each measuring instrument has its own v.h.f. transmitter, sending c.w. modulated by an a.f. varying from 700 to 1,000 cycles according to the reading recorded. The modulation frequencies are controlled by the movements of mu-metal armatures in the fields of tuning inductances. Gold-beater's skin operates that of the humidity transmitter, an aneroid capsule that of the barometric pressure transmitter, and a bimetal coil that of the temperature transmitter. The receiver on the weather ship is so arranged that incoming signals from any of the 3 balloon transmitters may be brought in either as sounds or visually on the screen of a cathode-ray tube.

Electrons and the aurora

Displays of the aurora borealis are, I believe, much more frequent in America than here. In the southern parts of England they are comparatively rare, in conspicuous form at any rate. The kind of aurora most often seen here consists of luminous cloud patches, which may pass unnoticed by most people. However, when we do have a big display, short-wave men know that we are in for strange reception effects, particularly on signals coming from northerly or southerly directions. And "northerly" includes a large part of the United States, for radio waves follow great-circle courses, which may be very different from those found by ruling straight lines across the maps of an atlas. Even that is not the whole story, for the Magnetic North Pole, from whose neighborhood Nature appears to center a good deal of her unwelcome broadcasting, is a long way south and west of the Geographic North Pole. Some idea of the efficacy of the aurora in interfering with radio signals has just been given by Dr. A. C. B. Lovell of the Jodrell Bank radio and radar experimental station, situated near Manchester. On August 15 the station received radar echoes from the tip of a streamer of an auroral luminous cloud at a height of about 500 kilometers. Subsequent calculations showed that the electron density in this neighborhood was about 100 times that of the normal ionosphere. As these effects extend downward for a considerable distance, it is no wonder that we complain of large-scale short-wave troubles.

New all-purpose tube

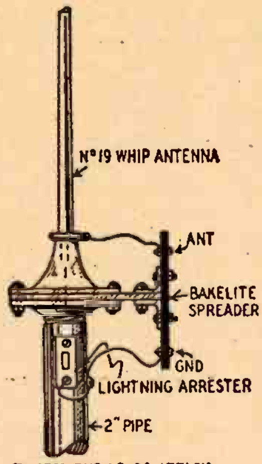
The newest all-purpose tube to make its appearance here is a very interesting piece of design, with many novel fea-

(Continued on page 50)

TRY THIS ONE

DUAL-PURPOSE ANTENNA

Here is an antenna system that serves a double purpose at my summer cottage. It makes an efficient antenna as well as a lightning rod. It consists of a lightning arrester, a length of 2-inch iron pipe, and a whip antenna from a No. 19 Mark II or other surplus radio equipment, picked up at a local store.



TWISTED PAIR LEADS ATTACH AT "ANT" AND "GND"

The arrester is mounted inside the pipe with internal connections to antenna and ground. External connections to antenna and ground are supported by terminals in a bakelite or plastic spreader. Twisted pair is used between the antenna system and the radio.

P. DAOUST,
Montreal, Canada.

HANDY BLOWER

If you need a small blower for removing dust from close places in radios and other equipment, you can construct one from an old 6-volt automobile horn and a small power transformer with burned-out high-voltage secondary.

Disassemble the horn and remove the the motor. Remove the small fan from a defective phono motor or make one 3 or 4 inches across from sheet metal. Mount it on the motor shaft. Connect the 5- and 6-volt filament windings in series and wire to the motor leads. A switch in the 117-v, a.c. line completes the blower.

ELLISON RADIO SERVICE,
Pentertown, Ky.

IMPROVING PORTABLES

Many travelers and vacationists find their small personal radios almost useless in places far from broadcast stations. Their antennas are usually loops built into the lid of the set, and have not enough signal pickup to receive distant stations. Very few of these sets are fitted for use with an external antenna.

To improve such sets, cut slots around the perimeter of a piece of heavy cardboard, roughly the size of the lid of the set. Wind approximately 100 turns of fine insulated wire, about No. 28 or 30, on the slots in pancake form. Connect the ends of the coil to 10-foot lengths of insulated wire terminated with crocodile clips. These serve as antenna and ground connections.

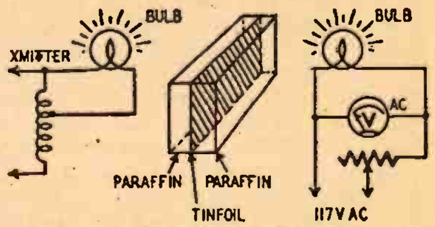
Connect one of the leads to a good ground, a radiator or water pipe, and the other to an antenna—bedsprings or window screens can be used in emergencies. Place the lid in receiving position and turn on the set. Place the loop against the lid of the set and experiment with its position to get the best results. Fit a small clip or clamp on the loop so that it can be clamped to the lid in a position that will give best reception.

C. B. BOVILL,
Morden, England.

SIMPLE PHOTOMETER

In the article "Lamp Bulb Resistors" in the April, 1947, issue Mr. Parchman suggests that a colored filter or smoked glass be used when comparing the brilliancy of 2 lamps. The paraffin-block photometer is easily constructed and is a more accurate method of making such a comparison.

This device is merely 2 small blocks of paraffin, about ½ inch thick, separated by a sheet of tinfoil. The measurements should be taken in as little direct light as possible with the



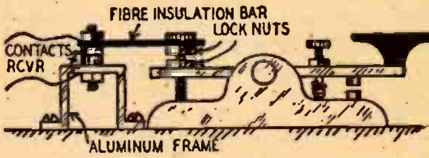
photometer half way between the lamps. The line resistor is adjusted until both blocks are equally illuminated.

A. C. WILSON,
Ottawa, Ont.

(Such a photometer was described briefly by Mr. J. G. Reed in the article "An Electronic Photometer" in the July, 1947, issue of RADIO-CRAFT.—*Editor)*

BREAK-IN KEYING

Simple break-in keying is easy if you add a pair of normally closed contacts to your key. The lower contact is mounted on a thin metal bracket close to the rear of the key. The upper contact is mounted on a strip of bakelite or other insulating material drilled and tapped to pass the thumbscrew used for



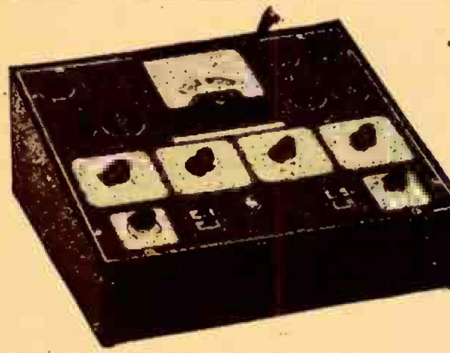
adjusting the spacing between the normal contacts.

The extra contacts may be connected across the receiver send-receive switch or between the center tap of the power transformer and the B-minus lead.

GEORGE I. SCOVILL, W8ECN,
Mt. Clemens, Mich.

(Contacts which short the set's antenna in key-down position are also good.—*Editor.)*

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



The New Model 60-T TUBE and SET TESTER

A COMPLETE TUBE TESTER

Tests all tubes including the new post-war miniature loctals such as the 12AT6, 12AU6, 35W4, 50B5, 117Z3, etc. • Tests by the well-established emission method for tube quality, directly read on the scale of the meter • Tests shorts and leakages up to 3 Megohms in all tubes • 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.

$49.85 NET PRICE Model 60-T operates on 90-120 Volts 60 Cycles A.C. Housed in sloping leatherette covered cabinet. Comes complete with test leads, tube charts and detailed operating instructions.

A COMPLETE MULTI-METER

- 6 D.C. Voltage Ranges: 0 to 7.5/15/75/150/750/1,500 Volts
- 6 A.C. Voltage Ranges: 0 to 15/30/150/300/1,500/3000 Volts
- 4 D.C. Current Ranges: 0 to 1.5/15/150 Ma. 0 to 1.5 Amps.
- Low Resistance Ranges: 0 to 2,000 Ohms (1st division is 1/10th of an ohm.)
- 2 Medium Resistance Ranges: 0 to 20,000/200,000 Ohms
- High Resistance Range: 0 to 20 Megohms
- 3 Decibel Ranges: —10 to +38, +10 to +38, +30 to +58 DB.

EXTRA: WE CAN NOW SUPPLY THE MODEL 60 HOUSED IN A BEAUTIFUL HAND-RUBBED OAK CABINET. COMPLETE WITH PORTABLE COVER MAKING IT SUITABLE FOR EITHER BENCH OR OUTSIDE USE. ONLY $2.75 ADDITIONAL. SPECIFY MODEL 60-C

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

- Operates on 110-120 Volts 50 to 60 Cycles A.C.
- R.F. Frequencies from 100 Kc. to 35 Mc. on Fundamentals in 5 bands by front panel switch manipulation. One additional band provides Harmonics from 30 to 105 Mc.
- Audio Modulating Frequency —400 Cycles Pure Sine Wave. Distortion less than 2%.
- Attenuation: Features a newly designed 3-step ladder type of attenuator (T pad). The first step provides lowest output and can be multiplied by 10 and by 100 by turning the multiplier switch.
- Hartley Excited Oscillator Electron coupled to a Buffer Amplifier. Frequency stability is assured by modulating the amplifier stage.

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

$39.95 NET

The New Model 670 SUPER METER

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

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

$28.40 NET

The Premier B-A-N-D-S-P-R-E-A-D DIAL SIGNAL GENERATOR

Exclusive Feature!

The "PREMIER" Model 570 is the ONLY low-priced Signal Generator with a MICRO-MASTER BANDSPREAD DIAL, equivalent to a scale length of approximately 60" — a major feature for logging, sharp and critical tuning.

AIR TRIMMERS ON ALL BANDS.

TRIPLE COPPER PLATED SHIELDING.

EFFECTIVE LINE FILTER— pure 400 cycle modulation (less than 5% distortion).

Range 75KC-50MC on fundamental, and 50-150MC on 3rd harmonic, useful for aligning FM and Television Receivers.

Accuracy better than 1%.

A.C.—115 volts, 50-60 cycles.

Overall size—12"x12½"x5½". Shpg. wt. 21 lbs. Complete with coaxial cable and complete operating instructions.

$54.75 NET

The New Model 450 TUBE TESTER

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

SPECIFICATIONS

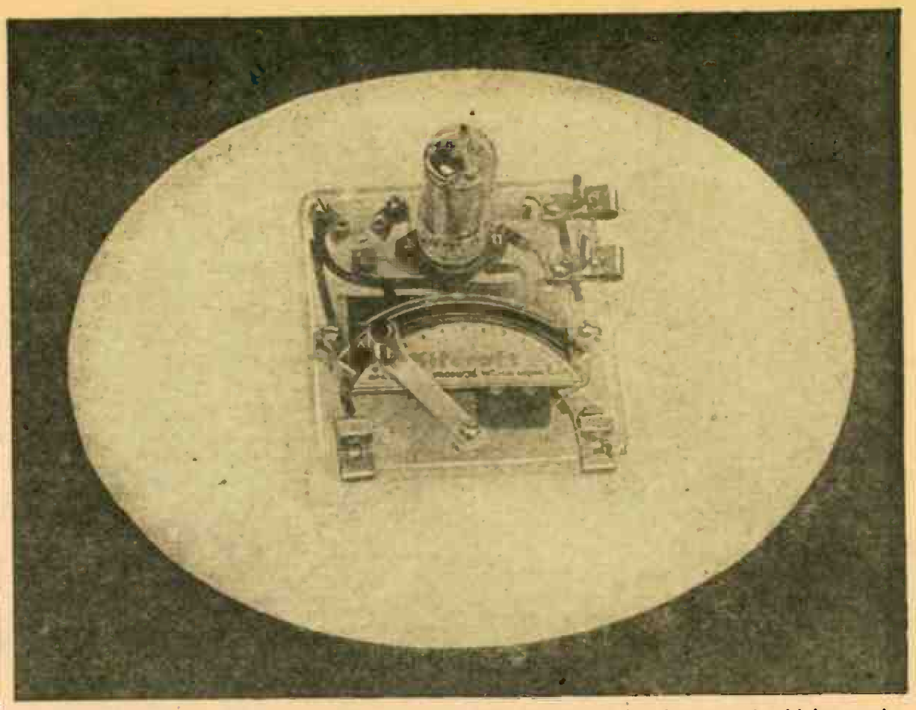
• Tests all tubes up to 117 volts. • Tests shorts and leakages up to 3 Megohms in all tubes. • Tests both plates in rectifiers. • New type line voltage adjuster. • Tests individual sections such as diodes, triodes, pentodes, etc., in multi-purpose tubes. • Noise Test-detects microphonic tubes or noise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

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

$39.50 NET

GENERAL ELECTRONIC DISTRIBUTING CO.

DEPT. RC-12. 98 PARK PLACE, NEW YORK 7, N. Y.



The Kitcraft radio is slider-tuned, like many crystal sets. Good headphones should be used.

A MODERN 1-TUBER

By HARRY WINFIELD

A NUMBER of crystal receivers were described in the July issue. For the beginner in radio who desires something better than a crystal, the 1-tube kit set illustrated in the photo is the logical next step. No regeneration is used. Thus interference with neighboring receivers is eliminated. A 1L4 or 1T4 tube is employed, together with a 1.5-volt A-battery (flashlight cell) and a B-battery of 22.5 to 90 volts. The higher the B-voltage used, the greater the amplification and the stronger the signal.

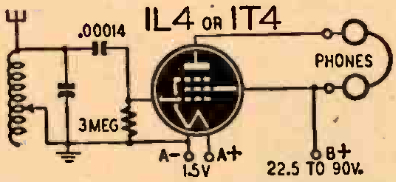


Fig. 1—The circuit could hardly be simpler.

The set is tuned by moving a slider across the tuning coil, the insulation being scraped from the wire along the path followed by the slider.

The base is of transparent plastic. Spring binding posts are provided for the aerial and ground connections, as well as the headphone cord tips. A 3-pin plug fits into a jack on the panel. Three colored wires lead from the jack plug: one for the B-plus, one for the A-plus, and the third wire for connection to A- and B-minus.

Fig. 1 is the schematic of the receiver.

A fixed condenser of suitable capacity is connected across the tuning coil. A second fixed condenser of 0.00014 μf is in series with the control grid of the tube, and a grid leak of 3 megohms connects to ground. The screen grid of the tube is connected to B-plus; pins 4 and 5 are not used.

An aerial 100 to 150 feet long is suitable for use with this set, plus a good ground connection. The headphones should be of good quality, at least 2,000 ohms resistance.

The plastic base measures 3⅛ x 3⅛ inches and the height of the set with the tube in place is 2 inches.

INSTRUMENT PICKUPS

An efficient vibration-type pickup for wooden musical instruments can be made from a set of high-impedance headphones and a length of shielded microphone cable. Wire the phones in series and connect them to the cable. One phone is to be placed on top of the instrument and the other on the back. Regular surplus Army-type headphones are ideal for the purpose. They have heavy spring-steel headbands which will hold the pickup firmly to the surface of an instrument such as a guitar. This type of pickup is easily removed. Select phones with rubber ear cushions as these prevent annoying rattle between the phones and the instrument.

A. L. SKALICKY,
Mangum, Okla.

(Headphone units have been used as string pickups on a guitar. Diaphragms are removed and the magnets placed directly under the strings. A screw adjustment moves them toward or from the strings. See also article on page 62.—*Editor)*

NOW AVAILABLE FOR IMMEDIATE SHIPMENT!

The New Model

777

20,000 OHMS PER VOLT!!

SET TESTER

A super-sensitive, complete all purpose testing laboratory, this versatile analyzer will quickly and accurately test all tubes. The extremely high sensitivity of the V.O.M. section (20,000 ohms per volt on D.C. and 10,000 ohms per volt on A.C.) will enable you to:

1. Measure A.V.C. Voltages at the grid return of tubes.
2. Measure plate or grid Voltages in resistance coupled amplifiers.
3. Measure grid driving Voltages in amplifiers and phase inverters.
4. Measure minute leakage Voltages and currents in R.C. amplifiers.
5. Measure diode rectifier Voltages in second detectors.
6. Measure squelch Voltage in noise reduction circuits.
7. Align discriminator in F.M. sets.
8. Analyze automatic frequency control circuits.
9. Align F.M. receivers by measuring the grid voltage in the limiter stage.
10. Measure the Voltage at the grid of picture tubes for proper television alignment.

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.
- **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 2,000/20,000/200,000 Ohms 0 to 50 Megohms
- **DECIBELS:** (Based on zero decibels equals .006 Watts into a 500-Ohm line.) —10 to + 18 D.B., + 10 to + 38 D.B., + 30 to + 58 D.B.)

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".

$59.95 NET PRICE

20% DEPOSIT REQUIRED ON ALL C.O.D. ORDERS

GENERAL ELECTRONIC DISTRIBUTING CO.

DEPT. RC-12 98 PARK PLACE, NEW YORK 7, N. Y.

NEW RADIO·ELECTRONIC DEVICES

OSCILLOSCOPE

Browning Laboratories, Inc.
Winchester, Mass.

Model OL-15A, an omni-purpose 5-inch oscilloscope has been designed for those requiring versatility of operation, minimum weight and bulk, and faithful presentation of high harmonic content waves.

The response curve of the vertical amplifier is linear and without positive

slope from 10 cycles to 4 megacycles. The transient response is such that a 100-kc square wave which rises or falls in the order of 500 volts per microsecond is faithfully reproduced. The horizontal amplifier response extends linearly from 10 cycles to 1 megacycle to accommodate any type of externally generated sweep voltage which one may wish to employ. The sawtooth sweep range is from 5 cycles to 500 kilocycles with synchronizing sensitivity permitting synching and viewing 10 mc r.f. sine waves.

Triggered sweeps of 0.2, 0.5, 1, 5, 20, and 200 microseconds per inch may be inaugurated by the internal trigger generator or by external pulses. Sweeps and internally generated trigger are phasable to each other so the sweeps may be adjusted to occur previous to or following the output triggers by varying degrees. Connections to all cathode-ray tube control elements are brought out the front panel to permit direct connection.

The total weight of the instrument including self-contained power supply is 95 pounds. The unit has a black wrinkle-finished cabinet and aluminum panel finished in black leatherette enamel with labels engraved directly into the aluminum. A cast aluminum bezel mounted over the cathode-ray tube screen assists in preventing glare and provides convenient means of changing ruled masks, color filters, and viewing aids.—RADIO-CRAFT

SOLDERING AID

Nelpin Mfg. Co.
Long Island City, N. Y.

The Solder-Matic is a new device that clamps on any standard soldering iron and feeds solder smoothly at the touch of a fingertip.

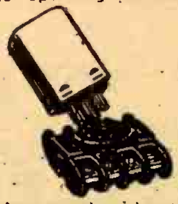
Solder in short lengths, in small coils, or fed from a spool as large as 25

pounds, can be handled. It takes solder from 1/16 to 3/16 inch in diameter, and feeds up to 3/16 inch per stroke. Screw adjustment of the stainless steel nozzle guides solder where needed, regardless of the size or shape of the particular soldering tip being used.—RADIO-CRAFT

SENSITIVE RELAY

Sigma Instruments, Inc.
Boston, Mass.

The Series 41 relay is designed for use with mercury thermostats and other small switches where contact current must be kept at about 4 ma or below when used on 115 volts a.c. One model operates with only 2 ma at 115 volts a.c. in the coil circuit. Relay contacts are suitable for operating solenoid valves,



indicator lamps, and resistance heaters.

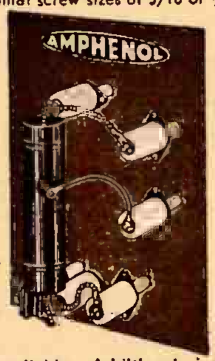
Replacement is made easy by plug-in mountings. The Type 41RO weighs 3 ounces and is 1½ inches square and 2 inches high above the base. This unit in combination with the new industrial octal socket permits screw connections to the relay.—RADIO-CRAFT

INDUSTRIAL TUBE SOCKET

American Phenolic Corp.
Chicago, Ill.

Direct mounting of metal industrial tubes, similar to the 172 thyratron, to noninsulated surfaces is facilitated by a compact steatite mounting bracket, available with or without feed-through bushings which permit wiring back of supporting panel.

Terminal screw sizes of 3/16 or ¼ inch



are available. Additional insulators may be used as tie points or feed-through insulators for the tube element connections. Surface electrical creepage distances are held at about 2 inches, enabling use at high voltages. Exterior of standoff is glazed and metal parts are plated.—RADIO-CRAFT

NEON-GLOW VOLTMETER

Industrial Devices, Inc.
Edgewater, N. J.

The Mini-Volt is a simple meter of practical accuracy calibrated for use on a.c. from 65 to 660 volts with an impedance of approximately ½ megohm. It is virtually burnout-proof and is operated by turning the knob until the glow extinguishes. The voltage is read directly off the scale. For d.c., which is indicated when only one electrode glows, the reading is multiplied by 1.15.

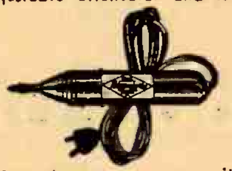
The meter is equipped with 12-inch test leads and is housed in a bakelite case that may be carried in the pocket or tool box without danger of damage. It is useful in checking fuses, line voltages, and radio plate voltages. The neon indicator is guaranteed for 10,000 hours of actual operation.—RADIO-CRAFT

MIDGET SIG. GEN.

Clippard Instrument Laboratory, Inc., Cincinnati, Ohio

The Signalette is a pocket-size signal generator producing r.f., i.f., and a.f. signals simultaneously from approximately 2,500 cycles through 20 mc. The instrument works on 115 volts a.c. or d.c. When a.c. is used, modulation is supplied at the line frequency. Modulation is not present when used on d.c. lines. It performs all the necessary functions of conventional signal generators.

The unit is approximately 9¼ inches long and 1½ inches in diameter. It has an adjustable attenuator and is iso-

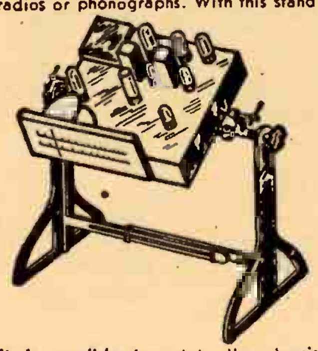


lated from the power source so it can be used safely with a.c.-d.c. receivers. —RADIO-CRAFT

CHASSIS RACK

JFD Mfg. Co., Inc.
Brooklyn, N. Y.

The "Repairack" is an all-purpose, cast aluminum radio chassis and phonograph turntable holder, useful to servicemen for assembling and repairing radios or phonographs. With this stand



it is possible to rotate the chassis through 360 degrees in a horizontal plane, making it unnecessary to remove the set until the job is completed. The unit is sturdily made to hold the heaviest chassis and phono turntables.—RADIO-CRAFT

REPLACEMENT SPEAKERS

Utah Radio Products
Huntington, Ind.

Known as Models SE5S6, SE6S6, and SE7S6, three new auto radio replacement electrodynamic speakers are

available in sizes of 5, 6, and 7 inches. Each model uses a 3-ohm voice coil and a 4-ohm field coil. Speaker mountings are square type. These new speakers supplement a wide line of Utah speakers now being produced in all required sizes and types.—RADIO-CRAFT

R. F. POWER TRANSFORMER

Electronic Engineering Service
Ridgewood, N. J.

A line of r.f. power supply transformers designed for use in television

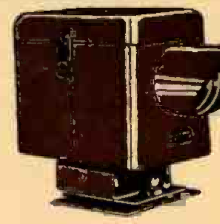
receivers, cathode-ray oscilloscopes, and other equipment requiring an entirely safe low-current, high-voltage source of power has been announced. Sizes available are: 1, 2.5, 4, 5, and 10 kv. All are conservatively rated at 250 microamperes, and each includes primary, secondary, feedback, and rectifier filament windings. All coils are Q-Max treated. A complete circuit diagram is included with each coil.—RADIO-CRAFT

PHOTOELECTRIC RELAY

General Electric Co.
Schenectady, N. Y.

A new photoelectric relay and light source operating on the modulated light principle has been announced. When operated at distances up to 1,000 feet, this equipment has sufficient sensitivity to prevent false operation due to rain, fog, or snowfall. Applications include traffic control, counting and limiting, and protection of restricted locations.

The light source contains a lamp, transformer, and motor-driven slotted disc which interrupts, or modulates, the light beam at about 900 cycles per second. The photo-electric relay has a tuned circuit which allows the relay to be responsive only to a light beam modulated at this frequency. It is not



sensitive to changes in natural or artificial illumination. The light source has an infra-red filter which removes most of the visible light from the beam.

The units are mounted in outdoor enclosures which are thoroughly weather proof and are equipped with a universal mounting.—RADIO-CRAFT

FM RECEIVER KIT

Radio Kits, Inc.
New York, N. Y.

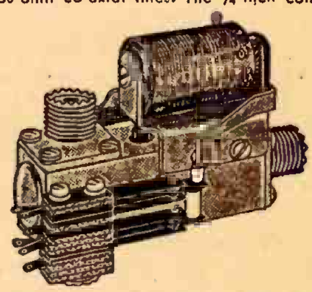
The Model FM-7 is a completely self-contained, 6-tube, table model FM receiver with a 86- to 110-mc tuning range. Provision is made for using the set as a tuner with a high-quality audio amplifier or for feeding its output into an extra speaker.

The kit comes complete with a bakelite cabinet, factory-tuned r.f. section, 2 i.f. stages, 1 limiter, discriminator, a.f. amplifier, and 6 miniature tubes.—RADIO-CRAFT.

CO-AXIAL RELAY

Advance Electric & Relay Co.
Los Angeles, Calif.

The Series 7200 a.c. and 8200 d.c. relays are designed for s.p.d.t. switching 50-ohm co-axial lines. The ¼-inch con-



tacts are reached through an inspection port at the top. External 3/16-inch silver contacts are provided for simultaneous control of associated circuits.

The standing wave ratio is 1.02 when RG-8U co-axial is used. Amphenol connectors are provided for this cable.—RADIO-CRAFT

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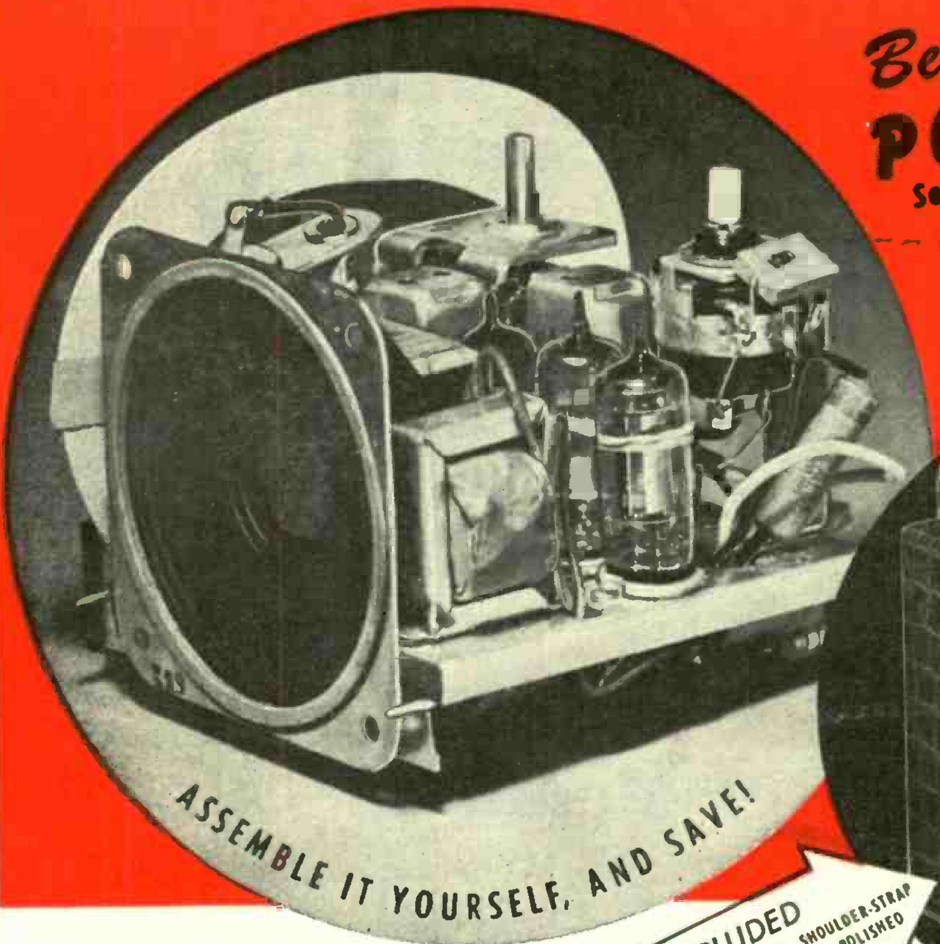

INCLUDED
THIS BEAUTIFUL, SHOULDER-STRAP CARRYING CASE WITH POLISHED BRASS FITTINGS.

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6½" HIGH BY 4¾" WIDE BY 3½" DEEP. THAT'S ALL!

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We urge you to bear in mind that this is NOT, *definitely* NOT, an ordinary portable, but a *tiny*, wonderful, beautiful, powerful set—which you can easily build yourself—quickly. Wait till you see the attractive case, covered in simulated leather, with adjustable shoulder strap. You'll want several. Use them as gifts.

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It has a 3½" ALNICO V PM speaker. Uses standard, easy-to-get, long-lasting batteries—easy to change. It plays with the lid open or closed. Has 4 tubes. Weighs 3½" lbs. (approx.) when complete and operating, case and all!

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An Aid to Meter Reading

By P. Hemardinquer

MOST of the test instruments used by servicemen and amateurs are designed for several uses. A single instrument may measure voltage, current, resistance, capacity and the decibel output of amplifiers. Several ranges may be provided for some or all of these uses.

To connect the circuits properly for each of these varied uses it is necessary to use one or more gang switches, sometimes accompanied by toggle switches or pushbuttons. In much European apparatus, changes from one use or one range to another are often made by means of tip-jacks into which the test leads are inserted. This complexity of controls slows down the operation of checking a receiver, besides risking damage to the meter through wrong settings.

The simple device shown here speeds up service work and makes errors due to wrong instrument settings almost impossible.

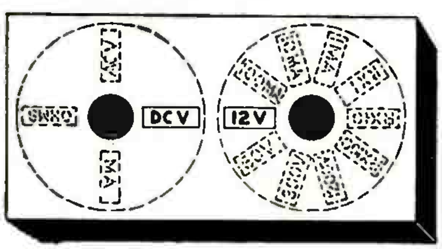

Fig. 1—All but desired figures are masked.

The method is simplicity itself. For the ordinary type of gang switch, a disc of bakelite or other plastic is made, on which are inked in or engraved the indications usually inscribed on the panel. This disc must fit tightly on the shaft, and may be further secured to it by coil cement. If two multiple switches are used—as in many instruments—the disc diameter should be such that the two discs just clear, as shown in Fig. 1.

Next a cover large enough to fit over both discs is made of thin opaque plastic or electrical fibre. A window or windows are cut in the cover, as well as holes for the switch shafts. Narrow strips of plastic material, thick enough to keep the cover clear of the discs, are cemented around the edges. Now when the knobs are put on, we have an instrument with all indications but the correct ones hidden from sight.

Now the operator's whole attention is fixed on the correct indications, and mistakes are unlikely.

The same method can be used in equipment furnished with pins and jacks, especially in apparatus constructed with the system in mind. The jacks can be lined up as in Fig. 2 and a protective cover placed over them. The cover has two openings directly over the jacks to be used, and may be held in place by another pair of pins which can be inserted in adjacent jacks.

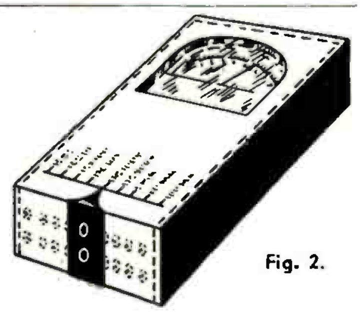

Fig. 2.

SPEAKER CLEANING KINK

My solution to the bothersome problem of removing metal particles from between the voice coil and pole of a dynamic speaker is simple and effective. Insert a long screw driver into a coil of insulated wire. I use a 6-volt speaker field, and energize it with direct current. This makes a powerful electromagnet that can reach into close places. Run the end of the magnetized screw driver around the opening between the voice coil and the pole, while gently moving the cone forward and backward. This removes magnetic metal filings. An air blast will remove nonmagnetic material.

E. S. COLEMAN,
Dallas, Texas

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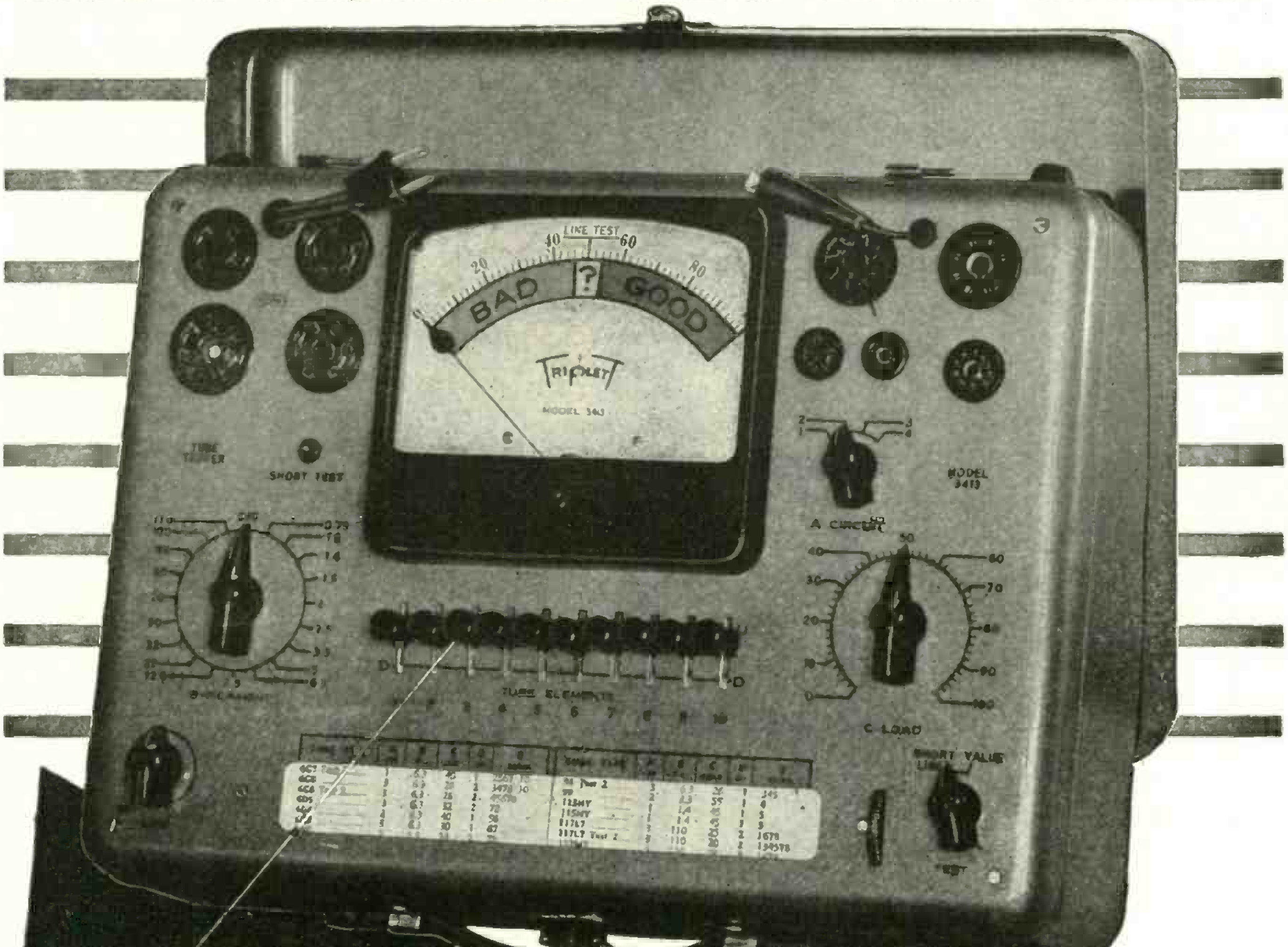
NEW model 3413 ...*LEVER SWITCHING*... tube tester



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FAST · SIMPLE · FLEXIBLE

Provides individual control of each tube element

With the new Model 3413 you can make your settings instantly—just snap the switch up or down. You actually "picture" the circuit. Usually not more than five of the ten lever switches need be set, yet you have individual control of each tube element. Many other convenient features make Model 3413 the buy of its field—such as the handy, built-in SPEED-ROLL tube chart, the larger easy-reading meter, the handsome new case with streamlined design. For either counter or portable use you will find Model 3413 a quality-packed tester that you'll be proud to own. Write today. Address Dept. L-127.

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STANDARDS ARE SET BY TRIPLETT

Triplett

ELECTRICAL INSTRUMENT CO. BLUFFTON, OHIO

TRANSATLANTIC NEWS

(Continued from page 39)

tures. It is the work of John Sargrove, inventor of the ECME system of mass-producing radio sets by electronically controlled machinery. Sargrove holds that the production of tubes also needs simplification and proposes a single type for use throughout the receiver. His new tube is certainly original. Imagine a beam tetrode with beam-forming plates of E section. Slice the electrodes (except the cathode and the beam-forming plates) in two by a vertical section, and you have, as shown in the accompanying figure, 2 beam tetrodes in 1 bulb. The halves of the tube are screened from one another by the cathode and by the middle arms of the E's, which come very close to it. Further screening between the leads to the 2 sets of electrodes is provided in the glass "foot" into which the electrodes are sealed. The 2 halves of the tube having identical characteristics, may be used if desired in parallel or in push-pull; or each half of the tube may be used in a separate way for a special purpose. Either half (or both) can be made into a triode. No less than 3 kinds of triode are possible: (1) the anode is connected to the outer grid; (2) the two grids are connected together; (3) the outer grid is used as control grid, the inner being connected to a slightly positive cathode. It is claimed that the tube can be used effectively as mixer-oscillator, i.f. amplifier, detector-amplifier, a.f. amplifier output, plain a.f. voltage amplifier, or power amplifier.

So far I have not had the opportunity of trying out these tubes; but the characteristics of the tube arranged for use in a variety of ways certainly seem to show considerable promise. It has one snag: the input-to-output capacitance is high. For this reason it is not likely to be useful in a really high-gain r.f. or i.f. stage with tuned input and output circuits. It may, though, answer well in the simpler broadcast receivers. It appears indeed possible that this, plus printed circuits, may be the answer to the problem of mass-producing low-priced domestic radio sets.

If the tube proves successful, it could be manufactured very cheaply, for long runs on a single type mean low production costs. Further, its highly original design means that the electrodes of the twin tubes in one bulb contain no more metal than would be required to construct a single tube of conventional pattern.

It will be curious if *the radio receivers of the future contain but one type of tube throughout*, for if this happens we shall have returned to the state of affairs prevailing in the early days. Then, as old hands will remember, we used the same kind of tube in every socket of the set, from input to output. We couldn't do anything else, for the high-impedance audion triode was the only tube available and it *had* to serve all purposes.

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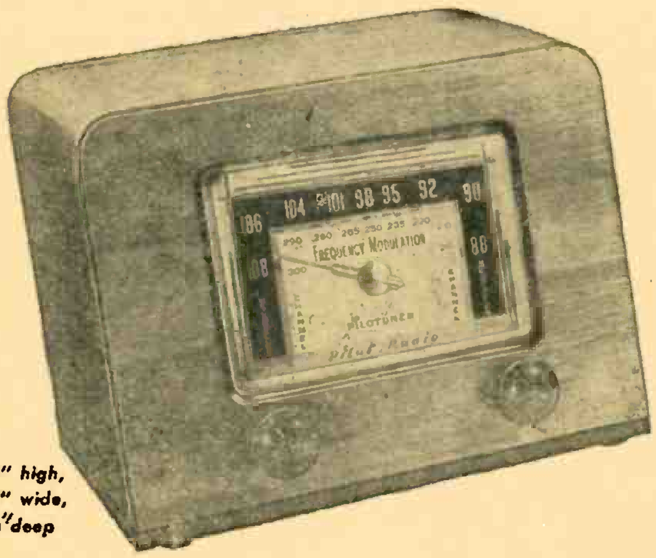

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New Radio-Electronic Patents

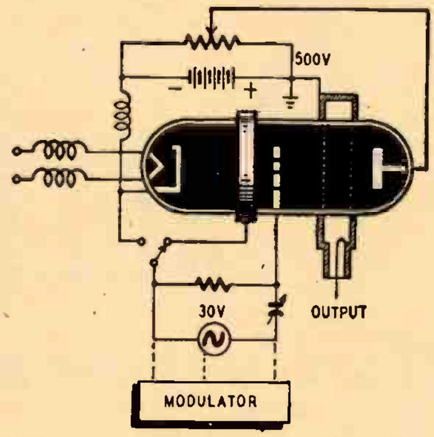
By I. QUEEN

MICROWAVE HARMONIC GENERATOR

John W. Tiley, Philadelphia, Pa.
(assigned to Philco Corp.)
Patent No. 2,422,146

Cavity resonator tubes like the Klystron are generally used as oscillators or amplifiers. Such tubes can be used also as harmonic generators in properly adjusted circuits as disclosed here.

The fundamental frequency input appears between grid and cathode (or external metal band around the tube). The cavity is tuned to the desired harmonic. As an example, these frequencies may be 200 mc and 3000 mc, respectively. The harmonic is brought to maximum strength by adjusting the potential of the repeller. Too much feedback should be avoided, however, to prevent self-oscillation.



The input voltage may be either unmodulated or frequency modulated (as shown).

DIRECTION FINDER

Wendell L. Carlson, Haddonfield, N. J.
(assigned to Radio Corp. of America)
Patent No. 2,419,987

In most types of direction finders a loop must be rotated until it points toward a transmitter for maximum signal response or away for minimum signal. In this improved direction finder, the loop does not have to be turned. Instead a visual indicator shows continuously whether the transmitter is located to the right or left of the receiver. This is especially convenient when either or both the transmitter or receiver are mobile.

The signal picked up by a loop is resonated by a series-tuned circuit and is amplified. The voltage from a vertical antenna is resonated by a parallel-tuned circuit. The signals are combined and applied to a suitable receiver. It is known that the sensitivity pattern of a loop is a figure eight. Reception is equally good from 2 opposite directions, but these signals are received out of phase. The vertical antenna has a circular pattern.

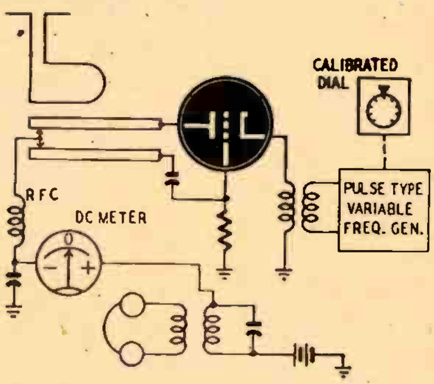
The indicating meter has 2 coils, M1 which is fixed and M2 which is pivoted. M1 is actuated by a low-frequency oscillator. The a.c. component of the receiver output is connected across M2.

Circuit theory shows that the voltage appearing across C is 90 degrees out of phase with the voltage across P, when both tuned circuits are resonated. If the series circuit is mistuned, the angle becomes greater or less than 90 degrees, according to which side of resonance it is tuned. Actually this circuit is wobbulated by a low-frequency oscillator which varies the inductance value of B 1,000 times a second.

Vector diagrams can be used to show how the circuit operates. If a transmitter is located at D in Fig. 2-a, the loop picks up no signal. Since the vertical antenna pickup is constant, there is no a.c. component across M2. The a.c. voltage across M1 produces an a.c. torque whose average is zero. Therefore the needle remains at midscale. Now if a signal originates at E, the loop intercepts it. The voltage across C varies periodically between L1 and L2 in Fig. 2-b. The vector A is the vertical antenna pickup. The vector sum of the signals varies periodically between R1 and R2. This a.c. component excites the meter coil M2. The voltage R1 exists at the same instant as the torque to the left from coil M1. R2 is synchronized with a torque to the right. Since R2 is larger, the needle deflects to the right in this case. If the transmitter is located within the other lobe of the loop pattern, as at point F, the loop voltage is reversed. The vector diagram of Fig. 2-c now applies. R1 is now larger than R2, and since R1 still corresponds to a torque to the left, the needle moves to the left.

DISTANCE INDICATOR

Patent No. 2,422,382
Henry T. Winchel, N. Hollywood, Calif.
(assigned to Bendix Aviation Corporation)



A patent has been issued for a superregenerator used for measuring distances to a target. Such a circuit becomes a transmitter as well as a receiver when it is closely coupled to an antenna system.

A pulsed variable-frequency oscillator periodically quenches or damps the oscillations of the superregenerator. The pulsed r.f. power is radi-
(Continued on page 70)

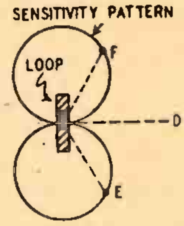


Fig. 2-a

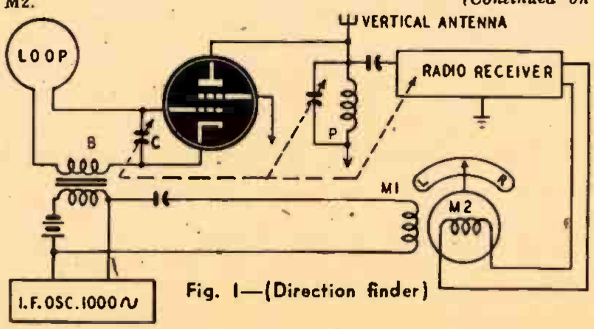


Fig. 1—(Direction finder)

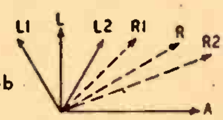


Fig. 2-b

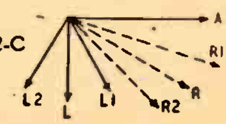
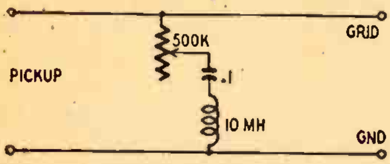


Fig. 2-C

RADIO-ELECTRONIC CIRCUITS

SCRATCH FILTER

This tuned scratch filter cuts record hiss considerably and reduces high-frequency distortion by lowering the cut-off limit. It reduces the volume level



slightly but this can be remedied by boosting the volume. Adjust for different scratch levels with the 500,000-ohm control.

PAUL WEISENBACH, II,
Cleveland, Ohio

USEFUL AMPLIFIER

This amplifier is simple to construct and supplies ample output for use as a small PA system, instrument, or phono amplifier. It can be used as a high-power intercommunicator with the addition of suitable switches.

A 6SC7 connected as a resistance-coupled cascade amplifier drives push-pull 6V6's. The grids of both stages are connected to input jacks through volume controls. The first stage may be used for an instrument pickup and the second stage for a high-output crystal microphone.

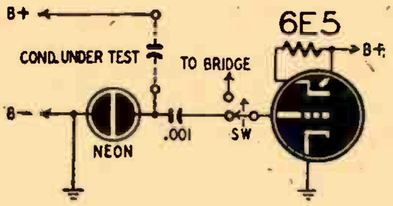
The phase-inverter system is similar to that used in several oscilloscopes. As the signal voltage on the grid of T1, swings in a positive direction more plate current flows through the non-by-passed cathode resistor common to T1 and T2. As the plate current increases or decreases, a corresponding voltage develops across the resistor to make the cathodes of both tubes vary in voltage with respect to ground. The grid of T2 is grounded and is more negative than its cathode, producing a plate current change of equal amplitude 180 degrees out of phase with the plate current of T1.

ALBERT ECKFELD,
Portsmouth, Ohio

Readers have written us in almost equal numbers approving and condemning the new Radio-Electronic Circuits, gleaned from recent technical literature. This month we are printing a number of the old type. Which kind do you like best? Let us have your vote on this subject by return mail.

CONDENSER CHECKERS

A number of condenser analyzers have been described which incorporate a neon leakage indicator as well as a capacity bridge. Usually, bridge balance is indicated by a cathode-ray indicator tube and leakage by flashes of the neon bulb. I find it possible to indicate leakage on the indicator tube also. A circuit is shown.

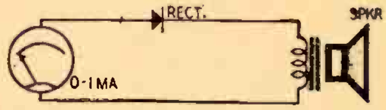


The condenser that usually by-passes the neon bulb is removed and connected between the high side of the bulb and the grid of the tube through a s.p.d.t. switch. When the 0.001-µf condenser is charging and discharging through the neon bulb, the shadow of the tube opens and closes. It is possible to conceal the neon bulb and use the indicator tube for all measurements.

HAROLD R. NEWELL,
Bradford, N. H.

NOVEL OUTPUT METER

For some time I have been using an output meter that is ready for use without having to be hooked to the set under test. It consists of a 1-ma d.c. meter and rectifier connected in series with a magnetic speaker. Place this speaker face to face with the speaker of the set under test, turn on the signal generator and align the set. A moderate signal will give a good indication on the meter. A PM speaker may be used,



although I find that a magnetic speaker is more sensitive.

Time is saved with this output meter because it does not have to be attached to the set under test.

H. ACKERMAN,
Brooklyn, N. Y.

(How will this system work in a shop with a high noise level or when several other receivers are going full blast? —Editor)

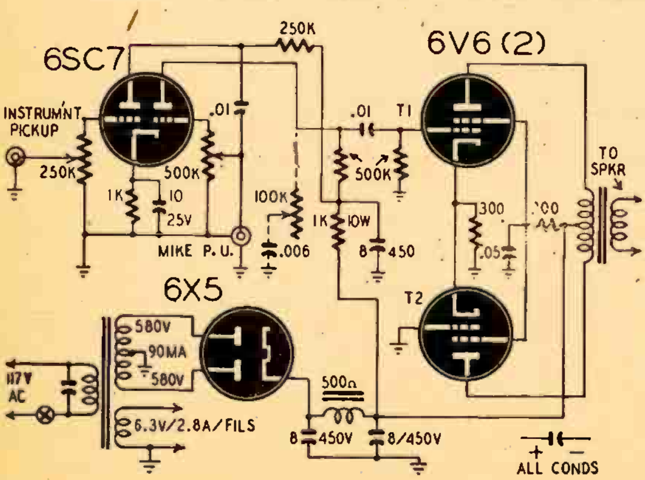
NOVEL EXPANDER

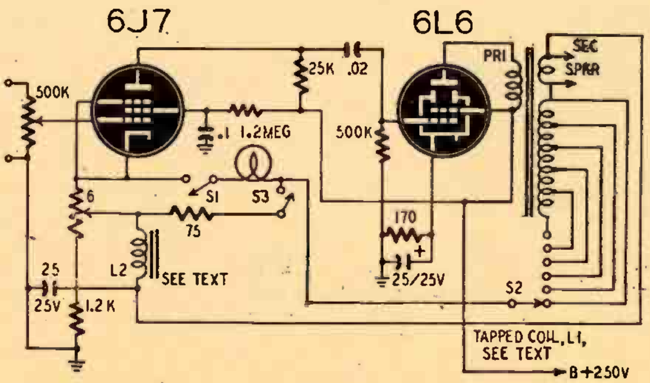
This circuit uses variable volume expansion and inverse feedback, through the addition of a 100-turn coil L1, of No. 32 wire, wound over the secondary of the output transformer. This coil is tapped at 20, 40, and 80 turns and connected to a 6-point tap switch S2. The choke L2 in the 6J7 cathode circuit has 50 turns of No. 20 wire on a core ½-inch square. Larger wire may be used, as the object is to keep the d.c. resistance below 1 ohm.

With S1 closed, the expander is in the circuit. An increase in current in the voice-coil circuit will develop an increasingly large voltage across the pilot lamp, because the resistance increases with temperature. This voltage adds to the cathode bias to increase the gain of the 6J7. S2 controls the amount of expansion. S3 completes the feedback circuit with the amount of feedback controlled by the setting of the arm of the 6-ohm resistor.

Various types of radio pilot lamps can be tried for best results.

A. A. BOSSCHART,
Amsterdam, Holland





Left—Simple and adaptable audio amplifier circuit with 6V6 output.
Above—This novel volume expander employs a low-voltage dial lamp.

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LOWEST PRICES • HIGHEST QUALITY • NO WAR SURPLUS

GENERATOR CONDENSERS

PHILCO part No. 61-0177—.5 mfd.—⅝" x 1⅛"—4" lead-slotted mounting strap for easy installation—Standard Merchandise—*not* war surplus—Present list price $1.00.
Our special—over 85% off **14c**

OUTPUT TRANSFORMERS

Clean stocks — long leads — mounting feet — made to fit where you need them.
For 6F6-6K6—to 4 ohm voice coil—size 2" x 1⅝" x 1⅜".
50L6-35L6-25L6 to 4 ohm voice coil 1⅝" x 1⅝" x 1⅜".
Specify quantity of each type you need at **49c**

CATHODE CONDENSERS

10 Mfd. at 25 working volts—1⁵⁄₁₆" x 1¾" tubular type—aluminum cans—overall cardboard sleeve—tinned leads—quality construction by a national manufacturer—backed by the famous R. S. & E. guarantee—list price **75c.** Priced to make you money at **12c** each
lots of 10 for......... **1.08** 100 for......... **9.00**

MIDGET I. F. TRANSFORMERS

100-500 Kc range—1¼" square x 2½" high—ceramic based mica trimmers—high gain iron cores—pep up old receivers—ideal for new construction. List price $2.10—up to 88% discount—stock up now for future use.
Each **29c** Dozen **3.39** Hundred **25.00**

AEROVOX GL 8-600

Genuine Aerovox 8 mfd.—600 volt working—inverted screw mounting — aluminum can 1⅜x4½" — 6" insulated leads. List Price $4.00—quantity limited—order now on this one time item at only...... **99c**

CINCo. MODEL 451A AC-DC

Volt—Ohm—Milliammeter

A dependable instrument of wide utility—sensitivity 1000 ohms per volt.
Ranges: Volts AC, DC, and Output Ranges, 0-10/50/100/500/1000;
Ohms full scale, 500,000.
Ohms center scale, 7200.
NET complete with batteries **14.90**

CINCo. MODEL 312

Volt—Ohm—Milliammeter

An economy pocket meter featuring a 2" moving vane meter.
Reads: AC-DC volts, 0-25/50/125/250;
Mills AC-DC, 0-50;
Ohms, 100,000;
mfd. .05-15.
Jacks provide range selection.
NET Complete with cord and plug....... **6.75**

Start Your Own RADIO SERVICE SHOP

as low as **99.50**

Complete Starting-In Business Stocks of
TEST EQUIPMENT, TUBES, PARTS, TOOLS, EVERYTHING
Write, Wire, Phone for Full Details

PHONO PICKUP CRYSTALS

Standard types—Set Manufacturers close-out—all Guaranteed

Webster F2—Replaces L26-L40-L70 etc.—pin type terminals—1 oz. pressure—1 volt output—5000 cycle cut off.
List price $5.00—you pay us..... **1.49**

SHURE P93—W57A—pin type terminals—¾ oz. pressure—1.6 volt output—6000 cycle cut off. List price $4.45—our Special.. **1.98**

Astatic L-70—new postwar design—solder terminals—1¼ oz. pressure—1 volt output—4000 cycle cutoff. List price $5.55—we quote you... **1.98**

Pep-Up PHILCO CHANGERS

At last! All the parts you need to restore brilliant tone and volume to "sick" changers! You'll need all three items—sell your customer a 100% reconditioning job—
Selenium cell only, no holder............ **$1.80**
Sapphire needle only, no mirror.............. **$1.20**
Special original equipment lamp.............. **.27c**
RECONDITIONING KIT — all three above items—postpaid—special at.................. **3.21**

RADIO RULE

Here is a clear 6" plastic rule.—a necessity for radio students, draftsmen, hams, all who desire cleaner, more precise work—National advertised at $2.00. Order yours today postpaid only................. **35c**

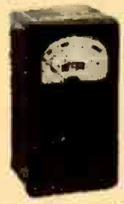
SEND FOR FREE CATALOG

MULTI-RANGE MILLIAMMETERS

Two types—for A.C. or D.C. measurements

MODEL 671—for A.C. current. Seven switch selected ranges of 0-5, 10, 25, 100, 250, 500, and 1000 milliamperes.
MODEL 675—for D.C. current. Eight switch selected ranges of 0-1, 5, 10, 25, 100, 250, 500, and 1000 milliamperes.
Here are two meters you can't afford to pass up—just the thing for radio servicing, transmitter trouble-shooting, general lab and experimental work.
A One-Time only Special buy at **7.95**

TRIPLETT 606B-VOLTAGE TESTER



Checks voltage and polarity. Range: 0-440 AC-DC volts—definite indications for 115, 220, and 440 volt lines. Separate polarized vane for AC or DC indication. Built in test leads. Excellent for checking wiring, fuses, general factory installation and maintenance. Every plant — every electrician needs several at this low price. Regular net 16.67 Special at............ **8.95**

TRIPLETT VOLTMETERS

Panel meters by Triplett! Top quality instruments—new—boxed—five popular types—priced right—your chance to get those meters you've always wanted—
MODEL 332—0-150 A.C. volts—3" round flush mounting black brass case.
MODEL 231—0-150 A.C. volts—2" round flush mounting bakelite case.
MODEL 237—0-150 A.C. volts—2" square flush mounting bakelite case.
MODEL 221—0-30 D.C. volts 2" round flush mounting bakelite case.
MODEL 324—0-400 D.C. volts—3" round projection mounting—bakelite case.
Supply limited—order now—list models you desire.
2.95 EACH

RESISTANCE LINE CORDS

Standard 3 terminal 135 ohm AC-DC cords—sturdy construction—flexible—5½' long—complete with plug—for sets having approximately 69-75.2 volts drop in the filaments—Regular list price 1.17—
Only 33c

Include full remittance with orders of $3.00 or less. Include 25% deposit with all C.O.D. orders of $3.00 or more. All shipments sent express collect if postage is not included. Prices subject to change without notice.
BE SURE TO INCLUDE SUFFICIENT POSTAGE. EXCESS WILL BE REFUNDED.

RADIO SUPPLY & ENGINEERING CO., Inc.

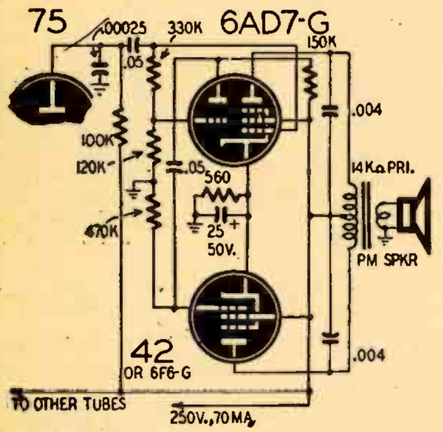
125 SELDEN AVE. DETROIT 1, MICH.

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.

ADDING PUSH-PULL STAGE

? *I have an automobile radio that has been converted to 117-volt a.c. operation. Its present a.f. system consists of a 75 and a 42. I would like to change this to use push-pull 42's or 6F6's in the output stage. Can this be done?—J.C.M., Glendale, Calif.*

A. Here is a circuit showing how a push-pull output stage may be added to your receiver. A 6AD7 triode-power am-

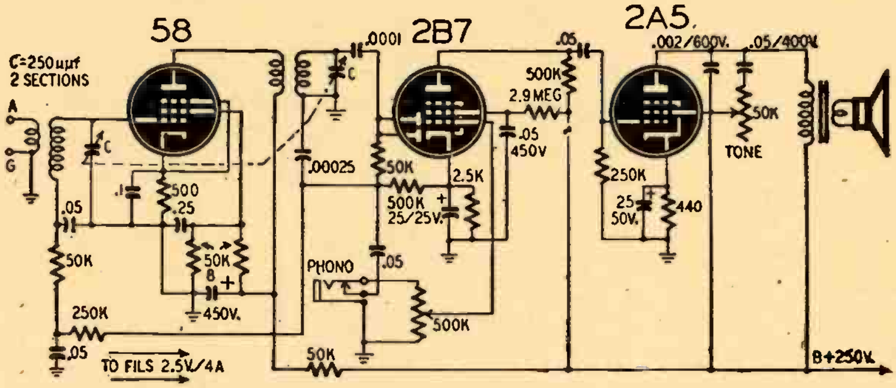


plifier pentode is used to supply the additional power amplifier tube as well as the phase inverter stage with a saving of one tube. The other output tube may be either a 42 or a 6F6. These tubes can supply 6 watts.

3-TUBE RADIO FROM AMPLIFIER

? *I have a small phono amplifier using a 2B7 as voltage amplifier and a 2A5 output stage. The diodes on the 2B7 are unused. Please show me how a t.r.f. stage may be added to feed the diodes of the 2B7 and make a radiophonograph.—J.N.M., Brooklyn, N. Y.*

A. Your amplifier may be converted to a radio by adding a 58 or equivalent as an r.f. amplifier stage feeding into the diodes of the 2B7. If the phono input jack is wired as shown, the radio will be disconnected when the phonograph is plugged into the amplifier.

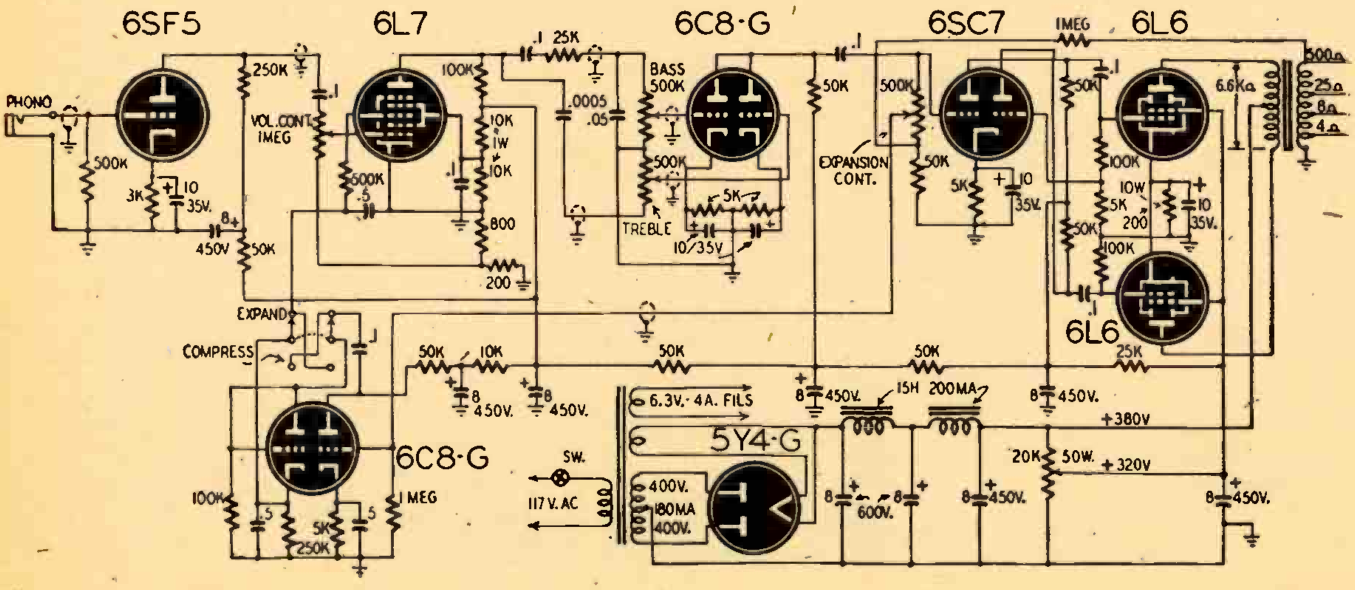


SUPERIOR PHONOGRAPH AMPLIFIER

? *I would like to build a "super" phonograph amplifier with good volume, dual electronic tone controls, inverse feedback and volume expansion and compression.—C.A.B., Wheeling, W. Va.*

A. Here is a diagram of a good phonograph amplifier. The 6L6 output stage will deliver 30 watts maximum output, far more audio power than normally needed in the home. Operation at lower volume levels will therefore result in practically no distortion. Electronic tone control is incorporated in the grid circuits of the 6C8-G.

(Continued on page 83)



RADIOMEN'S HEADQUARTERS ◄|► WORLD WIDE MAIL ORDER SERVICE ! ! !

BC-947A ONE KILOWATT HIGH FREQUENCY TRANSMITTER

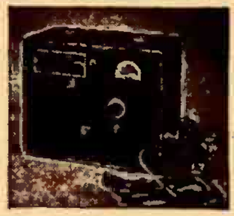
This relay-controlled transmitter includes a 115V, 60 cycle power supply, protected by 8 magnetic circuit breakers, that alone is worth more than the price we are asking for the whole rig, even on today's surplus market. On the front panel are six 3½" GE or Weston meters, including 250 MA, 50 MA, 1000 MA, 150V AC, and 1500V DC at 1000 ohms per volt for screens and plate. The rack-type 21"x15"x86" 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, as is, only $69.95.

AT LAST YOU CAN AFFORD A LABORATORY STANDARD SIGNAL GENERATOR

The famous Measurements Corp. Model 78B, 5 Tube Laboratory Standard Signal Generator (currently selling new, FOB Boonton, N. J., for $310.00 net), is available in perfect condition for 25 to 60 cycles. 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."



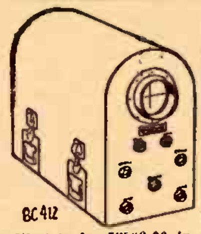
Model 78-B Standard Signal Generator. Two Frequency Bands between 15 and 250 megacycles.

5" "SD" RADAR P.P.I. OSCILLOSCOPE, complete with 9 tubes. This unit contains magnetic deflection yokes and a Selsyn motor and has a self-contained power supply designed to run on the AC supply on LST or PT boats. The most satisfactory scope available for navigational radar or panoramic television applications. Uses 807 tube in final-power stage that provides yoke deflecting current. Your cost $39.95. **"SO" RADAR ECHO BOXES. THE PERFECT CALIBRATED CAVITY WAVEMETER—$10.00.**

5 INCH RADAR OSCILLOSCOPE BC-412. Easily converted by a few hours' work 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 and a brand new 5BP1 for the scope application. Specify your choice. Your cost $59.95

LORAN INDICATOR OSCILLOSCOPE, complete with 26 tubes and a 5" cathode ray tube, government instruction manual included—$39.95.

2 INCH OSCILLOSCOPE EQUIPPED WITH 2AP1 TUBE $9.95



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. Supplied with at least 29 of the original 40 odd tubes, including a new separately crated scope tube. Makes a wonderful laboratory instrument and is better adapted for television than any other war surplus item. Your cost $69.95

GENERAL ELECTRIC RT-1248 15-TUBE TRANSMITTER-RECEIVER

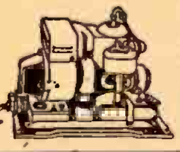
TERRIFIC POWER—(20 watts) on any two instantly selected, easily pre-adjusted frequencies from 435 to 500 Mc. Transmitter uses 5 tubes including a Western Electric 316 A as final. Receiver uses 10 tubes including 955's, as first detector and oscillator, and 3—7H7's as IF's, with 4 slug-tuned 40 Mc. IF 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.

ARMY BC-312 COMMUNICATIONS RECEIVER

This receiver covers the frequency range of 1.5 MC to 18 MC in six direct reading bands. The dial, that is driven with split gears to prevent backlash, has 4500 logging divisions per band with approximately 600 divisions on the 20 and 40 meter ham bands and 1000 divisions on 80 meters. Two stages of RF before the converter in this set give it a very high signal to noise ratio and maximum sensitivity. Outstanding features of this receiver are: BFO with pitch control send receive relay, jacks on the front panel for headphones and speaker output, and mike and key inputs. All tubes are standard 6 volt types. This receiver was designed to withstand rough usage in the field and for operation from vehicles while in motion, so it is ruggedly constructed and contains a dynamotor power supply—Your cost $49.95. Conversion kit to 110 V AC is available for $6.50

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 that 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.

PE-109 32-Volt DIRECT CURRENT POWER PLANT



This power plant consists of a gasoline engine that is direct coupled to a 2000 watt 32 volt DC generator. This unit is ideal for use in locations that are not serviced by commercial power or to run many of the surplus items that require 24-32V DC for operation. The price of this power plant is only $59.95. We can also supply a converter that will supply 110v AC from the above unit or from any 20-32V DC source for $29.95.

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

SCR-610 or BC-659 TEN METER TRANSMITTER-RECEIVER. Voice only FM, 27 to 38.9 MC, crystal controlled, 2 watts output, 6, 12, or 24 volt DC input. The ideal battery powered portable $49.95

SERVICEMEN

Check This Column for Lowest Prices on Quality Parts

TUBES; all types in stock, 60% off on all tubes if ordered in lots of 10 or more.

RESISTOR KITS—100 assorted 2 watt resistors—only $1.95.

TRANSFORMERS—All types in stock. **AUTO-TRANSFORMERS**; Steps up 110v to 220v. or steps down 220v to 110v—$1.95. **FIL. TRANS.**: 6.3v, 20 Amps.—$1.98; Universal Output Trans. 8 Watt—89c; 18 Watt—$1.29; 30 Watt—$1.69. **AUDIO TRANSFORMERS**: S. Plate to S. Grid. 3:1—79c; S. Plate to P.P. Grids—79c; Heavy Duty Class AB or B. P.P. Inputs—$1.49; Midget Output for AC-DC sets—69c; **MIKE TRANSFORMER** for T-17 Shure microphone, similar to UTC ouncer type—$2.00. Stancor SB or DB mike to line or grid—$1.95.

POWER TRANSFORMERS—Half-shell type. 110V. 60 cy. Centertapped HV winding. Specify either 2.5 or 6.3V filament when ordering.

For 4-5 tube sets—650V. 40MA. 5V & 2.5 or 6.3V......$1.49
For 5-6 tube sets—650V. 45MA. 5V & 2.5 or 6.3V...... 1.75
For 6-7 tube sets—675V. 50MA. 5V & 2.5 or 6.3V...... 1.90
For 7-8 tube sets—700V. 70MA. 5V & 6.3 or two 2.5V.. 2.35
For 7-8 tube sets—700V. 70MA. 5V & 6.3 (25 cycle).... 3.60
For 8-9 tube sets—700V-90MA. 5V-3A. 2.5V-3.5A, 2.5-10.5A 2.65
For 9-11 tube sets—700V. 100MA. 5V &6.3V-4A......... 2.85
For 9-15 tube sets—600V. 150MA. 5V & 6.3V........... 2.95

CONDENSERS—PAPER TUBULAR 600 WV—.001. .002. .005—8c; .01. .05—9c; .1—10c; .25—23c; .5—36c; **ELECTROLYTICS**: 8mfd 200v—20c; 10mfd 35v—20c; 20mfd 150v—23c; 20/20mfd 150v—35c; 30/20 150v—46c; 50mfd 150v—43c; 8mfd 475v—34c; 16mfd 350v—65c; **OIL CONDENSERS**: 4mfd 600v—49c; 2mfd 600v—29c; 3X.1mfd 600v—29c.

FILTER CHOKES: 200, 300, 400, 500 ohm light duty—59c; 200 or 300 ohm heavy duty—99c; 250 ma 35 ohm, made for U.S. Navy, fully shielded—$1.95; 75 ohm 125 ma—25c or 25 for $4.25; "Meissner type" tapped filter chokes—25c; 8 amp. iron core A filter—25c; Choke-condenser combination. Ideal to replace any size speaker field when installing PM speakers—79c.

110 V. CIRCUIT BREAKERS of Magnetic type; Following Current Ratings in Stock; 1.25, 3, 4, 8 Amps. Please specify. $1.95 each.

Seven Assorted I.F. Transformers—$1.98; Five Asstd. Oscillator Coils—69c.

SPEAKERS-PM dynamic type-4"—$1.55; 5" $1.55; 6"—$1.95; 8"—$3.95; 10"—$5.95; 12"—$7.50.

SELENIUM RECTIFIERS—Dry disc type 1½" by 1", 1.2 Amp. maximum, suitable for converting DC relays to AC, for supplying filament source in portable radios, converting DC meters to AC applications, and also may be used in low current chargers—90c.

METER RECTIFIERS—Full wave, may be used for replacement, or in construction of all types of test equipment—$1.25 Half Wave—90c.

MICROPHONES—All nationally known brands. Bullet crystal—$5.45; Bullet Dynamic—$7.45; Mike Jr.—60c; Handy Mike—90c; Lapel Mike—93c; **SHURE** T-17 MIKES, with push to talk switch—99c.

20 ASST'D COIL FORMS, including 11 ceramic, 3 polystyrene, and 6 fiber, all useful sizes—50c.

VARIABLE CONDENSERS: 350 MMFD. 5 gang—$1.95; 4 gang—$1.49; 3 gang—83c; 2 gang—79c; 7.5 to 20 MMFD. 1750v spacing, extra long shaft Hammarlund—69c; miniature variables, 25 MMFD—39c; 50 MMFD—49c; 75 MMFD—59c; 100 MMFD—69c; 140 MMFD—79c.

TRANSMITTING RF CHOKES, 4 PIE, 350 Ma.—25c or 5 for $1.00.

INTERRUPTION FREQUENCY COILS for super-regenerative receivers or the tremendously popular FM adapters for standard broadcast sets. Iron core with a resonant frequency of 50 KC—39c; Air Core, 100 KC— 29c.

30 MC IF TRANSFORMERS, double slug tuned—25c **VIDEO AMPLIFIER PLATE COILS**—Slug tuned—25c. **REMOTE CONTROL UNIT**: Aluminum case 4x3x2" containing 2 potentiometers, triple pole switch, 4 knobs, gear mechanism, counter and phone jacks—59c.

MODULATION TRANSFORMERS—10 watt, metal case,98c; 30 watt, open-type, $1.95; 40 watt, cast aluminum case, $2.95; Class "B" input transformers, cast aluminum case, $1.95; Transceiver audio transformer, 65c; Transceiver modulation transformers, 65c.

PUBLIC ADDRESS AMPLIFIERS—25 watts peak output. This unit has separate input circuits for microphone and phono. The gain of the microphone circuit is 122db. The phono circuit has a gain of 82db. The frequency response is flat from 50 to 12,000 cycles. A $65 value for only $32.

Miniature plier set contains one of each of the following: Needle nose, flat nose, parrot nose, standard nose. All contained in a leatherette case. Your cost—$1.98.

ATR battery eliminator—Handy for servicing car radios or any other purpose requiring 6 or 12v at 14 amps. Net price—$36.

SOCKET WRENCH SET consisting of 5 sockets ranging in size from 5/16 to ½" and a handle—79c.

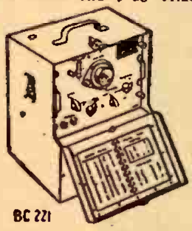
AUTOMATIC WIRE STRIPPERS will strip up to 1000 wires per hour, a handy tool for any service job—$3.52. Six Foot Asbestos Insulated Flat Iron Cord, one end has a male plug, the other end has a standard flat iron socket. Your price—70c each or 10 for $5.

LINE FILTERS—110V—each unit contains two 2 mfd. oil filled condensers and a 15 amp. iron core choke. This filter has innumerable uses such as oil burner line filter, etc. A ten dollar value for 98c.

Crystal pick-up phono motor and turntable—$5.25.

FLUORESCENT LIGHT BALLASTS. Single 30 or 40 watt, $1.68; Dual 40 watt High Power Factor—$3.75.

HEADPHONES—Highest quality Signal Corps headsets with 12" cord and plug $1.25. 5' rubber covered patch-cords with phone plug and socket—45c.



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 $39.95.

BUFFALO RADIO SUPPLY, 219-221 Genesee St., Dept.12C. BUFFALO 3, N. Y.

Cable Address: BUFRAD

TECHNOTES

.... 25D8 SUBSTITUTION

When 25D8's are not available, make an adapter for mounting a 12BA6 and a 12AT6 in the base of the 28D8. Connect the filaments in series and wire the other terminals to the pins of the old tube. Shield the external grid lead to prevent oscillations.

A. W. POWELL,
Rolfe, Iowa

.... MOTOROLA 55X11 AND 55X11A

Intermittent reception in these models sometimes can be traced to a rivet on the speaker frame. This rivet is insulated and used as a terminal for one of the voice coil leads—the other is intentionally grounded to the frame. When the insulated rivet develops a short to the frame, it short-circuits the voice coil. A simple remedy is to remove the voice coil lead from the rivet and connect it to an insulated mounting lug that has been soldered to the defective rivet.

C. T. MARTOWICZ,
New York, N. Y.

Brand New Automatic Direction Finder

RADIO COMPASS

SCR-269F Complete with Component Parts Less Power Supply **$75.00**

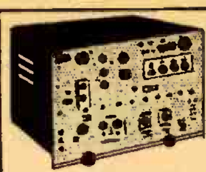
This equipment comes complete with 17 - tube superheterodyne receiver which is tunable from 200-1750 KC in three bands. A complete instruction book for operation and maintenance accompanies this equipment.

TRANSMITTER TUNING UNIT BC-375

Approximately 65 MMFD cond., coils RF chokes, dials, assorted mica condensers, 2500 WVDC. Over $50.00 parts! **$1.95**

DYNAMOTOR UNIT PE-101-C

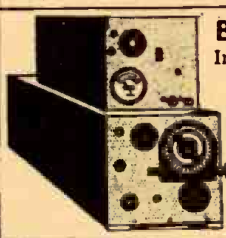
Duo output Dynamotor, input voltage 12 to 24V., output voltage 400V. at 135 ma, 800V at 20 ma, and 9 V. at 1.1 amp. **$2.95**



IFF TRANSMITTER AND RECEIVER

$9.95

Successfully used as a television receiver. 30 MC I.F. channel and video amplifier; original diagram furnished. Less tubes and power transformer.



BC-AR230 Transmitter

Including 4 tubes and Rf Amps. meter.

BC-AL229 Receiver

Including 6 tubes. Used in aircraft.

BOTH UNITS ONLY **$9.95**

BC223AX TRANSMITTER

Complete with tubes and tuning unit covering 80 meter Ham band, including frequencies charts. less xtals. **$12.50**

BC 433G RECEIVER

Complete with tubes, used in good condition. **$29.50**

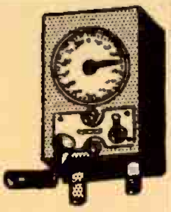
T-17 CARBON MICROPHONE

89¢

Like new.

Azimuth Control

49¢



Dial calibrated. 360 face. ideal for antenna rationalizing indicator.

Overload Relay

$1.95

Patter and Brumfield. Relay 1, 5,000 ohms, coil current 10 MA., Relay No. 2, 110V, 60 Cy, AC coil. S.P.D.T.

POWER TRANS.

$1.95 110V, 60 cy. Sec. 1: 4V at 16 Amps, Sec. 2: 2½V at 1.75 Amps. Ideal for 2x2 and 826 tubes. Hermetically sealed. size 6" x 3½" x 4¼".

GEN. ELECTRIC METER

$3.95

Type DO41, 3" 0-1 MA, meter scale graduation 0-5 D.C. Kilo V and 0 10 MA D.C.

BK22K RELAY

$2.95 Used in conjunction with SCR269F. changeover contains 29V, step relay, 5 deck, 6 position switch. 12V D.P.S.

Variable Resistor

2500 ohm. 100 W. **49¢**

IF TRANS.

95¢

Mounted in aluminum shield can 1500 KC. with air trimmer. impedance coupled type.

BC-654 Transmitter & Receiver

With tubes and xtals, used, in good condition. The frequency range of both transmitter and receiver is continuous from 3700 to 5800 KC; all stages gang tuned by anti-backlash worm gear dial mechanisms......$12.50

FILAMENT TRANS FORMERS

110-V, 60-cy. Pri. Sec. 5-V, 3". Shelled case. **$1.49**

110-V, 60 cy. Sec.: 2.5V at 5.25 amps. Shelled case. **$2.45**

5 GANG VARIABLE CONDENSER

$1.95

5 gang, approx. 50 M.M.F.D. per section with individual air-tuned padders. 18 to 1 vernier drive.

POWER TRANSFORMER

$1.95 110V, 60 cy Sec. 300V ea side of center of 125MA. 6.3V at 2.1 Amps, 5V at 3 Amps. Hermetically sealed. size 6" x 3½" x 4¼".

PYRANOL CAPACITATOR

$2.95

General Electric. 1 MFD. 5.000 VDC.

4" x 4½" x 3¾".

DYNAMOTOR DA-3A

$1.50

Input. 28 V.D.C.. 10.5 AMPS Output. 300 V.D.C.. .260 AMPS 150 V.D.C.. .010 AMPS 14.5 V.D.C.. 5 AMPS Shipping Wt. 25 Lbs.

Toggle Switch

39¢

D.P.D.T. 30 Amps. in black Bakelite case.

POWER TRANS.

Primary 110V. 60 cy., Sec. 700V each side of center at 80MA. 6.3V at 1.2 Amps, 5V at 3 Amps. Hermetically sealed size 6" x 3½" x 3". **$1.95**

FM Radio and Transmitter BC-620-A, 20 MC - 27.9 MC

$9.95

This Xtal controlled FM set has 13 tubes and has dual Xtal controlled channels. It also contains built-in Fil. and Plate Meter. Tubes used: (4) 1LN5, (1) 1LC6, (1) 1LH4, (2) 1291, (4) 1299, (1) 1294. Ideal for communication between Trucks. Boats. etc. Used, in good condition. Less power supply. Wt..38 lbs. Complete with carrying case and diagrams.

30MC IF TRANSFORMER

29¢

Slugged Tune.

Condensers

Cap. MFD	Working Volt	Your Cost
1	1000 oil	44c
8	600 oil	95c
2	600 oil	49c

Butterfly Condensers

Oscillator assembly 76 to 300 MC with acorn tube socket mounted on condenser. **$1.95**

Type B, frequency range 300 to 1000 megacycles. **95¢**

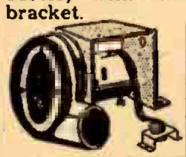
antenna condenser 105-330 MC. **$1.95**

Oscillator 105-330 MC. **$1.95**

Squirrel Cage Blower

$7.50

2" outlet, 110 AC, 60cy Silent Ball Bearing Motor, with mounting bracket.



Sockets for acorn tubes	$ .19
Powdered iron ⅜ slug	.10
Jacks. PL55, PL68	.15
Asst. mica condensers	1.95
3 lbs. asst. hardware	1.00
Pin straightener for min. tubes	.49
Ear phones, 2000 ohms, used	.95
Johnson sockets, No. 210, 25W	.39

CORONA BALLS

$1.00 Dozen 10¢ Each

High-Speed Photo Flash Tube

10,000 Flashes

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

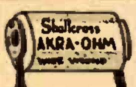
$8.95

TUBES

813	5.95	872A	1.95
VR150	.69	9004	.49
955	.65	9006	.59
9002	.89	5085	.89
RK60	.95	VT127A	2.95
9001	.89		
6J4	1.50	35W4	.69
5 FP7	1.95	3AP1	1.95
7BP7	2.95	3BP1	1.95
9LP7	3.95	6J5	.49
6N7	.89	5BP1	3.95
		6H6	.59

1T4. 3Q5. 6SN7 .59
3S4. 5W4. 6SA7. 1G5. 12H6. 6SH7 **44¢**

General Electric 25 MFD Photoflash pyramol capacitator, 2000 VDC-INT	$14.95
SPST relay 24V, 528 ohm. coil contact rating 5 amp. Packed 2 to a carton ....2 for	.49
Coaxial solid copper tubing, 30 foot	2.95
30-20 MFD Solar condenser. 150 V. tubular	.49
Assorted tubular oil-filled condensers, up to 5 MFD, 15 for	1.00
3 lbs. assorted hardware	1.00
Westinghouse oil 1MFD 6000V, WVDC	7.95
144 MC radar osc., uses 15E with variable coupling. complete less tubes	3.95
Assorted high frequency chokes, 25 for	1.00
Thordansen 300 MA power transformer, 110 or 220V, 60 cy. input, secondary 500/ct/100 tapped at 400/400 extra bias winding 200/ct/100 at 50 MA, 18 lbs.	4.95
Assorted resistors ½ watt fully insulated in popular ohmages, 100 for	1.49
Thordorsen T48003, 2H-7H 550 MA swing choke, size 4½x5½x5½. square black crackle case. 15 lbs.	5.95
Assorted mica condensers, per 100	1.95
Wafer sockets, 4, 5, 6. 7 and 8 prong, per 100	2.95
12" Utah PM speaker Alinco No. 5 with 6F6 output transformer	6.95
Assorted knobs, push on wood and plastic	1.95



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MAKING MAGNETIC PICKUPS

By EDWIN COOPER

MY experiments with magnetic pickups for steel-stringed musical instruments have led to development of 3 models that work well. All models can be constructed cheaply and simply. Each uses Alnico magnets that may be obtained from discarded PM speakers, a coil of fine wire, and some scrap metal. Aluminum or brass will do.

The first model, shown in the photograph, consists of a magnet about ⅝ inch square and 1¼ inch long, a nonmagnetic metal bracket, a 2½- x 3-inch sheet of ¼-inch plastic, a 2-inch piece of ¼-inch steel rod, and a field coil from a small speaker. The coil used in this model is ¾ inch thick, 1¾ inch outside, ¾ inch inside diameter, 2,600 ohms, d.c. resistance. (Fig. 1).

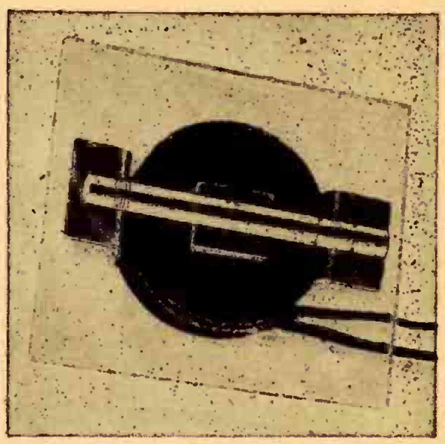

Fig. 1—A very simple and easily-made pickup.

Cut a hole in the center of the plastic plate so that it will make a snug fit around one end of the magnet. Insert the magnet in the hole so it projects about 1/16 inch through the plate. Place the field coil over the magnet and bend a U-shaped bracket from brass or aluminum so the magnet and coil can be fastened firmly to the plastic plate. Lay the steel rod across the top of the magnet and drill a small hole through each end. Tap the holes, drill corresponding holes in the plastic and bracket, and assemble the unit with brass screws. Connect the leads from the coil to the input jack of the amplifier.

For the second model (Fig. 2), 2 identical magnets from small speakers are used. The end plates are cut from

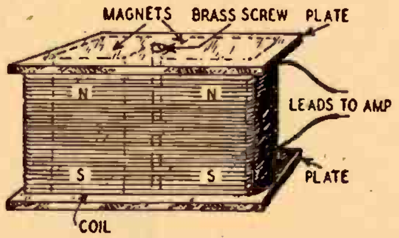

Fig. 2—Two magnets are used in this device.

nonmagnetic metal. These are long enough to extend about ⅛ inch on each side of the instrument strings and wide enough to form sides for the coil that is to be wound around the magnets—½ inch wider than the cross section of the magnets should be about right. Drill a hole in the center of each plate and tap one for a small screw. Locate the magnets as shown with *like* poles against the same plate. Hold the magnets in position with a brass screw through the holes in the plates.

To check the polarity of the magnets, place them end-to-end so that they do not attract and mark these ends. Place them against the same plate.

Wrap each magnet with 3 or 4 layers of Scotch tape. Wind a single coil of very fine enamel-covered wire on the form made by the magnets and end plates. The coil should have a resistance of 2,000 ohms or more.

The third model (Fig. 3), works well but is slightly larger than the others. In this model, magnetic metal plates are used. Two magnets are mounted on the same end of the plates with like poles against the same plate.

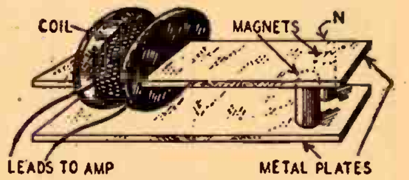

Fig. 3—Plates can be shorter when required.

A coil of many turns of fine wire is wound on the opposite end of one of the plates, as shown.

The pickups are mounted on the instrument just in front of the bridge. The first model has the rod at right angles to the strings, and the others have the planes of the coils at right angles to the strings.

(The impedance of the pickup coils depends on a number of variables. If the unit does not work well in the high-impedance input circuit of an amplifier, try using a multimatch input transformer and adjust for best performance. *—Editor)*

SPEAKER SHIMS

Good speaker shims, particularly for small speakers, can be made from rejected negatives from roll film. The material is 0.005 inch thick and of uniform stiffness. Negatives can be cut to fit exactly around the pole piece. Be careful not to get any service solvent on the shims.

THOMAS E. RUMNEY,
Toronto, Canada

WORLD WIDE STATION LIST

(Continued from page 38)

9.570	KWIX	SAN FRANCISCO, CALIF.: Alaskan beam, 0115 to 0345
9.580	GSC	LONDON, ENGLAND: 1100 to 1315; 1330 to 1415; 1430 to 1530; 1615 to 2300; 2345 to 0030
9.580	VLG	MELBOURNE, AUSTRALIA; 1100 to 1200
9.590	VOD5	DELHI, INDIA: 0900 to 1230
9.590	PCJ	HUIZEN, NETHERLANDS: 1400 to 1500; 1745 to 1815; 2000 to 2200
9.600	XEYU	MEXICO CITY, MEXICO
9.600	GRY	LONDON, ENGLAND: 1800 to 2230; 2300 to 0030; 1230 to 1600
9.610	ZRL	CAPETOWN, SOUTH AFRICA; 0300 to 0700; 0900 to 1030
9.610	ZYC8	RIO DE JANEIRO, BRAZIL: 1500 to 2200
9.610	VLC6	SHEPPARTON, AUSTRALIA; 0830 oo 1200
9.610	TIPG	SAN JOSE, COSTA RICA: 0700 to 2330
9.620	XGNC	KALGAN, CHINA: 0400 to 0815
9.620	CXA6	MONTEVIDEO, URUGUAY; 1530 to 2100
9.620	GWO	LONDON, ENGLAND: 0045 to 0130; 0200 to 0300; 0600 to 0630; 0700 to 0900; 1045 to 1400; 1700 to 2030
9.630	CKLO	MONTREAL, CANADA: 1600 to 1800
9.640	GVZ	LONDON, ENGLAND: 1500 to 1730; 1800 to 2230; 0100 to 0500
9.650	XGOY	CHUNGKING, CHINA: 0630 to 1030
9.650	KRHO	HONOLULU, HAWAII: 0400 to 1100
9.650		MOSCOW, U.S.S.R.: 1100 to 1220; 2200 to 2235
9.650	WCDA	NEW YORK CITY: Caribbean beam, 1715 to 1745
9.650	KNBA	DIXON, CALIFORNIA; Hawaiian-Australian beam, 0245 to 0345
9.650	KCBA	DELANO, CALIFORNIA; Hawaiian-Australian beam, 0400 to 1000
9.650	KCBN	DELANO, CALIFORNIA: South American beam, 2000 to 2200
9.670	WRCA	NEW YORK CITY: Brazilian beam, 1900 to 2100; South American beam, 2115 to 2215
9.670	VUD4	DELHI, INDIA; 0125 to 0180; 0200 to 0400; 0730 to 0745; 0800 to 0830; 0845 to 1230; 2040 to 2245
9.670	WNRX	NEW YORK CITY: Brazilian beam, 1800 to 1900; 2000 to 2200
9.680	HVJ	VATICAN CITY: 1200 to 1330
9.680	XEQQ	MEXICO CITY, MEXICO: 0700 to 0045
9.680	VLB2	SHEPPARTON, AUSTRALIA: 0900 to 1100
9.680	EQC	TEHERAN, IRAN: 1200 to 1430
9.680	LRA1	BUENOS AIRES, ARGENTINA: 1600 to 1630
9.700	WLWR1	CINCINNATI, OHIO: South American beam, 1900 to 2400
9.700	KCBF	DELANO, CALIFORNIA; Japanese-Chinese beam, 0400 to 0900
9.700		FORT DE FRANCE, MARTINIQUE; 0900 to 1245; 1600 to 1010; 1730 to 2030
9.710		MOSCOW, U.S.S.R.; 2800 to 0730
9.720	PRL7	RIO DE JANEIRO, BRAZIL; 0430 to 0600; 1415 to 1445; 1500 to 2100
9.730	XGOA	CHUNGKING, CHINA: 0900 to 1030
9.730	CSW7	LISBON, PORTUGAL: 1900 to 2000
9.740	OTC	LEOPOLDVILLE, BELGIAN CONGO: 1300 to 2015
9.750	KCBA	DELANO, CALIFORNIA: Philippine beam, 0400 to 0900
9.820		VIENNA, AUSTRIA; 2345 to 2030
9.820	GRH	LONDON, ENGLAND: 1215 to 1600; 1700 to 2300
9.830	COBL	HAVANA, CUBA; 0715 to 0045
9.860		MOSCOW, U.S.S.R.; 2200 to 0200; 0830 to 0930; 1000 to 1200
9.900	ZTJ	JOHANNESBURG, SOUTH AFRICA; 0315 to 0715
9.930	SVM	ATHENS, GREECE: 1300 to 1800
9.960	HCJB	QUITO, ECUADOR: 0545 to 0845; 1200 to 2230
10.000	WWV	WASHINGTON, D. C.: U.S. Bureau of Standards; frequency, time, and musical pitch; broadcasts continuously day and night
10.000	XGOL	FOOCHOW, CHINA: 0400 to 1000
10.229	PSH	RIO DE JANEIRO, BRAZIL; 1700 to 1800
10.730	VQ7LO	NAIROBI, KENYA; 0500 to 0600; 0830 to 0915; 0945 to 1100
10.780	SDB2	STOCKHOLM, SWEDEN; 1100 to 1720
11.040	CSW6	LISBON, PORTUGAL: 0900 to 1130; 1230 to 1500; 1600 to 1800
11.090		PONTA DEL GADA, AZORES; 1500 to 1600
11.630		MOSCOW, U.S.S.R.: 1930 to 0300; 0600 to 0800; 0830 to 1300
11.650	XTPA	CANTON, CHINA; 0400 to 0915
11.680	GRG	LONDON, ENGLAND: 0600 to 0645; 0700 to 0900; 1000 to 1130; 1145 to 1200; 1230 to 1430
11.690	XORA	SHANGHAI, CHINA; 1830 to 2400; 0300 to 0930
11.700	HP5A	PANAMA CITY, PANAMA; 0700 to 2300
11.700	GVW	LONDON, ENGLAND; 2300 to 0030; 0600 to 0715; 0830 to 1015; 1130 to 1600; 1800 to 2330
11.700	SBP	STOCKHOLM, SWEDEN; 2000 to 2100
11.710	WLWS2	CINCINNATI, OHIO; South American beam, 1900 to 2400
11.710	VLG3	MELBOURNE, AUSTRALIA: 0230 to 0345; 0100 to 0145
11.710	HEI5	BERNE, SWITZERLAND; Tuesdays and Fridays, 1000 to 1130; Saturdays, 1550 to 1625
11.720		KIEV, U.S.S.R.
11.720	PRL8	RIO DE JANEIRO, BRAZIL; heard at 0500

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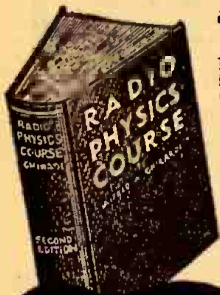

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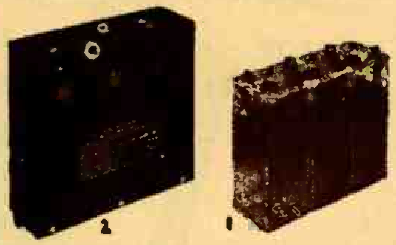

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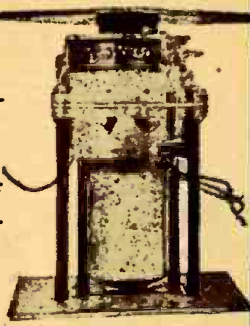

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Used to rotate your beam antenna
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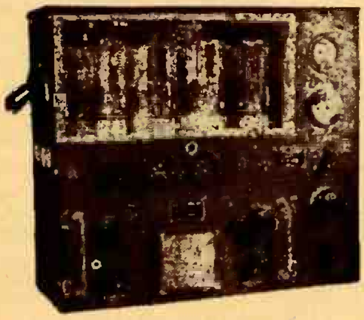

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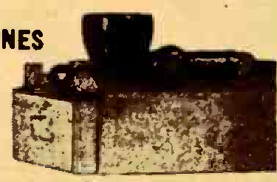

Headphone Extension Cords .... .75

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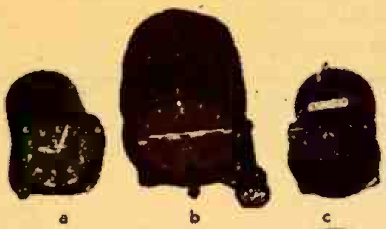
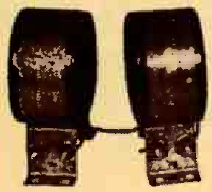


a—Sensitive Altimeters $9.00
b—Gyro-horizons 7.50
c—Magnetic Compasses 6.00
d—MN-26 Radio Compass (New) 69.50
SCR-269F Radio Compass (New) 69.50

LANDING LIGHTS

Landing Lights, 24 V. retractable 600 watts.

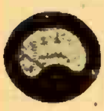
$3.95



TUBE HEATERS

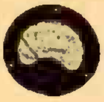
Tube Heaters, 807's. Can be used for various purposes.

.75



Westinghouse 0-500 Milliamps or 0-10 Milliamps meters, choice

$3.50



SCR-522 Transmitter and Receiver Closing Out) $9.50
RCA AVT-12A Aircraft Transmitters (Closing Out) 3.00
BC-929-A (Closing Out) 4.00

SETCHEL-CARLSEN RECEIVER BC-1206-C

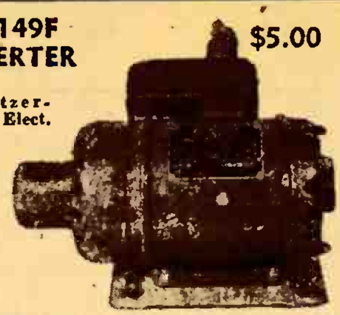
24-28 V. DC. Tubes, 3-14H7; 1-4R7; 2-8D7; 195-400Kc. Size, 4" x 4" x 6⅝" wide, 4 lbs. With manual (New, in cartons)

$5.95

MG-149F INVERTER

$5.00

(Holtzer-Cabot Elect. Co.)

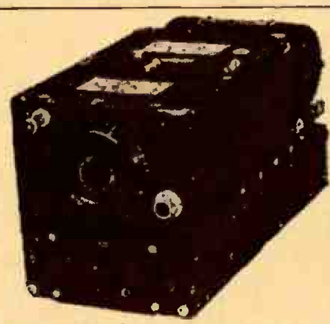


Input 24V. DC 36 amps. Output 115 V. 400 cy. AC, 500 V. A. Output at 90% P.F.

PE-103 GENERATOR

PE-103 Generator. Dynamotor power supply. Operates from 6 or 12 V.; delivers 500 V. DC at 160 Ma. (Brand New) $8.95

SCR-274N Command Set (ARC-5) components

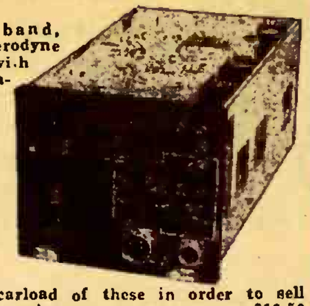


Modulator with dynamotor $4.75
Receiver, 3-6 Mc. (BC-454-A) 3.80
Receiver, 190-550 Kc. (BC-453-A) 4.75
Receiver, 6-9.1 Mc. (BC-455-A) 3.75

Transmitter, 3-7 Mc. (BC-966-A) $4.95
Transmitter, 4-5.3 Mc. (BC-457-A) 4.95
Transmitter, 5.3-7 Mc. (BC-458-A) 4.95

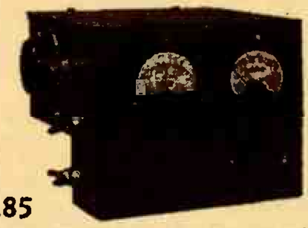
ADDRESS DEPT. RC-12

ARB (CRV-46151) AIRCRAFT RADIO RECEIVER



6-tube, 4 band, super-heterodyne receiver 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 $16.50

GENERATOR CONTROL BOX



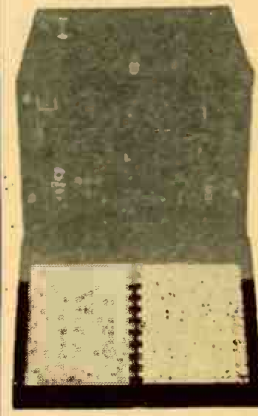
$5.85

Contains one 2½" round 0-300 AC voltmeter and one 2½" round 30-0-30 DC ammeter. Also plug, switch, relay, condensers and choke coil. (New.)

RECTIFIER RA-63-A

Battery charger or rectifier or power supply units. 110 V. 60 cy. input; 12 V. 8 amp. output. (New)

$19.75



BC-221 FREQUENCY METER

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

$39.95

TWO BAND BC-222 WALKIE TALKIE

Operates 28-38 and 38-52 MC. Ideal for use as ten meter field units. Less accessories and tubes. (Uses typo 30 and type 33 tubes)

Price $19.50
Battery pack for above unit $5.00 (New)
Hand set for above unit $5.00 ea. (New)
Telescoping antennae $2.95 ea.

ESSE Radio Co
130 W. New York St.
Indianapolis 4, Ind.

Unless Otherwise Stated, All of This Equipment Is Sold As Used
CASH REQUIRED WITH ALL ORDERS
Orders Shipped F.O.B. Collect

FM AND TELEVISION DESIGN

(Continued from page 38)

to a double superheterodyne circuit is shown in Fig. 7. The unusual feature of this circuit is the use of a single oscillator (Colpitts) for both mixing operations.

There are 3 coaxial tuners: C1T1, T2C2C3, and C4T3. C1 and T1 tune over the 88-108-mc range. They receive the input signal and apply it to the grid of V1 (½ 7F8). At the same time V1, using C3, C2, and T2, is operating as a Colpitts oscillator and generating a voltage which mixes with this input signal. For a station signal of 100 mc., the oscillator frequency is 47.85 mc. The difference between these 2 frequencies is 52.15 mc, and T3 and C4 are resonant to this frequency. The 52.15-mc signal now mixes in V2 with the 48.75 mc of the oscillator, producing a difference frequency of 4.3 mc, and i.f. in this particular receiver. The signal is thus lowered twice to reach the final 4.3-mc value.

RCA Transmission-Line Tuner: A tuner using what might be termed a parallel-wire transmission line is found in the latest RCA television receivers. (See Fig. 8.) A television receiver must be capable of tuning to each of the 13 television channels; so the line is constructed to act as a quarter-wave transmission line for each channel. To vary the effective length of the line, a movable shorting bar is used. Adjustable coils L25 and L26 provide the correct length of line for the highest channel, No. 13. Its frequency range is from 210 to 216 mc. For each lower channel, the shorting bar is moved progressively down the line. As we insert more inductance into the line, the frequency becomes proportionately less. Between channels 6 and 7 there is a frequency gap of 86 mc. Channel 6 extends from 82 to 88 mc; channel 7 from 174 to 180 mc. Adjustable coils L11 and L12 are inserted into the line to make the transition between these 2 channels.

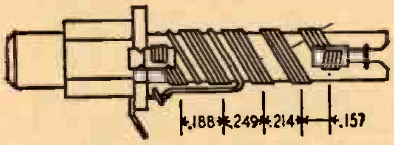


Fig. 9—Permeability tuner used by Zenith.

The inductances which compose the line are of 2 types. From L11 to L26 inclusive, each coil is a small nonadjustable silver strap between the switch contacts. Each strap is cut to represent a 6-mc change in frequency. Coils L1 to L10 inclusive are wound in figure-8 fashion on fingers protruding from the switch wafer.

Each of the 3 input circuits, the r.f. amplifier, the oscillator, and the mixer, have the same type of construction. The mixer is coupled to the r.f. amplifier through C10, C12, C13 and a single turn of link coupling. The coupling is close, purposely so, to produce at least a 4.5-mc band pass on each of the 13 channels. Within the mixer itself, a 10,000-ohm resistor is shunted across the circuit to insure a sufficiently wide band spread.

The 10,000-ohm loading resistor is effective only in channel 9 and all lower channels. Above channel 9 the resistor is shorted out by the shorting bar. In the 4 highest frequency channels, sufficient band spread can be achieved without the use of this loading resistor.

It is obvious that in tuners of this type, each coil switched into the circuit depends upon the coils which are already in the circuit ahead of it. Hence, in alignment, we start with the highest channel and adjust coils progressively until the lowest frequency channel is reached. In the r.f. amplifier line, adjustments can be made only at the beginning of the 7 higher channels and at the beginning of the 6 lower channels. The same number of adjustments are available for the converter line. If the circuits are functioning properly, all of the remaining channels will fall into line. In the oscillator, adjustments are provided for each channel. This is necessary because a single frequency is generated in each instance and it must be accurately set.

In the tuner of Fig. 8, double triodes are used in each r.f. circuit. In the r.f. amplifier, the transmission line lead-in

(Continued on page 71)

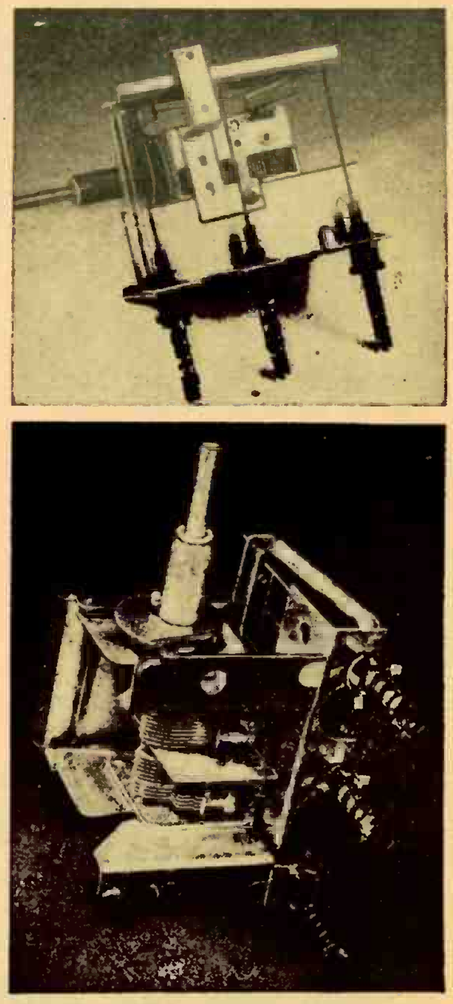
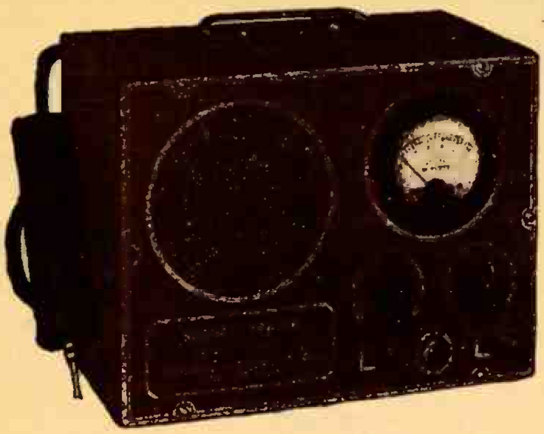


Fig. 10—AM-FM tuning assembly, two views.

BUILD YOUR OWN SIGNAL TRACER

and Save!!



We are pleased to announce we have obtained an exclusive franchise to distribute the well known Model CA-12 Signal Tracer in kit form. The Model CA-12 sells regularly for $34.85, here is your opportunity to save $10 with the added advantage of complete familiarity of design and operation made possible when you build your own instrument.

THE MODEL CA-12 KIT COMES COMPLETELY ASSEMBLED. Can be wired in 30 minutes. Components and circuit guaranteed to meet the following:

FEATURES:

- ★ COMPARATIVE INTENSITY OF THE SIGNAL IS READ DIRECTLY ON THE METER—QUALITY OF THE SIGNAL IS HEARD IN THE SPEAKER.
- ★ SIMPLE TO OPERATE—ONLY ONE CONNECTING CABLE—NO TUNING CONTROLS.
- ★ HIGHLY SENSITIVE—USES AN IMPROVED VACUUM-TUBE VOLTMETER CIRCUIT.
- ★ TUBE AND RESISTOR CAPACITY NETWORK ARE BUILT INTO THE DETECTOR PROBE.
- ★ BUILT-IN HIGH GAIN AMPLIFIER—ALNICO V SPEAKER.
- ★ COMPLETELY PORTABLE—WEIGHS 8 POUNDS—MEASURES 5½" x 6½" x 9".

MODEL CA-12 Kit includes ALL PARTS assembled and ready for wiring, circuit diagram and detailed operating data for the completed instrument.

$24.85 NET

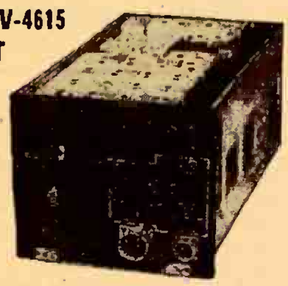
20% DEPOSIT REQUIRED ON ALL C.O.D. ORDERS

GENERAL ELECTRONIC DISTRIBUTING CO. Dept. RC-12, 98 Park Place NEW YORK 7, N. Y.

NAVY CRV-4615 AIRCRAFT RADIO Receiver

INCLUDING CASE

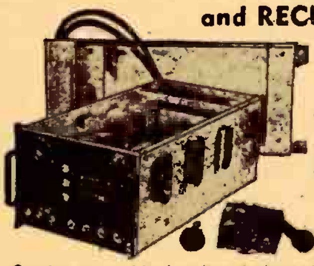
$16.50



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. No cables.

ARC-4 TRANSMITTER and RECEIVER



INCLUDING CASE

$19.75

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.

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

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".

$8.95

FOB INDPLS.

TERMS: CASH WITH ORDER
Address Orders to Dept. B

AMERICAN SURPLUS PRODUCTS CO.
537 N. CAPITOL AVE.
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NEW WILLARD RECHARGEABLE STORAGE BATTERY

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
Lots of Ten	3.35
Without metal case, each	3.00
Lots of Ten	2.85

Brand New SCR-625 MINE DETECTOR

Attention, Prospectors, Miners, Oil Companies, Plumbers, Etc.

Metallic Objects Only

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 is 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.

$55.00

RADIO-ELECTRONIC PATENT
(Continued from page 52)

ated and may be reflected from any target in the path. If the reflected power is received during an instant when the superregenerator is not oscillating, there is no effect. However, if the pulses return just before the initiation of the pulses from the variable oscillator, they combine and cause the latter to start earlier than normally. The results are: lowered hiss (which is ordinarily present in a superregenerator) and a reduction of plate current. Therefore a meter in the plate circuit indicates when an "echo" is being returned.

To determine distance, the pulse frequency is varied for lowest plate meter reading (or minimum hiss). If the frequency is known, the distance can be calculated. The pulsed oscillator dial may be calibrated directly in terms of this distance, either by experiment or calculation.

AUTO RADIOS

Six or seven volts from a filament transformer rated at about 10 amperes can be used for testing auto radios if they use nonsynchronous vibrators in the power supply. Remove the vibrator and ground one side of the primary winding of the power transformer and replace the speaker with a PM unit. Connect the secondary of the filament transformer in series with the primary of the power transformer.

Joseph Friederer,
Worcester, N. Y.

(This method should not be used for prolonged periods since many automobile power transformers are designed to operate at almost twice the standard line frequencies.—*Editor)*

FM AND TELEVISION DESIGN
(Continued from page 68)

is terminated in 300 ohms of resistance (the two 150-ohm series resistors), its characteristic impedance. T1 prevents signals at frequencies lower than the television channels from passing through the set. It is essentially a simple high-pass filter. C3 and C4 are small neutralizing condensers, designed to prevent the tube from oscillating. This tendency may arise in the upper television channels. Similar condensers are not required in the converter because here the grid and plate circuits are tuned to different frequencies. All 3 stages operate their tuned circuits in push-pull.

Permeability Coil Tuning: We have covered every type of tuner but the permeability coil tuner. In this unit, an iron core is moved up and down in a coil, with a corresponding inductance variation. This method of changing frequency has recently become popular in standard AM broadcast sets and is certain to find wide acceptance in the FM receiver.

The design used in Zenith AM-FM sets is shown in Fig. 9. Four parallel wires are used to overcome the difficulty of obtaining by using a single wire, the necessary inductance change (and hence frequency change) for a complete travel of the core within the distance allotted to it on the dial. If we take a coil formed by using a single strand of wire and increase the width of that wire, we find that for a given change in core displacement, a greater tuning variation is obtained. A similar result may be achieved by winding the coil with parallel wires.

Another unusual constructional feature of the coil is the uneven spacing of the turns. If the winding is made uniform in pitch, the tuning curve for the permeability unit is found not to be linear. The nonlinear slope at each end occurs because the incremental inductance variation is maximum when the leading edge of the coil core is in the center of the coil and minimum at the start or finish of the core travel. To straighten out the curvature at the ends of the characteristic, the coil turns are bunched at the ends and spread out in the center. The inductance variation with core movement is thereby increased at each end and decreased at the center. To further insure that the tuning curve will be linear, the coil and core lengths are made longer than necessary and only part of the complete tuning curve is used. The core, with this construction, is never out of the coil turns.

Any difference in tracking is compensated for by a single initial advance or retraction of the iron core of each coil.

A photograph of the entire assembly is shown in Fig. 10. The standard AM broadcast frequencies are tuned by the conventional ganged condenser. For the FM portion of the set, the antenna, mixer, and oscillator coils are mounted on a bracket fastened to the side of the gang condenser.

SELLING A RADIO

By JACK KING

WHEN the prospective purchaser of a radio receiver enters the store he has an idea of the kind of set he wants. In most cases that idea is vague and general. His mind is not made up. The salesman's business is to sell him a radio of a type that will satisfy his needs and will make him a regular customer for other electrical equipment.

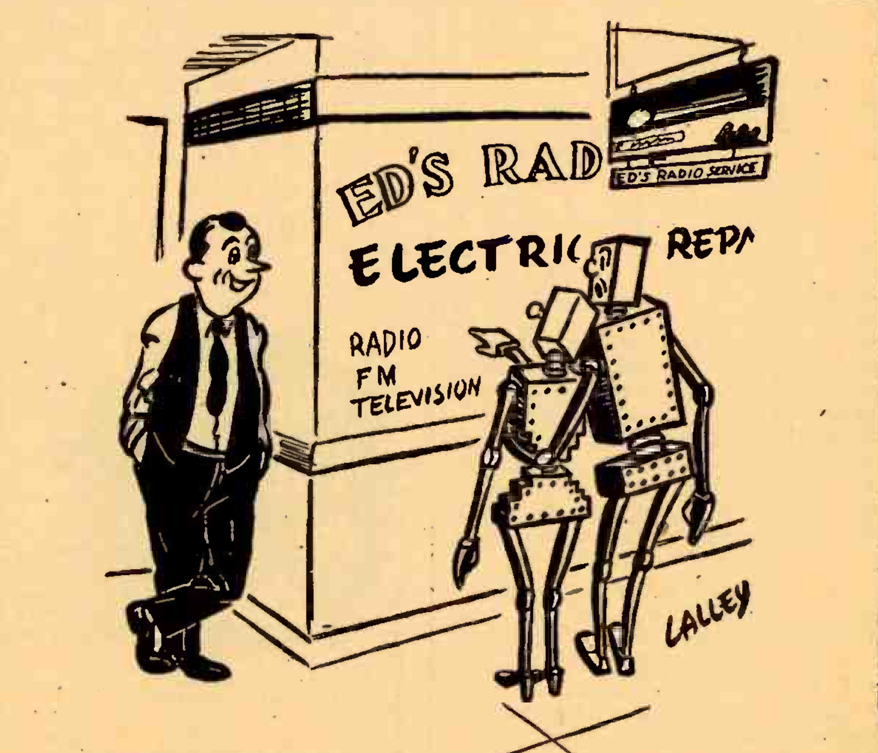
The first consideration with most people is price. More fortunate people may be interested first in quality and second in cost, but they also expect to get full value for every dollar spent. Selecting a good radio from among the many types and brands available is not for the non-technical and inexperienced customer.

The price-minded customer is well aware that price is generally a clue to quality. Both radio dealer and customer have been beset with low-priced radios which offer aurora borealis dials, automatic frequency control, silent a.v.c., a battery of loudspeakers, and multicolored pilot lights. Faced with such an array of talking points, the wise salesman will do well to point out that, of several sets at the same price level, the one with fewer special features is likely to be a better buy. Common sense indicates that costs must rise as the number of gadgets is increased. Flimsy soldering, hasty assembling, and decrease in the quality of individual components may be expected in the elaborate set which sells at a bargain price. There is absolutely no percentage in handling these sets, for the kickbacks and ill will engendered by frequent breakdowns and poor operation will more than eat up any profit gained in the original sale.

After price, the customer usually has in mind a generalized picture of the type of set desired—whether plastic or wood table model, console or combination. Women especially are impressed with appearance and styling. They want the radio to fit harmoniously into its surroundings. They may be shopping for a receiver for Junior's or the maid's room, living room, or kitchen.

In some cases the woman of the house may be looking for a piece of furniture in which the radio—though important—is of secondary significance to her. To the technician used to thinking of a radio as a chassis this may seem illogical. Actually it is good sense. She is thinking of a room as a whole and of the room as part of the home picture, and seeking to integrate into that picture a new element—the radio receiver in its cabinet. A console radio may be one of the most important features in a living room, and if well and suitably styled will add greatly to the room's appearance.

If the purchaser is a music lover, the salesman has an opportunity to sell a receiver priced in the higher range, particularly an FM set. For adequate reproduction a large speaker or combination



Suggested by J. B. Lalley, Red Bank, N. J.

"Come on in and get spliced."

of speakers, with adequate baffling, is a necessity. Fortunately, the music lover is quick to recognize even small differences of quality, and equally quick to see the advantage of paying more for a radio that will give him the quality he wants.

Few prospective buyers take the trouble to look inside radio cabinets. If a chassis is well made and of good size, with the parts not crowded and jammed together, it is worth the salesman's while to call that fact to the customer's attention. Such a chassis speaks of quality and workmanship and the customer is usually quick to see the point.

The man of the house is usually more technically minded than his wife, sister, or mother. He is the one who will be interested in such items as chassis construction. He may also be the victim of the gadgeteer. While many people like such conveniences as push-button tuning, it is well to point out that such tuning adds to the cost of a receiver. In an automobile set, the additional cost is well justified, since the push-buttons permit tuning without taking too much of the driver's attention away from the all-important job of handling the car. There is no such problem in the home, and push-buttons are simply a convenience.

The demand for automatic record players is a mystery to the average radioman. It is no great task to change a record, but to avoid that task the owner of a record player is willing to trust his fine records to an automatic unit which too often goes berserk and starts destroying them. He is willing also to pay the increased maintenance costs and tolerate the loss of service during the periods when his player is in the repair shop. The radio dealer can do little to change human nature, but if any manufacturer *should* eliminate the changer and substitute a one-record type of player, the salesman should assist him by pointing out its simplicity and ruggedness of construction as well as the freedom from the annoyance and cost of excessive maintenance.

Cost is tied in with the pickup used in record changers. The crystal is light and cheap, but is subject to mechanical shocks during operation and is relatively fragile and delicate. More ruggedness and much better quality are claimed for many of the new pickups. Some of these are magnetic and others are based on various principles. As they are new, the radioman will have to use good sense and theory as well as drawing on such experience as he gains with these pickups when making recommendations to customers.

There is little point in recommending a receiver with short wave to the average customer, as most people are not interested as soon as they find that the quality of short-wave reception is not equal to that from a good local. This is not true of certain classes of buyers. Some people who have short-wave bands on their receivers become short-wave fans. They may then become good prospects for communications receivers. Many people of foreign extraction are

(*Continued on page* 76)

An 11-ounce printed-circuit Citizens Radio is being readied for the market.

RADIO PILOTED OCEAN FLIGHT

(Continued from page 23)

This is wrong. In the All-Weather plane the flight control is completely within the plane and its only outside collaborator is the radio beam on which it is homing.

The trans-Atlantic flight last September was not the first major pilotless flight accomplished by the All-Weather C-54. In January 1947 it flew from New York to Wilmington, Ohio, and the following June it flew from Long Beach, California, back to its home base at Wilmington which is also the headquarters of USAF's All-Weather Flying Center.

The Automatic Flight is accomplished in 12 successive phases. The 1st is the pre-takeoff during which the plane is manually aligned with the runway. Second is the takeoff and the first phase under automatic control. When the aircraft reaches an altitude of 50 feet, phase 3 sets in automatically and the landing gear is retracted. This phase holds until an altitude of 1,000 feet is reached when the 4th phase takes over, automatically retracting the flaps. This phase continues until the plane reaches the previously determined cruise altitude.

The next 4 phases are navigational, during which the aircraft flies a ground course based on directional information from radio stations, magnetic lines of force of the earth and the air miles computer. In the trans-Atlantic flight there were two relay surface ships at sea on which the plane homed. After passing the second ship, the beam at Brise Norton brought the plane to its destination.

The 9th phase is the beginning of the descent to landing at destination, dropping to approach altitude over a pre-selected radio station (in this case the radio station at Brise Norton). The 10th phase becomes operative after the plane has descended below a 2,000 foot altitude. The flaps are dropped and landing gear lowered. Phase 11 occurs when the plane reaches the glide path and begins the final approach on localizer directional beam and glide path beam. The flight is concluded with phase 12 as the aircraft touches down on the runway and the brakes are activated.

Of all the steps in automatic flight, the application of brakes on landing is the only operation not electronically guided. They are applied by purely automatic but mechanical means. As the wheels touch the runway a mechanical process takes over, which gradually and effectively slows down and stops the plane. The stimulus for this operation comes from the momentum of the wheels as they start revolving on contact with the runway.

The brain for automatic flight is called the *master sequence selector*. It is located in the main cabin and is powered by an auxiliary gasoline generator. Navigation is controlled by 2 mileage counters and magnetic heading selectors. These instruments control the flight until the plane clicks off the pre-set number of miles on the predetermined heading. Final descent is at present geared to the AAF Instrument Low-Approach System (SCS-51 localizer and glide path).

The *master sequence selector* is used in conjunction with the A-12 Automatic Pilot and is essentially a coordinated system of aircraft controls whose functions are pre-set much in the same manner as a calculating machine. Various mathematical operations are set in the machine, then the total button is pressed and the answer is given accurately. Similarly all flight data is fed into the brain a button is pushed and the destination is reached safely despite the most hazardous weather conditions.

Through the ingenuity of the U. S. Air Force it is conceivable that one day you can sit in your own private plane and instead of being confronted with a maze of dials and controls, to face a set of buttons marked, "New York," "Chicago," "Rochester," or "Philadelphia" . . . just as your push-button radio is marked. Press the button marked "Rochester" and you take off, fly to, and land there without touching a control, looking at a navigational chart or worrying about the weather. All the intricate operations of flying will be fed into the automatic flight controller before you take off. Indicative of the universal application of this device, is the fact that any broadcast station can be used as a homing beam.

According to Colonel Kelsey, "new doors are now open to aeronautical progress and toward practical and sane flying, regardless of weather, since the functioning of equipment is unaffected by outside weather conditions. It now becomes possible through radio and electronics to set up a flight at any point, over any route. This can be done simply by pre-selecting settings of automatic components."

Automatic Flight is just one of the many radio-electronic projects of the peacetime Air Force, directed at making all flying—civilian and military—safer and more economical. In this fascinating sphere of activities, hundreds of young men each month are taking advantage of the career opportunities in radio and electronics offered by the United States Air Force.

"SUPER-R" FM RECEIVER

(Continued from page 35)

When the set has been built and wiring checked, it should be turned on and allowed to warm up. As the regeneration control is turned up, a loud "hiss" should be heard. When a station is tuned in, the hiss disappears.

You will find that the best reception is obtained when a very slight amount of hiss is allowed to remain in the background. If no hiss is heard when the set is not tuned to a station, the set is not operating properly. Check the wiring.

If C3 is not the proper value, the hiss will sound like a hum, feedback, or roar; and the value should be varied till best results are obtained.

No external ground of any kind may be used with the set under any circumstances. If you must experiment, connect the ground through a 50-μμf condenser.

The set is easy to build and make work. Be sure the coil-condenser combination, (L and C1) "hit the band." Check with a wave-meter if necessary.

Quality of reproduction will not stand comparison with that of receivers which use a discriminator and which do not superregenerate. It does serve as an excellent stopgap receiver for use in areas with an FM broadcaster and few or no FM receivers, as it is much easier and cheaper to construct than a tuner with a standard FM circuit.

SELLING A RADIO

(*Continued from page 73*)

interested in hearing broadcasts from their native country, and to them the short-wave band is often a most important one.

Tone controls help to get better quality or at least make the radio sound more pleasant. The presence or lack of one always should be pointed out to a customer.

In cities where electrical interference makes AM reception very noisy, FM is a boon and a blessing. A good FM set will of course cost more than a good AM receiver, but is well worth the difference in price because of the better quality achieved not only by FM's greater tone range but by the reduction of noise and static which often spoils AM programs.

Television may be a luxury for some time in the future for all but those of higher-than-average incomes. But don't shy away from the possibility of a sale for that reason! More than one television set has been sold to a buyer whose income would not seem to warrant it. Some people are very much interested in the new form of entertainment and are willing to scrape and save to have a receiver. Others with large families feel that the set is well worth its cost because it provides home entertainment for the children, and part of the cost is returned in reduced expenses for movies and other forms of outside amusements.

THIS NEW PORTABLE RADIO TAKES PICTURES

A new development in portable radios is this combination of a radio and a small camera, making a single unit interesting to amateur photographers and radio enthusiasts alike.

Known as the *Air-King Radio-Camera* Model A410, it is a superheterodyne radio with a 1R5, 1T4, 1S5 and 3Q4 as tube complement. Batteries are a 67½-volt B and two 1½-volt flashlight cells, No. 2 size.

The camera occupies the top 2½ inches of the 9½-inch case (which is 4⅞ inches wide and 3⅝ inches deep). It is of the common miniature box type, using No. 828 film (picture size roughly 1 x 1½ inch). A 50-mm fixed-focus meniscus lens is used, with a single stop and provision for both time and instantaneous exposures. The viewfinder is direct, mounted on top of the case, with the film-winding knob beside it.

The loop is so mounted in the lid that it does not depend on the hinges for contact. One heavy lead soldered to a contact in the middle of the door acts to prevent it from swinging too widely open. The other, a wiping contact, "makes" when the door is closed.

Volume, quality and sensitivity appear to be average or above the average for this type of receiver, and the workmanship on the radio is excellent. Total weight of the radio-camera is less than 4 pounds, with batteries.

NOW—GLASS THAT CONDUCTS ELECTRICITY

Conductive glass, which can be electrically heated to keep it free of ice, is being installed in the control cabins of the giant Stratocruiser passenger planes, it was rev aled last month.

This g'ass, called Nesa and developed by the Pittsburg Plate Glass Company, has ins de and outside layers of plate glass with a layer of a clear vinyl plastic between. On the inside surface of the outer layer is a transparent but electrically conductive coating, whose composition is secret. By passing an electric current through the coating, regulated heat can be applied to the glass, keeping it ice and fog free at all times. The idea, it is suggested, may be applicable to automobile windshields.

SHOULD SERVICEMEN BE LICENSED?

(Continued from page 17)

time country-wide licensing by authorities is not necessary if the radio servicing industry can regulate itself.

◆ RADIO-CRAFT *believes that the issue is urgent.* It believes also that unless corrective steps are taken in the near future, licensing will very certainly result.

◆ RADIO-CRAFT would welcome suggestions from within the radio servicing industry and particularly welcomes codes set up by local associations which will be publicized as models in future issues of this magazine.

◆ RADIO-CRAFT will welcome all suggestions on this important subject and will devote ample space to it in future issues.

Silent Sound with power enough to pop corn, light a pipe or kill a mouse was reported from the Pennsylvania State College last month. The sound is produced by an ultrasonic siren which operates on the same principle as those on fire or police cars.

White mice placed in the sound field died after one minute of exposure. Another mouse, exposed a half minute, appeared normal eight minutes later. The following day, however, its outer ear had deteriorated. The silent siren also was found effective in killing insects. Mosquitoes died in 10 seconds but a monarch butterfly caterpillar lived 215 seconds.

RADIO AND RAILROADS

(*Continued from page* 18)

or with ships equipped with ship-to-shore phone.

The train phone service will be available at all times when the train is within 25 miles of the 30 or more cities which have mobile telephone systems. As the use of mobile telephone increases, it will be possible to call from almost any point along any railroad line. Calls can be received while the train is within the same range of mobile service control stations. (Mobile service has already begun on standard railroad runs, as described in RADIO-CRAFT in October.)

A person who wishes to talk to a passenger first calls long distance, then asks for the mobile operator. Given the approximate location of the train, the operator routes the call over regular land lines to the nearest mobile radio operator, and the last link is by radio-phone.

Communication with the train is effected with FM. An antenna is mounted on the roof of the lounge car for transmission and reception. The train transmitter operates on 157.89 mc, the receiver on 152.63 mc.

Radio Central of "The Train of Tomorrow." Radiophone handset is at (1) a control box at (2) wire recorder at (3) broadcast receiver at (4) and PA amplifier at (5). Mobile radio transmitter and receiver are in cabinet below.

$3.00 FOR CARTOON IDEAS

RADIO-CRAFT prints several radio cartoons every month. Readers are invited to contribute humorous radio ideas which can be used in cartoon form. It is not necessary that you draw a sketch, unless you wish.

IDEAS NOT WANTED

No electrical or radio definitions wanted. Some of these were published in the past, but the subject is about exhausted.

All checks are payable on publication.

Address RADIO CARTOONS, RADIO-CRAFT, 25 West Broadway, New York 7, N. Y.

Radar equipment designed by Raytheon for use on the Great Lakes has 6 ranges: 1, 2, 4, 8, 20 and 40 statute miles. The short ranges are expected to be particularly useful at the close ranges encountered in lake navigation.

HIGH-RANGE OHMMETER

(Continued from page 34)

If the scale could be expanded at the ends and compressed in the middle either arithmetically or logarithmically, the difficulty could be overcome. A satisfactory and simple method of expanding the scale distances at the ends and compressing them in the center was found. Through this scale the value of the ohmmeter was immensely enhanced.

The scale is best drawn on a piece of good strong drawing paper. The longer the scale the better, as readings will be clearer. The maximum length is limited by the available space on the panel. A length of 8 inches is excellent.

Four horizontal lines, about ¼-inch apart and 8 inches long, should be drawn. The exact center is determined. Then the beginning is marked 0, the middle 0.5, and the end 1. ma. Vertical lines are drawn from the top to the bottom lines. The spacing for the other values of milliamperes is arrived by marking off 5 to 6 and 5 to 4 each ⅝ inch apart. From 6 to 7 and 4 to 3 the distance is ⅝ inch. From 7 to 8 and 3 to 2 it is ¾ inch. From 8 to 9 and 2 to 1 there is 1 inch distance, and the last gap at both ends is 1¼ inches.

This produces a scale with ends 3 times as open as the middle. Ample space is provided for writing in ohmic values. The scale is therefore compressed in the center and expanded at both ends.

TABLE I

READING, MA	MEGOHMS
0.1	2.7
0.2	1.2
0.3	0.7
0.4	0.45
0.5	0.3
0.6	0.2
0.7	0.13
0.8	0.075
0.9	0.033
1.0	0

Full-scale reading (1 ma) corresponds to zero resistance with 300,000 ohms in the internal circuit. Half scale (0.5) will correspond to 300,000 ohms limiting, plus 300,000 ohms test resistance, so the 300,000-ohm mark falls at the center of the scale. Values for other markings will be as per Table 1, provided always that the instrument is working on exactly 300 volts.

A better method of marking appears in Fig. 2. The readings of this latter table have been rounded off, but are near enough for all practical purposes. A glance shows that useful readings are obtained from 10,000 ohms to 14 megohms. For voltages other than 300, a corresponding set of scales would have to be worked out, either by measuring actual resistances or by computation based on Ohm's law.

The help offered by this scale may not seem important at first glance, but use will convince you of its value.

FM TUNERS

(Continued from page 25)

and are wound with No. 12 enameled wire. Turns are spaced ¾ inch. RFC-1 and RFC-2 are 5 millihenries each. RFC-3 is 15 turns of No. 16 wire, close-wound on a ¼-inch dowel.

The physical layout for the 10.7-kc i.f. amplifier should be made with caution. Each wire from the i.f. transformer can should be brought out through a hole drilled as close to the correct socket pin as possible. It is preferable to mount the stages in a straight line to avoid extra shielding. The interstage shield needed in this tuner can be seen in the under-chassis photograph. Also, small circular shields were soldered in the center of the circle of pins on 2 of the tube sockets. If the i.f. transformers are not provided with swamping resistors, each winding should have a 37,000-ohm resistor (or such resistor value as the manufacturer recommends) paralleled across it.

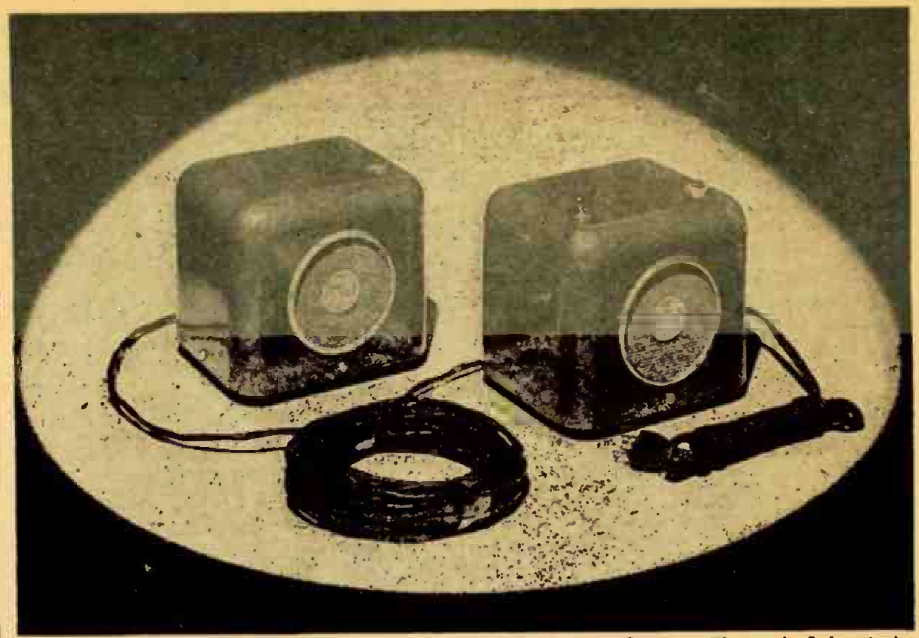
The tuner of Fig. 2 is like that of Fig. 1 in most details. A 6BE6 is used as the oscillator. The oscillator coil is tapped 1 turn from the bottom. Limiter voltages and constants differ from those used when there are 2 limiters. If desired, a 6AL5 discriminator can be used instead of the crystals. This will probably result in a saving in expense, but will increase the filament drain slightly.

Some important points

Many considerations are overlooked by the constructor who is assembling his first FM receiver or tuner. In wiring the r.f. mixer, and oscillator sections it is important not only to secure the shortest grid lead but also to provide thorough grounding and bypassing. Especially important are low inductive paths to the tuning-condenser frame and wiper contacts. Each stage should have its own heavy braid ground wire from the coil (if the coil is not mounted on the condenser) and tie point for the bypass condensers running as directly to the tuning condenser as possible. If tuning is noisy, it is usually the result of poor rotor contacts. This common trouble is easily cured by a cleaning and lubricating job. If the circuit is wired properly and decoupled, there should be no oscillation trouble in the i.f. stages. Filament bypassing is very important in high-gain circuits. Don't forget it!

Oscillation is not usually evidenced as a whistle or squeal in an FM receiver. Heavy oscillation is evidenced by complete closing of the tuning eye even without any signal. Light oscillation results in distortion on strong FM signals.

As stated before, all the bugs have been worked out of this circuit and there should be little trouble. For alignment of the circuit it is best to beg, borrow, or steal a high-frequency generator. It can be done by hand, but it is tedious business. Much better alignment information is given in the handbooks and circuit manuals than could be given in this brief article, and their use is recommended.



Courtesy Electronic Laboratories

Interesting Intercommunicator

THE widespread use of intercommunications systems in the Armed Forces and industry during the war has resulted in ever-increasing demands for these versatile units on farms, in homes, stores, offices, and business organizations. Remote stations at the front entrance to the home, in basements, attics, garages, barns, nurseries, and numerous other places are becoming very common as well.

An interesting postwar intercom recently tested by RADIO-CRAFT is the Utiliphone manufactured by Electronic Laboratories, Indianapolis. It is a wired intercommunications system consisting of a master and 1 remote station operating up to 500 feet apart. Each unit is housed in a gray, wrinkle-finished metal box with a chromium-trimmed speaker grill. Each station is only 5¼ inches wide, 4½ inches deep, and 5 inches high. It can be mounted on a desk or hung at a convenient place on a wall by 2 keyslots on the rear panel. Three-wire cable is used between stations with connections made to a 2-screw terminal strip and common ground screw on each unit.

A 3-tube amplifier is included in the master unit. The amplifiers are available in 3 models. Loctal tubes are used in Model 2660, miniatures in the 2660A, and octals in 2660B. The circuit, Fig. 1, is the same in all models. V1 is the speech amplifier, which is resistance-coupled to the power amplifier V2. Operation is from 117-volt, a.c.-d.c. lines with the half-wave rectifier V3. The series-connected filaments are supplied through a dropping resistor. The tube line-up of the 3 models is:

Function	MODEL 2660	2660A	2660B
Speech Amplifier T1	14A7	12BA6	12SK7
Power amplifier T2	50A5	50B5	50L6
Rectifier T3	35Y4	35W4	35Z5

A remote station can be installed in a child's playroom or nursery. When its switch is locked in position, the parents are able to listen to the child while in remote parts of the house.

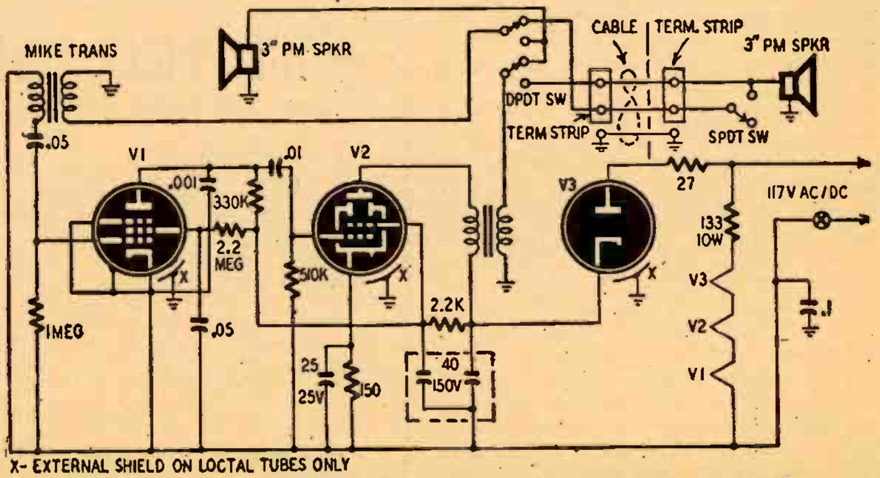


Fig. 1—This 3-tube circuit combines high sensitivity, good speech quality and high output.

TUBE SHIELDS

While constructing a small portable receiver, I found that I could not obtain shields for the 1N5G and other tubes in this series. I salvaged the can of a discarded wet electrolytic condenser. The top was sawed off and the can sliced into lengths equal to the length of the tube. Screw lugs were fastened to the bottom edge and used for mounting on the chassis. These make good shields.

JOHN L. TARDIF,
Toronto, Ont.

ELEMENTARY RADIO QUIZ

By HAROLD GLENN

Check your radio knowledge. A more advanced quiz will appear in an early issue.

1. Light and electricity are energy, and travel in the form of: 1.—waves; 2.—frequency; 3.—amplitude; 4.—electrons.
2. Which has the longest wave length? 1.—light; 2.—heat; 3.—radio.
3. The inductance is: 1.—a coil; 2.—a condenser; 3.—an air core; 4.—an iron core.
4. The to-and-fro surge of an electric current in a circuit is called: 1.—detection; 2.—inductance; 3.—oscillation; 4.—capacitance.
5. The loudspeaker changes: 1.—sound into electric waves; 2.—r.f. to a.f.; 3.—a.f. to r.f.; 4.—electric waves into sound waves.
6. In order to operate, the loudspeaker must have: 1.—r.f. waves; 2.—a.f. waves; 3.—pure direct current; 4.—pure a.c. sine wave.
7. The purpose of the detector is to change: 1.—a.f. to r.f.; 2.—r.f. to a.f.; 3.—resonance to oscillation; 4.—oscillation to resonance.
8. The action of the detector is called: 1.—resonance; 2.—rectification; 3.—oscillation.
9. Resistance in the tuned circuit causes: 1.—distortion; 2.—rectification; 3.—broad tuning; 4.—oscillation.
10. What is the frequency of 60-cycle, 117-volt, 100-watt house current?

(See page 93 for answers)

THE QUESTION BOX

(Continued from page 56)

Expansion and compression is made possible by taking the amplified signal from the grid circuit of the 6SC7 and applying it to a 6C8-G where it is amplified and rectified. The output of the rectifier section is applied to the No. 3 grid of the 6L7. Polarity of the control voltage may be changed to give either compression or expansion.

Sufficient gain has been built into the amplifier to enable it to operate efficiently from almost any microphone or phonograph pickup.

If you find that the 6L7 is microphonic in this application, use its non-microphonic version, the 1612.

A.F. WATTMETER TESTS SPEAKERS

(Continued from page 31)

Calibration

After the circuit is wired up and checked, the plate voltage is adjusted to 120 and the 500-ohm wire-wound (bias) potentiometer is varied until the plate meter reads just above cut-off. A slight residual reading of less than 1% of full-scale may remain but does not interfere with the operation. The impedance switch in the grid circuit is set to 8 ohms (center contact) and a variable 60-cycle voltage is applied to the wattmeter input circuit. This voltage may be from a variable toy transformer, a variac, or a voltage divided across a fixed voltage. Two 6.3 filament windings in series and correctly phased are suitable for the latter. A reliable voltmeter should be used in any case.

Fig. 2 shows required input voltages for specified plate currents. For example, a 4-volt input causes the meter to read 2.0 watts, that is 20 micro-tentiometer. The cathode resistor has the same effect on the spread when it is decreased. A slightly different setting of the grid (2,000-ohm) potentiometer also may be tried if necessary.

After several adjustments, the wattmeter should be within 2% of the graph calibration. Still leaving the impedance switch at 8 ohms, adjust the meter to mid-scale. This requires 8.95 volts (9 volts for practical purposes). If this comes out right, throw the switch to 4 ohms and note that the plate current rises to full-scale. Now change to 16 ohms and the reading should drop to 50 microamperes. If these values are not obtained, the resistance of the input impedance loads are probably not exactly 8 and 4 ohms each.

With the 8-ohm load, the meter is direct-reading, 0-20.0 watts. Voice coils of this impedance are usually designed for a maximum of about 15 watts, so

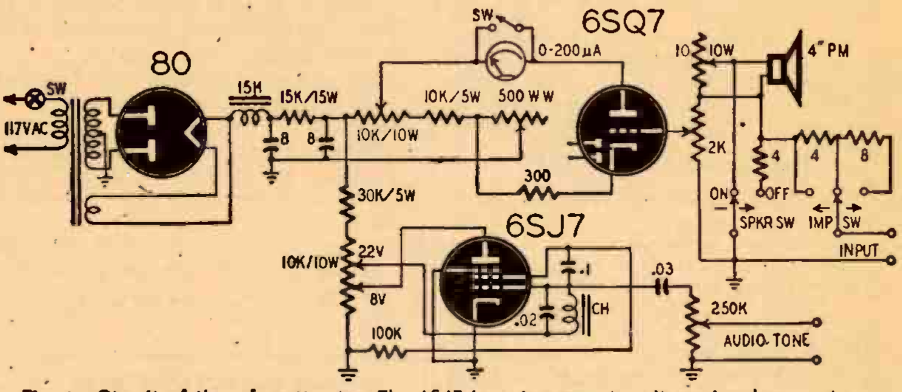


Fig. 1—Circuit of the a.f. wattmeter. The 6SJ7 is a sine-wave transitron signal generator.

amperes. The grid potentiometer may be adjusted for this value. Then as the input is increased the plate meter should show current values like those in the graph. At 12.6 volts (2 filament windings in series) the meter reads just a hair above full-scale.

With the voltages previously given the first attempt will probably give a result close to that desired. It can be improved by slight adjustments. Increasing the grid bias (and plate voltage if necessary) produces a greater spread of the readings, and vice versa. In other words, if the upper scale readings do not advance fast enough, increase the resistance of the 500-ohm po-

there is plenty to spare for peak or instantaneous values. With the 4-ohm load, the meter readings must be *divided by 2* since it actually shows 0-100 watts. With the 16 ohm load, the wattmeter measures 0-400 watts so the readings must be *multiplied by 2*. To accommodate the high power handled the impedance switch should be of heavy construction, such as an Ohmite multitap power switch.

The auxiliary PM speaker may be switched into the circuit when an audio check is desired. It is shunted by a variable 10-ohm resistor to bring the combined impedance to 4 ohms. The shunt is correct when no change is noticed when switching the speaker in or out. A sustained audio tone is needed for this test. Distortion may be checked with the speaker, the meter itself showing only power level.

The transitron is conventional and is included as a source of pure sine wave audio power. With the voltages shown in Fig. 1, the output has very low distortion. In some cases it may be found that the feedback is so low (for pure wave form) that the oscillator does not start. The line switch may be thrown off and then on again quickly to start it oscillating.

The choke coil in the screen circuit of the oscillator may be a small filter or transformer winding. A small inductance bypassed with a large condenser gives low distortion. The condenser may be chosen to give the desired frequency,

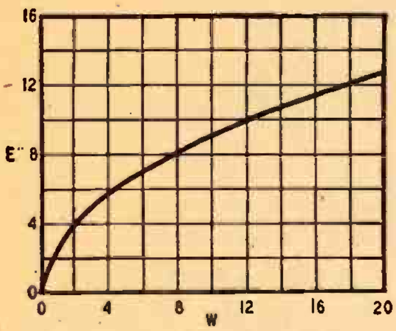


Fig. 2—Input voltage vs plate current curve.

which should be about 400 cycles. The power output is sufficient for amplifier testing.

The 10-watt voltage divider used to provide transitron voltages, as well as the other 10-watt voltage dividers in this circuit, may be of the "Dividohm" or similar type. A shorting switch is added across the microammeter to protect it when not in actual use. (When the instrument is turned off, the needle will tend to slam off scale on the lower impedance ranges.)

The wattmeter may be used not only for direct measurement of power but also for alignment or adjustment of a receiver or amplifier. Wattmeter readings are much more sensitive to changes than are voltmeter readings. For example, a 41% increase of voltage is equivalent to a 100% increase of power. Thus where a linear wattmeter will deflect from mid-scale to full-scale, the same change will only bring a voltmeter from mid-scale to less than three-quarters scale.

Amplifier distortion is checked by switching in the speaker while noting the power. It will be interesting to vary the load impedance while listening. The correct load is the one which gives minimum distortion but not necessarily greatest output.

RADIO PROPAGATION

(Continued from page 22)

tance of the station with which communication is to be established.

At lower frequencies the E-layer may enter into the picture. An E-layer chart in the *Predictions* helps the radioist to use reflections from that layer. After selecting the best frequency from the F charts, consult the E chart. If the E-layer muf is higher than that reflected by the F-layer, use the E-layer frequency.

Adapting the predictions

All these methods are excellent for transmission between 2 fixed points, such as 2 commercial or government stations. They are not so good for the amateur or short-wave listener. The amateur wants to know what frequencies to use to cover a large area—possibly a continent—or in what direction to send a CQ to get results and dx on his transmitter's frequency. The short-wave listener would like to find out when to listen for elusive short-wave broadcasters. Both are on the alert for times when higher frequencies than those predicted are useful, for these are the periods of dx.

A few attempts have been made to broaden the scope of the *Predictions* to cover amateur and general requirements. The most successful of these is based on the observation that a given muf "cloud" drifts along the earth from east to west, maintaining a constant angle with the sun. The amateur who works on 10 meters, for example, can note the area over which 30 mc or higher is the muf. If this area covers the control points between him and any desired station, he can work that station on 10 meters. Another system calculates owf's for narrow strips along the American coast and that of other countries.

The table presented here represents a new approach to the problem. Based on latitude 40 N in the western zone, a large number of calculations have been made, giving the optimum frequency for any part of the day for any distance and any direction. As conditions drift west with the sun, this chart will be correct for any part of the United States on the 40th parallel, and approximately correct for considerable distances north and south of that line.

The table shows conditions at intervals of 3 hours and at ranges from 2500 miles (4000 km) to 12,500 miles (20,000 km) at intervals of 2500 miles. These intervals are close enough to permit interpolation for times and distances between those given. The same is true of directions.

Use of the table is simple. The user merely consults it for the current hour and notes the optimum working frequencies in each direction for the various ranges. A combination of high working frequencies and great distance spells dx. Low frequencies in a given direction indicate the limits within which a receiver or transmitter should be held

(Continued on opposite page)

A thyratron motor control announced by Sylvania makes it possible to operate a special electric motor at a speed of 120,000 revolutions a minute.

to work or hear from stations in those great-circle directions.

A great-circle chart based on a point near the user's location is exceedingly useful for ascertaining the bearing of distant points. Less convenient is the chart published in the *Instructions*, but distances as well as directions can be obtained from it. A globe and piece of string is possibly the simplest means of finding direction and distance.

For example, to find the muf for working between New York and San Francisco at 9 p.m. Eastern Standard Time during December, 1947, first find the bearing and distance by any of the means above. The distance is between 2500 and 3000 miles, and thus fits most closely the 2500-mile table. Bearing is a little north of west (in spite of the fact that San Francisco is south of New York). At 21 hours the maximum usable frequency west is 24 mc. For reliable work this should be converted to the optimum working frequency (owf) by multiplying by 85%. The owf is then about 20.5 mc. The nearest amateur band is 14 mc, though short-wave listeners may look for Treasure Island right up to its 21-mc frequency.

Again, suppose a short-wave listener is interested in getting Shanghai or Nanking. Distance is ascertained to be approximately 12,000 km and the bearing slightly west of north. Looking at the chart, it appears that 13 mc at 9 p.m. offers the best opportunity, as read from the 7500-mile chart in the direction N. Checking with NW, the best times appear to be between 3 and 9 p.m., with a frequency as high as 33 mc at 6 p.m. However, the bearing is much more nearly north than northwest, leaving 9 p.m. the best hour.

Only one direction is given for the 12,500-mile range, as it is the same distance in all directions. There is very little difference in muf over a wide angle from NE to NW. The operator with a rotatable antenna may find it worth his while to try various paths.

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 December, 1913, ELECTRICAL EXPERIMENTER:

Dr. de Forest on the Audion Amplifier.

Modern Radio-Telegraphic Receiving Sets by *H. Winfield Secor.*

Constructing an Oscillation Transformer by *Samuel Cohen.*

How to Make a Novel Wireless Recorder by *Albert E. Shaw.*

Effect of Sunlight on Radio Waves.

Wireless Helps Explorers 800 Miles Away in Anarctic.

Learning the Radio Codes.

A TWO-TUBE FM CONVERTER

(Continued from page 30)

CIRCUIT ALIGNED	DIAL POINTER	SIGNAL GENERATOR 30% Modulation Freq. Connection	TRIMMER OR SLUG ADJUSTMENT	PROCEDURE
I.f.	108 mc.	21.75 mc. Through .01-capacitor to point A or pin No. 1 of F8 tube	Bottom slug i.f. can	Adjust for maximum output.
R.f.	105 mc.	105 mc. Through 300 ohms to terminal No. 1 and terminal No. 2	Local osc. trimmer	Adjust for maximum output.
R.f.	108 mc.	105 mc. Through 300 ohms to terminal No. 1 and terminal No. 2	Antenna trimmer	Adjust for maximum output while rocking the variable condenser.

the converter was connected to an a.c.-d.c. receiver, even when the plug was reversed for optimum connection.

The serviceman is likely to find this the first 1-tube-and-rectifier set he has been called on to align. Nevertheless, it is a superheterodyne and calls for standard alignment procedure, which is given in the table.

In the absence of a high-frequency signal generator, the r.f. section may be easily aligned on a local station. With the proper antenna attached, tune in an FM station, preferably between 97 and 108 mc. Note any difference in calibration and correct accordingly with the local oscillator trimmer. Then, adjust the antenna trimmer for maximum output while rocking the variable condenser.

DIAMONDS

(Continued from page 19)

the circuit. The output from this tube is then applied to a two-stage amplifier, from which pulses of sufficient magnitude to operate the detecting instrument are obtained.

The pulse-producing property of the diamond is thought to be a result of its highly symmetric crystalline structure, characterized by a very regular arrangement of carbon atoms with relatively large intervening spaces. According to this theory, when a photoelectron is emitted by a diamond atom as the result of the absorption of gamma radiation, the freed electron is accelerated through the interatomic space toward the positive electrode. Within a very short distance it acquires such high velocity that other atoms along its path are ionized by collision with the release of additional electrons, which in turn are accelerated in the same direction. This multiplication of charges repeats itself in rapid succession, producing a sudden avalanche of electrons equivalent to a small pulse of current. The larger the diamond the more electrons would be involved in the sudden pulse.

Apparently the diamond quickly recovers from its ionized state, as the pulses registered are extremely sharp. The diamond counter is thus a very fast counter, capable of indicating a much greater number of pulses per minute than is possible with the ordinary Geiger-Muller counter.

Diamonds tested in the Bureau's laboratories have been found to have a sensitivity per unit volume equal to or greater than that of any counter constructed by man. One of these diamonds, measuring about ⅛-inch on each face, has approximately the same sensitivity for gamma radiation as a laboratory-constructed Geiger-Muller counter of the usual type. Many diamonds are larger and would be more sensitive.

CRYSTAL OSCILLATORS

(*Continued from page 29*)

harmonics also produce parasitic output. The action is somewhat more subtle than with the tritet. Removing the crystal generally stops all oscillation, at least until a condenser is put back into the grid circuit! Broadness of output tuning is the give-away symptom of trouble. Crystal currents are very low with this hookup, but at the cost of low output. Incidentally, with the 59, 802, and RK25, external feedback between grid and plate (a few μμfs) must be used to make the unit oscillate.

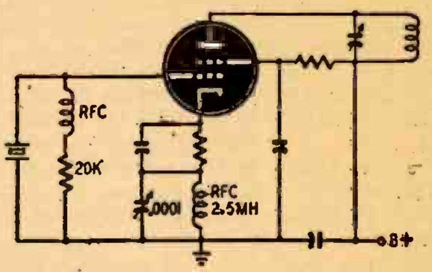


Fig. 3—Another popular harmonic generator.

Additional checks were run with several of these 20-meter crystals that are actually ground to 1/3 their marked frequency. Using an 80-meter cathode coil, the output of these crystals on 20 was slightly higher (with the single exception of the 59 to the contrary) in tritet than in a TPXG circuit, with only a modest increase in crystal current.

Ten-meter output could be obtained from these crystals with a 20-meter cathode coil subject to similar limitations as to parasitic activity as with the 40-meter fundamental crystals. Unfortunately, however, the good screening characteristics of the 59, 89, 802, and RK25 have an adverse effect in this instance, resulting in negligible output. The 6L6 with its shell tied to B-plus emerged as the only stable tube, it provided generous output with moderate crystal current.

Summing up: The "good behavers" (the 59, 89, 802, and RK25) are the most reliable, safest, and most flexible tubes for use on all harmonics and the fundamental in all types of circuits and conditions with the single exception just mentioned. The 6L6 acquits itself particularly well on most counts and would seem to be the only tube capable of providing appreciable 4th-harmonic output without too high voltages, but the requirement of returning the shell to B-plus is not a desirable one. All beam-type tubes have to be handled with care, as they are marginal cases of instability at best. Any tendency to self-oscillate can be checked by grounding the control grid and searching carefully for output with the crystal removed.

Returning to the "big four"—the 89 must be operated at lower potentials than the others. About 300 volts on the plate and 200 on the screen is the maximum or the tube will overheat, *seize up*, and oscillate only intermittently.

COMMUNICATIONS MEET CLEARS ETHER PATHS

ACCOMPLISHMENTS of the International Telecommunications Conference, which completed its work at Atlantic City in October, include the important work of conserving space in the radio spectrum and insuring its most efficient use. Charles R. Denny, chairman of the conference, reported gains in 3 important respects:

"First" he said, "we have adopted a world-wide frequency allocation table extending up to 10,500 mc.

"Second, we have planned practical machinery for putting this new allocation table into effect. Until now, every country using frequencies has simply notified the headquarters of our Union of the assignments to be entered on a master list. There was no concerted international effort to make arrangements which would best conserve spectrum space. There was no planned sharing of frequencies on a time basis or on a geographical basis. Frequency assignments spilled over the available spectrum space, radio interference became widespread, and the world was deprived of the full advantages of which radio is capable. To meet this situation, we are providing for a Provisional Frequency Board which will be comprised of technical experts. It will be the task of this Board to re-engineer the operating assignments throughout the world so that they will be put on a sound engineering basis so as to conserve spectrum space and eliminate interference.

"Third, we have provided for a permanent board of experts, the International Frequency Registration Board, which, starting with the newly-engineered list of frequency assignments, will consider every future assignment to determine whether it will cause international interference."

Numbers of delegates hailed the establishment of the International Frequency Registration Board as one of the most important results of the Conference, pointing out that it would insure uniform application of modern standard methods of radio communication throughout the world and would make possible the best use of available channels, as well as provide solutions for interference problems.

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Communications

A LETTER FROM BENJAMIN F. MIESSNER

Dear Editor:

Your September RADIO-CRAFT is especially interesting to me because:

1. On page 18, the story on the photoelectric proximity fuze is much like the scheme described in my book *Radio-Dynamics* (1916) for target-seeking missiles, which used the photoelectric stimulus of an aircraft silhouette against a bright sky as a means for automatic guiding, with 2 pairs of photoelectric cells at right angles, and with appropriate relays and guiding controls.

2. On page 34, Mr. Straede's article *Response Equalization*. I used similar methods in 1920-22 (in what I believe to be the earliest electrophonographic recording) while head of the acoustical research laboratory of the Brunswick Phonograph Company in Chicago. I went even further, using tuned, resonant, a.f. circuits, with correct resistance, not only for reducing resonant overresponse in microphones and cutter heads, and for building up weak regions in the over-all frequency-response characteristic of the entire recording system; but also to correct, in the record, reproduction for similar variations in the reproducer.

3. The article on *Post-War Phonograph Pickups* describes the FM pickup on which I hold several patents.

I always enjoy RADIO-CRAFT.

B. F. MIESSNER,
Morristown, N. J.

SIMPLE BOOKS SOLVE BEGINNERS' PROBLEMS

Dear Editor:

I have little fault to find with the last few issues of RADIO-CRAFT. There have been articles for servicemen and hams and also engineers, besides material to widen the beginners' scope of knowledge.

When I was a beginner, I hunted through libraries for books and built every 1-, 2-, or 3-tuber ever dreamed of. Then I wished there was a magazine devoted to set builders and experimenters, without so many advanced articles. Now I'm on the other side of the fence. I wish there was a magazine that dealt entirely with service and advanced data. I know that would be nearly impossible from the publisher's point of view.

I believe the beginner can get his 1-tube and crystal circuits from RADIO-CRAFT books. They are available to any beginner at all times, while an article in the magazine would be read by only a few of them, and a month later another group would want the same information. Get the idea? There were no RADIO-CRAFT books in my day!

I always mention them to a beginner, and I help any one of them today, if he is a child or aged person, to make a 1-tube set or superhet, and try to explain what he wants to know. More power to the beginner!

W. G. ESLIK,
Casper, Wyoming

Suggested by:
Walter Price,
New York, N. Y.

"I want a Teleset so that they can see me at the Television Studio."

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933.

Of Radio-Craft and Popular Electronics, published monthly at Springfield, Mass., for October 1, 1947.

State of New York }
County of New York } ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Hugo Gernsback, who, having been duly sworn according to law, deposes and says that he is the editor of Radio-Craft and Popular Electronics, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Radcraft Publications, Inc., 25 West Broadway, New York 7, N. Y.; Editor, H. Gernsback, 25 West Broadway, New York 7, N. Y.; Managing Editor, Fred Shunaman; Business Managers, none.

2. That the owner is: (if owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member must be given.) Radcraft Publications, Inc, 25 West Broadway, New York 7, N. Y.; H. Gernsback, 25 West Broadway, New York 7, N. Y.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner: and this affiant has no reason to believe that any other person, association, or corporation has any interest, direct or indirect, in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the twelve months preceding the date shown above is .... (This information is required from daily publications only.)

(Signature of publisher)
H. GERNSBACK.

Sworn to and subscribed before me this 12th day of September, 1947.

[Seal] MAURICE COYNE, Notary Public.
(Commission expires March 30, 1948)

STAMP MODEL NUMBERS!

Dear Editor:

May I suggest you get after the set manufacturers and tell them to please *stamp* the model number and year of manufacture on their chassis? Many sets are still made with the model number pasted on, or printed on a label pasted in the cabinet. It soon falls off, and I have had several chassis without identification, some of them made by the leading manufacturers. This can cause delay in servicing the receivers, and consequent bad will toward the brand.

Volume controls should also have the number and resistance plainly printed on them.

I have had many complaints from customers about the short-wave bands included with broadcast receivers. The public wants AM and FM and *no short wave* in their new receivers.

E. C. FREISEN,
Detroit, Michigan

A CORRECTION

In the circuit diagram of the "Scotch Receiver" shown on page 35 of the October 1947 issue the 500,000-ohm resistor in the grid circuit of the 12A6 is shown connected to the B-plus line. The bottom end of this resistor should be grounded or connected to the common negative point in the set.

We thank Mr. Robert Kendall of Columbus, Ohio, for calling this to our attention.

Answers to Quiz on page 83

1.—1; 2.—3; 3.—1; 4.—3; 5.—4; 6.—2; 7.—2; 8.—2; 9.—3; 10.—60 cycles.

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BOOK REVIEWS

FUNDAMENTALS OF INDUSTRIAL ELECTRONIC CIRCUITS, by Walther Richter. Published by McGraw-Hill Book Co. Stiff cloth covers, 6¼ x 9¼ inches, 569 pages. Price $4.50.

The author has devoted a number of years to teaching industrial electronics in an evening school where students have widely differing educational backgrounds. Under these conditions, it was necessary to prepare and present his material so it would be easily understood by all. With this background experience, he prepared this book as a text to be used by all classes of students. It presents highly technical material clearly and with a minimum of mathematics.

The book contains 27 chapters, the first 10 being devoted to electrical and electronic fundamentals. The remaining chapters discuss various types of complete circuit elements that have applications in industrial control mechanisms. Each chapter concludes with a number of practical questions and problems, a list of suggested reading material, and a bibliography of related reference material.

The manner in which the book is written and organized makes it equally useful to laymen, students, experimenters, and advanced engineers. This reader is glad to see that the author uses a large number of original diagrams as illustrations instead of going to the catalog of major equipment manufacturers for illustrative material as a number of recent authors on the subject have done.—*R.F.S.*

A TREASURY OF SCIENCE. Edited by Harlow Shapley, Samuel Rapport, and Helen Wright, with an introduction by Dr. Shapley. Published by Harper & Brothers. Stiff cloth covers, 6½ x 8½ inches, 772 pages. Price $3.95.

This large work ranges from the role of genes in sex determination, to the whys and wherefores of atomic fission. It includes many original papers and reports of such famous scientists as Sir Issac Newton, Curie, Pasteur, Jeans, and Oppenheimer.

The articles are arranged in carefully edited groups, presenting a smooth—reading symposium on general science. The first group is titled "Science and the Scientist." The next selection of articles covers "The Physical World—The Heavens—The Earth—Matter, Energy, and Physical Law."

The evolution of life is well covered, including explanations by famous scientists on the Characteristics of Organisms—Where Life Begins—Life of the Simplest Animals — Warrior Ants — Darwin and the Origin of Species.

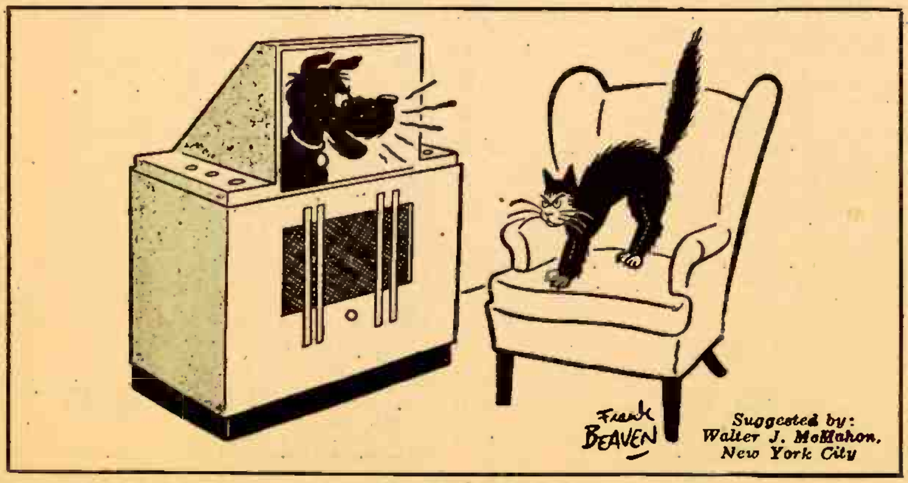
The section on the World of Man includes such subjects as "From the Ape to Civilization"—"Missing Links"—"You and Heredity"—"Biography of the Unborn"—"Conquest of Disease"—"History of the Kine Pox", and others.

Articles in the section on "Man's Mind" are "Thinking," "the Psychology of Sigmund Freud," and "Brain Storms and Brain Waves."

Atomic fission opens with the War Department's report on the New Mexico tests. "Atomic Energy for Military Purposes," "Nuclear Physics and Biology," "The Atomic Bomb and International Relations" are other articles on the subject.

In other sections we find the original discourse on the law of gravity by Newton; "Notes on Zoology," by T. H. Huxley; "Secrets of the Ocean," by William Beebe; "Evidence of the Descent of Man from some Lower Form," by Charles Darwin; and "Exploring the Atom," by Sir James Jeans.

The general science student will find in this book answers to such questions as: What is atomic medicine? Is there life on other planets? What has the flight of bats to do with Radar? What is the role of the genes? How has Einstein's theory been substantiated? What are the laws of heredity?—*H.W.S.*



Suggested by: Walter J. McMahon, New York City

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