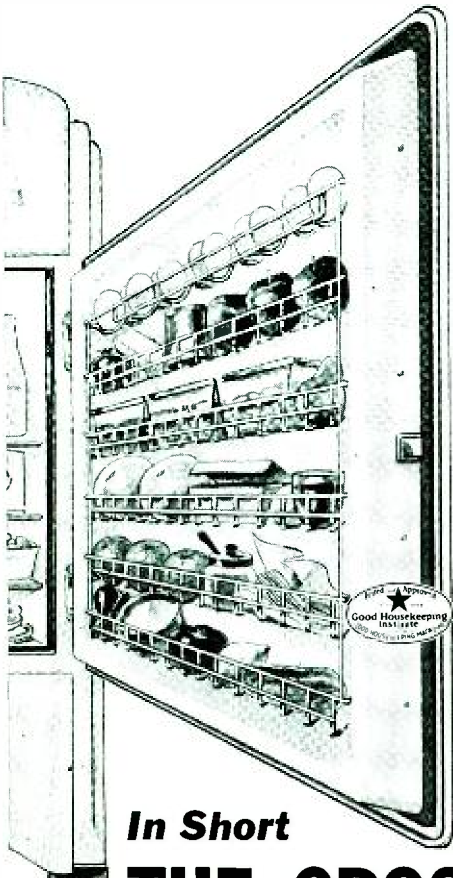
RADIO

ESTABLISHED 1917

July, 1936 | 30c in U.S.A. and Canada | 1/8 in the United Kingdom; 2/- in Australasia | No. 211

THE WORLDWIDE TECHNICAL AUTHORITY • OF AMATEUR • SHORT WAVE AND EXPERIMENTAL RADIO •

This Month



Yes Sir—

SHELVADOR IS TOUGH COMPETITION!

No one knows that better than dealers trying to sell other makes

TOUGH to sell against . . .

this much more in a Shelvador

TOUGH to sell against . . .

the world's most beautiful refrigerator

But mighty sweet to fall in line . . . To push the refrigerator that, for four consecutive years, has shown the fastest sales growth; the refrigerator that is now making merchandising history; the refrigerator that fits the millionaire's kitchen and the working man's purse . . .

In Short

THE CROSLEY SHELVADOR

Priced from $99.50 to $244.95 including delivery and installation. Five-year Protection Plan. (All prices slightly higher in Florida, Texas, Rocky Mountain States and West.)

SHELVADOR DEALERS' ENTHUSIASM REACHES NEW HIGH AS SALES AND PROFITS SOAR!

- ***from Massachusetts***
  300% SALES INCREASE
- ***from Tennessee***
  SELLS 1000% OF QUOTA
- ***from Ohio***
  SELLS SEVEN TIMES MORE THAN ALL COMPETITORS

The American Housewife vote for Shelvador is at flood tide. Dealers are profiting as never before. Surely—Now is the time to tie up with the leader!

THE CROSLEY RADIO CORPORATION
POWEL CROSLEY, Jr., *President* **CINCINNATI**

ELECTRIC WASHERS
REFRIGERATORS
RADIO

ERLE HYDE, Inc.
Electrical Appliances

ELECTRIC RANGES
WATER HEATERS
IRONERS

123 Eighth Ave., North
PHONE 6-1110
Nashville, Tennessee

Crosley Radio Corporation,
Cincinnati, Ohio

Gentlemen:

Immediately on organizing this business, we took on the complete Crosley line.

Starting with a very limited capital, we have been successful in selling 220 Crosley Shelvadors in our first season, realizing quite a satisfactory net profit on our sales therefrom. Our inventory turn-over has been very rapid and our service expense has been low. Furthermore, our customers are uniformly happy and satisfied.

When Crosley first announced the Shelvador it appealed strongly to me and my experience in 1934 as Sales Manager for a company handling a competitive line made me appreciate still more the sales and profit possibilities with Crosley. It was hard competition.

The Crosley dealership is a real opportunity. An active organization can operate on a small investment, secure fast turn-over and make a real profit. Crosley gives you more than just a line -- it gives you a 12 months' business.

We do not feel it is necessary to handle competing lines -- for Crosley covers the field and Crosley acceptance -- created by WLW and Crosley advertising -- brings sales volume easily and quickly.

With the splendid cooperation of the Crosley factory and the Gambill Distributing Company, the Crosley wholesalers in this, the TVA territory, we look forward to a substantial increase in our business this next season.

With the new models and the "word of mouth" advertising of many satisfied Crosley users -- there surely will be a "sales slide" to Crosley in 1935.

Sincerely,

E. E. Hyde
ERLE HYDE INCORPORATED

EEH:LC

ALL MAKES OF RADIO SERVICED

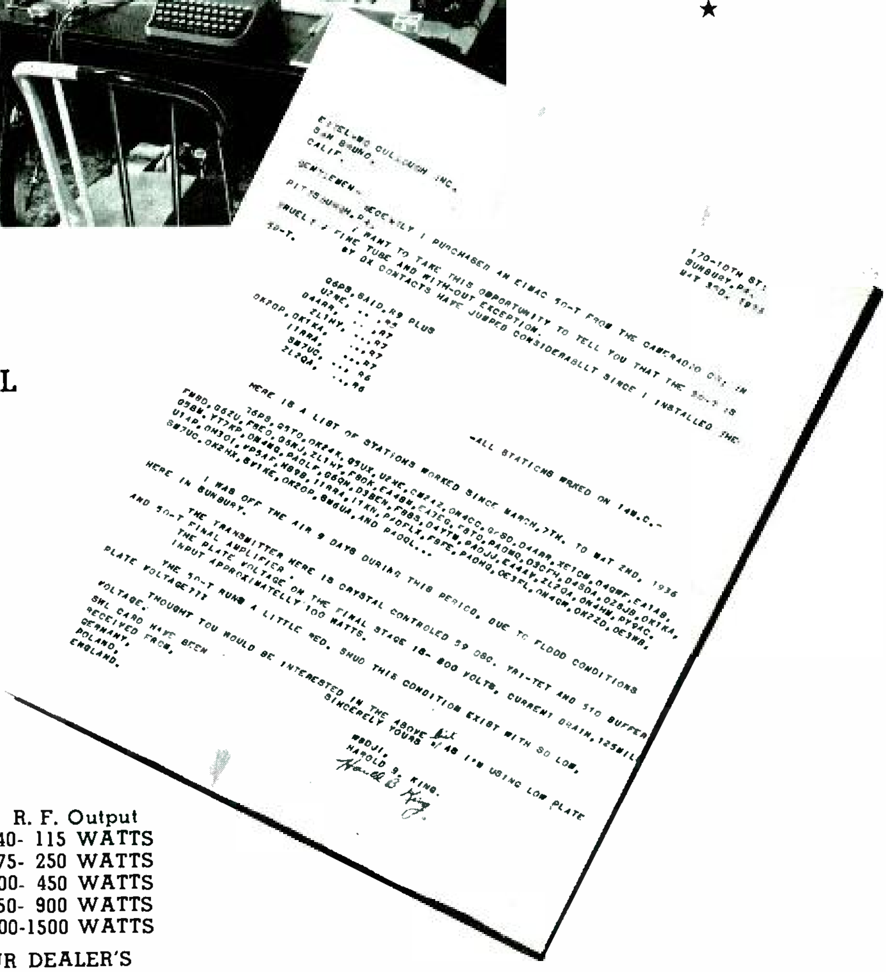
For Maximum Results . . .

Regardless of Plate Voltage or Frequency--Use

EIMAC Transmitting Tubes

W8DJI owned and operated by Harold B. King of Sunbury, Pa. A neat simple, effective station employing 59 xtal oscillator, 10 buffer Eimac 50T Final with only 800 volts on plate.

★



170-10TH ST.
SUNBURY, PA.
MAY 3RD, 193[illegible]

EITEL-MC CULLOUGH INC.,
SAN BRUNO,
CALIF.

GENTLEMEN-

RECENTLY I PURCHASED AN EIMAC 50-T FROM THE CAMERADIO CO. IN PITTSBURGH, PA.

I WANT TO TAKE THIS OPPORTUNITY TO TELL YOU THAT THE 50-T IS TRUELY A FINE TUBE AND WITH-OUT EXCEPTION. BY DX CONTACTS HAVE JUMPED CONSIDERABLLT SINCE I INSTALLED THE 50-T.

G6PS, SAID, R9 PLUS
U2NE, ...R5
D4ARR, ...R7
ZL1HY, ...R7
OK2OP, OK1KA, ...R7
I1RRA, ...R7
SM7UC, ...R6
ZL2QA, ...R6

HERE IS A LIST OF STATIONS WORKED SINCE MARCH, 7TH. TO MAY 2ND, 1936 -ALL STATIONS WRKED ON 14M.C.-

G6PS, G5TO, OK2AK, G5UX, U2NE, CM2AZ, ON4CC, G[illegible]SO, D4ARR, XE1CM, O49WF, EA1AB, FM8D, G6ZU, F8EO, G5NJ, ZL1HY, F8OK, EA4BM, EA3EG, F8TO, PA0MQ, D3CFH, D4SDA, OZ8JB, OK1KA, G5BM, YT7KP, ON4MQ, PA0LF, G6QN, D3BEN, F8BS, D4YTM, PA0JJ, EA4AY, ZL2QA, ON4HM, PY9AC, U1AP, ON3OI, VP5AF, HS9B, I1RRA, I1KN, PA0FLX, F8FE, PA0HQ, OE3FL, ON4GM, OK2ZD, OE3WB, SM7UC, OK2HX, SV1KE, OK2OP, SM6UA, AND PA0QL...

I WAS OFF THE AIR 9 DAYS DURING THIS PERIOD, DUE TO FLOOD CONDITIONS HERE IN SUNBURY.

THE TRANSMITTER HERE IS CRYSTAL CONTROLED 59 OSC. TRI-TET AND 510 BUFFER AND 50-T FINAL AMPLIFIER.

THE PLATE VOLTAGE ON THE FINAL STAGE IS- 800 VOLTS, CURRENT DRAIN, 125MIL INPUT APPROXIMATELLY 100 WATTS.

THE 50-T RUNS A LITTLE RED. SHUD THIS CONDITION EXIST WITH SO LOW PLATE VOLTAGE???

THOUGHT YOU WOULD BE INTERESTED IN THE ABOVE AS I'M USING LOW PLATE VOLTAGE.

SWL CARD HAVE BEEN RECEIVED FROM, GERMANY, POLAND, ENGLAND.

SINCERELY YOURS
W8DJI,
HAROLD B. KING.
Harold B. King

THERE IS AN EIMAC TRANSMITTING TUBE THAT WILL MEET YOUR SPECIFIC REQUIREMENTS

EIMAC TUBES NOW AVAILABLE

★

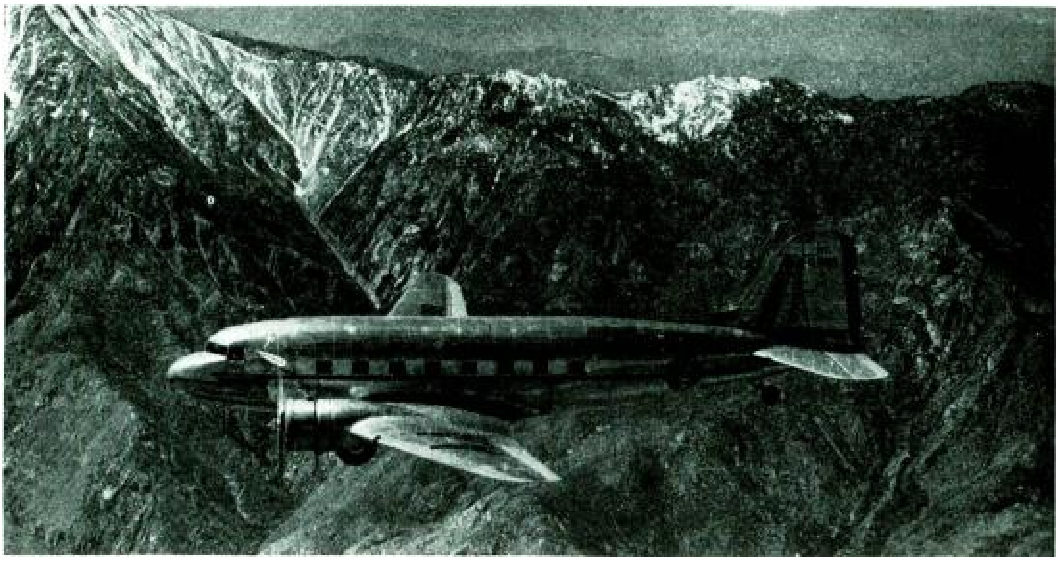
Type	R. F. Output
35T	40- 115 WATTS
50T	75- 250 WATTS
150T	100- 450 WATTS
300T	150- 900 WATTS
500T	200-1500 WATTS

SEE THEM AT YOUR DEALER'S

Eitel-McCullough, Inc.

SAN BRUNO, CALIFORNIA U. S. A.
CABLE "EIMAC"

RADIO, July, 1936, no. 211. Published monthly except August and September by Radio, Ltd., 7460 Beverly Blvd., Los Angeles, Calif. By subscription, $2.50 yearly in U.S.A. Entered as second-class matter February 6, 1936, at the postoffice at Los Angeles, Calif., under the Act of March 3, 1879.



SAN GORGONIO PASS

NON-STOP ... NEW YORK - CHICAGO

• AMERICAN AIRLINES' new giant FLAGSHIPS are now operating two NON-STOP flights daily both ways between New York and Chicago as part of "American's" frequent service between these two great cities. Soon, FLAGSHIP service will be extended to other major routes on "American's" nation-wide network of airways.

• The FLAGSHIPS will bring you a new feeling of glorious flight. No other planes in America today are so large, so fast or so luxurious as these giant Douglas airliners—with their top speed of 220 miles per hour . . . two pilots, automatic gyro-pilot, stewardess . . . and Four RADIO installations for two-way voice communication, continuous wave and directional beam flying.

TRANSCONTINENTAL ... SLEEPER PLANES

• On "The SOUTHERNER", American Airlines' Sleeper Plane service between New York and Los Angeles, you can undress and go to bed in a large comfortable berth. Wake up in the morning at your destination, fresh and rested, after a full night's sleep aloft.

• By late Summer 1936, present luxurious Sleeper Plane service will be replaced with the new FLAGSHIPS . . . large 14 passenger Pullman-style Sleeper Planes flying coast-to-coast overnight.

•

**AIR SERVICE TO 57 MAJOR AMERICAN CITIES
FROM COAST-TO-COAST, CANADA TO MEXICO**

AMERICAN AIRLINES, INC.

THE LARGEST AIRLINE IN THE UNITED STATES

THE WORLDWIDE TECHNICAL AUTHORITY OF AMATEUR, SHORT WAVE, AND EXPERIMENTAL RADIO

RADIO

The publishers assume no responsibility for statements made herein by contributors and correspondents, nor does publication indicate approval thereof.

No. 211 July, 1936

CONTENTS

"RADIO" CONTRIBUTIONS

Contributions to our editorial pages are always welcome; though they will be handled with due care we assume no responsibility for those which are unsolicited; none will be returned unless accompanied by a stamped, addressed envelope. We do not suggest subjects on which to write; cover those you know best; upon request, we will comment on detailed outlines of proposed articles, but without committing ourselves to accept the finished manuscript.

Since we regard current "chiseling" policies as decidedly unfair, a small payment will be made, usually upon publication, for accepted material of a technical or constructional nature. Freehand, pencilled sketches will suffice. Good photographs add greatly to any article; they can easily be taken by the layman under proper instructions. For further details regarding the taking of photographs and the submission of contributions see "Radio" for January, 1936, or send stamp for a reprint.

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Notice of change of address must *reach* us by the first of month preceding nominal date of issue with which it is to become effective. We will not supply back issues nor pay forwarding postage because of failure to receive such advance notice.

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Address all correspondence and manuscripts to the home office at Los Angeles except as follows:

1. Technical and constructional manuscripts and relevant correspondence from east of the Mississippi River which may be sent to R. S. Kruse[1].
2. *Radiodditties, Strays*, and the like may be sent to Rufus P. Turner[3].
3. Calls Heard may be sent to George Walker[2]; also dx news and station descriptions from eastern America and from transatlantic countries.

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[5] 500 Fifth Avenue, New York.

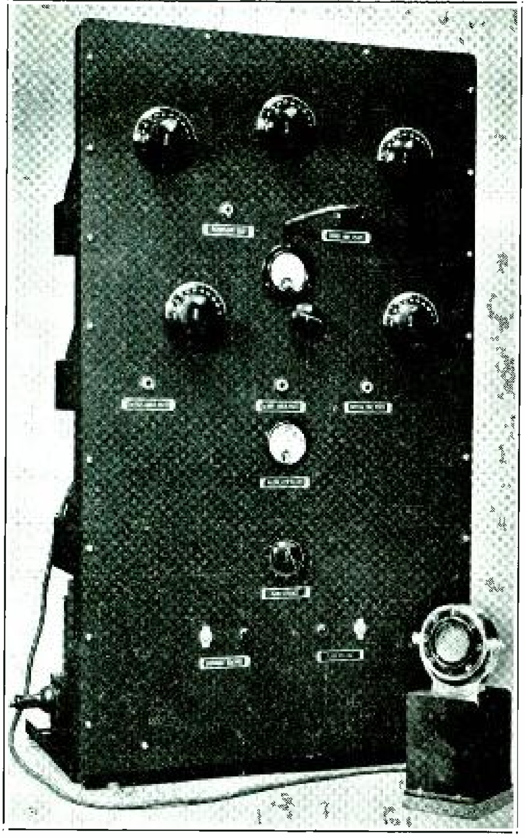
An Inexpensive, 100 Watt Phone

By Fay Harwood, W6BHO

Here is a transmitter that incorporates the newest in tubes, the newest in modulation transformers, is economical to build and operate, and looks nice enough to repose in the parlor. It turns out approximately 100 watts on all phone bands down to and including 10 meters, and the quality of modulation is excellent.

When it came time for designing a 100 watt phone rig that was scheduled to be built, the following items were first given careful consideration: 1) first cost, 2) flexibility, 3) efficiency (and upkeep), 4) stability, 5) quality of emitted signal, and 6) simplicity. While we were at it, we figured that as a matter of course the newest developments in tubes and other apparatus should be utilized, especially in view of the fact that some of the recently released amateur apparatus lends itself particularly well towards realizing the above items as they would appear in the "ideal" rig,—low cost, high efficiency, etc.

After considerable head-scratching and study of the characteristics of the new crop of tubes and other amateur parts, the circuit shown herewith was decided upon, and the parts not already in the junk box or otherwise on hand were ordered.



LEFT: The Complete Transmitter, Condenser Microphone at Right

The Rack

A relay rack was first built, of angle iron, of such size as to support the four chassis (trays) on which it was decided to mount the various units. A piece of "tempered" Masonite was cut for the front panel, and when given a coat of crackle paint looked like a factory item. It looks so much like quarter-inch crackled aluminum that it fools not only the casual observer, but nearly everyone who examines the rig. In fact, it is necessary to show most of them the back of the panel to prove to them that it is not metal.

100 watts, 100% modulated, 100% 1936, and the tubes cost $19.36. Less than 20c per watt for every tube in a phone transmitter is really something to crow about; many c.w. rigs cannot boast as low a tube-cost-per-carrier-watt. Here is how the tube stacks up at amateur prices:

R.F. PORTION	
1—T-55	$8.00
1—802	3.90
2—42 @ .49	.98
POWER SUPPLY	
1—83	.45
3—80 @ .30	.90
PREAMPLIFIER, SPEECH, AND MODULATOR	
2—6L6 @ $1.08	2.16
3—6C5 @ .54	1.62
1—6F5	.54
1—6N7	.81
	$19.36

Each of the four trays measures 17 x 10 x 2½ inches. The bottom tray holds the larger power supplies, including filament transformers, rectifiers, filter condensers, etc. The second tray (from the bottom) holds the pre-amplifier power supply, main speech amplifier, and modulator. The pre-amplifier is housed in the can on which is mounted the condenser microphone. The third tray houses the exciter unit, and the top tray supports the final amplifier and auxiliary antenna tuning gear (used only on 160 meters).

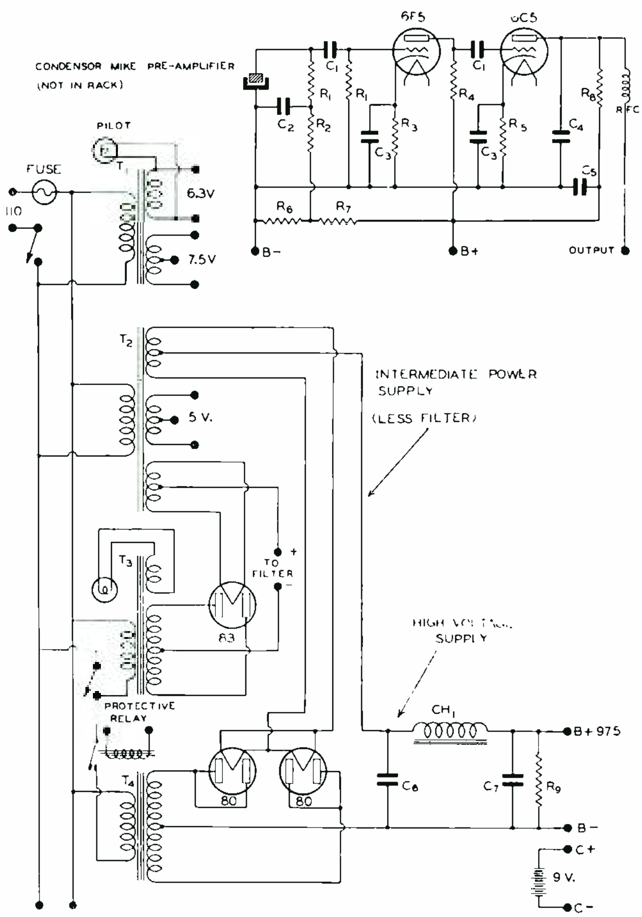
Plug-in cables are used to carry power to the different units, and the trays are so mounted that they can be easily unfastened from the rack. This construction makes it a simple matter to remove any particular unit when it is desired to work on it. Also, it simplifies the original construction, as each unit may be wired and tested individually.

When giving the Masonite panel a coat of crackle paint, it is desirable first to "fill" it with a coat of regular black lacquer. The metal rack and trays also may be given this preliminary treatment, though it is not absolutely necessary.

Although the transmitter circuit is not particularly involved or intricate, it is not exactly to be recommended for the novice or beginner. For that reason we will assume that anyone attempting construction of the rig has had a fair amount of experience in transmitter construction, and therefore we will not go into lengthy description of the transmitter and its construction. The beginner will do well to start with a less elaborate rig of a little less power, and other amateurs will need little other than the circuit diagram and the assurance that the transmitter as pictured and wired will perform like nobody's business, which it most certainly does.*

With 135 watts input, the T-55 just loafs along, and grinds out from approximately 90 watts on 10 meters to slightly over 100 watts on 75 and 160 meters. As an experiment an Eimac 35-T was substituted for the Taylor T-55, with practically no change in performance, though the 100 ma. plate current limit on the 35-T makes it necessary to run higher plate voltage if one wishes to run the full 135 watts input without exceeding the plate current rating. The only changes necessary are to drop the filament voltage to 5 volts and readjust the neutralizing condenser, which takes a bit less capacity for the 35-T, though it is extremely low with either tube. The value of grid resistor shown is satisfactory with either tube.

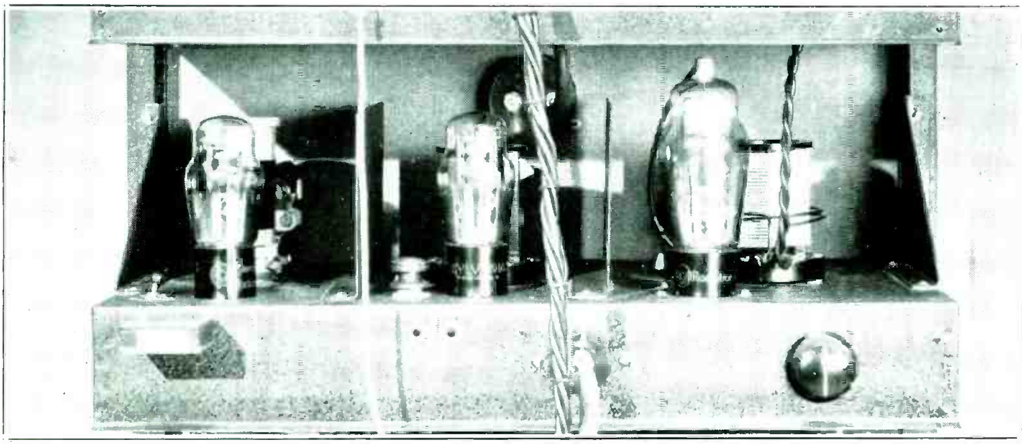
*Check.—EDITOR.



Preamplifier (Not in Rack), Intermediate Power Supply, and High Voltage Supply (First Tray)

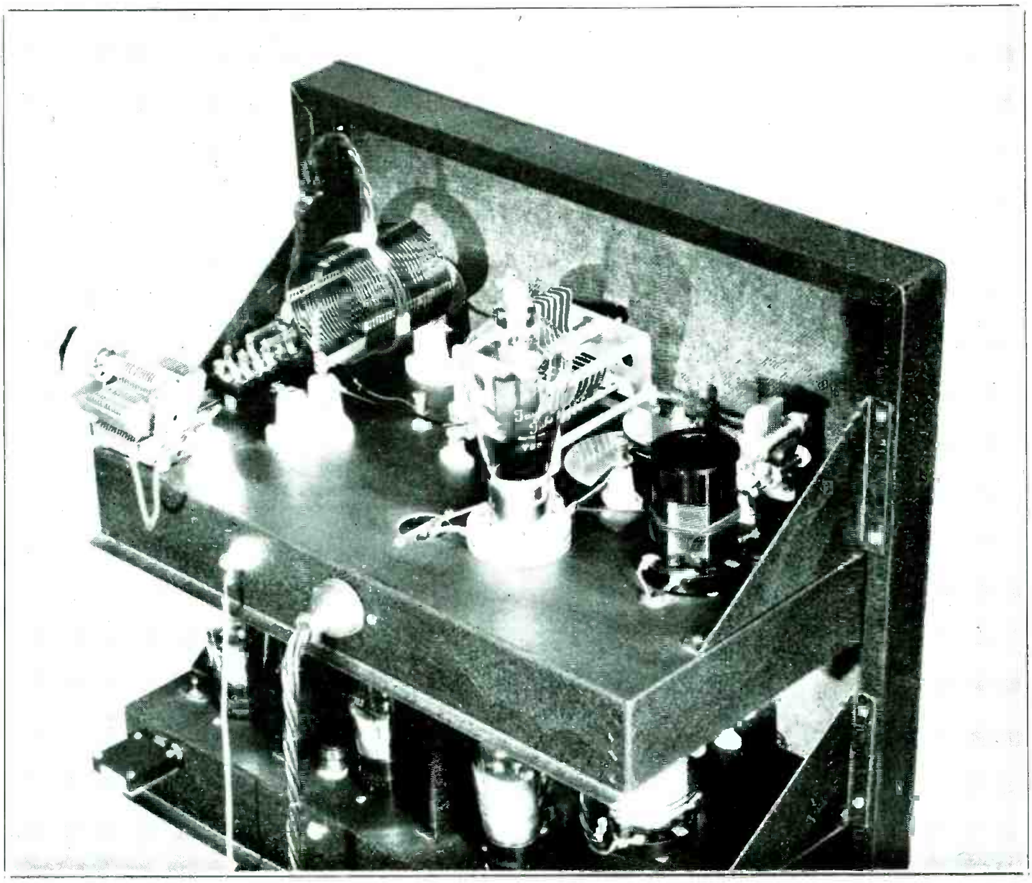
R_1—20 meg., ½ or 1 watt
R_2—1 meg., ½ watt
R_3—5000 ohms, 1 watt
R_4—250,000 ohms, 1 watt
R_5—3000 ohms, 1 watt
R_6—500,000 ohms, 1 watt
R_7—150,000 ohms, 1 watt
R_8—100,000 ohms, 1 watt
R_9—50,000 ohms, 50 watts
C_2—0.5 μfd. paper tubular
C_1—.003 μfd., mica
C_3—10 μfd. 25 volt electrolytic
C_4—.00025 μfd. mica, r.f. bypass
C_5—0.5 μfd. paper tubular
C_6, C_7—4 μfd., 1500 working volts
CH_1—20 hy., 200 ma. smoothing choke
RFC—Receiving type r.f. choke (pie wound)
T_1—Filament trans., 6.3 and 7.5 volt windings
T_2—Filament transformer for bridge 83's (extra winding used for filament of 35-T if used)
T_3—500 volts each side of c.t., 350 ma., 5 volt rectifier winding (latter winding used for pilot, not absolutely necessary)
T_4—825-850 volts each side c.t., 200 watts

Notes: If otherwise unused, the extra 5 v. winding on T_2 may be wired in parallel with the 5 v. winding that supplies the filaments of the two 80's in the h.v. supply, allowing the second-mentioned winding to run cooler. The protective relay is a "back contact" type, adjusted to work on about 15 ma. If the grid current falls below this, or there is excitation failure, no high voltage is applied to the final amplifier. 9 volts fixed bias is used on the 55-T stage to prevent "filament hum".



ABOVE: Showing Arrangement of Parts in the Exciter Shelf

BELOW: Showing Layout of the T-55 Final Amplifier Stage



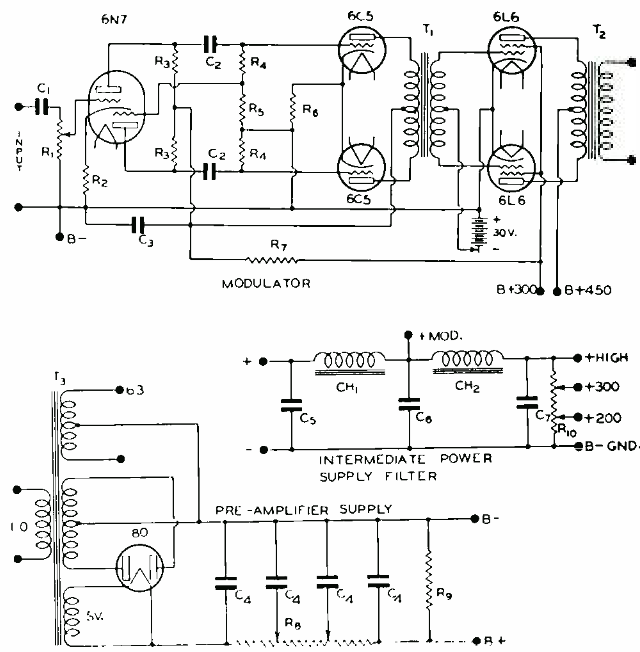
The exciter is the same as was described by the author in *R/9* for December, 1935, under the title of "The Common Sense Exciter". With but two crystals, one a 40-meter plate and the other a 160-meter rock, this exciter furnishes more than ample excitation on 20, 75, and 160 meters; and very satisfactory excitation for 10 meters.

The Speech System

The speech system utilizes metal tubes throughout, starting out with the pre-amplifier described in RADIO for January, 1936, and ending up with a pair of the new 6L6 beam power tetrodes as modulators. With fixed bias on the modulator tubes, no trouble is experienced in greatly overmodulating 135 watts input, indicating a reserve of audio power. This reserve is always desirable, as then the speech just "loafs along" with low distortion at normal levels.

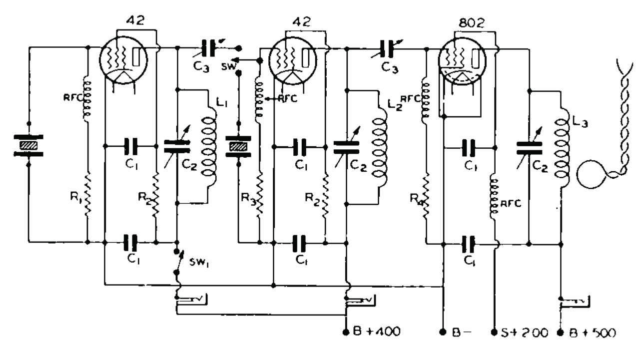
It has always been the policy of the author when "pungling up" good United States dollars for amateur gear to purchase "with an eye to the future". The versatility and lower obsolescence factor of the new "multiple tap" modulation transformers just released appealed from this standpoint, and hence one was incorporated in the rig. Not only is an extraordinarily large number of different load impedance choices offered by the several secondary taps, but in addition the tapped primary allows use of the transformer with most any modulator tubes in the same power classification. If, in 1940, we want to use 8L8's in our modulator, it will not be necessary to discard this transformer even if the tube specifications call for a widely different plate-to-plate load.

Only two meters are used in the transmitter. One is a 0-200 ma. and the other a 250 ma., both 2-inch meters which happened to be already on hand. The meters are plugged into various circuits by means of shorting jacks. After the rig is once tuned up, the 200 ma. meter is left in the plate circuit of the T-55, and the 0-250 ma. meter in the plate circuit of the 6L6's. When the latter meter gets to "whamming the pin", we know that the final stage



Modulator, Preamplifier Power Supply, and Intermediate Power Supply Filter (Second Tray)

C_1—.005 µfd. mica
C_2—.05 µfd. tubular paper
C_3—8 µfd. electrolytic
C_4—8 µfd. midget electrolytics
C_5—4 µfd., 800 working volts
C_6—4 µfd., 800 working volts
C_7—4 µfd., 600 working volts
R_1—500,000 ohm tapered pot.
R_2—2000 ohms, 2 watts
R_3—100,000 ohms, 1 watt
R_4—250,000 ohms, 1 watt
R_5—15,000 ohms, 1 watt
R_6—500 ohms, 2 watts
R_7—2500 ohms, 5 watts
R_8—50,000 ohms, 30 watt, slider type
R_9—250,000 ohms, 2 watts
R_{10}—15,000 ohms, 75 watts, slider type
T_1—Driver transformer, 6C5's p.p. to 6L6 grids
T_2—"Varimatch" output transformer (unused taps not shown)
T_3—B.c.l. power transformer, 325 v. each side, 40 ma.
CH_1—20 hy., 350 ma.
CH_2—30 hy., 200 ma.



The Exciter Unit (Third Tray)

C_1—.006 µfd., mica
C_2—100 µµfd. midgets
C_3—50 µµfd. midgets
SW, SW_1—One double-pole double-throw toggle switch
R_1—10,000 ohms, 2 watts
R_2—50,000 ohms, 2 watts
R_3—15,000 ohms, 2 watts
R_4—25,000 ohms, 2 watts
RFC—8 mh. pie wound r.f. chokes
Note: The 802 stage must be well-shielded from the preceding stages.

COIL TABLE

160 m.	**(160 m. crystal)**	
(A)	L_2—50 t. no. 22 enameled, 1¾″ form	
	L_3—50 t. no. 22 enameled, 1¾″ form	
	L_4—50 t. no. 22 enameled, 1¾″ form, 3 t. link	
	L_5—36 t. no. 14 enameled, 3¼″ form, 3¾″ long	
	Antenna coil—24 t. no. 16 d.c.c., on 3″ form, 3″ long	
75 m.	**(160 m. crystal)**	
(AX)	L_1—50 t. no. 22 enameled, 1¾″ form	
	L_2—28 t. no. 22 enameled, 1¾″ form	
	L_3—26 t. no. 22 enameled, 1¾″ form	
	L_4—26 t. no. 22 enameled, 1¾″ form, 2 t. link	
	L_5—24 t. no. 14 enameled, 3″ form, 3¼″ long.	
20 m.	**(40 m. crystal)**	
(B) (C)	L_1—19 t. no. 16 enameled, 1¾″ form	
	L_2— 8 t. no. 14 enameled, 1¾″ form	
	L_3—10 t. no. 14 enameled, 1¾″ form	
	L_4— 9 t. no. 14 enameled, 1¾″ form, 2 t. link	
	L_5—10 t. no. 14 enameled, 3″ diameter, 3¼″ long	
10 m.	**(40 m. crystal)**	
(BX) (CX)	L_1—19 t. no. 16 enameled, 1¾″ form	
	L_2— 8 t. no. 14 enameled, 1¾″ form	
	L_3— 5 t. no. 14 enameled, 1¾″ form	
	L_4— 5 t. no. 14 enameled, 1¾″ form	
	L_5—10 t. no. 14 enameled, 1⅜″ diameter, 2 inches long	

Note: "X" denotes coil is used twice

is being overmodulated, as the operation was checked on a borrowed 'scope and the point on the modulator plate meter observed at which 100% modulation of the 135 watts input occurred. Thus, the milliammeter serves as a very effective overmodulation indicator.

Antenna System

It is somewhat of an imposition on the good nature of any antenna to ask it to work efficiently on 160, 75, 20, and 10 meters. So we will let you figure the antenna problem out for yourself. It will be determined largely by the room available for the purpose of stringing sky-wires. At the writer's location, two doublets are made to do duty on all the above-mentioned bands. One doublet is cut to 75 meters, and hits the 10-meter band on its 7th harmonic. It serves therefore on both 10 and 75 meters as a link-coupled doublet. On 160 meters a switch is thrown which ties the feeders together (d.p.d.t.) and connects them to the auxiliary 160-meter coupling gear, consisting of a coupling coil and tuning condenser in series. The whole system is then tuned up against ground as a "T" Marconi.

For 20 meters the 20-meter doublet does duty, link coupled to the 20-meter final tank coil.

For the receiver, whichever doublet is not being used on the transmitter at the moment is used as a receiving antenna ("T" type, feeders and all acting as the antenna).

Some may look askance at two 80's in the power supply, but in spite of the fact that the output voltage to the T-55 is almost 1000 volts, no trouble is had with failure of the rectifiers. Using them this way with condenser input allows the use of a comparatively low-voltage (about 800 r.m.s. each side of c.t.) plate transformer, further cutting down the cost. However, make sure it is rated at *least* at 150 watts. Do not buy an 800 volt, 150 ma. transformer and expect it to do the work without groaning, even though the plate current pulled by the T-55 is under 150 ma.

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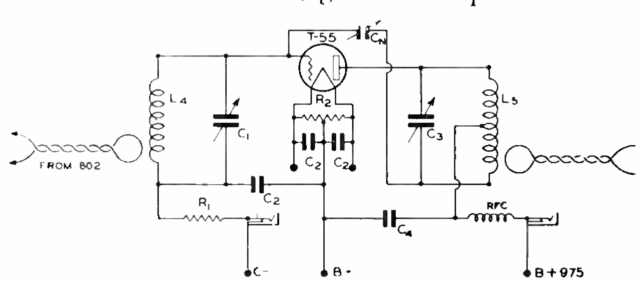
6L6 PRECAUTIONS

(Editor's Note)

Several weeks of "playing around" with 6L6's in the RADIO lab. have disclosed several interesting things. One is that the plate leads are "hotter than a firecracker", and many of the fiber-type wafer octal sockets go up in smoke from the audio voltage, especially when mounted on a metal, grounded subpanel. The new



The 55-T Final Amplifier (Fourth Tray)

C_1—100 μμfd. midget
C_2—.006 μfd. mica
C_3—100 μμfd., 6000 volt spacing
C_4—.002 μfd., 5000 v. mica
C_N—5 μμfd. home-made neutralizing condenser
R_1—2500 ohms, 20 watts
R_2—50 ohm c.t. resistor
RFC—8 mh., 200 ma. r.f. choke
Note: C— post connects through 9 volt bias battery and relay to ground. Relay set for 15 ma.

TABLE I

		Minimum capacity μfds. of C_1 at different plate voltages.				Range of adjustment for C_2 (μfd.)
		1000	2000	3000	4000	
Load Current (ma.)	100	2	2	1	1	½-1
	200	4	2	1	1	½-2
	300	5	3	2	2	1-2
	500	6	4	3	2	1-4

the result of considerable experiment and seems to fill the bill adequately. Its most important feature is the easily saturable core: it has no air gap, has a small cross-section, and has a long magnetic path. Low d.c. resistance (a requisite of any tuned circuit) and numerous taps for adjustment are also requirements. The core has a one-inch-square cross-section with a window 2" x 4", and is stacked up from 3" x 1" and 5" x 1" laminations cut from the core of an old pole transformer (the cutting was done in a few minutes at a local tin shop). Approximately 1000 turns of no. 20 enamelled wire constitute the winding. Ordinary wrapping paper was used between layers to keep the wire in place. Taps were taken out at the end of every layer after the 500 turn mark. The winding can be easily done by hand and usually the core of an old transformer will do if its cross-section is reduced a bit by removing laminations. Regular one or two-henry chokes can be used if taps are taken off and the air gap is closed tightly.

The resonant part of the filter* must be adjusted under normal load conditions using a good monitor or other sure check on the transmitter output quality. L_2 should be adjusted first, then C_2 varied in rough steps for the cleanest note. In most cases the required capacity at C_2 will increase with the load. The table above gives approximate values for C_1 and C_2 at different values of load current and voltage. It will be noted that, at constant load current, the capacity required at C_1 is inversely proportional to the plate voltage.

During experiments on the filter, several oscillograph studies were made and some of these are shown in figure 2. They are presented as visual evidence of correct and incorrect filter adjustment.

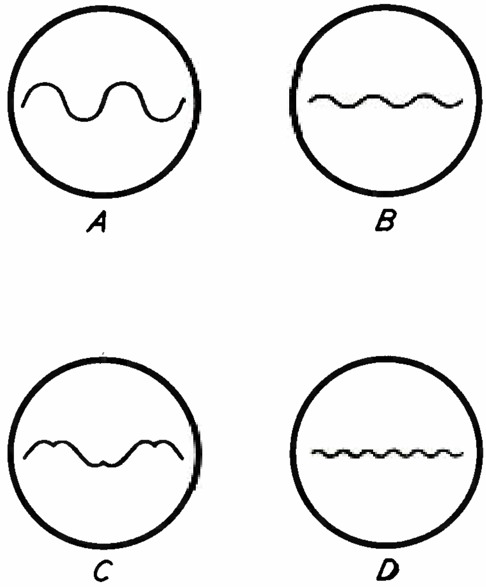


Figure 2

Oscillographic studies of filter outputs
A) Ripple with C_1 alone (about 15%)
B) Ripple with circuit of figure 1A (about 4% when properly adjusted)
C) Ripple and sharp a.c. rasp when C_2 is left out of 1A.
D) Ripple with circuit of figure 1B (between 1% and 2%)
Note: The above ripple values were for the test set-up and will vary with different filter constants.

In closing, the writer hopes the above information will help those having trouble with the resonant filter. And while this filter does change the tone of a signal, it must be emphasized that the F.C.C. Monitoring stations will be just as quick to nab you if the ripple exceeds about 5%, and such a note will shortly find you looking at one of the "For Official Use Only" envelopes with the tell-tale Grand Island postmark.

*The "resonant" feature should not be considered as making a condenser into a filter, but rather as a *means* of increasing the *effectiveness* of a filter condenser. As such, it is really worthwhile when dealing with 5000 volt filter condensers. At 1000 volts however, the wisdom of using resonant filter sections is open to argument in view of the fact that a 4 μfd. 1000 volt condenser costs but little more than a 2 μfd. condenser of the same voltage rating, and the condenser is relatively inexpensive in either case. The resonant filter system is a blessing confined primarily to the amateur using high power.

◆

VK3AL to Visit U.S.A.

Alf Kerr, VK3AL, well-known to a host of U.S.A. amateurs, will be touring the States this fall and is anxious to meet radio amateurs in this country, especially those whom he has contacted over the air. He will arive in Los Angeles on the *Monterey* August 8th. Tentative route follows through Los Angeles, Fresno, San Francisco, Salt Lake City, Denver, Chicago, Detroit, Boston, New York; returning via Washington, Pittsburgh, Cincinnati, Dallas, El Paso, San Diego. If you are anxious to see VK3AL and live somewhere on this route, drop a card to him care Hotel Clarke, Los Angeles; or Hotel Times Square, New York City.

A Novel, Directable Antenna

By Robert S. Kruse

Antennas supposed to be directional very commonly produce patterns looking far different than the theoretical pattern, the difference being discovered when a tedious "field survey" is made to find why the "wrong" stations are being heard and worked.

The worst offenders seem to be those antenna systems in which a number of ½ wave antennas are all supplied with power from a tapped feeder system, with the intention of getting radiation broadside to the row of antennas, or antennas and reflectors. Some careful workers are obtaining patterns which suggest that the pretty patterns printed for such antennas are about as likely to be attained as you are to look like the man in the picture who's just used his third tube of Gooko toothpaste.

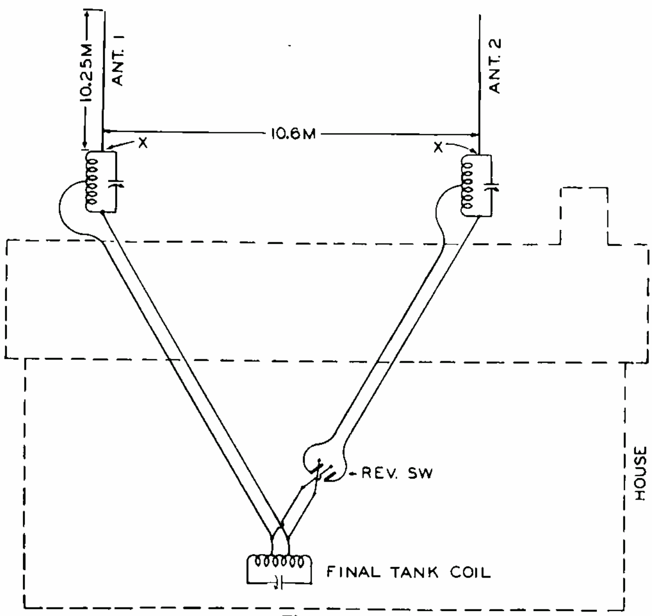


Figure 1
The antenna system, with 20 meter dimensions.

The difficulty is that these picket-fence antennas work if—and only if—all the antennas are properly phased; and since phase is not visible, that's a very tedious job, and one for the American Telegraph & Telephone Company, whose "life is continuous while that of the employee is limited."

Dodging the Phasing Job

Often it is excellent engineering to throw out a device of high theoretical possibility and replace it with a less efficient device which the user can understand and manipulate properly. This boils down to those antennas in which:

A) A single feeder-pair brings the power to an antenna, usually ½ wave, and then stops. Any additional ½ wave sections are then fed either by being directly connected to the first without feeders, or else get their power by absorption.

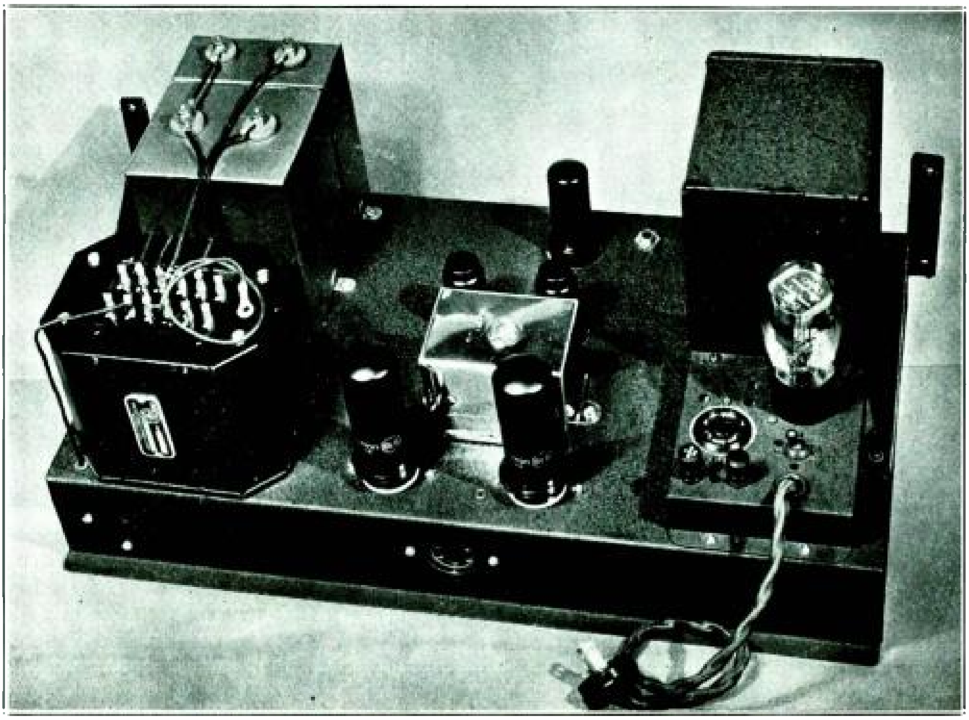
B) Only two antennas are used, with independent adjustable feed.

The antenna shown here is of the second sort, which has the advantage over type A of permitting the beam to be swung by simple switching without rotating any frameworks or cross-arms. It is seen to be merely two half-wave antennas spaced an approximate half wave apart. The picture-diagram shown is a modification of one appearing in *CQ-MB,* the German amateur paper, but the idea is an old one, and easier to operate than the diagram may suggest.

The two feed-lines may be either parallel-wire as shown or twisted-pair, since the clip on the tuned tanks at the antenna permits matching impedance with ease. The length of the feeders is immaterial, though it is simpler to make them of about the same length. The phase of the right-hand antenna can be reversed by the switch, and as a result the radiation pattern takes *theoretically* one of the two forms shown in figure 2, which is reproduced from *CQ-MB.* Even theoretically the directionality is quite broad, and for many stations no particular change takes place when the switch is thrown. For others a great change is found.

Details

The dimensions on the drawing are suggested for the 20 meter band. Any guys required on the antennas may be of tarred rope, or better, the light rot-resisting stuff sold to fishermen for lobster-traps and the like. The masts may as well be of pipe, and serve as the antennas, though some adjustability must be provided as one seldom guesses right initially. This adjustability may take the form of a sliding top-



The Modulator and Main Speech Unit, Preamplifier Power Supply, and Filter Components for the Intermediate Power Supply

ceramic octal sockets are the safest bet.

Another thing that came to light was the fact that paralleling the tubes oftentimes (but not always) resulted in parasitic oscillations at radio frequencies, due, no doubt, to the extremely high transconductance of the tube. Putting a small r.f. choke or 100 ohm resistor in the lead to *one* of the parallel tubes will usually cure this bug.

Mismatched Tubes

It was also noticed when running 6L6's in push-pull parallel that four tubes must match up fairly well if full output is to be obtained. One combination of four poorly-matched tubes gave but 150% of the output of a single pair at the same plate voltage and bias. The best match obtainable from trying different sets of four (out of 10 tubes on hand) gave 190% of the output of a single pair. The theoretical 200% increase is not obtainable in actual practice (same plate voltage, bias, harmonic distortion tolerance, and driver capacity per output tube).

◆

An Illinois auto license plate seen recently reminded us of the old sure-fire standard transmitting rig; it was 474610.

SCHEDULE OF 5-METER STANDARD FREQUENCY TRANSMISSIONS FROM W1AY.

DATE: Each Monday evening.

TIME: 8 P.M. Boston time. (*Eastern Daylight Saving Time throughout the summer months*)

8:00 P.M. 56 Mc. Voice announcement and tone signal
8:05 P.M. 58 Mc. Voice announcement and tone signal
8:10 P.M. 60 Mc. Voice announcement and tone signal

F.C.C. Rule 24 Superseded

Rule 105.23 of the *Practice and Procedure* of the Federal Communications Commission, which supersedes Rule 24 of the *Rules and Regulations* of the Federal Radio Commission, requires the licensee of a station to forward within three days after receipt of a notice of violation, a reply to the Commission at Washington, D. C., with a copy to the office originating the complaint when that office is other than the Commission at Washington. This procedure will afford the inspector citing the station for violation an opportunity to review the licensee's reply and present to the Commission for consideration, along with the reply, any facts and observations which are pertinent to the proper handling of the case.

Resonant Filter: Orchids or Raspberries?

By CHARLES D. PERRINE JR., W6CUH

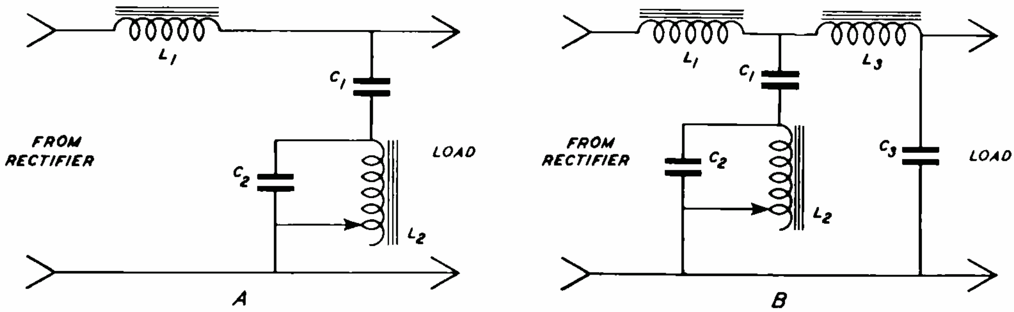


Figure 1
Two applications of resonant filter. See text and table I for constants

It is becoming increasingly apparent that most users of the "resonant filter" have only a vague idea as to its correct adjustment and operation. This has resulted in a large number of unlawful signals,* many of the gang seeming to think that mere installation of a resonant filter will solve their worries forever. It is the intention of this article to straighten out the problems of those already using resonant filter and to point out its pitfalls to prospective users.

Many improvements have been made on the original resonant filter first used at W6CUH in 1933. Recent experiments have finally evolved the correct choke design, circuit arrangements, and load limitations. Hence the following will deal with the use of an input choke with this filter, constructional details of a correct resonant choke, and give a table showing the capacities required to filter suitably various loads. We cannot stress too strongly the fact that correct adjustment of this filter is no easy matter and should only be attempted by experienced hands. Beginners and newcomers should leave it alone as it will more than likely lead them into trouble.

*Unfortunately, many stations use and intentionally adjust the resonant filter to give a broad note, thinking that the use of a potentially adequate filter puts them within the law. But the F.C.C. is not concerned with the type of filter used; the results are what count. So no matter how many mikes you have, you will be in line for an all-green QSL card unless your actual signal is clean. Incidentally, a broad note from a station is not *necessarily* a reflection on the particular type of filter used. As stated above, some operators *want* modulation, and do not adjust the filter to give the maximum filtering action of which it is capable.

Figure 1A shows the recommended circuit of the new resonant filter. C_1 and L_2 form the resonant circuit, which is tuned to twice the ripple frequency of the rectifier output; this gives approximately double the degree of filtering obtainable from C_1 alone. L_1 is a standard *swinging* choke (a standard non-saturating input choke should not be used as it impairs the action of the resonant circuit) that both reduces the ripple and greatly improves the regulation of the power supply. L_1 also reduces the peak current drain on the rectifiers and should always be used at the higher plate voltages. C_2 prevents the resonant circuit from causing a parasitic oscillation in the rectifiers at the peak of each cycle (see oscillograms) which introduces a very bad a.c. rasp into the signal. The various capacity ratings for C_1 and C_2 are given in the table. C_1 should have a voltage rating at least 1.4 times the r.m.s. output of one-half the plate transformer secondary; C_2 is usually rated at one-fourth the voltage of C_1.

In Figure 1B an additional stage of filter has been added for phone work. In some cases 1A will also be satisfactory for phone. Both circuits can be used to supply a Class B modulator (1B being recommended, with at least 4 μfd. at C_3). Under certain conditions the swinging choke in 1A can be left out to give the effect of condenser input filter, thus raising the output voltage 20 to 30%. However, this last is not recommended for general use as the adjustment becomes very critical and any misadjustment results in a strongly-modulated (oftentimes rough) signal.

The present resonant choke at W6CUH is

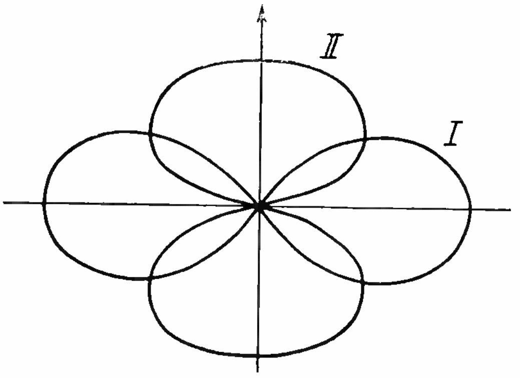


Figure 2
The directional effect is not too sharp to be useful.

section, or it may be a very small variable capacity between the tank circuit and the alleged ½ wave antenna section. End-feeding of an antenna from a tuned circuit is also very old. We formerly called it "voltage feed" and there is no reason whatever for now calling it by an imported name. The antenna so fed is never actually a half wave long; there is always some capacity-loading effect and there may be inductance-loading. Hence the suggestion that a variable condenser of about 50 micro-microfarads maximum capacity be inserted at "X" for tuning is rational. This is not a "zero-current point"; the antenna would receive no power if there were no current, since current as well as voltage is necessary to represent real power—and where there is current a series condenser always produces an effect.

The Tanks

The big drawback of the system is the difficulty of adjusting the tanks on the roof; it takes two people: one to throw switches below, the other to tune on the roof and yell orders down. First the antennas are disconnected and the tanks tuned with a flashlamp-loop, replacing the lamp as it is blown out. When properly adjusted the tanks show the same current approximately, even when the "Rev. Sw." is thrown. Readjustment of the clips downstairs may be necessary. The "Final Tank Coil" should not carry plate voltage, else the man on the roof will be in danger. The antennas are then connected and if small series condensers are used at "X" the tanks will require only moderate readjustment if they are built on a basis of about 5 micro-microfarads per meter of wavelength—which is to say about 0.0001 μfd. for the 20 meter band. The antennas are then provided with temporary current indicators in the form of small lamps or meters shunted around 1 to 4 feet of the antenna, and final adjustment made for largest antenna current, throwing "Rev. Sw." again to make sure all is well.

The only structural difficulty is in the roof-tanks, which must be moisture-proof and covered by enclosures having a glass window to discourage the gloom-hunting spider and its power-consuming web. For a trial installation even the old-fashioned maple-cooked-in-wax is not bad; for permanent work one may consider glazed insulating material of a moisture-resisting sort. The glaze is important to slow down the accumulation of surface dirt, but it cannot and will not make spongy porcelain into good porcelain. A good test is to break a sample across and soak it for several days in a solution made from the purple "lead" of a copying ("indelible") pencil. Then break up the sample and see if the color went in at all. If it went in even 1/32"—don't use that material out of doors, nor in any damp location.

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"Super Dx Super" Data

W4DHZ, designer of the "Super DX Super" described in the June issue, comes forth with the following coil data, greatly simplifying the coil-winding process for those building the receiver:

40 Meters: R.f. and det. coils 20 turns on 1¼" form. Cathode tap on r.f. coil 1/6 turn from ground. Antenna coil, 4 turns. Primary on det. coil, 4 turns interwound from ground side. Oscillator coil 15 turns on 1½" form, tapped 3 turns from gnd. for cathode and 6 turns from ground for bandspread condenser.

20 Meters: R.f. and det. coils 12 turns 1¼" dia. Cathode tap 1/4 turn from ground. Antenna coil, 3 turns. Det. primary, 7 turns interwound from ground end. Oscillator coil, 7 turns 1½" dia. Cathode tap 2 turns from ground, bandspread tap 5 turns from ground.

10 Meters: R.f. and det. coils 4 turns 1¼" dia. R.f. cathode tap 3/4 turn. Antenna coil 3 turns. Det. primary, 3 turns interwound. Oscillator coil, 3 turns 1½" dia. Cathode tap 1 turn from ground, bandspread tap 2¼ turns from ground.

Evans offers to help anyone who encounters trouble in getting the receiver to operate properly. Write him at 132 Leslie St., Atlanta, Ga., and inclose a stamped return envelope.

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Now that the alphabet is exhausting itself in three-letter W9 calls, there is no end of speculation as to the set-up of future calls. Some hold that the F.C.C. will just naturally start assigning four-letter calls; others that the massive ninth district will be torn to pieces to enlarge its lesser neighbors.

6L6's in a High Power Modulator

By PAUL D. LANGRICK, W6PT

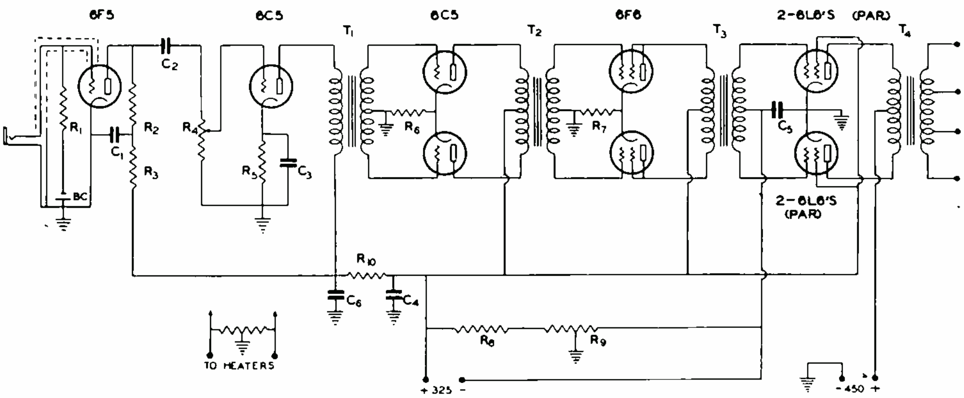
The first 6L6 tubes to find their way into this section of the country were not all "peaches and cream". For that reason we held off running any constructional data on equipment utilizing the tube. Now that the general production tubes seem to be uniformly "okay", we feel safe in presenting a low-cost 6L6 modulator using them. Its performance is really astonishing; in fact, it will fully modulate 200-300 watts input to a class C stage.

There has recently been placed on the market a new tube that holds great possibilities for the radio amateur. This new tube is the so-called "Beam Power Tube" which has been given the R.M.A. designation number of 6L6.

The tube has high-power sensitivity and practically no distortion when used under the proper operating conditions. When it is stated that with 400 milliwatts of audio power as grid drivers it is possible to obtain an output of 60 watts of audio from a pair of 6L6 tubes at 400 volts with the proper plate load, it can be readily seen what is meant by high power sensitivity.

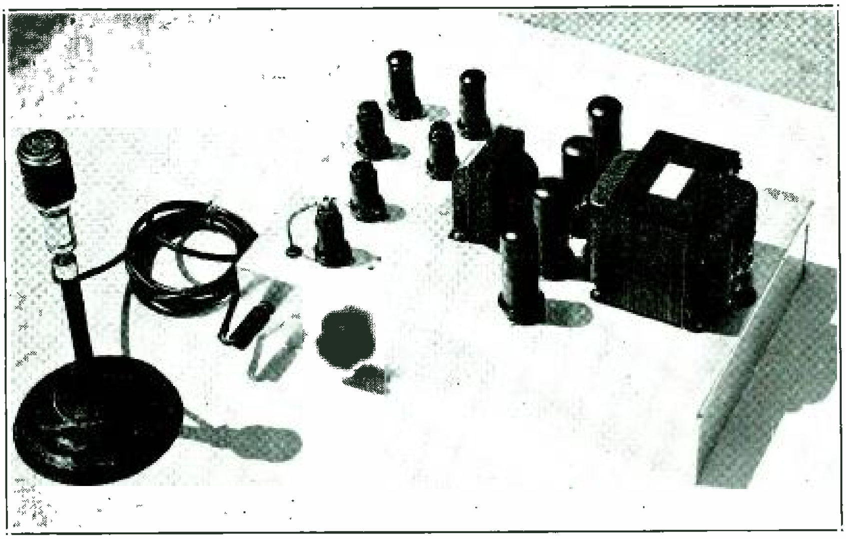
First, upon looking into the technical aspects of the tube, we note that the mechanical construction is different, and therein lies the secret of its exceptional performance. The usual cathode is at the center, then next comes the control grid and the accellerator grid, both of which are elliptical in shape. The active portions of the plate are semi-circular and correspond with the sides of the elliptical grids. At the ends of the grids are two beam-confining plates. The advantage of this construction is immediately apparent when one considers that practically all of the available electrons are confined to the operating space where they can be controlled by the central grid, which accounts for the high efficiency of the tube.

Another noteworthy point is the fact that the control and accellerator grids are identical (wire for wire) and lined with each other exactly. The electron stream is not attracted to the control grid when it is negative, but is compressed and passes through between the wires. As the screen grid wires are directly behind the control grid wires, the screen acts as a very effective accellerator of the electrons, yet draws low screen current as few of the electrons strike the screen. The high density of the electronic field at the plate, induced by the beaming, forms an electron barrier between the screen and plate, so that 'secondary emission' of electrons is forced back to the plate. Therefore, primary electrons meet no resistance in their travel to the plate, but secondary electrons are completely prevented from returning to the screen.



The 100-140 Watt 6L6 Modulator

R_1—5 megohms
R_2—1/4 megohm
R_3—50,000 ohms
R_4—1 megohm tapered
R_5—2500 ohm
R_6—1500 ohm, 2 watts
R_7—750 ohms, 10 watts
R_8—15,000 ohms, 10 watts
R_9—1,000 ohms, 10 watts, variable
R_{10}—5,000 to 10,000 ohms, 10 watts
BC—Mallory bias cell
C_1—0.5 µfd. 400 volts
C_2—.02 µfd. 400 volts
C_3—10 µfd., 400 volts, electrolytic
C_4—8 µfd., 500 volts, electro.
C_5—25 µfd., 50 volts, electro.
C_6—8 µfd., 500 volts, electro.
T_1—P.p. input, 1-1 ratio
T_2—P.p. interstage, 1-1 ratio
T_3—Special driver transformer (p.p. 45's to 46's class B also suitable)
T_4—P.p. parallel 6L6's to r.f. load, to carry class C current



The 6L6 Modulator and Speech Unit Ready to Go

In the past the pentode has been the best available high-efficiency, high-sensitivity tube. From plate-current plate-voltage curves of pentodes it will be noticed that a rounding out at the knee of the curve occurs under conditions of lowered plate voltage. The ideal condition would be to have a small slope and then a sudden drop. This has been accomplished in the 6L6 tube.

For a consideration of other data and operation characteristics, we refer you to other technical articles regarding this tube, and confine ourselves to the particular operation characteristics as employed in this modulation unit.

The complete amplifier is straightforward, no "trick" circuits being employed. It was felt in designing this circuit, that it would be best to follow the most conventional engineering practice possible. Under the circumstances here in which it is necessary to have an over-all amplification factor running into the millions, it would not be possible to use any trick circuits and achieve the necessary stability and ultimate performance without considerable "bug-chasing." The complete modulator unit is very simple indeed when the tremendous amount of amplification is taken into consideration.

The crystal microphone used with this modulator unit is down 64 db, and as a consequence, that portion of the circuit usually referred to as the "pre-amplifier" has a rather high amplification factor.

The input tube is a 6F5, which has an amplification factor of 100 and works into a 6C5. Resistance coupling is used between these two tubes. The 6C5 is transformer coupled to the following push-pull stage, which also employs 6C5 tubes. These in turn are transformer-coupled to push-pull 6F6 tubes, which are used in this instance as triodes, and form the driver stage for the 6L6's.

It will seem to some a waste of good power to use the 6F6 type tubes as the driver stage for the class "AB" modulator tubes, considering their high power sensitivity. As the 6F6 tubes will never be called upon for much over one watt of audio power, it will be seen that they will just be practically idling along. With proper circuit design and treatment it is possible to keep the distortion down to a minimum up to the class "AB" grids. Therefore it is felt that the use of this type tube in the driver stage is not a waste of good audio power, but on the contrary, is good engineering practise.

The class "AB" input transformer is designed to couple a plate-to-plate load of 10,000 ohms on the primary to the class "AB" grids. A noteworthy feature of this transformer is that it is exceptionally large for the amount of power it is to handle. The secondary is composed of two separate windings. If necessary it would be possible to return the two individual C bias leads to separate taps on the voltage divider to equalize the plate current on each side of the output transformer. The 6L6 tubes on hand matched up quite well; so the two C bias leads were returned to the same point on the voltage divider.

Push-pull Operating Characteristics

Plate voltage	400	
Screen voltage	300	
Control-grid bias, volts	-25	
Zero signal plate current ma.	50	per tube
Full signal plate current ma.	114	per tube
Zero signal screen current ma.	2.5	per tube
Full signal screen current ma.	9.5	per tube
Signal input, peak volts	42.5	per tube
Load, plate to plate, ohms	3800	
Power output, watts	60	
Total distortion, per cent	2	

The C bias for the 6L6 tubes is taken from the bleeder on the B power supply to the low level stages. This bleeder is mounted on the modulator unit proper, and is composed of two resistors: a fixed 15,000 ohm, 10 watt resistor and a variable 1,000 ohm resistor. The one shown in the photograph of the under side is actually a 50 watt resistor, although a 10 watt size is sufficient. By referring to the diagram it will be easily seen how the C bias is obtained.

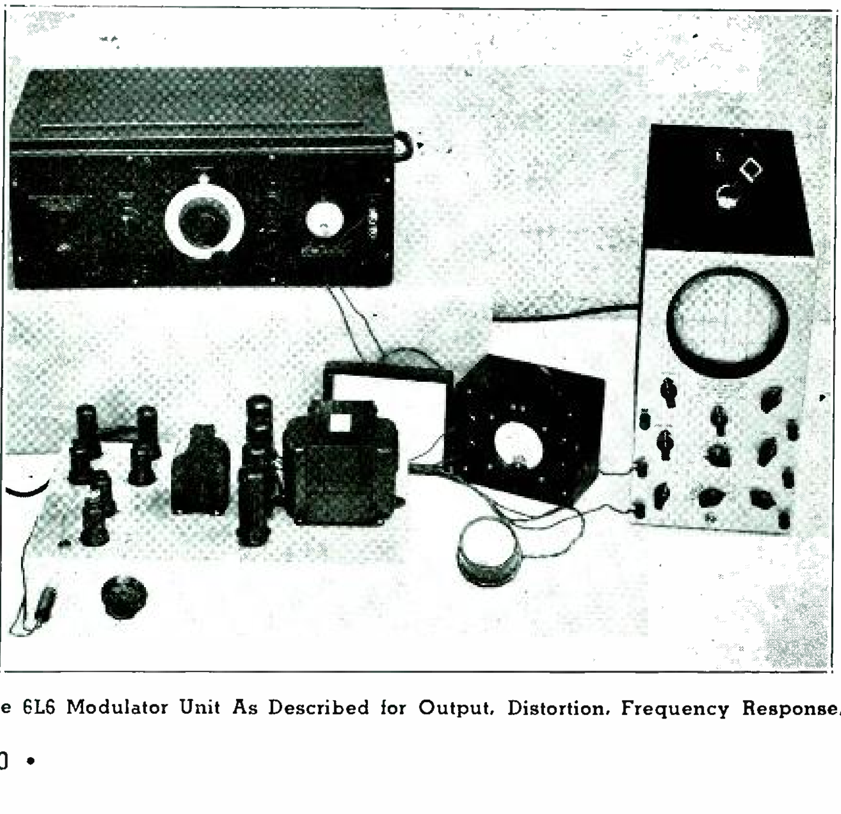
The output transformer is of husky construction, having been designed to handle 150 watts at 20 cycles. Both the primary and the secondary are tapped to facilitate the use of several different load values. The core was designed with an air gap to allow running of the class C plate current through the transformer.

The usual amateur practise of "dynamiting" tubes was taken into consideration in the design of this output transformer, and it is felt that the size is ample to handle the full output of four 6L6 tubes in push-pull parallel.

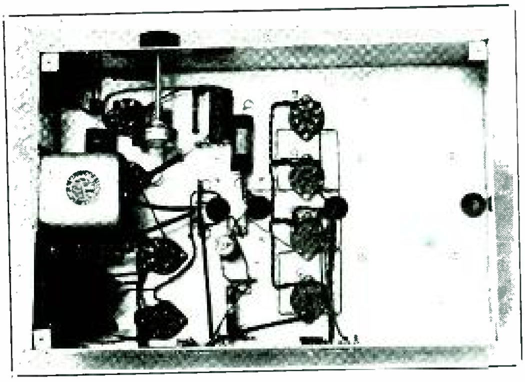
It is possible to use the modulator unit without shielding around the first two tubes, provided it is kept several feet from the transmitter as it is at the author's station. It is always best practise to do so, in order to minimize radio frequency pick-up and feed-back in the modulator unit. If it is desired to use the modulator unit near the transmitter, as in the case of rack and panel type construction, it will be advisable to shield at least the first two tubes.

The chassis is 17 inches long, 11 inches deep and 3¼ inches high. It can be mounted back of a standard 19 inch relay rack panel by using braces between the sides of the chassis and the panel to help support the weight.

From the picture of the under side of the unit it will be seen that the volume control is mounted very close to the input tube, and has a long shaft that comes out to the front of the chassis. This placement keeps the leads, and



Checking the 6L6 Modulator Unit As Described for Output, Distortion, Frequency Response, and Gain.



Bottom View of the Chassis, Showing Layout of Parts. Note Extension on the Gain Control, Allowing Shorter Leads.

especially the grid lead, down to the shortest possible length, reducing possibility of radio frequency pickup to a minimum.

The Mallory C bias cell simplifies the circuit considerably, doing away with the usual grid filter network and allowing the cathode to be grounded, which eliminates the possibility of hum being generated in a high-μ tube when the cathode is worked above ground potential.

The frequency response curve is essentially flat between 50 and 10,000 cycles. Owing to the almost entire absence of harmonic distortion the quality on music is exceptional.

Two power supplies are used, the first a 300 to 325 volt unit, supplying about 85 ma. for the voltage amplifier, driver stage and the C bias and screens of the 6L6 tubes. The second power supply unit is capable of supplying 450 to 500 ma. at 450 volts, with good regulation.

The 300 volt supply should not be grounded, but plugged directly into the modulator unit where the voltage divider is located. The ground is placed 25 volts above the negative end of the divider and the 25 volt section that is below ground is used as C bias. The 25 μfd. electrolytic condenser is very necessary and should not be eliminated, as it has a large bearing on the response curve at low frequencies.

The overall gain is in excess of 130 db. This permits the latest types of crystal microphones to be plugged directly into the input, and drive the modulator unit to full output.

The bias voltage was intentionally allowed to appear across the crystal microphone, as it seems to improve the performance of the microphone in the presence of strong r.f. fields.

This modulator unit is the answer to the amateur phone operator's prayers, because of the use of low-priced tubes throughout and the fact that it is not necessary to use high voltages in the power supply. It is capable of modulating a relatively high powered phone at the least possible expense.

(Photos courtesy W6CZ)

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F.C.C. to Hear Phone Request

At a session of the Telegraph Division of the Federal Communications Commission held at its offices in Washington, D. C., on the 9th day of June, 1936:

The Telegraph Division having under consideration the request of the Board of Directors of the American Radio Relay League that the Commission's Rule 377, providing for a sub-allocation of frequencies for Class A amateur radiotelephony operation (type A-3 emission), be amended to expand the present band 3900 to 4000 kilocycles to include the band 3850 to 4000 kilocycles, and

It appearing, that many licensed amateur operators are opposed to any expansion of the existing radiotelephony bands, and

It further appearing, that it is desirable in the public interest for the Commission to be more fully advised in the premises;

It Is Therefore Ordered, that a public hearing be held before the Telegraph Division in the offices of the Commission at Washington, D. C., beginning at 10 a.m., on October 20, 1936, and continuing from day to day until completed, for the purpose of assisting the Commission in determining whether the proposed change in Rule 377 would serve public interest, convenience and necessity, and such other questions as may be properly considered by the Commission before acting upon the said request.

It Is Further Ordered, that notice of the hearing shall be given interested parties by posting a copy of this order in the office of the Secretary of the Commission, by publication in the Federal Register, and by issuing a press release thereon.

It Is Further Ordered, that all persons desiring to be heard at the hearing herein provided for shall, not later than ten (10) days prior to the hearing, file with the Commission a notice of such intention stating their interest in the proceeding and in a general way the nature of testimony to be presented.

◆

Had Adam sent out a radio SOS, Walter Winchell assures his readers, it still would not have reached the nearest star!

Dynamic Shift, Grid Bias Modulation

By F. E. TERMAN* and F. A. EVEREST**

We had heard that Dr. Terman was working on a high-efficiency amplifier which reduced the unmodulated plate loss of a linear amplifier or grid bias modulated amplifier. We find that he was working along practically the same lines as Mr. Hawkins[1] in causing a dynamic shift, at syllabic frequencies, of the grid voltage, plate current characteristic of the amplifier. By limiting the modulation capability of the amplifier in the resting, or unmodulated condition, materially higher unmodulated plate efficiencies are achieved. The means used by Terman and Everest to achieve the expansion of plate and bias voltages, during modulation, are the same as those shown by Hawkins: namely, saturable control reactors and grid controlled rectifiers. This article is not a duplication of what we have already presented on dynamic shift amplification, as it discusses grid bias modulation and also presents some valuable data on saturable control reactors.

—EDITOR.

Because of the fact that grid bias modulation is accomplished with a minimum of apparatus it has found a limited use in low-powered transmitters in aircraft, amateur, and the smaller broadcast transmitters. Low-powered broadcast transmitters of this type have been manufactured by Western Electric and Collins. As the modulator normally works into a negative grid, very little power is required of the modulator. Low power output per tube and low efficiency, however, have limited the application of bias modulation.

Figure 1 shows the instantaneous values of grid voltage and plate current in the conventional grid-bias-modulated amplifier. For simplicity the dynamic characteristic has been assumed to be a straight line between the limits of A and C. The point B represents the radio frequency operating point. The grid is biased beyond cutoff to D and the magnitude of the exciting r.f. voltage is adjusted so that the plate current peaks reach the point B. Plate current does not flow as long as the instantaneous value of the voltage on the grid is beyond cutoff point C. Beyond C, however, the plate current flows in a pulse of something less than 180 electrical degrees or less than half sine waves (for class C operation). As the audio modulating signal is superimposed upon the d.c. bias, the r.f. exciting voltage is driven varying amounts beyond cutoff, causing the plate current pulses to vary at an audio rate.

In figure 1 it is seen that for complete modulation the peak plate current amplitude on positive modulation peaks is twice the peak plate current for the unmodulated condition. As the power output is proportional to the square of the voltage across the load, doubling this voltage (by doubling the peak plate current pulse magnitudes) calls for an increase in power of four times. The efficiency is thus twice as high on modulation peaks as when unmodulated. As modulation peaks are scattered and of short duration, the average efficiency is still very low.

Another result of the requirement that the

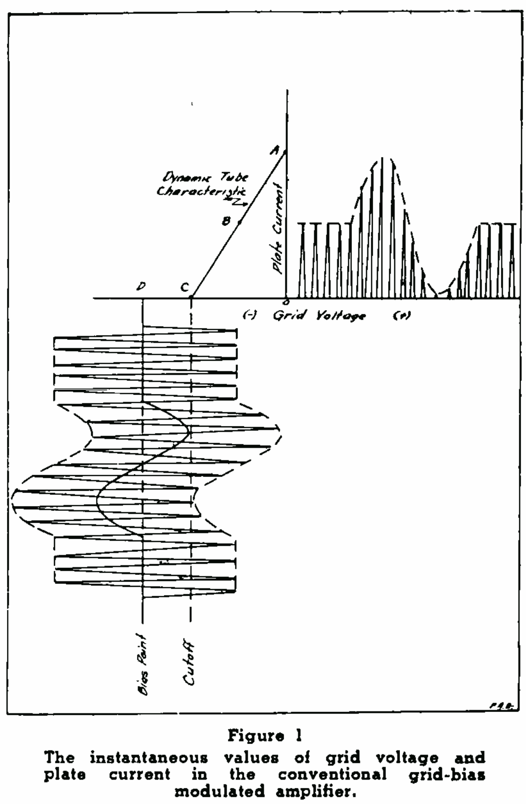


Figure 1
The instantaneous values of grid voltage and plate current in the conventional grid-bias modulated amplifier.

*Stanford University, Calif.

**Care Don Lee Television Lab., Los Angeles, Calif.

[1]See RADIO for May, 1936, page 8, and June, 1936, page 63.

peak output power be four times the unmodulated carrier power is that the power output per tube is very low. If the efficiency on modulation peaks is 60%, the unmodulated efficiency would be 30% and the average efficiency only slightly greater than 30%. With this efficiency, 2 1/3 watts of plate dissipation are required for every watt of carrier power, resulting in extremely high installed tube costs and power costs.

Linearity is not a limitation on the bias modulation system if properly adjusted. If the load impedance is high, the bias modulated amplifier will be essentially linear. As the total plate supply voltage is consumed across the load impedance and the tube, the high load impedance will cause a great part of the total voltage to appear across it with only a small plate current pulse flowing. This load voltage builds up until the point is reached where any further increase of voltage across the load impedance would leave none on the plate of the tube and the plate current pulse would be reduced to zero. The amplitude of this voltage across the plate tank circuit follows the modulation upon the grid very accurately. It does not particularly hold that the amplitude of the plate current pulses will always be proportional to the grid

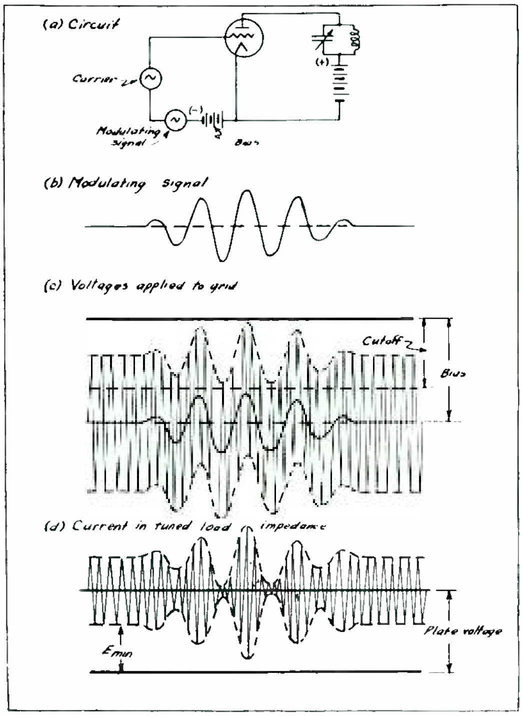


Figure 3
Voltage and current relations in conventional grid bias modulated amplifier

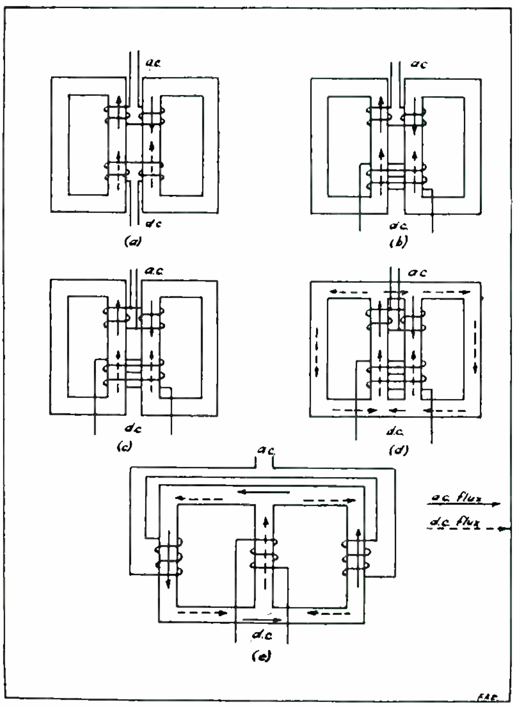


Figure 2
Various designs of saturable-core reactors

voltage, but the power represented by the pulses, taking into account both the angle of flow and the amplitude, will follow the modulation upon the grid very closely. Therefore, with a sufficiently high load impedance, the grid bias modulated amplifier is linear.

The great drawback of bias modulation is its inherently poor efficiency. During periods of low or no modulation the voltage drop across the tube must be high in order to care for modulation peaks. High tube drop results in high plate loss. *By applying the dynamic shift principle the plate and bias potentials may be varied with the modulation envelope in such a way that the plate current pulse magnitude and angle of flow are not affected, but excess power capacity is made available for the modulation peaks.* By limiting the modulation capability when resting, the plate loss can be reduced and the resting efficiency can be increased greatly. The dynamic shift principle allows complete modulation to take place by automatically shifting to another dynamic grid voltage-plate current characteristic curve. The modulation capability is thus varied with the envelope of the modulating voltage, allowing full advantage to be taken of the higher efficiencies that can be

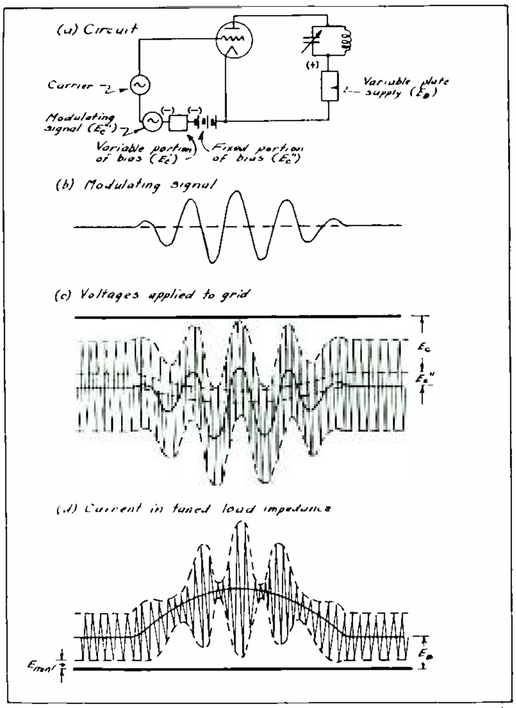


Figure 4
Voltage and current relations in the dynamic shift grid bias modulated amplifier

realized by limiting the modulation capability. The only limit to the amount the modulation capability can be reduced is a practical one. If it were reduced to zero, the finite time required for the dynamic shift apparatus to function may be greater than that required for the modulating voltage to build up, resulting in distortion on the audio wave fronts. By adjusting so that 20 or 30% modulation capability exists while resting, no distortion will be caused when a modulating signal suddenly appears.

As pointed out by Hawkins[1] there is no advantage in causing the plate and bias voltages to drop more than 50% of the fully modulated values, for the carrier average will not remain constant with more than 50% dynamic shift. There is some optimum shift between the 50% point (which has no resting modulation capability but very high resting efficiency) and the 0% point (which has 100% modulation capability and very low resting efficiency) that will give the best results. A compromise must be struck between the conflicting factors of resting efficiency and resting modulation capability.

This compromise between resting plate efficiency and resting modulation capability partly depends on two factors which have not, as yet, been accurately determined. These two factors are: inherent time delay in the control circuit, and steepness of wave front in speech, music and dramatic sound effects.

From what is now known about the lag in the control circuit and also about the steepness of many audio wavefronts, it is probable that 33% resting modulation capability will satisfy amateur requirements and that 50% to 66% resting modulation capability will be sufficient for broadcast use.

From the standpoint of maximum carrier power output from a given tube it is only necessary to use enough dynamic shift to keep the resting plate loss down to the value of tube loss at 100% modulation. This can usually be achieved by not more than 20% dynamic shift downward from the 100% modulated condition. From considerations of plate power economy it is desirable to use the maximum amount of shift possible in order to make the resting plate efficiency as high as possible.

As the maximum peak plate efficiency of the grid-bias-modulated amplifier discussed in this paper approximates 66%, due to the fact that the angle of plate current flow is about 180 degrees on the peaks of modulation, the table on

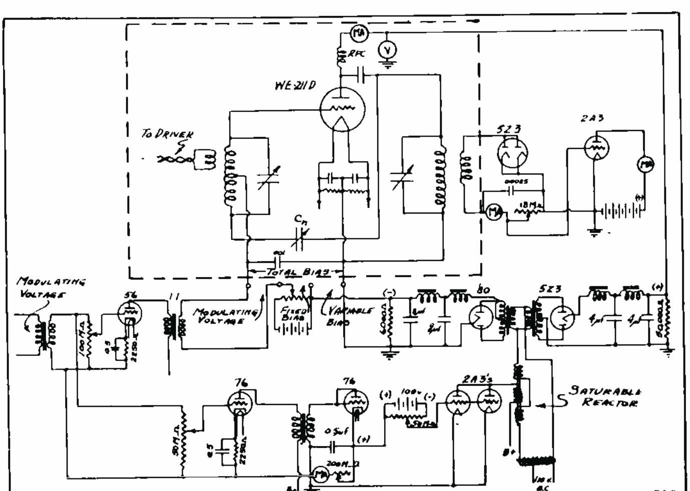


Figure 5
Complete wiring diagram of experimental dynamic-shift bias-modulated amplifier.

this page shows the relationship between dynamic axis shift, resting plate efficiency, and resting modulation capability.

The dynamic shift is obtained in the same manner for the control-grid-modulated amplifier as for the Hawkins expanding class BC linear amplifier. It may be conveniently obtained by using saturable reactors or by using grid controlled rectifier tubes. The former offers one of the simplest and cheapest means of obtaining the dynamic shift.

The Saturable-Core Reactor

The effects of direct current flowing in a transformer winding or a reactor are well known. The direct current saturates the core, causing the incremental inductance (the inductance to an alternating current superimposed upon a direct current) to decrease. The reason for this lies in the fact that the permeability of the iron changes with flux density. It is this factor that causes a distorted current wave to be drawn when a sine voltage is applied to a transformer. This distortion may be increased by saturating the iron with a direct current. Before the days of the vacuum tube oscillator, this method of generating harmonics was used in radio work as a frequency multiplier. However, this phenomenon of a changing reactance with a d.c. saturating current has many useful applications. The harmonic generation can be held to a minimum if desired.

Figure 2(a)* shows two single-phase transformers connected for use as a saturable-core reactor. The a.c. voltages of fundamental frequency induced in the d.c. coils by interaction will neutralize each other because at any instant the voltages are 180 degrees out of phase in the two halves of the d.c. coil. However, there will be an a.c. voltage to ground which will be impressed upon the d.c. supply system. Because

[*Continued on Next Page*]

Percentage drop in plate and bias volts. (Dynamic shift in %)	*Resting plate efficiency. (Taking 66% as peak)*	*Resting modulation capability*
0%	33%	100%
10%	37%	80%
16.6%*	40%	66%
20%	41%	60%
25%	44%	50%
33%	50%	33%
40%	55%	20%
45%	60%	10%
50%	66%	0%

*Note that 16.6% dynamic shift allows maximum output to be realized from a given amplifier tube as the resting plate loss is equal to the plate loss with complete sine wave modulation. Also note that the 66% resting modulation capability associated with 16.6% dynamic shift makes overmodulation on the first few cycles of a high amplitude audio wave highly improbable unless excessive lag is present in the control circuit.

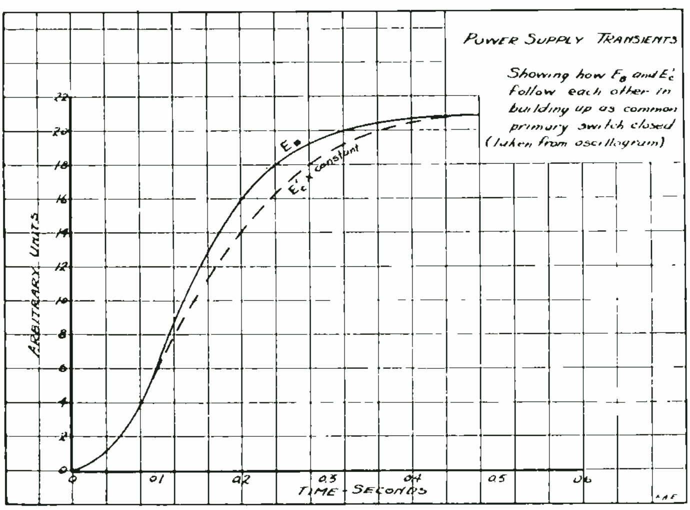


Figure 6
Re-plotted oscillogram showing the degree with which the bias and plate power supplies were made to follow each other over the most severe of transient conditions.

*The table shown above is taken from Hawkins' formulae*** where*

$$\mathrm{Eff}_R = \frac{100\ \mathrm{Eff}_p}{100 + M_c}$$

$$M_c = 100 - 2S$$

$$\mathrm{Eff}_R = \frac{50\ \mathrm{Eff}_p}{(100 - S)}$$

Where Eff_R equals resting, or unmodulated plate efficiency.

M_c equals percentage modulation capability.

Eff_p equals maximum attainable instantaneous peak plate efficiency.

S equals percentage dynamic axis shift downward from 100% modulated to resting condition.

*"Theory of D.C. Excited Iron-Core Reactors and Regulators" by A. Boyajain, *Journal A.I.E.E.*, Vol. 43, p. 959 (1924).

**RADIO, May, 1936, page 14.

the d.c. winding may have many times the number of turns of the a.c. winding, this induced voltage to ground may be of a magnitude that will cause insulation trouble. Grounding one terminal of the d.c. supply will help somewhat.

Figure 2(b) shows a design in which the difficulties due to a.c. voltages induced in the d.c. coils are overcome. The d.c. winding encircles both cores and the a.c. voltage induced in it is neutralized in each turn and no great amount of a.c. voltage can appear in the circuit.

In the designs of figures 2(a) and 2(b), the a.c. voltages of fundamental frequency are neutralized in the d.c. coil, but the even harmonics are phased in such a way that they add in each turn. If the internal impedance of the d.c. supply is high, these even-harmonic voltages may build up to destructive proportions. The design of figure 2(c) eliminates the high, even-harmonic voltages by providing a circulating path for even harmonic currents in the a.c. coils. In this design the wave shapes in the external circuits are better, the effectiveness of the control of a.c. reactance by variation of the d.c. saturating current is improved, and the time constant of the circuit is lower, allowing faster control.

The design shown in figure 2(d) is essentially the same as figure 2(c) with an improvement in that the a.c. fluxes are kept in a shorter iron path, cutting down the losses.

The variable reactor shown in figure 2(e) is the type manufactured by the United Transformer Corp. and called the "Variactor". The solid arrows represent the a.c. flux on one part of the cycle. The a.c. fluxes from the two a.c. coils oppose each other in the center leg and cancel. One half cycle later the a.c. fluxes are in the opposite direction, but still they cancel in the center leg. A direct current passing through the d.c. coil will saturate the core, cutting down the flux linkages between the two a.c. coils, thus lowering their incremental inductance. It will be noticed that the 120-cycle harmonic component of the a.c. flux is phased in such a way that the 120-cycle flux adds in the center leg instead of opposing, as the 60-cycle flux does. The only practical significance of this fact is that instead of a pure direct current being drawn from the source, a direct current having a strong 120-cycle current superimposed will be drawn. The effect can be minimized by shunting a large value of capacitance across the d.c. coil terminals if the internal impedance of the d.c. source is large enough to allow the shunting capacitance to be an effective by-pass at 120 cycles.

Figure 7 shows how the incremental inductance of the a.c. coils in series with the power

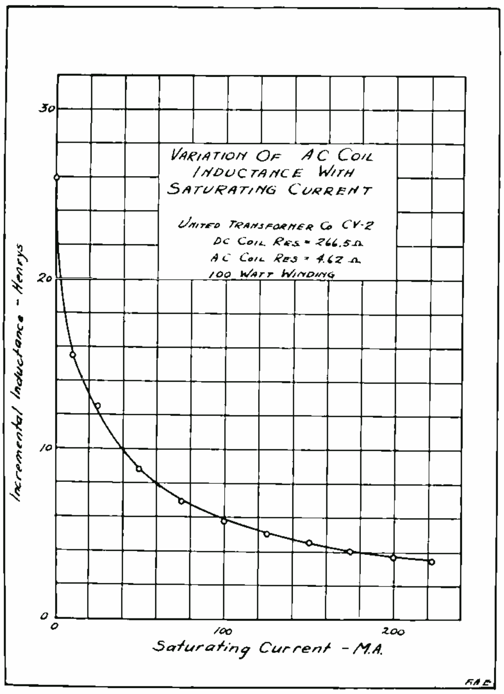


Figure 7

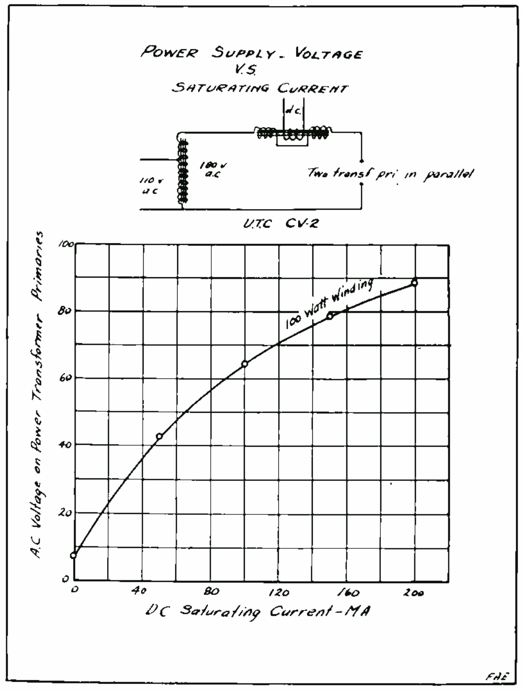


Figure 8

supply primaries varies with direct current in the saturating coil. Figure 8 is a more practical method of presenting roughly the same information. As the saturating current is increased, the reactance voltage drop in the primary circuit of the power supplies decreases. As this drop across the saturable reactor is decreased, a greater portion of the 110 volts appears across the primaries of the plate and bias power supplies. It must be remembered that this is a reactive

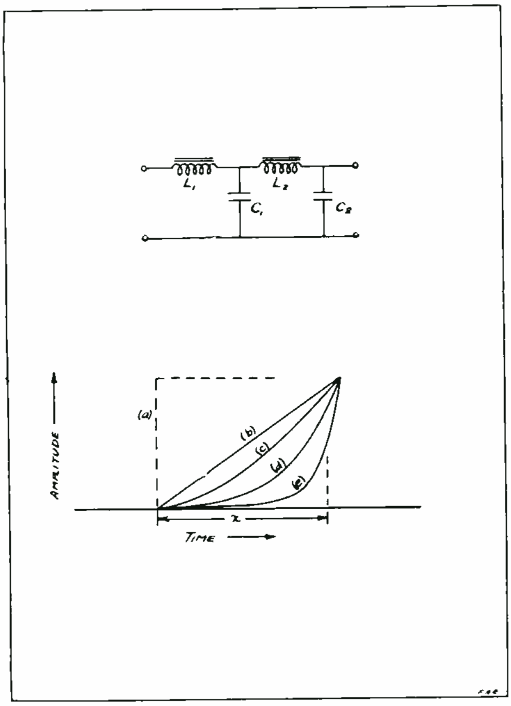


Figure 9

Analysis showing the reason for the time delay in the power supply filters.

voltage drop and is accompanied by no power loss, because of the quadrature phase relationship between voltage and current. It will be noted that two forces are working against each other when the saturable reactor is used in an actual circuit. From a more detailed analysis than can be included in this paper it has been shown that:*

(1) For a given alternating current, the incremental inductance to the alternating current will be less the greater the saturating current, and
(2) With a given saturating current, the incremental inductance to the flow of alternating current will increase as the alternating current is increased.

Radio Engineering—F. E. Terman (McGraw-Hill)

As the saturating current is increased the inductance of the a.c. coils decreases. This allows more voltage to be applied to the power supplies and a greater a.c. current is drawn through the a.c. coils of the saturable reactor. The increased alternating current flowing tends to increase the inductance of the a.c. coils, but this effect is much less than that of the d.c. saturating current. The curve of figure 8 is a composite of these two effects. Because the phenomena of incremental inductance is wholly one of changing permeability of the core material, it makes no difference whether the saturating current flows in the same coil as the alternating current or in a separate coil on the same core structure.

As shown by the curve of figure 7, with even a very high d.c. saturating current the inductance descends relatively less as the curve flattens. It is uneconomical to utilize this portion of the characteristic curve for control purposes as a great saturating current change results in only a small inductance change. As it is desired to apply full voltage to the power supply primaries on modulation peaks, means must be provided to overcome the voltage drop that will occur because of this minimum incremental inductance of the a.c. coils. The power supply

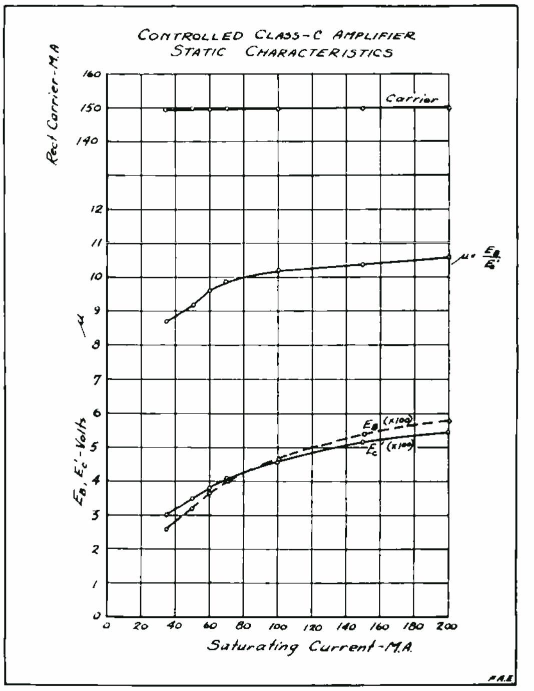
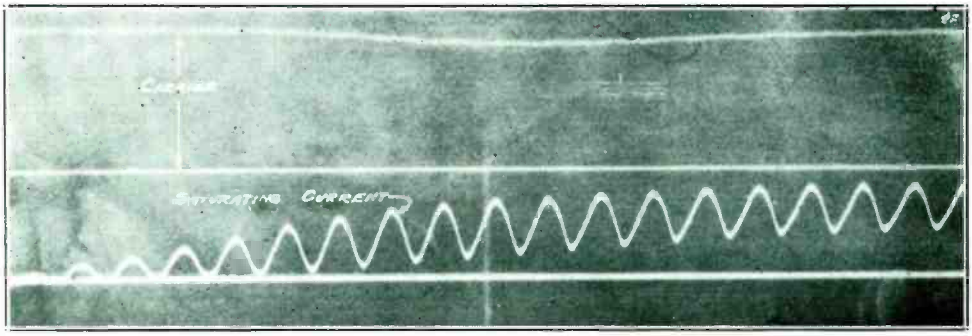
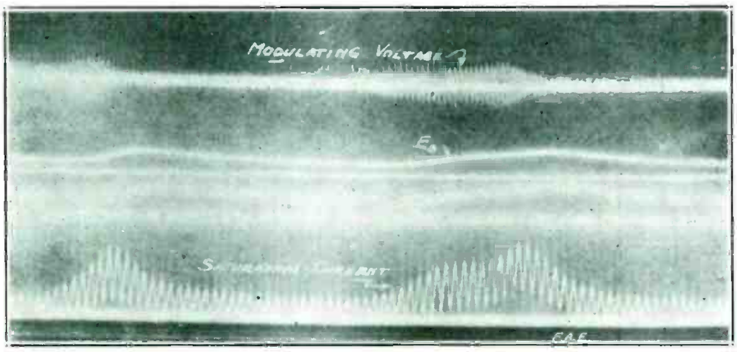


Figure 10

Characteristics of dynamic-shift controlled amplifier under static conditions.

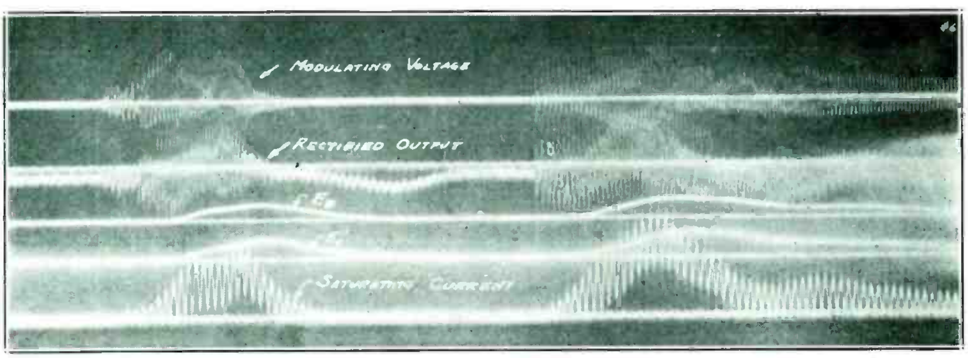




ABOVE
Figure 11

LEFT
Figure 12

BELOW
Figure 13



transformers may be designed to work at rated output at the line voltage less this drop. Ordinarily an auto-transformer is used to step the 110 volts up to about 180 volts so that the 70 volt reactance drop across the a.c. coils will still leave 110 volts on the power supply primaries available for a modulation peak.

Applying Dynamic Shift to Bias Modulation

Figure 3 shows the voltage and current relations in the conventional grid bias modulated amplifier. Note how the voltage drop across the tube, E_{min}, is large except when modulated. It must be great in order that the amplifier may be completely modulated. As this voltage drop across the tube represents wasted energy radiated as heat, any method of decreasing it will of course increase the efficiency greatly. Figure 4 shows the voltage and current relations in a bias modulated amplifier using the dynamic shift principle. It will be noted that the voltage drop across the tube, E_{min}, is very low in the unmodulated condition. Using a saturating device actuated by the modulating signal envelope to control the amount of voltage applied to the bias and plate power supply primaries, the plate and bias voltages are swung as shown in (c) and (d) of figure 4.

In the dynamic-shift bias-modulated amplifier there are four voltages applied to the grid of the tube: the carrier, the audio modulating voltage, a fixed portion of the bias, and a variable portion of the bias. The fixed portion may be supplied by batteries or cathode bias, and the variable portion is that supplied by the bias power supply controlled by the saturable reactor. The value of the variable bias is so proportioned that it will always be just sufficient to bias the tube to projected cut-off no matter what the plate voltage is at the time. This adjustment requires that:

$$\frac{E_B}{E_c^1} = \mu$$

where E_B is the total plate voltage applied to the tube and E_c^1 is the controlled portion of the bias, and μ the amplification factor of the tube. When this adjustment is made, the plate current angle of flow remains the same irrespective of the reactor saturation.

Figure 5 shows the wiring diagram of the laboratory set-up used to check this application of dynamic shift to bias modulation. It will be noted that part of the audio modulating voltage is fed into a diode rectifier which, by adjustment of the diode load resistor by-pass resistor, causes a voltage to appear across the load resistor, which varies at the syllabic rate. This voltage is used to buck out a fixed bias on a pair of high mutual conductance tubes whose plate current is used as the saturating current.

Power Supply Transients

It is imperative that the time constants of the bias and plate power supplies be very nearly the same if momentary distortion is to be avoided. If the ratio of each incremental change of E_B to each incremental change of E_c^1 is not constant, distortion will occur. If the time constants of both power supplies are the same, it means that these two voltages will follow each other exactly. For practical purposes it was estimated that a 10%, or perhaps even a 25% deviation from the perfect condition would not be excessive.

As the conventional power supply filter composed of two chokes, two by-pass condensers, and a bleeder resistor is a complex multi-circuit transient problem, the problem of calculating its time constant is an extremely laborious process. Difficulties as to the interpretation of the

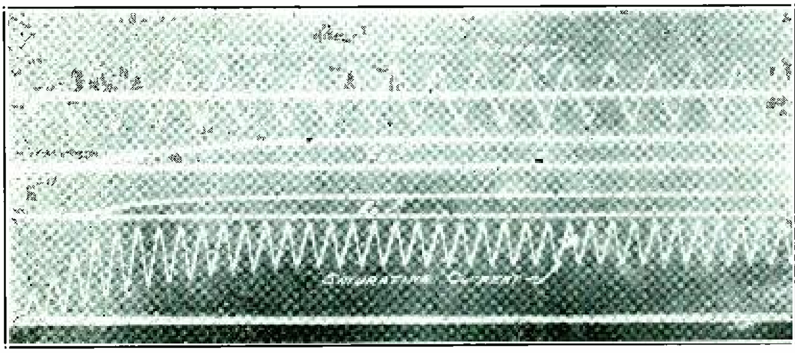


Figure 14

results might also be expected. Because of the above reasons, the oscillograph was used to obtain building-up and decaying transients of both power supplies. By adjusting the value of the bleeder resistor of one of the power supplies, they were made to follow each other more closely. Figure 6 shows the extent to which the two power supplies followed each other. This record shows the output voltage of the plate and bias supplies plotted against time as they built up after the closing of a common primary switch. The bias voltage has been enlarged by a constant amount to make the scales comparable.

Overall Static Characteristics

Figure 10 shows the characteristics of the controlled, modulated amplifier under static conditions. The curve representing the carrier is the rectified current in the diode circuit coupled to the plate tank circuit of the modulated amplifier stage. As the angle of plate current flow is constant as the common voltage on the primaries of the plate and bias power supplies are varied, the carrier should remain constant. The static characteristics bear this out partially, and the dynamic characteristics to be shown later completely verify this conclusion. Any variation in the

$$\frac{E_B}{E_c^1}$$

ratio in operation will change the carrier. The curves for μ, E_B and E_c^1 of figure 10 would all be straight lines were it not for the non-linear relationship existing between saturating current and the power supply primary voltage as shown in figure 8. However, this non-linear relationship will cause no distortion unless the instantaneous modulation capability is exceeded. As the resting modulation capability is commonly adjusted to care for any modulation up to 20

[*Continued on Page 80*]

A Home-Made "Ham" Slide Rule

By CHAS. F. BAKER*, W9VN

The slide rule usually slides out of the aspirations of most hams for either of two reasons: it costs too much, or it is too complicated to use; yet those who are acquainted with this gadget know that it is one of the most useful things which the experimenter can possess. This article should dispel both of these objections; for it describes a home-made slide rule which will solve in a very simple manner almost every ham problem, with the exception of how and where to get the cash which most radio stores require before handing over apparatus to amateurs. Best of all, the sum of fifteen cents will purchase sufficient material for the construction of several rules. While this article will present explicit instructions for making a real "ham rule", the author feels that the principle of construction can be utilized by ingenious amateurs for making rules of different types to fill certain particular needs.

The rule here described will give at a glance the values of L (from 0.01 microhenry to 900 millihenries) and of C (from 0.25 micromicrofarad to 40,000 micromicrofarads) which resonate for any frequency between 10 kilocycles and 300 megacycles; will convert the above frequency range into meters; will compute the reactance of condensers between 2.5 micromicrofarads and 40 microfarads and the impedance of inductances between 0.025 millihenries and 400 henries over a frequency range of 1 cycle to 90,000 kilocycles; and will compute the inductance of any single layer solenoid having from 2 to 250 turns per inch on diameters of ½ to 10 inches and lengths of ¼ to 10 inches. If your problem happens to fall outside of these ranges, a simple extension scale will extend any of the scales indefinitely.

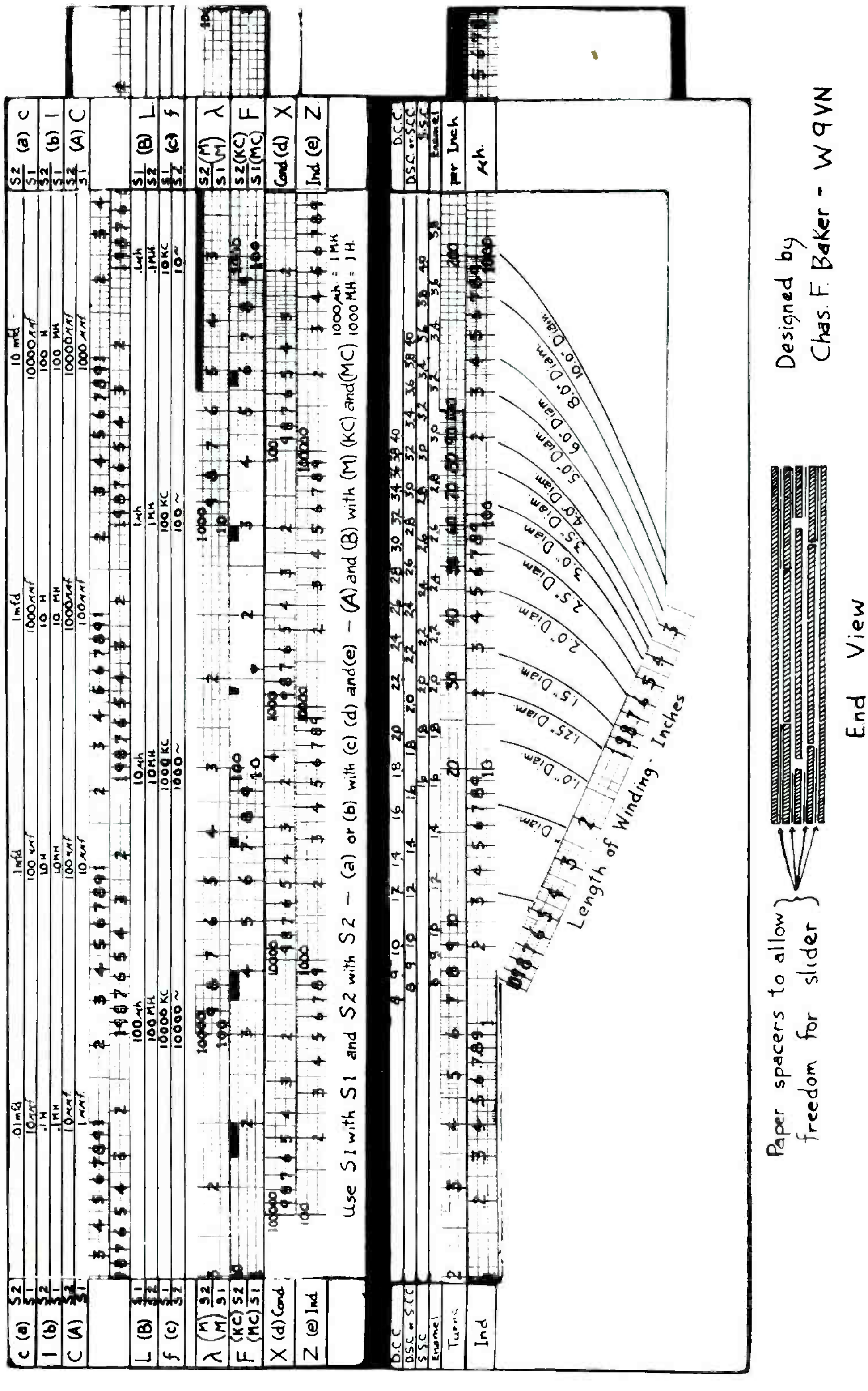
The secret of success and ease of construction lies in the use of regular log cross-section paper cut in strips for the scales and glued on to the rule, which is made from strips of bristol board glued together. The following materials will be needed: 1 sheet of heavy white bristol board or show card material, 1 sheet of Keuffel & Esser, no. 358-62, 2 cycle, semi-logarithmic paper, 1 sheet of Keuffel & Esser, no. 358-81, 4 cycle, semi-logarithmic paper[1] and 1 sheet of typewriter paper, and mucilage.

The most difficult operation will be in cutting accurately the strips of bristol board for the rule. If the strips are cut wedge-shaped, the sliding member will naturally stick at one end and wobble at the other. Use a sharp razor blade with a heavy steel rule for a straight-edge. A little care will produce a smooth-working rule of which you will be proud. Cut the following strips, all 12½ inches long: 2, ½ inch wide; 2, ¾ inch wide; 2, 1 inch wide; 1, 1½ inches wide; 1, 2 inches wide; 1, 2¼ inches wide; also 2 strips 3½ by ⅞ inches; and one irregular-shaped piece for the "length of winding" scale, cut from a strip 3½ by 12½ inches. Study carefully the illustration to grasp the method by which the rule is assembled. Cut the last-mentioned strip as follows: Beginning at the upper left corner measure across ⅞ of an inch and make a vertical cut 1 inch long, and then a horizontal one 3 inches long. Now starting at the upper right corner measure across ⅞ of an inch and make a vertical cut 2¾ inches long, and then a horizontal one 3⅞ inches long. Now connect the ends of these two cuts with an angling cut, which should be 4⅛ inches long.

Next assemble the rule. Glue typewriter paper to each side of the ½ inch strips, and then a ¾ and a 1 inch strip on each side of both ½ inch pieces, causing the three edges to align on one side. These form the stationary pieces between which the slider fits. The slider is formed by centering and glueing the 1½ and 2 inch strips on either side of the 2¼ inch piece. Next place the slider between the two stators, and on one side glue the two end strips to hold the stators together and on the other side fasten the irregular-shaped member, glueing the tabs to the top stator and the bottom to the entire length of the lower stator. If the work has been done accurately, the rule is now ready for the scales. Because the scales are longer than the log paper, all except "X", "Z", and

*2831 No. Murray Ave., Milwaukee, Wisc.

[1]These papers have 5-inch and 2½-inch cycles respectively; any papers bearing this two-to-one ratio may be used. In the event such paper cannot be obtained locally, send to Keuffel and Esser, 520 South Dearborn Street, Chicago. The paper costs five cents per sheet.


Use S1 with S1 and S2 with S2 – (a) or (b) with (c) (d) and (e) – (A) and (B) with (M) (KC) and (MC)
1000 µh = 1 MH
1000 MH = 1 H.
Length of Winding: Inches
Paper spacers to allow freedom for slider
End View
Designed by Chas. F. Baker - W9VN

INDUCTANCE TABLE

DIAM.	COIL LENGTH—ALL VALUES FOR 20 TURNS PER INCH										
	.25″	.5″	.75″	1.0″	1.5″	2.0″	3.0″	4.0″	6.0″	8.0″	10.0″
.5 ″	.33	.83	1.3	1.9	3.0	4.1	6.3	8.5	12.9	17.4	21.8
.75″	.62	1.66	2.8	4.0	6.4	8.8	13.7	18.8	28.7	38.7	48.7
1.00″	.95	2.66	4.6	6.6	10.8	15.2	24.0	32.8	50.4	68.2	86.0
1.25″	1.28	3.78	6.6	9.8	16.2	22.9	36.5	50.2	77.7	105.	133.
1.50″	1.66	5.00	9.0	13.3	22.5	32.0	51.4	71.1	110.7	150.	190.
2.00″	2.42	7.61	14.1	21.3	36.9	53.3	87.2	122.	192.	262.	333.
2.50″	3.20	10.4	19.7	30.3	53.5	78.4	130.	184.	292.	402.	512.
3.00″	4.00	13.3	25.7	40.0	72.0	106.	180.	256.	411.	568.	717.
3.50″	4.88	16.3	31.4	50.2	91.6	137.	235.	337.	546.	760.	975.
4.00″	5.61	19.4	38.4	60.9	112.	170.	295.	436.	698.	975.	1254.
5.00″	7.24	25.6	51.2	83.3	157.	242.	428.	627.	1043.	1471.	1904.
6.00″	8.88	32.0	65.4	106.	205.	320.	575.	853.	1440.	2048.	2666.
8.00″	12.2	44.9	93.6	155.	307.	487.	903.	1365.	2363.	3413.	4491.
10.00″	15.5	57.9	122.4	205.	413.	666.	1263.	1939.	3430.	5019.	6666.
	The above values are given in microhenries										

Inductance formula used: $$L = \frac{.2\ A^2\ N^2}{3A + 9B}$$

A = Diameter in inches B = Length in inches N = Number of turns

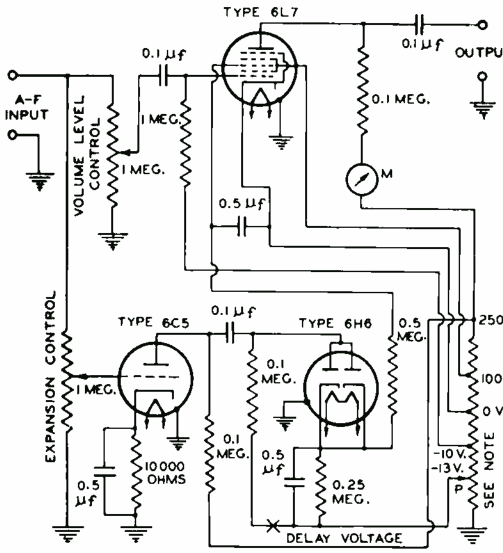
"Length of Winding" will have to be spliced. Care should be taken not to stretch the scales while they are wet with glue, else they will not coincide. Scales "C" "l" "c", "L" "f", "X", "Z", on one side, and "Ind." and "Length of Winding" are cut from the four-cycle paper; all others from two-cycle.

Cut scale "L" "f" two divisions wide and attach to top of slider with 1 at the right end. Cut "F" and attach to bottom with "1" at left end, and immediately above this attach "λ" with "1" at the right end. "F" and "λ" should be four divisions wide. Next close the rule and attach "C" "1" "c" to upper stator so that it reads in the opposite direction to "L" "f", and so that the cycles exactly correspond. Then attach "X" and "Z", each three divisions wide, to lower stator with their cycles coinciding but reading in opposite directions, so that the left ends of these scales coincide with 2 on the "F" scale. With the rule still closed, an index pointer is drawn on the slider to coincide with 1591 ohms on "X". The slider is then moved to the right exactly one cycle on "L" "f" and an index pointer drawn on the lower stator to coincide with 5 megacycles on "F". All of the scales should then be lettered and numbered as shown.

Turning the rule over, the "Turns per Inch" scale is attached to the stator beginning at "2" at the left end. Likewise the "Ind." scale is fixed to the slider beginning at "0.1" at the left end. Then the "Length of Winding" scale is fastened to the slanting section beginning with "0.25" at the bottom right. You are now ready to draw in the coil diameter curves and your rule will be completed. The accompanying inductance chart is computed for 20 turns per inch. The method of procedure is to set the slider so that the inductance values in the chart coincide with 20 turns per inch and then make a needle prick on the slider immediately adjacent to the proper point on the "Length of Winding" scale. When this is finished, draw in the curves through the points made and

[*Continued on Page 84*]

The 6L7 as a Volume Expander



NOTE: ALL TERMINAL POINTS ON POWER UNIT SHOULD BE ADEQUATELY BY-PASSED.

RCA MANUFACTURING COMPANY, INC

Volume Expander Circuit Using 6L7 Tube

Radio broadcasting is often objected to because it cannot handle the range of volume which is emitted by a symphony orchestra; hence the volumes are "compressed" at the transmitter. This holds true to an even greater extent for phonographs; faint sounds tend to disappear under the "surface noise" of the phonograph; loud sounds cause "overloading" of a type making one groove cut into an adjacent groove or making the reproducer jump.

One way to dodge this is of course to compress the volume ranges even more than is done in broadcasting and then play the record on a phonograph which consists of a pickup feeding an amplifier which "expands the volume", or in other words, which responds disproportionately to the loudness of sounds, thus tending to re-expand them to the original proportions which they had before compression.

Circuits for volume expansion are numerous. A more-than-ordinarily-simple one is shown in the R.C.A. Manufacturing Company's "Application Note" no. 53, available from Camden, N. J. It admits of some adjustment in the degree of volume expansion, as may be necessary in the recordings of other matter which does not represent such great variations as does an orchestra.

The device depends on the combination of a 6L7 and 6C5 tube. The signal from the pickup device is fed to the input grids of both tubes and the output is taken from the plate of the 6L7. The output of the 6C5 (which is a triode) is fed to a 6H6 rectifier with the two halves connected in parallel and used as a bias on the third grid of the 6L7, bucking the original bias. The relation of these two biases determines the action of the device. The original bias from the general power supply is such as to bring the amplification of the 6L7 very low. It does not cut off because this tube has a variable-µ input grid. When a signal is put through the system the bucking bias from the 6C5 and 6H6 pushes down the original bias in proportion to the "received" signal, so that a loud signal causes increased amplification, which is the desired volume-expander action.

Several modifications are possible. By feeding the 6C5 from a potentiometer the *degree* of action obtained from it may be controlled. By putting a fixed bias in series with the 6H6 rectifier one can control the *strength* of the signal required to start the device; that is, one can give it a "threshold value".

The constants of such a device are tricky and a study of the diagram in the original "note" is advised. If you are considering the use of such a device in radiophone work a point to be remembered is that it needs a signal input from one volt (peak) downward. Two amateur radiophones could make possible use of volume expanders if the transmitters were equipped with volume compressors, which is a device in which the signal is used in a similar way to push down the amplification of an audio stage so that the modulation is less than proportional to loudness, permitting the faint sounds to be run up (with the hand volume control) so that they over-ride the noise and QRM without permitting the loud sounds to overload the transmitter. From a circuit standpoint this is done by using an initial bias which is small and permits good amplification, then causing the rectified signal to serve as an additional (not bucking, but *adding*) bias, which pushes down the amplification by providing more gain. In the diagram herewith this can be done by reversing the connections to the 6H6 tube and running the slider P further up (less negative) on the potentiometer.

The initial settings are about as follows:

For the volume expander:

Set P to give a 6L7 plate current of around 0.15 ma. with no signal and use circuit as shown. For amateur work a "delay" bias should be inserted at X to prevent noises from triggering the thing off. This can be provided most handily by means of a battery and potentiometer and adjusted for most pleasing results.

If the speech sounds queer the device may be acting too fast and trying to follow the syllables. Follow the constants in the diagram; the idea is merely to follow the general level. A sudden, loud horse-laugh in the midst of silence is too much for these affairs.

For the volume compressor at the transmitter:

Set P to give a 6L7 plate current of 1 ma. as a starter; reverse connections on the 6H6 and by trial set the position of P and of the "expansion control", watching for overloading of the transmitter. Too high an initial bias on the 6L7 (from P) or too low a position of the slider on the "expansion control" will vitiate the action of the device, leaving simply an ordinary amplifier with small gain. Too small a bias on the 6L7 (position of P) and too much "expansion control" will so much compress the signal that it cannot be properly re-expanded at the receiver.

The inverted 6H6 may cause objectionable hum. The addition of bypasses may change the time-constant and produce bad "hangfire". During the experimental stages it is just as well to heat this tube from a storage battery.

Devices working along this same general idea are used on some of the A. T. & T. radiotelephone circuits under the name of "compandor", meaning "compressor-expander". The R.C.A. circuit is shown by preference because it is in a form that an amateur can build. The circuit diagram is reproduced by permission from the R.C.A. application note.

QRQ

The Commission (Telegraph Division) modified Rule 404, prescribing the scope of the examination for amateur operator license, at its meeting held June 2, 1936, as follows:

"a. Applicant's ability to send and receive in plain language messages in the international Morse Code (five characters to the word) at a minimum speed of 13 words per minute."

It is pointed out that the former requirement was ten (10) words per minute.

The change would be understood as applying to any statement of the required speed at any point in the Commission's rules or other material, for example, amending Rule 407 to that effect as well as Rule 404.

In other words, the requirement applies to all amateur applicants, whether for Class A, B, or C operating privileges, except those who are not required to take any code test, e.g., a professional radiotelegraph operator, who has qualified at higher speed.

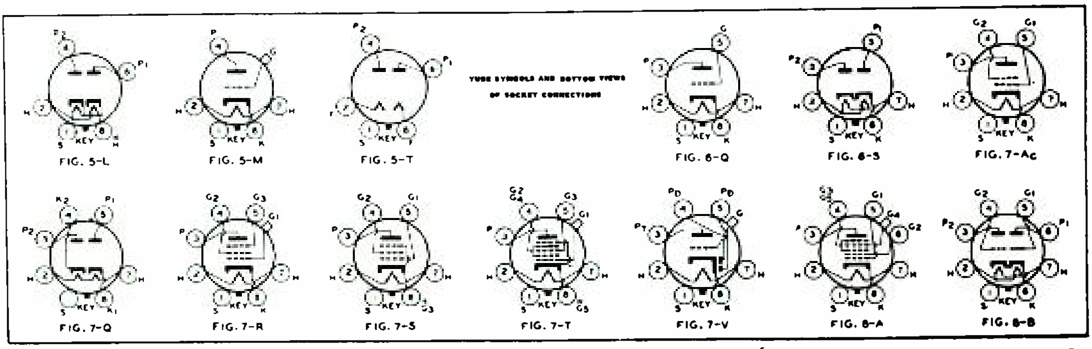
It applies regardless of the class of emission contemplated; there is no difference in the basic amateur examination for an applicant who contemplates amateur radiotelephone operation from that for one who proposes to operate a radiotelegraph station or one who proposes to experiment with amateur picture transmission. Such amateurs often use code as well, and in each case the license authorizes code operation whenever the license holder sees fit to use it. The examination includes it for this reason and to accord with provisions of treaty, law and regulation.

◆

Speaking of 50%: Phelps, W2BP-W9BP, at one time said he had 50% worked a Tasmanian station with a 199—he called the station.

METAL TUBE SYMBOLS AND SOCKET CONNECTIONS OF THE METAL TUBE LINE

(See Table on the Following Page)



ALL-METAL RADIO TUBE CHARACTERISTICS CHART

TYPE	NAME	BASE	SOCKET CONNEC-TIONS	DIMENSIONS MAXIMUM OVERALL LENGTH x DIAMETER	CATHODE TYPE ■	RATING FILAMENT OR HEATER VOLTS	RATING FILAMENT OR HEATER AMPERES	RATING PLATE MAX. VOLTS	RATING SCREEN MAX. VOLTS	USE Values to right give operating conditions and characteristics for indicated typical use	PLATE SUP-PLY VOLTS	GRID VOLTS ■	SCREEN VOLTS	SCREEN MILLI-AMP.	PLATE MILLI-AMP.	A-C PLATE RESIS-TANCE OHMS	MUTUAL CON-DUC-TANCE MICRO-MHOS	VOLT-AGE AMPLI-FICATION FACTOR	LOAD FOR STATED POWER OUTPUT OHMS	POWER OUT-PUT WATTS	TYPE
6A8	PENTAGRID CONVERTER ●	SMALL OCTAL 8-PIN	FIG. 8A	3¼″ x 1 5/16″	HEATER	6.3	0.3	250	100	CONVERTER	250	− 3.0 min.	100	3.2	3.3	Anode Grid (# 2): Supply**, 250 max. volts; Current, 4.0 ma. Oscillator-Grid (# 1) Resistor, 50000 ohms. Conversion conductance, 500 micromhos.					6A8
6C5	DETECTOR ★ AMPLIFIER TRIODE	SMALL OCTAL 6-PIN	FIG. 6Q	2⅝″ x 1 5/16″	HEATER	6.3	0.3	250	—	CLASS A AMPLIFIER	250	− 8.0	—	—	8.0	10000	2000	20	—	—	6C5
										BIAS DETECTOR	250	−17.0 approx.	—	—	Plate current to be adjusted to 0.2 milliampere with no signal.						
6F5	HIGH-MU TRIODE	SMALL OCTAL 5-PIN	FIG. 5M	3¼″ x 1 5/16″	HEATER	6.3	0.3	250	—	CLASS A AMPLIFIER	250	− 2.0	—	—	0.9	66000	1500	100	—	—	6F5
6F6	POWER AMPLIFIER PENTODE	SMALL OCTAL 7-PIN	FIG. 7S	3¼″ x 1 5/16″	HEATER	6.3	0.7	315	315	CLASS A AMPLIFIER	250	−16.5	250	6.5	34.0	80000	2500	200	7000	3.0	6F6
								375	250	PUSH-PULL CLASS AB, AMPLIFIER	375	−26.0	250	—	Power output value is for 2 tubes at indicated plate-to-plate load.				10000	19.0	
6J7	TRIPLE-GRID DETECTOR AMPLIFIER	SMALL OCTAL 7-PIN	FIG. 7R	3¼″ x 1 5/16″	HEATER	6.3	0.3	250	125	SCREEN-GRID R-F AMPLIFIER	250	− 3.0	100	0.5	2.0	exceeds 1.5 meg	1225	exceeds 1500	—	—	6J7
										BIAS DETECTOR	250	− 4.3	100	Cathode current 0.43 ma.		—	Plate coupling resistor 500000 ohms. **Grid coupling resistor 250000 ohms.				
6K7	TRIPLE-GRID SUPER-CONTROL AMPLIFIER	SMALL OCTAL 7-PIN	FIG. 7R	3¼″ x 1 5/16″	HEATER	6.3	0.3	250	125	SCREEN-GRID R-F AMPLIFIER	250	− 3.0 min.	125	2.6	10.5	600000	1650	990	—	—	6K7
										MIXER IN SUPERHETERODYNE	250	−10.0	100	—	—	Oscillator peak volts = 7.0					
6L6	BEAM POWER AMPLIFIER	SMALL OCTAL 7-PIN	FIG. 7AC	4 3/16″ x 1⅝″	HEATER	6.3	0.9	375	250	SINGLE-TUBE CLASS A, AMPLIFIER	300	−12.5	200	2.5	48.0	—	—	—	4500	6.5	6L6
								400	300	PUSH-PULL CLASS AB, AMPLIFIER	400	−25	300	—	Power output value is for 2 tubes at indicated plate-to-plate load.				6600	34.0	
								400	300	PUSH-PULL CLASS AB, AMPLIFIER	400	−25	300	—	Power output value is for 2 tubes at indicated plate-to-plate load.				3800	60.0	
6L7	PENTAGRID MIXER & AMPLIFIER	SMALL OCTAL 7-PIN	FIG. 7T	3¼″ x 1 5/16″	HEATER	6.3	0.3	250	150	MIXER IN SUPERHETERODYNE	250	− 3.0	100	6.2	2.4	Oscillator Grid (# 3) bias, − 10 volts. Grid # 3 peak swing, 12 volts min. Conversion conductance, 350 micromhos.					6L7
										CLASS A AMPLIFIER ◀	250	− 3.0	100 max.	5.5	5.3	800000	1100	880	—	—	
6N7	TWIN-TRIODE AMPLIFIER	SMALL OCTAL 8-PIN	FIG. 8B	3¼″ x 1 5/16″	HEATER	6.3	0.8	300	—	CLASS B AMPLIFIER	250 300	0 0	— —	— —	Power output value is for one tube at stated load, plate-to-plate				8000 10000	8.0 10.0	6N7
6Q7	DUPLEX-DIODE HIGH-MU TRIODE	SMALL OCTAL 7-PIN	FIG. 7V	3¼″ x 1 5/16″	HEATER	6.3	0.3	250	—	TRIODE UNIT AS CLASS A AMPLIFIER	250 ■	− 2.2	—	—	0.5	—	Gain per stage = 43				6Q7
6R7	DUPLEX-DIODE TRIODE	SMALL OCTAL 7-PIN	FIG. 7V	3¼″ x 1 5/16″	HEATER	6.3	0.3	250	—	TRIODE UNIT AS CLASS A AMPLIFIER	250	− 9	—	—	9.5	8500	1900	16	10000	0.28	6R7
25A6	POWER AMPLIFIER PENTODE	SMALL OCTAL 7-PIN	FIG. 7S	3¼″ x 1 5/16″	HEATER	6.3	0.3	180	135	CLASS A AMPLIFIER	95 180	−15 −20	95 135	4.0 7.5	20.0 38.0	45000 40000	2000 2500	90 100	4500 5000	0.9 2.75	25A6

■ Grids # 3 and # 5 are screen. Grid # 4 is signal-input control grid.
★ For Grid-leak Detection—plate volts 45-100.
▲ Grids # 2 and # 4 are screen. Grid # 1 is signal-input control grid.

◀ Grid # 3 connected to grid # 1.
** Applied through 20000-ohm voltage-dropping resistor.
■ Applied through 200000-ohm plate-coupling resistor.

** For grid of following tube.
■ Either A.C. or D.C. may be used on heater.

TYPE	NAME	BASE	SOCKET CONNEC-TIONS	DIMENSIONS	CATHODE TYPE	VOLTS	AMPERES	PLATE MAX. VOLTS	SCREEN MAX. VOLTS	USE	RATINGS	TYPE
5W4	FULL-WAVE RECTIFIER	SMALL OCTAL 5-PIN	FIG. 5T	3¼″ x 1 5/16″	FILAMENT	5.0	1.5	—	—	FULL-WAVE RECTIFIER	Maximum A-C Voltage per Plate ... 350 Volts, RMS Maximum D-C Output Current ... 110 Milliamperes	5W4
5Z4	FULL-WAVE RECTIFIER	SMALL OCTAL 5-PIN	FIG. 5L	3¼″ x 1 5/16″	HEATER	5.0	2.0	—	—	FULL-WAVE RECTIFIER	Maximum A-C Voltage per Plate ... 400 Volts, RMS Maximum D-C Output Current ... 125 Milliamperes	5Z4
6H6	TWIN DIODE	SMALL OCTAL 7-PIN	FIG. 7Q	1⅝″ x 1 5/16″	HEATER	6.3	0.3	—	—	TWIN-DIODE DETECTOR RECTIFIER	Maximum A-C Voltage per Plate ... 100 Volts, RMS Maximum D-C Output Current ... 4 Milliamperes	6H6
6X5	FULL-WAVE RECTIFIER	SMALL OCTAL 6-PIN	FIG. 6S	3¼″ x 1 5/16″	HEATER	6.3	0.6	—	—	FULL-WAVE RECTIFIER	Maximum A-C Voltage per Plate ... 350 Volts, RMS Maximum D-C Output Current ... 75 Milliamperes	6X5
25Z6	RECTIFIER-DOUBLER	SMALL OCTAL 7-PIN	FIG. 7Q	3¼″ x 1 5/16″	HEATER	25.0	0.3	—	—	VOLTAGE DOUBLER	Maximum A-C Voltage per Plate ... 125 Volts, RMS Maximum D-C Output Current ... 100 Milliamperes	25Z6
										HALF-WAVE RECTIFIER	Maximum A-C Voltage per Plate ● ... 250 Volts, RMS Maximum D-C Output Current per Plate ... 85 Milliamperes	

● Plate voltages greater than 125 volts RMS require 100-ohm series-plate resistor.

(Tables Courtesy R.C.A. Manufacturing Co., Inc.)

Impedance Matching Simplified

By I. A. Mitchell*

In this story Mr. Mitchell "takes apart" an audio transformer in simple language that anyone can understand, and explains such things as "primary impedance", "500 ohm winding", etc. He also explains the why-for and applications of a new universal modulation transformer of wide utility. It permits one transformer to be used with a large variety of modulator tubes and load resistances.

The writer has frequently been asked questions like the following: At what frequency does the primary of your type X transformer represent the impedance at which it is rated? The general nature of these inquiries would indicate that there is a popular misconception as to the function of an impedance matching transformer.

Inherently a transformer is a device presenting a means of transferring power from one circuit to another without any direct connection between these circuits.

In simple form, we illustrate in figure 1 an ideal transformer; that is, a transformer having 100 percent efficiency. In such a case the power delivered to the input will equal the power taken from the secondary, or:

a) $$V_pI_p = V_sI_s$$

As is well known, the voltage ratio of a transformer is directly proportional to the turns of the respective windings; that is,

b) $$\frac{V_p}{V_s} = \frac{N_p}{N_s}$$

Combining (a) and (b), we obtain

c) $$\frac{I_s}{I_p} = \frac{N_p}{N_s}$$

From Ohm's law we know that

d) $$V_s = I_sZ_s$$

We can substitute (b) and (c), obtaining

$$V_p\frac{N_s}{N_p} = \frac{I_pN_p}{N_s}$$

Therefore

$$\frac{V_p}{I_p} = Z_p = \frac{(N_p)^2}{(N_s)^2}Z_s$$

This result indicates that the impedance ratio of a transformer is directly proportional to the square of the turns and is the basis upon which all impedance matching is done in audio transformers.

It will also be noted from this formula that frequency does not enter into the impedance matching ratio of an ideal transformer. This means that the impedance, which is seen at the primary side of the transformer, bears a definite relation to the impedance connected across the secondary side of the transformer.

As an example of this let us refer to figure 2 illustrating a transformer of ratio 1:2 with a pure resistance of 100 ohms across terminals AA on the high side. If we were to measure the impedance of the transformer terminals BB, we would find that to all purposes the impedance would be 25 ohms, which value would remain constant throughout the entire frequency spectrum if the transformer were a perfect one. Similarly, if we were to connect a pure inductance or capacitance across the AA terminals, then terminals BB would respectively measure

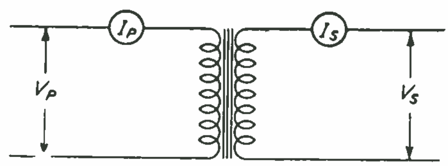


Figure 1
An Ideal Transformer

as a pure inductance or capacitance. It is instructive to note therefore that if we were to tie a 2 μfd. capacitor across AA, then terminals BB would measure 8 μfds. This method is used occasionally in certain types of circuits to obtain a high capacitance where d.c. does not pass through the transformer. We see then that a transformer can be made to reflect any type of impedance that we choose.

Due to limitations in commercial transformers, a given unit cannot be used for a very wide range of impedances beyond a certain point. Using a transformer to obtain a given impedance ratio, but with impedance diverging considerably from that for which it was originally designed, frequency discrimination and loss in power transfer will result. This can be more readily understood if we analyze the actual "T" equivalent of a transformer.

Assuming a simple transformer, as in figure 3A, we find that, in addition to the power transfer characteristics of the unit, we have a primary inductance which shunts our source impedance; a leakage reactance which, in effect, operates in series with our load, and a dis-

*Chief Engineer, United Transformer Corp.

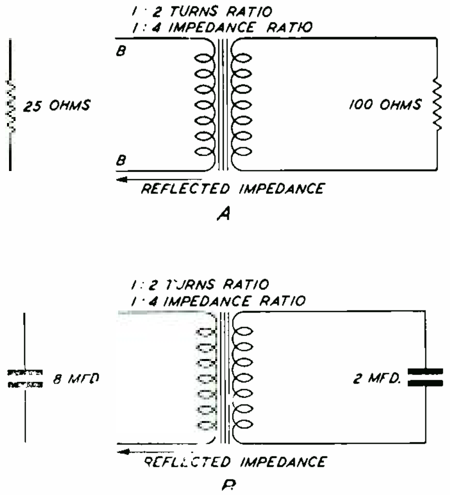


Figure 2

tributed capacitance, which can be lumped to shunt the load. This simplified form is indicated in figure 3B. As we reduce the frequency feeding into this transformer, the impedance of the primary inductance decreases. This decrease may reach the point where some of the power, which would normally be transferred from primary to secondary, is shunted through this inductance. Similarly, as the frequency increases, the impedance of the distributed capacitances decreases and shunts some of the power, which would normally pass through the load.

The third element to be considered is the leakage reactance, whose impedance increases with frequency and produces a strong series loss, at the higher frequencies. The effects of primary inductance, distributed capacitance, and leakage reactance, since they are related with primary and secondary impedances, become variable, depending upon these impedances. This is illustrated in the curves of figures 4 and 5. Figure 4 illustrates the loss in low-frequency response caused by the primary inductance with the source and load impedances taken into account. It is seen that as the source impedance increases, the low-frequency loss increases; also that as the ratio of load impedance to source impedance is increased, our loss decreases. A similar effect, due to the distributed capacitance, is illustrated in figure 5. It is seen here that as the source impedance increases, the loss increases, and that also as the ratio of load to source impedance is increased, the loss decreases. *If we examine these facts, we find that if we reduce the source impedance of a transformer below rated value, while maintaining the load constant, an improvement in frequency response is obtained.* Conversely, if we increase the source impedance, a loss in frequency range is entailed. This fact is illustrated in figure 6, where operation of a typical line-to-grid transformer is shown using various source impedances.

Going back to our impedance-matching problem, in using this information we find that we have two interesting possibilities that can be considered where special impedance matching is required. Summarizing these facts, we may state them as:

1. The primary impedance of a transformer depends upon the secondary load.

2. A transformer may be used for other impedances than that at which it is rated, as long as the variation is not too far from the manufacturer's rating, with a knowledge that the original impedance ratio will still apply.

3. A transformer, when operating out of a lower source impedance than normal, will generally give a better frequency response.

Analyzing the use of the condition 3 mentioned above, we find that a transformer will generally function better if operated out of a lower source of impedance than its rated impedance. Let us take the case where it is desired to match a 30-ohm dynamic microphone to a grid. The nearest standard inexpensive transformer available has a split primary with

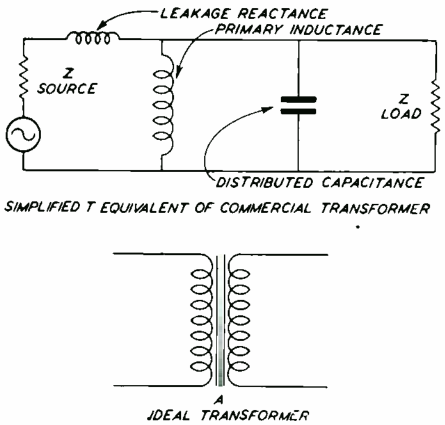


Figure 3

which 50 ohms can be obtained. Since operating this transformer from a lower impedance than that at which it is rated will improve the characteristic, we see that operating the 30-ohm mike to a 50-ohm transformer is perfectly satisfactory.

Another application where impedance matching must be considered is in driver transformers for class AB and class B amplifiers. Since in a

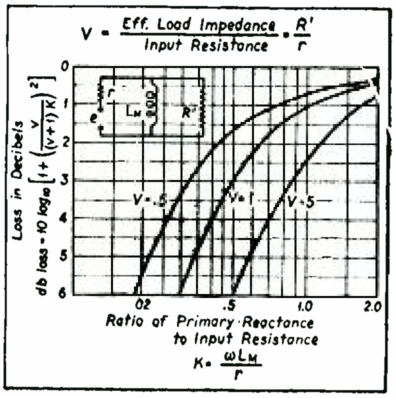


Figure 4
Curves showing the loss due to the shunting effect of the primary of a a transformer.

class B amplifier only one-half of the input transformer secondary functions at a time, impedance matching must be considered from the total primary to one-half of the secondary. Figure 7 illustrates a circuit of a driver tube feeding into a class B system. To make our analysis simple, let us assume that we have a perfect transformer of the correct ratio for the purpose intended. The impedance reflected into the grid circuit will be equal to the impedance ratio (total primary to ½ secondary) multiplied by the source impedance. It is desirable to keep this impedance as reflected in the grid circuit much lower than the impedance to which the grid is driven at high levels. That is, if our grid drops from infinity to 200 ohms at maximum output, the reflected impedance, which the transformer shows in the grid circuit, should preferably not exceed more than a fraction of this 200 ohms.

As an example, let us take the case of 4 type 46 tubes, operating in class B. If we check back to a typical transformer for these tubes, we find a ratio, total primary to ½ secondary, of 3.2. Since this is the voltage ratio, it must be squared to obtain the impedance ratio, which we find to be 10. If we use a 46 driver, the source impedance would be 2380 ohms. Dividing 2380 by 10, we obtain a reflected impedance in the grid circuit of 238 ohms. *The lower we can make this impedance, the further we can drive our output tubes with low grid distortion.*

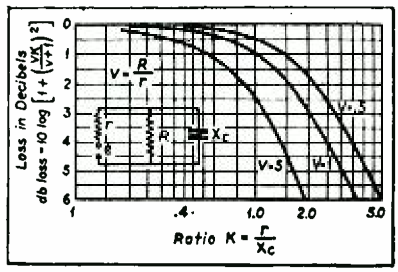


Figure 5
Curves showing the loss due to distributed capacity in an audio frequency circuit.

While it is possible to obtain a lower grid impedance by increasing the step-down ratio of our transformer, it is also possible to obtain the same effect by using the same transformer and changing our driver tube. Let us assume that we use the same transformer with a 2A3 tube. Since the plate impedance of this tube is approximately 800 ohms and the impedance ratio of our transformer is 10, the reflected

Pri. Ohms P to P	SECONDARY RF LOAD IMPEDANCES AVAILABLE										‡AUDIO LOAD IMPEDANCE	
2000	1070	1950	2150	3620	3920	4300	6350	6550	7900	8600	11400	200	350
3000	1620	2950	3240	5500	5900	6500	9400	10000	11800	13000	17000	300	520
4000	1380	1850	2160	2850	3450	4300	5500	7300	8650	12500	17400	250	400
5000	1730	2300	2700	3500	4300	5400	7000	9150	10800	15700	21600	300	500
6000	1070	2140	2180	2750	3620	4250	4300	5150	6350	8300	8600	200	370
7000	1250	2400	2500	3200	4280	5000	5050	6000	7300	9700	10000	230	430
8000	1440	2760	2900	3700	4900	5650	5800	6900	8400	10000	12000	270	500
9000	1620	2050	3100	3240	3900	4150	6200	6500	7750	9400	12500	300	550
10000	1800	2300	3500	4300	4600	6100	6900	7100	8600	10500	14000	330	600
12000	2070	2150	2750	4250	4320	5150	7250	8300	8700	12500	17400	370	400
14000	2440	3200	4900	6000	9700							430	
16000	2780	3700	5600	6900	11000							500	
18000	3140	4150	6300	7750	12500							550	
500*	1070	1950	2150	3620	3920	4300	6350	6550	7900	8600	11400		

* In some cases it is desired to match an RF load to the 500 Ohm output of a PA amplifier. The terminal arrangement noted will take care of this application.

‡ These impedances are suitable for PA applications. If a monitor speaker is desired, proper distriburion of power is obtained by operating this low impedance into the high impedance primary of the speaker transformer.

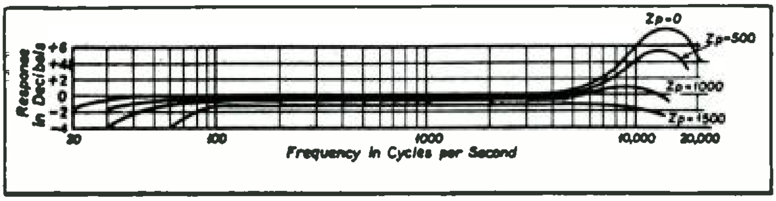


Figure 6
Variation in frequency characteristic against source impedance for a line-to-grid transformer.

impedance in the grid circuit would be only 80 ohms. This is much less than that obtained with the 46 driver.

The use of pentodes and other high μ tubes has been frequently recommended for class B driver service. An analysis of the above paragraphs will immediately show the fallacy of this. A typical mistake in this respect is the recommendation of the 6B5 tube as a driver for high power class B systems. Since the plate resistance of this tube is 24,000 ohms, it is readily seen that the reflected impedance will be 30 times as great as that obtainable with a 2A3 tube having 800 ohms plate resistance. The very high impedance which the 6B5 would reflect into the grid circuit of our class B tubes would limit their power appreciably; in some cases to less than half that obtainable by using the 2A3 tube.*

Illustrating a problem involving the application of 1 and 2 above, we may take the case where we have a transformer with an impedance ratio of 2:1 designed to operate from a 53 having a 10,000 ohm push-pull primary load to a 5000 ohm secondary load. If a 4000 ohm secondary load were used on this transformer, 8000 ohms would be reflected on the primary side, which is suitable for class AB 42's or class A 50's. Similarly, 6000 ohms applied on the secondary would reflect 12,000 ohms plate to plate, which is suitable for the 79 and 53 tubes under certain conditions of operation. Other possibilities of applying standard transformers to special applications are obvious.

The use of a standard transformer for other impedances than that for which originally designed should not be carried too far, however. It is not recommended to vary more than 30% from the manufacturer's rating and in all cases it must be remembered that the ratio is not altered.

New Universal Transformer

Using this fact as one of the design principals, and other data that has been worked up over a period of time, a new type of universal modulator transformer has been developed. Through the use of special windings and taps, a tremendously wide range in impedance-matching combinations is available. A standard structure using 6 terminals on the primary and 6 terminals on the secondary affords a range of applications as illustrated in the table. In addition to the exact applications specified in this figure, intermediate values of plate-to-plate impedance are obtainable. In such cases the connections for the nearest plate-to-plate load are used and the available secondary impedances

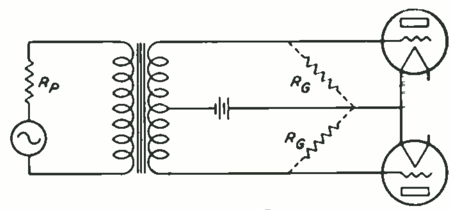


Figure 7
Operating conditions of a driver transformer.

are multiplied by the ratio of the new plate-to-plate load as compared to the plate-to-plate load shown in the chart.

As an example, if the modulator is to use two 838's at 1250 volts, the proper plate-to-plate load is found to be 11,200 ohms. The power output is 260 watts. With this a.f. output the d.c. input to the class C stage should be 520 watts. If 2500 volts is used on the r.f. stage, the plate current would be 208 ma., giving an r.f. load impedance of 12,000 ohms. Examining the chart, we find that the nearest plate-to-plate load to that desired is 12,000 ohms. We use this impedance termination for our 838's and multiply the r.f. impedances available by

$$\frac{11,200}{12,000}$$

This changes the 12,500 ohm impedances in the chart to 11,700. This impedance is within $2\frac{1}{2}$% of the actual 12,000 ohm r.f. load impedance desired.

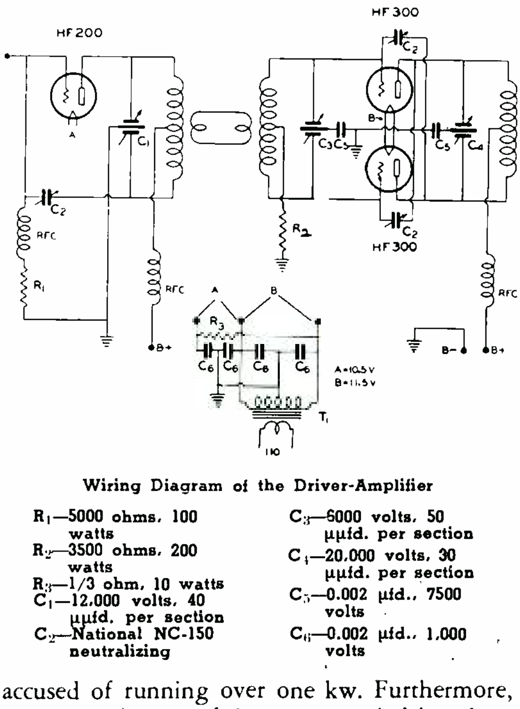
*However, the 6B5 makes a better driver tube than a conventional triode of equivalent (24,000 ohms) plate resistance, because the trick construction of the 6B5 makes it somewhat less insensitive to changes in load impedance.

A Corn-Fed Kilowatt

By Herb Becker, W6QD

For the high power man who really wants some output at moderate plate voltage, who wants a rig that will put in with the best of them and take a back seat for none, we offer the de-luxe, combined driver-amplifier unit of W6QD. It will easily take 1 kw. at as low as 1800 plate volts, yet will not flinch at taking 4000 volts, should you have a high-voltage, low-current power supply.

"Herb," I says to W6FET, assistant worrier at the shack of W6QD, "these insinuations of our eastern seaboard palsy-walsies have gone far enough. Just because some of us west coasters are R99 back there they figger we are all using 10 kw. out here. Just because we have room to put up beam antennas, or maybe because signals travel better from west to east, and the W6's knock their cans off back there, we are accused of running over one kw. Furthermore, the very existence of that water-cooled jug there in my rig automatically convicts me in the eyes of anyone too far away to come around and measure the input with his own meters."



Wiring Diagram of the Driver-Amplifier

R_1—5000 ohms, 100 watts
R_2—3500 ohms, 200 watts
R_3—1/3 ohm, 10 watts
C_1—12,000 volts, 40 μμfd. per section
C_2—National NC-150 neutralizing
C_3—6000 volts, 50 μμfd. per section
C_4—20,000 volts, 30 μμfd. per section
C_5—0.002 μfd., 7500 volts
C_6—0.002 μfd., 1,000 volts

"Herb," W6FET says to W6QD, "I am inclined to agree with you. It is rather incriminating, to say the least."

"When actually," I rejoin, "I haven't nearly as much in the antenna as some of the eastern boys, because the first 3000 volts on that tube just get washed down the sink."

"But try to convince anyone of that," remarks Herb.

"Yes, just try to convince anyone of that," assures Herb, "especially the R.I."

"The smart thing to do," reflects Herb, "is to put in a couple of smaller tubes in the final, so that, in the eyes of the public, at least, you will be running less power."

"Yes, I am inclined to agree with you," I remark. "Besides, since I blew that 15,000 volt filter condenser, I must figure out some way to get some output at 2800 volts."

"Let's sit down and figure out a new final amplifier, one that uses a pair of tubes in push-pull and will take one kw. at 2800 volts," Herb suggests.

All is silence for a minute: heavy thinking.

"Now let's see. What does a push-pull amplifier have?" I ask myself, half aside.

"It has two tubes," Herb offers.

"Doc Stuart uses four," I remind him.

"But that is to give more plate dissipation for working grid modulation when he works phone," he reminds me.

"Phone, phooey," I remind him.*

This went on far, far into the night, But next day work was started on the amplifier shown in the accompanying pictures. After considerable exercise of jaw bone, referring to the handbook, and calling upon past experience, the design was worked out completely before the thing was ever started.

The final amplifier utilizes a pair of Amperex HF-300's in push-pull, driven by a single HF-200. All three tubes run at 2800 volts, the common power supply being keyed in the primary of the plate transformer. Incidentally, the plate voltage was run up to 4600 volts to test for breakdown of any of the components, but as adequate filter was not available for this voltage it was not deemed wise to put it on the air. No part in the whole outfit showed any signs of strain at the higher voltage, indicating that at 2800 volts there is a wide safety margin.

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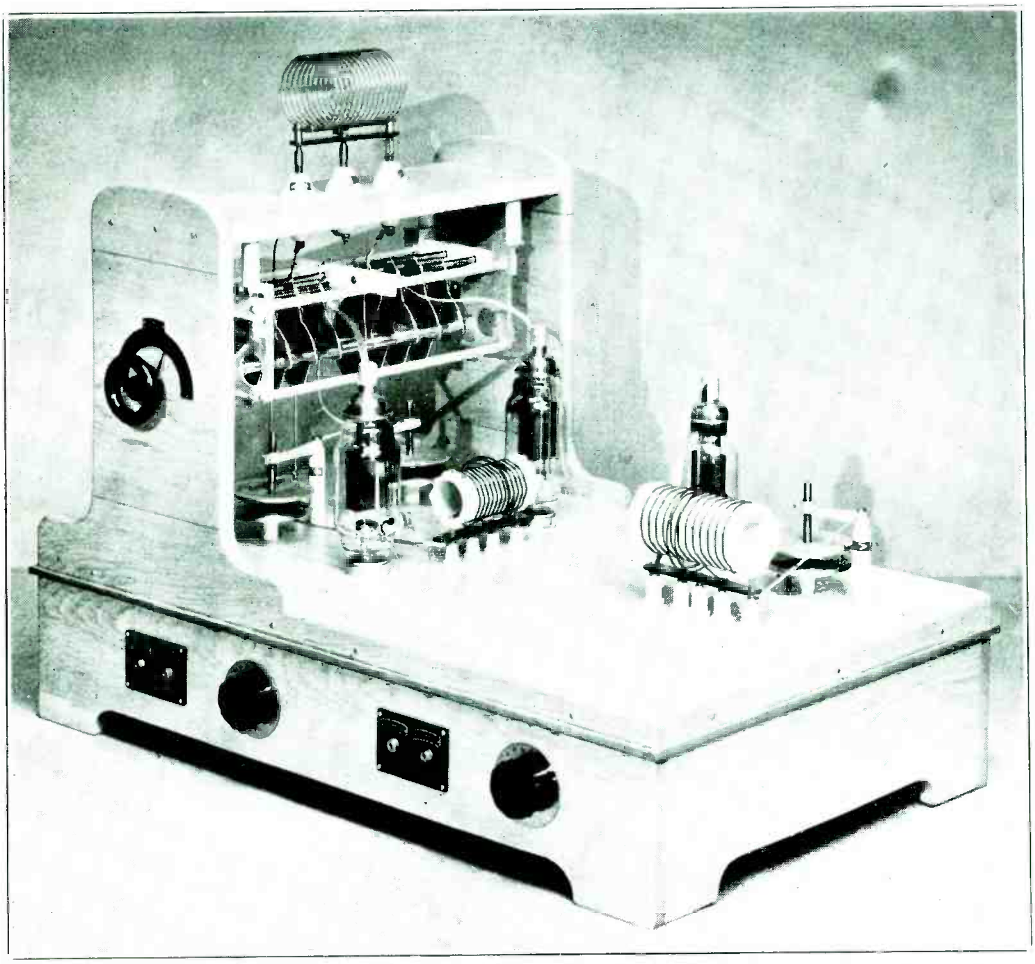
*W6QD is reported as being recently overheard asking "if the class A examination is very hard."
—Editor.



A Breadboard Rig Does Not Have to Look Like a Parasitic in a Whirlwind. It can be made to Have Real "Eye Appeal", As Evidenced by This Photograph.

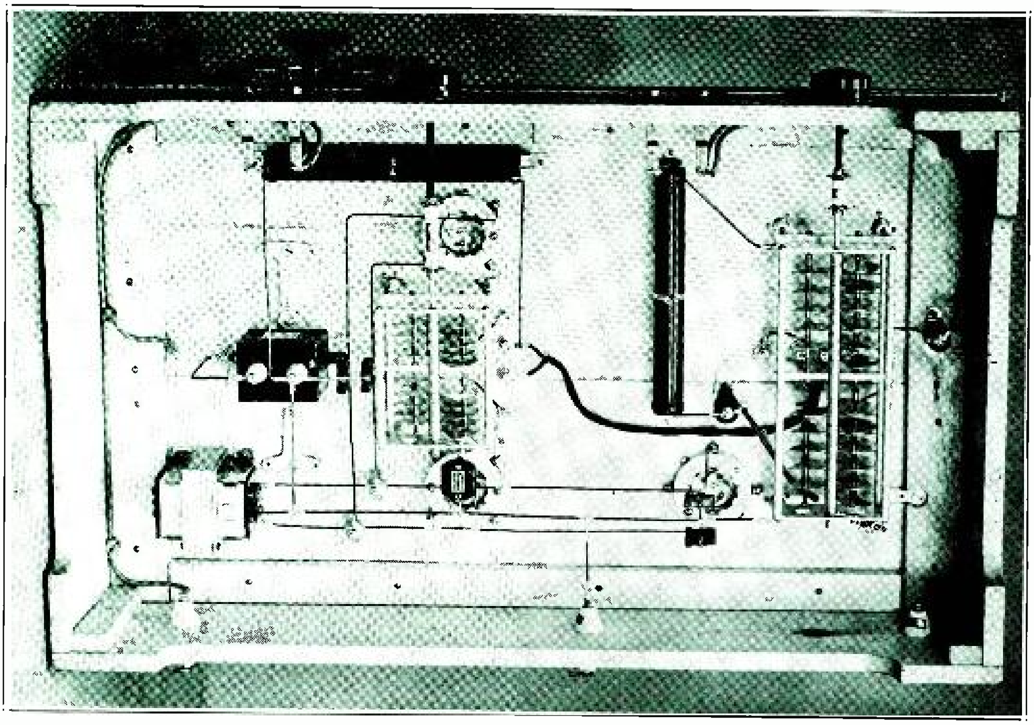
The first glance at the rig always elicits the same enquiry: "Where are all the parts?"

They are all there—under the main deck. This layout provides shorter r.f. leads, and in addition keeps a good portion of the parts covered and immune to dust. It also keeps them immune to visitors' overcoats, but as all parts are screwed down firmly anyhow, this item is of secondary importance.

The Coils

The tank coil shown in the photograph is the 20 meter coil, and consists of 12 turns of no. 8 wire 3½" in diameter. The 40 meter coil consists of 22 turns of no. 10 wire, 5 inches in diameter. Both coils are of the celluloid-supported, "air-wound" type. Giant jacks and plugs are utilized to facilitate quick coil changing. The grid coil for the final stage consists of 12 turns of no. 12 on a small National form for 20 meters and 24 turns for 40 meters. The plate coil for the HF-200 is wound on the medium size National ceramic form, and has the same number of turns. Both sets of coils have the links mounted on the individual coils, thus making it unnecessary to fuss around with coupling adjustment each time the coils are changed. The links are adjusted initially for proper operation, and need never be changed unless something else is changed in the rig. Each link is mounted on the victron strip on which each coil is mounted, and has its own pair of plugs and jacks.

Resistor bias is used on both stages, and has been found entirely practicable. However, if some other system than primary keying is used, some form of safety bias or protective relay should be incorporated. The values for the grid leaks were found to be not the least bit critical,



Bottom View of the Driver-Amplifier. The Filament Transformer May Be Seen in the Left Lower Corner. Note Method of Mounting Sockets.

though those given are about optimum.

All sockets are mounted under the deck, with just the shells showing above. This keeps the filament wiring below deck and lowers the tubes. The neutralizing condensers are mounted likewise, greatly simplifying the wiring as well as adding to the appearance of the unit.

Because of the heavy current drawn by the three tubes, the filament transformer was mounted directly on the unit, allowing shorter filament leads. A 1/3 ohm resistor drops the 11.5 volts needed for the HF-300's to the 10.5 volts needed for the HF-200.

Care should be taken to keep the layout of the push-pull stage symmetrical mechanically, even to the small details. If you watch these finer points, you will be rewarded by better operation at the higher frequencies. The amplifier has not yet been tried on 10 meters, because no effort has as yet been made to get down there, the band being somewhat dead at the time this is written. However, from the way the rig works on 20, with nary a parasitic or bug, leads us to believe that it should work like a million on the 10 meter band. To preserve symmetry, the connection to the final tank condenser (which is rather large physically) was made by fastening a resistor clip halfway down one of the rods that run the length of the condenser.

Other Tube Arrangements

The tubes shown in the transmitter "take things easy" at a kilowatt, and amateurs not wishing to put so much money in the initial outlay can cut the cost down somewhat by substituting a pair of HF-200's in the final and a 203-H in the driver stage. The rig was fired up with borrowed tubes in this line-up, and no difference in operation was noticed, the output being the same as with 1 kw. to the HF-300's. The only change made was to cut the plate voltage on the 203-H driver to about 1800 volts.

With the HF-200 driver in the rig as shown, there is reserve driving power, and hence the tube can be operated for maximum power gain rather than maximum efficiency. This means that a very small tube, such as an 801, or even a 210, may be used to drive the HF-200.

With the rig working properly, the grid current to the final stage should run between 110 and 135 ma., and to the HF-200 anywhere from 15 to 50 ma., the latter figure being preferable, but the former being permissible, as the tube will deliver sufficient driving power when work-

[*Continued on Page 72*]

CALLS HEARD AND DX DEPARTMENTS

Numeral suffix indicates "R" strength. Send Calls Heard to Calls Heard Editor, not to Los Angeles.*

Eric W. Trebilcock, BERS-195, Telegraph Station, Tennant Creek, North Australia February 26 to April 4, 1936

(7 mc. c.w.)

CR7AW-5; G6GT-4; GI6XS-5; J2IX-6; J5CC-8; PK1AL-6; VQ4KTA-5; VQ8AF-5; XU6BY-6; ZB1H-5; ZS4E-5; ZT2Q-4.

(14 mc. Phone)

CO60M-8; HI5X-5; HP1A-7; KA1AK-6; KA1AN-6; KA1ME-8; NY2AE-6; PK1MX-8; PK4AY-6; PK4DG-7; PK4VR-6; TI2FG-6; VS6AF-6; VS6AG-6; VU2BG-6; W1AIQ-6; W1IFD-6; W2FHI-5; W3CIJ-6; W9CSI-6.

(14 mc. c.w.)

W 1AB-6; 1ADB-4; 1AEP-4; 1AFO-5; 1AJZ-4; 1ALA-5; 1APQ-4; 1APQ-4; 1APU-5; 1AVJ-4; 1-AXA-7; 1BLO-5; 1BPY-5; 1BUX-4; 1CCA-8; 1CEQ-5; 1CMX-7; 1CO-4; 1CPM-3; 1DEO-5; 1DGG-5; 1DLD-4; 1DMA-5; 1DNL-5; 1DUK-6; 1DUJ-5; 1DZE-5; 1EBO-3; 1EWD-6; 1EZ-4; 1FLZ-4; 1FTR-7; 1GF-7; 1GLF-5; 1GRM-5; 1GSH-5; 1HWP-4; 1IBD-4; 1ICA-4; 1IED-4; 1IGU-4; 1IIB-4; 1IJZ-4; 1ILV-5; 1IPG-5; 1JCE-4; 1JPE-7; 1LZ-4; 1SZ-7; 1TS-7; 1ZD-4; 1ZI-4; 2AA-4; 2ADQ-5; 2AFU-4; 2AHC-7; 2AIW-7; 2ALO-6; 2AUP-5; 2BC-5; 2BLD-4; 2BYP-7; 2CBO-6; 2CJM-3; 2CJX-6; 2CPA-5; 2CTO-5; 2CTX-6; 2CVJ-4; 2CWC-6; 2CZV-6; 2DJT-6; 2DLO-6; 2DSB-5; 2DXX-5; 2DZJ-7; 2ENO-4; 2EUG-5; 2FAB-4; 2FAR-5; 2FE-6; 2FPZ-4; 2GCN-4; 2GIA-5; 2GJK-7; 2GJD-3; 2GOM-5; 2GTP-5; 2GUM-5; 2GVZ-4; 2GYB-3; 2HHF-4; 2HJ-6; 2HMD-5; 2HNO-5; 2HTO-6; 2HWF-4; 2IFZ-4; 2IIS-5; 2IRP-6; 2KL-6; 2MJ-5; 2MU-5; 2OA-7; 2PY-6; 2RS-5; 3ADD-5; 3AHS-4; 3AIY-5; 3ANH-6; 3ANS-6; 3AWH-5; 3BBB-4; 3BEK-5; 3BET-5; 3BKZ-5; 3BPT-6; 3BQP-4; 3BRZ-5; 3BSY-4; 3BVE-5; 3BWA-4; 3BWI-6; 3CBN-5; 3CBR-6; 3CDX-7; 3CDZ-5; 3CHG-4; 3CPN-4; 3CRG-5; 3CXI-4; 3CYN-4; 3DBD-6; 3DBV-5; 3DCG-6; 3DDO-5; 3DEK-5; 3DMQ-7; 3EDP-4; 3EMA-6; 3EMM-6; 3ENX-4; 3ERD-4; 3ESM-3; 3EVT-5; 3EXW-5; 3FAL-5; 3FCU-5; 3FPX-5; 3FRE-4; 3FQP-6; 3FST-5; 3FTR-6; 3GAP-6; 3JM-4; 3JX-5; 3PC-6; 3RT-5; 3SI-6; 3UVA-6; 3ZD-8; 4AGP-5; 4AH-4; 4AMC-5; 4AUU-5; 4AXO-4; 4AZB-5; 4BOJ-4; 4BPD-7; 4BYS-5; 4BYY-5; 4CCH-5; 4CEI15; 4CFD-6; 4COO-4; 4CPK-5; 4CPZ-6; 4-CUO-5; 4CYA-5; 4CYB-5; 4CYC-6; 4CYU-5; 4DAC-5; 4DHZ-7; 4DTR-5; 4DTZ-6; 4DZO-4; 4EF-5; 4EG-4; 4FT-7; 4ID-4; 4OC-5; 4RA-4; 4TR-7; 4UP-6; 4ZH-3; 5AAX-5; 5BB-4; 5CQI-5; 5CUJ-6; 5DDP-6; 5EAI-5; 5EHM-4; 5FI-6; 5JC-7; 5WG-5; 6ABF-5; 6AWA-7; 6BAG-6; 6BIP-6; 6BYB-6; 6CLP-6; 6CNX-8; 6CIS-6; 6CUG-6; 6DCV-6; 6DSZ-5; 6DVI-5; 6EMQ-6; 6EYC-6; 6FMY-6; 6FQY-5; 6GAL-4; 6GDJ-5; 6GEI-6; 6GK-6; 6GNZ-7; 6GRL-6; 6GTM-6; 6HJT-5; 6ATL-5; 6IBQ-5; 6IRW-6; 6ITH-7; 6JAB-8; 6JGQ-7; 6JIR-6; 6JKH-5; 6JNL-3; 6JVB-5; 6KHV-5; 6KJK-4; 6KRI-5; 6KSB-5; 6KZH-5; 6LBE-; 6LDD-5; 6LDJ-5; 6LCA-7; CLEA-6; 6LLQ-9; 6LS-6; 6LWR-5; 6MPK-4; 6NGD-5; 6QD-6; 6RH-7; 6TI-7; 6WN-4; 6ZS-4; 7AFN-6; 7AMX-7; 7ABV-5; 7BPE-4; 7BTG-5; 7BYW-6; 7CMB-4; 7CWM-6; 7DAA-6; 7DL-7; 7DMM-4; 7EK-7; 7EXG-4; 7MB-7; 7MD-6; 8AAX-7; 8ADG-5; 8AU-4; 8AYO-5; 8BCK-4; 8BCT-6; 8BRN-7; 8BTI-7; 8BTK-5; 8CKG-6; 8CJJ-8; 8CRA-8; 8DGP-6; 8DJJ-4; 8DLP-6; 8DPS-4; 8DBV-5; 8DVX-7; 8EUJ-5; 8FCV-4; 8FJN-5; 8HCL-6; 8HWE-4; 8HWE-4; 8HXO-5; 8IIL-8; 8IIS-5; 8INQ-7; 8ITA-6; 8IRH-4; 8JIN-5; 8JJW-4; 8JLW-5; 8JMP-6; 8JQV-6; 8JRL-8; 8JXY-6; 8KDO-5; 8KPB-6; 8KTL-5; 8LIR-5; 8LSA-5; 8LUQ-5; 8LZK-5; 8MTF-6; 8NUY-7; 8NV-5; 8NWL-5; 8OCQ-5; 8OE-7; 8PH-6; 8WU-5; 8ZY-6; 9AEQ-5; 9AHX-4; 9APF-7; 9ARE-7; 9ARL-7; 9AZH-5; 9BLU-5; 9BPD-6; 9BPU-5; 9BFT-7; 9DMY-5; 9DSX-4; 9ELA-6; 9-EGQ-7; 9FS-5; 9FUR-6; 9DWQ-6; 9HFK-4; 9HUZ-7; 9IGW-6; 9IU-5; 9KPZ-4; 9LB-5; 9LKI-7; 9MIN-5; 9MKZ-6; 9OKZ-7; 9OT-6; 9OVY-6; 9PAO-6; 9PK-7; 9PLM-7; 9PST-6; 9PTC-8; 9RGB-6; 9RGE-4; 9TB-6; 9TDK-5; 9SXV-5; 9UHE-4; 9UNZ 6; 9USL-5; 9VVQ-5. — EM2AZ-3; CM6AA-6; CM8AH-5; CP1AC-6; CR7GC-5; CT3AD-5; D4ARR-4; D4BBF-4; D4BBF-4; D4BIU-5; D4GJC-5; D4QET-4; DD4TKP-5; D4XBG. — EA 3DL-4; 3EG-3; 4AO-6; 4AP-4; 4BM-5; 7AV-5; 8AF-5; 8AO-6. — I6G-5; EI8B-5; EI9G-5; ES2D-5. — F ..3AD-3; 7JDY-6; 8DC-5; 8EB-6; 8EO-4; 8NR-4; 8NV-6; 8PZ-6; 8VJ-5. — FA8GK-6; FB8AB-7; FK9AA-7; FR8VX-5; FM8B-5. — G 2TM-4; 5KG-5; 5LA-4; 5WY-5; 5ZG-4; 5ZX-4; 6CL-4; 6IF-5; 6IR-5; 6DX-4; 6NJ-5; 6RL-3; 6UF-5; 6WR-4; 6WY-5; 6XN-4; 6ZU-4. — HAF2G-5; HAF4H-3; HB9AQ-5; HB9AT-3; HB9AY-4; HB9J-5; HB9M-4; HH5PA-4; HJ3AJH-6; HP1A-4; I1TKM-5. — J 2CL-8; 2HJ-8; 2HY-6; 2HZ-6; 2IF-5; 2KJ-8; 2LJ-6; 2LL-7; 2LO-7; 2LU-6; 2LW-7; 2MH-7; 4CP-5; 8CA-7; 8CD-7; — K 4BRN-6; 4UG-5; 5AC-6; 5AY-4; 6AIU-6; 6AKP-7; 6ESU-7; 6GCL-7; 6EO-6; 6IDK-5; 6LEJ-4; 6MEG-3; 6NJV-6; 6NLD-5; 7UA-5. — KA 1AN-7; 1DS-5; 1ER-6; 1FM-4; 1LD-6; 1MD-7; 1US-7; 1WP-6. — LA4K-4; LU4DQ-6; LU6JB-5; LY1J-5; MX2B-8; NY1AD-6; NY2AB-6; OA4J-6; OH2NE-4; OH3NP-5; OH5OA-6; OH8NE-5; OK1BC-6; OK2AK-5; OK2HL-3; OK2OP-4; OZ1A-2; OZ2M-5; OZ7KT-4; ON4FE-5; ON4CSL-5; ON4CJJ-4; ON4UU-4; ON4VK-4. — PAO AZ-4; CE-3; DZ-4; MQ-5; NP-5; PN-5; UN-5; XD-3; XR-3; XM-3. — PK1BO-8; PK3BX-7; PK3WI-4; PK3ST-6; PK4LC-8; PK4RK-7; PY2MO-6; SM5SX-5; SM6WL-5; SP1LM-6; SU1RO-5; SU1SG-5; SU1WM-4; SU5NK-6; SX2AD-6; TI2FG-6; TI2RC-5. — U 3CI-4; 3QE-5; 3QH-6; 3VC-5; 5AE-4; 6MC-7; 8AF-5; 8ID-5; 9AC-6; 9AL-4; 9AR-5; 9AV-5. UE3EL-6; UK3DT-4; UX3QH-5. — VE 1CO-5; 1DT-5; 1ET-6; 1IW-5; 2AX-5; 2BD-4; 2BE-5; 2JK-4; 3EA-6; 3NF-3; 3UG-6; 4AE-4; 4AW-3; 4DU-4; 4RO-6; 4TJ-7; 5HA-5; 5QP-3; 5KC-5; 5LM-3. — VP 1JR-5; 2AT-4; 2BX-6; 2CD-6; 2TG-6; 4TJ-6; 5AB-6; 5PZ-5; 6MR-4. — VQ3FAR-7; VQ4CRE-6; VR4BA-5. — VS 2AE-6; 2AG-8; 3AC-7; 6AF-8; 6AH-6; 6AK-8; 6AO-6; 6AQ-7; 6AS-5; 6AX-7; 6AZ-7; 6BD-7; 7JW-; 7RA-6; 7RZ-3. — VU2AU-5; 2EB-5; 2EQ-5; 2HQ-6; XE1AA-7; XE1AM-6; XE-1CM-5; X2N-6; XOH2NQ-3; XU1B-7; XU2HY-7; XU3DF-6; XU3ST-6; XU6SW-5; XU8AL-7; XU8HW-6; XU8MT-6; YR5AA-5; ZB1H-5; ZE1JE-6; ZE1JR-5. — ZL 1CK-5; 1DS-6; 1DV-7; 1HY-6; 1JQ-7; 1KY-7; 2BP-6; 2BX-4; 2BZ-7; 2HA-6; 2HR-8; TI1-7; 2FA-8; 2KD-8; 2KK-7; 2IQ-4; 2NN-6; 2OQ-6; 2QA-8; 2QM-8; 3AB-8; 3DJ-5; 3GM-5; 3GN-7; 3GR-6; 3GS-5; 3JA-6; 3KG-4; 3JK-6; 3JR-7; 4AP-6; 4BQ-6; 4CK-6; 4FS-6; 4GM-4. — ZS1AL-6; ZS4U-3; ZS6M-2; ZT5Q-5; ZT6AK-5; ZT6AW-5; ZT6M-5; ZT6Q-5; ZU1T-8.

J. Vincent McMinn, NZ16W, 12 Edge Hill, Wellington, New Zealand Heard During April

(7 mc. Phone)

EA1AS-6; EA2BH-6; EA7CA-5.

(7 mc. c.w.)

CT1LZ-6; D4SPP-6; D4WYG-5; D4XBG-5; D4YBF-5. — EA 1AW-6; 1BD-6; 1BU-6; 5AQ-5; 5AU-6; 5CG-6; 5CK-5. — F3BJ-4; F3HG-5; F8GG-6; F8PK-7; F8RS-6; FA8LC-7; FB8AD-5; G2AV-5; G5JM-5; G5TP-4; G5XC-5; G6JW-5; HB9X-5; KA9JO-6; LU4AA-8; OE6MP-7; ON4GB-4; ON4POM-6; OZ7KG-7; PAOWV-5; SM6UA-4; SP1AU-6; SP1FD-5; SP1FU-5; SV1K14; U5AZ-5; UK3AH-5; UK5AA-6; VE3AGM-7; VQ8AG-5; XU3ZC-6; XU6SW-7; YL1M-8.

(14 mc. Phone)

W 1ARC-5; 1DNL-6; 1FTJ-6; 1GJX-7; 1IYI-6; 2AGA-7; 2FDA-5; 2DX-6; 2FF-5; 2HFS-5; 2JNE-6; 2LHI-5; 3ABN-7; 3APO-6; 3BDI-6; 3BMR-6; 3BSY-6; 3CC-7; 3CEI-7; 3CRG-6; 3EHY-6; 3EOZ-7; 3GNQ-6; 4AH-6; 4AT-6; 4AXZ-6; 4CFO-6; 4OC-6; 5ACF-7; 5BAT-5; 5EUC-6; 5EXL-6; 5YW-6; 6AH-7; 6BAY-6; 6BYW-7; 6BWE-7; 6CFJ-7; 6GAL-7; 6GAT-7; 6FGR-6; 6HCE-6; 6HOE-6; 6LHF-7; 6LY-5; 6SJ-8; 6UT-7; 7BUH-5; 7IF-6; 7MD-5; 8CBX-6; 8FC-7; 8IZN-6; 8IKI-6; 8JK-6; 8LPI-7; 9CVN-8; 9DGY-6; 9DUM-7; 9GIC-6; 9ITS-7; 9IZY-7; 9KFA-7; 9MRH-6; 9PIY-6; 9OLY-6; 9QC-5; 9RUK-7; 9SZY-7; 9UVC-6; 9VVG-7; 9VXZ-6. — EA2BT-6; EA5BC-6; EA5BE-7; EA7AI-5; F8DC-5; F8OV-4; G5ML-6; K6GAS-7; K6JLV-7; KA1ME-6; NY2AE-6; ON4VK-6; TI2RC-7. — VE 3DB-6; 3EO-6; 5BY-7; 5DK-4; 5HA-5; 5HI-6; 5JB-5; 5OT-7. - XE1G-7; XE1Q-7.

(14 mc. c.w.)

CE3AO-7; CE3CA-5; CM8CK-5; CT1AA-6; CT1CB-4; CT1GD-5; CT1KR-4; CT1LC-6; CXC1CB-4. D 3DEN-4; 4CEF-5; 4CSA-6; 4HCF-4; 4MNL-5; 4SIG-4; 4SLD-4; 4TKP-5; 4VRR-5; 4XCG-6. — EA 1AW-6; 3BP-5; 3CZ-6; 3DL-7; 3EV-6; 4AV-6; 5BS-5; 7A1-7;. — ES2D-4. — F 3BJ-4; 3LE-5; 8BS-6; 8DC-6; 8EB-6; 8KJ-4; 8NE-7; 8NR-4; 8NV-4; 8PZ-7; 8WB-6. — FA8GK-5; FK8AA-7. — G 2AO-4; 2DV-5; 2ZQ-4; 5QA-4; HAF4K-4; HB9AT-5; HB9AY-4; HB9DD-5; HB9J-6; I1TKM-6; I1WW-5; I1ZZ-4; J5CC-8; K5AG-7; LY1J-5; OE1CM-6; OE1FP-5; OE7JH-5; OH3NP-5; OH7NF-5; OK2HX-7; OK2KU-5; OK2RN-3; OK3VA-7; ON4FE-6; ON4FK-5; ON4HC-4; ON4HN-6; ON4VK-6; ON4VW-5; OZ2M-4; PAOAW-5; PAOMU-4; PAOWHS-5; PY1DI-4; PY2QUD-6; SM5SC-4; SM5SX-6; SM5UU-5; SM7YG-5; SM7YN-5; SP1BA-5; SP1DE-5; SP1GZ-5; SU1KG-5; SU1WM-4; 5RL-4; 5TZ-5; 5WP-5; 6BS-4; 6CW-6; 6NX-5. — HAF8C-4; SV1K-5. — U 2AZ-4; 2NE-6; 3AG-5; 3QUE-5; 3VB-5; 5AE-5;

*George Walker, Assistant Editor of RADIO, Box 355, Winston-Salem, N.C., U.S.A.

9MF-5. — UE3EL-7; UK1CC-4; VE1ET-4; VE2CA-5; VE2GA-6; VE4AA1-5; VP1WB-4; XE2BH-5; XE2CG-4; XE2GQ-4; XE2ZZ-6; XU-3DF-4; YT7VN-5.

Leslie R. DeGross, W2GPA, 643 Monroe Place, West New York, N. J.
March 28 to April 28

(14 mc. Phone)

CO2HY; CO2WZ; CO60M; G5ML; HI5X; HP1A; TI2FG; VO1I; VP5IS; XE2N.

(14 mc. c.w.)

CE3AO; CM2AI; CM2BG; CM2DO; CM7AB; CM7A1; D4AUU; D4BIU; D4SDA; D4SIG; D4WXG; EA2CZ; EA3AN; EA5BD; EI5F; F8KE; F8PZ; F8WB. — G 2TR; 2WQ; 5GS; 5PZ; 5QY; 5VS; 5YH; 6AZ; 6BR; 6HW; 6JW. — HH1P; K5AC; K5AH; K5AL; K5AY; NY1AA; NY1AD; OE3FL; OK1RO; OK2AK; ON4UU; OZ9Q; PAOAZ; PAOMQ; PAOWHS; PY5AG; VO4K; VP5IS; VP5PZ; XE1DD; XE2N; XE2V; YR5CP; ZL2FA; ZL2KK; ZL3AX.

Donald W. Morgan, BRS1338, 15 Grange Road, Kenton, Middlesex, England
April 5 to May 5

(14 mc. Phone)

W 1ADW-7; 1ARC-7; 1AJK-6; 1AXA-6; 1BIC-7; 1BQQ-7; 1CRW-6; 1DLL-7; 1DNL-6; 1EAQ-7; 1ESU-7; 1GJX-7; 1GFX-7; 1VA-6; 2BSD-8; 2BYP-7; 2CWC-7; 2EO-8; 2EOY-8; 2GKA-7; 2HUQ-7; 3APO-7; 3BLL-6; 3CBT-6; 3CUB-7; 3CQ-7; 3DNC-7; 3EFH-7; 3EHY-6; 3FCB-7; 3HF-7; 3MK-6; 4AHH-7; 4AKY-7; 4BCQ-7; 4BMR-6; 4CAL-6; 4CYD-7; 4FQ-7; 8ATI-7; 8CJZ-6; 8CNA-8; 8FDC-7; 8HPX-7; 8JK-7; 8MNH-6; 8ZA-6; 9CHB-7; 9RLH-7. — CE1AR-6; CO2HY-7; CO2KY-7; CO2LL-7; CO2WZ-7; CO60M-7; CO7CX-6; CT1BY-8; CT1CB-8; CT1DV-8; CT2AB-6; CT2AV-7. — EA 1BA-6; 3AA-6; 3AQ-7; 3CZ-6; 3DY-7; 4BM-7; 5AQ-6; 5BC-8; 5BE-8; 7AI-7; 7BB-6; 8AF-7; 8AL-7; 8AO-7; 8AT-7. — F8AB-7; FGCT-7; FT4AA-6; FT4AH-7; G2BY-6; G2RT-6; G5BY-6; G6LI-7; G6ML-6; G6NI-6; G6RD-6; HB9A-7; HB9DT-7; HI5X-7; HI60-7; HI7G-7; I1KA-7; I1KG-7; I1KS-7; I1RK-6; I1TKM-7; LA1G-8; LA2Y-7; LA3B-8; LA4H-8; LU1DA-7; LU1EX-7; LU6NC-6; LU8AB-7; LY1AG-7; LY1J-7; OH2NE-7; OK2AK-8; OK2KO-8; OK2PMS-7; OK3VA-7; ON4VK-7; OZ1D-8; OZ1I-7; PK4AU-6; PY1DK-7; PY1EK-6; PY2BA-8; PY2CK-7; PY2ET-7; PY7AA-6; PZ1AA-6; SM5SI-7; SM5WZ-8; SM7YA-7; SU1CH-6; SU1RK-6; SU1RO-7; SU8NA-6; TI2RC-6; TI2AV-7; VE 1AW-7; 1DR-7; 1DT-6; 1EA-7; 2BO-7; 2CW-7; 2HY-7; 3AB-7; 3AFD-7; 3GO-7; 3JV-7. — VK2AS-6; VK2TC-6; VO1I-8; VP2CD-7; VP3BG-7; VP9R-7; YV4AC-7.

J. L. Evans, Jr., W2BBK, Jefferson Medical College, Philadelphia, Penna.
March 9 and 10

(14 mc. c.w.)

D4AEC-7; D4NPR-5; D4YVM-5; EA3CZ-7; EA4AV-7; EA5BS-7; F3AU-9; F3KH-5; F3TB-8; F8TQ-9; FA8GK-8; FB8AB-6. — G 2PL-6; 2WP-6; 2WQ-6; 2ZQ-7; 5BP-6; 5MS-7; 5SY-7; 5UY-6; 5WP-6; 5ZG-6; 6CL-7; 6FO-6; 6HP-7; 6QX-7; 6VP-8; 6XL-6. — HAF2I-6; HAF3D-6; K6LEJ-9; K7FCR-6; OH3NC-6; OH5NR-5; OK1TK-5; OK2SK-9; ON4DX-8; OZ2M-7; PAODC-6; PF2DB-7; U2NE-7. — VK 2CW-7; 2EX-6; 2OW-7; 2QP-8; 2UU-6; 2ZR-4; 3BJ-7; 3CZ-6; 4US-6; 5GA-5; 5HG-6; 5QR-7; 5WR-6. — VU2CQ-6; ZL3K-7.

Howard Seefred, 343 South Fremont Ave., Los Angeles, Calif.

(14 mc. c.w.)

CM2AD; CM2A1; CM2AO; CM2DA; CM2MD; CM7A1; CX1FB; D4GWF; EA4AV; EA8AO; HB9J; HH1P; HJ3AJ.— J 2HJ; 2LK; 2LL; 2LU; 2ME; 2MH; 2HI; 4CT; 5CE. — KA1AN; KA1RB. — K 5AG; 5AR; 5AY; 6AKP; 6AUQ; 6BUX; 6CGK; 6CJG; 6EO; 6HZI; 6KVX; 6LEJ; 6LEO; 6MEJ; 6NEK; 6NLD; 6NJ; 7UA. — LU 1AB; 1CH; 2AX; 7BH; 7EF; 7EK; 8DI; 9AX. — NY2AB; OA4J; OA4Q; OA4AT; OA4U; OE1FH; OH2OB; OK1DC; OK2AK; OK2HX; OZ2M; PAOQQ; PK2KO; PK6AJ; SM5UU; SM6WL; SM7QA. — VK 2AP; 2AS; 2AZ; 2BD; 2BP; 2DI; 2EO; 2EX; 2FY; 2HF; 2HF; 2HP; 2HV; 2HY; 2IB; 2IQ; 2LZ; 2MY; 2OW; 2OT; 2PX; 2QE; 2SQ; 2PO; 2VA; 2WR; 2WW; 2XS; 2ZP; 3CN; 3CP; 3CX; 3DF; 3DP; 3GU; 3RJ; 3UF; 3UH; 3WW; 3XP; 4DO; 4ER; 4GK; 4HR; 4JC; 4KS; 4LW; 4US; 5JC; 5MZ; 5WK; 7JB. — VP2AM; VS6AH; VS6AK; VS6BD; XC3I. — ZL 1AO; 1AR; 1CK; 1CV; 1DI; 1DS; 1DV; 1GX; 1HY; 1LM; 1LV; 2BX; 2CI! 2DS; 2FA; 2HR; 2II; 2JA; 2KK; 2KN; 2MR; 2OQ; PX; 2QA; 2QM; 2TI; 3AZ; 3DJ; 3GR; 3KG; 3JA; 4BQ; 4CK; 4FK; 4FS. — ZS 1AH; 1AJ; 1AL; 1AX; 1D; 2A; 2X; 4U. — ZT6Q; ZU6P; ZXMQ; ZZ2A.

VK3YP, East Malvern, Victoria, Australia. (Report received by radio through W6KB.)
April 1 to May 1

(28 mc. c.w.)

W....1ZZ; 2CPA; 2DTB; 2TP; 3FAR; 3AIR; 4AH; 4AJY; 4DCK; 5AUJ; 5BEE; 5CQG; 5DUQ; 5FPE; 5FHJ; 5QL; 6AAA; 6AC; 6BPD; 6DQT; 6DHZ; 6DJJ; 6EWC; 6FQY; 6GRL; 6HB; 6JN; 6JNR; 6KB; 6KIP; 6WWC; 61XZ; 6MFR; 6MTU; 6MCT; 6NFA; 6PN; 6QG; 7CHT; 7DOX; 8ANO; 8JFC; 8MWY; 8ZY; 9BHT; 9DKU; 9DRD; 9FFUL; DLF; 9SNP; 9TTB; 9WFV. — D4ARR; FB8AB; G6DH; HJ3AJH; HP1A; J2CC; J21U; J2IS; J2LU; J3CG; J3DC; J3FJ; K6KSI; K6MVV.

L. Martin, W6KB, 1922 Bank Street, Bakersfield, Calif.
April 1 to May 1

(28 mc. c.w.)

CP1AC; HI5X; HJ3AJH; J2CE; J2IS; J3FK; K6FJF; K6KSI; K6MVV; K6NJV; NU2AE; OA4J; VK2CZ; VK2PN; VK3BD; VK3CP; VK3MR; VK3YP; VK4EI; XE1AY; ZL1DV; ZL3AB; ZL3DJ; ZS1H.

D. Reginald Tibbetts, W6ITH, 165 Purdue Avenue, Berkeley, Calif.
January 15 to May 3

(7 mc. c.w.)

CX1CG-6; J2IX-6; J2LO-7; J8CA-5; KA1AP-7; KA1MD-7; KA1US-6; PK3LC-5; PK4XM-6; VK3KX-5; VK3MK-6; VK7JB-6; XE2N-7; XU3FK-5; XU8JR-7; ZL1GX-6; ZL1HY-6; ZL2KK-7.

(14 mc. Phone)

CE1BC-6; CO8YB-8; EI2J-4; G5N1-8; HH2B-7; HI5X-8; HI7G-8; HJ1K-7; K4DDH-9; KA1ME-8; NY2AE-9; OA4AA-7; OA4R-7; TI2AV-6; TI2FG-7; TI2RC-8. — VK 2ABD-8; 2abg-7; 2AP-7; 2AX-7; 2BG-5; 2BK-7; 2BQ-8; 2BW-8; 2EX-8; 2HP-7; 2HS-7; 2IQ-5; 2JU-8; 2LZ-8; 2MH-5; 2NO-7; 2NY-6; 2OW-6; 2RD-7; 2TI-7; 2UB-7; 2UC-8; 2UD-7; 2VR-5; 2WJ-6; 2YW-8; 3BD-9; 3EG-7; 3GM-7; 3JC-7; 3KE-7; 3OC-7; 3ZL-6; 4BB-7; 4FD-8; 4JU-7; 4LI-8; 5JC-6; 5RT-5. — XEICS-9; XEIG-8; XE2CK-7; XE2EC-8; XE2FM-9; XE3AG-7; YN1OP-8.

(14 mc. c.w.)

CE7AA-6; CM2AD-6; CR7GD-6; CXICG-6; CX2AK-7; D4BQO-5; EA4AO-5; G6NJ-5; HJ3AJH-5; J2HJ-5; J2LU-6; J2MI-6; K5AV-5; KA1US-5; LU1CH-6; LU1EP-5; LU2AX-6; LU7EF-5; OA4J-7; OM2RX-6; PAOAZ-4; U2NE-6. — VK 2AP-7; 2EG-5; 2EO-5; 2MY-7; 2NY-6; 2PX-7; 2UU-7; 3DD-5; 5JC-6; 6SA-7. — VS6AH-6; XE1CC-6; XE2C-7; XE2N-6; YM4AA-5; ZE1JN-6. — ZL 1BC-7; 1DV-8; 2II-7; 2KK-6; 2NM-7; 2PV-7; 2QA-6; 2QM-6; 3CU-5; 3DJ-6; 3GR-7; 3OD-5; 3OJ-6; 4FO-6. — ZS1Z-4; ZT5Q-6; ZT6K-5; ZT6Q-7.

(28 mc. Phone)

VK3BD-9; VK3MR-8; VK3YP-7.

(28 mc. c.w.)

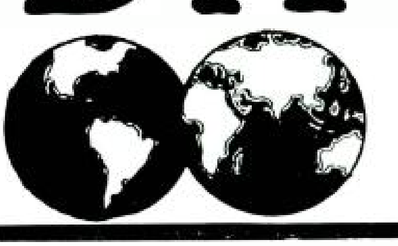
HJ3AJH-5; J2CE-7; J2HJ-4; J2LU-6; K4DDH-6; LU9AX-6; OA4J-6; VK2AS-6; VK21Z-6; VK2YP-6; VK6SA-7; XE1AY-7; XE2CM-7; XE2N-8; ZL2KK-5.

J. C. Patterson, W5EHM, 4148 McKinney Ave., Dallas, Texas

(14 mc.)

CE4AD-7; CP1AA-6; CX1BG-7; CX2AK-7; CZ2G-7; D3CFH-6; D4AOO-6; D4ARR-8; D4CSA-6; D4DLC-5; D4NPR-7; D4TGT-5; D4VRR-7; D4XCG-7; EA4AV-9; EA8AO-7; F8LG-5; F8PZ-7; F8WQ-5; F8ZG-6; FB8AB-7; FK8AA-5; G2PL-8; G2WQ-6; G2YL-6; G2ZQ-6; G5BJ-8; G5BP-5; G5GA-5; G5MS-7; G5SO-7; G5WP-7; G5YH-7; G6CL-7; G6OY-6; G6VP-7; G6RB-5; G6QX-6; G6ZU-6; G6WU-7; G6XL-7; G6WY-8; HB9AK-6; HB9AQ-5; HJD2-7; HP1A-8; HP1CM-5; HR1JR-7; J2JJ-6; J2KS-6; J2KJ-7; J2LL-7; J2LU-6; J2ME-6; J3CR-6; J3FI-6; J5CE-7; KA1ME-7; KA1WP-7; K7ELM-6; K7UA-7; LY1J-7; OA4AA-8; OA4AK-5; OA4AT-7; OA4AE-8; OA4N-7; OH2KB-5; OH3OI-6; OH5NG-6; OH8NE-6; OK1UK-6; OK2AK-7; OK2HK-6; OK2HX-6; ON4AU-8; ON4FE-7; ON4MY-6; ON4VU-7; OZ2M-6; OZ4H-5; PAOAZ-6; PAOCE-6; PAOJM-7; PAOJMW-7; PAOKC-7; PAOQL-5; PAOUN-7; PYIDH-6; PY2AP-6; PY2BU-6; PY2BX-5; PK3BM-7; SM5UU-7; SM5YS-7; SM6FJ-5; SM6UJ-7; SM7YA-5; SM7YN-6; SP1GZ-5; TI2DB-7; U1AB-7; U1AD-7; U1AP-6; U1CN-7; U1CR-6; U2NE-7; U3AG-7; U3DI-6; U6SE-5; U9AC-5; U9MF-6; U9MI-6; VO1L-7; VO1P-5; VP1DM-7; VP1WB-8; VP2TG-7; VQ8AB-6; YL2BB-6; YN1AA-8; YR5JS-5; YR5MP-5; ZS1AL-6; ZS6AF-6; ZN2M-8.

DX



By HERB. BECKER, W6QD

Readers are invited to send monthly contributions for publication in these columns direct to Mr. Becker, 1117 West 45th Street, Los Angeles, California

Vacations . . . holidays . . . trips . . . fishing . . . swimming . . . parties . . . girls . . . romance . . . tomato juice . . . that's what summer brings. And oh, those June brides; we mustn't forget them. But by this time you say, "What the deuce has this to do with dx?" That's what I'd like to know myself, but it does. Anyway, dx must go on forever; so let's dive into it and see what's doing. But I'm warning you, if it's a little more disconnected than usual it's because I feel the urge for another swim.

W9KG . . . w.a.c.'d in 2 hours and 10 minutes on May 14, and on May 15 made it in 2 hours and 35 minutes. Guess that's about tops for the W9. Keat has been shaggin' dx for 13 months and has 34 zones to his credit, and has stacked up 87 countries. New ones at W9KG are SM6UJ, OA4N, U3DI, U1AB, J3CR, U3CY, OZ7ON, ZU6P, OH3OI, SM7WS, OE3FL, HH3L, J2JJ, J2KJ, PY5AB and VQ3FAR, which was his 34th zone. Speaking of low power, W9LBB has done some swell work: 33 zones . . . 5 U9's, 10 different J's, VQ8AB, FB8AB, FB8AG, and made w.a.c. about 15 times. W9ARL seems to be very modest about his dx achievements, as no one can get much from him (although he has worked about 125 different European stations in the last two months) . . . 33 zones for him, also. W2BJ works country Nr. 101 by snagging VQ4KSL in Kenya. The VQ wants QSO's and is found at 14,310 kc. T9. ES5C wants W6 and W7 contacts, and he's on 14,300 kc. T9. LA2B told Ray (W2BJ) to tell someone else that LA4U is working on board the ship *Havprius* . . . call LTAG.

W8OPG (Ohio's perfect gentleman) has contacted stations in 23 zones and has never used a larger tube in his final than an 800 . . . another QRP feller doing well by himself. Keep it up, Glen. Ah, there's always a comeback for every question asked on these pages . . . We've found a new w.a.c. time for the W5 to shoot at . . . W5AFX is w.a.c. in 2 hours and 59 minutes . . . Nice going, but who started this w.a.c. contest by districts 'anihoo'? It really isn't such a bad idea; so if you fellows want it, just hop to it and we'll find out who is the best in each district. And now I must put in my crack about sending in your zone totals. A nice list has been started and in October RADIO (out in September), which will be the next issue, the list will be published. Now back to W5AFX: he has 33 zones and 90 countries.

Here's this man Trebilcock again, BERS-195. Says he got a bang out of a certain W9 on phone working VK5JC in Sydney, Australia. This may not appear goofy to you at a glance, but it so happens that VK5JC lives 750 miles from Sydney and that district is VK2. Trebilcock, who is a postal employee, received a QSL card from the Dominican Republic, HI5X. Says he wouldn't like the job of selling stamps in that place, as on this card there were three stamps which, placed end to end, measured 7½ inches, hi. BERS-195 pulls a good one. As you probably know, he is about the best-known and most consistent listening station I've heard of, and he claims he is "H39Z". . . In other words, he has heard sigs from 39 zones . . . and now he is gunning for 40. In answer to the query by BERS-195 and others re-

OA4AA

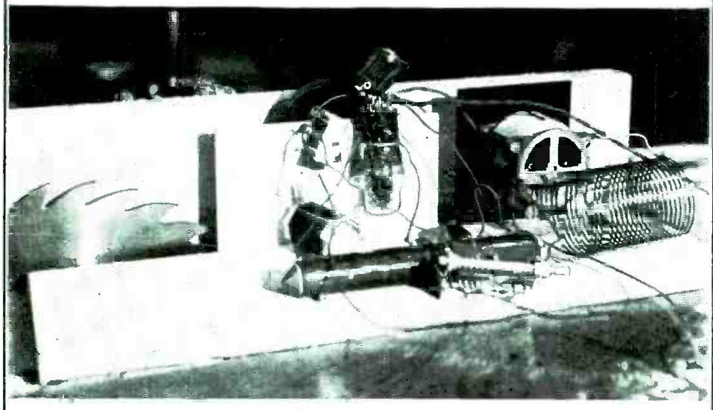
Randy Enslow, transport pilot for Pan-American Airways, at home with his wife at Lima, Peru. His 20 meter phone signals have a terrific wallop in the U. S. A. The rig uses a pair of 10's modulated by 10's in class B. Give him a shout on 14 megacycles.

THE PERFECT QRA

A group of northern California amateurs could not resist the urge to take some high power gear to the top of Mt. Hamilton to see just what could be accomplished in the way of dx from a "perfect" QRA. All power wires are underground and autos seldom go by the place, giving a noise-free location. Any desired power up to 30 kw. is available with perfect regulation. A real ham Utopia! The location "looks down" on all four sides, the country seen in the distance being near San Jose, approximately 4200 feet below. The dome and buildings are the Mt. Hamilton Observatory.

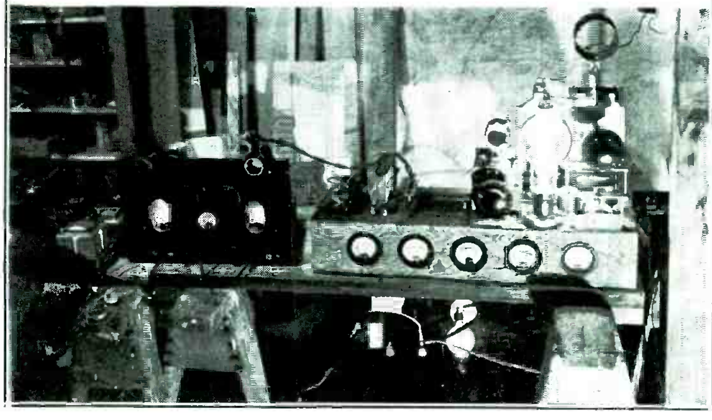
PERSONNEL

The transmitter was hurriedly installed in the carpenter's shop as seen in this photo. By working in shifts, the rig was kept on the air 24 hours a day. From left to right are W6UF, W6SC, W6CEO, W6CHE, W6DZZ. The picture was taken 6:00 a.m., May 31st, while QSO a ZT. 17 countries were worked May 31st; 22 altogether. W.a.c. was made three times. Strange to say, not a single K6, K7, or K5 was worked.



EMERGENCY EXCITER

The Brown (W6HB) Howe (W6CEO) sin (just for the devil of it) push (suffix just because it sounds nice) oscillator-exciter. The "Brownhowsin Push" was built up out of junk begged, borrowed, and "stole" during the wee sma' hours. The only crystal on hand that would double to the edge of the 20 meter band was an 80 meter rock, and as the regular exciter was designed to use a 40 meter crystal for 20, the "B-P" was improvised. The saw does not in any way reflect on the note.



THE "PORTABLE" GEAR

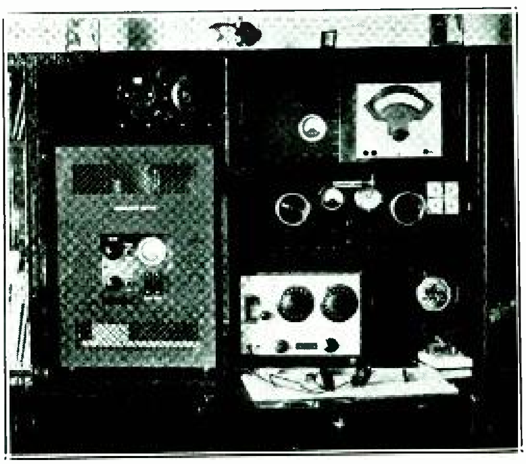
A close-up of the gear carried to the top of Mt. Hamilton. The "Xmas tree" effect of the tubes is due to poor lighting and long exposure. The panel-mounted exciter was borrowed from the transmitter of W6BAY, and will be described in detail in a future issue of "Radio". The 300-T's in the final amplifier were fed 3100 volts from the power supply seen underneath the transmitter.

garding the QRA of OS1BR . . . W1IJO comes to the rescue. Sezze . . . the QRA is "just 8 km. outside of Jiddah, Hedjaz, Arabia," which is Asia . . . and, while thinking of it, why not print a few QRA's of these elusive dx fellows? Whenever you find out the QRA of some of these stations which are not in the call book, send them in, as many fellows will really appreciate it. But by that I don't mean that every time a W9 moves to send in his new address.

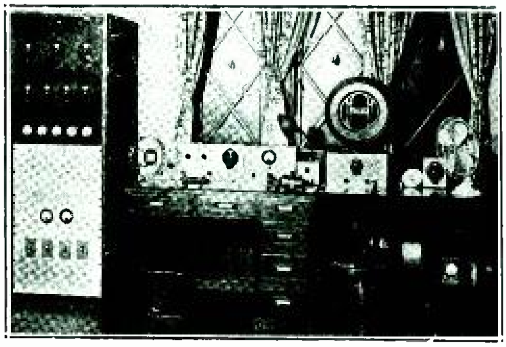
Hams on Hamilton

Over the week end of May 30th, a group of the San Francisco bay gang trekked up to the top of Mt. Hamilton to the QRA of W6SX, Dr. Jeffers of the University of California observatory, which is about 65 miles south of San Francisco. A wide variety of portable (?) rigs was brought along, ranging all the way from 60 mc. transceivers to a big 7 and 14 mc. c.w. rig of W6UF, using a pair of 300-T's in the final. The gang included W6DZZ, W6UF, W6CHE, W6CEO, W6EKQ, W6HB, W6BNU, W6OU, W6SC, W6DGP, W6BAX, and W4DHZ of contest fame. W6AAR missed out, due to a touch of the flu after driving 450 miles from L.A. W6WB also built up a 50-watt portable phone driven from a 250-watt 350-cycle gasoline generator, but just failed to arrive.

W6OU brought up a particularly f.b. 10-meter crystal-controlled portable phone using about 7 of the new 35-T's in it. The input ran around 250 watts, with class B plate modulation of the push-pull final. He worked some good dx on 10, but details are lacking. After dragging the gear up the hill, the two receivers were set up first, and as one warmed up, the air was made hideous with FK8AA calling a CQ. Then LY1J was also heard while getting set up. In the rush to get on, the one and only 80 rectifier in the crowd laid an egg, so the 5Z3 in one of the two Bretings was shuffled back and forth from receiver to transmitter in order to get going. The 40-meter and 20-meter exciter flooied and after several hours of effort a strange and wonderful "Brown-Howe-sin Push" exciter was held together with string and other haywire. No sockets, no resistors, no bypass condensers, but the thing worked. It was found that all the 40-meter crystals



Receiving position at OK2HX, Emil Zavadil



J3FK, owned by Teruro Wakimoto, Osaka, Japan

on hand hit the 20-meter phone band. After some judicious grinding, it was found that the frequency of one of the crystal's harmonic had changed from 14,150 to 14,075 . . . get that . . . grinding *lowered* its frequency. All sorts of strange things happened up there. Looking around through a junk shop, the gang located not only a piece of plate glass to grind the crystal on, but found said plate glass covered with *grinding compound* . . . Dx conditions were terrible until Sunday night, when they really broke loose, and the fellows worked about 20 countries in three hours on 20. Heard and worked PA0JMW several times during the week end and had a nice three-way with G6RB and G6XL, both on the same frequency. W6SC, while wandering around in the dark, fell off a cliff and landed on a freshly-tarred road below. A couple of engineers in the party went into a huddle and announced that SC's dielectric constant went up to 12.2 after his impregnation with tar. Everyone slept on the floor of one of the buildings except the chief of police of Piedmont, who rated a cot. He caused a small earthquake turning over, and his r.a.c. snore will be missed by the gang.

W6DZZ and CEO climbed a water tank to hang an antenna in the dark. They took their time and moved very carefully as the ground seemed far away. They took a lot of credit for their bravery until the next morning, when they found that the hill came up behind the tank and they would have had a hard time falling 6 feet.

The weather was cold and stormy all week end and a bad lightning storm threw sparks around the gear for a time. The lightning intensity was measured by a reaction voltmeter. W6UF provided the reaction. For every inch each jolt lifted him out of the operating chair it was assumed that a hundred-volt potential was applied. This calibration was corrected for the effect of the side cutters in UF's hip pocket. W6SC lost interest when he found that he couldn't work dx at 50 w.p.m. on his weightless bug. W6SX proved a combination of Santa Claus, Aladdin, and a swell host, and in spite of the wild animals, including deer and jack rabbits as big as donkeys, who helped make life interesting, the gang all want to repeat the session.

Resonant Filter

Last month's dx section contained a paragraph about the resonant filter that so many of the boys are using. As a result of it, quite a few interested letters came in, asking questions . . . and I must say

[*Continued on Page 74*]

28 and 56 Megacycle Activity

The big 5 meter day was May 9th, when 14 and 28 mc. were also subject to short skip and followed by a good day for dx. Ohio and Illinois stations could work each other on "ten" while the midwest and east coast were having their field day on "five".

Harry M. Harvey, W2BKW, heard W9PKU in Covington, Ky., call "cq 5 meter dx" at 9:45 p.m. eastern time on the 9th. He was 100% readable with some slow fading. A phone QSO immediately resulted. W2BKW was using 60 watts into a pair of 210's, operating into a bent half-wave antenna in the attic of his house. W9PKU said he was putting 200 watts into a pair of 801's. This contact was verified by QSL cards and was overheard by W2JAX. W2BKW also heard a station signing from some point in Kentucky, the call apparently being W9KUK, also calling "cq 5 meter dx", but was unable to hook up with him.

W3HG writes that he was on 57.6 mc. phone and i.c.w. at 9:10 to 9:20 p.m. May 9, calling mobile W3IK. At the conclusion of calling, he heard a W9 phone tell another of hearing him. The W9 was R7 on about 57 mc., with bad fading. Up to 11:45 p.m., W3HG heard W9PKO, W9UAQ, W8ORI, W9PEV, W9PMQ and W9RTE. The receiver was a super-heterodyne, the transmitter a pair of 10's driven by a pair of 45's, with 80 watts input. Antenna consisted of two half-wave verticals fed in phase with a ½ wavelength section and twisted pair feeder—an ideal low-angle non-directional antenna.

And lest we forget, we are told by W9HPG that one of the Chicago five meter stations actually took a message for Chicago from an East coast station—something of a record!

W9LWI reported working W1FHN, W2JCY, and others. He also reported W1ZE (calling Kalamazoo, Michigan) and W2JCY who were heard by W8NSS. He heard a W4 in Georgia, a W1 in Stamford, Conn., and a station in Rochelle Park, N.J., without definitely identifying the calls. Here is his list, heard from 9 to 11 p.m. Eastern time May 9:

W1DVO, W1FHN, W1HCK, W1HRZ, W1IYX, W1JVE (?), W1ZE, W2AMJ, W2CLD, W2CQI, W2DCP, W2DNL, W2HRB, W2HWC, W2JCY, W3ACB, W3AMW, W3AYG, W3CTT, W3EPN, W3EUI, W3FJN, W3FJW, W3GAH, W3GK, W3KW, W3NU, W3PO.

W9PEI, W9UOV and W9DTN were among the Chicago stations to raise Eastern stations.

W3FAR writes: "A sudden drop of 30 degrees in temperature in the late evening of May 9. . . Understand that the five-meter band went wild, local W3 working W9 stations. 28 mc. dx came through on the 9th and 10th."

W8INS advises that he is taking a 56 mc. station in a trailer on a tour to the south and west. His stops will include Chattanooga, Atlanta, Birmingham, Montgomery, Mobile, New Orleans, Jackson, Dallas, Del Rio, El Paso, Albuquerque, Gallup, Mt. Carmel and Los Angeles. From there he will go north to San Francisco, Portland, Seattle, then east through Spokane, Butte, Billings, Rapid City, Chicago and Fort Wayne. His starting date is June 18, but our guess is that he will still be on the road when this issue of RADIO is in your hands!

W6GEI relays the information that VK4AP is on 56 mc. with 100 watts into a 50T crystal controlled. He is looking for a QSO with the U.S.A. on "five". Who will be first?

It is quite generally recognized, now, that 56 mc. dx beyond about 300 miles is due to K-H layer refraction (or reflection) in a manner quite similar to the 14 and 28 mc. bands. On May 9, Chicago stations largely heard W2's and W3's, when W8NSS in Ohio heard W1's almost entirely, the nearer stations being "out" due to skip. There is exhibited a direct relationship with the shorter skip distance on the lower frequency bands, all becoming shorter simultaneously.

One difference, though, is that on the higher frequencies there are likely to be several "good" zones with silent zones between, whereas on lower frequencies, usually only one silent zone is present, and any station beyond that distance can be heard.

As the ionization becomes stronger to the east of a point, the first silent zone should become narrower, and the first reception zone nearer. During that period, 56 mc. contacts might be limited to a rather short period before the stations fade out. When the ionization becomes a maximum just east of the station, however, the zones should stop advancing and permit rather steady signals for perhaps an hour or two before ionization falls and the zones move outward to the east again. When the point of maximum ionization reaches your station, north-south communication should be steadiest and for the shortest possible distance. After this, the western zones will move closer, stop, and move away. We are, of course, assuming a level layer; some sort of tilt could upset it, particularly causing fading.

In Illinois, we seldom hear many districts at one time on 28 mc. Usually, New England opens up first, the reception swinging down the Atlantic coast, around to Texas, then back again.

It follows that when the five-meter band opens up for dx, you shouldn't quit when the eastern signals pass out. Keep at it for several hours while northern, southern, and finally western signals have a chance to reach you. The absence of signals under these conditions indicates nothing more than the absence of a five-meter station on the air at the proper distance and direction. You will have to do some calling and listening to let him know that the band is wide open to your station.

Some of the gang have asked for an explanation of the late hour at which this 56 mc. dx has taken place. One reason is simple: there are more stations on the air in the evening—or on Sunday—which increases the probability that some two-way work can be done. The second is the fact that the shortest skip in summer can actually take place much later than noon. Here is our reasoning:

In winter, particularly in late December, the sun's ionizing effect may be very small. It is easy to see why the skip should be shortest then near mid-day. In the spring and summer—possibly reaching a maximum in late June—the sun has a strong effect particularly during the middle part of the day. But the ionization can be stored up quite like a storage battery on charge which is also being drained by a load. The ionization decreases at a relatively constant rate, let us assume. As long as the sun can produce more ions than are normally lost, the "charge" is increasing. In June, the sun may be able to supply more than the normal loss for perhaps all of the daylight hours. Under such conditions, the maximum "charge" will be reached only in the evening, which will produce the shortest skip. Ions are lost throughout the rest of the night, the skip becoming longest around sunrise or before, depending on the direction of transmission.

28 Megacycles

During May, lots of the gang moved out of the 28 mc. band because of fewer dx contacts. We think that the June-July conditions, which will permit fine inter-district low power work, will bring back much activity. This will particularly relieve the 4 and 14 mc. phone bands. Good South American work should also continue when those stations are on the air. Here is a summary dated May 19th, from Frank South of W3AIR:

"Since the dx contest 28 mc. has certainly been acting up. There have been but a few days when conditions came up to par, and then most of the signals came from the south, with real strength. The calls heard for last month will prove the above statement, although all continents except Asia were heard. The South Americans have had the heaviest signals since early last fall. The VK's have about half their usual wallop and are being heard as late as 10:30 p.m. now. ZS1H has made his appearance but a few times, and then only for a short while; his signals can be heard sometimes for only about five minutes. Winter apparently affords better East-West working conditions as observed so far. European signals are as scarce as hen's teeth and J QSO's."

On May 8, Bill Atkins of W9TJ wrote us as follows:

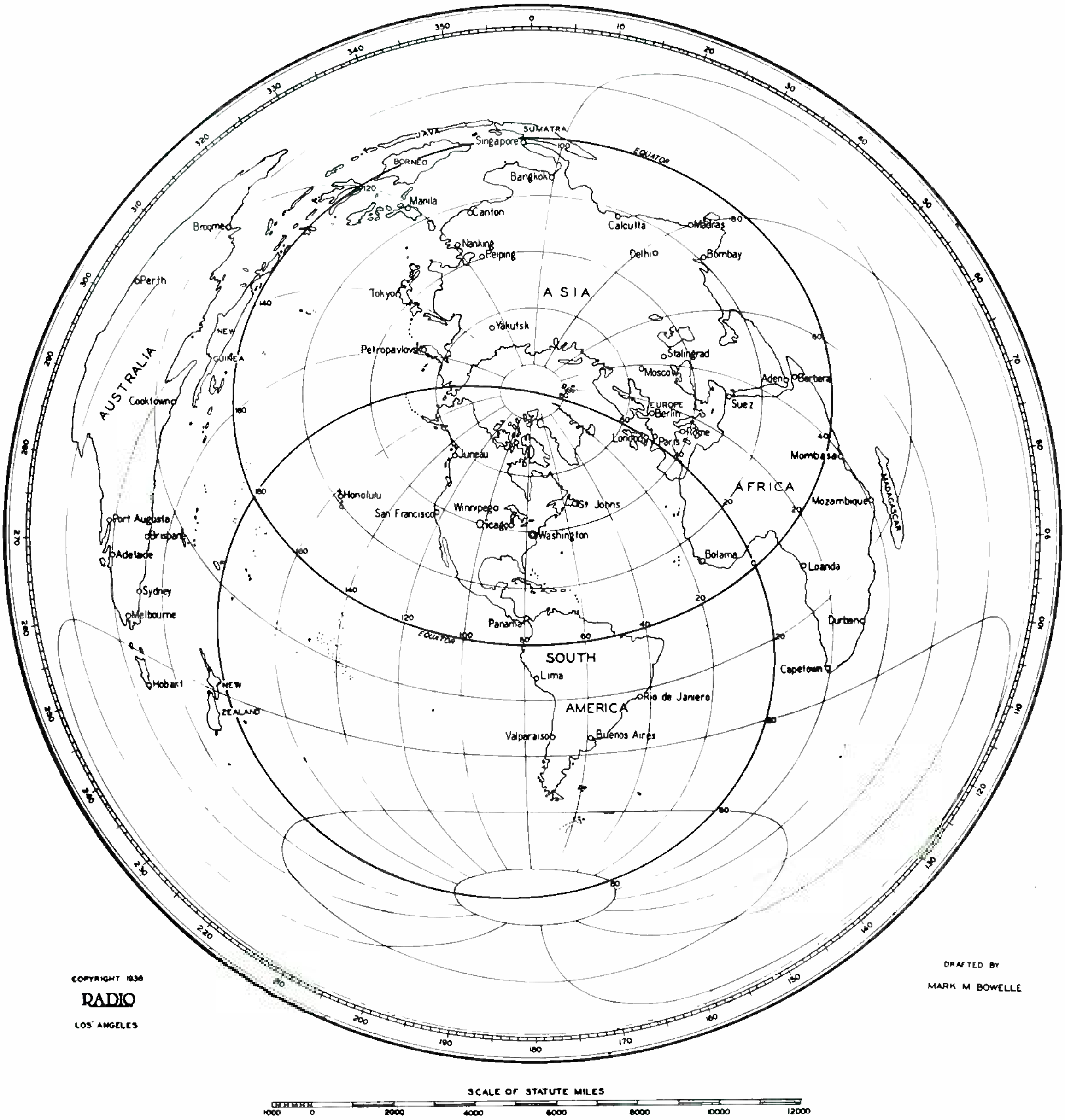
"At various times during April, strong commercial harmonics were heard. I am wondering whether the lack of amateur signals was due to conditions or no activity. Possibly the gang became discouraged and joined the ranks of the 14 mc. QRM battlers."

Station Reports

ZS2A: In two and a half months on 28 mc., not including all of the good week-ends, I have close on 32 prefixes, 250 QSO's with W stations, 76 of these in the one week during the contest. I would probably have more prefixes if W stations would not answer my directive CQ's to other parts of the world.

G2YL: Countries heard or worked by G's during April: EI, F, D, ON, OE, U, EA, CT3, PA, FB8, ZS1, ZT6, ZU5, ZE1, SU, VU, J, VS6, VK3-4-5-6, KA, VO, all W except W7, VE1-2-3, VP1, K4, K5, NY2, HP1, HJ, OA, LU, PY, CP. BRS1847 heard W6BAY, W6MDU, and W6KRN phones on April 7th. G6DH worked G6DEI on April 14. During the month, South Africa was heard by G's on every day except the 3d and 7th. South America was heard April 1, 3, 5, 8 to 12, 15, and 26. Australia was heard April 5, 7, 12, 18, 25 to 29. Asia was heard spasmodically. U.S.A. signals were reported April 1, 2, 3, 5 to 8, 10 to 12, 14, but not after. The fact that the return of short-skip summer conditions has not cut down South African reception suggests that we shall continue to work Africa at all seasons. FB8AB and FB8AG in Madagascar have been coming

[*Continued on Page 73*]



GREAT CIRCLE MAP OF THE WORLD

Centered on Washington, D. C.

The great circle distance from Washington to any other point on the surface of the globe may be scaled off directly on this map using a straight-edge and the scale of miles shown directly below the map. Perth, Australia, scales roughly 11,500 miles from Washington. Distances of distant points from other cities in the eastern United States can also be scaled off directly with sufficient accuracy for most amateur purposes. To determine distance in kilometers multiply miles by 1.6.

The great circle direction of any point from Washington may be determined by laying a straight-edge from Washington to the point whose direction it is desired to determine. The point at which the straight-edge crosses the numbered circle will give the direction. Thus Perth lies about 33 degrees north of west from Washington (303 on the numbered circle). Verify this on a globe if you doubt it.

More on the Conversion Exciter

By Robert S. Kruse

Since the original Conversion Exciter story* was written by Messrs. Keeley and Hayes, it has become apparent that amateurs own every sort of crystal except the one which an article calls for. Fortunately the conversion exciter eats such problems alive.

For instance, suppose we take four crystals that are wrong. The idea is not that one amateur owns four crystals *at the same time*; only the wealthy have four un-chipped "rocks" all at the same time. We speak of four amateurs, each with one mis-fit crystal.

Amateur A has a 1715 kc. crystal which is too close to non-amateur territory to let him sleep well. Furthermore, if he doubles or triples, the thing is altogether worthless.

Amateur B has a 2000 kc. crystal—and wants to work c.w. Again the crystal is worthless on its own frequency: doubled, tripled, or quadrupled. Even if doubled and then tripled it is no good.

Amateur C has a 3750 crystal and an 80 meter phone permit.

Amateur D has a 3800 crystal and wonders what it is good for besides 80 meter c.w.

Now watch the conversion exciter fix them all up nicely!

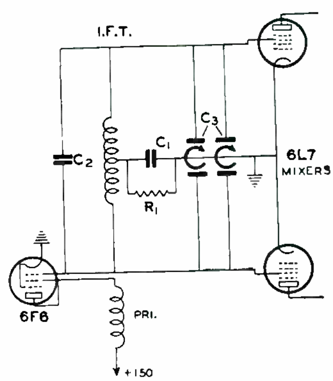


Figure 1

The 200-300 kc. oscillator connected to the mixers.
R_1—50,000 ohm, 1 watt **C_2—I.f.t. trimmer**
C_1—0.005 µfd., mica **C_3—4 gang b.c.l.**

After spoiling a sheet of paper with a pencil we decide that the conversion exciter can be made to use all four of these crystals with one and the same low-frequency oscillator range. The Keeley-Hayes crystal oscillator, as you remember, is a special circuit requiring no tuning whatever, so that it works immediately with any of our four mis-fit crystals, and the only change will be in the low frequency self-oscillator which heterodynes the crystal oscillator and shoves it over into useful territory, besides permitting us to shift frequency by tuning the l.f. oscillator. The l.f. oscillator range which will do our job is 200 to 300 kc. Let us first show that this will come out right, then explain how the 200-300 kc. oscillator is made.

Outputs of Conversion Exciter When Using 200-300 K.c. Range of L.f. Oscillator

Crystal Frequency	*Output*	*Doubled*	*Quadrupled*
A—1715	1915-2015	3850-4030	Not useful
B—2000	1700-1800	3400-3600	6800-7200
C—3750 (Diff.)	3550-3450	7100-6900	14,200-13,800
C—3750 (Sum)	3950-4050	Not useful	Not useful
D—3800	3500-3600	7000-7200	14,000-14,400

Thus amateur A gets a portion of two bands instead of a single spot in one band. Amateur B can work c.w. in three bands. Amateur C can use his 80-meter phone permit, besides working in an additional part of the c.w. section of that band, and part of the 40 and 20 band, while amateur D operates in three bands instead of one.

Do not forget that all 4 of them now are able to shift frequency quickly, with no additional crystals. They make these shifts to any point between any pair of figures in the tabulation.

The 200-300 Kc. Oscillator

Now it is true that we have taken these crystals somewhat at random, and that for another group of crystals it might be better to choose some other range than 200-300 kc. for the l.f. oscillator. In fact, for some of the crystals here mentioned, a different l.f. range would be better. However, it would be a very long story to take the crystals up one at a time, and if we tell how one oscillator range is obtained the idea will be clear and adaptations easy.

Suppose we start with a 465 kc. intermediate frequency transformer to be used as the tuned coil of the l.f. oscillator. You will remember that the primary serves as a plate coil and the center-tapped secondary serves as a tuned, grid coil. It is necessary for the secondary to be center-tapped because it is also used as an input coil to a push-pull pair of 6L7 mixer tubes. It is also necessary to use rather large tuning

*Radio, June, 1936, p. 8.

capacity to prevent serious unbalance due to differences between the condenser-sections and the fact that the two ends of the coil are not quite equally loaded, one of them having to carry the grid of the 6F6 l.f. oscillator itself (see figure 1). Fortunately, 465 kc. transformers with center-tapped secondaries are used to feed various sorts of push-pull detectors, and are commercially available. Such a transformer ordinarily tunes to 465 kc. with about .0001 µfd. of trimmer capacitance across the secondary. Sometimes it is less, but that is a fair jumping-off place, and we probably will be on the safe side if the guess is wrong. To tune to our lowest frequency, 200 kc., will take nearly 5½ times as much capacitance (.00054) while tuning to 300 kc. will take around 2½ times as much (.00024). There are several ways of providing such a capacity range. One is to use an ordinary 4-gang t.r.f. tuning condenser with sections 1 and 2 in parallel and connected to one end of the coil, the frame to centertap, and sections 3 and 4 connected in parallel to the other end of the coil (again see figure 1). Usually the sections have a maximum of about .00036 µfd. or better, so that the resultant is .00072 µfd. on each side, and as the two sides are in series across the coil the result is again .00036 across the coil. This can be brought up to the required .00054 by connecting across the coil several small mica condensers totalling .00018. (A single .0002 will usually answer.) The 300 kc. point is evidently easily reached as it required .00024 µfd., which is the pad capacitance plus .00008 from the variable condenser, which is .00016 per section, hence a safe ways from the minimum setting (where unbalance takes place).

With a 2-gang condenser the thing is less convenient, as we must use too much fixed condenser to get down to 200 kc., and accordingly must take a part of it off again to reach 300 kc. This gives two tuning ranges with an overlap which is not as handy and may cause confusion. If the condenser is to be purchased, the 4-gang

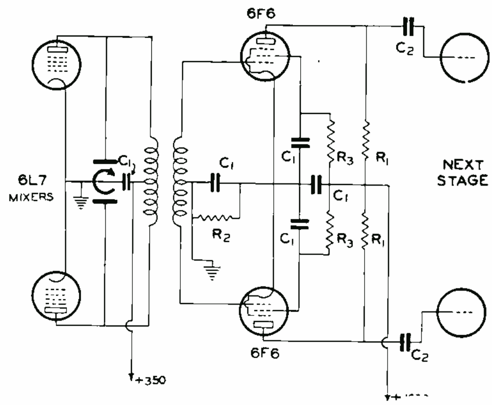


Figure 2
The untuned 6F6 buffer stage to run in class A with an output of 10 watts.

R1—15,000 ohm, 1 watt
R2—220 ohms, 10 watt
R3—85,000 ohm, 1 watt
C1—0.001 µfd., mica
C2—0.0001 µfd., mica

is worth the extra 50c. If a two-gang is used, get one with a large capacitance if possible. For instance, if the condenser runs to .00045 µfd., as some types do, the total capacitance for the two sections in series is .000225 µfd. and the fixed mica padding to bring it to the prescribed total is .000315 µfd., but this cannot be all in one mica condenser or we cannot get down to the .00024 needed for 300 kc. It will be found that the time taken in tinkering with the sectional pad, and the cost of the extra mica units, will pay for the 4-gang condenser recommended at first.

Still another way out is to begin with a larger coil, as for instance one intended for 175 kc. operation, or better, one intended for 260 kc. or 370 kc., all of which are commercially available at the same price as the 465 type. It is then necessary to set up with whatever tuning condenser you intend to use and "prune" the secondary coil until it tunes to 200 kc. (or whatever you have picked as the low end of your frequency range), while the tuning condenser is set to maximum.

A Tuning Stunt

The first time this is done with a strange i.f.

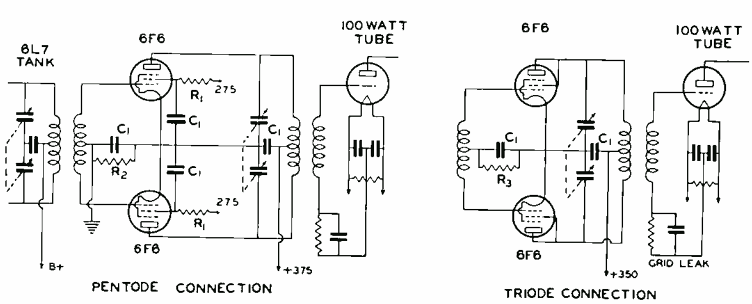


Figure 3

Triode-connected and pentode-connected 6F6 buffers to operate class A-B with an output of 20 watts.

R1—5,000 ohm, 2 watt
R2—350 ohm, ten watt
R3—750 ohm, ten watt
C1—0.001 µfd., mica

transformer, one must do a little high-powered guessing. For instance, we can guess that the original trimmer of the i.f. transformer had a capacitance of .0001, set the tuning condenser of the l.f. oscillator (without any padding from any source) to some setting supposed to give about the same capacitance as the trimmer, and then hunt for the second harmonic of the oscillator with a b.c. receiver, meantime tuning the l.f. oscillator around the same neighborhood (not wandering all over the scale!). The beatnote of a 465 kc. oscillator should of course be found at 930 kc., that of a 370 kc. oscillator at 740 kc. and so on. Dollars to doughnuts you will not have a b.c. station in the right channel, but there is always one a channel or two away, from which one can get bearings. After that the b.c. receiver is tuned slowly, and at each channel which shows anything like a b.c. signal, the tuning is stopped while the l.f. oscillator follows it up. In this way the l.f. oscillator is given a preliminary pencil calibration and one then knows what adjustments are needed to get the required range.

If the start is made with a 175 kc. or 260 kc. transformer it is clear that the 2d harmonic is not immediately within reach, but a little thought about the particular job will show what *other* harmonic may be used. The same remark goes for the 200-300 kc. oscillator discussed above. When in doubt remember that a harmonic can always be identified by hunting for the rest of the family. Thus if a beatnote is found at 900 kc. and one is not sure whether it is the 2d harmonic of a 450 kc. oscillation or the 3d harmonic of a 300 kc. oscillation, one has only to tune the b.c. receiver to 600 kc., at which point there would be nothing from a 450 kc. oscillator, but a good solid beatnote from a 300 kc. oscillator's second harmonic. Tune the l.f. oscillator very slightly back and forth while hunting. Warning: it is not uncommon for some harmonics to show up very much more loudly in the b.c. receiver. Do not work with the volume control squeezed down—let the family go to the movies while the yowling proceeds. Of course if you live in an apartment, the folks on the other side of the wall will be receiving your beatnotes in fine style and you may have to wait until before breakfast when the b.c. stations are up but some of the audience is not. It helps matters along to use low voltage on your l.f. oscillator, then couple it closely to your own b.c. receiver.

Do not let all this talk about b.c. interference worry you. After the rig is complete, the b.c. frequencies do not get to the antenna in any considerable amount, as was explained in the original Keeley-Hayes article.

Class A R.F. Amplifiers

In the original article reference was made to the use of the 6F6 receiving tube as an r.f. amplifier to raise the power of the exciter. Some readers may wonder how the tubes can be driven satisfactorily when the output of the 6L7 mixer tubes of the exciter is under one watt. The explanation of this is that the 6F6 pentodes are operated as class A r.f. amplifiers (that is, without grid current). Their grids accordingly take very little r.f. power from the 6L7 tubes. If the exciter is used to drive a transmitter which uses an output stage working at 1000 volts or more, it is possible to use the 6F6 stage without adding any tuned circuits. This is done as in figure 2 by tapping the grids of the 6F6 tubes to an untuned coil coupled to the output coil of the 6L7 tubes, and working the plates of the 6F6 tubes into resistance loads. The plates of the 6F6 tubes are then coupled to the next-stage grids through condensers. The 1000 volt supply is mentioned because resistance coupling is not very effective unless the resistance is high. A high resistance of course produces a large d.c. voltage drop, so that the original plate-supply voltage must be high. *It is important not to drive the 6F6 tubes into the grid-current region* in such a stage, as this will produce undesired harmonics and other bad effects, including short tube life. About 10 watts output is right.

Larger r.f. output can be secured from the 6F6 pair, provided one is willing to use another tuned circuit. The circuit then becomes that shown in figure 3. This permits the tubes to be driven into the semi-class-B or "A-B" region without getting into trouble, and an r.f. output of 20 watts is *easily* obtained with either the triode or the pentode connection. This will drive an 838 or similar tube to better than 100 watts carrier output for plate-modulated phone, and to several times that much for c.w. where one does not have to provide for upswings.

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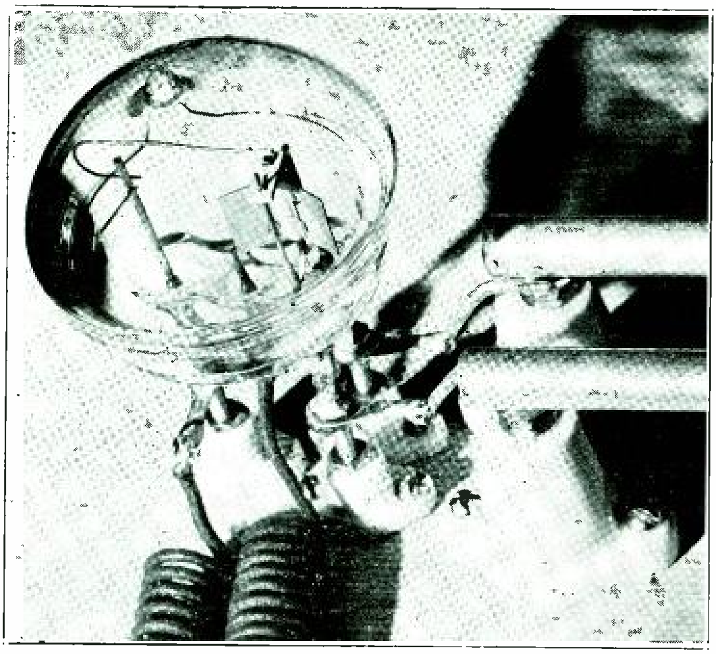
Instances continue of 5-meter stations rebroadcasting regular broadcast stations, allegedly for test purposes. Not only is this particular act an offense of the first order, but the transmission of any type of music from amateur stations for audio test purposes should be made with the greatest of judgment over short intervals. This is straight dope from the Commission.

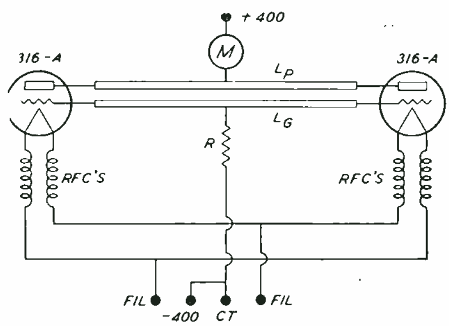
The WE-316-A U. H. F. Midget Power Triode



The 1¼ meter oscillator shown in the photo was built in the RADIO laboratory for the purpose of running tests and getting data on the performance of a new ultra-high-frequency vacuum tube which has been brought out by Western Electric.

The new tube, the 316A, is a filamentary air-cooled triode intended primarily as a power oscillator or amplifier at frequencies from 100 to 600 megacycles. With a plate voltage rating of 400 volts with plate modulation and 450 volts with unmodulated plate supply, and a maximum plate current rating of 80 ma., this tube will show outputs of substantial amounts of power in comparison with ultra-high-frequency tubes which have been previously available to the experimenter.

The push-pull linear oscillator shown uses quarter-inch aluminum rods spaced approximately an inch between centers. As no bases are provided for the tubes, connection by means of brass or copper sleeves equipped with set screws is recommended. In the experimental model, the connectors were made by removing the clips from an octal socket, cutting and bending them to fit, and soldering them to the ends of the connecting wires going to the tubes. Soldering to the tube leads should not be attempted as there is danger of cracking the seal. Due to the amplification factor of the tube being low (6.5) the grid clips need not be tapped down on the grid rod. The grids attach directly to the ends, simplifying construction.



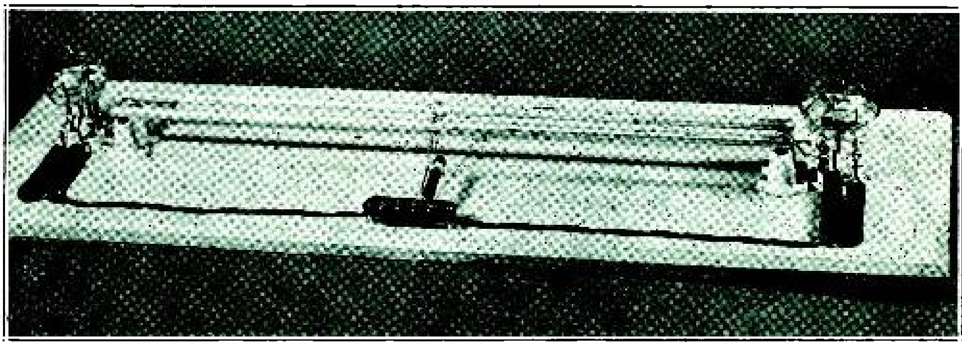
The 1¼ Meter Oscillator

L_P, L_G — Quarter inch aluminum tubes, 21¼ inches long.
R—5000 ohm, ten watt resistor.
RFC's—22 turns each, pushback hookup wire, ⅜ inch inside diameter.
M—0-200 ma. d.c.

In both modulated and unmodulated circuits, the grid bias or leak should be adjusted for optimum results. In the particular arrangement shown, a 5000 ohm leak proved a good value of bias resistor (10,000 ohms for 1 tube).

The tube is about two inches in width across the flat portion through which the tungsten rods project, and, to quote one amateur who saw it for the first time, "looks like a mud turtle."

Despite the extremely small size of the plate (about the size of a 99, with small cooling vanes attached), the plate dissipation rating is 30 watts, and even with the small spacing of



1¼ Meter Linear Oscillator Using a Pair of 316-A's in Push Pull

the elements (necessary to cut down time of electron flight) the interelectrode capacitances are very low.

The following table indicates the nominal output obtainable from single 316A tube as an unmodulated oscillator with an input of 400 volts and 0.080 amperes d.c.

Frequency, mc.	*Power output, watts*
300	8.5
400	8.0
500	6.5
600	4.0
750	Limit of oscillation

BOOK REVIEW

New Antenna Handbook

THE "RADIO" ANTENNA HANDBOOK by the staff of RADIO. 80 pages, profusely illustrated with tables, charts, and diagrams. Published by Radio, Ltd., 7460 Beverly Blvd., Los Angeles, Calif. 50c in U.S.A. and Canada, 60c elsewhere.

This new and very practical handbook on the principles and practice of antennas and antenna arrays covers in considerable detail the whole field of antennas suitable for amateur and experimental high frequency use.

The first portion deals briefly with antenna and wave propagation theory, skip distance effects, fading, angle of radiation, radiation resistance, etc.

The next chapter deals with directly excited or end-fed antennas. Many different types are shown. Resonant and non-resonant transmission lines are covered in detail including data on the "Zepp." antenna systems. Charts for two wire and concentric lines are presented.

A complete section deals with methods of coupling a line to the output stage of a transmitter. Practically every known type is shown.

Coupling between a line and the antenna proper also comes in for considerable discussion. The linear matching section ("Q" section) and stub matching is discussed. The various matched impedance antennas including the "J", "T", "Y", single wire feed, capacitively loaded "T", Johnson "Q", and Collins Multiband are shown and discussed in detail. There are complete tables of wire length and feeder location for various frequencies in each band for every useful type of antenna.

A thorough discussion on harmonic operation of antennas brings out the point that a wire does *not* resonate at the integral harmonics of its fundamental frequency. This point has not been properly treated in most books on radio.

There is considerable data on directive arrays of many types and both long wire and stacked dipole arrays are discussed. The directional data covers diamonds, Vee beams, Bruce staggered quarter wave array, broadside arrays in phase, "end fire" arrays, out of phase, reflectors, directors, Chirex-Mesny "W" arrays, and others.

The latter part of the book covers "all wave" receiving antennas in detail. Data is shown for the first time on the special coupling circuits between antenna and line and between line and set for both the symmetrical and non-symmetrical types of receiving doublets. The new G.E. Vee doublet and the R.C.A. Spiderweb antennas are also treated.

Some information in this book so far as we know has not appeared elsewhere. Several new ideas for 20 and 75 meter phone on one matched impedance antenna are included. The new capacitively loaded antenna is shown which matches impedances without any matching networks or transformers.

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Grounding a transmitting antenna does not always ensure against the lightning hazard. W8GXC left his shack for a few minutes to get a drink and when he returned several hundred dollar's worth of equipment and half the shack had gone up in smoke. Lightning had paid him a short but destructive visit via the *grounded* transmitting antenna.

◆

W4DHZ and W6CUH recently ran some tests to determine the best height for a vertical, 20 meter, half-wave radiator. For best all around performance, the answer seemed to be to stick the bottom end a quarter-wave off the ground.

A Truly Portable Station

By O. P. Taylor*, W6BAX

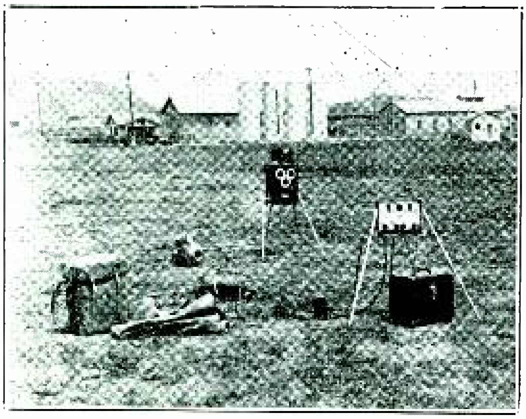


Figure 1
The Equipment Set Up and Ready to Go, 75 Watts into the Portable Antenna.

A completely a.c. operated portable transmitter and receiver using a gasoline-driven alternator is rather rare but deserves to become popular due to the simplicity and reliability of gasoline power. Batteries are remarkably efficient devices at the present time, but battery power is still very expensive compared to gasoline power, especially where continuous operation is desired. The portable rig shown herewith is designed for ham and expedition use and is husky enough to stand continuous use. Most portables are really better described as temporary transmitters which have been cut down and simplified to the point where they really are only make-shifts for the job they have to do.

The rig shown here is designed to stand up on long trips and has all the features that any ham would want in his rig at home. The transmitter and receiver are rather conventional. The transmitter uses a 6A6 oscillator-doubler driving an HK354 neutralized amplifier which is grid bias modulated with a good-quality three-stage audio channel. The carrier output is approximately 75 watts on 75 and 20 meters on phone and somewhat more when operating keyed for c.w. The receiver is a six tube superhet with one stage of r.f. gain, one stage of i.f. and one stage of audio. As this rig is used only on the ham bands, the coils were tapped to give bandspread over each band only.

Figure 1 shows the whole equipment set up in the open. The transmitter is shown in the background near the generator and the receiver and carrying cases are shown in the foreground. The mechanical construction of the transmitter and receiver is quite similar to that used in commercial gear, although the circuit details are "ham" practice throughout. It was found that the average haywire construction of amateur rigs is even more troublesome in portable gear than in permanent fixed equipment due to the mechanical shocks which portable equipment must undergo. Thus the mechanical work on this gear, while not beyond the capabilities of the average well-equipped shop, represents the biggest advantage of this rig over the average portable, and might be difficult to copy without shop equipment.

The Generator

As the gasoline generator (see figure 2) is the most interesting feature of the portable rig it will be described first.

It is a single cylinder, two cycle, valveless gasoline engine built in a unit with a rather

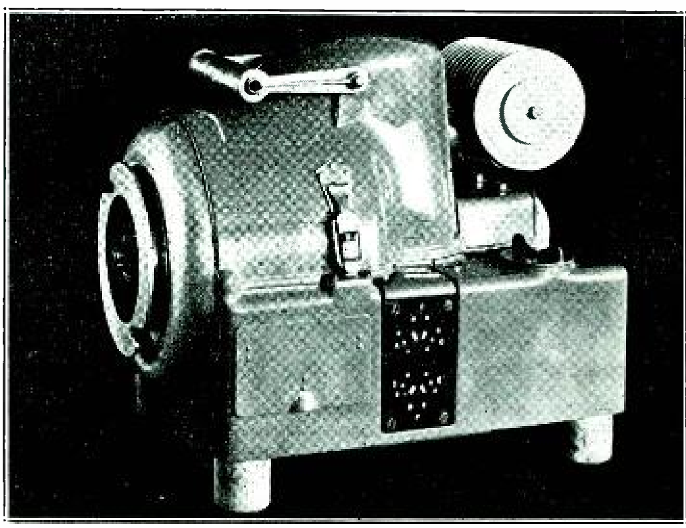


Figure 2
350 Watts, 37 Pounds. A Valveless Gas Engine Drives a Special, Light-weight, A.C. Generator.

*Engineering Dept., Heintz and Kaufman, Ltd.

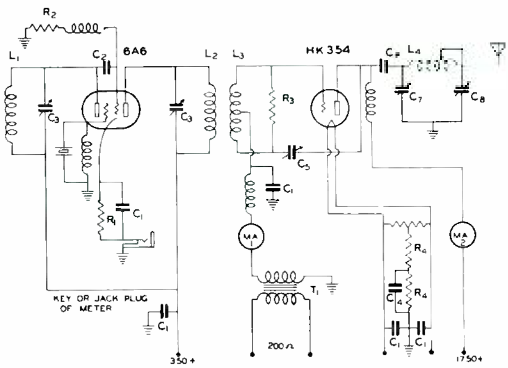


Figure 3
The HK354 Portable Phone

R_1—500 ohms
R_2—5,000 ohms
R_3—3,500 ohms, non-inductive
R_4—1,000 ohms
C_1—.01 µfd. mica
C_2—.0001 µfd. mica
C_3—.0001 µfd. variable
C_4—8 µfd. 400 volts
C_5—5 µµfd. variable
C_6—.002 µfd. mica
C_7—.0002 µfd. variable
C_8—.00035 µfd. variable

unusual type of a.c. generator. The generator uses a rotating permanent-magnet field and a stationary armature. The rotating generator field acts as the flywheel for the gas engine, which accounts for the low overall weight of the engine generator unit of only 37 pounds, ready to run.

As the field uses high grade permanent magnets of the new aluminum-nickel alloy type, there is no field winding, no brushes or slip rings, and no d.c. field excitation required. This simplifies things considerably and the elimination of brushes and slip rings is especially valuable when operating a sensitive receiver nearby. At the normal operating speed of the engine-generator, 3200 r.p.m., the frequency of the a.c. output is 320 cycles per second.

The 350 watts of generator output is divided between two separate outputs. The main output is a three-wire center-tapped 230 volt or 115 volt supply which is used for plate supply to both transmitter, receiver, and speech amplifier. The other supply is a three-wire 40 or 20 volt winding used for filament supply for the whole rig, including rectifiers. Two rectifier-filter assemblies are used, one of which supplies approximately 350 volts to the receiver, speech amplifier, and the 6A6 oscillator-doubler in the transmitter.

The other supply uses two mercury vapor half-wave rectifiers which closely resemble the type 866 except in physical size, which is somewhat smaller than the type 66. These rectifiers were made by Westinghouse and supply approximately 1750 volts d.c. for the HK354 used in the final amplifier. The d.c. plate current drawn by the final amplifier on phone is about 130 ma. As the load drawn by the transmitter is constant and independent of modulation, voltage regulation in the high voltage and filament power supplies is not a problem.

The Transmitter

Figure 4 shows an external view of the phone transmitter and its associated universal antenna coupling unit. The antenna coupler is a conventional π-type filter which allows practically any type of single-wire-fed or end-fed antenna to be used. This feature is rather important in a portable transmitter, as rarely can the ideal antenna be put up unless the reader is luckier than the writer.

Figure 5 shows an interior view of the transmitter with the 6A6 stage hidden behind the final amplifier plate tank condenser. Plug-in coils are not used, as the inductance of the tank coils is completely variable by rotating the coils against a movable shorting brush. The speech amplifier is contained in the receiver cabinet and uses three tubes. The speech amplifier is resistance coupled throughout, mainly to save space and not for reasons of high fidelity. The mike is a conventional diaphragm-type crystal mike. Figure 6 shows the circuit diagram of

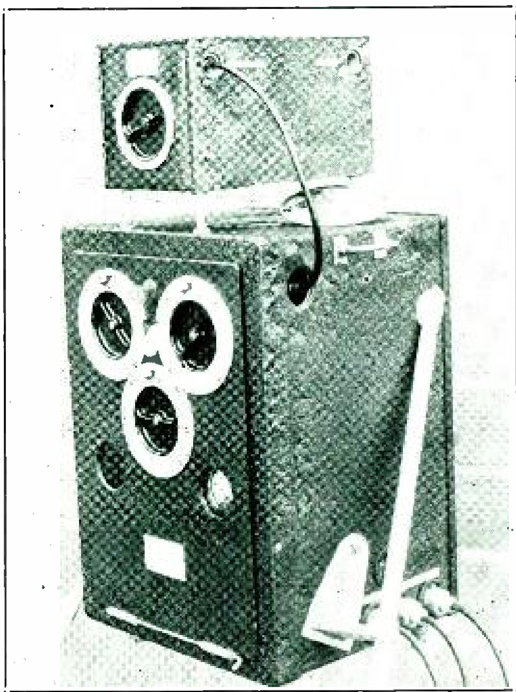


Figure 4
The Transmitter and Associated Antenna Coupler.

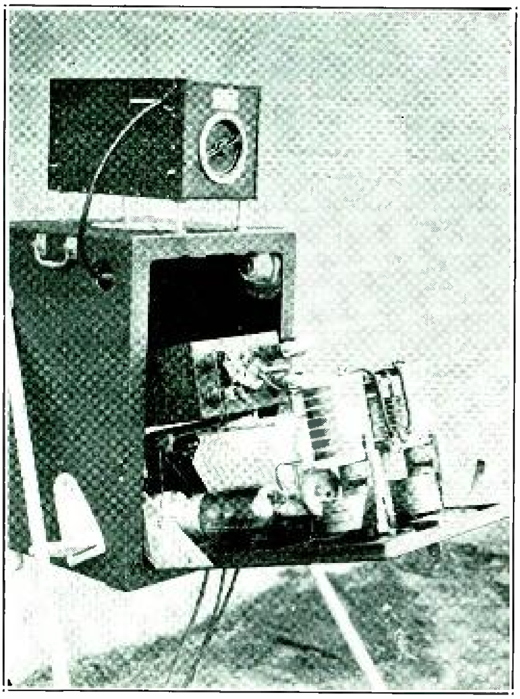


Figure 5
Showing Interior Construction of the Transmitter.

the transmitter and speech amplifier. While the lineup and layout are quite modern, there are no tricks in the circuit and standard, proven amateur practice is used throughout.

The Receiver

The receiver and transmitter control unit is shown in figure 7. The key will be seen on the folding front panel in a position convenient for the right hand. Placing the key in the left hand corner may seem a little unusual at first but a little thought will show that that is the only place for it in order to provide a support for the right elbow when sending.

A circuit diagram of the receiver is not shown as it is quite conventional. No crystal filter is used and the tube lineup is a 6K7 r.f. stage, 6L7 first detector, 6K7 high frequency oscillator, 6K7 460 kc. i.f. amplifier, 6Q7 second detector, 6K7 b.f.o., and 6F6 audio amplifier. The speech amplifier uses a 6F5, a 6C5 and a 6F6, which is coupled to the grid circuit of the HK354 through a 500 ohm line. The gain control for the speech amplifier is in the grid of the second stage.

The power transformers for the transmitter and receiver are almost microscopic compared with conventional 60 cycle transformers due to the high frequency output of the gas-driven generator. The 320 cycle output of the generator may be a disadvantage in that unless the receiver and the speech amplifier are rather carefully shielded and filtered the 320 cycle component in the heater circuit tends to ride through on top of the transmitted and received signals. However, a little shielded cable plus common sense in locating leads eliminates all this hum. The 320 cycle a.c. appears as 640

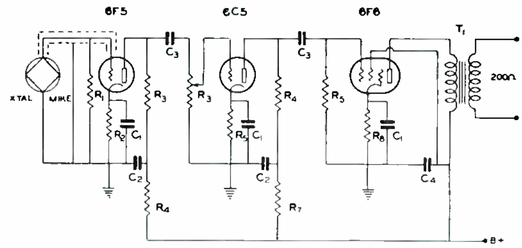


Figure 6
Speech System for the Grid Modulated Phone

R_1—5 megohms, 1 watt	C_1—10 µfds., 25 volt
R_2—1000 ohms, 1 watt	C_2—0.1 µfd., 400 volt
R_3—0.5 megohm, 1 w.	C_3—0.006 µfd., mica
R_4—50,000 ohms, 1 watt	C_4—4 µfds., 400 volts
R_5—0.1 megohm, 1 w.	T_1—8,000 ohm to 200 ohm pentode to line transformer
R_6—2500 ohms, 1 watt	
R_7—25,000 ohms, 1 w.	
R_8—500 ohms, 2 watts	

cycles out of the full-wave rectifiers and only about one-sixth as much hum filtering is necessary in the plate supplies as would be necessary with 60 cycle power. This also reduces the cost and weight of the whole rig.

For the ham who travels a lot or who is planning a trip into wild country this rig should be worth copying, as it is extremely efficient for its weight and also is foolproof. Incidentally, the whole gas engine and generator can be entirely taken down and reassembled with only three wrenches in a surprisingly short time.

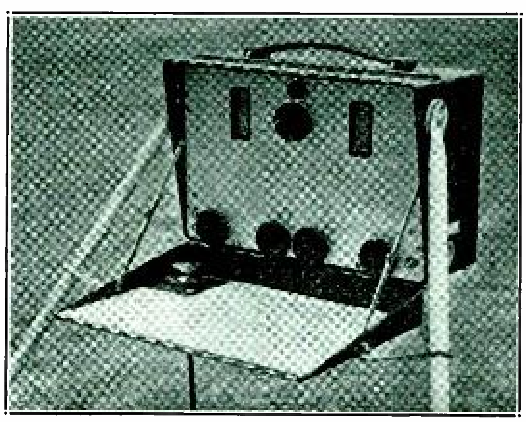
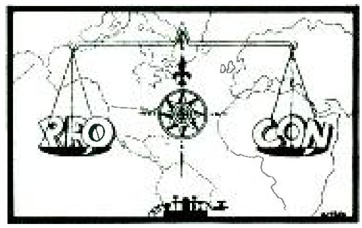


Figure 7
The Superheterodyne Receiver and Transmitter Control Unit.

THE OPEN FORUM



Sidney, Australia.

Sirs:

When one considers the truly International nature of amateur radio it is realized that in effect it is, and could be, the most powerful of weapons for world peace. Give the youth of today a free hand and drill them in amateur radio instead of colored shirts, and the world would be a far better place for our alleged "civilization". Invariably communications between amateurs are of a most friendly nature, even if one of those amateurs is a Soviet commissar and the other a scion of a wealthy family in an imperialist country.

Bad feeling between amateurs in distant countries is as yet unheard of, and whatever the political or racial differences of two communicants, the one would be mighty glad to shake hands with the other in person. When a case occurs of an expression of bad taste, particularly by employment of an amateur radio channel, it is time to turn on the spotlight, to ensure that there is no repetition.

I regret, therefore, to have to bring before the notice of all American amateurs a glaring case of breach of etiquette, and for which I consider the perpetrator should be censured. At present, remarkable trans-Pacific conditions are prevailing on 20 meters, and daily and nightly, Americans and Australians are indulging in excellent QSO's, both on phone and c.w. One American, a W4, left a very poor impression on Australians for the nature of his words, fortunately by c.w. but even so, quite bad enough. Here is the text of this W4's traffic with a VK2 in Sydney, copied verbatim.

"How long are you going to keep the Royal Family in style? When is England going to pay up what she owes to Uncle Sam? You will all soon be cannon fodder down there and Uncle Sam won't be dragged into any world conflict. Millions here will back up what I say. We have a 20 million dollar fence on our East Coast."

This citizen of the U.S.A. is certainly entitled to his own opinions, but he quite definitely has no right by the terms of his amateur license to perpetrate such an offence. The fact that it was done by the key does not excuse it, and one can only be relieved in view of the way American phones are being heard here just now, that it wasn't by speech.

During the Great Folly of 1914-18, I fought alongside Americans, and formed a very high opinion of those I knew. To one I owe my life for helping me out of a tight corner in Bolshevik Russia in 1919. It is a sad state of affairs when irresponsibles can make use of the greatest of scientific gifts, amateur radio, to express views which are best left to the alleged controllers of our respective national destinies.

It is out of the sphere of amateur radio, and as the Englishman says, "It simply isn't done". Every true amateur knows in his heart that if radio amateurs the world over were given the utmost facility for international exchange of ideas with wide frequency channels instead of a few skimpy kilocycles, the next generation would not know the meaning of war or its aftermath. But the armament dictators and others don't want it that way!

Amateur radio is something to be used as a great benefit to mankind, not something to be used as a means of abuse, as this particular W4 has done.

DON B. KNOCK,* VK2NO.
Radio Editor, *The Bulletin*.

◆

Minneapolis, Minn.

Sirs:

Well, the Board meeting was disappointing this year.

As you know by now, the Investigating Committee failed to conduct a real investigation. It failed to call Foster before it and carefully avoided talking with any ex-employees. It exhibited strong bias toward the existing regime, according to the Minority Report.

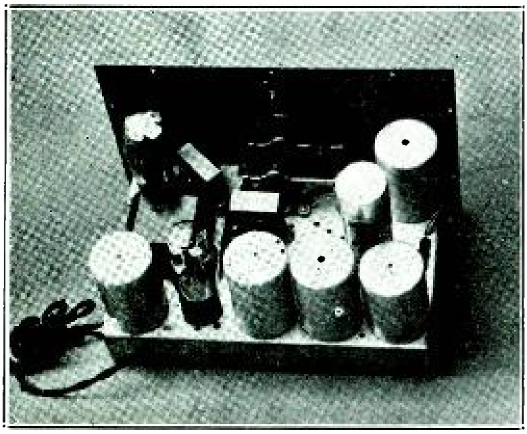
Similarly the Cairo Committee didn't really do much. It failed to make any very real effort to locate a competent man to represent us at Cairo and to have him available at the proper time. Time was short [when the board met] and a brief had to be in by June first (in the U.S.A. preparations for Cairo), and argued June 15th. So the Board told Warner and

[*Continued on Page 83*]

*Vice President, N.S.W. Division, Wireless Institute of Australia.

An All-Wave Line-Up Oscillator

By Edward Woodward*, W6DMW



Back View with Cover Removed

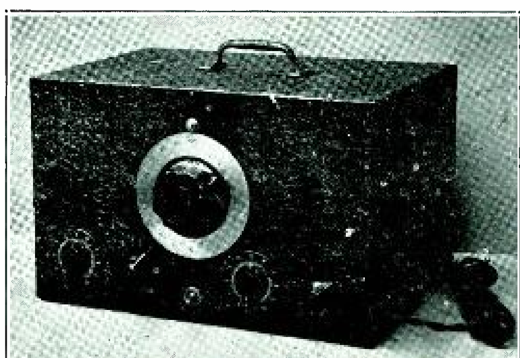
Parts List:

3—Sockets
1—2-pole, 4-throw short wave switch
1—6A6 tube
1—6A7 tube
1—80 tube
1—Audio oscillator transformer
1—Audio oscillator tap switch, 2-pole, 4-throw
1—4-tube power transformer
2—30-henry, 40-ma. chokes
1—2000-ohm, 5-watt resistance
1—6000-ohm, 5-watt resistance
1—50-ohm, 5-watt resistance
1—1-megohm, 1/2-watt resistance
1—0.25-megohm, 1/2-watt resistance
3—0.1-megohm, 1/2-watt resistance
2—50,000-megohm, 1/2-watt resistance
1—40,000-megohm, 1-watt resistance
1—10,000-megohm, 1/2 watt resistance
2—10,000-megohm potentiometers
2—4 μfd. condensers
6—.25 μfd. condensers
3—.05 μfd. condensers
2—.02 μfd. condensers
1—.006 μfd. mica
1—.002 μfd. mica
1—.00025 μfd. mica
1—.0001 μfd. condenser, mica
1—R.f. choke
1—Chassis with shield box
1—Tube shield
1—Antenna and ground post

A "line-up" oscillator should be capable of producing an r.f. signal with the modulation percentage continuously variable from 0 to 100%. It should be possible to reduce the input to the set under test to practically zero without the necessity for expensive shielding. The audio- and radio-frequency modulation and output controls should be absolutely independent of each other with no interaction. With these details in mind, a signal generator was designed and constructed, using one 6A6 tube as an audio oscillator and coupling tube and one 6A7 as the grid-modulated radio frequency oscillator.

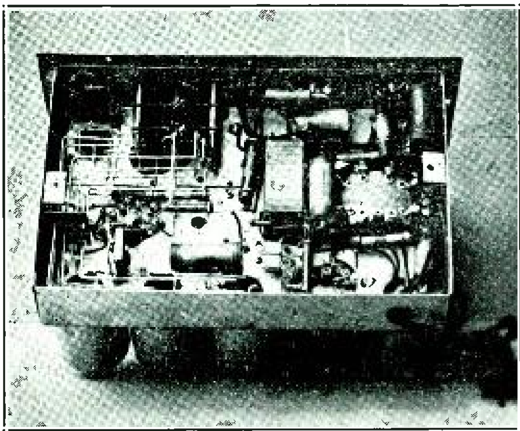
The transformer for the audio oscillator was made by hand. It consists of three windings: a 500-turn grid coil on the bottom, then a 500-turn plate winding, and finally a 10-turn secondary to drive the audio coupling tube. Plain, enameled no. 36 wire was used and the coils were random wound on a form 3/4 x 3/4 x 1" long. Three layers of waxed paper were put between the coils. The completed coil was held together with adhesive tape and it was then dipped in melted beeswax and rosin. The core was from an old audio transformer and was stacked with ten one-thousandth's of an inch gap. The audio oscillator oscillates at approximately 3000, 1500, 1000, and 500 cycles. A midget center-tapped output transformer may be used instead of the above transformer by parallel-feeding the oscillator plate. The midget transformer will oscillate at approximately 400 cycles.

Fixed bias was used on the second section of the 6A6 and on the second control grid of



Front View of the Self-Contained Line-Up Oscillator

*1814 Menlo Ave., Los Angeles, Calif.



Sub-chassis View of the Oscillator

the 6A7 in order to make the oscillator more stable. More voltage than is needed is developed in the plate circuit of the audio coupling tube; therefore a 0.1 megohm resistor was placed in series with the modulation control. This control has to have the zero end grounded; therefore, it is necessary to isolate it from the plate and grid circuits. If the zero end is grounded through a condenser it will be impossible to obtain zero modulation.

A 465 kc. i.f. transformer with 150 turns removed from each coil forms the long-wave inductance, and the other coils are wound on 1" bakelite tubing. The grid and plate windings have the same number of turns and a small space is left between the inside turn of each winding for insulation. It is also necessary to ground one end of the output control; therefore the 6A7 plate is parallel-fed.

The power transformer is for an ordinary four-tube set; the chassis, 7" x 11", is for a seven-tube superheterodyne. The box is 18-gauge sheet steel. You will notice the variable condenser has to be insulated from ground. The only other critical things necessary are to wire the r.f. oscillating circuit with bus bar, and to run a ground lead through to everything rather than using the chassis, in order to prevent circulating currents through the chassis (which would reduce the shielding effect).

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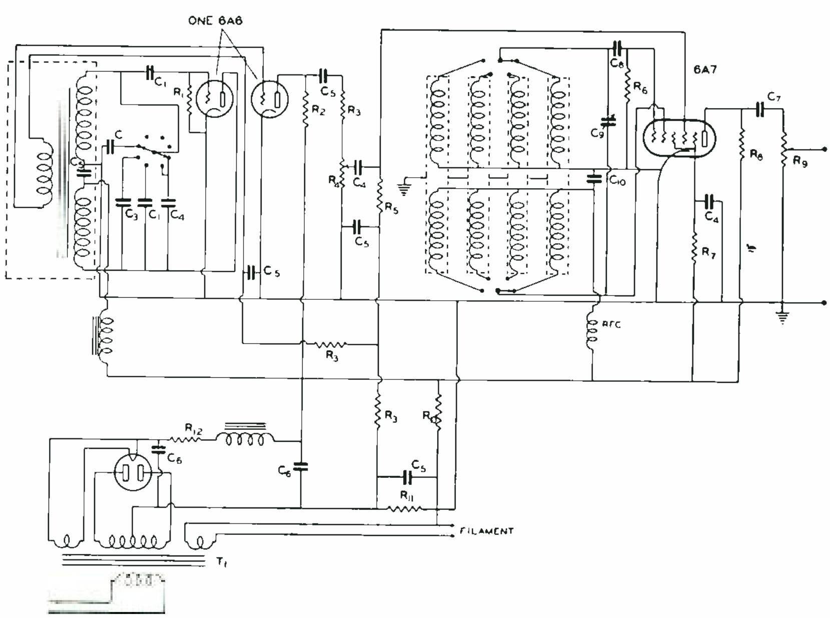
Editor in Chief, Business Manager, General Manager, Employment Manager, Secretary of the A.R.R.L., Secretary to the Board, Boss of the Field Contacts, Washington Representative, Boss of the Treasury, Boss of the Payroll, Surplus Spender, Boss of the Directors, Boss of the Amateurs, and the Dictator are some of the titles ascribed to A.R.R.L.'s K. B. Warner by Director Roberts of the Central Division in a recent mimeographed release. The bulletin is headed: Warner the Acquisitator, what a man! What a Job Getter! What a Boss! Salute the Governor, the Dictator, the Ruler. The list of titles is succeeded by the statement, "Everyone in West Hartford is dependent upon Warner. He can take away any of their jobs if they don't cater to him."

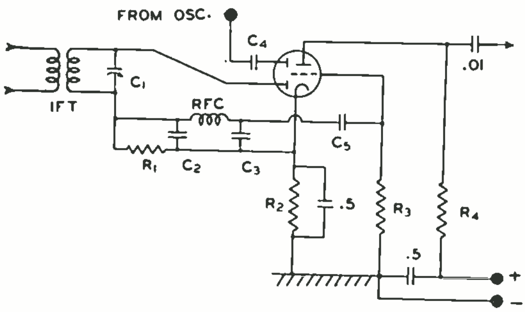
Wiring Diagram

C_1—0.01 µfd. fixed condenser
C_2—0.25 µfd., paper
C_3—0.002 µfd., mica
C_4—0.05 µfd., paper
C_5—0.25 µfd., paper
C_6—4 µfd., 450 volt
C_7—0.0001 µfd., mica
C_8—0.00025 µfd., mica
C_9—0.00035 µfd., variable
C_{10}—0.006 µfd., fixed mica
R_1—10,000 ohm, 1 watt
R_2—40,000 ohm, 1 watt
R_3—0.1 megohm, ½ w.
R_4—10,000 ohm potentiometer
R_5—1 megohm, ½ watt
R_6—50,000 ohm, ½ w.
R_7—0.25 megohm, ½ watt
R_8—50,000 ohm, ½ w.
R_9—10,000 ohm potentiometer
R_{10}—6000 ohm, 5 watt
R_{11}—50 ohm, 5 watt
R_{12}—2000 ohm, 5 watt



Improving the Superhet

By ROBERT S. KRUSE



The Circuit Under Discussion

In most of the older superheterodynes, and some recent ones, the so-called "second" detector is a triode or pentode which is expected to detect (rectify) and also to amplify. Triodes do not do both jobs in the best possible way at the same time. That is to say, a triode can be made into a good detector, or else it can be made into a good r.f. or a.f. amplifier, but it isn't a good amplifier and a good rectifier at the same instant; the conditions are different.

In many receivers an improvement is possible by divorcing the jobs of rectification and detection. One way of doing this requires no extra sockets and increases the receiver sensitivity, while materially reducing the possibility of carrier-blocking or choking. The drawback is that the selectivity falls off slightly as the last i.f. transformer secondary looks into a load of lower impedance and usually shows rather flat tuning as a result. If you lack selectivity, leave the change alone; if you have ample selectivity but want the other improvements mentioned the change is worth trying. It is quite simple.

The idea is simply to hand the detection job (rectification) over to a pure detector (a diode rectifier) and then to amplify the output with a pure triode (or pentode) amplifier, as is done in many recent receivers. In making this change on an assortment of amateur receivers the owners have mostly felt that it was well worth while. None have changed back.

As was promised, no additional sockets are needed, since we have a good variety of tubes which contain both a diode and a triode or pentode. Of these the 55, 6R7, and 85 contain a double diode and a triode, while the 75, 6Q7, and 2A6 are the same except that the triode has a high μ. We have found the 75 and 2A6 rather "fussy" and prefer the 55 or 85. Equally good are the 2B7 and 6B7, which also contain a double diode, but in place of the triode section have a pentode section, which gives higher amplification. These tubes will be touched on later in the story. The 1A6 tube, though also a diode-triode combination, is less suited to the job here described.

The First Circuit

Referring to the diagram we see how a 55 or 85 tube can be used, with one diode plate for detection, another to feed in the beatnote oscillator, and with the triode portion acting as a full-efficiency audio amplifier unhampered by any other jobs. If the plate voltage is between 180 and 250 volts the constants can be as follows.

The last intermediate frequency transformer is connected as shown and C_1 re-trimmed. The resistor R_1 is not critical and any value between ½ and 1 megohm seems to serve well. Across this resistor we find several sorts of voltages. The d.c. voltage is not used in this circuit and is kept from reaching the grid by the condenser C_5, which should have a capacity between 0.01 microfarad and 1/10 "mike". The residual i.f. voltage is filtered out by RFC and C_2 and C_3. The filter condensers are about .0001 µfd. each and the choke must have a quite large inductance. Even better, replace it by a plain resistor of 100,000 ohms. This resistor (or choke) and the condenser C_5 must pass the audio voltage (also appearing across R_1) to the triode grid. The grid leak R_3 may be ½ megohm, but if blocking is encountered it may be reduced to as little as 100,000 ohms. The bias for the triode section is supplied by the 2500 ohm cathode resistor R_2 and the audio output is coupled to the next tube by means of the 0.01 µfd. output condenser and the 100,000 ohm plate resistor R_4. The triode will work nicely into a headset which is then connected from chassis to the arrow-pointed terminal at the right of the 0.01 µfd. condenser. This leaves only the beatnote oscillator to attend to. It is brought into the picture by connecting some portion of its circuit, to the "From Osc" terminal. The right place on the oscillator circuit is to be found by trial on both strong and weak signals, a compromise generally being necessary. The coupling condenser C_4 is very small; it may even be the end of a piece of insulated wire, merely wound 3 to 5 turns around some portion of the oscillator circuit. No d.c. voltage from the oscillator should get to this diode plate as this interferes with the action of the other diode plate.

The Second Circuit

The circuit just described operates the triode section self-biased, which is a useful arrangement for phone reception, and also works well for c.w.

It is also possible to operate the triode with a bias taken from the resistor R_1 (that is, we can use the rectified i.f. as our bias). This bias does not exist until a signal is received; therefore the triode has no initial bias and the plate-resistor is necessary to limit the current. Also, because the bias keeps disappearing, this circuit tends to "plop" when receiving c.w. signals. This circuit can be gotten from the one in the diagram by the following changes: Remove the grid leak, short-circuit C_5, short-circuit R_2. Note that this transfers the d.c. grid return to the left end of R_1 and eliminates the cathode resistor. Thus the bias voltage, that is, the d.c. voltage between grid and cathode, is simply the d.c. voltage across R_1, which is of course produced by the output of the diode rectifier. This circuit is therefore spoken of as "diode biased". It is simpler than the one in the diagram, but for c.w. is not so good.

The Third Circuit

If somewhat more amplification is wanted, the circuit of the diagram may be used with one easy change, which is to use a diode-pentode instead of a diode-triode. Such tubes are the 2B7 and 6B7 already mentioned. No important circuit change is needed. The suppressor-grids of the 2B7 and 6B7 tubes are connected to their cathode inside the tubes and hence do not even appear at the socket. The screen needs only to be bypassed to chassis and supplied with about 100 volts from the general power supply of the set, either by tapping the main voltage divider or by adding another small one of high resistance. Sometimes one can simply connect the screen to other screens in the set through a 2000 ohm resistor. The other constants are as already mentioned, including the cathode resistor.

If the receiver originally used a 57 pentode "second" detector, the 2B7 fits in nicely and of course the 6B7 will replace a 6C6, both changes improving gain, decreasing overloading, and slightly spoiling the selectivity, though this effect is small and some set-owners deny its appearance.

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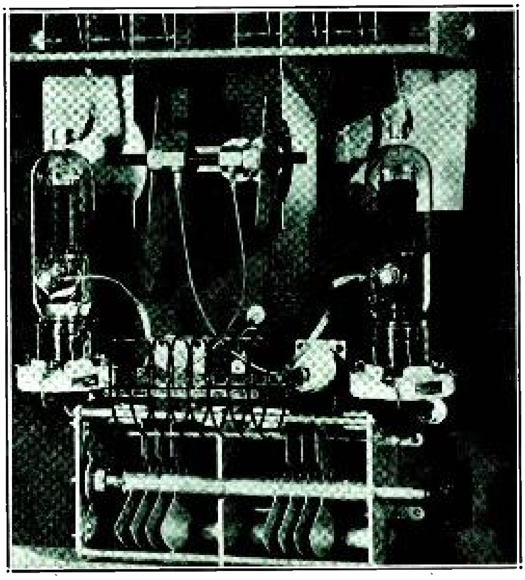
NOVEL NEUTRALIZING SCHEME



Above is shown a new wrinkle in neutralizing condensers. The leads are the shortest we have seen; in fact, there are none! The stator plates of the neutralizing condensers are extensions of two stator plates, one from each section, of the split-stator tuning condenser. The ganged, rotor assembly of the neutralizing condensers is mounted on ceramic stand-off insulators. The tubes happen to be a pair of the new ZT4B high-frequency "100 watters", which were installed in the amplifier in a test to see how much output could be obtained at 1600 volts. The tubes showed up very well, giving large output without the necessity for resorting to extremely high plate voltage.

◆

To save the cutting edge of drills, circle cutters, etc., while working on metal, use the following solution: Thoroughly dissolve two tablespoonfuls of soap powder (or soap shavings) in about one pint of hot water. Apply this liberally to tool with a small brush. The solution may be sealed in a small glass jar for future use.—W6DOB.

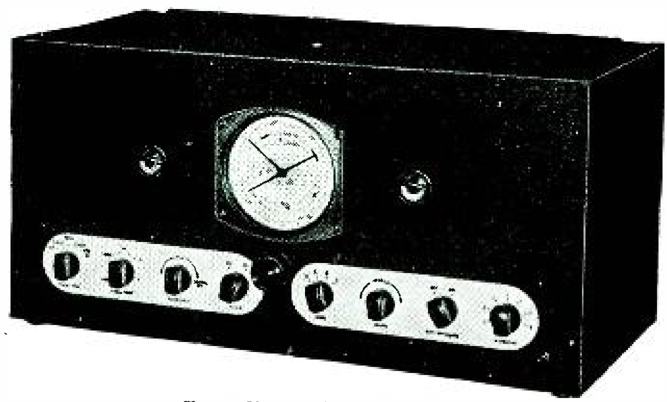
◆

Among the newest comers to the ten-cent store tool counters is a micrometer; and while the instrument certainly would not be recommended for painstaking work like crystal grinding, still it is not too bad.

The ACR-175 Superheterodyne

[This article is one of a series based on tests of current amateur receivers in the RADIO laboratories. The ACR-175 test was somewhat delayed due to the fact that the first sample sent for test was damaged in transit.]

Fundamentally, the ACR-175 is not an amateur-band receiver but an all-wave receiver, covering the whole range from 0.5 megacycles to 60 megacycles in four tuning ranges. Such receivers are more useful than amateur-band receivers, provided they do an equally good job on the amateur bands.



Front View of the Receiver

The usual objection to all-wave receivers is that amateur bands are badly cramped and hence that both tuning and "logging" are difficult. This has been circumvented in the ACR-175 in an ingenious manner.

4 Ranges, 6 Scales

The unusual tuning scheme is not stressed sufficiently in the instruction manual of the ACR-175 and some owners are quite unaware of it, though this is the outstanding novelty and one of the best points of this receiver. Therefore we shall detail it here.

As there are 4 tuning ranges, one expects the usual 4 scales, cramped to about the usual degree. This is all true, but these scales are not used for anything but rough reference. The actual "logging" depends on two additional scales which have no frequency figures at all but relate purely to the positions of the two pointers which easily give readings to three decimal places on any signal which is heard. This is accomplished as follows: The black pointer moves at the same speed as the tuning condenser and traverses an inner scale with 9 divisions. To this pointer is geared a second pointer of a bright red color. The gearing has the slack removed by a split gear with a spring takeup, so that the red pointer travels quite accurately 18 times as fast as the black one. While the black pointer is covering its semi-circular scale the red pointer is making a full circle, with its tip traveling on a special outer scale divided into 100 parts.

Now we come to the point:

Any station having been tuned in we can glance at these two pointers and the position of the range-switch, and then record as follows:

C754.3	W6CXW
C761.0	VE5GI
C771	W6KR
B635.3	W3FBF
B632	W8FT
B628	W8DPI

Any of these stations can then be recovered within an audible beatnote by resetting to the recorded figure.

The "red pointer" scale divisions for the various bands are about:

Band	160	80	40	20	10	5
Scale division	170	65	45	27	27	30

There are two knobs with which to operate these pointers and the associated tuning condenser. One of the knobs turns 20 times for the full scale, the other turns 100 times. Since all the dial ideas in the world are useless unless the visibility is good and the mechanical action smooth, it is pleasant to record that the ACR-175 dial meets both requirements.

The Circuit

The circuit is normal, except that the 1-stage pre-selector is cut out of circuit in the D band covering the 5 to 19.6 meter or 15.5 to 60 megacycle range. The pre-selector tube is a 6K7, as are the two i.f. tubes, which are coupled by means of litz-wound transformers tuned by screw-in r.f. iron cores instead of air or mica trimmers. A crystal filter is provided for those

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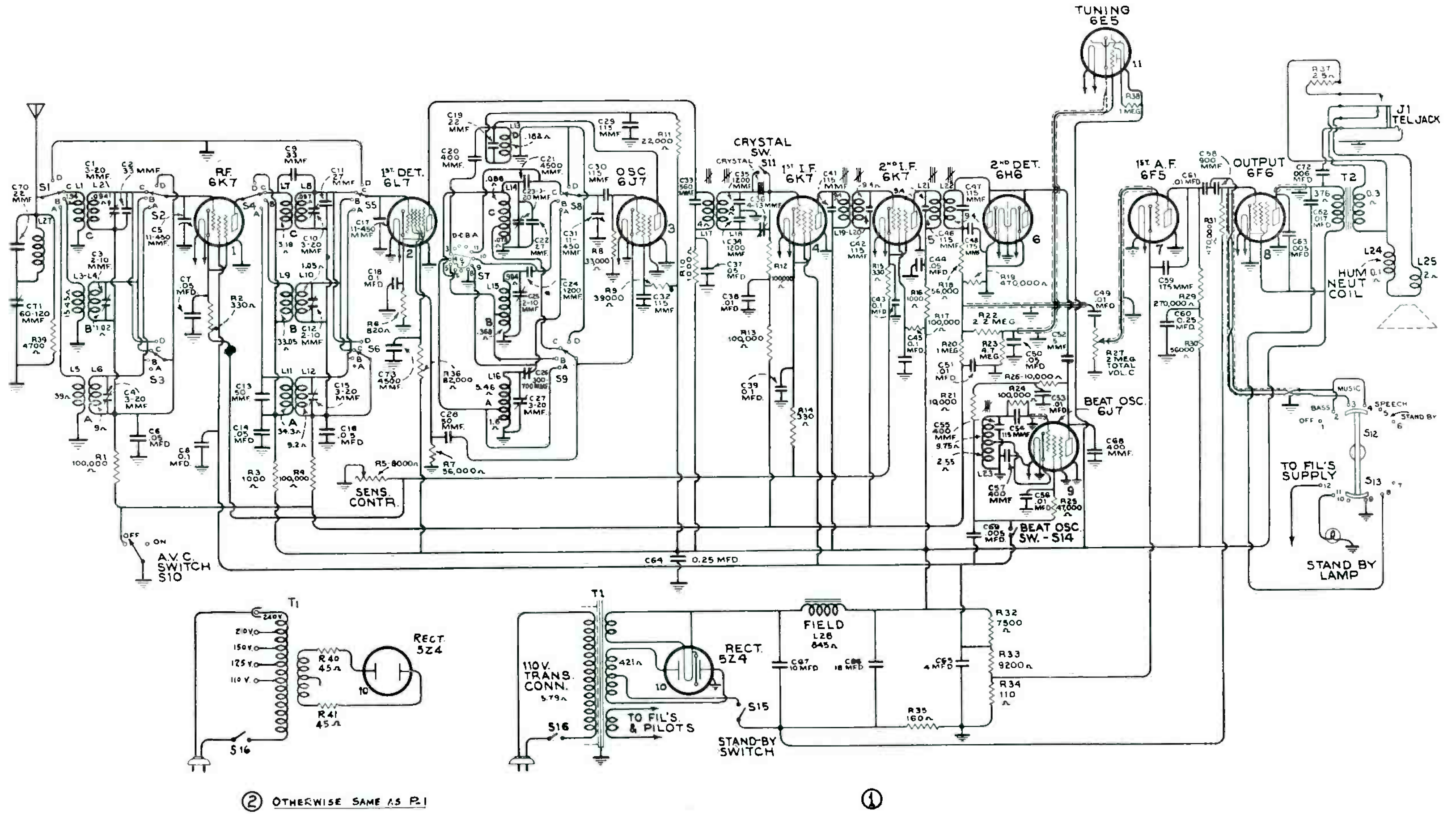
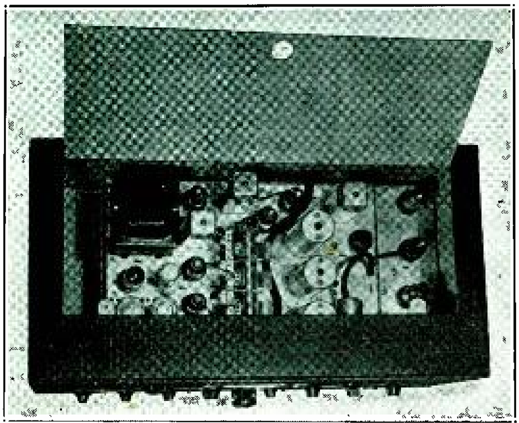


② OTHERWISE SAME AS P.1

①

ACR-175 Schematic Wiring Diagram

Courtesy R.C.A. Mfg. Co.



Looking Down into the "Works".

that wish to use it. The variable condenser for balancing the crystal bridge carries a switch which short-circuits the crystal at one end of the range.

This arrangement was found to be advantageous in operation. The mixer, translator, or first detector, is a 6L7, whose advantages have been discussed in RADIO in detail. In this case the oscillator is not the usual 6C5 triode but a 6J7 pentode operated as a species of Dow oscillator. The other, or beatnote, oscillator works in the same sort of circuit at a frequency near the i.f. as usual, but adjustable from the panel by another r.f. iron-core screwing into the litz-wound coil. The output of this oscillator, and also of the 2d i.f. amplifier, is fed to a 6H6 used as a single diode detector-mixer. The 6H6 output goes to a perfectly normal audio system consisting of a 6F5 triode with resistance coupling to a 6F6 pentode, which feeds the separately-mounted loudspeaker through an output transformer, but if a headset is plugged into the jack at the left of the set the loudspeaker is replaced by a resistor and the headset is fed through a small condenser so that we have a "cold" headset.

Special Features

The automatic volume control is supplied as usual by feeding the d.c. output of the 6H6 through a resistor, the voltage drop across which is filtered and sent back to act as grid bias for the r.f., i.f., and first detector tubes, the usual a.v.c. shorting switch being provided. At this point another feature enters. The tubes mentioned, of course, have another source of bias, through cathode resistance. This cathode bias is controllable, for the r.f. and i.f. tubes, by a hand volume control which has a scale calibrated in (approximate) microvolts, the incoming signal voltage being read when this control is turned so that the 6E5 cathode-ray tuning-indicator (which the advertising department calls a "magic eye") just begins to indicate (which is to say that the a.v.c. voltage has risen to a certain level). Naturally this input-voltage scale does not read correctly in the D range where the pre-amplifier has been cut out, and must there be multiplied by about 10. This is a very quick way of measuring approximate input from a received signal and seems like a nice feature.

The beatnote oscillator coil is doubly shielded to prevent harmonic beatnotes, which effect seems to be satisfactorily removed.

There is no monitoring provision, but the 3-point tone-control has one additional position in which the plate and screen voltages are cut off while leaving the filaments hot.

A wave-trap, adjustable by the owner, is provided to eliminate commercial interference near the intermediate frequency. It did not quite accomplish this with the tremendous signal WSE puts into the eastern laboratory of RADIO, but neither has any other one-circuit wave trap accomplished that feat for sets subject to such interference. 15 miles inshore this would be no bother at all.

General Performance

The general performance of the receiver was very good. Having become interested in the stationary-scale dial with the special features mentioned before, we'd like to see it re-done some day with the A, B, C, and D scales printed faintly, to make the user aware of their secondary importance, with the black ink of the two special "logging" scales emphasizing this very fine feature, and making it easy to read those scales.

The heating drift of the oscillators is moderate and seems to be consistent. The hum-level was very low in the samples tested. The mechanical operation of the controls is good, and that of the dial notably so.

The instruction manual recommends the use of the various R.C.A. double-doublet and triple-doublet antennas. At this laboratory, where "man-made noise" is not a serious problem, equally satisfactory reception was obtained with a simple Marconi antenna. This is about the normal result of such comparisons and seems to indicate that the ACR-175 has normal adaptability to the standard sorts of antennas. However, it is only fair to say that the WSE near-

[*Continued on Page 93*]

The Television Situation

The amateur 5 meter band may be vitally affected by the placement of the ultra-high-frequency "standardized" television band. From present indications it looks as though there is a good chance of the band being located between 42 and 90 megacycles. Naturally, in this event a continuous band would be desirable. What about the amateurs' pet ultra-high-frequency band at 56-60?

Television is definitely coming closer, as evidenced by the recent F.C.C. hearing held in Washington, starting on June 16, to discuss frequency allocations and standard picture specifications. Naturally it is desirable to standardize the specifications of all broadcast pictures so that all receivers may utilize all programs available. However, it is difficult to lay down picture specifications without limiting future development somewhat. It is hoped that the F.C.C. will standardize the highest definition possible with present equipment and also provide a definite future time to review the standard specifications with an eye to revision if technical progress warrants a change in the standard picture specification.

The Radio Manufacturers' Association offered a tentative program of suggestion for the Communications Commission that may be interesting to our readers. Note that the suggestions are tentative and may be modified if later study of the problem makes modification desirable.

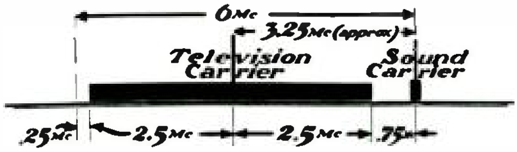
SUMMARY

R.M.A. TELEVISION COMMITTEE'S RECOMMENDED STANDARDS

Item	*R.M.A. Recommended Standard*
1. Frequency allocation — Lower limit	42 Mc.
Upper limit	90 Mc.
An experimental band starting at	120 Mc.
2. Channel Width	6 Mc.
3. Spacing between television sound carriers	3.25 Mc. (approx.)
4. Relation of sound carrier to television carrier	Sound carrier higher in frequency
5. Polarity of transmission	Negative
6. Number of lines	440-450
7. Frame frequency	30 per second
Field frequency	60 per second, interlaced
8. Aspect ratio	4:3
9. Percentage of television signal devoted to synchronizing signals	Not less than 20%
10. Synchronizing signal	No recommendation*

* "Serrated" vertical signal favored by R.C.A. "Narrow" vertical signal favored by Philco, Hazeltine, Farnsworth, General Electric Co.

There is one point which should interest amateurs generally. The R.M.A. suggests that the television bands should start at about 42 megacycles and should extend to about 90 megacycles. They also suggest that the television band should be continuous, if possible, which brings



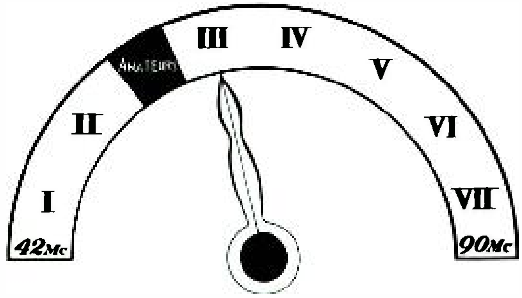
Typical Television Channel

up the matter of the 56 to 60 mc. amateur band.

While recognizing the desirability of making the television bands continuous and also the probable troubles from ham self-excited QRM on the television bands adjacent to the ham 5 meter band, nevertheless we of RADIO feel that the 5 meter band is too valuable to be given up to an entertainment service. We believe that some day almost every amateur will have a 5 meter duplex rig in his car and also that 5 meters will be used to control remote lower frequency receivers and transmitters. Therefore, the remarks of Mr. James M. Skinner, President of Philco and Chairman of the special committee on television of the R.M.A., will be of interest. The following is an excerpt from Mr. Skinner's report to the Federal Communications Commission.

". . . The most valuable part of the spectrum for television starts at 42 megacycles. At this frequency a given amount of broadcasting power provides the greatest signal intensity in the surrounding territory. The R.M.A. Television Committee report will request therefore a television band extending from 42 to 90 megacycles.

"From 56 to 60 megacycles, there is a band allocated to amateurs. R.M.A. recognizes the service the amateurs have contributed to radio development and their importance to the na-



Television Receiver Dial

tion in providing a reserve of trained radio operators in times of emergency. R.M.A. will therefore not request these frequencies for television unless it is found by the Commission that this band is not urgently needed by the amateurs, or is not especially well suited for amateur work. If so, another desirable television channel could be provided from 54 to 60 megacycles and a highly desirable continuous television band would result. . . ."

Mr. Skinner's remarks obviously are pertinent and he is quite right in suggesting that we have no right to the 5 meter band unless we can show that this band *is* urgently needed by the amateurs and also *is* better suited than any substitute band would be. Thus it is up to us to hurry up and put the band to all possible use and to clean up the unnecessarily broad signals common in this band.

◆

R.C.A. Develops New Broad-band Three Meter Circuit

R.C.A. has just placed in operation, on a more or less experimental basis, a rather unusual type of ultra-high-frequency radio circuit between New York and Philadelphia. The frequencies used are around one hundred megacycles or three meters. The sideband width is sufficient to handle two separate facsimile transmissions, two teletypewriter circuits, and a manual Morse circuit. A pilot tone is continuously sent out over the circuit to keep the intermediate repeater stations on the air. The band width of the sidebands can be materially expanded if and when desirable by changing the filters at the terminal and repeater points.

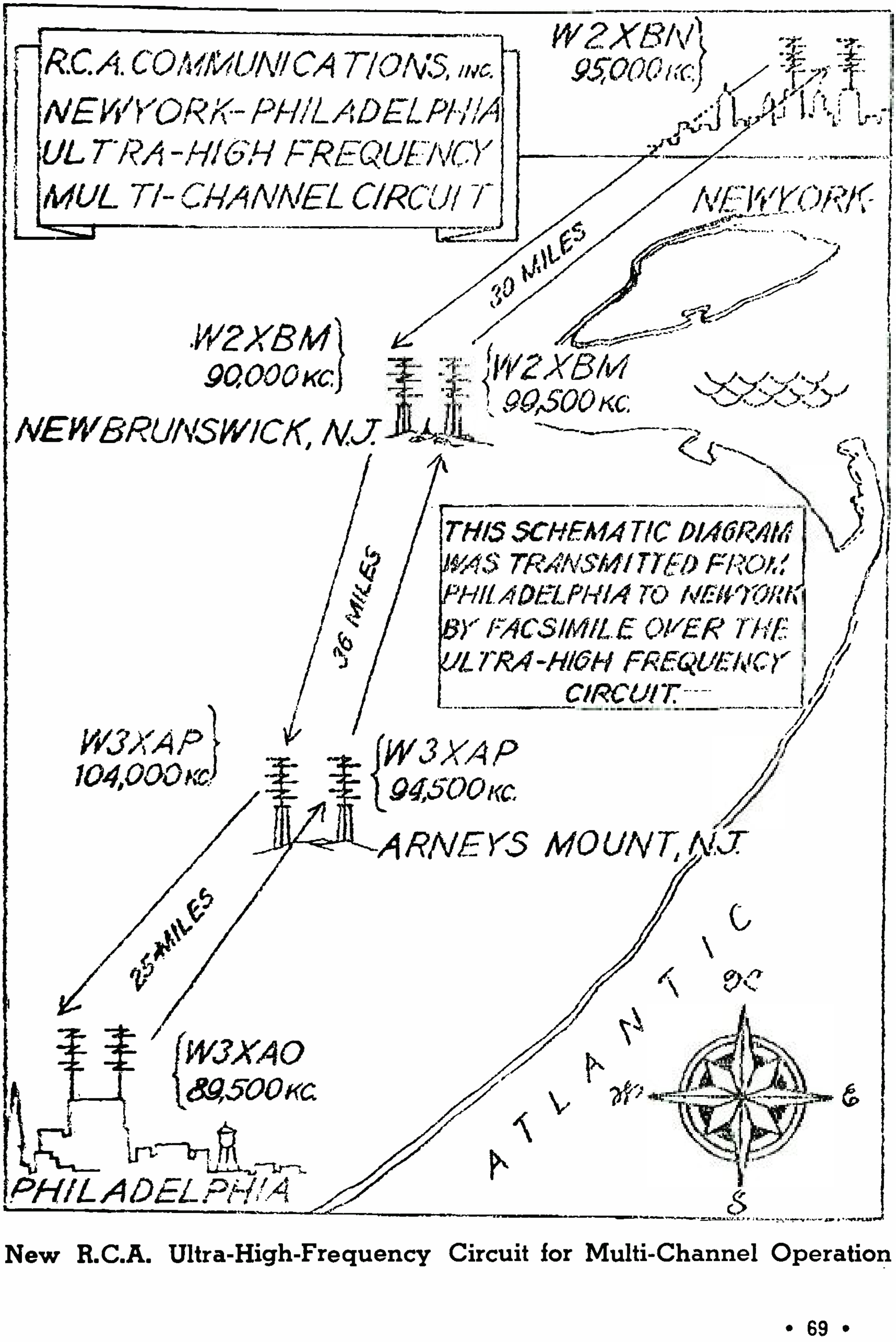
The terminal stations at New York and Philadelphia are located on high buildings to increase the "line of sight" transmission from each station. As the two terminals are way below each other's "line of sight" (horizon) two intermediate repeater stations are located at high points along the great circle course between the two terminals. These repeater points are New Brunswick and Arney's Mount, N.J. Each repeater station uses two associated transmitters and receivers, one for each direction of transmission. Unidirectional antennae are used to select and project each signal at the repeaters.

Each of the repeater stations employs two different transmitting wavelengths, or one for each direction. The two terminal stations each use one sending wave, making a total of six wavelengths, or frequencies, for the complete circuit. It was explained that, if it should be desired to extend the circuit beyond either terminal point, those six micro waves could be used over and over again in the same sequence. Thus, two waves of the same length would be generated at points about one hundred miles apart, and would not interfere with each other, because of the line-of-sight limitation to their range.

One of the most interesting engineering features of the new circuit is the method by which the unattended relay stations may be turned on or off from either one of the terminal stations by radio. The receivers at each of the four stations are always alive and ready to catch impulses from their assigned transmitters. When it is desired to make the circuit ready for traffic, New York or Philadelphia starts up its transmitter and sends a certain audio tone which the receiving circuits are pre-set to "recognize". At the unattended receiver at New Brunswick the tone passes through electrical filters which "accept" the tone and relays are actuated, turning on the power for the "south" transmitter, which, when in operation, passes the tone on by radio to the Arney's Mount station. There the operation is repeated.

When the tone signal reaches the Philadelphia station, the transmitter at that city is also automatically turned on, and the tone starts on its return journey, back to New York. Operators in New York know that when the tone comes back to them from the "north" transmitter at New Brunswick the entire circuit is in full operation and ready for traffic. The constant presence of the tone keeps the relays closed, and the circuit in an operating condition. When the tone is withdrawn from the circuit, relays click in the same succession over the round trip to Philadelphia, and one by one the transmitters are automatically turned off. Philadelphia has the same control over the circuit as New York.

[*Continued on Page 78*]



New R.C.A. Ultra-High-Frequency Circuit for Multi-Channel Operation

The Question Box

By JAYENAY

What is the most important meter in a transmitter? If you had to get along with one meter permanently wired in where would you put it?

I would use a grid milliammeter in the final amplifier. It might be a little hard to find resonance the first time on the plate tanks, but if mercury vapor rectifiers are used it is easy to tune each stage for minimum glow in the rectifiers. After all is said and done, when the final grid current is normal and nothing is hot and there is some spark on the feeders we know that the rig is working. There are lots of bugs that only show up in abnormal d.c. grid current on the final.

•

What is meant by "cut-off" and "twice cut-off" referring to negative grid bias?

At any value of plate voltage there is a grid voltage that will just bring the plate current to zero. That amount of negative grid voltage is called "cut-off bias." It can be determined approximately by dividing the plate voltage of a triode from plate to filament center-tap by the amplification factor or μ of the tube used. The μ is given in all tube tables. However, in tetrode and pentode tubes the term μ is meaningless and bears no relation to cut-off bias. Manufacturers of tetrodes and pentodes should give the control-grid-to-screen-grid μ in order to allow cut-off bias to be determined, as the screen voltage has much more effect on the cut-off point than has the plate voltage.

Twice cut-off bias is two times once cut-off; three times cut-off is cut-off times three, etc.

•

What is meant by plate efficiency?

Plate efficiency, sometimes called conversion efficiency, defines the efficiency with which a vacuum tube turns d.c. plate input into r.f. or audio power output. If it takes 100 watts of d.c. input to get 60 watts of r.f. power output, then the device is 60% efficient. The difference between plate power input and useful power output must be dissipated in the form of heat from the plate of the tube. Thus the higher the plate efficiency the higher the output and the lower the tube plate loss for a given plate input.

•

My final amplifier refuses to neutralize. What points should I check to correct this situation?

See that the grid and plate circuits are complete with r.f. bypasses to ground at the proper points. See that these r.f. bypasses are at *least* .001 μfds., and even .01 μfds. is advisable for 160 meter stages. See that the neutralizing condenser goes to the opposite end of the split tank circuit from the tube element connected to that tank circuit. See that the split tank circuit, across which the neutralizing voltage is obtained, is bypassed to ground *only* at its center. See that there is no excessive inductive coupling between grid and plate tank circuits. See that the plate and grid leads are as short as they can be made. See that the neutralizing condenser is neither too big nor too small for the grid-to-plate capacitance of the tube which it is neutralizing.

Why does the d.c. grid current on my final amplifier drop when I couple up the antenna?

Coupling up the antenna has the effect of raising the minimum plate voltage. Raising the minimum plate voltage causes the more positive plate to steal electrons away from the control grid. This is desirable as it reduces the grid driving power that must be supplied by the buffer in order to get a given grid voltage swing. However, if the drop in d.c. grid current is more than about 15 to 25% when the antenna is coupled up, it will usually be due to degenerative feedback in the stage where the r.f. voltage feedback from the plate circuit bucks out some of the grid excitation voltage. This is highly undesirable as the buffer output has to be increased to get the grid swing back up where it belongs. Perfect neutralization and good shielding and isolation will usually eliminate both regenerative and degenerative feedback. Sometimes degenerative feedback can be neutralized by intentionally adding a slight amount of regenerative feedback, but this expedient should only be used for c.w. and not for phone use, as the neutralization would be perfect only at one value of plate voltage. The grounded-grid or inverted ultraudion has so much inherent degeneration in it that sometimes it takes more grid driving power than there is output.

•

What is meant by the term "power gain"? Is there any yardstick of power gain that can be applied to transmitting tubes in order to judge their merit?

Power gain is the ratio of useful plate power output to grid driving power. In other words, a.c. voltage times the current in a resistive load on the plate circuit divided by a.c. grid voltage times a.c. grid current. All a.c. values should be taken as *effective* values. The measurement of power gain is not easy except by substitution of resistance for the grid circuit and antenna load.

Grid-to-plate transconductance is a fair yardstick but can be very inaccurate in a high efficiency amplifier as transconductance neglects d.c. grid current. A curve combining the grid-current characteristic and plate current characteristic in the positive grid region might provide the required yardstick of power gain. Just how the two characteristics would be combined I don't know as they are so dependent on each other. The higher the grid voltage, the lower the plate voltage. The lower the plate voltage, the higher the grid current, etc. The amplification factor alone means nothing as far as power gain is concerned. Minimum plate and grid resistance have much more effect on the power gain, and these factors are not constants but variables.

•

With all plate voltage removed from the transmitter I can hear a terrific r.a.c. carrier when I cross my crystal frequency with my receiver. How come?

You may *think* that you have removed all plate voltage, but as long as any filaments are lit you have plate voltage equal to at least half of the a.c. fila-

[*Continued on Next Text Page*]

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[Continued from Last Text Page]

ment voltage. If the oscillator and amplifier tank circuits are of really low-loss design, even such a small value of plate voltage will set up weak oscillation. Thus to eliminate this noise while receiving, put 4.5 to 22.5 volts of battery or pack bias on one or all of the transmitter stages until the hum disappears.

◆

HF-300 Amplifier

[Continued from Page 42]

ing class "B".

No antenna coupling system is shown, as every amateur has his own ideas on the subject, and no coupling system would work satisfactorily in all installations and under all conditions anyhow. At the writer's station, the commonly-used system is to clip the untuned line directly to the tank coil through a couple of blocking condensers, the latter being merely a protective measure to keep the high voltage d.c. off the antenna, though I suppose the r.f. itself would be just about as damaging to one's carcass.

For the benefit of those not familiar with the tubes and to facilitate adjustment of the transmitter, the specifications and operating constants of the HF-200 and HF-300 are given below:

Ratings and Data

	HF300	HF-200
Filament:		
Voltage	11.5 volts	10.5
Current	4 amps.	3.4
Geometric characteristics:		
Amplification constant	23	18
Inter-electrode capacities:		
Grid to plate	6.5 mmf.	6.0
Grid to filament	6.0 mmf.	5.2
Plate to filament	1.4 mmf.	1.2
Mutual conductance 5600 micromhos at plate current of 150 ma.		
Maximum operating ratings: when used as class C oscillator or power amplifier at frequency of 60 mc.		
Allowable plate dissipation	200 watts	150
Plate voltage	2200 v.d.c.	2000
	3000 v.a.c.	2500
Plate current	275 ma.	200
D.c. grid current	75 ma.	60
D.c. grid bias voltage	400 volts	350
Attainable plate power output	600 watts	400

◆

After soldering the wires in the prongs of plug-in coils, a small wire brush should be used to remove all the surplus rosin that has hardened on the outside of the prongs. This assures positive contact to the socket clips. Such a brush can be found at the cut rate auto supply stores for only a dime.—W6DOB.

28 and 56 Megacycles

[*Continued from Page 49*]

through. VP1AA, VP1JR, TI3WD, HP1A and NY2AE from Central America have been getting over, several stations reporting the last one when the band was otherwise quiet.

SM6WL: Reported to R.S.G.B. that conditions in Sweden are very similar to those in England. He worked five continents in two months but was short an Asian contact for w.a.c. on 28 mc. (you have lots of company on that, om!).

ZL3AJ: Also reported via R.S.G.B. Heard OH7ND, ON4NC and G6LK on March 3, the last one several times in March, but hasn't had a European QSO for several months. Completed first ten meter w.a.c. for a ZL station on March 14 by contacting ZS1H.

ZE1JJ: Reported via W9TJ by radio. First ten meter QSO was with ZS1H. Still lacks Asia for ten meter w.a.c., looking for a contact with India. Says VK and W signals vary from R2 to R8. Very quick fading but, "taking it all round, ten is f.b. for dx, even though one gets days with nothing on. When they come through, they come through strong." Using two antennas, each fed with two-wire non-resonant line as shown in RADIO handbook page 182. Transmitter input is 45 watts.

CM2AD: Started on ten meters about two weeks before the dx contest in March. During the contest, heard many stations from Europe, Australia and South America. Most were R7 to R8. Transmitter here uses a pair of 46's as a final doubler with 60 watts input. Average report is R7; it seems to perform well. Use no antenna on regenerative receiver, which won't oscillate on "ten" with the antenna.

ON4NC: Conditions generally were very bad on "ten" during April. On the first of the month, U.S.A. came through quite well, then conditions became gradually worse. Returning to the air late in April, I heard a few Europeans, also ZS1H and VE1EA coming through very weak and fading.

EI8B: Reported May 19 via W2DTB that the band has been dead or nearly so since the last Sunday of the dx contest except that on May 10 some South Americans came through.

D4GAD: Also via W2DTB, reports band dead since the first week in May for dx.

W2DTB: Returned to 28 mc. May 7th. Worked FB8AG (37th country on ten meters) and ZS1H daily until the 10th, the best day here on the East coast. Also worked F8WQ, EA4BM, and VK3MR on the 10th. On the 12th, VK3MR was worked, LU5BZ and PY2QD heard. On May 17, VK3YP was contacted. On the days not mentioned, no dx was heard.

W9TJ: On May 8th, Bill Atkins said that for three weeks conditions were poor—in fact, there were no conditions. VK4AP was worked on March 31 for the last QSO. SU1SG was heard on the afternoon of April 16. Building a new rig using a pair of 801's in the final.

W5BZR: On May 13th wrote: "The band has seemed very dead over here. Some days I don't hear a signal. Last Sunday morning I worked three Europeans, the lowest report being R5 from G6DH. At times about five or six stations can be heard but they are not as thick as last November and December.

W5WG: Conditions similar to those at W5BZR; K6's pounding in R9 plus on phone; at times

[*Continued on Next Page*]

[*Continued from Last Page*]

the VK's come through f.b. on phone as well as c.w. The skip seems to be a little longer than last fall or there are not quite as many fellows on "ten" in the U.S.A. now.

W3AIR: Best work has been to South in May, though all continents except Asia have been heard (see "Calls Heard" list).

W6QG: Worked G5AX at 4:30 p.m. Pacific time April 15 (about midnight his time). Thought he was a hoax until I read of HJ3AJH work with VK's after midnight. Europe has ceased coming in mornings. Last J's worked were J3DC, J3FJ, J2IS, and J2LU on April 6 and 7. Heard J2CE on April 18. Worked ZS1H April 18 for w.a.c. on ten meters. VK's come through regularly each afternoon and evening.

W6GEI: Conditions rather poor in mid-May with very few signals at any time of the day, but I believe it due more to lack of stations than conditions, because 20 meter harmonics come through. Last European heard or worked was G6DH on April 14. Need Africa for w.a.c., having so far been unable to raise ZS1H. Australia has been most consistent, phones often R8 to R9. Asian and South Africans scarce in past few weeks but fine before that.

W3FAR: From April 19 to May 18, completely dead days were April 20, 21, 25, 29, May 4, 12 to 16, and 18. Feels good to hear the neighbor's Ford rolling by these days, after listening all day and hearing great gobs of nothing. U.S.A. signals but no dx heard on April 22, 27, 30, May 1, 2, 3, and 5. W and XE signals only on May 11. W and K6 signals only on May 6 and 17. Some dead days, however, did permit HJO and other harmonics to come through, so it was at least in part due to lack of active stations. On some days that W stations were reported above, only one was heard. ZS1H was heard or worked on April 19, 23, 24, 26, May 7 and 8. South and Central Americans came through April 19, 23, 24, 26, May 7, 9 and 11. On May 10, worked EA4BM and D4WBT; also heard F3GG and K6MVV. Heard LU9AX working ZS1H on May 7.

DX News

[*Continued from Page 47*]

that only one letter out of the batch was "sour grapes". Now, if you haven't already done so, all of you should turn back toward the front of this issue of RADIO and read some interesting dope on resonant filter written by my ol' pard in crime, Charlie Perrine . . . or W6CUH to you.

Received a letter from my friend Court Matthews, W6EAK, whom I haven't seen for a year or more . . . He is op. on the Dollar round-the-worlder, S.S. *Pres. Van Buren*, and has spent a lot of time listening to the hams while scowing around Asiatic ports . . . He even goes so far as to say that QD has been heard over there. Well, that's a little better than W9 at that.

W3SI is still on 20 phone and has worked his 104th different VK phone. W5CPB doesn't like the zone idea . . . says countries are still ok with him. What's wrong with both, my friend? W5CPB has worked 32 countries and uses an 852 with 200 watts input.

W1DLD reports that the QRA of VQ3FAR is: J. A. Farrer, Tanganyika Central Gold Mines, Ltd., Sekenke via Kinyangira, Tanganyika. That's a real QRA . . . no foolin! The VQ says best time to work W stations is about 0400 g.m.t., and he is using a 3-stage rig with 25 watts to the final. W6FZL works J9CA in Formosa . . . low freq. end of 7 mc.; also, J9PA in Marshall Island, near Guam, is coming through on 14,300 kc. W6FZY, who is one of the most consistent dx men on the air, has a brother who just recently became a ham (W6NQO) and within the first 12 hours after he got on the air he was w.a.c. W6GNZ hasn't worked a W for 3 months. Shame!

Good ol' Ned, W8KPB, says he's irked . . . Think nothin' of it, Ned; even the W6's have bad days . . . and nights. Ned received something from ZB1E saying that ZB1I has left Malta for good, and that the call is extinct. Both KPB and CRA have been passing up VP2DF, but imagine their high blood pressure when they found he was on Grenada Island, B.W.I. Same happened with VP2KM. Must be an old story by now with those guys. VP2DF is self-excited and about 14,310 kc.

What's happened to W8CRA? . . . Oh, by the way, it seems that he has a new pet name . . . "Ming Toy Lucas". . . Boy, that gets me . . . If anyone hears of the origin of that one, shoot in the dope p.d.q. New ones worked by W8KPB take in YR5VC, YR5CP, YR5OR, SP1AO, SP1BA, SP1GZ, ES5C, LY1J, ZB1E, ZB1I, YV4AC, PK6AJ, VQ4CRT, U9AC, U9MI, U9ML, YU7DX, YT7VN, J2LU, J5CE, PK1BB, PK1MO, PK1PK, PK2KO, VU7FY, PZ1AA, I1IT, FA8GK, OK3VA, OK2KO, GI5UR, HB9B, HB9AL, OZ7CC, OZ5BK, OZ4H, VP7AA, CT3AB. Country Nr. 88 was ES5C and 34 zones. VQ4CRT is in Kenya, and the QRA is: Mr. Pritchard, Nairobi, Kenya. PZ1AA is now PZE. SV1KE suddenly quit after promising to give everyone a crack at Greece.

If any of you dx'ers have worked a sig that signed FY8AA or TG2R, don't get excited, as they are located somewhere in Ohio. I mean they were, as now they have apparently been well taken care of.

Bill Atkins, W9TJ, is touring the country, I guess, as every time I hear from him, he is in a different burg. Here's something I think is interesting . . . In 62 days of operation, W9TJ had 419 foreign QSO's with 362 foreign stations, in 68 countries, and was

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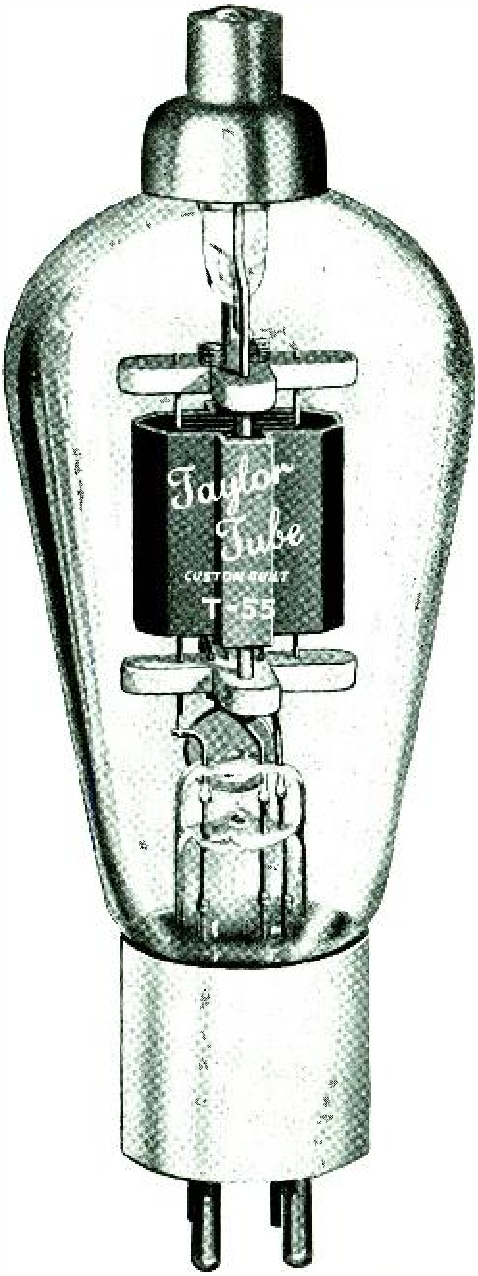

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FIL. CURRENT .... 3.25 AMPS.

Class "C" . . . OSC. . . . and R.F. Amp.

5 METERS

	CLASS C R.F. AMP.	OSC
MAX. PLATE VOLTS		
UNMODULATED D.C.	1500 VOLTS	1250 VOLTS
MODULATED D.C.	1500 VOLTS	1000 VOLTS
MAX. D.C. PLATE CURRENT	150 M.A.	125 M.A.
MAX. D.C. GRID CURRENT	40 M.A.	40 M.A.
MAX. RF. GRID CURRENT	5 AMPS.	5 AMPS.
RF. OUTPUT	168 WATTSa	66 WATTSb

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a—@ 75% Efficiency
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PLATE TO GRID .... 2.5 MMF.
GRID TO FILAMENT .... 1.7 MMF.
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[*Continued from Last Text Page*]

w.a.c. 31 times and WBE 11 times. Total zones for him are 38, while altogether he has worked 104 countries. W2GTZ is using two 242-A's in push-pull with 750 watts input and has been doing good work by hooking U9AC, FR8VX, VQ3FAR, OX7ZL, LX1AO, PZ1AA, VP7AA, K7UA, J2KJ, J2HJ, KA1CM and many others. He has worked 80 countries in 17 months. After trying for 11 years to hook Asia for his w.a.c., W2MU worked U9MI . . . Then, as if it were no trouble to do it again, he w.a.c.'s two days in a row.

G2JH reports that he is on 60 mc. entirely and that the 20-meter phone signing his call is a phony. It probably is a W6 bootlegger, as all the QSL cards are from W and eastern VE stations. What happened to the phoney signing G5NI on 20 who was caught recently by a W8 and a W2 working together?

Now that VU2CQ has obtained a receiver, the gang might chip in and buy one for PK3AY.

W2BHW worked U9MF for his 89th country. W6KNH informs us that YV4AC is on 14,150 kc., 2300 to 0400 g.m.t.; YN1AA, 14,405 kc.; ZC6CN, 14,403 kc., 0000 g.m.t. LY1J has his phone on 14,-410, 0030 g.m.t. KNH's 48th country was VP2AG.

We hear that W6ABF reached Cape Cod ok, where he will operate W1CCZ for several months. He should be able to make W1CCZ really get up and go to town if he uses an Altadena Kilowatt back there.

W2DFN springs a new one . . . He gets griped when he is working some bird on the other side of the world and this guy says, "G.e. o.m." . . . when it really is morning where W2DFN is. This is a very serious situation . . . What'll we do, fellows? Send your comments to Nick, hi. W9AKH wants OH2HV to put just one more gurgle in his signal, as then the fellows could copy him better. Bill Hank's W9OLC has 37 zones to his credit. W6NLQ is going after 80 meter dx along with W6KMQ, LWO, and MJF.

Dr. Chas. E. Stuart, W6GRL, has been punching that key again, and I guess he really punched it pretty hard as his country total jumped to 107, the new ones being FK8AA, HI5X, and PZ1PA. Another thing that this "man from Ventura" did was to carry on phone tests with VK3BD on 10 meters to see how long they could hear each other. It is interesting to know that they finally faded out at 11 p.m. p.s.t., which is about two hours longer than they had figured it could last. VK3BD is using 4 half waves in phase for a beam antenna.

W6DRE made w.a.c. in 2 hours and 15 minutes, working FB8AB, G6XL, J2LL, VK2DO, CP1AA, and W3ANH. New ones for him are FA8BG, ON4CJJ, OH5NR, EI7F, FB8AB, PAOQF, ZU1T, FK8AA, YL2BK.

Some femme with a sweet young voice phones W6EWC, Wayne Cooper, a few weeks ago and asks him to send a message to China. With his transmitter scattered around the shack, it looked hopeless, but he stumbles over a 47, so tosses that into a circuit using a crystal . . . and after a couple of days of calling XU's, discovers that it helps if the antenna isn't lying on the ground . . . Finally came to pass that the next a.m. he got rid of the message. Funny what a sweet young voice will do.

Chas. Smack, W3AYS, has 28 zones and 70 countries . . . and uses a 203-A with about 150 watts input. Somebody whispered into my left ear that W6AWA has combined with W6RH to make a super-super-super-station. That will help them work W9's too. W5EHM has worked 82 countries and 32 zones, is w.a.c. on 28, 14, and 7 mc. bands, has four continents on 3.5 mc., and his shortest time for w.a.c. is 1 hour and 50 minutes.

As I said before, this summer weather is getting me, the ocean still looks tempting, and as a matter of fact I don't know what the devil is holding me back. The part I regret is that my quota of W9's will fall way down this summer, but on the other hand, now that Herb Stovall, W6FET, is located at the shack, we might be able to give each other a fight talk and keep up our quota. We'll see . . . but somehow I doubt it. Am still after the number of zones you have worked. So come on; "kick through", and we'll print 'em in October RADIO. Gotta go now . . . vacation . . . trips . . . holidays . . . romance?? (no) . . . but, now that swim . . . see ya soon . . . SPLASH.

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TELEVISION DEMONSTRATION

Cathode ray television, using 300 line images 24 times per second, was given its first public demonstration on June 4 in Los Angeles by the Don Lee Broadcasting System. Using film for television subjects, the system was developed during the last year and a half by Harry R. Lubcke, director of television at their experimental station W6XAO, and is broadcast on a 45,000 kc. carrier. The system is an outgrowth of experiments which started at the experimental station in December, 1931, using cathode-ray 80-line scanning and gradually developing into the present system.

The equipment, on which patents are held by Mr. Lubcke, consists of the cathode-ray tube unit, two scanning sources, the power supply, and the receiver proper, which is of the self-synchronized cathode-ray tube type.

On June 5, the experiments were put on a regular daily public demonstration schedule and will continue from 3 to 5 and from 6:30 to 8:30 a.m., P.s.t. During these periods the public is invited to see and hear the combination sight-and-sound receiver which is on the main floor of the Don Lee building in Los Angeles.

Although factory-built receivers for these broadcasts are not as yet available, Mr. Lubcke states that those amateurs who are interested in experimental reception of television and who want to build their own receivers may secure details of their construction by writing to the Television Division, Don Lee Broadcasting System, 1076 W. 7th St., Los Angeles.

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W6HXU says that in looking for good dx nowadays, it is a good idea to spend a lot of time listening on the new foreign dx band which extends from 14,400 kc. on up.

HAMFESTS AND CONVENTIONS

Pennsylvania

Hams in the western Pennsylvania area have been invited to Mountour Park, Pittsburgh, Pa., by the Amateur Radio club of Pittsburgh for a hamfest on July 19. Albert Maas, secretary, writes that entertainment has been arranged for all and prizes will be awarded. Tickets can be secured for 75 cents and a self-addressed envelope sent to George Weber, W8NSA, 9 South Howard Avenue, Bellevue, Pa.

California

Oakland Radio Club, Inc., will be host to the Pacific Division A.R.R.L. convention on Sept. 5, 6 and 7 in Hotel Leamington, Oakland, Calif. In addition to several thousand dollars worth of radio equipment prizes, a Chevrolet four-door master sport sedan will be awarded. Hams purchasing their registration tickets before Aug. 29, will have a chance on a Hammarlund Super Pro. Three days will cost $3.75. For men who wish only to attend the final banquet in the Scottish Rite temple, the cost of $1.50 will prevail. They will not be eligible for prizes, however. Banquet tickets for women are $1.50 apiece. For further information, communicate with Horace Greer, W6TI, Convention General Chairman, Room 423, Hotel Leamington, Oakland, Calif.

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R.C.A. U.H.F. Circuit

[Continued from Page 68]

The transmitters all use resonant transmission lines to provide the required frequency stabilization without recourse to crystal control and a long string of frequency multipliers.

The transmitters use some of the newly developed ultra high frequency transmitting tubes which have low shunt and interelectrode capacitances as well as short and direct low resistance connections to the tube elements.

The receivers use the acorn type tubes to provide sufficient gain at 100 megacycles to make up for the transmission losses.

The "turnstile" and "Christmas tree" antennae are particularly interesting as examples of the newest thought in directive arrays.

The whole circuit was developed under the direction of Mr. H. H. Beverage, Chief Research Engineer of R.C.A. Communications, Inc.

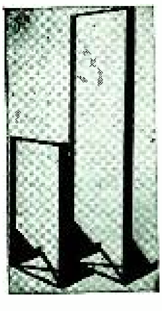
◆

A burnt-out metal tube makes a handy makeshift octal plug for set analyzers.

REMARKABLE PRICE REDUCTIONS

On LEEDS Constructional Accessories due to greatly increased demand

RELAY RACKS



Our Relay Racks are built to stand up under the heavy loads of modern transmitter construction. Uprights are made of 3/16" stock, 1¾" wide. Welded angle supports, cross braces and sturdy cross bars insure extreme rigidity. LEEDS Racks, unlike some units on the market, are drilled for panel mounting according to Bureau of Standards specifications.

Table Rack type RAD 33¼" panel space high, 20½" wide, 12" deep, with a complete set of drilled and tapped panel mounting holes **$5.75**
Shipping weight 30 lbs.

Type RBD rack 66¼" panel space high, 20½" wide, 12" deep, with a complete set of panel mounting holes.................................. **$7.45**
Shipping weight 50 lbs.

Brackets—4" high, 5⅜" deep, ½" bend for mounting; pair **25c**; 7½" high, 9½" deep, ½" bend for mounting, pair **35c**

GENERAL RADIO VARIACS

Are the ideal answer to the QRP problem. Type 200 CU delivers 0-135 volts continuously variable at 900 watts from 115-volt line. Price **$14.50**

Type 200-B — 0-115 volts at 170 watts. Price **$10.00**

No. 100-K—0-115 v at 2000 w. Price **$40.00**

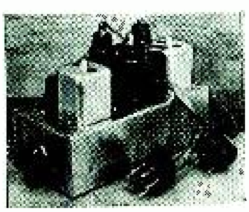
LEEDS Leads as the only distributor in the country, handling G.R. Amateur accessories and laboratory apparatus. Bulletin No. 936 mailed on request.

GENERAL RADIO coil forms type 677-U price **50c**; type 677-Y price **75c**. G. R. amateur accessories always in stock.

G.R. dials, with fluted knobs 4"—**$1.50**; 3¼"—**$1.25**; 2¾"—**$1.00.**

NOISE SILENCER ADAPTERS are a great help on reducing natural static too. Leeds "QUIET CAN" and "SILENT CAN" also provide freedom from ignition noises and afford an ideal arrangement for push to talk phone and break-in CW.

Leeds **"Quiet Can"** for receivers with 2 IF stages; complete with tubes and instruction............ **$7.95**



Leeds **"Silent Can"** illustrated herewith, for receivers with 1 IF stage; complete with tubes and instructions. **$9.95**

Rack Panels

By LEEDS are furnished with black shrivel finish in the standard 19" length, ⅛" thick. Mounting slots are spaced according to Bureau of Standards specifications, insuring freedom from all trouble in mounting or interchanging panels.

Steel	*Price*	*Width*	*Aluminum*	*Price*
PS-1	$.52	1¾"	PA-1	$.74
PS-2	.57	3½"	PA-2	1.03
PS-3	.68	5¼"	PA-3	1.30
PS-4	.71	7 "	PA-4	1.55
PS-5	.95	8¾"	PA-5	1.90
PS-6	1.15	10½"	PA-6	2.45
PS-7	1.30	12¼"	PA-7	2.90
PS-8	1.50	14 "	PA-8	3.35
PS-9	1.70	15¾"	PA-9	3.70
PS-10	1.90	17½"	PA-10	3.95
PS-11	2.05	19¼"	PA-11	4.45
PS-12	2.30	21 "	PA-12	5.20

Brass panel mounting screws ½" long 10/24 thread. 15c per dozen.

Important Announcement

On our NEW LD-5 Mounted Crystals These low drift plates, factory sealed in the new LEEDS metal holders, are outstanding from the standpoint of stability, accuracy, high output and low cost. Low drift—5 cycles per million per degree. Accuracy of calibration — better than .05%. Orders filled plus or minus two kc of specified frequency. Last but not least, the price of the mounted crystals, anywhere in the 160-80 and 10 meter bands is only...... **$3.50**

Money back guarantee if you are not Completely Satisfied.

THORDARSON TRANSFORMER special, 1200 volts CT 200 ma. 5 v. 3 amp. 7½ v. 3 amp. 2½ v. 10 amp. a quality cased job... **$2.45**

Thordarson 12 henry 250 ma. choke, **1.95**

Thordarson cased class B transformers input and output.

For 46's. Per pair................................ **$6.17**
For 210. Per pair................................ **8.23**
For 203-A. Per pair............................. **17.64**

TRIPLETT METERS

all standard ranges; 0-10 to 0-1000 MA
3½" bakelite case.................................. **$3.75**
2" bakelite case.................................... **$2.94**

READRITE milliammeters 15 to 400 mils; any range, each......................... **.59c**

WESTINGHOUSE AND SANGAMO watt hour meters; 110-129 volt, 60 cycle-2-wire meters; 5 ampere capacity **$3.50**
Shipping weight 15 lbs.

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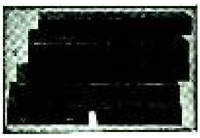
BASES and DEMI-BASES



By LEEDS for use with rack panels are now available in a greatly increased variety at lower prices. Crystaline finished units of 20 gauge steel; each base is finished with a bottom cover plate, so that apparatus underneath the chassis may be kept free from dust and at the same time electro statically and electro magnetically shielded.

8½ x 8 x 2......	**.65**	10 x 17 x 2......	**1.10**
8½ x 10 x 2......	**.70**	10 x 17 x 3......	**1.30**
8 x 17 x 2......	**.95**	12 x 17 x 2......	**1.30**
8 x 17 x 3......	**1.15**	12 x 17 x 3......	**1.40**
4 x 17 x 2................	**.70**		

OUR VACATION Special

ATWATER KENT Model No. 48 TRF broadcast six tube battery receivers, in sealed cartons. These receivers may be operated from 6 volts with 201A's, or 2 volts with 230's with 90 volt B battery. Ideal for the summer camp "beyond the power line". Quantity limited --better order early.
Less accessories...................... **$4.95**

LEEDS Type 1-B Freqmonitor

is now in use in hundreds of amateur stations. A complete description of this two purpose instrument may be found in the April 1934 issue of "QST". "Ask the man who owns one." Complete with tubes and calibration chart.......... **$19.75**

Our type **1-E Power Supply** is ideal for use with the 1-B priced at **$6.50**

Aladdin Iron Core I-F Transformers in Stock

MEISSNER FERROCART iron core transformers. These units will increase selectivity, double the gain, increase signal, lower set noise. 175 —262 —370—456 kc. each.... **$1.18**

Wet Process 1" Diameter Glazed Porcelain Insulators

Wet Process 1" Diameter Glazed Porcelain Insulators

7"........**25** 12"........**35c** 20"........**50c**
Egg-type strain insul. 10 for............**35c**

Overseas Amateurs Attention

There is a satisfied LEEDS customer near you, regardless of your QRA. LEEDS export service is being used constantly by amateurs and professionals in 70 countries. One shipment will convince you.

The Dynamic Shift Amplifier

[*Continued from Page 29*]

or 30% resting, this non-linear relationship will have no practical effect at all upon the action of the bias modulated power amplifier.

Overall Transient Characteristics

In order that actual operating conditions be determined, free use was made of an oscillograph. Figure 11 shows how the carrier varied under the most extreme of transient conditions. Under the ordinary speech envelope variations with this same adjustment, the fluctuations would be even less. The saturating current switch was closed and records of the rise of saturating current and changes in carrier were recorded. Note that the saturating current has a very strong 120 cycle component superimposed as explained previously. In this particular case the carrier fluctuated about 8%, which could not be noticed when picked up on a receiver. This fluctuation is caused by a change in the angle of plate current flow due to momentary changes in the

$$\frac{E_B}{E_c{}^1}$$

ratio, which in turn is due to differences in time constants of the two power supplies. The degree of carrier fluctuation is very sensitive to changes in the proportion of the bias voltage being supplied by the controlled source. If the time constants of both supplies were identical, there would be only one portion of fixed and variable bias that would keep the carrier constant over any transient variation. In practice this could be easily adjusted by adjusting the sliding tap on the bias power supply bleeder until the plate current meter of the modulated amplifier remained constant while speaking into the microphone. In figure 11, a falling of the carrier trace means an increase in carrier output, because the plate current of the 2A3 connected to the output diode circuit was used to actuate the oscillograph element. This 2A3 was essentially linear over the limited region used.

Figure 12 shows the controlled, bias-modulated amplifier under actual operating conditions. This modulating voltage is that obtained from a local broadcasting station by means of a small receiver. E_B is the d.c. voltage applied to the plate of the bias-modulated stage, pulsating with the modulating envelope. $E_c{}^1$ is the controlled portion of the bias derived from the other controlled power supply. The lower record shows the fluctuating saturating current with the 120 cycle component superimposed. Note how the saturating current follows the envelope of the modulating voltage and not the rapid changes. This testifies to the effectiveness of the saturating device shown in figure 3. The reference lines in figure 12 are the true zero lines.

Figure 13 shows the same variables as figure 12, with the addition of a record of the rectified output. (Note: the reference lines are the no-signal conditions and not zero lines.) If there were no distortion at all, the records of the modulating voltage and the rectified output would be identical. The important thing from the point of view of this paper is the fact that there is no measurable time delay between the microphone and the antenna as can be seen by a comparison of the relative phase of the modulating voltage and rectified output. However, there is a delay of approximately .05 second between the modulating peaks and the E_B and $E_c{}^1$ peaks. There is a smaller delay of about .03 second between the modulating peaks and the saturating current peaks. This last delay can be cut down by lowering the value of the capacitance shunting the diode load resistor in the saturating device.

Tests were made to localize the delay occuring between the saturating current and the power supply outputs. The oscillogram of figure 14 was taken to find out whether any appreciable amount of the delay was caused by the inductance of the a.c. coils of the saturable reactor. The switch was closed, which started the saturating current to build up, and the phase displacements of the 60 cycle a.c. voltage on the primaries of both power supplies were recorded as well as E_B and $E_c{}^1$, the voltages on the outputs of the two power supply filters. It was found that the primary voltage built up almost immediately and that practically all of the time lag was in the power supply filters.

The reason for the delay in the filters can be seen by analysis. Let us supply an impulse with a vertical wave front to the input terminals of the filter of figure 9 as represented by sketch (a). The current will build up in L_1 as the area under (a) or the first integral of it, which can be represented by the straight line

[*Continued on Next Page*]

[*Continued from Last Page*]

(b). The voltage across C_1 will build up as the first integral of (b), or the second integral of (a), which we will represent as the parabola (c). The current through L_2 (d), builds up as the first integral of (c) or the third integral of (a), a cubic. And finally the voltage builds up across the condenser C_2 as the first integral of (d) or the fourth integral of (a), a quartic. From this it can be seen that the vertical wave front of the unit function (a) is changed in passing through the filter to something similar to (e). The main difference between (a) and (e) is the time of starting to rise rapidly. There is a time "x" during which the value of (e) is finite but very small. Applying the analysis to E_B and $E_G{}^1$ of figure 13, one can see that they probably really start to rise the instant the saturating current starts to rise, but, because of the above effect, their rapid rise is delayed by an amount of "x".

The effect of this time required for the plate and bias voltages to arrive at the tube to care for a modulation peak makes it necessary to provide means to minimize distortion on the front parts of the audio modulating signal. The simplest method of doing this is, as stated before, to provide at least 20% or 30% modulating capability for the modulated amplifier in the resting condition. With such an adjustment, it was absolutely impossible to note any distortion in the many aural tests made upon talking, singing, and instrumental music. To the ear of the layman it was impossible to tell whether dynamic shift or the conventional, low-efficiency bias modulation was used.

For high-fidelity broadcast work the solution is to use some delay system to hold up the modulating voltages from the grid until the plate and bias voltages from the controlled supply have arrived to care for the modulation peak. The artificial transmission line, acoustic delay tubes, or the magnetic tape recorder could be used for this purpose. For amateur work, however, such additions are unnecessary.

By applying the dynamic shift principle to bias-modulated amplifiers, the old limitation of low-power output per tube is removed. Plate dissipation is no longer the chief limiting factor. As the plate dissipation is very materially lowered, the plate voltage can be increased greatly, with a resulting increase in power output. Bias modulation can now compete with plate modulation, the much lower modulating power required being a strong point in favor of the dynamic shift bias-modulated amplifier.

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W2CTS ELECTROCUTED

Grimes Rayburn Waller, W2CTS, was found dead of electrocution in his hotel room at the Hotel Victoria in New York City, on June 12.

A hotel watchman, smelling smoke, entered the room and found Waller seated at the operating position of the amateur phone transmitter, with his feet, the toes of which were badly burned, on the power pack under the table, and with his hands clasped around the microphone, the victim of an accidental circuit from the high voltage pack through his body to the grounded microphone. He was fully dressed except for coat and shoes.

Despite repeated warnings, this is another example of a type of accident which continues to occur when adequate care is not taken to protect the operators from the high voltages used on most amateur transmitters. Do not wire your transmitter in such a way, or construct it in such a way, that any high voltage is exposed to the extent that one must "remember not to touch it". Sometimes one forgets to remember, and then we have a recurrence of the above gruesome tragedy.

Open Forum

[*Continued from Page 59*]

Segal to do this work. Then, being unwilling to divide responsibility, it told them to go to Cairo.

Mr. Woodruff served as Chairman of the Cairo Committee, and he's now President of the League. Bailey was on both the Investigating Committee and the Cairo Committee. He's now Vice-President. One is inclined to speculate as to whether or not some kind of a political "trade" was entered into between the hq. crowd and these "whitewash-and-delay" experts, but maybe I have one of those evil minds one hears about.

At the 1936 Board meeting a number of important liberal moves were voted down 8 to 6. So there were at least some signs of improvement; the tide seems to be rising, though slowly. Some of the directors were *trying* at least to direct.

Warner kept his present salary by only one vote, 8 to 7.

Most reports rendered to the Board of Directors at the beginning of the meeting spoke of strong sentiment among the rank and file in favor of moving hq. out of Hartford and to a more convenient and central location.

Segal raised all the legal bugaboos he could think of to discourage the idea of moving, but the Board wasn't inclined to listen. The members were of the opinion that a way to move could be found if necessary. Of course it can be.

A committee of three—Roanoke's Caveness (N.C.), Southeastern's Adams (Ala.), and Canada's Reid (P. Q.)—was elected to consider the question of moving hq. and report within four months. In preliminary talk at the Board meeting, St. Louis was mentioned most frequently as a likely place for a new site. We hear that Reid favors staying in West Hartford and that Caveness wants Washington, D.C., or no place at all. What Adams wants, I don't know.

My guess is that hq. will remain in West Hartford unless *the members at large make their wishes for a move so plainly heard that the committee and the Board won't dare refuse.* It seems clear to me that it is vital to tell the hams that unless they put "heat" under their Directors and this Committee the chances are greatly in favor of another "flop".

I hope they will rise to the occasion.

SUMNER B. YOUNG, W9HCC

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[Unless every interested club and individual amateur makes his or its wishes known—pronto—we believe the Committee is unlikely to recommend a change in HQ location. A logical location would be somewhere a bit east of Kansas City, about half way between the center of population and the geographical center.—EDITOR]

◆

W9QC's QRA is an elevator penthouse.

Home-Made Slide Rule

[*Continued from Page 32*]

label for coil diameter. If you desire, a scale for wire sizes with various types of insulation can be drawn above the "Turns per Inch" scale.

This may sound like considerable work, and it is, but the job will be a real education in the inter-relationship of these factors of inductance, capacity, frequency, and resistance, and at the same time will produce a most useful piece of equipment for any ham shack or laboratory. Of course, you want to know how to use it, now that you have made it; so here goes.

Suppose you desire to make a coil for your frequency meter to tune to 1700 kc. at a maximum of 80 μμfd. Set the slider so that the index points to 1700 kc. (or 1.7 mc.) on "F — s 1" and read opposite 80 μμfd. on "C — s 1" the answer, 108 mh., on "L — s 1". Now turn the rule over and cause 108 mh. on "Ind." to coincide with the number of turns per inch of the wire you expect to use. Suppose it is number 28 enamel, which has 73 turns per inch. With 73 set at 108 mh., you will now find the coil diameter curves intersecting the length of winding, giving the following combinations, any of which will give 108 mh.: 0.5 inch diameter, 3.8 inches long; 0.75 inch diameter, 1.85 inches long; 1 inch diameter, 1.2 inches long; 1.25 inches diameter, .88 inch long; 1.5 inches diameter, 0.7 inch long; 2 inches diameter, .53 inch long; 2.5 inches diameter, .43 inch long; and so forth. Choosing from these for the best coil form (form factor), the 1 inch diameter is chosen.

Now suppose you want to know how much current a .03 μfd. condenser will consume when connected across the 1100 volt secondary of a 60 cycle transformer. Set .03 μfd. on "c — s 2" to coincide with 60 cycles on "f — s 2" and read opposite the index, 88,000 ohms on "X", the reactance of .03 μfd. at 60 cycles. Solving for Ohm's law, it is found that the condenser will pass 12.5 milliamperes. Or suppose a choke coil passes 0.5 ampere when connected across 110 volts at 60 cycles. What is its inductance? Solving for Ohm's law it is found that the choke offers an impedance of 220 ohms. Now set the index on the slider to 220 ohms on "Z" and read opposite 60 cycles on "f — s 2" the answer, 0.585 henries, on "l — s 2", the inductance of the choke.

What will be the frequency range of a transmitting coil having 10 turns of one-quarter-inch brass strip, flatwise wound, 5 inches in diameter, and spaced 1/4 inch between turns when used in conjunction with a condenser having a minimum of 30 μμfd. and a maximum of 250 μμfd.? The coil is 5 inches in diameter and 5 inches long; so set the 5 inch diameter curve to 5 inches on length scale, and since the coil has 2 turns per inch, read opposite this figure, 8.6 mh., the inductance of the coil. Now turn the rule over and find 8.6 mh. on "L — s 1" and first make it coincide with 30 μμfd. on "C — s 1" and read opposite the index, 9.8 mc., the highest frequency, or 30.5 meters, the lowest wavelength. Doing the same for 250 μμfd., it is found that this combination will tune to 3.4 mc. or 88.2 meters.

Always use scales marked "S 1" with those marked "S 1" and scales marked "S 2" with those marked "S 2". Reactance of condensers is read on "X" and the impedance of inductances on "Z". Scales marked (A) and (B) are always used in connection with those marked (M), (KC) and (MC); those marked (a) or (b) are used with (c) to derive (d) or (e). The amateur bands can be blocked in on scale "F" for ready reference as shown. A very handy adjunct for the rule is an extension scale made of a narrow strip of bristol board with a strip of 2-cycle paper on one side and a piece of 4-cycle on the other. In case the scales run out for the particular problem you want to solve, they may be indefinitely extended.

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After reading about QTW, QTX, and QTZ, W6FFP suggests the following:

QTZ—Please don't send station description.

QUA—If you send any more station description I'll sign off!

For bigger and better carriers we give you the
"HAYNES RIGCHECKER"
Complete with self-contained tube, batteries, and seven plug-in coils for all bands.
Net . . . $17.90

Presenting . . . THE HAYNES RIGCHECKER

An all-purpose instrument for Hams, which will delight the heart of every "Old-Timer" and make the "Young Squirts" chirp with glee. Designed by A. J. HAYNES for his own use at W2JHV (ex-2DY). Here are a few of its uses:

As **FIELD STRENGTH METER;** shows relative power **actually radiated,** permitting perfect adjustment of antenna length, transmission line coupling, rig efficiency, etc. The only satisfactory way to get the whole rig perking "on the nose."

As **MONITOR;** checks key clicks, line hum, voice quality, overmodulation or carrier frequency shift.

As **FREQUENCY METER;** may be calibrated for any or all bands from 5 to 160 meters.

As **D.C. VOLTMETER,** 0-10, 0-100, 0-1000 volts.

As **VACUUM TUBE VOLTMETER** for A.F. or R.F. with linear scale reading.

As **TUNING METER**—and signal strength indicator with receiver, also showing overmodulation of received signals, etc.

In short, as one old-timer put it: "It's the most useful gadget that ever cluttered up an operating table." It's the best radio investment you'll ever make. Descriptive circular and instruction sheet FREE on request.

BUY YOUR NEXT SET FROM HARRISON

OUR NEW FREE

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HALLICRAFTER . . .
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- ACR-136

NATIONAL RECEIVERS

PATTERSON PR-16

. . . Etc.!

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NOISE SILENCER

Shuts Out "Man-Made" Static!

The Lamb noise "Check Valve" has been acclaimed as one of the greatest discoveries in Radio! For the first time, really noise-free reception is possible.

Harrison presents a compact version of this amazing development. A neat metal case measuring only 2"x5½"-x4½" houses all necessary parts and tubes. Just bolt the "Noise Silencer" to your receiver and make three simple clip connections. A few minor adjustments and you enjoy REAL reception on all bands, unmarred by sparking motors, automobile ignition, dial telephones, oil burners, etc. Draws only a few mils plate current from the receiver.

Complete kit of all necessary, high-grade parts, crystal finished cabinet with all holes drilled and complete instructions.
$3.85
Three Sylvania metal tubes $2.50

WIRED and TESTED—Ready to operate, with tubes.
$8.55
For Superheterodyne Receivers only. (BCL and Amateur) Mention make and model of set when ordering.

FREE: **SEND CARD for Diagram and Instruction Sheets.**

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An exceptional value in well constructed Transmitting Tubes.

All have standard characteristics and are designed for extra heavy service. Made especially for us by one of the largest tube manufacturers. Bearing our name, they are fully guaranteed by both the manufacturer and ourselves for 1000 hours of actual service. You will be well pleased with their excellent quality.

*203-A	$8.45	*838	$11.75
†210-HF	1.75	*†841-A	2.95
211	8.45	845	8.45
242	8.45	*†852	11.50
*304-A	9.45	860	19.75
*†800	7.25	*865	8.45
*†801	2.95	866	1.50
*†830	6.75	866-A	1.95
*†830-B	7.25	872	110.25

* Graphite Anode. † Isolantite Base.

OIL FILLED FILTER CONDENSERS

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DC WORKING SPECIAL $1.45

Real oil impregnated, oil filled condensers. Conservatively rated at continuous DC working voltage. Fully guaranteed! Metal case 3¾"x3¼"x1⅞"

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"SHORT WAVE SPECIALISTS SINCE 1925"

NEW LITERATURE

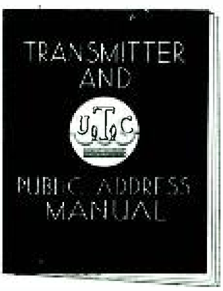
Tube Data Sheets

In regard to the tube data sheets offered by Audio Products and mentioned in this department last month, it should be pointed out that a request should specify what tubes are being used (or what you expect to use) in your transmitter. As these sheets were rather expensive to compile, it is necessary that blanket requests for "all the sheets" be turned down.

Because of the unexpectedly large number of requests received for these data sheets, it has become necessary for Audio Products to ask 10c in stamps to cover the cost of postage and handling.

Transmitter and P.A. Guide

The research department of the United Transformer Corporation has just completed a study of Transmitter and Public Address hookups, circuits and applications. This information has been compiled into an attractive 44-page illustrated bulletin which is now being printed. A limited number of copies will be available at local distributors at a special price of 25c.



P.A. Catalog

A new 48-page catalog describing the complete 1936 line of Lafayette public-address amplifiers, systems and accessories is announced by Wholesale Radio Service Co., Inc., of New York, Chicago, Atlanta, Newark and the Bronx, N.Y. It is printed throughout in black rotogravure and is profusely illustrated with large pictures.

Amplifiers ranging in power output from 3½ to 100 watts, suitable for a wide variety of applications from kitchen call-systems to theatre "talkies", are listed.

Copies of this new catalog are obtainable free of charge from any of the Wholesale Radio Service Co., Inc. offices at the following addresses: 100 Sixth Avenue, New York, N.Y.; 901 West Jackson Blvd., Chicago, Ill.; 430 W. Peachtree St. N.W., Atlanta, Ga.; 219 Central Avenue, Newark, N.J., and 542 East Fordham Road, Bronx, N.Y.

Sound Equipment Catalog

Two new catalogs describing in complete detail the latest developments in equipment, discs and parts for the instantaneous recording and transcription field are announced by the Presto Recording Corp. Copies furnished upon request at 139 West 19th Street, New York City. A special article on instantaneous recording, prepared by their chief engineer, is also available.

Galvanometer Catalog

A complete line of galvanometers and dynamometers is listed by the Leeds & Northrup Company in its catalog on these instruments which has just been revised. Several newly-developed instruments are included in the publication. A narrow-coil galvanometer provides an extremely high voltage-sensitivity combined with a very short period. A dual galvanometer includes all the advantages of a portable lamp and scale galvanometer, and has a sensitivity fifty times as high. Specifications and listings have been brought up to date throughout the catalog.

A copy of this publication (catalog ED) may be obtained upon request to the Leeds & Northrup Company, 4934 Stenton Avenue, Philadelphia, Pa.

New Television Book

Television with Cathode Rays by Arthur H. Halloran. This new 188-page loose-leaf handbook of television by Mr. Halloran should prove valuable to all interested in having a fundamental understanding of the theory and practice of television. The book really starts at the beginning and goes right through to the most complex matters in the field. There is considerable elementary electricity, radio and mathematics, as a thorough understanding of these fundamentals is essential to a clear picture of the problems and practices of television.

The cathode ray oscilloscope is described in detail and both electrostatic and electromagnetic beam control are discussed. There are no receiver or transmitter circuits shown in the book, and modern mechanical scanning methods, which are not obsolete by any means, are not mentioned. However, the loose leaf feature, through the quarterly supplements, will undoubtedly rectify these omissions.

If the supplements are as valuable as the first part of the book, it will be a worthwhile addition to the library of all experimenters and engineers.

Replacement Condenser Catalog

Due to the constant addition of new replacement units to the already extensive listing in its latest general catalog issued several months ago, the Aerovox Corporation, 70 Washington St., Brooklyn, N.Y., announces a new supplementary catalog No. 5625 covering up-to-the-minute listings. This catalog lists units according to set manufacturer, set model, characteristics of condenser, set manufacturer's part number, and Aerovox catalog number. A copy of this catalog may be had on request.

WARNING

Radio, Ltd., cannot be responsible for any subscriptions placed with a Mr. Burton of Elmira, New York.

What's New

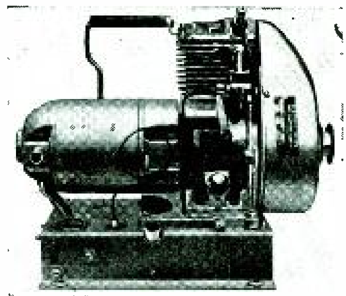
New Analyzer

Many outstanding advantages are claimed by Solar for their newest analyzer unit. This is a capacitor-analyzer and resistance-bridge, designed to suit the needs of engineers as well as service men: a refined and extended Wien bridge built into instantly useful form for laboratory, shop, or field work. All readings are secured direct from a color-coded panel.

Descriptive literature on this and other Solar products will be sent dealers or service men who address the Solar Mfg. Corp. on their business letterheads. Address is 599 Broadway, N.Y.C.

Portable Power Plant

The Kato Engineering Co. has released a new portable power plant with the designation of *JR-3 Katolight Jr.* It furnishes up to 300 watts at 110 volts, 60 cycles, and weighs but 50 lbs. It will furnish 1000 watt-hours at a cost of approximately 3 cents, running for 10 hours on one gallon of gas. It is equipped with filter and ignition suppressor to minimize radio interference. Special sizes are also available for 50 cycle, for 32 volts (d.c.), for 6 volts (d.c.), etc. These units make ideal sources of power for a strictly portable transmitter or for the amateur who is isolated from wired power. Literature will be sent on request.



New Beatnote Oscillator

About the only way of testing the peformance of audio amplifiers and loudspeakers, as well as the audio response of modulation systems, is to feed various audio frequencies through the system, while measuring the output. Adjustable-frequency audio oscillators are costly and cumbersome, especially if one wishes to use low frequencies while retaining good waveform. This leads to the common use of the beatnote oscillator, a device in which a fixed-frequency r.f. oscillator and a variable-frequency r.f. oscillator are both fed to a detector which "outputs" the resulting audio beatnote. This note is of course variable by tuning the adjustable one of the two

[*Continued on Next Text Page*]

PLEASE

Do not write in to notify us when you receive no August or September issue. See page 4, column 1 under "Frequency".

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Subscriptions received before this policy was announced have been entered on a basis of 12 issues for each "year" ordered. Those received subsequently (in accordance with notices in each issue, advertisement, or subscription form) have been entered on a basis of 10 issues per "year" including the enlarged special annual number.

[*Continued from Last Text Page*]

r.f. oscillators, whose scale is calibrated in audio frequencies. Since there is some drifting of the radio frequencies it is always necessary to provide some sort of a reference-frequency and some sort of a trimmer.

The R.C.A. 9633 beatnote oscillator fits this general description and is novel mainly in that the use of "acorn" 954 pentodes as r.f. tubes and 955 triodes for detection and audio amplification has permitted the device to be built into a case measuring 10" x 6½" x 4½", the whole weighing under 11 pounds with built-in power supply. The manufacturers state that the calibration accuracy is 10% from 30 to 1000 cycles, 5% from there to 15,000 cycles. The output is said to be "flat" within 1 db. from 120 to 10,000 cycles, and "down" not over 3 db. at either 30 or 15,000 cycles, the distortion not exceeding 5% at 20 mw. load, nor 10% at 60 mw. load. The output transformer is tapped for loads of 250, 500, and 5000 ohms with grounded centertap. The preliminary trimming is done against the supply-line frequency (50 or 60 cycles) as a reference with the aid of a neon light used as a synchroscope.

Special Solder Flux

Of interest to solder and flux users everywhere is a new flux developed by the Alumaweld Company of America, 2442 South Park Way, Chicago, Illinois. This new Flux used in conjunction with a special, high strength solder does a job heretofore considered impossible.

With Alumaweld flux it is possible to make high strength permanent repairs on joints of any metals. It makes soldering twice as easy because Alumaweld solder and flux is applied with an ordinary soldering iron or blow torch. The soldering job is done at a low temperature but has the advantage of requiring high temperatures to melt it a second time. It works equally well on aluminum, stainless steel, die cast pot metals, cast iron, copper, brass, etc., which makes it easy to join any two different metals if desired.

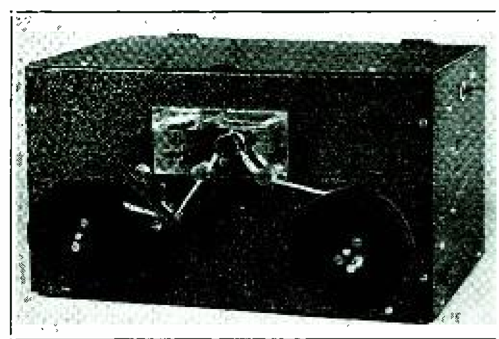
New "G" Tubes

Since originating and introducing "G" Tubes a year ago last April, the Arcturus Radio Tube Company, Newark, N.J., experiencing an unusually heavy demand for this line (glass equivalents of metal tubes), has had to round out that series and announces the addition of the following types:

6B6—Duplex Diode Triode Detector Amplifier
6N7-G—Duplex Triode Amplifier—Class A
6P7—Triode Pentode Amplifier
6Q7-G—Detector Amplifier
6X5-G—Full Wave Rectifier
25A6-G—Pentode Amplifier—Class A
25Z6-G—Rectifier Doubler

Tape Transmitter

A new automatic tape transmitter for amateurs and schools is offered by Universal Signal Appliances, 64 West 22d St., New York City. It uses standard Kleinschmidt perforated tape, and may be used either to increase code speed or to key a transmitter. The



black crackle-finish cabinet contains an a.c.-d.c. ⅛th horsepower motor, with silent reduction gears. The sensitive polarized relay will accurately send code signals at speeds between 5 and 75 words per minute. Automatic wind and rewind of tape on bakelite reels is provided. The "Autotrans" is supplied complete with two rolls of practice tape, containing approximately 5000 words of press, etc.

Sectional Relay Rack

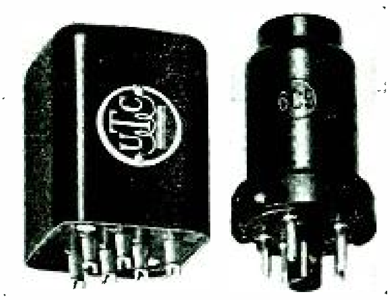
Constructors of rack and panel jobs have long felt a need for a system which would allow any desired height rack and panel to be built using standard knock-down parts.

I.C.A. presents such a useful item to the service man, p.a. engineer and amateur in the I.C.A. Sectional Standard Construction Rack. In this rack, any desired number of standard panels of any desired standard size may be accomodated simply by mounting together the requisite sections, which are available in as many sizes as there are standard panel widths.

The I.C.A. Sectional Standard Construction Rack is assembled easily with a screw driver and when completed forms a fully enclosed rack of professional appearance. The rack has a highly durable black wrinkle finish. Both sides and rear are sufficiently louvred for ventilation.

Ultra-Compact Audio Units

A new line of ultra-compact high-fidelity audio components is offered by the United Transformer Corp. Used with metal or acorn-type tubes an astonishingly small and light amplifier is made possible.



Weighing but 6 or 7 ounces, they measure up to good broadcast standards, the response being flat to plus or minus 2 db from 30 to 20,000 cycles. The units are primarily intended for noise-meter, remote, aircraft, and other work where a more bulky transformer would be undesirable. The line is fully described in bulletin V1100-D, available on request.

New Series of R.F. Chokes

Because of the need for plate chokes capable of carrying a fair amount of current without failure, Ohmite has recently brought out a complete line of single-layer wound chokes. These units are wound on porcelain tubes and covered with an insulating moisture-resisting material which holds the turns firmly in place. Because of the single-layer winding the difference in potential between adjacent turns is very small and possibility of breakdowns between turns or collapse due to inductive effect are eliminated. There are four sizes as follows:

Type	*Frequency*	*Wave Length*
Z-1	- 60,000 kc.	5 meters
Z-2	28,000 - 14,000 kc.	10- 20 meters
Z-3	14,000 - 7,000 kc.	20- 40 meters
Z-4	14,000 - 1,800 kc.	20-160 meters

All of these units with the exception of the 5 meter unit are furnished with non-magnetic mounting brackets and have sufficient spacing between the winding and brackets to insure against breakdown even when the chokes are mounted on metal panels. For high power operation it is recommended that the chokes be mounted on stand-off insulators.

Transmitter Tuning Wand

By a wave of the hand the inductance of a radio coil is either raised or lowered as desired by the operator using the magic Neon Tuning Wand as illustrated. For example, the wand indicates whether a capacitator should be increased or decreased to correct the tuning. The 10-inch tube is filled with sen-

sitive neon gas and gives a very brilliant light when brought into the r.f. field of a transmitter; it is perfectly safe because the caps are made of heavy molded

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bakelite, thus insuring protection against shock or burns.

The wand is manufactured by Sundt Engineering Co., 4238 Lincoln Ave., Chicago, Ill., for the primary purpose of aiding in tuning transmitters, indicating oscillation, resonance, and neutralization. However, it also may be used in aligning receivers.

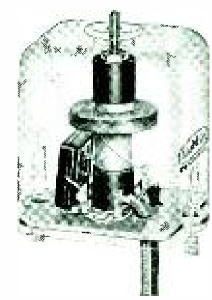
Special Purpose Oscillographs

To meet the demand for special applications, the R.C.A. Parts Division has announced the addition of two new types of oscillograph instruments to its standard line of test equipment. These are: a model operating on 25-cycle alternating current and a special "sweep" model.

Both are identical to the standard R.C.A. Oscillograph except that one operates on the 25-cycle alternating current in use in some areas, and the other has a special sweep oscillator which extends from 4 cycles to 18,000 cycles. After more than a year of successful operation in a wide variety of applications, it has been found unnecessary to make any changes in the original design of the standard R.C.A. Oscillograph, which will continue to sell at the same price.

Polyiron Wave Trap

To prevent code interference from commercial ship-to-shore stations, a unique new type of wave trap has been placed on the market by Aladdin Radio Industries. This wave trap differs from ordinary interference filters in that it is tuned by the movement of a magnetic core. The movable core varies the inductance of the coil which in combination with a fixed capacitor tunes to the frequency of the undesired code signals. The rejection ratio of the Polyiron wave trap is so much greater than that of the conventional air-core device that it effectively suppresses interference from code signals before it reaches the first tube of the receiver, without interfering in any way with normal reception of desired signals. The new wave trap is particularly effective on five- and six-tube superheterodyne receivers which do not have a radio-frequency stage preceding the converter tube.



New Technical Periodical

A new quarterly publication devoted primarily to technical papers on communication, broadcasting, television and the electronic and audio arts will make its initial appearance in June, under the title of *R.C.A. Review*. It will be published and distributed through the R.C.A. Institutes Technical Press, a department of R.C.A. Institutes, Inc., 75 Varick Street, New York.

In scope the new quarterly will be practically a record of significant developments in the engineering and research laboratories of the Radio Corporation of America and its associated companies. It also occasionally will contain papers presented before the radio, acoustical, optical and motion picture engineering societies. Among the special articles by R.C.A. research engineers and executives in the first issue of *R.C.A. Review* will be papers on television by L. M. Clement, Ralph R. Beal and Dr. V. K. Zworykin; the new micro-wave transmitter by O. B. Hanson, safety of life at sea by C. J. Pannill, radio communication by C. H. Taylor, and others.

HISTORY IN THE MAKING

The following resolutions, formulated by the Board of Directors of the Greater St. Louis Amateur Radio Club ["the Midwest's Largest Radio Club"] were presented by the Chairman, Mr. Royal Fisler, W9NBA:

Resolved:

1. That Mr. Norwine, W9EFC, Director of the Midwest Division of the A.R.R.L., oppose any move to purchase on behalf of the A.R.R.L. the building now occupied in part by the A.R.R.L. headquarters.
2. That Mr. Norwine initiate and/or support a motion to move the A.R.R.L. headquarters to the middle West where it would be more accessible to directors and members alike, and be able to more truly reflect the will of the majority of the members rather than a small geographical group centered near Hartford.
3. That Mr. Norwine initiate and/or support a move toward electing Mr. Roberts, the Director of the Central A.R.R.L. Division, President of the A.R.R.L.
4. That Mr. Norwine initiate and/or support an effort to remove Mr. K. B. Warner from the office of Secretary of the A.R.R.L.

Upon motion of adoption, duly made by Mr. Griffiths, W9OWD, and seconded by Mr. Wellman, W9FJP, and after discussion, the Club *unanimously* adopted said resolutions. Though only paid-up members were allowed to vote, all persons present were permitted to take part freely in the discussion which preceded the adoption of these motions.

◆

The ACR-175

[*Continued from Page 66*]

intermediate-frequency interference is notably less strong when receiving with a horizontal doublet, which of course discriminates against such ground-wave signals and may make it quite possible to reduce even severe commercial interference to low levels. Therefore, the doublets should be considered when noise or long-wave interference enters the picture, even if "man-made interference" from other sources is not objectionable.

◆

There are enough copper telegraph lines in America (1,864,643 miles) to provide 8 complete lines to the moon, if this were possible.

Osockme, Japan.

Dear Sirs, Gentlemen, and Ed.:

I are writing you, hon Ed., on account of because I are very sorrow. Very soon ago Scratchi send away for all parts for kilowatts transmitter at 40 per scents discounts so that he can come on air with colossus signals and be kings pin of land of Rising Sun. Sakes goodness alive, hon. ed., what you think. Scratchi are just getting new transmitter warm up after working few United Shakes stations and getting R's-9 reports, when in stalk importance looking gentleman with sour looking puss.

"Scratchi," he say, "I are the R.I., and it are against regulation for using of such kilowatts inputs. You will have to stopping same. It are a sin and a shame."

"Yes," I resnort, full of sorry. "It are a sin to using such high powers and a shame to have to stop."

I guess he are taking those remark as an insulk, Hon. ed., because he looking like perhaps will losing of temper and maybe prevoke Scratchi's license so are not allowing of operation at all. Also, this fellow he are very big guy, full of healthy and bulging of muscles, so are not such good ideas to aggravating him into taking haymaker at Scratchi's jaw. Scratchi are a very carefully person, and are always taking considerably precaution to preserve brotherly love, especials when other fellow are bigger than Scratchi.

Now this fellow are looking somewhats of crackpots gentleman, and Scratchi think maybe he can fool him with deseat. So I dashing around back quick like a rabbits, hon. Ed., and putting shunt on milliammeter, and also one on voltmeter for good measures, while R.I. gentleman are taking moment to glance at Poleece Gazette which are happen to repose on operating table. "Okay," I saying to the R.I., and grabbing hold of knob on panel which are not connected to anything back of panel. "I will reducing power to under legal Japanese maximum." Then I punch key and say to him: "Looking the meters, please. Input are now 249 volts at 73 ma." Which are the readings, hon. ed., after numbers 12 wire shunts are have been put across meters.

But the R.I. he are very wise guy. "I are not trusting you, Scratchi," he say. "I are going to check for myself. If input are low what you say, then grabbing hold of tank coil and to ground with other hand will not hurting. I are going to see if you are lying."

And what you thinking, hon ed? Those crazy fellow are taking quick grab ahold of tank coil on Scratchi's power house and punch key before you can saying "Fujiyama." Whooey. When Scratchi's ears stop ringing and smoke have settled, Scratchi have on hands one defunct R.I., deader as a doornail. My, my; woe are me. Oh, oh, hon ed., that are very serious offense, as serious as using phone on 40 meter band almost. And besides, hon. ed., it are blowing all the fuses, which are costing five perfectly good yen.

What I want to know, are how are Scratchi going compell the government to pay for new fuses which Scratchi had to put in. Those bunch of crooks do not wanting to pay for same, and I are most unhappy, hon. ed., because it do not look as though Scratchi will be able to collect. If you are having of ideas on the subject, please advise p.d.q.'s on account of I could use the 5 yen to help pay the power bill, which are certainly stewpendous now that Scratchi are using a Kalifornia Kilowatt, and there are no R.I. to make Scratchi simmer down on the inputs.

I are respectively yours,

Hashafisti Scratchi.

Universal Wheatstone Bridge

The R.C.A. portable "Universal" wheatstone bridge is a straightforward device of this class in unusually compact form. It is not intended for precision work, but the 5% (overall) precision obtained is enough for all ordinary radio needs, though it might not please a laboratorian. Weighing under 6 pounds and

The New R.C.A. Universal Bridge

measuring about 6" x 10" x 4", the case contains not only the bridge proper but also the 9 standards of resistance, capacitance and inductance against which comparisons are made, likewise a 25Z5 rectifier whose filtered output serves as plate supply for a 1000 cycle oscillator and a 2-stage audio amplifier. The oscillator tone is used to make measurements, while the 2-stage amplifier increases the output of the bridge so that a better balance can be obtained by ear, using a headset. The amplifier is tuned for better amplification and to suppress oscillator harmonics which sometimes cause a "dull" balance in bridge work.

The measurement ranges are 100 microhenries to 10 henries, 1 ohm to 1 megohm, and 10 micro-microfarads to 10 microfarads. These ranges are subdivided, the proper range being chosen by a 9-position gang switch and a high-low switch. The balance is always obtained by the same central knob which controls the ratio arm and has a plain scale from 1 to 10.

There is no such thing as a *pure* inductance, a *pure* capacitance or even a pure high resistance. Inductances have resistance and when a bridge-balance is made in inductance measurement, this resistance must also be balanced to obtain a good measurement. The R.C.A. bridge has two "phasing" controls which permit this correction to be made.

The same phasing controls are useful in getting good condenser-measurement balances.

Finally, if a high resistance is being measured, there is a good chance that a "dull" adjustment will result from capacity effects due to either the standard or the resistance under measurement. The R.C.A. bridge provides a compact, built-in variable condenser to effect this adjustment. It is used for resistors above 100,000 ohms.

None of the individual devices used in this bridge are new, as far as we can see, but their arrangement is new, and such as to do away with nearly all of the tedious adjustments of ordinary bridges. No calculation at all is needed—unless you call multiplying by 10 a calculation. It is a very nice job of simplification. The price may seem high at first—but this device measures just about all the constants of ordinary interest and requires no auxiliaries except a headset.

BUYER'S GUIDE

Where to Buy It

PARTS REQUIRED FOR BUILDING EQUIPMENT SHOWN IN THIS ISSUE

The parts listed are the components of the models built by the author or by "Radio's" Laboratory staff. Other parts of equal merit and equivalent electrical characteristics may usually be substituted without materially affecting the performance of the unit.

Becker 1 Kw. Amplifier

C_1—National type TMA-40DC

C_2—National type NC-150

C_3—National type TMA-50D

C_4—National type TML-30DE

C_5—Aerovox type 1883

C_6—Aerovox type 1450

RFC—National type R-154U

Fil. Trans.—U.T.C. type CS-403

The Marketplace

(a) Commercial rate: 10c per word, cash with order; minimum, $1.00. Capitals: 13c per word. For consecutive advertising, 15% discount for 3rd, 4th, and 5th insertions; 25% thereafter. Break in continuity restores full rate. Copy may be changed often as desired.

(b) Non-commercial rate: 5c per word, cash with order; minimum, 50c. Available only to licensed amateurs not trading for profit; our judgment as to character of advertisement must be accepted as final.

(c) Closing date (for classified forms only): 25th of month; e.g., forms for March issue, published in February, close January 25th.

(d) No display permitted except capitals.

(e) Used, reclaimed, defective, surplus, and like material must be so described.

(f) Ads not relating to radio or radiomen are acceptable but will be grouped separately.

(g) No commissions nor further discounts allowed. No proofs, free copies, nor reprints sent.

(h) Send all Marketplace ads direct to Los Angeles accompanied by remittance in full payable to the order of Radio, Ltd.

(i) We reserve the right to reject part or all of any ad without assigning reasons therefore. Rates and conditions are subject to change without notice.

120 WATTS OF AUDIO from 4 6L6's with our type 6L6-4 transformers, $16.50 per pair. 60 watts from 2 6L6's and type 6L6-2 transformers, $10.00 per pair. Power transformer to deliver 450 volts at 500 mills from filter, $9.75. Swinging and smoothing choke 500 mills each in single case, $11.00. Amplifiers and modulation equipment built to order. Prices net, FOB Los Angeles. Transformers guaranteed for one year against defects in material and workmanship. LANGRICK RADIO ENGINEERING SERVICE, W6PT, 626 Maltman Ave., Los Angeles, Calif.

W9KSR may write for free Handbook.

PORTABLE racks for your equipment. Send for circulars. R. H. Lynch, 970 Camulos, Los Angeles, Calif.

QSL'S! Bliley Crystals! RME 69's! "QST", "Radio" Subscriptions! W8DED, Holland, Mich.

A free Handbook to W5RB.

160 METER phone transmitter (r.f. portion and power supply) described in June RADIO, complete with tubes but less microphone, $55 (approximate cost of parts) F.O.B. Los Angeles. Delivers 35 watt carrier, may be modulated by any audio amplifier of 25 or more watts outut. RADIO, 7460 Beverly Blvd., Los Angeles.

WRITE us for trade-in price on your old receiver. We buy meters. Walter Ashe Radio Co., St. Louis, Mo.

One Handbook free to W1AYZ.

TRANSFORMERS REWOUND and built to specifications. Very best quality materials and workmanship. Ecoff Transformer Co., 7721 St. Albans Pl., St. Louis, Mo.

One Handbook free to W6MZY.

CRYSTALS and blanks. X or Y cut; 1750 to 2000; 3500 to 4000; close to your specified frequency $1.35. Blanks, unfinished 60c. Bill Threm, W8FN, 4021 Davis Ave., Cheviot, O.

RAW QUARTZ—finest quality, for the manufacture of piezo crystals. Largest, most complete and varied stock in America. Brazilian Importing Co., Inc., 6 Murray St., New York City.

$1.50 will buy an Eidson "T-9" 40 meter crystal, accurately calibrated and fully guaranteed—see May ad. Something new:—attractive and efficient Insulex (low-loss ceramic) 40 meter plug-in holder only $1.10 postpaid, very FB. "Eidson's", Temple, Texas.

SPECIAL 866B's—$3.75. 866's—$1.65. Guaranteed six months. F. B. Condenser mike heads $10.00. 100 watt Universal Class "B" transformers $8.00 pair. Langrick Radio Engineering Service. W6PT. 626 Maltman Ave., Los Angeles, Calif.

TRANSFORMER—2½ kw., 110 V.—New, Hilet, 3000-2400-1850 each side. Cost $78.00. Will sell or trade for gun, binoculars, machinery, or what have you. Leitch, Park Drive, West Orange, N. J.

QSL's 300 one-color cards $1.00. Samples. 2143 Indiana Ave., Columbus, Ohio.

SELL 75 watt phone transmitter, including speech and power supplies, $80. Portable 75 watt c.w. transmitter, complete with power supply but less accessories, in handy carrying case, $45. Half kilowatt output stage, 5 to 160 meters, less power supply, $45. All prices f.o.b. Los Angeles. RADIO, 7460 Beverly Blvd., Los Angeles.

POWERFUL X CUT CRYSTALS. ACCURATELY CALIBRATED. PERFECT OSCILLATORS. COMPLETELY GUARANTEED. 40 meter band $1.85. 80-160 bands $1.50. Jobbers write. W9JRY OMAHA CRYSTAL LABORATORIES, 501 World Herald Bldg., Omaha, Nebr.

CRYSTALS: AT cut, your frequency 80 or 160 meters $1.75. BT cut, 40 meters $3.25. All full size. Holders $1.00. W8CHJ, 9255 Herkimer, Detroit, Mich.

FIVE METER equipment Receivers $9.50; Transmitters $7.00. We build equipment to order. Precision Radio Laboratories, 109 East 94th Street, Brooklyn, N. Y.

METERS repaired—reasonable prices. Braden & Apple Co., 305 Park Drive, Dayton, Ohio.

QSL SWL Cards, neat, attractive, reasonable. Samples free. Miller, Printer, Ambler, Pa.

SELL—Silver 5B $30; Silver converter type 11C wired $8. W6GTM.

To W3FAQ a free Handbook.

DIATHERMY—de luxe construction. Complete. $125 F.O.B. W2CFU, Pelham, N.Y.

SPECIAL CRYSTALS . . . AT cut with shielded mounting. 80 and 160 meter bands, $2.35. White Radio Laboratory, Sandpoint, Idaho.

FOR SALE: Complete 250 watt fone transmitter. Microphone to antenna. Push-pull class A. modulated. A real quality job of commercial appearance. $235.00 complete. For complete details, write W6DA, 829 Boston Place, Pomona, Calif.

100 watt 3000 volt tetrodes type UW-100 last two at $10. Robert S. Kruse, Guilford, Conn.

To W8JMH a free Handbook.

SELLING surplus: 400 watt amplifier, 1500 or 2000 volt power supply. SW3, two mills, meters, 261A's, 212D, 211, 852. 300 mil modulation choke. MG and transceiver. Miscellaneous parts. Swap? W6QF, North Hollywood, Calif.

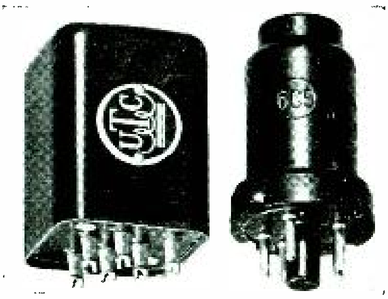
TRANSFORMERS, chokes, all types. Reasonable. Guaranteed. Special universal class B inputs and outputs 100 watts audio—pair $8.00. California Radio Labs., W6CYQ, 2523 South Hill Street, Los Angeles.

W7BQW may write for free Handbook.

Most Complete Transformer Line in the World

QUALITY • RELIABILITY

New ... UTC ULTRA COMPACT AUDIO UNITS...

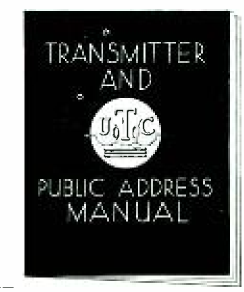


Designed as companion units for acorn and metal type vacuum tubes. They measure up to good broadcast standards, having a response of plus or minus 2 db from 30 cycles to 20,000 cycles. The average weight is 6½ ounces, and the overall dimensions are 1 7/16 x 1 7/16 x 1 15/16. These units are primarily intended for noise meter, aircraft and remote pickup work. Full description of these units is contained in the new U1100D bulletin.

TYPICAL ULTRA COMPACT AUDIOS

Type	Application	Primary Impedance	Secondary Impedance	List Price
A-10	Multiple line or microphone to single grid	500, 333, 250, 200, 125 or 50 ohms	50,000 ohms	$10.00
A-12	Multiple line or microphone to 2 grids	500, 333, 250, 200, 125 or 50 ohms	80,000 or 20,000 ohms	10.00
A-14	Dynamic microphone to 1 or 2 grids	30 ohms	50,000 or 12,500 ohms	9.00
A-16	Single plate (6C6, 955, 262A etc.) to single grid	15,000 ohms	60,000 ohms	8.00
A-18	Single plate (6C6, 955, 262A etc.) to 2 grids	15,000 ohms	80,000 or 20,000 ohms	9.00
A-20	Multiple line or microphone to multiple line	500, 333, 250, 200, 125 or 50 ohms	500, 333, 250, 200, 125, or 50 ohms	10.00
A-22	Dynamic microphone to Multiple line	30 ohms	500, 333, 250, 200, 125, or 50 ohms	9.00
A-24	Single plate (6C6, 955, 262A etc.) to multiple line	15,000 or 3,750 ohms	500, 333, 250, 200, 125, or 50 ohms	10.00
A-26	Push pull plates (6C6, 955, 262A etc.) to multiple line	30,000 or 7,500 ohms	500, 333, 250, 200, 125, or 50 ohms	10.00
A-28	Bridging transformer	4000 ohms	500, 333, 250, 200, 125, or 50 ohms	10.00

Ask your distriubtor for the U1100D bulletin describing these new ULTRA COMPACT AUDIOS.



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VM-4

VARIMATCH transformers are designed to match all available modulation tubes to class C, RF stage.

Type	VARIMATCH Modulation Transformer	List Price	Net Price
VM-1	Will handle any power tubes to modulate a 20 to 60 watt Class C stage	$8.00	**$4.80**
VM-2	Will handle any power tubes to modulate a 40 to 120 watt Class C stage	12.50	**7.50**
VM-3	Will handle any power tubes to modulate a 100 to 250 watt Class C stage	20.00	**12.00**
VM-4	Will handle any power tubes to modulate a 200 to 600 watt Class C stage	32.50	**19.50**
VM-5	Will handle any power tubes to modulate a 450 watt to 1 KW plus. Class C stage	70.00	**42.00**

The secondaries of all Varimatch transformers are designed to carry the class C plate current.

THE VARIMATCH TRANSFORMER NEVER BECOMES OBSOLETE

Full details can be found in the June issue of "RADIO". If not available, ask your distributor for VARIMATCH bulletin listing load impedance chart & typical examples.

THE units illustrated below are typical examples of the flexible manufacturing facilities of the UTC organization. In addition to the large number of standard items manufactured by UTC, many units are specially designed and produced to customers' specifications. Among the users of this service are such organizations as RCA, GE, Western Electric, Bell Telephone Labs., ERPI, and others of similar calibre.

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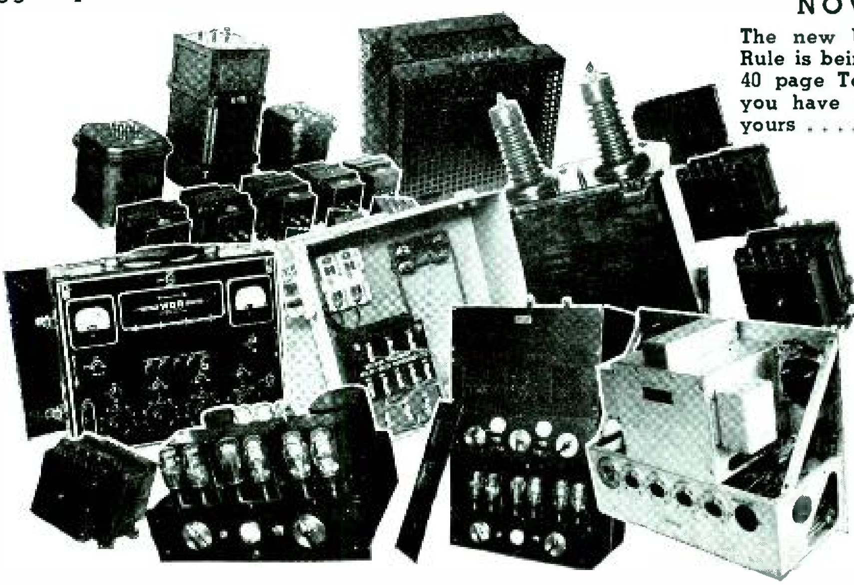

UNITED TRANSFORMER CORP.

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