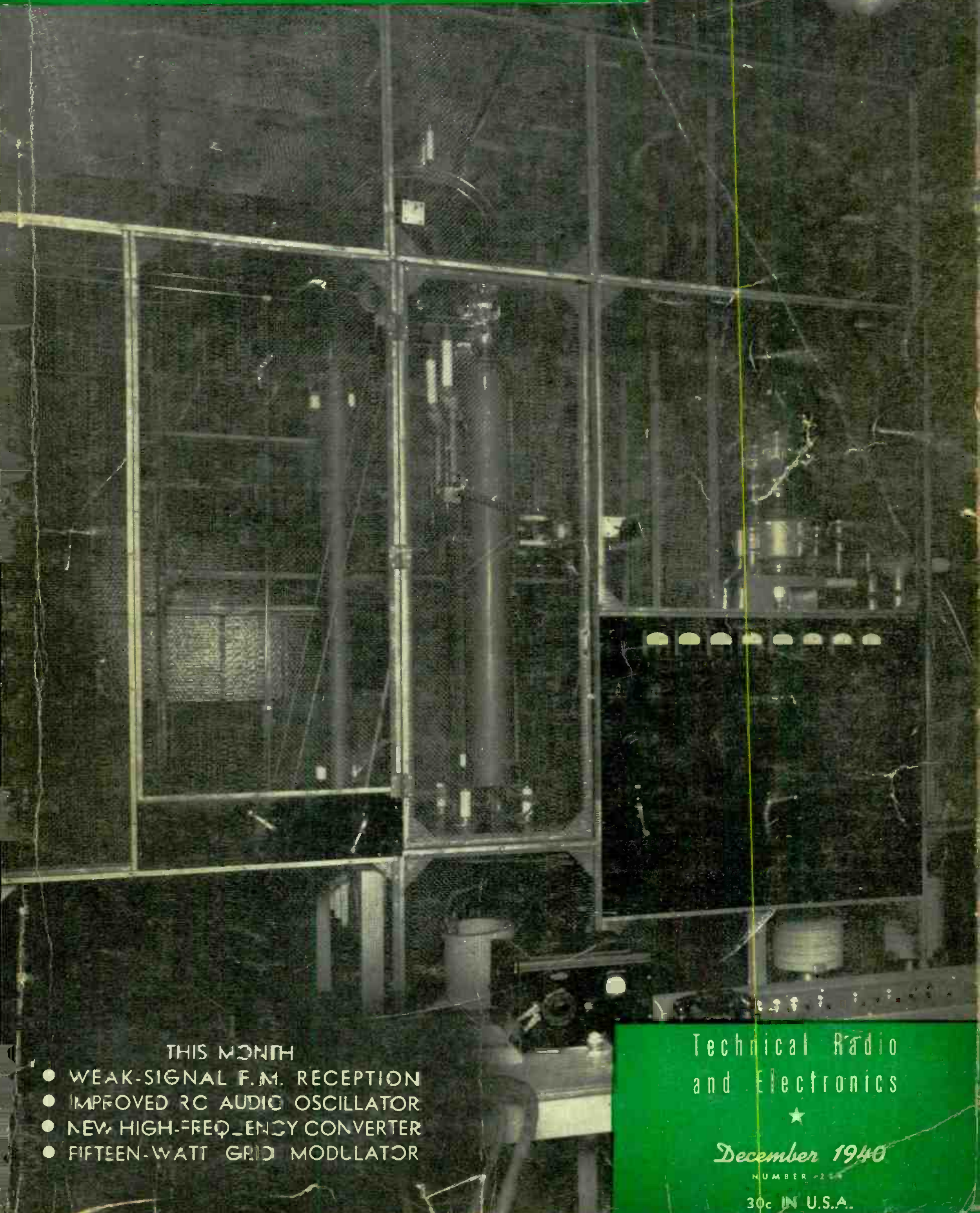
RADIO

ESTABLISHED 1917



THIS MONTH
- WEAK-SIGNAL F.M. RECEPTION
- IMPROVED RC AUDIO OSCILLATOR
- NEW HIGH-FREQUENCY CONVERTER
- FIFTEEN-WATT GRID MODULATOR

Technical Radio
and Electronics

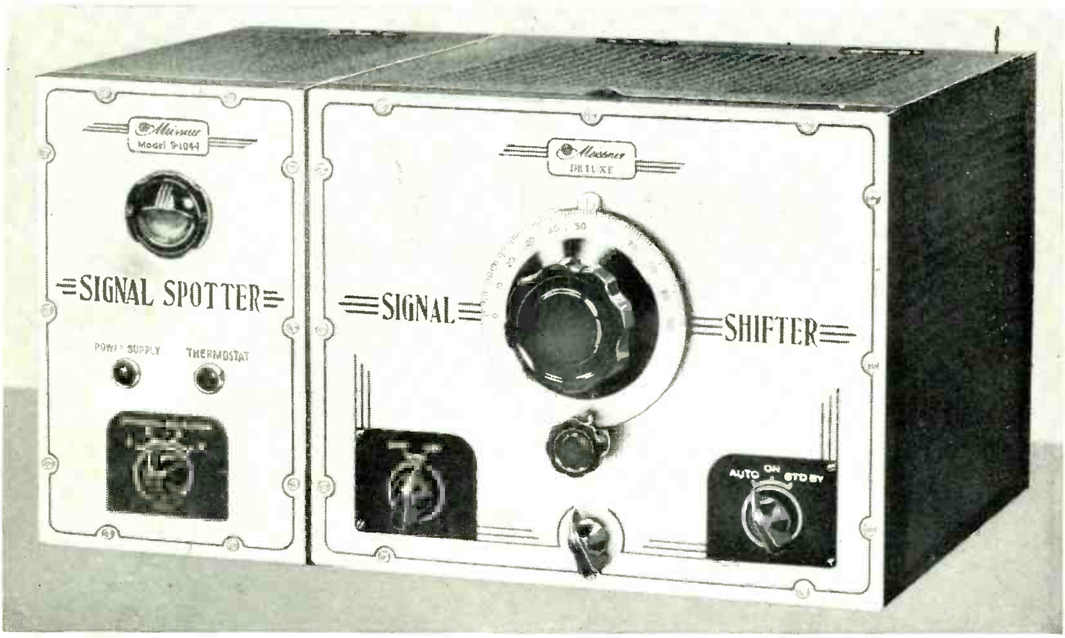
★

December 1940

NUMBER 2[illegible]

30c IN U.S.A.

Here's the Winning Combination—



Four X'tals and a Precision E-C-O!

The New Meissner

SIGNAL SPOTTER

- ★ Four "Spot-Frequency" Crystals
- ★ Front Panel Crystal Switching
- ★ Pre-Tuned Tank Circuits
- ★ Provision for Crystal Oven and Thermostat Temperature Control

In response to unprecedented demand, we present a companion unit to the popular Meissner Signal Shifter—the Signal Spotter. Basically, the Signal Spotter is a crystal-controlled oscillator, operating from the voltage-regulated power supply of the Signal Shifter. Four crystals may be used and the desired "spot frequency" is instantly selected by a front panel control knob. A separate control on the Signal Shifter panel enables the operator to switch to either ECO or Crystal excitation. The four crystals can be placed on any one amateur band or may be divided over any two bands. Provision is made for installation of a Meissner Crystal Oven, designed to accurately control temperature of the crystals. Independent, pre-tuned tank circuits; designed for operation with any type amateur crystal.

SIGNAL SPOTTER, Complete with tubes and coils
No. 9-1044 Amateur Net $22.45

The Improved Meissner

SIGNAL SHIFTER

- ★ Positive ECO Stability-Flexibility
- ★ Oscillator Keying for Break-In
- ★ Instant Switching from Crystal to ECO
- ★ Complete Voltage Regulation and Temperature Compensation

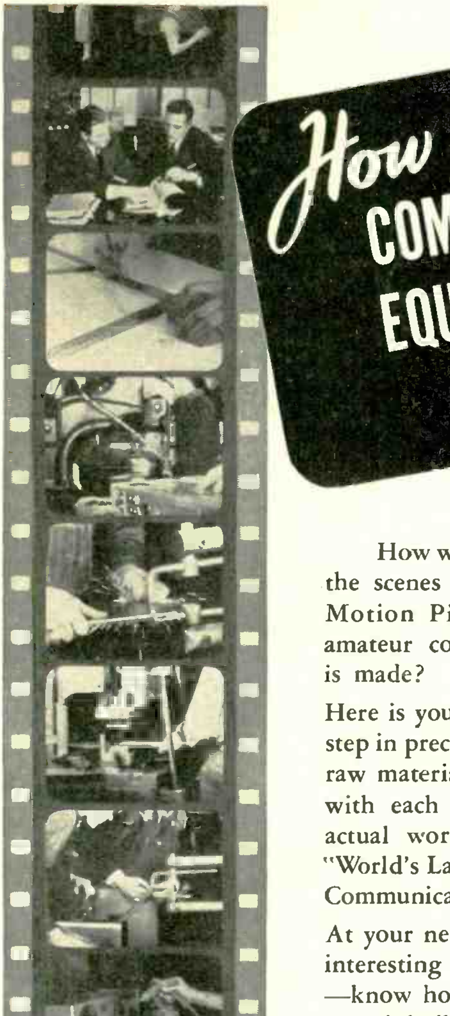
The popular Meissner Signal Shifter, universally used and accepted as the outstanding standard of ECO design, now features oscillator keying for perfect "break-in" operation. The Signal Shifter is so well known that it is hardly necessary to repeat the story about its many points of merit. Positive PROOF of dependability, accuracy, stability and flexibility is clearly shown by the widespread acceptance of the precision-built Signal Shifter—throughout the amateur fraternity! The Signal Shifter—Signal Spotter Combination provides a COMPLETE SYSTEM for positive frequency control and selection: the Signal Shifter for full-band flexibility—the Signal Spotter for extreme band-edge operation, network frequencies, etc. This team deserves a place in every modern amateur station.

SIGNAL SHIFTER, Complete with tubes and coils
No. 9-1028 Amateur Net $47.50

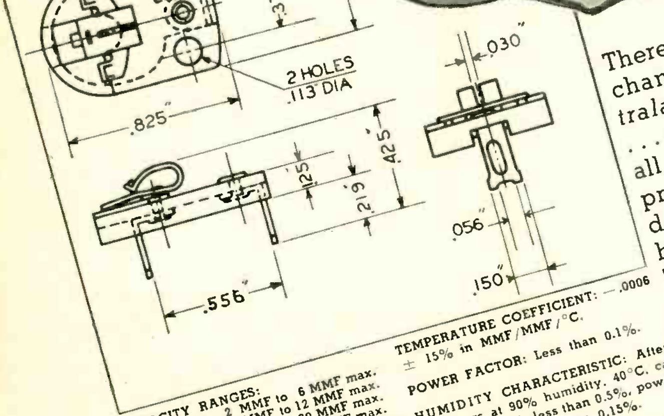
Write Today for Complete Amateur Catalog!

ADDRESS DEPT. A-12

Meissner
MT. CARMEL
ILLINOIS
"PRECISION-BUILT PRODUCTS"



Centralab's
New Trimmer
CERAMIC CONDENSER



CAPACITY RANGES:
(a) Less than 2 MMF to 6 MMF max.
(b) Less than 3 MMF to 12 MMF max.
(c) Less than 7 MMF to 30 MMF max.
(d) Less than 60 MMF to 75 MMF max.
Other ranges may be manufactured if in demand.

RETRACKING: After repeated cycles of heating and cooling, capacity change is less than 0.5%.

TEMPERATURE COEFFICIENT: —.0006 ± 15% in MMF/MMF/°C.

POWER FACTOR: Less than 0.1%.

HUMIDITY CHARACTERISTIC: After 100 hours at 90% humidity, 40°C. capacity change is less than 0.5%, power factor reading less than 0.15%.

There are no erratic capacity changes with the new Centralab Trimmer Condensers . . . the dielectric and base are all one piece moulded under pressure with a ceramic so dense that no temperature or humidity changes can affect it. The stationary plate is silver, bonded to the ceramic with no air film between. The movable plate is metal, rotatable on the flat ground surface of the ceramic . . . a worthy companion . . . and a new member of the famous CENTRALAB family.

CENTRALAB Div. of Globe-Union Inc., Milwaukee, Wis.

RADIO

the worldwide authority . . .

Published by
RADIO, Limited

Home offices: 1300 Kenwood Road, Santa Barbara, California

Telephone: Santa Barbara 4242
Bell System teletype: S BAR 7390
Cables: RADIOLTD SANTABARBARACALIF

December • 1940 The publishers assume no responsibility for statements made herein by contributors and correspondents, nor does publication indicate approval **No. 254**

Table of Contents

Cover: The high power amplifier stages at FM station W2XMW, Alpine, N. Y.

ARTICLES

MISCELLANEOUS FEATURES

DEPARTMENTS

CORRESPONDENCE and **ORDERS** should be sent only to our home offices. **MANUSCRIPTS**, if unsolicited and unusable, will be destroyed unless accompanied by a stamped, self-addressed envelope.

ADVERTISING copy and cuts (fully mounted and mortised) should be sent to "Radio," Production Office, 417 S. Dearborn St., Chicago; send duplicate copy and insertion order to Santa Barbara, as no advertisement will run until home office telegraphs its approval thereof.

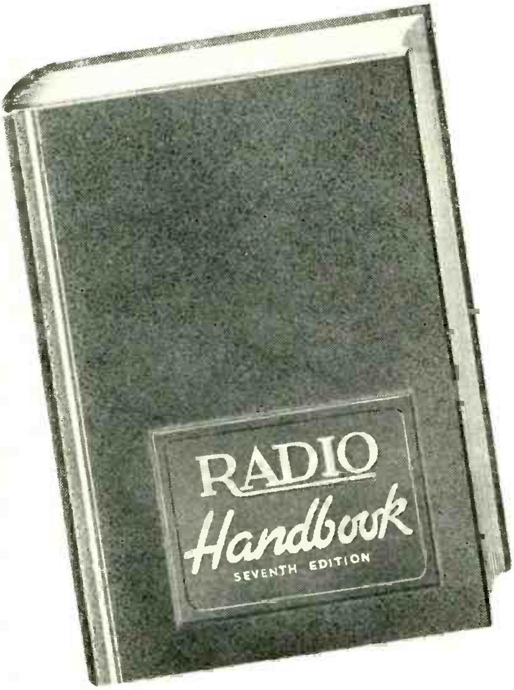
SUBSCRIPTION RATES (in U. S. funds): Two years, $4.50, or $2.50 yearly in U.S.A. (plus tax in Illinois). To Canada (inclusive of current taxes), Pan-American countries, and Spain, $0.50 per year additional. Elsewhere, $1.00 per year additional. Ten issues yearly; back issues are not included in subscriptions.

IF YOU MOVE, notify us in advance; we cannot replace copies sent to your old address. Notice must be received by the 5th of the month preceding the cover date of first issue to go to the new address.

PUBLISHED monthly except August and September (and **COPYRIGHTED**, 1940) by Editors and Engineers, Ltd., 1300 Kenwood Road, Santa Barbara, Calif. **ENTERED** as second-class matter Sept. 26, 1939 at Santa Barbara, Calif., under the Act of March 3, 1879. Additional entry at Mt. Morris, Ill. All rights reserved. **TITLE REGISTERED** in U. S. Patent Office. **PRINTED** in U. S. A.

1941 "RADIO" HANDBOOK

Clothbound and Goldstamped



Indisputably the outstanding annual text of practical and technical radio, the big 1941 "Radio" Handbook is *available now!* No other radio book contains so much previously unpublished and easy-to-understand material between two covers. No other radio book contains over 600 profusely illustrated pages, bound in cloth and stamped in gold. No other radio book offers you so much for its price.

ORDER YOUR COPY TODAY

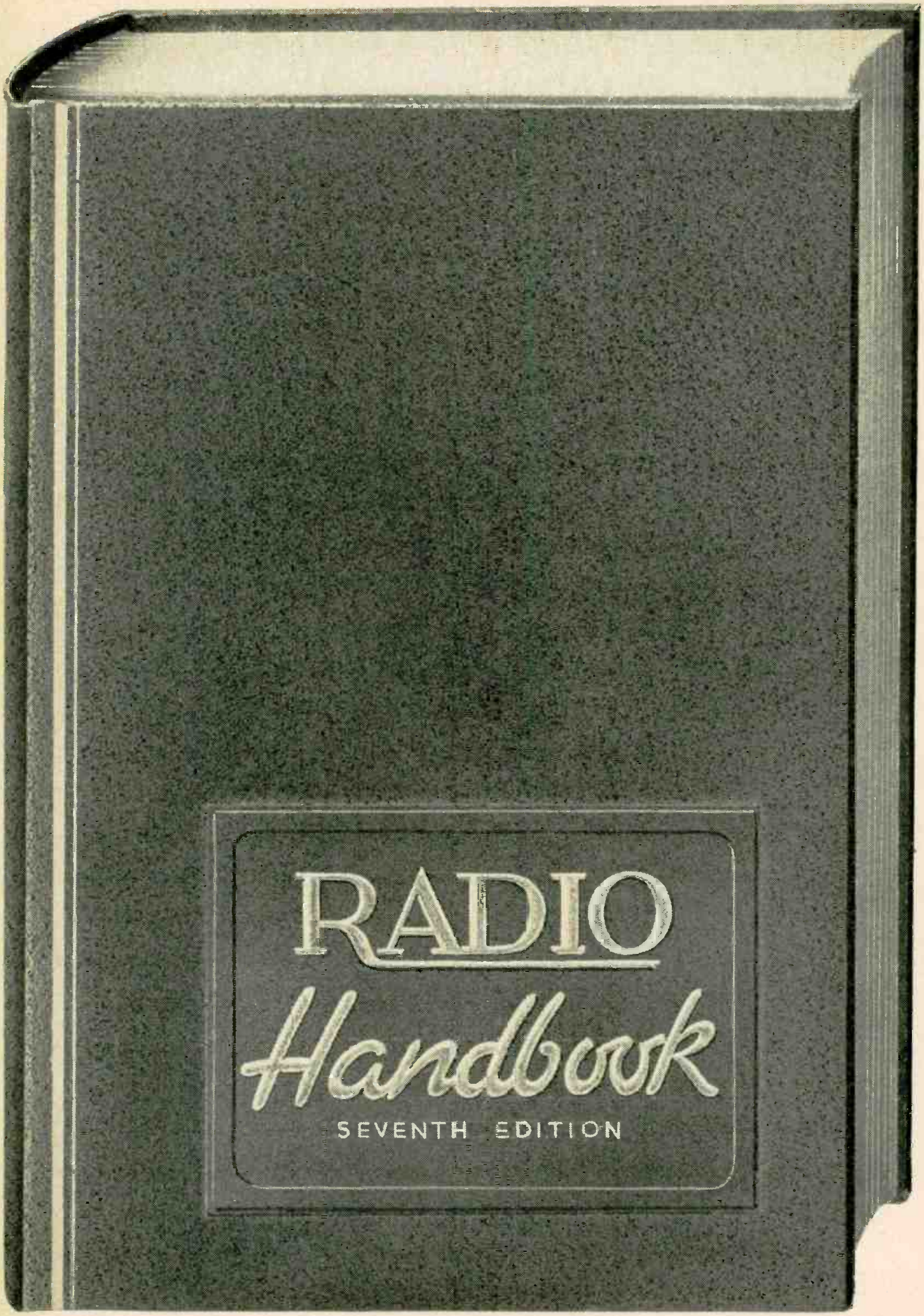
This is the first time we have published a clothbound, goldstamped edition of this famous book! We offer it to you at a popular price—only ten cents more than previous paper bound editions. Be sure to *order your copy today* prepaid direct from us, or at your favorite radio parts store or newsstand.

Copies of the previous paper bound edition have been exhausted for several months. 20,000 of them were sold during the first six months of the sale period. To avoid disappointment and to avoid waiting for the second printing, we urge you to *order now.*

$1.60 in Continental U. S. A. **(prepaid)** **Elsewhere $1.85**

(On mail orders, Illinois and California customers please add 3% sales tax)

THE EDITORS OF
RADIO *technical publishers*
1300 Kenwood Road, Santa Barbara
CALIFORNIA


RADIO
Handbook
SEVENTH EDITION

Past Present and Prophetic

Low-Frequency Economy

Pity the poor 160-meter man. He often laments that no publisher pays any attention to him—this in spite of the material expressly intended for the low-frequency devotee which has appeared in this magazine. Just to show that our good intentions remain intact, we present Adams' 160-meter final amplifier on page 22, which shows how economy of tank design can be achieved through a proper choice of operating conditions.

10,000 to 1

As promised last month, Editor Dawley whipped his audio oscillator into shape for this issue. We never cease to be amazed at the frequency range of this type of oscillator. There seems to be no limit to the upper frequency end. The new oscillator, which is shown on page 16 easily covered a range of 10,000 to 1 in frequency, going from 17 cycles to 170 kc. with the greatest of ease. Of course there is no useful purpose in having high frequency operation above 20,000 cycles for audio testing, so the values used in the final design do not include provision for the extremely high frequency range. A mighty useful gadget, though, and we heartily recommend it to that increasing group of experimenters interested in audio measurements.

Rttn Splg es Ntnl Dfnse

Much as we hate to suggest the possibility, your scribe is willing to bet that a dozen eighth graders picked at random could spell down a dozen radio amateurs picked at random. Basis for this prediction is the atrocious spelling found in some of the letters from our readers. The quality of spelling in manuscripts offered to us for publication is often but little better. We never cease to be amazed at the highly original phonetic spelling employed by several of our best qualified technical writers.

Now, we would not be concerned in the least with the spelling of either our readers or authors except for one thing: It behooves every one of us to justify Uncle Sam's faith in us by raising his code proficiency to the highest possible degree. If you can not spell accurately and with facility, you can never expect to become much of a speed demon when receiving code. Good copying technique requires that the operator copy "behind" at high speeds. For a poor speller this is exceedingly difficult.

As a painless method of spelling improvement, we offer the following suggestion:

When you are engaged in a rag chew on c.w., forget the "ham abbreviations" which we have used for so long not only for purposes of time saving but as a means of covering up our shortcomings with regard to spelling. Keep a dictionary handy—an inexpensive pocket volume will do—and spell out every word. If you stumble on one, look it up after the QSO. And don't be afraid to use words of more than one syllable for fear of being considered pedantic. Instead of the usual "Wx fb hr 2da," why not "The weather here is unusually fine today."

It is unlikely that there is a word in that sentence that anyone will have trouble in spelling correctly; but if you start spelling out every word used in your rag chewing, you will be surprised at the number of times you will bog down with uncertainty in the middle of a word. Unless, of course, you are one of those amateurs whose spelling is impeccable.

F.M. DX

Now that the F.C.C. has issued commercial licenses to about 15 frequency modulation stations in 13 different metropolitan centers, you might be interested in knowing the possibilities of worthwhile reception from these stations in your particular location. If so, read Ferrell's article beginning on page 11. The results of a lengthy period of experimentation with f.m. at the limit of the reception are discussed. One interesting sidelight of a recent article concerning f.m. coverage is that while 1 kw. will cover approximately 80 miles with a reasonably good signal, an increase of power to 50 kw. will only increase the coverage to around 110 miles.

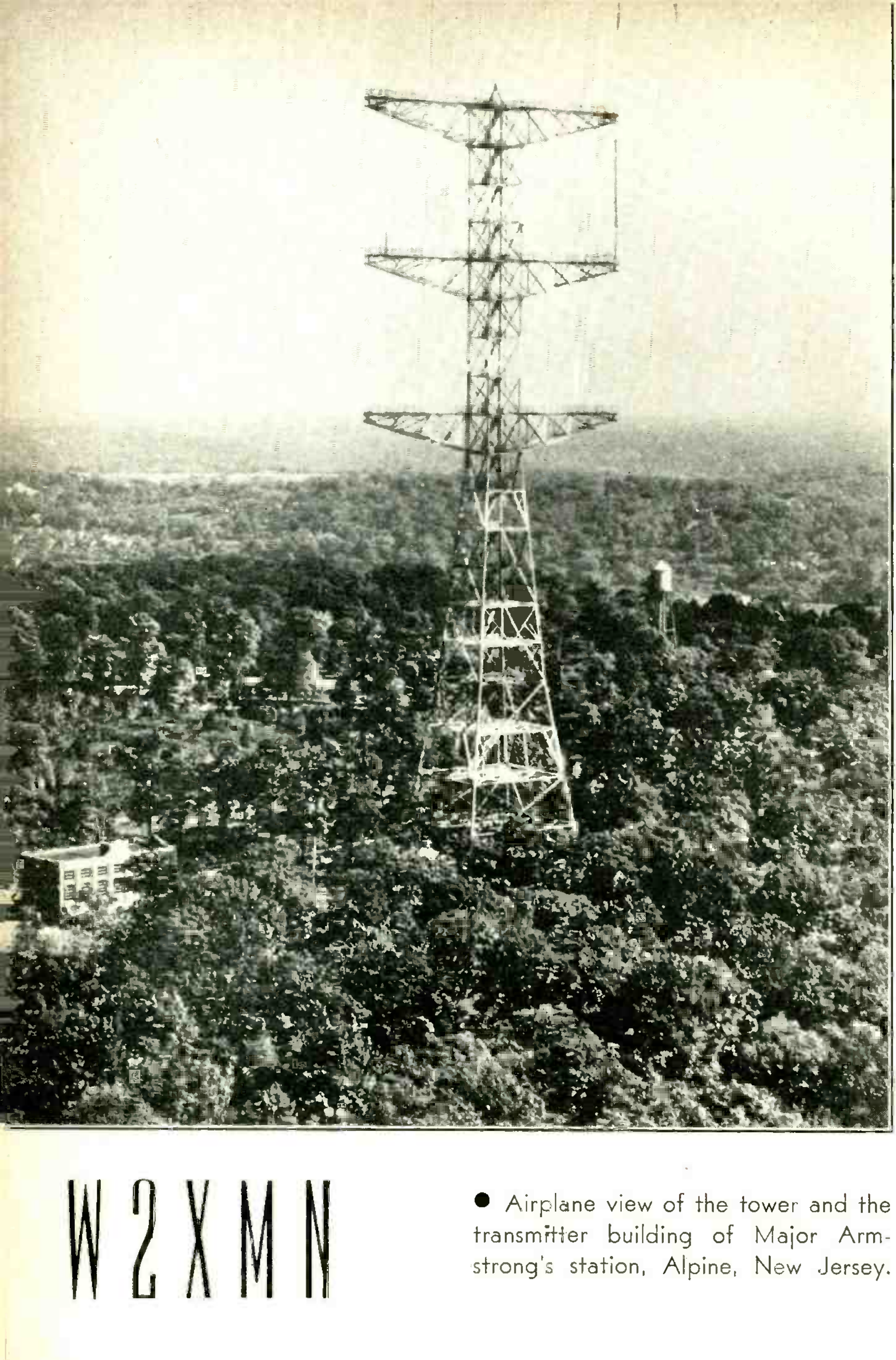
Author

Do you have a piece of equipment or an idea that you believe merits description or discussion in Radio? If so, look over Production Manager McNatt's article on page 39 and hie yourself to the mill. McNatt should know about these things, since he wangled several excellent articles past the editorial blue pencil before becoming a member of the staff.

Diathermy Band?

When we told about Seattle's diathermy regulations last month we didn't know that the F.C.C. was also on the trail of the hapless diathermy oscillator. But a late release announces that an engineering conference will

[*Continued on Page* 77]



W2XMN

● Airplane view of the tower and the transmitter building of Major Armstrong's station, Alpine, New Jersey.

Weak Signal
FM RECEPTION

By PERRY FERRELL, Jr.*

A discussion of the reception of weak FM signals over a non-optical path. The results indicate the possibility of utilizing FM transmission as a means of increasing the usable coverage of UHF transmitters.

After going over most thoroughly the recent published mass of technical material about FM, it was noted that there is a particular lack of data on actual FM reception over long or, rather, extended ground wave paths. It was evident, for the most part, that little extra thought had ever been given, also, to skywave propagation. The idea seemed to be current that little difference between old amplitude modulation as applied to the u.h.f. and the present new FM system would be noted, except, naturally, for the noise suppression qualities of FM.

The writer, who has had more than a passing interest in u.h.f. reception during the past five years, has been able to study at first hand weak signal FM reception by utilizing an R.E.L. 517A FM receiver given him for such work by Major E. H. Armstrong. This particular receiver, although a standard model, proved to be excellent for our purposes. The careful designing that resulted in such good performance can be noted from the following tube complement: In the r.f. stage is an 1852 which is separately tuned from the panel; a 6K8 acts as converter tuning 40.0-44.0 Mc. This is followed by two more 1852's in the 1700-kc. i.f., with a 6SJ7 limiter and a 6H6 as detector. The audio comprises a 6C8G and two 6V6's in the push-pull output stage with an 83V as rectifier. Mechanically, there are provisions for a shielded di-pole input, 8-ohm and 500-ohm line output, and two meters on the panel. One meter is solely for correctly centering the broad FM carrier by the swing-through method. The other is for reading the limiter grid current (which is hereafter referred to as l.g.c.) up to values of 2.0 ma.

Electrically, the received FM signal affects the l.g.c. (It may be considered, for all practical purposes, that the limiter grid reading is a field strength reading, as the plot of r.f. voltage input against l.g.c. is practically linear on low signal strength values) and readability as graphed in figure 1. Here the left hand ordinates are values of a.c. voltage measured from the 8-ohm line in the a.f. output of the receiver. Although this method would appear to be slightly rough, it proved quite effective in our particular case. To the right the ordinates are db values, which were likewise measured from the output circuit. In both cases the abscissas are milliamperes of l.g.c. The heavy line graph shows the output in a.c. volts of a received 1000 cycle tone signal from W2XMN, while the light line graph shows in db the tube rush and noise in the a.f. output as being reduced by effective unmodulated carrier strength.

From that we are able to draw the following information. The normal resting position of the l.g.c. meter is between .05 and .10 ma. due to the tube rush, and as we said before the readings vary proportionally to the local signal strength. In generalities an extremely weak signal which would draw but .10 ma. of l.g.c. could be 100% readable, if no fading were present, with only a very slight decrease in the rush level. Nevertheless, from an amateur standpoint a signal this weak could provide contact with a station that in amplitude modulation work would be completely inaudible! Fractionally this constitutes a signal with a field strength at the antenna terminals of much less than one microvolt. Correspondingly, a signal with a strength of .25 ma. would be considerably steadier, in regard to fading, and would have about 25 db of the noise and tube rush suppressed. Signals draw-

---

*107 East Bayview Ave., Pleasantville, New Jersey.

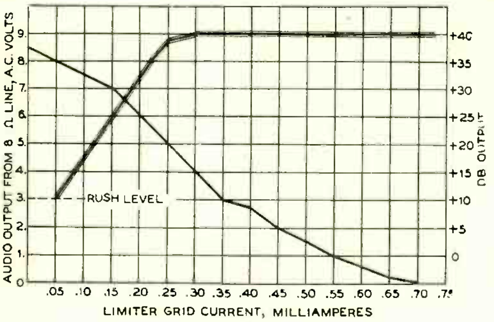


Figure 1. Graph showing limiter grid current plotted against inherent noise in the receiver (narrow line), and against audio voltage across the 8-ohm output terminals (heavy line). The heavy line is plotted against the left-hand vertical scale (ordinate) and shows the output in a.c. volts of a 1000-cycle test tone signal received from W2XMN. The light line is plotted against the right hand ordinate and shows the reduction in decibels of the inherent receiver noise as a function of the received signal strength (limiter grid current values).

ing up to .50 ma. would have less than 4 db of the rush left in the a.f. output and are still to be considered extremely weak.

The heavy line graph also indicates the effective natural a.v.c. action, the output remaining almost constant on input values greater than .30 ma.

The Tests at Pleasantville

The first tests were made at the home location in Pleasantville, which is on the southern New Jersey mainland, 5 miles inland from the Atlantic Ocean and exactly 100 miles south of the heart of New York City. A horizontal dipole 74 feet above sea level and a vertical dipole 65 feet above sea level, both well in the clear and free of all obstructions, were used as the receiving antennas.

At the time of the first tests the only stations on the air were: W2XMN, 42.80 Mc., the Major's own station in Alpine, N.J., at distance of 114 miles using a 16-element turnstile 900 feet above the Hudson River and about 20,000 watts power output; W1XPW, 43.40 Mc., the WDRC outlet at a distance of 174 miles who were using an 8-element turnstile 700 above sea level atop Meridan Mountain outside of Avon, Conn., with a power of 1000 watts; and W1XOJ, 43.00 Mc., the 25-kilowatt Yankee Network station on the summit of Asnebumskit Hill, Paxton, Mass., using a 12-element turnstile, which was 243 miles away.

Theoretically and in actual practice all these signals were to be considered weak. In fact the strongest, W2XMN, only averaged .50 ma. of l.g.c. over an extended period of observation. This is a greatly attenuated signal because our location is some 2,300 feet below the quasi-optical range of our combined antennas. However, as an average weak FM signal it was still suitable for "program value," were it not for the factor of fading, which will be discussed later. The signal strength of .50 ma. will remove all the audible tube rush in the receiver. The receiver will then be subject only to very severe ignition noise or to the effect of the 2 to 1 signal to noise ratio in FM reception.

The maximum signal observed from W2XMN was during a spell of especially good air boundary bending when a reading of .80 ma. second i.f. grid current was taken. The minimum signal was heard during Easter Weekend, 1940, when all amateurs probably will recall the severe ionosphere disturbances. Here the signal dropped to .10 ma. and developed peculiar fades and sounds of roaring in the program background (barrel-like effect). It is not positively indicated here that during bursts of sporadic E and aurora extended ground wave signals tend to drop in strength, although such is most probably the rule and not the exception.

Tests from Atlantic City

By the middle of August plans were completed whereby the receiver would be demonstrated and air-tested from the Tower Room of the Haddon Hall Hotel in Atlantic City, N.J. This change in location entailed a move of 6 miles eastward, placing our antenna 260 feet above sea level with the ocean but 100 yards away. At this position the signal from W2XMN increased to an average of .90 ma. Noticeable here, also, was the surprising increase in the depth of fading as compared to that of the home location (see figure 2). Something might be said here toward the use of diversity reception, although it appears doubtful that the fading situation can be improved through diversity due to the nature of the condition which causes the fading making the placement of antennas impracticable, if not impossible.

Reception of 1-Kw. W1XPW

The signal of W1XPW under the circumstances was very impressive remembering the 1 kilowatt of power. During the period of tests from Pleasantville the signal was always "in there" and it was an exceptionally poor day that even the W1XPW carrier could not be heard on the 43.40 Mc. channel. (In listening for very weak FM signals the presence of a carrier makes a slight increase in the rush level of the receiver before sufficient strength is obtained to actuate the limiter circuit.) From the average of .10 ma. the move to Haddon Hall increased the signal to an average of .25 ma. and a peak of .70 ma. Here, also, the extent of fading was changed, but its severity somewhat reduced.

Consistent Reception Over 243 Miles of W1XOJ

Reception of W1XOJ was to prove most interesting since during the interim of the first tests the W1XOJ power output was varied between 500 and 2,000 watts while the antenna was being tested before its assembly atop the 400-foot pole. At that time of year when even the slightest lower atmosphere bending was absent, only "spot-tuning" could be used. On fade lulls not a sound could be heard on that channel, while even on fade peaks only a few words or the sound of a weak carrier would break through the receiver rush. The raising to full power, correspondingly, raised the local strength to a steady .15 ma. at the home location. This signal, although originating from a point 243 miles distant, now became audible at all times and again was not as subject to the severe fading that affected W2XMN.

At the portable location, the signal increased beyond the expected value; it then averaged .45 ma. and was peaking at .80 ma. (At the portable location these readings were taken with a dipole, horizontal, directly favorable to each station. The end-on to broadside signal difference on W2XMN, for example, was .40 ma. end-on and .95 ma. broadside.)

Conclusions from the Foregoing

All in all we were able to conclude from the preceding information that the use of FM was giving us program quality reception 85 per cent of the time from one station and readable signals from two others in the New York area. At the same time amplitude modulation reception from this area was generally unsatisfactory due to the high noise level and low signal strengths from stations of comparable power and antenna height. A possible exception to this was the signal from W2XBS, the 10-kilowatt sound transmitter of the NBC television station. The antenna of W2XBS was about 100 miles distant and although located at a height of 1250 feet above sea level the signal strength was only about R4 to R5 and greatly bothered by automobile ignition.

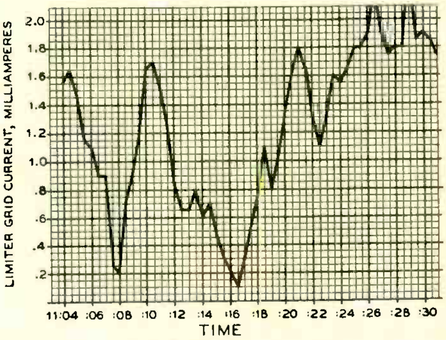


Figure 2. A typical version of the roller fade. The signal is W2XMN as received at the Tower Room, Haddon Hall Hotel, Atlantic City, N. J.

Later in the year the addition of W2XWG, 42.60 Mc., New York City, was added to those stations with .15 ma. or better signals. W2XQR, Long Island City, N.Y., remained inaudible at the home location, except on days of good lower atmosphere bending, although at the portable location they too were audible with a .15 ma. signal.

Sky-Wave Propagation

It is admittedly possible to sidetrack the factor of sky-wave propagation by two means. First, the present sunspot cycle dictates a considerably lower maximum usable frequency, such that the probability of F2 layer transmission or interference is virtually eliminated. Secondly, the actual working knowledge of F2 transmission is, needless to say, very meager. However, this can be attributed to the fact that to date few stations have been using these frequencies regularly and still fewer receivers have tuned these bands.

While discounting F2 layer work, the action of the sporadic E layer requires attention. Although it occurs principally throughout the summer months, the length of time of periods of such action is much longer, the strength of sporadic E signals is greater, and the skip distance is practically one-third of normal calculated F2 skip.

Actual Sporadic-E FM Reception

With those points in mind it wasn't surprising to hear on the very first two big "short-skip" days for 5 meters, May 1st and 2d, the signals from W9XAO, 42.60 Mc., Milwaukee, Wis., and W9XEN (now W9XZR), 42.80 Mc., Chicago, Ill. The former was the stronger of the two with an l.g.c. reading varying in an enlarged version of a scintillating fade from .10 to 1.20 ma. The rate of fade was about 6 times per minute. Particular note was paid to the audio quality, since in FM work this is a "first." Accordingly, to the ear the symphony being presented at that time was received in full unmarred fidelity, indicating that although there was a turbulent condition in the ionosphere it apparently was having little or no effect on the audio quality of radio signal, a condition worth acknowledging.

It will be observed that W9XEN was operating on the W2XMN channel, which gave rise to another experiment. The W2XMN signal that particular evening was low in strength, fading slowly between .20 and .45 ma. l.g.c. On the other hand the W9XEN signal was also fading between the same values but at a considerably faster rate (about 12 to 15 times per minute). Fortunately, both the Chicago and Alpine stations were carrying the same CBS program. Naturally the a.v.c. action and the 2-to-1 ratio masking effect kept the output of the receiver constant, although by fading the station actually being received was automatically being shifted in the receiver from Alpine to Chicago to Alpine several times per minute.

Only those who have heard this happen or who could analyze the action beforehand could anticipate the effect—the program was being distorted by an echo! With the W9XEN carrier fading upward to mask W2XMN, the last word spoken over the Alpine station before the change in the receiver became effective, was echoed by the Chicago station due to the minute time loss in the signal transfer from Chicago to the receiving location as compared to that from Alpine to the receiver, and the much greater time lag on the wire line from New York City, where the program originated, to Chicago. Conversely with W9XEN fading downward and possibly W2XMN building slightly a few notes of music or a few syllables of speech were lost in the action.

Sky-wave propagation does not tend to be an outstandingly important topic to commercial FM. However, in amateur work it will produce a more readable signal than AM, although many weak stations will be lost due to the masking of stronger stations on the same or adjacent channels.

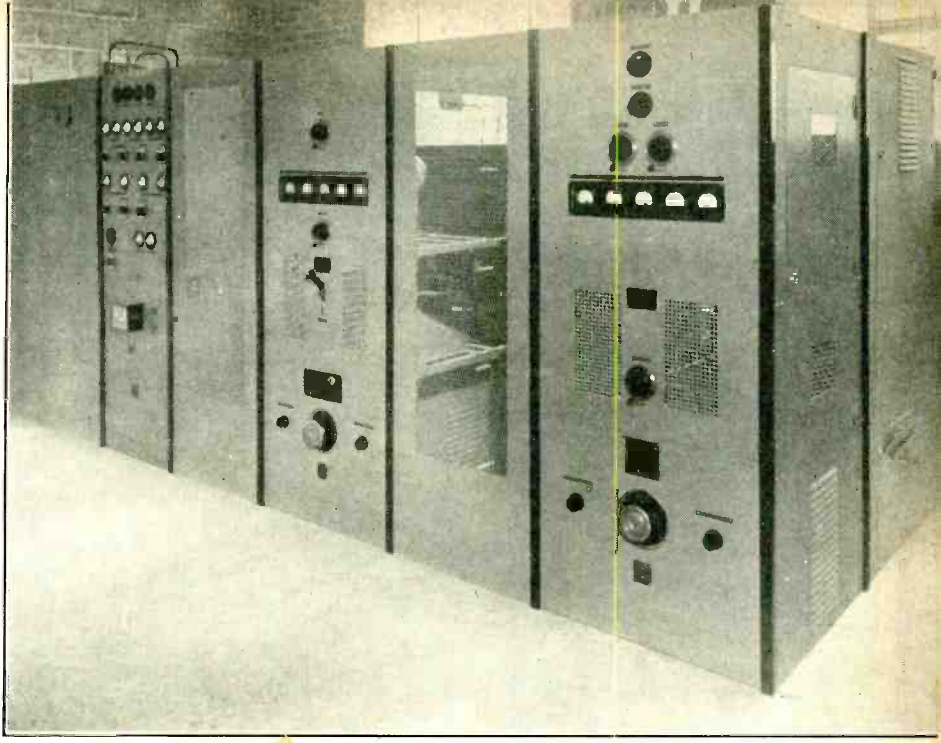
Antenna Polarization

No conclusive experiments were made to prove the superiority of either type of wave polarization. This is because American commercial u.h.f. practice is to use horizontal polarization almost entirely. The single exception was the case of W2XOR, 43.40 Mc., whose move from Carteret, N.J., to New York City was followed by regular transmissions with vertical polarization. The reasons for this somewhat radical move were explained by the fact that not only is a vertical antenna much easier to erect, but it will provide equally good reception in all directions—a practical necessity in home FM reception. Likewise if automobile FM reception is to be considered the vertical antenna would be inevitable, since with horizontal polarization the signal would be apt to disappear, build or drop sporadically in strength as the car twisted and turned along the roads and highways.

With W2XOR resuming operation on 43.40 Mc., and the schedule of W1XPW being expanded till both stations were on the air at identical times, an interesting sidelight to this picture came in the selection of the received station at the Haddon Hall location by shifting from the horizontal to the vertical antenna. This was pronouncedly more effective here at the portable location than at the home location due to the .25 to .45 ma. strength of W1XPW and the .30 to .50 ma. strength of W2XOR, on their respective antenna polarizations. The angle above the horizontal at which W2XOR masked W1XPW was consistently noted as 30 degrees, although this may be an individual variation dependent upon their relative signal strengths.

Localization of Air Boundary Bending

It was interesting to observe that there apparently exists some sharp degree of localization of air boundary bending. This effect was pronouncedly noted a great number of times due to the fact that four stations, W2XMN, W2XWG, W1XPW and W1XOJ are relatively adjacent in terms of angles from the receiving position. However, on various evenings it was possible to record W1XPW stronger in strength than average while W1XOJ would be well down and W2XMN and W2XWG only at usual strength. Likewise, when W2XMN and W2XWG would gain considerably in strength indicating some strong bending action along the Jersey coast, only a slight corresponding gain was noted



The exciter and low power r.f. amplifier stages at W2XMN, Alpine, N. J.

from W1XPW and none on W1XOJ. It is quite evident that the wave front causing this bending action is very well defined in location. Considerable study could be advanced along these lines in calculating and determining its location, speed of formation and possibly its direction of travel, if one exists.

Fading

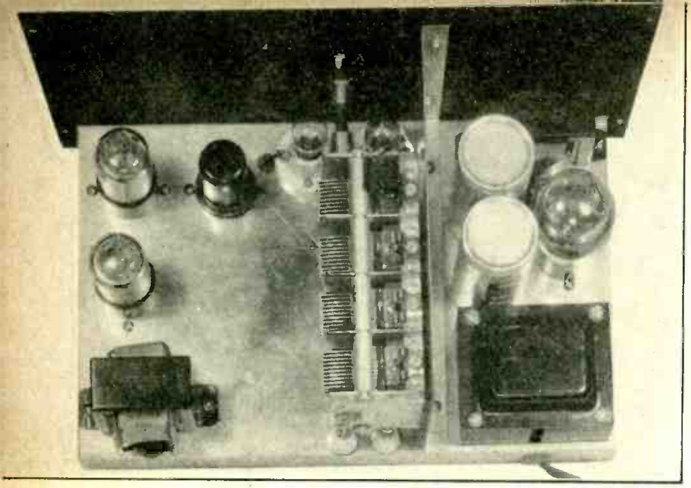
At these distances (110 to 240 miles airline) it was found that the perfectly steady signal that might be found in the local diffraction area of an FM station could not and did not occur. Always there was some type of fading present, resulting probably from the interference of the waves over the various paths the signal was being propagated. However, it is not our point to penetrate into the theory of diffraction and refraction in the lower atmosphere, but to show some characteristics of the principal types of fades.

The primary u.h.f. fade is the slow rising and falling of signal strength called the "roller," which is graphed in figure 2. The graph or an oscillogram of this seems to show a rather saw-toothed pattern, the particular version being a slow then rapid dip in signal strength followed by an even but moderately rapid build out of the lull. This type of fading is the least bothersome to FM, as the natural receiver a.v.c. well takes care of any severe changes in strength. However, occasional out-of-phase effects nearly cancel the signal at the antenna terminals, which can be noted from the graph.

The secondary u.h.f. fade is the "scintillating." A graph of this would show a very rapid but nearly perfect sine wave with variations in strength being only about .35 ma. Although this difference from peak to lull is comparatively small, it is worthy of note that scintillating fades occur only when the signal is very weak. Fades such as this can be annoying to FM reception. The low signal strength to begin with, and the fading itself combined with the slight increases and decreases in the rush level of the receiver, produce a sound in the program background like a locomotive slowly gathering speed in "chugs" and then losing it and picking it up again.

The fade that accompanies sky-wave propagation appears to be the rhythmical scintillator enlarged to the proportions of the "roller," which adds up to the worst u.h.f. fade.

We would like to pay particular note to the extent of fading of W1XOJ as compared to that of W2XMN. As we have said throughout the article, the severity of the W1XOJ fades, even at that excessive distance, never equaled those of W2XMN, whose strength varied almost constantly in wide extremes of strength. What effect causes this or whether this is just another singular incident can only be decided through further investigation.



The top-chassis placement of components is shown quite clearly by this photograph. Note especially the metal shield, extending almost to the top of the panel, which separates the oscillator portion from the power supply.

The Improved Wide-Range AUDIO OSCILLATOR

Widespread interest and acceptance were accorded the simple wide-range audio oscillator described in the June, 1940, issue of RADIO.[1] However, several correspondents who built the oscillator experienced certain minor difficulties, and quite a large number of interested parties wrote in and requested exact data on a practical method of extending the undistorted low-frequency output of the unit. The interest shown seemed to warrant an additional article on an improved version of the instrument—hence the following pages.

Fundamental Circuit

The basic circuit of the improved version of the wide-range audio oscillator is the same as that of the unit described in the June issue of RADIO; certain circuit modifications have merely been incorporated to extend the range of frequencies over which the instrument will operate and give sine-wave output, and an isolation stage has been incorporated. The oscillator still consists of a two-stage audio amplifier with both regenerative and degenerative feedback, the ratio of the two types of feedback being automatically adjusted so that the amplifier will oscillate at a frequency determined by a variable resistance-capacitance bridge.

For the above reason, it is recommended that all persons who are interested in this unit, and in other arrangements of this type, read the original article. As additional references the reader is directed to footnotes [2, 3, 4] which give basic theoretical discussion of circuits using the Wien (resistance-capacity) bridge as a frequency determining circuit.

Modifications Upon the Original Arrangement

It was suggested in the original article that the frequency range of the oscillator could be extended further into the lower register by making certain circuit modifications. As a result of inquiries concerning data on exact procedure for making these alterations, a series of tests were made upon the original unit to obtain quantitative information on the alterations needed. These tests showed that, while the lower frequency limit could be extended to about 50 cycles, it was necessary to make a considerable number of changes in the unit,

---

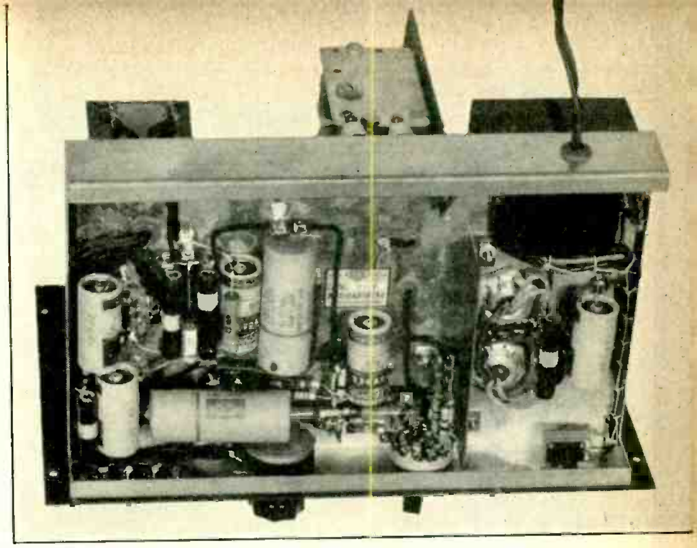
* Editor, RADIO.

[1] Dawley, "A Wide-Range Audio Oscillator," RADIO, June 1940, p. 17.

[2] H. H. Scott, "A New Type of Selective Circuit and Some Applications," *Proceedings* I.R.E., February 1938, p. 26.

[3] H. H. Scott, "A Low-Distortion Oscillator," General Radio *Experimenter,* April 1939, p. 1.

[4] Terman, Buss, Hewlett, and Cahill, "Some Applications of Negative Feedback," *Proceedings* I.R.E., October, 1939, p. 649.



Under-chassis view. The small metal shield between the range switch and resistors, and the filter condenser leads in the power supply, is important if ripple difficulties are to be eliminated.

By RAY L. DAWLEY*, W6DHG

A revised and improved version of the resistance-capacity audio oscillator described in the June issue of RADIO. The new version features very low harmonic content in the output on all frequencies from 15 to 85,000 cycles.

including the substitution of a different output circuit. For this reason it was deemed desirable to redesign the unit, with particular emphasis on improved low-frequency response.

For those persons who are interested in an oscillator having output extending above the audio frequency range, and needing low frequencies only down to 75 cycles, the unit described in the June, 1940, RADIO is very satisfactory and inexpensive. One suggestion which improves the low-frequency range is to return the bottom end of the lamp resistor R (in the original diagram) to the ungrounded side of the secondary winding of the output transformer. With one polarity of the output transformer the oscillator will become very unstable, while with the other connection the unit will cease to oscillate or will oscillate very weakly. If the first condition is obtained, the secondary connections of the transformer should be reversed so that the amplifier will cease oscillation, and then a 3500-ohm resistor should be substituted for the 2500-ohm one shown at R_{11} in the diagram on page 19 of the June issue. Making this change in connections will improve the waveform on the frequencies from 100 down to 75 cycles, and the operation on other frequencies will be very slightly improved. Also, if any residual hum previously appeared in the output of the oscillator it will be greatly reduced.

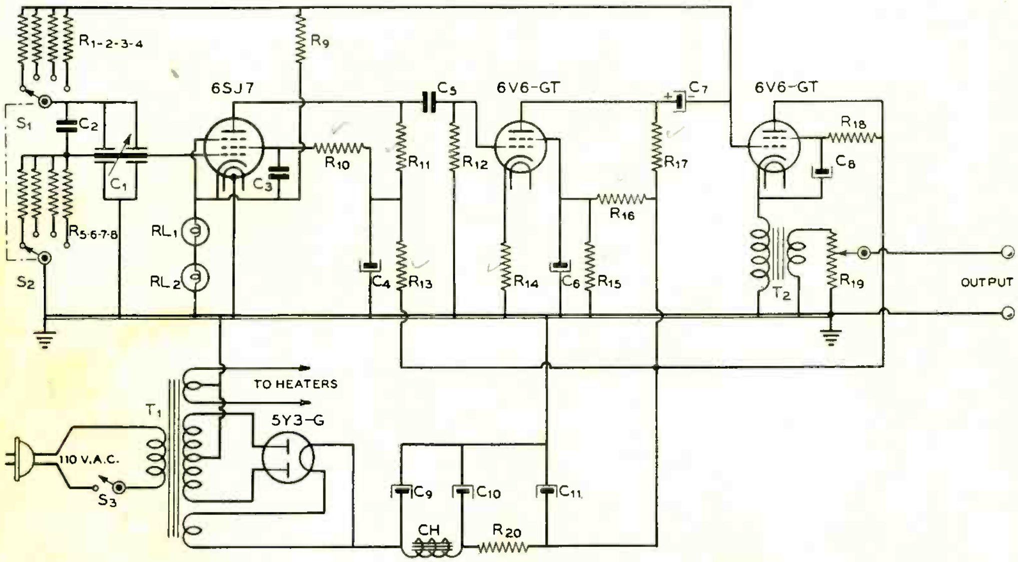
The New Circuit

Since the oscillator was to be completely redesigned, it was felt desirable to incorporate a number of new ideas and features which had been suggested by others or had suggested themselves from actual operating experience with the earlier oscillator. Considerable credit is due to Mr. William N. Weeden of Mount Vernon, N.Y., for several suggestions incorporated into the finished unit as a result of mutual correspondence and experimentation.

There are three major differences between the improved unit shown and the original oscillator: The degenerative feedback circuit has been changed considerably in the theory of its action, although at first glance it appears to be the same. The values of coupling and bypass condensers have been considerably increased throughout, this to allow satisfactory operation on the lower frequencies which the unit generates. And a degenerative feedback output stage has been added to eliminate any interaction between the load circuit and the oscillator section.

The Degeneration Arrangement

As has been mentioned before, the operation of this oscillator is dependent upon an automatic adjustment of the ratio between the regenerative and degenerative feedback between



Wiring Diagram of the Improved Audio Oscillator.

C_1—4-gang 365-μμfd. b.c. condenser
C_2—.000075-μfd. midget mica
C_3—1.0-μfd. 400-volt tubular
C_4—8-μfd. 450-volt electrolytic tubular
C_5—1.0-μfd. 400-volt tubular
C_6, C_7, C_8, C_9—8-μfd. 450-volt electrolytic tubular
C_{10}, C_{11}—16-μfd. 450-volt electrolytic
R_1, R_5—10 megohms, ½ watt
R_2, R_6—1.25 megohms, ½ watt (1 megohm and 250,000 ohms in series)
R_3, R_7—150,000 ohms, ½ watt
R_4, R_8—20,000 ohms, ½ watt
R_9—2500 ohms, 1 watt
R_{10}—500,000 ohms, ½ watt
R_{11}—100,000 ohms, ½ watt
R_{12}—500,000 ohms, ½ watt
R_{13}—100,000 ohms, ½ watt
R_{14}—200 ohms, 10 watts
R_{15}—40,000 ohms, 1 watt
R_{16}—50,000 ohms, 1 watt
R_{17}—10,000 ohms, 10 watts
R_{18}—25,000 ohms, 10 watts
R_{19}—1000-ohm potentiometer
R_{20}—500 ohms, 10 watts
RL_1, RL_2—6-watt 120-volt tungsten mazda lamp
T_1—580 c.t., 50 ma.; 5 v. 3 a.; 6.3 v. 2 a.
T_2—Universal output to voice coil trans.
CH—10-hy. 65-ma. filter choke
S_1, S_2—2-pole 6-position switch (only 4 positions used)
S_3—S.p.s.t. a.c. line switch

the output and input circuit for satisfactory operation. The magnitude of the regenerative feedback is fixed and is fed back directly to the grid of the 6SJ7 through the resistance-capacity input circuit. On the other hand, the degenerative feedback is coupled through R_9 into the two lamps RL_1-RL_2 in the cathode circuit of the 6SJ7. These lamps have a very positive resistance-temperature characteristic, hence the amount of feedback voltage increases more rapidly than does the current through the lamps.

In the earlier arrangement, reliance was made upon the varying cathode current to the first tube under different amplitudes of oscillation for the variation in the resistance of the lamps. In this unit, reliance is made upon the change in magnitude of the audio current fed back from the plate circuit of the first 6V6-GT to determine the varying voltage drop across the lamp resistor circuit. This system of feedback control has proven to be more satisfactory than the earlier arrangement.

The Output Amplifier

In the original arrangement, output was taken directly from the plate circuit of the second stage in the audio amplifier through a step-down output transformer. This arrangement was perfectly satisfactory for all normal amateur usage where the oscillator is fed into the high-impedance grid circuit of an audio channel. But for such applications where the oscillator is fed into the primary of a transformer or into a low-impedance line, a certain amount of reaction upon the oscillator was caused by varying output circuit conditions.

For the above reason it was deemed desirable in the improved model to include an output amplifier for the purpose of isolating the external circuit from the oscillator proper. Since the output voltage appearing at the plate of the second tube of the oscillator itself is about 20 volts, it was felt that there was no need for any gain in the isolating amplifier stage; as a matter of fact, a reduction in the output voltage would be desirable for most applications. Also, since an additional requirement of the audio stage was that it be capable of substantially constant gain and low distortion over a very wide range of frequencies (15 to 85,000 cycles), it would be necessary that a considerable amount of degenerative feedback be incorporated into the isolating stage.

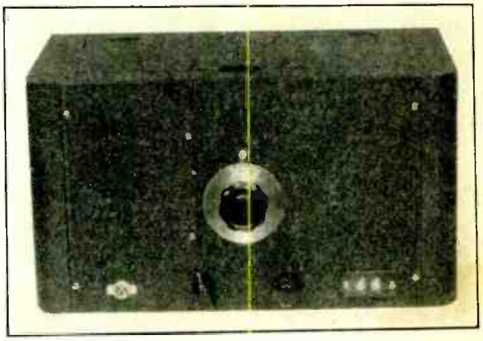
The isolating amplifier finally chosen was a 6V6-GT cathode-coupled stage with a step-down output transformer in the cathode circuit. It has proven to be quite satisfactory, giving substantially constant output from 20 to 30,000 cycles and covering the balance of the range with no reaction on the oscillator. The voltage available from the output terminals is variable up to about 1.25 volts over the audible range, dropping off slightly above 25,000 cycles. If higher voltage output is desirable for some purpose, a lead connected to the cathode of the 6V6-GT output tube will supply about 18 to 20 volts. Should it be deemed that the higher voltage output would be convenient at certain times, an additional potentiometer may be connected across the cathode-to-ground circuit and the movable arm brought out to another terminal on the front of the chassis.

Components

An inspection of the list of components and the photographs will quickly show that the general parts complement of the new oscillator is essentially the same as the earlier version. Nearly all the original components have been used; the only additional components required are a batch of resistors, several high-capacity electrolytic condensers, and an additional tube and 6-watt lamp. As a result of this interchangeability, it will be comparatively inexpensive for a person to convert his earlier unit over to the one shown—should the additional features of the improved version make the conversion seem desirable.

Shielding

In this oscillator, as in the earlier one, the frame of the tuning condenser is at grid potential above ground. For this reason it has been found necessary to shield the entire oscillator portion of the unit from the power supply section, and, for that matter, from surrounding fields in general. The shielding was accomplished by placing a large shield directly behind the tuning condenser and between it and the power supply, and by inserting a small shield in an analogous position below the chassis. With these two shields in place and with the entire unit in its shielding metal cabinet, there is no interaction between the oscillator and the line frequency, and no hum appears in the output. However, when the oscillator is removed from the cabinet the large area of the tuning condenser will pick up a certain amount of hum from surrounding a.c. lines. The result of this a.c. pickup will be quite noticeable on the lowest frequency scale, where the oscillator and its harmonics will tend to lock in with the various harmonics of the a.c. line frequency. For this reason it is important that the oscillator be operated only when it is thoroughly enclosed in its shielding cabinet.



Front view of the oscillator. The controls are: on-off switch on the left, range switch, output control, and the output terminals on the right. Although a simple 0-100 dial is shown, reliance being made on an external calibration chart for determining the frequency, a dial of the type shown on the Rothman High-Frequency Converter, elsewhere in this issue, would be ideal for direct calibration.

Trimmer Adjustment

One factor which contributes greatly to the increased coverage of the improved version of the resistance-capacity oscillator is the fact that it was possible to leave off the fixed padder condensers across each section of the tuning condenser. Only one condenser is used in the improved version, and this one serves merely to assist in maintaining a capacity balance of the two sections due to the much greater capacity to ground of the lower section of the condenser. This 75 $\mu\mu$fd. fixed condenser is placed across the upper half of the dual tuning condenser, the trimmers on the lower section are turned all the way out, and the trimmers in parallel with C_2 are varied until smooth oscillation is maintained over all bands. The adjustment is not particularly critical, although a cathode-ray oscilloscope will be of assistance in determining the best position. If the trimmers are not set correctly, it will be difficult to maintain oscillation in the vicinity of 150 cycles on the lowest scale, and there will be a peculiar dissymmetry in the waveform in the vicinity of 1000 cycles on the second scale.

Other than the above adjustment of the trimmers on the tuning condenser, there most likely will be no need for any alteration in the oscillator. It will be found to be very foolproof and trouble-free in operation.

Coverage

Due to the lowered minimum capacity across the tuning condenser, it will be found to be possible to cover a range of about 10 to 1 on each set of resistors. Also, since each band will cover a range of 10 to 1, only four bands have been shown in the instrument. The coverages of these four ranges are as follows: 1.—15.5 to 155 cycles, 2.—125 to 1250 cycles, 3.—1200 to 12,000 cycles, 4.—10,000 to 85,000 cycles.

Calibration

The calibration of a variable-frequency audio oscillator is somewhat of a problem, unless some time of a calibrated oscillator is already at hand. In that case it is merely necessary to feed the outputs of the two, in series, to a pair of phones and then to zero beat them up the scale. The calibration points can then easily be transferred from one to the other.

Since a calibrated audio oscillator is, naturally, probably not available to the constructor of a piece of equipment such as is described, an oscilloscope having a saw-tooth sweep circuit can be pressed into service. A description of the process is rather lengthy, so for the benefit of those who do not have a copy of the June 1940 issue of Radio, it will be given again.

Calibration with an Oscilloscope

If an oscilloscope having a sweep oscillator going from about 10 to 5000 cycles is available (the one shown on page 478 of the 1941 Radio Handbook was used in our case), the calibration becomes a simple matter of about one-half hour's watching of interesting waveforms. It may sound slightly involved or complicated in the description but it is really absurdly simple once the 'scope and the oscillator are in front of the operator. The procedure, though simple, must be followed exactly as given in order that no error be introduced, since any error introduced at the outset would be cumulative throughout the calibration.

First, it is best to have both the phones and the vertical plates of the oscilloscope (through the amplifier in the 'scope) connected across the output of the oscillator. Then with alternating current directly from the line fed into the horizontal plates of the 'scope adjust the frequency of the oscillator on the lowest range until a figure such as is shown in figure 2A is obtained. This figure indicates that the vertical deflection frequency is exactly twice that of the horizontal deflection frequency. If your local line frequency is 50 cycles the audio oscillator is putting out at exactly 100 cycles; if it is 60 cycles the oscillator is on 120 cycles. We will assume that the local line frequency is 60 cycles, since that is the line frequency in most places.

Then turn in the tuning condenser until a circle is obtained on the screen of the 'scope—the audio oscillator is now operating on the *same* frequency as the local line. Now turn the condenser in still further until a figure the same as described in the preceding paragraph *but lying on its side* is obtained—the oscillator is now on *half* the frequency of the local line (30 cycles for a 60-cycle line and 25 cycles for a 50-cycle line). If the oscillator condenser is turned in still further it will be possible to obtain a figure which will have one loop in the horizontal plane and three loops in the vertical plane—the oscillator is then on one-third of the line frequency. These calibration points can then be set down on the chart. In-between fractional ratios between the line frequency and the oscillator can be obtained for additional calibration points if Lissajou's figures as described in the literature and in later paragraphs are formed on the screen by careful adjustment of the oscillator frequency. The oscillator should now be returned to the position which gives the figure described in the preceding paragraph, with the oscillator on twice line frequency.

Turn the synchronization control until there is no interlocking between the incoming signal and the sweep oscillator, turn on the sweep oscillator, and adjust its frequency until a single stationary sine wave appears on the screen. The sweep oscillator is now on exactly 120 cycles. We have thus transferred our standard of frequency from the 60-cycle line to the 120-cycle linear sweep oscillator. Make up a chart of calibration frequencies against switch positions and dial settings. Make this the first calibration point: 120 cycles, range 1, dial 52 (or whatever it happens to be in your particular unit).

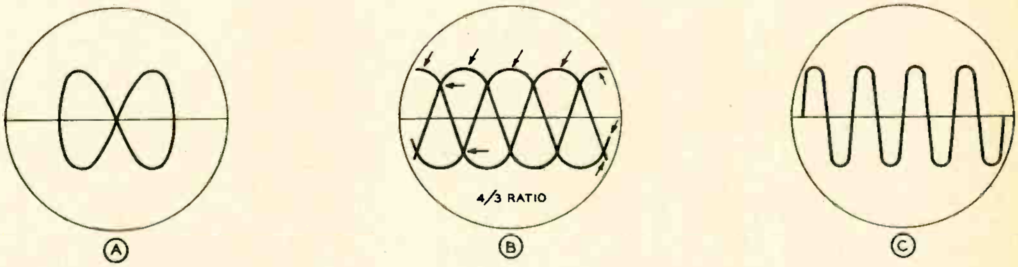


Figure 2. Examples of the oscilloscope patterns used in the calibration of the audio oscillator with the aid of a cathode-ray oscilloscope (A) Pattern obtained with 60 cycles (sine wave a.c.) on the horizontal plates and 120 cycles (sine wave a.c.) on the vertical plates (or 50 cycles on the horizontal and 100 cycles on the vertical). (B) Figure showing a relation of 4/3 between the frequency of vertical deflection and the frequency of horizontal saw-tooth sweep. (C) Figure showing a relation of 4/1 between the vertical deflection and horizontal saw-tooth frequencies.

Lissajou's Figures

The determination of the calibration points for frequencies intermediate (fractional multiples) between the fundamental and integral harmonics, such as the second, third, etc., can be determined through a knowledge of certain geometrical patterns which will be seen on the screen of the oscilloscope, called Lissajou's figures. Their interpretation is simple enough since they represent, when standing still, fractional relations between the two frequencies which are being impressed upon the vertical and horizontal plates of the oscilloscope.

The fractional relation between the two frequencies can be determined by a simple inspection of the waveform which appears on the 'scope. First, the number of complete bumps which appear along the top in the horizontal direction is counted—this is the numerator of the fraction. Then the number of traces is counted (this may be determined by counting the number of free "tails" at either end of the figure, or by taking *one more* than the number of crossovers on any ascension or descension of one half of one of the sine waves) and this value is the denominator of the fraction which represents the relation between the frequency on the vertical plates with respect to the frequency of horizontal saw-tooth sweep.

Figure 2B shows a Lissajou's figure which represents a 4/3 ratio between the impressed voltage and the horizontal saw-tooth frequency. If the sweep frequency were still 120 cycles in this case, the input frequency would be 160 cycles. Calibration points for frequencies which are intermediate between integral multiples may be obtained in this way.

Integral Multiple Calibration

Now switch to the next higher frequency range and, keeping the *sweep* oscillator on 120 cycles, set the dial of the audio oscillator to the point where two complete sine waves appear on the screen. The oscillator will now be on 2/1 times 120 cycles or 240 cycles. Put this down in the chart and increase frequency until three sine waves appear: this will be 3/1 or 360 cycles. Next comes four sine waves or 480 cycles (the figure for this is shown in 2C, five sine waves or 600 cycles, six sine waves or 720 cycles, and 7 sine waves or 840 cycles.

Since it becomes difficult to count the number of waves accurately with a small c.r. tube, we must increase our standard frequency to enable the calibration of the higher ranges. This is a very interesting and comparatively simple procedure, but it must be followed carefully, step by step. First, the oscillator is tuned down in frequency again until there are five sine waves on the screen indicating 600 cycles. It is important in making all these adjustments to tune the oscillator carefully until the pattern stands quite still. Now retune the *sweep* oscillator in the oscilloscope until there are *six* sine waves on the screen where there were five before. The sweep is now on 100 cycles instead of 120—hence the six waves instead of the five. Now retune the audio oscillator until there are *five* waves on the screen instead of six, the oscillator now being on 500 cycles, and then retune the *sweep* oscillator until there is only one sine wave on the screen. This puts the sweep oscillator on 500 cycles, our new base frequency.

Now by switching the oscillator to the third

[*Continued on Page 68*]

A Medium-Power
160-METER AMPLIFIER

By RAYMOND P. ADAMS*, W6RTL

Those who work 160-meter phone exclusively may or may not be new to the amateur ranks. Certainly there are many beginners who find this band a satisfactory place to operate. On the other hand there remain an appreciable number of more advanced amateurs who similarly find the band a fine place for their radio activity. For the man who is interested in turning on at the rig at any old time and hitting off with a sure-fire QSO, 160 meters is ideal.

Therefore there is a place in the amateur scene for an exclusively 160-meter phone transmitter—a rig requiring none of the compromises so necessary in the all-band type of transmitter, and featuring a final amplifier providing proper Q for correct low-frequency operation (with high efficiency maintained). Such a transmitter, provided it costs little to construct, would not only meet the requirements of those interested wholly in this band but would also be of value to the amateur whose high-frequency final does not provide proper circuit value for 160-meter work. In the latter case common modulator and power supplies could be used, if desired.

Requirements

Before discussing an inexpensive and effective final amplifier which has been developed to meet the specific requirements suggested by this application, let us dwell for a moment on the requirements themselves. These are three:

1. Power—Medium power seems quite in order for 160-meter work. Medium power suggests an input to the final amplifier of approximately 100 watts, and an output to the antenna of 75 watts, under 75 per cent efficiency conditions. Higher output has, of course, its place on this band. Lower output, such as is provided by one or two 6L6's or similar tubes is often satisfactory local or moderate-distance QSO's, but 75 watts seems a reasonable compromise between cost and capabilities.

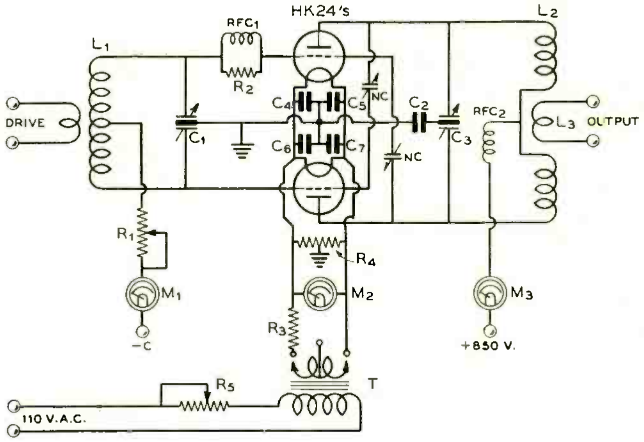
2. Proper Q—Not only do a great many all-band rigs fail to have proper final amplifier plate-tank Q at the lower frequencies, but many transmitters designed specifically for such low-frequency work also are lacking in this important requirement. This is particularly true where manufactured tank coils calling for a specific capacity across them are used in conjunction with final amplifier tubes whose proper operation gives a d.c. plate impedance all out of line with the necessary C of the circuit. In building new transmitter most amateurs, quite logically, try to use equipment already on hand, but this procedure quite often leads to an unavoidably low-Q tank circuit, which in turn requires a great reduction in antenna coupling with a consequent loss of power output capabilities.

3. Selection of Components—In this respect it is first necessary to decide upon suitable tubes. Here we usually have a choice (for a push-pull stage at 100 watts input) between tubes requiring between 600 and 750 plate volts and drawing about 200 ma. for the pair and tubes operating at somewhat higher voltages and at late currents well below the 200-ma. mark. In the first case the d.c. plate resistance will be down around 3000 ohms, making necessary a plate tank condenser having a recommended capacity value[1] (maximum per section) of at least 300 μμfd., or an effective value of 150 μμfd. for the two sections in series. This would allow no capacity reserve, of course, 150 μμfd. being the proper C under these low-voltage, high-current condi-

---

*1215 Justin Avenue, Glendale, Calif.

[1] Radio Handbook, Seventh Edition, pps. 169 and 170.



Circuit Diagram of the 160-Meter Amplifier.

C_1—250-μμfd. per section
C_2—.002-μfd. 2500-volt mica
C_3—170-μμfd. per section, .084 spacing
C_4, C_5, C_6, C_7—.01-μfd. 600-volt tubular
NC — 2-10-μμfd. neut. condenser
R_1—3000 ohms, 10 watts, with slider
R_2—Parasitic suppressor
R_3—0.2 ohms, 10 watts
R_1—50 ohms, c.t., 10 watts
R_5—50-ohm 25-watt rheostat
RFC—2½ mhy., 500 ma. choke
L_1 — Manufactured 25-watt coil
L_2—Manufactured 250-watt coil
L_3—Swinging link assembly
T_1—7.5 v., 6 a. If 6.3-v. transformer is used, R_3 may be omitted.
M_1—0-100 ma.
M_2—0-10 v., a.c.
M_3—0-200 ma.

tions. The coil would have to be designed to tune to the low-frequency edge of the band with the full capacity in the circuit.

However, the plate resistance increases as the plate voltage is increased and the plate current is reduced, and as this resistance increases the required amount of capacity for a given Q decreases. With a pair of tubes operating at 1000 plate volts at a plate current of 120 ma., for instance, the plate resistance is somewhat over 8000 ohms, which requires a minimum allowable tuning capacity of 35 μμfd., or a recommended value of from 52 to 70 μμfd., (50 to 100 per cent increase over minimum) for correct Q in the push-pull 160-meter amplifier. In this case less than half the capacity required in the first case is needed, and the physical size of the condenser is appreciably reduced. Also, the cost of the condenser is reduced, regardless of the necessary increase in plate spacing, called for with the higher voltage arrangement. Therefore it would seem that our 160-meter amplifier should use tubes whose normal operating characteristics provide for a relatively low current drain and as high a plate voltage as is consistent with the required power output and economical construction. Such tubes are available in types which are specifically intended for high-frequency operation but which are, nevertheless, general-purpose types.

The Amplifier

The foregoing discussion brings us to the representative amplifier shown in figure 1. The tubes used are HK-24's, since these are admirably suited to the operating conditions dictated by the requirements previously set forth. These tubes draw comparatively little plate current: 60 ma. per tube, or 120 ma. for the pair in push-pull. This low current consumption facilitates achieving a good plate-circuit Q with relatively low tank capacity and, incidentally, permits the use of inexpensive receiving-type chokes in the power supply filter circuit. The plate voltage for the 24's may be anything from 750 to 1250 volts, with the corresponding plate input running from 90 to 150 watts for the final stage. In the amplifier shown the plate voltage is 850 volts, and the input 100 watts.

Tank Circuit

Under the aforementioned operating conditions the d.c. plate resistance is approximately 7200 ohms, which allows excellent tank circuit Q to be obtained with an effective tank capacity of 65 μμfd., as provided with some leeway by a condenser having a maximum capacity of 170 μμfd. per section. The tank condenser has a plate spacing of .084 inch, which is adequate at 850 volts, provided the rotor is grounded through a by-pass con-

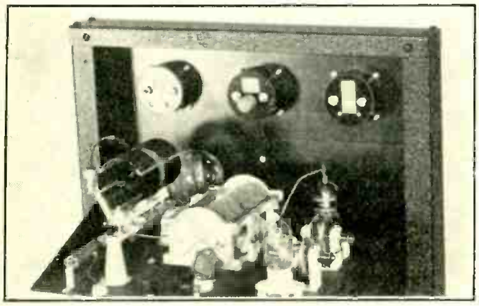


Figure 1. Top rear view of the 100-watt, 160-meter amplifier. Note the dummy antenna resistor bulb between the plate coil and the panel.

denser, rather than directly. At higher plate voltages increased spacing would be necessary, of course.

The manufactured tank coil used tunes to the low-frequency end of the band with a capacity of 65 μμfd., making it perfectly suited for use in this final. The coil mounting includes a swinging link having a shaft which may easily be extended, through use of a coupling, to allow the antenna loading to be adjusted from the front panel. Actually this coil consists of two separate windings with their connection at the center each brought to separate plugs; this arrangement facilitates individual plate metering if this refinement is desired. To meter the plate current to each tube separately it is only necessary to tie the two coil ends together for r.f. through a .002-μfd. mica condenser and bring separate plate supply leads out from the coil through r.f. chokes to two 0-100 ma. meters or to a s.p.d.t. switch and through a single 0-100 ma. meter.

The neutralizing condenser used in the amplifier are rather large units originally intended for somewhat larger tubes. In spite of the fact that their designated minimum capacity is 2 μμfd., they are suitable for use with the HK-24's ($C_{gp}=1.7$ μμfd.), because there is always unavoidable stray capacity between the grid and plate circuits which must be balanced out by the neutralizing condensers in addition to their intended task of neutralizing the interelectrode capacity.

If the individual constructor desires to cut down on the cost of the amplifier, home-built neutralizing condensers may be substituted for those shown. Suitable neutralizing condensers can be made from metal tabs having an effective surface area of approximately 1½ square inches. These tabs should be mounted on small stand-off insulators and located so that their surfaces are separated by one-half inch, and arranged in a manner such that they may be swung on their mounting to adjust the neutralizing capacity.

Separate meters are provided in the amplifier for grid- and plate-current measurement, while a third meter is used to keep a constant check on the filament voltage at the sockets. The latter meter, incidentally, is a practical and worthwhile investment. All tube manufacturers state that their tubes should be operated between certain set limits of filament voltage, and this requirement calls for both an

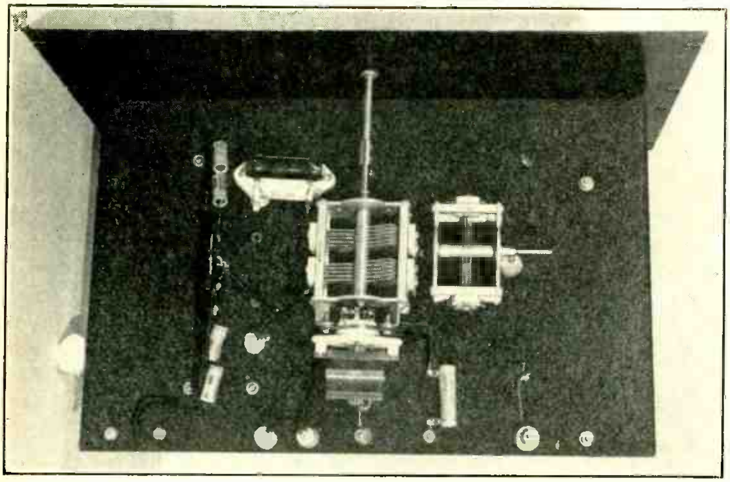


Figure 2. The implifier grid tank circuit is located below the chasis. The two grid tank condensers seen in this photograph could well be replaced by a single splitstator unit of greater capacity, as described in the text.

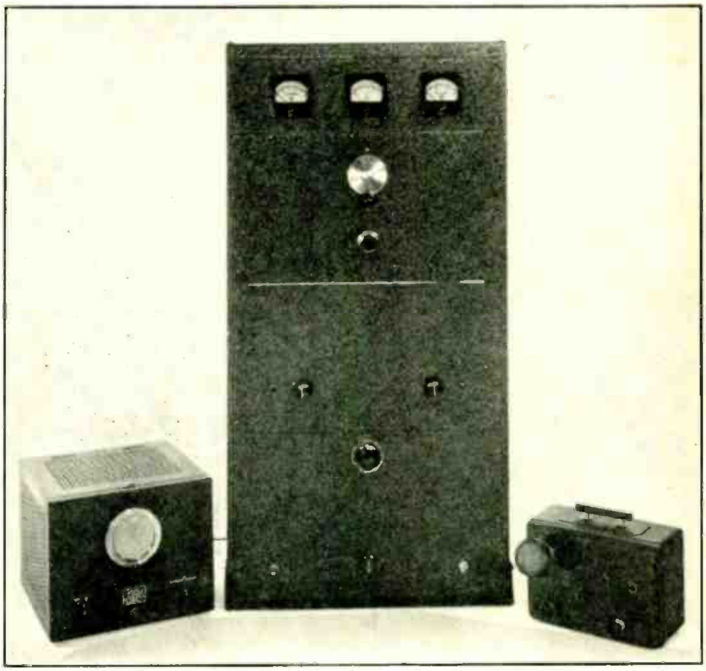


Figure 3. The complete transmitter. The v.f.o. at the left excites the final amplifier directly on 160 meters. The crystal microphone is mounted directly on the preamplifier at the right, which feeds through a 500-ohm line to the audio driver and modulator stages in the transmitter.

indicating meter and some sort of a control permitting the operator to hold the filament voltage at the correct value. Filament power is supplied by a 7.5-volt transformer located in the power supply section of the transmitter. As the two HK-24's require 6.3 volts at 6 amperes, the voltage is dropped the necessary amount by a 0.2-ohm resistor in one filament lead. The electrical center tap on the filament circuit is obtained by means of a center-tapped resistor located at the tube socket. Filament voltage variation to compensate for line-voltage changes is made possible through the inclusion of as suitable rheostat in the a.c. line supplying the filament transformer.

As the underside-photograph of the chassis shows, the grid condenser consists of two units in parallel, one of these being a split-stator affair of 100 $\mu\mu$fd. per section, while the other has a capacity of 50 $\mu\mu$fd. and is bridged across the whole tank circuit. Originally, home-constructed grid coils of rather high inductance were used, and the dual 100-$\mu\mu$fd. unit had sufficient capacity to resonate these coils. However, when the "Baby" coil shown in the photograph was installed additional capacity was necessary to reach the 160-meter band, so the additional condenser was placed across the circuit. A 250-$\mu\mu$fd. per section unit would be the logical choice for the grid condenser, and this value is specified in the diagram.

Exciter and Power Supply

While it is not the purpose of this article to describe a complete transmitter, the final amplifier being the important part, perhaps it is not amiss to touch briefly on a suitable modulator, power supply and exciter, and on the general transmitter layout.

Plate power for the amplifier could, of course, be provided by any 850-volt power supply. However, due to the low plate current requirements of the amplifier we can get by nicely with something which costs very little to construct—little, that is, in comparison with the more conventional type of power supply. To begin with we can, as previously mentioned, use filter chokes designed primarily for low-power p.a. or receiver power supply service. These chokes need have a maximum current carrying capacity of no more than 150 ma. As for the power transformer, this may well be a standard 600-volt, 300-ma. type, which, with bridge rectification, will supply as much as 1000 volts when used with a choke-input filter. In spite of the fact that a power supply of this type requires three rectifiers of the 83 or 5Z3 type, as well as three filament

[*Continued on Page 68*]

A RECEIVER
for
14- AND 28-MEGACYCLES

By FRANK J. LUNDBURG*, W7BME

The need for a good receiver for ten and twenty meters prompted the author to undertake the design of the receiver to be described in this article. The necessary prerequisites are those that would be desired in any modern communications receiver. Following is a list of these requirements although their order shows no favoritism to any one, as they are all major and indispensable features:

1. High sensitivity on both bands
2. Good selectivity (including image rejection)
3. A high signal-to-noise ratio
4. Stability of operation

The receiver has been in use for some period of time and during this time circuit changes have been made where necessary in an effort to fulfill the above requirements. Only those circuit features that proved worthwhile were retained for the present design.

A mechanical design and layout was chosen that would provide the ultimate in shielding and at the same time allow changes to be made in the circuit without requiring a complete rebuilding of the receiver. The separate shielding of each stage as employed by Perrine[1] in conjunction with a standard type of sub-chassis was decided upon. This type of shielding is most effective and results in each stage being a self-contained unit. These individual boxes lend themselves admirably to the set builder that is continually changing his receiver. To remove a stage just unsolder a few leads, remove a few bolts, and the stage is free from the rest of the receiver where it can be easily worked on.

The sharp cut-off tube of the 6J7 type in the r.f. and first detector with regeneration in the r.f. stage provides a high degree of weak signal sensitivity on ten and twenty meters. Regeneration is obtained by tapping the cathode up on the grid inductance. High values of Q and L to C ratio in these stages give the highest possible voltage rise to the grid of each tube. Tuning is accomplished by midget 35-$\mu\mu$fd condensers ganged with insulated couplings. Bandspread is obtained by tapping these condensers down on their respective inductances. Small air-trimmers provide for alignment. These small trimmers

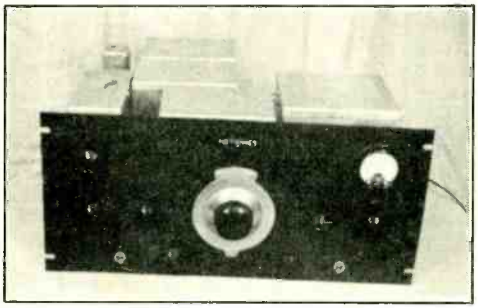
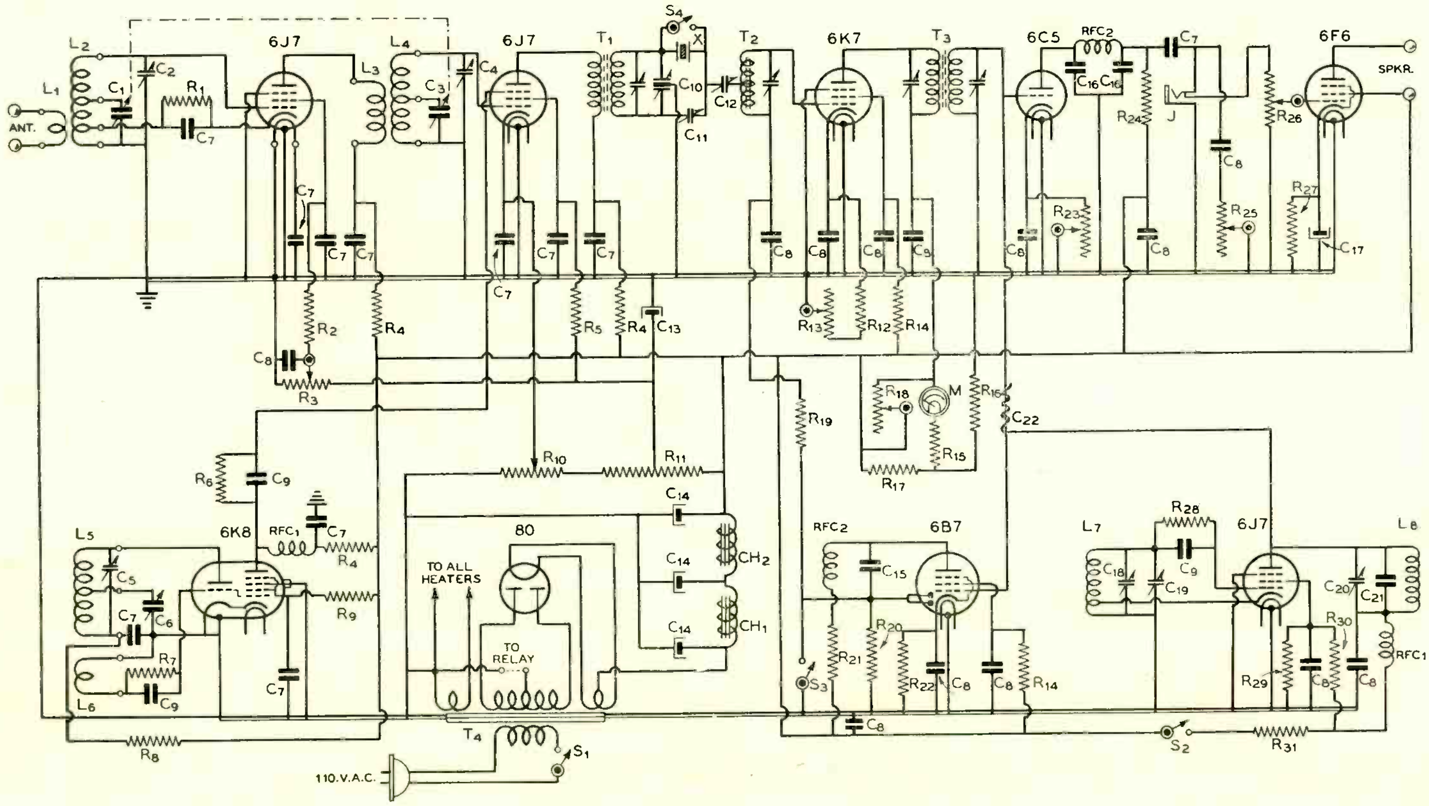


Figure 1. The three similar boxes in the center house the r.f. first detector, and h.f.o. stages. On the left is the crystal filter and i.f. channel, and on the right the b.f.o. Controls, left to right: crystal phasing and switch, crystal selectivity, r.f. and first detector ganged tuning, r.f. gain and regeneration, a.f. gain, i.f. gain, and tone control. The switch on the lower left is the a.v.c. and switch on the lower right the b.f.o.

---

*188-3rd Street, Idaho Falls, Idaho.

[1] Perrine—"A DX Superheterodyne—1936 Model," RADIO, July 1935.



CIRCUIT DIAGRAM OF THE RECEIVER.

List of Components for Receiver.

C_1 — 35-μμfd. midget variable
C_2—25-μμfd. air-dielectric trimmer
C_3 — 35-μμfd. midget variable
C_4—25-μμfd. air-dielectric trimmer
C_5—50-μμfd. air-dielectric trimmer
C_6 — 35-μμfd. midget variable
C_7 — .01-μfd. 600-volt tubular
C_8 — 0.1-μfd. 600-volt tubular
C_9—.0001-μfd. mica
C_{10}—50-μμfd. per section dual midget
C_{11}—15-μμfd. midget variable
C_{12} — 3-30-μμfd. mica trimmer
C_{13}, C_{14}—8-μfd. 450-volt electrolytic
C_{15}—.002-μfd. mica
C_{16}—.0001-μfd. mica
C_{17} — 10-μfd. 50-volt electrolytic
C_{18} — 1000-μμfd. variable (two-gang 500-μμfd. b.c. condenser)
C_{19}—50-μμfd. midget variable
C_{20} — 1000-μμfd. mica trimmer
C_{21}—.004-μfd. mica
C_{22}—See text

R_1—350 ohms, 1 watt
R_2—5000 ohms, 1 watt
R_3—50,000-ohm potentometer
R_4—1000 ohms, 2 watts
R_5—10,000 ohms, 1 watt
R_6—50,000 ohms, 2 watfs
R_7—100,000 ohms, 1 watt
R_8—60,000 ohms, 1 watt
R_9—30,000 ohms, 1 watt
R_{10}—1000-ohm wire-wound potentiometer
R_{11}—40,000 ohms, center tapped, 50 watts
R_{12}—300 ohms, 2 watts
R_{13}—10,000-ohm potentiometer
R_{14}—20,000 ohms, 1 watt
R_{15}—150 ohms, 1 watt
R_{16}—100,000 ohms, 1 watt
R_{17}—350 ohms, 1 watt
R_{18} — 400-ohm wire-wound potentiometer
R_{19} — 250,000 ohms, 1 watt
R_{20} — 500,000 ohms, 1 watt
R_{21}—10,000 ohms, 1 watt
R_{22}—3000 ohms, 1 watt
R_{23}—50,000-ohm potentiometer
R_{24} — 100,000 ohms, 1 watt
R_{25}—100,000-ohm potentiometer
R_{26}—250,000-ohm potentiometer
R_{27}—400 ohms, 1 watt
R_{28}, R_{29}—100,000 ohms, 1 watt
R_{30}—50,000 ohms, 1 watt
R_{31}—75,000 ohms, 1 watt
RFC_1—2.5 mhy.
RFC_2—80 mhy.
T_1 — 465-kc. iron-core crystal input trans., air tuned
T_2 — 465-kc. iron-core crystal output trans., air tuned
T_3 — 465-kc. iron-core interstage trans., air tuned.
T_4—750 v., c.t., 100 ma.; 5 v., 3 a.; 6.3 v., 4 a.
CH_1—30 hy., 100 ma.
CH_2—Speaker field. (Choke may be substituted if p.m. speaker used)
S_1—S.p.s.t. (on R_{26})
S_2, S_3—S.p.s.t.
S_4—S.p.s.t., low capacity.
L_7, L_8—See text
M—0-1 ma.

COIL TABLE

Band	10 Meters						20 Meters					
Coil	L_1	L_2	L_3	L_4	L_5	L_6	L_1	L_2	L_3	L_4	L_5	L_6
Turns	4	4.9	2.6	4.9	4	1.2	5	12.3	5.5	12.3	7.4	1.9
Length	close-wound	1"	inter-wound with L_4	1"	close-wound	close-wound	close-wound	1¾"	inter-wound with L_1	1¾"	1"	close-wound
Wire size	no. 16 enam.	no. 16 enam.	no. 28 d.c.c.	no. 16 enam.	no. 16 enam.	no. 16 enam.	no. 16 enam.	no. 16 enam.	no. 28 d.c.c.	no. 16 enam.	no. 16 enam.	no. 16 enam.
Bs. tap, turns from ground end		1.25		1.25	2.75			3.9		3.9	3.4	
Cath. tap, turns from ground end		.75						.7				

All coils are 1½ inches in diameter

are not mounted in the coil forms but are located under the small sub-chasis in each stage. These small chassis are shown in figure 2.

Separate Oscillator and R.F. Tuning

The high frequency oscillator is not ganged to the r.f. and first detector stages but is controlled separately. The several advantages of the separate control of the r.f. and detector stages from the h.f. oscillator tuning control far out-weigh the disadvantage of the added control. First, the separate control allows the peaking of the h.f. stages on each signal which is almost a necessity when using regeneration. This peaking in conjunction with regeneration results in almost complete image rejection with only the strongest image signals coming through slightly on ten meters. Second, the necessity for waiting for the initial receiver warm up due to the differences in drift between the r.f. stages and h.f. oscillator is eliminated. A third but less important advantage is that by detuning the r.f. and detector gang control the receiver can be used as a signal monitor without blocking.

Plug-In Coils

Plug-in coils are used for their resulting short leads and the elimination of noisy contacts and high capacities associated with band switches. Band switching is definitely out on a high frequency receiver for use on twenty meters and below with the common type of band switches available to the set constructor.

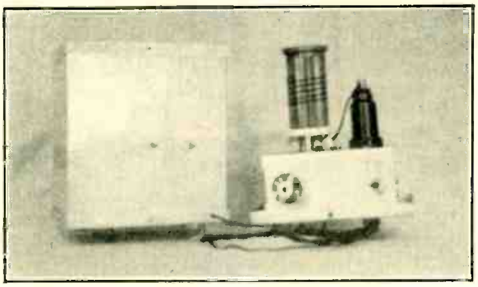


Figure 2. On the left is shown the completely assembled r.f. stage, on the right is the first detector stage with the outer shield removed showing the type of construction and shielding.

Regeneration

Regeneration is controlled by varying the screen voltage of the 6J7 by means of a potentiometer. Liberal use is made of resistors and condensers for filtering all power leads to r.f. circuits. This results in no regeneration except that which is intentionally introduced. Such filtering is essential if a high signal-to-noise ratio is to be obtained.

Positive Suppressor Injection

The r.f. stage is inductively coupled to the first detector by L_3 which is inter-wound with L_4. The h.f. oscillator voltage is injected into the positively biased suppressor of the first detector. This method of injection results in a high conversion transconductance and was retained after all other methods of injection had been tried, using this type of tube and various other converter type tubes.

Fixed bias is obtained for the first detector by a 1000-ohm potentiometer in the bleeder of the power supply. This fixed bias results in stable detector action by fixing the operating point for the 6J7. A small amount of self bias results due to cathode current flowing through the potentiometer but is a small part of the total bias. The potentiometer is supplied with screw-driver adjustment to allow for a maximum signal-to-noise ratio setting.

In a receiver using a ganged r.f. and first detector control and a separate oscillator control for tuning, special consideration must be given to the design of the high frequency oscillator and in the method of taking off the oscillator voltage for mixing. This precaution is necessary if pulling is to be entirely eliminated and the signal-to-noise ratio kept at a minimum. In a single dial control receiver a small amount of pulling can be tolerated. However, any pulling is an indication of oscillator instability and should not be tolerated.

Oscillator Circuit

The electron-coupled oscillator, either of the triode or pentode version, is definitely out for use as a h.f.o. This oscillator has several disadvantages when used in this position. First, it is a source of a.c. hum since its cathode is above ground for r.f. potentials. There are means for placing the cathode at ground potential but these methods lead to constructional difficulties and merely complicate matters. Second, if the signal-to-noise ratio is to be kept at a minimum the mixer voltage must be taken from the grid tank circuit which always results in pulling. Due to the buffer action of the pentode elec-

COIL SPECIFICATIONS

28-Mc. Band

L_1—4 turns
L_2—4.9 turns, tapped 1.25 up from ground for bandspread and 0.75 up from ground for cathode tap
L_3—2.6 turns
L_4—4.9 turns, tapped 1.25 up from ground for bandspread tap
L_5—4 turns, tapped 2.75 up from ground for bandspread tap
L_6—1.2 turns

14-Mc. Band

L_1—5 turns
L_2—12.3 turns, tapped 3.9 from ground for bandspread and 0.7 up from ground for cathode tap
L_3—5.5 turns
L_4—12.3 turns, tapped 3.9 up from ground for bandspread tap
L_5—7.4 turns, tapped 3.4 up from ground for bandspread tap
L_6—1.9 turns

SPECIAL DATA ON COILS

All coils are wound on XP-53 coil forms. L_1, L_2, L_4, L_5, L_6, are wound with no. 16 enameled wire. L_3 is interwound with L_4 and is of no. 28 d.s.c. wire. L_1 and L_6 are closewound on the ground ends of L_2 and L_5 respectively. L_1 should be trimmed depending upon the antenna used. L_2 and L_4 are wound to occupy 1.0 inch, and L_5 1.0 inch on 10-meter coils. L_2 and L_4 are wound to occupy 1.75 inch and L_5 1.0 inch on the 20-meter coils.

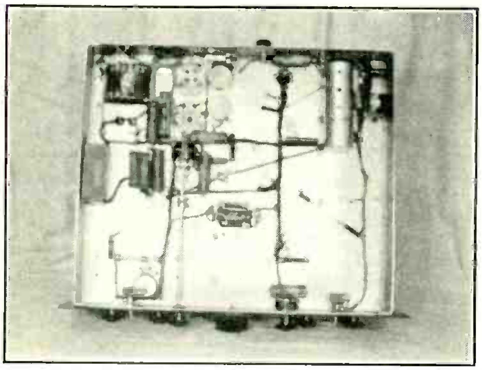


Figure 3. Under view of the sub-chassis showing power leads coming from the various stages, power supply and a.f. wiring in the upper left, and the a.v.c. tube in the upper right.

tron-coupled oscillator no pulling will result when the mixer voltage is taken from the plate of the tube. However, due to the poor wave-form in the plate circuit of such an oscillator, the 2nd and 3rd harmonics of the oscillator fundamental fed to the mixer are nearly as strong as the fundamental component of voltage. This can be substantiated by running the receiver on ten meters with the oscillator on twenty meters: the mixer output is almost that obtained when using the ten-meter oscillator coil. This poor waveform is a source of general noise.

To this end an unconventional oscillator employing a 6K8 is used. The triode section is used as a tuned-plate oscillator which is electron-coupled to the hexode section used as a buffer. This buffer action thoroughly isolates the oscillator from the mixer and all traces of pulling are eliminated. Due to the low harmonic content of the tuned-plate oscillator the characteristic hiss of the plate-coupled e.c.o. is absent. For good frequency stability in a tuned-plated oscillator certain precautions should be observed[2]. The grid feed-back coil should be closely coupled to the plate coil and should have as few turns as possible for sustained oscillations. The negative grid bias should be high as well as the Q of the tuned circuit. Since the tuned circuit is at a positive d.c. potential the rotor of the tuning condenser must be isolated from the chassis. In this case it was isolated by a 0.01-μfd mica blocking condenser. The tuning condenser is also insulated from the chassis in order to prevent any loop circuits which result when not using a one-point ground.

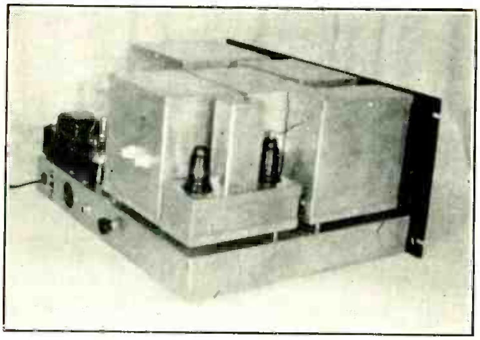


Figure 4. The crystal filter unit on the right feeding into the i.f. amplifier and second detector. The two terminals with the bushings lead into the r.f. stage. The ground terminal, phone jack, speaker socket, and B-relay connection are shown from right to left along the rear of the sub-chassis.

Tapped-Coil Bandspread

Bandspread is obtained in the other h.f. stages by tapping the tuning condenser down on the tank circuit inductance. This method of bandspread may result in spurious signal reception since a reactance vs. frequency plot of the resulting tuned circuit will show two anti-resonant points. However, such spurious response has not appeared in the receiver so this method of band spread was decided upon because of its ease of band spread adjustment. Small 50-$\mu\mu$fd air-padding condensers are mounted in the type XP-53 oscillator coil-forms to provide the necessary high C to L ratio. The resulting reduction in Q due to the mounting of the condenser in the coil-form is not great enough to effect the oscillator stability so is permissible in this stage. The coil should be doped along the coil-form ribs to insure the mechanical stability necessary for permanent oscillator calibration.

Crystal Filter

The crystal filter circuit is conventional in every respect so warrants no further discussion here. One stage of 465-kc. iron-core i.f. provides ample gain and selectivity. A 6K7 is used and is a.v.c. controlled. An 0-1 milliameter in a wheatstone bridge circuit with one leg of the bridge consisting of the plate to cathode resistance of the 6K7 serves as an R-meter. This control of the a.v.c. on one

---

[2] See *Phenomena in High Frequency Systems* by Hund, page 97.

stage is not all that could be desired but the meter does serve as a visual indicator when making the usual line of antenna tests. Manual i.f. gain is provided for by varying the negative grid bias by means of a potentiometer in the cathode circuit.

A 6C5 is used as a conventional plate detector. A 6B7 provides an amplified a.v.c. voltage for the 6K7 i.f. tube. The a.v.c. tube is mounted in a horizontal position under the sub-chassis as shown in figure 4. A 50,000-ohm variable resistor in the cathode of the 6C5 provides a means of variable self-bias which is adjusted to give good detector action.

The b.f.o. is similar to that suggested and used by W6CUH[1]. This oscillator has well proven worth the extra space occupied by it. The high-C tuned circuits in both the grid and plate circuits improve the wave-form of this type of oscillator and reduce the hiss as mentioned in the case of the h.f.o.

A jack is provided in the output of the second detector for headphones. Ample a.f. gain for loudspeaker operation for those that prefer the speaker to the phones on local contacts is provided by a 6F6. A potentiometer in the grid circuit of the 6F6 furnishes means for a.f. gain control.

The power supply is well filtered with a total of 24 μfd. in a brute force filter. The speaker field and a 30-henry choke make up the filter inductance. The power transformer and choke are mounted in one far corner of the chassis. No trouble has been experienced with magnetic hum pick-up as a result of the power supply being an integral part of the receiver.

Constructional Details

The chassis is formed of no. 18 gauge auto body steel, cadmium plated, and measures 17″ x 14″ x 2″. The panel is a standard steel relay rack panel 8¾″ x 19″. The remainder of the shield cans are made of no. 20 gauge cadmium plated auto body steel. The r.f., first detector, and h.f.o. stages are housed in cans 5½″ x 6″ x 4″ with removable top and bottom covers. These covers are held on with self-tapping screws. The components of these stages are mounted on smaller boxes as shown in figure 2 located in the larger cans. Each box is 4½″ x 3″ x 2″. These boxes are mounted above the bottom covers of the larger cans by small insulated spacers.

The crystal filter components are mounted in a 6″ x 6″ x 2½″ can. The i.f. stage and second detector are mounted on a 6″ x 2½″ x 2″ box. The b.f.o occupies its own compartment which is 6″ x 6″ x 6″. This can is located at quite some distance from the second detector requiring a shielded lead for its output to the detector grid. This shield consists of a 3/16″ diameter copper tubing with a length of insulated wire inserted through its center. Coupling to the detector is through a small capacitance formed by twisting a few lengths of this feed wire together in the usual manner. The number of "twists" is determined in the individual case by the operator. There should be no more capacity than necessary to give a good beat note on an average signal. More coupling tends to decrease the signal to noise ratio on weak signals. All cans are mounted by ⅝″ insulated spacers above the sub-chassis and are grounded to it at one point only. For an excellent discussion and illustration of the proper method of shielding and grounding the reader is referred to the indicated reference[3].

The 6F6 audio stage and power supply are mounted directly on the sub-chassis. All the power leads from each stage are brought out through the bottom of the stage cans and wired under the sub-chassis. Each stage has its own filament leads of No. 14 solid wire.

Alignment Procedure

The usual procedure for alignment is followed. The crystal can be used in an oscillator circuit for a rough adjustment of the i.f. channel. The crystal should then be placed in the receiver and the channel peaked right on the nose by means of a variable frequency oscillator. *Do not use the R-meter for peaking the i.f. channel but use some sort of output meter in the audio stage with the a.v.c. off.* The variation of input capacitance of the i.f. stage with the change of grid bias through the a.v.c. lead can be great enough to throw the i.f. channel off the xtal peak when the a.v.c. is switched off for weak signal reception. If the R-meter must be used, limit the input signal at the generator to the point where a reading on the R-meter is just noticeable. The i.f. gain should be wide open during the alignment.

The alignment of the r.f. and first detector stages require a certain degree of patience. As trimmers are not mounted in the individual coils the stages must be peaked by cut-and-try. When winding the coils for the r.f. and first detector stages pains should be taken to make the coils identical. Then final peaking can be done by a slight shifting of the turns until the stages are peaked. In the author's case the ten-meter coils were peaked with the small trimmers in the circuit and then the

[*Continued on Page 74*]

---

[3] *Measurements in Radio Engineering,* Terman, pages 218 to 220.

A 28- *and* 56-MC. TRANSMITTER

By HENRY P. HARSCH*

A description of a 75-watt 5- and 10-meter transmitter utilizing bandswitching in the exciter stages.

It has always been the opinion of the author that the most satisfactory all-around crystal oscillator is one of low power capabilities with consequent low crystal current. Since the 6J5G tube has proven itself to meet these specifications, and since it is also a good tube to use with high-frequency crystals, one of these tubes was used as oscillator with the 14Mc. crystal which controls the frequency of the transmitter to be described.

The Crystal Oscillator

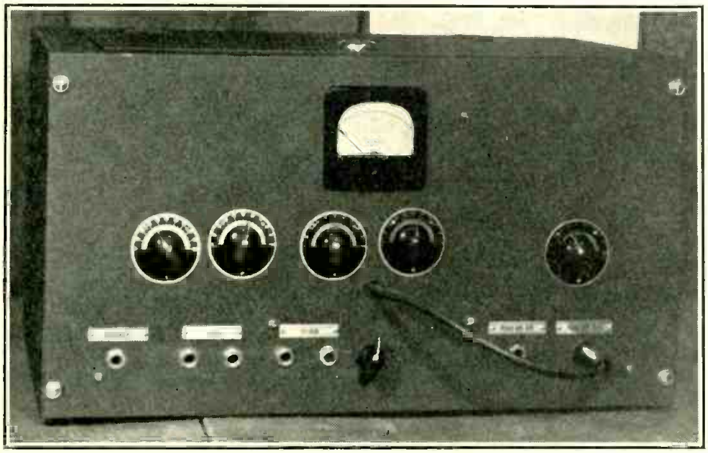
The 6J5G is used as a regenerative triode oscillator, with the plate circuit of the tube operating on the crystal frequency. Operating the oscillator stage straight through, even though the regenerative circuit has been employed, gives greater power output with less crystal heating than would be obtained with a conventional oscillator or with a doubling oscillator. The tube is operated with 300 volts plate potential, this value of voltage being obtained by adjustment of the slider-type resistor, R_2. Through the use of an out-of-band crystal (14,500 kc.), the heavy interference usually obtained from stations doubling down from the 40 and 20 meter bands was minimized.

Since the crystal oscillator is operating on the 14Mc. band and the final amplifier is to operate on both the 28 and 56Mc. bands, two doubler stages were required to facilitate rapid band change. Since the output power of the crystal oscillator is only two or three watts, a tube requiring comparatively low driving power, and yet capable of driving the final 35T, was needed. Since the 807 seemed to fill the requirements splendidly two were used: one as a doubler from 20 to 10 and the other as a doubler from 10 to 5 when the latter band is in use.

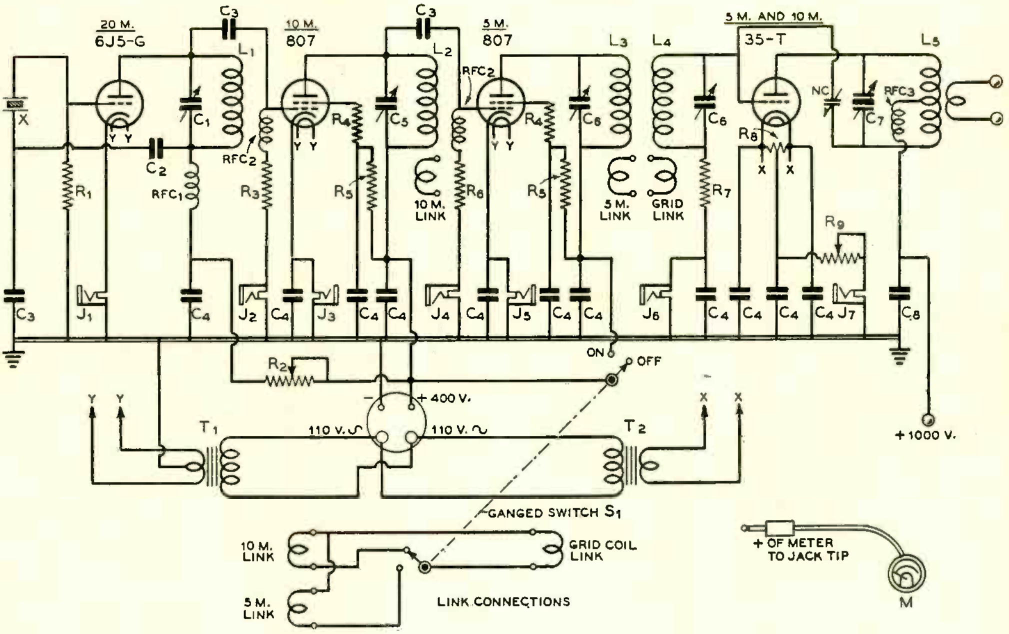
The transmitter was designed for use as an auxiliary ultra-high r.f. unit for use with the power supplies and modulator of an existing 100-watt transmitter. Since the power supply for the exciter stages was already built up and since it only supplied 400 volts, the 807's are not running at their full output capa-

---

*1915 89th Avenue, Oakland, California.



Front view of the 100-watt transmitter. Reading from left to right, the tuning controls are: crystal plate, 10-meter doubler plate, 5-meter doubler plate, final amplifier grid and final amplifier plate. The small bar knob at the bottom center of the panel operates the switch which cuts the 5-meter doubler in or out of the circuit. By means of a plug-and-jack arrangement, the single meter serves for all stages.



Wiring Diagram of the 5- and 10-Meter Transmitter

C_1—35-μμfd. midget variable
C_2—.001-μfd. mica
C_3—.0001-μfd. mica
C_4—.002-μfd. mica
C_5—35-μμfd. midget variable, double spaced
C_6—15-μμfd. midget variable, double spaced
C_7—35-μμfd. per section, .084" spacing
C_8—.002-μfd., 500-v. mica
NC—Neutralizing condenser
R_1—25,000 ohms, 1 watt
R_2—3000 ohms, 25 watts, slider type
R_3—100,000 ohms, 2 watts
R_4—50 ohms, 2 watts
R_5—15,000 ohms, 10 watts
R_6—150,000 ohms, 2 watts
R_7—2000 ohms, 10 watts
R_8—75 ohms, c.t.; 25 watts
R_9—500 ohms, 25 watts, slider type
RFC_1—2.5 mhy., 125 ma.
RFC_2—1.5 mhy., 125 ma.
RFC_3—U.h.f. choke
S_1—D.p.d.t. ceramic tap switch
X—20-meter crystal
T_1—6.3 v., 3 a.
T_2—5 v., 5 a.
J_1, J_2, J_3, J_4, J_5, J_6, J_7—Closed-circuit jacks
M—0-200 ma.
Coils—See "Coil Specifications" in text

bility by a considerable margin. However, with only 400 volts of plate potential the 807's supplied ample grid excitation on both bands: 30 to 35 ma. on 28Mc. and 25 to 30 ma. on 56 Mc. If a higher voltage power supply is to be used with the exciter, the resistance values of both R_2 and R_5 will have to be increased.

The 35T Final Amplifier

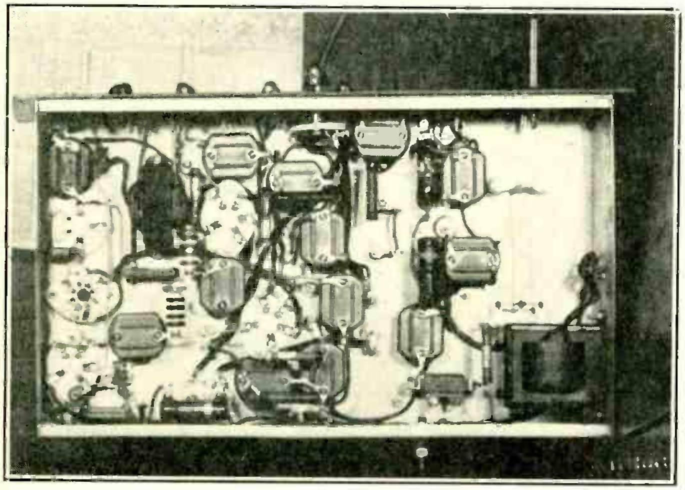
The final amplifier consists of a 35T with a combination of cathode and grid leak bias. Cathode bias was incorporated to protect the tube in the event of excitation failure. Straight grid-leak bias was used on the exciter stages since the incorporation of cathode bias would lower the already low plate voltage, and since the plate current drain on the 807's without excitation is not dangerously high for short period of time.

The system of excitation switching to the final stage is shown in the circuit diagram. Fixed links are placed on the plate tanks of the two 807 doubler stages, and the leads from these links are run through a switch which selects the output from either the 28Mc. or the 56Mc. doubler stage. When the switch is placed on the 28Mc. position, the plate voltage is removed from the 56Mc. stage so that this tube will not unnecessarily drain energy from the power supply. When changing bands, however, it is necessary also to change both the grid and plate coils in the 35T amplifier stage.

In the particular case of the transmitter shown in the photographs, the final amplifier was designed to operate with from 100 to 125 watts input. The measured output was between 80 and 100 watts on the 28Mc. band and about 75 watts on 56Mc.

Coil Specifications

All coils, with the exception of the 20-meter oscillator coil, are air-wound and self-



A good deal of the transmitter wiring is under the chassis. The transformer at the right rear corner of the chassis supplies the 35T filament power, while the smaller transformer toward the left front of the chassis delivers heater power to the three exciter stages. Note that the sockets for the two 807's are sunk below the chassis to help in obtaining short leads from the plates of these tubes to their tank circuits.

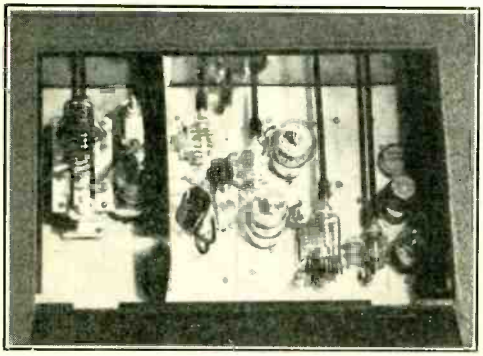
supporting. The 20-meter oscillator coil L_1 consists of 11 turns of no. 18 enamelled copper, wound on a 1¼″ in diameter form and spaced the diameter of the wire. L_2 consists of 8 turns of no. 12 enamelled spaced ⅛″ between turns, on a diameter of ¾″. L_3 consists of 4½ turns of no. 12 enamelled spaced ⅛″ between turns, on a diameter of ¾″.

The final grid coils are shown on the diagram as L_4 and, naturally, there are two of them, one for 28Mc. and the other for the 56Mc. band. The 28Mc. coil consists of 12 turns of no. 12 enamelled spaced ⅛″ between turns and wound to a diameter of 1-⅛″. The 56Mc. final grid coil consists of 6 turns of no. 12 enamelled spaced ⅛″ between turns and wound to a diameter of 1-⅛″.

Similarly, there are two final plate coils, one for each band, which are shown on the diagram as L_5. The final plate coil for 28Mc. consists of 12 turns, center tapped, of no. 10 enamelled wire spaced ⅛″ between turns and wound to a diameter of 1-⅛″. The 56Mc. final coil consists of 6 turns of no. 10 enamelled wire spaced 3/16″ inch between turns and wound to a diameter of 1-⅛″. Both coils have antenna coupling links wound around their centers consisting of 2 turns of no. 10 enamelled wire spaced 3/16″ inch and wound to a diameter of 1½″.

Links are also wound around the lower ends of L_2, L_3, and the coils L_4 for both 28 and 56Mc. These links consist of 2 turns of no. 12 enamelled wire spaced ⅛″ and wound to a diameter of 1-⅛″.

See Buyer's Guide, page 97, for parts list.



Looking down inside the transmitter cabinet. The crystal oscillator and doubler stages at the left are separated from the final amplifier by shield partition which runs from the front to back of the chassis. The use of several pieces of bakelite shafting allows the exciter tank condensers to be located at the proper position to secure short tank leads.

• • •

"Didjano?"

In the old days, when the fashion was to wind plate tank coils with bell wire, the builder was frequently admonished not to use bell wire with *green* insulation. Remembering this, we checked with several old-timers to find out why. Unanimous is the statement that the green cover was slightly conductive.

We thought we had received another refrigerator ad when *G. E. Ice* tumbled out of an envelope. But it turned out to be the handle of W7HTW.

A 15-WATT GRID MODULATOR

By LEIGH NORTON*, W6CEM

The amplifier about to be described was originally intended to serve as a grid modulator for a high-power phone transmitter using the class C system of high-efficiency grid modulation. However, its design and capabilities are such that it can well serve in other capacities, such as cathode modulator, p.a. system, class B driver, recording amplifier, etc., with little, if any, changes.

Were it not for the fact that the grid modulator must, like a class B driver, work into wide variations in load impedance, the output from the amplifier could well be considerably less than the 12-15 watts that the push-pull 6L6's in the output stage provide. However, since the grid impedance of the modulated stage does vary so widely during the modulation cycle it becomes necessary to stabilize the modulator output by means of a swamping resistor. Developing the required modulating voltage across the resistor calls for a moderate amount of power output from the modulator. The amount of swamping that is required depends almost entirely on the plate impedance of the modulator tube or tubes, and in this case the swamping requirements are not too stringent, since the effective plate impedance of the 6L6's has been reduced considerably through the use of degenerative feedback.

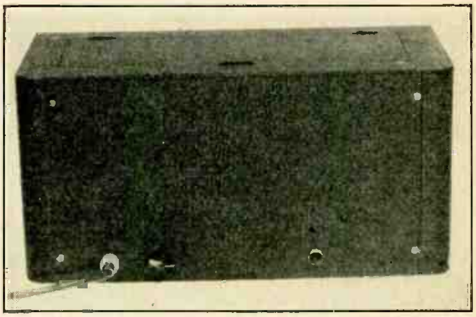
Circuit

In circuit design, the amplifier takes a good deal of its inspiration from the single-ended grid modulator shown in the sixth and seventh editions of the RADIO HANDBOOK.[1] The changes necessary to allow push-pull operation are the principal difference between the two. The same system of parallel inverse feedback has been used, since this method has been found to be simple and most effective.

The parallel feedback circuit requires only the addition of a single resistor on each side of the circuit between the plates of the output tubes and the plates of the preceding tubes. The prime requirement of this circuit is that the "driver" tubes have high plate-to-ground impedance, which calls for high-plate-impedance pentodes as drivers and moderately high values of plate and grid resistors between the two stages. When the circuit is operating properly the grid-current point in both stages is reached at the same time. That is, when sufficient signal voltage is applied to the driver to cause that stage just to begin drawing grid current, the driver is then delivering just sufficient output voltage to cause the output stage to commence drawing grid current.

Phase Inverter

In arriving at a circuit to supply out-of-phase excitation to the two 6SJ7 grids several possibilities were considered before the arrangement shown in the diagram was finally decided upon. Since a voltage gain of 10 to 20 was required between the amplifier input and each 6SJ7 grid, the choice finally resolved

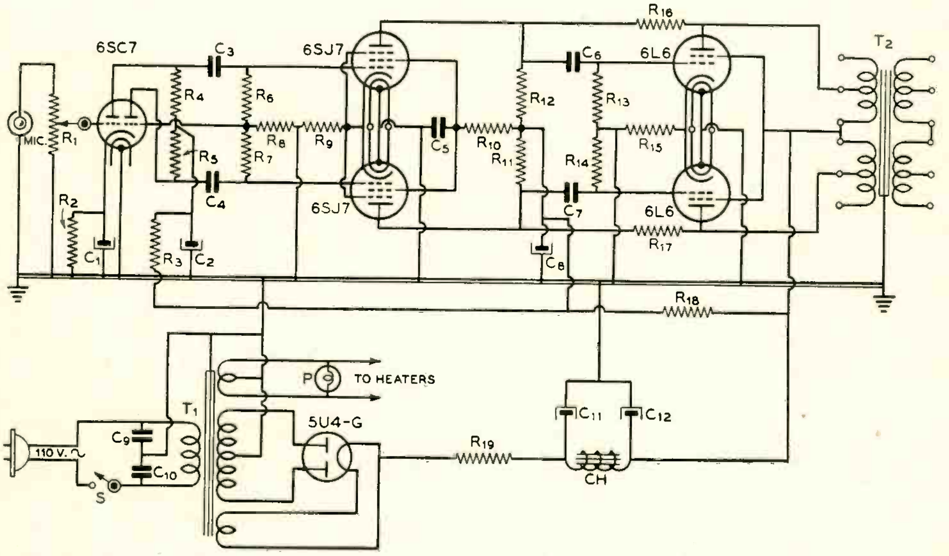


Front view of the complete amplifier in its cabinet.

---

*Associate Editor, RADIO.

[1] P. 227.



Amplifier Wiring Diagram.

C_1—10-μfd. 25-volt electrolytic
C_2—8-μfd. 450-volt electrolytic
C_3, C_4—.01-μfd., 600-volt tubular
C_5—.25-μfd. 600-volt tubular
C_6, C_7—.05-μfd. 600-volt tubular
C_8—8-μfd. 650-volt electrolytic
C_9, C_{10}—0.1-μfd. 600-volt tubular
C_{11}, C_{12}—8-μfd. 450-volt electrolytic
R_1—2-megohm potentiometer
R_2—1500 ohms, ½ watt
R_3—10,000 ohms, ½ watt
R_4, R_5—250,000 ohms, ½ watt
R_6, R_7—500,000 ohms, ½ watt
R_8—100,000 ohms, ½ watt
R_9—250 ohms, ½ watt
R_{10}—200,000 ohms, ½ watt
R_{11}, R_{12}—100,000 ohms, ½ watt
R_{13}, R_{14}—250,000 ohms, ½ watt
R_{15}—150 ohms, 10 watts
R_{16}, R_{17}—500,000 ohms, ½ watt
R_{18}—10,000 ohms, ½ watt
R_{19}—200 ohms, 10 watts
T_1—700 v. c. t., 145 ma.; 5 v., 3 a.; 6.3 v., 4.5 a.
T_2—Tapped 40-watt output transformer
CH—12 hy., 150 ma.
S—S.p.s.t. (on R_1)
P—6.3-volt pilot lamp

itself into deciding whether to use a triode input stage having a voltage gain of from 10 to 15 followed by a "hot cathode" type of phase inverter,- which has 100 per cent degenerative feedback and gives no voltage gain, or to use a phase inverter as the input stage and drive the 6SJ7's directly, without further amplification, thus eliminating one stage. In spite of an inherent distrust of phase inverters which do not have 100 per cent degeneration, the latter system was chosen, and has performed extremely well in use.

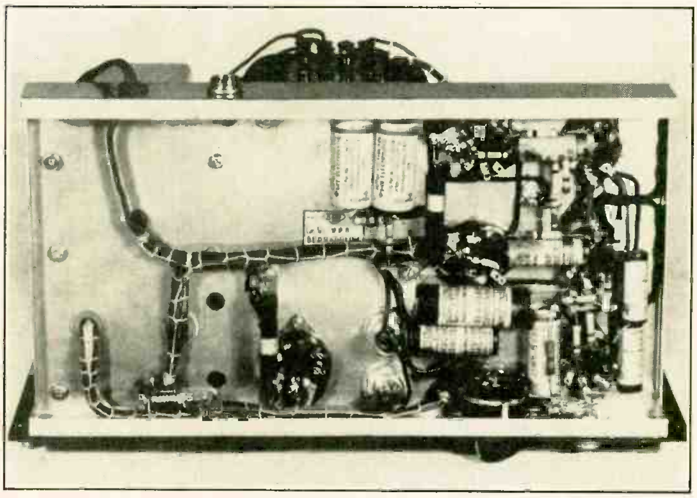
The phase inverter shown in the diagram is commonly known as the "self balanced" circuit, since there are no critical resistor values to be adjusted to obtain balance between the two sides. In this circuit resistor R_8 is common to both the plate and grid circuits of the right-hand section of 6SC7 and is also included in the plate circuit of the left-hand section. Because of this method of connection, the voltage applied to the right-hand, or output, section is dependent upon the difference in output of the two sections, and the circuit tends to balance itself.

Because of the degenerative effect obtained, the circuit is quite stable in operation. However, one consequence of the degeneration, which is applied only to the right hand section of the phase inverter, is that the output of the two sides is never absolutely equal. The amount of unbalance is extremely slight, and is probably less than is usually obtained with conventional phase inverters. In tests, the phase inverter has continued to give distortionless output at levels far higher than are needed to give maximum undistorted power from the output stage.

Output Transformer

At first blush the use of a 40-watt output transformer for a 15-watt amplifier might seem a little odd, to say the least. However, since a tapped transformer was desired to allow the amplifier to fulfill several probable uses beside acting as a modulator, the choice of the 40-watt unit was made necessary because of a dearth of available transformers between the 15-watt and the 30- to 40-watt class. While the 15-watt item undoubtedly

Looking down on the amplifier from the rear. The two 6SJ7's and the 6SC7 are at the right, while the 6L6's are located next to the output transformer. The output transformer has been mounted so that its terminal strip is located at the rear, to facilitate making changes in the impedance ratio. The locking shielded connector at the rear carries the amplifier output.



Underneath the chassis. Parts are located largely as convenience dictates, keeping in mind the necessity of separating input and output circuits to avoid feedback troubles. The power switch is located on the gain control seen in the lower right corner of this photo.

would serve satisfactorily if exceptionally good low-frequency response is not desired, the larger transformer provides all that could be desired in outstanding performance at the low-frequency end. For the constructor who is interested in this type principally for use as a modulator, the 15-watt class of transformer might well be used, since the extended low-frequency response is unnecessary for voice work.

Power Supply

Power for the complete amplifier is supplied by a 145-ma. transformer of the type commonly sold for receiver replacement purposes. A 200-ohm, 10-watt resistor ahead of the filter serves the dual purpose of reducing the peak rectifier current and dropping the voltage to the required 300-volt value. The major portion of the filtering is supplied by the two 8-μfd. electrolytic condensers, C_{11} and C_{12}, and a 12-henry, 150-ma. choke. Additional filtering for the first two stages is provided by condensers C_2 and C_8 in conjunction with the two 10,000-ohm resistors, R_3 and R_{18}.

There was some doubt when the amplifier was constructed as to the advisability of plac-

[*Continued on Page 70*]

MINIMIZING NOISE LEVEL

In A. F. Systems

When a low noise level is desired in an a.f. system having very high gain, such as would be required with a high-fidelity low-level microphone when the speaker is several feet from the mike, there are many things to be taken into consideration besides the amount of power supply filter.

Virtually all of the noise (including hum) will come from the first stage, assuming the balance of the a.f. system is of good design and all stages are provided with adequate plate voltage filtering. Hence, to keep noise to a negligible value, it is only necessary to give careful attention to the first stage.

The choice of a tube is important. High μ triodes having high transconductance have been found to give the best signal to noise ratio. Also, for minimum hum it is best to use a "double ended" tube, one having the grid out the top. A tube that meets these requirements is the 6F5. While other tubes may be used, a 6F5 is to be recommended, as it is inexpensive and has a high ratio of transconductance to the square root of the plate current, and noise has been found to be inversely proportional (approximately) to this ratio.

To minimize hum from the a.c. heater supply, the heater voltage should be dropped to about 5 volts by means of a 2 ohm resistor in each heater lead. The use of two resistors instead of a single 4 or 5 ohm resistor avoids upsetting the center tap. The common practice of grounding one leg of the heater to the chassis, while perfectly permissible for most purposes, is not to be recommended in a very high gain amplifier. An accurate center tap on the heater supply should be used.

Reducing the heater voltage to 5 volts greatly reduces hum from this source, and the signal-noise ratio will not be affected. The heater voltage should not be reduced to a value lower than 5 volts, however, or the noise level will increase. Obviously reduced heater voltage should be applied only to the first tube, or to those tubes drawing not over a very few ma. of plate current. When a 6.3 volt 0.3 amp. heater type tube is drawing only a milliampere or so of plate current, it is not necessary to run the tube at full rated heater voltage, and the reduced heater voltage will greatly prolong its life.

There is little point in choosing a tube with a low inherent noise level if it is to be used with a high impedance in its grid circuit. The d.c. path from grid to ground should be as low as possible. If a dynamic or ribbon velocity microphone is used, this condition will be met automatically. If a crystal microphone is used, the grid resistor should be made as low as will still permit satisfactory bass response, which will be about 1 megohm for music and 250,000 ohms for voice (with the average crystal microphone). There will still be considerable noise with these values, and if the noise level is found too high, a high impedance choke should be substituted for the grid resistor. The choke should have an inductance of from 400 to 1000 hy., reasonably low distributed capacitance, and, if near any a.c. transformers, should be of "hum-bucking" construction.

A low d.c. resistance path in the grid circuit is highly advisable for another reason if a high-μ triode is used in the first stage. Cross modulation or detection is possible if there is a powerful transmitter in the vicinity (when a high value of grid resistor is used) unless very elaborate shielding is employed. The tube serves as a grid leak detector when the cathode bias is sufficiently low, and the balance of the a.f. system serves as a high gain amplifier. Very little r.f. signal on the first grid will result in an audible signal in the output of the a.f. system. By using a high impedance choke in place of the grid resistor, the tube no longer can act as a grid leak detector.

Should detection still persist, as a result of the non-linearity of high-μ triodes, a small mica condenser of about 100 $\mu\mu$fd. should be placed across the high impedance grid choke and an r.f. choke or a 10,000-ohm resistor be placed in series with the grid of the tube.

AUTHOR! AUTHOR!

"You, too, can write!"

By W. E. McNATT*, W9NFK

It is the purpose of this article to give some "inside dope" to you, a potential author with great gobs of knowledge to impart to your fellow ham via the media of RADIO, a good example of a technical-radio publication.

A few misconceptions should be straightened out concerning the editor and staff of a typical publication (not necessarily *this* one, however). In order to have a magazine, it is evident that editorial material be obtained. Naive as it seems, that statement carries plenty of meaning, and is not as facetious as it may appear.

Contrary to the opinions held by some people, an editor and his staff do not spend much of their time dictating words on end pertaining to their own ideas, eventually to appear as an article. True, an editor must write. But, he must produce material which is even better than normally expected from outside contributors to the magazine. If it isn't, he is wasting his time. Furthermore, considerable effort must be exerted by an editor and his staff to dig up *new* material which is not only new, but *good.*

In addition to his own writing activity and search for above-average subject matter for articles, the editor must also read and judge the contributions which daily arrive on his desk. These contributions are the work of writers and would-be-writers, even as you and I, who have been urged by their friends, their self-convictions or by a desire to prove something-or-other, to send an article about *The Idea* to their favorite magazine. These contributions *must* be read; an editor *wants* to read them. He never knows when something really "hot" may turn up in the day's mail.

Send It In!

This magazine, for one, solicits and accepts contributions from outside authors. The publishers and editors have for many years maintained the policy of paying the author of an acceptable article, upon its publication. The rates vary, of course, and depend upon the article itself. A good, bang-up technical article which features *construction* of a certain item of equipment may rate six dollars per *printed* page. At the opposite end of the scale, a discussion article containing little constructional or practical data may bring only three dollars per page. An exception to this rate is made for articles of the discussion type which also present data for construction of the device, or idea. For example, an article describing the derivation, theory and dimensions (with construction hints) of a new type of antenna will warrant a slightly larger payment than one delving into the theory and operation of standard rectifier circuits, which by now have been pretty well covered by innumerable articles.

The general conception of an editor is that he has a pretty soft spot in the organization.

Editors, when they write, must produce material which is far above the standards applying to that of contributors to the magazine.

---

*ex-W6FEW; Production Manager, RADIO

Our Editors Speak

The acceptance of an article is subject to many—very many—factors. Most of these are contained within the mind of the editors; and psychologists will readily tell you that human behaviour (including editors') is highly unpredictable. Consequently, lack of space, (and our own editor), forbids my reciting more here than just a few points affecting the acceptability of an article.

Messrs. Smith and Dawley, our "top" editors, voiced the following in response to my query concerning material for RADIO:

"We like to receive stories with a basically good idea that are written like those of John Kraus, L. C. Waller, Douglas Fortune, and other 'regulars', and which usually can be sent to the printer without a mark (correction) on them. And, we pay top prices for such material. But, if the idea is *good,* we'll still accept the story even if it has not been well written. Of course, this latter type of acceptance does not warrant quite as large a payment, since considerable time is required of our staff to whip it into shape . . ."

Speaking further of acceptance of an "article" which consists merely of a few words of description accompanying a diagram and pictures (*always* send pictures, if there's anything pertinent to "shoot"), Smith and Dawley said:

"If it concerns a *good* enough idea, we'll accept it. Some of our best articles have come in this way, and were ghost-written[1] into the finished story. One ham wrote in, after his article had been published, 'Gee, I didn't know I could write so good!' "

Therefore, it should be apparent that you do *not* have to be a literary great in order to make a few dollars from some good idea. Of course, if you can write fairly well, then your author's check will be larger. The *less* work our editors do on your material, the more money you will be paid.

Our editors stress the point that, if the basic idea is good, an acceptable "article" may consist of nothing more than sketches and notes. But, if written into an article, the idea warrants more remuneration.

Out of ten articles received, for instance, there may be three, four or five which are acceptable as they were written (with the exception of some grammatical and technical corrections or clarifications). Occasionally the prize of them all pops up: an article which has been well written, technically and grammatically sound and—of all things—with a subject that will at once be of interest to the majority of the readers, as well as being technically "hot". Yes, this sort of article is a rarity, but it's one of the main reasons why an editor looks forward to his morning's mail, and why every contribution is read. He never knows when such a prize will show up.

Errors of the Embryonic Author

I took the trouble to find out what we budding authors consider an "acceptable" manuscript. The following remarks are representative of our collective sins as would-be-writers:

1. We type our manuscripts with no extra spacing between lines and/or with little or no margins between the writing and the edges of the sheet. (Manuscripts should be typewritten with at least 1½" margins, and double spaces between lines.)

2. We don't type our manuscripts at all; we just jot down a few notes, scrawl a diagram (usually omitting circuit constants) and blissfully place it in the mail. (Even this *may* be acceptable material, however, as was earlier pointed out, but only under the conditions there stated!)

3. We type some of the article and write some in long-hand. Or, we write it all in long-hand. (This is fine, *if* you can write longhand as well as it's done in the movies.)

4. We fail to include all constants on the wiring diagram.

5. We forget to send one or more pages of the manuscript. (This is a great stimulant to an editor, especially on a Monday morning!)

6. We overlook the little matter of writing our name and the title of the article on each sheet of the manuscript, which is likely to be scattered far and wide, sheet by sheet, before the editors have finished with it. (One editor, reading the mss., will say: "Hey, Joe, whaddaya think about this?" Joe will reply, "Lemme have the copy a minute." Whereupon the first editor will pass the particular sheet of copy to Joe, but will go on reading the rest of the article.

7. We fail to number the sheets consecutively, and sometimes place the sheets out of

---

[1] A term used by editors and writers to indicate an article or story written by one person, but published under the name or "by-line" of another who (supposedly) compiled the pertinent data.

reading order. (Another great stimulant!) Remarks under 6 apply well for this.

8. We place little notes between certain pages of the manuscript, or paste two or more sheets together just to see, when the mss. comes back, if the editor really did read it all. (The motive also applies to 7).

9. We blissfully write: "You know what I mean" to the editor when long-neglected composition fails us utterly in an attempt to explain some detailed portion of our work.

10. We have heard something about being paid "so much per word". So, we write needless words on end, as long as we dare. This stunt is known in publishing and writing circles as "padding". For *goodness'* sake, *don't* think the editor won't spot it instantly. He's so used to it that it stands out like Ann Sheridan. Only it's not one-tenth as acceptable. The net result of this foolishness is that the padding is cut out by the roots. Your payment, which is *not* rated by the word in Radio, is reduced because of the extra work involved in retyping the manuscript around the "holes" made by killing (deleting) the excess verbiage.

The foregoing could continue for many more items, characteristic of the inexperienced writer. But, those ten groups should give you a fair idea of what confronts an editor, day in and day out.

Our errors and failings are not all on the negative side. There are cases wherein a budding young author goes to the opposite extremes. These instances are less prevalent than the types previously discussed, but they do pop up frequently.

For instance, when we decide that the time is ripe for the literary birth of our "brainchild", we only too faithfully recall how we handled that theme in *English Lit. III,* or that thesis in *E. E. IV* on *"Long Transmission Lines: Their Solution by Assumption of an Infinite Length".* Some of us, who have a longer memory, usually fall back on the modus operandi employed to entice that "A" out of the Freshman English teacher.

The usual result of applying such faithful recollections is that *The Article* arrives on the editor's desk wrapped up like a Christmas present and hand-bound in a beautiful and relatively expensive cover.

Yes, there is even a title page. We knew it would be there! Would you like to bet on whether or not the illustrations are drawn in rusty 1st-year drafting? We win: they are! (The staff draftsman will re-draw them in the style of the magazine). Sketches and diagrams drawn free-hand are quite adequate *if* they are accurate and readable.

The photographs couldn't be better than if they had been taken by a professional. But, here's why the editor invariably will set his teeth and mutter to himself as he wades through the article:

1. He knows it will be written in the "best" recalled style of English composition.

This is fine, if it's plain, ordinary good English. But, usually, it will be stiffer than a dress shirt. And, like a dress shirt, it's appropriate only for certain occasions. In the writing field, those "occasions" are found in profound publications such as the *Proceedings of the I.R.E., Journal of the A.I.E.E.* and others. They are very fine publications; but, the magazine devoted to less formidable presentation of theory and analysis in technical radio is read by people who prefer the more comfortable reading exemplified by the informal style of writing.

2. The editor knows that the odds lean heavily in favor of the possibility that the professional photographer has taken few pictures of apparatus and therefore was not aware of the electrically or mechanically important features of the apparatus. Or, if taken by the author, the pictures are likely to have poor contrast, be out of focus, or taken at an improper exposure.

The editors of Radio have for many years made available a very comprehensive leaflet[2] describing the simple requirements and methods involved in taking acceptable photographs of equipment.

"Encounter"

However good or bad it may be, the manuscript is now in the editor's hands. As stated earlier, it's an impossibility to cite all the factors which influence an editor in his decision to accept or reject the article. However, many of the foregoing factors often

The editor knows all about the faults of authors before he sits down to read an article. However, he doesn't want a display of vocabulary and composition half as much as he wants clarity in a write-up.

---

[2] "Taking Apparatus Photographs for Magazine Reproduction"—"R/9," February, 1935, later reprinted as a leaflet.

exert considerable influence in the decision. There are others of importance.

It may seem incredible, but editors have been confronted by manuscripts which were so unintelligible on the whole that the only action possible was to reject them. The unintelligibility was not always due to poor handwriting or typewriting of the words of the article. Too often it resulted from the author's attempt to employ words the definition of which he was only vaguely familiar. Or, he would become involved in a complicated description and try to get it all within one sentence and eventually become so bogged down with words and commas and parentheses that the entire meaning of the sentence, and of the subject, became obliterated—as it has, by now, in this sentence which I use as a parallel example of what I started out to illustrate. Break it up into short, snappy sentences. The more involved the subject, the more sentences should be used.

A good subject is sometimes difficult to find. A poorly-written article with a good subject usually has preference over a well written story with a weak subject.

The "scatterbrain" style of writing is a frequent fault of an inexperienced writer. He takes up one subject, then forsakes it for another. This in turn he drops in his haste to attempt a clarification of a point which should be later discussed. Too often, these bits of business are "sub-scattered" within their own sentences.

The whole thing is so simple: merely sit down and think of what you did first in constructing your equipment or whatever it is. Make a few notes. Then write all about it. Take up the second step and write all about it. If there's some connecting point between the two, as there usually is, write it in the second step so as to make a logical connection. Proceed likewise until your story is finished. That's all there is to it. Let the editors worry about "polishing up" the continuity or composition. A "brilliant" style of writing is *not* a prime requisite; the only essential is to state the facts in a simple and comprehensive manner.

The Subject

Of greatest importance is the subject of the article. This in itself, if it's *good,* decides the acceptance of a *poorly* written article; or, if it's *weak,* decides the rejection of a *well* written article.

The subject must indeed be a versatile thing in order to "hit" the editor. It is his task to decide whether or not it will be of interest to the majority of the magazine's readers[3]. It should be "different" (definition wanted). It must not require too much expense or mechanical ability in order to duplicate the apparatus. It should be *new*: entirely, in part, or in its application. These are the most difficult requirements which the article must satisfy. Finally, the technical principles involved must be sound and presented in a manner such that they permit a clear conception of the operation or application of the device described.

In addition to the manuscript, the necessary circuit diagrams (with values and make of components used), photographs and sketches must be included. All are necessary, since in many instances the apparatus or a portion thereof is duplicated in the laboratory (in the case of RADIO). In order that the test be wholly fair to the author, the editors must know exactly what components were used in the original. The photographs and sketches should reveal any special requirements of construction or placement of parts.

If, before going to the trouble of writing your article, you would prefer an "authoritative opinion" as to its suitability for a particular publication, write a letter about your idea to the editor.

While firmly declaring your faith in your idea and extolling its virtues, your letter should be as modest as you can permit. Be sure you can back up your statements. However you express it, be sure to state the fundamental point(s) of merit of your proposed article. Next, present a short, concise outline. If the story concerns equipment, send along a photograph which will plainly show its best features. A circuit diagram is an additionally helpful enclosure.

If you wish return of your papers and

[*Continued on Page 74*]

---

[3] At this writing, u.h.f. equipment, u.h.f. antennas and u.h.f. theory (both a.m. and f.m.) command peak interest—*Author.*

A HIGH-FREQUENCY CONVERTER

for Home-Station Service

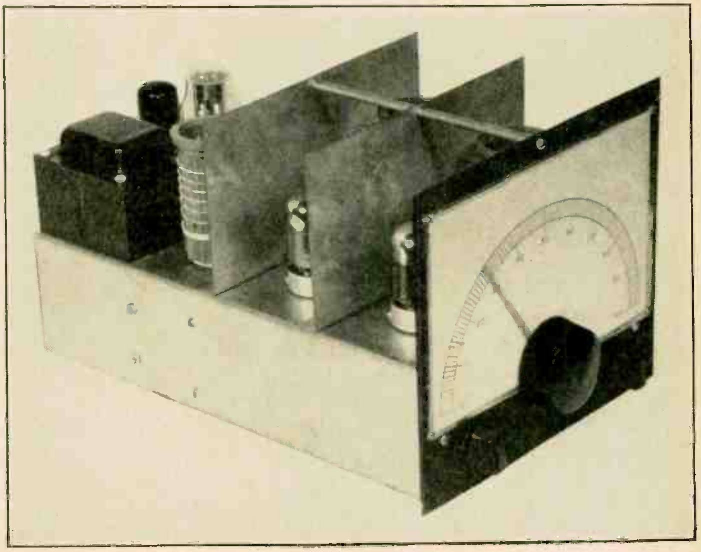
By JACK ROTHMAN*, W6KFQ

The performance of even the best all-band communications receiver can be improved on 10 and 20 meters by the addition of this converter.

An interesting observation made in connection with almost every one of various simple converters constructed in RADIO's laboratory was that they almost invariably—though they lacked an r.f. stage ahead of the mixer—were found to perform as well on 10 meters as the majority of the higher priced communications receivers and even better than many of the medium priced jobs. This is no reflection upon the commercial receivers used in the comparisons; when a receiver must cover from 10 meters to 160 or even 550 meters by means of ganged bandswitching, it is obvious that certain compromises must be made.

The fine performance exhibited by comparatively simple converters designed expressly for high frequency use led to the suspicion that by going to a little more trouble a converter could be made which would improve the performance of even the best all-band commercial receivers on 10 and 20 meters.

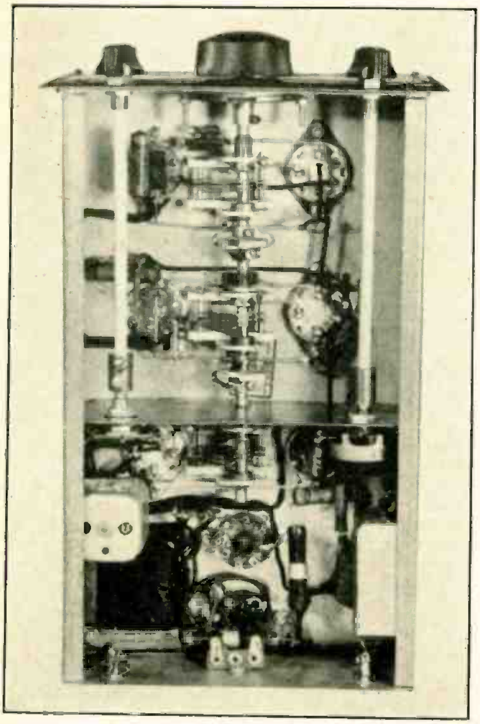
The converter to be described, shown in the accompanying illustrations, lived up to even the most optimistic expectations. When hooked ahead of one of the most popular of the high



Front angle view of the high-frequency converter. The 1232 r.f. tube cannot be seen but occupies the same position behind the rear shield as the coils take in the mixer and oscillator compartments. The dial, which lends itself well to any use of this general type, is described in the text.

---

*Technical Assistant, RADIO.



Underchassis view of the converter. Note the inter-stage shield between the r.f. and detector-oscillator compartments, and that the gain control and antenna switch are mounted upon this shield.

priced commercial all-band jobs, the converter pulled in readable signals on 28 Mc. that were "down in the mud" without the converter. On 14 Mc. the improvement was not so noticeable, but was still worth while. 14 Mc. signals which were above the noise level only on "up fades" without the converter were readable a much higher percentage of the time when the converter was used.

On the lower frequency bands, as was expected, there was no noticeable improvement. This, of course, was with an expensive receiver. With modest receivers in the lower priced brackets (especially those not having an r.f. stage) the converter also provided improved performance on 40 and 80 meters. For this reason, data on 40 and 80 meter coils are included in the coil table; the converter might just as well be used on every band where its use results in improved performance.

While the heater and plate current requirements are not great, they are somewhat more than can be robbed safely from the plate supply of many commercial receivers. Hence, a small power pack has been made an integral part of the unit. To prevent drift as a result of heating of the oscillator components, the oscillator is placed to the front of the chassis and the power pack to the extreme rear. This also gives a positive drive on the oscillator tuning condenser, as there is no flexible coupling between dial and oscillator tuning condenser to permit backlash. To stabilize the oscillator against frequency changes due to plate voltage changes (as a result of line voltage changes) a voltage regulator tube is used.

To provide maximum conversion gain in the mixer, grid leak bias and control grid injection are employed. This, in conjunction with the high gain tubes used both in the r.f. and mixer stages, gives a high potential overall gain. The full potential gain is closely approached as a result of fairly low-C low-loss tank circuits, difficult to obtain on high frequency bands with all-band bandswitching but easily obtained with plug-in coils when proper mechanical layout is employed. The oscillator is made high-C for the sake of stability, as it provides more than sufficient excitation when control grid injection is employed.

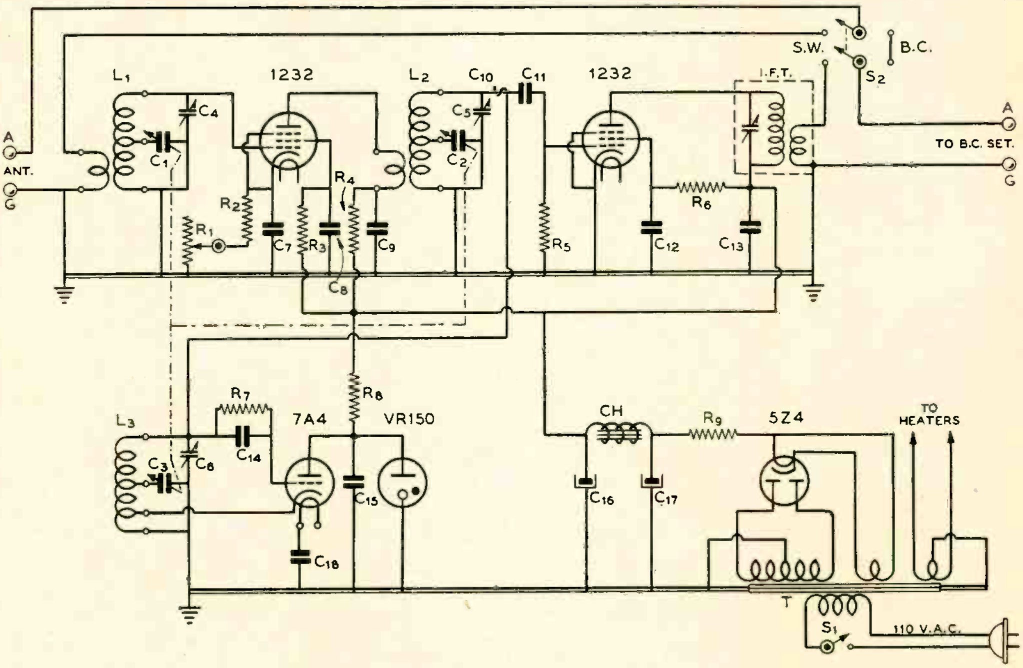
For maximum signal-to-noise ratio, the r.f. stage is run "wide open" on weak signals. However, the converter has so much gain that the receiver with which it is used may be blocked on loud local signals. Hence, an r.f. gain control (R_1) was incorporated. This is normally left full on, and backed off only when a signal is so loud that there is blocking.

Construction

The converter is constructed on a 7 x 12 x 3 inch chassis, with a front panel 7 inches high by 8 inches wide. The two stage shields are Bud type 1246, cut down to 4 inches high.

Under the chassis, a partition is placed 5¼ inches from the rear of the chassis. It is cut from a piece of 20 gauge sheet metal, either aluminum or zinc plated sheet iron. This partition is 2¾ inches high and serves both as a shield between the r.f. and mixer stages, and as a mounting support for the antenna switch and the gain control, both of which are operated from the front panel by means of shaft extensions. No shielding is employed between the oscillator and mixer condensers, as it is unnecessary.

All three tuning condensers are bolted directly to the underside of the main chassis, and are connected by means of flexible shaft couplings. The arrangement of the balance of the components should be clear from inspection of the illustrations.



Wiring Diagram of the Converter.

C_1, C_2, C_3—35-μμfd. midget variable, straight line capacity (semicircular).
C_4, C_5, C_6—Mounted inside coils, see coil table
C_7, C_8, C_9—.01-μfd. 400-volt tubular
C_{10}—Injection coupling; see text.
C_{11}—.0001-μfd. mica
C_{12}, C_{13}—.01-μfd. 400-volt tubular
C_{14}—.0001-μfd. mica
C_{15}—.01-μfd. 400-volt tubular
C_{16}, C_{17}—8-μfd. 450-volt electrolytic
C_{18}—.01-μfd. 400-volt tubular
R_1—10,000-ohm potentiometer
R_2—250 ohms, ½ watt
R_3—75,000 ohms, ½ watt
R_4—2000 ohms, ½ watt
R_5—5 megohms, ½ watt
R_6—75,000 ohms, ½ watt
R_7—50,000 ohms, ½ watt
R_8—5000 ohms, 10 watts
R_9—2000 ohms, 10 watts
S_1—S.p.s.t. (on R_1)
S_2—D.p.d.t. tap switch
IFT—Modified 1500-kc.i.f. transformer; see text.
T—700 v. c.t., 70 ma.; 5 v., 3 a.; 6.3 v. ct., 2.5 a.
CH—10 hy., 40 ma.
L_1, L_2, L_3—See coil table

The Output Coupling Transformer

The output transformer, IFT, is a modified 1500-kc. i.f. transformer. The secondary winding is removed and in its place is wound 15 turns of no. 22 d.c.c. as close to the primary coil as possible. To permit mounting of the transformer under the chassis, the transformer shield can is sawed off to a height of about 2 inches.

The Tuning Dial

With the tuning condensers mounted below the chassis in order to permit short leads, the problem of a suitable tuning dial arose. The answer is a semi-home-made arrangement which is built around the mechanism of a National type A vernier dial. The method of mounting the planetary drive unit is shown in the illustration of the bottom view. It is necessary to cut a small slot in the top front of the main chassis to take the top portion of the dial mechanism. The dial scale is drawn with india ink, preferably with a lettering guide; the scale proper is drawn with the aid of compasses. Sheet celluloid is placed over the scale to keep it clean and give it a "professional" appearance. A frame is made of thin sheet aluminum with the aid of tin snips. The pointer consists of a narrow strip of sheet celluloid which is scored down its middle with a sharp instrument, the groove then being filled with india ink. The whole job takes but a short time, and a smooth working, neat appearing dial is the result.[1]

---

[1] Since the converter was built, a tailormade dial similar to the one shown here has been announced. It is known as the type "ACN," by the same manufacturer.

To minimize losses on 28 Mc., either ceramic or polystyrene sockets are used for all three loctal tubes and all three coil forms. Ordinary bakelite sockets are used for the rectifier and voltage regulator.

Input and output connections are made to terminals on the rear drop of the chassis.

Injection Coupling

The control grid injection employed provides high conversion gain, and is not especially critical as to coupling. However, if too little coupling is used, there will be a reduction in conversion gain, and if too much coupling is used, there will likewise be a reduction in gain together with "pulling" between the mixer and h.f. oscillator when aligning the coils. Two pieces of pushback hookup wire, twisted together for about ½ inch, will be found to provide about the right amount of coupling if the exact mechanical layout illustrated is followed. Because of the stray capacity coupling present, very little additional coupling capacity will be required.

The Coils

All coils are wound on standard 1½ inch 5 prong forms with no. 22 d.c.c. wire. The padding condensers are mounted inside the coil forms, ceramic compression type being used for the r.f. and detector, and air tuned type for the oscillator coils. If the coil specifications are followed exactly, no difficulty should be experienced in getting the coils to track.

The oscillator is operated on the "high side" (i.f. frequency higher than signal frequency) on all bands except the 14 Mc. band. On 14 Mc. the coil specifications assume that the oscillator is on the "low side." Getting the coils to track is a simple procedure if the coil data is followed and the oscillator padder is adjusted so that the oscillator is on the specified side of the signal frequency.

The coils should be labelled in some manner to prevent getting the r.f. and mixer coils transposed, as these two coils look very much alike for a given band but are not always the same for a given band.

To align the coils, simply insert the proper coils for a band, adjust the oscillator padder (bandset condenser) to center the band on the dial (making sure the oscillator is on the proper side of the signal frequency) and then, after tuning in a signal near the center of the dial, peak up the mixer and r.f. trimmers for maximum signal.

See Buyer's Guide, page 97, for parts list.

All coils are wound on standard 1½ inch dia. forms, with no 22 d. c. c. wire. Plate and antenna windings are always placed at ground end of grid winding, and spaced approximately ¼ inch from the grid winding.

COIL DATA

28 Mc.

The oscillator coil consists of 3 turns spaced to 1¼ inches. Band spread tap 1¼ turns, cathode tap 1 turn from ground end. Bandset condenser C_6 equals 50 μμfd., air trimmer. Osc. tuned to high side.

The mixer coil consists of 6 turns spaced to 1½ inches. Band spread tap 1⅞ turns from ground end. Plate coil 3 turns close wound. Trimmer condenser C_5 equals 12 μμfd., ceramic compression type.

The r.f. coil is identical to the mixer coil, the antenna winding corresponding to the plate winding.

14 Mc.

The oscillator coil consists of 9 turns spaced to 1¼ inches. Band spread tap 1½ turns, cathode tap 2¼ turns from ground end. Bandset condenser C_6 equals 75 μμfd. air trimmer. Osc. tuned to low frequency side.

The mixer coil consists of 12 turns spaced to 1½ inches. Band spread tap 3 turns from ground end. Plate winding 6 turns close wound. Trimmer condenser C_5 equals 12 μμfd., ceramic compression type.

The r.f. coil is identical to the mixer coil except that the primary (antenna winding) has 5 turns.

7 Mc.

The oscillator coil consists of 18 turns spaced to 1½ inches. Band spread tap 6 turns, cathode tap 5½ turns from ground end. Bandset condenser C_6 equals 75 μμfd., air trimmer. Osc. tuned to high frequency side.

The mixer coil consists of 23 turns spaced to 1½ inches. Band spread tap 8 turns from ground end. Plate coil 12 turns close wound. Trimmer condenser C_5 equals 35 μμfd. compression trimmer.

The r.f. coil is identical to the mixer coil except that the primary (antenna winding) consists of 8 turns close wound.

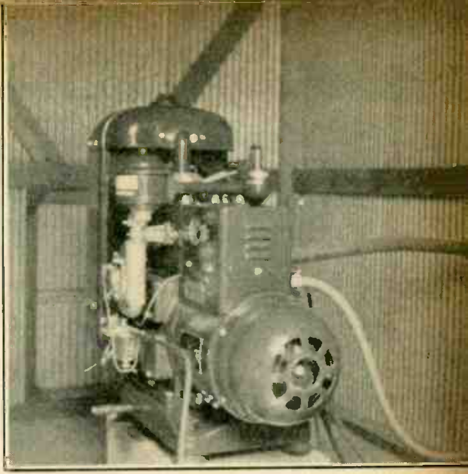
3.5 Mc.

The oscillator consists of 21 turns close wound. The band spread tap is 13 turns, the cathode tap 7 turns from ground end. Bandset condenser C_6 equals 75 μμfd. padder. Osc. tuned to high side.

The mixer coil consists of 40 turns close wound. The band spread tap is 26 turns from the ground end. Plate coil 14 turns close wound. Trimmer condenser C_5 equals 35 μμfd., compression trimmer.

The r.f. coil has 40 turns close wound. The band spread tap is 14 turns from the ground end. The antenna coil has 10 turns. Trimmer condenser C_5 equals 35 μμfd. compression trimmer.

Emergency power de-luxe. As a matter of fact, this is the regular 2000-watt power supply of W5EGJ, Perryton, Texas, since a.c. mains power is not available.



DEPARTMENTS

- **X-DX**
- **The Amateur Newcomer**
- **U. H. F.**
- **With the Experimenter**
- **Postscripts and Announcements**
- **Yarn of the Month**
- **What's New in Radio**
- **New Books and Catalogs**

"WAZ" HONOR ROLL

CW and PHONE	Z	C
ON4AU	40	158
G2ZQ	40	147
J5CC	40	130
W8CRA	39	156
W2BHW	39	156
W8BTI	39	154
W1BUX	39	153
W2GTZ	39	153
W2HHF	39	152
G6WY	39	151
W6GRL	39	151
W6CXW	39	150
W2GT	39	150
W9TJ	39	149
W4CBY	39	145
W6CUH	39	143
W6KIP	39	143
W8OSL	39	143
W9KG	39	141
W6ADP	39	140
W6BAX	39	140
W3AG	39	140
W8OQF	39	139
W8LEC	39	136
W6QD	39	135
W9TB	39	134
W2ZA	39	134
VK2EO	39	133
G5BD	39	133
W2GVZ	39	132
W4CYU	39	132
W3EVT	39	131
W8PQQ	39	131
W5KC	39	130
W2GWE	39	129
W6KRI	39	129
W1ADM	39	128
VE4RO	39	126
W6VB	39	125
W7BB	39	123
W6HX	39	123
W4IO	39	123
G5BJ	39	120
W8JSU	39	120
W2IYO	39	119
W2CYS	39	117
G2LB	39	115
W7DL	39	115
W3BEN	39	115
W2GNQ	39	113
W6FZL	39	112
ON4HS	39	111
ON4FE	39	110
W1AQT	39	110
W6FZY	39	109
W6SN	39	100
W9NRB	39	98
W6GPB	39	94
XE1BT	39	90
K6AKP	39	78
W1CH	38	150
W5VV	38	148
W2GW	38	143
W5VV	38	144
W3HZH	38	139
W3EMM	38	139
W5BB	38	138
W8BKP	38	138
ZL1HY	38	138
W3EPV	38	136
W9GDH	38	134
W3HXP	38	133
W4FVR	38	130
W9FS	38	130
W3EAV	38	130
W8JMP	38	127
W2GRG	38	127
ON4EY	38	126
W8ZY	38	125
W3GAU	38	125
W1BXC	38	125
W3EVW	38	124
W3GHD	38	121
W8AU	38	120
W8LYQ	38	120
W8DFH	38	119
W9PST	38	119
W8QXT	38	119
W8JIN	38	119
W3FQP	38	119
W8DWV	38	118
W1GDY	38	118
W2BMX	38	118
W1BGC	38	117
W6AM	38	117
LU7AZ	38	116
W3DDM	38	116
W9UQT	38	116
W9ELX	38	116
W8LFE	38	115
W8MTY	38	114
W9KA	38	114
G6CL	38	112
W8HWE	38	112
G2QT	38	112
W8EUY	38	112
W9CWW	38	112
W2BXA	38	111
W6GRX	38	111
LY1J	38	110
W1AB	38	110
W6HZT	38	110
K4ESH	38	110
W4MR	38	110
W8KWI	38	108
W8BOX	38	106
W9ADN	38	106
W8OE	38	106
W6NLZ	38	106
W9PK	38	105
W8GBF	38	105
W3KT	38	105
ON4UU	38	104
G2IO	38	103
W88WB	38	98
J2KG	38	95
G6XL	38	95
ON4FQ	38	92
W9VDQ	38	79
SU1WM	37	138
W2BJ	37	134
W6GAL	37	131
W8KKG	37	127
W7AMX	37	125
J2JJ	37	123
W2IOP	37	122
W1RY	37	120
W6MVK	37	118
G6NF	37	115
W8JAH	37	115
W9RCQ	37	114
W3TR	37	113
ON4FT	37	112
W9RBI	37	112
W6MEK	37	112
W6ADT	37	111
W1IED	37	111
G2MI	37	110
W7AYO	37	110
W8DOD	37	110
W6ITH	37	109
VE2EE	37	108
W4DMB	37	108
W5ENE	37	107
W9PTC	37	103
W3FJU	37	103
W9GBJ	37	103
G6GH	37	102
W3AYS	37	102
VK2DA	37	101
W6FKZ	37	101
W6JBO	37	101
W8KPB	37	100
W4DMB	37	100
W9AJA	37	99
W4EQK	37	99
ON4VU	37	99
W3RT	37	99
W3EXB	37	98
ZL2CI	37	97
W6DLY	37	97
W6MHH	37	95
W6MCG	37	92
G2UX	37	91
W2BSR	37	90
W6MUS	37	89
W9UBB	37	77
W8AQT	36	120
K4FCV	36	112
W8AAJ	36	107
W3GGE	36	106
W6BAM	36	106
W9AFN	36	105
W5PJ	36	105
W8QDU	36	105
W5ASG	36	104
SP1AR	36	103
W8LDR	36	101
W6NNR	36	100
W6KWA	36	99
W8LZK	36	99
G6BJ	36	99
VE1DR	36	98
W9VES	36	98
W9GKS	36	97
W8AAT	36	96
G6YR	36	94
W2IZO	36	94
VE5AAD	36	92
W4ADA	36	90
W1APU	36	91
W9LBB	36	90
OK2HX	36	86
VK2NS	36	84
W6TI	36	80
W7DSZ	36	73
W2GXH	36	71
W1WV	35	119
W8OXO	35	113
W6GHU	35	103
W4QN	35	103
W9PGS	35	103
W6HJT	35	103
W9VKF	39	101
K6NYD	35	100
W8CLM	35	99
W8OUK	35	99
W8CJJ	35	98
W2WC	35	98
OK1AW	35	96
W9EF	35	94
G6QX	35	94
W8NV	35	94
W3DRD	35	93
W6AQJ	35	92
VE5ZM	35	92
W6ONQ	35	92
LU3DH	35	89
W9GNU	35	88
W9ERU	35	88
K6CGK	35	88
W9VDX	35	86
W6KQK	35	85
ON4NC	35	82
GI6TK	35	80
W4ELQ	35	80
W8QIZ	35	78
W6GK	34	105
W6HEW	34	103
K7FST	34	102
W8CED	34	102
W8BSF	34	100
W1APA	34	98
W2BZB	34	99
VK2AS	34	94
W8HGA	34	93
W3EYY	34	91
W9MQQ	34	89
W2FLG	34	89
W6TE	34	88
G6WB	34	88
W6CVW	34	88
VK2OQ	34	87
G5VU	34	85
W9BCV	34	83
W6PNO	34	83
ZS1CN	34	82
VK2TF	34	81
ON4SS	34	80
W6HIP	34	76
VK2TI	34	75
W7AVL	34	75
W8JK	34	75
ZL2VM	34	72
W6LHN	34	71
VK2AGJ	34	70
VK2EG	34	70
VE5MZ	34	69
VK2VN	34	63
W9QOE	34	56
F8XT	33	112
W8ACY	33	106
W3DAJ	33	97
W6KEV	33	96
W8BWC	33	93
W6KUT	33	90
W6CEM	33	88

PHONE		
W3LE	38	128
F8UE	38	103
W6OCH	36	107
W6ITH	36	103
W3FJU	36	87
VE1CR	36	81
W1ADM	35	101
W9NLP	35	95
W9TIZ	35	93
KA1ME	35	79
F8VC	35	78
W4CYU	34	100
ON4HS	34	92
W9ELX	34	92
W6EJC	34	84
W7BVO	34	80
W4DAA	34	71
W2IXY	33	105
W6NNR	33	95
GM2UU	33	84
F8XT	33	70
W3FAM	33	68
W6MLG	32	97
W8LFE	32	93
W2IKV	32	90
W4DRZ	32	89
W9BEU	32	88
W9QI	32	86
W1HKK	32	85
W8QXT	32	85
G5BY	32	85
VK4JP	32	85
W4DSY	32	84
W6OI	32	83
W9TB	32	82
W6IKQ	32	80
VE1DR	32	59
W1AKY	31	93
W3EMM	31	88
W8LAC	31	85
G6BW	31	83
G3DO	31	78
W1KJJ	31	78
W6FTU	31	77
G8MX	31	73
W8RL	31	71
W9UYB	31	71
W6AM	31	67
F8KI	31	58
W9ZTO	31	53
W4EEE	30	86
W2GW	30	86
W1JCX	30	83
W8AAJ	30	82
W2IUV	30	79
W2AOG	30	77
W9BCV	30	68
W6MZD	30	52
G6DT	29	83
W4BMR	29	80
K6NYD	29	78
CO2WM	29	78
W9RBI	29	71
W6NLS	29	64
W6GCT	29	62
W6NRW	29	60
W2DYR	28	80
W2GRG	28	74
W6PDB	28	65
W8NV	28	65
W7EKA	28	63
VE2EE	28	62
W4DRZ	28	62
W1BLO	28	62
VK2AGU	28	61
W6MPS	28	60
W3EWN	27	93
W2HCE	27	76
W5CXH	27	52
G5ZJ	26	77
W5ASG	26	62
W5VV	26	61
W4EQK	26	61
W8QDU	26	61
W9NMH	26	61
W5DNV	26	60
W1JNX	26	57
VK2OQ	26	56
K6PTW	26	56
W4TS	26	54
VE4SS	26	50
W6FKK	26	47
W7AMQ	26	47
K6LKN	26	46
G6CL	26	46

X-DX AND OVERSEAS NEWS

By Herb Becker, W6QD

Send all contributions to Radio, attention DX Editor
1300 Kenwood Road, Santa Barbara, Calif.

There have not been many as yet who have sent in their cards for WAAP. I guess we will show those that have for the first time in the January issue. However, I will mention that no. 1 man to send in proof is W5BB. While we're talking about proof, we require a confirmation from each of the Possessions worked, either in QSL card form or by letter.

In case the dx station has not been able to send cards, but in their place has submitted a list of the stations worked, we will accept this as a confirmation. If a list has been sent to the A. R. R. L. and not to us we will accept a signed form to this effect. Of course you will have to arrange to get it. Remember, this is ONLY in case a list is submitted, and will not apply where the dx station involved actually sends cards too. A list of the possessions and prefixes, along with other details of WAAP can be found in October and November issues of RADIO. In sending in your cards be sure to send them via registered mail and enclose a self addressed stamped envelope for their return.

Want a New Country? KD4GYM

We do not count KD4GYM as one of the possessions for WAAP, but effective immediately it will go for a country. No doubt many of you have worked KD4GYM on 14240 phone. He is located on Swan Island at the U.S. weather station.

Reeve Strock, W2GTZ, was a recent visitor to these parts and we had quite a time talking about how dx used to be. Reeve informs me that in a letter from VK6SA, he states that he is in the Radio Police Patrol at Perth. He probably will not be called due to a few dependents. Incidently VK6SA has three children whose names are Jack and Jill, and David. Then, too, VK6FO is an instructor in the Flying Corps.

From the T. & R. BULLETIN we see where G6BQ met up with VU2FV and VK2IK in his particular division of the fighting forces . . . and that VK2ADE is an air gunner. It is with deep regret that we record the passing of G5ZQ, Lieut. Brigstocke, and G3FL, Ron-

W7GGG, Cheyenne, Wyoming. Owned by Doc Zuckerman, "Seven Triple Gee" operates on 10, 20 and 40 meters. On his desk may be seen a frequency meter (left) built by W9KNZ, the receiver is a Super-Pro, and next to it is his "X-EC". The transmitter uses a pair of TW75's in the final driven by an 807, which in turn is excited by the "X-EC". Doc's class B modulator uses a couple of HY51A's. He has four antennas at present. A Vee beam 350 feet long on each leg and 35 feet high. Doc uses this one on 10, 20, and 40, and is headed for Europe. (Where zat?) Then he has a three-section 8JK for the Orient and South America which he uses on 20. For 28 Mc. 7GGG finds two half-waves in phase, vertical, the best answer. When Doc operates 75 phone he has a half wave Zepp, although he admits most of his work is done on c.w.

ald Hunter. They succumbed due to injuries received in action. G3BR says that YV2CU has been a ship operator since the war began. YN1OP, whose address is E. H. Andreas, P.O. Box 118, Managua, Nicaragua, says YN9G is not, and never was, in Nicaragua. If anyone worked PK6XX and has not received a card they may be interested to know that the operator, VK4HN, is now at Tangue Verde Ranch, P.O. Box 1831, Tucson, Arizona. Bill Wadsworth, VE5ZM, one of the best dx men from VE, has been granted a commission as Pilot Officer in the R.A.F.V.R. Bill is in England and letters may be sent via G6CL. VS6AQ, G6LK, G8DA and G5MS are all connected to the party headed by G2ZQ. VS6AX and VU2FX are both active in service in England.

W6AM informs us that his son Bill, is now W6TCG. We haven't been able to find out whether he will burble into a mike or take after the brass. Just as a matter of information, and not having anything to do with ham radio, Bill is on the water polo team at U.C.L.A. While I think of it, Murray Mitchell, ex-W9RFA and x.y.l. (of just four months, tsk, tsk) was out here in last month. Murray is with American Airlines at La Guardia Field and is now W2NET. No, not on the air yet . . . let's give him a few more months, though.

W2UK and W1APA went duck hunting up around New Brunswick, and oh yes, did you know that Tommy's new dog is named "Kay-W"? Along the more serious vein (or is it?) we find that W6MEK is trying to learn whether "two can live as cheaply as one" . . . date was October 15th . . . unless I have been double crossed. While we're in the domestic trend we just can't ignore our friend Pat Jessup, W2GVZ, who had enough courage to do the same thing . . . and that date was October 9th. You fellows around Glen Rock, N.J. please drop in on Pat just any eve now, will ya, and see how he's getting along. Stay late, too.

My, my, what is this . . . our highly esteemed Editor W. W. "Woody" Smith, W6BCX, is a very Proud (note capital P) poppa. This all happened on October 18th and 'twas a yl . . . and as Woody puts it . . . "she weighed 0.0031 tons." Gosh these wireless men, don't they think of things? All three are doing nicely. If this keeps up this dept. will have to sponsor a contest of some kind, and award pink and blue ribbons.

W3KT says "don't drop the dx column". Alright we won't drop the column but I'm afraid we've already dropped the dx . . . unless 9's are dx, now. Jesse has received his card from CR6AF which brought his total up to 38. He also has under his belt, KE6SRA and KF6SJJ which gives him 107 countries, and has all QSL's except those last two. Nice percentage, Jesse. W9DIB wants a contest of some kind. W3GAU, Joe Gilson, expects to go to Brazil very shortly to do some surveying. We wish him luck, but gosh couldn't he find enough space to survey around here.

K6NYD, K6MVA and W6LJC dropped in the other night. NYD is enroute for duty on the east coast while MVA and LJC were along for the trip. Bill, that's NYD, left his very much heard of rig on the dock in K6, and it is to be shipped to him later. No doubt you will hear Bill on before signing K6NYD/4.

K6QYI, Doc Westervelt, Schofield Barracks, T. H. Doc used to be W3CZO and years before that he held 8UE. In this photo you will see Doc's receiver as being an HRO while the transmitter is the little 40 watt Bi-Push. However, just after this was taken Doc added a final using a pair of 35T's and now runs around 400 watts, using the Bi-Push as its driver. Most of the gang around USA claim Doc is the most consistent K6 on 20 c.w. By the time you read this QYI will be all harnessed up for 10 and 40 meters, too.

W6LS, Leo Shepard, Los Angeles. Most of the gang know him as "Shep", although a few of his close friends are permitted to call him Leo. This would of course, include his xyl, too. "Shep", or Leo, began his downfall in or around 1921 when he received his first "wireless" license. We wouldn't know definitely but he may have been on before that . . . with or without. When he came back on the air on c.w. he banged away at brasspounding for a number of years. Being an engineer with CBS he couldn't seem to get away from the urge of having something with a mike attached to it. With this in mind he set forth and built the transmitter as seen at the left on the picture. The final uses a pair of 250TH's driven by an 803, which is driven by a Bi-Push. In the rack to the right of the transmitter can be seen an RME. Above this is the patching panel. Leo also uses a rack mounted HRO receiver with coils and speaker mounted in a small rack in front of him. To the left of the HRO will be seen an "X-EC" which is coupled to the Bi-Push. HF-300's are used in his Class B modulator stage. "Shep", or Leo, uses a two-element rotary on a 60 foot tower, and puts in a very consistent signal everywhere. We actually mean everywhere because his location is a very good one, the antenna sets up in the clear, and the rig is as efficient as anyone could want. You can be the judge for the quality of the speech. He has done his share of dx although he hasn't lived for dx alone, but gets just as big a thrill out of working a K6, W6, or any W for that matter. Yes, he still has a key hiding in the background.

Speaking of K6's we hear K6LKN on both phone and cw, and the same goes for CGK. I gotta laugh out of hearing W9TJ on phone. My, my, and after all those years too, Bill. W6KW, Johnnie Griggs, in San Diego is still working KC4USA and USB on schedule, giving much help to the relatives to those at Little America. This happens usually on 20 fone now although Johnnie can jump on the key with the best of them. I guess I shouldn't have said "jump" on the key . . . for if he did, there wouldn't be any key; there's a *lot* of Johnnie.

Just about in the middle of the last paragraph our ol' friend Ted Curnutt, KA1ZL, pops in after being in the P.I. for three years or more. He was formerly W6BAY from S.F. Some of the tales he told regarding his trip back would almost make you shiver. He came back on the President Pierce, I believe, and it passed through the area near Wake Island and at the same time that the typhoon was in full force. No sleep, rest or hot food for two days, he said made most of the passengers feel like they had been through the

[*Continued on Page 83*]

The Amateur Newcomer

Simple

A. C. THEORY

By J. P. DOCKENDORF*, W6SGZ

The new amateur and commercial operator license examinations have required more study and actual knowledge than preceding tests. No longer can one memorize a few questions and answers and inflict himself (or herself) upon the rest of the trade or fraternity. A more thorough knowledge of fundamentals, and the analytical ability to carry a problem through to a solution is now required.

Experience with students, amateurs, and commercial operators some with twenty years or more experience, has shown that a fair knowledge exists on their part in the solving of the impedance of series a.c. circuits. But they seem to have almost no information on parallel circuits, or the voltage and current relationships that might exist.

Anyone seeking information can, by referring to the RADIO HANDBOOK, or any standard text, get clear data on series a.c. circuits. But data on parallel circuits seems vague, or requires the use of sine, cosine, and operator *j*. While these are of course needed for a basic understanding of such circuits, I believe the simple outline given here will permit the operator to get a complete enough grasp of the fundamentals that he will be able to solve problems of the type given on the commercial license examinations.

Simple arithmetic only is used, and one need not resort to tables for anything except angle of lag or lead (phase angle). To date, reference to tables has not been required on tests. This simple method should induce handbooks and texts to deal with parallel a.c. circuits and problems. Many amateurs seeing only reference to series a.c. circuit formulas apply them to parallel problems and know not how to get themselves straightened out.

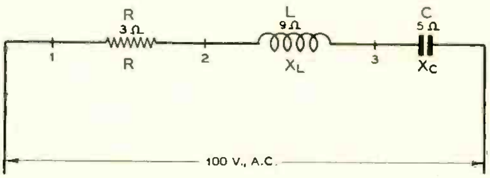


Figure 1. A simple series circuit containing resistance, capacitance, and inductance. If an ammeter were inserted into the circuit at points 1, 2, or 3, the current flow would be the same at all three places. Thus is postulated an important law for all series circuits: the line current is the same as the current measured in any portion of the circuit.

Assumption is made herein that the reader knows the simple principles and definitions of: d.c., a.c., inductance, inductive reactance, capacitance, capacitive reactance, true power, apparent power and the meaning of lag and lead. A short review would perhaps be in order at this point using the HANDBOOK or any standard school text.

In figure 1 is shown a simple series circuit, consisting of a pure resistance of 3 ohms, a coil having an inductive reactance of 9 ohms, and a condenser having a capacitive reactance of 5 ohms. In a series circuit, d.c. or a.c., there is only one path through which the current can flow from the source of e.m.f. back to the source. Hence current flow will be uniform. That is, in figure 1, if an ammeter is placed at point 1, it will read the same as it would if placed at point 2, or point 3, or at any other point.

---

*1702½ West 55th St.
Los Angeles, California

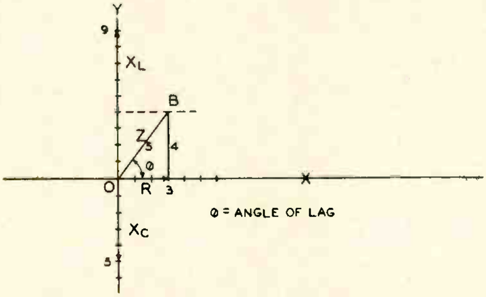


Figure 2. Diagrammatic representation of the determination of OB, the total impedance of the series circuit of figure 1, and of θ, the angle of lag.

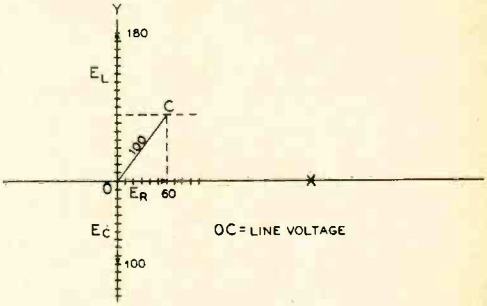


Figure 3. Representation of the voltages appearing across the three sections of the series circuit of figure 1.

Solving circuit 1, the commonly known equation, $Z = \sqrt{R^2 + (X_L - X_C)^2}$ is used and values substituting, give

$$Z = \sqrt{(3)^2 + (9\text{-}5)^2} = \sqrt{(3)^2 + (4)^2} = \sqrt{9 + 16} =$$

$\sqrt{25} = 5$ ohms. Hence, the impedance, or total opposition offered to the flow of current is 5 ohms. And the current flow is, by Ohm's Law for a.c.:

$$I = \frac{E}{Z} = \frac{100}{5} = 20 \text{ amperes.}$$

Therefore, at all points in the circuit there is a uniform current of 20 amperes flowing.

Inductive reactance is commonly called a positive reactance and capacitive reactance known as negative reactance. Referring to figure 2 we can solve circuit 1 by plotting a triangle, or parallelogram, as shown. Lay off on horizontal line OX, 3 units to equal the resistance R. X_L being positive will be plotted above OX on the OY line and 9 units marked off. Then, X_C is marked off similarly below OX to represent 5 units. Since X_L and X_C have opposite signs the difference between 9 and 5, or 4, is laid off as shown. The same thing can be visualized when you consider two boys pulling on opposite ends of a rope, one with 90 pounds, the other with 50 pounds. It can be seen that the rope has a 40 lb. greater pull in one direction than in the other. Therefore, the rope has in effect an effective pull of only 40 pounds in one direction. Completing our rectangle we can measure the diagonal and get 5 as the impedance of figure 1. Throughout this it has been assumed that the inductance has no resistance, and the condenser no resistance. In actual practice the rectangle will be a parallelogram because there is some resistance in the coil and condenser.

Now look at the voltages existing in the various sections of the circuit. According to Ohm's Law the voltage across a device is equal to current through that device times the resistance of the device. Considering circuit 1, the voltage existing across terminals of resistance R is 20 x 3, or 60 volts; across coil 20 x 9, or 180 volts; and across the condenser 20 x 5, or 100 volts. It is apparent that the condenser must be able to stand 100 volts and many operators fail to realize that the coil insulation between ends is subjected to 180 volts.

To prove this, and to keep source voltage relationship clear, refer to figure 3. On OX axis plot 60 volts which exist across R; above horizontal on OY line plot off 180 to represent voltage across coil and below the horizontal plot 100 which is voltage across the condenser. Again we get a triangle and the diagonal (hypotenuse of the right angle triangle OBC) equals 100 volts, or our line voltage. Or, to use the equation:

$$E \text{ (line)} = \sqrt{(E_R)^2 + E_L - E_C)^2} = \sqrt{(60)^4 + (180\text{-}100)^2} = \sqrt{3600 + 6400} = \sqrt{1000} = 100.$$

In any problem if we are given a series circuit with a known voltage across any portion and the resistance of that portion, we can, by Ohm's Law, find the current flowing through the portion. Knowing that, we know that the same current flows through all other devices connected in that series circuit; and usually more and more can be learned regarding voltages or impedances existing elsewhere in the circuit.

Referring to figure 2, θ is our angle of lag, that is, the angle by which current lags voltage. If figure 1 contained only pure resistance the line OB would coincide with OX and the angle would be equal to zero. If the circuit contained only inductance, or only capacity, OB would coincide with OY and angle θ would be equal to 90 degrees. If the capacitive reactance in figure 1 were larger than the inductive reactance our angle θ would be known as an angle of lead because then the current would lead the voltage.

A commonly given definition for power factor (P. F.) is: the power factor of a circuit is equal to the cosine of the angle of lag (or lead). After measuring angle θ with a protractor we look up in any trigonometry book the tables of *"natural functions of angles."* In the column marked cosine we read off the decimal, which is the power factor of the circuit.

A definition many operators prefer since it can be used without resorting to tables is: the power factor of a circuit is the decimal by which apparent power must be multiplied to obtain true power.

Apparent power is known as volt-amperes and in the series circuit of figure 1 would be equal to 100 x 20 or 2000 watts. Actually however, only resistance can consume power and in that case R only is considered. Across R is 60 volts, and through R flows 20 amperes. Then true power in figure 1 is 60 x 20 or 1,200 watts and our power factor is:

$$\text{P. F.} = \frac{1200}{2000} = \frac{3}{5} = 0.60.$$

Sometimes, 0.60 is expressed as 60% but the use of 0.60 is more common and to be preferred.

Thus, the power factor was obtained without books or tables. However, if tables are desired the following method is to be preferred:

$$\text{Tangent of angle } \theta = \frac{X}{R} = \frac{4}{3} = 1.333$$

Looking at the tables of natural functions of angles we find an angle of 53° 8′ has a tangent of 1.333. By definition: the power factor equals the cosine of 53° 8′ and referring to tables, the cosine of 53° 8′ is 0.5999 or 0.60. Many operators use cosine of angle θ as R/Z.

This "short-cut" will in some cases lead to errors, particularly in parallel circuits. Preference should be given to the method outlined, using first the tangent and then the cosine.

The relationship between the power factor and the true and apparent power is given by:

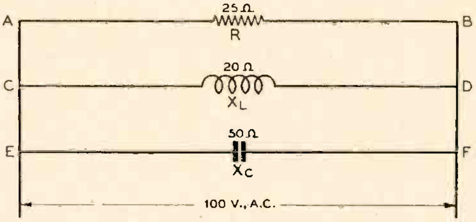


Figure 4. A simple parallel circuit containing resistance, capacitance, and inductance. The distinguishing characteristic of this type of circuit is that the same voltage appears across each portion of the circuit.

True Power = EI cos θ = Apparent power x-P. F., and in figure 1, true power = 100 x 20 x 0.60 = 1200 watts, or the same result we obtained by considering the resistance alone. In actual circuits, the resistances represent useful power and the reactances represent circulating powers although use is made of these currents.

Most manufacturers of electrical equipment perform tests and calculations on a basis of a power factor of 0.70. In a circuit in which inductance is predominant the P. F. is known as a "lagging power factor" and in the case of capacity being larger a "leading power factor" is applied as the term.

Parallel Circuits

The operator finds that rarely is a simple series circuit found; more common is the parallel circuit and figure 4 is a three-branch circuit. One fact is definitely known about that circuit, and any other parallel circuit, d. c. or a. c.; and that is, the voltage across each branch is the same as the line voltage. In figure 4, 100 volts exists across AB, 100 across CD, and 100 across EF. Therefore, with a constant voltage and various values of resistance and reactance the current in any branch will differ from the flow in any other branch. By Ohm's Law, the current through the resistance branch AB is:

$$I_R = \frac{100}{25} = 4 \text{ amps.}$$

Similarly, the other currents are found and I_L = 100/20 = 5 amperes; I_C = 100/50 = 2 amperes. It can be seen that each branch is considered in turn, as though that branch only existed. The reciprocal of the sum of the reciprocals, used to solve d. c. parallel resistances is not used in solving this a. c. problem.

[*Continued on Page 76*]

U. H. F. . . .

BY E. H. CONKLIN*, W9BNX

Already the final issue of RADIO for *1940* has arrived—a year of satisfactory interest and shift to higher frequencies and a breaking of 100 mile dx records right down to the 1¼ meter band. Someone will probably pull the stunt on the ¾ meter band next. But will that take all of the thrill out of the ultra-highs? No, not on your life. After 100 miles come 150 and 200 miles! And doing consistent dx from home locations. Without a great expenditure of money, the gang can monkey with receivers, transmitters and antennas, and squeeze the last mile out of their range.

It was a great thrill to get heard cards from Australia and elsewhere on 200 meters, but not a bit more than the thrill of "breaking the ice" on a new u.h.f. contact. For instance, after working ten states in five districts, W8OKC finally has raised W8FDA nineteen miles southeast and W3HWN 43 miles southwest, over the mountains! FDA is raised almost daily now but neither could hear the other early in the summer. FDA turns his vertical X-H array 90 degrees off, and seems to bounce the signal around the mountains. OKC uses four colinear half waves vertical which is not directional. Results are best during daylight with practically no fading, but there is severe slow fading at night suggesting wave interference from a low-atmosphere-reflected sky wave. A rain kills the fade as would be expected. W3HWN seems to come through only on the low atmosphere reflection.

Most of these contacts are on c.w. FDA uses three old type 30 tubes in his receiver in a regenerative circuit. OKC is using concentric lines, which worked satisfactorily in an 1851-6K8 converter combination.

Charles Singer of WOR says that the new one kilowatt FM transmitter, W2XOR, is operating on 43.4 Mc. The antenna at present is 625 feet above New York City street level, and is vertically polarized pending FCC standardization on polarization. Should FM stations decide to use horizontals, there may be some speculation as to how to rig up a suitable auto mobile antenna—which now bothers mobile hams in the midwestern "horizontal territory."

Antenna Talk

Mel Wilson, W1DEI, has moved down to Washington to do some special research work. He expects to be on the air again as a W3, as the landlord has let him drill two holes in his window. Mel did not say whether he would have to blow the signal through the holes, or whether he can erect another whooper-dooper beam. He feels that beams with parasitic elements should be tuned on the head, in position, before any feeders are connected to them. That does not rule out rechecking after the line is connected and matched in, of course. He urges hams to study antenna fundamentals rather than dimensions, and to design antennas based on what they want to accomplish.

Speaking of antennas, W9CLH corrects some rumors about his results. He had a four element flat H (horizontal, lying down, not lazy H) on a 90 foot telephone pole (oh boy!) and got good results with the horizontal gang in central Illinois. He even had satisfactory contacts with vertically polarized W8CVQ, 135 miles away, and just missed a contact with W8QDU close to 300 miles, who is also vertically polarized. The difficulties experienced were all the result of having the beam pointed at some station that could not raise CLH. So George put up one of these ground plane verticals with the four radial fins. Having only one element, signals dropped. Results fell way off for horizontal polarization and did *not* come up for vertically polarized dx. George feels that vertically polarized transmission can be picked up on a distant horizontal antenna which leads him to believe that he should always use a horizontal for receiving, no matter what is used on the transmitter. He does not feel that the reverse is necessarily true—that is, transmission from a horizontal antenna without much feeder radiation may not come in at all well on a distant vertical receiving antenna. All this refers to extended ground wave work, of course. His views may appear to disagree with currently published data but there has been much in the past to suggest that vertically polarized waves get to have a substantial horizontal component after travelling along a hundred miles or so.

Another experience at W9CLH is with a top-loaded vertical antenna projecting from the top of an automobile. For some reason, a ⅛ wave vertical with a copper screen "hat"

---

*Associate Editor, RADIO, 512 No. Main Street, Wheaton, Illinois.

56 Mc. DX HONOR ROLL

Call	D	S
W9ZJB	9	27
W9USI	9	23
W9USH	9	18
W9AHZ	9	16
W5AJG	9	34
W1DEI	8	20
W1EYM	8	20
W1HDQ	8	26
W2GHV	8	24
W3AIR	8	24
W3BZJ	8	27
W3RL	8	29
W6QLZ	8	20
W8CIR	8	32
W8JLQ	8	
W8QDU	8	25
W8QQS	8	17
W8VO	8	
W9ARN	8	17
W9CBJ	8	
W9CLH	8	
W9EET	8	15
W9VHG	8	
W9VWU	8	16
W9ZHB	8	29
W2AMJ	7	22
W2JCY	7	
W2MO	7	25
W3BYF	7	22
W3EZM	7	24
W3HJO	7	
W3HOH	7	17
W4DRZ	7	22
W4EDD	7	
W4FBH	7	17
W4FLH	7	18
W5CSU	7	
W5EHM	7	
W8CVQ	7	
W8PK	7	9
W8RUE	7	17
W9BJV	7	12
W9GGH	7	
W9QCY	7	15
W9IZQ	7	14
W9SQE	7	22
W9WAL	7	
W9YKX	7	12
W9ZQC	7	12
W9ZUL	7	18
W1LLL	6	24
W1CLH	6	13
W1JFF	6	11
W1JJR	6	17
W2KLZ	6	
W2LAH	6	
W5VV	6	18
W8LKD	6	11
W8NKJ	6	16
W8OJF	6	
W9NY	6	13
W1GJZ	5	15
W1HXE	5	18
W1JMT	5	9
W1JNX	5	12
W1JRY	5	
W1LFI	5	
W2LAL	5	11
W3CGV	5	10
W3EIS	5	11
W3GLV	5	
W3HJT	5	
W4EQM	5	8
W6DNS	5	
W6KTJ	5	
W6OVK	5	10
W8EGQ	5	10
W8NOR	5	16
W8OKC	5	10
W8OPO	5	8
W8RVT	5	7
W8TGJ	5	9
W9UOG	5	8
W9WWH	5	
VE3ADO	4	
W1LKM	4	6
W1LPF	4	16
W3FPL	4	8
W4FKN	4	7
W6IOJ	4	4
W7GBI	4	6
W8AGU	4	8
W8NOB	4	
W8NYD	4	
W8TIU	4	8
W1KHL	3	
W6AVR	3	4
W6OIN	3	3
W6PGO	3	6
W6SLO	3	3
W7FDJ	3	3
W8OEP	3	6
W9WYX	3	3

Note: D—Districts; S—States.

puts out a better signal than a ¼ wave unloaded vertical. The position on the top made the directional pattern almost circular. Now, that is an idea that the boys should work on, provided that they know how to plug the hole in the auto top afterwards!

Still Some DX

The band has not recently gone on any very unusual sprees, but some signals do get through occasionally. W6QLZ heard W7FFE in Oregon on September 3. He worked W5EEX in Houston and heard the harmonic of W9CXB in Kansas City on October 3; after QLZ went off the air, a local listener heard some W7's come in.

W9ZJB heard the aurora fade, flutter and distortion on the ten meter band on October 1, but found only one unidentified station on five meters. W9ZQC says that he and W9BJV heard nothing on five that day, in South Dakota, when W9's were coming through on ten, but W9EOJ located a weak carrier of somebody calling a W5.

The ionosphere storm on October 1 and early the next morning was reported by the National Bureau of Standards as being severe. Other such storms were reported on October 8 and September 26, with mild and moderate ones on nearby dates.

The Five Meter Gang

In Hartford, W1LLL still pokes out with 60 watts on a pair of metal 6L6's, working into a three element beam. He still is short three districts but has raised 24 states. Calls to W5AJG EHM VV DXB EEL W6QLZ OVK were all unsuccessful.

Perry Ferrell in Pleasantville, N.J., was impressed by longer average skip this year but restricted time prevented him from logging as many stations. Also, he has been working on FM from a high point in Atlantic City.

W6QLZ is again hearing east coast FM and television stations on long skip each morning. He spent a week with W6PBD who is now on five with 400 watts into 35T's modulated by 805's. A two inch line feeds a four element beam. Receiver is DM36 and RME69. In the October issue of RADIO, W9IZQ was reported to hear W6QLZ on July 15. That afternoon, Clyde heard loud FM stations on seven meters and he called CQ with no results though he thought he ran across W5AJG ALK momentarily. On June 2, his report of W9WHG was questioned as possibly being W9VHG but it was not. W9WHG in Des Moines was transmitting and W9TIO in Slater was receiving, relaying signals to WHG on 75 meters.

W8CVQ in Kalamazoo missed most of the five meter dx, but he has continued extended ground wave work, having a 56-112 cross-band with W8QDU in Detroit on September 3, a nice long haul of 130 miles. Walter has noticed that this path has developed a peculiarity in that five meter signals, when about to fade out, appear to change in frequency in jumps of several kilocycles and suddenly go out. It would seem difficult to explain it as a Doppler effect or to assume that a similar change took place in both receivers at about the same time.

Fred Bornman, W8QDU, continued his u.h.f. missionary work at the Indianapolis convention. On the way, he raised W9QCY UGE DCI of Fort Wayne, and W9DSC of Indianapolis. He thinks that he has convinced QCY and also W9AQQ of Indianapolis that if they will get the proper vertical antennas and step up the power, the net can be extended across the state from Toledo. However, W9BDL of Marshall, Illinois, seemed satisfied with his horizontal. Fred has raised 40 stations in the honor roll, and has been reported by another half dozen. Most are in the left hand column. He wonders how the others stack up that way. Of course, the honor roll does *not* include any large part of the u.h.f. stations who are doing dx work, but the sample might make an interesting comparison between stations.

Ninth District Activities

When W9ZJB moved into his house, he found some old ham equipment in the basement. In June he received a letter from W8UQC in Dayton, Ohio, who used to live in the same house and operate W9BMT there. UQC heard ZJB on a transceiver and was surprised to recognize ZJB's address as his former residence. A coincidence, what?

In Saginaw, W8TIU is planning a concentric line tuned receiver built for optimum results on five meters, but useful on ten and 2½ too.

Your columnist enjoyed an hour with W9VEK, a public accountant in Indianapolis who still likes the sensitivity of his coaxial line tuned acorn superhet. It greatly needs ganging of the tuning controls because of the extreme selectivity of the lines. He had trouble at first with a plug-in oscillator coil mounted near the business end of a HY615, because of the resulting long cathode lead. Mounting the coil near the center of the tube, to shorten this lead, fixed it up. He agrees that tubes with convenient grid and plate connections on the bulb could be improved for some applications by bringing a cathode or filament centertap out of the top too. Suggestions of this sort made to tube manufacturers a couple of years ago were not well received. John says that W9AQQ, the Indianapolis dx expert, likes the receiver and believes that it is just the thing needed to pull some of the weak ground-wave dx stations up out of the set noise.

For a while, Kansas was a difficult state. Activity has come up, however, with a number of stations on the air at isolated points. Now W9VWU is off to Camp Robinson, Arkansas, with the National Guard, but perhaps more fellows need Arkansas than Kansas anyway. Johnny has all districts but W7—which came through when he had part of the rig out on a field day contest. He uses push-pull 809's but will have only the 30 watts from the exciter at camp. Most stations worked during the summer told Johnny that he was their first Kansas contact. With few cards on hand, he said that he would QSL only on receipt of cards. The result has not burdened the mailman. Best signals during the summer were W2TP W3RL W6QLZ. The latter two were the first in and last out on openings in their direction. W6QLZ was worked nearly every morning in June. Stations worked were: W1AVV HDF KLJ HDQ KTF DEI JJR W2GHV LUR MEU TP BYM HWX AMJ W3CRT WA RL BKB DBC HDC HKM HIJ DI HWX BYF W4AUU FBH W5IHT W6QLZ W8CIR CMS NOR TIU QQS FHA JLQ NED MHM VO NKJ RUE OLX BJG UOS RKE QDU W9UJE GGH VHG. Stations heard include: W1KTJ ZE GZJ LLL W2BZB GPO MO FDJ HEJ CVF MO W3BZJ CGV EIS AIR IDS HOH BUD W4EDD W5VV ALK BYV W8LZN RTW AWD PZM QA CLS QFX FXM QJZ UBA TCX MST NYD DED QQP QGU LW W9QCY AQQ IZQ CLH LMX.

From Woodbine, Iowa, W9YKX says that he, W9TTL (40 miles) and W9FZN (8 miles) are on nightly from eight o'clock. YKX noticed that TTL's vertical puts in no signal but the horizontal comes in R9 regardless of the receiving antenna polarization. FZN with a horizontal gets TTL best when the latter transmits with a vertical, all of which adds to the confusion. YKX has replaced his three element with a five element, getting better reports. His coaxial tuned converter is really f.b., and sensitivity unbelievable, he says. Aha, more kind words for the plumbing.

Because of what he considers an appalling lack of South Dakota news in the October issue, W9ZQC decided to write in. W9BJV is a master sergeant in the 34th Signal Corps so may be leaving the state soon. W9USI is another who will probably be away for a year. But there are still W9EOJ in Aberdeen, CJS Bryant, ZQC Brookings, PZI TI DB Milbank, and W9AZE nearby in Bellingham, Minnesota. Also, W9ORE in Gary, So. Dakota, and W9HEO in Wilmar, Minnesota, are about ready to get on five. With 120 watts in a T55 and a three element beam, ZQC has worked seven districts including W7. He holds daily schedules with BJV, 44 miles away, with satisfactory results down to 1½ watts. The boys promise to keep active but wish that they could stir up some activity in Sioux Falls and on down to where a relay might reach the successful route to the east coast. Sioux City should be a good spot for some activity, then down to FZN, YKX, someone in Omaha or Council Bluffs like Storz who may get on the air, then on down to Kansas City. On 57.6 megacycles, ZQC could raise only W5AJG and W6QLZ. Others would not tune up to him, it seems, and his 56.392 frequency is down near QRM when the band is hot. The best spot was 57.2 but that crystal passed out.

2½ METER HONOR ROLL

ELEVATED LOCATIONS

Stations	Miles
W6KIN/6-W6BJI/6 (airplane)	255
W6QZA-MKS	215
W6BKZ-QZA	209
W6BCX-OIN	201
W6QZA-OIN	201
W1DMV/6-W6HJT (airplane)	165
W9WYX-VTK	160
W6KIN/6-W6OMC/6	140
W8CVQ-QDU (crossband)	130
W6IOJ-OIN	120
W1MON-W2LAU	118
W2LBK-W1HDQ	118
W1HDQ-W2JND	105
W1IJ-W2LAU	105
W2ADW-LAU	96
W2LBK-W1IJ	76
W2LBK-W3BZJ	76
W1MWN-W2LAU	75
W1KXK-IZY	73
W1MRF-W2LAU	68
W2GPO-LAU	50
W1LAS-W2LAU	45
W2JND-LAU	44

HOME LOCATIONS

Stations	Miles
W1HBD-W1XW (1935)	90
W1SS-BBM	74
W1LEA-BHL	45
W2MLO-HNY	40
W3CGU-W2HGU	40

1¼ METER HONOR ROLL

ELEVATED LOCATION

Station	Miles
W6IOJ-LFN	135
W1AJJ-COO (crossband)	93

ABOVE 112 MEGACYCLES

John Burke, W1KXK, is in Newmarket, New Hampshire. On 2½ he worked W1IZY of Bridgewater, Mass., 73 miles away, and has heard W1MBU in Warwick, Rhode Island, a distance of 108 miles. Other Mass. stations worked are W1JQA of Randolph and W1JPM of Brockton.

W2LBK in Jamaica, Long Island, has also done some nice work by hooking W1HDQ, 118 miles away. This might be considered as an elevated location contact because of HDQ's nice spot, but still it is good. He has also raised W1IJ and W3BZJ, both about 76 miles away, making it three districts and five states.

200 Miles on 112 Megacycles

A letter from W2LAU states that on October 5 he raised W1MON who is understood to have been at his home location at Holbrook, Mass., 220 miles away (rechecked as 198 miles). The signals were fading but very good for 45 minutes when they dropped out suddenly. It appears that no other W2 heard MON at the time. It is hoped that he will send in the dope on exact location, rig, and so on. LAU has also raised W1IJ in North Madison, Conn., 105 miles away; W2ADW in Flanders, 96 miles; W1MWN, Milford, 75 miles; W1MRF, Bridgeport, 68 miles; W2GPO, Huntington, 50 miles; W1LAS, Greenwich, worked 17 times at 45 miles; and W2JND, Syosset, 44 miles. LAU really seems to be getting places with his lines-controlled HK24's taking 85 to 100 watts input, and using a 1-10 receiver. Vertical antennas include a three element rotary for transmitting and three half waves in phase for receiving.

At Stanford University, W1DMV has been operating W6YX. He worked W6HJT from an airplane at a distance of 165 miles for a good bit of 2½ meter dx on May 5.

W6QLZ has been lending out his 2½ meter receiver for crossband contacts. He has tried three inch rainspout for antenna elements and has put his signal around Phoenix up 2R's above the ten meter signal. He wants more dope in Radio about large elements, and on ground plane radials. He thinks more fellows would get on 2½ if they know that five dollars would do it if they now have a rig on the air.

Michigan DX

W8CVQ gets into Grand Rapids and Battle Creek on 2½, and on September 3 during a 130 mile five meter contact with W8QDU in Detroit, he cut his 5 meter mike and went on 2½ with a pair of HK24's, taking 85 watts input. The antenna has a reflector and two directors. Fred brought over a two stage acorn preselector to go ahead of Walter's superhet, in the hope of making it two-way.

W8QDU says that 2½ is picking up fast around Detroit with plenty of stations on every night. He uses a Hallicrafter S27 in the FM position for modulated oscillators, finding the signals cleaner but sensitivity about the same as his 1-10 super-regen. Fred is one who has not found it difficult to make a push-push doubler work on 2½. With 1300 volts on the plates, the unloaded current is 95 mills and the stage loads up to 230. The tubes are thought to be HK54's. The grid coil, condenser tuned, is 8 turns of no. 12 wire, wound one inch in diameter and 1½ inches long, center-tapped. The plate coil is three turns of no. 8, 1¼ inches in diameter, 1½ inches long, by-passed at the cold end with a low loss mica condenser. The grid current is 40 m.a. through 15,000 ohms leak.

Fred says that the Greak Lakes Amateur Radio Phone Association will hold a u.h.f. contest in November, December and January, for 5, 2½ and 1¼ meter stations. He is not eligible, which may be a break for the contestants.

Chicago Area Picks Up

The C.S.R.A. 2½ meter contest had two winners, W9PNV on points and W9SIO on dx. Only the first contact with a station counted, so the dx could not be stretched by a continuous mobile contact. PNV uses T40 specials. A new 2½ meter station in the Chicago area is W9TAK of Hazelcrest, Illinois, who with W9RLA in Harvey gets into Gary and Evanston (37 miles). TAK uses 350 watts peak, controlled carrier, on T40 specials. RLA puts 400 watts into a 50T—or perhaps it is two of them, for that really is power on 2½. W9MAT in LaGrange gets to Harvey and Evanston with a pair of 76's. His antenna is an extended double zepp. W9LLM in Downers Grove works crossband, and may transmit on 2½ soon. W9RQA and W9MFS on Chicago's north side, and W9JZ in South Chicago, are on the band now.

W9BVB says that he and W9WZO in Naperville are on 2½ mobile, which about completes the stations necessary to get from Chicago to W9PQH in Batavia, Illinois, on the Fox River.

W9ZJB visited W9GK at Overland Park, Kansas, to see how 2½ sounds. GK works W9DDX at Independence, Missouri, 22 miles away, with a 6J5GTX transceiver and six element horizontal beam. DDX has a four element closely spaced beam, T20's in the transmitter and HY615 in the receiver. Vince heard the R9 signals with complete suppression of the receiver hiss.

W9ZQC and BJV in South Dakota are trying some 112 megacycle equipment over their 44 mile separation. They do not expect much company in the near future.

Question and Answer Department

Question: My 954 acorn mixer does not work right in my receiver. Even with the oscillator so strong that a neon tube lights on the mixer suppressor, there is no conversion gain. What is likely to be wrong?—*W8OKC.*

Answer: Your acorn tube may not be working. Check for shorts between adjacent elements, and check the static characteristics by varying fixed bias and measuring plate current. If the tube itself is not damaged, clean off the tube pins, check the r.f. by-pass in the output circuit. See that there is no trouble with the r.f. input circuit—if necessary, cut out the r.f. stage and couple a test signal into the grid circuit. See that the bias is high enough to reduce the plate current to 0.1 milliampere for grid or cathode injection, or low enough for normal amplifier plate current for other types of injection, with the oscillator off. If the trouble has not yet been discovered, disconnect the oscillator from the suppressor and see if leakage coupling to the grid is alone sufficient to inject enough oscillator voltage—sometimes an oscillator accidentally leaks enough signal into the mixer to buck out the direct injection. Try grid injection alone and see that it drives the mixer plate current up from the 0.1 m.a. to normal amplifier plate current. If the 954 still turns out a poorer job than a 6K8 or some other mixer, go back and recheck for socket shorts, proper voltages on the elements, clean tube leads, and for tuning of the grid, plate or oscillator to the wrong frequency. The low interelectrode capacity of acorn tubes sometimes misleads one in resonating its tuned circuits.

Question: My high power 2½ meter transmitter has a high unloaded plate current which rises only moderately when the antenna is coupled in, but considerable power gets to the antenna. Is something wrong?—*W9PNV.*

Answer: The difference between loaded and

[*Continued on Page 78*]

With the Experimenter

A 224-Mc. TRANSCEIVER

By John C. Reed, W6IOJ

How does dx on 1¼ meters compare with that on 2½ or 5? Can distances of 100 miles or more be covered reasonably often at distances of 100 miles? These questions rather than an attempt to set a new record led W6MYJ, W6QG, W6LFN and W6IOJ to do some serious experimenting with rather low power 224-megacycle rigs.

The distinct tendency of transmitters to be much less efficient—except when u.h.f. tube types are employed—and of receivers to be less sensitive, could have defeated the project unless elaborate equipment were available. However, good results especially when operating mobile from elevated locations, including a successful 130 mile contact, resulted from the use of inexpensive but carefully built apparatus. At fixed locations, W6MYJ uses a WE316A and W6QG has a pair of 35T's while the remaining two use HY615 transceivers. That of W6IOJ is pictured in figure 1.

The r.f. stage is mounted in a box directly at the end of the concentric feed line from the antenna. In this box is the HY615, the parallel rod tank circuit, and the tuning condenser. A socket is provided to connect a ten-foot cable to the modulator and send-receive switch. The circuit is shown in figure 2.

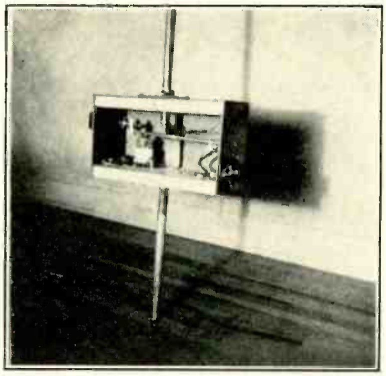
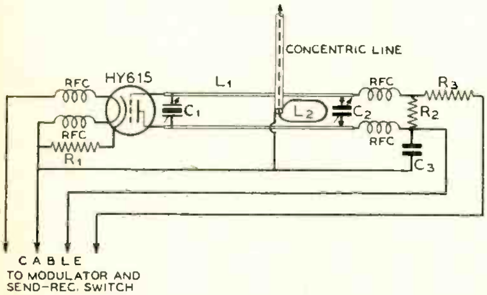


Figure 1. The oscillator portion of the transmitter-receiver shown as it is mounted half-way up the support pipe for the ground-plane vertical.

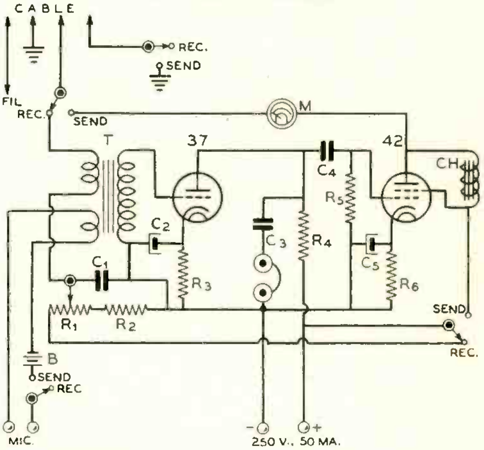
The plate rods are ¼-inch copper tubing seven inches long spaced one inch. These are mounted horizontally from the tube grid and plate connections to the other end of the box.

Figure 2A. The Oscillator-Detector Portion of the Transmitter-Receiver.



C_1—Rebuilt midget — two rotors are double spaced, and the one stator is split in center
C_2—3-30 µµfd. ceramic trimmer
C_3—.001-µfd. mica
R_1—600 ohms, ½ watt
R_2—2.0 megohms, ½ watt
R_3—10,000 ohms, ½ watt
RFC—30 turns no. 18 enam. wound on ⅛" rod, self-supporting
L_1—¼" copper tubing spaced 1" and 7" long
L_2—Small 1-turn loop

Figure 2B. The Audio-Modulator Portion of the Transmitter-Receiver.



C_1—0.5-µfd. 400-volt tubular
C_2—10-µfd. 25-volt elect.
C_3—.01-µfd. 400-volt tubular
C_4—0.1-µfd. 400-volt tubular
C_5—10-µfd. 25-volt elect.
R_1—50,000-ohm potentiometer
R_2—50,000 ohms, ½ watt
R_3—2000 ohms, ½ watt
R_4—250,000 ohms, ½ watt
R_5—500,000 ohms, ½ watt
R_6—600 ohms, 10 watts
CH—15-hy. 50-ma. choke
T—Transceiver audio transformer
M—0-50 d.c. milliammeter
S—4-pole double-throw switch
B—4.5-volt C battery

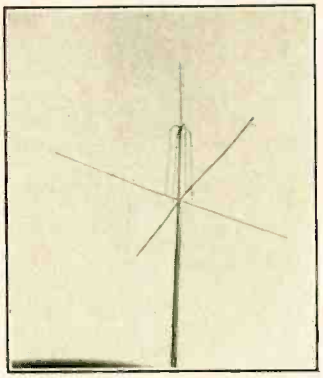


Figure 3. Photograph of the 224-Mc. ground-plane vertical with radials.

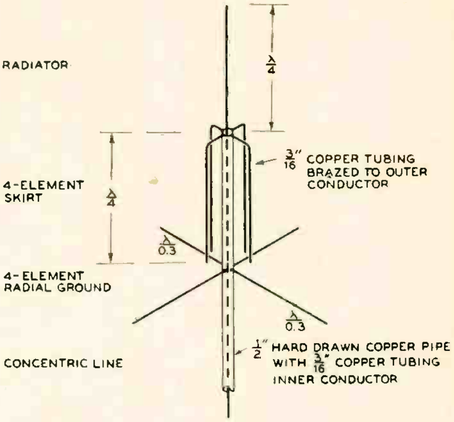


Figure 4. Schematic drawing of the 224-Mc. ground-plane vertical used by W6IOJ. The concentric line in this case is about 3 feet long.

The tuning condenser, located right at the tube, is a midget Cardwell with two rotor plates, double spaced, and one stator split in the center to make a small balanced condenser with a floating rotor. Chokes are placed in the grid and plate d.c. leads and in both heater leads but the cathode relies on a bias resistor alone to isolate it from ground. A 10,000-ohm grid leak is used to ground when transmitting, but a 2-megohm leak is operative on receiving. The concentric feed line, with the outer conductor grounded, is inductively coupled to the line at the opposite end from the tube, where a Hammarlund 3-30 μμfd. ceramic trimmer is used as a variable shorting bar.

The audio, speech amplifier and modulator are as shown in figure 2. The whole unit including the r.f. tube requires 250 volts at 50 ma. This is, of course, a common voltage for automobile b.c. receivers.

The antenna used on the W6IOJ mobile rig is somewhat unusual, to be sure, but is based on standard principles. The concentric feed line happens to be three feet long, and is made of ½-inch hard drawn copper pipe with a 3/16-inch copper tubing inner conductor. The inner conductor extends on upward a quarter wave above the top of the outer pipe. Four copper tubing radials, brazed onto the top of the pipe outer conductor, are bent down down beside the pipe for a quarter wavelength, acting like four elements of the concentric outer sleeve of a W.E. coaxial antenna. Just below the ends of these drooping radials there are four more radials extending 3/10-wavelength long, brazed onto the otuter pipe. The structure is shown in figure 3.

It is hoped that this discussion of a simple 224-Mc. rig will give others some ideas and lead them to give the band a try.

A 100-KC. OSCILLATOR WITH A.F.C.

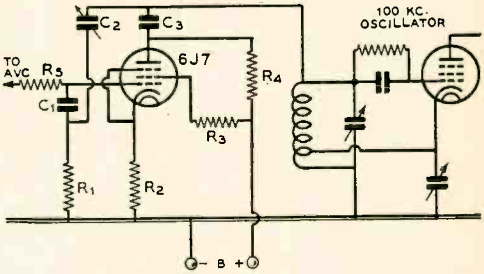
By R. M. Mason*, W8NN

Recent issues of the radio magazines have shown all sorts of ideas on frequency measuring devices, but all have had the disadvantage of requiring some sort of manual adjustment to bring the frequency control oscillator to the exact desired frequency. The little wrinkle that is shown in the accompanying diagram has been a great help to me in holding my 100-kilocycle sub-standard oscillator exactly on the nose.

[*Continued on Page 74*]

---

*711 Michael Avenue, Lima, Ohio.



Schematic of the 100-kc. a.f.c. oscillator control

C_1—.00025-μfd. mica
C_2—3-30 μμfd. mica trimmer
C_3—.001-μfd. mica
R_1—150 ohms, ½ watt
R_2—2000 ohms, ½ watt
R_3—200,000 ohms, ½ watt
R_4—100,000 ohms, ½ watt
R_5—200,000 ohms, ½ watt

POSTSCRIPTS...
and Announcements

No Further Extension of Order No. 75 To Be Granted

The promptness and cooperative efforts of the amateur and commercial radio operators in filing satisfactory proof of their citizenship and identification as required by Order no. 75 has been very gratifying to the Commission. In order to avoid any unnecessary hardship to the operators, the filing date for the responses to that Order has twice been extended by one month periods from the original date of August 15. Under the provisions of the Order as amended the responses were due on or before October 15, 1940. It is apparent that there has been an honest attempt on the part of the large majority of the operators to meet that filing date.

There will be no further extension granted. However, the Commission realizes that certain individuals and groups of operators will be unable to secure the necessary documentary proof of citizenship within the time provided by the Order due to factors beyond their control. Accordingly, the Commission is disposed to accept without further action such responses as may be tardily filed provided they are accompanied by satisfactory explanation of the reasons which prevented prompt compliance with the Order. At the same time it is desired to emphasize that arbitrary failure to submit the response in accordance with the Order, or to offer a reasonable explanation of the factors necessitating late filing, may be considered just cause for further action on the part of the Commission.

Unlawful QSO's

The following letter from the FCC in regard to unlawful contacts between U.S. and foreign amateur stations is self explanatory.

Sirs:

It has recently come to the attention of the Commission, through correspondence with certain amateur radio operators, that violations of the Commission Order no. 72 have occurred, such violations having been due to the apparent misinterpretation of call letters of foreign stations.

Such violations occur in a fashion similar to the following example: A Russian station, signing the call letters UK4AC might be misinterpreted as signing the call letters K4ACU.

Such errors may be due either to poorly executed sending of the foreign operator or to an error in reception by the United States amateur and may cause the latter to become subject to an official citation by the Commission.

This information is submitted for your attention in the event that you might consider it advisable to inform United States amateurs through your magazine of the problem involved.

James Lawrence Fly,
Chairman

Nalley Feedback Amplifier Error

Both the editors and the draftsman must have been slightly dazed from midnight oil burned in preparation of the 1941 HANDBOOK when it came around to preparation of one of the first articles for the October issue of RADIO. At least there must have been something wrong when it came time to make the drawing and prepare the copy for Leonard L. Nalley's article "A Volume Limiting Feedback Amplifier." The first error is found in the drawing, and is a fairly serious one: the feedback from the plates of the 6L6's should go to the *cathodes* of the 6J7's on the *same side* of the amplifier, *not* to the opposite side as shown in the diagram. Also, C_3 and C_8 were interchanged; the 1.0-μfd. condenser should have been shown as the *screen by-pass* and the electrolytic should be placed on the plate return of the 6R7.

Also shown in error was the calibration of the input levels on the chart shown on page 24. The bottom should have been scaled off *4 decibels per division,* rather than 2 db as shown, and the extreme left figure on the "INPUT, DB" scale should be −44 db. The point near the end of the arrow "End of Compression" should, with this scale of calibration, be −14 db.

Amateur Radio Saves Another Life

Bill O'Brien, W7EVT, recently played good Samaritan and together with K7HTI probably saved a woman's life. Jack Nichols, K7HTI, and his wife are the only white residents on Kanatack island, about 400 miles from the

[*Continued on Page* 77]

"The Season's Best!"

Whether it's a matter of being your own Santa Claus or of tipping off someone in the family as to what would bring the biggest smile to your face on Christmas morning, we suggest the AR-77. Whether you judge it by eye appeal, ease of operation, simplicity of tuning with the Uni-view Dial, or any one of countless technical features from the adjustable Noise Limiter to its amazing sensitivity and stability, you'll quickly agree that the AR-77 reigns supreme.

Here's to the Merriest Christmas ever to you and your station!

RCA

AR-77 COMMUNICATION RECEIVER

RCA BROADCAST EQUIPMENT
From microphone to antenna

Net Price **$139.50** *f. o. b. factory. 8" Speaker in matched cabinet* **$8.00**

RCA MANUFACTURING COMPANY, INC., Amateur Division, CAMDEN, N. J. • A Service of the Radio Corporation of America

YARN of the MONTH

THE BIRTH OF A NOTION

It all started way back in 1936 when I purchased a copy of the then current RADIO HANDBOOK. As I thumbed idly through page after page, marveling at the new gadgets and quirks, my eyes came to rest on a little diagram and associated photo situated in the lower right hand corner of page 229 which was labeled simply "2½-Meter Transmitter". I looked at that little rig almost as long as I did the potent Jones Exciter. Then and there I said to myself: "By gosh, I'm sure gonna build that job".

Well, some time later the Jones Exciter became a reality and the 2½-meter rig subsided to a state of suspended animation or hibernation—whichever you will. I won't say I forgot about it because I didn't. Every once in a while I would bump into page 229 while looking for some particular dope and would stop and glance at that circuit again. Whenever this happened, the old urge to build it would return, and then crawl back into its hole when I found what I was looking for.

Years passed, with numerous recurrences of this malady. Once I almost built the job, but back on the shelf went the germ when I decided to invest in a few new parts for the big rig instead. All this time I spent chasing dx with only passive interest in the forsaken u.h.f. spectrum. Then came the recent dx demise. This, coupled to a more recent meeting of the local ham club at which 2½ meters came into the inevitable ragchew after the meeting and the debut of Smith's little 2½ meter portable transceiver, was too much for me. The wee spark flared into an r.f. arc pulled from the plate circuit of a California kw. amplifier with a pencil in experienced hands.

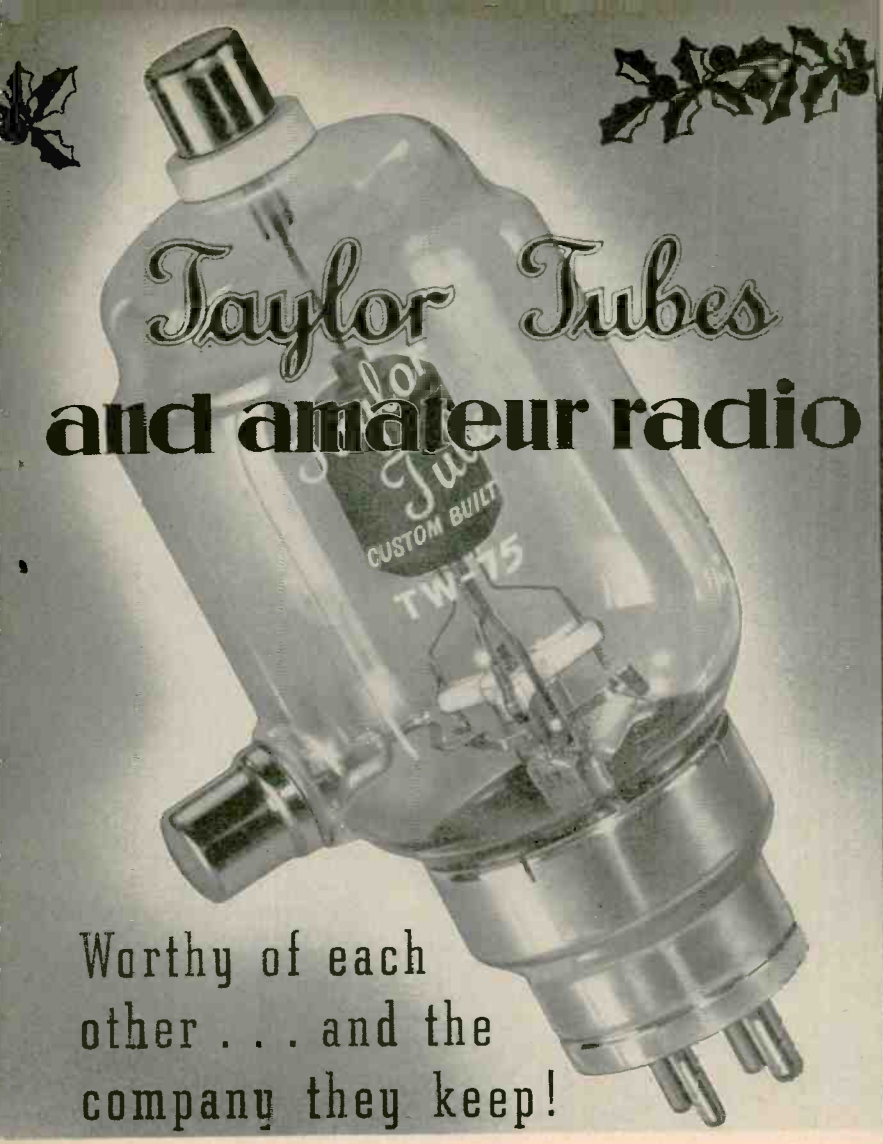
Down I delved into the junkbox for parts. The first thing to emerge was the 53 out of the old Jones Exciter. At this point an obscure relay popped someplace: "Why the heck can't I use this 53 instead of the RK34 originally specified? It worked like a million as an oscillator-doubler. . . . Sure, here goes!" So out came the odds and ends that go to make up a rig and into the plug went the soldering iron. After making the chassis and getting the tube socket set up on stilts to equal the height of a midget stand-off insulator, I discovered belatedly that I was the not-so-proud possessor of only three such insulators.

Resigned to the fact that I needed four for the rig, I again submerged in the junkbox to come up with four of the inch-high variety of stand-off. Two were white and two were brown, each had one ear broken off from too much elbow grease. Up went the tube socket on higher stilts to keep up with the insulators. Next came a trip to the garage for some 14 gauge wire for the parallel rod plate circuit.

After much rummaging, I located a sorry looking piece of said wire which was a veteran of sundry feeder and antenna systems. I pruned off a two foot piece from the end with the fewer kinks and started back to the shack when I realized that the wire should be bare to give the shorting bar a break. So back to the garage where I found a piece of steel wool that had been used to polish up the bottoms of our skiis last winter. After finding the spot on the ball of steel wool that had the least wax imbedded in it, I shined all the enamel and oxidation off the wire and this time made it clear to the shack. Things really began railroading then. The plate circuit was complete. Now for the grid circuit. "Five turns no. 18 bare wire ⅜" or 7/16" diameter", says the parts list. Well, that's easy—plenty of 18 wire. Here's a piece of tubing to wind it on—darn! it's ⅝" diameter. What the heck is 7/16" diameter around here anyway?

Finally I located an old pen that filled the bill in a tapered manner and soon had

By CLAY CASH, W6LGD



We of Taylor Tubes are proud both of being amateurs and to have had a part in the development of amateur radio.

Since the founding of Taylor Tubes, Inc., eight years ago, our sole policy has been to give the amateur, *"More Watts Per Dollar."* This aim, perhaps more than any other single factor, accounts for our rapid growth, sales leadership and the thousands of Taylor Tube boosters heard nightly on the amateur bands.

Undeniable is the fact that more and more amateurs are daily discovering the merits of Taylor Tubes and that it pays to get

"More Watts Per Dollar"

Taylor HEAVY **CUSTOM BUILT** DUTY **Tubes**

TAYLOR TUBES, INC., 2341 WABANSIA AVE.,

THE Taylor LOG

T-40 and TZ-40

Plate Voltage	1500
Plate Input, watts	225
Plate Dissipation, watts	40
Safety Factor 260 watts	$3.50

TW-75

Plate Voltage	2000
Plate Input, watts	300
Plate Dissipation, watts	75
Safety Factor 525 watts	$8.00

TW-150

Plate Voltage	3000
Plate Input, watts	600
Plate Dissipation, watts	150
Safety Factor 750 watts	$15.00

T-20 and TZ-20

Plate Voltage	750
Plate Input, watts	64
Plate Dissipation, 20 watts	$2.25

T-55

Plate Voltage	1500
Plate Current, MA	135
Plate Dissipation 55 watts	$6.00

New Shielded 866

Over 25,000 Taylor 866's in use. Known the world over to be the longest lived and most trouble-free 866's ever made $1.50

Other Taylor Tubes

T-21	203-A	872-A
203-2	211	249-B
805	845	204-A
T-125	822	814
T-200	875-B	866-JR
	T-450	

TAYLOR MANUAL

FREE! At your parts distributor or send 5c in coin or stamps direct to Taylor Tubes, Inc.

CHICAGO, ILL.

a five turn grid coil. Now, one 15,000 ohm and one 300 ohm 10 watt resistor. There's the 15,000 one first dig.—Whoa!—All those 10 watt resistors have (or had) paper labels glued to them. Due to a combination of heat in use and moisture in disuse, the labels were lying complacently in the bottom of that box. "#$%&¢ those manufacturers who don't color code their resistors! (Come to think of it, I never have seen a color coded 10 watt resistor anyhow.)

Oh, well, Columbus took a chance and landed in Ohio, so I grabbed the first resistor in the pile hoping that it wasn't the 20,000 ohm one that I knew darned well was in that box. A few deft twists of the soldering iron and there she is—just as pretty as you please. Now for the juice and we'll see how she works. Blazes!! The only available power supply was recently incorporated into the e.c.o. in the big rig. With the aid of a little time, a couple of old 201A sockets, and a few feet of cable, I soon had 250 volts out where I hoped it would do some good. On went the 110 and I leaned back in my chair and lit a cigarette while waiting for the tube to warm up. The doggone tube just didn't warm up. Hmmmm—no filament voltage. I wonder if the high voltage is coming through? Ow! Sure is. With a little persuasion and a file on the filament pins of the cable sockets, the filament voltage finally arrived at the 53.

Cautiously I closed the high voltage switch, hoping the tube would stay in the socket. It did and the plate meter read a bare 15 ma. I slid the shorting bar up and down about two inches of the far end of the parallel rods with no apparent results. I finally anchored it down near the end of the rods and started optimistically examining for r.f., armed with my trusty pencil. My fears were all realized when I found it completely lacking. I leaned back in my chair perplexedly and began wondering where in the deuce to start looking for bugs in a rig composed merely of one tube, two 12" lengths of 14 wire, an untuned grid coil, two ten watt resistors, and an r.f. choke. A lurking doubt made me pull out the unmarked resistor and ground the cathode directly. This produced about five more mils of plate current but still no signs of r.f.

Just as I sat back and glared at the 53 hard enough to make it blush with no voltage applied, I heard a familiar car pull into the driveway. Pleased with the thought of a little diversion, I went to the door just in time to see my old pal W6GVM clambering out of his car loaded down with 2½ meter transceiver and batteries. "Either the man is psychic or I live right", I thought to myself with little conviction for the latter.

"Come on in; I'm just tuning up my 2½ meter oscillator", I said optimistically.

"Thought you might be monkeying around on 2½ from the way you talked the other night at the ham meeting," he grinned.

We retired immediately to the shack and he turned on his tranceiver to see if he could pick up a signal from my rig (I knew full well he couldn't, but I still believe in miracles after seeing some of the things that I have built work.) Well, we just sat there and looked at the rig for a minute or so. Then I idly picked up the earphones of the tranceiver and took a listen over the band. At the same time, I absentmindedly slid the screwdriver I had in my hand up and down the parallel rods of the oscillator. All of a sudden I caught the fleeting sound of a voice about R1½. I instinctively tuned back to the spot to see who it was, only to find silence prevailing over the entire band. Then the realization struck me that this had happened when I had the screwdriver shorted across the rods near the center. So I tried it again and back came the voice. This time I concentrated with my best dx ear and lo and behold, what was it but a broadcast of the baseball game coming over the local b.c.l. station! Thereupon I solemnly swore off the Kentucky dew which had prevailed at the party I had attended the night before. I didn't believe my ears until GVM heard it too and then I felt much better.

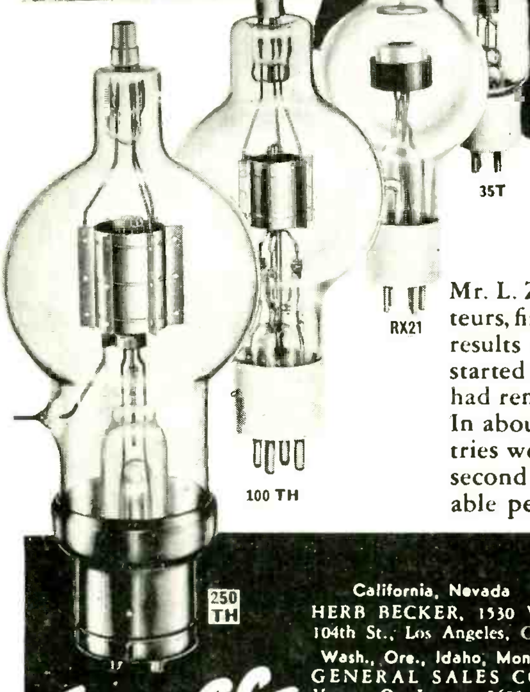
Well, it turned out that the place I had hit with the screwdriver was the resonant point of the parallel rods. So down, down, went the shorting bar. I even had to add more wire to make it reach. There! She started to oscillate and right square in the middle of the band too! Out came the old flashlight globe and loop and it lit up like my 100TH. Then I looked at the position of that shorting bar (just exactly six inches from the plate terminals) and fearful qualms began to assail me as I wondered if the darn thing could be on 1¼ meters. Was I hearing one of those foney "up" harmonics on 2½? These fears were quickly dispelled, however, when GVM pointed out that it sure as heck wouldn't oscillate on 1¼ meters with a five turn grid coil. Whereupon I felt like a dummy. I certainly found out from this little adventure why they make u.h.f. low capacity tubes, anyway.

My soul is at peace with the world now that I have the little rig built and working. All I have to do now is to build a modulator for it and a receiver for 2½ and I'll be on the air. I figure that this ought to be ac-

80 HOURS ON THE AIR...323 DX CONTACTS

KA1LZ

Second place in world wide DX phone contest using Eimac tubes



Mr. L. Zavattero, like most of the world's leading amateurs, finds that Eimac tubes reward him with outstanding results when it comes to gruelling DX work. KA1LZ started operation only 15 days before the war and has had remarkable results for so short an operating period. In about 80 hours operating time 19 zones and 28 countries were contacted . . . a total of 323 contacts to place second in the world wide competition. Certainly a creditable performance for both Zavattero and Eimac tubes.

Eimac TUBES

EIMAC REPRESENTATIVES

California, Nevada
HERB BECKER, 1530 W. 104th St., Los Angeles, Cal.

Wash., Ore., Idaho, Mont.
GENERAL SALES CO., Verner O. Jensen, 2605-07 Second Ave., Seattle, Wash.

Colo., Wyo., New Mexico, Arizona, Utah
RICHARD A. HYDE, 4253 Quitman St., Denver, Colo.

Ohio, Mich., Ky., Ind., Minn., Mo., Kan., Neb., Iowa
PEEL SALES ENGINEERING CO., E. R. Peel, 154 E. Erie St., Chicago, Ill.

N. Y., N. J., Penn., Md., Del., Dist. of Col., Maine, N. H. R. I., Conn., Mass.
ADOLPH SCHWARTZ, 14726 Elm Ave., Flushing, New York.

N. Caro., S. Caro., Georgia, Tenn., Flor., Ala., Miss.
JAMES MILLAR, 316 Ninth St. N. E., Atlanta, Georgia.

Texas, La., Okla., Ark.
J. EARL SMITH, 2821 Live Oak St., Dallas, Texas.

Chicago, Illinois, Wisconsin
G. G. RYAN, 549 W. Washington Blvd., Chicago, Ill.

EITEL-McCULLOUGH, INC. • SAN BRUNO, CALIFORNIA

complished in at least six or eight years; so if any of you fellers or your junior ops hear me on, why just give me a buzz.

The Improved Wide Range Audio Oscillator

[*Continued from Page 21*]

range the frequencies of 1500, 2000, 2500, 3000, etc., may be checked by their multiple sine wave patterns. Then the audio oscillator may be shifted to 1000 cycles, the sweep oscillator shifted to 1000 cycles to give a single wave, and the frequencies from 3000 to 12,000 cycles checked.

For extremely high audio frequencies the oscillator may be shifted to 5000 cycles and the sweep oscillator increased in frequency until a single sine wave is visible showing that the sweep is on the same frequency. Then this frequency may be multiplied on up in the manner used for the lower frequencies until calibration up to 75,000 cycles or above is obtained.

As a check upon the entire calibration the entire process may be reversed and the difference between the resulting check line frequency and the actual frequency determined. If it is very far off the whole process had better be repeated in order to obtain a more accurate calibration.

See Buyer's Guide, page 97, for parts list.

A Medium Power 160 Meter Amplifier

[*Continued from Page 25*]

transformers for the rectifiers, or a single three-winding transformer, the complete supply will prove less costly than a conventional center-tap rectifier with a 1200-volt transformer.

If break-in operation is desired it will be necessary to provide at least 35 volts of fixed bias, preferably more, to the final amplifier. This bias may be obtained from a suitable power supply having its output connected across the amplifier's bias resistor. The bias supply requirements are not particularly rigorous—it is only important that the bias pack deliver sufficient current to maintain the cut-off bias across the bias resistor.

The two HK-24's require 11 watts of grid driving power for class C operation at the plate current and voltage values which have been suggested. At 160 meters this amount of excitation is quite easy to obtain, the very simplest of exciters being required. A very suitable exciter can be had by using a small receiving triode as a Pierce crystal oscillator followed by a 6L6 or 807 output stage. It will probably not be found necessary to neutralize the 6L6 at this low frequency.

In the author's case, a Signal Shifter is used as an exciter, and, although the manufacturer rates this exciter at only 7.5 watts output, it seems to provide ample output to drive the HK-24's on 160 meters.

Modulation and Speech Equipment

One hundred watts input to the amplifier suggests the use of 6L6's in class AB_2 as the logical modulators. This type of modulator will deliver close to 60 watts of audio, which means that the modulator will not have to strain itself at 100 per cent modulation. The modulation transformer should have ample power-handling capabilities, and should reflect the proper load on the modulator when the secondary load is approximately 7000 ohms.

Construction

A suitable layout for the transmitter is shown in figure 3. Three 10½-inch panels mount the final amplifier, modulator and power supply sections in a standard 19-inch relay rack. An additional rack panel measuring 5¼ inches serves for the three meters, thus filling out the 36¾ inches of panel space provided by the rack. One more meter might well have been added, and is suggested, to read the plate current to the modulator.

The speech amplifier is external to the transmitter proper; it utilizes a 6L7 input stage with variable gain taken from an a.m.c. circuit, followed by a 6C5 and a 6N7 (sections paralleled) working into a 500-ohm line. At the transmitter end of the 500-ohm line, a pair of triode-connected 6F6's are used to drive the class AB_2 6L6 modulators.

Adjustment and Operation

In operation, the transmitter is first tuned up with the 34-ohm dummy antenna, and the output power checked by means of a r.f. ammeter in series with the load circuit. If the amplifier is operating properly the indicated power output (current squared times 34) should be close to 75 watts at the normal input of 120 ma. at 850 volts, the amplifier showing a plate efficiency of 75 per cent. If the output is much below this figure, a check

NEW items

DEVELOPED BY BUD Engineers

Here are three brand new BUD Products. They are designed, like all other BUD Products, to give you outstanding performance and long, useful service. Your jobber has these items in stock, and will be glad to give you full details. For further information on these and all other BUD Products, write for the No. 141 BUD Catalog.

CODE PRACTICE OSCILLATORS

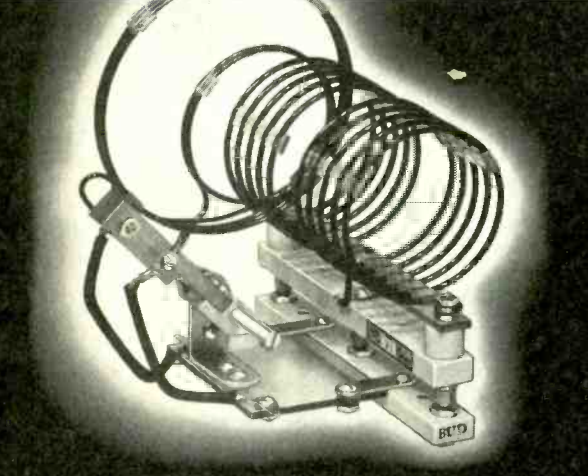
Our country's national defense program is creating a demand for a large staff of trained radio operators. In order to facilitate the training of the many operators needed, we have designed several new Code Practice Oscillators.

The Earphone Model illustrated here is capable of handling up to 20 pairs of earphones or five small magnetic speakers. A Variable Volume Control and a Variable Pitch Control are provided so that the volume and tone may be adjusted to suit individual requirements.

In addition to the Earphone Model illustrated, there is also a model similar in detail except that a built-in speaker is included. When earphones are used, the speaker is cut out of the circuit.

These Oscillators are housed in streamlined metal cases, finished in Grey Crackle enamel.

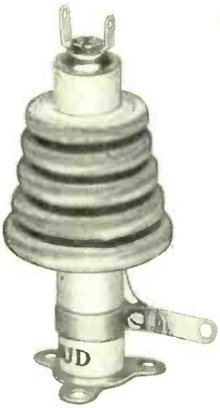
No. CPO-122 Earphone Model $5.85 Net
No. CPO-124 Speaker Model $7.95 Net



ADJUSTABLE LINK COUPLING

with the Helicalink

Here's a real improvement over previous types of adjustable link coupling methods. The helicalink coupling unit consists of a large and small diameter link coil in series, the small coil being placed eccentrically inside the larger. • This exclusive feature is incorporated in our 500 Watt VLS series and in our 1 Kilowatt MLS series of "Air-Wound" Transmitting Inductances.



Ceramic Coated TRANSMITTING CHOKES

This is the standard BUD Transmitting Choke with a new ceramic coating to keep it moisture-proof and to prevent collapsing due to momentary overloads.

These chokes are wound on Alsimag rods and are provided with heavy connection lugs. Several types are made for general use in transmitters operating on 10 to 160 meters. One type is made for 2½ and 5 meter transmitters.

BUD RADIO, INC. Cleveland, Ohio

should be made for ample excitation. It is necessary to have 50 to 60 ma. of grid current at 3 times cut-off bias for proper operation of the amplifier.

See Buyer's Guide, Page 97, for parts list.

A 15-Watt Grid Modulator

[*Continued from Page 37*]

ing the power switch, S, on the gain control, since it was thought that this might lead to hum being introduced into the grid of the first stage. However, when the line by-pass condensers C_9 and C_{10} were added, and the metal plate separating the switch from the resistance unit was grounded, all traces of hum disappeared.

Construction

The amplifier proper occupies very little space on the 7- by 13-by 1½-inch chassis, most of the space being given over to the two transformers and the filter choke. In order to keep the input circuit as far as possible from the power-supply components, the 6SC7 is located at the left front corner of the chassis. The grid connection to the input section of the 6SC7 from the gain control is made through a short piece of shielded wire to help in reducing hum and r.f. pick up. For a like reason, the connection from the microphone connector to the gain control is also made by means of a shielded lead.

Directly to the rear of the 6SC7 are the 6SJ7 drivers, and to the right of the latter are the two 6L6's followed by their output transformer. The output transformer is arranged so that its plug-in terminal board faces toward the rear, thereby simplifying the process of making changes in the transformer ratio.

All of the power supply components are located near the right-hand edge of the chassis, with the power transformer, rectifier and filter condensers occupying the forward section and the choke utilizing the remaining space at the rear. Underneath the chassis reasonable precaution has been taken to separate the input and output circuit leads, and thus avoid any tendency toward oscillation. With the amplifier out of its cabinet, it is possible to cause it to break into oscillation at a frequency near 20 kc. by placing a hand near the input portion, but the oscillation disappears when the hand is removed, and placing the unit in the cabinet completely eliminates any tendency toward instability.

The amplifier is housed in a neat appearing cabinet having outside dimensions of 8 by 8 by 16½ inches. Due to the curved-corner construction there is considerable waste space inside this type of cabinet. If space on the operating desk is at a premium, the amplifier may be made to occupy considerably less space by placing the chassis in a 7- by 7½-by 14-inch square-corner cabinet, which is commercially available to fit the same chassis.

Operation

In use, the amplifier does all that could be desired of it. Due to the inverse feedback, the effective plate impedance of the 6L6's is so low that wide variations in load impedance have little effect on the output. This is an ideal condition for grid-modulator service. When operated into a fixed-impedance load the transformer taps are adjusted to reflect a 5000-ohm plate-to-plate load on the 6L6's. However, no important change in performance is noted when the impedance is varied between 3000 and 8000 ohms. For grid-modulation service the transformer ratio should be adjusted to suit the modulated amplifier operating conditions, and will vary considerably with different transmitters. A good starting point for this type of service is to use an impedance ratio of 1:1 and load the secondary with a fixed resistor of approximately twice the required load impedance, or in this case 10,000 ohms. If the secondary voltage then proves to be too great or too small for proper modulation the ratio may then be increased or decreased accordingly, with corresponding changes in the value of swamping resistor.

On a frequency run the amplifier showed uniform output from 100 cycles to 4000 cycles, dropping 1 db at 50 and 5000 cycles, 3 db at 25 cycles, 5 db at 10,000 cycles and then uniformly out to 11 db at 20,000 cycles. No distortion was observable on an oscilloscope (probable accuracy, 10 per cent) at any frequency, as long as the last two stages are operated below their grid-current point.

No provision has been made in the amplifier for sidetracking any r.f. which might find its way into the input circuit. If such troubles should occur a 50,000-ohm carbon resistor in series with the input lead to the gain control should eliminate the trouble. In stubborn cases it may also be necessary to place a .0001-μfd. mica condenser between the 6SC7 input grid and ground. A *good,* low resistance common ground for the whole transmitter will often go a long way toward eliminating stray r.f. in the shack.

See Buyer's Guide, page 97, for parts list.

• • •

"California Kw."

Latest of the California kilowatts is Berkeley's new atom smasher. Operated at 10,000 kc., its power capability is 200 kilowatts.

Want To Play Santa?

Once again, RADIO's Christmas gift rates will be in effect from November 15th to January 15th. A subscription to RADIO is the ideal (and easy) way to play Santa to all your radio-minded friends—and we'll send an attractive card announcing the gift and your greetings! Unless otherwise instructed, subscriptions begin with the big January issue which is delivered about Christmastime.

ONE SUBSCRIPTION (one year)	$2.50
TWO SUBSCRIPTIONS, each	2.35
THREE or more SUBSCRIPTIONS, each	2.25
SIX or more SUBSCRIPTIONS, each	2.00
TWELVE or more SUBSCRIPTIONS, each	1.75

To Canada (inclusive of current taxes), Newfoundland, Pan-American countries, and Spain, add 50c per year. Elsewhere, add $1.00 per year.

You May Enter Or Renew Your Own Subscription At These Rates.

And if your friends already read RADIO, how about a copy of the "Radio" Handbook for them? The 1941 edition has just been published and it's clothbound and goldstamped this year! A beautiful BINDER that holds a year's copies of RADIO and the "Radio" Handbook makes a swell gift too. On these items, we suggest that shipment (prepaid by us) be made directly to you in order that you can gift wrap 'em and enclose your own card.

	Continental U.S.A.	Elsewhere
"Radio" Handbook	$1.60	$1.85
"Radio" Binder	1.50	1.75

For other gift suggestions for the radio-minded, write for our complete catalog. All remittances must be payable at par in Continental U.S.A.

73—and a Merry Christmas to you!

THE EDITORS OF RADIO

CORPORATE NAME: EDITORS AND ENGINEERS, LTD.

technical publishers

1300 KENWOOD ROAD, SANTA BARBARA, CALIFORNIA

What's New . . . . IN RADIO

NEW SHURE 708A CRYSTAL MICROPHONE

Shure Brothers announce a new 708A "Stratoliner" crystal microphone. It has smooth, wide-range frequency response, and high output level (49.7 db below 1 volt per bar at end of 7 ft. cable). The moisture-sealed bimorph crystal is mechanically isolated. The die-cast case is finished in iridescent gray and highlighted in satin chrome. It is suitable for semi-directional or non-directional operation. The swivel head is easily aimed at the source of sound.

For full details, write to Shure Brothers, Microphone Headquarters, 225 W. Huron Street, Chicago, Illinois.

CATHODE RAY TELEVISION TUBE LEAD WIRE ANNOUNCED BY BELDEN

A new corona-resistant wire has just been announced by Belden Manufacturing Company, 4689 W. Van Buren Street, Chicago, U. S. A. The special construction of the new 8868 makes it suitable for the high voltages carried in cathode-ray tube television circuits. A special rubber compound, high heat resisting Pyro-Glaze seal and braid of Belden Fiberglas (pure glass) protect this wire against corona and heat. The wire is white and has an outer diameter of .200″.

NEW LIGHTWEIGHT DYNAMOTOR

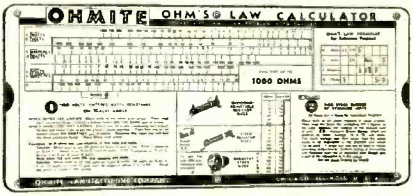
The Carter Motor Company, Chicago, announces a new line of small, light weight, aircraft-type dynamotors for aircraft, police and marine radio. They are made in two frame sizes, 35 and 100 watts output. The 35-watt frame, weighing only 4½ lbs. with aluminum bearing brackets, measures 5¾″ long x 3½″ wide x 3-13/16″ high. The 100-watt frame weighs 7½ lbs. with aluminum bearing brackets, and measures 7″ long x 3½″ wide x 3-13/16″ high.

Some of the features incorporated in both frames are a one-piece field ring simplifying construction and insuring perfect alignment; double enamel and silk wire is used on the armatures preventing shorts and grounds; an especially designed commutator with mica insulation extending beyond the copper bars at all points except where the brushes ride; grease packed double sealed ball bearings that require no oiling or attention; cartridge type brush holders insuring long brush life.

For further information and descriptive circulars, write to the Carter Motor Company, 1610 Milwaukee Ave., Chicago, Illinois.

NEW OHMITE OHM'S LAW CALCULATOR

A unique, new, convenient Ohm's Law Calculator has been specially designed by the Ohmite Manufacturing Company of Chicago for engineers, servicemen, amateurs, experimenters, salesmen, countermen, electricians, laboratory men, maintenance men, purchasing agents, teachers, students, etc. It gives the answer to any Ohm's law problem in a jiffy, with one setting of the slide. No decimal points to worry about. All values are direct reading. It does not require any knowledge of a slide rule to operate.



The Calculator has scales on both sides so as to cover the range of currents, resistances, wattages and voltages commonly used in both radio and commercial work. It covers the low current high resistance radio, sound and electronic applications. Also the commercial higher current range for motors, generators, lamps, electrical appliances, and other applications.

The calculator also has a convenient stock unit Selector, listing hundreds of stock values, immediately available, in Dividohms, Fixed Resistors (including Ohmite Brown Devils), and Rheostats. A setting of the slide shows you the stock number of the resistor or rheostat you may need. Simple instructions appear on the Calculator. The Ohmite Ohm's

NEW!

SEE IT! TRY IT! COMPARE IT!

NATIONAL NC-200

I SINCERELY BELIEVE YOU WILL LIKE THE NEW NC-200 VERY MUCH. MECHANICALLY IT IS "TOPS" LIKE ALL NATIONAL RECEIVERS AND THIS SET HAS BRAND NEW FEATURES THAT MAKE IT REALLY OUTSTANDING. WRITE TO ME FOR COMPLETE INFORMATION ABOUT IT OR ANY OTHER SET. LET ME SEND THE NC-200 OR NC-55 OR ANY OTHER SET TO YOU ON TEN DAY FREE TRIAL SO YOU CAN SEE IT - TRY IT - COMPARE IT. WE HAVE AN EXTRA LARGE STOCK OF NC-200s SO WE CAN SUPPLY THEM PROMPTLY.

SEND TO US FOR A FREE COPY OF THE 1941 NATIONAL CATALOG. WE HAVE A COMPLETE STOCK OF NATIONAL AND ALL OTHER AMATEUR EQUIPMENT.

WE HAVE A COMPLETE STOCK OF ALL MAKES AND MODELS OF COMMUNICATIONS RECEIVERS. I WANT TO HELP YOU GET THE BEST SET FOR YOUR USE. SO WRITE AND TELL ME ABOUT YOUR NEEDS AND WISHES.

IT PAYS TO DEAL WITH BOB HENRY, W9ARA

1. YOU GET TERMS ARRANGED TO SUIT YOU. I FINANCE ALL TERMS MYSELF SO I CAN GIVE YOU BETTER TERMS WITH LESS COST TO YOU - NO RED TAPE - QUICKER DELIVERY. WRITE TO ME FOR TERMS.

2. YOU GET BEST TRADE-IN FOR YOUR RECIEVER. SEND ME A DESCRIPTION OF IT AND GET MY OFFER. TERMS ON THE BALANCE IF YOU WISH.

3. YOU GET PERSONAL ATTENTION YOU CAN'T GET ELSEWHERE. I WILL COOPERATE WITH YOU TO SEE THAT YOU ARE 100% SATISFIED.

SO WRITE TO ME FOR ANY AMATEUR EQUIPMENT IN ANY CATALOG OR ADVERTISMENT. OR SEND ME YOUR ORDER AND I GUARANTEE THAT YOU CAN'T BUY FOR LESS OR ON BETTER TERMS ELSEWHERE. WRITE AND TELL ME WHAT YOU WANT AND HOW YOU WANT EVERYTHING HANDLED. YOUR INQUIRIES INVITED.

Bob Henry
W9ARA

HENRY RADIO SHOP

BUTLER, MISSOURI

Law Calculator can be obtained from your jobber or from the Ohmite Manufacturing Company, 4835 Flournoy St., Chicago, Illinois, for only 10c in coin to cover the cost of handling.

A Receiver for 14- and 28-Mc.

[*Continued from Page 31*]

twenty-meter coils adjusted to fit the setting of the trimmers.

In order to keep noise due to shot-effect at a minimum, the filament voltage of the r.f. stage should be checked at the socket terminals to insure a full space charge. The meter should read 6.3 volts or slightly over. With the transformer used by the author it was found necessary to connect one half of a center-tapped 2.5 volt winding on the power transformer in series with the 6.3 volt winding to give the proper terminal voltage at the socket, although the transformer was rated at 6:3 volts at the load and primary voltage used.

The receiver has proven itself a good all around one for ten- and twenty-meter phone and c.w. There is no reason why it cannot be adapted for operation on the lower frequency bands by winding the proper coils. There is plenty of room on the chassis for additional features, such as a noise limiter which would be of advantage in some locations.

Author! Author!

[*Continued from Page 42*]

photographs, by all means say so. Editors are often forgetful, or unaware of the fact that you may wish your material returned. They are not intentionally so, however. The last—and main—item to include with your letter and material is *your name and address.* Ridiculous as it seems, letters have been received by editors who could find nary a sign of name, address or call. And some people often wonder "why they never answered my letter".

In the majority of cases, it is impossible for an editor to state in advance that an article written around a submitted idea or outline will be either acceptable or unsatisfactory. In a case of this sort, the alternatives are to forget all about writing the article, or to take a chance that a write-up of your idea will more forcefully present itself to the editor. In rare instances, a *definite* acceptance is made before the subject itself is ever written into an article. Leading writers in the field usually command such responses, but few others.

The editor's reply to your letter will usually state whether the idea or the finished article is:

1. "Wholly unsuited to our present needs . . ."
2. " . . . worthy of *consideration* when written up . . ."
3. . . . very interesting. We shall be pleased to receive your article at an early date." Or: " . . . your article is being scheduled for publication in an early issue . . ."
4. "Please *rush!*"

If you get the type of letter exemplified by item 4, you'll know you've "got something". (You'll also be lucky, but it *does* happen.)

I could go on for pages more, but I have an idea for an article and I think I'll write it up. Good luck to *you* with yours.

With the Experimenter

[*Continued from Page 61*]

The entire unit in use consists of a 100-kilocycle oscillator, a 10-kilocycle multivibrator feeding into a mixer-harmonic amplifier, and a broadcast receiver with a 6A8, 6K7, 6R7, and 6E5 eye tube. Then, and this is the new feature of the unit, there is a 6J7 a.f.c. tube which holds the 100-kilocycle oscillator in exact step with any broadcast signal on a multiple of 100 kilocycles which you may desire to use for reference.

The a.f.c. tube will keep the harmonic of the 100-kc. oscillator which beats with the broadcast station in exact step down to a matter of a small fraction of a cycle. This is because the grid of the a.f.c. tube is fed from the a.v.c. bus, and the voltage on the a.v.c. bus is proportional to the relative phase angle of the b.c. station frequency and the harmonic of the 100-kc. oscillator. On one side of the cycle the slope of the a.v.c. curve will be in opposition to the frequency controlling characteristics of the a.f.c. tube, but due to the action of the tube the action will immediately switch over to the other side of the slope where the a.f.c. tube will take control of the frequency of the 100-kc. oscillator.

• • •

"73, OM"

We learn from the F.C.C. that hams have gone to the limit of marking their gravestones with their beloved calls. As a man lives, etc.

5 BIG ISSUES FOR $1

For all new subscribers or those who have not been on our subscription lists during the past year, we make this introductory offer of *five big issues of RADIO for only one dollar!* By acting now, the big January Yearbook Issue will be included on your subscription. This rate is good in U.S.A. only (elsewhere, half the one-year rates quoted below).

Here's the magazine that's known the world over as the authority of practical and technical radio. Every issue is packed with easy-to-understand and profusely illustrated text written by our own editors—and as RADIO pays for technical and constructional material, we publish the "cream of the crop" from outside authors.

Take advantage of this introductory offer by acting now. We'll send you the *next five issues of RADIO* for only one dollar!

$2.50 yearly **(U. S. A.)** **Two years $4.50**

To Canada (inclusive of current taxes), Newfoundland, Pan-American countries, and Spain, add 50c per year. Elsewhere add $1. per year. California and Illinois customers: please add sales tax.

THE EDITORS OF
RADIO *technical publishers*
1300 Kenwood Road, Santa Barbara
CALIFORNIA

As a matter of fact, the accuracy of the transmitted frequency of the broadcast station can be checked directly by beating the 5000-kc. harmonic of the oscillator against WWV. The 100-kc. and 10-kc. harmonics of the oscillator and multivibrator may be used in the normal manner in checking frequencies throughout the amateur bands.

Improving the Wide-Range Audio Oscillator

Mr. Mason also adds a suggestion concerning an alteration in the Wide-Range Audio Oscillator as described in the June issue of RADIO (p. 17), which improves the waveform of the oscillator in the range below 100 cycles. It is merely necessary to return the bottom end of the 6-watt lamp to the hot side of the 29-ohm secondary of the output transformer instead of returning the bottom of this lamp to ground. If the polarity happens to be improper for degenerative feedback, the oscillator will motorboat and act very erratic —it is then only necessary to reverse the connections at the *output winding,* and to substitute a 3500-ohm resistor for the 2500-ohm resistor shown at R_{11}.

The waveform of the lowest range of the oscillator will be made excellent down to 75 cycles. The operation of the oscillator on the higher frequency ranges will be essentially the same except that internal noise from the unit will be reduced.

The Amateur Newcomer

[*Continued from Page 54*]

Although branch currents are known, the line current must be solved for and the "square of the hypotenuse" is used. Thus $I\ (\text{line}) = \sqrt{(I_R)^2 + (I_L - I_C)^2} = \sqrt{(4)^2 + (5-2)^2} = \sqrt{25} = 5$ amperes.

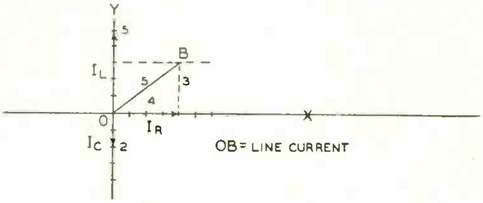


Figure 5. Diagrammatic representation of the currents passing through each portion of the parallel circuit, and the resultant line current, OB.

Four amperes represents current performing work passing through the resistance R, and the extra ampere (5—4 = 1) makes up the so-called "wattless" power circulating in L and C. In a *parallel* circuit the *currents* are treated vectorially, similar to the treatment of resistances in a series circuit.

Ohm's Law again tells the Z of figure 4.

Z = E/I = 100/5 = 20 ohms. Almost every amateur I know has tried to solve parallel impedance by the use of the series formula given earlier. This is wrong—current relationship must first be considered and Z found by application of Ohm's Law.

To find the true power, proceed:

P = ExI = 100 x 4 = 400 watts, where 100 is voltage across R and 4 is amperes through R.

Apparent Power = EI = 100 x 5 = 500 watts, where 100 is line voltage and 5 is the line current.

Then power factor equals true watts divided by apparent watts: 400/500 = 0.80.

To find angle of lag (or lead):

$$\text{Tan}\ \theta = \frac{I_X}{I_R} = 3/4 = 0.75.$$

Our book of tables shows that an angle of 36° 52′ has a tangent of 0.75. P. F. = cos θ = cos 36° 52′ = 0.80003, or 0.80.

Checking, true power = EI cos θ — 100 x 5 x 0.80 = 400 watts, or the same result we obtained by dealing with the circuit resistances only.

No attempt will be made to handle parallel circuits containing, say, both resistance and reactance in a given branch. This requires the use of sine and cosine or operator *j*. The former is my preference althought during World War 1 much time was saved in training engineers by application of operator *j*. Nor, has resonance been discussed. Good texts are: Timbie's *"Elements of Electricity"* for an electrical course. Nilson and Hornung give an abbreviated treatment of operator *j* in *"Practical Radio Communication,"* a book also of use to the practical operator on the job. A most thorough treatment of a. c., tuned circuits, and resonance is given by Glasgow's: *"Radio Engineering"*—a book appreciated as one advances in radio.

Postscripts and Announcements

[*Continued from Page 62*]

proposed U.S. naval base and the closest doctor. When Nichols learned of an Eskimo mother who was believed to be dying from childbirth complications, he called W7EVT and spent 45 minutes giving the latter all the details. W7EVT then contacted a physician, who, with the detailed information O'Brien was able to give him regarding the woman's condition, was able to prescribe for the woman.

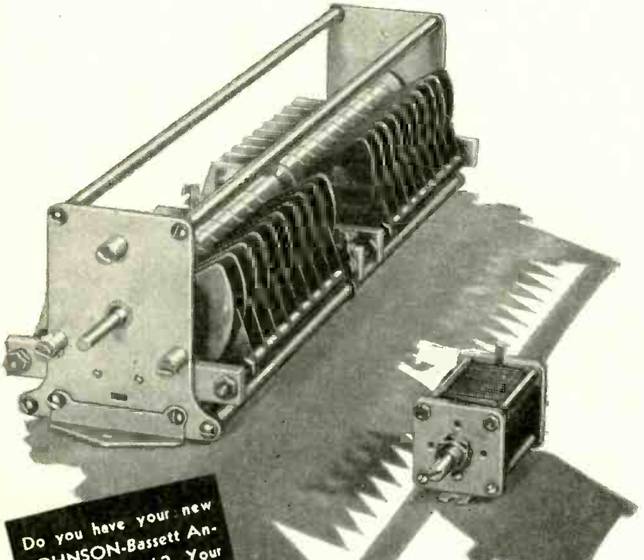
W7EVT then relayed these data to K7HTI, whose wife carried out the instructions in treating the afflicted woman. The last time W7EVT contacted K7HTI the latter reported that both mother and daughter were doing nicely, thanks to the treatment prescribed.

A number of amateurs working for the Western Union Telegraph Company has recently organized a voluntary "WU" net operating on 3592, 7184, and 14,368 kc. The main purpose is ragchewing and the establishment of common frequencies to be used in case of emergency. The only definite schedule time is 8:30 a.m. p.s.t., when a large number are usually on. At other times the procedure is to call "CQ WU" on one of the designated frequencies. "WU" amateurs interested in the net can obtain more detailed information from W6KMQ, W6REP, or W6SUT.

Past, Present and Prophetic

[*Continued from Page 9*]

be held, and we quote, (hangover from campaign speeches) "to facilitate establishing particular frequencies for the exclusive use of such equipment and promulgation of engineering standards to further promote these devices with mutual solution of interference questions." The "such equipment" refers to electro-medical equipment, presumably diathermy, electro-cautery, and the like.



U. H. F.

[*Continued from Page 59*]

unloaded plate current in an oscillator is not necessarily equal to radiated power. Other factors include changes in tube and circuit losses. Check the plate circuit to see that it has an extremely low resistance (copper rods are often noticeably better than brass). See that leads are extremely short particularly in the grid circuit, and that there are no parasitic oscillations present which might reduce the efficiency. Try different values of grid leak and try partial neutralization to reduce the amount of plate power fed back into the grid. Of course, some transmitting tubes may be working close to their frequency limit where the efficiency becomes low. In an amplifier, W9ZJB has found that special attention to chassis returns can make a huge difference in the resonant plate current dip and the efficiency.

Question: How about an index to u.h.f. articles, or else a handbook on the subject? I am wearing out my back copies. It would be easier if somebody would bring back a couple of January issues.—*W9ZQC.*

Answer: Will the guy that borrowed those very scarce January issues of RADIO please return them to W9ZQC? (Thanks—Ed.)

Question: My five element beam is fed with a 500 ohm line, connected through a matching section of 26 inch lamp cords in parallel. The antenna puts out a fine signal, but the transmitter is loaded almost as much by the line alone as when the antenna is connected to the lampcord. Should this happen? —*W9YKX.*

Answer: The power taken by the antenna and feed system is the product of the current squared times the sum of loss resistance and radiation resistance. Equal loading probably means that the power is the same without the antenna connected, although the current will become very high, increasing the losses, and both the current and standing waves on the unterminated line will cause power to be radiated unless the line is very closely spaced. Quite a bit of the loss may be in the lamp cord, and the radiation may take place from the spaced line. Your results do *not* mean that only the *difference* in loading represents antenna power. Some idea of line losses could be gained, however, if you terminate the lamp cord with a resistance exactly equal to the antenna resistance, assuming that neither the resistor nor antenna present any reactance to the line (at the resonant frequency). Then, the line loss plus the resistor loss would be equal to the power taken from the transmitter. If the square of the current through the resistor, times its resistance, indicates that antenna power is substantial, all is well. It is suggested that you replace the very much shortened quarter wave of lamp cord with a section made of two concentric lines of the proper impedance, or hook in parallel another two if necessary, thus eliminating most of the losses now taking place in the lamp cord.

Detroit Contest Rules

For the benefit of those interested, and to encourage other similar contests, the rules of the u.h.f. contest being run by the Great Lakes Amateur Radiophone Association are given in full:

RULES FOR THE ULTRA HIGH FREQUENCY CONTEST

Sponsored By

THE GREAT LAKES AMATEUR RADIOPHONE ASSN.

1. The contest will begin at 12:01 a.m., November 1, 1940, and will end at midnight January 31, 1941.
2. The contest is open to all licensed radio amateurs who are members of the Great Lakes Amateur Radiophone Association. No registration is necessary.
3. Contestants may use radio waves of types A1 (c.w.), A2 (i.c.w.) or A3 (phone) on the following frequencies—56-60 Mc., 112-116 Mc., and 224-230 Mc. Scoring will be credited according to the transmitter frequency, and out of band operation will not count. Cross-band operation is permissible. However, harmonics and sub-harmonics of the transmitter frequency will not be allowed for contact credit.
4. Serial numbers will be exchanged with each new station and shall consist of six digits, the first three constituting readability, strength, tone (RST) report and the last three reporting the number of the contact in consecutive order to be given only, of course, for new contacts, i.e. Contact no. 1 would be 001, no. 2 to be 002, etc. In case of phone contacts there will be only five digits, the first two being the readability-strength report and the last three the consecutive contact number. This will allow other stations to check as the contest progresses the number of contacts made by your station.
5. In the case of contacts made with any station not in the contest a verification of this contact must be submitted to the contest committee for confirmation. Stations entered in the contest will be cross checked by the committee upon receipt of logs received at the end of the contest. In order to receive credit for contacts, it is necessary to exchange serial numbers. Be sure that the other station receives your correct number.
6. The contest will be divided into several groups.
    1. Five meter fixed.
    2. Five meter mobile.
    3. 2.5 meter fixed.

4. 2.5 meter mobile.
5. 1¼ meters both fixed and mobile.

Scoring will be as follows: For all fixed stations in the metropolitan Detroit area within ten miles of Woodward and Grand Blvd. each contact on five and 2.5 meters will count one point plus one point for each mile of distance. For all fixed stations, both five and 2.5 meters outside of this area, each contact shall count five points for a contact with any station within this area and one point plus one point per mile for any other contacts. Portable mobile stations on both 5 and 2.5 meters will count two points for each contact and two points per mile additional. All 1¼ meter contacts will be credited at five points per mile. Fixed stations may work portable mobile stations under the same call letters as the fixed stations and count an additional contact. Portable mobiles may contact both fixed and mobile stations. The 10 mile radius circle in metropolitan Detroit does not apply to mobile stations.

7. Awards will be made on the basis of total points scored in each group. There will be separate awards for 5 meter fixed operation both in and out of the metropolitan Detroit circle with duplicate awards for 2.5 meter operation. Also, awards, for the two groups of mobile operation, both 5 and 2.5. There will also be an award for 1¼ meters, and in addition, a first and second award for the stations scoring most points in the combined group of classifications.
8. Fixed portable operation is permissible under the FCC regulations. However, such portable stations may enter from only one fixed location unless the operator of this station is moving his permanent address. Portable mobile stations may operate from any point at any time providing, however, that such equipment as is used is entirely self-powered and no connections be made to any antenna or equipment which is not fundamentally considered standard portable mobile equipment.
9. In the event of a tie, the winner will be chosen by the Committee on the merits of the contacts, such as RST reports, etc.
10. In the event that the same amateur is winner in two or more branches of the contest, he will have the choice of any one of the awards and will be declared winner of that branch of the contest chosen, thereby releasing the other award or awards to the next highest in the group.
11. All decisions by the majority of the committee will be final.
12. All operation must be in complete accordance with the FCC regulations.
13. Logs must be in the hands of the committee by February 15, 1941.
14. The following is an example of the log which each station must complete and present to the committee at the end of the contest for checking purposes and determining the winners. All stations, regardless of whether they consider

they have a chance to win an award, must submit a log, as otherwise it will be impossible to cross-check the contacts. Stations operating in more than one group must submit a separate log for each group.

15. The contest committee is as follows:

W8QDU	Fred Bornman, Chairman	To. 8-9664
W8KQC	Fred Stevens	Tu. 2-2651
W8MCD	Morrie LaBarre	Re. 5338-J
W8WO	Doc Van Becelaere	At. 1156

Committee members are not eligible for awards.

16. If you are not now a member of the Great Lakes Amateur Radiophone Association, you must join the club on or before the beginning of the contest. Get in touch with the President, W8JDG, Jack Thorpe, or the Secretary, W8QIX, F. W. MacDonald, or any member of the Committee.

17. Copies of the rules have been sent to all members of the club, and in addition, all amateurs known to have been active on the ultra high frequency bands the last few years. If you know of anyone who did not receive a copy and who desires to enter the contest, please notify the committee.

SAMPLE LOG

Log of Station *W8NKJ*
Name of Operator *Alphonse Furget*
Type of Operation *Fixed Station*
Location *16231 Appoline Ave.*
Frequency Band *56 mc.*

Station worked	Ser. Sent	Ser. Received	Miles	Points
W8QDU	59001	59003	3	4
W8SLU	58002	57002	19	20
W8QGZ-8	56003	57012	6	7
W8QQS	449004	539007	82	83

Note: (1) Mobile Stations must give exact location at time of each contact.

Note: (2) Contacts at greater distance with or by mobile stations made at a later date may be substituted for previous contact. Indicate which contact is desired for score, or include in your log only the longest contact.

SAMPLE LOG

Log of Station *W8QGZ-8*
Name of Operator *Byron Richards*
Type of Operation *Portable Mobile*
Frequency Band *56 mc.*

Station Worked	Ser. Sent	Ser. Rec'd.	Miles	Location	Points
W8KQC	58001	57027	22	Bald Mt.	46
W8RSD-8	55002	56012	7	Bald Mt.	16
W8QQS	54003	55020	60	Bald Mt.	122

To Our "Ham" Subscribers

We'd like to add your call-letters to our addressing stencils, and we believe you would like to have us do so.

If your call is not already shown on the stencil which addresses your copies of RADIO (or if you are in doubt), just send us your QSL card or an ordinary postcard and say, "Please add my Call". Be sure to give your name and address legibly.

The Editors of RADIO
Circulation Department

NEW BOOKS
and trade literature

New R. C. P. Catalog No. 124

A new 16-page catalog in 2-colors covering a complete line of radio and electrical test equipment for 1941 has just been released by Radio City Products Co., Inc., 88 Park Place, New York City.

In this Catalog No. 124, R.C.P. introduces a line of over forty-five models of equipment, ranging from tiny pocket-type multi-purpose meter units, to large counter-type combination tube and set testers, and including analysts, analyzers, trouble tracers, speed meters, and a highly flexible signal generator.

Copies of the new catalog can be obtained without charge from local radio and electrical distributors everywhere, or by writing direct to the address above.

New Stancor Catalog

Stancor's entire line of transformers for amateurs, servicemen or industrial users, as well as transmitter kits and a complete line of packs are all combined in a condensed form in complete catalog No. 140B.

Complete technical, as well as mechanical data is given on each unit. A numerical index, together with price list, and buying data are given on the inside front cover to help identify each unit.

The 140B catalog is free of charge by writing the Standard Transformer Corporation, 1500 North Halsted St., Chicago, Illinois, U.S.A.

RCA Issues Service Notes in New Volume

The largest and most complete bound volume of service notes ever issued by RCA Victor, covering all 1939 radio and radio-phonograph instruments and a number of 1940 models, has been made available for dealers and servicemen. The 480-page book, including more than 500 illustrations, has a net price to Service Dealers of $1.50. It is the eleventh in a series dating back to 1923.

More than 150 circuits are shown with schematic diagrams, or nearly double the number included in the 1938 edition. The volume also includes complete instruction books on new RCA test equipment, a new index for all bound RCA Victor service notes, and a special supplementary data section for receiver and equipment models covered in the 1939 and preceding volumes.

All service information is presented in the original, unabridged form, including complete alignment data. The volume also includes television service notes on the latest type receiver. The test equipment instruction-service notes cover such instruments as the Signalyst, VoltOhmst, Five-inch CRO, Television Sweep Oscillator, Crystal Calibrator, and Tube Tester.

[*Continued on Page 88*]

Wire Networks for Program Transmission

There has been some discussion as to the necessity or desirability of using means other than wire lines as interconnecting links between frequency-modulation broadcast stations. The following is what the Bell System has to say in regard to their ability to handle the material:

Recent discussions of the use of frequency-modulation broadcasting stations have in some cases included statements that inter-city program transmission networks provided by the telephone companies are not capable of transmitting the tonal richness which will distinguish frequency-modulation from present-day broadcasting. It may be that such statements result from the fact that the principal broadcasting organizations now use inter-city networks which transmit programs from about 100 to 5,000 cycles, while the frequency-modulation broadcasters, in recognition of the ability of most people to hear frequencies substantially above 5,000 cycles, have been talking in terms of 50 to 15,000 cycles.

Under listening conditions normally encountered in homes and at other points where broadcasting receivers are generally operated, comparatively little is gained from the standpoint of program appreciation by the transmission of frequencies above 7,000 or 8,000 cycles since it is difficult for most listeners, under such conditions, to appreciate the presence of higher frequencies. Furthermore, most present-day broadcast receivers do not respond to audio frequencies above about 5,000 cycles.

The telephone company has given to the principal broadcasting companies demonstrations of program transmission channels capable of handling a frequency band with some 60% greater than the 5,000 cycles now ordinarily employed. These demonstrations have been made over circuits as long as 2,000 miles and the broadcasters have been assured that the Bell System is prepared to provide facilities for transmitting this wider band if and when needed.

In the case of more than fifty transmitting stations, studio-transmitter channels which will transmit from about 50 up to about 8,000 or 10,000 cycles are now being furnished by the telephone companies. In a number of instances, channels transmitting frequencies up to 15,000 cycles have been provided between studios and transmitters of frequency-modulation broadcasting stations.

In anticipation of an interest in further improvements in program transmission and reception, a demonstration was made by the Bell System in 1933 during which an audience in Washington listened to the music of the Philadelphia Symphony Orchestra playing in Philadelphia. For this demonstration the wire channels between Philadelphia and Washington transmitted a frequency range of 40 to 15,000 cycles and a volume range of about ten million to one.

The Bell System companies have had extensive experience in the operation of broad band transmission systems, some of which employ frequencies up to more than 100,000 cycles. If better program transmission channels than those now generally utilized are desired by the broadcasting industry, the Bell System expects to be in a position to meet that need.

X-DX

[*Continued from Page 51*]

mill. Ted plans on settling down in the States again, and no doubt will harness up the rig.

Some of the boys who are a little hard up for a country have started a rumor that the East Base and the West Base of Little America are being counted as separate countries. There is no truth to this. Their only argument being that they are so widely separated . . . but so are Los Angeles and Boston. As far as RADIO is concerned KC4USA-USB-USC will be counted as one country.

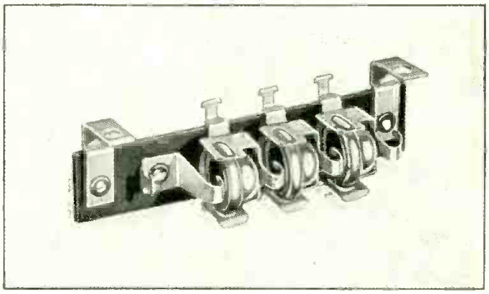
W1JNX has been trying to sneak into the Honor Roll for phone for quite a while and finally made it with 26 and 57. He runs 300 watts into a pair of HK54's. K6PTW is another who squeezes through with 26 and 56, most of them being worked after Europe closed down.

Operative No. 1492 at Work Again

I'm glad to say that somebody has been doing something around here lately. Ol' 1492 has been snooping and finds that W6GRX, although one of the best dxers, hasn't been on the air in months. W8LDR visited W8KCZ in Detroit recently and W6KIP, although not heard of for a long time, may be heard working his brother, W1HTP, on Sked every weekend. Alex is quite a shutterbugger, now, and in addition to this he has a television receiver waiting for a station around here to come on the air. W2GOQ is now located out here and is at CBS . . . no doubt soon to be a W6. W8ZY dug some 852's out of moth balls and found they worked pretty well on 40 . . . so Karl may be found on the roarin' 40's. Others who likewise still know the code and may be heard on 40 as well as 20 are W2BHW and W9FS. Lindy figures on joining the army very shortly. K4KD was found forsaking the mike long enough to take a crack at 40. After searching for weeks W1JPE was located early one p.m. on the low end of 40 banging away . . . on what he said was QRP. For those who haven't as yet worked KC4USA or USB, it might be a good idea to start looking for them because I understand they intend to shove off from there around February.

Here's How to Work KD4GYM

50,000 hams and W5BB have been chasing KD4GYM for the past month. BB started his campaign in the approved fashion by pulling a few strings. He contacted W9CSI who lives in KD4GYM's home town and



skeds him every day. 9CSI promised to have GYM listen for him. However, the sultan of Swan Island was very busy when approached with the idea and promptly forgot. Likewise he paid no attention to the hundreds of other hams calling him. Then W5BB's friend, NY1AE told him he would fix it up for him, but was foiled when on the first attempt the 20-meter band was dead, and thereafter KD4GYM didn't keep the schedules with NY1AE. By this time the 50,000 hams and W5BB were getting pretty discouraged . . . but listen to this! At 4 p.m. one rainy afternoon, W5HCH, operator of the local NYA's powerful 50-watter signing W5JAW, feels pretty gay. All because he tosses out a CQ on 14395 kc. and who do you think answers him. No need to tell you . . . you're right. There was KD4GYM way up at 14260 kc. answering him. W5BB has been trying to figure this thing out but can find no solution. However, all was not lost because W5HCH let Tom in on the thing and so W5BB finally hooked up. Anyway, KD4GYM asked Tom to pass along the info to the boys that he would attempt to let his hair down and work all stations calling him . . . this to take place after a boat arrived around November 9th. So I imagine by the time you read this all of you 50,000 guys will have him salted away.

W6PMB, one of the best 10 meter phone men in the business, passes along some info . . . KF6JEG now operating portable on Jarvis Island says that K6SBM is with him now and will soon be signing KG6SBM. SBM will use c.w. and be on 7027 kc. and 7176 kc. from 0700 to 0900 G.m.t. JEG also says that KH6SHS who has been operating on U.S. Samoa, is off the air for a couple of months, but will be back at his old frequency of 14395 kc. sometime around the first of the year. PMB is consistently on 10 phone and has a mighty fine station throughout.

Have You Any Nice Fresh Photos Today?

Listen, if you fellows have some photos lying around the joint that would be interesting for the rest of the gang to gaze upon, why the deuce don't you send them in to me? There must be quite a flock of them floating around. Take a look . . . now . . . and if they are good clear pictures, shoot 'em in to us. You have an idea just what we should print and what we should not . . . we want just the kind that you, yourself, would find interesting. They do not have to be a picture of a transmitter or receiver or antenna system. They could be of a group of dxers . . . er ah, that is, pardon me, ex-dxers . . . or you might have a shot showing an amusing scene (but don't let your imagination get the best of you). What I actually meant, of course, was something that might draw a laugh out of our gang.

And the W6's

In answer to several queries as to what has happened to some of the W6's out here I might bring up now that W6GRL is just as much alive as ever but hasn't had any time to pound much brass. Guess Doc has had too much work on molars lately. He said he was getting caught up and will be on 40 in the near future. W6CUH still has his transmitter in hiding . . . as a matter of fact it is hiding in some packing boxes . . . but Chas. threatens to bring it out someday. W6BAX is playing too much bridge to be much good on the air . . . W6WB is on 75 phone, for some reason best known to himself. Just heard that Bill Shuler, formerly of W6BC, W6CSJ and W6GEW is now W3IWM and has a Captain's commission at Fort Belvoir. W9TB is still defunct, whatever that is, but no doubt will show up when least expected. That's about it for now . . . but let's hear from you. I guess I shouldn't squawk as long as there are a few 9's on the air to work. I'll see you again around Xmas.

Adjustable
NEGATIVE COEFFICIENT CAPACITORS

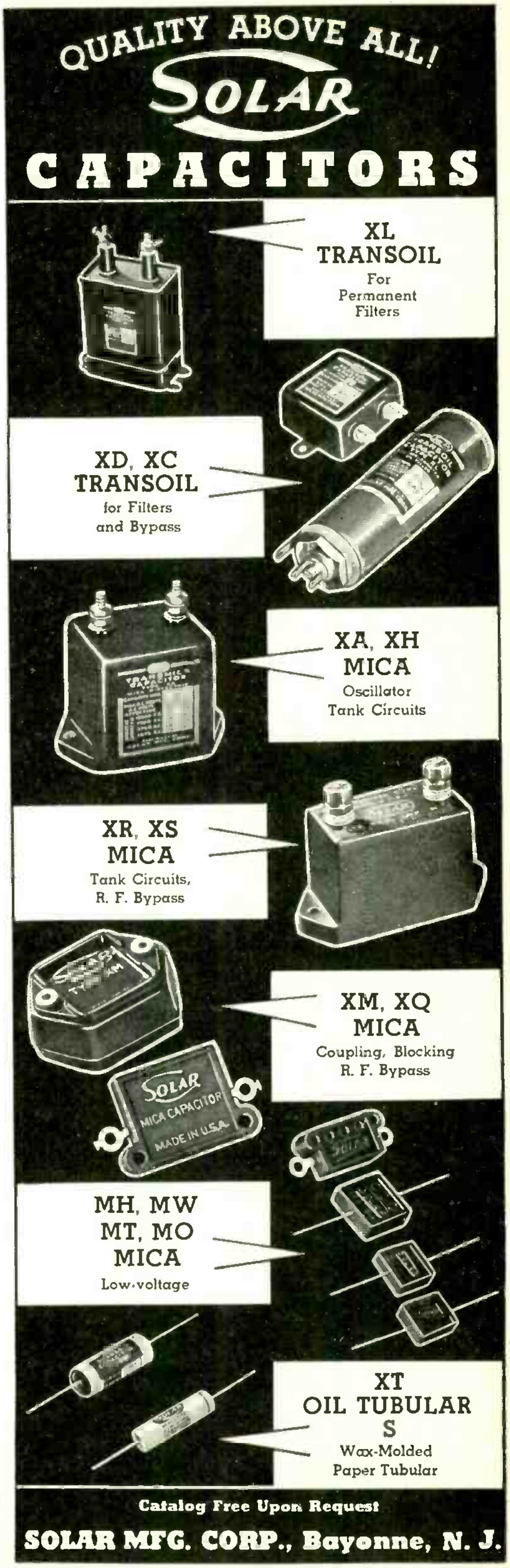
The problem of stabilizing the oscillator in a high frequency superhet or in a v.f.o. transmitter control has been greatly simplified with the availability of negative coefficient ceramic capacitors having provision for capacity variation.

Determination of the exact amount of compensation required, and the obtaining of this amount of negative coefficient capacity when of an odd value, have been quite a task. Now, however, it is only necessary to incorporate a negative coefficient capacitor of the approximately correct value and by a series of adjustments and observations set the capacitance to the value which gives minimum frequency drift. These condensers are available in the following ranges: 2-6 μμfd., 3-12 μμfd., 7-30 μμfd., and 60-75 μμfd. The 3-12 μμfd. capacitor is the one most likely to be found suitable for use in amateur gear. All have a negative coefficient of approximately .0006 μμfd./μμfd./per deg. C.

In stabilizing receivers against drift, best results will be had if individual compensators are employed for each oscillator coil, rather than a single capacitor across the tuning condenser. Ordinarily, compensation will be required only on 10 and 20 meters; very few receivers drift objectionably on the lower frequency bands. This means that two compensating capacitors would be required: one across the 10-meter oscillator coil and one across the 20-meter oscillator coil.

The capacitor should be adjusted until the frequency of the oscillator after one hour of operation is exactly the same as when the oscillator is first turned on from "stone cold." Then, a check is made to see if the oscillator first drifts lower in frequency when first turned on. (It probably will.) If it does, this indicates that the ceramic compensating capacitor is warming up faster than the components in the receiver which cause the drift. In this event, the ceramic capacitor must be wrapped with cotton to slow down its temperature rise. When the optimum amount of cotton is determined, it may be held in place with a rubber band.

All adjustments should be made with the oscillator tuned approximately to the center of the frequency range covered by the tuning condenser.



A New Alloy of Iron and Columbium

The metal tantalum has been an item of demand in industry for many years. It has been brought to the attention of radio men through its use in transmitting tubes, for which use it is particularly well suited due to its extremely low vapor pressure and its high melting point. In addition its gettering action at temperatures in the vicinity of red heat has made possible the manufacture of transmitting tubes with comparatively small elements for their dissipation capabilities.

Tantalum is obtained from a mineral, tantalite, which is almost always found in combination with another mineral, columbite, and as a matter of fact usually grades into the latter mineral. Tantalite is mainly composed of iron tantalite, a compound containing iron and tantalum, and columbite is a very similar compound of iron and columbium. Since the two metals are very similar in chemical properties, the smelting of the ore gives a mixture of the two metals, tantalum and columbium.

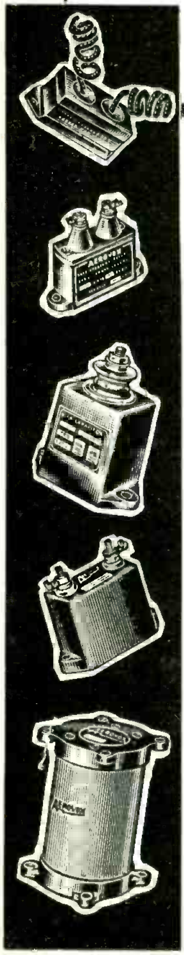
As was mentioned before, there is considerable demand for tantalum, but due to the comparatively low vapor pressure of columbium it has not been at all suitable for the uses of tantalum, and hence has been a drug on the market.

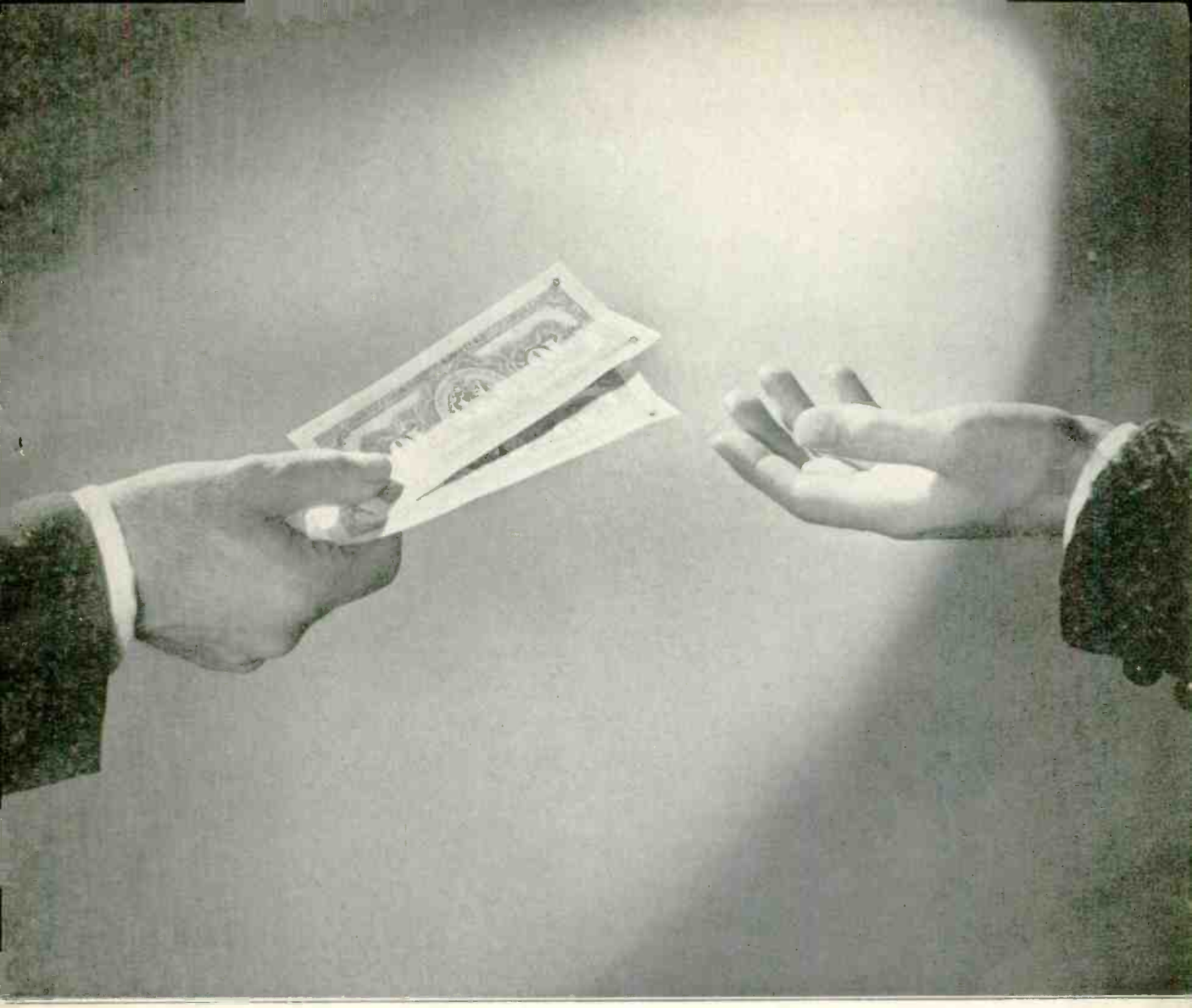
However, it was announced on October 22 by General Electric that when columbium is added to iron in small quantities it produces an alloy with exceptional heat-resisting properties. Samples containing three per cent of columbium and the balance of iron reveal exceptionally good rupture strength at 1100° F., a temperature not yet commercially used but being approached in modern high-pressure steam turbines. No carbon is contained in the alloy, so it is not a steel; instead, the iron contains the columbium as a finely dispersed stable compound of iron and columbium. The present highest temperatures employed in steam turbines are in the vicinity of 1000° F., high enough to cause the metals to glow visibly. The use of the new iron-columbium alloy will allow the design of turbines for operation at temperatures up to 1100°, with a worthwhile increase in the efficiency of operation of the turbines.

• • •

Persistent!

One F. C. C. file contains over sixty pieces of correspondence from one ham trying to get a particular call for himself.





We Pay:

Because we pay for accepted technical and constructional material, publications by the Editors of "Radio" contain the "cream of the crop" from outside authors.

THE EDITORS OF RADIO
CORPORATE NAME: EDITORS AND ENGINEERS, LTD.
technical publishers
1300 KENWOOD ROAD, SANTA BARBARA, CALIFORNIA

New Books

[*Continued from Page 81*]

HANDBOOK OF CHEMISTRY AND PHYSICS, 24th edition. Edited by Charles D. Hodgman. Published by Chemical Rubber Publishing Company, 1900 W. 112th Street, Cleveland, Ohio. 2581 pages, 7⅛ by 4¾ inches; price in U.S.A. of washable fabric-bound edition, $3.50.

The new and enlarged 24th edition of this world-renowned reference handbook has just come off the press. To those who are not familiar with previous editions, the book is a compilation of many hundreds of reference tables, charts, and listings under the five general headings: *Mathematical Tables; Properties and Physical Constants; General Chemical Tables, and Specific Gravity and Properties of Matter; Heat and Hygrometry, Sound, Electricity and Magnetism, and Light;* and *Quantities and Units, Conversion Tables, and Miscellaneous Tables.*

Although the book is devoted to a wide range of subjects other than radio and electricity, the information on these subjects alone makes the work well worth the purchase price. The features of the book make it a very worthwhile addition to the libraries of experimentally inclined amateurs and radio engineers.

To those who are familiar with the work, many of the older tables have been revised and almost 700 pages of new composition have been added. Among the pages of new composition will be found a large section devoted to the various properties of commercial plastics, including both the old and the newer types. Also, the information in regard to plate and film speeds has been completely revised.

RADIO OPERATORS' LICENSE GUIDE, by Wayne Miller, second edition. Published by Wayne Miller, The Engineering Bldg., Chicago, Ill. 157 pages, 6 by 9 inches, circuit diagrams, paper bound. Price $3.00.

This book contains over twelve hundred and fifty acceptable answers to the new Federal Communications Commission study guide based on the new "six element" commercial operators' examination. The paraphrased questions presented in the study guide are answered in such a manner that a thorough understanding of the basic principles on which the questions are based is achieved.

The author's background of fourteen years as a station engineer, instructor, operator, research engineer and design engineer well fit him to compile a work of this type. Beside the questions and answers, the book contains a 27-page appendix in which various data pertinent to radio operating, including the FCC rules and regulations, are given.

• • •

"Low Q"

Q½ is the strangest street in the callbook. That is where W5IAM lives.

Changes of Address

To become effective with
The Next Issue
must be RECEIVED at SANTA BARBARA
by the 5th of this month

●

Address labels are shipped to our mailers on that date. Remember: under U. S. postal laws, magazines sent to an old address are junked unless forwarding postage has been left **in advance** with the postmaster; unlike letters and cards, magazines are not forwarded either free or collect (except to addresses in the same city).

Circulation Department

THE EDITORS OF RADIO

CORPORATE NAME: EDITORS AND ENGINEERS, LTD.

technical publishers

1300 KENWOOD ROAD, SANTA BARBARA, CALIFORNIA

Commercial FM Receives F.C.C. Approval

More than 27,000,000 persons are embraced in the 110,000 square miles of potential service areas of the 15 frequency modulation broadcast stations initially authorized by the Federal Communications Commission to go on a full commercial basis as soon as practicable.

Varied geographic regions—from New England to the Pacific Coast and from the Great Lakes to the Gulf—are represented by the 10 States first slated to be able to listen to this newest type of broadcast.

Subject to certain engineering requirements, the FM applicants listed in the table are the first to receive Commission grants to go commercial:

Some of these stations have been operating experimentally and hope to start commercial operation almost immediately; the rest have construction work to do before going on the air.

Thirty-six additional applications are awaiting early action, the result of a rush of requests for high frequency broadcast facilities since the Commission, last May, paved the way for FM commercialization.

Meanwhile, the Commission is investigating the possibility of assigning identifying call letters to FM stations to distinguish them from standard broadcast stations.

Under Commission rules and regulations,

LOCATION	APPLICANT	FREQUENCY (kc.)	COVERAGE (sq. mi.)	POPULATION
Detroit	Evening News Ass'n	44,500	6,820	2,498,000
Los Angeles	Don Lee Broadcasting System	44,500	6,944	2,600,000
Schenectady	Capitol Broadcasting Co., Inc.	44,700	6,589	967,700
New York	Marcus Loew Booking Agency	43,500	8,000	11,000,000
	National Broadcasting Co.	45,100		
	Wm. G. H. Finch	45,500		
Brooklyn, N.Y.	Frequency Broadcasting Corp.	45,900		
Evansville, Ind.	Evansville On the Air, Inc.	44,500	8,397	465,000
Mt. Washington, N.H.	Yankee Network	43,900	31,000	2,000,000
Binghamton, N.Y.	Howitt-Wood Radio Co., Inc.	44,900	3,500	256,300
Baton Rouge, La.	Baton Rouge Broadcasting Co.	44,500	8,100	361,400
Columbus, Ohio	WBNS, Inc.	44,700	12,400	1,100,000
Salt Lake City	Radio Service Corp. of Utah	44,700	623	194,000
Chicago	Zenith Radio Corp.	45,100	10,760	4,500,000
Milwaukee	The Journal Co.	45,500	8,540	1,522,000

FM stations are available to every community. They are not subject to the same interference as standard broadcast stations and, therefore, can operate on the same channel with less mileage separation. However, FM stations serving the same area are not assigned adjacent channels. As many as a dozen or more different FM stations using alternate channels may operate in a large metropolitan area.

These high frequency broadcast stations are authorized to serve a specified area in square miles. Service area is comparable in places where one or more such stations may be located. To obviate possible monopoly, and to encourage local initiative, no person or group is permitted to control more than one FM station in the same area, and not more than six in the country as a whole.

At the outset, the Commission is requiring a daily (except Sunday) minimum operating schedule for FM stations of at least three hours during the day and three hours at night. To demonstrate the capabilities of the new service, one hour a day at least must be devoted to programs not duplicated simultaneously in the same area, which means programs distinct from standard broadcast. Otherwise, FM operation is governed largely by standard broadcast rules.

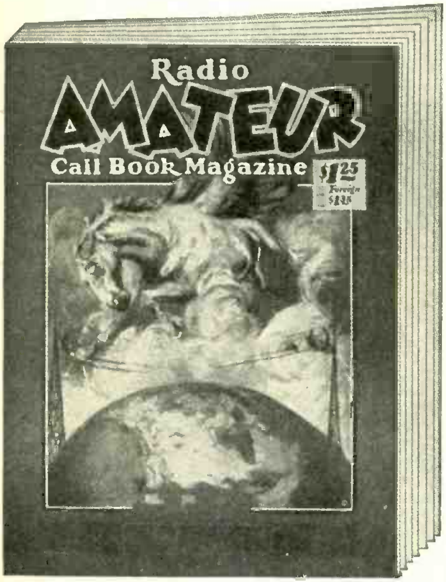
• • •

Three Dimensional Sound Reproduction

The first public showing of Walt Disney's "Fantasia," in the Broadway Theatre, New York City, will unveil an entirely new type of motion picture sound recording and reproduction, which projects a complete third-dimensional effect of sound and music. It is expected that within a few years the leading theatres, in order to show this new type of screen entertainment, will be equipped with this new type of sound equipment.

Christened "Fantasound" because, like the picture itself, it represents a revolutionary technique in sound reproduction, the new system of recording and reproducing sound-on-film employs entirely new principles both in the studio production and in theatre presentation. Three years of work by Disney and RCA engineers went into its developments.

"Fantasound" causes sound actually to



move with all action on the screen. This realism in sound is accomplished by the use of a number of loudspeakers placed at different points behind the motion picture screen. If a bee buzzes into the scene, for instance, to circle around the screen and off again, loudspeakers are automatically cut on and off to follow its progress. This drone can also be heard traveling all around the theatre.

"Fantasound" plays an enormous part in "Fantasia." The music of the 103-piece Philadelphia Orchestra under the baton of Leopold Stokowski is the chief and sometimes the only actor. But to achieve the unusual orchestral effects required a staggering amount of work.

"Fantasound" began as an idea in Walt Disney's mind several years ago. He watched a bumble bee buzz off the screen in one of his own cartoons, and the finality of the disappearance disturbed him. He felt that it should be possible to have the bee around even if it weren't needed on the screen any longer. RCA sound engineers were called in to consult with Disney engineers, and the development work began.

At about the same time Disney's studio was filming a super-short with Mickey Mouse in the title role. The picture was to be a pictorial interpretation of Dukas' musical composition, "The Sorcerer's Apprentice." The musical score was to be conducted by Stokowski. But, as production progressed, it was thought that the subject was too interesting to be dismissed with a ten-minute short, and so the decision was reached to expand it into a full-length concert feature.

Deems Taylor was called in to aid in selecting the music to be featured. The selections finally chosen, in addition to Dukas' work, were Bach's "Toccata and Fugue in D Minor"; Tschaikowsky's "Nutcracker Suite"; Stravinsky's "Rite of Spring"; Beethoven's "Sixth Symphony"; Ponchielli's ballet music, "The Dance of the Hours"; Moussorgsky's "Night on Bald Mountain," and Schubert's "Ave Maria."

The studio dispatched a crew of technicians and studio musicians to Philadelphia's historic Academy of Music, where the business of recording the Philadelphia Orchestra was carried on. Over 420,000 feet of music were recorded, from which 18,000 were to be selected for the final picture.

For every group of loudspeakers used in the theatre, there had to be a separate source of sound synchronized with the picture. So when Mickey Mouse appears on the right, a control mechanism switches on the loudspeaker directly behind him and veers the sound to another speaker when he moves.

Stokowski directed as he would ordinarily and the orchestra played with its familiar fire and skill. But there all convention ended. For the music had to be divided up in such a way that later it could be blended at will and reproduced through the required loudspeaker—wherever Disney wanted it.

To do this, the orchestra was divided into five sections—strings, basses, woodwinds, brasses and percussions. Each section was covered by three microphones, and recorded on a separate track. Also, there were three additional "straight" recordings, two on film, one on records, and a "beat" track giving the beat, entrance cues, etc., which the cartoonists used to synchronize the action to the music. Each of these tracks could be blended in any way with any other track or combination of tracks, so that actually any single instrument, section or the whole orchestra could be heard coming from any one point on the screen.

It worked out like this: During the recording, the music approaches a clarinet solo. The Disney engineer sharing the podium with Stokowski signals the engineer in charge of the woodwind section to look out for the clarinet, and gives him the level at which it is to be recorded. In the final blend, the clarinet's loudness is played up or played down depending upon what purpose it fulfills in the finished production. And it may be heard in the theatre from any desired loudspeaker.

"Fantasound" succeeds in taking music and sound out of its customary accesory or incidental role in the theatre, and elevates it to the position of an important tool in the hands of the dramatist.

The results can best be described as surprisingly delightful. The Disney experts who produced the picture had difficulty in believing their own ears when they first beheld their handiwork. They heard screen sounds come forth with flexibility for the first time. They followed the music with their ears and eyes all over the screen. In addition, they heard it coming from all around them in certain of the more exciting or dramatic parts.

"Fantasound" should prove an important step forward for the motion picture art. At present limited to "Fantasia" because of the elaborate sound reproducing system required for the theatre, it is expected nevertheless to form the basis for further research and development in the realm of sound on film, from which eventually will come new sound equipment which the average theatre can afford to install.

• • •

RCA Preference List Is Reduced to 31

The RCA Preferred Type Tube Program passes its first anniversary this month with the announcement that the number of receiving tube types it covers has been reduced from 36 to 31, and that two other types have been replaced to coincide with today's receiver design trends. The announcement is being made to the industry at the Institute of Radio Engineers Convention at Rochester, N. Y., Nov. 11, 12, 13.

L. W. Teegarden, Manager of the RCA Tube and Equipment Division, made the announcement after pointing to the Program's first year of fulfilled promises of greater economy and higher quality, to its reception by a total of 19 radio set manufacturers, and to its direct benefit to every tube jobber and serviceman.

Three types, 1G4G, 1G6G and 6N7G, have been eliminated from the preference list as the result of a swing away from class B audio systems by design engineers throughout the radio industry. Type 2A3 is becoming less and less popular with engineers, too, so that it has been dropped. The fifth deletion was accomplished by the program itself. It was found necessary to include both types 6J5 and 6J5GT in the original list because of a price difference. Increased volume of orders for the 6J5 has made possible manufacturing economies to bring its cost into competition with the 6J5GT, which has been deleted from the list.

Two changes of types on the list were caused by a growing tendency in the a.c.-d.c. set field for seven and eight tube receivers. The tube complement for such a receiver, if drawn from 150 milliampere tubes on the preference list, adds up to a greater heater voltage than the normal line voltage. So 6.3-volt 300-milliampere tubes must be substituted, although there have been no power output and rectifier types on the preference list useful for this purpose. Thus it is that types 25L6GT and 25Z6GT have been substituted on the list for types 12SJ7 and 12C8.

• • •

"Apropo!"

Newcomer W6QEP is named *Newcomer.*

Robot Airplane Control

A radio homing device and automatic pilot are combined in one aircraft control instrument, recently placed in production by Harvey Machine Company, Los Angeles, California. This new instrument holds the airplane on a straight line of flight, regardless of cross-winds or other weather conditions.

Each of two radio receivers is tuned to a transmitter. The sending stations are in the desired line of flight, or on a line at right angles thereto; may both be ahead of the plane, behind it, or ahead and behind it. The two signals are combined through grid-controlled rectifier tubes to control a vacuum servo motor, which in turn operates the rudder.

An automatic volume control in the receivers makes the strength of the signal proportional to the deflection from true course. Thus, a plane ten degrees off course receives a rudder deflection twice as great as one five degrees off course. This brings the plane smoothly back onto its course, without crossing over, or "hunting."

The frequency coverage of the receivers is 200-1750 kc, in three bands, with provisions for special frequencies. The equipment mounts in standard ATR mountings, with a total weight of 75 pounds. Electric consumption is not over 12 amps at 12 volts.

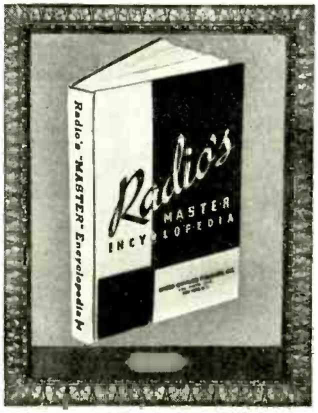
• • •

Record Surface Noise Filter

A radical new treatment of the acoustical problem presented by record surface and mechanical noises present in all phonographs, has been developed by RCA engineers.

Astonishingly simple in its operation, the new method has been christened "Tone Guard." The "Tone Guard" is a simple system of grooved wells around the inside edge of the phonograph compartment directly beneath the lid. It does not attempt to block out extraneous sounds, but to capture them. it is actually a tuned acoustical filter. Two grooved wells, one considerably larger than the other, capture sound in the audio frequency range where objectionable mechanical noises exist. When the lid is closed these objectionable sounds enter the space between the cabinet lid and the grooves. A large percentage of them fall into the first groove, where their energy is spent. The balance push forward into the larger groove and are likewise destroyed. Each of the grooves is scientifically designed to destroy objectionable sound frequencies.

Advertising Index



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 usually may be substituted without materially affecting the performance of the unit.

DAWLEY AUDIO OSCILLATOR

Page 16

C_1—Radio Condenser Co., 4 gang
C_2—Solar MO-1406 and MO-1410 in par.
C_3, C_5—CD or Solar S-0267
C_4, C_5, C_7, C_8, C_9—Aerovox Dandee or Solar DT-859A
C_{10}, C_{11}—Solar D-820 in par.
½-watt resistors—Centralab 710
1-watt resistors—Centralab 714
10-watt resistors—Ohmite Brown Devil
R_{20}—Centralab 72-107
RL_1, RL_2—GE Mazda no. S6
T_1—Thordarson T-13R11
T_2—Thordarson T-57S01
CH—Thordarson T-13C28
S_1, S_2—Yaxley 3226J
Cabinet—Bud C-1747
Chassis—Bud CB-997
Dial—Radiocrafters

ADAMS 160-METER FINAL

Page 22

C_1—Hammarlund MTCD-250-C
C_2—Solar XM-12-22
C_3—Hammarlund TCD-165-K
C_4, C_5, C_6, C_7—Solar S-0221
NC—Hammarlund N-10
R_1—Mallory-Yaxley A30
R_2—Ward-Leonard 507-622
R_3—Two .04-ohm Ohmite Brown Devils in parallel
R_4—Ohmite Brown Devil
R_5—Ohmite 0149
RFC—Ohmite Z-4
L_1—Barker and Williamson 160-MCL
L_2—Barker and Williamson 160-TVL
L_3—Barker and Williamson TV swinging link and base assembly
24's—Heintz and Kaufman

HARSCH 5- AND 10-METER TRANSMITTER

Page 32

C_1—Bud MC-902
C_5—Bud 319
C_6—Bud MC-565
C_7—Cardwell NP-35-ND
NC—Bud NC-853
R_1—Centralab 514
R_2—Ohmite 0379
R_3, R_4, R_8—Centralab 516
R_5, R_7—Ohmite Brown Devil
R_9—Ohmite 0372
RFC_1—Hammarlund CHX
RFC_2—Miller 4532
RFC_3—Ohmite Z1
J_1 to J_7, inclusive—Bud 233
T_1—Thordarson T-19F97
T_2—Thordarson T-19F83
S_1—Centralab 2505
6J5G, 807's—RCA
35T—Eitel-McCullough
X—Bliley HF2
Octal socket—Johnson 220
Four-prong socket—Johnson 224
Five-prong sockets—Johnson 225
Chassis—Bud 1196
Cabinet—Bud 695
Shield partition—Bud 1245
Meter plug—Bud FP-230
Cone insulators—Johnson 600
Small thru-panel insulators—Johnson 44
Large thru-panel insulators—Johnson 42
Stand-off insulator—Johnson 24
Cone insulators—Johnson 601J
Bar knobs—Bud K-559
Dial plates—Bud DP-1177

NORTON AUDIO AMPLIFIER

Page 35

C_1—Sprague TA-10
C_2, C_5—Sprague UT-8
C_3, C_4—Sprague TC-11
C_5—Sprague TC-2
C_6, C_7—Sprague TC-15
C_9, C_{10}—Sprague TC-1
C_{11}, C_{12}—Sprague PLS-8
R_1—Centralab 62-137
R_2 to R_{14}, inclusive—Centralab 710
R_{15}, R_{19}—Ohmite Brown Devil
R_{16}, R_{17}, R_{18}—Centralab 710
T_1—Thordarson T-70R62
T_2—Thordarson T-11M74
CH—Thordarson T-17C00-B
Tubes—RCA
Chassis—Bud CB-998
Cabinet—Bud C-1748

ROTHMAN CONVERTER

Page 43

C_1, C_2, C_3—Bud 1852
C_4, C_5—Sprague 45-12
C_6—Bud "Tiny Mite"

[Continued on Page 98]

The Marketplace

Classified Advertising

(a) Commercial rate 10c per word, cash with order; minimum, $1.00. Capitals: 13c per word. For consecutive advertising, 15% discount for 3d, 4th, and 5th insertions; 25% thereafter. Break in continuity restores full rate. Copy may be changed as 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 Santa Barbara accompanied by remittance in full payable to the order of Radio, Ltd.

WRITE BOB—W9ARA, for best deal on all amateur receivers, transmitters, kits, parts. You get best terms (because I finance them myself); largest trade-in; personal cooperation; lowest prices. Quickest delivery of the new NC-200 and all other receivers. New Howard 460s with crystals $59.95, SX-23s $79.50. Write. W9ARA, Butler, Missouri.

FOR CHASSIS—panels, racks, cabinets, write R. H. Lynch, 970 Camulos Street, Los Angeles, California.

TRANSMITTING TUBES REPAIRED—Save 60%. Guaranteed work. KNORR LABORATORIES, 1722 North Pass Avenue, Burbank, California.

PHONE SPLATTER SUPPRESSOR UNITS—See October RADIO. 5V @ 3A filament transformers 10,000V insulation $1.68 postpaid. One henry tapped chokes available. Complete amateur line. PRECISION TRANSFORMER COMPANY, Muskegon, Michigan.

RECONDITIONED—guaranteed amateur receivers and transmitters at lowest prices. All makes and models cheap. Ten day free trial. Terms. Write for free list. W9ARA, Butler, Missouri.

CRYSTALS—in plug-in-heat dissipating holders. Guaranteed good oscillators. 160M-80M at $1.25. 40X $1.65. 80M vari-frequency (5 Kilocycles Variance) complete $2.95. State frequency desired. C.O.D.'s accepted. Pacific Crystals, 1042 S. Hicks, Los Angeles, California.

QSL's—and Ham Stationery . . . W8JOT, Box 101, Rochester, New York.

SEVERAL—guaranteed reconditioned 350 watt JRA3 110-v. A.C. light plants at $45.00. Ideal for amateurs. Write Katolight Company, Inc., Mankato, Minnesota.

COMMERCIAL—radio operators examination questions and answers. One dollar per element. G. C. Waller, W5ATV, 6540 E. Washington Blvd., Tulsa, Oklahoma.

AMATEUR RADIO LICENSES, TRAINING IN CODE AND THEORY. RESIDENT AND HOME STUDY COURSES. HUNDREDS OF LICENSED STUDENTS. AMERICAN RADIO INSTITUTE, 1123 BROADWAY, NEW YORK.

RADIO KITS—$3.95 up. Single band; all wave. 5-10 tubes. Fluorescent lighting. Save 50%. Radio parts catalog—FREE. McGee Radio, P-2015, Kansas City, Missouri.

PROFESSIONAL—type recorder, 16" complete, air check, mike, playback. Will demonstrate. $125.00. W6AJR.

SUPER DEFIANT—Complete. Like new. Used about 15 hours. Original carton. Sell for $83. Must have cash. H. Coote, Riverbank, California.

Buyer's Guide

[*Continued from Page 97*]

Rothman Converter

C_7, C_8, C_9, C_{12}, C_{13}, C_{15}—Aerovox 484
C_{11}, C_{14}—Aerovox 1467
R_1—Centralab 62-113
R_2, R_3, R_4, R_5, R_6, R_7—Centralab 710
R_8, R_9—Ohmite Brown Devil
S_2—Centralab 1462
T—Thordarson T-13R12
CH—Thordarson T-13C27
Coil forms—Bud 126
Tubes—RCA
Chassis—Bud 793
Shield partitions—Bud 1246, see text

The NEW

RADIO HANDBOOK

(SEVENTH EDITION)

608 PAGES

CLOTH-BOUND—GOLD STAMPED

$1.60

ORDER NOW—SEE PAGES 6 and 7.

SENSATIONAL "TRADE IN" Offer

$1 95
PLUS YOUR
OLD TUBE

Y30Z

TO ACQUAINT YOU WITH THIS GREAT TUBE

When operated in accordance with the continuous service ratings, a Class "C" input (unmodulated) of 77 watts is allowable. Two HY30Z tubes in a Class "B" modulator will deliver up to 110 watts audio output. The HY30Z is a high-mu triode designed for zero-bias operation and has the following ratings:

Characteristics of HY30Z

Filament	6.3 volts @ 2.25 amps.
Plate potential	850 max. DC volts
Plate current	90 max. DC ma.
Plate dissipation	30 max. watts
Amplification factor	87
Mutual conductance	3600 μmhos

Although the HY30Z has a 6.3 volt filament, it may be used equally well with a 7.5 transformer by employing a dropping resistor in the filament lead. The HY30Z is for all practical purposes interchangeable with the HY25†, T20†, TZ20†, RK11, RK12 and 309, though slight changes in bias may be desirable. († have 7.5 volt filaments.)

Here is your chance to own a real 25 watt* transmitting tube with a graphite anode at no more than you'd pay for a "tin can" triode!

For a limited time only—amateurs can acquaint themselves with the definitely superior advantages of the HY30Z which replaces the HY25.

Although regularly priced at $2.50 you can now "trade in" your old 20 and 25 watt "tin can" anode tubes—regardless of brand or condition. During this "get-acquainted-with-graphite-anode tube campaign," these old tubes will be accepted as 55c credit on each purchase of an HY30Z. Thus you may purchase an HY30Z for only $1.95 cash.

The HY30Z is a low-power transmitting tube designed and manufactured just like the larger and more expensive types. The HY30Z is not an overgrown receiving tube with the plate lead brought out to a top cap. Instead, it uses real transmitting tube parts including low-loss lava insulators and a SPEER graphite anode which provide the finest in electrical and mechanical characteristics.

SIX FEATURES TO INSURE LONGER LIFE

No other tube selling for less than $3.50 has these outstanding features which insure long life and efficient performance.

1. Short, direct connections to both sides of plate.
2. Mica snubbers support elements in dome of bulb—increase strength—absorb shock.
3. Lava low-loss insulation used exclusively.
4. Heavy, non-warping, over-size SPEER graphite anode.
5. Filament heat radiators to reduce stem temperature.
6. Dual grid leads to halve grid current in each wire, further reducing stem heating and subsequent glass electrolysis.

SEE YOUR JOBBER TODAY

This special offer is being made by more than 250 of the country's leading radio distributors. Remember—any 20 or 25-watt transmitting tube regardless of condition will be accepted as 55 cents towards the purchase of an HY30Z tube making your cost only $1.95. Act now!—as this offer is for a limited time only.

*While the HY30Z is a so-called 25-watt tube, it actually has a continuous-service plate dissipation of 30 watts.

HYTRON
TRADE MARK REG.

HYTRONIC LABS.
23 New Darby St., Salem, Mass.

A DIVISION OF
HYTRON CORP.

Manufacturers of Radio Tubes Since 1921

CONTINUOUS POPULARITY IS WON ON RESULTS

RCA-
809

HIGH-MU TRIODE

D-C Plate Voltage
1000 volts maximum
Plate Input
100 watts maximum
Grid Driving Power
3.8 watts (approximate)
(Class C Telegraphy, ICAS Ratings)
$2.50 amateur net

MORE POWER / LESS $$ = Economy

Announced 3 years ago to the month—a winner in the 9th ARRL SS Contest—most used transmitting triode by winners of the 10th ARRL SS Contest—RCA-809 continues to ride the tide of fame.

Employed for amateur use under the ICAS Ratings, the RCA-809, priced at only $2.50 net, provides you with a tube that competes, with ample safety factor, with the "big fellows". For example, one 809 in class C telegraph service will handle 100 watts input. Two 809's in class B modulator service will modulate 100% an r-f stage up to 290 watts input! The tube has a high amplification factor of 50. (It requires, therefore, a bias of only —10 volts at a d-c plate voltage of 1,000 volts in class B modulator service.) Furthermore, the tube will operate at its maximum rating all the way up to 60 Mc and at reduced ratings up to 120 Mc!

Other features include the new, low-loss Micanol base, the largest anode in its class for real durability under temporary overloads, special ceramic insulation—the same as used in tubes selling for many times the price of the 809—and the famous RCA thoriated-tungsten filament. And don't forget that the filament voltage rating is 6.3 volts—a feature not to be overlooked in emergency work for efficient transmitter operation direct from a storage battery.

LOW-MU RCA-1623. *Similar to the 809, the RCA-1623 has an amplification factor of only 20. Like the 809, it is excellent for use as an r-f power amplifier, frequency doubler, class B modulator, or oscillator. Unaffected by ordinary plate-load variations and grid-excitation changes, this tube is an extremely stable oscillator. It performs smoothly at wavelengths as low as 2½ meters!*

RCA-1623 . . . AMATEUR NET PRICE, $2.50

RCA

Transmitting Tubes

PROVED IN COMMUNICATION'S MOST EXACTING APPLICATIONS

RCA MANUFACTURING COMPANY, INC., CAMDEN, N. J. • A Service of the Radio Corporation of America