QST

devoted entirely to

amateur radio

To This Issue—
A Single-Tube Two-Band Crystal Transmitter
How to Build

The Most Complete
Book on Amateur
Radio Ever Written

Radio and TV Handbook
The only available choke, for parallel feed in high-power transmitters, in which the highest useful impedance is effective precisely where it is wanted — at the 20, 40, 80 and 160-meter amateur bands.

Throughout these bands, as the diagram shows, this new Hammarlund Choke has the exceptionally high impedance of more than 500,000 ohms and, consequently, introduces negligible losses. It is also effective from 1500 to 15,000 kc. with the exception of frequencies between 5300 and 6400 and between 8000 and 9000 kc. Its use at these frequencies is not recommended.

Inductance 2.5 mh. Distributed capacity less than 1.5 m.mf. DC resistance 8 ohms. Maximum recommended DC (continuous) 500 milliamperes.

Six thin universal-wound pies on Isolantite core. Insulated mounting brackets secured by short machine screws. No metal passes through core. With brackets removed, may be mounted with single machine screw. Choke size: 1⅝ in. x 2½ in.

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with a "SIGNAL SQUIRTER"

... and Westinghouse Instruments

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put those 14, 28 and 60 megacycle signals just
about where you want them. Then your face
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carries a folding model in his pocket—a couple
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2 Say You Saw It in QST — It Identifies You and Helps QST
**QST**

Published monthly, as its official organ, by the American Radio Relay League, Inc., at West Hartford, Conn., U. S. A.; Official Organ of the International Amateur Radio Union

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**devoted entirely to AMATEUR RADIO**

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**MARCH 1934**

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Kenneth B. Warner (Secretary, A.R.R.L.), Editor-in-Chief and Business Manager; Ross A. Hull, Associate Editor; James J. Lamb, Technical Editor; George Grammer, Assistant Technical Editor; Clark C. Redimond, Managing Editor; David H. Houghton, Circulation Manager; F. Cheyney Beckley, Advertising Manager; Ursula M. Chamberlain, Assistant Advertising Manager.

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If you have a frequency meter, write for the circular on the Leeds frequency meter checker. The complete kit costs only $5.31. A thin dime brings you the dope on this $10 idea.

<table>
<thead>
<tr>
<th>Item</th>
<th>Price</th>
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<tbody>
<tr>
<td>GR No. 374-N .00035 SF</td>
<td>$1.25</td>
</tr>
<tr>
<td>GR No. 247-M .00025 Vernier</td>
<td>$1.25</td>
</tr>
<tr>
<td>GR No. 374-B .000125 SF</td>
<td>$1.25</td>
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<tr>
<td>GR No. 677-U coil form</td>
<td>$3.35</td>
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<tr>
<td>GR No. 247-K .00025</td>
<td>$3.75</td>
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General Radio No. 360 choke coil 60# of 6.9

Lynch transposition blocks — kit of 10.
Lynch cage aerial spreaders — kit of 10.

Sylvania Tubes

The new 830 — class B audio tube in stock. Order these tubes and when you order 190 watt audio with 1000 v. plate supply, each.

<table>
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<tr>
<th>Item</th>
<th>Price</th>
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<tbody>
<tr>
<td>No. 830 Osellia, amplimath</td>
<td>$8.75</td>
</tr>
<tr>
<td>No. 210.</td>
<td>$4.75</td>
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Complete bulletin and price sheet available.

The new R.C.A. No. 800 tube.

<table>
<thead>
<tr>
<th>Item</th>
<th>Price</th>
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<tr>
<td>GE Neon tubes, 14-1-1 watt</td>
<td>$0.40</td>
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General Electric Neon tubes, 2 watt. $0.50

Haynes Griffin phone jacks, each.

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<tr>
<th>Item</th>
<th>Price</th>
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<tr>
<td>Bulb.</td>
<td>$1.50</td>
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<tr>
<td>Burn.</td>
<td>$1.00</td>
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<tr>
<td>Co. Lo-Coil kits; 16 to 200 feet, space wound, ribbed, air core construction, 3 windings; 4 coils to set</td>
<td>$2.80</td>
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Western Electric No. 18 push back wire, 100 feet. $0.50

<table>
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<tr>
<th>Item</th>
<th>Price</th>
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<tr>
<td>Socket wrenches 2½&quot;shank; set of 4</td>
<td>$6.70</td>
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<tr>
<td>Socket wrenches 5&quot;shank; set of 4</td>
<td>$8.80</td>
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Complete line of Acme Delta transformers in stock.

Thordarson Cased Class B Transformers

Input and output for 46 tubes, each.

<table>
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<tr>
<th>Item</th>
<th>Price</th>
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<tr>
<td>Input to 210 tubes</td>
<td>$2.94</td>
</tr>
<tr>
<td>Output to 3000 and 10,000 ohm load</td>
<td>$3.55</td>
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</table>

Midget power transformer, for that high frequency meter power supply; 250 v. D.C. at 30 MA; 5 v. 2 amps. — 2½ v. 3 amp.

<table>
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<tr>
<th>Item</th>
<th>Price</th>
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<tr>
<td>Cardwell No. 410-B 50 mmf.</td>
<td>$1.49</td>
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</table>

Cardwell No. 147-B 440 mmf, double spaced transmitting condenser. $3.45
Cardwell No. 512-B 50 mmf, each section, split stator triple spaced. $4.85
We carry a complete line of Sprague condensers.

Universal Microphones

Model W single button lapel $1.75
Model X single button $4.41
Model X double button $4.41
Model BB double button $14.70
Universal standingchroom plated. Model X, desk $1.75; Model L, desk, $3.54; Model floor, $9.41.

Shure S-N double button $5.88
Shure 2-I-N double button $14.70
Shure floor stand; automatic adjustment. $11.75
Bruno velocity microphone kit. $5.75
Bruno condenser kit. $12.15
Pleo散户 Xtal mike D-104 $12.25
Chriessl cond mike; assembled, guar. $7.75

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is becoming increasingly popular. Light weight, compact size and simplicity make it a real portable rig. With two matched tubes. $18.25
Piclear type matched impedance antenna for 5 meters complete. $2.50

Navy Type Telegraph Key
List $3.60. Navy knob — 14" Tunsten contacts. Only a few left at.
With regular knob. $9.95
Leeds transmitting key, spec. $6.65

National

F.B. pre-selector unit in stock; $15.00 with coil for one band.

<table>
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<tr>
<th>Item</th>
<th>Price</th>
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<tr>
<td>PHX</td>
<td>$7.70</td>
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<tr>
<td>PHB</td>
<td>$10.70</td>
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<tr>
<td>PHB7A</td>
<td>$17.70</td>
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</table>

All FB coil ranges $6.09
SW 3 receivers $17.70
Short wave coil ranges, each $3.75
All the new National Insulator products as advertised Jan. 1934 now available. 40% discount from list.

Genuine Baldwin Type C phones. $3.75
Western Electric Type P-11 Signal Cores $3.95

Still a few left. Jewell No. 190 — two-inch. A.C. Voltmeters. 0-8; 0-10; 0-15; each, $8.50
No. 165 two-inch 0-1 Thermo-ammeters. $4.95

All metal cases instruments.
Leeds Relays as advertised last month, $2.9

Leeds Transformers
For Every Amateur Need

<table>
<thead>
<tr>
<th>Item</th>
<th>Price</th>
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<tr>
<td>Mounted Filament Transformers</td>
<td>$2.25</td>
</tr>
<tr>
<td>2½v.</td>
<td>6 amp. 2000 v. ins.</td>
</tr>
<tr>
<td>2½v.</td>
<td>10 amp. 2000 v. ins.</td>
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<tr>
<td>5 v.</td>
<td>3 amp. 2000 v. ins.</td>
</tr>
<tr>
<td>6½ v.</td>
<td>2½ amp. 2000 v. ins.</td>
</tr>
<tr>
<td>7½v.</td>
<td>2½ amp. 2000 v. ins.</td>
</tr>
<tr>
<td>Two 7½v. 3 amp, one 2½ v. 5 amp.</td>
<td>$2.50</td>
</tr>
<tr>
<td>Two 7½v. 3 amp, one 5 v. 3 amp.</td>
<td>$2.50</td>
</tr>
<tr>
<td>Three 5 v. 3 amp. for 83 Bridge Register.</td>
<td>$2.50</td>
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<tr>
<td>2½ v.</td>
<td>5 amp.; 5 v. 3 amp.; 7½ v. 3 amp.</td>
</tr>
<tr>
<td>2½ v.</td>
<td>C.T. 10 amp. 10,000 v. insulation.</td>
</tr>
<tr>
<td>10 v.</td>
<td>C.T. 7 amp. with tap primary</td>
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Mounted Plate Transformers

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<th>Item</th>
<th>Price</th>
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<tr>
<td>1100 v.</td>
<td>C.T. 150 M.A. 7½v. 3 amp.; 5 v. 3 amp.</td>
</tr>
<tr>
<td>950 v.</td>
<td>C.T. 200 M.A. two 2½ v. 5 amp.</td>
</tr>
<tr>
<td>Universal and plate transformers with stand-off insulators terminals, 300 w. capacity; 750-1000-1500 v. per each.</td>
<td>$10.95</td>
</tr>
<tr>
<td>Announcing a new casel plate transformer for class B 203A; 2500 v. C.T. at 500 mili.</td>
<td>$16.50</td>
</tr>
<tr>
<td>Leeds uncased class B transformer for 46 and 59 tubes, pair.</td>
<td>$3.50</td>
</tr>
<tr>
<td>Carter 20000 w. wire wound potential transformers — We have them.</td>
<td>$4.99</td>
</tr>
<tr>
<td>Dubliner, 3 mfd. 400 v. paper condensers, each.</td>
<td>$0.79</td>
</tr>
<tr>
<td>Aeroxor electrolytic 12 v. 1500 mfd.</td>
<td>$6.69</td>
</tr>
<tr>
<td>DeForest Audio Tranz. 3½, each.</td>
<td>$1.49</td>
</tr>
<tr>
<td>DeForest tubes, 451-450 only each.</td>
<td>$6.95</td>
</tr>
<tr>
<td>Kenyon KG 350; 30 H. 75 mils; 350 ohms</td>
<td>$5.00</td>
</tr>
<tr>
<td>Birnbach Insulators, complete list.</td>
<td>$1.25</td>
</tr>
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</table>

LEEDS’ precision crystal holder. $1.25
Y cut crystal 10 K ohm or 160 meters. $2.50
With crystal holder. $1.25
Y cut xtal 1½% accuracy. $3.00
With crystal holder. $4.98
X cut crystal 1½% accuracy. $3.75

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Wright Decoster 6½ dynamic speaker, with 2500 w. field and pentode output transformer. $2.75
Wright Decoster 8½ midget dynamics with 300 w. field and pentode output transformer. $2.75
Hammarlund Crystal “Pro”. $111.72

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LEEDS' precision crystal holder. $1.25
Y cut crystal 10 K ohm or 160 meters. $2.50
With crystal holder. $1.25
Y cut xtal 1½% accuracy. $3.00
With crystal holder. $4.98
X cut crystal 1½% accuracy. $3.75

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New York Headquarters for Transmitting Apparatus

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5
The American Radio Relay League, Inc., is a non-commercial association of radio amateurs, bonded for the promotion of interest in amateur radio communication and experimentation, for the relaying of messages by radio, for the advancement of the radio art and of the public welfare, for the representation of the radio amateur in legislative matters, and for the maintenance of fraternalism and a high standard of conduct.

It is an incorporated association without capital stock, chartered under the laws of Connecticut. Its affairs are governed by a Board of Directors, elected every two years by the general membership. The officers are elected or appointed by the Directors. The League is non-commercial and no one commercially engaged in the manufacture, sale or rental of radio apparatus is eligible to membership on its board.

"Of, by and for the amateur," it numbers within its ranks practically every worth-while amateur in the world and has a history of glorious achievement as the standard-bearer in amateur affairs.

Inquiries regarding membership are solicited. A bona fide interest in amateur radio is the only essential qualification; ownership of a transmitting station and knowledge of the code are not prerequisite. Correspondence should be addressed to the Secretary.

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Address all general correspondence to the executive headquarters at West Hartford, Connecticut
BOTH 'phone and c.w. have their special advantages. Telegraphy is cheaper and simpler, has much more range for given power, is a great deal more reliable a means of communicating. Its adherents find special pleasure in their mastery of key and code. Telephony is faster and easier. While both are amateur radio, they are poles apart in technique and procedure. It has always seemed to us that the special virtue of 'phone is that it permits communicating in a supremely natural manner. Words don't have to be spelled out letter by letter and abbreviating isn't necessary to save time. One simply engages in natural conversation with the other fellow. With these advantages of ease and naturalness, we find it difficult to understand why 'phone operators carry over into their work so many of the practices of the telegraph operator. The latter operator is proud of his knowledge of these devices, which are a natural part of his medium, but they are unnecessary encumbrances in voice operation. We would like to suggest that proper pride on the part of 'phone men would lead them to avoid these practices.

To give an example, the telegraph operator has only one way of conveying a laugh—he spells out ha. Just why a 'phone amateur doesn't convey laughter by actually engaging in it we don't know, but instead we hear a humorous remark climaxed by the spoken words ha diddle de dit or ha diddle de ditz way or some such gem. As Handy says in his first O.P.S. Bulletin, "With a 'phone we should think a ham could laugh and be proud that he had a device that would transmit a real laugh and didn't require hieroglyphics or expanded code abbreviations to put it over."

Whenever we hear a voice station "Calling CQ, calling CQ" it impresses us as being the height of something or other. This is the purely-telegraphic manner of saying that one desires to communicate with any available station within range, but we suggest it has no place in telephone operation. The 'phone operator can say precisely what he wants: "Calling any midwest station, calling any midwest station, WISZ West Hartford calling," or "Calling San Francisco," or "Calling any station." It fits voice operation, and the peculiarities of code operation do not. In similar fashion, why should 'phone stations say doe doe doe instead of "Go ahead" or "Come in now?"—is it any less fun? And doesn't simply saying "Good-bye" or "Good-night, old man" convey a lot more intelligibility and warmth-of-friendliness than the spoken letters SK or the awful diddle de bump de bump?

We suppose that these practices have just grown up without much thought, and we believe that sincere 'phone men will agree with our analysis. Amateur radio is founded upon friendly contact. Voice operation has certain superb potential advantages in that respect but they are frequently obscured to-day. We suggest to 'phone operators that the attempt to visit with each other in a natural manner will add enjoyment to the game and will eliminate some practices that often are just a little silly.

But there are some 'phone operators who are anything but inhibited and who carry "naturalness" to an offensive extreme. Although fortunately rare, every amateur has run across some of these idiots virtually broadcasting a drinking bout or exchanging smoke-house jokes. Need we affirm that there is no place for this kind of stuff in amateur radio? With no attempt to regulate any man's private life, still we say that what is prohibited on any street corner must be prohibited in amateur radio.

There are a great many short-wave BCL sets these days and these folks listen to amateur 'phone. What they hear in their homes is their chief impression of amateur radio. A sweet sense of the value and dignity and utility of ham radio they will get from that stuff! Amateur radio is pursued for sheer enjoyment but it must not be abused. Come on, now, 'phone men: be sports about this thing; use some judgment and remember that you have a personal responsibility as a representative radio amateur.

We have been asked why we have not printed in QST a complete exposition of our position on the Madrid convention and regulations, in view of the recent discussion of this subject in amateur circles. We have recently prepared a pamphlet on the amateur aspects of the Washington and Madrid regulations, with particular respect to international message handling. It deals with the facts. Any amateur may obtain a copy for the asking. But we have not printed it in QST because we do not believe that we should devote large quantities of our space to replying to unfounded criticisms of this, that and every other thing. Nor is there in essence anything to add to our original report to A.R.R.L. members that there is nothing in the Madrid treaty to worry about. The A.R.R.L. is twenty years old this year. It has always worked steadfastly for amateur rights. It is solely because we amateurs have an A.R.R.L. that we have the right to-day to be radio amateurs. Most amateurs know that if this treaty were what some have claimed it to be, A.R.R.L. would have been the first to point it out and the first to propose what we ought to do about it.

K. B. W.
A One-Tube Crystal-Control Transmitter
Practical Two-Band Operation With One Crystal

By George Grammer, Assistant Technical Editor

QST's most recent development—the Tri-tet oscillator—has made the single-tube crystal transmitter a really practical affair at last. Practical because it is now possible to work equally well in two—or, in a pinch, in three—amateur bands with a single crystal. Unless we miss our bet, this particular set marks the beginning of the era in which the new amateur's first transmitter will be crystal controlled. The design of the set is such that other higher power units of similar type can be added at will.—EDITOR

For the beginner, crystal control offers advantages which cannot be duplicated by self-controlled transmitters, no matter how simple their construction. Foremost is the all-important feature of positive frequency control; with a crystal of reliable make, delivered with an accurate calibration, the output of the transmitter is quite certain to be very close to the specified frequency. Secondly, the crystal gives an order of frequency stability which can be attained with self-controlled circuits only through the utmost care—and skill—in adjustment. High frequency stability is needed to give a steady, sharp signal free from keying chirps and "wobulation" (change in frequency with a change in power-supply voltage), and to eliminate the one which specifies that the signal shall be steady, sharp, and free from frequency modulation. Against this there is the impression that crystal control is "too complicated" for the beginner; that only the experienced amateur is capable of mastering its intricacies. There is some reason in this attitude if the word "crystal" conjures up a vision of complex circuits with many tubes and power supplies. But exactly the reverse is true if the crystal transmitter is a small affair having about the same power output as the self-controlled transmitter with which the average beginner makes his debut on the air. The crystal set can be actually simpler to adjust and operate—as it should be, with the two hardest adjustments, frequency setting and frequency stability, practically eliminated by the use of a crystal as the controlling element. The actual construction of such a set is equally simple, while the expense is little greater than that of an ordinary self-controlled oscillator—the difference being chiefly the cost of the crystal and holder.

Going on a bit farther, a workable crystal oscillator is never a wasted investment, because it always can be used as a driver for higher-power amplifiers as the station grows and as the operator's knowledge and skill increase. Particularly is this so if the first unit is designed with an eye to future expansion, and is made so that its type of construction can be consistently followed out when other higher-power units are added. This has been kept in mind in the design of the simple transmitter shown in the accompanying photographs. Higher-power stages of the same general construction, all being readily adaptable to the popular frame-type of mounting, will be described in subsequent articles. Of course if this feature is not desired, the transmitter can be laid out in any fashion that may be convenient.
A Practical Low-Power Crystal Transmitter

Before the development of the Tri-tet oscillator circuit, which is nearly fool-proof, the operation of a single-tube crystal transmitter was practically confined to a single amateur band—that in which the fundamental frequency of the crystal was located. Because of the high harmonic output of the Tri-tet oscillator, two bands can now be worked equally well with a single crystal, which greatly increases the usefulness of the single-tube crystal set. It is even possible to work in three bands with one crystal, although the power output of the transmitter on the highest-frequency band is considerably lower than on the other two because it then becomes necessary to operate the plate circuit of the tube on the fourth harmonic of the crystal, which is rather weak in comparison to the second harmonic. Nevertheless, fourth-harmonic operation will do quite well for local contacts and can lead to some interesting work on extremely low power. Surprising distances can be covered with a watt or so in the antenna, especially on 14 megacycles.

Primarily, however, the transmitter to be described as the one-tube basic unit is intended to work in two bands with a single crystal. For the beginner, we recommend that a combination of either the 1.75- and 3.5-mc. bands, or the 3.5- and 7-mc. bands, be chosen; the possibilities of consistent work at all hours of the day are greater in those bands than on the higher frequencies. Since the coils and crystal are readily interchangeable, however, the transmitter is adaptable for operation on any band if only a crystal of the requisite frequency is available.

All the apparatus is mounted on a baseboard measuring 10 by 14 inches—half of a 14-by-20 breadboard (or "pastry" board) of the type obtainable at hardware or "up-to-a-dollar" stores in most cities. This particular board has been given a coat of black lacquer for the reason that this and similar units to be described later are intended to be mounted on a wooden rack which will be painted the same color. The two tuning condensers, $C_1$ and $C_2$ (see Fig. 1), are mounted along the front edge, each 2 1/2 inches in from the edge, with $C_1$ at the left. The grid and plate coils, $L_1$ and $L_2$, are mounted on small porcelain standoff insulators located behind their respective condensers, as shown in the photographs. The coils should preferably be mounted with their axes at right angles to prevent coupling between them, although this is not absolutely essential since the two circuits are tuned to different frequencies and are physically well separated in this layout.

$C_1$, $C_2$—100-µfd. variable condensers (National type ST-100).
$C_3$, $C_4$—0.005-µfd. fixed mica condensers (Dubilier type 3).
$L_1$, $L_2$—See coil table.
$R_1$—50,000 ohms, 2-watt (I. R. C.).
RFC—High-frequency choke (National type 100).

The key is connected in the negative lead at the point marked with an "x." $C_4$ is used as a common "ground" point for the circuit. Just behind and parallel to $C_4$ is the grid leak, $R_1$, and next to it the radio-frequency choke, RFC, which is connected between $R_1$ and the grid of the tube. The tube socket is mounted with the filament terminals (the two large holes) facing the front edge of the board.

The socket for the crystal holder is mounted behind the tube socket. Whether or not this type of socket will be needed will depend upon the type of crystal mounting used, of course. Whatever the mounting, the same position is a good location for the crystal.

Power supply connections are brought out to a bakelite strip mounted flat on the baseboard at the rear left-hand corner. Ordinary 6-32 machine screws are used as terminals. Five half-inch holes in the baseboard underneath the screw terminals give plenty of room for the screw heads and for running in the connecting wires. The two terminals at the left are for the filament supply; leads from the tube socket drop down through the baseboard and run underneath to the terminals. Next in line is the negative plate supply terminal, which connects to the common "ground" between $C_1$ and $C_4$ mentioned previously. The second terminal from the right is for the positive screen voltage; a wire from this terminal under the baseboard connects to the screen grid through the machine screw which

![Figure 1: Circuit of the Single-Tube Crystal Transmitter](image-url)

The screen and plate by-pass condensers, $C_3$ and $C_4$ respectively, are mounted end to end just to the rear of and between $C_2$ and the socket for the 59 tube, by machine screws which pass through the condenser lugs to the under side of the baseboard. The tube socket is mounted slightly to the left of the center of the board to accommodate the length of the by-pass condensers so mounted. The junction between $C_2$ and

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The operating information on the Tri-tet oscillator in these three articles will be found helpful.

March, 1934
fastens the left-hand end of $C_1$ to the baseboard. The extreme right-hand terminal is for the positive plate voltage; it is connected underneath the baseboard to the machine screw which holds the right-hand end of $C_1$ in place. All these connections, which are made with bus bar of the same type used for the top-of-board wiring, are sunk in channels cut in the under side of the baseboard so the board will sit flat on the table. An alternative method, making the cut-out channels unnecessary, would be to mount the baseboard on rubber feet so the wires can clear.

The output posts at the right are National Type WGS insulators. Fahnestock clips are mounted underneath the metal heads to hold the antenna coil.

WINDING THE COILS

The self-supporting coils used with the transmitter are easy to make and much easier to mount than coils wound on cylindrical forms, besides having a negligible cost in comparison to plug-in coils wound on regular receiving coil forms. All except the 1.75-mc. coils are wound with No. 16 d.c.c. wire; the 1.75-mc. coils are wound with No. 22 d.c.c. wire. The coil diameter in all cases is 1 5/16 inches.

The method of winding the coils is fairly simple. A 1 3/8-inch cardboard mailing tube is used as a mandrel. Around it is wrapped a piece of sheet celluloid (sold for repairing side curtains at most auto-supply stores) cut so that it just fits around the tube and long enough to serve as a base for the total length of the coil. It may be held in place temporarily with string or rubber bands until after the coil is wound. The coil is then wound on tightly to the required length, using a machine screw through the mailing tube to hold the starting end of the wire, and tying down the finishing end so it cannot slip. Two or three coats of a good coil dope should then be applied, and the coil allowed to dry out thoroughly. The coil will probably be so tight that it will be impossible to slip out the mailing tube after drying, in which case it is a simple matter to cut it with a knife and to pull out the pieces with a pair of pliers, leaving a solid coil wound on the celluloid base. The No. 16 wire coils for this transmitter were all wound as a single coil having a total length of about 8 inches; after finishing, the correct number of turns for each coil was counted off, allowing enough over to make the leads, and the required portion cut off, using a sharp knife to cut through the celluloid. To make sure that the end of the individual coils would not come loose from the celluloid base, a dab of Duco Household Cement was put at the ends of the coils and allowed to set before the wires were straightened out. One of the photographs shows an unmounted coil and illustrates the method of finishing off the terminals. The two coils wound with No. 22 wire are also wound as a single coil and cut to the required number of turns after having "set" solidly. Other types of coils may be used, if desired, so long as their dimensions are the same as those given in the coil table.

For operation on any two bands with a single crystal three coils will be required, in addition to the antenna coupling coil. The specifications for coils for all four bands are given in the table, together with the combinations used for each frequency.

OPERATING THE TRANSMITTER

If operation on two bands is intended, it will be necessary to purchase a crystal having a frequency such that its second harmonic (twice the fundamental frequency) will fall inside the higher-frequency of the two bands. This has been indicated in the table; for example, if the transmitter is to be used on the 3500- and 7000-ke. bands, the crystal frequency should be between 3500 and 3650 kc., because frequencies outside those limits will not "double" into the 7000-ke. band. Of course for operation in one band only the fundamental crystal frequency can be anywhere between the limits of that band. In purchasing a crystal, too, it is well to consider that later on it may be desirable to add another doubling stage to the transmitter so that more effective three-band operation will be possible. For example, if the 3500-, 7000- and 14,000-ke. bands are to be worked, the crystal frequency
must be between 3500 and 3600 kc, so that the fourth harmonic will fall within the limits of the 14,000- to 14,400-kc. band.

When the transmitter output is at the same frequency as the fundamental frequency of the crystal, the tube operates as an ordinary tetrode or screen-grid oscillator. In this case no coil is required at $L_2$, but in order to complete the crystal circuit it is necessary to short-circuit the condenser $C_1$. The simplest method of doing this is to bend a corner of one of the outside rotary plates of $C_1$ so that when the condenser is set at maximum capacity the bent-over plate will touch a stator plate. When the transmitter output is to be twice the fundamental frequency of the crystal, the circuit is converted to the Tri-tet simply by tuning the circuit $L_1-C_1$ to produce oscillation at the fundamental crystal frequency, and adjusting $C_1$ to resonance at twice the crystal frequency.

As an example of tuning procedure, let us suppose that the transmitter is to operate on the 3.5- and 7-mc. bands and that a 3.5-mc. crystal of appropriate frequency is available. The filament and plate voltages indicated in Fig. 1 are connected to the transmitter. The output frequency is to be the same as that of the crystal. A 0-100 d.c. milliammeter connected in the plate-supply "plus 350" lead will be helpful, as will also a neon lamp for indicating oscillation. Coil No. 3 should be used at $L_2$. The first step is to set $C_1$ at maximum capacity, thus making it short-circuit itself. Then $C_1$ should be turned until there is a pronounced dip in plate current, indicating the beginning of oscillation. With a crystal of ordinary activity, the minimum point of the plate current dip will be in the neighborhood of 10 to 15 milliamperes; when the tube is not oscillating the plate current will probably be 60 or 70 milliamperes. It is generally better to set the condenser $C_3$ at slightly lower capacity than that which gives minimum plate current, because the oscillator will be more stable under those conditions. The antenna coil may then be coupled to $L_2$ and the tuning adjusted to give maximum antenna or feeder current. The oscillator plate current should rise to 40 or 50 milliamperes when the antenna circuit is tuned to resonance. After adjusting the antenna circuit, $C_1$ should be retuned to give maximum output and to make certain that the oscillator "starts" quickly each time the plate circuit is closed. The transmitter should be keyed and the signals monitored to make certain that the keying is clean and certain. It may be necessary to set $C_1$ slightly off the maximum output point to get the necessary keying stability.

To operate the transmitter as a Tri-tet with output at twice the operating frequency, in this case in the 7-mc. band, coil No. 4 would be connected at $L_2$ and coil No. 5 at $L_5$. Condenser $C_1$ should be set at about 75% of full scale and $C_3$ at about 20% of full scale. Apply the voltages and adjust $C_2$ for minimum plate current, which should be 15 milliamperes or less. Touch a neon bulb to the stator plates of $C_2$ and adjust $C_2$ to give maximum glow. The tuning of $C_2$ will be quite broad, but there will be a definite region on its scale over which the second-harmonic output, as indicated by the brightness of the neon lamp, will be greatest. Also, the frequency stability will be best (no "creeping") with the lower capacity of $C_1$. When these adjustments have been made the antenna may be tuned and tuned as before; it will not be found necessary to detune $C_2$ from the maximum output point in this case, however.

The plate current should again be in the vicinity of 40 or 50 milliamperes with the antenna connected and tuned.

The tuning procedure for any other pair of bands will be similar. The coil $L_1$ may be left in place all the time, of course, since it will be shorted out when condenser $C_1$ is set at maximum capacity for operation on the fundamental frequency of the crystal.

**ANTENNAS**

Antenna systems are so numerous that it is impossible to give very definite specifications for tuning. The antenna coupling coils should be tailored to fit the conditions under which they will have to operate. The coil shown in the photograph, which has five turns of No. 16 d.c.c. wire wound in the same way as the other coils, is about the right size to use for 7-mc. operation with a Zepp antenna having quarter-wave (about 33-foot) feeders, in which case series tuning will be used. With other antenna systems the coupling

<table>
<thead>
<tr>
<th>No.</th>
<th>Wire Size</th>
<th>Turns</th>
<th>Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>22 d.c.c.</td>
<td>75</td>
<td>13/4 inches</td>
</tr>
<tr>
<td>2</td>
<td>18 d.c.c.</td>
<td>45</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
<td>16 d.c.c.</td>
<td>40</td>
<td>16</td>
</tr>
<tr>
<td>4</td>
<td>18 d.c.c.</td>
<td>36</td>
<td>16</td>
</tr>
<tr>
<td>5</td>
<td>18 d.c.c.</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>6</td>
<td>18 d.c.c.</td>
<td>7</td>
<td>16</td>
</tr>
<tr>
<td>7</td>
<td>18 d.c.c.</td>
<td>8</td>
<td>16</td>
</tr>
</tbody>
</table>

All coils close-wound.

<table>
<thead>
<tr>
<th>Crystal Frequency</th>
<th>Coil at $L_1$</th>
<th>Coil at $L_4$</th>
<th>Output Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>3500-4000 kc.</td>
<td>No. 2</td>
<td>No. 3</td>
<td>3500-4000 kc.</td>
</tr>
<tr>
<td>7000-7200 kc.</td>
<td>No. 4</td>
<td>No. 5</td>
<td>7000-7200 kc.</td>
</tr>
<tr>
<td>14,000-14,400 kc.</td>
<td>No. 6</td>
<td>No. 7</td>
<td>14,000-14,400 kc.</td>
</tr>
</tbody>
</table>

"x" indicates short circuit across $C_1$.

The coil should be made larger or smaller as the tuning arrangement dictates.

The antenna coupling can be varied by sliding the antenna coil toward or away from $L_4$ in the Fahnestock clips mounted on the output posts. Maximum coupling will result when the two coils are end to end with their axes coinciding. It is possibly advisable to put a small block of wood or other support under the leads near the coupling coil itself to keep it from vibrating when once the setting for optimum coupling has been found.
For 3.5- and 7-mc. operation, a good antenna system would be a Zepp having a length of 130 feet, with 45-foot feeders. The five-turn coupling coil illustrated will work well with a 250- or 350-µfd. series tuning condenser for 7 mc., and a 10-turn coil with parallel tuning will suffice for 3.5 mc. The coupling will be fairly tight on 7 mc. and rather loose on 3.5 mc.

Other antenna systems are described in the Handbook, together with the tuning considerations involved.

POWER SUPPLY AND KEYING

Any well-filtered power supply having an output of 350 volts at about 100 milliamperes will be satisfactory for use with the transmitter. The powersupplyofFig. 1007, page 151, in the Eleventh Edition Handbook, for instance, is well suited to this outfit, and can be built up at little expense. If the 3,50-volt supply used has no voltage divider to give the 100 volts for the screen, a satisfactory divider may be made by connecting a 7000-ohm resistor between the “negative B” and “plus 100” terminals, and a 10,000-ohm resistor between the “plus 100” and “plus 350” terminals. The full output of the power supply may then be connected between the “negative B” and “plus 350” terminals and the voltages will divide in the right proportions. It is important that the screen voltage be kept as nearly as possible at 100 volts. Lower voltage will reduce the output while higher voltage is likely to cause the tube to heat and perhaps stop oscillating after a few minutes’ operation.

Keying can be accomplished satisfactorily by

(Continued on page 88)

### International DX Test Time-Table Forecast

**FOR** the benefit of every amateur who plans to enter the Sixth International Relay Competition from March 10th to 18th (and that probably means just about every amateur in the world), we present the following table of probable times to QSO the U. S. East and West coasts from the major geographical areas of the world. Data for the west coast forecast was contributed by Charlie Perrine, W6QD-W6CUH; that for the east by Harris Fahnestock, W1ZI. Obviously, since these forecasts were prepared a month and a half in advance, no guarantees as to their absolute reliability can be given, but that they will hit the mark fairly accurately we are confident. Times are, of course, G. T.

Our thanks to W6QD and W1ZI for this detailed information. May it help you to pile your score high! — C. B. D.

<table>
<thead>
<tr>
<th>Europe</th>
<th>Western U. S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oz., Sm., OH, OK, SP</td>
<td>2100–2230</td>
</tr>
<tr>
<td>G, F, ON, EA, CT, RY, U</td>
<td>2100–0100</td>
</tr>
<tr>
<td>South America</td>
<td>2330–0900</td>
</tr>
<tr>
<td>Asia</td>
<td>1300–1430</td>
</tr>
<tr>
<td>Japan</td>
<td>0730–0900</td>
</tr>
<tr>
<td>China, Hongkong, Siberia</td>
<td>2130–2210</td>
</tr>
<tr>
<td>India, Iraq</td>
<td>0830–1100</td>
</tr>
<tr>
<td>Africa</td>
<td>2120–2230</td>
</tr>
<tr>
<td>South Africa</td>
<td>2300–0500</td>
</tr>
<tr>
<td>Rhodesia, Mozambique, etc.</td>
<td>2200–0000</td>
</tr>
<tr>
<td>Egypt</td>
<td>0400–0530</td>
</tr>
<tr>
<td>Oceania</td>
<td>1300–1430</td>
</tr>
<tr>
<td>Australia</td>
<td>1100–1230</td>
</tr>
<tr>
<td>New Zealand</td>
<td>0900–1300</td>
</tr>
<tr>
<td>Philippines, Guam</td>
<td>1000–1200</td>
</tr>
<tr>
<td>Java, Sumatra</td>
<td>2200–2230</td>
</tr>
<tr>
<td>Malay, Borneo</td>
<td>0300–1000</td>
</tr>
<tr>
<td>North America</td>
<td>2100–1600</td>
</tr>
<tr>
<td>Alaska</td>
<td>0300–1500</td>
</tr>
</tbody>
</table>

**Note:**
- 1 — Possible, but improbable.
- 2 — Easiest time.
A Practical Cathode-Ray Oscillograph for the Amateur Station

Using the New Types 906 and 885 Tubes in a Complete Unit With Sweep-Circuit

By L. C. Waller, W2BRO*

The cathode-ray oscillograph herewith makes its bow as a highly practical piece of amateur equipment. It no longer can be regarded as too costly, too complex and too delicate for anything but laboratory use because recently-developed tubes are rugged, relatively inexpensive and work in simple circuits. The total cost of the complete unit described in this article is comparable to that of a good receiver, for instance, and it is as easily constructed. The cost per ham can be made really small by group cooperation, with the local club or a neighborhood gang of 'phones "chipping in". It is our intention to present in an early issue the description of a simplified version of the cathode-ray oscillograph.—EDITOR

ONE of the most useful devices known to engineers who are constantly dealing with electrical phenomena is the cathode-ray oscillograph. Since radio amateurs are dealing with electric currents, both direct and alternating, at audio and radio frequencies, it is inevitable that such an oscillograph should sooner or later come into the amateur picture. As a matter of fact, there are so many different valuable services such a device can perform in an amateur station that it is actually difficult to enumerate them all.

Until recently, the cathode-ray oscillograph was a piece of equipment that many amateurs may have heard about, a number may have wished for, but few ever hoped to possess. It was something only to be found in the laboratories of the larger industrial plants and universities. But new developments in the tube field have placed cathode-ray tubes within the reach of the amateur's pocketbook. The purpose of this article is not to theorize or to talk of generalities, but to describe a simple, compact and economical cathode-ray oscillograph intended for amateur use as a permanent piece of station equipment.

Contrary to prevalent impressions, modern cathode ray equipment is neither delicate nor excessive in cost of the parts required. The ever-useful "junk box" will, as usual, come in handy and the total cost can be surprisingly reasonable, all things considered.

HOW IT WORKS

In order that the operation of and the results obtained with the oscillograph may be better understood, a brief review of cathode-ray tube fundamentals is in order. The tube used, Type 906, contains eight useful electrodes; namely, heater-cathode, control electrode, anode No. 1, anode No. 2, and two pairs of deflection plates. The arrangement of the electrodes is shown in

* RCA Radiotron Company, Harrison, N. J.

Fig. 1. The assembly of the cathode, grid, anode No. 1 and anode No. 2 is known as the electron gun. This is an apt name, for the electrons furnished by the cathode are controlled, accelerated, and focused by the other gun electrodes into a tiny beam, the cathode ray. This beam of electrons strikes the viewing screen, which is coated with a substance that fluoresces to produce a brilliant green glow at the impact point of the electron beam. The cathode ray thus produces on the front of the screen a luminous spot which is easily visible even in a well-lighted room.

In order to keep the electron beam focused to a small spot-size on the screen, it is necessary to maintain a constant ratio of anode No. 2 and anode No. 1 voltage. The sharpness of focus is usually adjusted by varying the anode No. 1 voltage. The input power to the screen (the product of anode No. 2 voltage and the beam current) controls screen illumination. Anode No. 2 current is controlled by means of the negative bias on the control electrode.

SWEEP CIRCUITS

To obtain a useful pattern or wave-form, it is first necessary to move the spot horizontally back and forth across the screen at some convenient frequency and with
some suitable motion with respect to time. This produces a horizontal line of narrow width (equal to the diameter of the spot) in the middle of the screen. The horizontal motion or “sweep” is obtained by applying a suitable a.c. voltage across the deflection plates \( D_1 \) and \( D_2 \), which, in operation, are placed vertically (see Fig. 1). For studies of wave-form, a linear time base is generally required; that is, a sweep-circuit wave-form which moves the spot at a constant velocity. Such a wave-form is produced by the sweep-circuit shown in Fig. 2 utilizing a Type 34 and a Type 885. The latter is a grid-controlled gaseous-discharge tube of the heater-cathode type designed especially for sweep-circuit service, operating as a relaxation oscillator whose frequency can be controlled within limits by a.c. voltage applied to its grid.

In some applications a linear time base is not required and the 60-cycle line voltage is sometimes suitable for the horizontal sweep. A transformer having a ratio of about 1:1 is used (\( T_s \) in Fig. 2) to isolate the a.c. line from the horizontal-sweep deflection plates. A Class-B input transformer serves nicely. When \( S_5 \) is closed to \( T_s \), the 885 sweep-circuit is, of course, taken out of operation. A peak voltage of about 150 volts at the secondary of \( T_s \) will usually be adequate.

After a satisfactory sweep has been established, the voltage to be viewed is applied across deflection plates \( D_3 \) and \( D_4 \), which are placed horizontally. Thus, the spot is moved not only back and forth, but also up and down. Such movement produces a tracing of the desired wave-form of the voltage under inspection. An example is the audio-frequency signal-voltage tracing shown in A. This is the modulating frequency used to obtain the modulated radio-frequency pictures to be discussed later.

The oscillograms shown are actual unretouched photographs made with the equipment described in this article and picture the performance of W2BRO’s ‘Phone Transmitter

A shows the wave-form of the 500-cycle modulating signal with the audio stages operating properly while B shows the same audio signal with distortion from over-excitation of the Class-B driver stage. C pictures the unmodulated 14-mc. carrier and D the carrier partly modulated with good wave form. E represents what we all strive for—the carrier properly modulated 100 percent.

**Auxiliary Apparatus**

A cathode-ray oscillograph requires a power supply and, for convenience and utility, should 1 Haller, Cecil E., “A Linear Timing Axis for Cathode Oscilloscopes,” Review of Scientific Instruments, July, 1933.

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**FIG. 2—DIAGRAM OF THE CATHODE-RAY TUBE AND SWEEP CIRCUITS**

- \( R_s, R_a \) — 50,000-ohm Centralab potentiometer.
- \( R_1 \) — 15-ohm 1-watt.
- \( R_2 \) — 500-ohm Taeley wire-wound potentiometer.
- \( R_3 \) — 700-ohm 1-watt.
- \( R_4, R_6 \) — 2-megohm 1-watt.
- \( R_5, R_7 \) — 500,000-ohm Centralab potentiometer.
- \( R_8 \) — 500,000-ohm 1-watt.
- \( R_9 \) — 200,000-ohm potentiometer.
- \( R_{10} \) — 10,000-ohm 1-watt.
- \( C_1 \) — 8-µfd, 450-volt electrolytic condenser.
- \( C_2 \) — 400-µfd. fixed mica.
- \( C_3 \) — 0.001-µfd. fixed mica.
- \( C_4 \) — 0.01-µfd. fixed mica.
- \( C_5 \) — 400-µfd. 450-volt paper.
- \( C_6 \) — 0.5-µfd. 1500-volt paper.
- \( S_1, S_2, S_3 \) — S.p.d.t. toggle switches.
- \( S_4, S_6, S_8 \) — D.p.d.t. Federal anti-capacity switch.
- \( S_3, S_5 \) — S.p.d.t. Federal anti-capacity switch.
- \( T_1 \) — Line-to-line transformer.
- \( T_2 \) — 1-to-1 transformer. (See text.)
- \( T_3 \) — 1-to-2 transformer. (See text.)
- \( P \) — 2.5 volt pilot light.
- \( C_9 \) — 0.01-µfd. fixed mica.
- \( C_{10} \) — 0.5-µfd. 1500-volt paper.
- \( C_{11} \) — 0.001-µfd. fixed mica.
- \( P \) — 2.5 volt pilot light.

**THE OSCILLOGRAMS SHOWN ARE ACTUAL UNRETouched PHOTOGRAPHS MADE WITH THE EQUIPMENT DESCRIBED IN THIS ARTICLE AND PICTURE THE PERFORMANCE OF W2BRO’S ‘PHONE TRANSMITTER**

A shows the wave-form of the 500-cycle modulating signal with the audio stages operating properly while B shows the same audio signal with distortion from over-excitation of the Class-B driver stage. C pictures the unmodulated 14-mc. carrier and D the carrier partly modulated with good wave form. E represents what we all strive for—the carrier properly modulated 100 percent.
include the linear sweep-circuit. For this particular oscillograph, the necessary 250-volt and the 1000-volt supplies are obtained from the same power transformer by means of the circuit shown in Fig. 3. In addition, the 3-volt, 22.5-volt and 45-volt batteries are necessary, as shown in Fig. 2.

Although a cathode-ray tube requires relatively high voltage, its space current requirements are very small. Therefore, the power supply can be quite simple. No filter choke and almost no bleeder current are necessary (see Fig. 3). A half-wave rectifier using a Type 81 with a 2- to 4-µfd. filter condenser is adequate. The high-voltage bleeder consists of a 2.0- and a 0.5-meg-ohm fixed resistor in addition to one 500,000- and one 200,000-ohm potentiometer (carbon type). The sweep-circuit supply consists of a Type 80 connected as a half-wave rectifier with a similar type of filter. The voltage output of the 81 is approximately 1000 volts, while the bleeder tap in the 80 circuit is adjusted to give about 250 volts.

The deflection plates are returned to the positive 1000-volt lead, which is grounded for convenience of circuit arrangement. The deflection plates should be connected through 10-megohm resistors as shown in Fig. 2. This arrangement insures that the electron beam is not distorted by d.c. potentials built up by electrons accumulating on the free plates. The negative 1000-volt lead is the one dangerous connection in the cabinet, since the positive lead is grounded to the chassis. However, since the negative lead is connected only to the potentiometer $R_8$, it is possible to use heavily insulated wire and to isolate that connection so that it is practically inaccessible. The heater and the cathode circuits are also at a high negative potential with respect to the cabinet; therefore, these leads should also be protected adequately.

In any event, the a.c. line plug should always be disconnected from the oscillograph unit before its lid is removed.

The cathode-ray tube used, the Type 906, is chosen not only because of its low cost and convenient size, but also because it employs electrostatic deflection plates. The electrostatic plates shunted by a very large resistance present an extremely high impedance to most circuits across which they may be connected, with almost negligible disturbing effect on the circuit under observation. While the 906 has a screen only 3 inches in diameter, it has been found that this size is ample for nearly all amateur applications.

The ratings and characteristics of the 906 are as follows:

<table>
<thead>
<tr>
<th>TABLE 1</th>
<th>GENERAL RATINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heater voltage (a.c. or d.c.)</td>
<td>2.5 Volts</td>
</tr>
<tr>
<td>Heater current</td>
<td>2.1 Amperes</td>
</tr>
<tr>
<td>Direct interelectrode capacitance</td>
<td>10 (max.) µµfd.</td>
</tr>
<tr>
<td>Deflecting plate $D_3$ to deflecting plate $D_4$</td>
<td>4 (max.) µµfd.</td>
</tr>
<tr>
<td>(Top Set)</td>
<td></td>
</tr>
<tr>
<td>Deflecting plate $D_6$ to deflecting plate $D_3$</td>
<td>3 (max.) µµfd.</td>
</tr>
<tr>
<td>(Bottom Set)</td>
<td></td>
</tr>
</tbody>
</table>

THE VERSATILE CATHODE-RAY OSCILLOGRAPH UNIT IN ITS ALUMINUM CASE

The panel controls, left to right, are identified as follows:

Top row, screen end of the 906: signal-voltage-dividing potentiometer, $R_1$, synchronizing-signal potentiometer for the 885, $R_6$.


Third row, grid-bias potentiometer for the 906, $R_6$, Anode No. 1 potentiometer for the 906, $R_7$, filament-battery switch for the 34, $S_6$, sweep-circuit change-over switch $S_7$, bias-potentiometer switch for the 885, $R_8$, bias-potentiometer switch for the 34, $R_9$.

Fourth row, input-signal binding posts; ground or chassis binding post; synchronizing-signal input binding posts.

THESE OSCILLOGRAMS ILLUSTRATE COMMON CONDITIONS THAT MAKE A BROAD 'PHONE BROAD

F shows the carrier overmodulated, although with reserve audio power to maintain good wave form on the positive peaks. G was obtained with slight overmodulation but with audio distortion on the positive peaks from overloading. H shows a typically bad combination— heavy overmodulation with overloading causing high a.f. distortion and with insufficient r.f. grid excitation. Inadequate r.f. grid excitation to the modulated stage, indicated by the flattened positive peaks, is further illustrated by I. And J shows what happens when the tank circuit of the modulated stage is detuned from resonance, introducing phase modulation. Every one of the conditions illustrated causes broad signals and needless interference.
SWEEP-CIRCUIT OSCILLATOR SERVICE

| Peak plate voltage | 200 (max.) volts |
| Peak plate current | 300 (max.) milliamperes |
| Average plate current | 0.5 (max.) milliamperes |

CONSTRUCTION

The photographs show the general layout of the parts both on the panel and inside the cabinet while Fig. 2 gives the circuit. The aluminum cabinet measures 20 inches by 12 inches by 8 inches high. Any good tin-smith should be able to make a suitable box of either 1/16-inch sheet aluminum or of galvanized iron. If iron is used, it should be free of magnetization which might affect operation of the oscillograph. Except for the cabinet itself, practically all of the other work can be done with the usual tools found on every amateur work-bench.

The individual parts are mounted in the cabinet according to convenience for circuit wiring. Since a sub-base construction is not used, it is rather difficult to conceal much of the wiring. Most of the leads are short, though this detail is not as important as in the case of radio-frequency circuit wiring. The leads from the signal-input binding posts to the anti-capacity switch and to the signal deflection plates are made as directly as possible and are placed apart from other components, because they may carry a radio-frequency signal voltage. Capacity effects on these leads are avoided as much as the arrangement of parts will permit. The a.c. line receptor is in the back of the cabinet at the bottom, near the power supply. This receptor eliminates the necessity of having an a.c. cord dangling in the way when the equipment is not in use.

The layout of the parts can be made with a considerable degree of latitude. Other schemes will undoubtedly present themselves to those who contemplate the construction of an oscillograph. The one shown merely represents an idea of a logical arrangement.

It should be noted that the bias potentiometers for both the 34 and 885 (R1 and R9) are connected so that when their switches are open (to remove the bleeder drain when the apparatus is not in use), full bias is placed on the two sweep-circuit tubes. It is quite important that the various switches and potentiometers mounted on the panel be of the type which are insulated from their one-hole mounting studs, so that short circuits to the panel are prevented. The circuit is otherwise straightforward and requires no detailed explanation.

OPERATION

When the wiring is completed, all voltages should be checked with a high-resistance voltmeter before the 906 is inserted. Current measurements are not essential. With the 906 in place, switches S1 and S2 are closed. With a.c. sweep
voltage applied, \( S_4 \) to "A.C." potentiometers \( R_8 \) and \( R_9 \) are adjusted to give a narrow, brilliant line which should be near the middle of the screen when everything is working properly. When the tube is operated without sweep voltage, the spot should not be allowed to remain stationary for any length of time. If it is, damage to the screen may result.

Switch \( S_4 \) is now thrown to position I and switches \( S_1 \) and \( S_3 \) are closed; switch \( S_5 \) is left on the open contact and potentiometer \( R_3 \) is set at approximately center position. Then, with \( S_4 \) in the "Sweep" position, potentiometers \( R_7 \) and \( R_{10} \) are simultaneously adjusted until a narrow horizontal line appears across the entire face of the screen. These operations produce a 60-cycle sweep with a linear time axis, since the oscillations of the 885 are held in step with the 60-cycle line frequency by the small voltage, from secondary 2 of \( T_s \), which is applied across \( R_s \) through transformer \( T_1 \). The secondary of the latter transformer also furnishes the heater voltage of the 885.

The oscillograph is now ready to have an input signal applied. This brings up the use of condenser \( C_7 \) and switch \( S_7 \). When the signal to be viewed is a.c., \( S_7 \) may be open or closed. If open, the a.c. passes through \( C_7 \). If a voltage composed of both d.c. and a.c. is to be viewed, however, \( S_7 \) is opened. This blocks off the d.c. and prevents an undesirable deflection of the cathode ray, but allows the a.c. component to pass.

The first logical voltage to test is the a.c. line voltage. The line is, therefore, connected to the signal-input posts with \( S_1 \) open and \( S_3 \) in Position I. This position of \( S_3 \) merely places the input voltage across the voltage dividing potentiometer \( R_{10} \), in order to put an r.m.s. voltage on the deflection plates \( D_1 \) and \( D_2 \) of only 70 or 80 volts instead of the full line voltage of 115 volts, the peak line voltage being 115 \( \times \) 1.4 or 161 volts, which will deflect the beam completely off the screen. The maximum deflection-plate peak voltage which the 906 can handle is approximately 100 volts. Then, with switch \( S_4 \) moved to \( C_5 \) or \( C_6 \), potentiometers \( R_1 \), \( R_3 \), \( R_4 \) and \( R_5 \) are adjusted until a satisfactory wave-form is obtained. \( R_4 \) and \( R_{10} \) should give an adjustment which will hold the picture still and prevent the screening of the cathode ray, but the adjusting of the a.c. voltage applied, \( S_4 \), to "A.C." potentiometers \( R_8 \) and \( R_9 \) is adjusted to give a narrow, brilliant line which should be near the middle of the screen when everything is working properly. When the tube is operated without sweep voltage, the spot should not be allowed to remain stationary for any length of time. If it is, damage to the screen may result.

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When checking a modulated carrier it is necessary to throw switch \( S_4 \) to Position II and to apply a small amount of audio voltage (one or two volts) from the speech amplifier to the "synchronizing signal" binding posts. This can easily be done with an external 200-ohm-to-grid transformer, the 200-ohm winding being connected to the oscillograph and the high-impedance grid winding being placed in parallel with the plate load impedance of one of the low-level speech amplifier stages. Thus the horizontal sweep is essentially in proper phase relationship with the audio modulation on the carrier. With tone modulation a picture such as that shown in \( D \) and \( E \) should result.

To obtain a trapezoidal shape, such as that shown in Fig. 4, switch \( S_4 \) is left open and a peak audio voltage of about 40 to 60 volts is applied across \( R_{10} \). This gives a horizontal sweep voltage of the same form and frequency as that modulating the carrier. The trapezoid resulting has a minimum amplitude (\( H_{\text{min.}} \)) proportional to the lowest voltage reached by the modulated r.f. carrier and a maximum amplitude (\( H_{\text{max.}} \)) proportional to the peak carrier voltage. A perfectly modulated carrier (100%) will produce a close representation of an isosceles triangle, the point of the middle apex being approximately equal to 17 March, 1934
the diameter of the moving spot. A well-modulated carrier modulated less than 100% will give the trapezoid in its more usual form (with "flat" ends). The percentage of modulation is expressed by

\[ \frac{H_{\text{max}} - H_{\text{min}}}{H_{\text{max}} + H_{\text{min}}} \times 100, \]

where \( H_{\text{max}} \) and \( H_{\text{min}} \) are the larger and smaller vertical deflections, respectively.

**CHECKING THE 'PHONE TRANSMITTER**

With a cathode-ray oscillograph at hand, the first thing an amateur 'phone operator would naturally do is to look at the output of his transmitter. The pictures shown in Fig. 4 and various wave shapes from \( E \) to \( J \) show the modulated carrier of W2BRO under different conditions of adjustment. It must be emphasized that a dummy antenna is demanded for such testing. Unnecessary QRM must be prevented.

A modulating signal in the normal audio-frequency range is desirable. If no other signal source of known wave-form is available, 60-cycle voltage from the line may be used for the speech amplifier signal input through a step-down transformer.

\( A \) and \( B \) show the audio signal taken from the input to the 800 Class-B modulators (the transmitter is that described in the December and January issues of *QST*). \( A \) shows a good wave-form with a proper setting of the gain control. \( B \) shows the signal with the gain control advanced too far. The flat-topped, distorted wave is attributable to the 2A3 tubes being driven to draw grid current. With a speech amplifier output like \( B \), good quality on the carrier could hardly be expected.

\( C \) shows the unmodulated carrier. It appears as a solid green band across the screen, the 14,000,000-cycle frequency at which the spot is being deflected up and down being too high to show individual cycles. The width of the band is controlled by the r.f. input coupling.

\( D \) and \( E \) show a partially-modulated and a 100-percent modulated carrier of good audio wave-form. When his carrier looks like \( E \) an amateur does not have to worry about his quality reports (and when an oscillograph is a part of his station equipment, he does not have to ask anyone how his modulation or quality is). \( F \) shows an overmodulated carrier with sufficient audio reserve to retain good wave-form on the positive peaks. This type of overmodulation indicates excessive audio input and improper operating conditions for the modulated r.f. amplifier. \( G \) shows slight overmodulation with some a.f. distortion on peaks.

\( H \) shows a heavily overmodulated carrier with high a.f. distortion, an insufficient amount of reserve audio power, and/or inadequate grid excitation. That is, although heavy overmodulation is indicated on the negative audio peaks by the cut-off characteristic, the positive audio peaks do not rise to the expected amplitude, but flatten off badly. \( I \) shows the ragged peaks and poor wave-form which result when the grid excitation to the final r.f. amplifier is inadequate.

This picture represents the carrier when the two 800’s in the r.f. power amplifier had their d.c. grid current reduced to as low as 5 to 10 ma. per tube. \( J \) was taken with the plate tank of the final amplifier considerably de-tuned from resonance and shows the distortion resulting from mis-tuning of a circuit handling modulated r.f.

Only two or three of a multitude of uses for the cathode-ray oscillograph have been described. A few other practical uses which it has are the study of transient wave forms, the tracing of vacuum tube characteristics, the measurement of peak voltages, the study of phase relationships, the lining up and wave-form adjustment of intermediate-frequency amplifier stages in superhet's, the comparison of different frequencies, and the checking of audio-transformer quality.

Perhaps some day an oscillograph will be a standard item in as many amateur stations as the simple monitor is to-day. In the interest of better results and the further advancement of amateur radio, let’s hope so!

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**Strays**

Many Overlooked the Index

Prior to 1933 *QST* yearly index was inserted loosely in each December issue of *QST*. The 1933 yearly index was stitched into the December 1933 issue as pages 97-100 inclusive. Many members failed to note this change in annual procedure.
Suppressor-Grid Modulation
Its Application to Low-Power 'Phone and Future Possibilities

By James J. Lamb, Technical Editor

 UNDER the head, "Methods of Modulation," in Chapter Eight of the latest Radio Amateur's Handbook, mention is made of suppressor-grid modulation with the comment that its application to amateur transmission was hardly practicable because of the lack of suitable pentode-type screen-grid power tubes. At the time we prepared this chapter the utilization of the system did seem little more than something to hope for in the remote future. But experiments that have engaged us more recently convince us first, that at least one type of tube now available, although not ideally suited, is practical for low-power transmission with this system; and, second, that the merits of the pentode-type screen-grid power tube with the suppressor-grid connection brought out to an accessible terminal warrant its production not only for this system of modulation but for general transmitter use as well. We have given this suggestion to tube manufacturers and it is not unlikely that types in the intermediate 50-watt range will become available within the year.

As the name suggests, the modulating signal is applied to the suppressor grid of a tube in the modulated r.f. stage, this tube being a pentode containing also a screen-grid in addition to the cathode, control grid and plate, the suppressor grid being between the screen grid and the plate. This type of modulation is not original, by any means, but the specific method of using the suppressor as a control element to get wide-range linear modulation is a recent development. Now we confess, frankly, that we are not addicted to congenital enthusiasm over every "new" system of modulation. We have grown to be quite hard-boiled on the subject, in fact, and habitually view with skepticism each of the inevitable "new" circuits in the seemingly never-ending stream. As far as QST is concerned, to get to first base any modulation system must be able to answer "yes" to these questions:

1. Is it inherently capable of giving complete or nearly complete modulation without distortion?
2. Will it work with reasonable efficiency and make reasonably economical use of the gear and tubes practicable in an amateur 'phone transmitter?
3. Is it free of trickiness and can it be adjusted for known proper operation by given rules?

Most "new" circuits fall down on the first question; they are prone to be innate distorters and generators of spurious radio frequencies that make needless interference. This is especially characteristic of arrangements that claim to give something for nothing. Others fail to answer satisfactorily the second question, usually in tube requirements that are all out of line with the output they will give. Still others give a disappointing answer to the third question; their adjustment, as far as the amateur is concerned, must be a business of "by guess and by gosh."

First place on all counts has been held, with a fair margin, by high-level plate power modulation in its various forms, including Class-B. Second place goes to grid-bias modulation. Third place—well, there seems to be none to fill it, as far as amateur radio is concerned (and broadcasting too, for that matter). Therefore it appears that any other system must stand or fall in comparison with these two. Plate-power and grid-bias modulation are the established competition. We shall see how suppressor-grid modulation stacks up with them.

TESTING THE SYSTEM

In usual applications of pentode tubes, both of the audio power types (47, 2A5, etc.) and of the r.f. amplifier types (57, 58, etc.), the suppressor
serves primarily to prevent secondary emission from the plate and is connected directly to the cathode. In most audio-power tubes this connection is made within the tube, while in most screen-grid r.f. types there is an accessible base connection for the suppressor. Surveying the variety of available types having the external connection, we find that the most capable appearing tube is, again, the ever-adaptable Type 59. Even though it has less effective screening than the r.f. pentodes, its greater power ability makes it the choice for transmitter use.

Having decided on the tube, the next step is to rig the circuit. In our first trial this was a common volts negative, dry B-batteries being used to obtain the variable voltage in 22.5-volt steps. The r.f. amplitude was measured on the screen of a Type 905 cathode-ray oscillograph with a pair of dividers and a ruler. The solid line shows the actual suppressor-voltage—r.f. characteristic and the broken line indicates the ideal linear characteristic that would be desirable for modulation with the suppressor biased 45 volts negative and with a modulating voltage peak of approximately 67.5 volts (a total swing of 135 volts, from 22.5 volts positive to 112.5 volts negative). As is evident, the portion of the characteristic useful for modulation purposes is largely in the negative region, calling for a mean negative bias.

Despite the non-linearity of this particular characteristic, the wave-form of the envelope with tone modulation appeared to be quite good when viewed on the oscillograph screen, suggesting that inspection of the modulation envelope by means of the cathode-ray tube should serve as an approximate qualitative check rather than as a final quantitative measure of distortion.

Suspecting that regeneration in the unneutralized doubler might be responsible for the wobble in the curve, a neutralized stage to operate as a "straight" amplifier was hurriedly assembled on a breadboard, the circuit being that shown in Fig. 2. The Tri-tet oscillator unit described by George Grammer elsewhere in this issue was used as an oscillator-doubler to excite the pentode amplifier. After neutralization, with the handy cathode-ray tube serving as the r.f. indicator, the output was coupled to a dummy antenna and a number of tests were made with various plate and screen voltages, with grid-leak and combination leak-cathode bias and with varied r.f. excitation.

A decided improvement over the first arrangement was immediately apparent, as shown by Fig. 3, the r.f. output varying linearly between nearly cut-off negative voltage and slightly positive voltage. It was found that the linearity was unaffected by r.f. excitation voltage and control grid bias variation between relatively wide limits and was but slightly affected by changes in load impedance. Needless to say, these operating features, evidencing tolerance in grid excitation, control-grid bias and load-impedance values, are especially desirable in the amateur transmitter. The all-important output power developed to be about what would be expected from an equivalent stage operating as a Class-B linear amplifier and somewhat higher than could be realized with more critical grid-bias modulation of a comparable stage operating at the same plate voltage.

The peak output for a given d.c. plate voltage is about the same as the carrier output would be.

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FIG. 2—CIRCUIT OF THE NEUTRALIZED SUPPRESSOR-GRID MODULATED R.F. AMPLIFIER

L1, L2 and C1—As usual for the frequency.
C3—Neutralizing condenser, approx. 5-µfd. maximum for 1 or 2 tubes. Two 5/8-inch diameter brass plates with adjusta-
ble spacing.
C4—100-µfd. input coupling condenser.
C5—500-µfd. plate blocking condenser.
C6, C7—0.01 screen and plate by-passes.
C8—0.001-µfd. suppressor by-pass. Should not be large enough to by-pass audio.
C9—1-µfd. cathode by-pass (if R4 is used).
R5—50,000-ohm 1-watt grid leak.
R6—Audio load resistor. See text.
RFC—2.5-mh. r.f. chokes.
MA—0-50 or 0-100 d.c. milliammeter.

Plate supply (E1) and screen supply (E2) can be from same power pack. Suppressor-grid bias (E3) can be from small "B" batteries or a separate power pack.

paratively simple matter. With the original universal exciter unit* at hand, only a few minutes' unsoldering and re-soldering of connections of the doubler circuit was required—and it was ready to go. Specifically, the suppressor (No. 3 grid) was disconnected from the screen (No. 2 grid), by-passed to ground with a 0.001-µfd. condenser and connected to a binding-post terminal through a small r.f. choke. The control voltage for the suppressor grid was applied between this terminal and the common ground (negative B).

The curve of Fig. 1 shows the variation in r.f. output that resulted with variation of suppressor-grid voltage between 45 volts positive and 112.5 volts negative, dry B-batteries being used to obtain the variable voltage in 22.5-volt steps. The r.f. amplitude was measured on the screen of a Type 905 cathode-ray oscillograph with a pair of dividers and a ruler. The solid line shows the actual suppressor-voltage—r.f. characteristic and the broken line indicates the ideal linear characteristic that would be desirable for modulation with the suppressor biased 45 volts negative and with a modulating voltage peak of approximately 67.5 volts (a total swing of 135 volts, from 22.5 volts positive to 112.5 volts negative). As is evident, the portion of the characteristic useful for modulation purposes is largely in the negative region, calling for a mean negative bias.

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* QST, Oct., 1933.
with an equivalent amplifier operating Class-C with plate-power modulation. But the modulator required for suppressor-grid modulation can be of much lower power capability than the plate modulator that would give this four-fold increase in power output; and the d.c. plate voltage can be safely raised to a much higher value than would be allowable on the same tube with plate modulation. In fact, by raising the plate voltage the output of the suppressor-grid modulated stage might approach that which the same stage would give when safely operated with plate modulation. That is, the safe d.c. plate voltage with suppressor modulation may be twice the safe plate voltage with plate modulation, since the peak voltage with 100-percent plate modulation is twice the mean or d.c. voltage, while the peak plate voltage on the suppressor-modulated stage is the d.c. supply voltage.

CIRCUIT DETAILS AND PRACTICAL OPERATION

Following the preliminary investigation in which r.f. output was measured over a range of suppressor voltage obtained from batteries, tone modulation was applied with various values of fixed negative bias on the suppressor grid and the form of the modulated wave was observed on the cathode-ray oscillograph screen. The modulator used was the push-pull Type 45 driver stage of a Class-B audio unit that was conveniently at hand, the Class-B input transformer in the plate circuit of the 45's serving as the coupling to the suppressor-grid circuit.

With the output of the audio stage unloaded except for the suppressor circuit, distortion was evident with voltage swings into the positive region, irrespective of the suppressor negative bias. Measurement of the suppressor current showed that this circuit drew a small direct current at positive suppressor voltages, as would be expected, and showed also that there was a reversal of suppressor current in the vicinity of zero voltage. There was no current flow with negative suppressor voltage. In a typical case, the positive suppressor current (electron flow from suppressor to cathode in the external circuit) became nearly 1 ma. at maximum positive voltage of 45 or so; and the negative current (electron flow from cathode to suppressor in the external circuit) reached 20 microamperes at zero suppressor voltage. This indicates negative resistance.

Now with a low-resistance transformer secondary in the suppressor circuit this negative resistance might cause oscillation over a small portion of the audio cycle, as also has been noted in connection with Class-B audio amplifiers, and might account for the distortion that was observed. Loading of the coupling transformer with a suitable resistor \( R_2 \) in Fig. 2) prevents this "negative-load" oscillation and also stabilizes the load on the audio amplifier between the no-load condition of negative suppressor voltage and the positive load condition of positive suppressor voltage. The value of the load resistance will depend on the modulator tube and impedance ratio of the coupling device, of course, 4000 or 5000 ohms being generally satisfactory with 1-to-1 coupling to Type 45 and other power tubes.

With the audio distortion eliminated, the modulated r.f. wave form confirmed the linearity observed in the "step-by-step" suppressor-grid variation shown in Fig. 3. The d.c. plate current remained constant with modulation over this range, as did the linear-detector rectified current of a superhet receiver used for monitoring.

TRANSMITTER SUGGESTIONS

A recommended circuit arrangement of a suppressor-grid modulated stage for a small transmitter is that shown in Fig. 2, which can be used for a single tube or, for greater power output, for two tubes in parallel. By modifying the circuit suitably, two tubes in push-pull could be used, with their suppressors connected in parallel. Although plate voltages as high as 1000 \( V \) were used in the experiments, it is recommended that not over 700 volts be used for normal transmitter operation. In no case should the screen voltage exceed 150 volts, which seems to be universally the limit with Type 59 tubes. At higher voltages the screen gets too hot and away goes the plate current, even at moderate plate voltage.

It also appears that the peak plate current is...
should not be much higher than 40 ma. per tube, which means that the d.c. plate current for modulated operation should be kept down to 20 or 25 ma. (40 to 60 ma. for two tubes). At higher plate currents, even with proportionately higher plate voltage and suppressor-grid bias, distortion of the modulation envelope results.

The optimum suppressor-grid negative bias voltage runs approximately 15 per cent of the plate voltage value, at least for plate voltages in the range 350 to 700 volts. This bias is not especially critical, although it should be sufficiently negative to insure linear modulation. A good method of determining its value is to read the values of antenna current and plate current for zero suppressor bias (suppressor bias tap connected to negative B), and then to vary the bias negatively until these current values are halved, with plate voltage kept constant. In no case should the attempt be made to modulate with zero bias or very small negative bias. The amplifier just won't take it. It may be a temptation to operate with bias giving the higher carrier current, but the effective r.f. output represented by r.f. control of bias would be increased and the distortion of the modulated operation should be kept down to 20 or 25 ma. (40 to 60 ma. for two tubes). At higher plate currents, even with proportionately higher plate voltage and suppressor-grid bias, distortion of the modulation envelope results.

Another application of present tubes worth considering is the use of this system of modulation in the simple modulated test oscillator using a pentode-type screen-grid tube in an electron-coupled circuit. Performance observed in these preliminary tests indicates that the suppressor-grid system is somewhat between grid-bias and plate-power modulation in point of efficiency and ratio of output to tube rating. Like plate modulation and unlike grid-bias modulation, it is tolerant of circuit conditions, particularly control-grid bias and r.f. excitation. On the other hand, it has the desirable feature of requiring relatively small modulating power which serves to justify present systems of grid-bias modulation.

Although this application alone would seem to justify the development of pentode-type screen-grid power tubes, there are other applications that also would benefit from their availability. For instance, full-range simple plate power modulation should become practicable with the suppressor eliminating the dynatron kink in the plate characteristic which now makes such modulation impracticable. Also, the suppressor should prove to be a convenient control element for varying transmitter power output and telegraph keying.

It must be realized that the full potentialities of the system are hardly indicated by what a 59 or two can do. This tube is really a make-shift for the job, used because there happens to be nothing better available. But this condition may not be a handicap for long. If our suggestions to tube manufacturers are as fruitful in this instance as they proved to be in the case of the new 50-watt type tubes, we should have some real pentode-type screen-grid power tubes in the not too distant future. In the meantime, Don Mix is giving his best licks to a complete low-power 'phone working.

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FROM mile-high Denver in 1930 came Russell J. Andrews, W9AAB-W9ZZX, to represent the Rocky Mountain Division on the Board of Directors of the A.R.R.L. He is one of the old-timers, although amateur activity was curtailed from 1911 to 1920 while he travelled in domestic and foreign territory for a large automobile manufacturer, whom he joined from Lehigh University, following a course at Nazareth Hall. Automotive work has been his business, with the exception of five years in radio manufacturing in the early '20's. His main hobby is still trying to get some of Uncle Sam's gold—new silver dollars notwithstanding. The balance of his time is consumed by amateur radio, hunting, camping, and photography, not counting the idle moments spent trying to squeeze more miles out of a gallon of gas.

ANOTHER member of the "twenty year" club is Bob Eubank, W3AAJ, of Richmond, down in ol' Vuhjinny. It was back in 1914 when he started, with the coherer-spark-coil-Duck-catalog combination. When the Navy pulled his antenna down three years thereafter he concluded the only way to keep up with wireless was to join the Navy, so he went through Harvard naval radio school, and thence to NAJ, NAD, NAB, NAJX. His commercial "first" was issued by R. Y. Cadmus in Baltimore in 1923; since then he's been a commercial broadcast op, first with WMAS, then at WBBL, and now as chief operator of WRVA, all of Richmond. His first amateur call was 3CEB, but it was as 3AAJ that he became successively ORS, RM and finally SCM, organized the Virginia Net and published the Virginia Ham News, with the presidency of the Richmond club and a commission as Lieutenant (jg) in the U.S.N.R. among his laurels. Hunting is his outdoor hobby, ham radio the indoor—and he spends most of his time indoors!

TECHNICAL radio's highest honor—the presidency of the Institute of Radio Engineers—has been bestowed this year on C. M. Jansky, Jr., consulting radio engineer of Washington, formerly director of the Dakota Division of the A.R.R.L. Prof. Jansky first achieved prominence in amateur radio at the University of Wisconsin, initially as student and later as instructor, before 1920. In that year he accepted a call to the University of Minnesota, where as instructor of electrical engineering he was in charge of 9XI for eight years. This famous old station had as many as eighteen operators on its staff at one time. In 1928 he left Minnesota to serve as engineering consultant; in 1930 he organized Jansky & Bailey, in Washington. The firm specializes in broadcast coverage surveys; it was Prof. Jansky who devised the formula now used in indicating listener coverage. Radio engineering is his hobby as well as his profession. His chief delight is tinkering away in a well-equipped workshop in the basement of his home in Chevy Chase—still the amateur experimenter at heart.

AMATEUR extraordinary is C. Lee Herron, Minnesota amateur golf champion of 1933, several times entrant in the National Amateur Golf championship tournaments, and a radio amateur since 1916. His national reputation as a golfer was largely achieved by his winning the Minnesota open championship in 1932. At the present time, you'll find him playing in most of the important amateur matches, both national and local. In the intervening intervals, you'll find him operating his xtal station W9DWU on the 7 mc. band.

There are numerous radio amateurs outstanding in the world of sport, as well as in other fields. We want to present these interesting figures in "Hamdom." Your suggestions and contributions in this direction will be much appreciated.
Tuned R.F. for the Beginner’s Receiver
Improving Sensitivity and Selectivity with a Simple Amplifier Unit

By Don H. Mix, WITS*

That the several versions of the simple battery-operated receiver described in the three editions of How To Become A Radio Amateur are extremely popular with the beginner is proved by the fact that, with it, hundreds have enjoyed their initial thrill in the great ham game. Extreme constructional simplicity combined with very low initial cost and thoroughly practical and almost certain performance are its attractions for one taking his first steps into a new and somewhat complicated field.

Eventually, however, the progressive beginner starts to wonder what and how he may add to this receiver to secure more sensitivity. This is especially true in these days of a.c. receiver “wallop” and the recent trends towards detector stability and the necessity for increased selectivity.

Now it is usually thought that a stage of tuned r.f. amplification may not be added to an open breadboard receiver of this type without complete rebuilding of the existing detector unit into a thoroughly shielded form. As a result of this idea, the fellow looking for some sort of improvement turns to adding stages of audio amplification which serve only to raise the level of the general “hash” with little or no real improvement in performance. As has been pointed out before pre-detector amplifiers are desirable from other considerations than that of raising the signal level, not the least of which is to provide a means of controlling the input to the detector to prevent pulling and blocking on strong signals. With the question of the feasibility of adding an r.f. amplifier to a receiver of this type in mind, such an amplifier was made up. We will admit that we entertained no great hope of obtaining results which might be termed startling, but decided it would be worth the attempt even if we found detector isolation from the antennas as the only gain. We were, however, rather unexpectedly surprised when we found a real gain in “wallop” along with a respectable improvement in selectivity—with no serious amount of interlocking between detector and r.f. circuit tuning. That an r.f. amplifier will often eliminate the annoying a.c. hum from near-by power circuits so often encountered with the simple regenerative detector has proved to be especially true.

The two units as they line up with coil and tube shields in place

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The terminals from left to right in clockwise direction are as follows: Ground and -B; Antenna +67.5; +135\(^\circ\); -22.5\(^\circ\); -A Detector; -A and +C; +A to antenna terminal of detector unit; to ground terminal of detector unit.
in this case. For anyone who is using this type of receiver, it is well worth the few hours and few parts necessary to construct the r.f. amplifier.

CIRCUIT DETAILS

Fig. 1 shows the circuit of the r.f. amplifier in combination with that of the beginner's receiver described in the latest (third) edition of How To Become a Radio Amateur. It will be seen that no changes have been made in the original circuit. The r.f. portion follows the conventional circuit for such an amplifier with the exception that parallel plate feed through an r.f. choke is used. This was necessary so that the 5-prong detector coil forms might still be used. The advantages of the r.f. gain control have been pointed out in previous articles and need not be repeated here.

Since a filament type tube must be used and the filaments of the detector unit tubes are grounded, it was necessary to use the blocking condenser so that the tuning condenser might be mounted on the metal panel without short-circuiting the biasing battery. The rather peculiar filament wiring permits the A-battery switch to cut off all three filaments and also to connect the r.f. tube in series with the detector unit rheostat. The Type 34 variable-mu pentode was chosen because it is especially effective in circuits using the variable-bias method of gain control. It is the 2-volt d.c. version of the a.c. Type 58.

The photographs show the general construction. The aluminum panel, which is the same size as that used for the detector unit (9½ by 6½ inches in this particular case), is laid out so as to accommodate the exact dial and knob arrangement used in the original receiver. Likewise, the base dimensions are the same (9½ by 7½ inches). This identity of dimensions makes it possible to combine the two units easily and attractively as a complete receiver. Wooden cleats extending the entire length of both units may be fastened by a few screws to the under side of both bases, making a single solid unit. The metal portion of the r.f. base is of 1/16-inch aluminum 5½ by 7 inches.

On this are mounted the coil socket with its shield can and the socket for the Type 34 tube. A round hole is cut in the base to allow the tube socket to be mounted beneath the base so that a tube shield may be used. The coil shield used in this particular model is a National Type B30 and the tube shield is a National Type TS. Other shields of appropriate dimensions may be used, of course. To keep the losses within reason, the coil shield should not be much smaller than 3 inches in diameter and 3½ inches high. It should also be of a type the top of which may be readily removed for change of coils and which, at the same time, has an overlapping flange joint between the can and base capable of maintaining a good contact. The coil socket used in this receiver is a National 4-prong and the tube socket a National 5-prong. The coil socket should be mounted with suitable spacers between the socket and shield base.

The right-hand knob is the r.f. gain control, the other for the double-circuit type switch which

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serves to turn the filaments on and off, removing the r.f. gain control from the biasing battery at the same time.

The resistor $R_2$ is for the purpose of limiting the minimum bias on the control grid of the r.f. amplifier tube. It may be omitted entirely if a plate voltage of 90 or 45 volts is used, but should be used with plate voltages over 90.

**SUB-BASE WIRING**

The photograph of the under side shows the sub-base wiring and also the manner in which the wooden frame for mounting the metal base is cut out. In this case, the frame was made of three separate pieces of wood, the wide strips being 2 inches in width and the narrow one inch wide. The three strips are assembled by means of wood screws. It would be easier perhaps to make the frame from one piece of wood 9½ by 7½ inches and to cut an opening 6½ by 5½ inches. The panel and aluminum base are fastened to the frame by means of small wood screws. A space of about ½-inch is left between the panel and the metal base, and the two are connected together by means of a short piece of wire. This method removes the possibility of noise resulting from imperfect contact between the two. The wide strips serve as a means for mounting and insulating the various terminals. All wiring is done with semi-flexible "push-back" insulated wire. All circuit elements which should be grounded are connected to a common ground point by wire, eliminating the uncertainty of paths through the metal shielding.

The screen by-pass condenser and the grid circuit blocking condenser are mounted by means of one of the screws which hold the shield base in place. The r.f. feed condenser $C_7$ is mounted on its edge near one side of the sub-base opening. We happened to have one of the small Sangamo-Illini type on hand and used it, since it fits nicely into the small space between the tube socket and the frame. If one of the larger type mica condensers is used, it may be necessary to mount it differently.

The value of this capacity is not at all critical. Providing it is large enough since the coupling coil $L_3$ determines the degree of coupling between the amplifier and detector. Almost any value, 100 μfd. or larger, should be satisfactory. The National r.f. choke is connected to the plate terminal of the tube socket. It would be a good idea to wrap tape or a small piece of cardboard fastened with a couple of rubber bands around the choke to circumvent the possibility of the winding or terminals short-circuiting to ground. Looking at the top of the coil socket with the two large holes toward the observer, the left-hand small prong is connected to ground, the right-hand small prong to antenna, the left-hand large prong to the tuning condenser stator and the tube control grid, and the right-hand large prong to one side of $C_1$ and to the arm of $R_2$.

Fafnëstock clips are used as terminals and are fastened to the wooden strips by small screws similar to those of the original receiver. The battery connections as well as the connections between the two units are shown in the circuit diagram. It should be noted that the negative B-battery connection is made to the ground terminal in preference to connecting it directly to negative "A" battery externally. This connection is quite important to prevent burning out the tube filaments in case one of the positive "B" battery terminals accidentally comes in contact with any portion of the metal work. The two panels should be connected together with a short piece of heavy wire or metal strip.

**COIL CONNECTIONS**

The r.f. coils are wound on National 4-pin forms 1½ inches in diameter and are all wound with No. 30 d.s.c. wire. The number of turns for the different frequency ranges is given in the table. The spacing between $L_1$ and $L_2$ is not critical, 1½-inch being about right. When looking at the bottom of the coil form with the two large pins toward the observer, the lower end of $L_1$ is connected to the right-hand small pin, the upper end of $L_1$ to the left-hand small pin, the lower end of $L_2$ to the left-hand large pin, the upper end of $L_2$ to the right-hand large pin.

While the original detector antenna windings may be used satisfactorily without any change, greater signal strength will be obtained, especially at the lower frequencies if these windings are changed to conform with the specifications given for $L_3$ in the table. If the original windings were wound fairly close to the bottom of the form, it will be necessary to use smaller wire. No. 36 d.s.c. wire was used in this case.
TUNING PROCEDURE

The tuning procedure of the combined receiver is not at all difficult. It is true that the addition of the r.f. amplifier adds another tuning control, but the setting of this is not at all critical—much less critical than the usual regeneration control.

After the coils for any particular band have been plugged in and the filaments turned on and adjusted, the r.f. gain control should be set somewhere near maximum. With the detector padding condenser set at the desired point, the r.f. tuning condenser should be set at as nearly the same capacity as the detector padding condenser as may be roughly judged by eye. The detector unit is then tuned in the usual manner until signals are heard. It will usually be advisable to keep the regeneration adjustment somewhat away from the critical point during preliminary adjustments. Now tune the r.f. amplifier and a point should be readily found where the signal increases considerably as the r.f. stage is tuned through resonance. After this has been done, the regeneration may be brought to maximum and the r.f. gain control adjusted for the desired signal strength. The gain control will be found most useful on loud signals which have a tendency to block the detector with the gain control adjusted for maximum gain.

If the regeneration control is too close to the critical point during tuning, the tuning of the r.f. amplifier or the gain control may throw the detector into or out of oscillation. This is caused by the variation in detector loading and the extent to which this occurs will depend almost entirely on the stability of the detector circuit. It will be found that no adjustment of the r.f. amplifier tuning will be necessary over a fair portion of the detector vernier range. While a plate voltage of 135 should be used for the r.f. and audio output tubes for maximum performance, very good results may be obtained with a total plate voltage of 90 or even 45. When a plate voltage of 90 is used for the two tubes mentioned, the screen voltage of the r.f. tube should be maintained at 67.5 while the biasing voltage for the audio tube should be reduced to 9. For a total plate voltage of 45, the voltage of the r.f. screen should be 45 and the bias for the output tube 4.5 volts. Since not all brands of "C" batteries have a 9-volt tap, the required voltage may be secured by connecting an additional 4.5-volt "C" battery in series with the 4.5-volt tap on the 22.5-volt "C" battery as shown in Fig. 2.

![Diagram](image)

F.R.C. no longer writes letters to amateur licensees to serve as an extra operator license for the operation of a second station. Since the new regulations of October 1st, Rule 221(a) governs: "In the case of an amateur operator...the original operator's license shall be...posted or kept in his personal possession and available for inspection at all times while the operator is on duty.”

Note it must be the original operator's license. The business of photostat copies applies only to station licenses, where a copy may be used to cover the operation of a portable.

Hams who have trouble keeping dust off their bread-board layouts will find a dry paint-brush just the thing to sweep the dust out from under apparatus and wires.

--- W9KWZ

Judging by the sound of a lot of 'phones on the air these days, a good many hams must be using "depression" modulation—89% down from 100%.

--- W8CQO

As To Expired Licenses

MANY an amateur is finding himself in the following situation: He has been in temporary inactive; his operator license expired; his station license, having been extended automatically, is still in force; he is willing and able to pass the new examination for a new operator license; but Rule 402 seems to require activity of the station before issuing the new form of license, and obviously the station cannot be operated when the operator hasn't an operator license. What to do?

The answer is that the station license doesn't enter this picture. The amateur should fill out Part I of the application form, applying for a new operator license. It is not necessary to fill out Part II of the form, relating to station license, since the applicant already holds a valid station license. The station license is simply surrendered with the examination papers and then the F. R. C., for its own convenience, issues the new combined license form which not only serves as a new operator license but replaces the old station license. If you are taking the examination before an inspector, have your station license with you to surrender. If you are taking the Class-C examination by mail, send your station license along with your examination papers and filled-out application form.

That part of Rule 402 relating to station activity applies only in the case of renewal (and no station licenses expire until next January) or modification (as in case of change of address). It does not apply where the change is to be made only in the operator license.

--- W9KWZ

Correcting a misstatement in a "Stray" on page 84 of January QST:

--- W9KWZ

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Getting Power from the Winds

Constructional Details of Wind-Driven Battery Chargers for the Rural Amateur

The ham living off in the country away from power lines does not need to be reminded of his ever-present problem—getting enough power at the right voltage to operate a transmitter, even a small transmitter of modest power requirements. Now, turning the wind to useful work is far from new, but practical information on how to do it for the benefit of a radio station has been lacking. We are therefore pleased to be able to give the details of the installations used by two midwest amateurs to keep their transmitters on the air.

In both cases a home-made windmill with an airplane-type propeller—which, strictly speaking, is an impeller, not a propeller—is used to run an automobile generator which charges a bank of storage batteries. The power from the batteries is then converted for the transmitter by dynamotors or other suitable devices. The construction of the windmills will be of most interest to amateurs whose experience has been more along radio than mechanical lines.

The photographs and Fig. 1 give the details of the windmill built by Lewis Lamar, W9BWX, of Weston, Mo. The windmill and generator are mounted on top of an iron pipe which in turn is secured to a wooden tower. The station is in the shingled building which is built at the bottom of the tower, using the four sides of the tower as corner posts. The main details of the windmill construction should be made clear by Fig. 1. A piece of 1¾-inch pipe is the main support. Over it is fitted a short length of 2-inch pipe to the top of which is welded an 8-inch piece of auto frame. The small pipe holding the tail is welded to one end of the frame, while a front-wheel hub taken from an old Model T Ford is welded to the other end with the bearing axis vertical. A steel baseplate, 8×8×3¼ inches, welded to a spindle which fits the hub in its original bearings, supports the impeller bearing and the d.c. generator.

The impeller shaft, a piece of 1-inch steel rod, turns in hardwood bearings 2 inches thick, 3½ inches high and 8 inches long. The bearings are boiled in oil to make them waterproof. Two bolts fasten each bearing to the mounting plate; the same bolts also hold the generator mounting, which is made from small angle irons bolted to the generator frame through small holes drilled in the frame for that purpose. The impeller is held to the shaft by a special machined flange, while at the other end of the shaft a special fitting holds the large timing gear in place. The fitting permits unscrewing the gear so that the wooden shaft bearings can be renewed when necessary.

The mill turns freely on the hub in which the spindle is placed, thus making it possible to turn the mill out of the wind. One end of a rope is fastened to the baseplate as shown in the drawing; the other end runs down through a 1-inch pipe which is centered in the 1¾-inch mounting pipe. When the rope is pulled the baseplate swings around, against the tension of the coiled door spring, thus pulling the mill around at right angles to the tail. When the rope is released the mill springs back. To avoid cutting the rope as it comes through the frame a small pipe elbow, not shown in the figure, is screwed in the hole in the frame through which the rope passes.

The positive wire from the post on top of the generator—also from a Model T Ford—
runs down through the inner pipe as shown. The negative side of the generator is grounded to the steel frame of the mill and the connection taken off at the bottom of the supporting pipe. No. 6 rubber-covered wire is used for all leads. All joints in the mill are welded, and care was taken to see that the mill balanced nicely on the supporting pipe.

THE IMPELLER

The success or failure of the mill will depend upon the impeller. The one at W9BWX was built after a design by Prof. L. G. Heimpel, originally described in Popular Science for August, 1933. Its dimensions are given in Figs. 1 and 2.

The impeller blank was made by gluing together three 1×7 inch selected pine boards, 6 feet long. These were then roughed out as shown in the upper drawing of Fig. 2 with the aid of a bandsaw. The straight side is the front. The carving was done with a draw knife and smoothed down to final shape with a wood rasp and sandpaper.

A smooth taper is essential for best results. The lower drawing of Fig. 2 shows typical cross-sections at intervals along the length. The leading edges are rounded while the trailing edges are sharp; the front is straight and the back is tapered. With this particular generator and the gearing system used, the impeller must turn in a clockwise direction. It would be worthwhile to whittle out a small model first to make sure that the direction of rotation will be correct.

At W9BWX the mill is used to charge two six-volt storage batteries in parallel. Since the plate-supply dynamotor draws 30 amperes from the battery it is evident that the mill has plenty of work to do. The mill ordinarily runs two or three days a week, and charges at a reasonable rate in a strong wind. The batteries are kept fully charged with normal operation of the transmitter even during the time of the year when the least wind is to be expected at W9BWX's location.

The generator cutout is located in the battery shack, although it could be mounted in its original place on the generator. However, it is more convenient to have it with the batteries so that it is accessible when adjustments are needed.

AN ALTERNATIVE DESIGN

Another air-driven charger, working on the same principle but with different constructional details, is shown in Fig. 3. It was built by Rodney C. Mitchell, of Yukon, Okla. Again considerable use is made of parts from the always-useful Dearborn product.

The main bearing on which the mill assembly is mounted is taken from the front axle of a Model T Ford, cut off about 18 inches from the king bolt. The main support of the mill is a wooden head block of the dimensions shown in the drawing. The tail, which may be made of wood or sheet metal, is bolted to a length of pipe which in turn is bolted to the head block. The mounting for the impeller is a second section of Model T Ford front axle and hub (the side with the left hand threads), held to the head block by a bolt through the spring perch hole and a U-bolt fitting over the axe toward the rear of the piece. A brace should be run from the steering rod to the bolt in the spring perch hole to hold the axe bearing rigid; the king bolt and bushings in top and bottom also should be tight. The impeller is held to the wheel hub by four bolts, the

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spacing of which will depend upon the particular type of axle used. The brake drum, mounted as shown in the drawing, is used as a pulley; it should be at least 14 inches in diameter. Particular care should be used to see that the drum is correctly centered on the hub. The drum should be located so that it just clears the head block.

The impeller used at W9BWX, although the dimensions differ. The front face makes an angle of 42 degrees with the front of the board at the hub; the angle decreases uniformly until at the tips it is 15 degrees. The blades are 3/8-inch thick at the tips and 3/4-inch thick at the hub. The impeller should turn in a clockwise direction, unless the generator used is designed for rotation in the opposite direction. Again a small preliminary model will be helpful.

When the impeller is completed it should be carefully balanced indoors (to avoid air currents) by bolting it on the axle hub and bearing and then taking off thin shavings on the heavy side until it will stay put in any position. Light oil should be used on the bearing when balancing, but when the mill is put into operation cup grease should be used. After the impeller, tail and generator have been mounted on the head block the point of balance of the whole assembly should be found before boring the hole for the hub on which the head block revolves; if this is not done the head block will not be level nor turn freely.

The tower on which the mill is mounted is made 2X4's, with the Ford axle bearing bolted to a short length of 6X6 at the top. The tower should be high enough to give the impeller about 8 feet clearance so there will be no danger of its striking a person walking underneath. It will turn at about 500 r.p.m. in a high wind. The pulley ratio is about 8 to 1, while the generator will charge at 800 r.p.m.

The drawing is not to scale.

Details of the generator support are given in the lower drawings of Fig. 3. The generator rests in half-circles cut in 2-inch blocks, with a small piece of 2X2 between. When the generator is mounted on its support (left-hand lower drawing) a U-bolt goes over it, down between the mounting blocks and through the slot in the support. The support itself is a piece of 2X8, approximately 3 feet long. When bolted to the head block in such a position that the generator pulley will line up with the brake drum, the slot in the generator support permits locating the generator so that the belt will be tight. The belt used by Mr. Mitchell is a Dayton No. 510, 3/4-inch, V-type.

The impeller is cut from a 6X8 plank, 8 feet long. Fir or pine free from knots should be used. The general construction is similar to that of the

---

**FIG. 3—CONSTRUCTION OF THE WIND-DRIVEN CHARGER BUILT BY RODNEY C. MITCHELL**

The drawing is not to scale.

---

The wires from the generator are allowed to hang down with three or four feet slack. The impeller is tied to the head block with a rope when not running. The cutout is also installed at the battery location in this case.

---

G. G.
INTEREST in the 5- and 10-meter bands is increasing; it is going to be popular to operate in both of these bands during the coming season. All kinds of tubes are being used, from the small 30 to the mighty 800. Other types that should find favor among amateurs for low-power work on five or ten meters are the tubes made for Class-B work, such as the 19 and 53. Although designed primarily for Class-A driver and Class-B audio service, these tubes also make splendid oscillators in push-pull circuits, being especially suitable for unity-coupled circuits where the grid excitation coil is within the plate tank coil. Hence the above triple-purpose designation.

AS OSCILLATORS

The 19 has a two-volt filament drawing 0.25 amperes. Its maximum plate voltage is 135, while the maximum plate volts (instantaneous rating) are 50. As specified for Class-B service, it has an output of 2.1 watts. As an r.f. oscillator, two watts output also can be expected when operated at 135 volts. Hence it would appear to be the very tube we have been looking for to build into that portable transmitter. The 19 is actually two tubes in one, making all connections between elements the shortest possible since all terminals are on one socket.

The 53 is another such tube. Its cathode is of the indirectly heated type for operation on 2½ volts a.c. or d.c., but preferably a.c. With a plate voltage rating of 300 volts maximum and a plate current maximum of 100 ma., it will put up a good scrap on five or ten meters. As in the case of the 19, the unity-coupled circuit finds favor since all connections are at one socket. Ten watts of r.f. output can be expected.

At W1QP both types have been used with good results in the circuit of Fig. 1, the 19 as a portable transmitter tube and the 53 as an a.c. operated portable or fixed-station transmitter tube. For five-meter work, the 2½-inch diameter plate tank coil is composed of approximately two turns of ¼-inch copper tubing with the insulated grid coil inside. A hole is drilled in the tubing just midway—at the voltage node—with the grid center-tap emerging through this hole; this is also the place where the plate supply connection is soldered to the tubing. For ten meters, the number of turns is doubled, the diameter remaining the same. Some trouble was experienced in fishing the grid wire through the copper tubing, but it was accomplished eventually with exercise of patience. Spaghetti tubing is used as the insulator through which bare copper wire was pushed.

The copper tubing is soldered directly to the tabs on the socket at the plate connections, and the grid wires are crossed over each other to the opposite grid tabs and are soldered there. This arrangement allows the tube socket to be mounted on a bakelite baseboard so that the tube is above the shelf and the tank coil below. The antenna coupling coil of one turn is mounted so that it goes between the tank coil turns, from a binding post on one side to another on the opposite side. This keeps the antenna coupling fixed and out of the way. The Hertz antenna is connected to the binding posts. For five meters, each antenn-
half is 43 inches, while for ten meters it is 86 inches.

A 50-µµfd. variable midget condenser is used to tune the plate tank to the antenna, the antenna length being adjusted for resonance at the desired frequency. At resonance the plate milliammeter reads maximum, readings being less on either side of resonance. This was checked with an r.f. meter connected at the antenna binding post in series with one side of the radiating system.

Self-bias is used for the oscillator. For the 19 (with a separate filament supply), the resistance R₂ is 200 ohms, while for the 53 it is 400 ohms. This method of obtaining bias has the merit of providing self-protection, since, as the plate current increases, the bias does likewise. The method, therefore, limits the permissible plate current for any given plate voltage and is preferred to grid-leak bias. This brings us to ways and means for modulating the 19 or 53.

**DRIVER AND MODULATOR**

Both the 19 and 53 are good Class-B modulator tubes; the 19 will modulate satisfactorily approximately 4 watts and the 53 approximately 20 watts of oscillator plate input. The 19 as a Class-A tube will drive a 19 used as a Class-B tube; and the 53 as a Class-A tube will drive another 53 used as a Class-B tube.

The plate-to-plate load requirement of the 19 as a Class-B tube is 10,000 ohms and must be matched by the 2500-ohm plate circuit resistance of the oscillator (50 ma. at 125 volts). It should be remembered that the 200-ohm self-bias resistor subtracts 10 volts from the total plate supply of 135 volts. Likewise, the plate load requirement of 10,000 ohms for the 53 has to be matched to the input resistance of the r.f. tube, which is some 3000 ohms after the drop through the self-biasing resistor has been taken into account. (Plate input 90 ma. at 265 volts.) The transformer turns ratios are figured accordingly.

If one has a few old cores at hand that have a cross section of at least \(\frac{3}{4}\) by \(\frac{3}{4}\) inches and with winding space of 0.5 by 1.5 inches, the transformers can be made at home and, even though home-made, should give good results.

For the 19, the transformer primary should have a turn ratio of 3.2/1 primary to \(\frac{3}{4}\) secondary. With a core of the above size, the primary should be 7000 turns of No. 40 enameled wire, while the secondary has 4400 turns of No. 38 enameled with a tap at 2200 turns. The output transformer for the 19 may have a 2000-turn primary winding of No. 38 enameled wire with a tap at 1000 turns, and 1000 turns of No. 36 enameled wire for the secondary.

For the 53, the input transformer primary is 5500 turns of No. 40 enameled wire, and the secondary 2200 turns of No. 36 enameled with a tap at 1100 turns. The output transformer will have a primary of 3650 turns of No. 37 enameled wire with a tap at 1825, while the secondary will have 2000 turns of No. 34 enameled wire.

It will be best to wind the coils so that each \(\frac{3}{4}\) primary and \(\frac{3}{4}\) secondary is a section or pie; there will be four such sections for a transformer. The sections should be insulated with heavy paper, both over the core and between the sections. Afterwards the whole transformer can be immersed in molten paraffin to insure good insulation.

The set diagrammed in Fig. 1, using 53's, has been on the air from W1QP for over a month on both five and ten meters. Locally, the results have been splendid.

**Strays**

A machinist's scratch awl makes a handy tool to start nuts in tight places. The hooked end also is FB for fishing out small wires.

--- W1AUG

**FIVE METERS**

A Radio Playlet in Three Acts

All scenes are laid in the transmitting plant of one of the large network stations.

**Act 1, Scene 1**

A full-fledged 56-mc. bug, developed from a larva of the genus bookworm of the special type inhabiting the pages of QST, bites several of the operators in unguarded moments.

**Scene 2**

During one of the big "Ciggie" programs, the operator calls "Hello W blub blub blub, this is W blub blub blub calling you. Ye gosh, what terrible call letters . . . " — and more of the same.

**Scene 3**

Telephone begins ringing. BCL's all over town complain that some amateur is interfering with "Ciggie" program.

**Act 2, Scene 1**

Transmitter gets out. Swell! Decision is made to use regular voice modulation.

**Scene 2**

Telephone begins ringing. BCL's all over town complain that some amateur is interfering with "Ciggie" program.

**Act 3, Scene 1**

Operators hastily dismantle and hide parts of 56-mc. transmitter.

**Finis**

Yes, it actually happened. Where and when is a secret we're not giving away.
Biasing the Power Amplifier
Practical Considerations in the Use of Power Packs for "C" Bias
By George Grammer, Assistant Technical Editor

CAN I use a "B" eliminator for bias in an r.f. power amplifier stage? The answer to this question, lately a favorite among those addressed to our Technical Information Service, depends upon the circumstances. For some purposes a "B" eliminator has definite advantages over plain battery bias; it is certainly preferable to getting bias through a grid leak unsupported by a fixed bias-voltage source independent of the excitation. But in certain special cases a "B" eliminator of ordinary design may not fit into the picture at all. We shall point out the specific cases.

Consider first the case of the amplifier in which most of us are interested: the ordinary amplifier which follows—several stages of it, frequently—the oscillator in a c.w. transmitter; or the stages leading up to the modulated stage in a 'phone transmitter. (Class-B linear and Class-B audio amplifiers are in a separate category.) The bias on such a stage is commonly adjusted so that the output power is highest for the excitation available. If such an adjustment can be made as satisfactorily with "B" eliminator bias as with batteries, then there can be no argument against using the eliminator.

Now it might be said that voltage is voltage and it makes no difference whether it comes from batteries or a power pack. That would be true if the characteristics of the voltage source could be neglected; in other words, if the voltage regulation under load made no material difference. Regulation cannot be neglected when a "B" pack is used for bias. Lots of us have used eliminators for bias only to find that after the amplifier is running the eliminator can be shut off without changing the output or tube heating or anything else; obviously there is still bias, otherwise the tube wouldn't work with its former efficiency. The answer, of course, is that there is a grid leak in the circuit, and we don't have to look far to find it.

"B" eliminators are, or should be, equipped with bleeder resistors, which are nearly always tapped so that various output voltages are obtainable. Since the eliminators are inherently low-power devices designed to give small output currents at relatively high voltages, the voltage divider or bleeder must have fairly high resistance. A common value for an eliminator built to deliver 180 or 250 volts is about 15,000 ohms. A 15,000-ohm resistor makes quite a respectable grid leak.

SOARING BIAS

To get a picture of what happens when such a power pack supplies bias voltage in a transmitter, look at Fig. 1. Suppose the eliminator output is 180 volts and the voltage divider has a total resistance of 12,000 ohms, tapped every 3000 to give the voltages indicated. Assume that the desirable bias voltage for the type of tube in use is 90 volts; the negative terminal of the power pack is connected to the grid and the "plus 90" terminal to the filament center tap. Now between those two taps we have a resistance of 6000 ohms, which can and does act as a grid leak. As soon as the excitation voltage is great enough to make the amplifier tube draw grid current—and practically all amplifiers which operate with fair efficiency do take grid current—that current will flow through the 6000 ohms. Since it flows in the same direction as the normal current supplied to the voltage divider by the rectifier and filter, the two currents add together. The normal bleeder current as read by meter M2 would be 15 milliamperes in this example, if the grid current of the tube read by M1 is 10 mils, the resultant will be 25 mils. If 25 milliamperes flow through 6000 ohms, the voltage across the 6000 ohms will be 150 volts.

Actually, the calculations are not quite so simple, because when grid current starts to flow through the voltage divider the current supplied by the eliminator will no longer be 15 milliamperes. That part of the divider through which grid current flows takes on the characteristics of a small power pack itself and the voltage developed bucks the eliminator voltage so that the divider no longer looks like a simple resistance of 12,000 ohms. The effect of this is that the current read by M2 decreases so that the resultant of 150 volts arrived at by the simple calcula-

March, 1934
tion in the previous paragraph is inaccurate; the actual voltage would not be quite that high. The situation is further complicated by the fact that the output of the rectifier-filter will not remain constant at 180 volts when the current changes; the voltage regulation of most elim-

FIG. 2--A PRACTICAL CIRCUIT FOR THE "C" SUPPLY

A single 8-µfd. condenser often will suffice for the filter, but if trial shows that more is needed, a choke and second condenser, shown in dotted lines, may be added. The condensers should be rated at 500 volts, especially if the "C" supply is to be used on a high-power stage where the excitation is likely to be large.

The bias voltage, $E_b$, should be approximately that value which will cut off the plate current of the tube at the plate voltage used (roughly the plate voltage divided by the voltage amplification factor of the tube). Resistor $R_b$ should be equal to the grid leak value ordinarily used with the tube. The required resistance for $R_b$ can be found by the formula

$$R_b = \frac{E_b - E_t}{E_t} \times R_t$$

where $E_t$ is equal to the peak value of the transformer-rectifier output voltage (r.m.s. voltage of one side of secondary multiplied by 1.4).

itors is so poor that the output voltage is very sensitive to small changes in current. The voltage at the terminals of the divider therefore will rise to some extent. Fortunately the exact determination of bias voltage is of relatively little importance in the case of an ordinary amplifier; it is only necessary to know that the bias will increase when the amplifier is excited. It is desirable to remember this, however; When the grid current is sufficient to cause the voltage to rise to the peak value of the rectifier output voltage (1.41 times the transformer voltage) the rectifier-filter no longer will deliver current. It is possible to exceed this value if a low-voltage eliminator is used to bias a tube of medium power; if this happens watch out for the filter condensers in the eliminator. Some of the older units have condensers which just about stand up under ordinary service; they may go West in a hurry if the bias voltage builds up from grid-current flow.

USING A "C" SUPPLY

For the ordinary amplifier the "B" eliminator would seem to be an almost ideal bias supply. It does several things which should be done. It provides the necessary protection to the amplifier tube should the excitation fail. The actual bias on the tube automatically adjusts itself to the excitation, within limits, so that the tube operates at good efficiency over a wide range of excitation. The only disadvantage is that a single power pack for several stages is rather unsatisfactory for the same reason that a single grid leak resistor for several stages would be unsatisfactory; anything that causes the grid current on one stage to change (a tuning adjustment, for instance) also changes the bias on all the other stages, since all grid currents flow through a common resistor. Further, if two or three stages are supplied with bias voltage from a common power pack, the voltage drops caused by grid-current flow through the divider resistor add up; the greater the excitation at the last stage the higher goes the bias on the preceding stages. The net result of this is that all the stages are overbiased and the power output is cut down.

From the preceding paragraphs it is obvious that the resistance of the voltage divider used plays an important part in the performance of the "B" eliminator as a bias supply. If, as is often the case, the eliminator is one which has been picked up at a bargain price or inherited from defunct B.C.L. accumulations, it will pay to ascertain just what the resistances are between the various voltage taps. Here is a good rule to follow:

Choose the taps which will give just about the right voltage for cutting off the tube plate current when not excited, and make certain that the resistance between these taps is approximately the value that would be used as a grid leak for the same tube. This really amounts to using grid-leak bias, with all the advantages accruing from automatic bias, and at the same time having the protective feature of the steady voltage from the eliminator. As normally operated, the eliminator voltage does not have much influence unless the excitation is so low that grid current does not flow; with normal excitation the bias will be purely automatic. If the resistance between the correct voltage taps is, on measurement, found to be too high, a resistor of the right value should be connected across the taps. If this is not done the amplifier will be over-biased, just as it would be with a grid leak of excessive resistance. Make certain that the voltage divider and auxiliary resistor are capable of carrying both the eliminator current and the grid current without danger of burnout. A rating of 25 watts for every 5000 ohms should be ample for anything up to a pair of 100-watt tubes.

MAKING A BIAS ELIMINATOR

Although almost any "B" eliminator having a maximum output of about 200 volts will do a good job of biasing a single stage, provided the points enumerated above are kept in mind, there may be some who want to build one up from the ground floor. Comes then the question of filtering, which turns out to be easy. Since the rectifier-filter is called upon to furnish only bleeder current the filter need not be very elaborate. An ordinary brute-force affair with a choke of 25- or 50-mil rating and a couple of inexpensive electrolytic condensers will be plenty; in fact, a single 8-µfd.
STRAYS

W9BLE is enthusiastic about the argon tube to replace the neon bulb for touching hot places in the transmitter. A 12- or 14-inch tube can be made up by your local neon sign manufacturer at a cost of $1.50. It has the advantage that the relative intensity of the r.f. voltage at the point touched can be observed by noting the length of the glow in the tube, whereas the neon tube either glows throughout its entire length or not at all.

Fellows using 83 rectifiers at higher-than-normal voltage now and then run into trouble with breakdown of insulation inside the base and stem, even though the tube elements themselves seem to hold up under the abnormal inverse peak voltage. W9CKZ and W9AIK found that insulation troubles of this sort could be cured by drilling a pair of 1/8-inch holes in the bottom of the base and filling the base with transformer oil. After filling, the holes can be plugged up with sealing wax, or the tube can be mounted in an inverted position.

Live and learn, says W6CKS. It seems that a couple of Los Angeles 'phone hams recently discovered a marvelous new antenna called the "Fuchs," for which extreme DX and ease of installation are claimed. Maybe we ought to put a label on the "simple voltage-feed antenna" that has been in every edition of the Handbook. It's called the "Fuchs antenna" in Europe.

W2ESO suggests the slogan "We Doom Our Parts" for those guys who think tubes don't begin to work until you have at least double the rated voltage on them.

"Service Hints" is the title of a highly practical booklet containing outstanding service experiences of numerous service men. The notes are classified according to the make and type of receiver concerned. Copies may be obtained from the Hygrade Sylvania Corporation, Emporium, Pa.

W3BUU wants to know if someone has changed the meaning of "QSP"? The standard answer to the query seems to be "W1 nil hr cul 73"!

At a club raffle W3BZI won a nice bottle with ticket No. 13—and dropped it two minutes later!

The portable described in November, QST no longer signs W9ZZAF, the call having passed back to the F.R.C. to be buried in its files, under the new regs regarding portables. W9DLS (with the necessary addendums) is the call now being used.

Cheap transmitting coil forms can be made from old phonograph records. Boil the record in water until soft, then cut in strips and shape them about a cylinder of the desired diameter. After hardening, the forms can easily be drilled for mounting on stand-off insulators.

W2FIS claims that his rig knows the alphabet. His log shows that he worked 2GH, 3IJ, and 8KL in succession!

W2VY writes that, in using twisted-pair feeders as described in the Experimenters' Section, September, QST, the feeders should be taped at the point where they separate, otherwise they may cease to function in rainy weather. At W2VY, the feeders are covered with a layer of rubber tape over which is wound a layer of friction tape, the whole then being given a coat of lacquer. With this precaution the feed line works perfectly even after three or four days of continual rain.

A method of using the 5000-kc. transmissions from WWV every Tuesday to check the frequency of crystals or calibrate frequency meters is described in Letter Circular No. 314, "Use of Standard Frequency Transmissions in Checking Standard Oscillators," published by the Bureau of Standards, Washington. Copies are available from the Bureau on request.

W9FFH finds an old toothbrush handle filed down to work like a screwdriver is FB for adjusting neutralizing condensers, trimmers, and other variables where there is danger of a short-circuit or troublesome body capacity.

Our Information Service often receives requests for data on equipment for locating sources of electrical interference, and those who have occasion to want such information will be interested to know that a portable outfit is now being manufactured by the Toe Deutchmann Corp., Canton, Mass. It is described in Engineering Bulletin No. 232, which is available on request.

March, 1934
The Light-Bulb Resistor

By D. C. Redgrave, KAINA*

A HANDY type of resistor for all sorts of use around the "shack" is the ordinary light bulb. It is cheap and convenient, and can be quickly changed for one of another rating. It has the advantage over other types of resistors of giving a visual indication of the current flowing through it. Furthermore, because of the difference in the resistance-temperature characteristics of metallic and non-metallic filaments, we can choose the type of bulb desired and utilize this characteristic to advantage.

It is generally known that the resistance of a light bulb varies over a wide range as the current passing through it is changed. Of course we can calculate the resistance at rated current and voltage, but this will not give us the resistance when less than normal current is flowing. This very uncertainty is largely responsible for the lack of general use of the light bulb as a resistor, and our purpose here is to present certain data in tabular and graphic form so that we may estimate the resistance of any bulb with a degree of accuracy approaching that required in practice.

Fig. 1 gives the resistance-current curves of two bulbs, one having a carbon (non-metallic) filament, and the other a tungsten (metallic) filament. Observe how the carbon bulb's resistance starts at a value above normal, decreasing non-uniformly until about one-half normal current is reached, and from that point on decreasing with fair uniformity. On the other hand the tungsten filament starts at a very low resistance which increases rapidly at a nearly constant rate as the current is increased. The tungsten bulb is, therefore, not suitable for use where we want a fairly constant resistance over a wide range of current, but it is just the thing to use as a dropping resistor with constant current. Here we get a ballast action which opposes the natural increase of current due to an increase in voltage, and which reduces the drop in current when the line voltage falls. When operating constant-current devices from the house mains at reduced voltage, we can minimize the effect of line-voltage fluctuations by the use of the tungsten bulb as dropping resistor. For intermittent operation where an initial current surge followed by a drop in current is desired—for example, when dropping the voltage down for a keying relay—the tungsten bulb is ideally suited.

The carbon filament, within the range from one-half normal to normal current, is better suited for use where fairly constant resistance under varying load conditions is desired. Within this range the change in resistance is about 24% of the resistance at rated voltage; for smaller variations in current the change would be correspondingly less. If a more constant resistance is desired we might parallel a carbon and a tungsten bulb (each of half the wattage rating required of a single bulb) or use one of each type of twice the required rating in series. In a circuit where we wish to prevent a large initial rush of current or one in which we desire the current to rise gradually after the circuit is closed, the resistance-temperature characteristic of the carbon filament meets our demands.

The table gives the current, resistance at rated voltage, and the approximate cold resistance of a number of bulbs of different ratings. Data for other bulbs may be estimated. The resistance at normal current of bulbs of the same wattage rating varies as the square of the voltage rating. For example, required to find the resistance of a 50-watt, 115-volt bulb. The resistance of a 50-watt, 115-volt bulb is 264 ohms. The resistance required is, therefore,

\[
\left(\frac{32}{115}\right)^2 \times 264 = 20 \text{ ohms}
\]

Likewise, the resistance of a 100-watt, 240-volt bulb would be

\[
\left(\frac{240}{115}\right)^2 \times 132 = 575 \text{ ohms}
\]

The resistance of bulbs of the same voltage rating will vary inversely as the wattage rating. For example, required to find the resistance at rated voltage of a 60-watt, 115-volt, tungsten bulb. From the table, the resistance of a 50-watt bulb...
115-volt bulb is 264 ohms. The required resistance is therefore

\[
\frac{50}{60} \times 264 = 220 \text{ ohms}
\]

Fig. 2 gives us the means of determining quickly the voltage drop across any tungsten or carbon bulb, or a bank of either type in parallel, when the current through a single bulb is known. For example, required to find the voltage drop across a 50-watt 115-volt, tungsten bulb when a current of 0.3 amp. is flowing through its filament. From the table, its rated current is 0.44 amps. 0.3 amps is 68% of 0.44. Using the lower (tungsten) curve, we find that 47% of rated voltage corresponds to 68% of rated current. The required drop is therefore 47% of 115 or 54 volts.

Suppose we desire to operate a device which draws 0.3 amp. at a voltage of 90 using the regular HO-volt mains. The above calculations show that the 50-watt bulb would drop the line voltage too much and that lower resistance bulb should be tried. A 100-watt bulb of the same type would have \(\frac{0.3}{0.87}\) or 34% of rated current. Projecting this abscissa to the tungsten curve, we find the ordinate to be 15%, or 17 volts. This drop about meets our requirements, and due to the ballasting action of the tungsten filament the 100-watt bulb will be suitable. The diagonal dashed line in Fig. 2 may be considered as representing a resistor having constant resistance. Note that the carbon bulb curve more nearly approximates this condition. However, for many purposes, such for example as the one given above, the tungsten characteristic is more suitable.

Sometimes it is desired to make a rough estimate from the filament glow of the current flowing through a bulb. In the case of house-lighting bulbs, take one-third of the current at rated voltage for a dull red filament, and two-thirds for a bright yellow filament. For the smaller bulbs slightly greater proportions of the normal currents are required to produce the same color. In auto and flashlight bulbs about one-half normal current will produce a dull red filament and about three-quarters a bright yellow.

The experimenter will find many other uses in addition to those given here for the curves of Fig. 2 when using light bulbs at reduced voltages and, without the usual uncertainty regarding the resistance characteristics, should find more general use for this convenient form of resistor.

### Table of Filament Data

<table>
<thead>
<tr>
<th>Type of Filament</th>
<th>Rating</th>
<th>Current at Rated Voltage</th>
<th>Resistance at Rated Voltage</th>
<th>Resistance Cold (Approx.)</th>
</tr>
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<tbody>
<tr>
<td><strong>Tungsten</strong></td>
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<td>House Lighting</td>
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<td>1320</td>
<td>132</td>
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<td>.22</td>
<td>330</td>
<td>43</td>
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<td>32</td>
<td></td>
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<td>264</td>
<td>22</td>
<td></td>
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<td>10.0</td>
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<td>2.4</td>
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</tr>
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<td>8.8</td>
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<tr>
<td>3.8-volt</td>
<td>0.30</td>
<td>12.7</td>
<td>3.4</td>
<td></td>
</tr>
<tr>
<td><strong>Carbon</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>15-watt, 110-volt</td>
<td>.14</td>
<td>807</td>
<td>1380</td>
<td></td>
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<tr>
<td>50-watt, 110-volt</td>
<td>.45</td>
<td>247</td>
<td>438</td>
<td></td>
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<tr>
<td>100-watt, 110-volt</td>
<td>.91</td>
<td>121</td>
<td>258</td>
<td></td>
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Bell Lab. Record On Subscription Basis

Distributed previously on a complimentary basis to a selected mailing list, the Bell Laboratories Record, published by the B. T. L. as a companion to the well-known Bell System Technical Journal but of less technical nature, is now available on a subscription basis. Although its editorial content covers telephone equipment in general, a goodly share of radio and nearly allied articles make it interesting to people whose principal activity is in the radio field. The subscription price is $2.00 per year ($1.25 to employees of companies in the Bell System), foreign postage extra. Subscriptions should be addressed to Bell Laboratories Record, 403 West St., New York City.
Conference on Emergency Communication

We Retain Freedom To Render Maximum Public Service

RECENTLY a proposal was before the Federal Radio Commission to allocate one or more frequencies exclusively for emergency communication. An engineering conference was called by F.R.C. at which all organizations interested in the matter participated in a round-table discussion. Amateur radio undoubtedly being the nation’s most useful servant in time of community disaster, we attended the conference. All the government departments interested in radio and most of the American communication agencies were also represented.

The proposal arose from a suggestion made by an emergency-preparedness committee of a southern California city. The basic idea was that all stations of whatever sort participating in relief communication should use certain frequencies reserved for that purpose, and that all such communication work should be coordinated and controlled by a central station under management of the municipality concerned. One of the objectives rather plainly sought was censorship of news from the affected area.

The chief effect of any such unfortunate plan would be to reduce the ability of amateur radio to serve in emergencies—to reduce it about to the vanishing point. We went to the conference, then, in our fighting togs. We had prepared a partial chronological record of amateur service in emergencies and were ourselves amazed at its length and profound evidence of value. At the meeting we pointed out that this service was possible chiefly because there were skillful amateurs everywhere, and that its very success lay in letting each of us continue to use our own methods, our own frequencies. There are so many of us that each amateur may remain free to give his services to whatever emergency plan he elects and still adequately supply all of them with that invaluable blanket of service that only the amateur can give. We showed that such a plan as proposed would throttle off our ability to help, and we demanded in the nation’s interests the continuance of our complete freedom to serve as we have in the past. We were completely backed up by the Army Signal Corps, in liaison with whom we maintain the Army-Amateur Radio System, chief instrumentality of amateur assistance in community disaster. The Navy, although willing to coordinate its own emergency communication with any plan adopted, supported our right to liberty without submitting to censorship of compulsory coordination by unknown agencies; so did the Coast Guard. Thus although the suggestion that started the meeting would have tied our hands, our representations were convincing and the conference agreed with us. We have retained our freedom to render maximum public service. Just another A.R.R.L. job.

The conference brought out the importance of reestablishing wire telephone service after emergencies. Experience has shown that this generally takes one or two days. It is during this period that radio is most needed. Existing radio agencies already cover the United States. There is no need to set up a new national network for emergency communication. However, there is often need for better communication locally within a stricken area. This might well be effected by small complete radio stations strategically placed throughout an area subject to disaster, under the control of special local organizations which could have regular drills and practice, on frequencies suitable for local work. The conference then adopted recommendations, which were later confirmed by the F.R.C., whereby it was decided not to allocate any national distress frequency and not to foster any new national emergency-communication organization. Local emergency committees are encouraged to organize all existing communication agencies to provide effective emergency communication, but each radio station retains its freedom of action and in any work it does it will use its regular frequencies. Where an emergency network for local communication is needed, the Commission will license special emergency stations. These will use the frequencies of 2726 kc. (for c.w. telegraphy only) and 3190 kc. (for c.w. telegraphy only) and are to be employed only when all forms of wire communication fail, except that they may be used for testing purposes not to exceed two hours per week. Broadcasting and similar stations normally licensed only for a particular purpose or for work between stated points may engage in emergency communication service upon sending notice to F.R.C.

Nothing in this affects amateur radio. We remain individually free to give our emergency-time allegiance to the Army-Amateur Radio System, the Red Cross, the Naval Reserve set-up, our municipality or the public generally—as we elect. Of course it is only proper that all organizations requiring emergency service endeavor to make use of existing facilities of all agencies in their areas, as long as there is no compulsion behind it. We amateurs are tremendously proud of our ability to render service. Many amateurs have already fitted themselves into various planned networks for emergency communication and know just what they are to do if an emergency

(Continued on page 86)
Armistice Day Message

The fifth annual Armistice Day Message from the chief signal officer of the Army was transmitted on the night of November 6, 1933, from W3CXL-WLM, the Army net control station of the A.A.R.S., located in the War Department, Washington, D.C. Since 1929 this transmission has become an annual event, especially to amateurs affiliated with the Signal Corps in an organization whose origin was sponsored by the American Radio Relay League and which is known as the Army Amateur Radio System.

In accordance with established practice the reception of this message was made a competition for the nine corps area organizations of the A.A.R.S. Each amateur was requested to copy the message and mail the copy to the chief signal officer. The corps areas were scored on the highest percentage of mailed-in copies and also upon the highest percentage of accurate copies. A message was scored as being either accurate or inaccurate. The entire transmission was considered rather than merely the body of the message, this being a step further towards perfection than heretofore. Another change from last year was that the message was transmitted from only one station instead of from two, however, it was transmitted on three frequencies as follows: on 3680 kc. (W3CXL) every hour on the hour, beginning at 6:00 p.m., E.S.T., and continuing until 2:00 a.m.; on 3497.5 and 6990 kc. (WLM) every hour on the half hour, beginning at 6:30 p.m., E.S.T., and continuing until 2:30 a.m. The chief signal officer's message:

TO ALL ARMY AMATEURS: FIFTEEN YEARS HAVE PASSED SINCE THE SIGNING OF THE ARMISTICE. AGAIN IT IS BEFITTING WE PAY HOMAGE TO THOSE WHO GAVE THEIR ALL FOR OUR COUNTRY AND LEFT WITH US THE TASK OF MAINTAINING HER FREEDOM. TO THE ARMY AMATEUR WHO UNSELFISHLY GIVES HIS TIME AND ENERGY TO FURTHER AN UNDERTAKING OF VITAL NATIONAL IMPORTANCE I CAN BUT GIVE MY WHOLEHEARTED ADMIRATION. YOUR PURPOSE TO PROVIDE AN ORGANIZATION OFFERING A MOST COMPLETE COMMUNICATION SYSTEM NATIONWIDE IN SCOPE AVAILABLE TO THE AMERICAN RED CROSS AND YOUR GOVERNMENT IN TIME OF LOCAL OR NATIONAL EMERGENCY MERITS COMMENDATION OF THE HIGHEST DEGREE.

Irving J. Carr, Major General, Chief Signal Officer

A total of 740 copies was received by the chief signal officer from amateur stations located throughout the United States and Alaska. Of this number 65.4% were accurate in every detail and many more were accurate as far as the body of the message was concerned. The table on the following page shows the relative standings of the various corps areas.

To the Fifth Corps Area (Lt. Loren G. Windom, Inf.-Res., WLH-W8ZG, Radio Aide) went the honors for having the highest percentage of active members mail in copies of the message. Second and third places were won by the Seventh Corps Area (Mr. H. W. Kerr, W9DZW, Radio Aide) and the Second Corps Area (Captain David Tylley, Sig. C.-Res., WLNA-W2PF, Radio Aide) respectively. The leaders in percentage of accuracy were: first, the Ninth Corps Area (Mr. J. H. MacLafferty, Jr., WLVA-W6RF, Radio Aide); second, the Fifth Corps Area, and third the Third Corps Area (Cpl. Robert N. Fox, WLQ-W3SN, Radio Aide).

The chief signal officer is gratified that so many amateurs participated in the competition this year and he feels that the results achieved are most satisfactory.

The Honor Roll for 1933 includes the following stations:

War, Fort Myer, VA. This building houses the transmitter of WLM-W3CXL from which station the Armistice Day Message, 1933, was transmitted.

Photo by U.S. Army Signal Corps
QST attempts to maintain a complete list of dealers who are interested in and able to supply amateur radio equipment. We are frequently called upon to tell prospective amateurs where to go to buy equipment. We believe our present list is pretty complete, but if any dealer has the slightest doubt of his name's being on it, we should appreciate a line from him. We should like to know his complete address and any other information, such as lines carried, etc., which might be of value to us. We are, of course, interested in hearing of new dealers.

It is much cheaper to replace flashlight bulbs than meters or tubes. Put the bulbs in strategic locations in the circuit—in series with tube plates, meters, neutralizing condensers, etc. The 2.5-volt bulbs blow at about 300 mils and can be used in circuits with potentials as high as 800 volts.

—W2AOU
More on Silvering Crystals

Recently I came into the possession of a 160 meter crystal which was supposed to double into the 80-meter c.w. band. But for some of those reasons that we can't account for, it didn't.

Past numbers of QST \(^1\) had said that the frequency of crystals could be lowered by silvering, so a formula was found that sounded good and the process started. QST said that 20- and 40-meter crystals had been done successfully, but no one has handed out anything on 160-meter crystals that I have seen. Anyway, we put on five coats and tried her out. From scratch of 3935 kc., a perceptible but small change was noticed; maybe 5 kc. What a bright outlook, when some of our 20-meter friends had made 20 kc. per coat! Circumstance called for it, therefore we kept on; and after about twenty-five coats we pushed her over for a touchdown and no more QRM to the noble 'phones! It is my idea that the ratio of the thickness of the coat of silver to the thickness of the crystal is the answer to why one coat here makes so little progress as compared to that made by one coat on a 20-meter crystal.

It is not as bad as it sounds, however, for the formula used would put a coat on in about three minutes, and in another minute the next coat was being applied. This formula was cut down from a five-gallon job, but works nicely:

**SOLUTION NO. 1**

- Dissolve NaOH (sodium hydroxide) 1.13 gm.
- Distilled water 180 c.c.
- Dissolve AgNO₃ (silver nitrate) 1.13 gm.
- NH₃OH (ammonia) 120 c.c.

Add A to B, then add 2.5 c.c. NH₃OH more to clear solution.

**SOLUTION NO. 2**

- Distilled water 23.6 c.c.
- Sulphuric acid 2.0 c.c.
- Cane sugar 17.8 gm.

Bring B to a boil, add 2.25 c.c. of A and boil 15 min. Filter out precipitate and this is Solution No. 2.

**PROCEDURE**

Add 2 c.c. of No. 2 to 20 c.c. of No. 1, and as soon as it is a good amber color pour over the crystal (which we suspended in an evaporating dish on ivory pointed tweezers) and leave until the solution turns a muddy brown and looks thick. Remove, wash in distilled water, and put on another coat.

Before silvering, a third solution called "tin stock" was applied to the crystal after it had been thoroughly cleaned. This was washed off with distilled water before the first application of silvering solution. I suppose it was a filler. It was made up of 1 gm. SnCl₂ (tin muriate) to 200 c.c. of distilled water. It does not keep well, but is only used in starting to silver.

After the silvering was finished the edges of the crystal were ground down with fine grinding compound and cleaned with carbon tetrachloride. All results seem to be equally as good as those obtained with the bare crystal, and if ever we are fortunate enough to get into 80-meter 'phone a little nitric acid will clean it with far less effort than it took to put it on.

—Fred D. Armes, W1GMD

Longer “B” Battery Life With the Rationalized Autodyne

Since March I have had a receiver modeled after the January, QST autodyne in operation. "B" batteries are used for plate supply because they are without question smoother than any eliminator.

After seven months operation the receiver became noisy and a test of the "B" batteries showed that two of the three used on the receiver were run down. The two that were dead were the 2nd and 3rd (Fig. 1) and the one hooked in the detector circuit was still O.K. This seemed to be unusual as the detector "B" usually runs down first.

---

\(^1\) QST, March, 1932; February, 1933.
The diagram was then dug up and on looking it over the resistors $R_o, R, \text{ and } R_{io}$ can be seen to be across the last two batteries even when the switch "S" is in the "off" position. The total resistance shorting the last two batteries is 110,000 ohms, which does not seem so much, but by Ohm's law it figures a constant drain of 0.0008 mils. On my receiver a milliammeter shows a little over 1 mil constant drain with the receiver off.

The obvious remedy for this is to install a double-pole toggle switch breaking both the B—lead and the plus-45 lead at the position shown in the diagram. This will give you much longer life from your batteries.

—Robert E. Foltz, W9GBT

Leaky Tube Bases

Here is a kink which may help some of the fellows clear up their notes:

I had trouble in getting a p.d.c. note with my transmitter, a self-excited outfit using a single 10 with 800 volts on the plate. I tried everything imaginable but the note was n.d.c. I found out later that r.f. was leaking from the plate to the grid through the base of the tube.

I took the tube out and filed a slot in the base about $\frac{1}{8}$ of an inch wide and about $\frac{3}{16}$-inch deep as shown in Fig. 2. In doing this care must be taken not to file too deeply as one may break the glass tip which is enclosed in the base.

After putting the tube back into service I found that the n.d.c. had disappeared altogether and I got p.d.c., and at times crystal reports. I also noticed that my signal strength increased from an average R6 to R7.

—Andrew Janiga, Jr., W9HPQ

Half-Wave Hertz for Receiving

The selectivity and signal-to-noise ratio of the National SW3 has been greatly improved by coupling a half-wave Hertz antenna inductively as shown in Fig. 3.

The additional control, $C_1$, is not critical. The receiver remains "single control" over ranges of 40 to 60 kc. An optimum and critical value of coupling exists between $L_3$ and $L_2$. When the coupling is properly adjusted, variation of $C_1$ effectively discriminates between signals which would ordinarily interfere, and such tuning affects the signal strength alone and not the frequency of the beat note.

This attachment has proven very satisfactory during the past two months. There is no reason why it should not operate equally well at other frequencies when the aerial is cut to a length calculated to develop a voltage loop at the end connected to $L_n$.

—Robert A. Gallery, W8CTQ

Error's Note: The chief requirement of the circuit $L_n C_1$ is that it should be capable of tuning over the band to which the receiver is set. It is therefore an easy matter to apply the method to bands other than 7 mc. The antenna will work well on harmonics; it may, in fact, be made approximately 130 feet long and will be suitable for 35 mc. and all higher-frequency bands.

Threaded Coil Forms for the Transmitter

The most difficult items to construct in a c.c. transmitter, I believe, are the oscillator and doubler coils. Of course, if we are making them for a low-power job which does not require coils with wire larger than No. 18, these coils can be made very easily. However, when we graduate to higher power where the coils have to be wound with No. 14 or larger wire, then the difficulties increase in proportion to the wire size, especially if the coils are space wound.

I have space-wound doubler coils on a two-inch form only to have the spacing change and the turns slip together when the temperature rose and the wire expanded. In fact, it is almost impossible to wind a coil of this diameter with No. 12 or larger wire by hand and get the winding tight enough to stay put.

Threaded forms are the answer to these difficulties, but did you ever take a form to a machinist and ask the cost to have it threaded? To have threaded forms without having to pay a small fortune for them resort was made to the following scheme:

The forms are drilled for the terminals and then given a thin coat of melted paraffine with a small brush. After the paraffine has hardened, the coil is then wound with the exact spacing required. The wire is then unwound and we have
a marking on the form in the exact position of the winding.

The form is then placed in a vise and using an edge of a small three-cornered file, a "V"-shaped groove is cut in the form, following the wire marking in the paraffine. When the threading has been completed the paraffine is removed by warming the form in an oven and wiping off the paraffine with a rag.

We now have a threaded form on which the wire can be wound with the assurance that it will stay in place indefinitely. Other means may suggest themselves for marking the form other than using paraffine with equal results.

---H. M. Sheffield, W5DX

A Simple Volume Indicator

Those of us who are looking for a simple but effective volume-level indicator may find the one described here, developed for a public address system, of interest. Use is made of a 56 tube biased to cut-off, with a 0-1 milliammeter in the plate circuit as an indicator, as shown in the diagram, Fig. 4. The system takes its heater and plate power from the amplifier on which it is used.

The design shown uses capacity-resistance input to cut down space requirements and to minimize pickup and interaction with the amplifier circuit. A better method from the response angle, however, is to use an audio transformer. It may either be connected step-up for sensitivity when the comparatively-low impedance of the primary can be tolerated in the circuit, or step-down when the circuit on which it is used must not be appreciably shunted. Using a 3:1 audio transformer as a step-down (secondary as input, primary to indicator grid), 9 volts, 60 cycles, produced a half-scale deflection.

In the hookup shown, the divider system across the input presents a high impedance to the exciting circuit and a reasonably low impedance to the grid-cathode circuit—the latter feature prevents "floating" of the indicator meter. The condenser in the plate circuit is not necessary, but helps show up the peaks and, in case the indicator is used on high audio frequencies or radio frequencies, bypasses the meter. The values shown work out nicely in my case, but should not be considered sacred.

To operate, disconnect or short-circuit the input, adjust the meter to zero or some convenient low reading by means of the potentiometer supplying the grid bias (it might be well to add that this potentiometer should be set for maximum bias at the ground end to begin with, to protect the meter), and connect the input back to the point at which the level is to be measured—or disconnect your short circuit, as the case may be.

---P. C. Tait, W6AEA

Freqmeter Calibration from B.C. Stations

Some of the fellows are unfamiliar with the fact that highly accurate frequency-meter calibrations can be obtained by utilizing signals that we have with us all day long and most of the night—every day of the year. Stations in the regular broadcast band are required to stay within 50 cycles of their assigned frequencies—better than .01%—and the fact that the assignments are all even multiples of 10 kc. makes it possible to get nice round figures for harmonic spots in the ham bands. We reprint here part of a letter from E. Aymar, W9HVA, outlining an excellent scheme for using the B.C. transmissions. The method requires only one easily-built oscillator in addition to the equipment ordinarily to be found in amateur stations, and can be used by anyone who knows what harmonies are and has a slight knowledge of arithmetic:

"The apparatus consists of two oscillators; one, the regular frequency meter, covering the 1715-ke. band; the second, using the same circuit, covering the broadcast band.

"The two oscillators, a receiver which can tune from 7000 to 8000 kc., and a B.C. receiver are all turned on, with the antenna posts strapped together. Let's tune in WLW on the B.C. receiver. Tune the broadcast oscillator to zero beat with WLW. Shut off the B.C. set. Now you could listen for the 5th harmonic on 3500, but there is an additional advantage in using the 10th at 7000 kc., as I will show later, though we found it most convenient to refer all readings to the 80-meter calibration chart. So we set the receiver near the edge of the 7000-ke. band, and then set the regular frequency meter to zero beat. This gives us one calibration point for the chart, which we will call 3500 kc.

"The same process will give us a 3550 point from WOR on 710, and a 3600 point from WGN on 720 kc. But that's not all.

"Since we are really listening in the 7000-ke. range, we are now ready to go up in steps of 50 kc., for as long as we like, and get a series of calibrations as if we had the harmonic meter.
W9FAZ, Chicago, Ill.

W9FAZ is located at 21 Bellevue Place, Chicago, which to local hams means that it is in the d.c. zone. Naturally this factor has been important in the design of the station equipment.

The receiver, a home-made set, has two r.f. stages, one untuned and one tuned, both using Type 36 tubes, a 36 detector, 37 first audio, and two 12-A's in push-pull as a second audio stage. Filament power is obtained from an Edison battery; plate voltage comes from the 110-volt d.c. line with 70 volts of dry batteries in series. A loud-speaker is used most of the time for reception, although headphones are available.

Power for the transmitter is obtained from a rotary converter whose output is stepped up to 110 volts a.c. by means of a transformer. From then on the power-supply equipment is the usual transformer-rectifier-filter arrangement. Filament and plate power for all the tubes in the transmitter come from this source except the filament current for the final tube, a 211, which is heated from the 110-volt d.c. line with a resistor in series.

The transmitter itself consists of a Type 10 tube in the t.p.t.g. circuit, followed by a 10 buffer and a final amplifier using the 211. It is mounted on the rack shown in the photograph, together with the power supply and "C" batteries. Room has been left for the installation of modulating equipment at a later date.

W9FAZ has been on the air only for a little over a year, although Monro MacCloskey, its owner, has been interested in radio since 1915.

W2ETD, New York City

EDWIN J. DUNN, owner of W2ETD, is also an operator at WPEF, one of the stations of the Police Department of New York City. Since W2ETD works almost exclusively on 160-meter 'phone, the OM's activities, both work and recreation, are centered in the 150-meter region.

The transmitter is a Collins 32-B, a combination 'phone-c.w. outfit having a 47 crystal oscillator, 46 buffer, and two 46's in parallel in the final amplifier. The speech line-up is a 57 high-gain amplifier, a 46 driver and two 46's in Class-B audio. A double-button Universal Model X microphone is used. Crystals for three frequencies in the 1800-2000-ke. 'phone band are available. A 130-foot Marconi-type antenna is used for transmitting.

A seven-tube all-wave Colonial receiver takes care of the receiving end. The tube complement of this set includes a 56 oscillator, 24-A first detector, two i.f. stages with 58's, a 57 second detector, and 47 audio.

W2ETD has worked five U. S. and three Canadian districts on 160-meter 'phone. Although the station has been on the air only since December, 1932, Dunn is an old-timer, having operated 2CHN back in 1922, and has held several commercial tickets in the interim.
Decade:

Past months have found us commemorating many tenth anniversaries of initial international communications. The first transatlantic communication, the first transpacific communication, the first contact with this country and that continent—they pile up in an amazing array of history-making feats, accomplished by the pioneers of ten short years ago—ten years which span the entire existence of international amateur radio.

Recently we've been looking into some of those old records, checking up on them in the light of ten years, endeavoring to verify them beyond all question for history and posterity. We have one important change to make in the published QST account of first workings, both as published ten years ago and in QST's recent editorial on the first transatlantic contact. From unquestionable evidence recently adduced, it seems that the first contact between Canada and Great Britain was not between g5BV and cIBQ in Halifax on the morning of December 28, 1923, as stated. The Canadian station is correctly given, but the honors on the other end go to station g2OD, Mr. E. J. Simmonds, now vice-president of the R.S.G.B. These two stations first worked at 0500 G.T. on December 16, 1923.

Perhaps we'll have something to say later about the first transpacific QSO. At any rate, we want to get the record as straight as we possibly can.

DX:

Conditions continue to change, in many localities decidedly for the better. Down in Aussie signals have been strong, but QRN equally so. In South Africa they find two listening periods for March, 1934
Mackay 90' pole, KA1XA told W6AM on their Sunday morning schedule . . . . . . H. Collin, G2DQ, with an input of 10 watts, won the R.S.G.B.'s 3.5-mc. test, with R. A. Bartlett, G6RB, and J. Wyllie, G5YG, placing . . . . . . G2DQ's contacts included two with North American stations . . . . . . Speaking of low power DX records, G. B. Ragless of W.I.A. tells us that VK6SA, while working W6BIHQ recently, reduced power to .28 watt! . . . . . . The world's 56-mc. plane-ground reception record is claimed by G6FY and PAOHI, operating the R.C.C.'s test ship last August . . . . . . A late list­er's report arrived from the north of England confirming trans­missions when the airplane was 235 miles distant . . . . . . Band oc­cupancy checks taken by the R.S.G.B. last September showed 706 G stations active on one or more bands, an increase of nearly 200 stations since the March check . . . . . . Organization of amateur radio in Roumania is progressing, with CV5AF, CV5AS, CV5EV, and CV5FD as leaders . . . . . . A. H. Tilese, VK4WO, is another amateur to add to the list of those anxious to welcome overseas ama­teur visitors, so keep that in mind when you visit Brisbane . . . . . . First overseas applicant for mem­bership in the TBITO Club is R. A. Bartlett, G6RB, whose qualifying QSO's were with VE1BV . . . . . . He's anxious for 3.5-mc. W QSO's . . . . . .

The following amateurs were issued WAC certificates during the year 1933:

- Leonard T. Robinson, W6WO; Albrecht Leyn, D4POJ; Bryan Groom, G6BG; Lawrence D. Geno, W8PE; W. Wishart, VK4WT; Arthur Walz, VK4AW; Archie & Bennie Davis, XU1U; George T. Sperry, W9CBJ; Prof. E. Kaply, HAF2G; Edwin J. Sahm, W2CKR; W. J. Crawley, G5NP; A. S. Woolnough, VK3BW; Delbert Avery, W7BGH; Adelbert C. Lawrence, W7BFG; K. R. Rankin, VK3KR; C. L. Games, W7AAX; Antonn Macha, OK2MA; M. Libert, ON4CN; Lewis Mills, W5BZT; M. Kohno, J3CX; O. P. S. Ottozen, OZ5X; W. B. Weber, G6QW; Thomas C. Freshwater, CT2AW; Basil Wiekham, G2DW; Walter B. von Bergmann, W6BUC; F. Castro Curnow, G2CW; W. H. Bostwick, G6WQ; Albert N. Bode; G5SR; Otto Bauman, HB9X; Anisio Soares, XU1U.

G5RY, OWNED BY R. L. VARNEY, CHELMSFORD, ESSEX WAC ON C.W., FIVE CONTINENTS ON 'PHONE, WITH 30 TO 50 WATTS INPUT.

D.C. grid modulation is used.

(Continued on page 86)

Libbe, W5BBR; R. Mirche, D4UDO; Helmut Theysohn, D4NGQ; G. A. Shayer, ZS1H; S. H. Luitwieler, W6GRX; Jack Lees, G2IO; Clyde C. Anderson, W6FFP; Bill Werden, W8DMK; Dr. W. Heinze, D4ADC; L. Aubry, F8TM; P. G. Pretorius, ZT2H; A. R. R.L., W1MK; Miss Nelly Corry, G2YL; M. H. Wilkinson, G2YU; C. Haderka, OK2HM; T. Sargent, ZL1CE; H. McCabe, ZL2HA; J. Doesselma, PA0GO; L. R. Seal, G2OC; Krauzi Károly Jenő, HAFC1; Kenneth R. Booth, W5PJ; Veronn Gebhart, W6AOD; Alphard Anderegg, HB9S; Norman E. Huggett, G2PF; S. A. French, G6FN; Charles E. Spitz, W2API; Paul Heineman, OZ4H; Knud Bjarno, OZ7KB; W. Powell Hunter, W4TZ; Charles E. Perry, W9ASV; John Marshall Etter, W1DHE; A. H. Elener, W6ENV; Louis Lerambert, F8SG; Robert Carlisle, G16WG; LaMonte Rusche, W5AFV; K. F. Iwata, W6FZ; R. Hammer, D4JPC; Roy C. Corderman, W3ZD; Roy W. McCarty, W9KA; Carlos G. de Cosio, X9A; F. L. Hawthorne, ZL1GX; W. G. Collett, ZL4BP; E. G. Ingram, G6IZ; Joao Pinheiro, CTlBG; J. J. Curnow, G6COW; W. H. Bostwick, W2GW; George W. E. Shields, W2VY; Earl N. Schmoor, W9AZZ; Harold C. Turner, G5OF; R. E. Pinkham, W6BPT; William Breuer, W7TE; M. Hermans, ON4K; W. Met­selaar, PA0MM; Domingo N. Cordivuela, LU5FV; W. A. Sayles, W8ANO; P. J. Finn, G6UF; Fred E. Ziegler, W8BSF; Herbert E. Snyder, W3CJN; Edward C. Nau, W3CMB; Russell Bassett, W1AUF; W. E. Lane, V44CRH; John F. Karison, SM6UA; George Sinclair, W6GAL; Max Mousley, ON4KUP; Henry Bolton, F8UM; Theo. Githens, W9AEB; Dan L. McPherson, Jr., W5A00; R. M. Campbell, VK3MR; Robert Y. Chapman, W1QV; South African Military College, ZS6B; O. W. Reid, ZS2A; Pippo Fontana, IIAY; Arthur C. Webb, G6QW; J. S. Owner, G6XA ('phone); Norman LeBlond, W9FNO; Arthur M. Braaten, W2BSR; Ray C. B. Barnes, G6DS; R. A. Hiscock, G6LM; Eugene B. Kille, W6CF; Ed. W. Connell, W4AKH; A. Edward Hopper, W2GT; Jobs. Fundingsrud, LA2C; E. H. Fritsche!, OZ4H; Knud Bjarno, HB9AK; George W. Murphy, W8SI; A. Reimann, VK5JO; D. C. Shankis, ZT2A; Maurice Geude, ON44MG; F. H. A. Hoffmann, PA0CH; Paul Brumbaugh, W8FKY; Julio Murtinheira Machado, CT1DC; Stanley T. Toper, W1CLX; Charles D. Roe,
Operation and Co-operation
By G. Merriman, V56AH

International competitions provide a lot of good fun, and interesting new contacts, and sometimes give us a problem also. During the recent international competition our major problem was to copy DX signals while five or six truly local stations were all "getting out" with a hefty punch in their signals. The first few days of the contest were gruelling, QRM was heavy, with the dial full of W stations in addition to our local Stentors. Something had to be done! The main trouble seemed to be that there was not a clear space in the whole seven mc. band in which anyone could be sure of copying a W station without fear of a powerful local signal rising to the occasion and blotting him out.

By getting the gang together and getting suggestions from them we hit upon the plan of all using a transmitting frequency near to each other so that only one small part of the band was taboo. Accordingly we all swapped and borrowed crystals for the period of the contest which grouped us all somewhere near the low frequency end of the band. Thereafter the rest of the band was left clear for DX signals. This was real cooperation and it worked splendidly. A great deal of unnecessary interference was also eliminated by everyone using the fewest possible radio abbreviations to exchange the test signals and the signal reports. Instead of grinding out each time GE OM UR TX SIGS QRS S7 . . . we tried abbreviating it to UR SIG S7, hoping that the other fellow would get the idea and copy it. This too worked well. Of the hundreds of stations worked by our small gang only one or two failed to get this "frame" report and understand it. Another simple thing and interference saver was to end the transmission without an extra sign-off of the other stations call "de" our own, a practice which it is difficult to believe is of any further use in these enlightened times.

Those of us who have not tried anything new for a while would do well to try the simple expedient of sending QRZ de our own call after finishing a transmission. During the competition in March this year the writer raised no less than forty-four W stations by this method. Think of the time that was saved and the amount of local QRM which was eliminated.

Another useful thing to remember under special conditions or for that matter at any time is that the man at the other end should never be under-rated. While we grind out things at twelve words per minute sending double "to make sure" the receiving operator is often grinding his teeth with impatience wishing we would get a move on. A good operator indicates by the speed of his "come-back" just how fast he wants you to send to him. If he operates short and snappy it is a sure sign that he is trying to get you to do likewise. Those fellows who pound your call solidly and surely as though they were fearful of you not hearing them are the ones who need your double sending and steady spacing. A little study of amateur psychology can be very often of great help in operation. The moral of this story is that even in the most ham-mopolulated city it is possible to operate with ordinary unselective receivers without feeling sore at your neighbor if only the radio club members will get together and agree to use one narrow channel in the band to leave the rest of it free, and at the same time agree to cut transmissions to a minimum.

Flying Fun on Fifty-Six
By Stanley P. McMinn, W2WD

Fifty-six is fun. If you want to find out for yourself take a weeny little transceiver in your lap, climb into an airplane with a trustworthy pilot and go places. I did—and found out a lot of things about five-meter work. For months a dozen of us in the Garden City Radio Club have been duplexing nightly, using several varieties of station equipment. Dr. L. J. Dunn (W2CLA), pioneer ex-director of the Hudson Division, said to me one day, "Let's try out this flying stuff." Flying is not new to him (he holds a Transport pilot's license), nor is 56 mc. work new for that matter, but neither of us had tried a combination of the two. Dick Depew (W2SB), also an aviator, and an enthusiastic radio amateur as well, built himself a honey of a transceiver measuring about 5 inches on a side, and with the two '30 type tubes operating on about 135 volts dc." After operating this equipment all over the neighborhood against a quarter-wave dur-aluminum rod mounted on the radiator cap of his "Chevy" with 8-foot Zeff feeders, he was impressed to function

THE BASE STATION, DESIGNED AND BUILT
BY W2WD

A pair of '10s push-pull was used with a pair of 250s for modulation and a single 56 speech amplifier.


* 181 Doyer Parkway, Stewart Manor, L. L., N. Y. Editor, Automobile Merchandising.

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as the ground station for our first flying tests. These were carried out on a not too warm day, January 21st.

So successful were these tests that Arthur Lynch (W2DKJ)—of resistor and antenna fame—joined the group. He and Dr. Dunn organized a much more ambitious test. This was run off on Sunday, January 29th, this time using two ships, and a base station installed in one of the Roosevelt Field hangars for the purpose. The base station was the usual pair of 210's in push-pull with a pair of 250's for modulators, Class A, with one stage of speech using a 59 and a single button mike. A Picard-type antenna with feeders about 35 feet long was used, and a manufactured superregen receiver which gave a good loudspeaker signal.

In one of the ships Dick Depew (W2SB) installed his home-made transceiver feeding the same quarter-wave duraluminum rod mounted vertically between the wings and with 8-ft. Zepp feeders. On the other ship we mounted a full-wave antenna split in the center and fed with a twisted pair of random length from a transceiver with 180 volts of B-battery. Heavy duty B-batteries for both base station and the two ships were graciously supplied by the National Carbon Company, as were the necessary 6-volt "hot shots" for filament supply. Installation work was finished Saturday afternoon. Ground tests were made Sunday morning. About 1 p.m. the two ships took off with a gale blowing. The operators in both ships were able to establish contact with the base station practically at will and to receive flying instructions. This permitted quite an eye-filling demonstration. A big gallery had gathered for the tests, thanks to publicity in local papers and QST from W1MK.

Ship to ship contact was difficult due to several causes, the most prominent of which was the difficulty of hearing anything other than really strong signals through the roar of the motor. Ignition QRM gave little trouble, but it is not the easiest thing in the world to devise means of getting radio signals into one's skull without letting in noise from a 9-cylinder Whirlwind. However, a couple of contacts were made. Another great difficulty (and maybe there ought to be a law against it) was transceiver QRM. Literally thousands wanted to hear what the ship operators were saying. This was unfortunate, for these little bloopers blocked out the relatively weaker signals from ship to ship. One lad, with a fairly powerful transceiver mounted on a car parked in front of the base station, had a joyous time in the whole proceedings, not knowing or caring about the QRM his transceiver caused.

Another difficulty manifested itself in the choice of microphones. W2SB had a standard Universal single button Handimike which was entirely too sensitive and picked up an awful lot of the roar of the motor. The mike I borrowed for the occasion was constructed for aircraft use. Hence, it was most decidedly insensitive and it was necessary to shout pretty loud into it. However, the signals produced were far and away better than those produced by the more sensitive mikes.

At the base station signals from both ships were R9 even when the ships were as much as ten miles away and the altitude 5000 feet. Reports of R8 to R9 signals were received from a large number of stations all over Brooklyn, Long Island, New York, and nearby New Jersey, and both ships were able to QSO quite a number of stations.

The group including Harry Steenberg (W2AOL), who operated the base station, Randy Esslow (W2BI), Jim Tynan (W2BAX) and those already mentioned are planning to continue the tests, but under conditions that experiences will permit us to make more favorable and with equipment that we are reasonably sure will be better suited to the work. We are planning now on a couple of miniature transmitters and receivers which will be quite separate, though operated from the same plate supply. The transmitter in our judgment should probably be a '41 with 'some transceiver (for economy) using a 70 to drive another 70. With such equipment we shall be able to put out an even stronger signal than is possible with the sea power available in a transceiver, and we are hopeful that we may be able to eliminate about 90 percent of the transceiver QRM.

Ties That Will Bind
By D. V. Clack, W7AHz*

BEING a 'phone ham at heart (but broadminded) I often think how much more friendly an attitude we would have toward each other if we would but strive to have more 'phone-c.w. QSO's. We're missing half the fun of amateur radio, when we don't pull together, and keep in contact with all of amateur radio.

May I suggest a remedy? Here in my own station, I believe I've made many friends who would need to brush up on their code work instead of using 'phone; I quite often call CQ 'phone or c.w., and sometimes I get an answer on c.w. But not often enough to suit me. It certainly breaks the monotony of station experience to have more 'phone-c.w. contacts or vice-versa. Not only that, when you have completed one of these contacts you have almost invariably made a true friend.

Another thing—where is the "dyed in the wool" 'phone ham who doesn't need to brush up on his code work? We've bound to lose code speed if we don't use it once in a while. Come on fellows, let's give this a try. High time we had some friendly 'phone-c.w. QSO's. Are you with me?

Spanish DX Contest

The U.R.E., Spanish amateur radio society, announces a contest to be held between Spanish and foreign amateurs on each of the following weekends: from 0000 GCT Saturday to 2400 GCT Sunday: March 24th-25th, March 31st-April 1st, April 7th-8th. There will be prizes and diplomas for both Spanish and foreign participants. Contacts between EA (Spanish) and W amateurs will be considered for special awards. In the Spanish organization the highest four scorers in each region will be the competitors for the Asturias Cup, a special prize for Spanish amateurs. Any amateur working an EA station during the weekends mentioned should QSL to the headquarters of the U.R.E., making sure to give the code group which he will have received from the Spanish. Address of the U.R.E. is Apartado 282, Av. Pi y Margall, 5, 2, Madrid, Spain.

*Creswell, Oregon.
The following contribution by Mr. C. R. Stedman, W7ASQ, wins the C.D. article contest prize for this month. Your articles on any phase of amateur communication activity are likewise solicited and may win you a bound Handbook, or three logs, or message pack. Send yours today.—P. 14.

Fellowship and Amateur Radio
By C. Raymond Stedman, W7ASQ

In your contacts outside Amateur Radio you often hear the expression, "He's a swell fellow," or words to that effect. If you know the man referred to, the chances are 20 to 1 you think he is too. He is what that effect. If you know the man referred to, the chances seem to be headed toward a "rubber stamp" QSO, a word on the conversation, avoid the usual or two may divert him. When it comes your turn to carry feel toward him—friendly. If there is no traffic and he hesitates to refuse a message because he is afraid the other

in the end feels free to, but not compelled to chew the rag with you. Common courtesy of course demands that you slow down when asked to, and will find that alone will make a new man remember you favorably years later. Needless to say, a clean signal, good fast and clean operating also contribute their part to the impression you create upon the other fellow.

When you do these things you are building yourself a reputation as a "Swell fellow." It is a matter of common operating courtesy also. Most of all you are making the other fellow feel that amateur radio is even more worthwhile.

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Trans-Atlantic DX on 1.75 MC.

Following the announcement of tests every week-end on 160 meters (p. 58, Feb. '34 QST), the first 1934 two-way transatlantic contact took place on the morning of February 3rd—between GWU and W1DBM. See last month's announcement, and continue midnight to 8 a.m. (E.S.T.) 1700 kc, testing each Saturday and Sunday morning throughout March, if interested. Remember, starting at midnight, W/VE stations are invited to transmit for 15 minutes, alternate 15-minute periods. Do not transmit (but listen for Q stations) 0015-0030, 0045-0100, 0115-0130, and 0145-0200 E.S.T.

W1DBM, North Palmouth, Mass., worked G6FO 11:55 p.m.—12:50 a.m. E.S.T., Feb. 19/20, 1933 ... the first W-G contact (May 1924) in nine months of tests between Group 10A of the R. S. Q. B. and W amateurs. Input at G6FO to a P.T.T. (1791 kc, xtal. across grid coil) was 9.7 (watts 230 volt mains x 42 ma.). April 1924 QST (page 45) records the first such work which was trans-Atlantic DX on this amateur frequency band. "IBSD Providence, R. I., worked PCH Feb. 15, 1924, using one UV202, 64 watts input, on 150 meters." This same issue records what was apparently about the first recorded amateur work in Spain and the Atlantic by "phone. In February 1924, g2KF using voices hooked up with u1BDI using telegraph. About this same time u1XAR-BDT using 'phone established two-way communication with various European amateurs using code, so that we believe Mr. Heap holds the record for being the first 'phone amateur to work across the Atlantic using voice from this side. This issue of QST also indicates that Reimartz, u1XAM-u1QP, had just reached the unprecedented high frequency of 4600 kc. (75 meters) in his experiments working PCH (Netherlands) with 30 watts input that same month. The 3500-4000 kc. band became populated rapidly after that!! and the experimenters went on to the virgin territory at 7 and 14 mc.

On the historic date of Nov. 27-28, 1923, u1MO, u1XAM and ISAB first demonstrated two-way trans-Atlantic communication on 110 meters on schedule, Following this work, during December 1923 and January 1924 the exodus from 200-meters-and-above was rapid.

"GWU of Penarth Glamorganshire was heard and called by W1DBM at 0840 Greenwich on Feb. 25, 1923. W1APK, W2ASH, and W1AQF have also been heard. Transocean DX should be easy in 1934 on this band; probably the best time in early January will be 12:30 a.m. to 2:30 a.m. E.S.T.* It is noteworthy that on the last two tests, signals appeared to be better West to East in December, and East to West in February. Results point to a gradual improvement on the low-frequency bands in accord with the 11-year cycle theory."—Austin J. E. Foreman, G6FO.

Traffic Briefs

Byrd Expedition traffic by amateur radio continues to be routed via NY1AB, Darien, Canal Zone. During the period December 15th—January 16th NY1AB handled 1660 relays in schedules with KJTY (KJTY). NY1AB-KJTY schedules are maintained with NY1AB on 14 and 7 mc., and KJTY on 16, 400, 11,040 or 8290-kcs. In the Canal Zone, KJTY on 8290-kcs. is good from Midnight to 1600-1700 E.S.T., 1923. In December 1923 and January 1924 the exodus from 200-meters-and-above was rapid.

GWU of Penarth Glamorganshire was heard and called by W1DBM at 0840 Greenwich on Feb. 25, 1923. W1APK, W2ASH, and W1AQF have also been heard. Transocean DX should be easy in 1934 on this band; probably the best time in early January will be 12:30 a.m. to 2:30 a.m. E.S.T.* It is noteworthy that on the last two tests, signals appeared to be better West to East in December, and East to West in February. Results point to a gradual improvement on the low-frequency bands in accord with the 11-year cycle theory.*—Austin J. E. Foreman, G6FO.

An Arizona Hamfest is announced by the Arizona Short Wave Radio Club for March 17th and 18th to be held at Phoenix. Speakers, contests, prizes, banquet, everything that makes for a successful ham-get-together. Inquiries should be addressed to F. Heckman, W6HEU, Secy ASWRC, P. O. Box 1776, Phoenix, Arizona.

a going back to some old records, we find that conditions in 1923 and 1924 permitted transatlantic communication in January from the time the midwinter advance hit the east coast (see P. 14). The west coast contact was interrupted by sunrise in Great Britain. The period was "fair" for contacts (average 14 to 16 minutes, some longer, and nights were shorter) until communication in April and May 1924 was possible for only one or two hours, as predicted by QST, when the frequencies were fairly favorable. 1.76 mc. is rapidly "coming into its own" with a return to DX probable on this frequency for the next two or three years.

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The Western Massachusetts Amateur Radio Association installed and operated its station, WIFQQA (portable), at Longmeadow, Mass. during the Sesquicentennial celebration of that town, October 13th, 14th, 15th, 1953. A good number of messages were handled for the townpeople as well as numerous more important messages to local Boy Scouts to other troops throughout the country, and many new friends were made for "amateur radio." Well done, WMARA.

The Houston Amateur Radio Club is conducting code practice on the 1.7 me., 'phone band from its club rooms each Monday and Friday from 7:00 to 8:00 p.m. CST. This club also has a class of instruction on the class "B" license examination, with about 50 members enrolled.

Five hundred and sixty amateur radio enthusiasts attended the Banquet of the Federation of Radio Clubs, Southern California, held January 20 under the auspices of the Pasadena Short Wave Club, scattering all records for attendance and interest! Activities included an exhibition with a complete showing of latest equipment, and continued until the early morning hours. In the afternoon some very fine technical talks were given by W6GWW, W6CCH and Mr. Ray Gudin. Following a most PB turkey dinner, and an entertainment by a group of artists from KMTR, the evening speakers were introduced. Among these were Mr. J. M. Chapple, W6LA, and W6AN, SCM of the Los Angeles Section. At 11:50 o'clock the long awaited awarding of prizes gladdened some hearts and broke others. This entire affair, the biggest banquet ever held in Southern California, was voted a huge success by all.

W6ZX, So. New Jersey Route Manager, is organizing a transcontinental 'phone traffic route on 14 me. W6AHR, Wharton, Texas, is the midwest link, with W6AHP, Pomona, Calif., handling the west coast end. W6FSA, Pleasant Ridge, Mich., is northern outlet for W5AHR. A twice-weekly schedule is planned, and the stations involved hope to demonstrate the speed and reliability of 'phone for traffic handling.

Caution! Corps Area Net Control Stations and certain other Control Stations of the Amateur Radio System are authorized to use a special frequency of 3497.5-kcs., very close to the edge of the 3.5 me. band. Many amateurs seem to be using this A.A.R.S. frequency for a "band marker" but in doing so are forgetting that the frequency is 3497.5-kcs., not 3400-kcs. When you hear the stations signing "WLM, WLM, WLT, WLFN, WLV, etc." near the edge of the 3.5 me. band, remember they are on 3497.5-kcs. Likewise, the A.A.R.S. has a 6600-kc. frequency, which can hardly be used to spot the exact 7000-kc. "edge."

CMCCXJ, Frank H. Jones, Tumacu, Cuba, is testing with 'phone (records and voices) on 8270-kcs. on the following schedules: Daily, including Sunday 11:00-11:40 a.m. and 2:00-2:30 p.m. EST. Most Friday, 10:45-11:00 p.m. EST. CMCCXJ will be glad to arrange two-way schedules with any A.A.R.S. member using 14 me. 'phone.

W8JK sends the following interesting dope on ON4CAVL: Mr. Carroll Stognell, owner and operator of ON4CAVL, is a Presbyterian missionary in charge of a school of 700 pupils and 20 teachers at Lubonde, Belgian Congo, Africa. Lubonde is located 500 miles southeast of Luelo on the Lulua River. Mail requires seven weeks to reach the United States. ON4CAVL is on 14130-kcs. almost daily at 1900 GCT using a single type 'S' with 50 watts input.

BRASS POUNDERS' LEAGUE

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<td>W6W6A</td>
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<td>W6W1J</td>
<td>65</td>
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<td>W6W1V</td>
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<td>W6W4Y</td>
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<td>W6WLN</td>
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<td>WSF7</td>
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<td>W6W7F</td>
<td>176</td>
<td>47</td>
<td>223</td>
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These stations "make" the B.P.L. with totals of 500 or over. Many "rate" extra credit for 400 to 500. Delivers the following one-operator station.

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<tr>
<th>Call</th>
<th>Orgt.</th>
<th>Dist.</th>
<th>Total</th>
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<tbody>
<tr>
<td>W6GHD</td>
<td>329</td>
<td>121</td>
<td>556</td>
</tr>
<tr>
<td>W6VAH</td>
<td>108</td>
<td>119</td>
<td>327</td>
</tr>
<tr>
<td>W6XRE</td>
<td>118</td>
<td>105</td>
<td>324</td>
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<tr>
<td>W6DIX</td>
<td>277</td>
<td>299</td>
<td>574</td>
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<tr>
<td>W6W7A</td>
<td>176</td>
<td>47</td>
<td>223</td>
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</tbody>
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A total of 500 or more, or just 100 or more delivered, will put you in line for a place in the B.P.L. Make more schedules with reliable stations. Take steps to handle the traffic that will qualify you for B.P.L. membership also.

QST for April 7th and 8th. All hams are invited. For further information communicate with Don R. Larimer, W9IY, 334 Hill Hall, Champaign, Ill.
Traffic Briefs

The following is a supplement to the list of 1.7-mc. code practice stations which appeared in December '33 and February '34. QST: W5GMJ, Madison, Mass., 1890-kc. Daily 2:15-2:45, and 6-7 p.m.; W8SHA, Fairmont, West Va., 1870-kc. Tues., Wed., Fri. 7:30-8:00 p.m.; W5HMS, Shelby, Wis., 1870-kc. Daily except Sun. 7:30-8:30 p.m.; W9LXX, Highwood, Ill., 1875-kc. Mon., Tues., Wed., Thurs., Fri. 7-8 p.m.; W9NTW, Decorah, Iowa, 1876.4-kc. Daily except Sun. 12:30-1:00 p.m., Wed., Fri. 6:30-7:30 p.m. All times mentioned are "local time" at the transmitting station. These stations send code practice for beginning amateurs on the schedule listed. Other amateurs operating on the 1715-kc. band interested in sending code practice are invited to drop a postal to A.R.R.L. Communications Department for details on this work.

O.B.S.

The following is a supplement to the list of A.R.R.L. Official Broadcasting Stations in September QST (page 14):


ATLANTIC DIVISION

EASTERN PENNSYLVANIA—SCM, Jack Wagen­seller, W3GS—W3AFP, W3ALX, W3CL and W3SWT make BPL. W3CWS is now ORS. W3BWP is first OPS in Section. W3ADD and W3CW work west on 3.5 me. daily. W3CQJ is rebuilding. W3ASW has QRN from bakery. W3AQN and DJX want schedules. W3VD has trials working FB. W8EOH was off with pneumonia. W3CQP reported via radio magazine that they were pesting FB on 35 me. W3GS, CNP, CMW, OBD are on 56 me. The Allentown Amateur Radio League is planning a big hamfest for April 21st. W3CUG is QRL school. W3BOL and BUI are on from 8th District. Lycoming Radio Assn. (Williamsport) is having a QSL contest and planning a freq. needed Christmas contest. The Westmoreland Radio Society is planning annual banquet for March. The Main Line Radio Club (Ardmore) now has 27 members. W3ECM has new pole 35 feet on top of house. Nearly thirty hams attended the Five Meter Club meeting at Maple Shade, N. J.


MARYLAND-DELWARE-DISTRICT OF CO-LUMBIA—SCM, E. L. Hudson, W3BAK—RMs W3CXL, W3CQS, W3CJS. Chief RM W3BWT. The University of Maryland Radio Society is on the air with call W3EAX. W3BNB is local NCS A.A.R.S. Net of Md.—D.C. Anyone interested in this net, please write W3BNB for information. W3CXL, BWT, SN, BND make BPL. Please note W3CXL's modest total of 55621 W3DML joined A.R.R.L. W3BHE has remote control between his bedroom and "office" shack. W3EWW works at 11 a.m. on 7 me. W3CQZ has fine West Coast net. Building and rebuilding: W3DPA, DML, CWE, IL. Rebuilding receiver: W3ZD. New receiver: W3DWW, BOL. On 17.1, 'phone: W3CDG, BRS, DQJ, BOR.

Traffic: W3CXL, W5BWT 70 SN 655 BND 149 ABO 187 CIZ 120 BGI 56 CDG 48 CQS 39 WU 30 BHE 29 EAX 17 IL 12 CWE-DML 8 DFW 4 ZD 3 CRN-DREV-1.

SOUTHERN NEW JERSEY—SCM, Godfrey Rigor, W3QJ—W3EQS reports PB DX on 17.1, 'phone. W3CQV has new c.e. job. W3AN gets an OPS. W3ZX reports a coast to coast hookup on 'phone on 14 me. via W5AHK and W6AHF. W3BDQ is building W3KY's transmitter (Atlantic County Radio Assn.). W3E7I reports N.V.R.A. moving to new quarters. All hams in that vicinity are welcome to membership; get in touch with 3Z1. W3DPR rebuilt completely. W3U7 is back on the air. W3BYR has new QTH. W3CWW reports a receiver at_vl Lumbia soaring to heights. W3CXY should soon be ORS. W3DSC reports 3.5 me. for FB for traffic. W3CWL reports a gang of nice schedules. W3EPF will QSP anytime he is on the air. W3BEI finished a new rig. W3QL received his "A" license. The S.J.R.A. welcomes opinions; write the SCM for dope.

Traffic: W3CQV 6 EDP 8 CLQ 2 CWL 146 AFV 121 DISC 40 OXY 1 AEJ 18 BEI 16 BYR 19 UT 6 DRR 10 21 50 EGS 3 ZK 18 QL 3 AN-AVJ 6.

SOUTHERN NEW YORK—SCM, Don Farrell, W3DSP—W3WGY is now ORS. W3BJO is high traffic man. W3EBR and BQJ have SW3. W8GPO inquires if
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<th>Call Sign</th>
<th>Location</th>
<th>Notes</th>
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<tr>
<td>W9MMB</td>
<td>Illinois</td>
<td>Proud owner of a 52s.</td>
</tr>
<tr>
<td>W9ICN</td>
<td>Illinois</td>
<td>Operates sideband.</td>
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<tr>
<td>W9ILH</td>
<td>Illinois</td>
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soon as possible. W8BTK hopes for WAC. W8KOX reskating now! WSJO wants you fellows to get those official a night-owl-new shift. W9CWR is taking 'em March, Emergency Equipment Questionnaires back to him as W8WW ops WIBM. Applications for OPS sent to ports W8DVC showed WSPP the town. W9LKJ wonders! he his little troubles also! W9OWN is now c.c. WSIFD oaf these days—that jr. opr! W9EGF and NEZ have ORS: W8CEU, IOR, IFE, DNM. W8GSP joined the gang to make it a joint club. W9LLD is QRL with new depression I WSFDK is teaching the YL-code, of course. in hand. WSWO finds the "idle" men were busy during

Traffic: W9AUH 442 JYO 389 BWJ 292 OX 237 IXN 1934

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WSKZL uses Q1A. WSEPFW says Cleveland Heights Amateur Radio Club is very active. W8AOA works in law office. Intercity Radio Club consisting of hams from Shelby, Mansfield, Crestline, Galion, Congress Tiro, Bucyrus, etc., most every two weeks. W8DQA of Galion is a new ham. W8DQA reports the Amateur Radio Club is very active. W8AOA works in law office. Intercity Radio Club consisting of hams from Ohio Highwayway Amateur Net, to assist new Ohio State Police organization headed by Captain Black. New OPS: W8EKN, ORS applicants: W8LCO, FGC, LAJ, Schedulers: W9JE, GOD, AEL, JFW, EBY.

Traffic: W9JE, GOD, AEL, JFW, EBY.

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Traffic: W9JE, GOD, AEL, JFW, EBY.
WASHINGTON--SCM, R. E. Haight, W2LU--Our congratulations to W2CSM and Bob Knapp of White Plains, for their heroic efforts which resulted in the rescue of the last survivor of the Titanic. W2CSM takes electrical honors. W2EQD is perking up 'phone. W2BRS says he has two toes. W2CJS' antenna came down for the fifth time. W4BIR has new gross transmitter. W4AM was busy moving. W4BBT has his rig in a two by four, 'phone in cellar. CQ heard that never signs. W2GTW is our first traffic report. W2BSH is convalescing, having been out well "on ICE." W2EFU: QRL College. W2GTC is at Union College Radio. W2GSB is active in traffic. W2FEQ is located at WSM BC station. W4WT, formerly a DXer, is now busy with AARS. W4FR QSO'd a Swedish ship off South American coast. W2ETH handled message for Byrd Exp. from Holland. W2QY is on 1.7 mc. 'phone. W2CVL craves traffic. W3AC--Alean--needs first traffic report. W2EFU: QRL College. W2GTC is at Union College Radio. W2GSB is active in traffic. W2FEQ is located at WSM BC station. W4WT, formerly a DXer, is now busy with AARS. W4FR QSO'd a Swedish ship off South American coast. W2ETH handled message for Byrd Exp. from Holland. W2QY is on 1.7 mc. 'phone. W2CVL craves traffic. W3AC--Alean--needs first traffic report. W2EFU: QRL College. W2GTC is at Union College Radio. W2GSB is active in traffic. W2FEQ is located at WSM BC station. W4WT, formerly a DXer, is now busy with AARS. W4FR QSO'd a Swedish ship off South American coast. W2ETH handled message for Byrd Exp. from Holland. W2QY is on 1.7 mc. 'phone. W2CVL craves traffic. W3AC--Alean--needs first traffic report. W2EFU: QRL College. W2GTC is at Union College Radio. W2GSB is active in traffic. W2FEQ is located at WSM BC station. W4WT, formerly a DXer, is now busy with AARS. W4FR QSO'd a Swedish ship off South American coast. W2ETH handled message for Byrd Exp. from Holland. W2QY is on 1.7 mc. 'phone. W2CVL craves traffic. W3AC--Alean--needs first traffic report. W2EFU: QRL College. W2GTC is at Union College Radio. W2GSB is active in traffic. W2FEQ is located at WSM BC station. W4WT, formerly a DXer, is now busy with AARS. W4FR QSO'd a Swedish ship off South American coast. W2ETH handled message for Byrd Exp. from Holland. W2QY is on 1.7 mc. 'phone. W2CVL craves traffic. W3AC--Alean--needs first traffic report. W2EFU: QRL College. W2GTC is at Union College Radio. W2GSB is active in traffic. W2FEQ is located at WSM BC station. W4WT, formerly a DXer, is now busy with AARS. W4FR QSO'd a Swedish ship off South American coast. W2ETH handled message for Byrd Exp. from Holland. W2QY is on 1.7 mc. 'phone. W2CVL craves traffic. W3AC--Alean--needs first traffic report. W2EFU: QRL College. W2GTC is at Union College Radio. W2GSB is active in traffic. W2FEQ is located at WSM BC station. W4WT, formerly a DXer, is now busy with AARS. W4FR QSO'd a Swedish ship off South American coast. W2ETH handled message for Byrd Exp. from Holland. W2QY is on 1.7 mc. 'phone. W2CVL craves traffic. W3AC--Alean--needs first traffic report. W2EFU: QRL College. W2GTC is at Union College Radio. W2GSB is active in traffic. W2FEQ is located at WSM BC station. W4WT, formerly a DXer, is now busy with AARS. W4FR QSO'd a Swedish ship off South American coast. W2ETH handled message for Byrd Exp. from Holland. W2QY is on 1.7 mc. 'phone. W2CVL craves traffic. W3AC--Alean--needs first traffic report. W2EFU: QRL College. W2GTC is at Union College Radio. W2GSB is active in traffic. W2FEQ is located at WSM BC station. W4WT, formerly a DXer, is now busy with AARS. W4FR QSO'd a Swedish ship off South American coast. W2ETH handled message for Byrd Exp. from Holland. W2QY is on 1.7 mc. 'phone. W2CVL craves traffic. W3AC--Alean--needs first traffic report. W2EFU: QRL College. W2GTC is at Union College Radio. W2GSB is active in traffic. W2FEQ is located at WSM BC station. W4WT, formerly a DXer, is now busy with AARS. W4FR QSO'd a Swedish ship off South American coast. W2ETH handled message for Byrd Exp. from Holland. W2QY is on 1.7 mc. 'phone. W2CVL craves traffic. W3AC--Alean--needs first traffic report. W2EFU: QRL College. W2GTC is at Union College Radio. W2GSB is active in traffic. W2FEQ is located at WSM BC station. W4WT, formerly a DXer, is now busy with AARS. W4FR QSO'd a Swedish ship off South American coast.

Traffic: W9KQ 1564 NMR 907 FLG 559 ODV 320 IQI 256 IOL 265 GPP 255 OQC 201 BYM 223 B1 105 IVC 79 KQ 63 EFE 55 CMV 25 BMOE 3 WMX 24 AWP 33 OFR 42 MUY 31 CFN 27 BYV 17


WIFNG is QRL service work, W1HUX is new Wilson ham. W1APX has gone to work on a tug boat.

Traffic: W1IO 220 BOF 170 TE 156 BTG 110 CHF 94 GBM 67 EB 63 DFQ 51 CDX 36 GPK 40 DEH 31 CRF 24 AQW 18 BLI 14 APF 11 BTA 8 VF 6 FFZ 3 BMX 2.

EASTERN MASSACHUSETTS—SCM, Joseph A. Mullen, W1ASI—W1VS leads again with 417. Close behind is W1CRA, and our beloved Director, W1KZI, whose best has been shown by the highest score of 260. W1BJS is back in harness. W1BMW tried a BC crystal for M.O. W1EVJ takes the reins of RM from AGA, who has done a sweet job. W1BBY is starting his fourth year of VE schedules. W1LM has been away. W1VW's annual survey shows over 6000 QSOs! W1ABG led the section in ORS party for three consecutive times. W1ASI is on more often these days. W1CLEL is on 56 mc. W1GCLC is after ORS. W1CNA has triest going FB. Alice at W1FRO is now OBS. W1FEB is on the air again. What's the matter with the 1.7 mc. 'phones? Let's hear from you on the 16th of each month. Also the Army net. How about reporting your traffic totals as handled on your drills and get credit in QST if W1GEC passed away on Jan. 7th. W1GNA extends its sympathy to W1GBE, who lost his mother Jan. 11th. New officers of Community Amateur Radio Assn. of Framingham: Pres., W1EIL, Vice-Pres., W1WDDM, Treas., W1WGB, Secy. A. L. Shallen­brand, W1DBH.

Traffic: W1VWS 417 CRA 264 KH 193 WVV-YE 65 ABG 94 FRO 59 BFE 58 BZ 45 BGY 46 GCL 36 ASI 38 BMX 35 AGA 18 BE 7 CLE 3 EXT 2 CNA 1.

W1TFJ makes BPL I W7DJZ has power leak. W7BVEI has new Jr. YL. W7KZG is active at Idaho Falls. W7AOD holds schedules. W7BZA got R7 from Antipodes. W7BDC keeps I. 7 me. 'phone. W7BVE sends Official Broadcast on :3645 kc. W7BMX-AAT 18 AOD 15 BDS 8.

RHODE ISLAND—SCM, Stanley W. Atkinson, W1FAO—W1GTN has been elected president of the Providence Radio Assn. W1CAB has 14 mc. phone perking nicely. W1ASZ is now OBS. W1DWD has been appointed RM. W1GVY has gone 'phone since W1FEP, and HPE reports for first time on Newport. The Providence Radio Assn. Hamfest in Providence on January 20th was a very successful affair with nearly 150 in attendance. Director Bailey and Mr. Quimby of Delta gave good talks. traffic: W1GTV 131 GAB 57 ASZ-DDY 32 BSA 14 GV 13 BE 9 AWG 6.

VERMONT—SCM, Henry Page, W1ATE—W1JPW is pepping up 'phone activity. W1DQR and AXN are 'phone trouble men. A.A.R.S. is 'hot Stuff' in Vt. W1CUN visited B3F and installed DX antenna.

Traffic: W1AXN 124 BD 87 B7F 56 E7Q 57 CGV 37 GGT 16 FPS 13 AZY 9 GA 5 A7F 250 EFJ 35.

NORTHERN DIVISION

ALASKA—SCM, Richard J. Fox, K7PQ—K7AVU has gone south. Ex-K7BQE got his class C license. A new YL op aged 13 is on the air at Ugashik. K7BOE has twenty-seven schedules weekly, W7DEV at Nome got married. K7BFX is building traffic power. K7AOD goes c.c. K7VH was forced off the air account terrible local noise.

Traffic: K7AVU 1 DJA 17 DOE 68 PQ 96.

IDAHO—SCM, Don Oberbillig, W7AYV—W7AQK, W7BDX, W7BCU, W7HR and others in Northern Idaho rendered great service during Flood by use of amateur radio. Congrats. W7BCU, Ed are contacting 'phones for SCM. W7AT, AFY are working 3.6 mc. W7DCM visited SCM and scheduled W7AD at Moscow from Idaho. W7APT is QRL A.A.R.S. W7BNH has new Jr. YL. W7CAT, CBN are hanging up DX records. W7ATN takes trip to Calif. W7APF has new PR10. W7CTI organizes A.A.R.S. in Nampa territory. W7CMG uses low-power. W7DBP has about 100 antennas. W7ABK wonders when Boise hams are on the air. W7B7M holds FB schedules as ORS and DNCS. W7DSL has e.o. job. W7ASA is trying to eliminate key thumps. W7DKY won prizes at Ham Feed, Dec. 22. Gen State Amateur Radio Club had first annual feed with prizes; FB feed put up by W7DEQ's father, W7ZN, old timer, is getting the fever again. Ex-K7EIO was married recently. W7DEQ gets 50-watter. W7KX celebrated Christmas eve with SCM. W7CP and K7WGO received "bug" for Christmas. W7GU: QRL radio service. W7AXY has selling out idea. New Boise "tuns" W7EES, E2Z. W7AYH has new super. W7BRU, BAY, DEB debate question of radio costs at home school. W7BMF uses official BPL antenna. W7KRP spent holidays at home. W7AYP will be on soon. W7KI, ACP: QRL WUBJ. While W7GL was crossing ferry at San Francisco, man tried to sell him the ferry, but W7KL's strong transmission outsmarted him, demanding delivery in Idaho. W7CFX schedules on 3.9 mc. phone. W7CHN visited Jerome hams. W7BZJ will have more time for radio. W7BBJ has auxiliary transmitter, for emergency work. W7CSW has new shack and transmitter. W7BDY is on 1.7 mc. 'phone. W7D2O is active at Idaho Falls.


MONTANA—SCM, O. W. Cutting, W7BBF—W7CCR takes first traffic honors. W7BIQ has power leak. W7AOD holds schedules, W7EZA got RB from Antipodes.

Traffic: W7BFB 181 CCR 232 44 BMF 18 11 10 54 255.

Traffic: W7CCR 221 BVE 139 CPY 134 BSU 115 B5 59 BDC 54 BDF 14 BMX-AAT 18 AOD 15 BDS 5.

OREGON—SCM, Ray Cummins, W7ATB—W7AOD again makes BPL I W7DIP is in gear. W7WAB is going to a killowatt. W7SY got crystal going.
W7WR is lining up schedules. W7RKL schedules home town. W7PEA is in trouble with note. W7CXX has schedule W7DNC on Tillamook Lighthouse Rock, while telephonic communication was cut off from the mainland. W7DWQ is going c.w. W7BQY, COQ, and CZD started New Year right by reporting. W7AYV, AZ8, and CZD handled traffic. W7AYV has a gypsy transmitter. W7RT has a receiver trouble. Following reported: W7BVI gets out fine on low power. W7BWI has trouble. W7ADS is getting phone bug. W7APS is busy. W7BCS has a gypsy transmitter. It's a lice on all bands. W7BTO got car out of hock. W7BDU has 33 year old bug. W7AHI has FIX.10. W7BDK is experimenting with R1010 and W7BLB got on W7BOQ wants QRA of TC2FF. Following did their part in boosting this section by reporting: W7MQ, KH, BDN, B5P, AR, MY, AV, CTR, APE, NW, AWH, AQL, CAE, ASC, BGC, DSBI, CB5, WDQ, B5G, B6F, B8G, ALD, AYK, AVK, ECO, BQ, AMB, AXO, BXO, BDR, BMA, BRO, BXQ, COU, EBO, CIK, CRN, ARB, AER, DK, MF, DCR, DUE, CEJ, CBJ, AXI, BNX, CWF, BUF, and CSQ.

Traffic: W7DSE 429 AW 247 244 DUE 241 AXX 234 BHR 129 MF 111 CXX 102 CM 94 PN 86 PDI 81 LQ 72 BOO 69 BDU 65 ECO 59 CRN 59 CEF 58 BWD 55 CB7 47 BKL 32 BLN 30 BMA 29 BNC 28 BGO 27 BGF 25 BIW 24 BTZ 23 AMI 21 BDR 20 BMA 20 BGO 19 BGF 18 BGO 17 BGF 16 BGO 15 BGF 14 BGO 13 BGF 12 BGO 11 BGF 10 BGO 9 BGF 8 BGO 7 BGF 6 BGO 5 BGF 4 BGO 3 BGF 2 BGO 1 BGF.

Traffic: W6ETL 2414 EAH/FCE 1602 GXM 1064 CIK 879 CAU 765 JPT 596 GAS 455 le AB 384 K6GW 309 JPT 283 GXM 266 JAX 248 JPT 231 GAS 215 le AB 202 K6GW 192 JAX 175 GAS 158 le AB 139 K6GW 122 JAX 108 GAS 90 le AB 73 K6GW 54 JAX 39 GAS 23 le AB 19 K6GW 11 JAX 9 GAS 7 le AB.

Traffic: W6ETL 2414 EAH/FCE 1602 GXM 1064 CIK 879 CAU 765 JPT 596 GAS 455 le AB 384 K6GW 309 JPT 283 GXM 266 JAX 248 JPT 231 GAS 215 le AB 202 K6GW 192 JAX 175 GAS 158 le AB 139 K6GW 122 JAX 108 GAS 90 le AB 73 K6GW 54 JAX 39 GAS 23 le AB 19 K6GW 11 JAX 9 GAS 7 le AB.

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SANTA CLARA—Acting SCM, Barton Wood,
W6DBB—W6FQY BPLs both ways! W6QY is stinging with dirt. W6FQW still ties down a flock of schedule. W6AAK states a challenge. PPL in three days. W6CIZ
was 22914 in SS. W6AZC boasts 152 W9 cards. The
CUZ 67 AZC 44 C2R 39 IXJ 29 JCZ 28 YX 23 DBB 14 YL
finally rates a new shack. '16BCF is putting an '04A on
about to tangle with a new 'phone rig. W6HJF modestly
Club, has come to lifel W6DBB mixes YLs with radio
ing how to tune his FBXA. Keep the FB reports up,
Traffic: W6FQY 550 YG 168 FBW 134 AMM 132 CIU
7 AZC 44 QR 29 IXJ 26 JCZ 28 YX 23 DBB 14 YL
39 GOZ 8 HJF 5 JUQ 2 EBT 1.
EAST BAY—Acting SCM, P. W. Dunn, W6ZX—
RM-5A/ST came through with an FB report for his
gang. Ninth Corps Areas Aide W6RJ has moved his to
sez 22914 in SS. W6AZC boasts 152 W9 cards. The
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Club, has come to lifel W6DBB mixes YLs with radio
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Traffic: W6FQY 550 YG 168 FBW 134 AMM 132 CIU
7 AZC 44 QR 29 IXJ 26 JCZ 28 YX 23 DBB 14 YL
39 GOZ 8 HJF 5 JUQ 2 EBT 1.
Radio activity may be judged by nr. of monthly reports. W4AJ5 is moving to D. C. W4ADO never turned rig off during ORS Party.

Traffic: W3AEJ 32 DD 25 DNS 20 AJJ 19 ALF-DXY 8 A5E-CNY-CZI 7 B3A 6 BXX-DNX 4 A5T-CDW 3 C3R-DGT-DQQ 2 DDS-TJ 1 CMJ 200 DRK 1 CY 2 A5H 11 C4X 16 W3CFL and BST worked all W districts on 3.5 mc. W4CGY is moving to work 3.5 mc. W4DHJ is moving to work 3.9 mc. W4DLX is moving to work 1.7 mc. "phone. W4EJ is moving to work 1.7 mc. W4FVU is moving to work 1.7 mc. W4GJ is moving to work 1.7 mc. W4HIS is moving to work 1.7 mc. W4HYH is moving to work 1.7 mc. W4IJB is moving to work 1.7 mc. W4JGO is moving to work 1.7 mc. W4KCN is moving to work 1.7 mc. W4LGV is moving to work 1.7 mc. W4MDS is moving to work 1.7 mc. W4NAC is moving to work 1.7 mc. W4OAH is moving to work 1.7 mc. W4PAF is moving to work 1.7 mc. W4QFH is moving to work 1.7 mc. W4RHF is moving to work 1.7 mc. W4SAC is moving to work 1.7 mc. W4TAM is moving to work 1.7 mc. W4UQR is moving to work 1.7 mc. W4VQR is moving to work 1.7 mc. W4WQA is moving to work 1.7 mc. W4ZII is moving to work 1.7 mc. W5A is moving to work 1.7 mc. W6JRM in two hours worked 6 DX stations on 1.7 mc. 'phone. W6FKT reports club at Fallbrook has 10 members. W6GFB has an airplane. W6AME is looking for missing OBS. W6BBC put over a good Italian feed for Stockton link in link coupling. We welcome W6GJJ as a member. W6HGL has new transmitter. Portable W6BIG was in operation in Hawthorne. W6HCE is back with you, gang. Thanks to real cryatals. W6HLJ is putting in a crystal oven. W6FBQ is working DX on 3.5 mc. W6BHQ makes BPL as usual. W6BXB W6GXL's power supply went west. W6DXL with '52 . . .
new ORS: WSHCL, WSGB (reissued). The Ohio Huntington ham. WSCHP made 11662 points in SS. W8KLO attends Marshall College will soon enter fourth stage of Amateur Radio. Hi I CYV-JJA 1.

W8DFC converted a new 'phone ham. WSAHF W8CZ Valley Radio Club is planning tri-state hamfest to be held by SOM QSA5 R9 on 3.9 mc. 'phone. WSJWL got R9 3.9 mc. 'phone within hour placed one in coast town for 3.5-mc. c.w. from Kansas and with aid of W6BLE on Cedar City, is ex-W7AWG. W6EXL turned from west coast. WSHCL desires more schedules. WSGEG visited U.A.R.C. W6KBL is new SLC station. W6KDI, in U.A.R.C. meeting on his newly constructed reflex-vacuum-power portable. W6FYR took two death messages on tube voltmeter. W6ETB, BMB and IWY from Ogden U.,.w. and 3,9-mc. 'phone net for Wyo. W7ABO is on for schedules. W9EHC landed a job. W9FXQ and brother catch-as-catch-can on account of skip. W7 AMU keeps 8 GPJ 7 DEM 5 FFT 4 IOF-IWY-BLE 2. W'l'COH 91 sports new type lic _ense. C.C.: W7NY and EDC. W7CJR are: pres., Ed Drummeller; vice-pres., W9DYP; secy.-treas., W9EHC; serg.-at-arms, W9NKQ. W9ECY has eliminated key clicks. W9FRP needs another 50-watter.


UTAH-WYOMING—Asking SCM, Arty W. Clark, W4QGO—W4EGO demonstrated and theorized at U.A.R.C. meeting on his newly constructed reflex-vacuum-tube voltmeter. W4ETB, BM8 and 1YW—from Ogden visited U.A.R.C. W4KRL is new SLC station. W4KDL, in Cuba, is busy doing W4KEXL tells us A.A.R.S. not over to W6DJ. W6BV has 14 mc. W6AFN and FEN cut schedules for jobs. W6GQG is coming up with "air." W6BTX is back on for traffic. W6GPE uses low power portable. W6FYR took two death messages on 3.5-mc. 'phone and with aid of W6RLU on 3.9 mc. 'phone within hour placed one in coast town for delivery and other within 150 miles. W6CRX took two messages from Wallace, Idaho, flood area and delivered into Idaho via W.U. W7C0H is organizing 7-mc., 3.5-mc. c.w. and 3.8-mc. 'phone net for Wyo. W7ABO is on for Wyo, net. W7CXM is working on new hangar at airport. W7CMP has good note on 3.6 mc. W7C0H says schedules catch-as-catch-can on account of skip. W7AMU keeps Casper hams going, W7DE5 and CVDF are active. W7AG6 is interested in new "bells and whistles" W7EMP is busy on 440 mc. C.C.: W7NY and EDC. W7CJR is building c.o. W7BXS batching. W7CHR is building new shack. W7AEC has power difficulties. W7CE8 is interested in A.A.R.S. Casper Radio Club elected officers: Pres., W4BTO; Secy., W4XBP. W4BTX 138 AHD 80 GQR 37 A0-JV 32 JVB 18 BSE 14 EYS-CRX 8 GQJ 7 DEM 5 FPR 10-JWY-BLE 2. W7C0H 91 AOU 73 AMU 26 AEC 16 NY 6 CBL 2.

COLORADO—SCM, T. R. Becker, W4QGO has taken over W4QGO's duties. The Pabloh crowd are getting started. W4NL-Z, OTM, and NQV have gone to traffic. W4NLL uses low power. W4GQG has fine lot of trouble with MOPA. W4QGO has put out of game for a while on account of "trouble," in making his last report he makes BPL for final. W4BKD has given the OM an ll'B7A for Xmas, W4CQG is on 14 mc. W4CQG promises a letter about the FB work W4KJX to be globe trotting. W4APU is the Birmingham Club president and is working on trunk line J (ew). W4CQG has a few schedules. W4BCN is on 'phone, W4BZG is new ORS. W4ASM joined A.A.R.S. 'phone net, W4AHF rushed his report via the air. W4BDF has QST and is in semi-battle. W4KJM is building Thiet. W4KP is building freq. meter-monitor. W4KJM is not getting the "BULL," let us have your QRA and we will put you on the mailing list.

Traffic: W4JY 504 DS 292 AQ 234 BOU 264 AJY 125 C2F 120 APU 118 BEG 102 BSA 23 BMM 12 COP 11 ASU 3 5 ZS-82 CPE 1.

EASTERN FLORIDA—SCM, Ray Atkinson, W4NN—OPS applications are invited. RMs W4ALP, 4WS, 4ABG report new traffic stations needed badly. W4BSA and NN make "100 total club." W4BGJ took a long time from Byrd Expedition. W4BIN reports U. of F. exams keep him busy. W4BN's power supply went west. W4GK and ZZ do U.S.N.R. work. W4KB handles traffic on 'phone. W4JS reports WAC again on 7 me. W4CMJ has an SW3. W4BNR is on 14 mc. Nice traffic totals at W4AKJ and AQU.


WESTERN FLORIDA—SCM, Eddie Collins, W4MS—RMs: W4ACB, W4AUAW. W4GQA received W4GMS made WAC again on 7 mc. W4CMJ has an SW3. W4ASV has made WAC again on 7 mc. W4BRG operates on 3.5 mc. W4CQG is finishing transmitter. W4BBK is interested in 50 mc. W4QU, BOW and ZZ do U.S.N.R. work. W4KB handles traffic on 'phone. W4AXP wants South Fla. schedules. W4AEB is QL school. W4CMB, AGY and AUV are on 1.7 mc. 'phone. W4CDE is on 7 and 14 mc. W4AUF, ACB, CMJ and CDE use Tritet. W4BED and BSJ use c.c. W4CQG has 60 watter. W4QR reports conditions terrible. W4BET wants new receiver. W4CLP reports. W4BM works gobs of stations. W4BKD is on 28 mc. 'phone. Mrs. W4MS gave the OM an FB7A for Xmas. W4CQG is building new transmitter.

Traffic: W4JX 106 MS 10 AXP 4 ACB 11 AYQ 14 AUW 18 ODE 23 BFD 10 BGA 12 COG 15 BSJ 32 QR 2 AUV 2.

GEORGIA-SOUTH CAROLINA-CUBA-ISLE OF PINES-PORTO RICO-VIRGIN ISLANDS—SCM, G. A. Love, WATS—Assistant SCM, B. L. Stewart, W4CEC. W4BKG leads the section! At the annual banquet of Atlanta Radio Club attendance record was broken with 78 present. W4NT and BBR were among out-of-town visitors. CM2RA, NA, SV, QY and MO have phone fever. CM2DO, AN and WW use FBXAS. W4GB added pair of 800s. W4CQG is a new-comer (ex W9HJD) in S. Car. W4BCN is on 14 mc. 'phone. W4CQZ March, 1934 61
is on 3560 kc. W4BQM is A.A.R.S. W4ANK is on 3564 kc. W4BQM is A.A.R.S. W4ANK passed rules W4CAO and BLN. W4SI and ST are rebuilding.

W4AIF moved to Norfolk, Va. W4BCD was a two-week visitor. W4CAO is on 3580. W4BW wants a ORS renewed. W4lJP is active in Spartanburg. W4CE worked HRlUG on 3.5 me.

W4BKW has new receiver. W5YH is on 3.9 me. 'phone band. W5AXH reports local QRM bad. X-W5TE reports W5JO has FB 14 mc. 'phone. W5ON, BRC, CTC, and BOB report.


NEW MEXICO—SCM, Dan W. De Lay, W5DU—W5AX is new ORS and OBS. W5AOP joined A.R.R.L. W5AKR is on 3.9 mc. 'phone. W5BDU schedules brother W5CQF to perform W5CQG's duties. W5CQG is on sick list, W5BNT turns in third highest total using '45. W5ZM is building Triet. W5ZU was working at W5ZM during holidays. W5DSN is now Albuquerque ham. W5CMQ is now in Navy Radio School at San Diego.

W5OA and K5AY and B5A are on air. W5OJ is "op" at KGKO. W5AV has new QRA. W5AIF is "says" he worked Azores. W5DQW and W5AXP are "having at 'cm."

Please note: Reports should be mailed on the 16th. Amateurs in the capital city of each province were requested to obtain a message of Christmas greetings from the Lieutenant-Governor to the Governor-General, and the Lieutenant-Governor of each province was a complete success. This enterprise was conceived by Len Walker, W5JII, and planned with the cooperation of VES2X, VE2AP, and VE2ST.

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dope via 1BN: Active on 3.9 mc. 1BN, FI, AL, CN, DW, ED. Active on 14 mc. 'phone: 1DR, DM, DW. 1AH is QRL studies. 1CR is selling out. 1CR is QRL BC servicing. 1BM schedules 1BL, Labrador. 1PA schedules his brother in states. 1FW is new man at Glee Bay, 1AB built new home. 1AV lost everything in bad fire. 1ER is building tritet. 1YL is on hour each evening. 1EE worked VE3 without any antenna on 7 mc. 1EA is building modulator for 'phone.


ONTARIO DIVISION

ONTARIO—SCM, S. B. Trainer, Jr., VE3GT—3WX makes MPL and Windsor gang lead province. On Jan. 8 at 7:30 p.m., 3WE, who hails from South Africa, worked 25IM on 3.5 mc. band. Both sent words in Zola as a check. 3GT has gone Goyer Lock c.c. 3HT is new ORS. 3JI has new outfit. 3QW still has QSLs. 3PW worked LI. 3TB is moving to Windsor. 3NM and VS sent newsy reports. Ex 3QK will be on soon as 3MA, 3WO and XT are new Hamilton stations. 3HT is going c.c. The Hamilton A.R.C. hopes to get a booth at Annual Made-in-Canada Show. 3JA awaits receiver. 3IX and JO are on 3.9 mc. 'phone. 9AL is pleased with new 3.5 me. 'phone. 9AM is trying new 'phone. 2AC, AB, EO, DB, BF and RO have QSLs. 25 OE 18 BZ 22 OC 10 BY 67 WJ 14 WA 15 GP 24. 9AL is pleased with new 3.5 me. 'phone. 2BC is trying new 'phone. 208 OE 18 BZ 22 OC 10 BY 67 WJ 14 WA 15 GP 24.

A.R.C.: Pres., 3UY, 1st Vice-Pres., 3SG, Secy., 3GR, Treas., A. C. Rossborough. The University of T. Schools have reopened under 3XK. 3TO is put up. 25 OE 18 BZ 22 OC 10 BY 67 WJ 14 WA 15 GP 24. 25 OE 18 BZ 22 OC 10 BY 67 WJ 14 WA 15 GP 24. 3UB is organizing Simcoe League. 3HA continues occasionally. 3GS is installing Class B. 3WH uses new "Q" meter. 3EM reports traffic for first time. Ottawa A.R.C. hopes to get ORS. 3.XD is coming along. 1YW has frequency 3.9 me. 'phone. 1FM, VA, QY, XR, RU, QO, JO, RT. 30U rig. 3DW is giving code classes. 3NJ, PT and FZ have QSLs. 3AH has gone Goyer Lock c.c. 3JT is new man at Glace Bay. 3HH is dolling his brother in states. 3GT has gone Goyer Lock c.c. 3JT is new man at Glace Bay. 3HH is dolling his brother in states. 3GT has gone Goyer Lock c.c. 3JT is new man at Glace Bay. 3HH is dolling his brother in states. 3GT has gone Goyer Lock c.c. 3JT is new man at Glace Bay. 3HH is dolling his brother in states. 3GT has gone Goyer Lock c.c. 3JT is new man at Glace Bay. 3HH is dolling his brother in states. 3GT has gone Goyer Lock c.c. 3JT is new man at Glace Bay. 3HH is dolling his brother in states. 3GT has gone Goyer Lock c.c. 3JT is new man at Glace Bay. 3HH is dolling his brother in states. 3GT has gone Goyer Lock c.c. 3JT is new man at Glace Bay. 3HH is dolling his brother in states. 3GT has gone Goyer Lock c.c. 3JT is new man at Glace Bay. 3HH is dolling his brother in states. 3GT has gone Goyer Lock c.c. 3JT is new man at Glace Bay. 3HH is dolling his brother in states. 3GT has gone Goyer Lock c.c. 3JT is new man at Glace Bay. 3HH is dolling his brother in states. 3GT has gone Goyer Lock c.c. 3JT is new man at Glace Bay. 3HH is dolling his brother in states.


PRAIRIE DIVISION

MANITOBA—SCM, Reg Strong, VE4GC—The M.W.E.A. has a series of technical talks. 4LZ says Brandon gang is a c.c. 4CL has five watts input on 14 mc. 4BY is on at Airways station up north. 4DK and MV have totals: 4RX and GL have FB 14 mc. 'phones. 4CI has a fifty on 3.5 mc.; 4DU worked some DX. St. Paul gang is getting touch. 4CL is on 14 me. 'phone. 4AE is building tritet. 4MG wants schedules. 4QX is new Edmonton ham. 4VF is reappointed as Route Manager. 4JK and AC become proud fathers of girls. New ORS: 5EP, DO, JA, SRI still dodging shadow. Hi. 5US is ex VE4EL.


Traffic Briefs

WTLD offers: "CQ CQ CQ QRU Seattle? de WTLD." Such procedure is valuable as an aid in routing traffic into the larger cities. Traffic hounds should try it. You may find some traffic for your city flooding around awaiting just such an invitation.

I TAPPA KEY

Kenneth Isbell, WB6QQ-W6AMR, Sec'y-Treas., writes as follows: "The ITK amateur division is now being reorganized under the direction of Joe Meloan, W6CGM, Vancouver. This ITK is a "free" company, only for the best and experienced operators in the west, and is organized for the promotion of better operating and operators everywhere. Members meet on the air, the present membership being rather wide spread, though most is on the coast. It would like to be affiliated with A.R.R.L. and we will welcome members both new and old."

A.R.R.L. Route Manager W6AUT (John Claussen, Jr., Napa, Calif.) 7040 kc. crystal-controlled is proficient in American Morse as well as Continental and became a member of ITK last summer.

March, 1934

Page 63
Automatic Operation

355 Prospect Avenue, Brooklyn, N. Y.

Editor, QST:

It seems to me that the editorial in February QST is a bit inaccurate as to facts. Just to "keep the record straight" please turn to the "Station Descriptions" section on page 40 of March, 1933, QST where you will find a description of an automatically-operated amateur station, W2AYN.

Having visited W2AYN occasionally since 1926, I can testify that W2AYN has been on the air with full automatic equipment since at least 1927. The equipment... is completely homemade, with the exception of the Kleinschmidt typewriter-keyboard tape perforator.

I wonder if there are any other claimants to the title of first automatic amateur station in the United States?

--G. P. Casper, W2AGE

CQ DX

723 21 Street, San Bernardino, California

Editor, QST:

About this time last year, with the DX contest drawing near, a group of Chicago hams sent cards to the active amateurs whom they heard over the air, asking them to refrain from calling "CQ DX" during the contest, thus eliminating a lot of unnecessary QRM. At the time the amateurs here in town felt this to be a great idea and hoped that the fellows would get the drift.

Unfortunately this was not so, and the resulting QRM spoiled many a DX QSO. We are not complaining because we lack power or the DX; to the contrary, we are just asking that needless QRM be eliminated, either by common consent or by ruling in the contest. This only need to apply to the U. S. amateur for we certainly won't complain of too much interference from DX.

We believe that such an idea would make the contest much more democratic and at the same time give all amateurs a chance to pit their operating ability against others, and it would not be a contest of who has the higher power...

--J. V. Collett, W6ERU

Readability and Audibility

Stratford, Ontario

Editor, QST:

Concerning Mr. William W. McLain's suggestions on interpretation of the QSA signals:

Of what benefit is it to indicate receivability in percentage of words missed or copied? I do not see where this is of value, and anyway such a loss of text might not be due to signal strength. Further, it is not wise to have the proposed definition of "QSA1" read "20% of what is sent is received," when the official meaning is "zero % of what is sent is received."

The proper use of "QSA" as I see it is this:
We are seriously interested in our customers' problems and the results that they are able to obtain from our products. It is our plan every month to use this page as a means of bringing to their attention various ideas and suggestions that we may feel will prove helpful to them.

Just for instance, my own phone station is operated mainly in the 3.5 mc band. Recently we shifted to the 14 mc band and for a short time were rather disappointed in the apparent poor performance of our particular FB7A. Of course, the trouble was quickly cleared up — but the incident left us wondering whether or not other amateurs under similar circumstances might have failed to recall the necessity of readjusting the antenna trimmer to their particular antenna and consequently are not obtaining from their receiver on all bands the high degree of performance that the receiver is really capable of delivering.

All of the FB receiver coils are carefully tested and pretuned at our laboratory before shipment. These adjustments are quite critical and should the receiver be used at any time with an antenna differing appreciably from our laboratory standard, it is quite likely that the antenna trimmer condenser will require readjustment. This midget variable air dielectric condenser is located inside of each DET band spread coil and adjusted through the screw-driver hole in the handle. Checking of this adjustment is urged in the instructions that are furnished with each receiver and undoubtedly this is done when the receiver is first put into service. Frequently additional coils are added at a later date to the original equipment. We wonder if this important little adjustment is always remembered on such occasions?

Incidentally, if you are in doubt as to just how to make this adjustment properly, why not write for a copy of our booklet giving full alignment details for both the FB7A and FBX2A receivers?

JAMES MILLEN
GROSS CB-25
25 Watt Phone & CW Transmitter


— LITERATURE NOW AVAILABLE —

The GROSS "CW-25" Crystal Control Transmitter Kit — Less Tubes $13.95

The "CW-25" transmitter kit due to its low cost makes it possible for anyone to own a modern crystal controlled station. A schematic hook-up and parts layout sheet as well as tuning instructions are furnished, thus enabling the most inexperienced operator to wire and put the set on the air, for real results. The "CW-25" is supplied with a sharkskin finished sturdy metal chassis under which all parts are mounted, making the wiring and component dustproof. A plug-in crystal holder is furnished with the kit. Only one millimeter is required for tuning the transmitter and each stage is provided with a jack for this purpose, the "CW-25" uses one 47 as crystal oscillator, one 46 as buffer or doubler and two 46's in the amplifier stage. One set of three coils is supplied with the kit for 30, 40, 80 or 160 meter band. Any additional coils are 75 cents each.

80 or 160 M-stals — $2.75 each

The GROSS "CW-25" Power Supply Kit Less Tubes $8.75

Mounted on sharkskin finished metal chassis which matches the "CW-25" transmitter. Heavy duty power transformer, chokes, condensers, bleeder, etc., supplied. Uses one 83 rectifier. This unit and the transmitter make a neat combination as well as an efficient one.

GROSS RADIO, INC., 51 VESEY ST., N. Y. CITY

“5,” “4” and “3” should not be used unless there appears a reasonable chance of copying every word; “3” means that for one reason or another it is only possible to read the weak signal in spots; “I” means that signals cannot be read at all. “QSA” does not refer to absolute signal level; a “QSA4” signal may be rendered QSA1 by a steady QSA5 signal on top of it, or by other interference.

Why alter the official meanings? “QSA” is a traffic signal, not an experimenter’s signal, and as such seems quite adequate, as it provides a description of every condition from unreadable to perfectly readable. Amateurs, to whom the loudness of signals is of interest, have the “E” system, which appears to fill the bill where accuracy is not needed.

While on the subject of signal intensity, is there a better plan than to use a G.R. or equivalent output meter, and make reports in “db above noise level at this station?” Such a report could be accurate, it would be representative of the signal’s effect on the ears, and would indicate its suitability for communication. It would mean something!

— II. S. Gowan, VE3MQ

Traffic vs. Radio Golf

Agana, Guam

Editor, QST:

Having been a reader of QST since the era of King Spark, and having never before dipped my ear in the troubled waters, I herewith present my first growl.

Perhaps in the past amateur radio has not seemed quite as important as it does at the present time, particularly in regard to traffic handling. Under my present circumstances it has assumed vast importance. Here we sit, roughly five thousand miles from San Francisco with a mail service averaging once in three months! Amateur radio therefore becomes our only method of speedily contacting the States, without resorting to commercial cables. As a rule we are stacked with traffic originating not only on the island of Guam but coming in from the Asiatics as well.

Contacts with the States are easily made; in fact, all hands seem eager to work us. Signal reports are easily exchanged but in a large majority of cases painfully exaggerated. For instance W— reports us “QSA5 RS XPDC” etc. Upon the exchange both ways of signal reports we request QSP and what do we get? In a few instances really commendable stations take our traffic without trouble but the majority of contacting stations just about reverse the signal report when attempts are made to handle traffic. Why then should such an optimistic view have been taken in the first place? . . .

Then next in line comes the ear-splitting high-power station whose signals are always and without exaggeration a real QSA5. He

Say You Saw It in QST — It Identifies You and Helps QST
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Soma price 40-90-160 Meters
For greatest precision, power and stability, use Blyle
BC3 mounted crystals. Within 25 Kc. $4.95
BC3 mounted crystals with a frequency within 5 Kcs of
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Crystal oven $7.50

GROSS RADIO, INC. 51 VESEY STREET NEW YORK City

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850-1500-1500 V. each side of C.T. 400 watts...$8.95
(=ideal job to give 750-1000-1250 V.D.C. with choke input)
For use with 83 tubes will give an output of
500 volts D.C. at 350 MA with choke input. Run your entire R.F. and C.T. with
this transformer. The regulation for the class B is about 5%: filaments are two
1/4, and one 3/4. Special $5.75
A transformer having the same filament
winding as above—al 300 MA having
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$6.80
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800 Watts.
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Thord. 15 H 950 MA. $5.95
Thord. 30 Henry 500 MA chokes...
Thord. No. 1-248 double 18 H
550 MA.
Gross-cased 30 H 200 MA choke...
2.25

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123-B ... 0006 muf. $2.25
148-B ... 0009 muf. $2.35
147-B ... 0012 muf. $2.45
1-199 ... 0033 muf. $5.88
1-183 ... 00011 muf. $5.30

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381, $0.50
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Transmission Insulators .50
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$1.00
A commercial type crystal holder for half
the price you have to pay for ordinary
holders. New type pressure spring,
inside to prevent movement of
crystal, one piece molded body—dust
proof— will take crystals up to 1½" square
or round, Plugs standard spacing. This holder must be seen to be appreciated
for the extraordinary value offered.

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3-1 MA. 3" wide flange meters...
$2.25

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A pair of cased high grade transformers for 46's...
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Filament Transformers shielded in metal cases, center tapped secondaries.
2.5 Volt 10 amperes for 866's...
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Special 10-12 Volt 7.5 ampere filament
transformer, extra special...
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Ward Leonard Vitreous Resistors 200-
Watt 8½" Long with Variable Sliders.
1600 ohms...$1.99
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Pilot J-2310 0 mmf condensers...$0.60

20% deposit with all C.O.D. orders. Remit by M.O. Include postage. Prices subject to change without notice.
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Copper tubing — glazed porcelain supports — supplied with copper clips and three Jumbo plugs. Glazed porcelain base has three Jumbo jacks.

<table>
<thead>
<tr>
<th>Type</th>
<th>Turns</th>
<th>Sections</th>
<th>Inductance</th>
<th>Price</th>
<th>Base Type 680</th>
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<tbody>
<tr>
<td>Type 679-A</td>
<td>12</td>
<td>1</td>
<td>10 µh</td>
<td>$7.50</td>
<td>$1.25</td>
</tr>
<tr>
<td>Type 679-B</td>
<td>7+4</td>
<td>2</td>
<td>2+1.5 µh</td>
<td>$6.50</td>
<td></td>
</tr>
</tbody>
</table>

Obtainable direct from:

GENERAL RADIO COMPANY
30 STATE STREET
CAMBRIDGE, MASS.

Made by the makers of "GR" Plugs and Jacks

CQ's by the hour, directional CQ's to every point on earth, is seldom if ever contacted and when actually contacted, comes back with, "Sorry on this dx stn not interested in handling tlc," and so on to another CQ. . . . If half the stations could hear their signals as others hear them—but oh well, what's the use?

Next we have with us the station who upon being contacted seems tickled to death that his transmitter carries so well. As a rule he says: "Sure glad QSO w/ QSP one of your despatches provided that you mail me one of your cards" —and we stacked with traffic! Invariably he sticks to it and about one message is all he will take.

What is it, a racket? Shades of T.O.M! . . . Of what avail is it to be able to work WAC on any good night and never handle traffic? . . . Have we degenerated into a bunch of radio golfers? Is the real spirit of amateur radio buried in the mad race for high-power sets and longer DX contacts? As K. B. W. put it in a past editorial, every one of our stations is capable of reaching out, so why so much calling just to see whether they do or not? By now it occurs to me that such should be a proven fact! Other radio services handle traffic over much greater distances daily—in some instances with not very much higher power than some of our so-called best amateur stations. . . . Why should we be so thrilled over a five-thousand mile contact, particularly if all we do is exchange a signal report and request a racket card? . . .

—S. A. Burnett, RM2/c, U. S. N. ex-IAIN

600-Meter DX

Editor, QST:

Although I am not technically an amateur by right of owning or operating an amateur station, still I claim at least an honorary inclusion in the fraternity through having gotten a good deal of fun out of radio while making a living at it as a commercial operator for seventeen years . . .

One thing has been mentioned in QST more or less recently which a commercial operator . . . is in a position to add weight to. I refer to the increasing improvement in the last year or so of the lower frequency bands. So much attention has been called to the DX possibilities of the short waves that perhaps many are not aware that considerable real DX is possible right on 600 meters. Back in the days of crystal detectors and "audions" we used to hear some exceptional DX, commonly spoken of as "freaks," on six hundred meters. I have heard JOC, Otchisi, Japan, at Victoria, B. C. on a silicon detector with no amplification, KHK, Honolulu, at Nome, Alaska, at four o'clock in the afternoon on a piece of galena . . . Then came the days of better receivers, but we got little better maximum distance, though we got
KENYON Dreadnought Line

Class B Components

Because of certain advanced features formerly to be found only in special and costly equipment intended for broadcasting, commercial and Government services, now included in regular production, KENYON is setting new standards for amateur radio practice. The KENYON Dreadnought Line stands for commercial radio equipment at regular ham-pocketbook prices,

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The KENYON Dreadnought Class B Input and Output Transmitting Units, although selling at popular prices, embrace engineering refinements and generous specifications heretofore commanding special prices. Here is a condensed listing:

### INPUT TRANSFORMERS — DRIVER TO CLASS B GRIDS

<table>
<thead>
<tr>
<th>Type</th>
<th>Turns Ratio (rot. pri.)</th>
<th>Case</th>
<th>Use</th>
<th>Weight</th>
<th>List Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>TD46</td>
<td>4.7:1</td>
<td>2C</td>
<td>Push-Pull 45 plates to Class B grids</td>
<td>3 lbs.</td>
<td>$8.50</td>
</tr>
<tr>
<td>TD10</td>
<td>2.8:1</td>
<td>2C</td>
<td>Push-Pull 45 plates to Class B grids</td>
<td>3 lbs.</td>
<td>$8.50</td>
</tr>
<tr>
<td>TD03A</td>
<td>3.2:1</td>
<td>LG3</td>
<td>Push-Pull 2A3 plates to Class B grids</td>
<td>6½ lbs.</td>
<td>$12.50</td>
</tr>
<tr>
<td>TD000</td>
<td>2:1</td>
<td>LG3</td>
<td>Push-Pull 2A3 plates to Class B grids</td>
<td>6½ lbs.</td>
<td>$12.50</td>
</tr>
<tr>
<td>TD841</td>
<td>10:1</td>
<td>2C</td>
<td>Push-Pull 45 plates to Class B grids</td>
<td>3 lbs.</td>
<td>$8.50</td>
</tr>
<tr>
<td>TD830B</td>
<td>1:7</td>
<td>LG3</td>
<td>Push-Pull 2A3 plates to Class B grids</td>
<td>6½ lbs.</td>
<td>$12.50</td>
</tr>
<tr>
<td>TD18</td>
<td>4:1</td>
<td>LG2</td>
<td>Push-Pull 2A3 plates to Class B grids</td>
<td>6½ lbs.</td>
<td>$12.50</td>
</tr>
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### OUTPUT TRANSFORMERS — CLASS B PLATES TO R.F. LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>R.F. Load</th>
<th>Sec. C.</th>
<th>Use</th>
<th>Case</th>
<th>Weight</th>
<th>List Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>T046</td>
<td>12,000</td>
<td>140 MA</td>
<td>Class B 46-59 plates to R.F. Load — Primary load impedance (plate to plate) — 6000 ohms</td>
<td>LC4</td>
<td>9¾ lbs.</td>
<td>$12.50</td>
</tr>
<tr>
<td>T010</td>
<td>10,000</td>
<td>140 MA</td>
<td>Class B 10-32 plates to R.F. Load — Primary load impedance (plate to plate) — 5000 ohms</td>
<td>LC4</td>
<td>9¾ lbs.</td>
<td>$12.50</td>
</tr>
<tr>
<td>T0800</td>
<td>20,000</td>
<td>200 MA</td>
<td>Class B 800-825 - RK1S plates to R.F. Load — Primary load impedance (plate to plate) — 12,500 ohms</td>
<td>1B</td>
<td>34 lbs.</td>
<td>$30.00</td>
</tr>
<tr>
<td>T001</td>
<td>10,000</td>
<td>100 MA</td>
<td>Class B 1L — 242A plates to R.F. Load — Primary load impedance (plate to plate) — 8,000 ohms</td>
<td>1B</td>
<td>49 lbs.</td>
<td>$35.50</td>
</tr>
<tr>
<td>T003A</td>
<td>400 MA</td>
<td>10,000</td>
<td>Class B 621A plates to R.F. Load — Primary load impedance (plate to plate) — 5,800 ohms</td>
<td>1B</td>
<td>48 lbs.</td>
<td>$47.50</td>
</tr>
<tr>
<td>T0830B</td>
<td>2,500</td>
<td>10,000</td>
<td>Class B 830B plates to R.F. Load — Primary load impedance (plate to plate) — 10,000 ohms</td>
<td>1B</td>
<td>48 lbs.</td>
<td>$47.50</td>
</tr>
</tbody>
</table>

CLASS B INPUT TRANSFORMERS: By the use of interleaved primary and secondary windings, leakage reactance and distributed capacity have been kept to a minimum, thus eliminating high-frequency transient effects. By the selection of the proper turns ratio, harmonic distortion has been kept down to the tubes' minimum.

CLASS B OUTPUT TRANSFORMERS: All of these transformers are designed to work at the full rating of their associated tubes. Core saturation is impossible, even at highest outputs. Here again leakage reactance and distributed capacity have been kept down to prevent transient effects, while still maintaining windings balanced in all respects. Inductance well over 30 henries assuring good bass response. Core size selected to prevent saturation by plate current of the Class C amplifier. Harmonic distortion, caused by operating core at too high a flux density, is eliminated.

Watch this page for further data on this line. Write for full particulars and bulletin. Meanwhile, ask your nearest amateur radio supply house about these products now on display and in stock for inspection and prompt delivery. These will be supplied you at usual amateur discount.

**TO JOBBERS AND DEALERS:** This line is being sold through a select group of merchandisers in exclusive territories. Certain territories are still open. If interested, write for our proposition.

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KEEPING A LOG

FEDERAL Radio Commission regulations require that every amateur station keep an accurate log of each transmission. The well-kept log is invaluable in checking your station operation. It is a permanent record and is a source of enjoyment in reviewing. The ARRL Log Book has been designed to meet all requirements. As will be seen by the illustration below, it provides for everything.

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American Radio Relay League
West Hartford, Connecticut

About QSL's

Editor, QST:

Much has been said in the past about the practice of exchanging QSL's. There seems to be a difference of opinion as to the purpose of them. You would think some hams used them in place of a log the way they rib you until you send one. There was a time when one needed a QSL to prove he had worked the coast, but to-day it is so commonplace that it seems hardly necessary to have proof. But enough of that. The original concern of this letter was the practice of not addressing QSL's.

In our city we have about twenty-five active and semi-active stations, and consequently quite a few QSL's come to town, most of them—it is safe to say 90%—addressed just "Radio W0— Lincoln, Nebr." As I work in the Post Office, they are turned over to me for disposal, and since I am acquainted with nearly all the ops, I supply the proper addresses.

I made a count one month last winter and I supplied the addresses for 131 QSL's, some addressed to Lincoln, Nebr. and intended for Lincoln, Kansas, Illinois, etc.
An inexpensive Cathode Ray Oscillograph by National will be available April tenth
**BACK COPIES OF QST WITH INDEXES**

THE LIST given below shows many exceptions, and as time goes on each yearly list becomes more incomplete. The 1931, 1932 and 1933 sets will not be complete when next presented. You'll be sorry some day if you don't stop, look and ACT now — Right Now!

Here they are:

<table>
<thead>
<tr>
<th>Year</th>
<th>Issues/Exceptions</th>
<th>Price</th>
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</thead>
<tbody>
<tr>
<td>1923</td>
<td>Only May and November issues</td>
<td>$.50</td>
</tr>
<tr>
<td>1924</td>
<td>Only November and December issues</td>
<td>.50</td>
</tr>
<tr>
<td>1925</td>
<td>copies (except January, March, May and July)</td>
<td>2.00</td>
</tr>
<tr>
<td>1926</td>
<td>copies — complete</td>
<td>2.50</td>
</tr>
<tr>
<td>1927</td>
<td>copies (except January)</td>
<td>2.50</td>
</tr>
<tr>
<td>1928</td>
<td>copies (except January, February and August)</td>
<td>2.25</td>
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<tr>
<td>1929</td>
<td>copies (except February, March, April and May)</td>
<td>2.00</td>
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<tr>
<td>1930</td>
<td>copies (except January, February and July)</td>
<td>2.25</td>
</tr>
<tr>
<td>1931</td>
<td>copies — complete</td>
<td>2.50</td>
</tr>
<tr>
<td>1932</td>
<td>copies — complete (except September)</td>
<td>2.50</td>
</tr>
<tr>
<td>1933</td>
<td>copies — complete</td>
<td>2.50</td>
</tr>
</tbody>
</table>

Complete Set of Copies as Listed $15.00
Single Copies 25c Each

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New binders to keep these files in order are $1.50 each, postpaid. Each binder holds 12 issues of QST and index, and does not mutilate the copies.

**AMERICAN RADIO RELAY LEAGUE**

West Hartford = Connecticut

And remember 1¢ cards are not returnable unless return postage is guaranteed. Not long ago QST contained an article in which it was stated that if the sender of the QSL would put his return address on the face of the card it would be returned in ease of non-delivery. To quote the Postal Laws and Regs: “Single postal cards and post cards (1¢) will be returned to the sender only when they bear his return card (address) in the upper left hand corner of the address side together with a pledge to pay return postage.” If you do not know the address, then put on a 3¢ stamp, so in case of non-delivery it will come back, and you won’t be defaming a good ham’s character when you don’t get his QSL in return for one of yours which he never received.

—John H. Leacoox, W3FDI

**Beginner’s Signal**

One Wall Street, New York City

Editor, QST:

Anent Frank Hawks letter January QST, I have had the same experience. I have been at the game since 1912, on and off, and find that to-day more than ever, the so-called “lid” has little or no chance to get to QSO anyone.

I suggest that those who are slow at code and really want to learn send out, instead of “CQ,” the call “CQ CQ CQ QRS”; then only those who wanted to help and send slowly would answer, being forewarned. If the signal here suggested is not a good one, possibly the helpful gang can think up one...

—Karl A. Kopetzky, W2GOW

**Identifying Harmonics**

9323 Rhodes Avenue, Chicago, Illinois

Editor, QST:

On page 42 of the November QST, I note a method of finding the 28-mc. band described by W6FFU. This method involves the use of a slide rule, which is an item not found in every shack. A method using pencil and paper only would be more universal...

More than a year ago I built an electron-coupled freq-meter-monitor whose fundamental frequencies covered the broadcast band. The harmonics were very easily determined for the 160-meter band but were increasingly difficult to identify for the higher-frequency bands. The following scheme was evolved to determine the correct order of harmonic.

The freq-meter was tuned to zero beat with the desired signal in the usual fashion, and then the dial was rotated very carefully until the next higher frequency which caused another zero beat was reached. Both of these fundamental frequencies were determined from the calibration curve, the lower frequency being designated as \( f_1 \) and the higher frequency \( f_n \). Let \( n \) be the correct order of harmonic of \( f_1 \) to cause...
HERE'S the power and performance you have been wanting. A transmitting tube with 100 watts output, and much more possible properly handled. New simplified, extra-rugged design for long, hard service. No "getter" to impede heat radiation. No plate-supporting collar on stem, eliminating that cause of stem breakdown (plate suspended from envelope dome). No internal insulators. Grid and plate elements made of Tantulum as protection against gassing. Thoriated Tungsten shielded filament. Nonex glass envelope. Conservative plate dissipation 100 watts. Widely adaptable, use unrestricted. Designed, made, and sold by —

HEINTZ & KAUFMAN LTD.
Radio Engrs. and Mfrs.
Since 1919
311 California St.
San Francisco, Calif., U.S. A.

$22.50
If you Act NOW! price goes up to
$24.50
MAY 1ST

SAY $2
by Mailing this Coupon NOW!

NOTE — Extremely low price prevents sale through dealers. Higher material costs necessitate $24.50 price, effective May 1st. Order NOW at $22.50 direct from Manufacturer.

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Please send me —

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........ FOLDERS describing the construction, use, and advantages of this Tube
(NOTE — When ordering tubes, P.O., Money Order, Draft, or Certified Check for full purchase price must accompany Coupon)

NAME: ..............................................................
ADDRESS: ..........................................................

Say You Saw It in QST — It Identifies You and Helps QST
TUBES

To fit the depression pocketbook of the amateur fraternity. These tubes are first class products and carry our absolute guarantee for 90 days.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Price</th>
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<tbody>
<tr>
<td>281</td>
<td>...........</td>
<td>$ .90</td>
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<tr>
<td>211</td>
<td>...........</td>
<td>$7.75</td>
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<tr>
<td>866</td>
<td>H.D. .......</td>
<td>1.50</td>
</tr>
<tr>
<td>303A</td>
<td>...........</td>
<td>8.95</td>
</tr>
<tr>
<td>445</td>
<td>...........</td>
<td>10.00</td>
</tr>
</tbody>
</table>

We are manufacturing a brand new cathode-ray oscillograph. We solicit inquiries.

POWER SUPPLY — 1200 v. — 250 ma and 600 v. — 250 ma

Uses four 83's in a bridge rectifier — completely filtered in both voltage legs.

$35.00

SYLVANIA

Graphite (210 — $4.75)
Anode (830 — 8.75)
.... (825 — 10.00)

PLATE TRANSFORMER — two 7½ and two 2½ volt fil. windings — 750-750 v. — 160 mils. .......... $3.50

EXTRA SPECIAL

Filament Transformer — 110 v. pri. — 2 separate 7½ v. center tapped windings — 3 amps., each ........ $1.35

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Reconditioned like new.

0-5 v. ................. $3.50
0-10 v. ............... 3.75
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WESTON 301 DC MILLIAMMETERS

Reconditioned like new. Following ranges only

0-10 mils ............ $3.75
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Baldwin Type C (new model) Phones ........ $3.35
No. 10 H.D. Enamel — any length — per
ft. ................................... .01
Neon Bulbs — ½ and 1 watt. .............. .45
No. 18 Solid push back wire — per 100 ft. .45
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Billey X cut 160 — 80 — 40 m. Crystals ... 3.90
Billey Xtal holders ...................... 1.50

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Crystal Pro ............. $111.72

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zero beat. Then from the previous consideration that the two harmonics are consecutive the following equation is true.

\[ f_n = f_s(n-1) \]

and solving for \( n \) this becomes,

\[ n = \frac{f_s}{f_r-f_s} \]

A typical example from my own freq-meter is as follows:

\[ f_s = 790 \text{ kc. and } f_r = 987.5 \text{ kc.} \]

Therefore

\[ n = \frac{987.5}{987.5-790} = 5 \]

\[ 5 \times 790 = 3950 \text{ kc. which is the value of the unknown frequency.} \]

—Leonard Tulasukas, W9LKF

Copying Behind

Sioux City, Iowa

Editor, QST:

... Our local USNR unit had a fine turn-out to copy the Navy Day message and I noticed more than ever before the difference between radio operators that never knew another code than Continental, and the converted Morse-radio operator. Besides myself there was another commercial Morse operator, and at the completion of the NAA broadcast we compared notes. The Morse operator and myself (being a "converted Morse" also) had perfect copies. The regular radio operators had a "perfecter" copy—if there is such an animal. Why? Well as near as I can figure, the regular men copied everything, including the intentional mistakes, while the other chap and I copied it as it should be—a habit of too many years to break, I guess. I copied about six or seven characters back all the time and naturally couldn't hear the intentional mistakes—whereas the boys that rode NAA's tail copied mistakes and all.

... An interesting comparison seldom seen, as it isn't often the two species get together under quite these circumstances ...

—Leonard Collett, W9DEA

Everybody Loves 'Em!

118 Grapeland Avenue, San Antonio, Texas

Editor, QST:

I've just finished listening to one of those long-winded CQ's.

While tuning around on the 14-mc. band I came across a CQ with an R8 d.c. signal. ... Well, I had listened to about 15 or 18 CQ's when a W3 came on, CQ'd using the 3 x 3 method for about 2 minutes, then signed. I kept listening for the first station to sign when I heard the W3 come back calling a W6. A report and QRA were given, then he signed. The other station was still CQ'ing and it was just before the W3 came back again that he finally did wake up and sign twice, only to start all over again. I
OF CAPACITY VALUES

Here is another accurate indicator of radio's fundamentals — one of a complete line bearing the name Weston. To the dealer and service man this means that the instrument is the "last word" in test equipment... that it will prove a dependable and profitable partner in his business.

Like other Weston instruments Model 664 will not become obsolete because of its wide ranges and because it indicates in fundamental units — microfarads and volts. It can be furnished in a leatherette covered carrying case, or will fit into the Weston Standardized Service Kits along with other Weston standardized service units. All the facts are included in the Weston bulletin. Send for your copy. Use the coupon today... Weston Electrical Instrument Corporation, 602 Frelinghuysen Avenue, Newark, N. J.

WESTON ELECTRICAL INSTRUMENT CORPORATION
602 Frelinghuysen Avenue, Newark, N. J.
Send Bulletin on Weston Radio Instruments.
Name.
Address.
City and State.

HEY, YOU YOUNG SQUIRTS!

Think you'll ever know as much about radio as Jim Lamb?

Well, you've got to learn, if you ever expect to get there. You can go to school — but the best school is experience. Whatever school you go to, you've got to have the proper kind of textbooks.

There are a lot of grades in radio school. If you're a young lad in junior high you've got a lot of them to pass before you get in the class of J JL, RAH, GG and the rest of 'em. It won't be so hard, though, if you study the Handbook carefully, and then tackle some of the books in the Amateur's Bookshelf. You'll get there — and we'll be glad to help.

But maybe you aren't even in the Handbook class, yet. Then there's only one answer — the League's famous beginner's booklet.

HOW TO BECOME A RADIO AMATEUR

Although No. 8 in the series entitled The Radio Amateur’s Library, it's the primary text of amateur radio. Deals with elementary things, told in clear, simple language. Tells how to build a complete, efficient, yet inexpensive amateur station — receiver, monitor, transmitter. Tells how to operate it, too — in fact, it's the complete beginner's guide to amateur radio. And the price is only 25c, postpaid. (No stamps, please.)

Order your copy today, and join our school right now.

THE AMERICAN RADIO RELAY LEAGUE, WEST HARTFORD, CONNECTICUT
Your Editorial in the December issue was a prod to recall many old memories. So you think the first transatlantic communication was a thrill—wait until you read of the real kick I got!

Larry Dutton of old 0ZN was with me on the S.S. Aeolus running to South America. When in New York one of our hangouts was with Hewitt at his old Brighton Beach Station 2RK. Not getting enough brass pounding at sea we worked hamming ashore.

On our arrival Hewitt was all thrilled about the forthcoming transatlantic test and at being selected to act as a test station. Among other things he was to replace his old sync spark (Grebe, wasn’t it?) with a 250-watt tube and send c.w.—correction, r.a.c.w.—60 cycles on the plate direct. The tests were to be about 6 or 7 p.m. that night, if memory recalls correctly. Something delayed us and Hewitt didn’t get the tube until late. Anyway, we all arrived at the shack about ten minutes before time to go on the air.

Hewitt sat down and tuned in the other senders and waited his time and turn. Dutton and I were to hook up. We worked frantically, Hewitt tuning around very nervously and reading his code script over and over.

Now I must digress a minute to describe that shack—it was about six feet square, eight feet high and lined with copper screen, connected to ground. Hewitt yelled it was time to start. Dutton was outside cutting the power over to 220 from 110 and I was making the last frantic twist onto the power supply transformer—a special 220 to 6000-volt job that Hewitt had borrowed for the occasion. I had my back against that screen wall and was twisting the last haywire connection onto the transformer secondary when Hewitt hit the key to start. I let out a bloodcurdling scream—did a complete somersault and landed in a heap in the corner of the shack.

2RK got across and all was well. But I still think I got the biggest kick out of that transatlantic test!

—W. H. Martin, W6JEI

Knowing that you have published another edition of How to Become a Radio Amateur, which describes another short-wave receiver, I thought you might like a few facts about the previous one. I built one... using the 2-volt Type 80 tubes and it was very successful. I am still using...
SHIPS of Yesterday!

SHIPS of the 14th century charted their course pretty much by chance. The magnetic compass was erratic... the stars were often hidden by clouds and fog... and ships delayed in voyage, or perhaps lost forever, were by no means few.

Transmitters without crystal control are like those poorly guided ships. The unexpected causes many a good transmitter to be off frequency... outside its allotted course, or band.

Billey Crystals are the sure and safe guide. They give greater power output... keep the transmitter LOCKED on one chosen frequency... and cut thru bothersome interference. Don't take chances... use Billey's.

For Billey Crystals see your nearest distributor. If he doesn't have your choice in stock, he can get it for you immediately.

Get our 1934 illustrated folder, and large 3-color frequency chart from your distributor... or write us direct. Both FREE for the asking.

BLILEY CRYSTAL OVEN

A scientifically designed constant-temperature holder-oven; compact, holds within one degree C., plugs into standard 3-prong socket. Operating on 7.5 V. For inch sq. 40, 80 or 160 M crystals. Type BC6, each, complete... $7.50

BLILEY PIEZO-ELECTRIC CO.
226 Union Station Bldg.
Erie, Pa.

Special crystals also manufactured between 20 Kc and 15 Mcs

ALUMINUM BOX SHIELDS

Genuine "Wacoa" stock, silverplated, 5 x 9 x 6, $1.65. 10 x 6 x 7, $3.65. Any Size on Order. SOMETHING NEW! Your call letters, or any marking for your panel, on BLACK aluminum ribbon. Looks like engraving on bakelite, 5c up to 2 inches, 5c each additional inch. Sample 5c. U. S. Army V.T. 1 tubes 56c. 10 for $2.50. Vol for condenser or velocity mike 3½ mill, 22c ft.

New Master Teleplex on demonstration.

BLAN, the Radio Men, Inc.
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New York City

Studio Technique
Guaranteed
KFDM
1000-Watt 560 W. E. Kilocycles

IN 3 to 7 months we train you to secure Amateur, Commercial Telegraph Second-class, and Radiotelephone First-class government licenses. Course consists of Wireless Code, Radiophone, Microphone-Studio Technique, Television, Service, Police, and Aeronautical Radio. We are authorized to teach RCA Institutes, Inc., texts. At completion of your course you receive practical studio technique experience in broadcast studios located in our administration building, and operating experience on KFDM (1000-Watt W. E. Commercial Broadcast Station), and WPA, 4000-Watt Commercial Wireless Station. Return coupon for details.

PORT ARTHUR COLLEGE
Port Arthur (world-known port) Texas

Technical Training Station
Phone C. W.

Say You Saw It in QST — It Identifies You and Helps QST
To Our Readers who are not A.R.R.L. members

You should become a member of the League! That you are interested in amateur radio is shown by your reading of QST. From it you have gained a knowledge of the nature of the League and what it does, and you have read its purposes as set forth on the page opposite the editorial page of this issue. We should like to have you become a full-fledged member and add your strength to ours in the things we are undertaking for Amateur Radio. You will have QST delivered at your door each month. A convenient application form is printed below—clip it out and mail it today.

A bona fide interest in amateur radio is the only essential qualification for membership.

American Radio Relay League
West Hartford, Conn., U. S. A.

I hereby apply for membership in the American Radio Relay League, and enclose $2.50 ($3.00 outside of the United States and its Possessions, and Canada) in payment of one year's dues, $1.25 of which is for a subscription to QST for the same period. Please begin my subscription with the . . . . . . issue. Mail my Certificate of Membership and send QST to the following name and address.


Do you know a friend who is also interested in Amateur Radio, whose name you might give us so we may send him a sample copy of QST?

Thanks
STANDARD CABINETS

There have been so many requests for standard National Receiver cabinets for use in constructing special equipment, that it has been decided to list them among our regular products. Illustrated above, left to right, are the cabinets regularly used for the SRR and FB-7 receivers, the PSK Pre-Selector, and the SW-3 receiver. Though shown with panels and sub-bases punched for standard assemblies, they are available plain at no extra charge. List prices are as follows, including sub-base and bottom cover: C-SRR, $3.50; C-FB7, $7.00; C-PSK, $6.00; C-SW3, $5.50. Usual discounts apply.

NATIONAL COMPANY, INC., MALDEN, MASS.
The NEW 800 Tubes

Use the RCA-800 Tubes for improved results

✓ As A.F. Power Amplifier and Modulator — Class "B"
✓ As R.F. Power Amplifier — Class "B" (Telephony)
✓ As Plate-Modulated R.F. Power Amplifier — Class "C" (Telephony)
✓ As R.F. Power Amplifier and Oscillator — Class "C" (Telegraphy)

RCA-800: Filament, 7.5 v., 3.25 amps. Max Plate Voltage, 1250; Price each, net, $10

No Tri-Tel is complete without the 800 We carry the full line of RCA-De Forest Transmitting Tubes

COMPLETE LINE OF NATIONAL PARTS including Midget Condensers and Type 51 Sockets, as advertised in QST.

H. JAPPE COMPANY
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It Cost us $17,000.00 to produce—and it's yours for $1.00 POSTPAID ANYWHERE

See the Second Cover

A.R.R.L.
38 LaSalle Rd., West Hartford, Conn.
Here's my dollar. Send me mine.

(Name)

(Street or Box)

(City and State)

Standard Frequency Transmissions

STANDARD frequency transmissions from W1XP have been suspended temporarily for changes and repairs in the frequency standard equipment at the Round Hill Station. Schedules of the S. F. System's Midwest and Pacific Coast stations, W9XAN and W6XK, continue as usual, according to the following schedule:

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STANDARD FREQUENCY SCHEDULES

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Say You Saw It in QST — It Identifies You and Helps QST
No. 771—4½-VOLT
Tapped at 1½, 3 and 4½ volts.
Length, 4 1/16"; width, 1 1/2"; height, 3¾".
Weight, 14 oz.
As an "A" battery with 2-volt tubes; start on 3-volt tap; finish on 4½-volt.

No. 768—22½-VOLT
Tapped at 6, 18 and 19½ volts.
Length, 4½"; width, 2 9/11; height, 3¾".
Weight, 1 lb., 9 oz.
Can be used as a combination "B" & "C" battery.

For Portable Radios

Headquarters for battery information

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"HI-MHO"
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Makers of Lynch Famous Metallized Resistors

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ACME-DELTA COUPLING TRANSFORMERS

We announce a new AD Coupling Transformer, AD-77, especially designed for Class "B" Driver use for 3 A3 Class A push-pull to 600 Class "B" grids. Our AD-76 Output Transformer should be used as Class "B" output. These two units give a full 100 watts audio power with excellent frequency characteristics and operating efficiency. List prices AD-77—$7.50, AD-76—$15.50, subject to usual 20% discount. Write for details of these transformers and also those which will soon be ready for the new Sylvania 830B tube.
TRANSMITTING PROCEDURE

The time allotted to each transmission is 8 minutes, divided as follows:
2 minutes — QST QST QST de (station call letters).
3 minutes — Characteristic letter of station followed by call letters and statement of frequency. The characteristic letter of W9XAN is "0" and that of W6XK is "M."
1 minute — Statement of frequency in kilocycles and announcement of next frequency.
2 minutes — Time allowed to change to next frequency.

W6XK: Don Lee Broadcasting System, Los Angeles, Calif., Harold Peery in charge.

WWV 5000-Kc. Transmissions

The 5000-kc. transmissions of the Bureau of Standards' station, WWV, are given every Tuesday continuously from 12:00 noon to 2:00 p.m., and from 10:00 p.m. to midnight, E.S.T. The accuracy of these transmissions is better than one cycle (one in five million).

Silent Keys

It is with deep regret that we record the passing of these amateurs:

G. W. Cates, W6GAI, Stockton, Cal.
George H. Fischer, Jr., W5CCJ, Abilene, Texas
G. T. Guile, ZL1FB, Ootopiki, N. Z.
Yoshinori Hayashi, Sendai, Japan
Andrew J. Kralovec, W9HXB, Menominee, Mich.
George W. Leach, W5BJU, Abilene, Texas
A. E. McFarlane, G6RM, E. Croydon, England
Argyle B. Proper, WDZG, Greenwood, Mass.
H. V. Reynolds, VR1HR, Georgetown, British Guiana
Raymond C. Sellers, W9DZM, Sycamore, Ill.
Thomas H. Van Buren, W6GOF, San Diego, Cal.

Information Service Rules

PROMPT handling of inquiries concerning amateur equipment and problems will be greatly facilitated if the following rules are observed when writing to the A.R.R.L. Technical Information Service:

1. Before writing, consult The Radio Amateur's Handbook and your files of QST. Nine times out of ten you will be able to find the answer in QST or the Handbook.
2. If reference is made to the Handbook, mention the page and the edition to which you refer. If reference is made to QST mention the page and issue you have in mind.

PROFIT BY THE EXPERIENCE OF OTHERS—Thousands of Amateurs Have Read HINTS AND KINKS

If you haven't yet gotten a copy of this indispensable compilation of the money-saving ideas of 189 experimenters, you'll be glad to know that the original supply, exhausted in less than six months, has been replenished by a second printing. You'll find in it hundreds of good ideas which amateurs have found helpful. It will return its cost many times in money savings — and it will save hours of time. Many of these little dodges would probably never occur to you. Order your copy at once.

HINTS AND KINKS FOR THE RADIO AMATEUR

No. 10 in the A.R.R.L. series entitled The Radio Amateur's Library

EIGHTY PAGES IN ATTRACTIVE PAPER COVERS

50 cents, postpaid anywhere (no stamps, please)

THE AMERICAN RADIO RELAY LEAGUE

West Hartford, Connecticut

Say You Saw It in QST — It Identifies You and Helps QST
Sa. O.M. Have you heard THORDARSON has just brought out an ALL NEW transmitting line, class B, 800 tubes, 'n everything.

The new THORDARSON power, filament, modulation, and amplifier transformers, and power chokes are everything you would have a right to expect from the pioneer builder of amateur transformers.

What's more, they not only embody many brand new engineering developments, but they are priced to make your dollars go farther. Write for full details or ask your jobber.

THORDARSON
Electric Mfg. Co.
500 West Huron St., Chicago, Ill.

Write for the New THORDARSON Transmitter Guide

DELUXE 5 meter antenna impedance matching transformer and rods — Picard type — highly efficient — especially suited for portable installations, quickly taken down, self supporting. Now used by many 5-meter experts. Enclosed transformer with sockets for 7/8" brass rods. Qth kit including transformer and two 30° brass rods $2.50. Complete plus postage.

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RCA — Radiotron type 866-A M.V., Rectifiers $5.00
De Forest types: 210, 230, 281, each $1.00
Johnson type "Q" antenna systems: complete 10 meters, $3.67; 20 meters, $5.82; 40 meters, $10.29; 80 meters, $15.16; 160 meters $37.46.
Johnson antenna insulators: 7" — 39c, 12" — 45c, 20" — 40c.
Transposition Blocks — porcelain, each 9c
Midget porcelain strain insulators, each 8c
Feeder spacers — porcelain, each 15c
Johnson 20-watt sockets National SW-3 — $4.20; FBGA $4.70 National SW-3, AC or DC models $15.70
National Preselector unit, with 1 plug-in coil for FB receivers $15.00
Hammarslund Comet "PRG" S.W. receivers, with coils, tubes and power supply $95.37
Bruno Velocity Microphone Kit $5.88
Xmitting chokes 1.95 m.h., 1600 ma... 85c
Xmitting chokes 1.75 m.h., 200 ma.. 60c
Thordarson chokes, 50 hr. 125 m. 95c
Resistors d.c., milliammeters 0-15 to 0-400 ma., each 9c "Go-Devil" Automatic Transmitting Key $6.00 net.

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QST Oscillating Crystals
"SUPERIOR BY COMPARISON"

All "Scientific Radio Service Crystals" are accurately ground to an accuracy better than .03% on equipment tested regularly by the U. S. Bureau of Standards, standard frequency signals.

Broadcast and Commercial Bands

Broadcast Band Crystal mounted in our Standard Holder and ground to our usual high degree of accuracy now $35.00 each. Mounted in our NEW Isolantite Mosel Metal Crystal Holder $45.00 (adjustable air gap). Prices for other Frequency Bands quoted upon application.

Amateur Bands

Scientific Radio Service Crystals ground to within 5 Kilo-cycles of your specified frequency in either 80 or 160 meter bands $15.00 each. Mounted in our Standard Holder $5.00 additional. Accurate calibration with each crystal.

Prompt Shipments Assured

Scientific Radio Service
"The Crystal Specialists" Since 1928
124 Jackson Ave., University Park, Hyattsville, Maryland Dept. Q-3
50-WATT SOCKET

In this quality product, the usual metal shell has been avoided, thus eliminating the usual source of arc-over. The insulation is a one-piece low-loss Steatite shell. The contacts are heavy and of the side-wipe type for low contact resistance. Fifty-Watt Socket. Type XC-50, List price $3.50.

In stock at authorized distributors, usual discounts applying.

NATIONAL COMPANY, INC.
MALDEN, MASS.

- R ME -
ANTENNA MATCHING NETWORKS

Maximum transferred energy from final tank to antenna — the aim of every amateur.

With these networks accurate matching of external circuits is readily obtained.

No harmonics are radiated from the system.

Installation is very simple.

Feeder lines may be made any length and DO NOT require tuning.

Coupling unit is inserted in the center of a half-wave Hertz.

The system becomes a simple resistive load to the final tank.

Weight of unit approximately 12 ounces.

Specify frequency and approximate height of antenna when ordering.

Units for any frequency. 10 meters to 175 meters, 1000-watt capacity. Any unit, net price ...................... $5.25

INSTALLATION INSTRUCTIONS INCLUDED WITH EACH UNIT

Feeders lines, accurately built with impregnated, non-slipping spacers every two feet of length. Per foot, net price ...... $0.10

COMPLETE DATA FORWARDED UPON REQUEST

For full particulars and information on RME-products, including the now famous RME-9 Super receiver, send 10c in stamps for loose leaf folder.

RADIO MFG. ENGINEERS
PEORIA 147 Cooper Avenue ILLINOIS

3. Write on one side of the paper only, and use a typewriter if possible.

4. Number the questions and make a separate paragraph for each question. Make the questions as brief and as direct as possible.

5. Make diagrams on separate sheets of paper and fasten them to your letter with a pin or paper clip. All diagrams should be schematic — do not send pictorial diagrams.

6. Print your name and address in full on each sheet of paper. A return address on the envelope is not sufficient, as the envelope is destroyed by the office manager as soon as the letter is opened.

7. Keep an exact copy of your questions and diagrams, and mention that you have done so.

8. Do not ask for opinions on, or comparisons of, business concerns or their products.

9. Enclose postage for the reply but do not send an envelope. It is much more convenient for us to use our own envelopes with our stationery.

10. Address all questions to the Technical Information Service, American Radio Relay League, 38 La Salle Road, West Hartford, Conn.

Any back copies of QST to which we refer you may be obtained from our Circulation Department for twenty-five cents each.

The observance of the above rules will be mutually beneficial.

Traffic Brief

With due apologies to the "great fraternity of newspaper reporters" we quote the following from an item found in a local paper by W1CII. The item deals with Federal agents locating an unlicensed radio transmitting station. The "headlines" read, "Unlicensed Radio Cleverly Concealed," and the reporter goes on to relate: "A short-wave set with a 1000 watt transmitter, the apparatus was grounded on the bathtub and used the electric light line as an aerial. Although the walls of the house are thin, no tenants ever had suspected the presence of a radio. Its instruments were well muffled and
WE SPECIALIZE IN HARD-TO-GET PARTS
Transformers Designed Especially for the Amateur
M. & H. Plate & Filament TRANSFORMERS
450 volts each side, C.T. 150 mls; 21/2 volts—3 amps, center tapped; 5 volts—3 amps, center tapped. Designed for Triton Unit or 47 xtal; 46 amplifier, 83 rectifier combination. Weight 81/2 lbs. Size, 31/2" x 4" x 6". SPECIAL Completely cased

M. & H. PLATE and FILAMENT TRANSFORMERS
750 volts, each side, C.T. 200 mls; 71/2 volts, 3 amps, center tapped; 5 volts, 3 amps, center tapped. Designed for 210 or 841 OSC—amp, 83 rectifier combination. Weight 181/2 lbs. Size 5" x 6". Completely cased. SPECIAL

Write for New 1934 M. & H. Radio Catalog

NEW ITEMS
We are Distributors of the Famous RCA Line of TRANSMITTING TUBES
See full details in our ad in Feb. QST.

Send for Free Amateur Schedule Card

The New Biley Crystal Oven in stock.........$7.50


LEARN RADIO
New Classes Forming! Send for 48-page catalog, explains fully, 180 licensed graduates placed in past 21/2 years in broadcasting, shipping, police radio, aviation, etc. We teach all branches. Oldest, largest and best equipped school in New England. Equipped with Western Electric sound and broadcasting equipment and RCA marine transmitter. Course prepares for United States Government telegraph or telephone license.

MASS. RADIO SCHOOL, 18 Boylston Street, BOSTON

Learn CODE in HALF the Usual Time!
It's Easy to Do at Home with
The NEW MASTER

As a child, you understood spoken English long before you could read or write. You learned by Hearing. CODE is the same way! Why make it hard for yourself, trying to learn with old-fashioned printed lessons alone? HEAR as you learn, and learn in half the time, with The New Master Teleplex. This world-famous instrument records your sending visibly — then sends back to you through headphones! The natural method; beginners learn faster, up speed up their wpm amazingly. Used by U. S. Army and Navy, R. C. A., A. A. T., and others. We give you Complete Course, and your instrument, instruct you personally and fully under MONEY-BACK GUARANTEE, no cost, easy terms. Write now for folder QST 3 — no obligation.

TELEPLEX COMPANY
76 Cortlandt Street
New York, N. Y.

GET THE DOPE ON THIS NEW ROSS SET

4 AMATEUR BANDS BY TURNING A SWITCH — No Coils to Plug In — No Coils or Other Extras to Buy

Your first cost — and it's surprisingly low — is your last cost on the NEW Ross Jupiter Model. The coils are an integral part of the set. What's more, you can switch from one amateur frequency band to another by the mere flick of a panel switch. Set has many other features as well. Equipped with powerful dynamic speaker, sold under absolute money-back guarantee. You must be pleased! Complete with speaker and permanently attached coils but less tubes, only $59.50 net.

A. H. ROSS and COMPANY
(Suburb of Philadelphia)

WRITE FOR FOLDER

Say You Saw It in QST — It Identifies You and Helps QST
EFFICIENT AMATEUR STATIONS USE

**RK-18** In the self excited oscillator, final amplifier and Class B modulator.
**RK-17** In the QST TRI-TET Oscillator. Low internal capacitances and low loss base permit higher output than with the 59.
**RK-19** For the power supply. A low drop, high vacuum full wave rectifier designed for the 1000 volt transmitter.

RK-18... $10.95
RK-17... 5.00
RK-19... 7.50

Write for Characteristic Data Sheets on these and other tubes for amateurs.

RAYTHEON PRODUCTION CORPORATION
30 EAST 42nd STREET, NEW YORK or SAN FRANCISCO - CHICAGO - NEWTON, MASS.

**PRECISION CRYSTALS**
FOR ACCURATE FREQUENCY CONTROL

FREE Plug-in, dust-proof holder with each amateur band crystal purchased.

PRECISION Crystals are of the highest quality obtainable. These crystals are X cut, one inch square, accurately ground for maximum output, thoroughly tested and fully guaranteed. They are accurately calibrated and will be supplied within 0.1% of your specified frequency. It will pay you to buy these quality crystals, 1750 and 2500 kc.

bands—$4.50 ea. 7000 kc. band—$5.50. Crystal holder (illustrated)—$1.50 (Holder free with each crystal purchased). Jacks to plug holder into—150 pair.

Crystal Holder bands 427 ASIA STREET BATON ROUGE, LA.

Write for Characteristic Data Sheets on these and other tubes for amateurs.

BIASING THE POWER AMPLIFIER
(Continued from page 34)

condenser may suffice. The transformer can be a midget job which furnishes 250 volts or so plus a winding for the 80 rectifier. Figure the voltage divider so that the part of the resistance connected in the amplifier grid circuit will follow the rule given previously, and try to have the output voltage high enough to cut off plate current when there is no excitation. For example: A pair of 10's are to get 90 volts of bias; the output of the rectifier-filter is 250 volts; resistance of the 90-volt portion of the divider is to be 5000 ohms. The remaining divider resistance needed will be

\[
\frac{250 - 90}{90} \times 5000
\]

or 8000 ohms, closely enough. The values are not critical.

Conference on Emergency Communication
(Continued from page 58)

arises. Those who have made no commitments and who wish to remain free agents, able to help as circumstances dictate, should read our Communications Department's recent suggestions on how best to serve.

K. B. W.

I. A. R. U. News
(Continued from page 60)

W6FT; Wayland M. Groves, W5NW; Clay Champion, W5CCW; W. H. Jones, W6FYF; Alois Weirauch, OK1AW; Leslie Cooper, G5LC; Jacques Mohien, ON4AU (phone); Francisco Roldan, EAR10; Lorenzo Navarro, EAR38; Joaquim Perez Cinto, EAR227; Herbert Fehse, D4BCD; P. Cuestaing, ON4LO; M. G. Brashear, K5AA; Seth O. Perkins, W6PKC; Masamoto Sumiyoshi, J1EE; M. Oshima, J1FF; Orval Wood, W6ASV; A. E. Dyson, G6NJ; Harold E. Wyer, W1DYE; Thomas J. Patterson, W5GEN; Manuel Cañedo, EAR226; John Marshall, W9ARL; Tadeusz Puleżyński, SP1BC; Angel Uriarte, EAR12; Luis San Juan, EAR46; Bertram E. Sandham, W6VO-W6EQF; W. Kempston, W6TA; Frederic Gillet, W6HS; Ladislav Zdunký, OK1WX; M. Griffin, G2XA; Manuel Joaquim Santos da Cunha, CT1CQ; Elvin Feige, W6TT; B. Th. Fjeld, LA1Y; Gerald Loban, W7BPE; Fumio Horitsuki, JC6C (phone); Roberto Castro G., T2RC; R. F. Loomes, G6RL; Wm. A. Nokes, G2ZG; G. E. King, ZE1JF; Harry W. Schüllman, W4ATS; William F. Erdman, W6CUZ; Lowell Popp, W9AOE; J. F. Stanley, G6SY.

A total of 1034 WAC certificates had been issued at the end of 1933.
"How's the new examination?"
"Tough, m'lad, tough. You gotta get down and dig, if you want to pass it. Them transmitter questions — wow!"

"We'// bet our 1933 auto license plate that a minimum of 10,000 conversations such as the above have occurred since October the 1st, that day of renown on which the new regs took over. But, happily, that isn't the end of the story. Listen to this:

"Yuh don't say! And me what ain't yet been able to see one itty-bitty electron climbing from filament to plate. Ain't there nothin' I can do about it?"

"Sure. Get a copy of
THE RADIO AMATEUR'S LICENSE MANUAL
from good ol' A.R.R.L. It's got all the dope — questions 'n' answers — technical info — the new regs — everything."

"Yeah? How much is it? — that's the burning query these days."

"Just two bits, postpaid. And it tells the whole story on the Class A license for unlimited 'phone, too, and all that complicated stuff on renewals and modifications."

Get your copy today, 25c, postpaid, no stamps, please
THE AMERICAN RADIO RELAY LEAGUE, West Hartford, Conn.

THE INSTRUCTOGRAPH
(Code Teacher)
The Scientific, easy and quick way to learn the code. Send a post card today for literature. Machines, tapes and complete instructions for sale or rent. Terms as low as $2.00 per month. Rental may be applied on purchase price if desired. Rent for a month, if the Instructograph meets every requirement, buy it; if not, send it back.
INSTRUCTOGRAPH CO., 812 Lakeside Place, Chicago

LOW RANGE FUSES

- Littlefuses for Instruments: Amps: 1/100, 1/32, 1/16=20c ea. 1/3, 1/4, 1/8, 1/16=10c ea. For milliamperes, lamp rectifiers, etc. Use 1/8 for radio B circuits. High Voltage
- Littlefuses: 100V, 200V, 10kw, 10,000 volt ranges in 1/16, 1/8, 1/4, 1/2, 3/4, 1, 11/2, 2 amps. Renewable. Price 25c to $1.25 ea. NOW—$1.00 PROTECTION GUARANTY. Get New Cat. 4-
LITTLEFUSE LABS.
1784 Wilson Ave., Chicago

FOR ULTRA H.F. JOBS
Cornell-Dubilier Type 9 — heavy-duty, low r.f. loss, molded bakelite capacitor for transmitting circuits. Ideal for high current blocking (plate to grid) unit. Also as by-pass for r.f. around any device or D.C. meter. Short-path connections for h.f. work. In standard bakelite or in special low-loss bakelite for ultra h.f. work. Up to 2000 v. D.C. 0.0005—0.015 mfd.
Write for 1934 edition of C-D catalog, describing this unit and all its options as well as complete line of transmitting and receiving condensers for every radio need.

CORNELL-DUBILIER CORP.
4377 Bronx Blvd.
New York City

Say You Saw It in QST — It identifies you and helps QST
Adjustable To Exact Desired Values

These exclusive features make TRUVOLTS the most adaptable of all resistors:
1. Patented design permits larger wire and open-air cooling.
2. Double spiral winding insures perfect electrical contacts.
3. Sliding clips provide exact adjustments.
4. 1,000 volt insulation.
5. Full-length protective guard.

All Standard Sizes

WHERE ELIMINATORS WON’T DO

The foregoing discussion should have made it plain that one of the chief virtues of a “B” eliminator in biasing a power amplifier is that the bias is automatic with protection. When automatic bias is undesirable, as in a Class-B linear amplifier or Class-B audio amplifier, the ordinary “B” eliminator will be unsatisfactory. It is, in fact, rather uneconomical to attempt the design of a power pack for such purposes. The resistance of the voltage divider must be made so low that a very considerable amount of power must be wasted in it if the desired output voltage is to be maintained, and even then it is doubtful whether the type of performance expected from batteries could be duplicated. Adequate filtering would be a severe problem. But for ordinary Class-C operation, or in the operation of c.w. or exciting amplifiers where linearity in the grid circuit is of little consequence, a “B” eliminator, intelligently handled, will be entirely satisfactory for a single stage.

A One-Tube Crystal-Control Transmitter

(Continued from page 18)

connecting the key in the negative power-supply lead. With a crystal of reliable make and correct transmitter adjustments, the keying will be positive and clean-cut at ordinary hand speeds.

POWER OUTPUT

A rough estimate of the power output shows it to be in the vicinity of 8 watts on those frequencies for which a 1750- or 3500-ke. crystal is used. The output with 7000-ke. crystals is not as great, being about 5 watts on both 7000- and 14,000-ke. These outputs are comparable with those obtained from the highly-popular self-controlled pair of 45’s in push-pull operating at the same plate voltage because the efficiency of the crystal oscillator is greater than that of the self-controlled oscillator. With the latter, some of the power output has to be sacrificed for the sake of frequency stability. And with the crystal set, being in the band and having a d.c. note are two things that can be crossed off the list of transmitter worries.

Strays

The Dallas Amateur Radio Club exhibited and operated station W5FC at the Texas State Fair, Dallas, October 7–22, 1933. This was the second year that W5FC had been in operation at the state fair. The transmitter used was W5PJ’s c.c. job with a ‘B2 in the final. Receivers were an FBX and a Comet Pro furnished by W5RJ and Mr. Hammerlund respectively. During the two weeks of operation W5FC became nationally (and internationally) known on its frequency of 7025-ke. A total of 2201 messages were accepted. Of the 417 QSOs at W5FC only 21 were scheduled-contacts. Communication was established with all U. S. districts, 33 states, Hawaii, Mexico, New Zealand and Australia. 27 different operators.
FOR A.R.R.L. MEMBERS

Use the Stationery

Wear the Emblem

Write your radio letters on League stationery. Lithographed on 8½ x 11 heavy bond paper. Postpaid. 100 sheets, $0.75; 250 sheets, $1.00; 500 sheets, $1.75.

The League Emblem, in heavy rolled gold and enamel, either pin or button type, $1.00 postpaid.

AMERICAN RADIO RELAY LEAGUE, WEST HARTFORD, CONN.

KLAUS RADIO & ELECTRIC CO.
707 MAIN STREET
PEORIA, ILLINOIS

RADIOTRONS—Transmitting and Receiving
Standard Lines of RECEIVERS and PARTS
WRITE FOR LITERATURE

NEW!

UNIVERSAL
Stretched Diaphragm Type
1934 MODEL "X"

Here is microphone value without precedent! A brand new 1934 model, stretched diaphragm type. Full Diaphragm Protection 2-button microphone, listing at only $10.00! Exceeds every reasonable requirement for quality performance.

UNIVERSAL MICROPHONE CO., Ltd.
434 Warren Lane
Inglewood, Calif., U. S. A.

WE STOCK—SYLVANIA AND RAYTHEON TRANSMITTING TUBES
HAMMARLUND "PRO" AND FBXA NATIONAL WRITE FOR FREE CATALOG

CAMERADIO
603 GRANT ST.
PITTSBURGH — PA.

Say You Saw It in QST — It Identifies You and Helps QST

99
HAVING made no investigation of the advertisers in the classified columns, the publishers of QST are unable to vouch for their integrity or for the grade or character of the products advertised.

OVER six pounds radio data, circuits, bulletins, 50¢ postpaid. Beyond Rockides 765 Kladag, Kent, Ohio.


All expenses low. Catalog free. Dodge's Institute, Byrd St., 6-15 volt 500 watt Aircraft with propeller $10. 500 cycle 500 offer takes. Ed McCall, Anniston, Ala.

WANTED: brand new We'llton Model 267, d.c., SELL, swap, two G.E. 211s, for $110. 85¢, 860. Parts wanted. QSLs, QSLs! Spend just a little more money and get the and SW receiver (complete station) including wavemeters.


WANTED: 500W 1000V motor-generator that will run in good condition. Henry O. Wilson, Angoon, Alaska.

WANTED—Caudier Advanced Courses, W2DIE.

QSLs by Maleco. Finest in country. Free samples. Maleco, 1512 Eastern Parkway, Brooklyn, N. Y.

SW-3, new, $11.70. Attention local amateurs. Also new Nations 600 V, 20 watt, $2.50. Fred Willey, 1754 Linden, Long Beach, Calif.


SELL, typewriter, telephones, mike, parts, tubes. Willey, Watts, Ohio.

TEN practical and low-cost changes, converting Dodge 12-V, Ford T-A, Chevrolet Delco 6-V generators into 100-500 watt capacity a.c. generators, or into 32-110V d.c. motor or generator. Dodge is 500-W self-excited. All in one book illustrated with complete simplified instructions and drawings for only $1. Autopower, 416 S. Hoyne Ave., Chicago.

You can't beat our prices FB-7, Comet, SW-3, short wave receivers. Hairy & Young, Hartford.

WANTED: Crystal Oscillators. W2DIE.

SPECIAL service: We install automatic volume control, any set, sw or broadcast. Latest, best types. Also repairs, reconstruction. Give details in asking estimates. Tone corrections, all kind radio rejuvenating, detector to speaker. Hairy & Young, Hartford.

CRYSTALS: Guaranteed excellent oscillators, 160 or 80 meters, your approximate frequency $1.35 postpaid. Crystal Mother of Pearl 1" 16-20s, 1" 165-200s, $5.00. Improved dust-proof Balleite Holders, 11/8" silvered electrode increase efficiency. Plugs into G.R. or tube socket metal post. Any position. 75¢—dozen $5.40. Fisher Laboratory, 1200 E, Nevada, El Paso, Texas.

QST superheteryodyne preselector, $10; Universal five-band condenser $12.20; transistor, $12.50. List. Logins' crystal transmitter, with power supply, $21.50. Write for new catalog. We build to order. Precision Radio Lab., 580 N. 8th St., Brookings, S. D.

QSL and SWL cards, 200 one color, $1.20 two color, $1.25. W9JUT, 1827 Cone St., Toledo, Ohio.


CONDENSER microphones $7.50, desk or suspended amplification. P. G. Carr, 75 Summer St., Lancaster, N. H. WICE.

WANTED: New tubes, parts. Write. Condenser microphones $7.50, desk or suspended amplification. P. G. Carr, 75 Summer St., Lancaster, N. H. WICE.

CALLBOOKS—new Spring 1934 Radio Amateur Call Book. Two copies of new edition of W9JUT, 1302 High St., Fort Wayne, Ind. first edition. We have the second edition. We have the second edition. Write for free samples. W9TER, 1600 S. Dearborn, Chicago.

COILS—soldering and maintenance. Complete stock. 50¢ off on new Amertran transformers. Limited supply. Mattlin, 2037 Euclid, Cleveland, Ohio.

QSL cards, two color, cartoons, message blanks, stationery, uncuttsy. Write for free samples to-day. W1BEF, 16 Stockbridge Ave., Lowell, Mass.

METERS, transformers. Lits, RCA theater amplifiers. State your wants. Mattlin, 2037 Euclid, Cleveland, Ohio.

REBUILT, 110 a.c. generators. Small, compact, operate emitter, etc, 300 watt $12. Neal Brown, Richland Springs, Texas.

PROFESSIONAL 'follow-up' service. We install automatic volume control, any set, sw or broadcast. Latest, best types. Also repairs, reconstruction. Give details in asking estimates. Tone corrections, all kind radio rejuvenating, detector to speaker. Hairy & Young, Hartford.

CRYSTALS: Guaranteed excellent oscillators, 160 or 80 meters, your approximate frequency $1.35 postpaid. Crystal Mother of Pearl 1" 16-20s, 1" 165-200s, $5.00. Improved dust-proof Balleite Holders, 11/8" silvered electrode increase efficiency. Plugs into G.R. or tube socket metal post. Any position. 75¢—dozen $5.40. Fisher Laboratory, 1200 E, Nevada, El Paso, Texas.

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WANTED: New tubes, parts. Write. Condenser microphones $7.50, desk or suspended amplification. P. G. Carr, 75 Summer St., Lancaster, N. H. WICE.
## Your Nearest Dealer

Your nearest dealer is entitled to your patronage. You can trust him. He is equipped with a knowledge and understanding of amateur radio. He is your logical and safe source of advice and counsel on what equipment.

### Patronize the dealer nearest you—

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<td>Radio Electric Service Co.</td>
<td>1024 Hamilton Street</td>
<td>Complete stocks transmitting equipment</td>
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<td><strong>Baltimore, Maryland</strong></td>
<td>Radio Electric Service Co.</td>
<td>303 W. Baltimore Street</td>
<td>Everything for the amateur</td>
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<td><strong>BOSTON, MASSACHUSETTS</strong></td>
<td>Nutter &amp; Cross, Inc.</td>
<td>99A Milk Street</td>
<td>All OMs, OWs, and YLs welcome — W1HRT</td>
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<td>913 Centre Street</td>
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<td>359 Capen Blvd. — Tel. Univ. 9380</td>
<td>Complete Stock Amateur Parts — Standard Discounts — W8AWK</td>
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<td>143 East Genesee Street</td>
<td>Western New York’s largest wholesale distributors— W8EHF</td>
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<td>Radio Inspection Service Company</td>
<td>227 Asylum Street</td>
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<td>1515 Grand Avenue</td>
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<td>Radio Manufacturers Supply Co., Inc.</td>
<td>1000 S. Broadway</td>
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<td>Radio Service Lab. of N. H.</td>
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<td>62 Court Street</td>
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<td><strong>New Orleans, Louisiana</strong></td>
<td>Rose for Radio</td>
<td>129 Camp Street</td>
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This advertisement is paid for by the firms listed above. Qualified dealers.

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Is Your Best Friend

you should buy. His stock is complete. He can supply your needs without delay. His prices are fair and consistent with the high quality of the goods he carries. He is responsible to you and interested in you.

You can have confidence in him

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<td>SHANGHAI, CHINA</td>
<td>Amateur’s Home, Ltd. 323 Kiangse Road. Radio Manufacturer, Wholesaler and Retailer</td>
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<td>T. F. Cushing 345 Worthington Street. An amateur, endeavoring to sell good parts</td>
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<td>PHILADELPHIA, PENNSYLVANIA</td>
<td>Eugene G. Wile 10 S. Tenth Street. Complete stock of Quality Merchandise</td>
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<td>Walter Ashe Radio Company 1100 Pine Street W9FIS in charge of the oldest and largest parts store in St. Louis</td>
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<td>WASHINGTON, D. C.</td>
<td>George’s Radio Co. 816 F Street, N.W. Washington’s largest distributor of radio parts</td>
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<td>TORONTO, CANADA</td>
<td>Wholesale Radio Company, Limited 355 Danforth Avenue Canada’s largest Amateur Supply House</td>
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<tr>
<td>TRENTON, NEW JERSEY</td>
<td>American Radio Co. 5 N. Broad Street Central Jersey’s leading radio parts store.</td>
</tr>
<tr>
<td>PITTSBURGH, PENNSYLVANIA</td>
<td>A &amp; A Radio Service Supply 101 Queen Street West Largest wholesale stock of Amateur supplies in Canada</td>
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<td>393 West Main Street Distributor radio equipment for amateurs and servicemen</td>
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<td>WINNIPEG, MANITOBA</td>
<td>Electrical Supplies, Ltd. 310 Ross Avenue A complete parts service for amateur and servicemen</td>
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<td>ZANESVILLE, OHIO</td>
<td>Thompson Battery &amp; Radio Service 393 West Main Street</td>
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You Are Protected When You Buy From QST Advertisers

"Advertising for QST is accepted only from firms who, in the publisher’s opinion, are of established integrity and whose products secure the approval of the technical staff of the American Radio Relay League."

Quoted from QST’s advertising rate card.

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QST's
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<td>1000 V.</td>
<td>7.00</td>
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E. T. CUNNINGHAM, President
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