In this Issue—
More DX per Dollar
Solving the Harmonic Problem
The Doherty Amplifier
The 202B is representative of the new Collins 200 Series Transmitters, having outputs from 300 watts to 2,000 watts and employing the most efficient quick frequency shift arrangement developed for high frequencies. A desired frequency in a predetermined group of channels can be selected from the panel. Performance on each frequency is equal to that obtainable in a single frequency transmitter. The many important design features of the 200 Series Transmitters have been thoroughly proved in the laboratory and in actual service. Brief specifications of the 202B are:

**POWER OUTPUT:** 600 Watts telegraph telephone

**FREQUENCY RANGE:** 1.5 mc. to 30 mc.

**R-F TUBES:** C-100A, 6L6, 6L6, 803, 2-C100A

**A-F TUBES:** 4-2A3, 2-C200

**POWER TUBES:** 2-5Z3, 2-872A

**DIMENSIONS:** 24" x 24" x 78"

The 300 watt models are similar in appearance to the 202B, use C-805 output tubes and are constructed in a six inch shorter cabinet. The 1,000 watt and 2,000 watt models are similar in appearance, but use two cabinets side by side for the telegraph models and three cabinets for the telegraph-telephone models. Many design features and components are standardized for all 200 Series Transmitters.
Announcing the SKY CHALLENGER

A New Hallicrafters Communications Receiver at a Sensationally Low Price

The Sky Challenger fills a very definite need for a communications receiver with the desirable features for efficient reception—at a price every amateur can afford.

It provides complete coverage from 7.5 to 540 meters (no gaps), including not only the amateur radio bands in this range but short wave broadcast, police, aviation and the regular broadcast bands as well.

With finer sensitivity and greater selectivity, Electrical Band Spread, 5 Band Dial with a simple and convenient Band Switch, the Sky Challenger answers every reasonable requirement for amateur and short wave reception. Available on Time Payments through your dealer.

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Never before have we offered such an outstanding value to the radio amateur. It has finer sensitivity, truly amazing selectivity, Electrical Band Spread — each feature and control to suit amateur needs — features ordinarily found only in receivers sold at higher prices.

As amateurs and dealers in amateur receivers and transmitters exclusively, we have long felt the need for a truly efficient receiver at this price level.

Every amateur regardless of the condition of his purse, can afford this fine and truly outstanding receiver designed especially for communications and short wave reception.

Send in the coupon today! Get complete information on this amazing receiver.

AVAILABLE ON EASY TIME PAYMENTS

Enjoy the splendid performance of the new SKY CHALLENGER as you pay for it on Hinds & Edgerton Easy Time Payments.

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19 South Wells Street, Chicago, Illinois

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Address: _________________________ City: __________ State: __________

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

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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Section Communications Managers of the A.R.R.L. Communications Department

All appointments in the League's field organization are made by the proper S.C.M., elected by members in each Section listed. Mail your S.C.M. (on the 16th of each month) a postal covering your radio activities for the previous 30 days. Tell him your DX, plans for experimenting, results in phone and traffic. He is interested, whether you are an A.R.R.L. member or not. If he wants a report from every active ham, he will want a report from you at the next meeting. Make your report as complete as possible.

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Ken Rose 2004 McColm St. Regina

Officials appointed to act until the membership of the Section choose permanent S.C.M.'s by nomination and election.
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 nation 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.

HIRAM PERCY MAXIM, FOUNDER

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State College, Pa.

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West Hartford, Connecticut

General Counsel........PAUL M. SEGAL
1010 Shoreham Building, Washington, D. C.

Address all general correspondence to the administrative headquarters at West Hartford, Connecticut.
AMATEUR radio this month sadly observes the first anniversary of the passing of those two fine old gentlemen who between them gave nearly sixty years to its service. President and vice-president, respectively, of both the International Amateur Radio Union and the American Radio Relay League, and the first the founder of both organizations, it is to be said with no exaggeration that our art of to-day owes its status to the quality of leadership, the character of organization and the principles of conduct which they personified.

Hiram Percy Maxim was the original relay man of modern-day organized amateur radio. Around the theme of relaying the League was first set up. With what we think is peculiar fitness, the anniversary of his passing—February 17th—is to be commemorated by a great A.R.R.L. relay. The details are announced elsewhere in this issue by the Communications Manager. They involve the transmission of an appropriate message from the President of the League by some selected stations, the interception of that message by amateurs everywhere, the transmission of a message to League headquarters by each interceptor, and the relaying of these messages to West Hartford by the amateur body generally. The President will send a souvenir QSL to every participant. The relaying of messages is one of the chief outward manifestations of amateur service. It is the League's thought in arranging the relay of February 17th to provide a medium by which each of us can participate in honoring the memory of our founder.

In this issue we also report the establishment of an annual award in memory of Mr. Maxim by his son and daughter. It is confined to the younger amateurs, in token of Mr. Maxim's great and warm-hearted interest in the struggling experimenter. It seems to us that it will very aptly perpetuate that interest, by seeking to recognize each year's outstanding young amateur. Father Time has already barred most of us from eligibility; the part that most of us can play is to bring meritorious young folks to the attention of our Section Communications Managers, who will make nominations for the award. Each year's award will consist of a sum of cash and an engraved miniature reproduction of the original Wouff Hong which is preserved at A.R.R.L. headquarters. When The Old Man, that genial pirate who was none other than H.P.M. himself, unearthed and forwarded to the A.R.R.L. Board the first and only known authoritative specimen of the awesome Wouff Hong, it straightway attained top eminence in our traditions. It is a fitting ornament for one who has been chosen best amongst us. Any authorized custodian of a Wouff Hong is automatically a person who has made his mark. We shall envy the young man or young woman who receives the Hiram Percy Maxim Memorial Award.

One more Maxim item is to be reported this month. We have pleasure in announcing that the Federal Communications Commission, with the special approval of the Maxim heirs, has changed the call of the A.R.R.L. headquarters station to WIAW. This station, the common property of us all, is in process of being rebuilt as a permanent radio memorial to Mr. Maxim. No more fitting aid to this memory could be devised than that it should perpetuate his famous old call. We believe this is the first instance of the F.C.C. authorizing a change in an amateur call. It was done in this case as a mark of special esteem for the founder of the amateur's own national organization. It must be regarded as a very gracious act on their part, and one of which we should all be appreciative. The new call will be used from headquarters for the first time on the memorial relay of February 17th.

Bracketed with T.O.M. in our affections must be the memory of Charles H. Stewart, who passed on in the same month a year ago. With the passage of the months he looms the more as a man of wisdom and stature in our regulatory problems and of the qualities of true friendship. A.R.R.L. this month salutes the memory of Stewart and Maxim, salutes anew the things for which they stood.

K. B. W.
The Hiram Percy Maxim Memorial Award
Our Founder's Daughter and Son Offer Annual Award for Best Contribution or Record by Young Amateurs

In memory of their father, Hiram Percy Maxim, the two children of the founder of the American Radio Relay League have established an annual award which will perpetuate in an effective manner the warm and vital interest which he had in the welfare and the activities of the young radio amateur. Mr. Maxim had a really great interest in the young amateur, particularly the one struggling under handicaps. It is singularly appropriate that the Hiram Percy Maxim Memorial Award will be given annually to that member of the League who is under twenty-one years of age at the end of the year and who has made the greatest contribution during the year to amateur radio, or who has the best all-around record for the year.

This award has been created in loving memory of our founder by Mrs. John G. Lee (Percy Maxim), his daughter, and Hiram Hamilton Maxim, his son. It will consist of a gift of one hundred dollars in cash and a miniaturereproduction of the "Wouff Hong" hearing suitable engraving. As every amateur now knows, Mr. Maxim himself was "The Old Man," author of QST's famous "Rotten" stories, in one of which the Wouff Hong was given birth.

This award does not involve a competition. This is no contest. It is an occasion for seeking out and recognizing the best young amateur amongst us. Candidates for the award are to be nominated by the Section Communications Managers, and from these the judges will select the winner.

One outstanding feature of this award is that it is to be made to amateurs who have not yet attained the age of twenty-one years. Equally significant, however, is the fact that it is to be for contributions and accomplishments in amateur radio, not in other fields. The scope of this field is very broad and there is opportunity for all young amateurs. What is sought is the outstanding one who, by his works, ought to have this recognition and encouragement. The award may be given for a single outstanding contribution, such as a technical development of far-reaching effect or some particularly meritorious communication, or for any similar specific accomplishment. Or it may go to that young amateur who has the best all-around amateur record for the year. In the latter event, the judges would doubtless take into account numerous factors that enter naturally into the determination of a good record: such items as the general excellence of the station and the ingenuity employed in constructing it, the message traffic handled, the participation in emergency communication, the quality of the sending, participation in the organized communication work of the League, the amateur's technical developments and contributions to QST, his similar contributions to the technique of operating or of club work or to the public relations of amateur radio, the cleanliness of his record in complying with government regulations, his cooperation with the broadcast-listening public, his versatility with different forms of amateur radio such as both telegraphy and phone and both domestic and DX communication, his observance of the Amateur's Code as concerns his attention to school work or his other normal duties as a young citizen, and so on. Any or all of these factors may enter, or the award may go for a single superb accomplishment.

In the future years of this award, arrangements will be made late each year for choosing the winner so that he may be announced early in the new year. However, there will be an award to the best young amateur of 1936, the search for whom is now under way, and the announcement will be made as soon as possible. At the special request of the donors, the judges for the first award are the radio members of the League's headquarters staff. The terms of their offer, however, alternatively provide that in future years the
Board of Directors may name a special committee of its members for this purpose if it so prefers.

There are a few simple rules:

1. The award is available only to members of the American Radio Relay League in good standing who reside in the United States or its territories or possessions or in the Dominion of Canada, and who hold amateur licenses issued either by the Federal Communications Commission or by the Canadian government.

2. To be eligible, the member shall not have reached his or her twenty-first birthday by the last day of the calendar year in respect of which an award is being made.

3. There is no competition, no "entries" by "contestants." Nominations will be made by the League's S.C.M.'s, the judges selecting the winner as the best of those thus nominated. Members of the League are invited to suggest likely candidates to the S.C.M.'s. Members of the headquarters staff of course are not eligible.

We are grateful to Mrs. Lee and Mr. Maxim for making this award available. It seems to us an altogether fitting way to keep green the memory of the Old Chief who gave so much to the amateur radio he loved. And we are quite delighted at the idea of a reproduction of the sacred and honorable Wouff Hong because it so successfully brackets those two delightful personalities, H. P. M. and T. O. M.

---K. B. W.

Announcing—The Maxim Memorial Relay

President Woodruff, W8CMP, to Send Commemorative Message February 17th—Following Reception from A.R.R.L. OBS—OPS You are Invited to Respond by Radiogram

One year ago, on February 17, 1936, amateur radio suffered the loss of the man whose energy and vision resulted in amateur organization, in the creation and upbuilding of the American Radio Relay League dedicated to mutual advancement, representation, fraternalism, and progress in communication and experimentation. It is fitting that on this anniversary date, all of us who benefit from the institution of amateur radio that his vision made possible, should pay our respects to the memory of our founder, his ideals, and the fine tradition of our amateur service. President Woodruff, in keeping with this thought, has a commemorative message for amateurs which will be addressed to us all by radio through the League’s Official Broadcasting Stations and Official ‘Phone Stations on February 17th.

The value and meaning in this message lies in our individual participation in reception and thoughtful observance of the occasion. Our president invites us each to acknowledge the reception of his words by sending to Headquarters a brief amateur radiogram giving the call and frequency band of the station from which you received the message on one of the scheduled transmissions... a radio activity such as honors to the utmost the memory of the Original Relayer, and such as we know would have appealed to him. There follow the definite plans for this observance on the evening of February 17, 1937.

1. Transmissions of President Woodruff’s message to you will be made from W1AW, and by e.w. and ‘phone, in all amateur bands, from all A.R.R.L. O.B.S. and O.P.S., some hundreds of stations well distributed geographically throughout the 69 A.R.R.L. Sections. On February 17th at 6:00 P.M. EST, the first transmission, from W1AW,* will be made, by tape sending on 3825, 7150, and 14,300 kcs. The identical message will be repeated, addressed to you through each one in the League’s nationwide chain of Official Broadcasting and Official ‘Phone Stations, on each following hour, your local time, for five consecutive transmissions. Look for the message on any band, at

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2. After hearing the message from any station, you are invited to start a reply or acknowledgment message addressed to A.R.R.L. In this message please give the call and frequency band of the station you heard with the message. It is understood that you will have a word by mail from President Woodruff for each radio acknowledgment received at Hartford. If your station is not active, try to send radio word of participation through another local amateur station. Message preambles should be sent in proper form—the

* W1AW, for many years H.P.M.'s personal call, has just been assigned the Headquarters' station, in lieu of W1MK, by very special F.C.C. action. This 6:00 P.M. transmission of President Woodruff's message is the first official transmission in the Relay. It is also the very first use of W1AW on the air as your Headquarters Station. The “memorial” occasion seems appropriately one in which to rededicate operation in the spirit of service and inspiration of our founder. Further details of W1AW operation are given in the Operating News department.
same as the order of parts in the message you
hear bearing Dr. Woodruff's signature. Start all
messages (or give them a filing time) before mid­
night your local time, i.e. on February 17th.
Observance of the relay is on this date. Traffic will
of course be on the air until it reaches destination.

Some suggestions about the reply messages:
Make them brief. It is not necessary to give your
response directly to W1AW or even to a Connect­
icut station. It may be better to give to inter­
mediate stations, to O.R.S. and members of
Section Nets and Trunks for a real relay depend­
ning on operator-cooperation. "CQ MM" will be
the general call used by stations with Connecticut
bound traffic. "CT" or "CONN" after calls will
identify stations on the delivery end ready for
your traffic. Of course voice operated stations
will not use telegraph abbreviations but will be
"Calling any Connecticut station." After your
message is off, you may be able to help in relaying
several others if you like.

A large number of Connecticut stations will be
on the air on every active amateur band, both
c.w. and phone bands, and frequencies all
through the bands, on February 17th and also the
18th to get this traffic addressed to A.R.R.L. A
special 30-hour watch at W1AW will be kept for
incoming traffic. Look especially for the following
stations whose operators have pledged coopera­
tion to get your messages.

1715-2000 kc.

PHONE W1MV JXY KAB KDK
3500-4000 kc.
3900-3633: W1AW BAW BDI BJG BUE CEJ DEP EH
ES EF FQG GC GME GVV HAX HXZ HYF JUP KE
JFN JMY JTD KAT KAY KBX KHM TD TS UE
JBB IYB
3933-3766: W1AW CTTI GME HXZ HTS ITI JMY JTD
JWN JXP TS UE AIB KV AFB APZ PAJ FRK HXL
3766-3000: W1AW BDI BPS RSM RNB CTTI FE
FKQ GC GME GVV HAX HXZ HXZ HYF ITI
JFN JTD TS UE INP HXL KV AIB FRK GKM
APZ PAJ
3000-4000 kc. 'PHONE: W1DWP EAO EEP GC HYF
IMV EZ
7000-7300 kc.
7000-7150: W1AW BDI CTTI FQG HYF IBT IRE JIR
JUL JPE JXY KBI TS CS E HR GKM FY
7150-7300: W1AW BDI BPS RSM RNB CTTI FE
FKQ GC GME GVV HAX HXZ HXZ HYF ITI
JFN JTD TS UE INP HXL KV AIB FRK GKM
APZ PAJ
4000-4900 kc. 'PHONE: W1DWP EAO EEP GC HYF
IMV EZ
14000-14400 kc.
C.W. W1AW BDI DF EH EGR IKE JPE JWW
JXY KBI TS HPI

PHONE: W1BZ

28 Mc.
C.W. W1JFTE GOP

"Activity" in a radio operating sense always
appealed to Mr. Maxim, our founder, as a sig­
ificant way to observe events. The "relay" idea
was the basis of founding our association and still
means the ultimate in universal cooperation and
friendship between amateurs. Commemoration is
a thing of the heart. Let us as we take part, pause
to reflect. Let us dedicate our purposes anew.

Amateur not members of A.R.R.L. should
become mindful of the need for their full support
of and membership in "the group working for the
individual" as President Woodruff so aptly refers
to our organization. Membership of every ama­
teur lends true strength to our national body.

Recently licensed amateurs should review (in
Chapter One of the Handbook, or Two Hundred
Meters and Down) the tradition and honorable
history of achievement of amateurs, to familiarize
themselves with what has gone before and
make a true commemoration possible for them.

Active amateurs, let us all renew our ideals
and rededicate our purposes even beyond the
bound of this relay activity in which we will
honor the memory of Hiram Percy Maxim. The
vast body of amateurs who are full fledged mem­
bers of the A.R.R.L. will pledge themselves to
renewed purpose in their amateur operation and
endeavors. The spirit of constructive contribu­
tions to others in our amateur work must not and
will not die. It was ever present in the efforts of
Mr. Maxim. This spirit lives and is renewed
through such practical media, as our individual
determinations to take part in and strengthen all
fields of amateur work.

Let us each make it our purpose to be a con­
structive member, to get a member, to be a con­
tributing member through experiments and arti­
cles; to operate actively—helping others as well
as ourselves, to make and keep schedules, to
become ORS or OPS, to give words of help and
kindness to fellow amateurs, to be watchful of
adjustments and testing which may affect our
fellow amateurs’ enjoyment, to build modulation
monitor or c.w. monitor listening equipment to
improve our signal and sending for the general
welfare (which includes our own), to join the
A.E.C., to be active in A.A.R.S. or N.C.R. con­
tributions to our country, to build and have
ready to use emergency-powered equipment . . .
or otherwise to make ourselves more capable of
serving the public (and amateur radio’s) true
welfare. Let us make this commemorative occa­
sion a time of new resolution, and purpose, for
each and every good radio amateur, in all our
accomplishment mindful of the perpetuation of
the spirit and ideals of T.O.M. that make for the
strongest amateur radio and strongest A.R.R.L.

---F. E. H.

Attention, W2 Hams!

An extra-special joint meeting of the A.R.R.L.
Hudson Division and the Hudson Phone Assn.
will be held at the Wurlitzer Auditorium, 120
West 42d St., Manhattan, at 8 P.M., Thursday,
Feb. 26th. Chance to meet everybody in the
division. The program will include two good
technical speakers, one supplied by each organi­
zation. It is likely that one of the speakers will
talk on harmonic troubles and practical, under­
standable methods of avoiding them. There will
probably be an open forum discussion in addition.
No admission charge. All amateurs invited.
Practical Organization and Equipment for Emergency Operation

S.A.R.O. Experience in Preparation for Amateur Service in Times of Disaster

By John P. Tynes,* W6GPY

This account of the development of amateur emergency communication organization and equipment in Oakland, California was sent us via A.R.R.L. S.C.M. Burchfield, W6ITV, of the East Bay Section. He says: “Every member of the Society of Amateur Radio Operators has a specialized job, and every man is doing that job when and where needed. These fellows have more on their minds than just contacts over the air, DX, or personal QSO’s. The article indicates the progress and development of less than two years.” Needless to say, members of the S.A.R.O. are also members of the A.R.R.L. Emergency Corps. Prepare now for emergencies—and it is not too early to get equipment going for use in the coming June Field Day dedicated to emergency testing of portables. We feel sure all hams can profit from the constructive information forwarded by the S.A.R.O.—EDITOR.

AMATEUR radio is one of the finest of hobbies; on that all amateurs are agreed. Its existence as a hobby, however, depends on factors which make it of value to the people as a whole. One of these factors, and the one we’ll talk about here, is the use made of our stations in the event of a major disaster. Amateur radio has furnished the principal, and on several occasions, the only means of outside communication in over one hundred emergencies. All amateurs are proud of this record of public service. So much for what has already happened. The purpose of this article is to show what is being done in one locality, in preparation for the rendition of public service should a major disaster occur.

On several occasions in the past few years, hurricanes, floods and earthquakes have given the amateur an opportunity to more than justify his existence. The history of these events will show without doubt that the amateurs who gave the best service were those who were the best prepared. Realizing this, about a year ago several amateurs in the San Francisco Bay Area banded together for the purpose of establishing an organization that could function as a unit in the event of a major disaster. The Society of Amateur Radio Operators (S.A.R.O.) was formed, a constitution adopted, officers elected and a general plan of action laid out.

A study of the possibilities of the 56-Mc. band for emergency purposes was carried on. Field tests were held on week-ends and holidays by the various members of the Society. Complete coverage tests were made in San Francisco and the East Bay cities. Some of the best locations on both sides of the Bay were chosen for the main control stations and excellent communication channels were obtained between these selected sites. But the old bugaboos of the ultra-highs came into the picture when contacts with the mobile units were tried. Shadow effects, transceiver QRM and general instability of the signals made it obvious that some other solution to the problem must be sought, pending further improvement of 56-Mc. technique.

The problem was discussed in a meeting, at which a general list of requirements was set down as an objective to work toward.

1. Stable transmitter frequencies (crystal control).
2. Selective receivers (superhets preferable).
3. Sufficient power in the carriers to insure reliable communications at all times.
4. Portable power supplies capable of furnishing power for both the transmitter and receiver at the same time, as well as an emergency light or two.

*Secretary, The Society of Amateur Radio Operators, 3044½ Telegraph Avenue, Berkeley, Calif.
It was felt that while mobile operation had many advantages, portable operation could be made very effective if the equipment was made really portable. We finally decided to try the 1750-kc. band for local contacts, and 3500 and 3800 kc. for contacts with outside stations.

The 1750-kc. band was chosen for the local contacts because it was felt that in an emergency where the local lighting supply had failed, there would be little or no QRM to interfere with the network operation.

Several committees were appointed to concentrate their efforts on the various phases of the work.

1. A crystal committee obtained the necessary quartz and set about the job of slicing, grinding and finally “spotting” AT-cut crystals for each member of the organization.

2. A technical committee was appointed to the task of investigating the various transmitter and receiver designs, and drawing up a set of specifications to be followed in general by the members in building portable equipment. A number of the transmitters in use at present has been built along the lines set down by this committee. They have proved very satisfactory in use.

3. One of the members reported to the Society the existence of published descriptions of the conversion of a 12-volt automobile starter-generator into a 110-volt 60-cycle generator with a capacity of several hundred watts. Another member offered to investigate this possibility and attempt one of the conversions. The story of this development is given later on in this article.

All of these things took time, but the start had been made.

The crystal committee finally distributed a few “rocks” to those members who were prepared to get on the air. The first network stations were home stations operating on 3500 kc. c.w. Each week a few new stations reported at the roll-call, and the others were busy getting equipment together in shape to work portable.

Summer time provided an opportunity to try out the network with several of the members who had taken their equipment with them on vacations. One of these stations maintained nightly schedules with the net, from a distance of about 400 miles. Another, using emergency power equipment, put in an S9 signal from his location in the mountains 200 miles away.

About this time it was found that the crystal frequency of 1900 kc., which had been selected as the network frequency, put the 3800-kr. harmonic used for c.w. directly on the Central California Traffic Net. Since we were the newcomers, we volunteered to move our frequency to a little higher spot. The emergency net frequency is now 1907 kc. We have had several individual cases of interference since the change, but by offering to supply a new crystal at a lower frequency or move the one in use to a higher spot, we have practically solved the interference problem. We have had excellent cooperation in this effort by the other amateurs on the band.

ANTENNA SYSTEMS

The rewinding of the generators proved a great success, so several of them were rushed to completion. Several portable stations were also completed about this time. Thus far nothing had been done about antennas, so it was decided that we hold a field day for the purpose of determining the best type antenna to use for our portable work. All types of sky-wires and coupling devices were tried. The location selected for these tests was a flat piece of land with no close obstructions. Three receiving sets at three widely separated locations were used as signal strength measuring points. The closest of these was about 5 miles and the farthest around 40 miles. These tests proved both interesting and instructive.

The pi-section antenna matching filter is without doubt the answer to the coupling problem. It gave the best results of any of the coupling devices used. One variation of the filter was tried, however, with very gratifying results when coup-
ling to the plate tank of a push-pull stage. As diagrammed in Fig. 1, this variation consists of a link between the tank coil and the network coil, \( L_1 \), no other changes being made. When this circuit is tuned to resonance and the proper loading arrived at, a neon bulb will show a cold spot at some place on the coil \( L_1 \). The link from the transmitter should be moved to this spot. The loading can be easily adjusted by varying the number of turns on each end of the link as well as the condensers and taps in the filter.

Antennas as short as ten feet can be matched with these units provided sufficient capacity is available in the condensers \( C_1 \) and \( C_2 \), and provided there are enough turns on the matching coil. The experience so far has shown that if 250- to 350-µfd condensers are used with a coil of between 40- and 50-microhenry inductance, most any antenna can be made "hot."

The half-wave horizontal antenna gave the best results on the day of the field tests. This was not surprising; in fact it was the thing we expected. The difficulty of keeping 265 feet of wire available, and the inability to find always the required amount of space in which to string up such a length of wire, ruled it out for our purpose. We desired to use an antenna that could be thrown up in a jiffy and at the same time be capable of supplying enough radiation to do the job. A length of 30 to 100 feet seemed to be sufficient for use with any of the transmitters with the power output of a pair of 10's. The smaller powered transmitters fare better with a longer antenna.

The first public demonstration of the S.A.R.O. 1.76-Mc. phone network took place on December 6th, when the Society set up and operated a six-station network as a part of a drill held by the Oakland Red Cross Chapter. On this day, the S.A.R.O. stations worked in conjunction with the Naval Reserve and the fixed and mobile 5-meter stations of the Oakland Radio Club. The results of this demonstration were very gratifying and clearly indicated the desirability of the higher powered emergency equipment.

There is very little new as far as the circuits of the transmitters are concerned. Most of them have appeared in the regular issues of QST and the A.R.R.L. Handbook. The main effort of the technical committees' work was to get the equipment required in as small a space as possible and arranged to work with a minimum amount of external wiring. Plugs and jacks are ever so much quicker to use than binding posts, and the cords can be rolled up and put in the transmitter case when not in use.

The most popular of the transmitters is the "old reliable" push-pull 10's modulated by a pair of 46's in Class-B. These transmitters vary only in the type of driver stages used. The first built used either a 47 or 59 Crystal oscillator, followed by either a 46 or 59 buffer-doubler. The more recently built rigs have a single 6L6 crystal oscillator loosely coupled to the push-pull 10's. The elimination of the buffer stage made it possible to decrease the size of the transmitter materially without sacrificing any power output. No noticeable frequency modulation has been detected on the transmitters using this circuit. These transmitters operate with 500 volts on the plates and 125 to 150 ma. plate current.

Another type of transmitter that has worked well is the 6A6 and 802, or RK25 combination with suppressor-grid modulation. Three of these transmitters are now in use at network stations.

One transmitter, consisting of a 47 crystal oscillator, 10 buffer and a 203A final, is grid modulated with a 66 and 45 in the speech portion. The 1500 volts, stepped up from the 110 a.c. supplied by the emergency power generator unit and used to supply the plate power for this transmitter, seems a far cry from the low voltages usually employed for portable work.

FIG. 2—AUTO-TRANSFORMER ARRANGEMENT FOR IMPROVING THE A.C. VOLTAGE REGULATION

The transmitter is of the 6L6-p.p. 10 type with 46 modulators. Its case is 14 by 18 by 9 inches. Dials at the bottom are 6L6 oscillator and push-pull 10 tuning controls. The antenna tuning controls are at the top. The receiver at the left is a standard 10-tube superhet.

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One of the members of the Society undertook to make low-loss coils for the network transmitters. These coils compare favorably with the regularly manufactured ones, and are supplied to members at cost. Individual specifications as to turns and spacing are used and special antenna coupler coils designed to work with the short antennas, have been made available.

**EMERGENCY GENERATOR UNITS**

The requirements for emergency power supplies are definite and numerous. Reliability and universal adaptation are of primary importance. Portability is another requirement. Some of the units must be capable of being transported by foot to locations inaccessible to automobiles, in order to be used at a semi-fixed location. Others are built into automobiles so that they may be transported quickly to remote points which are still accessible to auto travel.

The requirement of universal adaptability is best met, we believe, by the 110-volt a.c. type of supply. It means that should anything happen so that the portable transmitters and receivers are put out of commission, any standard receiver or transmitter that is available can be used. The S.A.R.O. has several of these a.c. supplies at present, some of them driven by small gasoline engines and some from the fan belts of cars.

Two types of generators have been used—self-excited and separately-excited. All have been rewound on frames built by the Northeast Electric Company, and originally used as starter-generators on the old four-cylinder Dodge cars. A number of such frames has been purchased from various junk dealers and auto wreckers in the Bay district for as little as $1.50 each.

The details of rewinding, fitting of the a.c. slip rings, etc., were found in a booklet entitled, "Autopower," by S. W. Duncan, 408 S. Hoyne Avenue, Chicago, Ill. This book will be found of great value to any one attempting the job of rewinding. It has been found, however, that for our type of work, where the loads are heavy and fairly constant, certain slight modifications of the winding design were desirable. The d.c. exciting winding on the armature originally consisted of 5 turns per coil of No. 20 enamel and single-cotton insulated wire. This winding now is being made with only 2 turns per coil. The field windings, which previously consisted of 200 turns per coil of No. 17 enamel and single-cotton insulated wire, are now being wound with No. 15 plain enameled wire.

The field current with these modifications runs in the neighborhood of 2 amperes. The machines run much cooler than they did before the modifications were made and the a.c. output voltage is just the same. These generators, after several hours of continuous running under load, are just warm to the touch. The cost of materials with the usual amateur discounts is about $4.00, and this added to the junk cost of the frame makes a total of $5.50 exclusive of the labor.

At the present time, all of the generators driven by separate gasoline engines are self-excited, thus eliminating the necessity of carrying a storage battery as part of the station equipment. The generators which are driven from the auto fan belts are all excited from the car battery, and the engine speed and variable excitation control are used to adjust the a.c. voltage to the proper value. The pulley ratios are computed so that the engine speed while driving the generators is slightly faster than the low idling speed of the motor. It has been found that an engine speed equivalent to a car speed of about 25 miles an hour gives very good results. Both types of generators turn at approximately 2000 r.p.m. This speed with the four-pole generator insures slightly higher than the usual 60-cycle frequency.

Good voltage regula-
Medium-Power Pentode Transmitter for Smooth Break-In Operation

Improved Suppressor Keying in a Shielded Tri-tet Oscillator—Pentode Amplifier with Suppressor Modulation for 'Phone

By Byron Goodman,* W1JPE

This transmitter started out to be a simple c.w. transmitter, capable of working near-perfect break-in on three bands; but like Topsy, it just grew, until it ended up as a medium-powered c.w. transmitter, a low-powered 'phone, and a proving ground for pentodes.

But let's start from the beginning. One of the logical output tubes for a 100-watt transmitter would be the RK-20 or 804 type, because the low excitation requirements permit the use of but one other stage, the crystal oscillator. To permit break-in operation, the suppressor-grid of the oscillator would be keyed, and the oscillator stage would be shielded to reduce the radiation from the continuously-running crystal to a minimum. An 89 gives sufficient excitation for an RK-20 or 804, so when the oscillator was first built it used an 89. However, tests showed that the 220 volts available for suppressor bias was not sufficient to cut off the oscillator output completely. This leads us to conclude, rather obviously, that if you wish to utilize the suppressor grid for much in a pentode type tube, a tube should be used in which some attention has been given to the control characteristics of the suppressor grid. Apparently receiver-type tubes are not satisfactory for 100% suppressor-grid modulation and transmitting-type pentodes should be used.

An RK25 (an 802 could be used with no circuit changes) was substituted for the 89. Now perfect cut-off of output was obtained, and break-in could be employed up to within about 2000 cycles of the working frequency. Obviously this type of operation is not suitable for spot-frequency net operation, but proves quite satisfactory for general use. The keying is clickless, and has no tendency to chirp, as is the case with many keyed oscillators. This results, of course, from the fact that the crystal in the Tri-tet oscillator is running continuously.

Since the pentode is easy to modulate through the suppressor grid, a modulator unit was added; most everyone likes to take a fling at 'phone once in a while, and the additional equipment represented no large investment.

The transmitter is built in two units, the upper portion carrying the radio-frequency section and the bottom half the low-voltage plate supply, bias supply, and the modulator unit. The high-voltage plate supply was already available, so it was not included in the transmitter, although it could easily be made an integral part by adding it below the low-power supply. Rack and panel type construction is used, employing 8¾-inch panels of crackle-finished Masonite. The sub-panels are also made of crackle-finished Masonite, fastened.

* Assistant Secretary, A.R.R.L.

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securely to the front panels by brackets in the case of the power supply unit, and to the oscillator shield compartment and tuning condensers in the case of the radio-frequency section.

The construction of the transmitter is perfectly straightforward in every respect. The only deviation from normal practice is the shielded Tri-tet oscillator unit. The oscillator tube, cathode coil and condenser, and all oscillator by-pass condensers (except the plate blocking condenser \( C_a \)) are mounted inside the shield can. The shield can, made from sheet aluminum and supported in the corners by \( \frac{1}{4} \)-inch brass rod, measures 5 inches square. A shield to fit over the crystal holder was improvised from an old i.f. transformer shield can cut down to cover the usual crystal holder. If some form of crystal holder was used that included its own shield, this precaution would not be necessary. The care taken in shielding and filtering the oscillator supply circuits will determine the extent to which reception will be bothered by the continuously-running crystal. In any event, it should not amount to more than an S9 signal with the receiver at normal gain. The cathode coil is tapped, the tap being brought to the switch \( S_t \). Thus for operation with a 7-Mc.
crystal, it is only necessary to plug in the new crystal, turn the switch so that part of the cathode coil is shorted out, and retune.

The plate circuit of the oscillator is coupled to the grid of the amplifier by means of a coil interwoven between the turns of the plate coil. This type of coupling eliminates any possibility of loss of excitation because of a poor choke (such as would be used if capacity-coupling was employed), and does away with the second tuned circuit necessary when link coupled is used. It is quite satisfactory for coupling pentodes.

The pentode amplifier tube is mounted horizontally, supported at one end by the tube socket and at the other by the plate lead made of heavy wire. A shield partition is used to eliminate possibility of self-oscillation, and in many cases might not be necessary, because of the isolation of the circuits. However, it is well to include it, especially if higher-frequency operation is contemplated.

The plate tank circuit of the amplifier is conventional. The tuning condenser helps support the front panel. The plate coils are plugged into two jack-top stand-off insulators. A link for coupling to a separate antenna is shown in Fig. 1, but this will be determined by the type of antenna system used. This particular rig, when used on 3.5-Mc., uses a single long wire, which is coupled through a variable condenser to the plate end of the coil. On 7- and 14-Mc. link coupling to an antenna tuning unit is used.

The power supplies and modulator unit are strictly straightforward. A piece of aluminum is secured to the Masonite base under the modulator unit to provide a good ground. The microphone jack is shielded by means of a portion of an old i.f. transformer shield can to prevent stray pick-up; and for the same reason the grid lead to the first amplifier tube is run through shielded cable. The speech amplifier is so designed as to have adequate amplification for communication type of crystal microphones and in most cases the gain control will not have to be opened very far.

One of the power supplies furnishes 350 volts for the oscillator screen and plate, amplifier screen, and, through a dropping resistor, plate voltage for the modulator unit. The other pack gives a little over 200 volts, supplying bias to the final amplifier and keying bias for the oscillator. The keying bias for the oscillator is taken off ahead of the filter choke, because it was found that sometimes there would be too much keying lag, as the result of the action of the filter choke preventing the rapid building up of the voltage when the key is opened. An 80 tube is used as the rectifier in the bias pack and a 5Z3 takes care of the greater demands of the plate supply pack. Filament voltages for the radio-frequency end of the set are supplied by a single 7.5-volt transformer, the voltage being dropped to 6.3 for the oscillator through a 1.5-ohm resistor.

When the set has been built and the wiring thoroughly checked, the voltages should be tested. The voltage on the oscillator plate and final amplifier screen grid should be between 300 and 400 volts, and when the modulator is switched on, the voltage on the plate of the 6F6 modulator tube should be approximately 250.

No provision has been made for metering the plate circuit of the oscillator tube, grid metering the following stage being considered sufficient. The crystal oscillator stage is tuned exactly as any Tri-tet oscillator is tuned, except that when working on the fundamental frequency of the crystal the cathode coil is not shorted out, as is usually done. Instead, the cathode condenser is set at almost minimum capacity. A little experimenting will give the best cathode and condenser setting. The keying should be clean and complete. A neon bulb touched to the plate of the oscillator tube should show no glow with the key up and, with the key up, the signal in the receiver should (Continued on page 106)
What the League Is Doing

League Activities, Washington Notes, Board Actions—for Your Information

**Election Results**

Two new directors and five new alternate directors were elected by the members of eight A.R.R.L. divisions in the 1936 elections, while six of the present directors and three of the present alternates were returned to office for two additional years. The new directors are R. H. G. Mathews, W9ZN, who succeeds Edward A. Roberts, WSHC, in the Central Division; and Edward C. Stockman, W9ESA, of Denver, who becomes the Rocky Mountain’s new director in the place of Russell J. Andrews, W9AAB. The story by divisions is given below.

**CENTRAL DIVISION**

In A.R.R.L.’s largest division, the Central, three candidates battled it out with some spirited campaigning. The result is a new director, by an overwhelming vote replacing Mr. Roberts, who has served the division for the past two years, but who did not campaign for reelection. The figures:

- R. H. G. Mathews, W9ZN: 1179 votes
- J. B. Wathen, III, W9BAZ: 360 votes
- Edward A. Roberts, WSHC: 157 votes

Since Alternate Director Wathen was running for director, there was but one nomination for alternate and he was declared elected by the membership without balloting: Adam F. Moranty, WSCZT, of Cleveland.

The new director, although not old, has been in amateur radio for twenty-seven years. Ralph H. G. Mathews is a former director and vice-president of the League and was for many years the Central’s Division Manager, a sort of super-S.C.M. of the earlier days of our operating department. He is very active in N.C.R. work, being a Lieutenant-Commander in the U.S.N.R. and executive officer of the Ninth Naval District Communication Reserve. He was one of the organizers and the first chief engineer of Zenith Radio Company, shortly after the war. His present business association is as a member of the firm of Ford, Browne and Mathews, advertising agents. His old calls, 9IK and 9ZN, were famous in the earlier days. He returns to our Board now after an absence of about sixteen years.

**HUDSON DIVISION**

The Hudson reflected both its director, Kenneth T. Hill, and his alternate, Robert M. Morris, each winning handily over a single contestant:

- For Director:
  - Kenneth T. Hill, W2AHC: 478 votes
  - Charles J. Hamreensen, W2FOP: 293 votes

- For Alternate:
  - Robert M. Morris, W2LV: 504 votes
  - Herbert C. Florance, W2IXQ: 183 votes

**NEW ENGLAND DIVISION**

The New England returned Mr. Noble, its director since August when he was elected to fill the remainder of Mr. Bailey’s term. His two opponents had also run against him in August. The result:

- Percy C. Noble, W1BYR: 323 votes
- Joseph A. Mullen, W1ASI: 226 votes
- Raymond W. Woodward, W1EOA: 194 votes

Frederick A. Ells, Jr., W1CTI, becomes the new alternate director without balloting, having been the only candidate. The office had been vacant since August, when Mr. Mullen resigned to run for director.

**NORTHEASTERN DIVISION**

The Northwestern returned both its director and his alternate, the latter without competition. Mr. Gibbons won handily as director, while A. L. Smith, W7CCR, was the only candidate for alternate and succeeds himself. The balloting:

- Ralph J. Gibbons, W7KV: 210 votes
- Wallace N. Wintler, W7KL: 163 votes
- John P. Grable, W7ET: 31 votes

**ROANOKE DIVISION**

The Roanoke’s story is the same as the Northwestern’s. Mr. Caveness was returned over his opponent, while J. Frank Key, W9ZA, was declared reelected as alternate, without competition. The story:

- Hugh L. Caveness, W4DW: 174 votes
- William H. Rihrdäfser, W8ZKQ: 78 votes

**ROCKY MOUNTAIN DIVISION**

The Rocky Mountain did no balloting, naming but a single candidate for each office. Mr. Andrews, the incumbent for long years since Paul Segal’s Colorado days, was not a candidate for reelection. The new director is Edward C. Stockman, W9ESA, also of Denver. The alternate directorship has been vacant since W6BTX moved from the division. The new alternate is Eddie L. Heyer, W9GBQ.

Mr. Stockman is not now actively engaged in business, but was previously in the automobile business in Denver. He is one of the real old-timers, having been in radio since 1909, and served as S.C.M. for Colorado during 1930–1932.
SOUTHWESTERN DIVISION

The Southwestern would have none but its present director, so Charles E. Blalack, W6GG, the only candidate, was returned for two additional years without membership balloting. There was competition for the post of alternate, however, resulting in the selection of John E. Bickel, vice-chairman of the Federation of Radio Clubs of the Southwest.

The tally:

John E. Bickel, W6BKY........................................... 130
Perry F. Backus, W6HUX........................................... 108

WEST GULF DIVISION

The West Gulf clung to its present director, Wayland M. Groves, over two other candidates, but selected a new alternate, William B. Hollis, the recent alternate having been one of the unsuccessful candidates for director. The count showed:

For Director:
Wayland M. Groves, W5NW........................................... 220
Frank M. Corlett, W5ZC........................................... 89
David H. Calk, W5BHO............................................. 49
For Alternate:
William B. Hollis, W5FDR......................................... 182
J. Pronto Poston, W6AJ............................................. 177

Since May of 1934, new members of the League may vote in A.R.R.L. elections only if they are at the time licensed amateurs. Unlicensed amateurs who were members prior to that date may vote, but only if their membership has been continuous. Lapses in membership and the dropping out of those who are not active in the game have caused a steady reduction in the percentage of the voting done by those who are not licensed amateurs. The average for the seven divisions in which balloting took place this year was 6.21% and in most divisions was well below that figure, comparing with about 8% in the previous year's elections and over 18% the year before that. Believing these figures interesting, we cite them:

<table>
<thead>
<tr>
<th>Division</th>
<th>Licensed</th>
<th>Relying Upon</th>
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<tbody>
<tr>
<td>Prior Membership</td>
<td></td>
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<tr>
<td>Central</td>
<td>94.22%</td>
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<td>Southwestern</td>
<td>94.50</td>
<td>5.50</td>
</tr>
<tr>
<td>West Gulf</td>
<td>94.42</td>
<td>5.58</td>
</tr>
<tr>
<td>Average</td>
<td>93.79%</td>
<td>6.21%</td>
</tr>
</tbody>
</table>

Perpetual Survey

In editing QST it is our constant effort to make it most useful to the largest number of its readers. To do this well, we must have the criticisms and suggestions of our readers and certain statistical information. We have, therefore, devised a questionnaire which is sent to each new member and to every old member as he annually renews his membership. Its prime purpose is to guide us in making QST exactly what you want it to be. Its aim is to produce a constant flow of opinions and statistics that can be analyzed to show continuously just what members need and want, and what they don't like and don't want, within those spheres of activity that are administered by the headquarters.

The data, in addition to applying to QST, of course also will be particularly helpful in the activities of the Communications Department and will also be of assistance to other headquarters departments. They are extremely important to us. We most earnestly ask our members, then, to fill out the questionnaire when it is received and return it promptly to us in the envelope that will be enclosed. Some of the questions may not seem to you to be pertinent, but we assure you that the answers to each one will help us to analyze problems and serve our members better. We express our thanks in advance for your cooperation.

Cairo

The Department of State has rejected our appeal from the decision of the Federal Communications Commission which had denied our plea for the inclusion of a proposal for more amateur frequencies in the representations to be made by the United States Government in preparation for the Cairo Conference. The formal proposals of the United States have now gone forward to the Berne Bureau for international distribution, proposing no changes in the amateur bands. The Department of State advises the League that, after reexamination, the administration's views remain the same and that it is accordingly impracticable to accede to our wishes. This makes three appeals that we have taken to successively higher authorities, and we seem now to have exhausted the possibilities. The reports are much the same everywhere. The request of Canadian amateurs has been similarly rejected. The Radio Society of Great Britain does not seem to expect favorable action. Amateur societies in some of the smaller nations continue hopeful that they will receive favorable consideration, but it does not seem that we shall be able to induce any administration that really "drags water" to put forward or to back a proposal for an amateur increase.

Another scheme for making a bug stay put: W7EQC glues small pieces of coarse sandpaper on each of the feet. These stick to the large blotter which covers the operating table and the bug does not walk under any keying speed.

W9AXL says that W9HHT tunes his transmitter by holding his tongue to the antenna lead!
About This Harmonic Radiation Problem

Practical Measurement and Suppression of R.F. Harmonics—Results with Pi-Network and Linked-Tuner Antenna Couplings

By R. W. Woodward,* W1EAO

How many of you have received an Official Observer's notification card informing you of a strong harmonic radiation from your transmitter? How many have done anything about it or even replied to the O.O. who sent the notice? Well, a short time ago the writer sent out 100 such notices, 60 to 'phone stations and 40 to c.w. operators, during the course of two or three days—and kept a record of the replies received. Two of the 'phone stations, or 3%, replied, indicating they were taking corrective steps; 22, or 55%, of the c.w. stations likewise replied. Most of the c.w. fellows were newcomers on the air and eager to abide by the regulations; the 'phones were mostly of longer experience and as a lot apparently indifferent to the situation. And one of the replies was, "Wish you had told me of this sooner—received a notice from Grand Island in the same mail."

Harmonic radiation from amateur transmitters really is a serious matter and its interference to other radio services but invites restrictions on our operation. It would be a revelation to many operators if they would listen on the second, third or fourth multiples of our busiest bands. For instance, from 7800 to 8000 kc. the QRM from harmonics is often as bad as on the 75-meter 'phone band itself.

Replies received from stations reported having harmonics over a period of two years or so show one fact to stand out as significant. Approximately 70% of these stations were using a pi-network (Collins) for coupling the transmitter to the antenna and believed themselves secure in view of the claims for this network to suppress harmonics. This system was first suggested for the purpose by W. L. Everitt¹ and later adapted to amateur needs by A. A. Collins.² It is intended to provide an impedance match between the final amplifier and the antenna system, and also to vary the coupling and power output. The inducances and capacities are arranged to form a pi-network which is supposed to be a low-pass filter which should attenuate harmonics—*when properly applied.*

But apparently theory and practice are not always in harmony, either through mis-application or maladjustment, and it was thought desirable to make a practical study of the pi-network type coupler from a harmonic standpoint and also to reach general conclusions for reducing harmonics in amateur transmitters.

How much harmonic radiation may be permitted? From the very nature of vacuum tube amplification, particularly in power r.f. circuits, some harmonics are generated. The F.C.C. regulations are not quantitatively specific as to the permissible limit. Rule 381 states that spurious radiations, which include harmonics, "shall be reduced or eliminated in accordance with good engineering practice and shall not be of sufficient intensity to cause interference—outside the frequency band of emission . . ." Because of the high frequencies at which harmonics of amateur emissions occur, skip effect may propagate even a very small radiation for considerable distance. Preliminary experience indicated that a second harmonic output of less than one watt falling in the 7-Mc. band could be copied at a distance of 150 miles or more.

Several methods are available for measuring harmonic content of transmitting output, most of which are complicated and beyond the scope of ordinary amateur equipment. Measurement of received field strength at a remote location, while permissible at low (broadcast) frequencies, may produce erroneous results at high frequencies.

because of constantly changing skip conditions. Measurements in the r.f. transmission line to the antenna present the possibility of upsetting the conditions being investigated. The method adopted by the writer, while making certain assumptions not entirely valid, gives results which are reasonably accurate and most certainly significant. Since it can be carried out with a reasonable amount of effort by any operator it will be described in more or less detail.

**CALIBRATION PROCEDURE**

Briefly, the method was to set up a field-strength meter directly under the antenna but far enough away from the transmitter so that the meter is not directly affected by radiation from the exciter unit. At the writer's location the transmitter is in the rear of the house. The 122-foot flat-top of the antenna system passes directly over the roof, so that by setting the field-strength meter near the front of the house, under the center of the antenna, the above condition was met. A location nearer the far end of the antenna might have been preferable, since at the center the fundamental field strength would be maximum and, because of the pattern of the antenna, the strength on even harmonic frequencies a minimum.

In order to calibrate the field-strength meter the output of the transmitter was determined for various inputs through a lamp-load dummy antenna which, in turn, was calibrated through commercial frequency electrical instruments, the brilliancy of the lamps being measured by a Weston photographic exposure meter. Ham radio and amateur photography seem to go hand in hand and if you do not already possess an exposure meter (or Weston photronic cell) no doubt a nearby ham has one that can be borrowed.

The dummy antenna is set up as shown in the accompanying photograph. It is important that the exposure meter be kept in exactly the same position when once calibrated. In this case it was about 10 inches from the center lamp socket. With these 100-watt lamps in the sockets this gives nearly full-scale deflection at rated lamp voltage.

The lamps are connected to a regular 110-volt power supply with a variable resistor or Variac for controlling the input which is measured by a watt-meter. Simultaneous readings of electrical power input and exposure meter are taken down to about one-half the rated voltage of the lamps, beyond which the sensitivity of the exposure meter is too low. In like manner two 100-watt lamps, one 100-watt, a 50, 25 and 15 are calibrated, giving a continuous range from over 300 watts down to about 4 watts. Of course, more or larger lamps should be included for higher powers. Each lamp should always be used in the same socket and it is well to label them and keep them out of reach so they do not get used for general household purposes.

The dummy antenna is then connected to the transmitter in place of the regular antenna, including any antenna coupling device which is

**FIG. 1—SCHEMATIC CIRCUIT OF THE SIMPLE FIELD-STRENGTH METER USED IN DETERMINING HARMONIC RADIATION**

L1, C1—Coil and condenser to tune to frequency (fundamental or harmonic) being measured. An absorption wave meter is convenient.

L2, C2—Coil and condenser tuned to fundamental output frequency. Shorted when measuring fundamental output.

C3—0.01 µfd. by-pass condenser.

R1—20-ohm filament center-tap resistor.

R2—Shunt to give 10-ma. meter range.

A—6-inch or 4-foot pick-up antenna. (See text.)

which are reasonably accurate and most certainly significant. Since it can be carried out with a reasonable amount of effort by any operator it will be described in more or less detail.

**TABLE I**

<table>
<thead>
<tr>
<th>Harmonic</th>
<th>Frequency</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>2nd</td>
<td>7040 kc</td>
<td>+</td>
</tr>
<tr>
<td>3rd</td>
<td>10,560 &quot;</td>
<td>+</td>
</tr>
<tr>
<td>4th</td>
<td>14,080 &quot;</td>
<td>0</td>
</tr>
<tr>
<td>5th</td>
<td>17,600 &quot;</td>
<td>+</td>
</tr>
<tr>
<td>6th</td>
<td>21,120 &quot;</td>
<td>+ or -</td>
</tr>
<tr>
<td>7th</td>
<td>24,640 &quot;</td>
<td>0</td>
</tr>
<tr>
<td>8th</td>
<td>28,160 &quot;</td>
<td>+</td>
</tr>
<tr>
<td>9th</td>
<td>31,680 &quot;</td>
<td>-</td>
</tr>
</tbody>
</table>

February, 1937
regularly used so that its losses will not be ignored. Naturally, here, as well as in calibrating the lamps, the exposure meter must be shielded from daylight or any strong illumination. The transmitter is then operated on its fundamental frequency and simultaneous readings are taken on the exposure meter (power output) and power input to the final amplifier, as the input is gradually reduced by varying coupling to the dummy antenna or by adjusting the plate voltage, but keeping excitation to the final at a constant reproducible value as indicated by grid current. Smaller and smaller lamps are used as the power decreases.

The same procedure is now repeated with the transmitter operating on the higher frequency bands so as to obtain data for calibrating the field strength meter at the harmonic frequencies. In these cases particular attention should be directed to operating the transmitter at low power levels.

While making these measurements you will probably have made some interesting observations on transmitter efficiencies. Using a pair of 203A’s in push-pull with Class-C operation, a maximum efficiency of 74% was obtained. Under grid modulation conditions this dropped to 35% and for real low-power Class-C operation to around 20%. Different combinations of plate voltage and current to arrive at a given power input show different efficiencies; with this particular transmitter better efficiency was obtained using currents near the rated values rather than high voltage and low current.

The field strength meter can now be set up in its operating location and calibrated. Fig. 1 shows the diagram of connections for this meter. A 56 tube with grid and plate connected together is used as a diode rectifier. L1 and C1 are conveniently an absorption type wave-meter which assists in positively identifying the harmonic frequency being measured. The 0–1 milliammeter must be by-passed for r.f. currents. A 10-times shunt is necessary when measuring fundamental output but is disconnected for harmonic measurement. Likewise, when measuring harmonics it is necessary to include the trap circuit L2C2 to suppress the fundamental. With L1C1 tuned close to but not on a harmonic frequency, L2C2 is tuned exactly to the fundamental as indicated by a minimum reading on the milliammeter with the transmitter operating. For high transmitter power levels a 6-inch vertical rod is used for pick-up; for low power or harmonics a four-foot vertical wire can be used. These two pick-ups and the two meter scales serve for a wide range of field strengths.

The transmitter, connected to regular antenna, is operated at various power levels and the maximum readings on the milliammeter observed as

C1 is tuned through resonance. On the higher frequencies particular attention must be paid to low power levels so as to calibrate the meter adequately at harmonic field strengths. The 56 tube will show a small space current of the order of 0.30 ma., without signal input. This must be subtracted from all readings.

The transmitter must, of course, be operated in exactly the same manner as when the dummy antenna was calibrated. Figs. 2, 3, 4 and 5 show the types of curves that are obtained during the calibration process.

**HARMONICS AND COUPLER TUNING**

Since preliminary experiments had indicated that improper tuning of the pi-network had a large effect on the transmission of harmonics, a more detailed study of this was made. Fig. 6 shows the constants of the network that was used. The antenna had 45-foot feeders. The first tests were made with the input of the network connected across 13 turns of the total of 24 in the final tank inductance. Each of the L1 coils had 18±½ active turns. Resonance in the network occurred with C1 at about 150 µfd. after C2 had been adjusted to give an input of 100 watts. Under the conditions of operation the tube efficiency was only about 50% and the output about 50 watts.

In Fig. 7 are given the final plate current, antenna current and percentage of second harmonic power output for small changes of the setting of C1 either side of resonance.

The prescribed method of tuning this circuit is to set C1 for minimum plate current after the tank has been tuned to resonance with the network disconnected. This minimum occurs at a C1 setting of 33.5 at which point there is 0.2% or 0.1 watt second-harmonic content. On either side of this minimum the plate current rises rapidly, as does the harmonic output, until at settings of 31 and 37 there is 14% output on the harmonic. The antenna current also rises because of the harmonic (Continued on page 9B)
A.R.R.L.'S Ninth International DX Competition

March 6th¹ to 14th, Radiotelegraph Contest—March 20th¹ to 28th, 'Phone DX Contest

All the World with W/VE—Advance Entry Not Required—Swap Number Groups (RST² Report³ +Self-Assigned Serial Nr.) in DX QSOs—Operating Time, 90 Hrs. in the Nine Days—Points from DX Contacts to Be Multiplied by Number of W-and-VE Districts Represented or Countries (Prefixes) to Give Total—Gaval Trophy to Winning Club!—Certificates for CW DX Winners—For 'Phone DX Winners in Each Section

By F. E. Handy *

Since many amateur stations utilize 'phone as well as telegraph transmitters, it has been decided to provide two separate periods for competitive work by each method of operation this season. Both periods should be at the same time of year with but a brief intermission so as to give both modes of operation the same opportunity at the ultimate in DX that the season affords! The time-tested rules for contest exchanges will be the same for both periods, except that no quota plan will apply in the 'phone period. This can be added in the future if 'phone participants ask for it. Whether or not a two-period DX competition is continued will depend entirely on participation and results submitted in one or both sections of this activity. We expect entries to fall in one period or the other—but any ham can take part in both periods if he likes. Scores are entirely independent, for each period. Last season's A.R.R.L. DX Contest had by far the widest participation of any DX tests to date. This is indicative of the general satisfaction and enjoyment in the rules for contest exchanges inaugurated at that time. Suggestions for changes have been carefully considered, but few changes are announced since greater general approval was accorded the competition than ever before. We reason that when suggestions for more restrictive quotas closely balance those for less restrictive quotas in numbers that the figure set last time was just about right, and satisfactory with the majority. And so it goes with other factors. The “quota” of 3-stations-per-country for W/VEs (telegraph period) is designed to give more time to look for new countries and reduce the QRM level so DX work and new countries will be easier to get. Since U.S.A. stations number several to each foreign station, participants at a distance need have no fears in regard to a scarcity of contacts.

To forget 28-, 3.5- and 1.7-Mc. bands will be to give your DX competitor the edge on building up the all-important multiplier. Use all bands that you can! Operating points, personal efficiency, and the “man behind the station” (most of all) count! Wise W/VE hams will avoid use of “CQ DX” like poison. Distant stations will not waste time answering such calls when one call from “outside” will bring hundreds of answers. All stations should try to work BREAK-IN for real operating efficiency. Hams outside W/VE urge more speed, asking W/VEs to shoot the number along first before anything else. U. S. and Canadian amateurs approve continued use of CQ by all stations in remote localities, but plead that these CQs be made shorter—when a flock of U.S.A.-Canadian stations are so eagerly competing for each one! Everybody agrees that CQ DX is “out” for W/VEs and ought to disqualify 'em. Remotely located participants: Please sign often in CQs or calls. Use QHM, QML, QLM, QMH as a guide of when or how long to call!”

*Communications Manager, A.R.R.L.

16:01 P.M., C.S.T., March 12th, see discussion under the contest period.


³In 'Phone exchanges only two numerals will be given in the report, the first always the “readability” and the second the “strength.” In other words, telegraph entrants will receive six figure groups, and 'phone entrants will receive five figure groups.

February, 1937 25
For those who swear by 'phone, this competition will be one for DX laurels, competing in the second period with fellow 'phone operators. For those working c.w., competition for DX will be in the first period, and largely with fellow hams using the same mode of communication. In either period: 'phone stations may work c.w. stations and vice versa, claiming points for one or two-way exchanges of six figure for five figure groups if such exchanges are possible. It must be realized that such 'phone-c.w. contacts, always involving one non-participant, will be almost nil, but such work is perfectly acceptable where such contacts are made, and the non-participant assumes a serial number (for his records and your report). Separate certificates will be awarded the c.w. winner, and the 'phone winner, for each country, and likewise for each A.R.R.L. Section. It's a chance for 14- and 28-Mc, 'phone hams to do their stuff in the second period—but it will in no sense be a competition of 'phone with c.w. operators. Choose any mode of communication you like; try your luck and DX, and report results one and all!

Logs on the first period will all be marked "C.W. station work," and those for the second period, "Phone work." The transmitter must be kept on c.w. or 'phone, too. It is unethical to shift to c.w. to call a station, or send numbers, when taking part in the 'phone period (and vice versa), and disqualification will be made of offending stations. Likewise, whistling of code for numbers (or similar means) is regarded as improper. Counting of consecutive numbers, spelling of the letters that constitute numbers, using word lists from the Handbook, etc., are regarded as the proper methods.

GENERAL CONTEST PLAN

Amateurs with the prefixes W and VE will be taking part in a QSO Party with stations in all parts of the world. When they effect DX QSOs, they will exchange self-assigned serial numbers (two or three-figure reports plus three self-assigned numbers that stay the same for all stations). This whole group is entered in the contest report. From this record each station will submit its score. From the scores (which the Contest Committee will verify by cross-examination of logs) the winners will be determined for each locality, and certificates awarded. Three points can result from a full exchange in any band, but no more can be obtained from the same station unless both stations connect in another band for additional exchanges.

Stations outside the U.S. and Canada will try to work as many W and VE stations as possible to exchange serial numbers. Stations in all localities need only take part on the dates announced and report results at the end of the tests to receive credit in QST, and be eligible for awards.

The main competition each operator must consider comes from operators in his immediate A.R.R.L. Section in the case of W and VE stations, and in the case of all other amateurs it comes from the individual operators in their own country or locality using the same prefix. The W/VE awards are for the operator running up the best record for each Section under the Rules.

THE CONTEST PERIOD

To avoid misunderstanding and possible confusion, the exact local starting and ending time for our DX competition is given in the above table. These times are based on "Greenwich" and should be computed for any part of the world from the Greenwich meridian. The contest runs (First Period) from Saturday, March 6th, through Sunday, March 14th (until Monday, March 15th, G.T.); (Second Period) from Saturday, March 20th, through Sunday, March 28th (until Monday March 29th, G.T.).

SERIAL NUMBERS

The first digits of the serial number sent shall constitute the Readability, Strength, and Tone reports of the station to which the number is sent. Every operator taking part in the contest...

---

5 Alaska, Hawaii, Philippine Islands, Cuba, Porto Rico, and Newfoundland, in fact, all localities using PREFIXES other than W or VE will receive QS7Q, which will carry a complete list of the Sections of the A.R.R.L. Field Organization.

6 Consult the list of call-prefixes for different countries of the world as given in Jan. '37 QST, page 52. This will be used as the official list. Also see I.A.R.U. this month.
assigns himself a distinctive three-numeral group, used by him throughout the contest as the last part of each number exchanged (sent). Try to send and receive one complete serial number with each DX station.

TIME LIMIT

Up to and including 90 hours' total contest operation (for either period) there is no penalty. (Continued on page 76)

LOG, NINTH A.R.R.L. INTERNATIONAL RELAY COMPETITION

C.W. Entry March 6th-14th

<table>
<thead>
<tr>
<th>Band</th>
<th>1.7</th>
<th>3.5</th>
<th>7</th>
<th>14</th>
<th>28 Mc.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logs from W or VE, show, for each band:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nr. DX Stations QSOed...........</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Nr. Countries (prefixes) QSOed...</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

Plate watts (input last stage).

Logs from remote points indicate; for each band:

Nr. Hours Station Operation (11 h. 29 m.)

Nr. W/VE stations QSOed ........

A.R.R.L. Section (for W/VE's)

Nr. U. S. A.—Canada licensing areas worked

<table>
<thead>
<tr>
<th>Station Time Record</th>
<th>Operating Time</th>
<th>Date and Time</th>
<th>Station Worked</th>
<th>Country</th>
<th>Worked Record of New Countries 8 for Each Freq. Band</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Serial Nrs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Points</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.7</td>
</tr>
<tr>
<td>On 7:31 P.M.</td>
<td>Mar. 13th</td>
<td>7:32 P.M. E.S.T.</td>
<td>G6RB</td>
<td>G. B.</td>
<td>568,543</td>
</tr>
<tr>
<td>Off 10 P.M.</td>
<td>2 h. 59</td>
<td></td>
<td></td>
<td></td>
<td>898,543</td>
</tr>
<tr>
<td>On 7 P.M.</td>
<td>Mar. 14th</td>
<td>7:38 P.M.</td>
<td>VK3WL</td>
<td>Aust.</td>
<td>570,543</td>
</tr>
<tr>
<td>Off 11:35 P.M.</td>
<td>4 h. 55</td>
<td>11:50 P.M.</td>
<td>JZG</td>
<td>Japan</td>
<td>487,543</td>
</tr>
<tr>
<td>On 12:00</td>
<td>Mar. 17th</td>
<td>12:05 A.M. E.S.T.</td>
<td>VK7RC</td>
<td>Aust.</td>
<td>596,543</td>
</tr>
<tr>
<td>Off 4:35 A.M.</td>
<td>4 h. 05</td>
<td>2 P.M. E.S.T.</td>
<td>PY2BN</td>
<td>Brazil</td>
<td>487,543</td>
</tr>
</tbody>
</table>

14 h. 29

Multiplier = 2 + 3 + 1 + 1

24 × 7 (countries—prefixes) = 168 Score

"Points" multiplied by the number of

1) Countries or localities (prefixes) for all bands

2) U. S. and Canadian licensing areas for all bands equals the SCORE . . . . . . . (This is the final score unless the operating time exceeds 90 Hours).

I hereby state that in this contest, to the best of my knowledge and belief, I have not operated my transmitter outside any of the frequency bands specified in, or in any manner contrary to, the regulations my country has established for amateur radio stations; also that the scoring points and facts as set forth in the above log and summary of my contest work are correct and true.

Signature of operator(s)

February, 1937

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---

8 Add second column in log to give total operating time.

9 "Countries" for W/VE Participants. Change this to read "Districts" or "Licensing Areas" on all reports from other parts of the World.

10 A progressive record of the number of new countries (or licensing areas) is kept in these columns. A notation is made for each station worked but the figure increases numerically only as additional prefixes (or lic. areas) are added on a certain band. These columns are not added, but the last number notation in each column added to similar numbers in other columns gives the "multiplier." Counting the "number of notations" in each of these columns gives the number of different contacts with "DX stations" or "W/VE stations" on each band, as the case may be, so the information at the beginning of the log-record may be filled in.
KING ARTHUR was a piker when it came to Round Tables. W4DLH, VU2CQ, SU1CH, HK1Z, G5ML and VK4LO have got it over him and his knights like Garbo and Taylor have it over the original Camille and his boy friend.

Getting down to details, “four dark lean horses” broke the barrier down in Florida at 1237 GT on the morning of December 30th, swung around the turn at Bombay two minutes later, cleared Cairo, Egypt, in another four lengths, doubled back to Cali, Colombia, in a hundred seconds more, rode with the whip to Kenilworth, England, and finally clicked the shutter away off in Brisbane, Australia, in a total elapsed time of 21 minutes.

All of which mixed metaphors—plus as many superlatives as one could hope to garner in an afternoon's Thesaurus hunt—are derived from the 100% record of success—each continent turning it over to the next, and each answering in turn. Each station was able to hear each of the others with satisfactory signal strength—and all on 'phone!

After the chain was complete VK4LO turned it back to W4DLH, who gave a report on the time required to complete the 'round-the-world radio tour. After congratulations and thanks for the hearty and effective cooperation, Bill started it around once more. Whereupon each station voiced further congratulations, and all settled down to a nice, friendly rag-chew!

HOW IT WAS DONE

Such a feat as this represents no coincidence, with the ham bands as they are to-day. On the contrary, it represented many days of hard work and watchful waiting. The story goes like this:

OFFICIAL 'PHONE STATION W4DLH, GOUWS, FLA.

Sitting at the operating position in comfort, Bill Burkhart picks his direction and turns his Signal Squirter to it by means of the boat wheel mounted above the desk.

following quotation from the log of W4DLH, a gentleman who specializes in growing potatoes and 'phone records down in sunny Florida:

"1237 GT—W4DLH, Goulds, Florida, officially called the All-Continent Round Table to order and turned it over to VU2CQ."

"1239 GT—VU2CQ, Bombay, India, checked in to the round table and turned it over to Ed, SU1CH."

"1243 GT—SU1CH, Cairo, Egypt, checked in to the round table and turned it over to 'Tony', HK1Z."

"1245 GT—HK1Z, Cali, Colombia, checked in to the round table and turned it over to 'Fred', G5ML."

"1252 GT—G5ML, Kenilworth, England, checked in to the round table and turned it over to 'Frank', VK4LO."

"1258 GT—VK4LO, Brisbane, Australia, checked in to the round table, making the all-continent chain complete in 21 minutes elapsed time."

A 100% record of success—each continent turning it over to the next, and each answering in turn. Each station was able to hear each of the others with satisfactory signal strength—and all on 'phone!

After the chain was complete VK4LO turned it back to W4DLH, who gave a report on the time required to complete the 'round-the-world radio tour. After congratulations and thanks for the hearty and effective cooperation, Bill started it around once more. Whereupon each station voiced further congratulations, and all settled down to a nice, friendly rag-chew!

Every operator must have suffered considerable inconvenience in the common cause. HK1Z and W4DLH were on at daybreak each day for nearly two weeks. VK4LO similarly stood by, until well after midnight on many occasions, with VK5AW serving as alternate station. The VU2CQ sked must have broken into his dinner hour more than once. And imagine the excuses SU1CH made to get on the air at 2 P.M. every afternoon—and G5ML's lunches at the operating table. Frequently success seemed right at hand. On one occasion there was only a slip-up on an European sked between success and failure; on another VU2CQ suffered the misfortune of having his transmitter break down at a crucial moment.

But on December 30th the break came. Condi-
tions were right—that became apparent as the zero hour drew near. Indeed, so confident was W4DLH that he QSO'ed W8RL just before the sked was due so that he would have the North American leg on a quick telephone WAC if things went right. And they did—every man was on the job, every transmitter worked perfectly, the operators moved through the contacts with precision and speed—the history-making deed was done!

TIME WAS CAREFULLY CHOSEN

A great deal of care was taken in choosing the exact time of the schedule, for conditions had to be such that each continent was able to hear every other continent if success was to be had. When the round table finally went through it was 7:30 A.M. in North and South America, G5ML was home for lunch, it was 2:30 P.M. in Egypt, 6 P.M. in India, and 10:30 in the evening at VK4LO—making the contacts not only 'round the table and 'round the world but 'round the clock as well.

Equal care was taken in choosing the stations and operators, for a maximum of efficiency in each. No—the "all-continent radiotelephone round table" did not just happen; it took the finest kind of coöperation, confidence, equipment, planning and work on the part of all concerned.

SIDELIGHTS

W4DLH’s foresightedness in contacting W8RL prior to the sked won him a phone WAC in 36 minutes—the fastest on record, and on phone!

The relative mileages covered on each leg were: Florida to India, 9062; Bombay to Cairo, 4712; Egypt to Colombia, 7612; South America to England, 5437; and, finally, the extra spurt of r.f. G5ML put in his antenna landed him in Australia 12,325 miles away. Qualifying the first figure above, the W4DLH-VU2CQ mileage is given for the short-way-round; but Bill Burkhart is convinced through numerous tests made with his "Mims’ Signal Squirt” that the Indian and Egyptian stations arrive at Goulds, Florida, not over the Great Circle route but by the long-way-round. As a result, he shoots SW when working into that region, except at about 2000 GT when the Great Circle Route is effective.

Anyway, a minimum total of 39,148 statute miles were traversed by the "Knights of the Radio Round Table" in making their history-making tour of the globe.

W2IXY’S RECORDINGS AND REBROADCAST

Perhaps the crowning thrill of all that exciting morning was the surprise tendered the successful world-girders by Mrs. Dorothy Hall, W2IXY, of Long Island, New York. She had been greatly interested in the outcome of the tests, and had followed the attempts on each successive morning. Standing by and “turning over” each time was her recording equipment, which operates directly from the station receiver. On the successful morning she was able to hear the participating stations with good signal strength and—got several transmissions permanently logged on the recorder! After the round table broke up, W2IXY rebroadcast to G5ML, HK1Z and W4DLH their transmissions while the six-way had been in session. G5ML’s surprise at hearing his own voice come bouncing back from the States a few minutes after it left his own transmitter can be imagined.

Well, that’s the story. Do you check with us on the metaphors and the superlatives, now? It’s getting hard to think of any stunt in ham radio still left undone. . . .

May these modern Knights of the Round Table live in radio legend as long as King Arthur and his pals, say we. They deserve it! —C. B. D.

Operating Data on the 100TH and 100TL

COMPLETE characteristics and recommended operating conditions on the new Eimac 100TH and 100TL have now been released by the manufacturers. These tubes, which both supplement the 50T and augment the Eimac line, are respectively high- and medium-µ triodes with

NORMALLY 500 WATTS ARE RUN AT W4DLH
THOUGH THE TRANSMITTER HAS A 1-KW. CAPACITY

A pair of HD203A’s modulate the 300T in the final stage

(Continued on page 108)
The Doherty High-Efficiency Amplifier Applied to Amateur 'Phone

Practical Circuit Design and Experimental Results at 3950 Kc.

By Bruce E. Montgomery,* W9AHH

LAST Spring, preliminary to the annual I.R.E. convention, notices were released concerning a new high-efficiency type linear amplifier for modulated r.f., developed in the Bell Laboratories, which was to be described at the convention; a linear amplifier that gave efficiencies twice as high as the well known Class-B type. Every amateur who read these notices hoped for more practical information on the amplifier, and the sooner it appeared the better. When the first brief article on the subject did appear, however, it was immediately evident that things were not as rosy as they seemed. The difficulty was in the apparent complexity and adjustment of the circuit. It was very definitely not an amplifier on which the beginner should cut his teeth.

Now that we have been a little pessimistic, we will say that the amplifier does have definite possibilities for the advanced amateur who likes to make complicated things work, especially if powers in the neighborhood of 1 kw. are contemplated. But before plunging into the operation of the high-efficiency linear amplifier, it will be desirable to review the operation of the conventional Class-B linear.

Suppose we have such an amplifier, grid bias adjusted to cut-off, the circuit neutralized, and the proper load coupled into the plate circuit. Suppose further that the r.f. excitation to the grid is continuously variable from zero to the maximum obtainable. As the excitation is increased from zero, the antenna current increases in exact proportion to the r.f. grid voltage. But finally a point is reached at which little increase in antenna current occurs with a large increase in excitation. At about this same point the grid meter begins to show direct current flow. When the r.f. excitation is zero, there is no alternating r.f. voltage present on the plate of the tube. As the excitation is started and increased, an alternating voltage appears superimposed on the d.c. plate voltage and increases linearly with increase in excitation just as the antenna current does. When the peak value of this alternating voltage reaches about 0.85 of the d.c. plate voltage, this increase ceases to be linear, and more excitation causes little increase in this alternating voltage. The antenna current and alternating plate voltage component of course depart from linearity at the same point.

To use the Class-B amplifier with 100% modulation, it is therefore necessary to reduce the unmodulated excitation until the antenna current is half of maximum. This means that the alternating plate voltage is also one half of its maximum value, and that the power output is one fourth of the maximum output. The efficiency of the amplifier when receiving maximum excitation is about 60%. When the excitation is reduced to half for 100% modulation, the carrier efficiency drops to about 30%. If the excitation is adjusted to give maximum antenna current and the modulation is applied, the average antenna current will decrease; and, on an oscilloscope screen, the negative peaks of modulation will appear quite as usual, but the positive peaks will be cut off at the carrier value. (See the oscillograph picture illustrating this.) However, the efficiency is high, being about 60% or more.

At about this point, Doherty shows how a tube

* 159 Washington st., Edgewood, Pa.
may be used in the above condition of high efficiency to supply the carrier and negative peaks of modulation. Then, by interposing a quarter-wave filter between this tube and the output load and connecting directly to the load another tube biased to about twice cut-off, it is possible to fill in the positive peaks of modulation and at the same time maintain high efficiency.

THE IMPEDANCE-INVERTING FILTER

This necessary filter has an interesting impedance inverting characteristic, and an understanding of its operation is essentially absolute to understand the operation of the amplifier. So it will be necessary at this point to delve into the intricacies of the gadget. What will be said will apply equally well to a pi or T filter, but only the pi low-pass type will be considered here.

The diagram of Fig. 1 shows the filter under consideration.

Each leg of the p-section has a reactance of $X$ ohms, either inductive or capacitive, as the case may be.

Further, this relation is true

$$Z_o = \sqrt{Z_1Z_2} = X$$

where $Z_o$ is the characteristic impedance of the filter section.

Solving (1) for $Z_2$,

$$Z_2 = \frac{X^2}{Z_1}$$

If the filter is terminated in a resistance, $R_1$, instead of impedance, $Z_1$, then

$$Z_2 = \frac{X^2}{R_1} = R_2,$$

or the filter appears as a resistance of magnitude $R_2$ when terminated by $R_1$. So if $R_1$ varies, $R_2$ will vary in the opposite direction. An analogy to this action, while not exact, will help us visualize what happens in the filter. Imagine a teeter-totter—a saw horse with a board balanced across it. The height of the saw horse represents the characteristic impedance $Z_o(=X)$ of our filter. The heights of the ends of the board from the ground represent the resistances in which the filter is terminated. When the board is horizontal, this condition exists,

$$Z_o = R_1 = R_2 = X.$$

Depressing one end of the board raises the other end, and likewise decreasing $R_1$ increases $R_2$. This analogy can be carried too far. Pushing one end of the board to the ground raises the other end to twice the height of the saw horse, but dropping $R_1$ to zero does not increase $R_2$ to twice the characteristic impedance. Instead, $R_2$ goes to infinity!

Relations (1), (2), and (3) may be proved without great difficulty by applying complex algebra to Fig. 1, and solving for the input impedance.

In addition to the peculiar impedance inverting characteristic, the filter introduces a lagging phase shift of 90°, or is a "quarter-wave long." This phase shift is not necessary for the operation of the amplifier, but is an inherent and unavoidable characteristic of the filter.

Now proceed to Fig. 2. Going back to equation (3) and replacing $R_1$ by $R/2$, it is seen that $VT_1$, which shall be called the "carrier tube," is working into a resistance of $2R$. $R/2$ represents the output load. The carrier tube is operating Class B with just enough r.f. excitation to drive the grid positive. In this condition, the carrier tube is operating at maximum output for a load resistance of $2R$ and its efficiency is 60% or better. The filter, having no resistance elements, must pass all the power output of the carrier tube into the load resistance, $R/2$. An application of the power relation, $P = E^2/R$, shows that the r.f. voltage $R/2$ is one-half that developed at the input of the filter by the carrier tube.

Assume now that the carrier tube and $VT_2$, the "peak tube," are the same type, that the same d.c. plate voltage is applied to each, and that each has the same value of grid excitation in proper phase. The carrier tube is biased to cut-off and the grid is driven to zero or slightly positive. The peak tube is biased to about twice cut-off and so will have little or no plate current flowing. This is the unmodulated carrier condition. As the excitation is increased beyond this value, no increase in r.f. voltage on the plate of the carrier tube occurs and so this tube can not contribute more power to the load by virtue of increasing r.f. voltage. But this increase in excitation is also applied to the peak tube and its plate current rises from zero.

This tube now begins to send power into the load. With any given value of resistance, the only way to increase the power into it is to raise the voltage across it. The peak tube is now contributing power to the load, and to do this the voltage across this fixed load must increase. This increase in power and rise in voltage at the load, caused by the increased excitation to the peak tube, appears to the filter as a rising resistance load. That is, as far as the filter is able to tell, the load resistance is actually increasing. Now the impedance inverting characteristic of the filter
comes into play. So, remembering the teeter-totter analogy, the resistance presented to the plate circuit of the carrier tube is decreasing as the load resistance is increasing. On this action hangs the whole operation of the amplifier.

This decreasing resistance in the plate of the carrier tube allows it to give more output without an increase in r.f. plate voltage. As the excitation continues to increase, the power contributed to the load by the peak tube also increases. This causes the effective load resistance to continue to increase and thus to decrease further the resistance presented by the filter to the carrier tube, which in turn allows the output of this tube to increase.

The maximum value of excitation is that which drives the grid of the peak tube to approximately zero. When this occurs, the r.f. plate voltage on the peak tube has become equal to the voltage on the carrier tube, and the effective resistance that each tube is working into is $R$. Since the carrier tube was operating into a resistance of $2R$ and this resistance has been cut in half, the output must have doubled. And since the peak tube is operating into $R$ ohms also and at the same r.f. plate voltage, this tube must contribute the same power to the load as does the carrier tube. This means that the power to the load is four times as much as when the excitation was just enough to cause the carrier tube only to supply power. This, then, fulfills the requirement that on the peaks of 100% modulation the instantaneous power must be four times the carrier power.

CORRECTING FOR THE PHASE SHIFT

It has been stated that the filter network introduces a 90° lagging phase shift. It is, therefore, obvious that the r.f. voltages on the plates of the carrier and peak tubes are 90° out of phase. It is equally obvious that the grids of the two tubes therefore can not be excited in phase, but must also be 90° out of phase. This is accomplished by inserting a filter, similar to the one in the plate circuit of the carrier tube, in the grid circuit of the peak tube. Fig. 3 shows the grid circuit. A loading resistor, $R$, is necessary to fix the input and output resistance of the filter. If $R = X = Z_0$, then the input resistance at the carrier tube end of the filter will be $R$ ohms also, and the same excitation voltage will appear at the grids of both tubes.

Putting Figs. 2 and 3 together, we get a more complete diagram in Fig. 4. This figure looks very much like the familiar push-pull amplifier; but it is only the skeleton of the real diagram.

NEUTRALIZATION

This amplifier must be neutralized for the same reason that any other triode amplifier requires neutralization. The simple cross-connection of neutralizing condensers can not be used because the plates and grids of the tubes are 90° out of phase and not 180°, as would be the case for the usual method of neutralization. It is necessary therefore to add a tuned tank circuit across each plate and to add a neutralizing winding so that the tubes may be neutralized separately. The condenser of the tank circuit and that of the filter may be combined into a single condenser to simplify the circuit.

Tank circuits were also added in the grid circuit, and the condensers of the tank and filter again combined. This was done so that link coupling could be used, and so that a more satisfactory way of securing the grid loading resistor was at hand if a tank circuit was used. The circuit, as finally developed for 3950 kc. is shown in Fig. 5.

CIRCUIT VALUE CALCULATIONS

It is necessary to calculate the characteristic impedance of the plate circuit filter, basing it on the output expected. $L_4$ is the critical element in the plate circuit and must have a reactance equal to the characteristic impedance of the filter. $C_1$ is a blocking condenser included so that the plate currents of the tubes may be measured separately. The following calculations show the method used to arrive at the inductance of $L_4$:

Given: $E_p = 1000$ volts d.c.
Assume: Carrier power = 60 watts
Efficiency = 60%

From which:

Maximum r.f. plate voltage $= \frac{0.9 \cdot E_p}{\sqrt{2}} = \frac{(0.9) \cdot (1000)}{\sqrt{2}} = 636$ volts r.m.s.
Input = \frac{60 \times 0.6}{100} = 100 \text{ watts}

and \( I_p = 100 \text{ ma.} \)

Under these conditions, the carrier tube must "see" the following resistance:

\[ R = \frac{E_r^2 f_r}{P} = \frac{636^2}{60} = 6750 \text{ ohms.} \]

As has been shown, this resistance is twice the characteristic impedance. So \( Z_n = 3375 \text{ ohms.} \)

The load resistance to be coupled into the output of the filter is \( Z_\text{f} = 1687 \text{ ohms.} \)

\[ X_1 = \frac{70.7}{0.15} = 471 \text{ ohms,} \]

and from \( X_1 = 2\pi f L \)

\[ L_1 = 19 \mu \text{h.} \]

If the bulbs dissipate 3 watts with 70.7 volts across \( L_1 \) and 0.15 amp. flowing, the equivalent parallel resistance is

\[ R = \frac{E_r^2 f_r}{3} = 1667 \text{ ohms.} \]

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CATHODE-RAY OSCILLOGRAPH PICTURES OF THE WAVE FORM OF THE HIGH-EFFICIENCY LINEAR AMPLIFIER WHEN CORRECTLY ADJUSTED

Left, partially modulated; center, completely modulated; right, over-modulated.

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\[ 0.15 \text{ amp. at normal brilliancy, so the reactance of } L_1 \text{ should be of such a value as to allow 0.15 amp. to flow with 70.7 volts at 3959 kc. present.} \]

from the familiar relation, \( I = \frac{E}{X_1} \)

Then, for the grid circuit filter, \( Z_n = X_n = 1667 \text{ ohms.} \) Because of the change in the resistance of the bulbs as their temperature varies, the value of \( R = 1667 \) varies considerably. Therefore it would be desirable to be able to vary \( X_n \) over a limited range. This was accomplished by first determining the correct coil size for \( X_n \) = 1667 ohms in the same manner as was done for the plate circuit, taking off about a third of the turns, and connecting the 25-\( \mu \text{fd.} \) condenser, \( C_5 \), across the coil. Starting with the plates all out, and then increasing the capacitance of \( C_5 \), the inductive reactance of \( L_1 C_5 \) will increase from a value less than 1667 ohms to one considerably greater until resonance may be reached. At this point \( L_1 C_5 \) becomes a pure resistance of high value. Somewhere in this range is the correct setting for \( C_5 \).

ADJUSTMENT PROCEDURE

Next comes the interesting, but sometimes exasperating, job of tuning up. With no plate voltage applied, it will first be necessary to bring the grid circuit into approximate adjustment. Adjust the grid bias on both the peak and carrier tubes to about cut-off for the plate voltage used, and apply excitation. Set \( C_5 \) at minimum capacity, and tune the two grid tank circuits for maximum brilliancy of the grid loading bulbs. Increase excitation until a small amount of grid current flows through one of the tubes. Now by resetting \( C_5 \), and retuning the tank circuits, a setting will be found that will cause the same grid current to flow through each tube. Keep the grid currents down as low as possible so that no more additional load than necessary will be put on the filter. With this adjustment both grids are receiving the same r.f. voltage.

At this point, the amplifier can be neutralized. Each tube is neutralized separately in quite the
usual manner. Simply adjust the neutralizing condenser belonging to the tube to be neutralized until tuning the plate tank circuit belonging to that tube causes no flicker in the brilliancy.

The voltages across the two tank circuits in both the plate and grid circuits are supposed to be 90° out of phase. If the voltage across one plate tank coil is applied to one set of deflection plates, and the voltage across the other plate coil to the other set of deflection plates, an ellipse will appear on the screen with the axes horizontal and vertical when the voltages are 90° out of phase. Using this method, the carrier-tube plate tank circuit should first be tuned for minimum plate current and the other tank tuned for the 90° phase shift. The full r.f. voltage cannot, of course, be applied directly to the oscilloscope, but by use of a condenser voltage divider. When the oscilloscope is removed, the circuit must be retuned to compensate for the capacity of the instrument. The first method seems to give good results and is simpler, so the oscilloscope can be dispensed with for this adjustment.

To secure the proper load resistance, the cathode-ray tube, through a condenser voltage divider, may be of help in making sure the voltage on the output side of the filter is one-half the voltage on the carrier tube side.

The plate voltage to the peak tube may now be applied. The plate current to this tube should be small, perhaps 10% of the current to the carrier tube. From this point on, a cathode-ray tube on the output wave is essential. The audio voltage doing the modulating may be used on the sweep circuit, or a linear sweep should be equally satisfactory to show the wave form. Whatever method is used, it is necessary to see what effect the various tuning adjustments have on the wave form. 100% sine-wave modulation may now be applied to the exciter. The 60-cycle a.c. mains may be used if no audio oscillator is available, and if the modulation equipment will pass that frequency.

If the positive peaks of modulation do not come up as high as they should, the peak tube is not contributing its share of the power. (See oscillograph picture.) This may be the result of a high load resistance, too much bias on the peak tube, or the grid filter may not be adjusted to give the peak-tube grid enough excitation. To increase the excitation to the peak tube, the combination of the tank circuit should be adjusted to a lower

(Continued on page 118)

FIG. 5—THE FINAL CIRCUIT FOR 3950-KC. OPERATION
L1—19-pk. coil 19 turns No. 20 d.c.c., 1/4-inch diameter, 1/2 inch long.
L2—11-pk. coil 10 turns No. 14 enameled, 21/4-inch diameter, 1/2 inch long.
L3—Neutralizing winding, 8 turns No. 22 enameled, close-wound.
L4—134-pk. coil 62 turns No. 14 enameled, 21/4-inch diameter, 1 inch long.
L5—Output coupling coil, 4 turns No. 20 d.c.c. wound over L2.
L6—Input coupling coil, 4 turns No. 20 d.c.c. wound over L1.
L7—26 turns No. 28 d.c.c., 1/4-inch diameter, close-wound.
C1—0.005 mfd. 2500-volt mica condenser.
C2—100-pkff. midget variable.
C3—50-pkff. 3000-volt neutralizing condenser.
C4—330-pkff. 3000-volt oil.
C5—0.005 mfd. mica.
C6—0.002 mfd. 2500-volt mica.
C7—25-pkff. midget.
C8—0.002 mfd. mica.
R—Three 6.3 volt, 0.15-amp. flash bulbs in series.

Except for the input and output link couplings to L1 and L2, no coupling should exist between any of the coils.

The voltages across the two tank circuits in both the plate and grid circuits are supposed to be 90° out of phase. If the voltage across one plate tank coil is applied to one set of deflection plates, and the voltage across the other plate coil to the other set of deflection plates, an ellipse will appear on the screen with the axes horizontal and vertical when the voltages are 90° out of phase. Using this method, the carrier-tube plate tank circuit should first be tuned for minimum plate current and the other tank tuned for the 90° phase shift. The full r.f. voltage cannot, of course, be applied directly to the oscilloscope, but by use of a condenser voltage divider. When the oscilloscope is removed, the circuit must be retuned to compensate for the capacity of the instrument. The first method seems to give good results and is simpler, so the oscilloscope can be dispensed with for this adjustment.

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From this point on, a cathode-ray tube on the output wave is essential. The audio voltage doing the modulating may be used on the sweep circuit, or a linear sweep should be equally satisfactory to show the wave form. Whatever method is used, it is necessary to see what effect the various tuning adjustments have on the wave form. 100% sine-wave modulation may now be applied to the exciter. The 60-cycle a.c. mains may be used if no audio oscillator is available, and if the modulation equipment will pass that frequency.

If the positive peaks of modulation do not come up as high as they should, the peak tube is not contributing its share of the power. (See oscillograph picture.) This may be the result of a too-high load resistance, too much bias on the peak tube, or the grid filter may not be adjusted to give the peak-tube grid enough excitation. To increase the excitation to the peak tube, the combination of the tank circuit should be adjusted to a lower

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Radio Fadeouts Through 1936*

By J. H. Dellinger**

Amateur reports on the radio fadeout phenomenon known as the "Dellinger effect" have been especially helpful in collecting useful data throughout the past year. Further reports from amateurs fortunate enough to encounter these lapses in high-frequency propagation will be greatly appreciated. Be sure to give the exact time of the beginning and end of the fadeout observed and send your report to A.R.R.L., West Hartford, Conn.—EDITOR.

IN THE January and June numbers of QST last year I reported on the remarkable phenomenon of high-frequency radio fadeouts which I have had the privilege of studying with the cooperation of amateurs and others. From the data then available it was concluded that the fadeouts occurred simultaneously over wide areas and were confined to the hemisphere illuminated by the sun. The indication that they were caused by something happening on the sun was corroborated by the observation of visible eruptions on the sun simultaneous with several of the fadeouts. It was also found that small but sharp changes in terrestrial magnetism and earth currents occurred at the precise times of some of the fadeouts. Finally, it was concluded that the effects were caused by absorption in the ionosphere caused in turn by electromagnetic waves (probably ultra-optical) from a solar eruption.

Data accumulated since the June article have verified all these conclusions and give considerable further light on the phenomena. The June article reported fadeouts through April 8th, and showed that the approximately 54-day period which had been observed at first was obscured by additional fadeouts on other dates. Since April 8th many fadeouts have occurred. There appears an approximately 54-day recurrence tendency in the intensity of fadeouts, but the dates of occurrence of the fadeouts are not predictable.

While the phenomenon has not been under study long enough to permit a definite conclusion about this recurrence tendency, it appears to be rather more definite than, for example, the 27-day recurrence tendency of ordinary magnetic disturbances.

The fadeouts became more and more numerous, up to May of last year. From about May 25th to June 19th a most extraordinary series of solar outbursts occurred, of the type which produce radio fadeouts. This seems to have been a climax of some form of activity in the sun which produced a few fadeouts in 1934, more in 1935, and still more in 1936. In the three months, April to June of 1936, there were 54 reported fadeouts, more than the total number reported previously (in the two years during which the phenomenon had been isolated from other effects). Then in the following three months, July to September, there were only 16 reported fadeouts.

Of the 54 fadeouts in April to June, 21 are known to have been simultaneous with visible eruptions on the sun, duly observed and chronicled by astronomers. Also, 10 of the 54 were accompanied by simultaneous sharp fluctuations in the terrestrial magnetism.

In the entire period of two years from July 1934 to June 1936 there were 94 reported radio fadeouts; 39 of these are known to have been accompanied by a simultaneous visible eruption on the sun; 15 of them are known to have been accompanied by simultaneous fluctuations of terrestrial magnetic elements; and for 4 of them simultaneous fluctuations of earth currents have been reported. The fluctuations in terrestrial magnetism and earth currents are abrupt pulses of about the same duration as the radio fadeouts, not similar to the fluctuations characteristic of magnetic storms. In none of these fields has there been an opportunity to make a thoroughly comprehensive study of world-wide data, and there is good reason to suppose that the number of coincidences has been greater than is known at this time.

The occurrence of visible effects in the causative solar eruptions is probably more or less fortuitous. The cause of the fadeouts and the related terrestrial phenomena is a sudden outburst of highly penetrating solar radiation of ultraviolet (i.e., ultra-visible) frequencies. This produces sudden ionization of the atmosphere below (or possibly in) the E-layer of the ionosphere, where the air density is great enough to insure numerous collisions of moving ions and hence rapid absorption of the radio wave energy during the few minutes it lasts. The degree of absorption is less for the higher radio frequencies than for lower ones, and so the lower radio frequencies fade out first, remain out longer, and return last. The critical frequencies for the F-layer are not affected.

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* Publication approved by the Director of the National Bureau of Standards of the U. S. Department of Commerce.
** Chief, Radio Section, National Bureau of Standards, Washington, D. C.

PERHAPS the most remarkable angle on W9ERU's winning of the Chicago amateur code speed contest is that in eight years of big-time traffic-handling he never used a mill. Yet Eugene A. Hubbell (27, single) says that, except for plenty of practice, high-speed typing is the most important requirement for record-breaking code work. His typing training occurred in high school and in radio school; code speed came from C.D. traffic work, plus N.C.R. and A.A.R.S. experience. Old "GL" at WLM gets the credit for teaching W9ERU the ropes. Since Nov. 22, 1927, he has been a continuously active amateur, serving as O.R.S., R.M. and O.B.S., high in freq. measuring contest, Sweepstakes, HPM birthday relay, Navy Day Honor Roll, and so on. In 1933 W9ERU reached the World's Championship finals with McElroy, Chaplin and five or six others. In 1936, in a strictly amateur contest, he won. He does not at present claim the world's amateur championship—but anyone who thinks they can beat 52.7 w.p.m. with one error is welcome to step up and try it!

WHEN George Bailey, W1KH, was elevated to the vice-presidency of A.R.R.L. the New England Division had to choose a new director. From a field of seven candidates it picked a well-known native son: Percy C. Noble, W1BVR-WLG, who, while born in 1905, only began to live in 1920 when the bug first bit! His radio activities and appointments, itemized, total more than two dozen (including being S.C.M. and Acting 1st C.A. Radio Aide); list all you can think of (except 'phone) and add a few more, and you'll have them. He smokes Camels by the barrel, enjoys rifle practice, boxing, wrestling and books, doesn't know how to dance and isn't particularly interested. He is principal of the Blandford Consolidated School, drives 25 miles each day to work. Since 1921 W1BVR has experienced just seven complete rebuildings; now, concentration is on traffic, rag-chewing and DX, in the order named.

FLORA LOUISE CARD HOOVER became an amateur in August, 1931, with the call W6EK, and the past five years have been the most eventful in her life. Since she is just 21 this seems quite reasonable. She is also 5 feet 6 inches tall, has light brown hair and hazel eyes, and is a beauty operator. She started in amateur radio with low power, but now she has an 860 in the final and a husband. Romance entered her life in the person of Sergeant J. F. Hoover ("CV" of W6ZG-WLV) when they were introduced over the air on Corps Area frequency. They were married in San Francisco in January, 1935. The OM, who is working for Mackay now, will be remembered for winning one of the three 100% accuracy cups last year. W6EK's chief interest is traffic-handling; she is B.P.L., O.R.S., N.C.R. and A.A.R.S. The Army receives a great deal of her attention; she has worked up from local to Alternate Corps Area Control as WLVK, which isn't bad for a YL soldier.

AS A boy James M. Chambliss was well-known around Hamilton, Texas, for his playing in the local brass band. At 16 he became a telegraph operator, "doubling in brass" as a black-face comedian in minstrel shows. In 1908 he created a great sensation by being the only person in the county to own a motorcycle. Thirty years later, after a period of b.c. set-building, he acquired his ham ticket and the call W5DNE. For a year he chased DX; then he turned to traffic, and became O.R.S., A.A.R.S., on T. L.

(Continued on page 108)
More DX Per Dollar

Facile Frequency Control in a Three-Band Transmitter of 1-Kw. Capability

By Charles D. Perrine, Jr.,* W6CUH

If you have indulged in a rag-chew with W6CVH during the past few months you won’t rest until you have read every word of this article. We raised him on the high-frequency edge of “twenty,” one night recently, and asked him if the new rig was finished. We can imagine his satisfaction as he demonstrated by shifting his kilowatts to any one of four frequencies faster than we could tune the receiver—which convinced us that this is the form our next transmitter must take. It sets a new standard for facile performance. We give you instantaneous frequency change by W6CUH—EDITOR.

Part I—The Exciter and Automatic Driver Stages**

FOUR years ago it was “Thirty Three Watts per Dollar” and 1-kw. 852’s.¹ Now it is more DX, more QSO’s, and more enjoyment per dollar, no matter what the power. New tubes and practice have largely solved the power problem; therefore the next logical step is increased frequency flexibility with its limitless opportunities. For flexibility can accomplish more than 10 or even 50 kw. ever could in the way of DX, QSO’s and general fun—and above all it places the low-power man on a much more nearly even basis with the high-power competition.

The 1936 DX Contest forcibly drove home the need of flexibility—of being able quickly and accurately to shift to any frequency in as many as three bands. With three bands often “open” at once, a terrific advantage could be gained by being able to shift into whichever band a CQ was spotted. Or, when a short “band-edge” call is made with no luck, snap the crystal-controlled frequency into the band and call again so the choosy DX’er will have to hear you again—or, if he uses QLM or QHM, you can instantly match his intention.

And if your competition down the street beats you to VSSAA in spite of all this, just switch to electron-coupled control and wind the transmitter over on his frequency (your pal’s) and you will have VSSAA hooked the moment he finishes. Then again, how often have you heard two of your friends QSO and wished to get into the discussion? The synchronized e.c. will get you in no matter what part of the band they are in. And from the operating position, the twist of a switch puts the output on the 28-, 14-, or 7-Mc. band; a second switch places this output on any one of five crystal-controlled frequencies in any one of the three bands (for instance, 7000, 7010, 7060, and 7200 kc. in the 7-Mc. band); and a third switch cuts over to e.c. oscillator control which, by means of a single dial, allows the use of any frequency in the 7- or 14-Mc. band and in the lower half of the 28-Mc. band. The operator thus has a multitude of frequencies available in three bands without even having to get out of his chair or interrupt his DX hunting.

The transmitter is in unit construction and

* 52 20th St., Hermosa Beach, Calif.
** The first of two parts. The second part will appear in a future issue of QST.

February, 1937
represents the author's attempt to solve the problem of having a "permanent" transmitter—everything is in finished form except the 28-Mc. amplifier which has been retained as the "guinea pig" for the inevitable future experiments. The five units are made up of the crystal-c.e. oscillator-doubler unit on the operating desk; the main rack containing the automatic driver, 7-Mc. final amplifier, and low-voltage power supplies; the separate high-voltage power supply in another frame; and the 14- and 28-Mc. final amplifiers, the last two being separate units.

Other important features of the transmitter include a new compact design for the 14-Mc. push-pull final amplifier. The high efficiency 28-Mc. power doubler utilizes to the full the possibilities of the new Elmac 250TH high-mu tubes. The tank coils are all wire-wound and unusually small. Lastly, there is an improved method of primary keying that gives perfectly clean signals at any speed no matter what amount of filter is used, yet retaining all the important advantages that make primary keying so indispensable to high power.

As is necessarily the case in most articles of this nature, many of the small details must be left to the reader. Furthermore, most of the ideas will probably be applied to transmitters already in operation; hence no detailed mechanical specifications are given except in the case of the band- and frequency-changing relays.

BAND AND FREQUENCY CHANGE

The tube line-up was chosen to give excess extinction at every point. Each stage does its job in easy, straightforward fashion without resort to any trick circuits. Automatic operation requires absolute dependability comparable to that of commercial jobs. An 802 serves either as crystal or electron-coupled oscillator driving a 6L6 as a doubler to 7 Mc. The 6L6 is linked to a 100TH plate neutralized buffer working also on 7 Mc. The 100TH is followed by a capacity-coupled 250TH driver, the output of which can be switched automatically from 7 to 14 Mc. as described later, the tube working as a power doubler to 14 Mc. Three separate final amplifiers are used for the three bands, each link-coupled to the above driver. A pair of paralleled 250TH's, grid neutralized, do the job on 7 Mc.; another pair in push-pull handle 14 Mc.; and a third pair power-double to 28 Mc. An attempt was originally made to have one amplifier do the job—three paralleled 250TH's worked straight through on 7 Mc., doubled handily to 14 Mc., and even handled close to 1 kw. quadrupling to 28 Mc. But that set-up proved unfeasible because of the difficulty of coupling three antennas to one tank circuit; not to mention the interlocking adjustments of all three bands.

So much for the general band-change method. Of greatest interest is the automatic frequency change which enables the output frequency to be shifted over ranges of 7000-7250, 14,000-14,400, and 28,000-29,000 kc. in the three bands. This means that the eleven tank circuits involved in the transmitter must cover a frequency range amounting to about 3% of the resonant frequency (100 kc. on 3.5 Mc., 200 kc. on 7 Mc., 300 kc. on 14 Mc., etc.). To help this coverage, advantage was taken of the fact that loading greatly broadens the tuning of any tank circuit, a high L/C ratio also helping in this respect. Seven of the tank circuits have been loaded sufficiently (tight load coupling) so that no tuning is required over the 3% range. For this reason the 802 and 6L6 plate tanks are tightly coupled to their loads. The grid tank of the 100TH is well loaded because of the low bias used on it. And the plate tank of the 250TH is broad because of tight coupling of the 7- and 14-Mc. links. Hence all these tank circuits are fix-tuned to the center of the 3% range. In spite of the broad tuning in these circuits, some variation in output takes place; but this has little effect because the excitation is more than ample at every point. Furthermore, none of the tubes is being overloaded, so that the slight off-resonance rise in plate current is not damaging.

The final amplifiers present a bit different picture, since adjustments are more critical. Nevertheless, it was found possible to operate the 7-Mc. final plate tank fix-tuned because of the close antenna coupling (lower load impedance) required to load the tubes properly when working in parallel and at low plate voltage. The grid and plate tanks on the parallel 28-Mc. stage were also found broad enough to allow coverage of the lower half of that band. The tuning of the four remaining tank circuits is too critical to cover a 3% range, but they can cover up to 1% of the

2 In addition to considerations of output and efficiency, possible generation of spurious components as the result of off-resonance tank circuits must be considered. Aggravation of r.f. harmonics is especially likely with circuits which are critical as to tuning, especially in the final stage. (See W1EAO's article on harmonic radiation, elsewhere in this issue.) Therefore, the practices regarding loading and tube operation described by W6CUH should be carefully observed—and certainly not misapplied in amplifiers working under different conditions. In any case, the final output should be carefully checked for spurious harmonic radiations over the various frequency ranges before putting the transmitter into regular operation.—Exerox.

38 QST for
resonant frequency effectively. These four tanks include the plate of the 100TH which is only lightly loaded because of the high bias required on the following 250TH as a doubler; also critical is the tuning of the 7-Mc. final grid tank which must be held closer to resonance to compensate for running its plate fix-tuned. The other two are the grid and plate tanks of the 14-Mc. push-pull stage—both relatively sharp because push-pull grids present a higher impedance to the grid tank than parallel ones; the same thing being applicable to push-pull plates which require looser antenna coupling than when paralleled.

A very simple method is used to keep these four tanks close to resonance. All are first tuned to operate fix-tuned over the high-frequency half of each band in question. Then it is an easy matter to bring them all into correct resonance for fix-tuned work over the lower half of these bands by means of small receiving type midget condensers connected across one or two turns at the center of each coil. About 70 to 100-µµfd. have been found sufficient in each case. It is thus possible to use such low voltage padding condensers even in the 14-Mc. final tank (requiring a 15,000-volt main condenser) because the voltage across one turn is relatively low. Once these padder condensers are set, change from one end of the band to the other is accomplished automatically by small relays that cut the padders in or out of action.

CONTROL RELAYS

The four relays in question are controlled by an extra set of contacts on the crystal selector switch. Thus the relays remain open for the two high-end crystals (3580 and 3600 kc.) and are closed when any of the low-end crystals are used (3500, 3505, and 3530 kc.). It is therefore only necessary to operate the one crystal selector switch to place the entire transmitter on that frequency. When using e.c. control instead of crystal, the same relays are controlled by a multipoint switch that is ganged on the same shaft with the e.c. tuning condenser. The switch contacts are arranged to cut in the relays and their associated padders when the e.c. oscillator is tuned (decreasing frequency) past the middle of the band. As a result, the entire transmitter frequency is continuously variable by means of a single dial.

The padding relays, as well as the separate antenna change-over relay and receiver input shorting relay, are operated by the plate current of the 802-6L6 exciter unit. Thus the four relays shown in the diagrams (Re1, 5, 4, 5) are connected in series, Re1 going to the Re4 terminal in Fig. 2 and Re5 to ground. The crystal and e.c. switches, Sw2 and Sw3 mentioned above, control the four relays by shorting them when it is desired to have the relays remain open. The band change relay, Re2, is operated from the keying relay supply as somewhat more contact throw is required.

The relays are all homemade, as is the antenna change-over relay, and merit description before going on with the rest of the transmitter. Fig. 1 shows the relay details. The magnets, one-inch long and a half-inch in diameter, are made from 3/16-inch stove bolts and ½-inch fibre washers (though almost any electromagnet core will do), wound full with No. 32 enameled wire for operation on the current of 100 ma. The magnets are mounted on a heavy strip of sheet metal (steel) bent at right angles as shown. Near the end of the
strip, a piece of No. 12 wire is supported by a bit of solder at each end so as to act as a bearing shaft for the sheet steel armature. The armature is a ½-inch strip of steel bent at right angles with the body of a ½-inch eyelet soldered to it in the vertex of the bend. The eyelet fits snugly over the No. 12 wire and provides a bearing for the armature. The vertical half of the armature comes opposite the magnet pole piece and, when attracted to it, raises the other end to which is attached the bakelite strip to give a greater contact throw.

The magnet winding on the back of the cabinet which consists of a standard pentode crystal oscillator with switch Sw1 in the "xtal" position, and as a conventional pentode crystal oscillator with switch Sw1, the crystal and e.c. indicating pilot lights, and the pad-der relays from the crystal switch Sw2 to the e.c. condenser switch Sw3. When working e.c. the oscillator portion of the 802 is on 1.75 Mc. for increased stability, and the plate of the 802 is tuned to 3.5 Mc. to give satisfactory oscillation with the highest frequency crystal (3600 kc.).

The complete circuit of the 802-6L6 exciter is shown in Fig. 2. The 802 operates as a conventional pentode crystal oscillator with switch Sw1, and the 6L6 doubles to 7 Mc. and coil to the plate, a condition which would be detrimental to stable e.c. opera-

Note that when Sw1 is on "EC," C2 no longer couples the 802 grid to the plate, a condition which would be detrimental to stable e.c. operation. The 6L6 doubles to 7 Mc. and is quite conventional. Its output is carried through the link L4 to the power stages by means of a 15-foot twisted-wire line cabled in with the power leads.

The two stages of the exciter are entirely contained in a National SRR cabinet with the exception of the crystals and the two switches, Sw1 and Sw2. The five crystals are in a combination holder on the back of the cabinet which consists of a common bottom plate (2 by 6 by ½ inch aluminum) and five top plates. Sw1 and Sw2 are mounted just under the crystals and connected to the knobs on the front panel by extension shafts—a type of construction that gives short crystal leads. A box-like metal cover is arranged to screw on the back of the cabinet to protect crystals and switches from dust. A measure of temperature control is obtained by a small feedback capacity of an insulated wire from the Sw2 switch arm wrapped around the 802 plate lead, just enough capacity being used to obtain stable crystal oscillation. Note that when Sw1 is on "EC," C2 no longer couples the 802 grid to the plate, a condition which would be detrimental to stable e.c. operation. The 6L6 doubles to 7 Mc. and is quite conventional. Its output is carried through the link L4 to the power stages by means of a 15-foot twisted-wire line cabled in with the power leads.

FIG. 2—CIRCUIT OF THE CRYSTAL-E.C. EXCITER UNIT

The small feedback capacity C2 consists of an insulated wire from the Sw2 switch arm wrapped around the 802 plate lead, just enough capacity being used to obtain stable crystal oscillation. Note that when Sw1 is on "EC," C2 no longer couples the 802 grid to the plate, a condition which would be detrimental to stable e.c. operation. The 6L6 doubles to 7 Mc. and is quite conventional. Its output is carried through the link L4 to the power stages by means of a 15-foot twisted-wire line cabled in with the power leads.

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10-watt wire-wound 1000-ohm resistor mounted on the under side of the aluminum crystal bottom plate. This resistor, and another just like it located inside the cabinet, are permanently connected to the 110-volt power line, and continually maintain the crystal and entire oscillator at near operating temperature. The crystals especially are kept well above room temperature so that ordinary variations have little effect on the frequency.

The photographs show clearly the general physical layout of the 802-6L6 unit. Everything is solidly mounted and wired. The oscillator coil L1 is particularly rugged; it is wound on a National GS-3 insulator and thoroughly doped. The switch Sw can be seen attached to the inside back of the cabinet directly lined up with the oscillator condenser shaft. The mounting plate, shaft, and detent mechanism were removed from the switch, so that it is now operated by the metal fin soldered into the end of the extension shaft coupled to the e.c. tuning condenser. One of the photos also shows the transmitter control box carrying the main filament switch, send-receive switch, band-changing switch, and the frequency indicating lights. Only two sets of lights are used, the 14-Mc. set doing duty for 28 Mc. also, because there was hardly room for more lights on this particular control box.

The performance of this unit leaves little to be desired. However, one or two precautions are in order. A shock absorbing mounting for the whole unit (four small sponge rubber pads glued to the bottom of the cabinet) is necessary to prevent vibration pick-up. The adjustment of the oscillator screen voltage by $R_4$ is important in reducing frequency shifts resulting from line voltage changes (especially important if the keyed load "blinks" the lights excessively). Thus it has been easily possible to obtain e.c. controlled signals.

(Continued on page 116)

![Diagram](image.png)

FIG. 3—THE AUTOMATIC DRIVER CIRCUIT

- $L_1$—14 turns No. 18 enamelled, 2-inch diameter, unspaced.
- $L_2$—23 turns No. 12 tinned, 2½-inch diameter, 3 inches long, air-wound.
- $L_3$—18 turns, same as $L_2$.
- $L_4$—1 turn No. 12 tinned.
- $L_5$—Same as $L_4$.

- $C_0$—500-µfd. 3000-volt (Cardwell MT350D).
- $C_1$—0.002-µfd. midget type. (Hammarlund MC-100S).
- $C_2$—0.002-µfd. 5000-volt mica. (Hammarlund MC-100S).
- $C_3$—Same as $C_1$.
- $C_4$—100-µfd. midget (Hammarlund MC-100S).
- $C_5$—2-µfd. 3000-volt (Cardwell MT350D).
- $C_6$—500-ohm 3-watt. (National NC800).
- $C_7$—500-ohm 50-watt. (National NC800).
- $R_1$—2.5-mh. r.f. choke (National R100).
- $R_2$—Paddder relay. (See text.)
- $R_3$—Band changing relay. (See text.)

February, 1937
A Simple Directive Antenna

By Manfred Asson, * ES2D

AMATEURS living in the forlorn wilds of Eastern Europe usually have great difficulties in purchasing even the simplest short-wave equipment. Long-distance contacts actually carried out with flea-power, and the receivers are of almost prehistoric design. So it is only natural that in such conditions amateurs take refuge in more effective antenna systems.

As it may be of certain interest to some of the amateur fraternity in the U. S. what kind of gear we are using here, we jot down a few lines concerning an inexpensive unidirectional array for 14 Mc. with simple means for reversing its directivity. The basic idea is simple to understand. A long wire antenna of four wavelengths gives intensive low-angle radiation in line with its ends, the radiation angle being approximately 25 degrees (Fig. 1). This long wire makes by itself an effective bidirectional antenna. Still, to increase its efficiency and to reduce interference from the unwanted side we have to add a reflector. This is done in a simple manner by placing a similar wire near it, so that its distance from the radiator is a quarter of a wave when viewed from the beam direction, that is, 25 degrees from the horizontal. It is evident from Fig. 2 that radiation will be greatest at the right side when the reflector is shifted to the left, and vice versa.

That means, we may reverse the system’s directivity by simply moving the reflector from the left to the right.

Now for the practical details. The radiator is 260 feet long, of hard-drawn enameled No. 14 wire, this gauge having proved sufficient to stand the strain when the location is not extremely stormy. This radiator was hung up about 40 feet above ground and its one end connected to the usual tuned feeder system. Ample space was provided between the antenna poles to allow sufficient reflector shift. Because a rather tight coupling resulted, the reflector wire had to be given a greater length; 268 feet was chosen, a length which while theoretically perhaps not the best, yet gives satisfactory results. The reflector was made of the same gauge wire and hung up exactly 8 feet below the radiator. Two guywires, a couple of pulleys and a weight made a simple arrangement for moving the reflector from the shack (Fig. 3), the ropes being adjusted so as to allow a total shift of 28 feet.

No attempt was made to change the data given above, as the results were most gratifying when compared with the kind of gear we are using here, we jot down a few lines concerning an inexpensive unidirectional array for 14 Mc. with simple means for reversing its directivity. The basic idea is simple to understand. A long wire antenna of four wavelengths gives intensive low-angle radiation in line with its ends, the radiation angle being approximately 25 degrees (Fig. 1). This long wire makes by itself an effective bi-directional antenna. Still, to increase its efficiency and to reduce interference from the unwanted side we have to add a reflector. This is done in a simple manner by placing a similar wire near it, so that its distance from the radiator is a quarter of a wave when viewed from the beam direction, that is, 25 degrees from the horizontal. It is evident from Fig. 2 that radiation will be greatest at the right side when the reflector is shifted to the left, and vice versa.

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No attempt was made to change the data given above, as the results were most gratifying when compared with the simplicity of the system. With the free end of the array pointed to northeast, Japanese and Siberian stations came in sometimes with SS on a two-tube receiver, similar reports being obtained when the antenna was used on the 25-watt m.o.p.a. transmitter. On the other hand, South American stations came in consistently with the antenna directivity reversed.

* Kloostri, 9–8, Tartu, Estonia.


(Continued on page 110)
Operating Notes on Power Crystal Oscillators

Safe Crystal Conditions for High-Power Beam, Pentode and Triode Tube Circuits

By J. M. Wolfskill,* W8QKT

The oscillator circuits and tubes to which crystals may be applied are many and varied. The tubes used range from all types of receiving tubes to expensive pentode transmitting tubes. The receiving type tubes have many advantages insofar as having respect for the crystal, and frequency stability, is concerned; but because of their low-power output, a high-power transmitter using them in the oscillator stage is of necessity quite complicated. With the general trend being towards higher-power crystal oscillators, many high-power triodes as well as pentodes are being used in conventional oscillator circuits, as well as in less conventional circuits. This in a way is unfortunate, because many who try these tubes and circuits do not take adequate precautions in protecting the crystal.

It must always be remembered that a crystal is, of necessity, a frequency-control device, and, although it is generally advantageous to obtain just as much power from the crystal oscillator as reasonable, the crystal is often endangered by doing so. Improvements in tubes and newly developed tubes have greatly increased the available power from the crystal stage without driving the crystal very hard, especially if the rated voltages of the tubes are not exceeded. Tubes like the 2A5, 59, RK-23, RK-20, etc., have sufficient shielding between the grid and plate to prevent excessive feedback.

In an attempt to obtain high power from the crystal oscillator, amateurs have attempted to use tubes with low amplification factors and high inter-electrode capacities, such as the 210, with high plate voltages. Needless to say, the crystals were badly fractured. These experimenters did not give consideration to the characteristics of the tube, and the factors which determine its performance as a crystal oscillator.

Now the ability for a crystal to drive a given tube, and stand up under oscillation, depends on:

1. Amplification factor of the tube.
2. Plate-to-grid capacity of the tube.
3. Bias required.
4. Grid driving power required.
5. Activity of the crystal.

The amplification factor of a tube to be used as a crystal oscillator should be fairly high, since it determines the amount of energy which has to be fed back to the grid (assuming constant grid circuit losses) to start and sustain oscillations.

The amount of energy actually fed back to the grid circuit is determined by the plate-to-grid capacity of the tube, and the r.f. voltage developed by the plate tank. Because of the high Q or low decrement of a crystal, very little feedback is required, and the plate-to-grid capacity of a high-power tube may be as low as 0.1 µfd, and the crystal will still start oscillating. It sometimes may be necessary with such tubes to add external feedback, in which case it can be controlled and varied until the crystal receives proper excitation.

An oscillator, whether crystal-controlled or self-excited, has the ability to adjust itself to varied conditions. When the circulating current in the grid circuit is not important, as in a self-excited oscillator, the bias adjustments are not critical and the oscillator will adjust itself to wide variations. Naturally, there are optimum conditions for best operation and highest efficiency; but in attempting to obtain them we need give little consideration to bias adjustments and over-excitation.

In a crystal oscillator the bias on the tube and the method of obtaining it become important. The crystal current, for instance, can be fairly well controlled by varying the grid resistor and controlling the bias. In general, the lower the grid resistor, the higher the output and the lower the crystal current; and vice versa. As the result of zero bias in the non-oscillating condition, the crystal is often hard to start and will not key well when using too low a value. By resorting to cathode bias, in addition to a grid-leak bias, the crystal starts oscillating under a bias condition. This initial bias, if not too high, has a tendency to increase the effective plate-to-grid feedback, and also gives the tube a higher gain; all resulting in easier and more rapid starting of oscillations. At the same time, the low grid resistor acts to keep the crystal current and increases the power.
output. Too high a value of cathode bias will have the opposite effect, and make starting of oscillations difficult. The best resistance value to use will vary from 200 to 500 ohms, depending on the tube characteristics.

This applies generally to pentode type tubes; for triode oscillators slightly different conditions exist because the amplification factor of the triode increases with increasing plate current. For the pentode tube, the amplification factor passes through a maximum when the plate current is at a fairly low value. If plate current is increased beyond this point, amplification decreases rapidly. This will be discussed more in detail later.

**PENTODE OSCILLATOR PERFORMANCE DATA**

In Figs. 1, 2, 3 and 4, are shown curves of the crystal current and power outputs of a conventional pentode oscillator using a 2A5 tube under various conditions of both grid-leak and cathode-resistor bias. Although these curves were taken with a low-power pentode, they are generally representative of what happens with the higher power tubes under different conditions of bias. All measurements were made with a 7-Mc. crystal, with 200 volts on the screen and 350 volts on the plate of the tube. An r.f. choke was used in series with the grid resistor and, in the case of cathode bias, the choke was connected directly across the crystal. It will be noticed from Fig. 1 that the crystal current is higher than for any other condition, and that the current in the loaded condition is approximately half the no-load current. This is roughly true for conditions of Figs. 2 and 3. However, for Fig. 3 the current has been greatly reduced. Fig. 4 is interesting in that the crystal current remains practically the same in both the loaded and no-load conditions. Power output from the oscillator is greatest for conditions of Fig. 2. However, the oscillator in this condition did not key as well as when cathode bias was added. In Fig. 3, the power output is almost as high, and the oscillator keyed much more readily, even with the low value of 10,000 ohms across the crystal. It will also be noticed that as soon as cathode bias is added, the plate current no longer has the familiar dip as the tank is tuned through resonance. The power output curves also broaden out as soon as cathode bias is added. This makes tuning and coupling to the plate tank less critical.

With a proper combination, then, of cathode and grid leak bias, the crystal current can be reduced and still maintain practically the same output. The fact that the crystal current drops as soon as a load is coupled to the oscillator shows how closely the crystal current is related to the r.f. plate voltage. These factors should be borne in mind when making measurements of crystal current. If the load should be removed at any time, the crystal current still should be below its rated value.

The grid driving power required by a tube furnishes another criterion for determining its suitability as a crystal oscillator. The lower this value, the lower can be the crystal current for rated output from the oscillator. Little, if any, gain in power output will result if the crystal current is increased beyond that normally required to excite the tube.

**CRYSTAL ACTIVITY**

Another factor which affects the performance of a crystal oscillator is the activity of the crystal itself. This often misconstrued term has been the source of controversy for some time, and to date no definite standards have been set by which it may be defined. There are three separate and distinct quantities which determine the overall activity of a crystal and its consequent performance as an oscillator. First, the Q or decrement; second, freedom from coupling to other vibrations, and spurious frequency response; and third, its piezo-electric activity, or charge developed per unit of pressure. The last is dependent entirely on the manner in which the crystal is cut with respect to the crystallographic axis, and the
freedom from inclusions in the quartz. The first two can be well controlled by proper mounting and grinding.

In the manufacture of crystals, every attempt is made to make this overall activity as high and as uniform as possible. This has done much toward clearing up variations in characteristics which may occur between crystals of different manufacture. Uniformity in crystal characteristics is most important in transmitter design. A sluggish crystal might, for instance, require several times more feedback than an active one because of its higher equivalent resistance and consequent higher grid circuit losses. This same crystal might drive a given tube without excessive crystal current. But if it be replaced by a more active one, the crystal current may become high enough to shatter it. This seems contradictory and it would seem that the sluggish crystal would be the one to be desired. However, it will be found that the power output or the efficiency as well as the ability to key the oscillator will be much better with the active crystal if the excitation is, in some way, reduced. It is for these reasons that whenever a high-power tube is used as the crystal oscillator, some precaution should be taken to see that the crystal current does not exceed its rated value.

The best way to check the current through the crystal is to use a thermo-galvanometer in series with the crystal. This will give a constant check on the current flowing through it. The cost of such an instrument makes its use almost prohibitive to most amateurs. Alternatively, an approximation of the current may be made by connecting a low-current pilot lamp in series with the crystal. Standard radio pilot lamps with ratings of 6.3 volts at 150 ma. or 2 volts at 60 ma. can be used quite effectively. The 60-ma. lamp should be used for crystals rated under 100 ma. and two of these 60-ma. lamps in parallel for crystals rated over 100 ma. These lamps will then act as a protective device as well as give a rough check on the crystal current at all times. A 60-ma. lamp will burn out at about 75 ma. and two in parallel will burn out at about 140 ma. The resistance of these lamps is low enough so that neither the power output nor keying is materially affected.

A summary of the above discussion follows:

1. By varying the grid-leak resistor, it is possible to vary the crystal current over a wide range.

2. When driving a high-power tube, the grid-leak resistance should be reduced to a low value. If difficulty in keying results, cathode bias in addition to grid-leak bias will facilitate rapid starting of the oscillator.

3. Always use some means of measuring the current through the crystal. A small low-current pilot light will serve to indicate the approximate amount of current and will act as a fuse as well. If difficulty with keying results, because of this added resistance, the lamp may be shorted out after preliminary adjustments.

4. Driving a crystal harder than normally required to drive the tube is simply a waste of power and endangers the crystal unnecessarily. Practically no increase in power output results by increasing the crystal current (with external feedback) if the oscillator keys well at the lower value.

5. Always measure crystal current at no load and see that it does not exceed its rated value in the no-load condition.

TUBES AND CIRCUITS GENERALLY

It is to be expected that practically the only type tubes which would have large power outputs as crystal oscillators, and still have low inter-electrode capacities, would be the pentode types. Several triodes, however, have recently appeared on the market which can be used satisfactorily as higher-powered crystal oscillators if proper precautions are taken.

The 6L6 beam tube has fired the enthusiasm and started the trend towards high-power crystal oscillators with low plate voltages, more than anything else. Before that, the only means of getting large amounts of power from the crystal stage was by using high voltages and tubes such as the RK-20 803, etc. Another method of obtaining high power from the crystal oscillator was by using the lock system, in which a self-excited oscillator was locked to the crystal frequency over a small range of the tank tuning capacity. The locked oscillator never enjoyed much usage because of the difficulty of correct coupling to the crystal and the danger of crystal fracture. Also the oscillator was held in step over only a small range of tuning capacity; consequently, variation of load or too tight coupling tended to pull the oscillator out of step with the crystal. Such methods were obviously dangerous for the crystal. However, many of the high-power tubes now being used as crystal oscillators are just as
dangerous, unless proper precautions are taken. The 6L6 tube, for instance, has been used by many as a crystal oscillator and, because of its high-power output possibilities, it appears naturally adapted to simple and compact transmitter design. The plate-to-grid capacitance, however, is rather high, the shielding effect of the screen being none too effective. This is evidenced by the necessity of neutralization when the tube is used as an amplifier; even as a doubler, trouble has been experienced with self-oscillation. It is an easy tube to excite, but because of its high amplification factor, difficulty with self-oscillation is encountered and this makes it difficult to use in some circuits.

Many other new tubes, as well as circuit variations, are making their appearance; when trying these new tubes and their circuit applications, anything which is a departure from a familiar setup requires every precaution possible to protect the crystal. This is true because of the difficulty of duplicating results with some of the newer tubes. Even though a given experimenter may have excellent results with one setup, another with supposedly the same circuit may have his crystal shattered, unless he has it protected. In high-power crystal oscillators, if the crystal leads are just slightly longer or the position slightly different relative to the tank circuit, a large increase in feedback may result. Because of the high r.f. potential at the plate of the tube, variation of socket capacities may cause a wide variation in feedback to the crystal. For several of the newer tubes, the manufacturers state that external feedback should be used. Every attempt should be made to see that the circuit is working properly before this feedback is added. If the oscillator is properly constructed, with the correct voltages applied, practically all crystals will oscillate without external feedback.

**THE 6L6 TUBE AS A CRYSTAL OSCILLATOR**

The first tests conducted on the beam type power tube were made with the 6LG6. The performance curves were similar to those of any pentode crystal oscillator, with the exception that the crystal current was abnormally high. The crystal current on a 7-Mc. crystal was 100 ma. with 400 volts on the plate and 250 volts on the screen. This was in the loaded condition and a power output of 25 watts was obtained. The normal rated crystal current through a 7-Mc. crystal is 100 ma., and as long as the oscillator was loaded this value was not exceeded. But as soon as the load was removed, the current rose to 175 ma., which is just about the breaking point of the crystal. With a 14-Mc. crystal, the r.f. current rose to 150 ma. when loaded, which is the rated r.f. current for this type of crystal. In all cases, with the load removed, the crystal current was anywhere from 50 to 75% over rated values.

Considerable difficulty was encountered in attempting to duplicate results, and the tube showed a tendency at times to go into self-oscillation. In order to remedy some of these troubles, all leads were made as short as possible, particularly the cathode connection to ground. The screen voltage was taken directly from a bleeder resistor in the oscillator power supply and was, at all times, kept below 275 volts. Any voltage above this caused the screen to run red, and in this condition the crystal would not start oscillating. Maintenance of the proper screen voltage remedied the tendency to go into self-oscillation and results were fairly consistent. However, the crystal current was still above rated values. The only safe bet with this tube is to reduce the plate voltage to 350 and screen voltage to 200 volts, using a cathode resistor of 250 ohms and a grid resistor of 10,000 ohms. Under these conditions, an output of 16 to 18 watts may be expected with either 7- or 14-Mc. crystals. Because of the greater thickness of 3.5- and 1.75-Mc. crystals, the crystal current did not exceed rated values even with the higher voltages on these lower frequencies.

If a metal-type tube is used, something can be (Continued on page 66)
Amateur Applications of the Static-Type Velocity Microphone

Automatic Low-Frequency Restriction on Close Talking; Experimental Feedback Control Circuits

By Paul von Kunits*

The amateur searching among the family of receiving tubes available today is apt to hold his head in his hands and long for the good old days when the 201-A was about all there was. Nevertheless, he is glad to find the tube which exactly fits his needs. He is coming to be faced with the same situation when he sets out to choose a microphone. There are available the single- and double-button carbon, condenser, dynamic, non-directional dynamic, magnetic velocity type in high- and low-impedance, the crystal sound cell, and crystal diaphragm type microphones. Now we have another member added to this family: a velocity microphone employing a static instead of a magnetic field and with many distinct characteristics of its own. The new type is known as the "Velotron." This microphone shows much promise in its application to the ham field and there is a great deal of experimental work to be done with it in this direction.

In the magnetic type velocity microphone a ribbon is suspended between the poles of a magnetic system. When speech energy causes the ribbon to move it cuts the magnetic lines of force and thus a voltage corresponding to its movement is induced in it. Since the ribbon has an extremely low impedance, it works into an immediately adjacent step-up matching transformer, the secondary of which may be of whatever impedance it is desired to have.

In the static velocity microphone there is neither magnetic field nor transformer. A number of ribbons, rather than a single ribbon conductor, are rather loosely laid across a perforated and totally insulated conducting back plate in such a manner that certain parts of each ribbon are free to move. A voltage difference is maintained between the ribbons and back plate, by means of the d.c. supply circuit as shown in Fig. 1. When the ribbons move they alter the capacity between themselves and the back plate, varying the charging current through the resistor and causing a voltage drop across it which is proportional to their movement. Their movement is proportional to the velocity component of the sound input. Hence, the voltage across the resistance will be an electrical translation (of the speech) which may be applied to the grid of any tube at the output of the microphone. It may be noted that whereas in a dynamic or magnetic type velocity microphone the only energy available in the circuit is the actual energy of speech, in this case the microphone is acting as a valve which controls the energy available from the d.c. supply. Therefore, it is possible to get considerably greater electrical output from the device than there would be if it were a direct translator of the incoming acoustic energy into electrical energy. The output level is at present on the order of –45 db.

The static type is a true velocity microphone having the typical characteristics of high directivity and uniform frequency response. In a velocity microphone it is necessary that the sound waves be allowed free passage through the unit; thus, if the back of the microphone is closed off the output is very materially affected. The unit is responsive on two sides in the familiar "figure-eight" pattern of the velocity microphone, but has a slightly wider angle of response than most velocity types and a very sharp cut off beyond this point. It may be brought out here that in a true velocity microphone the frequency characteristic of the output does not change materially with the angle of incidence of the sound to its face as it does in a pressure type using a diaphragm. This makes its use less critical in ham

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work, since it is not necessary for the sound to hit the microphone directly or at any special angle in order to retain high-fidelity characteristics. Its highly directional response makes it very applicable to use in noisy locations, since sounds approaching from either side of the microphone are not effective. Such a response pattern is almost essential in public address work where the "dead" sides of the microphone may be placed towards the loud speakers in order to minimize acoustic feedback.

AUTOMATIC LOW-FREQUENCY RESTRICTION

The ordinary ribbon microphone suffers from one difficulty in that it cannot be used for close talking without an unnaturally great increase in the low-frequency output. This may take place when the source of sound approaches nearer than 3 feet from the unit. Thus when a person speaks too closely to a typical ribbon microphone, the low frequencies are brought up to such an extent above the highs that the output becomes "boomy." Manufacturers faced with this problem in p.a. work have resorted to greatly reducing the low-frequency response of the microphone purposely. Thus when the speaker "climbs" into the unit the output is still passably clear because the unnatural reinforcing of the low frequencies which results from the pressure component of the sound, makes up for the deliberately curtailed low-frequency response of the microphone itself. The Velotron is able to overcome this difficulty because it has an adjustable frequency characteristic, the behavior of which is very peculiar and rather interesting. At low-polarizing voltages of approximately from 50 to 150 volts, the ribbons are barely attracted by the static pull between themselves and the back plate, and thus are very free to move even at the relatively great amplitudes required by the low-frequency components of the sound. In other words, the movement of the ribbons is unrestricted; therefore, the microphone behaves as a true velocity microphone having a frequency response extending from lower than 20 cycles to higher than 14,000 cycles. (There is no transformer to affect the fidelity of the output of the ribbon.) But if, under these conditions, the microphone is used for close talking, it will give an unnaturally exaggerated low-frequency response. However, if the polarizing voltage is increased the ribbons are attracted with some force to the back plate at predetermined raised points which break them up into a number of smaller ribbons whose amplitude of movement is restricted at the low frequencies. Therefore, the low-frequency output of the microphone cannot be driven above a certain point. Thus on close talking a natural output is obtained without sacrifice of normality in output when the same microphone is used for relatively weak sound inputs. It is important to note that this is a restriction on maximum low-frequency output and that the restriction does not occur until such a maximum has been obtained. The effect to the ear is as if the high-frequency output had been raised. If the polarizing voltage is further increased the restriction becomes such that there is an actual increase of the high-frequency output over that of the low end of the scale. It might be remarked that as the polarizing voltage is increased the output of the microphone is also increased because of the greater electronic charge accumulated between the ribbons and back plate. In normal operation,
a voltage of from 200 to 300 volts is recommended and voltages as high as 400 volts may be used.

The action of the microphone with close talking is of great importance to the amateur because the usual practice is to minimize the number of audio stages, making it necessary to speak relatively close to the microphone in order to get sufficient output for modulation; and it seems to be a perverse human habit (probably fostered by the

FIG. 3—ILLUSTRATING THE METHOD OF USING THE VELOTRON IN AN AUDIO-FREQUENCY FEED-BACK CIRCUIT, BETWEEN THE OUTPUT AND INPUT OF A SPEECH AMPLIFIER

use of the telephone) to "climb" into a microphone and yell, a procedure which in these days is certainly far from necessary. It has been shown by the Bell Telephone Laboratories that roughly 90% of the energy in speech occurs at frequencies below 500 cycles and that roughly 90% of the intelligibility of speech is carried by the frequencies above 500 cycles. Therefore, when modulating a transmitter, the high-amplitude swings are brought about by the low frequencies and the swings caused by the high-frequency components are quite small. If a microphone on close talking gives an abnormally great low-frequency output, the high frequencies which carry the intelligence of the speech may be considered as proportionately reduced. Therefore, with 100% modulation as our limit the effectiveness of the transmission is cut down below what it would be if the low frequencies were not unduly accentuated because it is these low frequencies which are swinging the r.f. output to its maximum amplitude — which automatically limits the permissible swing for the lower-energy high frequencies. If under these conditions we substitute a microphone having a normal or slightly less than normal low-frequency response, the proportionate difference between the low-amplitude high-frequency swings and the high-amplitude low-frequency swings will be greatly reduced. Since our maximum energy is limited, we have thus increased the energy available in the high frequencies which, after all, are doing the principal work in carrying the intelligence.

The restriction of the possible low-frequency output is also of great help in avoiding over-modulation as the distance between the speaker and the microphone is varied. Suppose yourself to be talking into the microphone at a distance of three inches and producing 100% modulation. You relinquish the microphone to your friend who talks at the same voice level but decreases the distance between himself and the microphone by one inch. In a microphone having unrestricted low-frequency output, the low-frequency energy reaching the microphone thereby could be increased, and might cause over-modulation — which immediately calls down all the curses of the fellows on adjacent frequencies. However, with restricted low-frequency output this would not occur, presuming that the limit of low-frequency response has already been reached in the first instance. Before leaving the subject, it might be noted that the velocity microphone is not the only type to suffer abuse through close talking, since in the diaphragm-type microphone this practice may result in acoustic pressure-doubling on the diaphragm and severe harmonic distortion.

THE INPUT CIRCUIT

In Fig. 1 is shown the standard Velotron circuit. The values of resistance and capacity given are not in the least critical. For maximum output and best frequency response, high values of coupling resistance should be used, although a change from a 10-megohm to a 5-megohm resistance will be hardly noticeable, and change from a 5-megohm to a 1-megohm resistance will cause only a minor reduction in output. In figuring the effect on frequency response of the coupling resistances and the coupling condenser, the circuit may be thought of as a normal resistance-coupled amplifier with the high impedance of the microphone substituted for the plate impedance of a tube.

The microphone has no current drain and, therefore, the polarizing voltage can be very easily filtered. The purpose of \( R_2 \) and \( C_2 \) in the diagram is to accomplish this filtering of the voltage. With the values shown, the filtering is so effective that it is often possible to take the polarizing voltage for the microphone directly from the output of the rectifier of the amplifier with which it is being used. Lower values of resistance and capacity may be used with decrease in efficiency of the filter circuit. The values are not critical.

It is important that the filter condenser used be a good paper condenser and that the coupling condenser be a good mica condenser. Leakage in these circuits resulting from faulty condensers will cause very noisy operation. The quality of the low-capacity cable used is also of great importance, since the microphone has a high impedance. With a good low-capacity cable, it is possible to run a 500-foot length between the microphone and its associated amplifier without a very noticeable loss in high-frequency response, although the overall output of the microphone is

(Continued on page 88)
How Would You Do It?
Announcing the Second in the Series of Prize Practical Problems

IF SOLUTIONS and would-be solutions to the first problem of our problem contest continue to arrive at the present rate, the editorial staff will have to quit producing a magazine and devote all of its time to a study of the material. We always thought the ham really got geared up the moment he had a problem to battle with. Now we know it. Maybe the first problem looked too easy. Perhaps the response to number two of the series will not be as heavy. In any case, we are in for a tough job picking winning solutions from the first batch. They will be announced, however, in March QST.

And now, gang, the second in the series, with the lurid details given in the adjoining column. And here is the dope on the rules and prizes, repeated for the benefit of those who may have missed the last issue:
1. Solutions must be mailed to reach West Hartford before the 20th of the publication month of the issue in which the problem has appeared. (For instance, solutions of problem given in the February issue must arrive at QST before February 20th.) They must be addressed to the Problem Contest Editor, QST, West Hartford, Conn.
2. Manuscripts must not be longer than 1000 words, written in ink or typewritten, with double spacing, on one side of the sheet. Diagrams and sketches may be in pencil, but must be neat and legible.
3. All solutions submitted become the property of QST, available for publication in the magazine.
4. The editors of QST will serve as judges. Their decision will be final.

Prizes of $5 worth of A.R.R.L. station supplies or publications will be given to the author of the solution considered best each month, $2.50 worth of supplies to the author of the solution adjudged second best. The winners have the privilege, of course, of stating the supplies preferred.

--R. A. H.

Problem No. 2

OUR hero, feeling certain that a good solution to his receiver protection problem will be forthcoming, has decided to build a new push-pull final amplifier. It must have, as its main feature, front-of-panel band switching, preferably operating with a single knob although two are permissible. He does not intend to switch to any predetermined frequency in each band but merely to shift the tuned circuits to any of three bands, then tuning to the exact frequency by means of the usual tank condenser. The amplifier will have a tuned grid circuit, transmission line coupled to the driver and a transmission line from the output circuit to the antenna tuner.

Our friend is anxious to reduce harmonic radiation to a minimum and insists that the transmission lines must be coupled to a low-potential point on each tank. The transmission lines may be coupled either inductively or tapped across the tank coils, but balance must be kept with respect to the center of the tank. Further, he insists that the band switching must be accomplished without introducing undue losses in the switching system. Hence if sections of the tank coils are shorted the shorting must be done at the center of the coils where the r.f. potential is lowest.

The method must be simple, easy to build, and must use the smallest possible number of switches. The obvious method, using eight switches, is, he thinks, too expensive and too complicated mechanically. He is willing to make special switches if they are easy and cheap to build. The amplifier is to use triodes and it is imperative that the neutralizing be undisturbed by band changing. The system must be capable of carrying at least 500 watts of r.f. power and the transmission lines must be insulated from the grid and plate d.c. Lastly, the amplifier must not take up a great deal more room than one with plug-in coils and, since it is a panel job, must be arranged to fit a relay rack.

Our pal is hoping for some really hot idea. It is his personal problem but he realizes that it is a very general and a very important one.

Silent Keys

It is with deep regret that we record the passing of these amateurs:
John W. Greig, Dayton, Ohio.
George J. Holt, W7EJO, Portland, Ore.
Franklin Huzzard, W3FNB, York, Pa.
Howard C. Maus, W6KOA, Ganado, Ariz.
Th. Wilmink, PA9TW, Groningen, Netherlands.

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QST for
Pi Harmonics

When is a pi-network not a low-pass filter? Well, one answer is, "when it is designed to be a high-pass filter"; and another is, "when it is designed to look like a low-pass filter but transmits harmonics away up and beyond its supposed cut-off frequency." In other words, low-pass pi on paper in a schematic diagram doesn't necessarily stay low-pass when something other than the intended termination is tied onto the network coupling a transmitter to its antenna. Dr. Ray Woodward, W1BAO, tells the interesting and illuminating story in his article on spurious harmonic radiation elsewhere in this issue. "Doe" works days researching on noise-silencing for typewriter tapping and such things in Underwood Elliott Fisher Company's laboratory, (he's a doctor of the scientific variety, not medico), and uses his home time in constructive efforts to silence some of the spurious emanations of ham transmitters. Don't pass up his article. It may save you a pink ticket.

Hi Efficiency

Amateur radio is full of "hi" these days; high power, selectivity, directivity, from C to Z. High efficiency has become something of a fetish, and anything contributing to its attainment is of high interest to all of us. One such thing is the high-efficiency linear amplifier for "phone, developed in the Bell Telephone Laboratories and presented by that organization's Mr. Doherty at the 1936 annual I.R.E. convention. Pre-convention release were instrumental in whetting everyone's thirst for more information. And the Doherty paper got more attention at its delivery than any other on the program. We followed it closely always with an eye to the ham angle, but must admit that we left the meeting with some misgivings as to the practical possibilities of the new circuit in amateur "phone transmitters. Undoubtedly it looked fine for high-power (50-kw. and up) broadcasting on the medium frequencies. A big saving on the power bill, as compared to the operating cost of a conventional Class-B linear of equivalent output, meant money in the pocket to station operators who must think in terms of revenue per hour versus kilowatt hours. The fact that the installed tube capacity must be practically the same as the peak power capacity in a Class-B linear of the same carrier output was not, apparently, a factor of major importance to broadcasting people. But what of the amateur point of view? Wasn't tube first cost of major moment to us, and power consumption, even with our 1-kw. maximum final input, a secondary matter? The obvious advantage of obtaining twice the carrier power output (600 watts) that could be obtained with low-level modulation and conventional Class-B linear amplification, with maximum input restricted to 1 kw., seemed to be its real justification in our field. Against this there stood considerable circuit complication, and no specific information concerning the feasibility of the new amplifier for frequencies higher than the broadcast band. Would it work at all for us? Well, it will work—has been made to work, in fact—at amateur 75-meter "phone frequency. W9AHH gives the details, and an excellent explanation of the principles involved, in his article elsewhere in this issue. As he says, the job isn't one for a beginner to cut his teeth on. Even though it may develop that the high-efficiency linear will not attain immediate adoption and cannot overcome the competition of plate-modulated Class-C systems in our field, every progressive amateur must give it consideration and know something about its operation. It is not too much to hope that from it we may realize simpler modifications of wide utility and equal performance. This is a serious article deserving the serious consideration and study of advanced amateurs.

Tuning DX

When most of us think of DX success, we visualize a 1-kw. rig working at almost the smoking point in one corner of the shack, permanently parked on a "good" frequency on 40 or 20. Not all of us, however. Take Charlie Perrine, sleepless wonder at W6CUH. Certainly, Charlie likes his high power, diamond antennas and Squeezed-Selectivity receivers. But, he insists, that isn't all. You can't work them with all the power in the world if your frequency isn't right where they are tuning. So he adds another prerequisite for successful DX working—the kind that measures results in contacts per hour, not hours per contact. It's frequency flexibility in the transmitter, and desired convenient operating flexibility at that. It may take more effort to build it into the transmitter than most of us would make without urging. But look at all the operating effort we'd have to spend plugging in and out coils, retuning tanks and tipping over chairs if we tried to get the same results without having it built into the rig to start with. He tells all in his article starting in this issue.

—J. J. L.
HINTS and KINKS for the Experimenter

Output Coupling Method

The output coupling of Fig. 1, suitable for working into an antenna or feeder system or into any type of load for a power tube (dummy antenna for testing, or feeding the grid of a following stage, etc.) is suggested by Walter Van B. Roberts, W3CHO. Outlined below are his adjustment procedure and a résumé of the advantages of the arrangement. To adjust:

1. Reduce $M$ (the mutual coupling between the plate tank coil, $L_1$, and pickup coil, $L_3$) to a negligible value and adjust $C$, the amplifier tank condenser, for minimum plate current.

2. With $Z$ (any impedance such as that represented by antenna or feeders, a following tube grid circuit, etc.) disconnected and $M$ very small, tune $A$, the secondary variable condenser, to resonance, as evidenced by a slight increase in plate current.

3. With $Z$ connected across a small part of the secondary inductance, retune $A$ to cause an increase in plate current. Connecting $Z$ increases the effective resistance of the secondary so that $M$ may have to be increased to obtain a noticeable increase in plate current as $A$ is varied to retune the secondary circuit (which now includes the effective reactance introduced by $Z$).

4. Connect $Z$ across more of the secondary and retune. Continue this process until $Z$ is across the whole coil or across so much of it that the circuit can just be tuned comfortably by $A$.

5. Finally, increase $M$ until rated plate current is drawn and make a final readjustment of $C$ to be sure the plate current is minimum with respect to the setting of $C$. If at maximum $M$ the plate current is still too low, it may be brought to normal value by bringing the taps for $Z$ on $L_2$ closer together. The preferable method, however, is to increase $M$, either by closer physical coupling between $L_3$ and $L_1$ or adding a turn or so to $L_3$.

The reason for the fourth step in the outline above is to reduce the circulating current in the secondary. If there were no resistance in the secondary circuit except that introduced by $Z$, it would not matter where the taps were placed so long as the secondary could be tuned by $A$.

The system has the following desirable features:

1. It will match a wide range of complex impedances to the optimum tube plate load resistance; that is, it permits using nearly any sort of load for $Z$.

2. The antenna and matching network are isolated from the high-voltage d.c. without requiring expensive blocking condensers.

3. It works equally well from a single-ended tank to a balanced load or vice versa, or from balanced tubes to balanced load or single-ended stage to unbalanced load. A small amount of incidental capacity coupling between tank and secondary is not objectionable since it merely increases or decreases the effective $M$ slightly.

4. It requires only one condenser in addition to the regular tank condenser.

5. Since the secondary is tuned to give maximum plate current, any accident to the antenna (short circuit or the like) which detunes the secondary causes the plate current to drop rather than increase, as can happen in some arrangements. This protects the tubes.

6. The adjustments are substantially independent rather than interlocking—as in the low-pass filter type of impedance-matching network, for example. Thus it is easier to understand and carry out the adjustments.

The only drawback to the system is the variable mutual coupling. At W3CHO, the coil $L_3$ consists of two turns of heavy wire mounted on a hinged block of bakelite, the hinges acting as connections to the rest of the circuit. The same coil is used for 20-, 75- and 160-meter operation. The diameter of the turns is large enough to allow them to swing off the tank coil (a 1½-inch diameter plug-in form) for very loose coupling. With larger-diameter tanks the coupling coil could be slid inside. In push-pull circuits, for complete symmetry the tank coil could be split into two parts, with $L_3$ a spider-web type coil slid or hinged into the slot between the two halves of the tank coil.

Regarding circuit constants, the prime requisite is that the secondary should be tunable to the...
transmitter frequency. A 100-µfd condenser should suffice for practically all bands at A, and the inductance of the coil $L_a$ should be chosen so that the unloaded resonance setting of $A$ does not fall too near either minimum or maximum capacity. This will give some leeway in adjustment as the load is increased and thus permit compensating for the reactance, if any, introduced by the load. With a purely resistive load, the setting of $A$ should be practically the same either loaded or unloaded, provided the loading is not carried beyond the optimum point.

**Meter Switching**

The circuit of Fig. 2 shows a meter switching arrangement used by Ted Hansen, W9IX, for shifting a milliammeter to any one of three circuits. A three-pole, three-gang switch does the job. The meter is connected in the cathode circuit of each tube, the extra gangs being needed to complete the cathode circuits of the unmetered tubes.

In common with all circuits in which the meter is in the cathode circuit, in this arrangement the current reading is that of the total tube space current. With triodes, the sum of grid and plate currents is read; with screen-grid tubes, the screen current also registers simultaneously with the grid and plate currents.

**Tuning Indicator**

Those who have low-range d.c. milliammeters but lack r.f. ammeters will find this kink, contributed by Norman Bush, VE3KW, of interest. It uses the aforesaid d.c. meter in combination with a tube and a few spare parts to provide comparative indications of r.f. flowing in feeders.

The circuit diagram is given in Fig. 3. Note that the filament of the tube (any type which will work on fairly low filament current) is clipped across a short length of feeder. The rectified current, therefore, depends to a considerable extent on the filament temperature as well as upon the difference in r.f. potential between one end of the filament and the diode element consisting of grid and plate tied together. The chokes and by-pass are for the purpose of keeping r.f. out of the meter; VE3KW also found the resistors indicated to be necessary to prevent overheating of the chokes. The arrangement has worked out to be quite sensitive indicating instrument for tuning purposes.

The most pronounced change in meter reading for a small change in feeder current will occur when the filament is somewhat below normal operating temperature. The spread between the clips attaching to the feeder should preferably be such that the maximum current will cause the filament to come up to approximately normal temperature. Naturally, the spread will depend upon the type of tube used and the magnitude of the feeder current, and must be determined by experiment.

**Another Use for the Auto Transformer**

Probably a good many of our readers, especially those troubled with poor line voltage regulation, will recall the article on using an auto-transformer for matching up filament voltages and compensating for line-voltage changes.1 We now have a letter from W4IS in which he describes another use to which he put the same auto-transformer. Here it is:

"I wanted sufficient bias to key the transmitter (the oscillator and buffer are simultaneously keyed) with complete blocking of the final and preceding amplifier when the key was raised. Now the 805 final draws some 40-80 mils grid current and therefore calls for a supply of good regulation. About 60 volts or maybe as much as 80 volts with full plate voltage is needed to cut off the 805. Additional bias for Class-O 'phone operation was needed and is readily obtained with a grid leak. That is to say I employ combination bias, but it was requisite that the 'C' supply be sufficient completely to block the

---

1 Blitch, "An Improved Method of Voltage Control," QST, August, 1936.
805 (and 804 driver). Now the very first obstacle was the proper transformer to supply this bias. It was evident that a heavy 'C' supply using a heavy-duty receiver transformer would be all line only, the meter would not read as the return circuit would be through the earth. Under these circumstances, the voltage would be low unless both grounds were low resistance contacts to earth. Most power company services, today, are three-wire and designed to forestall such theft of current.

The diagram of the 'C' supply used by W4IS is given in Fig. 4. A 5-volt transformer of course is necessary to supply the filament of the 83. Enough b.c.-type filter chokes are used in parallel to carry the current safely; this current should be between 125 and 150 ma. with the 1000-ohm bleeder resistor. The voltage input to the filter can be adjusted over a rather wide range by selecting suitable taps on the auto-transformer.

The Two-Tube Receiver on Ten Meters

ANTENNA coupling to a regenerative detector on 28 Mc. can be quite critical, as many users of such receivers have found out. A suggestion from Adolfo Dominguez, Jr., CM2AD, should be of help. Using the two-tube receiver described in June, 1934, QST, and in the Handbook, he had difficulty in making the detector oscillate with an antenna connected, although the set functioned normally without the antenna. The cure was to connect a 50-µfd. variable in the antenna lead, as close to the antenna post on the set as possible. Adjustment of the condenser will result in a setting which will give good coupling and strong signals with the detector in a satisfactory oscillating condition. It was found necessary, however, to have the condenser right at the antenna post—connecting it in the antenna lead even but two feet away from the set brought on the same trouble again, evidently because the short length of wire loaded the detector so heavily that it could not oscillate.

A Modified Crystal Oscillator Circuit

THE crystal oscillator circuit used in conjunction with pentode tubes often requires the use of a feed-back condenser from plate to control grid, particularly at the lower radio frequencies, for stable oscillations. In certain tubes such as the 802, which has the grid pin on the base and the plate clip at the top of the glass envelope, this requires a rather messy mechanical construction.
Further, the optimum feedback coupling capacitance is quite definite; too low feedback lowers the tube output and too large a feedback unduly strains the crystal.

In the circuit shown in Fig. 5, these objections have been overcome. The suppressor-grid is connected directly to the control grid, the suppressor-to-plate capacitance acting as the feedback condenser. This eliminates the feedback condenser and simplifies mechanical layouts. A further function of the suppressor grid, however, is to limit the amplitude of oscillation: strong crystal oscillations imply a large negative bias on the suppressor-grid as well as on the control grid, thus tending to reduce the tube transconductance and gain, and lowering the amplitude of oscillations until an equilibrium position is obtained.

The constants shown in Fig. 1 are quite satisfactory at 1650 kc. and the oscillator provides more than sufficient excitation to a pair of RCA 802 tubes in parallel as suppressor-grid modulated class C r.f. amplifiers.

—P. M. Honnell, W2AFA, ex-5KG

Operating Notes on Power Crystal Oscillators

(Continued from page 46)

done about overloading these higher-frequency crystals. Practically all available information about this tube suggested that the metal shell be left floating. When this is done, the tube performs exactly like the glass tube. However, by connecting the shell to cathode, at the socket, the effective feedback to the crystal is greatly reduced and the crystal current is cut almost in half. Using the circuit as shown in Fig. 5, the crystal current with both 14- and 7-Mc. crystals was reduced by more than 50% over what it was when the shield was floating. Apparently the fact that the shield when floating was at a high r.f. potential, caused excessive feedback to the crystal. At the same time that this reduction in crystal current was obtained, the output remained practically the same, the crystal was still oscillating strongly enough to drive the tube, and there was no increase in plate current. In other words, the efficiency remained the same as in the floating condition. When used in this manner, 250 volts may be applied to the screen and 400 volts to the plate without danger to the crystal. In fact it was necessary to increase the grid resistor to 20,000 ohms, in addition to the cathode bias, in order to key the crystal rapidly. It was also possible when using the tube in this manner to remove the load from the oscillator without having the crystal current go above rated values.

The curves in Fig. 6 show the performance of the tube under the two conditions, shell grounded and floating, as the plate tank is tuned through resonance. These curves were taken with a 7-Mc. crystal and the circuit constants as shown in Fig. 5. Notice the marked decrease in crystal current

(Continued on page 115)

Transatlantic 56-Mc. Reception Reported

The following cable was received at Headquarters on January 10th:

MY FIVE METER SIGNALS RECEIVED BY W2HXD DECEMBER TWENTY-SEVENTH HIS REPORT CHECKS EXACTLY PARTICULARS FOLLOWING

(Sig.) CHEFFERNAN G5BY

The news, naturally, comes under the head of genuinely hot stuff. We put it in the record along with the reported reception by Cecil Mellanby, N. Wales, of W2JCY (on May 10 and November 1, 1936) and of W2IIQ (on September 12, 1936). Strangely enough, while the Mellanby reports are of reception over an all-darkness path, the reported W2HXD work was done with an all-lightday condition prevailing.

The indications all point toward the early accomplishment of the first two-way Transatlantic 56-Mc. band working in history. Who is to be first?

FIG. 7—CIRCUIT OF THE HIGH-POWER TRIODE TESTS

FIG. 7—HIGH POWER TRIODE CRYSTAL OSCILLATOR DATA

<table>
<thead>
<tr>
<th>Tube</th>
<th>Plate Voltage</th>
<th>Frequency</th>
<th>Crystal R.F. Current, Loaded</th>
<th>Normal Rated Crystal Current</th>
<th>Output Watts</th>
</tr>
</thead>
<tbody>
<tr>
<td>35T</td>
<td>1000</td>
<td>3.5 Mc.</td>
<td>40 ma.</td>
<td>100 ma.</td>
<td>40</td>
</tr>
<tr>
<td>357</td>
<td>1000</td>
<td>7</td>
<td>100</td>
<td>100</td>
<td>38</td>
</tr>
<tr>
<td>357</td>
<td>1000</td>
<td>14</td>
<td>150</td>
<td>150</td>
<td>35</td>
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<tr>
<td>350</td>
<td>720</td>
<td>3.8</td>
<td>50</td>
<td>150</td>
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</tr>
<tr>
<td>800</td>
<td>750</td>
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<td>170</td>
<td>150</td>
<td>30</td>
</tr>
<tr>
<td>808</td>
<td>1000</td>
<td>3.5</td>
<td>50</td>
<td>100</td>
<td>45</td>
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<td>14</td>
<td>160</td>
<td>150</td>
<td>39</td>
</tr>
</tbody>
</table>

February, 1937 55
Devoted to the interests and activities of the

INTERNATIONAL AMATEUR RADIO UNION

Headquarters Society: THE AMERICAN RADIO RELAY LEAGUE, West Hartford, Conn.

CALENDAR:

The December, 1936, issue of the I.A.R.U. Calendar, the bi-annual medium through which I.A.R.U. business is transacted, proposals formulated, presented, and voted upon, has, at the time of writing, just been completed. Known as Calendar No. 18, it contains items of general interest to amateurs everywhere, and will therefore be reviewed briefly.

The Union continues its march of progress. During the year its membership has increased, both in terms of member-societies and the number of individual amateurs represented by these societies. Its influence and prestige have also increased, through the filing of advanced technical studies in connection with the Bucarest C.I.R., through the representations of member-societies to their governments in connection with Bucarest (notably by the R.E.F.) and Cairo matters, as well as by recording in international bureaus and lists and in other less important ways.

One of the notable accomplishments by a member-society during the year has been the securing after years of struggle of governmental legislative recognition for amateur radio in Colombia by the L.C.R.A. (see December, 1936, I.A.R.U. News). In other countries modifications of the regulations have been secured, in some instances tending to liberalize existing restrictions, in others imposing new requirements necessitated by growth and changing technique. For the most part, the fight of amateur radio to secure adequate legislative recognition has been successfully waged; the alternative objective of securing adequate administration and control is now foremost in many countries.

During the year two new member-societies were admitted to membership: the R.C.V. (Venezuela) and the M.R.A.O.E. (Hungary), bringing the total to 28. Both of these societies have already displayed a commendable initiative with regard to Union affairs, and constitute valuable additions.

Among the suggestions of the past year was QST for...
that of the D.A.S.D. in which they voiced the opinion that a “Contest Calendar” would be of great help, in view of the fact that an increasing number of member-societies are conducting international contests, and a calendar would avoid any possible conflicting of dates such as took place last year. The Contest Calendar would also include the rules of the various DX awards (WAC, WAS, WBE, DSM, HBE, etc.), and all in all should prove useful as a clearing-house for competitive work of all kinds. The headquarters society has formulated the Contest Calendar, and it is urged that all societies contemplating international contests of any sort, as well as special awards, inform the headquarters society well in advance so that the information can be included in the next Calendar.

Clarification of the QSL-forwarding problem was achieved through Proposal No. 27, adopted, which states that “each member-society shall cease all forwarding of QSL cards to non-member societies in countries where there exists a member-society.”

Other matters discussed were planned use of the 7-Mc. band, Cairo preparation, and the serious problem created by amateur interference to the transatlantic telephone service by off-frequency operation.

Germany:

A new series of D.A.S.D. broadcasts, designed particularly for amateurs, will start shortly, according to a letter received from Wolf Franzok, D4GZF. The first regular transmission will be as follows:

Zone 2 (East Asia) February 20, 1315 GT
Zone 3 (Africa) February 19, 2015 GT
Zone 4, 5, 6 (South America, North America, Central America) Feb. 19, 2200 GT (5 P.M. EST.)

The transmissions will be from DJD, 11,770 kc. and DJC, 6020 kc. Reports on the broadcast will be appreciated.

F. W. Behn of the D.A.S.D. reports that QST has been included in the list of eligible printing matter issued by the German postal authorities, and may therefore be ordered direct by simply going to the nearest postoffice and placing the order at the current rate of exchange. This obviates the general restriction against the importation of goods from abroad into Germany insofar as QST is concerned, and should be a useful privilege for the D’s.

Spain:

The news from Spain this month is from Ray Farwell, W2BJ, who says that ON4EF told him that EA1AN, EA1AR, EA1BE and EA1BF had all been killed in the war.

South Africa:

Excerpts from a letter from R. C. H. Taylor, secretary of the S.A.R.R.L.: “The Ross Kent DX Trophy which is awarded annually to the S.A.R.R.L. member obtaining the highest score in the B.E.R.U. Contest, has gone this year to Mr. L. R. Arnott, ZEIJO. The C & B Trophy, awarded for the most meritorious feat of the year, goes to Mr. Shoyer, ZS11H, for his extremely fine work on ten meters. Mr. Shoyer has established an enviable international reputation, and the award is a particularly happy one.

“The Annual Conference of the League was held in Johannesburg during October, Mr. Joseph White presiding. Members scattered throughout the Union attended for the double purpose of meeting old friends and visiting the Empire Exhibition. The most outstanding feature of Conference was the falling into line with other societies on the part of the S.A.R.R.L., in that the work of the League is now being carried by paid part-time Secretaries.

Continued on page 70
A new record! On the morning of December 30th, six stations got together on 14-Mc. phone for a round-table all-continent rag chew, to the tune of all continents worked in 21 minutes. The stations in the QSO were W4DLH, SU1CH, G5ML, VK4LO, HK1Z and VU2CQ. These stations have worked toward this objective for some time. On December 15th W4DLH WACed in four hours 47 minutes, working VK2ACO VU2CQ SU1CH G8CL W1ARC and HK1GK. On the morning of the 30th this was done in 36 minutes. See additional details concerning Official Phone Station W4DLH, elsewhere in this issue. What next?

Broadcast listener interference complaints and amateur requests for information on elimination of such interference receive prompt attention at A.R.R.L. Headquarters. Two different types of mimeographs available with suggestions on alleviation of interference have been combined into one, with the exhaustion of the supply of the older form and the very complete treatment of the subject now given in Chapter Ten of the Radio Amateur's Handbook.

Write for assistance if we can help. In any case do your part to keep down the number of complaints made to us and to the F.C.C. by thoroughly checking your own station and taking steps to stop complaints from individual listeners at their source—by canvassing them—and handling them efficiently as found necessary. Our interference mimeograph contains many general facts regarding interference suitable for study by our neighbor—B.C.L. The large number of possible sources of electrical noise difficulties is mentioned as well as an approach made to the subject of interference determination and elimination of "blanketing" due to proximity to amateur stations. Ask us for two or three of these one-page mimeographs to pass along to your particular listener neighbors who will most profit from the outline, if you like.

Our first duty to ourselves is to prevent complaints by cooperation and action. The F.C.C. handled 2842 complaints in twelve months covering the previous season, a number high enough to be dangerous to the general ham welfare. We also understand complaints are far too numerous in some districts this season. Something must be done. It is an individual responsibility. Every transmitter built should have as an integral part of it suitable key click suppressors and indicators to prevent modulation beyond the capabilities of the transmitter for linear response. Speaking of individual responsibility, making friends of listeners near your station is a desirable first step. Regardless of such responsibility as may be placed on B.C.L. receiving equipment, most listeners need certain misunderstandings and misapprehensions tactfully straightened out. Cooperation pays big dividends, and it is good to know that the folks next door are friendly and will work with you before running to outsiders in case of future difficulty. It is good for you, and it is good for amateur radio.

The New Year brought some B.C.L. complaints to our desk from different cities. We informed the hams concerned and made suggestions to all parties. We don't wish to discuss the cases, but we do wish to stress the importance of preventing the start of complaints at the source. We have seen legal trouble develop. It is easier than one thinks to get into, expensive to bear, important as can be, requires a record of "right" facts to win, can be avoided by care usually. Let every amateur ask himself—if his transmitter and monitoring equipment could stand searching inspection and analysis, thorough investigation by the F.C.C.,—if his log is a model for system, and is neat and complete, fulfilling government requirements. If produced in court would it be up to the standard set by F.C.C. regulations? Would it impress the court favorably or otherwise? Would your record of practical cooperation with listeners and other services stand full recital? We respectfully suggest that every amateur owes it to himself, and the fraternity a whole, to be fully and adequately covered on all these points.

In the course of a self-conducted inquiry regarding receiving conditions in your neighborhood you will often be able to pass along some radio information of interest—whether interference exists or not. Even if interference has been observed, a courteous approach and helpful attitude will pave the way to a mutually satisfactory relation. In stubborn low-frequency cases discretion may indicate a transfer of activities to higher frequency bands until time permits application of an adequate remedy. In any case where general
interference to modern receivers is noted the regulations require quiet hours. Voluntary exercise of discretion, observance of quiet periods, etc., is much better than official trouble, not only for you personally, but for the ham fraternity, and it is the best good of the whole we have in mind in penning these remarks. It is too often the case that when interference is cured by application and Handbook reading after official action on complaints, that the personal feelings aroused are slower to mend. Advance consideration avoids this part, and reduces that complaint total that is held against the amateur service as a growing threat. Is it not better to investigate, and know the facts, and avoid trouble and F.C.C. notices? It certainly is better to have our B.C.L.'s ring us on the 'phone when suspecting trouble than to go to airing and exaggerating interference stories to friends, local newspapers and service men—not to mention the Federal Communications Commission itself!

It is always much better to prevent trouble in advance, than to face the consequences of inattention to these matters. We have seen quiet hours officially required, and what should have been ordinary cases capable of technical solution flower into legal proceedings over the subject of interference. Let us avoid such things. Consider yourself the local ambassador of the whole amateur fraternity, charged with the responsibility of maintaining public good which is essential to you and all amateurs. The whole amateur service may be judged by your action and farseen-minded attitude. "An ounce of prevention is worth a pound of cure."

-F. E. H.

Code Practice

THE following additions have been made to the stations sending code practice on "100 meters": W2DSII (White Plains, N. Y.), 1777 kc., transmits code practice at 8:00 p.m. EST each Thursday. . . . W9RL (Hendon, Va.), 1971 kc., sends code lessons daily from 6:15 to 6:30 p.m. EST. . . . W9FTF and W9HUI (Springfield, Mo.), 1957, 5 kc., are cooperating in giving code practice each Tuesday from 6:30 to 7:30 p.m. CST. . . . W9RTE (Lincoln, Nebr.), 1803 kc., transmits code practice daily except Sunday at 8:00 p.m. CST. . . . A complete list of stations taking part in A.R.R.L.'s Program of Code Practice on 1715 kc., together with other code-learning helps, will be mailed to anyone requesting same by postal card to A.R.R.L., 28 Lafayette Road, West Hartford, Conn.

Stations Needed to Send Code Practice

Many new stations are needed to send code practice on the 1715-kc. band. With the code speed requirement now 13 w.p.m., beginners find the service of even greater assistance than in the past. Phone stations can perform this service well, since announcements may be made on voice, shifting to the key for actual code lessons. Any amateur working on "100 meters" who is willing to volunteer regular schedules of code practice is invited to drop a card to A.R.R.L. Headquarters. Please state the days and hours you would like to send code lessons, and list your exact frequency. Helpful hints on the work are furnished to all volunteers. What say, ham, will you help the newcomers master the code?

CORPS, p. 1.

Brazilian DX Contest

Major G. Vidal, PY1AT, Communication Manager LABRE, Society of Brazilian radio amateurs announces an LABRE-sponsored International DX Contest to be held from January 30th (10 p.m. EST) to February 13th (10 p.m. EST). The 3.5-, 7-, 14- and 28-Mc. bands will be used. Contacts must be by code (c.w.), scoring will be as follows: For each QSO on 7 Mc., 15 points; on 14 Mc., 30 points; on 28 Mc., 45 points; on 3.5 Mc., 35 points. Only one QSO with each station will count. The LABRE will issue a certificate award to the highest scorer in each country. Mail results to Liga de Amadores Brasileiros de Radio Emissao, Caixa Postal 2383, Rio de Janeiro, Brazil.

WIAW

ON FEBRUARY 17TH, at 6:00 p.m. EST, is scheduled the first use of an authorization by the F.C.C., assigning WIAW (in lieu of W1MK) to your A.R.R.L. Headquarters station. Some explanation seems due, with information on our current schedules. Last May your League's Board of Directors appropriated money for a new Headquarters station, building, and site, this to become an active memorial to the League's founder. Full progress on this station has been held up, pending a decision on location of the Headquarters, by the Board, which probably will not act on its committee reports until the May 1937 meeting. After the '36 floods, the old station site was abandoned. Many of the inundated W1MK units were torn apart, and reconstruction and building of new units has been progressing slowly. Operating for this season has been carried on from W1INF, the station of the Headquarters Radio Operators Club, On February 17th, with the new license and units completed to date, W1AW, temporarily located in the Eq. office building itself, will carry on as your station. W1INF will "QRX" operations in favor of W1AW until space again permits it to enjoy separate quarters.

It seems fitting that regular operation as W1AW be inaugurated on the date, and for the event, in which all amateurs honor and revere the memory of our founder, and his accomplishments for amateur radio. The call sign WIAW is a perpetual reminder to all amateurs of the identity of our founder, and a stimulus to us to aim at his ideals of A.R.R.L. service and radio operating perfection. The exceptional F.C.C. action changing our call to W1AW permits fullest realization of the desires of League members, expressed through their Board, for making their station a truly memorial-station.

WIAW addresses information to all amateurs on the following schedules:

Sunday 8:30 p.m. EST 15 w.p.m. 3825 7150 and 14,300 kc.
10:30 p.m. EST 25 w.p.m. 3825 7150 and 14,300 kc.
Monday 8:30 p.m. EST 20 w.p.m. 3575 7150 and 14,300 kc.
10:30 p.m. EST 15 w.p.m. 3575 7150 and 14,300 kc.
Tuesday 8:30 p.m. EST 15 w.p.m. 3575 7150 and 14,300 kc.
10:30 p.m. EST 15 w.p.m. 3575 7150 and 14,300 kc.
Wednesday 8:30 p.m. EST 15 w.p.m. 3575 7150 and 14,300 kc.
9:00 p.m. EST 20 w.p.m. 3825 7150 and 14,300 kc.
Thursday 8:30 p.m. EST 15 w.p.m. 3825 7150 and 14,300 kc.
10:30 p.m. EST 25 w.p.m. 3825 7150 and 14,300 kc.
10:30 p.m. EST 25 w.p.m. 3825 7150 and 14,300 kc.
Friday 8:30 p.m. EST 25 w.p.m. 3825 7150 and 14,300 kc.
10:30 p.m. EST 15 w.p.m. 3825 7150 and 14,300 kc.

Regular schedules are kept with W1INW, W1IP, W1AJH, W2DOX, W3BWT, W3JTT, W8KWA and W8CSE, and traffic connections exist with all A.R.R.L. Trunk Lines.

February, 1937 59
Join the Emergency Corps

A R.R.L.'s Emergency Corps now has a membership of 438. The A.E.C. is open to all amateurs and every amateur is urged to join as an individual, (1) Emergency Powered Stations, or (2) the Supporting Division. For membership in the first group it is necessary to possess equipment suitable for operation in an emergency when regular power facilities are disrupted. Auxiliary power must be on hand or must be obtainable from a reliable source upon a few minutes' notice. Membership in the Supporting Division is open to all amateurs who will pledge themselves to assist on hand or must be obtainable from a reliable source upon a few minutes' notice. Membership in the Supporting Division is open to all amateurs who will pledge themselves to assist in the event of failure of regular communication facilities as long as normal power is available. These amateurs do not have to have auxiliary power, although all members are urged to join the Emergency Powered group at the earliest opportunity.

To join the A.E.C. simply send a postal to the Communications Department, A.R.R.L. (or write for application blank), listing what equipment you have. Applicants for Emergency-Powered membership should list fully all emergency apparatus, especially auxiliary power facilities. An Emergency Manual now in the course of preparation will contain definite suggestions and rules relative to emergency work; this will be furnished free to all A.E.C. members. Send your application NOW!

ARTICLE CONTEST

The articles by Mr. G. H. Johnstone, W9CRU, and Eugene A. Hubbell, W9ERU, win C.D. article contest judged this month. Each merit the most interesting and valuable article received marked "for the C.D. contest." Contributions may be on any phase of amateur operating or communication activity (DX, phone, traffic, car-chewing clubs, experimentation, etc.) which adds constructively to amateur organization and equipment. The winning article will be published in the September QST. Winner and League Emblems, six logs, eight page pamphlet diagrams, DX Map and three pins, or any other combination of A.R.R.L. supplies of equivalent value. Try your luck. Send your contribution to-day!

"You Must Hear Them First"

By G. H. Johnstone, W9CRU

It is a known fact that a receiver is not one of high or low power in the sense that we rate transmitters. It is equally well known that the sickly 201-A putting out its under-nourished watt and a half at Gopher City, can be heard in Asia. If the Asiatic has a sensitive and selective enough receiver the above statement deserves thought by all hams. Why? We are constantly endeavoring to make our contacts more reliable, our trunk line skeeze as near fool proof as possible. To go back a bit—Schnell proposed a "high power holiday" which didn't seem to take hold very well. I think that the idea had merit. Am I suggesting another? Nay, brother, stuff that sky wire as full of healthy nourishing watts as your receiver is far wiser than the addition of a couple of hundred dollars on the O.M.'s light bill, let him pause and consider what follows.

You can't work 'em if you can't hear 'em. That is a sad truth. What avail a ham if he has the limit of the FCC regs, and a small, insensitive, non-selective inhaler? Will he hear that he is RST 599X in Magellan Straits? Not by Ohm's hear! He will get his report from some brasspounder about a thousand miles off as best. Then he will wonder, why don't I get out better. All I get in 8-9 reports, but no DX. When this condition exists, look to your receivers ye brethren of the glass arm.

Ah, but let us look at the other course that Johnny Ham could follow. He figures up the cost of the high-power stage, its cost of operation, and the effort and knowledge required to keep it out of the BCL's receivers. Cannot the same results be obtained some other way? Yes, brother, it can be done. Instead of building a high-power rig, insert in a really good receiver. The next time your aged 210 does a startling bit of DX, ask the op what his receiver is. You will usually find that it is an "SS," or at least a Super.

Getting the receiver will do two things for you—eliminate the "QRM" from existing low-power rigs, and give you greater opportunity for DX QSO's. It is surprising what a properly handled rig with 25 watts output will do, IF you can hear the ones that answer you. And don't forget, there are as many low powered foreigners as there are Hi-powered domestic rigs.

It is the opinion of the writer that the purchase of a good receiver is far wiser than the addition of a couple of hundred watts to the antenna, as the receiving range has not been increased in accordance with the transmitting range. Receivers can be purchased now from reliable houses on the deferred payment plan, so think it over, O.M.'s and see if it isn't so.

Pulling 'Em Thru

By Eugene A. Hubbell, W9ERU

A WELL-TRAINED pair of ears are the biggest advantage a ham can have, and the amount of interference necessary to make a message unreadable is astounding. All of us, however, know the exasperation of having QRM that completely wrecks communication, even though the crystal filtered superhetrodynes do wonders. Breakin reduces the time lost, but doesn't make it possible to get the message thru the QRM. So the final solution seems to be to shift the transmitter frequency.

A simple solution of this shifting would seem to be to two or three crystals ground to frequencies only a kilocycle or two apart. A small shift usually suffices to allow the receiving operator some adjustment where he can hear the signal distinctly, while any great change makes the new location hard to find, as well as making it necessary to retune the transmitter. A shift of a kilocycle or so will not produce any appreciable difference in tuning or output, and the shift can be accomplished in a few seconds. Remote control enthusiasts can manage with a relay switch designed to shift grid connections to the second crystal, while others can arrange a simple manual switch for a number of crystals all in the same vicinity.

Incidentally this removes the blinking feeling occasioned when the clock indicates schedule time and one realizes that crystal over to W's house the night before and forgot to bring it back, or dropped it while cleaning it, or some other one of the many accidents always liable to happen to the lose rock for that important frequency.

Good reliable crystals are now available at bargain prices, so all good traffic-handlers should lay in an extra rock for their traffic frequency, even the boys on the one-spo `net, since rarely do these single-frequency networks maintain any appreciable frequency, but rather operate within a narrow band. A single holder can be rigged up with a heavy metal plate, ground on both sides, for the grounded side of the circuit, and a crystal and top-plate put on each side of this, with three connections taken off. Not long ago I saw a commercial holder advertised with provisions for no less than six crystals, all in one holder, designed to plug in to a few prong socket.

A bit of doggerel may point the moral.

Johnny Ham, if very wise,
Fools the interfering guys.
Sends 40 watts and the beat.
Some crystal and two more.
Goes on sending merrily.

* Box 85, Milford, Kansas.

* 227 N. 4th St., Rockford, Ill.

QST for
Briefs

On December 24, Wayne University of Detroit and Carnegie Tech at Pittsburgh played chess via amateur radio. Two games were started at 7:30 P.M. in Wayne U., winning the first at 10:30 P.M. The second game was finally called off, to be played later, when the clock got around to 2:30 A.M. without an ending. W8UGT sent the plays for Carnegie and W8QGF, with W8CEZ at the key most of the evening, handled the plays for Wayne.

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Marine Corps League Convention

An amateur radio station was installed and operated under the call W1GEK at the National Convention of the Marine Corps League held at the Parker House, Boston, Mass., in August, 1936. The Parkway Radio Association was in charge of the installation. Operators were W1GEX, W1OBK and W11XL. The station went on the air August 4th although real activity didn't start until the 17th. When greetings were transmitted to all Marine Corps Leagues throughout the country. About 60 messages were handled, all but two being originated. 25% of this traffic was handled on 8-Mc., “phone, and thanks are due W2GEE and W2LII for assisting in this. The remainder of the traffic was moved on 3.5 and 7-Mc., c.w. A deep interest was shown by those who visited the station and amateur radio received a definite boost.

---

W8PLA was QSO W8PWU early one morning and discussing their equipment. PLA uses 250 watts input to a 20-Mc. “phone. and thanks are due W2GEE and W2LII for assisting in this. The remainder of the traffic was moved on 3.5 and 7-Mc., c.w. A deep interest was shown by those who visited the station and amateur radio received a definite boost.

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W8QV calls attention to a common fault in amateur operating—that of repeating back, or OK-ing bit by bit every item of information received, especially after saying “OK, solid.” W8QV gives as a typical example of this poor practice: “W8QV de WBXXX R R OK solid FB—on your QSA OK—on your rig—OK on your wife thinking radio is a darn nuisance—”

When you say “Rall OK,” or “R solid,” or just plain “R” for that matter, it means you have received everything all time), they had an FB QSO. PLA has promised PWU half the proceeds from W6HEZ calling CQ near PLA’s frequency. PLA gave W6HEZ for assisting in this, The remainder of the traffic was moved on 3.5 and 7-Mc., c.w. A deep interest was shown by those who visited the station and amateur radio received a definite boost.

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Additional W.A.S. Members

At this writing there are 229 members in the Worked All States Club. Sixty-eight operators have qualified for W.A.S. certificates since September 1, 1936, as follows: W8IMS (No. 162) W1GMB W9AWF W8SNP W8QWQ X82Q W8BET W7CMO W1GOU W8DOY W8JNB W1APU W8QGF W8TAO W8HEZ W8BSE W8BFQ W8KFL W8ELZ W8CCW W4CYY W8NCJ W9P0P VEGER W0RP W0BN W8HBD VE4IG VE4KS W4CXO VE5JQ W8ID W8CCY W8CHI W8CEN W8OHG W0MPT W8APU W8EFC W8FP W8SOQ W2EQQ W1UE W86G W3BEX W8ITE W8ED W8VF W8VFR W8NBD W8RZ W8AGU W8CZU W8J4V W8RQG W3OP W8F4G W7DS W6N1K W8QND W8W4G W8DFB W8PO W8MEP W8GLU W8AHA (No. 229).

XEC2 is the third amateur outside the United States and Canada to qualify for W.A.S., the other two being OA4J and K5OOG.

It is a real operating feat to work all states. W8AHA puts it, “Working all states is the best training one can get in the effective use of the amateur bands.” Have you made “WAS”? There is nothing like “purpose” to make your operating interesting. Make one of your goals “to work all states.” Will you be among the first 250 WAS? . . . the first 300? Forty-eight cards or other confirmations submitted to the A.R.L. Communications Dept. as proof of contacts with the forty-eight United States will make you eligible for the W.A.S. certificate. Sufficient postage must be sent with the confirmations to finance their return. Contacts may be made on any of the amateur bands and at any number of different addresses, provided no two addresses are more than twenty-five miles apart. A special rule permits either a confirmation from the District of Columbia or one from Maryland itself to count for the state of Maryland. Send your confirmations as soon as you can qualify.

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BRASS POUNDERS’ LEAGUE

(No. 16th–December 15th)

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MORE-THAN-ONE-OPERATOR STATIONS

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How's DX?

How:
The office was treated to a visit the other day by Mr. Robert Lang, XUSRL of Shanghai, China, here for a brief stay with his family in Massachusetts. He intrigued us for hours with his stories of conditions in China, radio and otherwise. We learned plenty about radio over there, and of some of the hardships under which they work. But it has its compensations, too. He told how one sits down at an evening, knocks over a few east coast W's until the west coast QRM blocks them out, then turns to South America, until the ZL's and VK's start roaring through—working a few PK's, VU's, and the like until Europe and Africa open up, finally turning in at 17 A.M. with the world in his log. But it isn't DX; it's rag-chewing, and that's what makes it so different from the particular brand of cut-throat DX-chasing indulged in around these parts. These rag-chews often mean a lot to amateurs in countries considered DX, so the next time you have decent signals at both ends, see if you can't do a little more than find out if he had any

QSL cards printed yet. Who knows? It may even turn out to be interesting . . . .

Where:
Speaking of China and stuff, a station active in Tibet should be good news for those who have worked every other country. Using 100 watts on 14 Mc., AC4YN has already worked all continents, and would like suggestions as to the best time to be on for W contacts! The station is operated by Lieut. J. L. Darg and Lieut. E. Y. Nepean, Political Officer's Camp, Lhasa, Tibet, via Gyanas Post Office, Tibet . . . . . .

Next month, J. R. Miller, WSCPB, has practically given up on VSTAI, worked last year on 7 Mc. A letter from VSTAP discloses that VSTAI was quite probably a fraud, not located in Ceylon at all, V67MB is believed to fall in the same category . . . .

28,285 kc.; VK2XP, 28,050 kc.; VK3YP, 28,040 kc. Dictated for ten . . . . . . Reg. Tibbitts, W61TH, sends a new station in the B. W. I., operated by Cyril F. L. Volney, Hillside, Castries, St. Lucia, B. W. I. A pair of '45 tubes is used on 7 Mc, and most of the operating is done from 6-10 P.M. and 4-6 A.M., E. S. T.

A new station in the B. W. I., operated by Cyril F. L. Volney, Hillside, Castries, St. Lucia, B. W. I. A pair of '45 tubes is used on 7 Mc, and most of the operating is done from 6-10 P.M. and 4-6 A.M., E. S. T.

VQ1KR has worked VE2QG on 35 Mc. "QO DX" early one morning on 160 phone, he might never have been heard by WO1GA-K6 down there at Jarvis Island in the South Seas . . . . . . 5 Mc. shouldn't be overlooked, either. V3A4WH has worked H30AD with only 15 watts to a 6L6 oscillator. W11NW worked H30Y and W10DX worked D3C0K, OZ5M, and OZE5K. But the lad who has been working overtime is W2BMLX, Prose Walker, in Dover Plains. That is, if you call week-end overtime. During the last month, Prose has worked a flock of G's, D's, H'B's, F, K5 and OZ, and has heard CQ, ON, ZU, HAF, VK, K7, PA5, VO, OK, LA, TI, and ZL. Most of all these stations were operating at the low-frequency end of the band, and start to come through around 11 P.M., lasting nearly until 3 A.M., E. S. T., W8NCG claims to have heard a couple of J's on 80, but we can't hear it directly from him so we won't pass it on . . . .

W1ET and W18Z have worked VK3KX on 35 Mc. phone . . . . . . .

And if still you are not convinced, W2BGO kept a schedule for 24 consecutive days on 80 with G6GM, who blasts through with 9 watts. W2BGO's "California k. w." amounts to 28 watts.

On ten meters, Japan has started to come through again on the east coast. W1WY, W1EBD, W1BUX, W1TW, and W1IAA have all worked J2IN (28,100 kc., T9) at around 6 P.M., E. S. T. European and African signals are being worked from all over the States, and another good season is predicted for ten . . . .

Reg. Tibbitts, W61TH, sends a few frequencies that may help you to find 'em: VE2A9J, 28,044 kc.; VE8AH, 28,044 kc.; J2IS, 28,150 kc.; J3FZ, 28,385 kc.; VE2XJ, 28,050 kc.; VE2YT, 28,040 kc. (Good 7-Mc. DX from the east coast is the South Seas . . . . . . .)

Of EMMETT SIMMONS, WSCPT, OF CLARENDON, TEXAS

The transmitter is a 78 Triode oscillator driving a '12A final, with 8 watts input from B batteries. With it Mr. Simmons has worked WAC four times, W5A, and has worked five continents with 1 of a watt at 45 kata. There is nothing unusual about the installation, except that a 2-wavelength "Vee" beam is used. W5CPB, who sends the information, says, "And I'll tell you it gives me the nicest DX I ever heard from Europe." He told how one sits down at an evening, knocks over a few east coast W's until the west coast QRM blocks them out, then turns to South America, until the ZL's and VK's start roaring through—working a few PK's, VU's, and the like until Europe and Africa open up, finally turning in at 17 A.M. with the world in his log. But it isn't DX; it's rag-chewing, and that's what makes it so different from the particular brand of cut-throat DX-chasing indulged in around these parts. These rag-chews often mean a lot to amateurs in countries considered DX, so the next time you have decent signals at both ends, see if you can't do a little more than find out if he had any

How's DX?
SVY7AZ (7100 kc., T9), heard by W1EWD at 2 A.M., U6MFR, with no success, has been waiting around 3 A.M., E.S.T., while USOF (7200 kc., T6x) was worked by W1BFT at 11 P.M., E.S.T.

The east coast gang, with some exceptions, of course, has been getting a minor thrill out of working V5RFR (14,350 kc., T6) at Lindula, Ceylon, who comes through in the afternoon and evening . . . . . . Another one good for a new country is HR7WC (13,955 kc., T7), heard at the same time . . . . . . And don’t go past 14,050 kc. too rapidly, W4CQR found YA2R, Afghanistan, there the other day at 2 P.M., sporting a T6 signal . . . . . . 7,84.1 (14,306 kc.) has worked all states east of WAC. His was made on last Oct. 9th, in the amazing time of 50 minutes, with 40 watts input to the 14-Mc. band, and LU1DA and LU4BH in the high-frequency end. Reg has a rhombic pointed at London in an effort to wangle a few more European countries.

Who:

Consider for a minute the pleasures of low power. G5CM, for example, worked ZS1H, V8KU, V8RF, W6KBD, W6BH, W6JU (three times), and W9’s galore, on 28 mc. with 7.5 watts input to an R. C. C., and has successfully worked W6PC with only 2 watts input! . . . . . . And Miss Barbara Dunn, G6YL, is WAC and WBE on ten with only from 6 to 10 watts input. Miss Dunn chooses a frequency higher in the band than most, so don’t be afraid to go looking for her . . . . . . The "Ford-powered" station, W7AHX, now boasts a rhombic antenna which, during the first two days, was good enough for G2FF, G8NQ, G9ZB and G97FF . . . . . . W3AWH and W6ON, continuing to work stations in the 14-Mc. band, and LU1DA and LU6BH in the high-frequency end. Reg has a rhombic pointed in London in an effort to wangle a few more European countries.

WAC:

Erroneously reported here was the "phone WAC of Joseph Robertson. VE2GA, who, by an office oversight, received a "phone WAC instead of the earned one for c.w. He has, however, since then, that he still has the interest in 'stick it out' . . . . . . 

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Santa Clara 1.75-Mc. 'Phone Net

A new 160-meter "Phone Traffic Net has been organized in the Santa Clara Valley A.R.R.L. Section, covering that Section and San Francisco and East Bay as well. W6JR, W6NTM, W6LOS, W6UVQ, W6HBY, W6OA and W6NML comprise this net, which meets daily at 4:45 P.M. on 1804 kc. Connections are maintained with the Central California Net and excellent traffic outlets are available to any point in the United States, Canada, Alaska, etc. More stations are needed. Those interested in some real operating fun on 1.75-Mc. 'phone should get in touch with W6JRU, Pacific Grove, California, or with W6LW, R.M., or W6FBW, S.C.M.

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New A.E.C. Members

Emergency-Powered: W1AGM W1EHT W1FGO W1GUL W1KCG W2AZM W2BNJ W2CVZ W3FUT W6HBL W6JWJ W6BBY W6CBX W6DEW/1 W6JRU W6KBD W6LW W6MIL W6P1A W6STJ W6TVL W6V8J W6WJR W6W8J W6WSL W6X5J W6WAS W6X5J W6X5J W6W8J W6Y4C W6Z5J W6Z5J W6Z5J

---

Briefs

160-Meter DX

As reported elsewhere in this issue 56-Mc. signals have at last spanned the Atlantic! Likewise, the first report of "160-meter" trans-Atlantic signals this season comes from W1BMR, who reports hearing 132TM on approximately 1755-kc., RST 359, at 9:12 p.m., EST, January 10. Who else is hearing or working "160 meter" DX this year? Let us have your reports.

---

R. C. C.

The Rag Chewers’ Club is going strong. If you like to use your amateur radio station to make and maintain real friendships, if you are a disbeliever in the "Hello-Goodbye" brand of contact, get into the R.C.C.—fraternize with this group of operators who know how to mix the human element into their QSO's. Many early R.C.C. members are still on the air and express delight at the revival of the club's activity. W3DGO writes, "I held 3VT at the time I was a member of R.C.C., which was in the first month it was formed in 1926. My contact was with 3BVZ, who was a charter member, I am very glad to see a revival in the Club and will do my best to boost it. It is going over big now." "Have been in the R.C.C. since 1925."—W9EUK. "I became a member of the R.C.C. in 1927."—W8DED. "When the R.C.C. was organized I qualified for membership under the call of 2DZ. I was glad to see this club revived."—W2DXX.

"I am a member of the R.C.C. since 1925. This one is pretty well worn and battle scarred. Would appreciate a new type certificate, but wish to have this old one to keep."—W8DGL. "Note to George B. Smith: Why don't you have your R.C.C. card approved as the rubber stamp type of QSO's are getting me fed up with them?"—W8DGL.
**Observers' Honor Roll**

Caliero Commercial Occupancy Survey
For November 1 and December 2 1936

<table>
<thead>
<tr>
<th>Location</th>
<th>Total Occupancy</th>
<th>Percent Occupancy</th>
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<tbody>
<tr>
<td>Caliero</td>
<td>4000-4500</td>
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**Election Notices**

**To All A.R.R.L. Members residing in the Sections listed below:**

(Thirteen different Sections choosing petitioning for Section Manager, the name of the present incumbent and the date of expiration of his term of office.)

In cases where no valid nominating petitions have been received from A.R.R.L. members residing in the different Sections in response to our previous notices, the closing dates for receipt of nominating petitions are set ahead to the dates given herein, in the absence of nominating petitions of Members of a Section, the incumbent continues to hold his official position and carry on the work of the Section subject, of course, to the filing 0f proper nominating petitions and the holding of an election or ballot or by delegate. Petitions must be delivered to the A.R.R.L. office or postmarked before the date of which the notice announces.

**Section**

**Closing Date**

**Present SCM**

**Present Term of Office Ends**

San Francisco Jan. 5, 1937 Alan D. Whittaker, Jan. 13, 1937

Manitoba Feb. 15, 1937 A. R. Simpson, Feb. 15, 1937

New Jersey Feb. 15, 1937 Noble Hart, Mar. 1, 1937


South Carolina Feb. 15, 1937 L. E. Smith, Mar. 1, 1937


Hawaii Feb. 15, 1937 Atlas O. Adams, Apr. 22, 1936

Indiana Feb. 15, 1937 Archie E. Bland, July 19, 1936


No. Texas Apr. 20, 1937 Richard M. Cobb, Apr. 21, 1937

East Psa. Apr. 15, 1937 Harold J. Burchett, Apr. 15, 1937

South Dakota Apr. 1, 1937 Howard W. Bixler, Apr. 21, 1937

Rhode Island Apr. 15, 1937 Clayton C. Gordon, Apr. 15, 1937

Santuario Apr. 15, 1937 George L. Bower, Apr. 15, 1937

Valley Woodington, Apr. 15, 1937

N. Y. & C. Apr. 15, 1937 Edward L. Bannach, Apr. 15, 1937

L. I. May 3, 1937 Carroll D. Kenter, May 8, 1937

New Jersey May 17, 1937 John W. Singleton, May 23, 1937

* In Canadian Sections nominations for the position of the Section Manager are made by petitioning for the name of the candidate. The petition must be signed by at least six members of the Section, and the name of the candidate must be submitted in writing as a nomination in accordance with these notices.

**Active R.C.C. Members**

**WA1DG ABF BAW BDJ BFT BVA BVR C GKM HBG RFX HIC INV JNF JFN JMY JQD JTD JWG JWY JYW JZB KAW KFN TS UE WBCB BZJ DBX DOO GFZ HFL HYQ IIE JEG IJG JWE LG WABK AQN BWT CDQ DCG DNU EDC EFT FOK FWS GPC OP WA4F AKJ DZB W4ALQ CISO HSU HNIE KSZ WZ DTHS SY WY QWAE BIC BRS DEED DQG EQI EQU GEB GXY HIC I0H KUN KWA MIW TGF MSG MUL NRC NDF OGI OPH PCL FCW PIT PLF PNL PQF FSM QM3 TS W8AB AHI CAA EBX HLD KX FQ TPD VDG VQF WEG WFP VSAU SSTM 38E JWE K4RD 11R**

**Additional R.C.C. Members**

**WI4FP CM0 IHN JIN JUN KAY WA4FI BMX HUG W814 WCEC W4MCQ W4APD BWW DCF FYH MU NDE OSA PGI W8DXX FW2 T1WW VLP WN VZR VE1BY V3AEL**
ELECTION RESULTS

Valid petitions nominating a single candidate as Section Member for each of the Sections, as provided in our Constitution and By-Laws, were received by the Section Managers. No other nominations were received.

Ontario Division

Ontario Section QSO Contest

Sunday, February 21, 1937
2:30 P.M. to 10:30 P.M.

Frequency: 3.5-Mc. Band

All Ontario amateurs are invited to take part in a contact contest, beginning at 2:30 P.M. and ending at 10:30 P.M., on Sunday, February 21, 1937. The contest is open to all amateurs in Ontario, and the results will be published in the next issue of QST. OE3, ZU, VE3, and VE3W are the high-scoring stations in the past four contests.

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Maritime Division

Maritime—SCM, A. M. Crowell, VE1DQ—VE1GL

Between schedules is hard at work finishing the new rig. HH received the R.M. appointment and is doing an FB job. GK, new O.R.S., schedules HH in the net. BB, in addition to schedules with HH and IB for net traffic, does some nice 3.5-Mc. 'phone work and shoots in several GQ on the Moncton gang. EA had the ill luck to have his Johnson Q antenna strike his car while it was in harness again, and active in net work. CO has a new pair of T55's. YQ, HX, and AAN are on 3.9 Mc. 'phone and MR on 1.75 Mc. from their QRL lot of the time as chief op at VOGY. IL has taken unto himself a YF—congrats. LF is rebuilding to use 6L6's. Also quite active are 3F, 30, SR, 3X (ex-3HM) and 4K. 4Q is a little less active commercially. It has been decided to discontinue "VO News" for the time being, as the gang do not seem to have the time to report or contribute.

Traffic: VE1GL 87 HH 52 GK 20 EV-BA 12 EX 4.
QUEBEC DIVISION

QUEBEC—SCM, Stan Comach, VE2EE—AH has been having trouble with a 6L6. BB has been staying with BW in Clova and visiting the Quebec gang. LJ has overcome the troubles in his transmitter, but EX will be on phone by the time this appears. FO is remotely controlling his transmitter across Westmount, BN has been doing his share of traffic handling and has built himself a pre-selector for the FBI. LA is another new O.R.S. DV has gone North to join LQ on the staff of Dominion Skyways. TX has a peak of an exciter unit, from 3.5 right up to 38 Mc. IN has been down for several months and his transmitter is getting its speech equipment. CA has the misfortune to blow his HD500A. GA has received his W.A.C. patchwork. DY has practically recovered from his somewhat lengthy indisposition. Glad to hear you are on again, AX has a 276A final and has a card on from UX. BY has found the 14-Mc. band at last. CO is doing FB with his new Sky-Buddy. DA is very active on the 3.5 Mc. band, and BE and BO have deserted 14 Mc. to operate on the same band. EZ is progressing steadily with his new rack job. GO has been building doll's houses, two in series. We ask HM to accept our rather belated congrats on the 14-Mc. band, and on 14 Mc. DF has been staying with the OM. LE and FX are practically neighbors. LE is back on the air in Quebec City. HL is doing his share of the traffic handling. The Quebec Radio Club has applied for affiliation with the A.R.R.L. LL is rebuilding. FA won a strong phone signal on 14 Mc. He is also heard on this band. QA has been having considerable B.C.L. trouble with his 14-Mc. phone, but this is now satisfactorily cleared up with all concerned. LF has been heard a few times on 14-Mc. phone with a nice quality signal. AG will be heard most on the 3.5-Mc. band for phone and S.W. contacts. BQ has a 52 final on 14 Mc. BS is changing his T55 final over to a higher powered tube and is building a 22-tube receiver to go along with it, incorporating everything from a speech amplifier to a modulator indicator. EJ is on 1.75-Mc. phone. BK's RK-20's on 14 Mc. are still going FB. ER is still finding the full 6L6 a little too much. FM is looking around for a 214Mc. rig. FY finds that home-made bakelite sockets for his 276A are not so hot. ZK has a prosector for his RME receiver. UX works 14 and 28 Mc. with a 150T final. Visitors to Winnipeg last month were VE2SN and VE7ADP, ADP was passing through on his way to the coast. The M.W.E.A. is in full swing and the Winnipeg Radio Club transmitter, JT, is on the air.

VANALTA DIVISION

ALBERTA—SCM, Alfred D. Kettenbach, VE4LX—LQ has Class AB modulator using 6L6's ready for 1.75-Mc. phone. VJ is using 6L6G in final. APB is using 6L6 and the oscillator is doing a good job of mixing. VN is very active again. VSB is not so hot. BQ and FX are practically neighbors. BH has begun operating on this band. BB is remote controlling. AY's snowdistortion is very FB. EJ's RK-23 has very good exciter. ZF has a large rig on 14 Mc. and has a large 276A final. QC is using a 276A on 14 Mc. with four '46's Class B. QZ and PQ think they live too close for their own comfort. XB's 'phone has T55 final. AY is using 6L6 and has a full size and is FB. EJ's RK-20's on 14 Mc. are still going FB. ER is still finding the full 6L6 a little too much. FM is looking around for a 214Mc. rig. FY finds that home-made bakelite sockets for his 276A are not so hot. ZK has a prosector for his RME receiver. UX works 14 and 28 Mc. with a 150T final. Visitors to Winnipeg last month were VE2SN and VE7ADP, ADP was passing through on his way to the coast. The M.W.E.A. is in full swing and the Winnipeg Radio Club transmitter, JT, is on the air.

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(Continued on page 100)
CORRESPONDENCE

The Publishers of QST assume no responsibility for statements made herein by correspondents.

Flea-Power Association

58 Thorndyke St., Springfield, Mass.
Editor, QST:

This letter is to introduce to you the "Flea Power Association", a new organization of radio amateurs to stimulate flea power activity on the amateur bands as a definite help in solving the QRM problem. We think that the use of flea power on the more crowded amateur bands by a good percentage of amateurs will do much toward helping to eliminate the excessive QRM on those bands, which at times is intolerable. We are soliciting your cooperation in this matter.

There is on the air to-day a large number of amateur stations operating with flea power, 25 watts or less; but these stations are greatly handicapped by the number of high-powered stations, which cause most of the QRM. Nor can it be denied that many of these low-powered stations are owned by operators who are unable to afford higher power, and also by those who operate low-powered stations for the enjoyment and satisfaction they get from DX on low power. We would like to see these fellows get a break, not be crowded off the bands altogether. I believe the A.R.R.L. is well aware of the accomplishments of flea-powered transmitters. For the past six months here at W1EXZ I have had in operation a transmitter with an input power of only 1.64 watts, and with it I have worked VE1, VE3, W1, W2, and W3 on 3600 kc.

It is our aim, if the cooperation of enough stations can be enlisted, to have a portion of the 80-meter band set aside for flea-power work. The band from 3000 to 3700 kc. has been suggested as a possible range. If this aim could be realized it would certainly give the low-powered fellows a break, and also leave a good portion of the band to the high-powered signals. I think you will agree with me that this will be to the advantage of all. It is not impossible to copy a signal through QRM of approximately equal signal strength, but try and do it through QRM caused by a kilowatt or even a half-kilowatt station.

Furthermore, in the construction of flea power the ham must utilize his ingenuity to the fullest. His transmitter should be made to operate at the peak of efficiency, for, with flea power, it takes a well-made outfit to go places. Is it any great accomplishment to work DX on a high-powered rig? Even with losses and poor operating efficiency a high-powered rig can send out a good signal for hundreds of miles, but consider the thrill you get when you are sending a signal out a few hundred miles with each watt input.

The F.P.A. is not anti-high power, but we would like the cooperation of the amateur fraternity in bettering conditions on the amateur bands so that the fellows with flea power can get more enjoyment from their efforts in amateur radio as a hobby.

Robert A. Curtis, W1EXZ

Young Squirts Club

901 West Virginia Ave., Peoria, Ill.
Editor, QST:

I'm writing this letter after a very fine and interesting QSO I had with a fellow my own age on 7 Mc. We young squirts in high school have the greater majority of our QSO's with fellows many years our senior. However, I know that now and then we QSO with someone our own age without even knowing it. Well, this contact is probably "just another QSO," when it could be made in to a very interesting rag chew if we only knew the other fellow's age.

So the purpose of this letter is to try to form a sort of 40-meter "young squirts" club for all hams of high school age or younger. When a member graduates from high school he automatically graduates from the club. The only members to date are W3GOU and myself. Any of you young fellows interested in this club can write either to W3GOU, 4711 Lafayette Ave., Merchantville, N. J., or to me, and we will be very glad to send you the dope. Meetings will probably be held twice a week on 40-meter c.w.

We know there are plenty of you so let's... get together and have a big ragchew and discuss our YL's to our heart's content. Lord knows that soon enough we'll blossom into OM's and have to talk about our "mojulashun" down on twenty. Then we will always have the OW on our neck with the ten or twelve young'un's. ...

Kenneth Bruce, W9VF

And Now Religion

53 East 7th St., Holland, Mich.
Editor, QST:

Religion is one subject hams seldom mention and it never appears in any amateur publication,
so I think it is about time something is said in regard to religion.

Some of the finest people any person could find any place in the world are radio people. Any person who has met any number of amateurs will readily agree to that. However, it seems that a rather small percentage of these fine fellows are interested in religion in any way. Perhaps the reason is that they are too busy with other things to bother about religion. However, as any person knows or should know, religion is a vital thing in a person’s life because some time during everyone’s life it will be found wanting. Besides, with religion a happier and finer life is actually possible. Whatever faith it may be, it is a necessity to a complete life.

The fellows interested in religion should get together and organize a club which any person who professes his faith can join. This same club can do much to help along unfortunate bands in many ways.

I am not a religious fanatic, but I do think that the amateurs could organize a club which would be of great benefit, as the ranks of amateurs is steadily increasing, and we should all try to get together and make the most of amateur radio.

Those fellows who are interested can write to express their interest, and perhaps a club can be organized which would be of great help to the fellows who are “down in the dumps,” etc. Let’s try to make amateur radio the finest and cleanest hobby in U.S.A. and the hobby that offers the most benefit to its participants.

—RUS SAKKERS, W8DBD

Editor, QST:

It is my object to organize a league of Masonic amateurs throughout the U.S.A. I wish that you would please publish in QST some notice to this effect.

I would like to correspond with, and arrange schedules with, all amateurs located in Masonic Institutions, who would be interested in exchange of athletic material, messages, or other social activities which are being carried on at various institutions.

—Charles Snyder, W8GQJ

“Two Hundred Meters and Down”

Ma. Clinton B. DeSoto
American Radio Relay League
W. Hartford, Conn.

Dear Mr. DeSoto:

My editorial department has recently shown me a copy of “Two Hundred Meters and Down,” which I have carefully looked over.

I notice the various comments which you have made on my early days in amateur radio, but I was rather surprised to see that the one thing in which I always took greatest pride did not get any mention at all in your book.

For historical purposes, I presume you wish to have correct information. . . . On page 31, paragraph 3, you have the following line: “The legislators—or someone capable of lending them inspiration—had had a new idea.”

In the paragraph of which you speak was given to the writer—and no one else. You speak on page 30 of my editorials in “Modern Electrics” which were the cause for individual amateurs to rise up in arms against the Depew Bill. But the important consideration was that no one took the trouble to decide what tone band the amateurs should occupy, also what power they should use.

All of this was suggested by the writer in his editorial in “Modern Electrics” where the frequency of two hundred meters first was mentioned, as well as the power. A photostat of this editorial is attached hereto referring to this phase. Also a number of other photostats giving you the complete history of the case are attached as well. . . .

This, however, was not the only contribution to amateur radio made by the writer. He personally made a number of trips to Washington and personally put the amateur angle up before the legislators, and some good must have come of it because when the Radio Act of 1912 finally was enacted, you will note that the writer’s recommendations were practically copied in toto, and were incorporated into the Radio Law of 1912.

—H. Gerstbach

Emoron’s Notes.—The photostats copied mentioned constitute an account of the legislative activities of “Modern Electrics,” as recorded in “Two Hundred Meters and Down.” The significant paragraphs in connection with the point raised in the above letter follow, from the February, 1912 issue: “There should be a bill passed restraining the amateur from using too much power, say, anything above 1 K.W. The wave length of the amateur wireless station should also be regulated in order that only wave lengths from a few meters up to 200 could be used. Wave lengths of from 200 to 1,000 meters, the amateur should not be allowed to use, but they could use any wave length above 1,000. If this is done, all interference with Government, as well as commercial station, will be done away with and the wireless situation will then be the same as to-day. The amateurs will have the same liberty and perhaps greater liberty than to-day, and complaints against them from Government or Commercial stations will cease automatically.”

The Radio Act of 1912, as finally passed on August 13th, provided: “No private or commercial station not engaged in the transmission of bona fide commercial business or radio communication or experimentation in connection with the development and manufacture of radio apparatus for commercial purposes shall use a transmitting wavelength exceeding two hundred meters, or a transmitter input exceeding one kilowatt.”

Simple Television Methods

1309 E. 4th St., Salt Lake City, Utah

Editor, QST:

Certainly the amateurs are able to advance the interesting art of television if only there were a more noise-free band for its use. For the present frequencies the apparatus itself would be no problem. The lenses need not be achromatic. If you are lucky and own a cathode-ray tube your reception troubles are nearly over, but if not, an ordinary neon bulb behind a disk will make a fairly receiver, and the inexpensive photo-cells are sensitive enough for thirty or sixty line pictures.

The side-bands on high definition transmissions are too broad at 1.7 Mc., but they would keep within reasonable limits at 56 Mc.

Two twenty-five-cent 750-watt photo-flood lamps are sufficient for scanning a frame up to about 8’’ x 10’’. Any one can learn the fundamentals within a short time, and the amateur would have no trouble. . . .

—H. R. Hagan, WALKG

Danger—High Voltage

Riesel, Texas

Editor, QST:

Being nearly electrocuted may not be news to amateur radio but it gives one much to think about, especially on the importance of caution and safety.

We will not dwell on the horrorfulness of the experience except to try to see why it did happen.

The transmitter here is in a metal rack and I was trying to load up the final to a dummy antenna. The tank coil was copper tubing and I was using an one-turn wire loop as a pick-up coil, pushing it in or pulling it out to vary loading.

I formerly operated phone without a key in the circuit, but recently I changed things and put in a key, and here is...
ABOUT CONDENSER INSULATION: High grade ceramic insulators (such as the best quality of Isolantite) are properly regarded as second only to fused quartz for high frequency insulation. Quartz is so very expensive that it is out of the question for most uses. Fortunately it makes but little difference, because the best ceramics give results almost equally good, when properly used. “When properly used” is a big phrase however, and covers a multitude of things. As far as the user is concerned, the main thing is to keep the insulator clean. Dust (and particularly the sooty dust of industrial districts) causes a marked reduction in the breakdown voltage as well as an increase in losses. The best cure is to inclose the rig in a dust cover, but where this is not practical all insulators should be cleaned periodically. Carbon tetrachloride is usually used for this purpose, but it leads to unfortunate results unless proper precautions are taken. Unglazed ceramic insulating materials of the highest grade are quite porous and consequently absorb moisture readily. To prevent this absorption it is usual to impregnate the material with a low-loss wax. As carbon tetrachloride dissolves the wax, cleaning by this method leaves the insulator at the mercy of atmospheric conditions unless reimpregnated or otherwise protected. Probably the best treatment that the amateur can use is simply to paint the surface, after cleaning, with National Victron Coil Dope. This gives excellent results in every way.

ABOUT PICK-UP COILS: Pick-up coils for antenna or link coupling are often constructed by winding ordinary rubber covered wire around the outside of the coil. Although convenient, this method has serious objections. It is definitely not safe, since the low breakdown strength of the rubber often allows lethal voltages to appear in unexpected places. Further, losses at high frequencies are unreasonably great. A better scheme is to wind the pick-up coil of heavy bus wire, and mount it inside the coil form. To do this, wind the pick-up coil with a diameter slightly greater than the inside of the form. Then, holding one end of the coil in each hand, twist it as if you were winding up a spring. As you twist the turns of wire will grow smaller in diameter. When small enough, insert the pick-up coil in place, and release the ends. As it unwinds it will expand again until it fits snugly in the form. The ends of the coil are brought out to terminals on the coil form. The result is a neat, efficient, and well-insulated job.

ON SOLDERING COIL PRONGS: Many plug-in coil forms have hollow terminals similar to tube prongs. We are sometimes asked how to solder wires in these terminals without leaving lumps on the side of the prong. Answer: Dip the prong in a small pool of solder, and withdraw it slowly. This is the only practical method. It is handy to have a small cup drilled in the tip of your soldering iron for this purpose. It should be about \( \frac{3}{4} \)" diameter and \( \frac{1}{4} \)" deep. Though less convenient, the same results can be secured by melting a lump of solder in an iron spoon.

ON LEAD-THROUGH BUSHINGS: Occasionally also we are asked why we do not make a small lead-through bushing. We do. A GS-8 Stand-off, mounted through the panel, leaves nothing to be desired either for efficiency or neatness.

JAMES MILLEN
LEADERSHIP
has to be
EARNED

No other radio book has ever sold a tenth or a twentieth as many copies as the Radio Amateur’s Handbook. Of course it’s the biggest book on radio in the world. And of course it’s painstakingly complete in every detail. But the important thing is that it is accurate, honest, carefully written by experts who know what they are talking about. Anybody can write a book and call it a “Handbook,” but it takes time and ability and costs money to produce the Radio Amateur’s Handbook. As a matter of fact, it cost us fifty thousand dollars—but it’s yours for

POSTPAID
$1.25 OUTSIDE
CONTINENTAL
U. S. A.

American
Radio Relay League
West Hartford, Conn.

where the slip-up came. When I released the key in the buffer stage the current on the final dropped to zero, but of course the voltage (1000 v.) was still there. Several times before I caught myself reaching into the final compartment, but stopped. This time I didn’t, and when I touched the tank coil—wow!—my wrist was against the metal frame and my fingers on the coil, and I couldn’t get away.

The XYL saved the day, like happened to be at the desk writing a letter and jumped to the switch. Otherwise, I might not be here to tell the story.

My analysis brought out these thoughts:
1. Subconscious habits developed through continued operation become fixed.
2. When a new method of operation is introduced one must be doubly careful because of the tendency to fall back into the old habit. In my case, when the current dropped the mind-set was, “The power is off.”
3. Why not practice safety—even if you have to cut off the filaments? They will heat up again.

Before you do anything in or near the transmitter, get into the habit of cutting off the power. It means only an extra motion and may spell life or death to you.

I intend to talk about it on the air. It’s an important subject that we forget so easily. Next time you are cut of soup, in a rag chew, why not bring up safety practices? It will remind you and also the other fellow that it isn’t pleasant to be caught between 1000 volts.

—Rev. Alex Greeb, W6EJK

I.A.R.U. News
(Continued from page 67)

“The League is extremely proud of the confidence reposed in it by the Postmaster-General of the Union. At the present moment amateur regulations are being revised and the S.A.R.U.L. has been called upon to submit its proposals in this connection. It is hoped thereby to secure legislation which will be both favorable to amateurs and fair to other users of the ether.

“Recently there occurred an event which has enhanced considerably the status of our League in the eyes of the Government. The Minister of Posts and Telegraphs addressed members from an amateur station in Durban and was replied to by stations throughout the Union. This practical demonstration of the efficiency of amateur equipment created an extremely favorable impression which will certainly have beneficial repercussions on the amateur cause.”

Countries:

Crowded last month in this department with our list of countries, we were unable to include the method for using the list. Upon inspection of the list, you will find that some countries are cross-indexed, e.g., “Abyssinia, see Ethiopia,” and “Ethiopia (Abyssinia).” In every case like this, the alternative name is given in parentheses.

Note also that there are two countries using the prefix VP2, the Leeward Islands, which include Antigua, and the Windward Islands, which include Grenada and St. Lucia. Five countries use the prefix K6: Guam, (unofficial OM), Hawaii, Midway Island, U. S. Samoa, and Wake Island. VK4 should not be passed up, since it can be either Australia or Papua Territory.

Say You Saw It in QST — It Identifies You and Helps QST
The radio amateur's handbook

1997 EDITION

The Standard Manual of Amateur Radio Communications

Published by the American Radio Relay League
We are proud of the fact that CARDWELL condensers are recognized as the finest available anywhere. But, at the same time, we do not believe in "ballyhooing" our products with meaningless superlatives or exaggerations.

CARDWELL RATINGS are CONSERVATIVE and DEFINITE

MT-100-GD Very popular for high power buffer stages or medium power final tank circuits. Especially desirable for 50 meter push pull arrangements, where the General Electric mycalex insulation proves its worth. The advantage of the small compact Midway frame is apparent when used in exciter units, limited in width to the standard rack and panel size.

<table>
<thead>
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<th>Capacitor, per section</th>
<th>100 Mmf.</th>
<th>Net Price</th>
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<tr>
<td>Insulation</td>
<td>General Electric Mycalex</td>
<td>$4.70</td>
</tr>
</tbody>
</table>

NP-35-GD A special high frequency double section capacitor for 5 and 10 meter medium powered tank circuits. Also widely used in the manufacture of 6 meter short wave diathermy machines. No closed loops to absorb energy parasitically. Minimum surface leakage losses due to small area of stator block in contact with insulation. Not a double spaced "midget" but a better than medium power double section capacitor designed for high frequency circuits.

The plates of these condenser are buffed and polished, with a resultant increase in peak flashover rating of approximately 35 percent over and above what would be obtained if the plates were plain.

See your distributor for catalog listing other "Ham" units

In error on the list was the prefix of Zanzibar; it should be ZK1.

More on the "High-Frequency" Hiss:

Further data on the hiss observed by G6DH, and reported in the December issue, is furnished by Frank Valentich, W6MEK. He has "also noticed this phenomenon on the frequencies above 14 Mc. The hissing oscillations usually occur from about 6:30 to 7:30 A.M., at various intervals, and cover approximately 10 kc. The hissing will start at the higher frequencies and proceed slowly to the lower frequencies. There may be as many as ten different resonant points for the noise. It usually

(Continued on page 110)

Practical Organization and Equipment for Emergency Operation

(Continued from page 16)
AGAIN IT'S TAYLOR!

866 JR.

For trouble free, economical performance the 866 Jr., a medium voltage half wave rectifier can't be beat. Here is truly the answer to that rectifier tube problem.

CHARACTERISTICS
Half-Wave Mercury Vapor Rectifier

- Fil. Volts: 2.5
- Fil. Current: 2.5 amps.
- Max. R.M.S. A.C. Volts: 1250
- Max. D.C. Current per pair with choke input: 250 M.A.

$1.00

T-20

Here is Taylor's latest contribution to the amateur world. This tube is truly a revelation in characteristics and price.

CHARACTERISTICS

- Fil. Volts: 7.5
- Fil. Current — Amps: 1.75
- Plate Volts — max.: 750
- Plate Current — M.A. max.: 75
- Max. D.C. Grid Current: 25 M.A.
- Amp. Factor: 20
- Grid to plate capacity: 4 Mmf.

CLASS B

- Output at 800 Volts: 70 Watts
- Plate to Plate load: 12,000 Ohms.

$2.45

Your favorite distributor stocks these new Taylor Tubes. For complete data on all Taylor Tubes, consult your Taylor catalog and handbook. If your distributor cannot supply you, write Dept. Q72 today — FREE.

"More Watts Per Dollar"

TAYLOR TUBES, INC., 2341 WABANSIA AVE., CHICAGO, ILLINOIS
AT LAST an ALL-PURPOSE Microphone . . . 

With a sensitivity that provides sufficient power to permit almost unlimited lines. . . Different impedances to match any amplifier having from five to five hundred thousand ohms input impedance. . . A perfect microphone for indoors yet rugged enough to meet every outdoor purpose. . . Tone quality equal to much higher priced instruments of similar type.

Consider these SEVEN outstanding "BULLET" features combined in one microphone:

- Maximum sensitivity
- Effective at long distance from amplifier
- Wide choice of impedances
- Attractive, modern appearance
- Unequaled for severe outdoor work
- Remarkable tone quality
- Moderately priced

A few territories are still open for exclusive distribution

TRANSDUCER CORPORATION
30 Rockefeller Plaza
New York, New York

eicted generators, developed 420 watts, continuously, and consumed fuel at the rate of about 10 hours to the gallon. The 1-H.P. unit developed 600 watts with a fuel consumption of around 7 hours to the gallon. No continuous tests have been made on the car-driven units; however, one of them was tested for a short period at 800 watts.

The ½-H.P. engines retail for about $40.00 and the 1-H.P. engine for $50.00. The total cost of the 400-watt plant is near $50.00 and that of the 600-watt plant, $60.00. These prices, of course, are exclusive of labor costs.

GOOD RECEIVERS NECESSARY

None of the strictly portable receivers has been completed to date, so no data can be given at this time concerning their performance. However, there are a few points found in the experience of operating the receivers on hand that may be of interest. One of these is the desirability of having complete shielding, in order to keep down the noises from the engine and commutator. The receivers used in the field have clearly demonstrated this necessity on several occasions. Noise silencers on the receivers used with the car-driven units have also been found of great advantage.

The idea we are trying to convey in these few remarks is this: A portable receiver does not necessarily mean one with two tubes in a cigar box. It should mean one that contains all of the features of a good home receiver with the addition of the items mentioned above if they are lacking. The reason for this is that the conditions found at portable locations are seldom as good as at a good home location where an excellent antenna helps out. A receiver of this type is hard to find. Not all are able to acquire such an operating aid. There is no harm, however, in dreaming about that ideal portable receiver. There are a lot of us who are doing just that.

It is hoped that the ideas presented in this article will be of some help to those who would like to prepare themselves to be of service to their fellow men in times of disaster. The S.A.R.O. will be glad to work with other organizations in an exchange of ideas which will be of mutual benefit and for the good of the people as a whole.

Says Mr. George E. Sterling, for many years the Radio Inspector in Charge at Fort McHenry, Baltimore, has been promoted to assistant chief of the field section of the engineering department of the F.C.C. at Washington. This section handles the administration of the 21 field offices and the several monitoring stations of the Commission. Its chief is the amateur's old friend, Mr. W. D. Terrell. Mr. Sterling himself is well known to amateurs as the author of Sterling's Manual, famous textbook of a few years back, as well as by his personal ham activity. He is succeeded at Baltimore by Mr. C. A. Ellert, located there for several years as Radio Inspector.

74 Say You Saw It in QST — It Identifies You and Helps QST
In response to popular demand

RCA PRESENTS

TYPE

806

Amateur's net price $24.50

The tantalum-plate RCA-806 employs an improved grid and filament structure which results in a more rugged mount assembly. For Class C telegraph service the maximum ratings are 3,000 plate volts, 200 plate ma., and 150 watts plate dissipation. Your supplier will be pleased to fill your requirements immediately.

RCA presents the Metropolitan Opera every Saturday afternoon. And "Magic Key of RCA" every Sunday 2 to 3 P. M., E. S. T. Both on NBC Blue Network.

RCA Manufacturing Company, Inc., Camden, N. J.

A Service of the Radio Corporation of America

Say You Saw It in QST — It Identifies You and Helps QST
He's flying high these days... and the service man who is throttled to Centralab's speed is bound to be well satisfied with 1937's possibilities. '36 has been a big year for Old Man CENTRALAB.

The famous smooth control with the long resistor has the place of honor on thousands of service benches and in as many service kits. Fly with CENTRALAB again in '37.

Centralab
Milwaukee, Wisconsin
British Centralab, Ltd.
Canterbury Rd., Kilburn
London N.W.6, England
French Centralab Co.
118 Avenue Ladv-Rollin
Paris XI, France

VOLUME CONTROLS
FIXED RESISTORS
SELECTOR SWITCHES

DX Contest
(Continued from page 87)

and nothing to do when computing your score. Should you find that you operated a total of 100 hours (for example), your gross score should be multiplied by the fraction \( \frac{100}{100} \) to give your net or “corrected score.”

You can operate 6 hours per day, 12 hours each Saturday, and 16 hours each Sunday, working DX in the contest, and come out about right. This plan permits the average ham to plan for his working day, for meals, for 8 hours' daily sleep, etc. Cross examination of logs makes it possible to check the operating time submitted as may be necessary, of course. The time limit puts contestants on a fair basis whether employed or having full time to apply to the contest.

Operate as much as you want to during the contest period. Keep track of the time you start and stop operating your station. This must be shown in your log report. In counting up your total contest time, please be fair and honest. We know you will. What constitutes “contest operating hours”? Not hours spent keeping local skeds with each other within the U.S.A. and Canada. Not the time spent in local rag chews, swapping DX results, scores, and other dope. If you listen for DX with the ability to call DX stations if, as, and when, you hear them, that time counts, whether you do any calling or working or not.

The whole period is to be charged against “contest operating time,” and not just the time after you started transmitting.

AWARDS

Certificates handsomely lithographed and imprinted will be awarded: (1) Two in each remotely located country or territory, to one 'phone and one c.w. winner—all hams using the same prefix compete for an award, and (2) two in each of the 64 A.R.R.L. Sections, mainland U.S.A. and Canada (see page 5, QST), one to the 'phone, and one to the c.w. winner.

All operators in the same country 7 will be in competition with each other—and similarly each A.R.R.L. section-boundary circumscribes a competing group. DX-transmission characteristics being the same for all operators in each award area, and in each period, the chances of being a winner depend on operating ability and stations and are equally fair to all.

CLUB PARTICIPATION

To encourage local participation, additional certificate awards (besides the A.R.R.L. Section awards) will be made through each club where three or more individual club members, or new local hams invited by such a club, take part. For a club to rate a c.w. winners certificate awarded on behalf of the club group, at least three reports from c.w. club-member (First Period) partici-

7 The official list of prefixes was published in January '37 QST, page 52. See tabulation of the last A.R.R.L. DX Contest results showing classifications of prefixes and geographical-political distinctions observed.
The New Amateur
CLASS "B" TUBE
Low-Distortion Zero Bias Amplifier
NEW AMPEREX ZB 120

A high current low voltage tube with the following general characteristics and ratings:

Amplification Factor ........ 90
Grid to Plate Transconductance at 100 ma .......... 5,000
Filament Voltage .......... 10 volts
Filament Current .......... 2 amps
Maximum Allowable Plate Dissipation .......... 75 watts

The combination of an amplification factor of 90 and a transconductance of 5000 is only approached in one or two of the larger transmitting tubes. This combination of characteristics in a low cost tube is made possible by exclusive Amperex design features (covered by pending patents). It is these design elements which invest the ZB 120 with the properties that enable it to deliver, under similar operating conditions, at zero bias, power outputs of an amplitude equivalent to larger and costlier tubes, with such a greatly reduced distortion factor, that the tube may be practically termed "DISTORTIONLESS."

The excellence of its performance in various classes of service can be judged from the following paragraphs.

PERFORMANCE AS CLASS B AUDIO AMPLIFIER-MODULATOR
Zero Bias for Plate Voltages up to 1250 volts. Power output up to 300 watts per pair of tubes. Straight line dynamic transfer characteristics, and practically constant and high input resistance, minimize circuit requirements and make possible practically distortionless operation with exceptionally low driving power.

PERFORMANCE AS LINEAR RF POWER AMPLIFIER
The special characteristics of this tube that result in its ideal operation as a Class B Audio amplifier, also afford superior performance with minimized circuit requirements in Class B RF amplifier service. Carrier output in the order of 40 to 50 watts per tube are readily attainable in this service.

CLASS C—RF POWER AMPLIFIER
In this class of service the ZB 120 will deliver up to 150 watts of r.f. power with lower driving power requirements and at economical plate voltages.

FREQUENCY MULTIPLYING POWER AMPLIFIER
The exceptionally high mu coupled with a high r.f. grid voltage tolerance, makes practical the use of the ZB 120 as a frequency multiplying final amplifier, with consequent savings in total tube costs and elimination of neutralization requirements.

GRID MODULATED POWER AMPLIFIERS
The characteristics of the ZB 120, ideally adapt it for use as a grid or bias modulated class C amplifier, or doubler amplifier. In this class of service, fully modulated carrier outputs of the order of 40 to 50 watts may be obtained even while doubling, with exceptionally low modulation distortion.

$10

Additional engineering information and typical performance data may be obtained by writing to our engineering department.

AMPEREX ELECTRONIC PRODUCTS, Inc.
79 WASHINGTON STREET • BROOKLYN, NEW YORK
STUCK?

CANDLER'S
Scientific Code System
Will Help You "Over the Hump!"

Don't be discouraged if you're stuck or have failed your code exam! Maybe you've spent hours in faithful practice — maybe you've tried again and again without progress — yet the Candler System can help you "over the hump" that seems to be your limit.

It's not how much you practice but how you practice that counts in learning code or gaining speed — and Candler can show you how.

Thousands of high speed radio ops — men like Champion Ted McElroy and other skilled amateur and commercial operators — can testify to the effectiveness of Candler System Code Training. It's different — you learn to read code by sound as you read print by sight. It's sure — Candler guarantees you whatever ticket you're working for, amateur or commercial. It's quick — the rapid progress of Candler students is amazing — in a few weeks they accomplish what years of undirected practice failed to give them. It's easy — only a short time daily will suffice. And last but not least, it's inexpensive.

It's a method used by commercial and commercial operators. It's quick and inexpensive.

CANDLER'S
SYSTEM can help you "over the hump" to be a skilled radio operator. Let Candler train you the right way — the quick way. Ask any skilled operator about the Candler System. He can't testify to its effectiveness unless he's worked Candler. Let Candler train you today for the Free Book of Facts that tells you all about the Candler System.

COURSES for BEGINNERS and ADVANCED STUDENTS

Candler takes you right through from the very beginning to your amateur or commercial license. There's a course for beginners that teaches you all the necessary fundamentals scientifically — a course for operators who want to prepare themselves for the commercial radio field — and a Telegraph-Touch Typewriting course for those who want to become expert in the use of the typewriter, in receiving fast stuff. Remember, Candler trained operators are in demand for attractive commercial jobs. Send the coupon today for complete details.

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CANDLER SYSTEM CO.,
Dept. Q-2, Asheville, North Carolina
Please send me Free Book of Facts.
Name
Address
City..............State..............
Code Speed..............WPM

RULES

1. All contest work must take place in the contest period.
2. Reports must show each time of starting and stopping station operation in the log submitted to A.R.R.L., and if the total time of station operation exceeds 90 hours (in either period) the proper factor must be applied to the gross score as shown under "time limit."
3. Logs must include date, time of QSO, call of station worked, serial numbers exchanged and other information required tabulated neatly with the claimed score. (See the log examples for required data.)
4. Scoring: Both the W/VE station, and the station in the remote locality receive one point when the W or VE station number is acknowledged by the station in the remote locality. Each entry must include the station call so much as to have individual member-stations, but the idea is not to operate that station so much as to have individual members all working at their own stations.

W/VEs:

First Period (C.W.). Quota of three stations per country (prefix) may be worked in each different band and is the limit to count points toward the score, except that if one way exchanges with some of these three have been made, more stations can be worked to give not more than 9 points (basic) per country. This quota shall be permitted in each different band.

W/VEs:

First Period (C.W.). Quota of three stations per country (prefix) may be worked in each different band and is the limit to count points toward the score, except that if one way exchanges with some of these three have been made, more stations can be worked to give not more than 9 points (basic) per country. This quota shall be permitted in each different band.
Still Following Orders from Headquarters

Thanks to Burgess Portable Power!

In war time or peace
time—policing or pro-
tecting—the U.S. Coast
Guard is always ready
to serve in any emer-
gency.

Fortunately, they can be contacted and di-
rected from headquarters—with the help of
two-way radio com-
munication.

It almost goes with-
out saying that here—where the com-
munication equipment must be com-
pletely dependable—they turn to
Burgess Batteries as a source of power.

They, too, have proved Burgess Batteries, as
we have proved them in our own labora-
tories—where they give amazingly long life
and stand up under most adverse and try-
ing conditions.

Use Burgess Batteri-
es in your own experi-
mental work. A fair test will convince you
of their economy and dependability
for any and all battery services.

BURGESS BATTERY COMPANY
FREEPORT ILLINOIS

BURGESS

Say You Saw It in QST — It Identifies You and Helps QST
79
NEW — a low cost
Cathode-Ray Oscillograph

CLOUGH-BRENGLE
MODEL 105
complete with
five tubes
Net $48.90
(5.50 down, bal. 10 mo.)

The surest, quickest check on
MODULATION
DISTORTION
EXCITATION, etc.

Employs the new Type 913 Cathode-ray tube, yet
retains every feature of the most expensive instruments,
such as: Linear Sweep with Type 885 Thyatron in
synchronizing circuit; separate high gain amplifiers for
horizontal and vertical plates; beam centering controls;
etc.

Makes every test needed to secure the maximum per­
formance from your rig and assures operation within
FCC regulations.

Compact, easily portable — yet the most complete
instrument ever offered using the Type 913 tube. Not
one of these features can be omitted without limiting
the use of the oscillograph.

Get the Complete C-B Catalog

Use the coupon below to secure a copy of the new
1937 CLOUGH-BRENGLE catalog, describing the
MODEL 105 oscillograph in detail, as well as the
complete C-B line of audio oscillators, r-f signal
generators, and all-purpose volt-ohm-milliammeters.

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Name.................................................................
Address..............................................................

Second Period (’Phone). No quota limit on
stations per country.

6. Multiplier shall consist of the number of
countries (prefixes) worked on one band plus
those worked on a second band, plus those worked
on a third band, etc.

All Others:

7. No quota limit on stations.

8. Scoring points shall be multiplied (for total)
by the number of U. S. A. and Canadian licensing
areas contacted (a possible 14). The multiplier is
also increased further by working the same areas
on additional frequency bands. (Example: All dis­
tricts are worked on two bands, possible multi­
plier is 28; 10, 8, 6, and 5 lie. areas are worked on
four bands. The sum, 29 licensing areas, is the
multiplier to use to get the gross score.)

9. All entrants agree to be bound by the Rules
and Contest Announcement and the regulations
of their licensing authority. In a contest of this
magnitude, no correspondence can be entered
into regarding Award Committee Decisions.

10. The highest scoring individual operators
score is the official score for all awards. Other
operator scores must also be submitted sepa­
rate ly if more than one operator worked a station.
The station score (all points by all countries)
may be stated for purposes of comparison,
but will not have official significance in making
awards.

11. More than one receiver and receiving
operator in use at one time to log available DX
is not permissible and shall be grounds for
disqualification.

12. The same station can be worked in more
than one band, provided the quota of three (per
country, per band) which applies in the first
period only is not exceeded.

13. Cross band work does not count in this
contest.

14. Reports and logs from participating sta­
tions must be received at A.R.R.L. Hq. from all
W/VE stations on or before noon, April 23, 1937,
to be considered for awards. From all outlying
localities, reports must be received on or before
May 28, 1937. Play safe ... mail your report
immediately at the end of each contest period to
avoid delay and insure that your results are
credited in QST. Show your claimed-score in full,
following a tabulation of points in the log-form
indicated with this announcement.

15. The entries received after the competition
will be passed upon by an A.R.R.L. Award Com­
mittee whose decision will be final in all
cases.

WARNING!

Good notes, not ragged ones are advisable. The F.C.C. monitoring station personnel are well
acquainted with the dates of our DX contest,
and will be on the job as usual to mail a bunch of
discrepancy reports for poor notes and
overmodulated signals! You don’t want to be a
recipient of one of those colored slips for a bum
note or a parasite—better lose out in some
operating hours rather than jeopardize your ama­
teur license. Let’s make it a contest with no bum

Say You Saw It in QST — It Identifies You and Helps QST
Efficiency of operation is largely dependent upon attention to detail. That is why TEMCO Engineers have worked untiringly to approach perfection of design. For example, note the TEMCO Automatic Plug in Chassis with conduit-protected intercabling illustrated below. This is but one of many innovations which distinguish TEMCO Transmitters as being distinctly superior. Other features are Band switching up to and including grid circuit of final amplifier stage • Full remote control • Complete relay protection • Separate high fidelity speech amplifier unit including 2 channel mixer • 100% high level modulation • 6 position crystal selector switch • Operation from 1.7 mc. to 30 mc. • Power control switch permitting inputs of either 500 or 1000 watts.

The perfection of detail which is so evident in the TEMCO 1000 watt transmitter is typical of the precise engineering design that is found in the TEMCO 100, 350 and 500 watt units. You are invited to write for complete illustrated technical data sheets. Address inquiry attention W2KR.
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330 W. 42nd St., New York, N. Y.

Send me Radio Engineering Library, 5 vols., for 10 days' examination on approval. In 10 days I will send $2.50, plus few cents postage, and $3.00 monthly till $23.50 is paid, or return books postpaid. (We pay postage on orders accompanied by remittance of first installment.)

Name: ____________________________
Address: __________________________
City and State: ____________________
Position: __________________________

Company: __________________________
(QST-2-37)

Reduction of 45 db is given for normal cable length of 8 feet. Any leakage in the cable circuit will, of course, result in noisy operation, and all soldering should be made using rosin flux. The additional two condensers and resistances needed to adapt the microphone to its amplifier should be placed, if possible, under the chassis or in an individually shielded can. The microphone has no hum pickup from magnetic fields, since there is no transformer to be affected. The whole unit may be laid with its cable on top of a working power transformer without the slightest indication of hum. Its radio-frequency pickup should be negligible, since the construction places a double static shield around the ribbon which effectively protects it from r.f. pickup when used with a well-shielded cable.

SPECIAL CIRCUITS

During the early development of the microphone numerous experimental circuits were worked out in an effort to overcome the cable losses resulting from the very high impedance which it had at that time. In later development the problem was solved by increasing the output and inherent capacity of the unit to such an extent that special circuits were not necessary. Although these experimental circuits were all tried out and made to work, they were never developed to any final stage because it was evident that the solution of the problem at hand should be as simple as possible. However, they offer possibility for experiment in the ham field, especially in reducing the amount of equipment necessary for modulation purposes. Whatever their eventual worth, they do offer intriguing opportunities which open a new field for the experimenting ham.

The circuit given in Fig. 2 shows how the microphone may be used without any polarization voltage to modulate an oscillator output directly by means of feed-back control in an associated circuit. The circuit employs a pentagrid converter tube, the oscillator section of which is oscillating at the desired frequency and is as independent as it can be made of the amplifier or mixer section of the tube. Grid 1 is acting as the oscillator grid, Grid 2 as the oscillator plate and the r.f. cathode return of the oscillator section is made directly to the cathode. It will be noticed that Grid 4, the control grid, is returned to ground. The tuned circuit consisting of the microphone and L, in the cath-

Say You Saw It in QST—It Identifies You and Helps QST
PARTS for ASSEMBLIES

Coils and condensers go together electrically, but sometimes not so well mechanically. To see how nicely National parts combine in assemblies, consider the photograph above.

The rigid, well-insulated structure for a "Collins-type" network is made entirely of standard National parts. XR-10A Coil Forms and Jack Bases (1 and 3) clamp rigidly on the tie bars of the TMA Condensers, which in turn mount on GS-5 stand-offs. For tanks, a single coil and condenser may be assembled with equal ease (9), with a plug base (2) for coil changing if desired. In similar fashion, the UR-13 and TMC assemblies for other purposes and of different power ratings can be built up readily (as in 7).

Next time you plan construction, thumb through the National Catalogue and plan your layout as a complete National Assembly.

All parts shown above are in the $260 National Catalogue, except the plug base (Fig. 2, Type PB-15, Net Price $0.81) and the jack base (Fig. 3, Type XB-15, Net Price $1.05)

NATIONAL CO., INC. Malden, Mass.
FREE
A NEW ILLUSTRATED
BOOK EVERY ONE
INTERESTED IN
RADIO SHOULD OWN

"THE
INSIDE STORY
OF
RADIO BATTERIES"

It tells, and shows, how batteries are made, how they should be used to best advantage, what you should expect from them. It contains performance curves, charts and helpful technical information. Profusely illustrated.

If you want to be "up" on the latest in battery-operated sets, get this book. There's dope in it every ham will want.

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QSTI

Say You Saw It in QST — It Identifies You and Helps QST
Thordarson Laboratories offer new suggestions for getting "Peak" performance from the All-Star Transmitter. Send at once for your copy of Bulletin SD-262.

100% Excitation Increase
Following the suggestions given in Bulletin SD-262 the excitation of the All-Star line of transmitters can be increased 100% and still retain all original efficiency.

New Developments for All Bands
These tested and approved suggestions apply to 10, 20, 40, 80, 160 meter operation of All-Star Transmitters. Don't delay. Send now for your free copy of Bulletin SD-262. Write Dept. Q-72 or see your parts distributor.
SPRAGUE

Type UC “CASED” Uncased Paper Sections

Save the Cost of Metal Cans

WHETHER you’re an amateur interested in building a reasonably priced Transmitter, or a serviceman replacing an old condenser block, you’ll find these new Sprague Paper Sections unexcelled.

It is hard to describe in words the vastly improved appearance of these Condensers. That’s why I urge you to go to your jobbers and see for yourself. Note how dearly we seal the units so the wax cannot melt and so moisture cannot possibly creep in.

Available in capacities of 1 and 2 mfd.s, in volatages of 400, 600, 800 and 1,000 volts. You have my personal guarantee that they’re honestly rated and will not break down if operated according to their ratings.

If you don’t like these condensers after a fair trial you have my full permission to return them personally to me for full credit.

Try them today! If your jobber does not have them, send me your orders direct. Prompt shipment will be made. Ask for our new Catalog describing the complete Sprague line including our new fixed mica 600 volt condensers.

Radio Fadeouts Through 1936

(Continued from page 85)

With the sudden ionization below (or in) the $E$-layer, sudden changes occur in the currents flowing there, currents which are the cause of a certain part of the earth’s magnetism. The changes in these currents directly cause the special magnetic fluctuations which are observed, and also inductively produce changes in earth currents.

The absorbing ionization and the radio fadeouts are produced on the illuminated side of the earth and do not occur on the dark side. They are most intense where the sun’s radiation is perpendicular (i.e., around noon and at low latitudes). This distribution is also true of the special terrestrial magnetic variations, and probably of the earth-current and other phenomena if any. The effect is thus quite distinct from ordinary magnetically-disturbed periods, sometimes called magnetic storms, whose effects are much more marked at high than low latitudes. Ordinary magnetic disturbances and the special effect here reported have no necessary connection with each other, except for a general tendency to occur more frequently when sunspots are more numerous. Ordinary magnetic disturbances occur simultaneously with lowered ionization density in the $F_2$ layer, as shown by my colleagues. Thus magnetic storms and the special magnetic effects simultaneous with radio fadeouts are associated with different levels in the atmosphere. It is believed that certain rare observations reported in the past by astronomers, of magnetic pulses simultaneous with visible solar effects, such as the coincidences reported by Prof. C. A. Young as occurring on August 3 and 5, 1872, were the special type of magnetic effect now found to be associated with radio fadeouts.

I wish to record my appreciation of the valuable assistance given by the amateurs in this investigation. The importance of the part they have taken can be judged by the fact that amateurs observed and reported the fadeouts of November 28, 1934; December 17 and 23, 1935; and the following in 1936: Feb. 6, 8, 14, 16, April 8, May 25, 26, 28, June 3, 9, 10, 19, Aug. 25, Nov. 6. In every case the times of the phenomena as reported by different observers agreed within a few minutes. The amateurs gave data for locations not otherwise reported.

As there is reason to suppose that radio fadeouts (and the associated magnetic and other phenomena) are caused by one type of ultraviolet

EIMAC 250TL and 250TH TUBES
The Practical Answer to Amateur High Power

AT ANY PLATE VOLTAGE AND AT ANY FREQUENCY THE 250TL AND 250TH TUBES PROVIDE AN ECONOMICAL ANSWER TO THE PROBLEM OF OBTAINING HIGH POWER

A kilowatt of class "B" audio power from a pair of 250TL or 250TH tubes.

A single 250TL or 250TH tube will permit a carrier power of 125 watts in a conventional class "B" R.F. linear amplifier. (33% eff.) Higher carrier powers with more efficient circuits.

A kilowatt input to a pair of 250TL or 250TH tubes with plate voltages as low as 1500. Higher inputs and efficiencies can be obtained at higher plate voltages.

More than a quarter kilowatt of output power can be obtained from a 250TL or 250TH operating as a frequency doubler.

The 250TL and 250TH tubes make excellent class "C" amplifiers for the ultra high frequencies. Outputs of more than a half kilowatt can be obtained from a pair of these tubes at 100 megacycles.

Why Guess at Your Transmitter Efficiency?

The use of tantalum for anodes in EIMAC tubes has given to the amateur a useful method of visually checking transmitter efficiency. The color of the anode of the newer EIMAC tubes at ratings is best described as a bright orange-red. Coloring of the anode is first noted at about 40 to 50% of maximum ratings. It is suggested that users of EIMAC tubes, by means of a variable power supply, dissipate various wattages on the anodes of their tubes. Either by making a mental note of the color at various dissipations or better still by calibrating a photometer as used for home cinema work, a fairly accurate method of estimating plate dissipation is obtained. On the lower frequencies the power input minus the plate dissipation gives a close approximation of transmitter outputs. An instant check on the balance of loading, neutralizing, and excitation on push-pull amplifiers is obtained by noting the variation of color on the anode of EIMAC tubes.

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San Bruno, California, U. S. A.

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Build this unit, and you have a powerful 80 Watt input C.W. Transmitter complete with built-in power supply to which you can add other units that will be available in kit form so that eventually you can have a complete Half K.W. phone transmitter at a fraction of the cost you would otherwise pay.

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TORONTO

Buenos Aires

Ontario, Canada

(Usho Radio Products Co.)

15 YEARS OF LEADERSHIP

(i.e., ultra-visible) solar radiation, and that ordinary magnetic disturbances, auroras, etc., are caused by a solar emanation of different character, these phenomena present powerful means of keeping track of two different and very interesting types of events on and in the sun. Although these events are sometimes accompanied by visible radiation, nevertheless the emanations which cause the terrestrial effects are outside the visible spectrum and probably do not penetrate through the atmosphere to the earth's surface at all. Further study of radio fadeouts is thus eminently worth while, as it furnishes information of value to astronomers and geophysicists as well as those of us whose primary concern is radio transmission.

---

**Educational Radio Broadcasts**

Over WIXAL

YOu have achieved the impossible... being both entertaining and instructive." "...just about the finest thing that has been put on the air." "Please send the blueprints and drawings you spoke about so I can enroll in the club."

And in they pour, the requests to "join up" with the most distinctive vocational educational broadcast program on the air—the lectures on "Modern Radio" over WIXAL at 7 P.M. EST each Monday evening. This is an instruction course conducted by C. Davis Becher, instructor in Commercial Radio Operation, Massachusetts University Extension, member of the staff of Eastern Radio Institute and of the staff of WIXAL.

In conjunction with this course there has been worked out a unique plan of combining visual and aural instruction by mailing to enrolled students blueprints and circuit diagrams illustrating the various lectures. The instructor in Boston uses a large blueprint to which he constantly refers during the lecture as a professor would to a blackboard in the classroom. The same blueprints in the hands of listeners really act as miniature blackboards all over the world. Listening to the broadcasts is, of course, free; an enrollment fee of one dollar covers the cost of preparing and mailing the blueprints, which are mailed upon request.

Following the lectures there is given a course in International Morse code in which the speeds are graded to suit all different classes of listeners. This feature is particularly valuable to amateurs. WIXAL's frequency on these broadcasts is 6:04 Mc.

These broadcasts are carried on a non-profit basis, as are all the activities of WIXAL. The station is operated by the World-Wide Broadcasting Foundation, of which Walter S. Lemmon is founder and president, an organization maintained by individual subscriptions and largely sponsored by a group of leading educa-
These A.C. solenoid relays are ideal for remote control of transmitters, for control of crystal ovens, and for any general remote control application except for keying. *These relays will not operate in keying service.* Silver-to-silver double-break contacts are used throughout.

The maximum contact rating is 10 amp. at 220 v. or 3 amp. at 550 v. The relay coils are wound for 115 volts 60 cycle alternating current. Relays for other voltages can be supplied on special order. Use coupon below.

### Circuit Diagram

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Enclosed find money order for $_________ for which please send me, shipping charges prepaid, the following items:

__________________________________________________________ for _______ Volts _______ Cycles

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Headquarters
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and THRU-PANEL
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Because.. exclusive JOHNSON features give you the most in utility and convenience.

Because.. JOHNSON insulators cost no more than substitutes.

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Cable: "SIMONTRICE"

E-F JOHNSON COMPANY
Manufacturers of Radio Transmitting Equipment
WASECA MINNESOTA U.S.A.

Standard Frequency Transmissions

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Standard Frequency Schedules

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The time specified in the schedules is local standard time at the transmitting station. W9XAN uses Central Standard Time, and W6XK, Pacific Standard Time.

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 "O" 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 Perry in charge.

Schedules for WWV

EACH Tuesday, Wednesday and Friday (except legal holidays), the National Bureau of Standards station WWV will transmit on three frequencies as follows: noon to 1:00 p.m. E.S.T., 15,000 kc.; 1:15 to 2:15 p.m., 10,000 kc.; 2:30 to 3:30 p.m., 5000 kc. On each Tuesday and Friday the emissions are continuous unmodulated waves (c.w.): and on each Wednesday they are modulated by an audio frequency. The audio frequency is in general 1000 cycles per second.

Strays

Here's one that looks as though it might be a world's record for miles-per-watt on 'phone: K6LTV, using a home-made 56-2A5 five-meter transceiver revamped for ten meters, worked W6KPR on two-way phone, April 10th. The distance is about 2400 miles. Power input was between 1.3 and 1.5 watts. Has anyone done better over a distance of a thousand miles or more?

Now

HEADSET ADAPTER KIT
by TRIMM

The Trimm Headset Adapter Kit fills a long felt need for a simple means of adding a headset to the present day radio. No longer need the family be kept awake at all hours of the night with a loudspeaker; and in addition, weaker signals can be more clearly heard.

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WARD'S ANNOUNCE

APPOINTMENT OF "Dixie Dave" Elam - W9FPP
AS DIRECTOR OF WARD'S AMATEER RADIO ACTIVITIES

MR. ELAM is shown here at the controls of the new Super Sky Rider. Long a Ham himself, he will be able to give you expert help.

In order to better serve its thousands of amateur radio customers, Ward's have appointed Mr. David Elam (W9FPP) as director of its amateur radio activities. Prominent as a Ninth District amateur, his work as Business Manager of last September's "Ham Fest" in Chicago (biggest amateur affair ever held) will long be remembered. At present he is chairman of the Chicago Area Radio Club Council; is generally recognized as an outstanding authority on S-meter work and writes extensively on short wave matters.

Mr. Elam is now at your service; he will give you the expert service and advice that you would expect from an unbiased brother Ham. Don't hesitate to write him of your problems. In addition—Ward's have issued the finest radio catalog they ever printed. Experts—manufacturers, writers, editors of radio magazines agree on this. It has the sensational new developments in ham transmitters, receivers, parts, P. A. equipment and servicemen's supplies. Everything can be bought on monthly payments; terms as low as $3 Down, $4 a Month. If you haven't yet received your copy, send coupon for it TODAY!

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DON'T READ THIS
IF YOU LIVE IN PETROPAVLOVSK OR KHABAROVSK

Smart hams in all USA districts have purchased new equipment on the DEL*RAD payment plan. Write at once for complete price list and details. Down payments as follows—

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
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<tr>
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<tr>
<td>1937 Super Skyrider</td>
<td>10.25</td>
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Time Payments on Transmitters and Parts Orders

A-1 Used Sets 50% to 75% Off Original List Prices

W3DO has been a ham since 1910, and takes a personal interest in your radio problems. Reasonable trade-in allowance for your old receiver.

WILLARD S. WILSON—W3DO
DELAWARE RADIO SALES CO.
405 Delaware Ave., Wilmington, Delaware

About Harmonic Radiation
(Continued from page 85)

output. If an attempt were made to tune for maximum antenna current a harmonic content of 4% could well be attained. The minimum harmonic content, in fact too small to measure, occurs at a setting of C1 of 34 or slightly on the capacitive reactance side of resonance. At this point the antenna current is also a minimum.

Fig. 8 shows the effect of decreasing the number of turns coupling to the final amplifier inductance. In this case the network was connected to only three turns of the 24 in the coil. Input was slightly less than in Fig. 7 and the output about 42 watts. Note that the harmonic content is much less in this case and does not rise as rapidly either side of minimum plate current. The plate current also rises more slowly. Harmonics are undetectable only at the exact minimum plate current. At 10 divisions off resonance they rise to

FIG. 6—CIRCUIT OF THE PI NETWORK USED IN THE TESTS

L1—24 turns, 3½ inches long, 2½-inch diameter.
C1, C2—500-μfd, variable condensers.
C3—0.004-μfd, blocking condensers.

FIG. 7—THE EFFECTS OF MISTUNING THE PI NETWORK WITH CLOSE COUPLING TO THE FINAL TANK

Note the rapid rise in harmonic output with apparently slight misadjustment.

3% (not shown in Fig. 8). The antenna current again shows an increase because of harmonic content.

Similar production of harmonic radiation was obtained in both cases by slightly disturbing the resonance setting of the condenser in the final amplifier tank circuit and curves like those in Figs. 7 and 8 obtained.

FIG. 8—THE EFFECTS OF MISTUNING THE PI NETWORK WITH CLOSE COUPLING TO THE FINAL TANK

Note the rapid rise in harmonic output with apparently slight misadjustment.
STATION OPERATING SUPPLIES

For full enjoyment of your operating activities you will want these forms designed to meet your needs

HANDY TO USE
The most interesting feature of the new LOG BOOK is the incorporation of spiral binding. This permits the book to be folded back flat at any page, requiring only half the amount of space on the operating table and making it easy to write on. The log-sheet has been redesigned by the Communications Department so that there is space provided for recording the number of messages handled and QSL’s sent and received. General log information (prefixes, etc.) has been brought up-to-date. The LOG BOOK price has been reduced and is now 35c per book, 3 books for $1.00, postpaid.

FOR PRESTIGE
The radiogram blank is now an entirely new form, designed by the Communications Department to comply with the new order of transmission. All blocks for fill-in are properly spaced for use in typewriter. It has a strikingly new heading that you will like. Radiogram blanks, 8½ x 7¼, lithographed in green ink, and padded 100 blanks to the pad, are now priced at 25c per pad, postpaid.

FOR CONVENIENCE
Radiogram delivery cards embody the same design as the radiogram blank and are available in two forms — on stamped government postcard, 2c each; unstamped, 1c each.

AMERICAN RADIO RELAY LEAGUE, INC.
WEST HARTFORD, CONNECTICUT
IF YOU ARE ONE OF THE 69%

"... CREI Training Will Improve Your Present Position"...

A recent survey discloses that despite the late depression, 69% of CREI graduates now have improved positions, and the average salary has increased 37.4%. TECHNICAL TRAINING will not only help YOU acquire the ability to succeed, but is necessary to keep pace with the many new developments in the industry. Take definite steps to insure your future by writing for —

A FREE COPY OF THE CREI "TESTED PLAN"

An informative and illustrated 48-page booklet for professional radiomen who are not satisfied with their present positions in the radio field.


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14th and Park Road  29 Broadway

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

LINK-COUPLED TUNER

Using the same excitation condition, the final amplifier was next coupled to the antenna system by a simple link coupling and antenna tuner, the feeders being tuned by series condensers. Coils L1 in Fig. 6 were used to load the feeders to permit series tuning and an additional 12-turn coil with two-turn link was inserted between them. The link was connected across four or less turns of the final, depending upon the power output desired.

The harmonic output then was measured at various fundamental outputs up to 225 watts and the tank condenser varied either side of resonance as before. In no case was the harmonic output greater than 0.2 watts or a maximum of about 0.1%; and lack of perfect resonance did not increase this value as with the pi-network.

OTHER FACTORS

In all of the above tests the exciter was purposely operated under conditions known to favor harmonic production. The second buffer or driver, using a pair of 10's in parallel, had a tank circuit with a capacity of only 67 µµfd. By changing to a smaller inductance requiring a capacity of 280 µµfd., the exciter harmonic output was reduced to about one-tenth of its former value. Under this condition of exciter operation, and coupling the final to the antenna with link coupling, the radiated harmonics were too small to measure. Likewise, with the pi-network properly adjusted they could not be measured; but if either C1 or the plate tank were disturbed harmonic radiation of a somewhat less degree was again obtained.

For those who do not wish to go to the trouble of constructing and calibrating a field strength meter very good indications of harmonic strength and the effect of various adjustments can be obtained by observing the R- or S-meter on the receiver. The receiver should be some distance from the transmitter and, of course, should be well shielded and only a very small pick-up used. By this means the exact setting of C1 in the network for minimum harmonic can be observed. Also, it will be found often that a reduction or increase in excitation voltage will change the harmonic content.
It's Always LEEDS Who Leads

Rack Panels

By LEEDS are furnished with black shrivel finish in the standard 19" length, 1/4" thick. Mounting slots are spaced according to Bureau of Standards specifications, insuring freedom from all trouble in mounting or interchanging panels.

<table>
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Brass panel mounting screws 1/4" long 10/24 thread, 1/16" hole diameter. Masonite Crystalline finish panels, sizes as above, prices slightly lower.

NAVY TYPE TELEGRAPH KEY

List $3.60. Navy knob ½" Tungsten contacts. While they last .................. $1.15
With regular knob ........................................... 95c
1 mfd. 1000 v. ............................................. 75c
2 mfd. 1500 v. ............................................. 1.30
MFB-25 .......................................................... 65c
MFB-40 .......................................................... 85c
MFB-50 .......................................................... 95c
MFB-60 .......................................................... 1.00
MFB-75 .......................................................... 1.10
MFB-100 ......................................................... 1.30
MFB-250 ......................................................... 2.50
MFB-500 ......................................................... 4.50
MFB-1000 ....................................................... 8.50
MFB-2000 ....................................................... 17.50

LEEDS Oil Filled and Impregnated Condensers

1 mfd. 1000 v. $1.59 1 mfd. 1500 v. $1.67
2 mfd. 1000 v. $1.97 2 mfd. 1500 v. $2.09
4 mfd. 1000 v. $2.85 4 mfd. 2000 v. $2.99
2 mfd. 2000 v. $2.79

Electrotube and tubular condensers in stock

HAMMARLUND "STAR" MIDGET CONDENSORS

A handy variable condenser for receiving, transmitting, short wave tuning, verniers, etc., the usual Hammarlund high quality, at unusually low prices.

<table>
<thead>
<tr>
<th>Type</th>
<th>Mmf</th>
<th>Price</th>
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<td>SM-15</td>
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<td>SM-25</td>
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<tr>
<td>SM-60-X</td>
<td>60</td>
<td>75c</td>
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TRIMM 2000 ohm phones .................. $1.90 4000 ohm .................. $2.25
TRIMM featherweight .................. $5.90 DX 20000 ohm imp. .................. $5.90

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

LEEDS "Quiet Can" for receivers with 2 HP stages; complete with tubes and instruction ........................................ $7.95
LEEDS "Silent Can" illustrated herewith, for HP stages; complete with tubes and instructions ......................... $9.95

We Are Headquarters for the Following

Hammarlund — Meisner — Alladin — Triplett — Littelfuse — United Transformer—Cornell-Dublmer—Thoradson

BASES and DEMI-BASES

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

8 x 8 x 2 ....... $ .65 10 x 17 x 2 ....... $1.10
8 x 10 x 2 ....... 70 10 x 17 x 3 ....... 1.50
8 x 14 x 2 ....... 1.75 12 x 17 x 2 ....... 1.40
8 x 17 x 3 ....... 1.15 12 x 17 x 3 ....... 1.40
8 x 17 x 2 ....... 8.70

GENERAL RADIO

Variae Transformers

A wonderful line voltage control, that is smaller, more convenient to use and furnishes higher output than other known transformers within a narrow voltage range.

Type 70-B — 115 v. at 2 amps ...... $10
Type 80-B — 115 v. at 7.5amps .. $15
Write for Bulletin 67-D for complete data.

Here are two handy G.R. forms for that always needed 1500-2000-2500 v. each side.

Type 677-Y — 10 turns 4" diameter, resonant 1.7 mc with 100 mfd, capacity; shipping weight 2 lbs. Price ................... 50c
Type 677-X — 80 turns 4" diameter, resonant 1.7 mc with 100 mfd, capacity; shipping weight 5 lbs. Price ................... 75c
Also 7-pin base to fit above forms vs 90c, a matching base with jacks at 65c.

G.R. 247M — .00025 condensers .... 49c
G.R. Amateur accessories always in stock

GOING LIKE WILD FIRE

Our NEW LD-5 $10 Value

These low drift plates, faceted so as to be outstanding from the standpoint of stability, accuracy, high output and low cost. One Drift — 5 cycles per million per degree. Accuracy of calibration — better than .05%. Orders filled plus minus two kc., up to specified tolerance, but not least, the price of the mounted crystal, anywhere in the 100, 200 and 500 mc. range.

Money back guarantee if you are not completely satisfied.

LEEDS type A134 metal crystal holder, as illustrated above, fits standard 5-prong socket ........... 90c

NATIONAL C R M Oscilloscope

Employing a 913 RCA tube; net $11.10 (without tube). RCA 913 tube ........... $5.00
NC 100 — NC 100 X and 101 X Hammarlund "Pro" and "Super-Pro" Sold on time at cash prices in metropolitan area. No down payment.

Leonard allowance on your old set.

We carry the complete line of NATIONAL and HAMMARLUND.

The Bullet 7.T.R. 2 Electro-Dynamic Microphone, made by 1 Transistor Corp. Special ....... $23.23

TAYLOR Custom Built TRANSMITTING TUBES

15 watt plate dissipation ..... $18.00
T155 — 155 watt plate dissipation .... 19.80
T200 — 200 watt plate dissipation ... 21.80
866 Mercury Vapor Rectifying tube ... 1.65

All other types in stock

TRIPELLET METERS

All standard ranges; 0-10 to 0-1000 MA bakelite case ....... $2.94
20 ma bakelite case ........... $2.94
READRITE milliammeters 15 to 400 milli; any range, each ....... 95c
All Tripllet testers at regular wholesale prices, available to all.

The record is 100% perfect, Thousands of microfarads of LEEDS oil filled condensers are in use without one case of failure.

1 M F 1000 volt D.C. working .......... $1.10
2 M F 1000 volt D.C. working .......... 1.75
3 M F 1000 volt D.C. working .......... 2.40
4 M F 1000 volt D.C. working .......... 3.05
5 M F 1000 volt D.C. working .......... 3.70
M F 2000 volt D.C. working ........... 3.70
4 M F 3000 volt D.C. working .......... 4.50
5 M F 3000 volt D.C. working .......... 5.25
M F 3000 volt D.C. working ........... 5.95

LEEDS has the most complete line of Antenna Wire found in any shop. Hard and soft wire, stranded, tinned copper — tinned wire — any length, at lowest prices.
For the AMATEUR

USE Electrad "Varishm" Dividers and get exactly the right plate, screen and suppressor voltages for those new pentodes. Five sizes from 25 to 200 watts to suit all power packs. $3.75 each, list.

Write Dept. O-2 for Complete New Catalog of Resistors for All Purposes

SOME CONCLUSIONS

As a result of the tests that have been made a few general conclusions for reduction of harmonics from amateur stations can be made.

1. Harmonics will not be radiated if they are not generated in the transmitter. Low-C circuits and high efficiency operation of vacuum tubes tend to create strong harmonics. In exciter stages particularly, it is better to use larger tubes and operate them at low efficiency. A reasonable factor of safety is always good engineering practice. In this connection note the F.C.C. ratings of tubes for broadcast purposes wherein, for instance, a 203A is given a rating of 75 watts output. Remember that it takes about a ten-times increase in power output to increase the useful received signal strength noticeably, and that squeezing a few more watts out of the rig will not help the signal but may bring a "pink ticket" for interfering harmonics.

2. Do not use a pi-network unless you have a meter in the plate circuit of the final amplifier to indicate exact minimum plate current.

3. With the pi-network, do not tune for maximum antenna current.

4. The use of pi-network with tuned (Zepp.) feeders is not advised because a match cannot be obtained except under certain critical conditions which seldom exist.

5. Variable QSY systems such as variable air-gap crystals, e.c. oscillators or other means of rapidly changing frequency should not be used, particularly with a pi-network, unless the final circuits are retuned exactly with each frequency change.

6. If in any doubt about possible harmonic radiation, use a simple inductive coupling system such as the link-and-tuner arrangement rather than a pi-network.
NEW HAMMARLUND PRECISION RECEIVER

Many new and unusual features include directly calibrated "hand width" panel control; graduated sensitivity and audio gain controls. Cam operated knife switch has five shielded sections with silver plated knife contacts. 12-Band Condenser. 12 to 1 ratio direct reading dial calibrated in megacycles and kilocycles, accurate to within ½% of 1%. Signal to noise ratio on 14 megacycles is 6 db. at 7 microvolt input. Real high fidelity—30 to 7500 cycles with 6 db. image ratio at 14 megacycles is 8 db. to 1 and at 7500 cycles is 30 db.

The receiver covers five ranges of from 2.5 to 5; 5 to 10; 10 to 20 megacycles each. Each range covered is from 540 to 1160 and 1160 to 2510 kilocycles. Use 14 tubes, 6 metal and 8 glass, including a 6A as class A driver, and two (2) 6BY6's operated at plate class "A", as well as an 80 and a 56A in the special power unit.

WATCH OUR LIST OF SPECIALS GROW

TRANSMITTERS

Thordarson No. T6787 Plate and Filament Transformers 600-0-600 V. at 200 MA. 2.5 V. at 10 amp. SV. at 3 amp. 7.5 V. at 3 amp. $2.45

High Voltage Transformer, 1000-750-500-0-500-750-1000-5000 MA. 7.5 & 444 x 5%. $5.95

These transformers are heavy cast iron frame open mounting type. Heavy Rockbestos leads. Fully insulated. Heavy Rockbestos leads. Fully Guaranteed.

1400-1335-0-1335-1600 A.C. R.M.S. 1250-1000 V. DC -- 400 MA. 7" x 6" d. x 3" h. $13.25

1950-1600-0-1600-1950 A.C. R.M.S. 1500-1250 V. DC -- 500 MA. 8 3/4" w. x 7" d. x 7" h. $17.50

2350-1950-0-1950-2350 A.C. R.M.S. 2000-1500-0-1500-2000 -- 500 MA. 8 3/4" w. x 7" d. x 7" h. $22.50

Filament Transformers

If you like to save money on your fancy merchandise here's some real bargains.

2.5 Volts 10 Amperes 2500 Volts Insulation N. 2510 $0.95

6.3 Volts 10 Amperes 1600 Volts Insulation No. 62 $0.95

7.5 Volts 3 Amperes 1600 Volts Insulation 725 $0.95

CHOKES

16 Henriques, 125 M.A., $1.15 A real quality choke. Asta­lation 150 Ohms. No. N515 $1.15

Thordarson No. 10697 Heavy Duty Choke. 15 henries at 250 MA. $1.95

FREE JUST OUT! BIG NEW CATALOG!

Big Bargains in Parts, Equipment and Supplies for Hams, Servicemen and Dealers. Lowest wholesale prices. Write quick!

NEWARK ELECTRIC COMPANY

226 W. MADISON ST. Dept. Q CHICAGO, ILL.

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

CHOOSE THE SHURE 70S

Clear, crisp speech... double power on important intelligibility speech frequencies... dependable 24 hour-a-day service... that's the real communications performance you get with the famous Shure 70S "Communications-Type" crystal microphone... at low cost. That's why a well-known air transport company installed a Shure 70S as standard equipment in each of its ground stations.

Use the 70S for hi-efficiency in your station. List Price, complete with Desk Mount and cable............................$25

Also available in the Shure "4-Way Utility" model. At your Jobber or write for Bulletin 129QC today.

Licensed under patents of the Brush Development Company.

Neobeam OSCILLOSCOPE

Foundation Kit

Kit—Ready to assemble $24.50
Factory assembled—Ready to operate $40.00

What it does: Checks modulation, locates distortion. Good for checking amplifier, microphone and speaker response. Makes Sound Visible. This kit makes a high grade, invaluable experimental instrument that every radio amateur should have. FOUNDATION KIT includes cabinet, etched chrome front panel, chasis, view shield, front and rear terminal strips, special power and output transformers, vari-speed scanning motor, mirror and special neobeam tube. Accurate and reliable — an advanced instrument of advanced engineering design. Easy to assemble. Fully guaranteed.

ORDER TODAY

SUNDT ENG. CO.
(Affiliate of Littlefuse Laboratories)
4246 Lincoln Avenue, Chicago, Ill.

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

7. In any system, use as small coupling to the antenna as possible. Stations have been contacted on their second harmonic, advised of the fact, and a reduction in coupling has immediately cleared the trouble.

8. Listen for your own harmonics on your own receiver and use a tuning indicator to adjust for minimum harmonic radiation.

The reason that the pi-network can increase harmonic radiation rather than suppress it is another story. For the present suffice it to say that a mathematical analysis of the situation indicates that a perfect impedance match is seldom, if ever, attained as this coupler is generally used in amateur stations. This applies particularly with feeder systems such as the Zepp which require tuning to resonance.

The Hudson Division Convention

The Eleventh Hudson Division Convention, held at Schenectady on October 2nd and 3rd, attracted 340 amateurs from many sections of the country. Early arrivals Friday morning, after registration at the Hotel Van Curler, were treated to an extensive tour through the General Electric Company's shops, followed by a demonstration of u.h.f. police radio by Mr. H. Duval. The afternoon saw many conducted trips made through transmitting stations WGY, W2XAF, and W2XAD. On Friday evening the local engineers were provided with an opportunity to show the wonders of the "House of Magic," and their demonstrations will long be remembered. A party followed, featuring entertainment and plenty of refreshments.

Saturday morning gave the members of the Hudson Division 'Phone Association a chance to get together for their regular meeting. The afternoon meeting featured talks on various radio subjects, including "A.A.R.S." by Capt. David Tally, "N.C.R." by Lt. John L. Reinartz, "Antennas and Transmission Lines" by L. M. Leeds of the General Electric Company, "Heterotone C. W. Telegraph Reception" by James J. Lamb of A.R.R.L. Headquarters, and "A Substitute for Crystal Control" by John L. Reinartz of RCA. An A.R.R.L. meeting, presided over by Director Kenneth T. Hill, introduced President E. C. Woodruff and Vice-President George W. Bailey, and the many questions asked were answered by the League officials present. An A.A.R.S. meeting conducted by Captain Tally concluded the afternoon program. The YL's had not been neglected, during the afternoon meeting, their minds having been temporarily taken off radio by a sight-seeing trip around Schenectady and vicinity and a theatre party.

Director Hill acted as toastmaster at the banquet Saturday night, and introduced many notables, including Dr. E. C. Woodruff, George W. Bailey, Mayor Robert Baxter of Schenectady, Lt. Colonel S. W. Stanley and Lt. John L. Reinartz. The banquet was followed by a well-conducted prize drawing at which over 200 prizes were awarded.

—G. S. H.
FAIR DEALINGS plus FAIR PRICES

We "know what it's about" and go to no end of bother to get numerous specials to give QST readers many money saving values. Our customers of Foreign Shores find it profitable to buy direct from one of the world's greatest radio markets. We know just what declarations, etc., your country requires for prompt and economical delivery of your goods. We realize you are far away and fill your orders most carefully.

SPECIAL! WHILE THEY LAST
The "EAGLE" Three-Tube Short-Wave Receiver

"Band Spread" over any portion of the tuning range — The finest material used throughout. Employs one '37 Detector and one '33 Pentode Audio — 15 to 200 meters — four coils, supplied. The "EAGLE" is economical — two dry cells will operate the filament.

"Eagle" completely wired and tested .......... $9.95
Three tubes tested in your receiver ............. $2.50

AT LAST! PREMIER CRYSTALS
Gross Radio, realizing the needs of the ham for a real crystal, brought pressure to bear on Pioneer Laboratories, caterers to Government, Laboratory, Broadcast, and other commercial users to produce high-grade crystals to meet the demands of the amateur.

Premier crystals now available at prices you pay for ordinary crystals. Formerly these crystals could only be bought by the lucky few able to pay the regular price 2 to 2½ times our price.

When you buy Premier crystals, you are getting the finest crystals money will buy, real power oscillator, full size approx. 1" x 1" (not small chips, etc.), expertly finished and guaranteed accurate calibrations.


NEW!!
CW-50—Uses 6L6 Tubes
FB for 30 MC
Output — 50 watts
42 osc., 6L6 Buffer
2-6L6 amp.

Coils can be supplied for 30, 14, 7, 3.5, and 1.7 MG Bands. Complete Kit, with one set Coils, less tubes and crystal ........ $16.95
Descriptive Bulletins on request

NEW! "THE STANDBY" (2 TO 2000 METERS) 3-TUBE A.C. AND D.C. RECEIVER

This excellent 2 to 2000 meter receiver is offered with full realization of the present-day need of the amateur for a dependable "standby" receiver which will cover practically all of the radio bands in use today. Super regeneration, which is the most efficient form of detection at these frequencies, is used from 2 to 15 meters. The R.F. stage is effectively used over the entire tuning range. Throughout the entire tuning range, there are no skips or dead spots. Loud speaker volume is available from practically every station received.

1. 1000 to 1 tuning ratio
2. Automatic change over from straight to super regeneration.
3. Power supply incorporated
4. Individual antenna tuning for high and low wave ranges

Complete kit of parts, less coils, tubes, cab, etc....$17.59
4-10-meter coils (set of 4) ....... $9.50
15-200 meter coils (set of 4) ....... $9.50
200-310 meter coil ....... $9.30
310-550 meter coil ....... $9.50
550-1000 meter coil ....... $6.60
1000-2000 meter coil ....... $6.00
Metal cabinet ....... $1.50
Kit of three tubes 2.40
Wired and tested in our lab., add. 2.00

FAIR DEALINGS plus FAIR PRICES

GROSS RADIO, INC., 51 VESEY STREET, NEW YORK CITY

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

(Continued from page 90)

DAKOTA DIVISION

NORTH DAKOTA—SCM, Hartwell B. Burmer, W9OEL—DM at Hovland,melds with W9JL and schedules with TCRI and 9WLL. SWC reports hearing 78HII calling QRR, Calgary on Dec. 14th on about 7100 kcs.; made attempt to hook him but failed; nevertheless, the old Amateur Spirit to the rescue. RIF of Fargo will be on with a pair of 500-Watts, BMT to join with 6L6 exciter in QSO with W9JL. RFQ of Dakota, now running radio shop in Dunseith.

LOW-POWERED RIG TO KEEP IN TOUCH WITH THE GANG. WLI, at KOVC, Valley City. DWB and YHF are new 1.75-Mc. 'phones in Bismarck. YXB is new call at Watford City and will attempt to hook BNO, from YMN,; also LBO. YWC is new Hope call. WWL and DXW, who are O.R.S. and are looking for traffic schedules. WEQ is now working Break-in and likes it FB. FYK of Valley City dropped in on the S.C.M. for a visit and plans low-powered rig to keep in touch with the gang. WLI, Grand Forks, now has crystal for 3065 kcs. on T.L. "H," of the Sioux F'alls Amateur Radio Club. Hams were present from Adrian and Luverne, Minn. The gang from Brookings nailed another QRM and busy "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activities, 8cofield. OED and WGN report a "Publicity." PG'S and Activi...
all of you enjoyed the Holidays.

Traffic: W9ILH 707 RMN 653 E97 487 T7V 138 KJY 131 RN until he can find work. LAX expects to plunge into the sea at Duluth Hamiest. CUC is working 28 Mc. PDE reports were received, but too small, I am not sending in a W7 for traffic.

Traffic: W9ILH 977 RMK 465 E67 487 T7V 138 KJY 131 RN until he can find work. LAX expects to plunge into the sea at Duluth Hamiest. CUC is working 28 Mc. PDE reports were received, but too small, I am not sending in a W7 for traffic.

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The new inductance-tuned i-f transformer
(Type L)

Tuning is accomplished by changing the position of the Polyrion cores in the fields of the respective coils. High quality fixed capacitors are used instead of variable trimmers of the compression type. Greater stability is afforded with this type when used under extreme conditions of temperature, humidity and vibration.

ALADDIN RADIO INDUSTRIES, INC.
466 W. Superior St.
Chicago, Illinois

List Price
L 150 converter for 262 kc. $2.50 each
L 250 diode for 262 kc. 2.50 "
L 1016 converter for 465 kc. 2.50 "
L 200a diode for 465 kc. 2.50 "

ALADDIN MANUFACTURING CO.
4831 Flounoy St.
Chicago, Ill.

Operating Data on the 100TH and 100TL

<table>
<thead>
<tr>
<th>100TH</th>
<th>100TL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filament voltage</td>
<td>5 to 5.1</td>
</tr>
<tr>
<td>Filament current</td>
<td>6.5</td>
</tr>
<tr>
<td>Amplification factor</td>
<td>30</td>
</tr>
<tr>
<td>Grid-plate capacitance</td>
<td>2</td>
</tr>
<tr>
<td>Input capacitance</td>
<td>2.2</td>
</tr>
<tr>
<td>Output capacitance</td>
<td>0.3</td>
</tr>
<tr>
<td>Maximum plate voltage</td>
<td>3000</td>
</tr>
<tr>
<td>Maximum plate current</td>
<td>225</td>
</tr>
<tr>
<td>Maximum grid current</td>
<td>50</td>
</tr>
<tr>
<td>Normal plate dissipation</td>
<td>100</td>
</tr>
</tbody>
</table>

As Class-B audio amplifiers, the outputs obtainable at various plate voltages, with the optimum load resistance chosen in each case, are as follows:

<table>
<thead>
<tr>
<th>Plate Voltage</th>
<th>Power Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate to plate</td>
<td>100TH</td>
</tr>
<tr>
<td>1000</td>
<td>5200 ohms</td>
</tr>
<tr>
<td>1250</td>
<td>5600 &quot;</td>
</tr>
<tr>
<td>1500</td>
<td>6000 &quot;</td>
</tr>
<tr>
<td>2000</td>
<td>16,000 &quot;</td>
</tr>
<tr>
<td>2500</td>
<td>22,000 &quot;</td>
</tr>
<tr>
<td>3000</td>
<td>30,000 &quot;</td>
</tr>
</tbody>
</table>

A pair of 6L6 tubes will deliver more than enough power for driving purposes. The bias on the Class-B tubes should be adjusted to give normal plate dissipation (indicated by a bright orange-red color) under no-signal conditions. The 100TH can be operated at zero bias with plate voltages up to 1250.

Following is typical operating data on the tubes as Class-C amplifiers.

<table>
<thead>
<tr>
<th>Plate Voltage</th>
<th>Plate Voltage</th>
<th>Power Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate to plate</td>
<td>100TH</td>
<td>100TL</td>
</tr>
<tr>
<td>1000</td>
<td>200</td>
<td>150</td>
</tr>
<tr>
<td>1250</td>
<td>150</td>
<td>115</td>
</tr>
<tr>
<td>1500</td>
<td>250</td>
<td>185</td>
</tr>
<tr>
<td>2000</td>
<td>300</td>
<td>230</td>
</tr>
<tr>
<td>2500</td>
<td>400</td>
<td>320</td>
</tr>
</tbody>
</table>

For r.f. power amplification, the 100TH is recommended in preference to the 100TL because its higher amplification factor makes it easier to excite. For the same reason, the 100TH is particularly suitable for frequency multiplication. Parenthetically, it may be noted that the 100TL can be used for direct replacement of the 50T in existing equipment, although the tube carries higher ratings than the type it superseded.
TYPE O DIAL

The National Type O Dial is definitely a handsome piece of equipment. The circular-grained, solid nickel-silver dial is 3½ inches in diameter. Numerals and division lines are clean-cut and accurate. The large bakelite knob is well proportioned and comfortable to the hand. For safety, the dial is positively insulated from the hub by a large bakelite boss. Ask to see the National Type O Dial at your dealers.

NET PRICE
$.90

NATIONAL COMPANY, INC., MALDEN, MASS.

ANNOUNCEMENT

The Bellefonte Radio Engineering & Manufacturing Co., Inc. is pleased to announce that they have entered into and are continuing with the business formerly conducted by the Bellefonte Radio Eng. Lab. and Bellefonte Crystal Lab. We wish to assure the friends of the old Companies the same courteous and prompt service and solicit their valued patronage.

We will forward you price lists upon request and offer all information concerning any type of quartz crystals

Traffic: W6SSE 192 GWK 87 BSX 83 (WLTD 22) AKT 56 ZNB-SSL 46 RQM 51 GNM 9 WSY 3 HXK 2 GYQ 1.

Midwest Division

Iowa—SCM, Owen Williams, W9NNM—Your new SCM assumes the guidance of Iowa’s activities with traffic handling as its major accomplishment. The SCM is now the state about zero. Live stations willing to maintain schedules and handle traffic are needed in all of the Mississippi River cities as well as in the larger inland towns. Reliable schedules will be arranged for the state. SCM will apply, supply the schedules, and have the state now in operation. We also need traffic men in Sioux City and Fort Dodge. Let’s hear from the locals on 7 Mc. VUS has moved to Ames. HUZ returned to the larger inland towns. Reliable schedules will be arranged for the eastern half of the state about zero.


Kansas—SCM, Harry E. Legler, W9PB—Nice bunch of University of Kansas Amateur Radio Club members every Wed. evening on 1.75-Mc. c.w.; a good time is being had by all. FZJ is going strong; YDZ is praying for a communication receiver; YFZ is building super; YIN and YNO are hard after W.A.S. VUQ is planning new rig with T-T in final. SGQ will soon have new rig with pair of 212’s in final on 3.9- and 1.75-Mc. phone. VHS is having good luck on 28 Mc. SMH returned to California.

Traffic: W8NBT 1141 (WLU 296) POF 310 FAM 289 DI 229 UGT 71 UDH 40 EWH 6 KJP 4 BQR 3 RWN 7.

West Gulf Division

Northern Texas—SCM, Richard M. Cobb, W5BBI—W5DXXA, Route Manager, leads in traffic this month with 266 reports in need of schedules. SCM is using a 6L6 crystal and a 211-D now. EFS is running several good schedules. BCW has six daily schedules and is going to try for the B.P.L. next month. FAE reports DNE is feeling better. FLG’s house burned last month; he is in the process of rebuilding. VCW has some good traffic schedules on 7 Mc. AZE is experimenting and chewing the rough out of the rig. TXA is working with a new rig in the rig. SMX reports from Gulfport, Miss.; he is now FZS Operator at WQCM, on the coast. FQZ is 15 years old and likes to chew the rag on 7 Mc.


Oklahoma—SCM, Carter L. Simpson, W5CEZ—CEZ discovered a crack in the envelope of his ‘39A; looks like some additional water will be needed soon. EXZ has the Okla. Net working; it’s all-O.R.S. BTZ sent traffic report for the A.A.R.S.; W.D. for O.R.S. for FSP and W.D. for O.B.S.; his appointments being transferred to this Section. CPT finally got his W.A.C. certificate. AID is mostly on 3.9-Mc.; phone; he is president of the 36th Division Radio Club. FSB is doing all day long; pass your traffic through him if you want it to go places. Old ‘K.’ TGN says the J’s roll in fine on his new Breting 14. DWB has had his hands full arranging for daytime traffic schedules. FMF is operating portable at Parsons for indefinite period. PHY wishes us luck in our new S.C.M. duties. A newcomer from Missouri is KCO who copies Trans-Radio Press for KFBL. YRN is now ham in Salina and already reports CWW handled messages from Norway and also reports ‘S.C.M. about O.B.S. and O.O. LOW wants the scope on O.P.S. UVW 58 Mc., and says don’t waste dope on O.P.S. DZM has new NC100X. UPH sports new Class A ticket. EJQ worked Texas on 3.5 Mc. with A.E.C. portable rig using 6L6 and 6 watts input. SCM, Legler, heartily endorses the Legler’s program to improve procedure and standards of ‘phone operation and expects to promote this work in the Section. Get in touch with IQI, the R.M., for traffic schedules so your traffic will not be missed.


Missouri—SCM, J. Dewey Mills, W5CJR—ARH is QSL radio and service. SCM is selling stamp collection to get cash for transmitter parts!! NZN reports WEC, WBQ, WEM and WKF all active in Kirkville. DHN worked OS5ML on 5.5 Mc. with 55 watts!! EDF is DXing on 28 Mc. LBA had his Fall Buc. Neighbor, DVB for visitor. JAP was away in the Missouri Circuit and had a good schedule active. KEI is keeping 5 daily schedules in addition to O.B.S. schedules. TGN is keeping A.A.R.S. schedules.


Missouri SCM, Owen Williams, W9NNM—Your new SCM assumes the guidance of Iowa’s activities with traffic handling as its major accomplishment. The SCM is now the state about zero. Live stations willing to maintain schedules and handle traffic are needed in all of the Mississippi River cities as well as in the larger inland towns. Reliable schedules will be arranged for the state. SCM will apply, supply the schedules, and have the state now in operation. We also need traffic men in Sioux City and Fort Dodge. Let’s hear from the locals on 7 Mc. VUS has moved to Ames. HUZ returned to the larger inland towns. Reliable schedules will be arranged for the eastern half of the state about zero.


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SOUTHERN TEXAS—SOM, Ammon O. Young, W6BDT—\^\textsuperscript{1}OW turns in the regular high traffic total. MN is knocking the usual high. LKDD is a new receiver which uses a 6J7 and a 6CS, DWN hopes to be back on with his regular schedules soon. FGP has \textsuperscript{32} on 14-Mc, \textquotesingle phone. ETR is building a rig with a T55, FFM and FFGM, all \textsuperscript{5} to visit Bexar, TX. He heard some FD DX on 18 and 14 Mc. EJW has moved to a new QTH and hopes to be able to work some DX, as he left his old noise behind. EKF is experimenting with preamplifiers. BHO is building a new beam shaker over his garage. The Houston A.A.R.S. Club sponsored ice skating party and is working on plans for the next West Gulf Convention. C1Z is back on 7 Mc. BDI hopes to have the transmitter working on all bands and a 6-tube home made adapter for reception.


NEW MEXICO—SCM, Joseph M. Eldottch, W5CQJ—\textsuperscript{D}CQ leads with hands in this traffic month; we expect him to make the B.P.L. soon; he has ten regular schedules daily and says he can handle as many more. Here is a chance for anyone wanting a regular contact down this way to get it. The Carlsbad gang is getting pretty active. DWP attended the West Gulf Division Convention and they joined the A.A.R.S. and c.w., with about 80 watts. YYH is a new Arvada ham.

Traffic: W6DP 446 ENI 206 ZM 100 (WLOJ 108) DJY 70 CQG 84 (WLJE 4) DJG 34 FSP 26.

ROCKY MOUNTAIN DIVISION

COLORADO—SCM, Glen R. Glasscock, W9FA—PVZ carries off the traffic honors again this month with his string of 10 daily schedules. ESA is getting back into the traffic swing too, principally A.A.R.S. work. Speaking of A.A.R.S., Eddie is looking for more members, so any of you fellows reading this, just get in touch with him, and he will give you all the dope. GBQ and ESA have been attempting some 55-Mc. tests with 3FFJ, but so far the results have been nil. EKO is another of the A.A.R.S. gang who has traffic on one of the A.A.R.S. Trunks. TDR in Pueblo has been QRL at the Airport. PWU has been keeping the mike hot on four bands: 175, 3.5, 14, and 28 Mc., and he's not neglecting the traffic angle either. WWB in Pueblo is making good use of his O.R. appointment. CAA expects to be going full blast by the time this is published. SVL plans to be on all bands, \textquotesingle phone and c.w., with about 80 watts. YHY is a new Arvada ham. The C.C.R.A. held a New Year's Party at the home of Colorado Springs gang. Carl is awaiting delivery of a new ODF, with prizes and refreshments. The Rocky Mt. Net suffers. GCM, PWO and SJT with S.U.M. would like to have the name and address of every active ham in the state. Let's keep our traffic growing.

Traffic: W6DP 446 ENI 206 ZM 100 (WLOJ 108) DJY 70 CQG 84 (WLJE 4) DJG 34 FSP 26.
The many enthusiastic reports which we have received from leading amateurs from coast to coast concerning the VT-73 voice transmission microphone are greatly appreciated.

The VT-73 and other Turner crystal microphones are completely described in a new six-page Kolor bulletin soon off the press. It is yours for the asking. Just say "Send me Bulletin 70-B".

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CEDAR RAPIDS, IOWA
Licensed Under Patents of the Brush Development Company

VISASIG Full Automatic Siphon Tape Recorder for Amateur and Commercial use
Will record code signals from the air up to and in excess of 100 WPM. Use it to make a record of your own lists or the fellow's you work. Make a permanent record from your receiver of weather reports, press news, speed contests, etc. See how it helps improve your skill!

VISASIG — with electrically driven tape puller complete in one unit. . . . . . $49.00
VISASIG — without tape puller. . . . . $35.00

PRICES F.O.B. NEW YORK CITY
Commercial Station Managers and Executives write for particulars of professional 200 WPM model

UNIVERSAL SIGNAL APPLIANCES
64 West 22nd Street New York City
Visasig Blueprints $1.00

Medium Powered Pentode Transmitter

(Continued from page 19)

be no louder with the oscillator plate coil in the socket than with it out. But be careful when you pull the plate coil out—the voltage is on all the time. If you do not get complete cut-off of output with the key up, it indicates that the suppressor negative bias voltage is not high enough. As mentioned previously, the amount of radiation picked up in the receiver will be determined by the completeness of shielding and filtering, but this will not be given a chance to work unless the electrical cut-off is complete.

The final amplifier is tuned in the usual manner. When the oscillator has been adjusted, the grid current of the amplifier should be from 7 to 10 milliamperes. The plate tank condenser is tuned for minimum current and the antenna is connected. Normal current for the amplifier is from 75 to 90 milliamperes. With the key up, the final amplifier should show neither plate nor grid current. If some plate current is drawn, it indicates that the fixed bias on the amplifier is not high enough and it should be checked with a voltmeter. Between 100 and 150 volts is correct. If grid current shows with the key up, it indicates that the keying is not complete.

The method of adjusting the transmitter for "phone is just as simple. Throw the switch to "Phone" and tune the oscillator. When the excitation has been adjusted for maximum, the suppressor grid lead to the final amplifier stage is opened and a 45-volt battery inserted, connecting the suppressor grid to the positive side and returning the negative side to ground. The load is then adjusted until the tube draws normal plate current (80 to 90 milliamperes). Remove the battery and reconnect the suppressor grid...
CONVENIENT SIZE • LOW LOSS • INEXPENSIVE

These condensers are used widely by amateurs in all circuits requiring small, simple-to-mount, low-loss units. They can be used either as single hole panel or bracket mounting. The insulation is a small end-plate of hard rubber placed in a weak field. Rated at 500 volts, peak, they are very suitable for use in low power transmitters. The plate shapes are straight-line capacitance. The Type 368 Condensers are supplied in three sizes:

Type 368-A: 15 µµf maximum, 2 µµf minimum; $0.75
Type 368-B: 50 µµf maximum, 3 µµf minimum; $1.00
Type 368-C: 100 µµf maximum, 4 µµf minimum; $1.50

Write for bulletin 94-Q for a description of the many General Radio amateur parts and accessories.

GENERAL RADIO COMPANY
Cambridge, Massachusetts

VOLUME TWO
OF
HINTS & KINKS

Has Just Appeared!

A personal appearance, too — nothing impersonal, because Hints & Kinks always has been a collection of personalities — because it is again a collection of practical ideas gleaned from personal experiences in ham shacks the world over.

128 pages in attractive paper covers. Price: 50 cents (no stamps, please), postpaid anywhere.

THE AMERICAN RADIO RELAY LEAGUE
WEST HARTFORD, CONNECTICUT
ASTATIC RELEASES A NEW QUALITY CRYSTAL PICKUP

TRU-TAN
MODEL B-10

BETTER REPRODUCTION LONGER RECORD LIFE

Its scientifically designed offset head reduces needle tracking error from the 10° to 15° prevalent with regular straight arm pickups to a maximum never exceeding 1.5° with the TRU-TAN. Plus absolute freedom from mechanical resonance. Plus a reversible head for easier needle loading.

ASTATIC MICROPHONE LABORATORY, INC.
Youngstown, Ohio, U.S.A.

Write for Bulletin Giving Complete Details

ASTATIC

How Old Is Your LICENSE MANUAL?

You know that the F. C. C. makes frequent changes in amateur regulations? That many of these changes deal with the rules for getting new licenses and renewals? That when the regs are changed, the appropriate questions are changed in the license examination, and the answers have to be different?

To keep pace with these changes, the Radio Amateur's License Manual is frequently revised. It is now in its seventh edition. Moreover, each copy is, when necessary, accompanied by a change sheet summarizing any changes that have been made since it went to press. The License Manual is as invaluable to the practicing amateur as it is to the aspirant — but only if it is the current edition.

Price 25¢ postpaid

American Radio Relay League
West Hartford, Connecticut

BOOK REVIEW


This book, written by acknowledged authorities on the subject, will doubtless be the standard reference work in its sphere in years to come. It is a complete, detailed, authoritative and scholarly treatment of the entire telecommunications field, covering both economics and regulation. It commences with chapters detailing the development of the telegraph, cable, telephone, radio, communication and broadcasting industries, proceeds with an analysis of the economics involved, including a detailed examination of rate-making procedures, and then carefully examines the regulation of these forms of communication from the local, national and international standpoints. There is a particularly penetrating chapter on communications and national policy.

The amateur, of course, will find only incidental direct interest in a volume as comprehensive as this. Yet there is no amateur who could fail to read it without deriving a measurably fuller understanding and appreciation of amateur radio in its relationship to other radio services. Many of the self-anointed prophets of a new legislative deal in amateur radio might do that with benefit.

As for any serious student of the machinery of telecommunications administration and regulation, this book is definitely required reading.

--C. B. D.

In connection with the warning regarding mounting of beam power tubes on page 76 of the December issue, RCA-Radiotron advises that their beam tubes can be operated in any position without danger of grid misalignment.

Say You Saw It in QST — It Identifies You and Helps QST
Hundreds of hams, all over the country, are rejoicing at the convenience of their RADIOLAB CLUB PLAN MEMBERSHIPS. They buy whatever they need from the huge Radiolab stock and pay out of monthly income.

Why not you too? A penny post card will bring complete details

RADIOLAB
1515 GRAND AVE, KANSAS CITY, MO.
HARVEY 700-R

The 700-R is a new transmitter comprised of our standard 80-T and 700-A units assembled in a single rack cabinet. Such a combination is especially desirable for present 80-T owners who wish to increase power at nominal cost and for prospective 80-T purchasers who are assured that their first investment will be well protected when higher power is contemplated in the future.

- **POWER OUTPUT**
  - 150 watts, Phone.
  - 450 watts CW.

- **R.F. SECTION**
  - 6L6 crystal oscillator, RK-20 modulated amplifier, two Eimac 150-ts as class B linear amplifier.

- **FREQUENCY RANGE**
  - 1500 to 30,000 kilocycles.

- **SPEECH AMPLIFIER**
  - Designed for single diaphragm crystal microphone input.

- **FREQUENCY Shift**
  - Plug in coils are used on all bands.

- **INSTRUMENTS**
  - A complete complement of meters is furnished as well as built-in modulation monitor and carrier shift indicator for constant checking of transmission characteristics.

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HARVEY RADIO LABS., INC.
12 Boylston St., Brookline, Mass.

Export: 25 Warren St., New York City
CABLE: "SIMONTRICE"

A Simple Directive Antenna
(Continued from page 48)

How does that sound to the low-power boys? It was extremely thrilling to move the reflector with the receiver on and to watch the DX signals weaken and fluctuate, while signals from the opposite side rose out of the background. The array was tested for a whole month and was then given up due to leaving the place. The new antenna, a vertical half wave, does not stand any comparison with the old one, although it is known as a not bad DX radiator. It is hoped, however, to resume the experiments with long wire antennas in the summer of 1937.

I.A.R.U. News
(Continued from page 78)

occurs just before sunrise, and seems to tie in with the appearance of the sun’s rays.”

The phenomenon still intrigues us.

Boy Scout:

We feel rather good at this point, in view of a letter received from Gordon Kempton, VK2CI. Says Mr. Kempton: “I am pleased to give you a big ‘Thank you’ for being the means of reuniting me and my long-lost cobber (VK for ‘pal’) Bill McGutcheon, W2CET. He saw the bear and self in QST (October) and I got a letter from him before I got my QST. He was at one time ZL2JX and VK20X, and I had not heard from him since he went back to the U.S.A.”

Does anyone know the bear?

Mica CONDENSERS

AERVOX offers you 13 types of mica condensers to choose from — tiny "postage-stamp" unit to large cast-metal case high-voltage type.

- Widest choice of bakelite-molded units for any receiving or transmitting circuit use.

Available in voltages from 500 to 7000 D.C. Capacities from .00004 to .1 mfd. All units plainly stamped with capacity.

New Catalog: Covers most extensive line of condensers and resistors. Sent on request.

Say You Saw It in QST — It Identifies You and Helps QST
BLILEY offers the amateur the only complete line of crystal units for 20-40-80-160 meter band operation. The Type LD2 is the most popular low-drift crystal unit (less than 4 Cycles Mc./C.) on the market today. It is outstanding in power, activity, ability to key well, frequency, accuracy and stability. The Type HF2 Unit is the only crystal unit on the market specifically designed for 20 meters. It makes possible more efficient high frequency work, eliminates expensive doubler stages and gives a clean sharp note that goes a long way in breaking through QRM. You don't have to take our word for it; trust the judgment of the thousands of amateurs all over the world who say that BLILEY'S ARE BEST.

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BLILEY for DEPENDABILITY

OK2AK GAMMATRONS WIN ON BOTH SIDES OF THE WATER!

Hans Plisch, OK2AK, winner of W VE...DX contest for Czechoslovakia with 46,560 points.

A new 20-page brochure is now available containing data for the latest Type 354 Gammatron as well as a revision of the Type 354 Gammatron literature. Request the new Catalog 5357.

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Jobbers write: W9JRY, NORTH PLATTE, NEBR. W9CPM

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Say You Saw It in QST — It Identifies You and Helps QST
In the January, 1920 issue of QST there appeared an editorial requesting suggestions for the design of an A.R.R.L. emblem—a device whereby every amateur could know his brother amateur when they met, an insignia he could wear proudly wherever he went. There was need for such a device.

The post-war boom of amateur radio brought thousands of new amateurs on the air, many of whom were neighbors but did not know each other. In the July, 1920 issue the design was announced—the familiar diamond that greets you everywhere in Ham Radio—adopted by the Board of Directors at its annual meeting. It met with universal acceptance and use. For years it has been the unchallenged emblem of amateur radio, found wherever amateurs gathered, a symbol of the traditional greatness of that which we call Amateur Spirit—treasured, revered, idealized.

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AMERICAN RADIO RELAY LEAGUE

West Hartford Connecticut

The 1936 Northwestern Division Convention

THE Marcus Whitman Hotel at Walla Walla, Wash., served as headquarters for the group of over 200 northwestern amateurs and YL’s that attended the Eleventh Annual Northwestern Division Convention on Aug. 21st, 22nd, and 23rd.

On Friday evening, Director Ralph Gibbons, committee chairman, introduced Nick Foster, W7RX, of Seattle, who gave an interesting illustrated talk on the development of the vacuum tube, from the early models up to the modern metal tube.

At the business meeting Saturday morning, a welcome to Walla Walla was extended by the mayor, after which President Woodruff and Assistant Secretary Goodman of A.R.R.L. spoke on amateur affairs. After lunch, the technical meeting was opened with an interesting talk by John Reinartz, W1QP, who demonstrated his new oscillator circuit and universal exciter. Dr. Woodruff proceeded to open his “bag of tricks,” and explained a few of his famous gadgets. Don Wallace, W6AM, spoke on “Directive Antennas,” followed by Byron Goodman, W1JPE, and “Single-Side-Band Telephony.”

The banquet, Saturday evening, was run off smoothly, under the capable handling of the toastmaster. A feature of the entertainment, which included short talks by the guests of honor, was the capable singing of George Peckham, W7ABD. Prizes were distributed, and the floor was cleared for a dance that left nothing to be asked for by the attending devotees of terpsichore.

Sunday morning the code speed contest was held; J. Gruble, W7RT, winning in the amateur class at better than 36 w.p.m. (copying with a pencil), and Conrad Schmidt, W7BEX, topping all others in the open contest at 41 w.p.m. ‘Tis said Schmidt can do much better, but no one present could send any faster! At Pioneer Park soft-ball games were held, a picnic lunch distributed, portable equipment was demonstrated by the Third Signal Corps and by W. Miller, W7AAN, and general rag-chewing was indulged in until the delegates reluctantly said their goodbyes.

Much credit is due Ralph Gibbons, Wilbert Beal, Alex Halverson and the other members of the committee that made possible a carefully-planned and well-balanced convention.

Strays

Out of several entrants for the “most-calls-held” honor, Ed Raser, W3ZI, RM for Southern New Jersey, heads the list by a wide margin. Starting in 1913 with self-assigned “RE” on spark coil, he’s had 3NG, 3CS, 3AEC, 3XAN, W3AOV, W3ZZB, W3ZZH, W3ZZJ, W3ZI, W3CMH, W0AX, WMAL, WWAB, KUJQ, KEBR, NA1, NSD, 99A, CD1, UG3, AX3, BE9, WLNE—ham, commercial, navy and army.

Say You Saw It in QST — It Identifies You and Helps QST
The December, 1936, issue of QST marked its twenty-first anniversary. It especially reminded us of the increasing value of back copies. You will note from the list below that copies covering the first ten-year period (1915–1924) are no longer available. Vol. 1, No. 1 in particular, and other pre-war copies in general, are so rare that they command high prices when available. Copies issued since the war (beginning with the June, 1919, number) up to the beginning of 1925 are becoming increasingly rare — as soon will be many of the copies from 1925 on. In fact, as the list shows, many since 1925 are already out of print.

(SUBJECT TO CHANGE)

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1926 copies — complete 2.50
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High-Power Crystal Oscillator
(Continued from page 55)

and the small drop in power output. With 3.5- and 1.75-Mc. crystals, the shell may be left floating since tests show that the crystal current was not excessive at these frequencies. Because of the tendency for this tube to self-oscillate when a tank circuit is connected in the cathode, caution should be used in Tri-tet operation. With all beam power tubes the screen voltage preferably should be obtained from a dividing resistor, and not from a series dropping resistor.

The 807 Tube

A relatively new tube to take the place of the 6L6 as a transmitting tube has been announced recently. This glass tube has the same beam power operating principle as the 6L6, and gives large power outputs with low plate voltages. It has considerably better shielding and requires less driving power than the 6L6. Since the shielding is more effective, the tendency toward self-oscillation and erratic performance is greatly reduced and this type is much to be preferred to the 6L6. When used in a conventional pentode oscillator with 20,000-ohm grid leak and 250-ohm cathode bias resistors, outputs of 25 watts may be obtained with a 14- or 7-Mc. crystal without overloading.

The data sheet supplied with this tube gives valuable suggestions on circuit design at the higher frequencies, and should be carefully read before planning the layout.

The R639

This tube is similar to the 807 type and also operates on the beam power principle. It is designed to stand a higher plate voltage and consequently a larger output may be obtained.

When used as a crystal oscillator with 750 volts on the plate, a cathode bias resistor of about 350 ohms should be used and a grid leak resistor of 15,000 volts. Under these conditions, outputs of 30 watts may be obtained with 3.5- or 7- or 14-Mc. crystals. The crystal current, even in the no-load condition, was well below rated values.

35T, 800 and 808 Triodes

Of the triode high-power tubes used as crystal oscillators, the 35T, the 800 and the 808 were tested. These tubes were used in the circuit shown in Fig. 7 and the table gives the output and maximum crystal current for different crystals and tubes. It will be seen that all crystals except the 3.5-Mc. were worked to their rated value, even with the circuit heavily loaded. Attempts to remove the load resulted in currents of 200 ma. and several blown 7-Mc. crystals. The lowest crystal current was obtained by using 500-ohm cathode-resistor bias. Any attempt to add grid leak bias increased the drive on the crystals. The plate voltage was reduced in order to decrease the crystal current; however, when reduced much below its rated value, the crystal was driven just as hard and the output was con-
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For some time our advertising in QST has carried a by-line reading "Number . . . . . . . in the series entitled Radio Amateur's Library." Many requests have been received for copies of this list and now we present it in QST in its complete form — to give a comprehensive picture of our publishing services to the amateur.

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More DX Per Dollar
(Continued from page 41)

that hardly can be distinguished from crystal control.

AUTOMATIC DRIVER

From the 6L6 we go to the two-stage automatic driver shown in Fig. 3. A plate neutralized 100TH is capacity coupled on 7 Mc. to a grid neutralized 250TH operating either straight through on 7 Mc. or doubling to 14 Mc. The capacity balanced plate tank, L3-C4, of the 100TH thus serves to neutralize both tubes. Grid neutralization is used on the 250TH so that changing its plate tank from 7 Mc. to 14 Mc. will have no detuning effect on L2-C4. R1 and C1 constitute the padder used to shift L2-C4 from the 7100-7200 region to 7000-7100 kc. The bias resistor on the 100TH is low to suit the excitation of about 6-8 watts available from the 6L6; some power is lost in the long link, but even 5 watts are sufficient drive for the 100TH. And with everything tuned right on the nose, a little over 1 watt excitation is enough for better than 100 watts output from the 100TH. The bias on the 250TH is left at a high value for doubler operation; this is away high for straight 7-Mc. work, but there is no need for full output on this lower-frequency band. The 100TH provides about 100 watts of drive to the 250TH to assure a reserve of excitation when the 250TH is doubling (especially as the latter's plate tank is operated fixed-tuned over the whole 14-Mc. band). Under the above conditions, the 250TH will deliver 400 watts on 7 Mc. and 300 watts on 14 Mc.—making it a respectable automatic two-band transmitter.

The chief point of interest in the circuit is the "two-band" plate tank, L5-C5-C8. With the bandchange relay Rel closed, C8 tunes the upper portion of L5 to 14 Mc. and the link L4 couples it to the 14-Mc. final amplifier. Then, when Rel opens, the lower portion of L5 is added to the circuit along with C8, which is used to bring the combination into tune on 7 Mc. (C8 remaining un-

siderably less. This condition exists because the amplification factor of a triode decreases rapidly with decrease in plate current. Therefore the best operating point for these tubes is near their rated plate voltages. Because of the lower amplification factor of the 6L6, however, the plate voltage could not be increased much above 750 volts.

No attempt should be made to use any of these tubes as crystal oscillators unless the crystal is adequately protected either by a low-resistance fuse designed to blow below the rated current of the crystal or by a small pilot lamp, in series with the crystal.

If high-voltage tubes are to be used to obtain high-power outputs from the crystal stage, it is best to stick to high-power pentodes. In any case, the crystal must be adequately protected by one of the above mentioned methods.
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When the amplifier is correctly adjusted and 100% modulation of sine-wave form is applied, the plate current of the carrier tube will remain substantially constant, and the current to the peak tube will increase by an amount equal to a little more than $\frac{1}{2}$ of the current to the carrier tube. The fact that the plate current increases about $\frac{1}{2}$, and not $\frac{1}{2}$, indicates that the amplifier increases in efficiency as the modulation is applied. That has been our experience in regard to the efficiency. The unmodulated efficiency was measured as 57% and increased several percent at 100% modulation. On the other hand, Doherty states that the plate current increases about $\frac{1}{2}$, and that the efficiency remains practically constant for different percentages of modulation.

Part II, describing the 7-, 14- and 28-Mc. final amplifiers, as well as the keying system and antennas, will appear in an early issue.—Essex.

The Doherty High Efficiency Amplifier

(Continued from page 58)

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CHICAGO, ILL., Allied Radio Corp. 833 W. Jackson Blvd.
CHICAGO, ILL., Wholesale Radio Service Company, Inc. 901-911 W. Jackson Blvd.
CHICAGO, ILLINOIS, 25 North Franklin Street Electric & Radio Supply Co., Inc.
CLEVELAND, OHIO, Goldhamer, Inc. 610 Huron Road
DETROIT, MICH., Radio Specialties Co. 171 E. Jefferson Ave.
MINNEAPOLIS, MINN., Lew Bonn Co. 1124-6 Harmon Pl.

RAYTHEON AMATEUR TUBES

AKRON, OHIO, Brighton Sporting Goods Corp.
CHICAGO, ILL., Newark Electric Company 925 W. Madison Street
CINCINNATI, OHIO, Steinberg's, Inc. 633 Walnut Street
CLEVELAND, OHIO, Northern Ohio Laboratories 8073 West 85th Street

Listings on this page do not necessarily imply endorsement by QST of the dealers or of other equipment sold by them.

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An explanation of this difference and in the slightly lower efficiency than expected probably lies in the relatively "hi-loss" tank circuits used in the experimental model. The tank circuit across the carrier tube has full r.f. voltage across it at all times and gets quite warm in operation. Losses in both plate tank circuits are supplied by the carrier tube when no modulation is present. When modulating, the peak tube supplies loss to its tank circuits only. On 100% modulation peaks, the carrier tube would be supplying more than twice the carrier output to the filter, while the peak tube is supplying just twice the carrier power.

The W. E. 211-D tubes used in the experimental model are old timers of the type recently advertised for sale at bargain prices. After our experience with them, we most emphatically do not recommend them for use in this amplifier, at least not at as high a frequency as 3900 kc.

As to the possibilities of this amplifier at higher frequencies, frankly we do not know. We would like to try our hand at it on 14 Mc., but not being able to do that, we hope that amateur-engineers will see what can be done about it at that frequency.

In conclusion, I wish to thank faculty members of the Electrical Engineering Department of Iowa State College for their aid during this project, and also to thank W. E. Stewart, chief engineer of WOI, for his criticisms during the preparation of this paper.

"Enamel-on," a bakelite paint sold in the dime stores, looks great on tempered Masonite panels.

—W1KC

W2CLM apparently doesn't believe in the use of radio frequency. He spent half an hour the other day at W2HEU trying to raise someone with the entire r.f. unit turned off and the Class-B modulator working into a dummy load. The diligence with which he combed the 20-meter band after a CQ looking for an answer to his 60 to 5000 cycle transmissions was quite amusing.

—W2HEU

AMATEURS
everywhere

Use VALPEY Crystals

The type VM2 mounted crystal employs a power type X cut crystal, precision ground to its finished frequency, supplied to within 5kc's of your specified frequency in the 1.7, 3.5, 7Mc. bands — $3.00. Exact frequency $5.00.

The type VM2A mounted crystal employs a power type crystal, frequency drift less than 4 cycles/M%c precision ground to its finished frequency, supplied within 5kc's of your specified frequency in the 1.7, 3.5, 7Mc. bands — $4.50. Exact $6.50.

Our products may be obtained from your dealer or by ordering direct.

THE VALPEY CRYSTALS, 377 Summer St., Medway, Mass.
HAM-ADS

(1) Advertising shall pertain to radio and shall be of such nature as to radio amateurs or experimenters in their pursuit of the art.

(2) Name of any character will be accepted, nor can any special typographical arrangement, such as all or part capital letters be used which would tend to make one advertisement appear larger than another.

(3) The Ham-Ad rate is $1.50 per word, except as noted in (1), (2), and (4) below.

(4) Remittance in full must accompany copy. No cash or check discount or agency commission will be allowed.

(5) Closing date for Ham-Ads is the 23rd of the second month, for publication in the following month.

(6) A special rate of 75c per word will apply to advertising which, in our judgment, is obviously non-commercial in nature. At any rate, such a member of the American Radio Relay League. Thus, advertising of bona fide experimenters, experimenters, used and for sale by an individual or apparatus offered for exchange or advertising in the classified equipment, if only a member of the American Radio Relay League takes the fee rate. An attempt to deal in apparatus is for resale, even if by an individual, is commercial and takes the 150c rate. Provisions of paragraphs (1), (2), (6) and (8) do not apply to all advertising in this column regardless of which rate may apply.

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.

QUARTZ—Direct importers from Brazil of best quality pure quartz suitable for making plex-electro crystals. Diamond Drill Co., 382 W. 38th St., New York, N. Y.

RADIO engineering, broadcasting, and police radio, servicing, marine and Morse telegraphy taught thoroughly. All expenses low. Catalog free. Dodge's Institute, Byrd St., Valparaiso, Ind.

NATIONAL—Hammarlund. RCA-RME used sets, 60% off list. W3DQ, 405 Delaware Ave., Wilmington, Del.

QSL's, W2CT, Palmetto, N. J.

CLASS B transmitters—Transmitting for two or four 40's, 6000, 20,000, etc., $7.75 pair postpaid. 70 watts audio from 40's, 100 watts from 10's. Write for details. W3UHD, Douglas, Mich.

CALL BOOKS—new D-X calls, new prefixes, thousands of new W and VE calls, in the Winter J936 Radio Amateur Call Book, Sent postpaid $1.25, or a whole year (four issues) for $4. (In foreign countries $1.35 and $4.35.) Your call and QRA printed in large type $1 per year. Radio Amateur Call Book, 619 St. Dearborn, Chicago.

TELEGRAPH speed keys in kraft form, only $2.89. A post card brings full information. Electric Specialty Mfg. Co., PO Box 405, Cedar Rapids, Iowa.

GENERAL Electric Dynamos 24/750 volt, 200 mills $23. Operate on lower battery delivering 30 v per input volt. 500 cycle 500 watts with exciter $10, slightly used $6. Henry Kienzle, 215 Hart Blvd., Staten Island, N. Y.

ORDER $5 for good copy December 1936 QST with both covers. V. B. Young, Mapleswood, Wayzata, Minn.

CALL pins for label or vestment—satisfaction guaranteed. $1.50, W2CZB.

QSL's. Free samples. Printer, Corwith, Iowa.

TRANSMITTER 5 K. W. 1200-2200-3000 each side $20. Frank Greben, W9CES, 122 S. Peoria St., Chicago, Ill.


C.R.S. X-cut; 60m within 5 3c. $1.10; 40m $1.40. AT, X-cut, near zero drift, $1.25, $2.25, $2.75, $3.75. QRA, $1.50. Ground C. O. D. if desired. Premium Crystal Co., Box 2250-B, Kansas City, Mo.

TRANSFORMERS 1 K. W. 1200-2200-3000 each side $20. Frank Greben, W9CES, 122 S. Peoria St., Chicago, Ill.

QST-NEW—New designs. Finest yet. Samples on request. W2ALY.

HALLICRAFTERS 1937 Skyriders, W9ANZ. 1000 volt Motor Generator, W9ANZ.

HALLICRAFTERS 1937 Skyriders, W9ANZ. RME-69 practically new, perfect condition—$110 each. Dr. Stael, Herman Kaier Hospital, Detroit.

SKYESRIDER Transformer Super—Complete, Prefessional, prespective, speaker. Highest offer takes it. W2FZJ.

QSL's: Better designs; better stock; better workmanship. Free samples to Hams only. W2FJE, 143 DeKalb Ave., Brooky, N. Y.

C.R.S.: Unconditionally guaranteed, small X cut, 80-160 meters, within ten kilocycles, $1.50. Approximately 10 per second frequency $2.50. Small X cut, 80 meter semi-finished blanks, including carbonizing material, $1.40. 80, 40, 20, 10, 800, etc., $4. Miller Surprise, 255 Madison, Chicago.

QSL'S—2 color—$1. hundred. WSNOS.

SURPLUS parts list, W9ANZ.

HALLICRAFTERS 1937 Skyriders, W9ANZ. RME-69 practically new, perfect condition—$110 each. Dr. Stael, Herman Kaier Hospital, Detroit.

SKYESRIDER Transformer Super—Complete, Prespective, speaker. Highest offer takes it. W2FZJ.

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QSL'S—2 color—$1. hundred. WSNOS.

PLATE transformers—Hill 2 1/2 kw, new and guaranteed, all voltages, $39, Send for circular. Leich, Park Drive, W. Orange, N. J.

LAEIGH stock Eidson's X cut, accurately calibrated, 40 meter crystal, $1.50, 80 X cut, $1.50, 40 meter on ground, $1.40, Efficient ceramic holder standard banana prongs $1.10 postpaid. Hieronymus Radio, 88-200th St., Queens Village, N. Y. Postcard C. O. D. orders O.K.

SALE—Fort Wayne type KK W. H. meters, 60 cycle, 110 or 220 volts, $2 each, W9DOH.


CRYSTALS: 1" square, X cut 80-160 meters $1.40, 40 meters $2.50, Within 8 kc. of desired freq., Naval Reserve Freq., $1.40. Guaranteed the very best. The Ransom Lab., N. Syracuse, N. Y.

SUPERHET—wanted—cheap. W3FWY.

USED RK879’s, WSANT.

USED receivers, WSANT.

USED tank condensers, WSANT.

ALL lines of new equipment, WSANT.

NEW receivers, all makes, WSANT.

NEW 42A. Cheap. WSANT.

ALL lines of new transmitting tubes, WSANT.

WSANT—1 kw—1000 ft., per QSL, WSANT.

ALL lines of new and used amateur equipment for sale, Parts bought, sold, and exchanged. Write to Southern Ohio’s only amateur owned amateur business. Jos. N. Davies, WSANT, 2767 N. Bend Rd., Sta. A, Cincinnati, Ohio.


Monroe City, Mo.


CRYSTALS: 1 square, X 220V; 4.25KVA; Primary switch gives RAC 4000, 3650, 3300. 2767 N. Bend Rd., Sta. A, Cincinnati. Ohio.


WE are specialists supplying precision cut blanks to many grinders of fine crystals. Write for prices. Faberadio, Sandwich, III.

8000V GE transformers centertapped. Type KD950; 110 or GUARANTEED the very best. The Ransom Lab., N. Syracuse, N. Y.

SUPERHET—wanted—cheap. W3FWY.

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ALL lines of new equipment, WSANT.

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WE are specialists supplying precision cut blanks to many grinders of fine crystals. Write for prices. Faberadio, Sandwich, III.
Your Nearest Dealer Is Your Best Friend

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 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.

Patronize the dealer nearest you—You can have confidence in him.
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.

Every conceivable need of a radio amateur can be supplied by the advertisers in QST. And you will know the product has the approval of the League's technical staff.
Details Count!

In designing and assembling communication type equipment too much stress cannot be laid on individual details.

Sturdy frames, adequate and well bonded shields, rigid mounting of coils, and correct location of parts for electrical efficiency throughout the circuit spell the difference between just an ordinary receiver and an RME-69 Single Signal Super.

RME has always invited rigid inspection and knows from past experience in the Ham game that—details count!

Write for Bulletin 69

Radio Mfg. Engineers, Inc.
Peoria, Illinois
Power Equipment is NEVER OBSOLETE with UTC VARIPower Autoformers

These UTC Varipower Autoformers are being put to new uses daily. In addition to the many amateur applications, they are being used for testing and measuring work... soldering iron and electrical heat control... illumination control for theatre and photographic use... motor speed and welding current controls.

For amateur service, they may be used for:

**LINE VOLTAGE CONTROL** — Using the Varipower Autoformer, any line voltage from 60 to 130 volts can be corrected to within 2½% of desired value.

**VARIABLE VOLTAGE UNIT** — UTC Varipower units are arranged so that simultaneously with line voltage correction any output voltage can be obtained from 0 to 130 volts in 5 volt steps. Using the autoformer with a standard plate transformer a very wide range in plate voltage can be obtained. Power can be cut down for local service, or a plate transformer intended for one application can be used for another. An 801 plate transformer can be used for 6L6's, or a plate transformer for HF300's or 250T's can be used with 203A's till the larger tubes can be bought.

**FILAMENT CONTROL** — It is very important for long tube life that the tubes be operated within 5% of their rated filament voltage. If tubes are operated above manufacturers' plate dissipation rating, it is desirable to have filament voltage 5% to 10% above rated voltage. The Varipower Autoformer permits control of filament voltage at the tube socket to within 2½% of any desired value simultaneously with the line voltage and plate voltage control mentioned above. Filament transformers can be connected to supply other than rated voltage... an 875 transformer can be used for 866's... a 203A transformer can be used for 800's, 6L6's, 83's, or what have you...

**AMATEURS:** The value of the UTC Varipower Autoformer cannot be overemphasized from the angle of universal application when tube types or operating conditions are changed. As a typical example, let us see what can be obtained from the UTC PA-112 plate transformer:

```
PA-112 Primary, 105, 115, 220, 230 volts. Sec. voltage 1250 or 1500 each side—500 mA. net $31.00
FULL WAVE RECTIFIER — 500 MA D.C.
D.C. output voltages 275, 320, 330, 365, 380, 410, 435, 455, 485, 500, 540, 550, 595, 640, 650, 685, 705, 730, 760, 775, 815, 830, 850, 870, 910, 920, 960, 970, 1000, 1020, 1100, 1140, 1150, 1250, 1300, 1360
BRIDGE RECTIFIER — 300 MA D.C.
D.C. output voltages 100 to 1000 volts in approximately 80 volt steps, then 1100, 1190, 1290, 1300, 1370, 1410, 1460, 1520, 1550, 1630, 1640, 1720, 1740, 1890, 1840, 1920, 1940, 2000, 2040, 2100, 2160, 2200, 2280, 2300, 2380, 2500, 2600, 2720
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Using a DUPLEX RECTIFIER
In addition to the voltage obtainable from the bridge portion, half that voltage can be obtained simultaneously from the full wave section.

**UTC VARIPower Autoformers**

| VA-1 | 150 watt output rating | 3.60 |
| VA-2 | 250 watt output rating | 4.50 |
| VA-3 | 500 watt output rating | 6.00 |
| VA-4 | 1000 watt output rating | 9.00 |
| VA-5 | 2000 watt output rating | 12.00 |

See your distributor for data sheet VA-10 showing circuits on Varipower application for line voltage regulation, automatic line voltage regulation, power and voltage control and modification of regular transformers for universal application.

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**UNITED TRANSFORMER CORP.**

72 SPRING STREET • NEW YORK, N.Y.

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QST for FEBRUARY, 1937, CENTRAL Edition
FOR AMATEURS:

The NEW NC-101X

The new NC-101X is strictly an amateur receiver, combining the more popular features of the HRO and the NC-100. Like the HRO it provides extreme electrical bandspread, with each of the amateur bands padded to span a uniform 400 dial divisions. Like the NC-100, it employs the Movable Coil Tuning Unit which makes plug-in coils as rapid and convenient as a coil switch, without sacrifice of electrical efficiency.

The general chassis design is similar to that of the NC-100. Details include variable band width crystal filter*, built-in power supply, CW oscillator, micrometer dial, amplified and delayed AVC, tone control, B-supply switch, AF and RF gain controls and tuning indicator. Coils cover the amateur bands only (10, 20, 40, 80, and 160 meters). Net Price, Type NC-101X Receiver, including power supply, tubes, speaker, and crystal filter*, $125.00.

* U.S. Patent 2,054,757

Now at your dealers
Battery model now also available

NATIONAL COMPANY, INC., MALDEN, MASS.
The ACR-155 answers the need for a moderately-priced communication receiver capable of superior performance under modern operating conditions. Like its predecessor, the ACR-136, it provides a number of features not usually found in receivers of its price class, but a new design makes the ACR-155 an even greater value per dollar than the ACR-136. Outstanding features are tabulated for your convenience.

1. Continuous frequency coverage from 520 to 22,000 kilocycles.
3. Improved, large tuning knob with crank handle for smooth, easy tuning.
4. Easily read, accurately calibrated selector dial.
5. Calibration-spread dial for accurate logging.
6. 100 to 1 Vernier Tuning Drive.
7. Adjustable, air-dielectric r-f trimmer capacitors for greater sensitivity and permanent alignment.
8. Magnetite-core i-f transformers for greater sensitivity and permanent alignment.
9. Heterodyne oscillator for c-w reception.
10. Headphone or loudspeaker operation.
11. Two-point audio-tone control.
12. Antenna rejection filter reduces interference.
15. A. V. C. at will.
16. Six-inch, dustproof electrodynamic speaker for high-quality reproduction.
17. Preselection for better signal to noise ratio, lower image response.
18. Built-in power supply.

Amateur's Net $74.50 f.o.b. factory

For further information see your supplier or write for descriptive folder. Complete operating instructions; performance data, and service notes will be sent upon receipt of 25 cents to cover costs of handling and mailing.

RCA presents the Metropolitan Opera every Saturday afternoon.
And "Magic Key of RCA" every Sunday 2 to 3 P.M., E.S.T.
Both on NBC Blue Network.