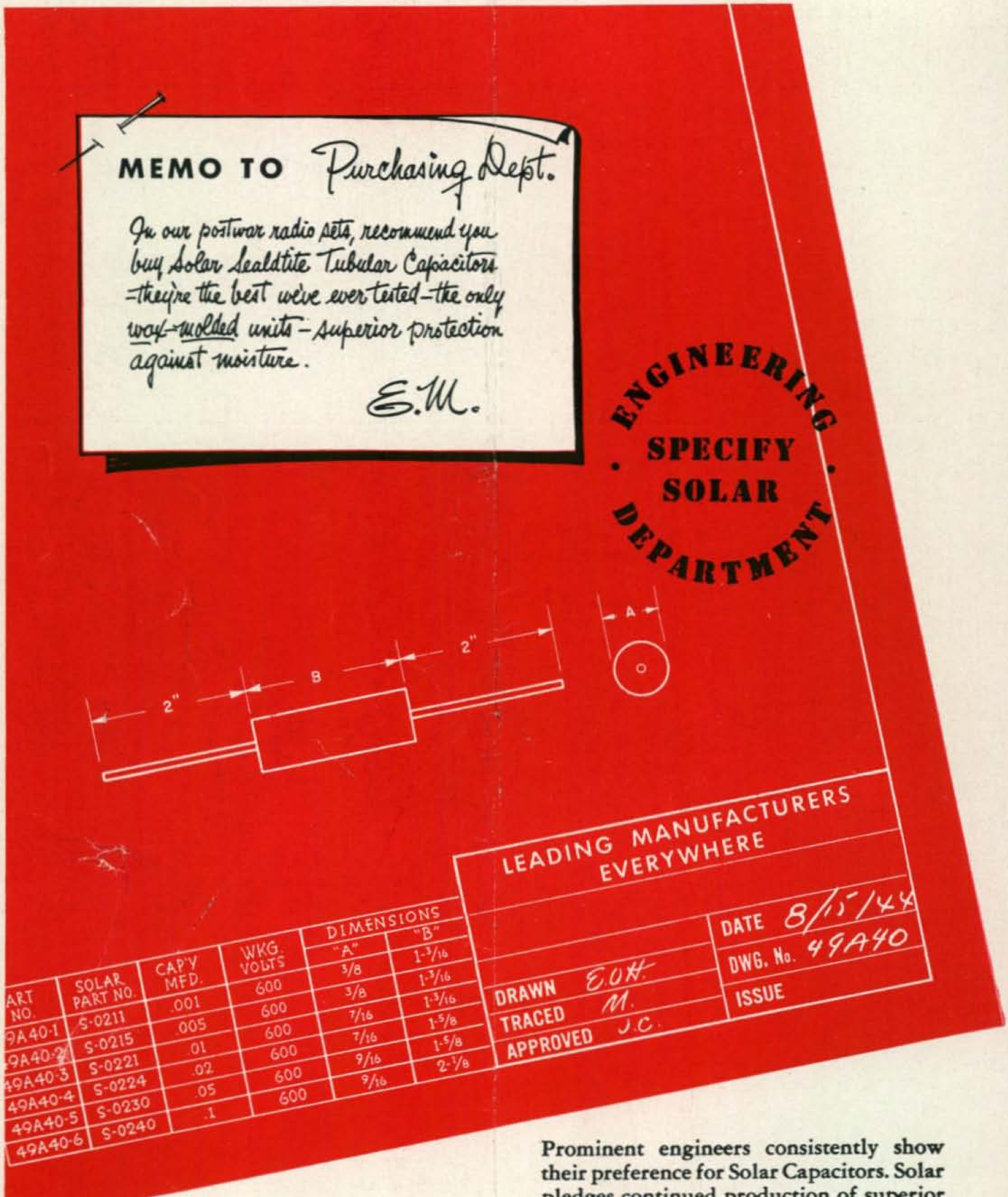
FEBRUARY, 1945

W2FX

CQ

The Radio Amateurs' Journal

Published by RADIO MAGAZINES, INC. Subscription $2.50 a year — Single Copy 25¢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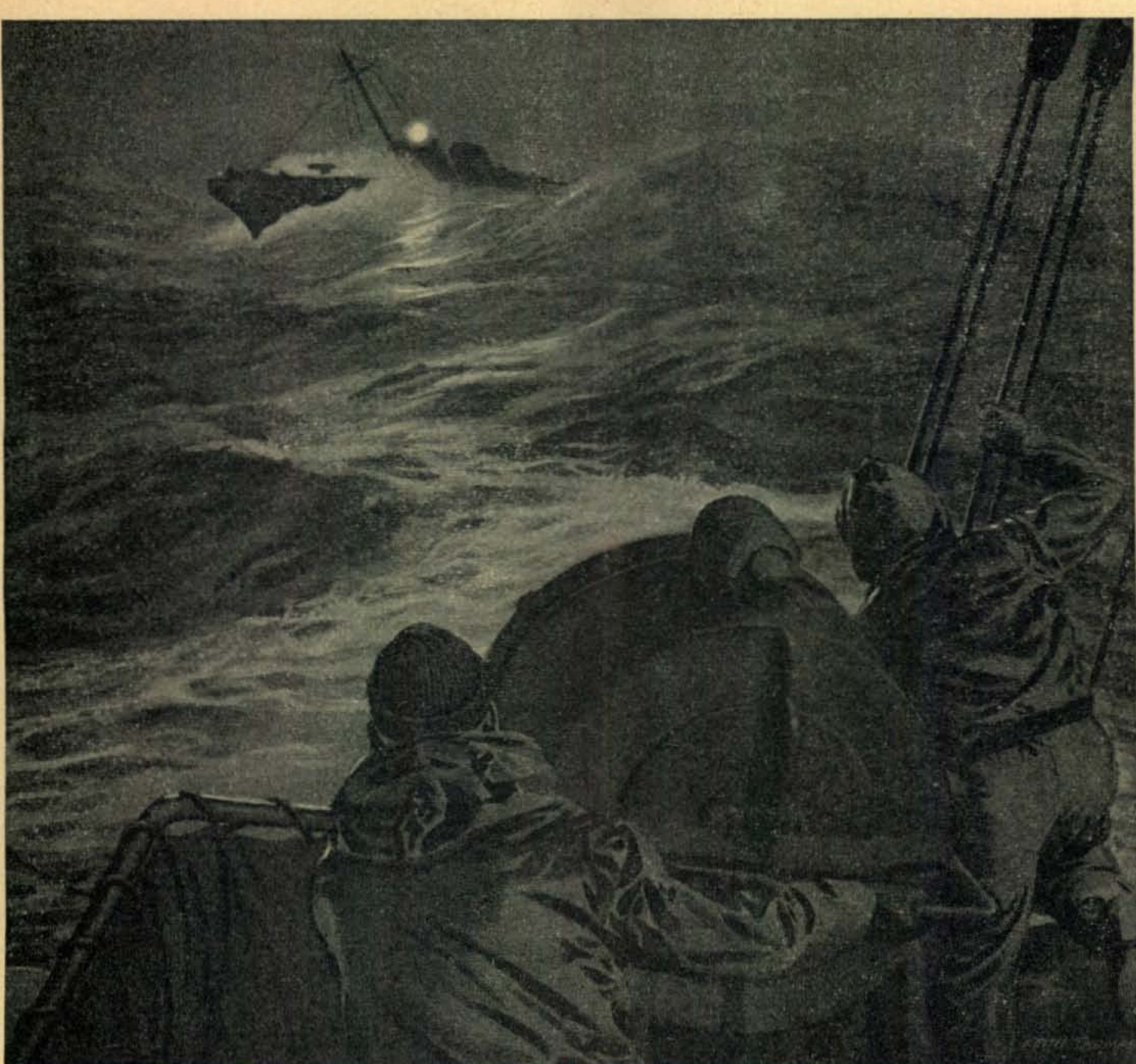

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Published by RADIO MAGAZINES, INC.

John H. Potts............... Editor
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CQ, Published by RADIO MAGAZINES, INC.

Executive & Editorial Offices

342 MADISON AVENUE
NEW YORK 17, N. Y.

Telephone MUrray Hill 2-1346

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VOL. 1, No. 2 FEBRUARY, 1945

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COVER

Soldier using a Western Electric P-17 Microphone in combat service. (*Signal Corps photo*)

ARTICLES

MISCELLANEOUS

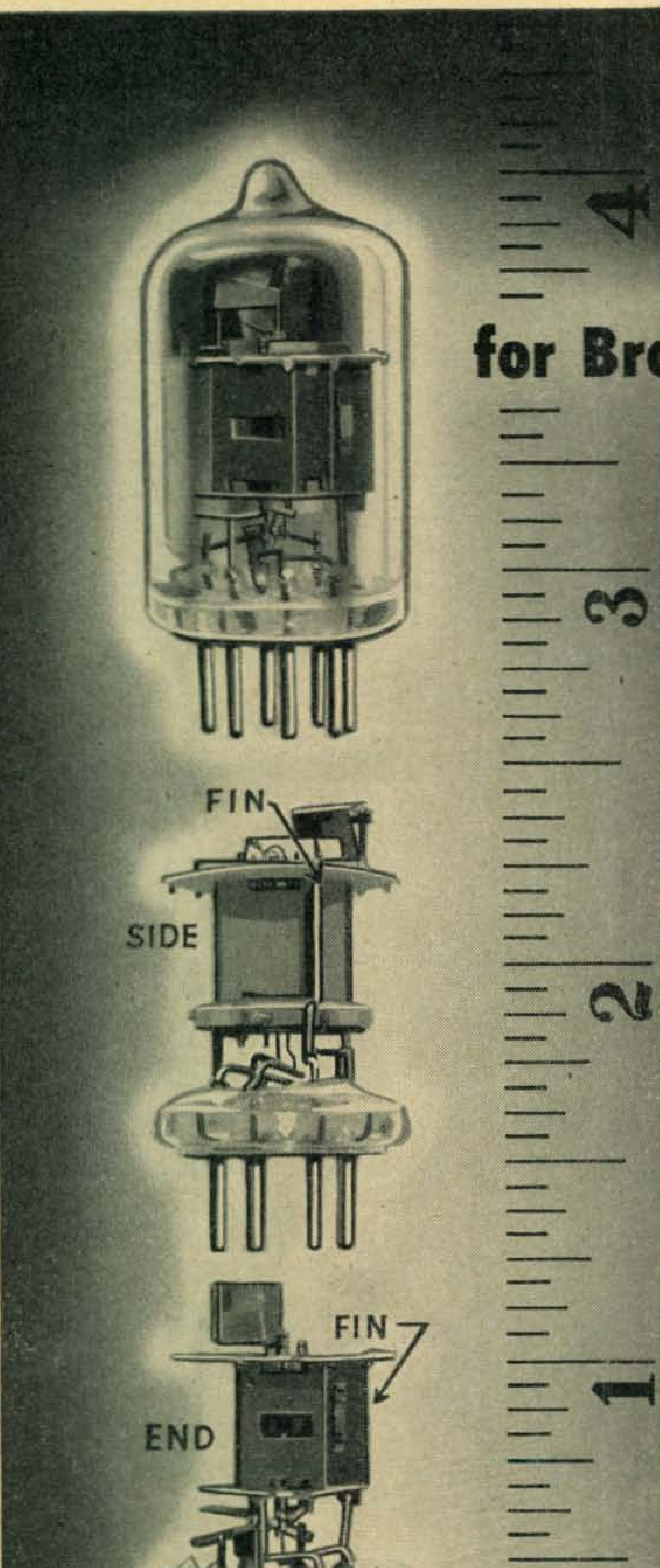

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Plate Voltage	180	120 volts
Screen Voltage	120	120 volts
Control Grid Bias	—2	—2 volts
Plate Current	7.7	7.5 ma
Screen Current	2.4	2.5 ma
Transconductance	5100	5000 umhos
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Input Capacitance*		4.0 μμf
Output Capacitance*		2.8 μμf

*Using RMA Miniature Shield.

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Post-War Licensing

With the quietus put on practically all amateur radio activities for the duration, it might be a good idea, after the war is over, to start from scratch in the matter of ham license requirements. The qualifications and classes of amateur licenses have been practically static for many years, whereas the types of commercial tickets have been varied from time to time to keep pace with the two main services, telegraphy and telephony, and the many classes of stations now involved in each category—aircraft, ship, shore, broadcast, police, forestry, emergency services, etc. The code requirement has long since been waived in most commercial telephonic licenses, and comparably the key expert does not have to be a telephonic engineer. However, licenses can be endorsed for other classes of operation as the operator subsequently passes additional examinations.

This differentiation in the commercial services is altogether logical, but unfortunatly nothing parallels it in the assignment of amateur privileges. The most perennial gripe has always been heard from the phone ham—protesting against a code examination when his sole interest lay in vocal QSOs. While there is reason in this attitude, the phone amateur—particularly the Class A Licensee—does not give the relatively unprotesting continuous-wave virtuoso an equal break. All phone operators, Classes A, B or C, can invade the cw bands as they wish—the inexpert splattering the channels with QRM, illegal notes and gibberish. On the other hand, the Class B and C operators are not permitted to use the microphone on the most desirable 20 and 80-meter phone bands.

We do not question the desirability of higher technical qualifications for certain phone allocations. This provides the ham with something to shoot at, proclaims a high technical standard to government and international circles, reduces interference with other services and limits the employment of preferential bands to those amateurs capable of making the best use of them. But it follows that a similar consideration should be accorded the cw artist! This balance could be achieved by patterning ham licenses after the commercial tickets—allocating special phone channels to operators (without code ability) according to technical qualifications and experience, while the cw spectra would be similarly assigned in recognition of code proficiency and operating technique. The highest grade license in each category would permit operation in all phone (only) or cw (only) bands. Phone and cw licenses could be endorsed for cw and phone operation respectively upon qualifying.

The necessity for license diversification becomes more apparent when we consider the additional techniques and problems which will inevitably arise when the amateur sets his teeth firmly into FM and television. The desirability of different classes of licenses or endorsements for AM, FM, cw and television is not illogical. Such license requirements would impose no hardship upon the amateur or prospective ham. Rather they would make it much easier for him to break into the game—by stages as it were—and would simplify matters for what will undoubtedly be an understaffed examiner's office. The days are past when one could secure an all-inclusive ham ticket in exchange for ten-words-per-minute plus the wiring diagrams of a one-tube receiver and a spark transmitter.

It is entirely possible that some narrow portion of the ether above 300 megacycles might be opened for telephone communica-

[*Continued on page 40*]

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Take Mt. Carmel, Illinois, a typical American city, where men and women can work to produce and acquire the better things of life. Add pleasant and congenial working conditions like those you'll find at Meissner, exacting jobs like those you'll find in electronics — wait for the smile that means pride in a precision piece of work well done, and — presto — there you have it — "precision-el."

The men and women whose progress is shown on these pages are typical of Meissner famed "precision-el." Look at them. You'll find them just one more reason why Meissner products, precision built by "precision-el," do your job better.

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"Precision-el" at work — still smiling, intent on the job at hand. Now it's a job that will bring victory nearer . . . After victory, it will be a job that makes for better living. Always, it's a better job, thanks to the smile that's always there.

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Fig. 1.
The author's station, W2DBQ-WLNB, Brooklyn, N. Y. WLNB is a special-frequency call. He is Radio Aide to the Signal Officer, Second Service Command, AARS

ZCAA

RICHARD E. NEBEL
W2DBQ-WLNB

ZCAA is the same as CQ in Army Amateur Radio System, discussed in this article

SINCE December 7th, 1941, when all amateur radio operation ceased, many individuals have obtained amateur operator licenses and are now looking forward to the day when they may have amateur stations of their own and participate in the many and varied thrills that communication in the amateur bands yields. Few of these future hams are familiar with the Army Amateur Radio System, its prewar operation and the part it has played in promulgating many of the proud traditions of amateur radio.

In 1926 the AARS was founded after conferences between the War Department and the ARRL representing the transmitting radio amateurs of the United States. The need was recognized for an affiliation between the Signal Corps and the licensed amateur radio operators of the country. The plan was to provide auxiliary radio networks that might be of assistance to the War Department and at the same time familiarize amateurs with the operating procedures of the Signal Corps. Those amateurs affiliated with the AARS would then be a valuable asset to the War Department and to the nation. How much of an asset they actually were will be shown.

Policies

In 1929 the general organization was changed and the policies set forth as follows:

"The Army Amateur Radio System has been organized by the Chief Signal Officer to bring forth an affiliation of the Signal Corps and the civilian radio transmitting amateurs of the United States. This affiliation was desired for the following purpose:

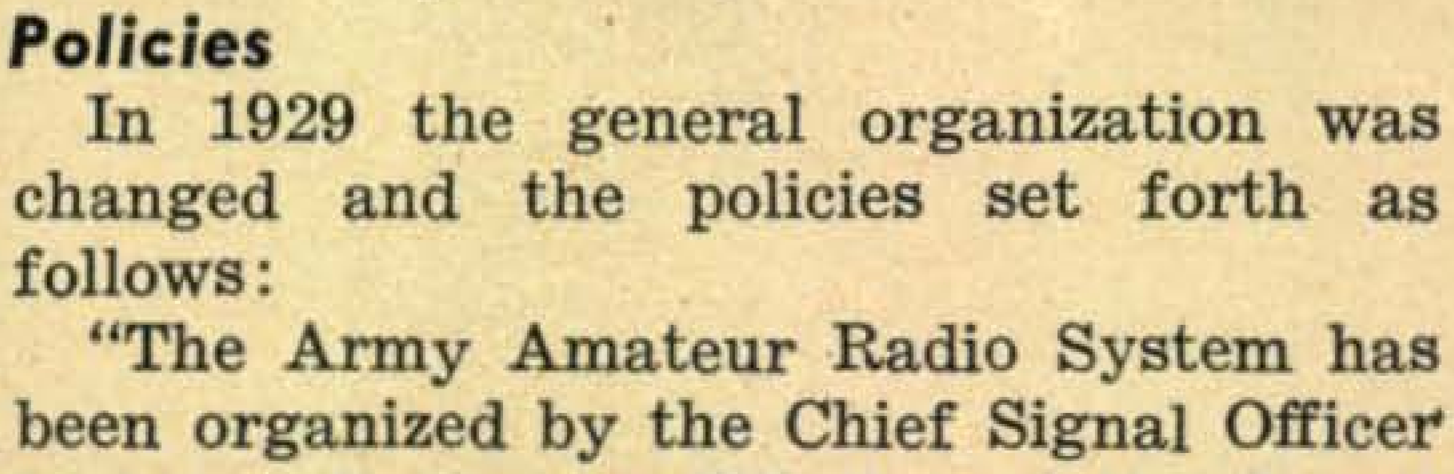


Fig. 2. The main business of the Army "ham" was traffic. His QSO's were ZCB's, and messages went through in disciplined order

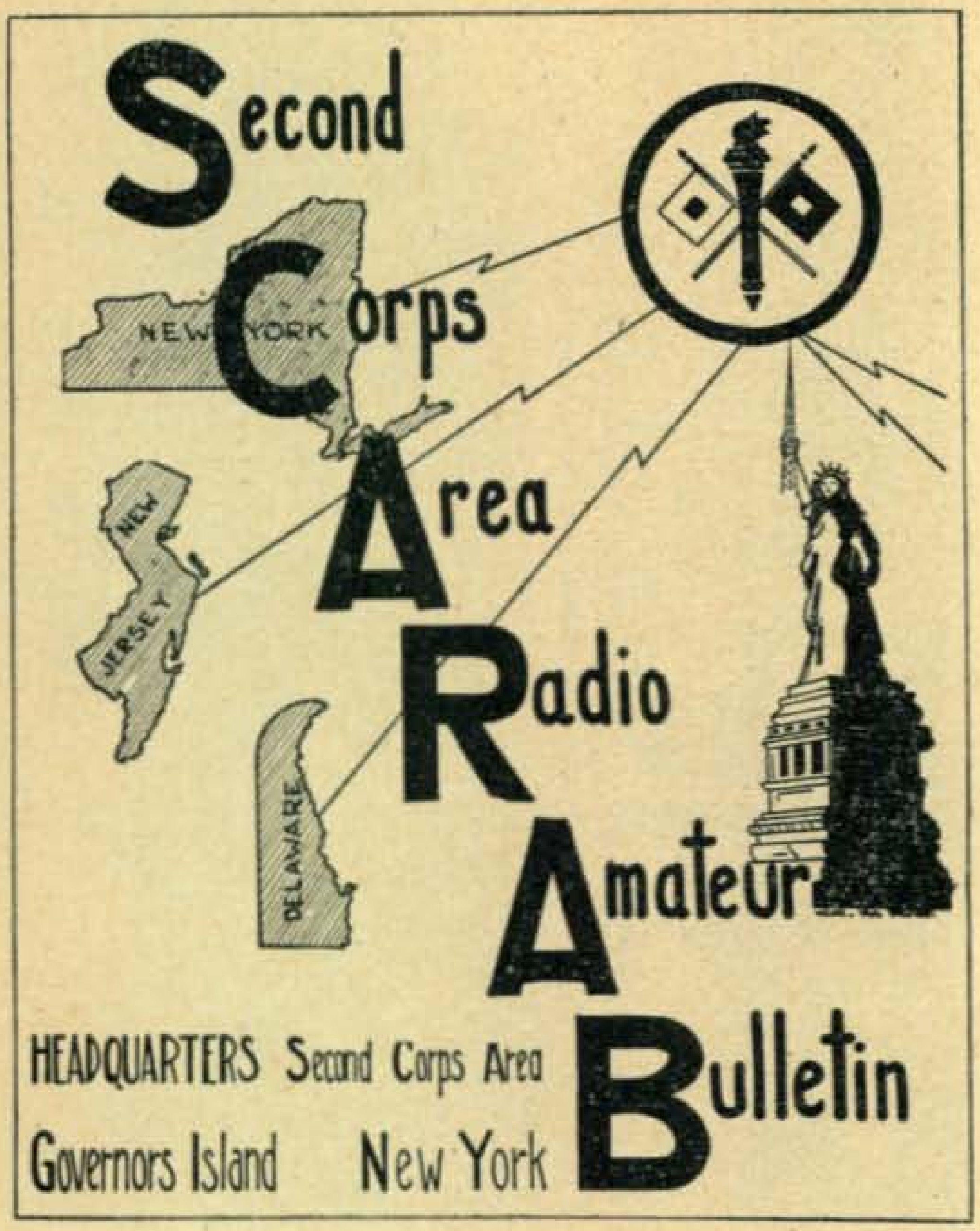
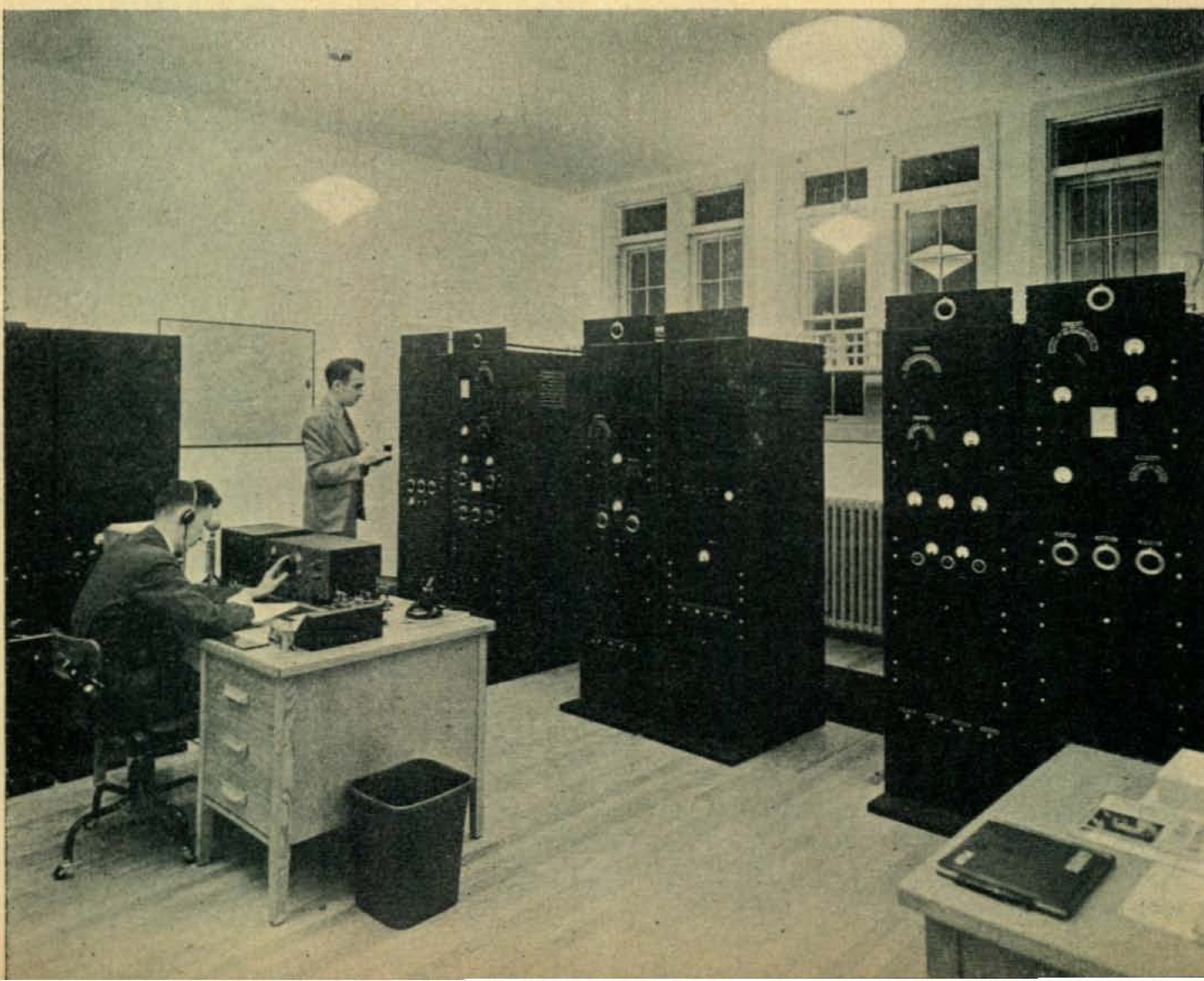


Fig. 3. A monthly bulletin — often a he-man magazine — was published by each of the nine corps areas. W2JZX-WLNN is the artist for this cover

Fig. 4. ARRL Headquarters, Hartford, Connecticut, is also WLMK (special frequency) in the Army Net. Special frequencies provide a clear channel for traffic



"1. To provide additional channels of radio communication throughout the continental limits of the United States that may, in time of emergency, be used to augment or replace the land lines, both telephone and telegraph, that might be seriously damaged or destroyed by flood, fire, tornado, earthquake, ice, riot, or insurrection.

"2. To place at the disposal of military commanders of all components of the armies of the United States and representatives of the American Red Cross such amateur radio channels of communications as may be developed under this plan.

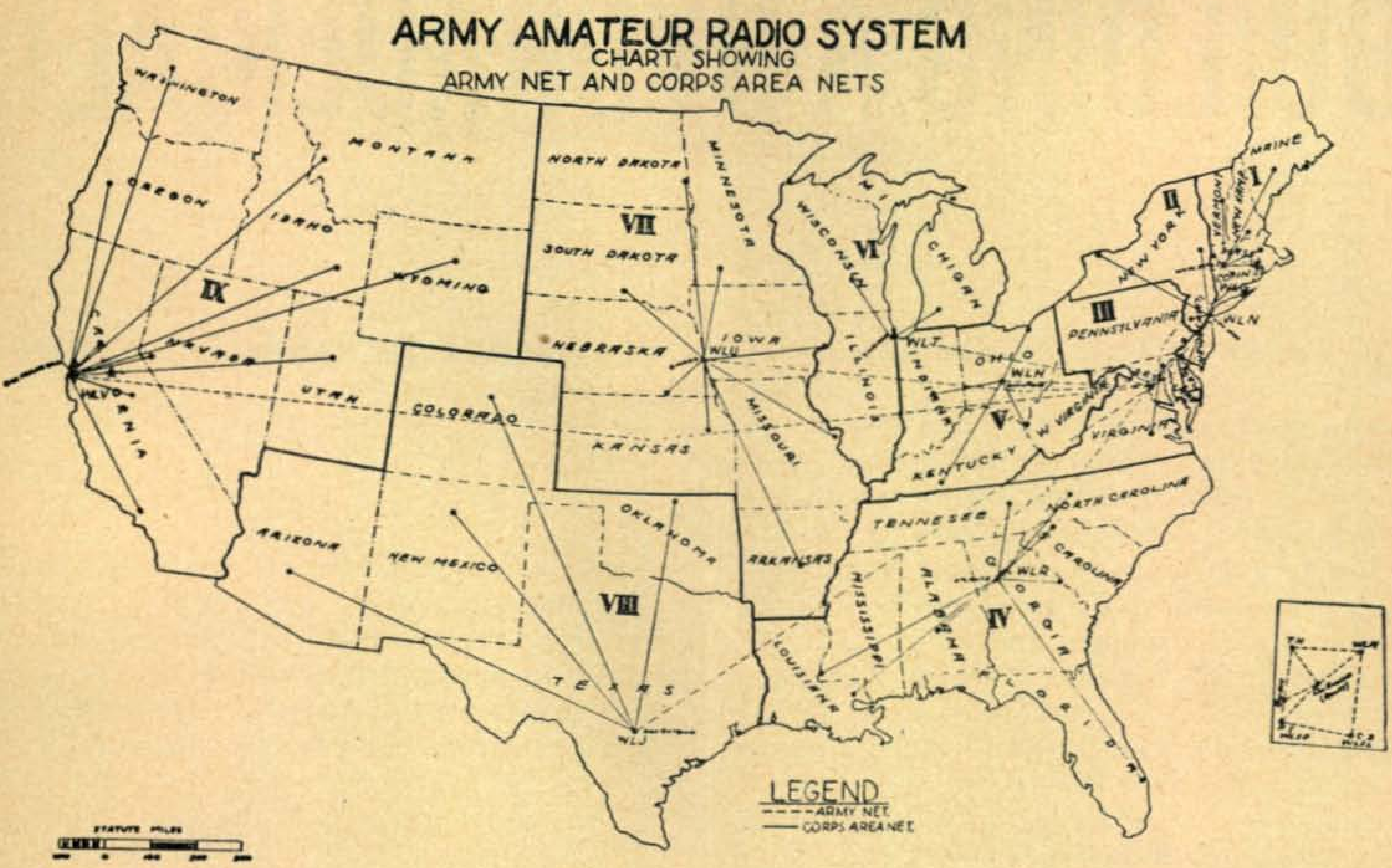
"3. To provide civilian amateur radio operators with a knowledge of Army methods of radio procedure and of the methods using radio as a means of signal communication in the field.

"4. To establish contact with a considerable number of civilian amateur radio operators for the purpose of acquainting them with the Signal Corps and securing their aid in experimental work, tests, etc.

"5. To render such encouragement and assistance as may be desirable to firmly establish and perpetuate the American amateur."

Control

The entire system is controlled by the Chief Signal Officer of the Army who appoints an officer on his staff to act as



Liaison Officer, AARS, who is responsible for the administration of the system. Following the basic pattern of Army administration, the United States is divided into nine Corps Areas (now called Service Commands) each comprising a certain group of States. The Signal Officer of each Corps Area appoints a Liaison Officer to adminster AARS operations within the Corps Area. To assist this Liaison Officer, one of the more experienced members receives the appointment of Radio Aide to the Signal Officer. Each year a prominent radio amateur is appointed Chief Radio Aide to the Chief Signal Officer.

The most important activity of the AARS was traffic (message) handling, and, with a membership of approximately 3500, the service was exceptionally good. At the head of the traffic organization was Army Net Control Station WLM/W3USA, staffed by the Chief Signal Officer, Washington. The Army Net consisted of WLM/W3USA as net control station and the nine Corps Area Net Control Stations. These stations were usually located at the Headquarters of each Corps Area and operated by enlisted men assigned that duty. Each Corps Area Net consisted of the NCS (net control station) and the NCS of the various State Nets in that Corps Area. Each State Net was in turn divided into District and Local Nets. In this way traffic would move up and down the line to its destination. All nets operated regularly on daily schedule and each had its assigned net frequency. Each member station was required to maintain his own net frequency to a close tolerance.

Bands

The backbone of the AARS traffic system was the 80-meter cw band. However, each Corps Area also had 40-meter cw nets and 160 and 75-meter phone nets. In addition to the amateur bands, the AARS was assigned two special Government frequencies outside the amateur bands—3497.5 and 6990 kcs. Certain selected stations were authorized to operate on these frequencies and were assigned special call letters for that purpose. Assignment of one of these special calls was an honor and provided a basis for competition among the members.

Most of traffic handled was of the third party type and thousands of messages were delivered monthly. In addition to the continental system, the AARS covered all U. S. possessions such as Puerto Rico, Canal Zone, Hawaii, Guam, Philippines, etc., and for a time, a route was maintained to the Marine Barracks in Shanghai. Many worthwhile communications were handled and it is difficult to appreciate the satisfac-

[Continued on page 34]

BUILDING A HYDRAULICALLY

LAWRENCE Le KASHMAN, W2IOP

A ROTARY beam antenna consists of two essential main units . . . the antenna itself and the rotary mechanism for supporting and turning the antenna. Considerably more has been written about the beam design, although in practice the antenna base is just as important. A satisfactory installation must be carefully planned and executed from the ground up. It is the purpose of this article to discuss a hydraulically-braked rotary beam mount. In actual tests, during a wind which attained a maximum velocity of 90 M.P.H., this base, with a 24 foot 4 x 4 mounted on top, did not rotate any meausurable distance.

In considering what a rotary beam base must do, one fact becomes immediately apparent. No design, regardless of its versatility, can satisfy all the conditions which *can* arise at different locations, In other words, a mount which is ideal for one spot may be inadequate for another. The solution presented here will not fit all individual problems. It does present possibilities calculated to cover many variations. In addition, by utilizing various components of the entire system, it may prove helpful in solving other rotary beam base problems whose demands are not fully met in this design.

The conditions which this mount was designed to meet were as follows:

1. It must be inexpensive to construct.
2. Everything required to construct it must be available today.
3. The actual rotation of the shaft must be so arranged that either direct drive or motor drive can be used.
4. The base must be able to support no less than dual directional transmitting antenna.
5. Absolute and positive braking must be provided which will be independent of the drive system.
6. There must be a minimum number of parts to go out of order.

Auto Parts Used

The use of automobile parts is not original. They fill most of the basic require-

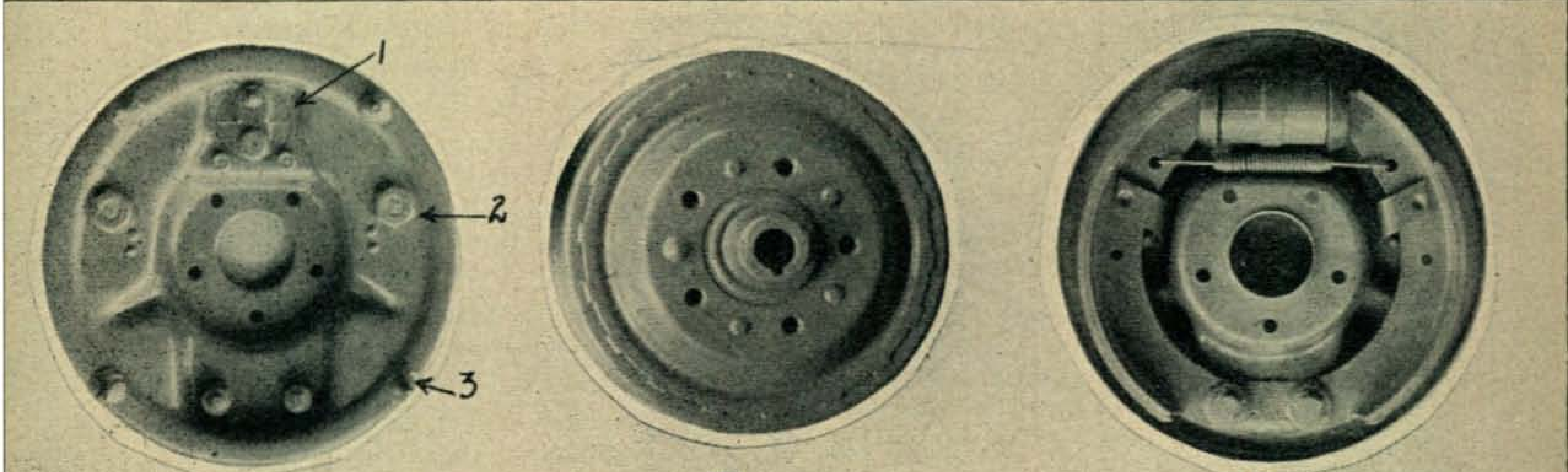


Fig. 1. In A (1), escape valve on wheel cylinder; (2), brake clearance adjustments; (3), mounting studs. In B, wheel drum for supporting beam. In C, brake drum, showing cylinder and brake lining.

BRAKED BEAM MOUNT

You can build this mount for a rotary beam antenna from parts which are easy to get

ments of the design, with one exception. Their weight makes them almost unmanageable. This is overcome by cutting away excess material. An ordinary hack saw can be used except for the axle, which is case hardened steel. This operation must be done by a welding torch. Cutting the axle down to half its original length (actually one quarter the size used in the car, since only half the rear end is used) is recommended because a large percentage of the weight is in this solid steel piece. A coupling is necessary to extend this shaft for direct drive, whereas the full length is not needed when motor driven.

Covering the axle, and terminating at the wheel and brake drum, is a piece called the axle housing. This should be cut off as close to the bearing retainer as possible. It will be evident upon inspection that about ten inches of the end of this housing is used to hold the axle bearing in place. At the line where this ends, the housing will get slightly narrower. Cut somewhere near this spot. There are no further cutting operations, but the weight will have been reduced to a degree where the entire unit is easily lifted. To facilitate mounting, four bolts are welded to the base. This permits fastening directly to the mounting platform. It is essential to bear in mind that a cut-out on the stand must be provided to permit bleeding the escape valve on the wheel cylinder. This procedure is described more completely in another paragraph.

With any kind of luck, most of the parts, if not all of them, can be secured on a single trip to the junk dealer. Ask for one

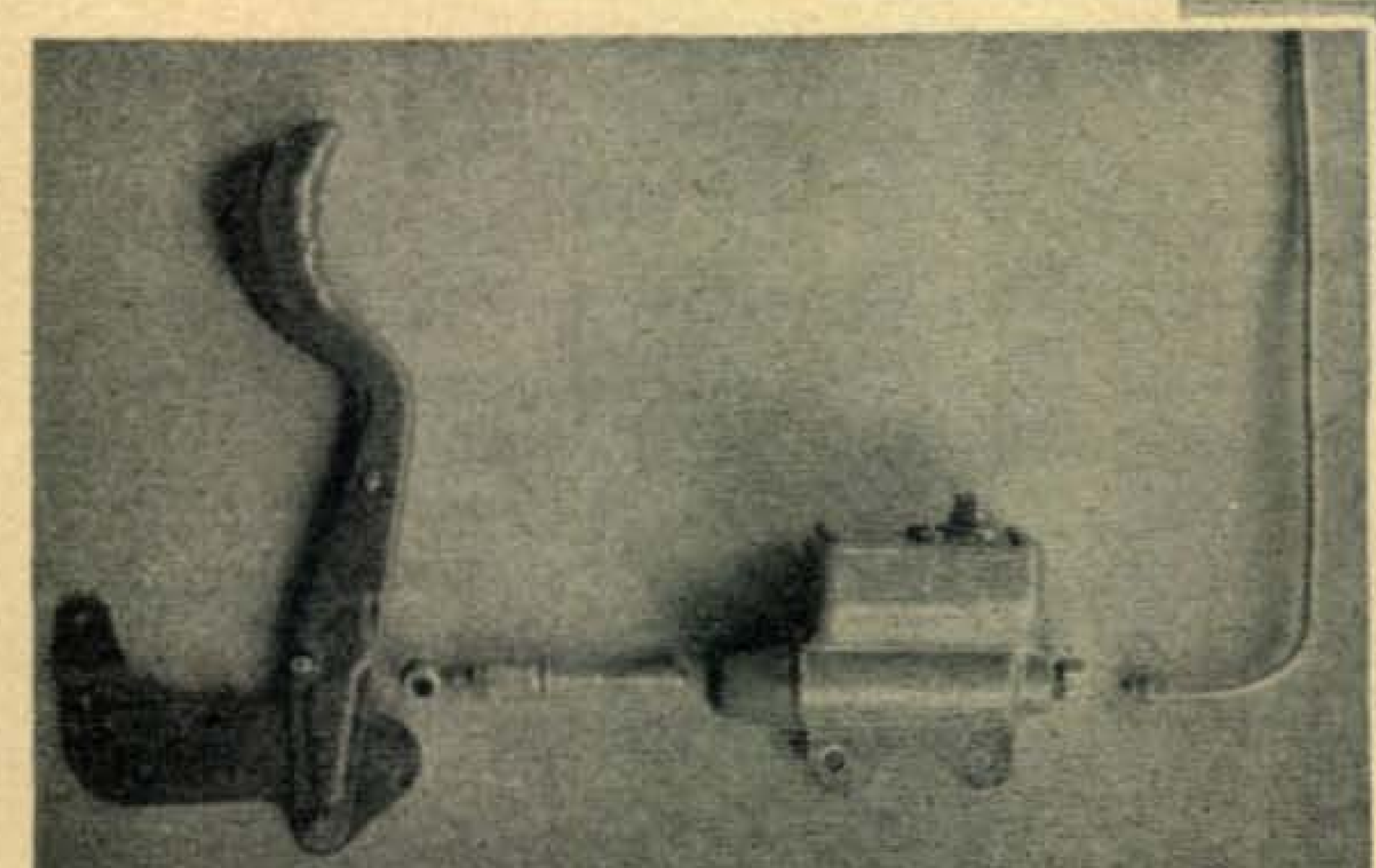
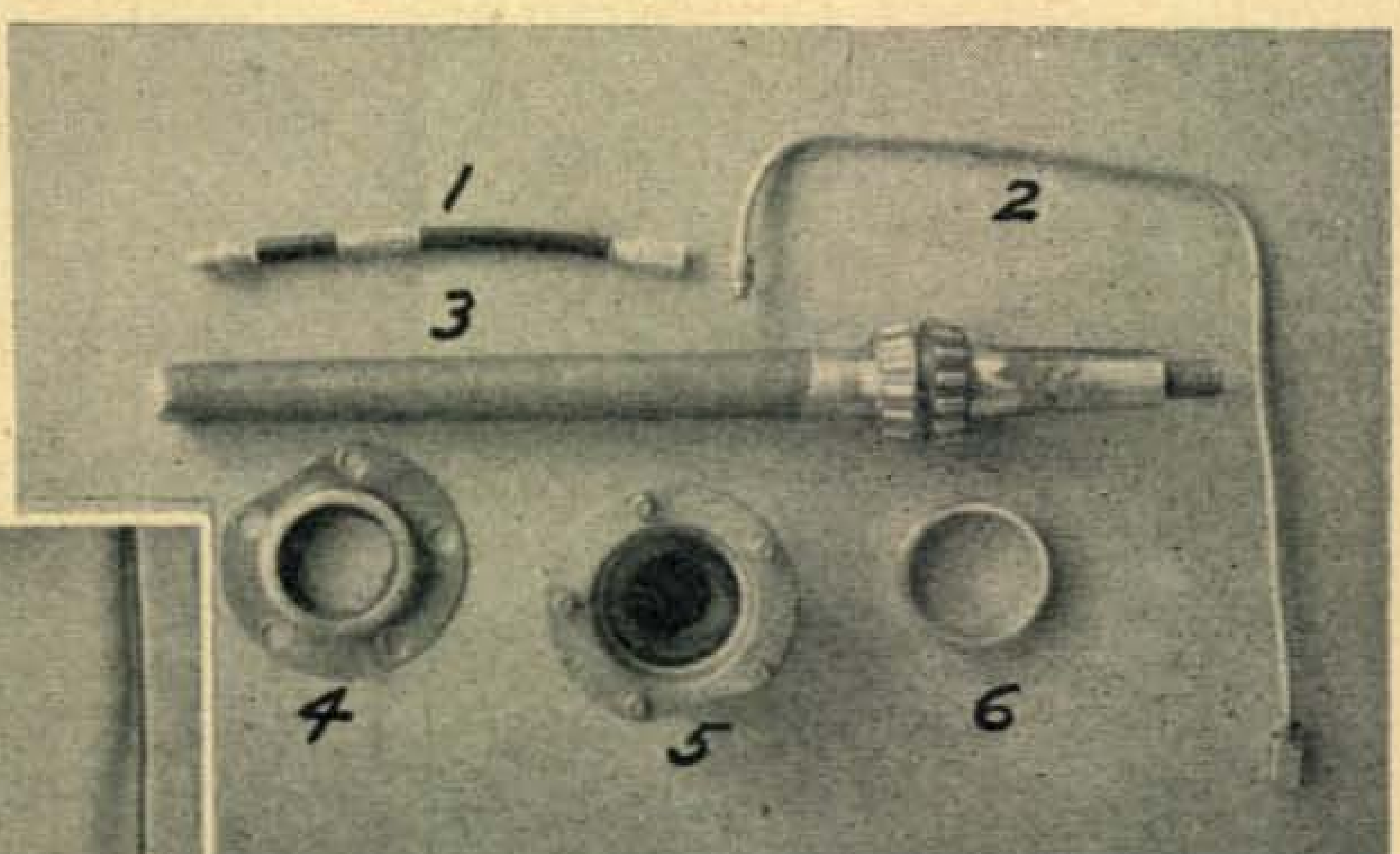


Fig. 2. Brake assembly. Hand brake is fastened to piston which exerts pressure on master cylinder. This pressure is transmitter through copper line to wheel cylinder



Disassembled parts. 1 and 2 form the hydraulic line. Axle 3 fits into the bearing retainer 5 which is packed in grease. Gear race, 6 is inserted. This assembly supports the brake drum. Before bolting down, washer number 4 is placed over the studs

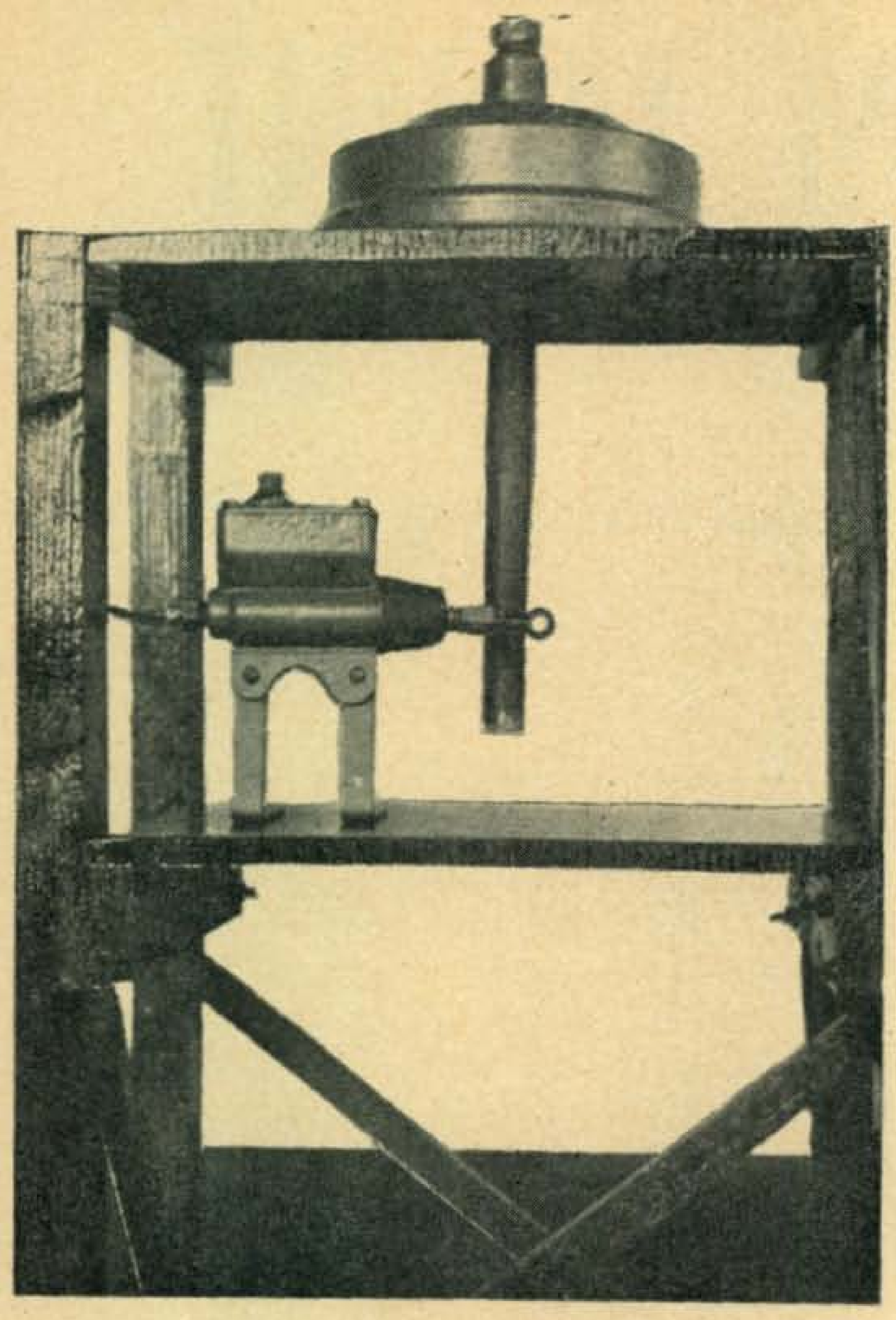


Fig. 3. Completed assembly, mounted for experimental tests

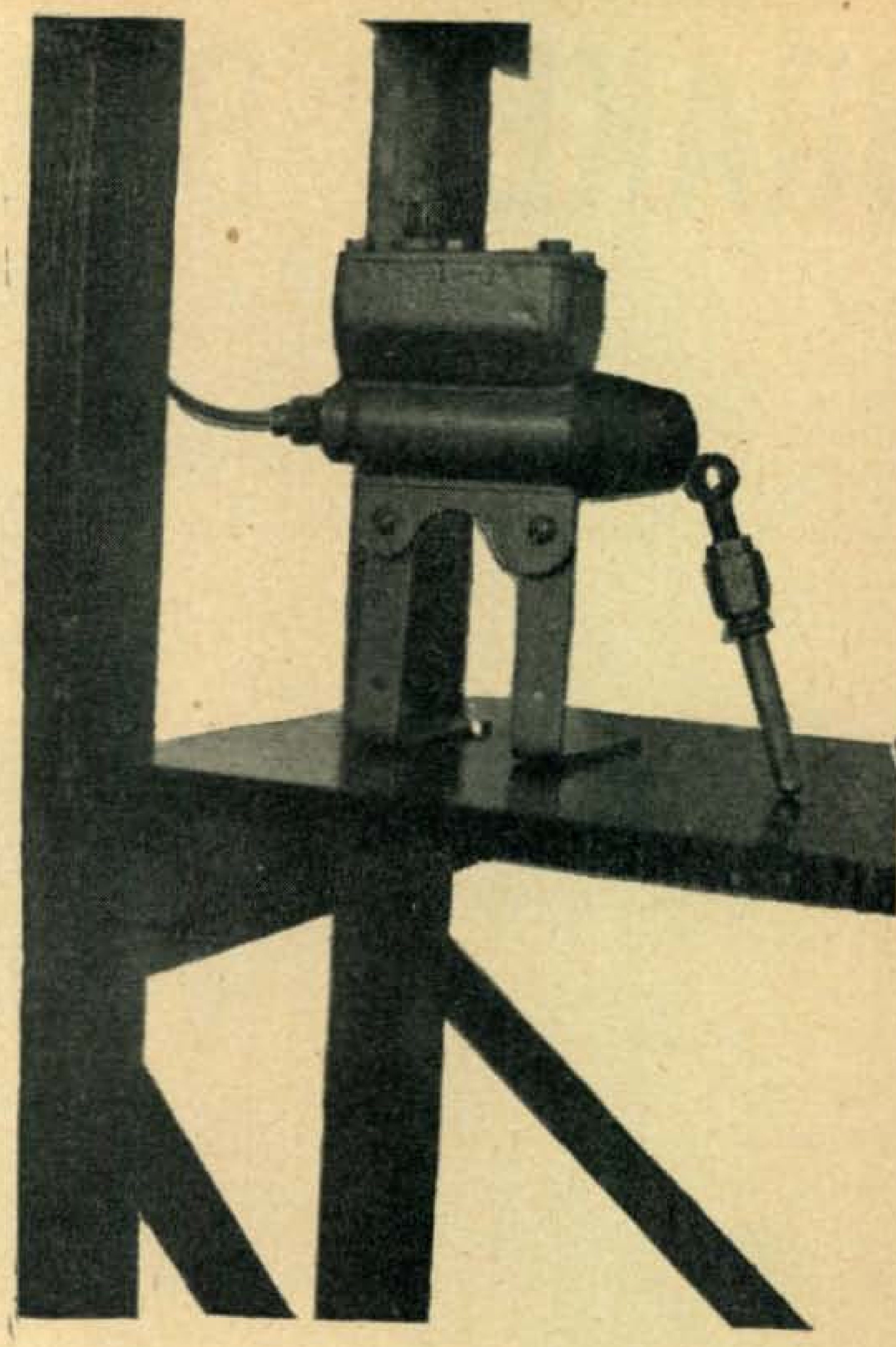


Fig. 4. Master cylinder and piston

half the rear end of any small automobile such as a Plymouth, Willys, or Ford. Make sure that the rear end is not the reason that the car has been junked. The bearings on the axle and the bearing races on which they ride, must be in good condition. Even poor automobile brake linings are satisfactory, since the maximum drag exerted by the antenna will nowhere equal the short stop of a car. In addition to the half of the rear end, you will require a master cylinder and very important, the coupling to go between the master cylinder and the wheel cylinder. For experimental purposes, until you have the entire setup working, a short length of copper tubing and a non-expansive flexible hose connection will serve to connect the components of the system. When installed, all that will be required is to replace the copper tubing with a line of the desired length. A hand emergency brake of the type illustrated is the final item on the list.

The hydraulic braking system of the automobile is used to prevent the rotary antenna from swinging during wind. For varying conditions it is possible to adjust the drag of the brake shoes. How much pressure is desired will depend upon the type drive, but most electric motors, when geared down to a slow RPM will have a torque sufficient to rotate the beam with considerable drag on the brake shoes.

Operation

The principle of operation of the braking system is elementary. It will be reviewed in order to permit optimum adjustments of the units. The emergency hand brake, in an inverted and reversed position, is connected to the piston in the master cylinder. By pushing the brake forward the piston exerts pressure on the fluid in the cylinder. The ratchet on the hand brake prevents it from slipping back unless the trigger release is pressed. Fluid is forced through the copper line and the non-expansive flexible hose connection—the flexible hose is used for convenience only, and can be eliminated—into the wheel cylinder. The wheel cylinder contains two opposed pistons. The fluid enters the opposed pistons, forcing them outward. The face of the pis-

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MEET THE "YL"

VIOLA GROSSMAN, W2JZX-WLNN

. . . the hand that rocks the cradle often wields a wicked bug . . .

ABOUT five per cent of radio amateurs are women—but their influence on the art is considerably more than that. After all, we YLs and XYLs have pretty much the say-so concerning what goes into the bedroom, living room or kitchen (for a ham, like a cat with its kittens, will deposit his rig anywhere) and the allocation of the family budget—whether it's a pair of 6L6s or shoes for the baby, or a new 1000-watter vs. his college education twenty years later.

A "YL," of course, is a "young lady" operator. Just why we become "XYLs" the moment the ring is slipped on the finger is a mystery to me—the transition from young to ex-young in the fraction of a second and without regard to the actual age of the party concerned. But at least that's better than being an "OW" (old woman) as a counterpart of "OM," which was our title when we first took the air.

I have often been asked just why a woman should go in for ham radio (instead of sticking to her knitting and pots and pans). As a matter of fact, few XYLs neglect their household duties for their hobby any more than a lawyer or doctor lets his business slide down hill because he relaxes in front of key or mike in his spare time. Many women take up radio because they have a mechanico-scientific leaning—as has been well evidenced by their superior dexterity and rapid learning in many phases of our war industry. Others marry hams, and become amateurs themselves in pure self-defense. And then there may be something in nameology (or is it orismology?). I know at least three on the distaff side of hamdom whose first name is *Dot.* Others become hams just because they're queer—a little bit screwy—exactly the same as many male hams. If more women knew about amateur radio, fewer of them would take up with cats, gold fish and canaries.

I don't know whether I'm typical or not. I hope so — because I'm generally considered normal. I became interested in ham radio some ten years ago mainly with the idea of providing our son Ken, who was approaching the teen-age, with an outlet for superfluous energies which might otherwise be expended in less salubrious directions. (At this point I should mention that "our" includes Sam, the OM of our menage, W2JDG.)

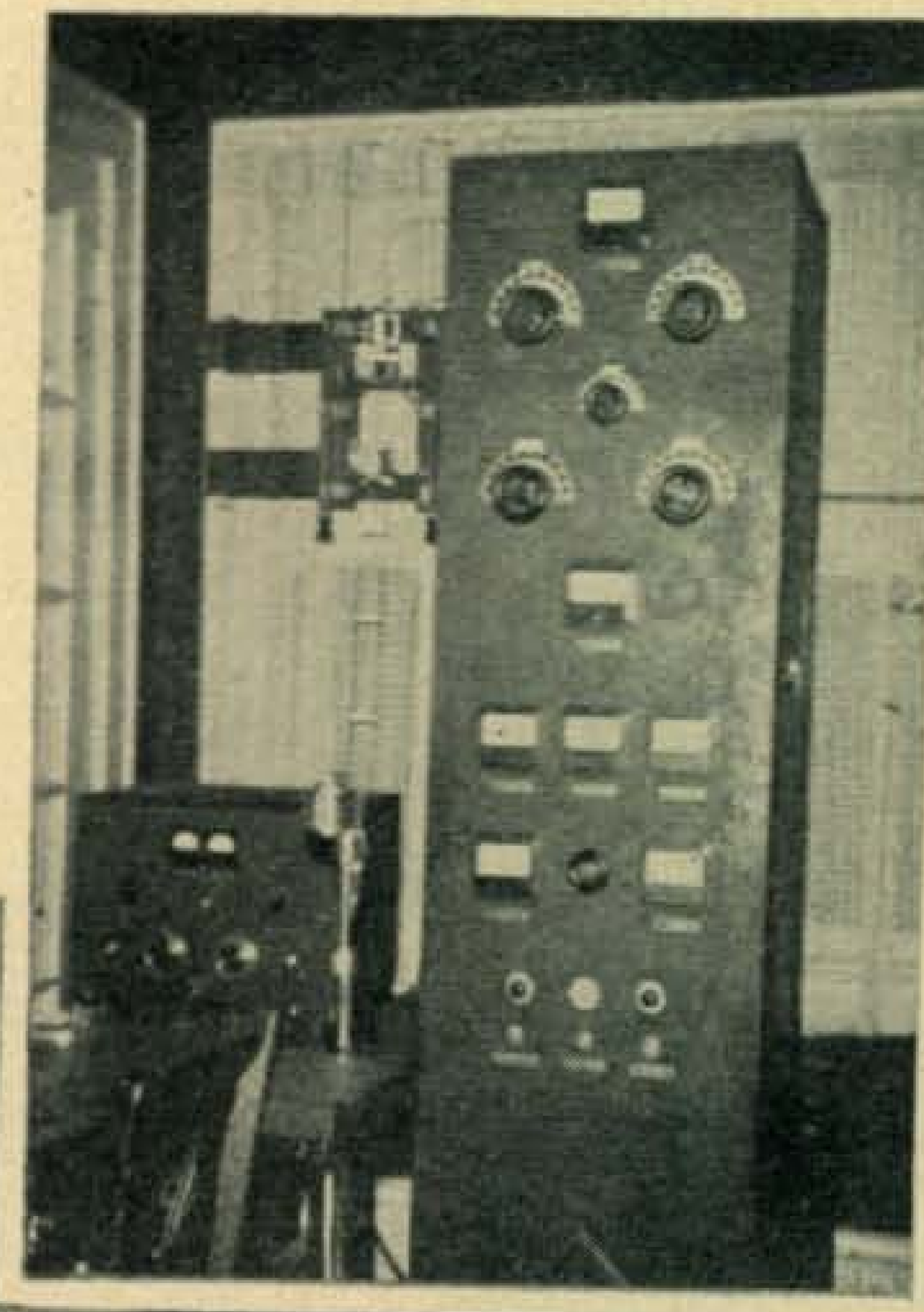
School work is routine. Things academic, in the school shop or school sports, are still part of the school. We decided we had to interest Ken in a hobby — chemistry, stamps, photography, golf, or some years we had not listened on the ham bands, and one night he tuned in 160 meters. Watching Ken's face as he listened gave us our answer—ham radio!

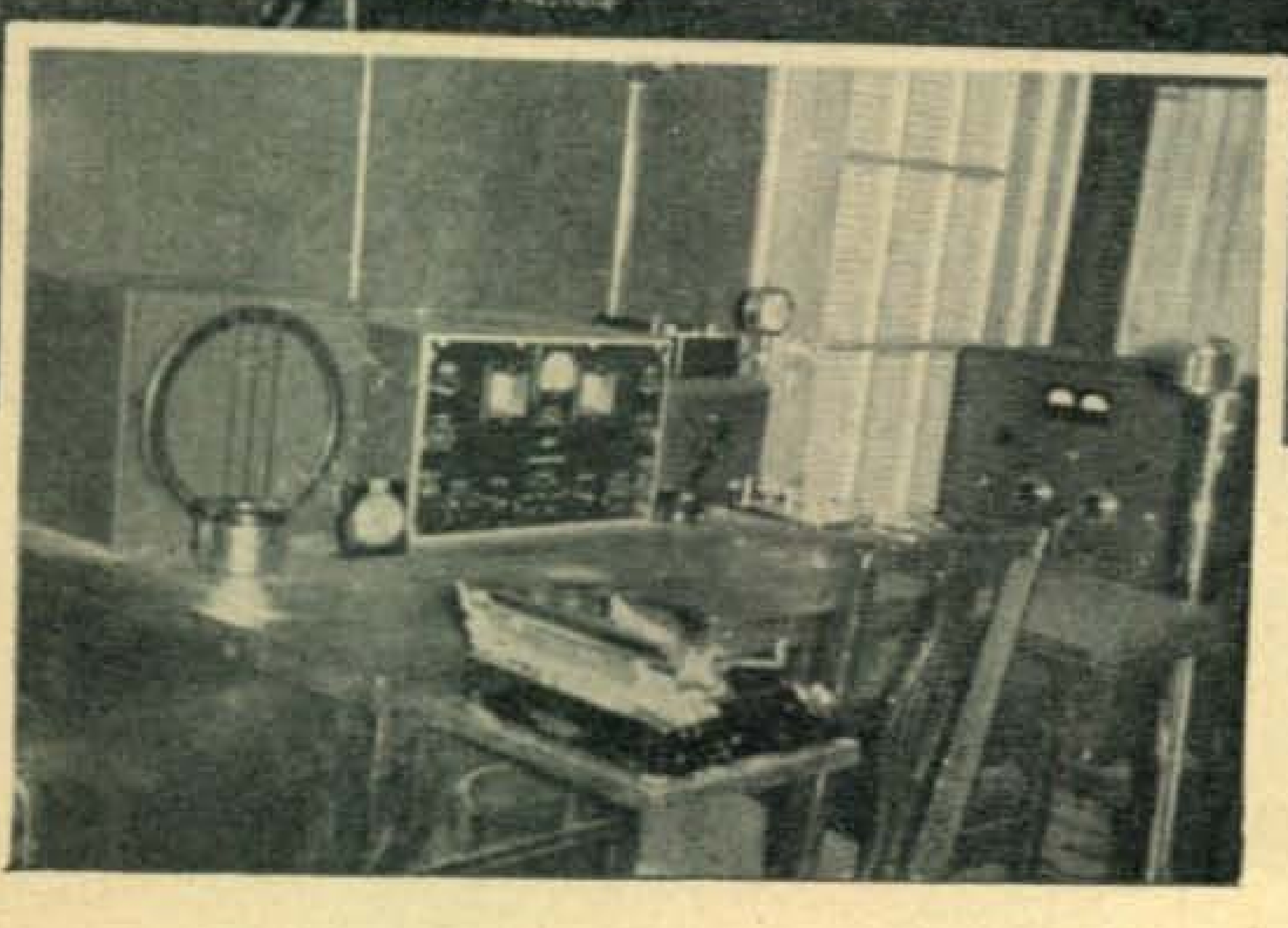
Sam brought himself up to date, brushed up on his code speed, and pretty soon went down and got his ticket. It was a bit more difficult for me, but ardent application had its reward, and six months later I became W2JZX. We caused some BCL trouble on 160, but by watching our hours and installing wave-traps on neightbors' radios, we turned this into an asset and formed some very lovely friendships.

Fig. 1. (Bottom left), W2JZX-WLNN in pre-Pearl Harbor days

Fig. 4. (Center), Operating position at W2JZX-WLNN, with a 50-watt cw transmitter on the right

Fig. 5. (Top), The wallop behind W2JZX-WLNN —the 1000-watt final





W2JZX was nominated by the Army to receive the 1938 Paley Award. In 1939 she was named winner of the ARRL OPS (Official Phone Station) cup. She dined twice with her husband during that year.

Ken was intensely interested and learning fast. Inasmuch as we believe the laborer worthy of his hire and that youngssters should learn the value of money, Ken was paid 30c an hour for building new layouts. When the minimum wage rate was raised, we jacked it up to 40c. (This was before the Little Steel Formula.) He was learning what he wanted to. His work was constructive, educational, and his mind was in the channels of clean, elevating and enlightening thoughts. What he was learning should well benefit him when applied to his life work. He had to plan, think, devise, analyze, use tools, exercise caution, learn patience and neatness. At an early age he had learned and achieved pride in accomplishment.

Ken was W2LJJ before he was fifteen years of age. If for no other reason, our entrance into ham radio has found its worth in the fact that when war came the U. S. Army Air Force obtained in Ken a master radio technician who knew all the ropes. Straight key, bug or phone, he was an expert. Through his membership in the AARS, he knew Army procedure. W2LJJ is now a Staff Sergeant in New Guinea.

I imagine my progress in amateur radio parallels that of many other ham—OM, YL or XYL. Assimilation of tradition, improved code speed and phone technique, deeper technical knowledge, attendance at hamfests. Of the last I recall particularly the get-together at Asbury Park in 1937, where we met W2PF-WLNA—now Lieutenant-Colonel David Talley, U. S. Signal Corps (just recently returned from two years' overseas service). Dave interested us in the Army Amateur Radio System, and talked me into active participation.

I'll never forget the first night I checked into the AARS net. The boys had let each other know they were getting a YL. Very sweetly they planned a welcoming message with signature from about twenty net members. W2DBQ batted out the msg and waited for my acknowledgement, which was as golden as silence never was before. Then he evidently asked me if I had received the message, but all I recognized were my call letters, W2JZX. I came back and asked him if he was calling me. Never again do I expect to hear the air filled with so many HIs—or if I do, I hope to be on the laughing end! DBQ instantly and correctly evaluated the situation. I was nervous and slow. He patiently transmitted the following: "Will mail message in morning," But it wasn't too long after the red in my face cooled off that I could copy 35 words per minute.

Fig. 3. Ken (W2LJJ), in Guinea, and who was the cause of it all, receives three cans of beer from home

Then this XYL's ham activities began to pyramid—staff artist, editor and stencil cutter on SCARAB (Second Corps Area Radio Amateur Bulletin), then Net Control Station with a special frequency call, WLNN. Outside of the AARS, in Nassau County, N. Y., I took on the chores of Emergency Co-ordinator, Communications Chairman of the Disaster Relief Committee American Red Cross and Communications Chairman for the County Defense Council. All this led to many memorable and interesting experiences.

It is difficult to write in the first person here — because so many other amateurs took part, were ready and even willing to gamble their lives if necessary. I'll never forget the hurricane of 1938 when our group spent four days and nights away from home. When we left Nassau for Suffolk County we didn't know how we'd get

[*Continued on page 39*]

MAKE A RECORD

ZEH BOUCK, W8QMR-WLNG

HAD Robert Burns gone in for ham radio he probably would have written—"Would some power the giftie gie us to *hear* oursels as others hear us!" A bad fist — a "glass arm" — like halitosis, is a matter concerning which your best friend will be reluctant to inform you. Even a total stranger will hesitate to pull you up with a QSD (your keying is incorrect) or the Army ZOB (characters are indistinct — words are poorly spaced) — although in the Army you may receive a very tactful and diplomatic ZEJ (your key or relay appears to be sticking).

Listening to one's self transmit is highly desirable — only the expert can send "blind" (without monitoring). But this affords no check on the quality of transmission. In simultaneous transmission and listening, the operator can no more recognize his defects than a skunk does his own stench. Some ops, of course, are "naturals." They are born to rhythm and smooth their way into perfect sending as easily as Pavlova took to dancing. *But don't take it for granted you're in this class.* There's only one way of checking your own transmission, and that's by making a record of it. Let it cool for a day or so — so that you forget the text — and then play it back. (If it's coded rather than straight copy, you can play it back immediately.) Lend a critical ear. If you can copy it, it's not too bad. If you can't, there are probably two reasons, both individually unpardonable and worse than that in combination. Your first is just plain execrable — or you are transmitting faster than you can copy.

The Home Recorder

There are special devices available, such as the McElroy "School Recorder," designed to make records of practice transmissions and re-transmit them. They have the added advantage of providing visual inspection of keying characteristics, and are ideal for school or group study. However, for the individual, the standard home recorder is excellent and possesses some features not found in tape recording equipment.

The home recorder is usually combined with an all-wave radio and phonograph. Recordings can be made from microphone or air. The most simple way of recording your fist is by acoustic coupling between the microphne and the code practice unit. If you are using a buzzer, it will be sufficient to position the mike on top of the buzzer, or within a few inches of it — according to sensitivity and gain. With an audio oscillator and earphones, it will be necessary to clamp the phones around the microphone. A separate headset, in parallel or series, should be used for monitoring.

If desired, a simple amplifier can be constructed for the audio oscillator, pro-

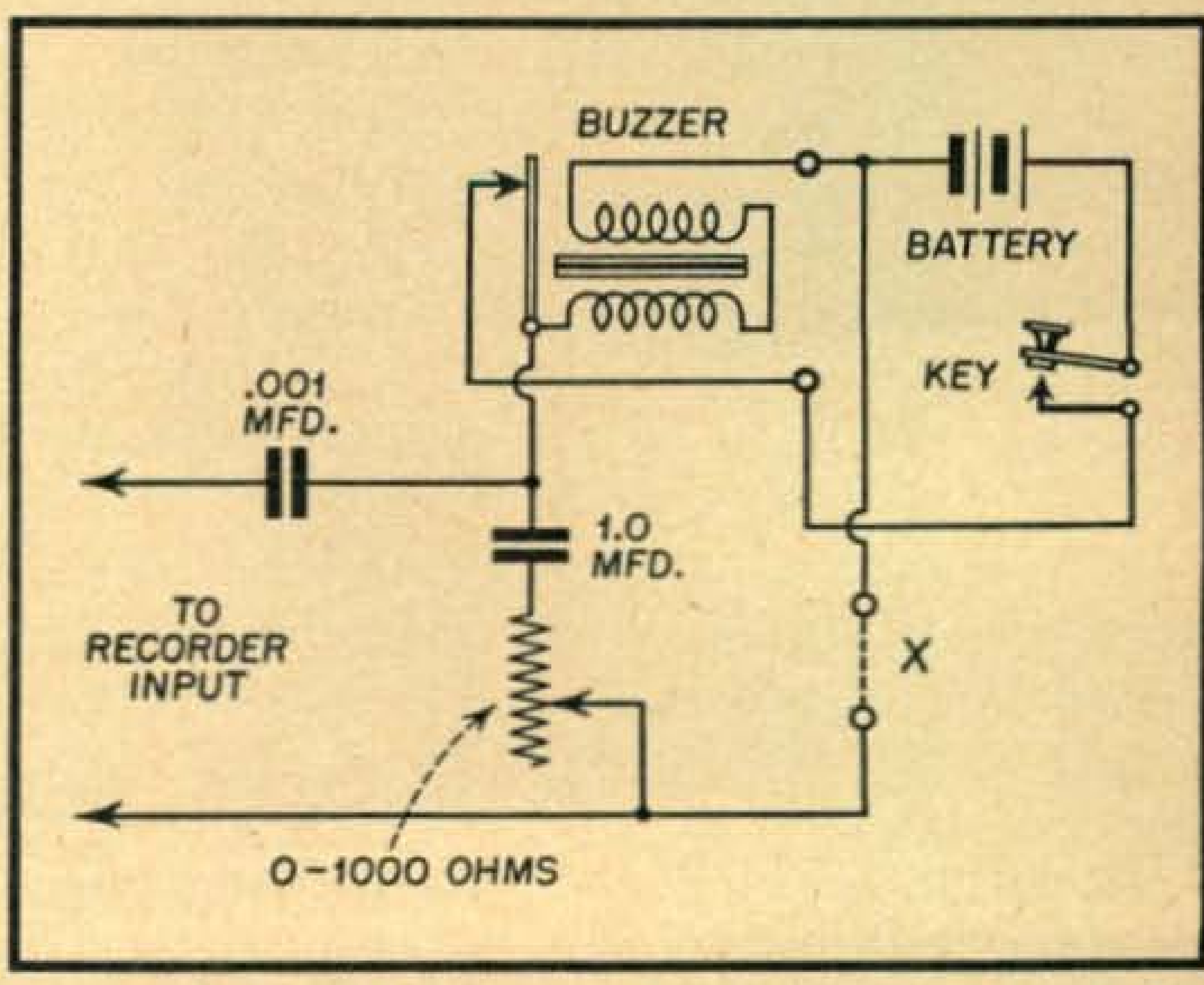


Fig. 1. The old familiar buzzer-type code-practice hook arranged for plugging in on a home recorder

OF YOUR CODE

. . . a home recorder will help a lot in improving both your fist and receiving speed . . .

viding a loudspeaker signal for both recording and monitoring. The author has made many recordings of his own transmissions (discovering they weren't too perfect, by the way), employing standard station equipment in conjunction with a Wilcox-Gay "Recordio." With the finals disconnected, the transmitter was keyed as usual, the audio signal being provided either by the station monitor or the HRO receiver — with the mike conveniently located for adequate pickup.

Direct Hookup

The buzzer or oscillator can of course be coupled electrically to the recorder at the microphone jack. The accompanying diagrams suggest how this can be done. Where a buzzer is employed, some form of external volume control will probably be necessary as shown in *Fig. 1.* If adequate volume control is provided in the recorder amplifier, a medium-low value of fixed resistor (about 100 ohms) can be

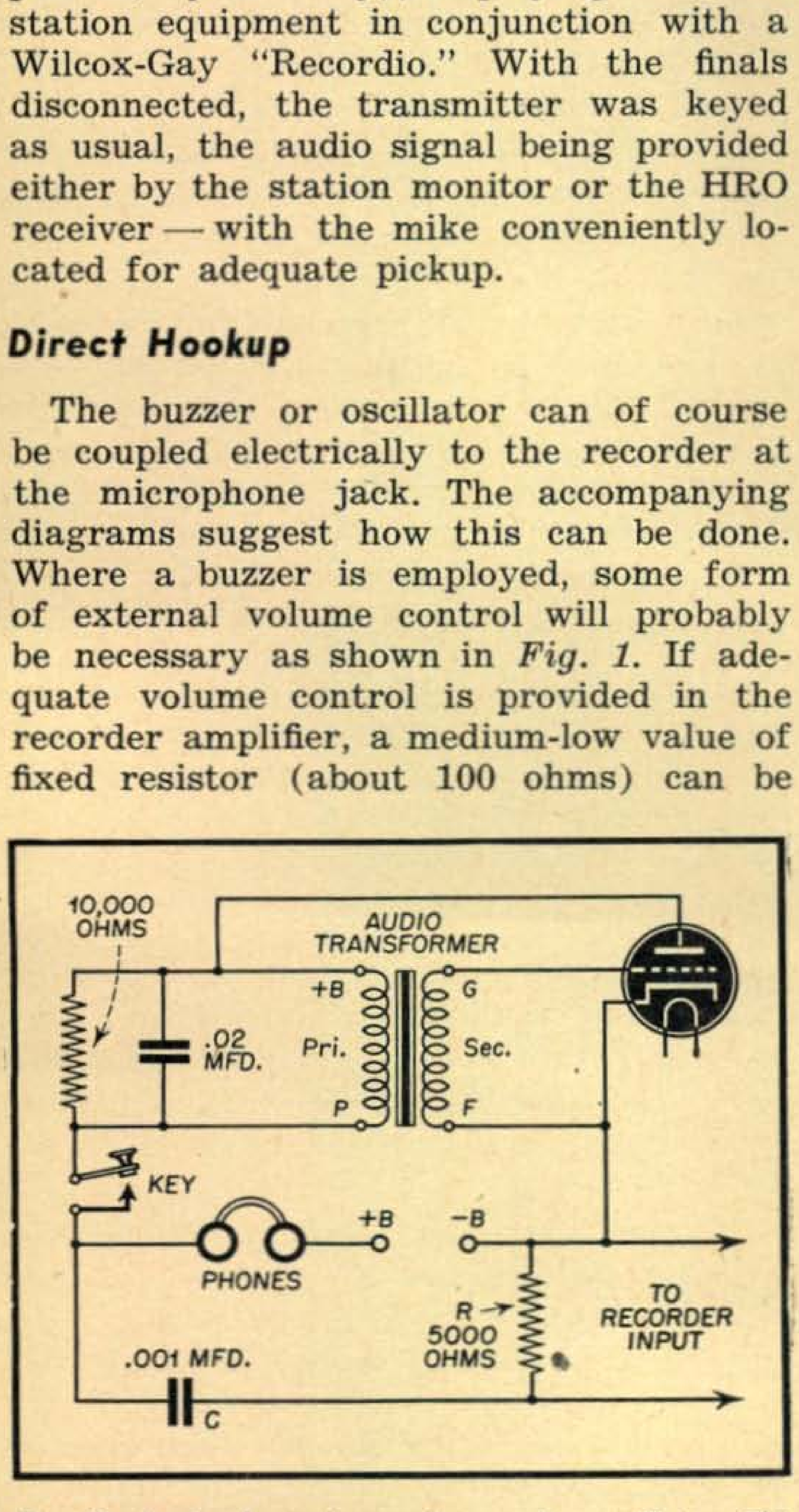


Fig. 2. A simple code-practice audio oscillator. This is easily connected to the conventional recorder

substituted for the variable unit. Telephone receivers can be inserted at X if desired for monitoring. The circuit for the audio oscillator arrangement is shown in *Fig. 2.* Some variation in the capacity of the coupling condenser C may be in order, depending on the input characteristics of the recorder amplifier, and resistor R may or may not be required. However, no particular impedance matching is necessary, as, with a constant pitch, frequency distortion is not a problem.

High-Frequency Oscillator

Another system is to construct a simple high-frequency oscillator, which is nothing more than a low-power transmitter, tunable to some short-wave band on the receiver, and operating without an antenna. An elementary "transmitter" is shown in *Fig. 3.* Coil L consists of 21 turns of number 18 enameled wire, spaced to take up two inches on a 1½-inch diameter form. This will fall plumb in the center of the 3.5-megacycle amateur band (80 meters). The dimensions are not too exacting, however, as you are not going on the air. Using approximate constants, you'll pick up the signal somewhere around this neighborhood. This is an electron coupled oscillator (e.c.o.), and should provide a clean, stable signal. The values of R_1 and R_2 may require some adjustment for maximum output, and the tap position on coil L is occasionally critical. Any comparable beam-power tube can be substituted for the 6V6. This "transmitter" is not connected to the all-wave receiver in any way. It is merely tuned in as any other short wave "station" would be. (However, the receiver power supply can be used for the oscillator.)

The signal, of course, is cw — which, ordinarily, would produce only clicks in the receiver. A beat frequency is required to produce the familiar whistle of the cw signal. In many instances this can be obtained by the simple expedient of removing a few tube shields in the radio-recorder. If this doesn't work, an external oscillator will be necessary. If you have a standard test oscillator, this will fill the bill nicely. You can input it to either the antenna or i-f circuits. In the former case the frequency should be set close to the wavelength of the transmitter, and if the i-f input is employed, adjusted to within audio-frequency range of the intermediate frequency. Either the test oscillator or "transmitter" should be tuned so that a pleasing, musical note is obtained.

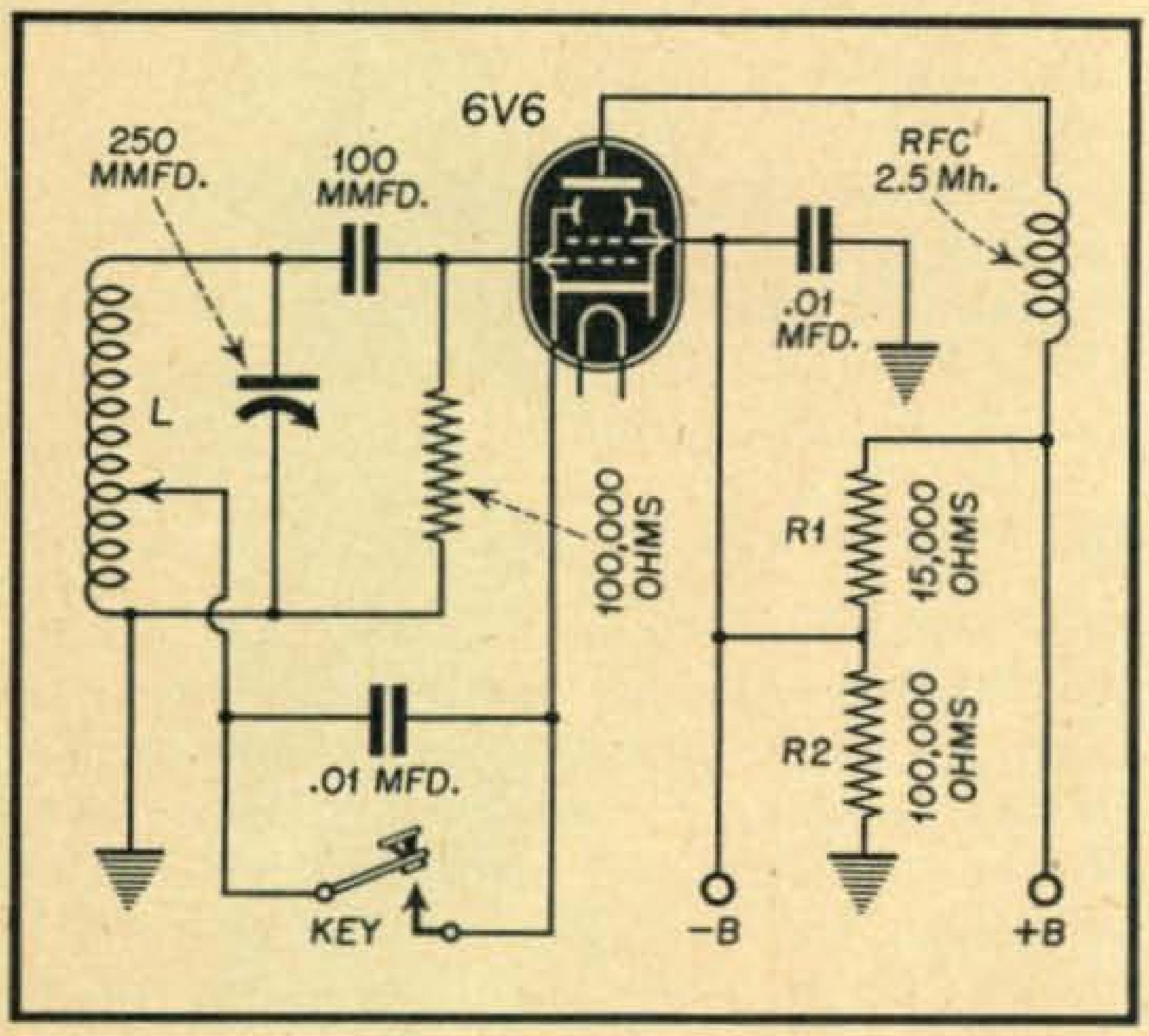


Fig. 3. An electron-coupled oscillator, keyed for transmission directly to the receiver section of recorder

If no test oscillator is available, a second "transmitter" can be constructed — minus the key and the parallel .01-mf. click-eliminating condenser. The 250-mmf. tuning condenser can be of the fixed-variable type if preferred. Both oscillators — the beat oscillator and the "transmitter" — can be operated from a common power supply.

Using Standard Frequency Records

One's own fist can be "put on wax" by the process known as dubbing — that is, playing from one record to another. A standard frequency record will be required — 500 or 1000 cycles. These can be obtained from most well-stocked music shops, and satisfactory recordings are made by Speedy-Q, Audio-Tone (recorded by Columbia) and by Victor.

Most radio-phonograph-recorder combinations have two turntables — one for recording and the other for play-back. The electrical circuit can usually be switched so that a record being played can be simultaneously recorded — or "dubbed." The circuit between the player and recorder is broken at a point which also isolates the record player from the loud-speaker amplifier, and the key inserted at this break. Keying will then feed both recorder and monitor.

An external record player can also be used for dubbing. If it is of the audio-frequency type, keying is best accomplished as close to the pick-up as possible. In the wireless design, the oscillator can be keyed in the cathode circuit — or almost anywhere in the oscillator-modulator-amplifier layout.

In purchasing a standard-frequency record, make certain that it contains at least two minutes of constant-frequency recording and that it is of the correct speed for your turntable. A standard all-variable-frequency record (say from 50 to 7500 cycles) will not be satisfactory. Also, in playing the record, note whether it is to be played from inside to outside, or vice versa. (It makes no difference, of course, how the recording is made.)

Other Uses for Recorder

Aside from recording your own fist, regular radio transmissions can be recorded for code practice at your leisure. This also permits repetition of dubious portions which would have been lost in "live" copying. Usually there is an adjustable differential between recording and play-back speeds, which makes it possible to record faster code than you can copy and play it back within your speed limit. This will lower the tone (pitch of the signal) somewhat, but in no other way affect the quality of transmission.

While much code transmission is continuous wave, there are plenty of tone modulated signals which can be picked up on the conventional radio-phono-recorder combination. If cw reception is desired, try removing a few tube shields, as suggested in tuning in the miniature "transmitter." Similarly, an external test oscillator can

[*Continued on page 30*]

AN RC TUNED A-F OSCILLATOR

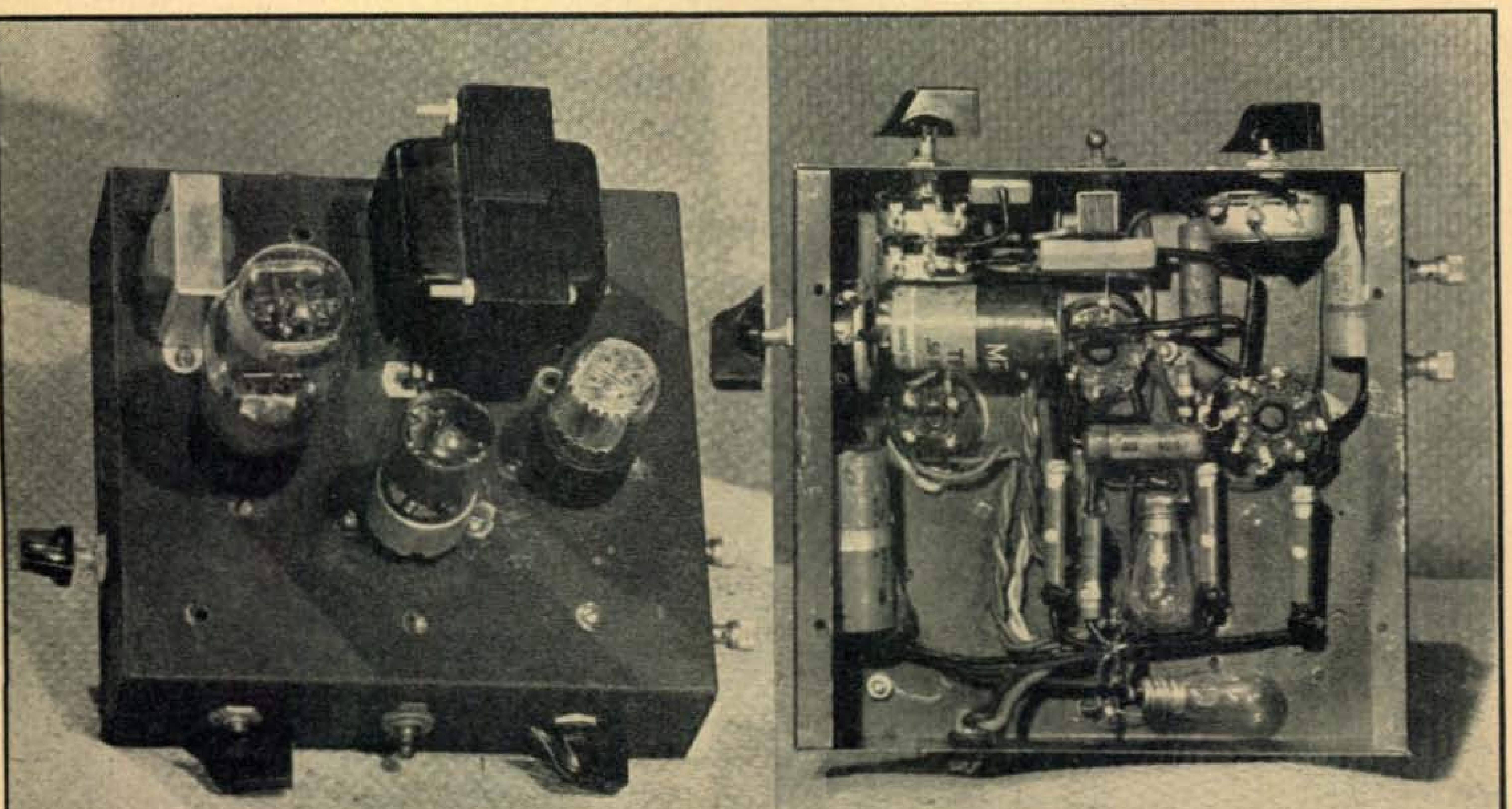
WILLIAM DONAWA

This audio oscillator is simple to build and will come in mighty handy for many tests

IT IS OFTEN desired to have available a source of audio frequency voltage for testing the frequency response of amplifiers, radio receivers, transmitters and in experimenting with other electronic equipment.

The equipment described in this article utilizes a basic circuit that is stable enough to be employed as a secondary standard. The accuracy and stability is determined by the degree of accuracy of calibration, the quality of the components used and the care employed in the adjustment of the variable elements.

The instrument is very simple in construction, can be fabricated from the party



Left, top view of a-f oscillator and, right, under-chassis view

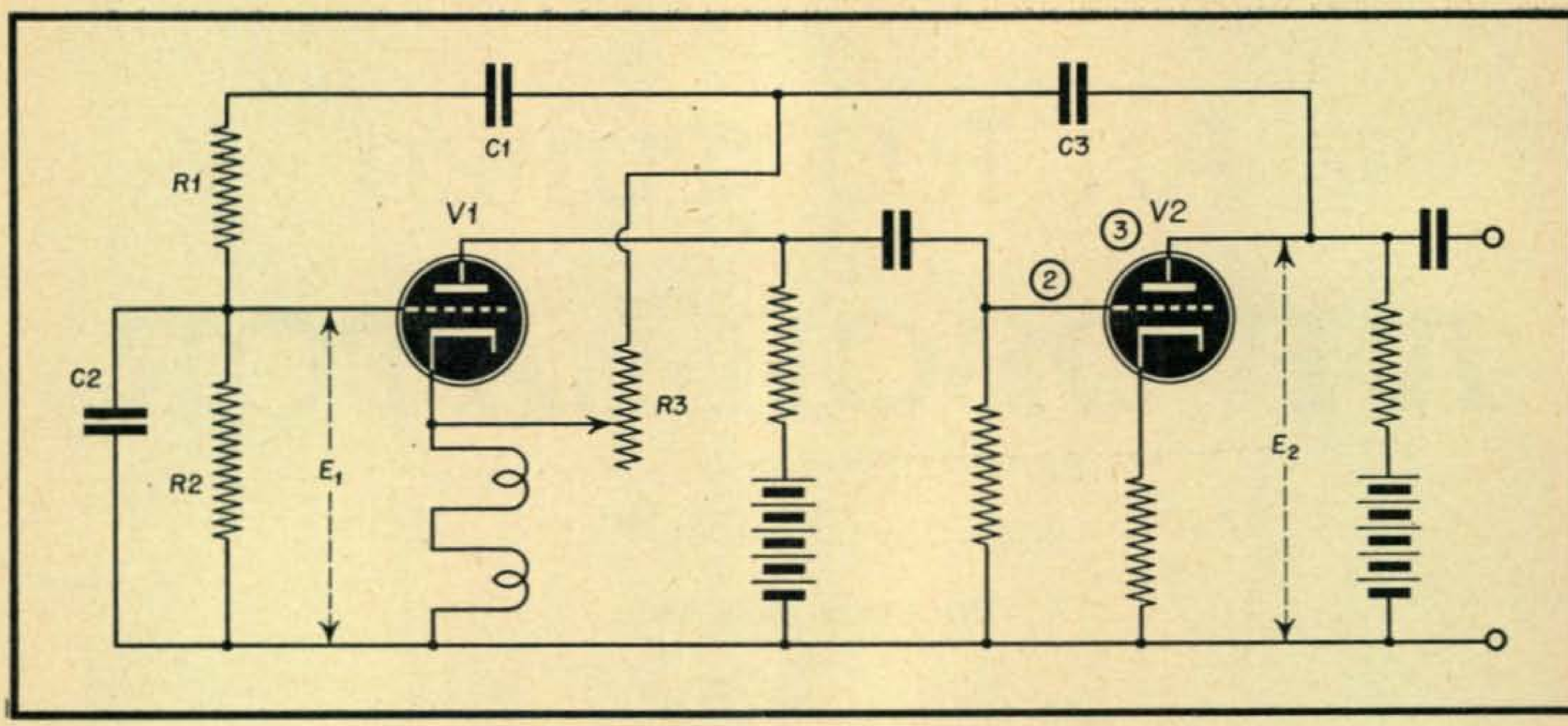


Fig. 1. Fundamental circuit of the oscillator

generally available around a shop (with the possible exception of the dual potentiometer.)

The type oscillator produced by this circuit is known as a resistance-capacitance tuned oscillator of the feed-back type. The oscillator is basically an amplifier with a portion of its output coupled back to the input in such a manner that oscillations are generated and sustained. The basic circuit is shown in *Fig. 1.*

Theory of Operation

Any transient in the power supply voltage, or in any other portion of the circuit, that causes a transient voltage to appear at point 1, on the grid of tube V_1, is amplified, shifted in phase by 180 degrees and delivered to point 2.

The signal is then impressed on the grid of tube V_2, amplified still further and shifted in phase by another 180 degrees.

The voltage appearing at point 3, the plate of tube V_2, is now back in phase with the original voltage that was present at point 1, the grid of tube V_1.

This signal is then applied to the grid of tube V_1 through R_1C_1 and across R_2C_2. The signal is amplified and shifted in phase again by tubes V_1 and V_2, then reapplied to the grid of V_1. This state is known as oscillation.

Oscillations will start and continue but, to be able to exercise some control over the oscillations, it is necessary to incorporate some additional features in the circuit which will enable one to select the frequency of oscillation and to control the amplitude and wave shape.

Let us consider the conditions necessary to obtain sinusoidal oscillations of a particular frequency and the means of establishing the conditions. The fundamental conditions necessary for sinusoidal oscillations of this particular type of circuit are:

a. Total gain must be unity.
b. Total phase shift must be unity.
c. The circuit constants must be frequency selective.

The signals applied to the grid of tube V_1 must not be increased in value after they have passed through tubes V_1 and V_2 and the *RC* network R_1C_1. If the gain is not limited to unity, the initial voltage will be amplified by tubes V_1 and V_2 over and over again and eventually over-drive the tubes so as to block them completely. A fraction of a volt initially applied to the grid of tube V_1 would be increased to several volts and eventually exceed the grid bias voltage. This is prevented by the action of the lamps which are placed in series with the cathode of tube V_1 and the negative feedback voltage fed through the *RC* network R_3C_3.

The resistance of the lamps is quite low when little or no current flows through them. As the current increases in value, the filaments of the lamps become hotter and the total resistance increases. The value of the resistance is directly proportional to the magnitude of the current flowing in the filament. As the current increases, the resistance increases; as the current decreases, the resistance decreases. This thermal action has, therefore, a positive temperature coefficient which tends to limit the amplitude of the oscillations.

The total current flowing through the lamps is comprised of a portion of the output signal, which is fed through R_3C_3 and the plate current of tube V_1. The circuit is adjusted, by means of R_3, so that for a certain output level and a particular value of plate current flowing in tube V_1, the total voltage drop across the lamps causes the tube V_1 to operate at a certain point on the characteristic curve.

If the amplitude of oscillations tends to increase, the current through the filaments of the lamps will tend to increase. When the current increases, the filaments will become hotter and their resistance will increase. As the resistance increases, the voltage drop across them increases, the bias on the grid of tube V_1 is increased, and the gain of tube is reduced. The amplitude of oscillations is reduced. The process operates in the reverse for any initial decrease in the amplitude of oscillations.

This action can also cause considerable trouble. Let us assume that the value of the output signal increases. The action of lamps will be such as to cause the gain of the tube V_1 to be reduced and the output will go down. As the output goes down, the action of the lamps will be such as to cause the gain of the tubes to increase and the output will go up. Thus we see that an oscillation of amplitude will take place. This modulation of the signal can be reduced to such a low value by careful adjustment of the negative feedback voltage that the presence of the amplitude mod-

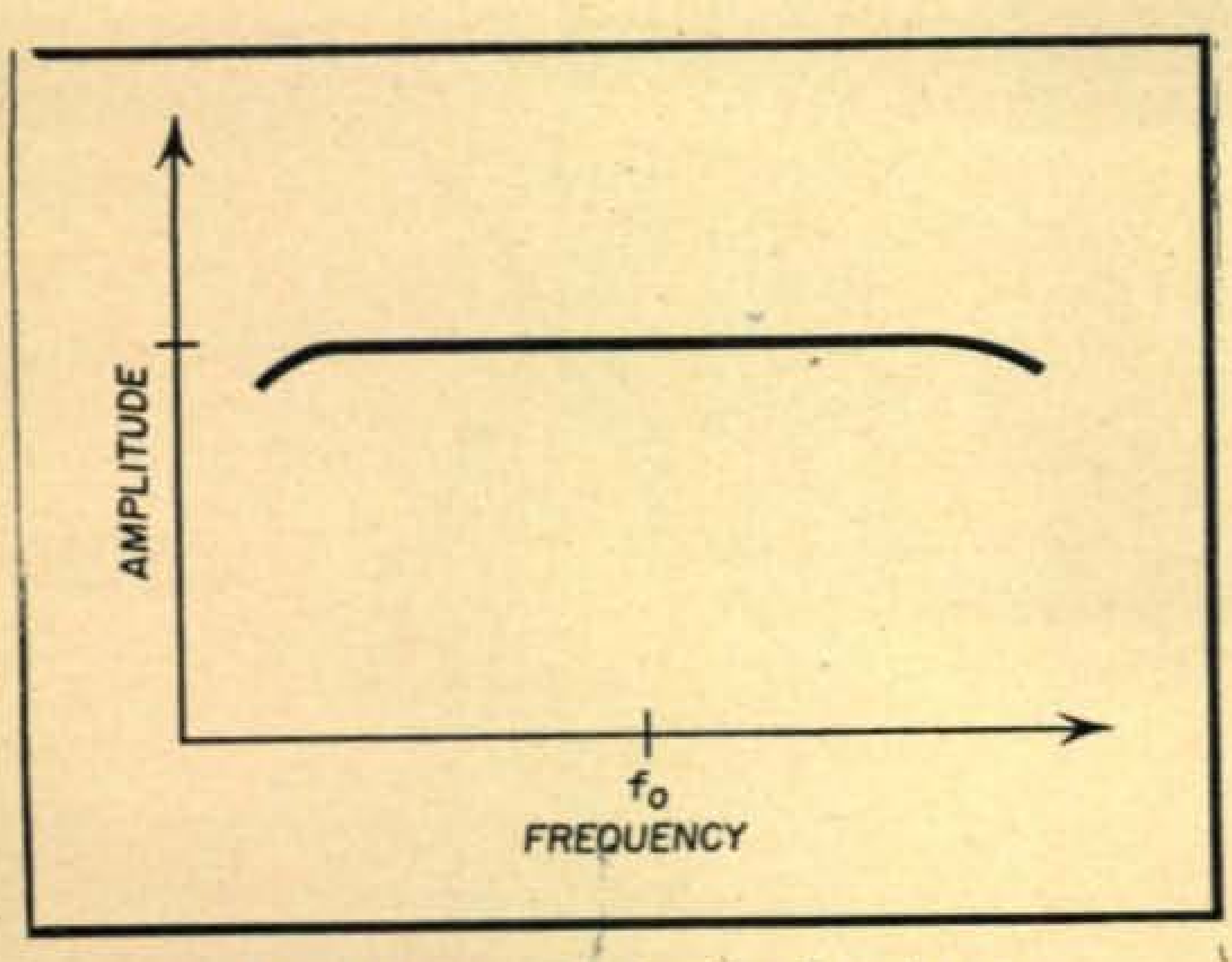


Fig. 2. Negative feedback voltage amplitude vs. frequency

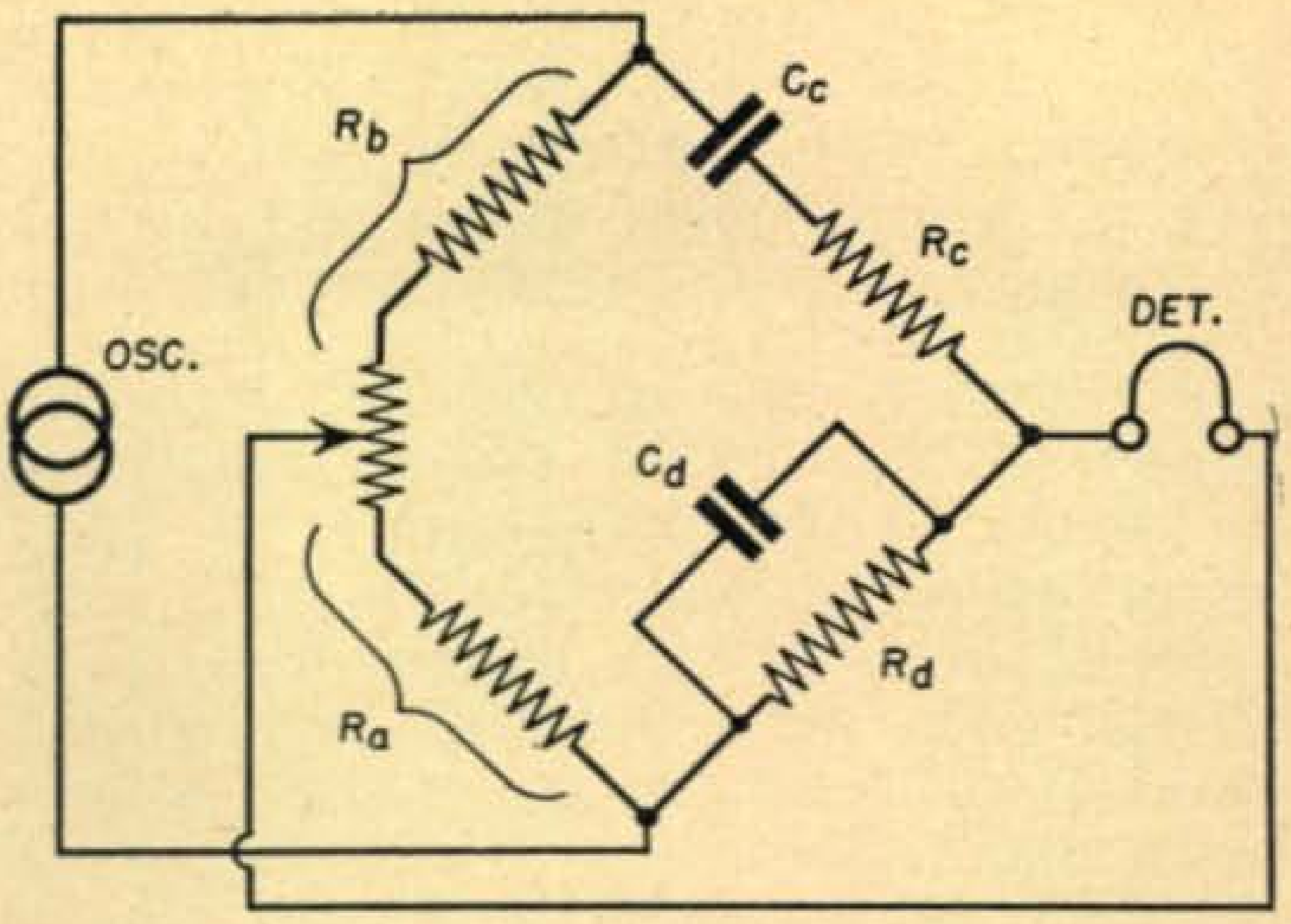


Fig. 3. Wien bridge circuit

ulation in the output signal will not be noticed.

The amplitude control action is known as degeneration, and its application in this circuit results in oscillations of fairly constant amplitude. Degeneration, as used in this circuit, also limits the operation of the tube over the small portion of the characteristics course which is most linear. The oscillations, therefore, will be more nearly sinusoidal for this reason also.

In the circuit described in this article, two each 110 volt, 6 watt lamps are used. The 3 watt, 110 volt size is very difficult to obtain. *Fig. 2* shows the negative feedback voltage amplitude versus frequency.

Phase Shift

Oscillations which are sinusoidal in wave form, containing only one frequency, will result if, in addition to other requirements, the total phase shift through the amplifier of a signal originally applied to the grid of tube V_1 amplified and reapplied to the grid of tube V_1 is equal to zero.

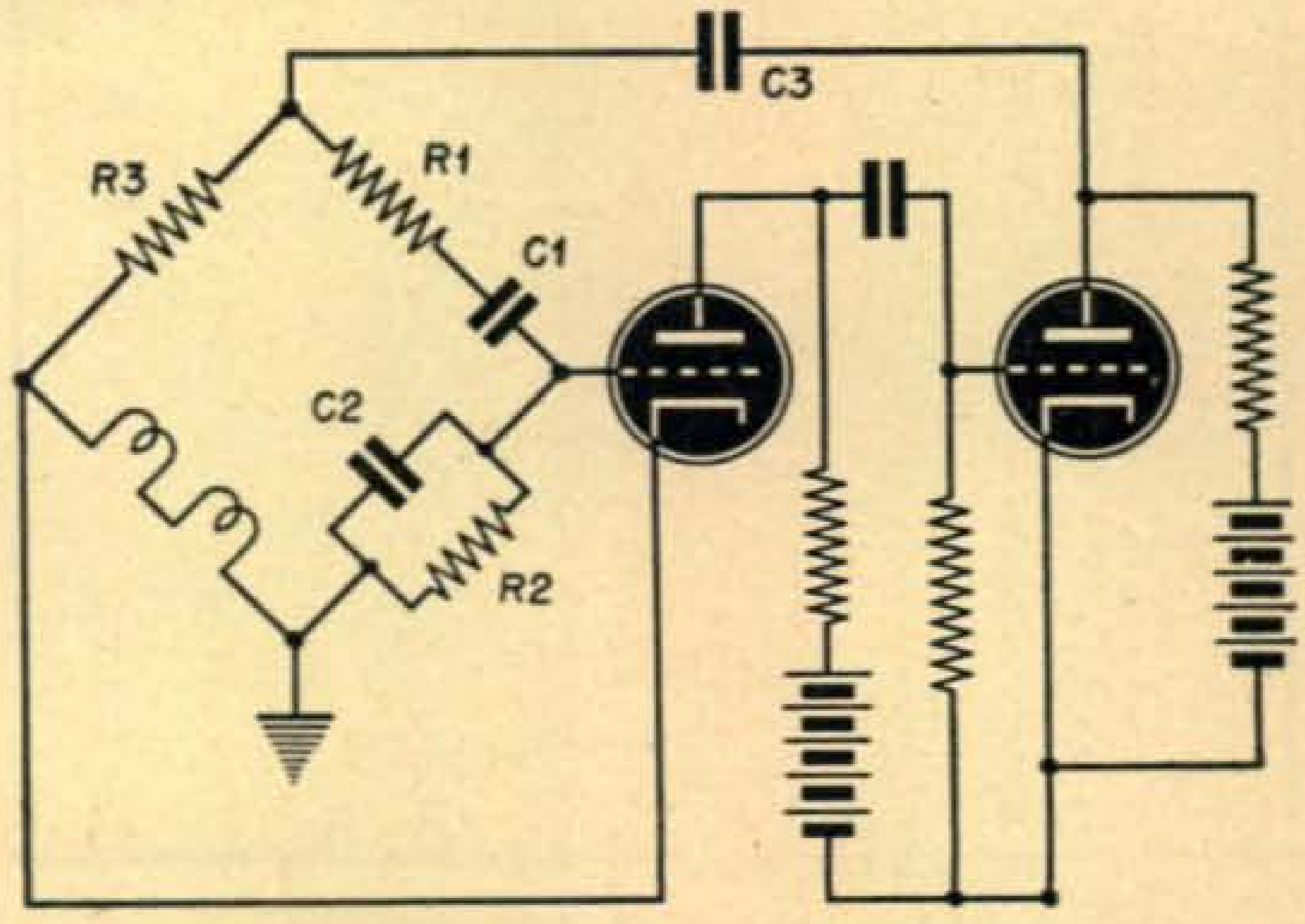


Fig. 4. The oscillator circuit in bridge form

The *RC* network and the number of stages of amplification will determine the frequency at which the phase shift is zero. Let us trace the phase of a signal through the amplifier.

A voltage E_1 appears at point 1, the grid of tube V_1. This voltage is shifted in phase by about 180° by V_1, appears in the plate circuit and is applied to point 2, the grid of tube V_2. In tube V_2, it is shifted in phase by about another 180 degrees and appears at point 3. The total phase shift is now about 360 degrees.

Now that we have established that through the amplifier the total phase shift is about 360 degrees, let us examine the phase shift characteristics of the *RC* network R_1C_1 and R_2C_2.

Fig. 3 is the diagram of a circuit known as a Wien Bridge. The Wien bridge is generally used to measure capacity in terms of resistance and frequency. The circuit may also be used to measure frequency in terms of resistance and capacitance.

The exact frequency of the input signal may be determined when the bridge is balanced. When balance in this bridge is obtained, the following two equations are true:

$$f = \frac{1}{2\pi/Rc\ Rd\ Cc\ Cd} \qquad (1)$$

$$\frac{Cd}{Cc} = \frac{Rb - Rc}{Ra\ \ Rd} \qquad (2)$$

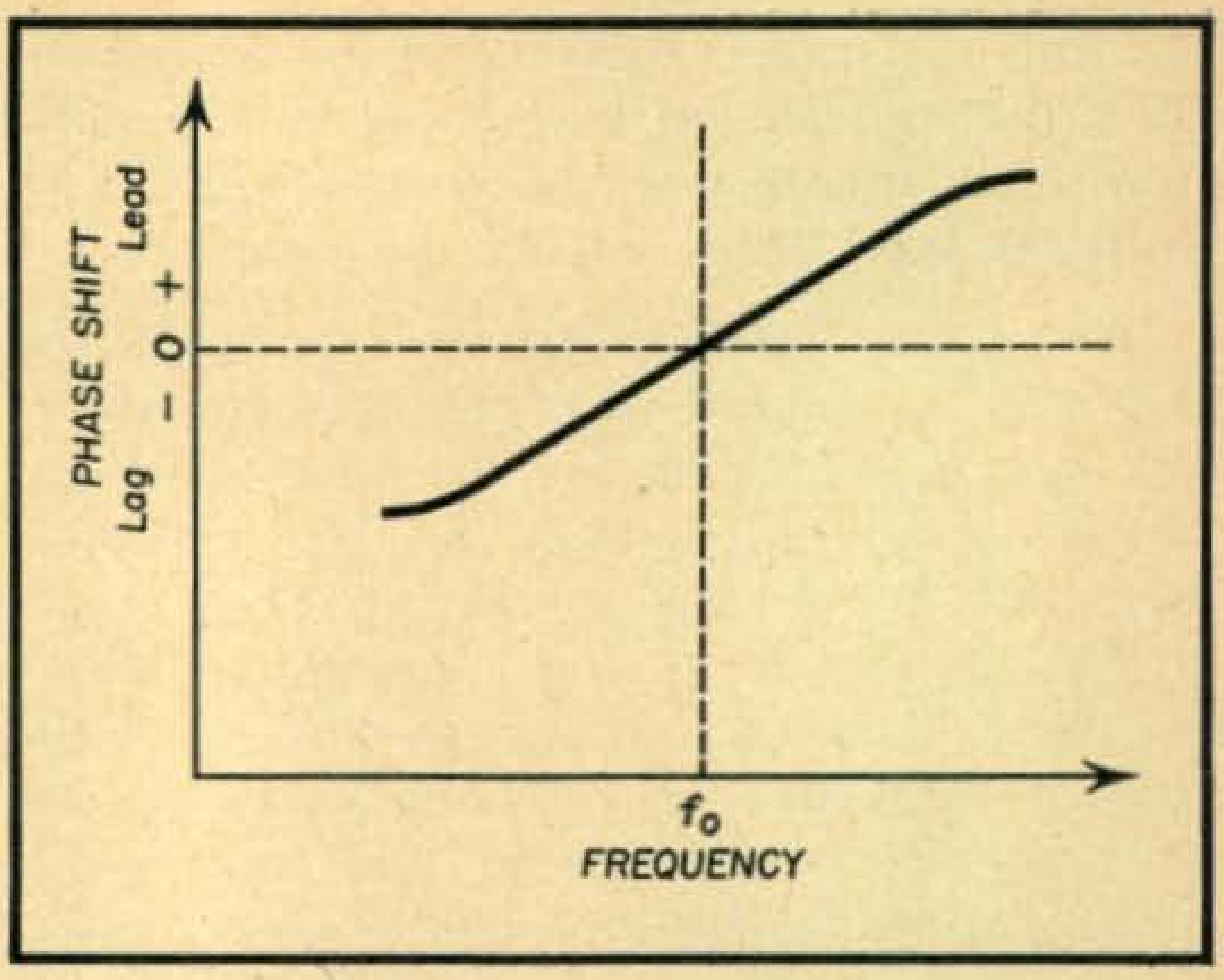


Fig. 5. Phase shift about mean frequency

If we make *Cc-Cd, Rc-Rd* and the ratio *Rb/Ra*-2, the first equation can be reduced to

$$f = \frac{1}{2\pi\ Rc\ Cc}$$

Fig. 4 shows how the circuit elements of the oscillator form a bridge circuit.

The frequency-sensitive characteristics of this bridge are such that it does not permit oscillations of any but one particular frequency to be sustained.

The bridge circuit causes the output voltage to be shifted in phase with respect to the input voltage and also reduces the amplitude of the voltage of all frequencies other than the particular one to which it is tuned. The operation of the circuit with respect to its phase shift characteristics is as follows:

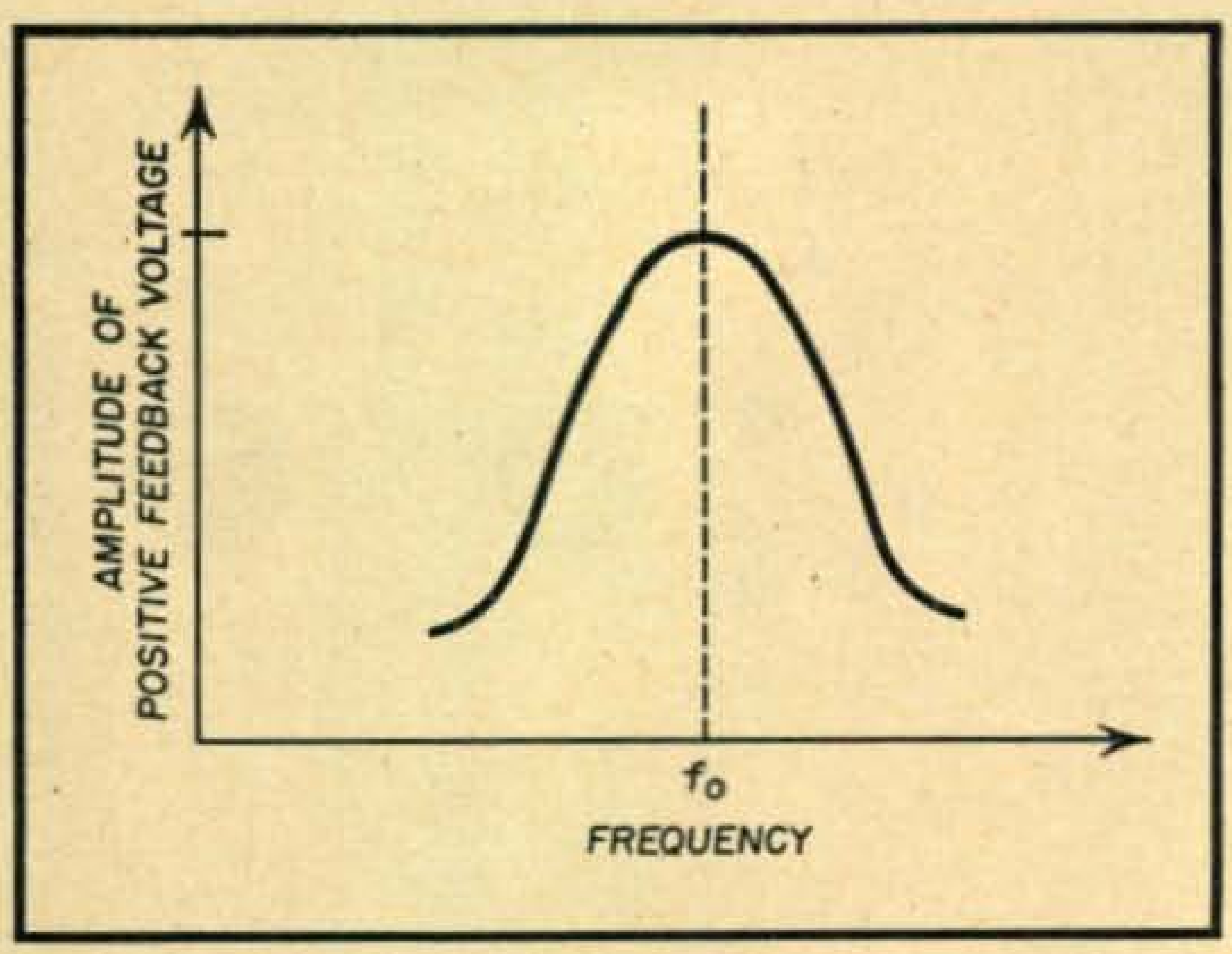


Fig. 6. Response vs. frequency characteristics of oscillator bridge circuit

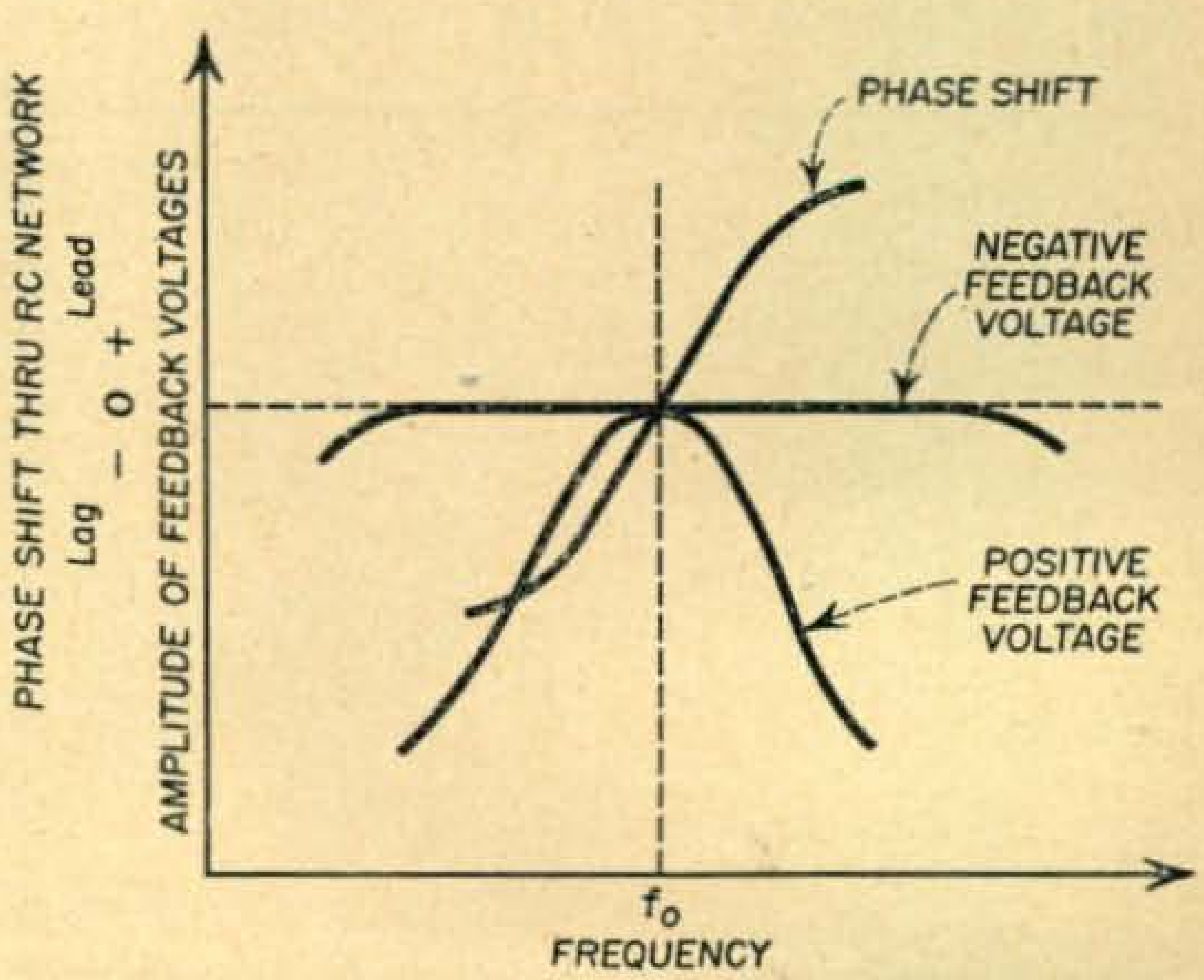


Fig. 7. Phase shift, negative and positive feedback voltages curves are superimposed

The voltage, E_1, across R_2, is in phase with the output voltage of tube V_2 if the time constant of R_1C_1 equals the time constant of R_2C_2. If the frequency of the output voltage, E_2, decreases, the voltage E_1 will lead in phase angle. If the frequency of the output voltage increases, the voltage E_1 will lag in phase angle. The phase shift about the mean frequency is a linear function of frequency. This is illustrated in *Fig. 5*.

This means that at some particular frequency, *fo*, the phase shift through the *RC* network will be zero and the output voltage E_2 will be allowed to be impressed across the input of tube V_1 in phase with the voltage E_1. The total phase shift will be equal to zero.

The total phase shift introduced by the amplifier and the resistance-capacitance network must be independent of changes in supply voltage, load, etc. Constant phase shift is necessary in order to insure a stable frequency.

The phase angle of the transfer impedance of the resistance-capacitance network varies only slowly with frequency. A small change in amplifier phase shift such as could be produced by a variation in supply voltage requires a very large change in oscillation frequency to produce a compensating phase shift in the resistance capacitance coupling system.

Circuit Constants

Since the amplifier will operate over a large frequency band, some means, in addition to the phase shift characteristic, must be employed to permit oscillations of only one frequency at a time. This is also accomplished by use of the frequency-sensitive bridge network. The frequency versus response characteristics of the bridge are

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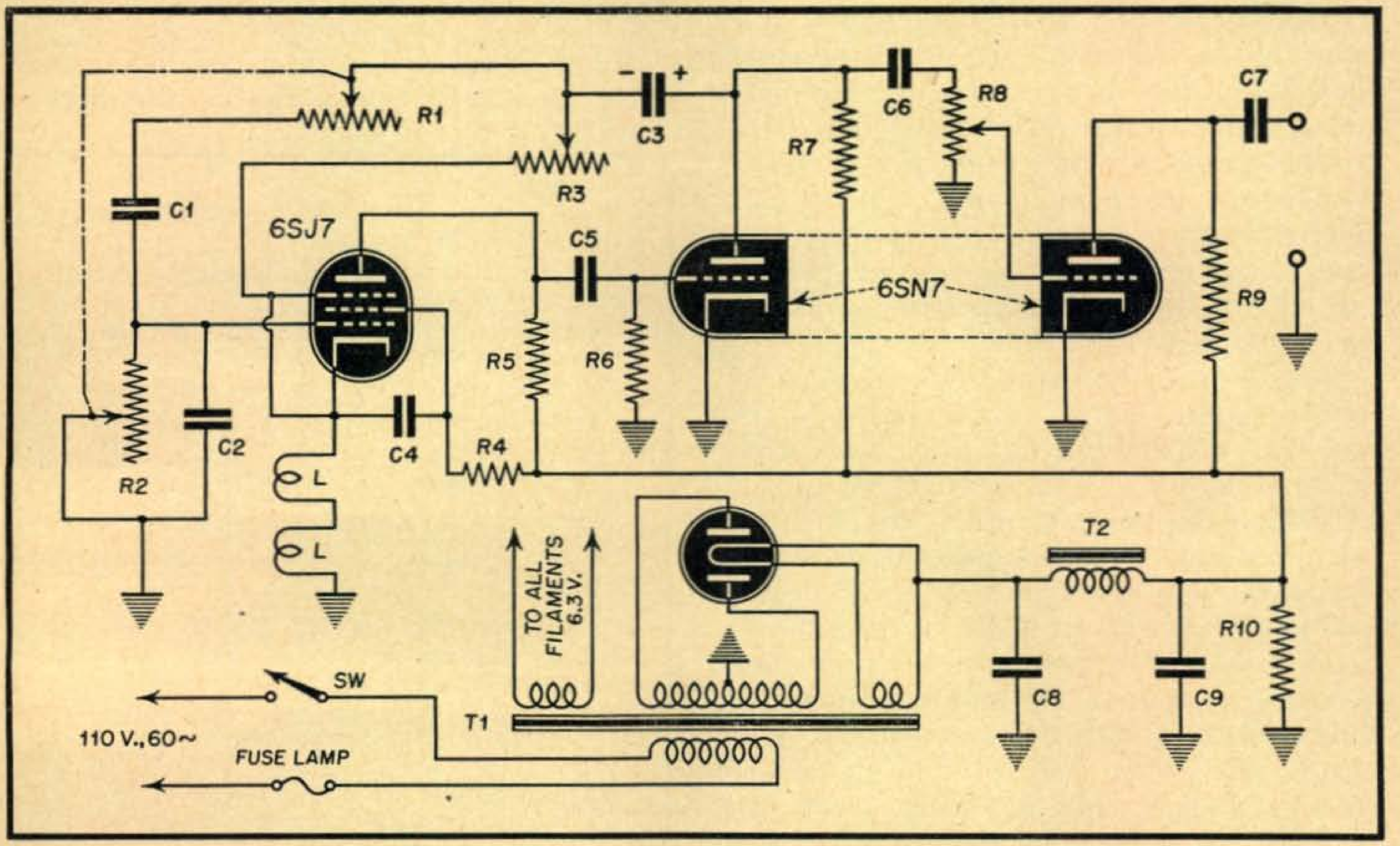

Fig. 8. Complete schematic of the oscillator. Parts list below

R1—dual potentiometer 100,000 ohms each section
R2—dual potentiometer 100,000 ohms each section
R3—1500 ohms wire wound potentiometer
R4—0.25 megohms, ¼ watt carbon
R5—0.1 megohms, ½ watt carbon
R6—0.5 megohms, ¼ watt corbon
R7—10.000 ohms, ½ watt carbon
R8—0.5 megohms, carbon potentiometer
R9—0.1 megohms, ½ watt carbon
R10—30,000 ohms, 10 watt
C1—0.002 mfd, 400 volt, mica
C2—0.002 mfd, 400 volt, mica
C3—15 mfd, 200 volt, electrolytic
C4—0.1 mfd, paper, 400 volt
C5—0.1 mfd, paper, 400 volt
C6—0.1 mfd, paper, 400 volt
C7—0.1 mfd, paper, 400 volt
C8, C9—8 mfd, 450 volt, electrolytic
T1—350--O--350 CT 25 ma
T2—10 henries, 25 ma
L—6-watt, 120-volt lamp

LOOKING INTO THE FU

... while you can't change the ham himself, his post-war equipment and technique will be another case of "something new has been added" . . .

WHILE it would be rather premature to make definite plans for post-war amateur radio, it is never too early to review the situation as it now stands. At the recent FCC frequency allocation hearings, recommendations were made by ARRL, RTPB and IRAC which are quite favorable to the amateur. Most previously occupied bands are retained (160 meter and 5 meter being questioned), while additional bands above 400 mc are proposed. Also a new band at 21 mc is being considered which should be welcomed by amateurs interested in DX. All in all, the picture at this time looks extremely promising for the "ham."

No indications have been made, however, to the requirements for occupancy of the new bands. This will, no doubt, be decided when some of the more urgent matters have first received attention; but it's logical to assume the new bands will at first be available to holders of any class license. The chart in *Fig. 1* of the proposed allocations show six or seven new bands above 400 mc exclusively for amateur operation. This compares with the pre-war allocation of 18.5 mc. With such a wide expanse of frequencies it might seem that the amateur bands would be sparsely occupied. However, recent surveys have indicated that the amateur population will increase from 60,000 (pre-war) to approximately 250,000 a few years after the conclusion of hostilities. The augmented interest is attributed to the fact that many men and women now in the services have been given radio and electronic training and will welcome the opportunity to incorporate this knowledge into a hobby when they return home. As many of these men and women will be particularly interested in the higher frequencies (since much of their training has been along these lines), there should be plenty of room for everyone for some years to come.

Progress

Much progress has been made in radio since the war began but unfortunately

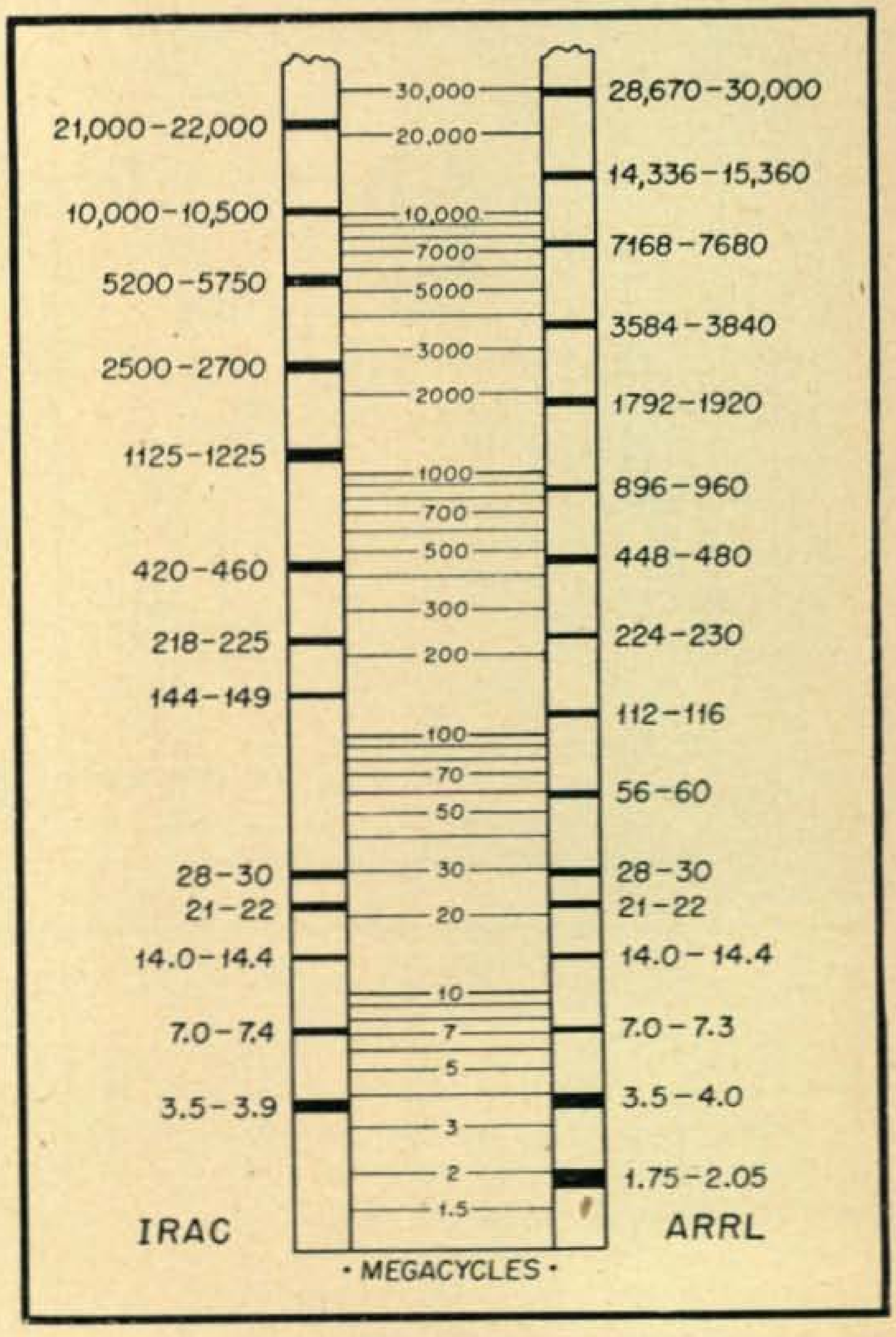

Fig. 1. The post-war amateur bands may end up in a compromise between the IRAC and the ARRL recommendations

TURE OF AMATEUR RADIO

A. C. MATTHEWS
W3FWJ

very little can be revealed as yet, due to security reasons. Progress has not been confined to purely technical developments; new processes of manufacture, new materials and new production measuring techniques have been evolved or discovered. All together they represent a tremendous step forward in advancing radio not only as a better public service but also as a more enjoyable hobby.

For example the armed forces needed quartz crystals in quantities never before required, with the result that new methods of mass producing crystals with precision accuracy, were developed. This should result in crystals being available at comparatively low prices, well within the reach of all amateurs. Instead of the average station having one or two xtals as in the past, in all probability they will use a dozen or more, not only in transmitters but also for receivers and frequency meters.

Frequency Meters

The frequency meter itself is another point of interest. Pre-war designs left much to be desired, particularly as to long-time stability. However, not long after hostilities began, a frequency meter which ful-

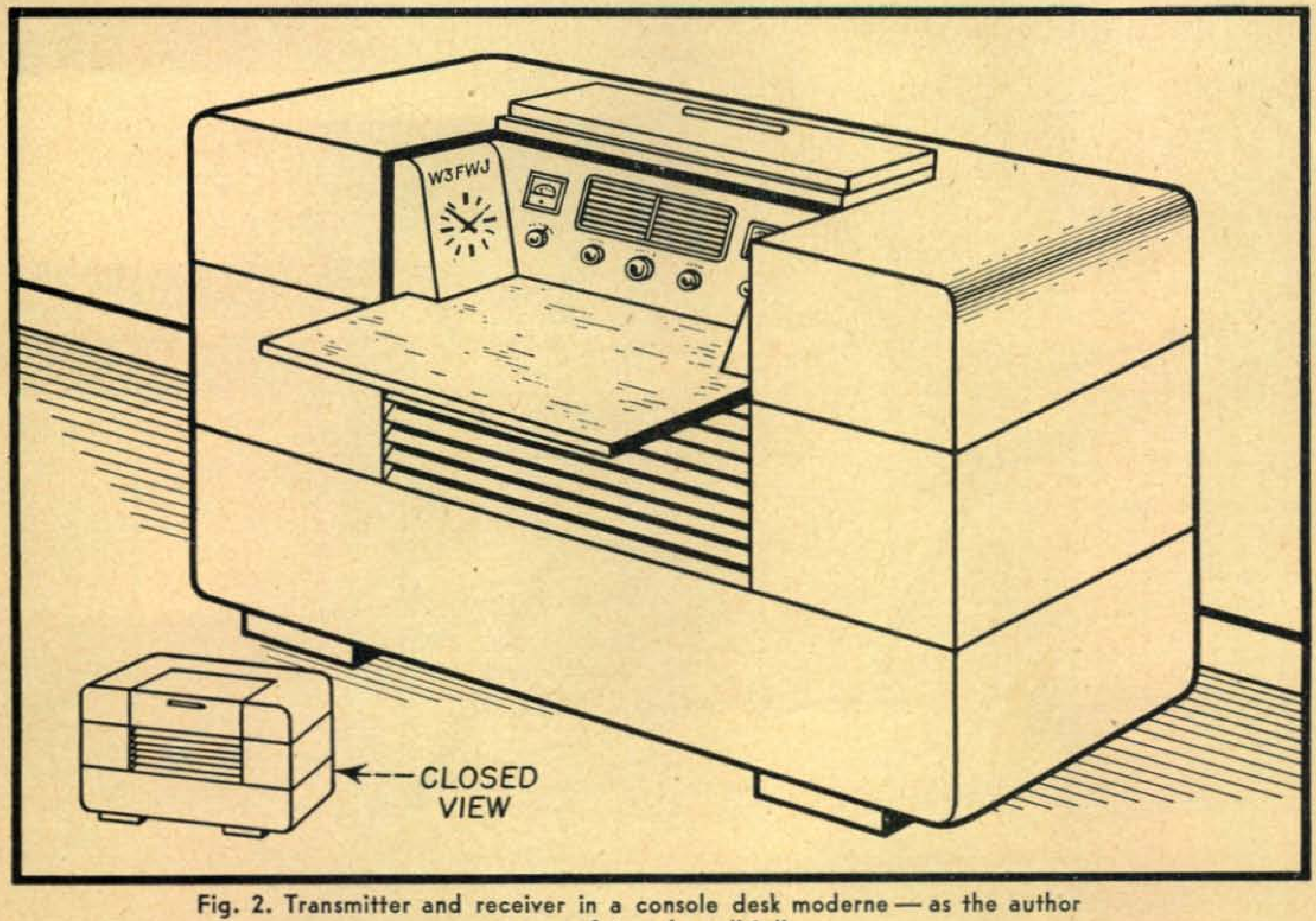

Fig. 2. Transmitter and receiver in a console desk moderne — as the author sees a future ham "rig"

filled the most exacting requirements was developed through excellent collaboration between the armed forces and the engineering departments of several manufacturers. From both an engineering and production standpoint, the knowledge and technique gained in the development of a stable frequency meter will undoubtedly result in equivalent instruments being made available to the amateur at a reasonable price.

Medium and UHF Bands

Improvements in medium and UHF amateur band operation will undoubtedly be characterized by more precision gear. The day when most "hams" built their own equipment is past. The future will see the majority of amateur stations equipped with factory-built units. Many of the manufacturers now producing war-time communications equipment will remain in the field and "cash in" on their newly acquired knowledge of radio and electronics. With a larger group of manufacturers producing equipment of this type, competition will push prices down to a level where it will not be worth while "rolling your own," except for experimental purposes.

New tubes which give better value on the amateur yardstick of more watts per dollar have been developed. These tubes, in general, are smaller physically than their pre-war prototypes of equivalent power rating. New techniques in manufacturing have resulted in tubes capable of withstanding severe overloads, a characteristic which the average amateur feels to be of importance since it allows him to "gyp" the circuit in an effort to increase the power output.

Since among our returning GI-Joes there will be many GI-Josephines, the influence of the latter will undoubtedly be evident in the appearance of post-war ham rigs. Much of the equipment will be streamlined, carrying out a trend that was apparent before Pearl Harbor. A 250-watt transmitter in Sheraton, Queen Anne or modernistic design should not surprise you. It will fit esthetically into the small apartment, and end forever the feminine objections to the mess and "machinery" of "ham" radio.

Reliability and versatility will go hand in hand in the post-war design. This in no small part will be due to the fact manu-

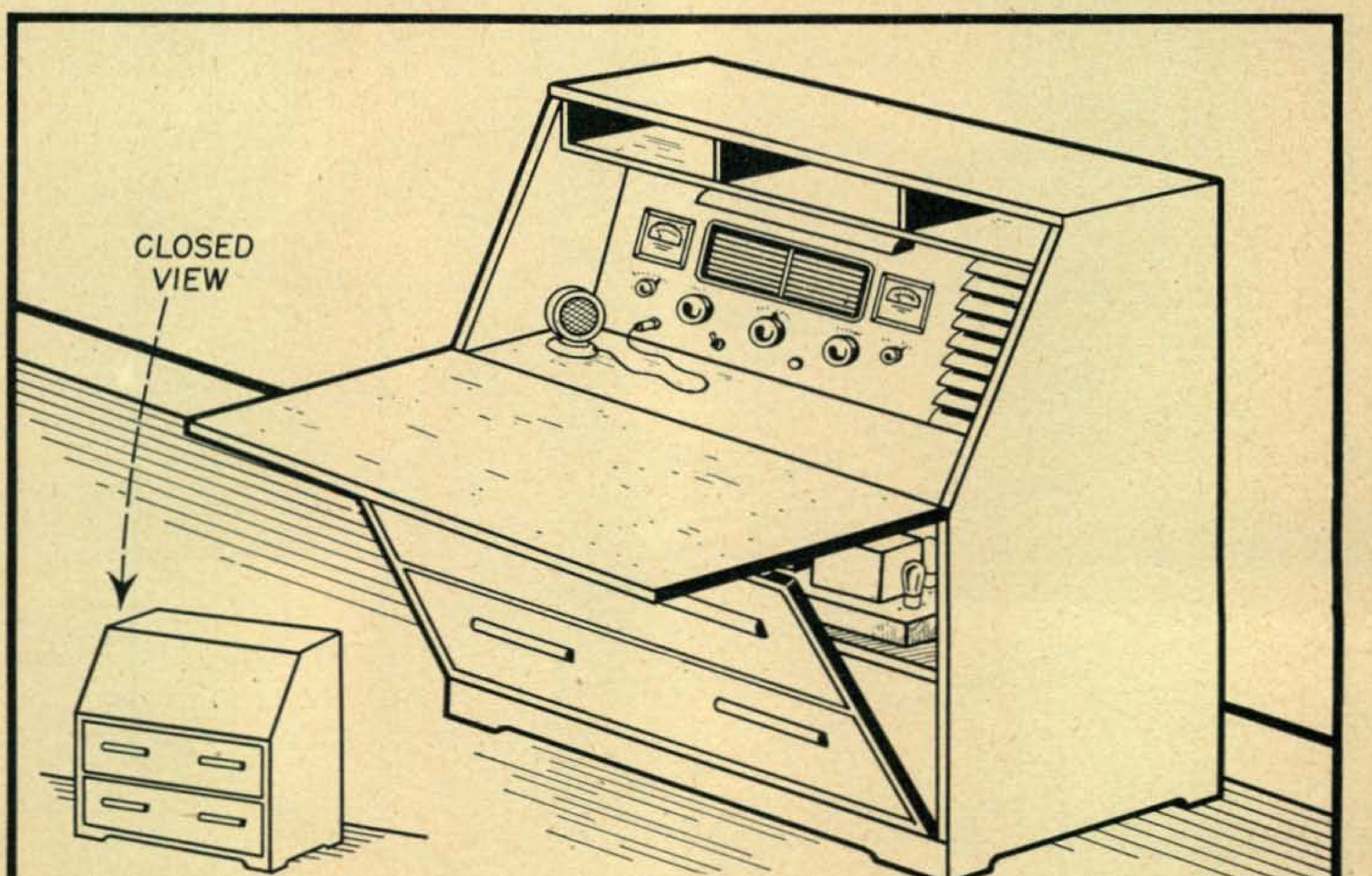

Fig. 3. The secretary-desk layout will fit in well with the rest of the furniture in the average living-room

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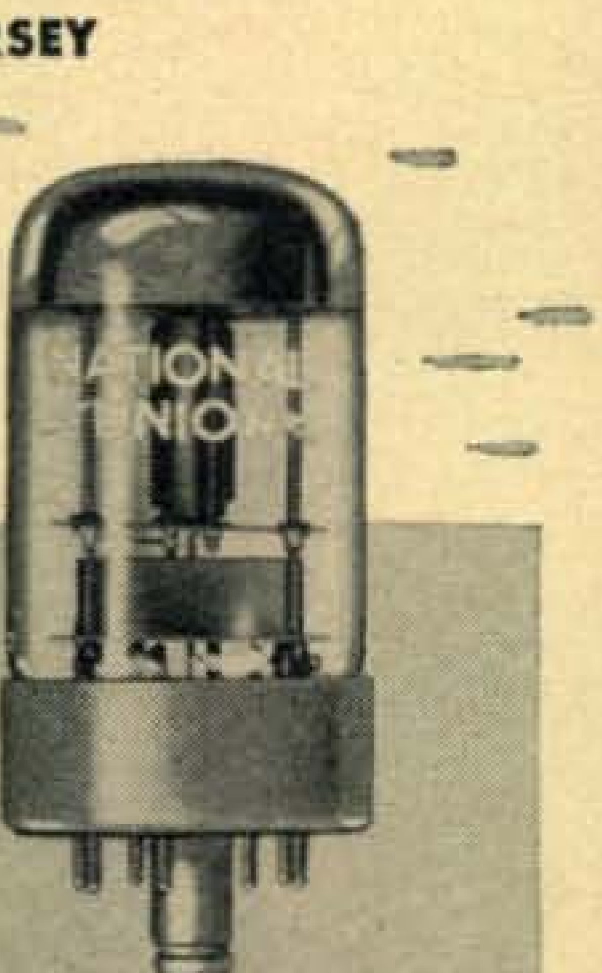

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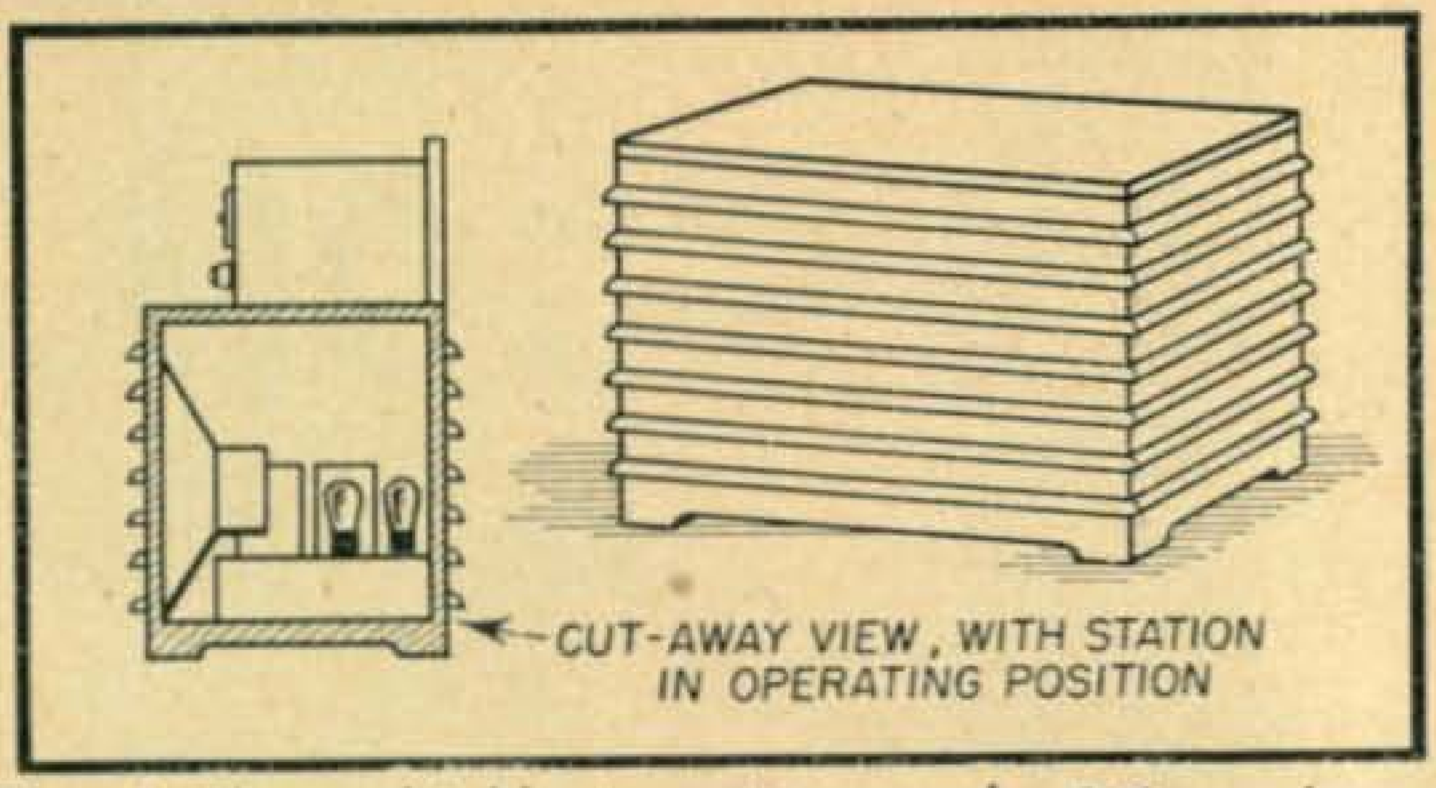

Fig. 4. The end-table type turns modernistic again — and maybe those flanges will radiate a bit of heat from the rectifiers and finals!

facturers had to produce equipment according to government specifications. Quality with large production has been the keynote during the war and the lesson will not soon be forgotten.

Television

Pre-war amateur television, like its big brother, commercial television, hardly had a chance to prove itself with only a few amateur stations on the air. Unfortunately, television equipment is extremely complex and requires not only considerable technical knowledge but a large amount of test equipment to get it "perking." Manufacturers were hesitant to produce a complete unit for amateur use because there was little demand for anything of this nature since commercial television had not yet become a reality.

Here again, new developments and increased public interest, have brought commercial television to the point where immediately following the war, or as soon as materials are available for civilian use, commercial television will be an accepted service. It will then be only a matter of time before commercially built transmitters and receivers will be available for amateur use.

The requirements of the amateur as to picture definition are not nearly as severe as those of the general public because the "ham" is limited to communication between similar amateur stations where close-ups are the usual type of transmission. A 120-line picture should therefore be satisfactory for this service. This simplifies both the receiver and transmitter design, and since the manufacture of cathode ray tubes has been stepped up to a high level during the war, the cost has been greatly reduced. It is probable that a complete station could be sold in the neighborhood of $300.00 if produced in quantities.

Narrow-Band FM

The many advantages of FM for communications purposes are well known. Even prior to the war several police departments used the system for a long enough period to establish its merits for UHF and VHF operation. With the return of amateur activities, narrow-band FM will come into its own especially for UHF use. The simplicity of design, with a minimum of power requirements makes it ideally suited for portable-mobile as well as fixed-station use. While this system of transmission occupies more space in the r-- band (which is likely to be crowded), the reduction of noise, the absence of whistles and tweets, makes its use highly desirable. Ordinarily the station being received will completely block out interfering signals if the desired signal is at least twice as strong as the interfering signal. Another advantage is that, due to lack of noise, the receiver can be operated satisfactorily at full sensitivity under conditions where an AM receiver is often useless. With these advantages it is only natural that the trend in UHF amateur operation should be towards narrow-band FM.

New FM circuits, as yet not fully proven, are being developed. Many more are yet to be invented; so there is plenty of room for both the operating and experimental amateur in the UHF field of narrow-band FM.

Microwaves

The newest, but not the least important, portion of the r-f spectrum is the microwave region. Since recommendations for frequency assignments have been made to the FCC for amateur bands in this region, and the likelihood of their being granted is good, it is desirable to consider some of the possibilities of this region for amateur use.

At present conventional type tubes are available which will operate as high as 1000 mc, and it is likely this limit will be increased slightly in the future. While it is true these tubes have very low power capabilities the fact remains that high or even medium power, as we think of these terms today, is not required for microwave work. Power outputs of less than ¼ watt can be satisfactorily employed, when advantage is taken of wide band FM with its natural noise reducing qualities, and

[Continued on page 32]

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CODE

[*Continued from page 18*]

be employed, or a fixed oscillator constructed that will tune around the intermediate frequency of the radio. This last is the best arrangement of all, and is that employed in commercial cw receivers.

Don't Forget the Mill

In making code recordings, of your own fist or from the air, the cheapest kind of recording blanks can be employed. Quality here is of no consideration, and quantity —the more records the better—is the goal. Do not consider it a bad habit to copy the same recording again and again —even when you know exactly what's coming. This is one of the best ways of giving you a bit of courage and relaxation and at the same time familiarize yourself with word pictures rather than letter forms. And while on the receiving end, don't neglect the typewriter—the "mill" to a radio operator. When your speed works up above thirty words per minute, you won't be able to push the pencil as fast as copy is dished out to you. All good operators use the mill, and it is best to learn this copying technique simultaneously with the long-hand method. Otherwise you'll have to take time off later on! And hunt-and-find is out—use the touch system if you are aiming at the 45-word-per-minute-up class.

Fig. 4. While you're gaining speed on the "bug" — don't forget the "mill"!

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copy your splatter bug your sending is okay. *He* may be the expert, not you. Your druggist can make out the hieroglyphics on your M. D.'s prescription and the post office can decipher names and addresses that would defy a cryptologist. So watch your bug. It just happens that poem of Robert Burns about "would some power the giftie gie us" was dedicated to a bug. The title is "To a Louse."

AMATEUR RADIO

[*Continued from page 28*]

transmission that is beamed by parabolic or other high gain antenna systems.

So much for the conventional types of tube. Let us now consider tubes designed especially for microwave work such as the Klystron, magnetron and "lighthouse" types. At present such tubes are not available, and if they were, the price would be too high for general amateur use. However, as more experience is gained and production methods are developed, the cost should automatically be reduced to a point where the average ham can afford them.

As for antenna design, it is here the experimental amateur can readily contribute. Antenna installations can be quite varied, from parabolas to cones, horns, stacked dipoles etc. All are capable of enormous gain if designed properly (power gains of 1000 and 2000 being not uncommon). Their use is made easier by the fact that the physical dimensions are such that the antennas can conveniently be handled and do not require a backyard for space.

Tuned circuits for microwave operation look like most anything except the familiar coil and condenser combinations of the erlow frequencies. The inductor and capacitor have been replaced by resonant cavities and the transmission line has given way to a "wave guide." Fortunately, new insulating materials have been developed which make the use of transmission lines still feasible at these frequencies with not too great a loss in power transmission. In all probability the amateur will make use of these lines, at least until such time as commercial wave guides are available, since the accuracy with which it is necessary to maintain the physical dimensions of the wave guides makes them nearly impractical for most home constructors.

ZCAA

[*Continued from page 9*]

the Chief Signal Officer and transmitted once each month. Those breaking down the cipher messages were accorded recognition in a future broadcast.

Contests

From time to time various types of contests were held, combining individual and Corps Area competition. Each year the Armistice Day message contest was looked forward to by all, as well as the annual Code Speed Contest in which transmissions were sent by WLM/W3USA at speeds ranging from 15 to 65 words per minute.

Many other activities were carried on in addition to traffic handling. Those who were interested in cryptography had the opportunity to increase their knowledge by means of a specially prepared correspondence course, and to ply their skill on coded messages in an unknown key prepared by the other side of the world carrying that day's date with the explanation to the addressee that it was transmitted via the Army Amateur Radio System, *no charge.* Every five minutes the speed was increased 5 w.p.m. and the object was to copy as long as you were able and then submit your copy for tabulation, on a Corps Area basis. Some of the Corps Areas arranged for valuable prizes to be awarded their winners. Believe it or not, we did have members who copied the 65 w.p.m. transmissions!

The entire staff was drawn from the membership, including the editor, and most of the make-up carried on by mail. Some of the magazine reached large proportions, as many as 50 pages, and gave evidence of the avid enthusiasm displayed by the members in volunteering their time and creative effort.

It is to be expected that the type of person affiliated with such an organization would go far in serving his country's needs in time of war. That has been the case in every instance. Hundreds of AARS members are in the Armed Forces and are still carrying on the traditions of achievement, self-betterment and service to one's country. Being more intimately associated with the affairs of the Second Service Command, the writer can name a few local members that come to mind who have gone far, their rank being a tribute to the Army Amateur Radio System: Lt. Col. David Talley, W2PF-WLNA; Lt. Col. Robert Hertzberg, W2DJJ; Major William T. Hodson, W2FJE; Major Joseph Keller, W2AZT; Major Howard E. Smith, W2GDF; Major George Hellmuth, W2BGV; Captain Harold W. DeMyer, W2DW; S/Sgt. Kenneth Grossman, W2LJJ. There are countless others who have reached officers' rank; any omissions are not intentional. It is interesting to note that, of the large number of AARS members with whom the writer is acquainted and who are in the armed services, not one comes to mind who is a private!

We look back upon the days from 1926 to 1941 as a time of wonderful achievement and as the fore-runner of exciting days yet to come. Be assured that there will again be an Army Amateur Radio System and that it will be bigger and better than ever. Personnel of the War Department in many fields have openly stated their recognition of the value of this organization and have indicated their full support of its perpetuation.

OSCILLATOR

[*Continued from page 23*]

illustrated in *Fig. 6* and are described as follows:

For a particular frequency the impedance presented by the R_1C_1 combination is equal to the impedance of the R_2C_2 combination. The voltage applied to the grid of tube V_1 through the network, for this particular frequency, is of a certain value. If the frequency of the positive feedback voltage increases, the reactance of C_2 decreases and the voltage across R_2 is decreased. Thus the voltage applied to the grid of tube V_1 decreases.

If the frequency decreases, the reactance of condenser C_1 increases and reduces the amount of the current flowing through it. As the current C_1 decreases, the voltage drop across R_2 decreases. The voltage applied to the grid of tube V_1 decreases.

Now that it has been established how the three basic requirements are met in this particular circuit, we can see, graphically, how all three combine to permit sinusoidal oscillations at one particular frequency.

In *Fig. 7* we have superimposed the three curves for each quality: phase shift, negative feedback voltage (gain), and positive feedback voltage (frequency-selective.)

At the frequency *fo,* the following conditions exist:

a. The phase shift is zero.

b. The magnitude of the positive feedback voltage fed to the grid of tube V_1 is just a little bit larger than the magnitude of the negative feedback voltage applied to the cathode of tube V_1.

This means that oscillations will be sustained at the frequency *fo.*

In order to change the value of the frequency *fo,* it is only necessary to change the values of either the resistive or capacitive elements in the *RC* network R_1C_1 and R_2C_2. This will change the frequency, *fo,* at which the phase shift is zero and the magnitude of the positive feedback voltage is greater than the negative feedback voltage.

In a large precision type of oscillator, the resistance values are kept constant for a particular band of frequencies and the

[*Continued on page 40*]

BEAM MOUNT

[*Continued from page 12*]

tons are in contact with the brake shoes; consequently the brake shoes are forced outward against the brake drum. When the hand brake is released the return spring on the brake shoes forces the wheel cylinder inward, so they return to the original neutral position.

Brake Adjustment

To set up and adjust the brake system is simple. The master cylinder has an opening on top to insert hydraulic brake fluid. About a pint of this will be necessary for the experimental work and final assembly. After the connections have been made between the master cylinder and the wheel cylinder, the master cylinder must be filled with the fluid. On the wheel cylinders is a small escape valve, which should be grasped with a wrench. Then applying gradual pressure to the master cylinder piston, this valve should be opened until a steady stream of liquid is flowing out. At this point it should be closed . . . **without** removing pressure from the master cylinder. This expels air from the hydraulic lines. The master cylinder can then be refilled and the braking system is ready for operation. A rubber hose emptying into a glass will save the fluid for re-use, while bubbles will indicate the presence of air. The process is easier if two people work together. If the brake drags, without any pressure on the master cylinder, and the drag is objectionable, there are brake band clearance adjustments on the bottom of the brake drum. These may be turned until the drag is removed.

The cost of all the parts for this rotary beam mount will vary in different localities. For the first and second model constructed they were as itemized:

On half rear end	$10.00
One hand brake	1.00
Master cylinder	2.50
Copper line and fittings	1.00
	$14.50

The welding work should cost an additional several dollars. The master cylinder and wheel cylinder can be exchanged at an automobile parts store for rebuilt units at a cost of about four dollars; however, it isn't essential.

Excessive pressure should not be applied to the bolts holding the brake drum on the bearing housing or it will cause binding. If the play in the axle is objectionable and further tightening causes binding, a paper shim can be inserted between the brake drum and the bearing housing.

OSCILLATOR

[*Continued from page 36*]

capacitance is varied.

If the frequency is varied (by means of an ordinary gang-tuning condenser, such as is used in broadcast receivers) a frequency range of 10 to 1 can be covered on a single dial. The different ranges of frequencies are obtained by switch selection of different values of resistances R_1 and R_2.

The usual commercial audio oscillator delivers signals varying in frequency between 20 and 20,000 cycles per second in four ranges of 20-200, 200-2000, 2000-20,000 cycles per second. This is accomplished by employing three sets of resistances and a four-gang broadcast condenser with the sections parallel in pairs for tuning.

In this particular circuit the capacitance is kept constant and the value of the resistance varied.

The formula which is used to determine the frequency is the same as given before:

$$f = \frac{1}{2 \pi RC}$$

where f is in cycles per second
R is in ohms
C is in farads

The values of R and C are the values of R_1, C_1, R_2 and C_2. R_1 equals R_2 and C^1 equals C_2.

The complete circuit is shown in *Fig.* 8. R_1 and R_2 are made up of the two sections of a dual potentiometer. Some care must be used in the selection of this item because the values of R_1 and R_2 must always be equal. The quickest way to determine if this is true is to measure the values of

[*Continued on page 40*]

MEET THE "YL"

[*Continued from page 15*]

there, but we did know they needed communications. We gave it to them—in return for some excitement, a little danger, some discomfort and next to no sleep. It was fun for the boys to walk into some of the remaining restaurants on Fire Island, order anything they wanted to eat and drink, and then tell the proprietor to "Charge it to the Mayor"—and those were the Mayor's orders.

Came Pearl Harbor! Telephone, telegraph lines, commercial radio circuits were jammed—running hours if not days behind. Mitchell Field called W2JZX and asked me to CQ a notice that all furloughs and leaves were cancelled—that service men were to report to base immediately. Hams had already been ordered off the air, but W2JZX received written authority for this special transmission, which was probably amateur radio's swan song for the duration.

The gang co-operated magnificently, merely breaking in to acknowledge receipt with guarantee of delivery. Short wave listeners—on BCL radios—likewise helped, and some messages may have been delivered a dozen times. But they got the men back on duty!

Right after that I checked out of my happy home to become Chief Radio Instructor in a temporary Air Warning School at Fort Dix. It was mighty cold in those 1918 vintage warehouses. And back in 1942 — before the advent of WACS, WAVES and SPARS — there were occasional comments concerning a woman's place in the home. But the work we did paid dividends, and my next assignment was to Drew Field, Tampa, Florida (where it was at least a bit warmer) and from there to the Army Air Force Technical Training School at Sioux Falls, S. D. (where it gets plenty cold again).

My last job was for the Signal Corps, training women operators for an Unlisted Post on Long Island. I don't doubt they'll be YLs and XYLs—not to mention OWs—after this sorry mess is over! 73.

ZERO BIAS

[*Continued from page 5*]

tion without license of any kind—anymore than the layman requires a ticket to speak over the radio telephone in a ham shack, or to call up overseas from his home. While a licensed operator must be on duty at the amateur station and at the trans-oceanic transmitter, such supervision is solely for the purpose of maintaining correct operation of the equipment (and remote-controlled transmitters are licensed). There is no good reason why low-power, fool-proof, micro-wave transmitters made by reputable manufacturers according to FCC standards, should not be okayed by the government for restricted operation without station and operator's licenses. Such transmitter-receivers would be used on large farms, ranches and for a variety of short-distance, semi-commercial uses, at the same time providing a painless introduction to the hobby of ham radio.

There are many who would favor the elimination of the Class C ticket—the mail-order variety issued to those who cannot journey to an examiner's office because of excessive distance or physical disability. The holder of a C license is entitled only to Class B privileges, apparently upon the illogical assumption that while the applicant and examiner will be perfectly honest in the code test and written Class B examination, they might cheat in the would-be ham's effort to pass the somewhat more rigorous written test for Class A operation! If licenses *in absentia* are to be issued, such restrictions do not make sense.

OSCILLATOR

[*Continued from page 38*]

resistance of each section, between the moving arm and one end, for several settings of the shaft.

R_3, the negative feedback control resistor, is set once for a good sine wave signal and need be adjusted only once in a great while.

R_5 is the gain control. Additional stages of amplification may be added if greater output is desired.

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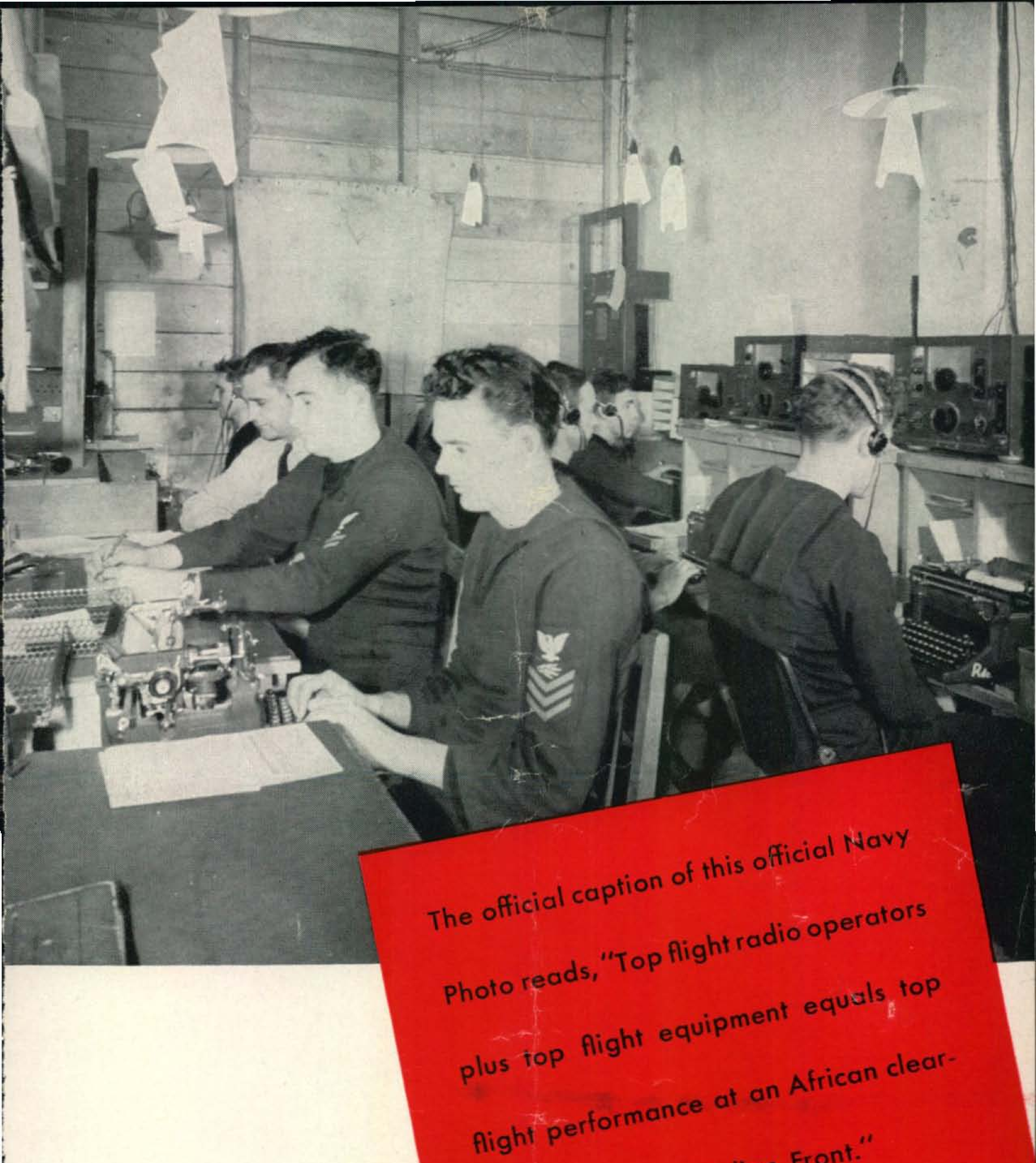

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