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The Radio Amateurs' Journal

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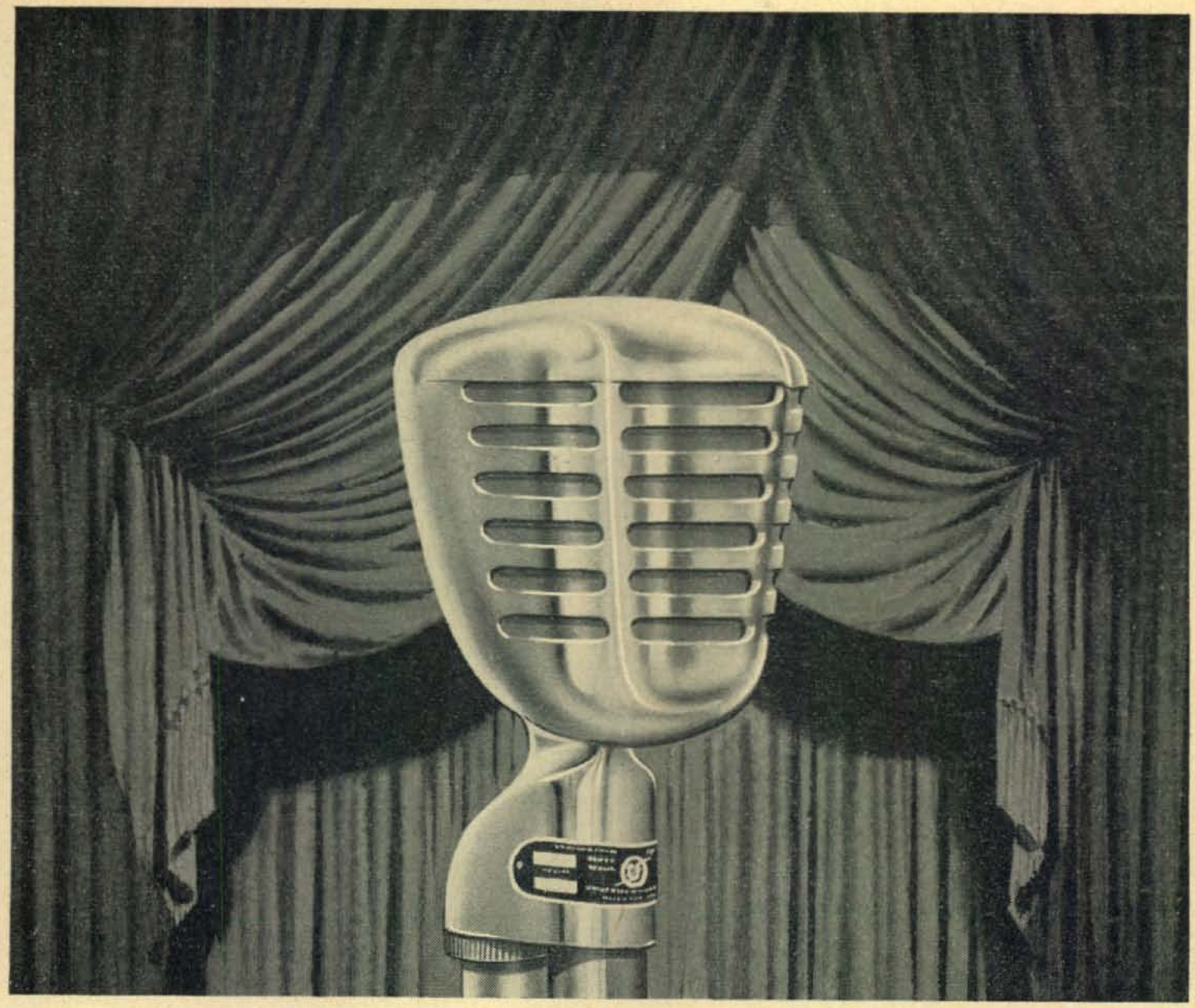

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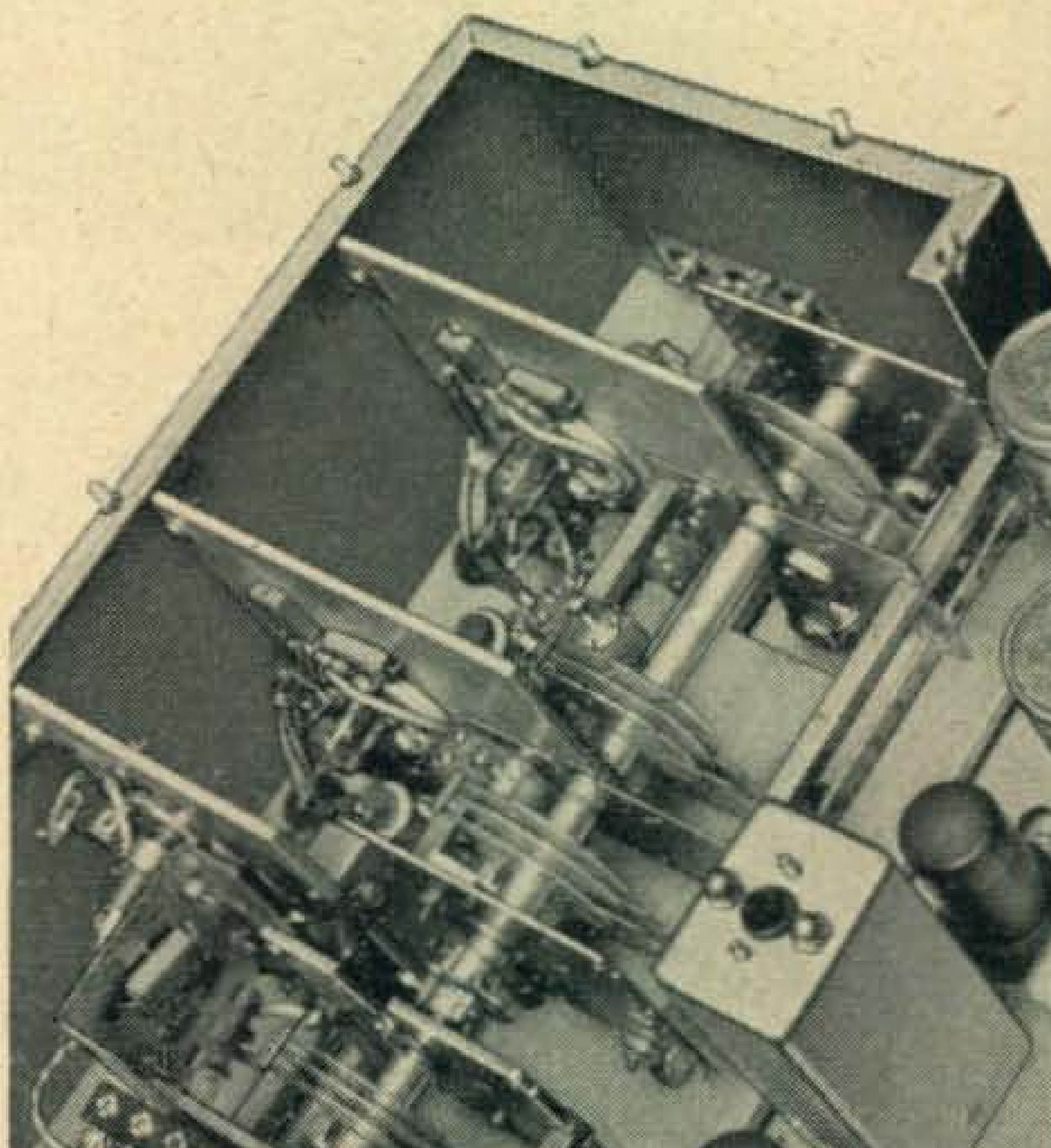

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VOL. 1, No. 5 **MAY, 1945**

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COVER

Operating position at the CAA inter-continental aircraft station WSY—*CAA Photo*

ARTICLES

MISCELLANEOUS

ZERO BIAS

FONE VERSUS C.W. The phrase itself rings with nostalgic echoes! Outside of that perennial problem "where does a ground begin," there is probably no more controversial a subject on the argumentative agenda of amateur radio than the relative merits of mike and key. There is much to be said on both sides of the question. However, before extending our editorial neck too far, we should like to state that there are plenty of Class A, B and C licensees, ordinarily operating on fone, who are expert code operators. That such hams are exceptions proving the rule is only natural.

The operator who gravitates toward fone loses interest in c.w. and simultaneously (as a rule) whatever code proficiency he once possessed. It is when the c.w. artist endeavors to explain the fone man's preference for the mike that the pyrotechnics start. The dot-and-dash-hound maintains that his very distant relative with the microphone is either too dumb, too lazy or both to develop code speed, and that most fone operators couldn't pass the 13 words per minute test if they had to be re-examined.

And the c.w. man is right—if we modify his epithets with a bit of psychological understanding. The code operator, like the poet, is born. The orator (fone man) is made. It is probable that anyone could be trained to copy code at 30 words a minute. Unfortunately, in many instances, the process might be infinitely laborious and painful. But all the training and application in the world wouldn't make a McElroy of the average person, any more than it could develop him into a math wizard, a chess master or a Paderewski. And so the radio-telephone operator is rightfully a conversationalist, and this is a country in which free speech is honored.

The fone man, of course, has an equally high and similarly expressed opinion of the c.w. operator, whom he considers too dumb, too lazy, or both, to assimilate the intricacies of voice-modulated transmission, particularly as exemplified in the Class A quiz. We might concede something here to anyone who will admit that the boots fit, but it's also true that many c.w. operators are key-bound because they prefer code. Hundreds of them are technical experts who have operated fone at one time or another.

The above are all controversial facets of the argument. You may agree or not, and one can argue pro and con until the radio club adjourns—and pick it up again over the beers. But the code men are on solid ground when they claim superior speed and accuracy for c.w. or i.c.w.—a truth that has been further demonstrated in WERS and aircraft operations. True, you can talk a lot faster than you can transmit with a bug, but speech is inaccurate even in face-to-face conversations! And when you have to spell out each word, with "R for Roger," etc., your speed is something slower than pig Latin.

While fone is satisfactory in making local WERS contacts, QSOs between the more widely separated control stations, such as Stamford, Conn., and New York City, are considerably expedited with i.c.w. This improvement is typical under any unfavorable conditions such as may be imposed by distance, low power, noise, propagation characteristics, etc., and has been emphatically demonstrated in air transport. In countless instances where radio-phone clearance and instructions could not be obtained, a shift to c.w. elicited the desired information in short order. On commercial planes, with top-notch men, c.w. is employed until the craft is within local radiophone communications range. Actual flight tests over some of Pan American's South American routes have further emphasized the superiority of code transmission—excepting in certain specialized circumstances where we all concede the advantages of fone.

In military operations, the walkie-talkie and comparable fixed installations have monopolized the spotlight. Radio-telephone is used in the majority of communications within Combat Units—divisions, regiments, battalions, companies to platoons, and particularly in the Armored Divisions. Distances are short—usually within line-of-sight—and it is essential that anyone can operate the equipment. A dead c.w. operator at a code station might very well mean a dead code station. However, c.w. comes into its own in the rear of Division Headquarters, and farther back at Corps and Army Hq.—though it may be secondary to wire lines which do not have disadvantages of radio-phone. Continuous waves are employed on the usual army communication bands within Armored Divisions and other units in maintaining contact with Headquarters during advances—where messages must be short and sweet (?) in considerations of security. Radio-telegraph is also used in transmission from the various major Hq., such as Army, Army Group, Communication Zone, etc., to the rear areas and to the U. S. However, this last is high-speed code with the teletypewriter. The trend is toward automatic and away from hand transmission.

This final thought may provide us with a new and post-war controversy—automatic transmission versus the bug and mill! Which is all to the good. As long as the hams have their preferences to argue about, we'll have amateur radio!

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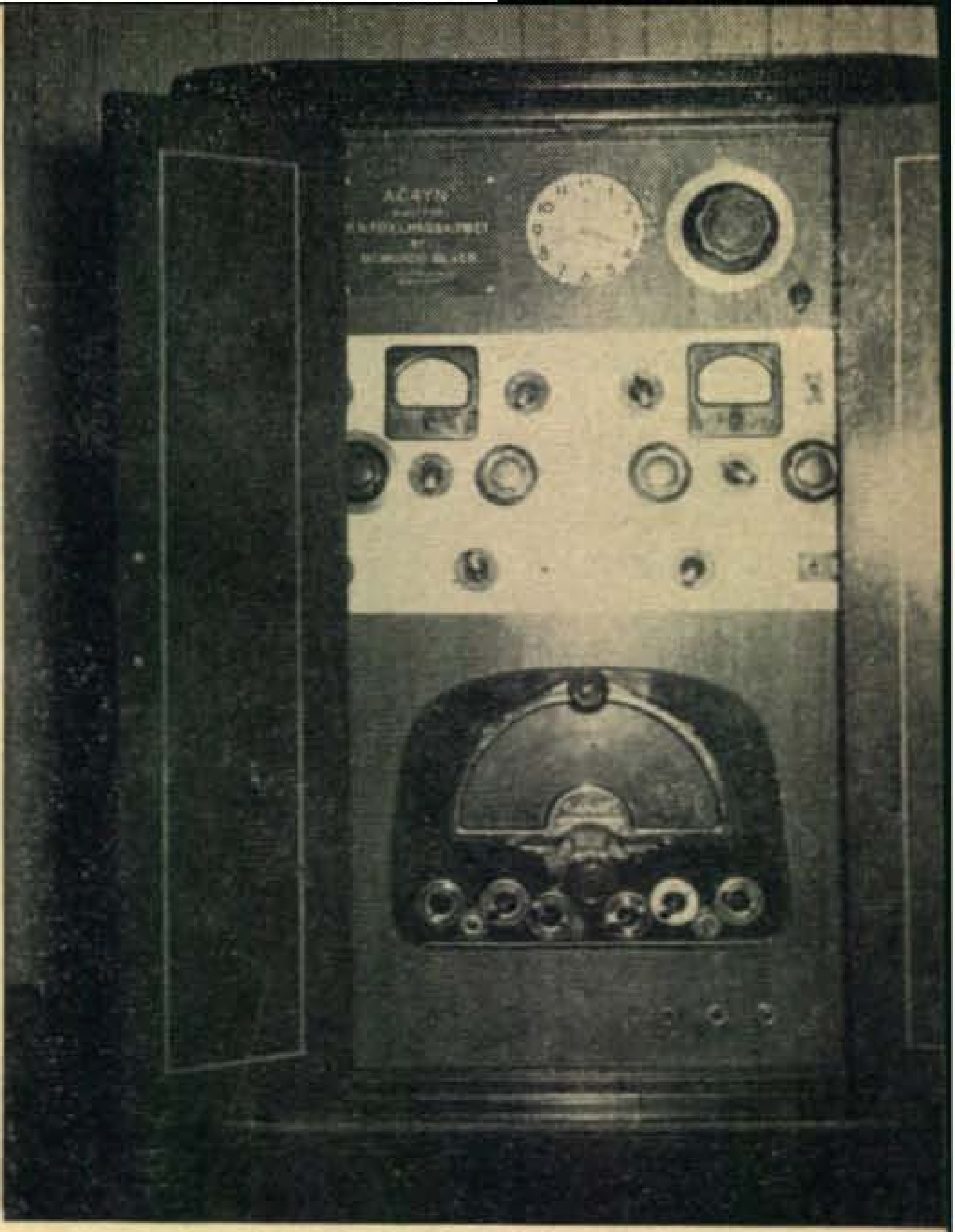
AC4YN
LHASA, TIBET

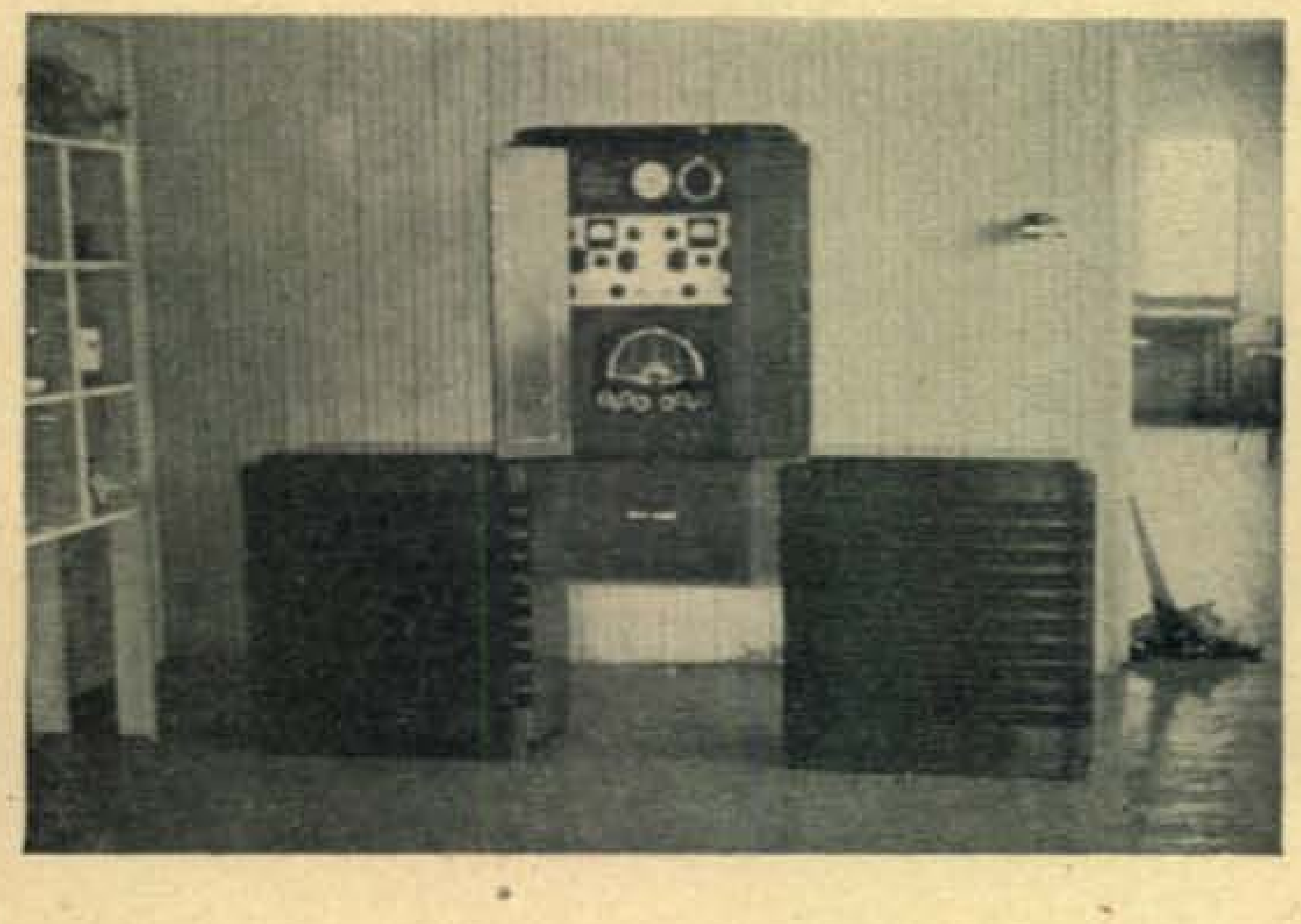


A MODERNISTIC RIG FOR THE LAND OF THE DALAI LLAMA—ONE OF THE OLDEST COUNTRIES IN THE WORLD

McMURDO SILVER

BUILT FOR operation in far-away Tibet, at the top of the world, high up in the Himalayan Mountains, the complete amateur radio station herein described may appear to be something of an anomaly. Its artistic design reflects an encouragingly modern trend in the arrangement of amateur gear; the layout pictured in *Fig. 1*, were it in a city apartment where space is at a premium, would solve many a ham's spatial as well as marital problems. However, station AC4YN was actually built to the sketches of Reginald Fox, British Agent (and bachelor) stationed in Lhasa, one of earth's most desolate and forbidding areas, where the problem of "too little room" is hardly prevalent.

Be all that as it may, the fine furniture illustrated in *Fig. 1* houses one of the world's most isolated amateur stations—a station undoubtedly used for direct official communication with London, half way round the globe, when not doing amateur duty. So far as is known there was no other means of communication, except by messenger, when this equipment was shipped to Lhasa. It was designed to replace a low-powered "bread-board" layout—by means of which reasonably consistent contact had been maintained with F. Claude Moore, W9HLF, of Pekin, Illinois, who relayed instructions as the design and construction project progressed. Shipped via Calcutta, India, in the spring of 1940, not only was a long ocean voyage involved, followed by train transportation to the end of the line, but each and every unit then had to be transported by mule, and finally by man, over probably the longest and most rigorous journey ever undertaken by amateur radio equipment. (All communication having been severed by the war shortly after shipment from the U. S. A., it is not even certain that this amateur "dream-station" has reached Lhasa—it may rest in "Davy Jones' Locker" via the submarine route, or be warehoused in Calcutta for the duration. All of which should not detract from its interest to non-bachelor amateurs looking forward to resumption of ham operation.)



High Fidelity For Tibet!

Figs. 1 and *2* illustrate the more decorative portions of the equipment. Two hinged doors on the vertical central cabinet section provide complete access to all operating controls. The drawer beneath

Fig. 1 (Left). Complete transmitter, receiver and record player in Motif Moderne for the ancient land of Tibet. AC4YN of Lhasa

Fig. 2 (Above). Close-up of the control panel, with receiver in the lower portion. The clock is mechanical. Not enough gasoline for radio and the time-piece!

the equipment cabinet houses a Garard automatic record changer—for the particular communication receiver employed was selected for fine musical reproduction through its audio channel as well as exceptional communication performance. A felt-faced desk-lid, hinged at the top of the drawer, gives access to the record-changer when lifted, and serves as a convenient operating desk when down. The left cabinet, fundamentally a McMurdo Silver "Carlton" model of hand-rubbed walnut with maple trim, houses the 15" Jensen high-fidelity loud-speaker. The face of the matching section at the lower right is hinged, serving as a record and storage cabinet. The four cabinet units are held together by dowels with matching holes providing a solid assembly which yet lifts apart for easy individual handling.

The balance of the illustrations picture the component parts of the station. *Fig. 2* shows the control panel. At top is the station nameplate and a large, precise mechanical clock. (An electric clock was "out." Juice is obtained from a gas-engine-driven generator, and fuel having to travel a perilous route to reach AC4YN, could be afforded only for radio operation). To the right of the clock is the dial for the heterodyne frequency meter, battery-powered and diagrammed at the lower left of *Fig. 7*. The large dial actuates the 25$\mu\mu$f band-spread condenser, the small pointer knob below controlling the 140$\mu\mu$f tank condenser. Dropping to the bottom right of *Fig. 2* the receiver head-phone jack is at the left, with two toggle switches (right) controlling the frequency meter and the 472-kc oscillator for checking receiver i-f alignment.

At the bottom center is the control panel of the receiver, a McMurdo Silver "15-17" model modified for communication work by the addition of front panel controls for avc-manual volume control, r-f gain, b-f-o pitch, and send-receive switch—these in addition to main and band-spread tuning dials, a-f gain, selectivity-phone, wave-band and bass-tone-b-f-o switch. Having a frequency range of 530 through 32,000 kcs, AC4YN was equipped for everything from the standard broadcast channel right on down through the 10-meter amateur band—just about every frequency via which useful signals could penetrate Tibet.

Watts vs. Decibels

Outside of the "furniture" aspect of this unusual station, the transmitter, a result of considerable cogitation, is probably of greatest interest. Power in Lhasa is at a tremendous premium as stated above. Obtained from gasoline carried by man and mule over the world's highest mountains and under climatic conditions guaranteed to freeze the tail of the proverbial brass monkey, not a drop could be wasted. Transmitter contacts would begin at distances ordinarily considered DX, with London, England, at the other end of a regular circuit. A full

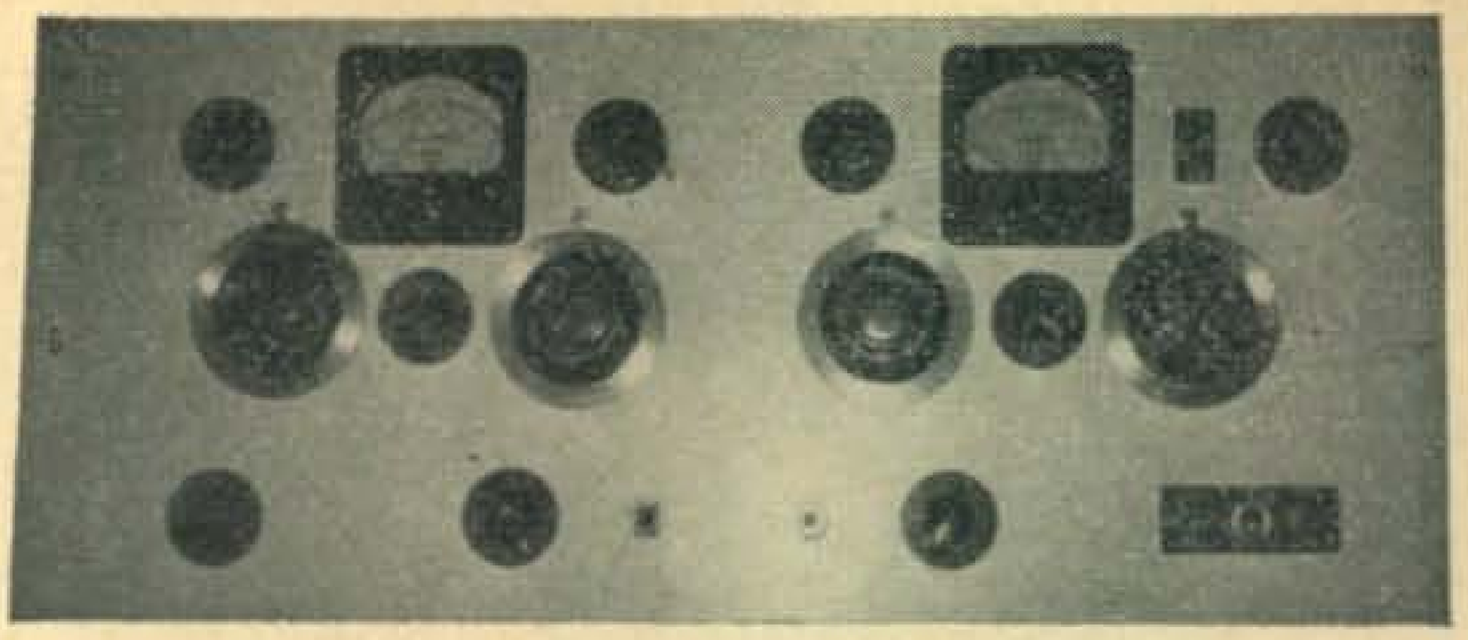


Fig. 3. The transmitter panel of AC4YN's installation. The two meters perform multiple functions by simple switching

kilowatt seemed in order, yet there was no power to generate such an input. Based upon AC4YN's Lhasa experience with low powers (where antenna erection at least was no serious problem) and the writer's studies, 75 watts input to the final was decided upon.

Considered in the only reasonable manner, transmitter power is logically chosen on the basis of desired communication range. Effective signals, delivered to a distant receiver, alone are what count. Power effectiveness must be considered in terms of decibels, not in terms of watts. Doubling the power of a given transmitter does not double its range, and raises the signal level at a given distant point only 3 db. An increase of 3 db is ordinarily just about a minimum perceptible increase in loudness. Multiplying power by ten times would yield a nominal 10 db increase in volume. Such a ten-time *power* increase would in turn sound as though the transmitter power had been "upped" in three steps each so slight as to be barely noticeable. Thought upon this subject will lead inescapably to the conclusion that to double transmitter power produces no increase in range commensurate with the greatly increased cost (in this case also of fuel consumption) and that unless power could have been initially established upon a 750-watt input basis, it might just as well be set at 1/10th that figure—the 75-watt input chosen—in terms of effective range.

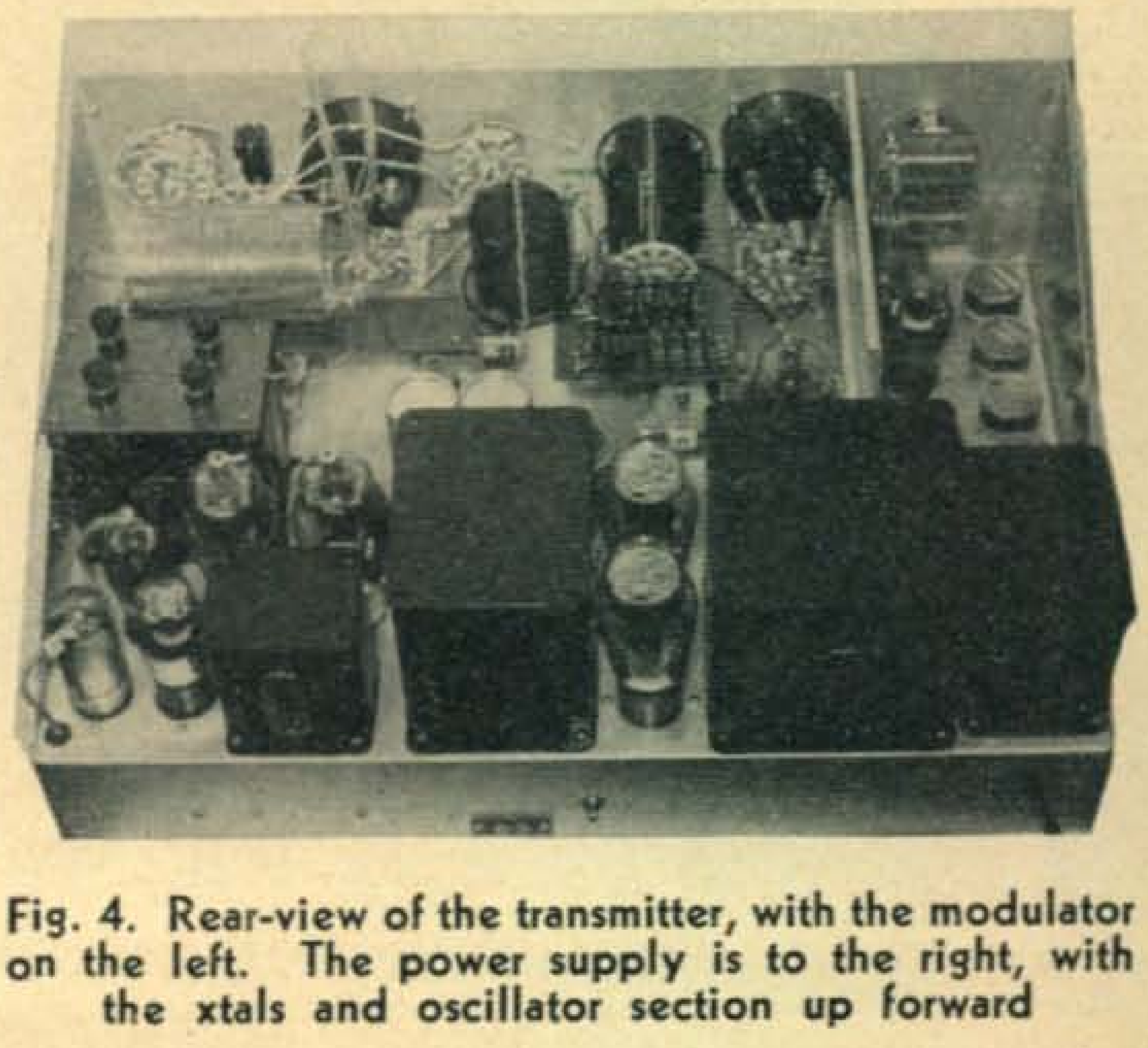


Fig. 4. Rear-view of the transmitter, with the modulator on the left. The power supply is to the right, with the xtals and oscillator section up forward

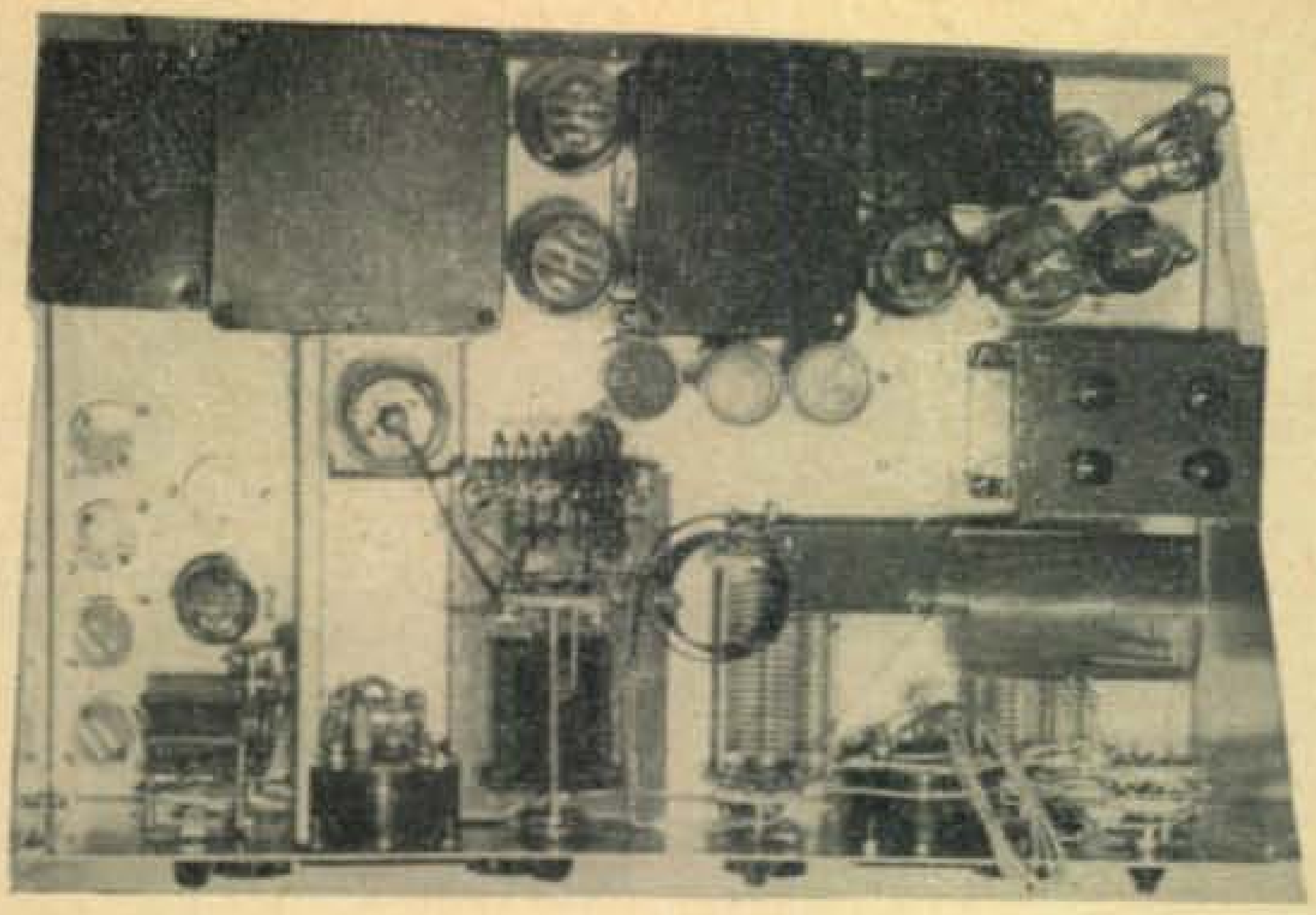


Fig. 5. Top view of the transmitting chassis. Note the shield around the base of the HY-61 r-f power amplifier at right center

Crystal Switching

The transmitter itself is illustrated and diagrammed in *Figs. 3* through *7*. It consists of a 6J5 crystal oscillator with five switch-selected crystals between 1750 and 30,000 kcs plugged into suitable sockets. This oscillator drives an HY61 beam-power amplifier at 750 volts plate supply to 100 milliamperes or 75 watts input. Efficiency checked at better than 66%, resulting in an antenna power of 50 watts or more. Crystal controlled, highly stable, completely free from hum, this signal in preliminary tests on relatively poor antennae in the U. S. A., adequately demonstrated its ability to "reach out."

The oscillator plate circuit consists of a B. & W. 2A 5-band air inductor assembly, tuned with a Bud 200 $\mu\mu$f variable capacitor. This unusually large condenser was employed to permit operation with the next-higher-band inductor in the event that it might be desired to run the oscillator self-excited with high C in emergency. The oscillator functions in any of the five amateur bands from 10 through 160 meters, driving the power amplifier always on fundamental frequency—no power being "expendable" for doubler stages.

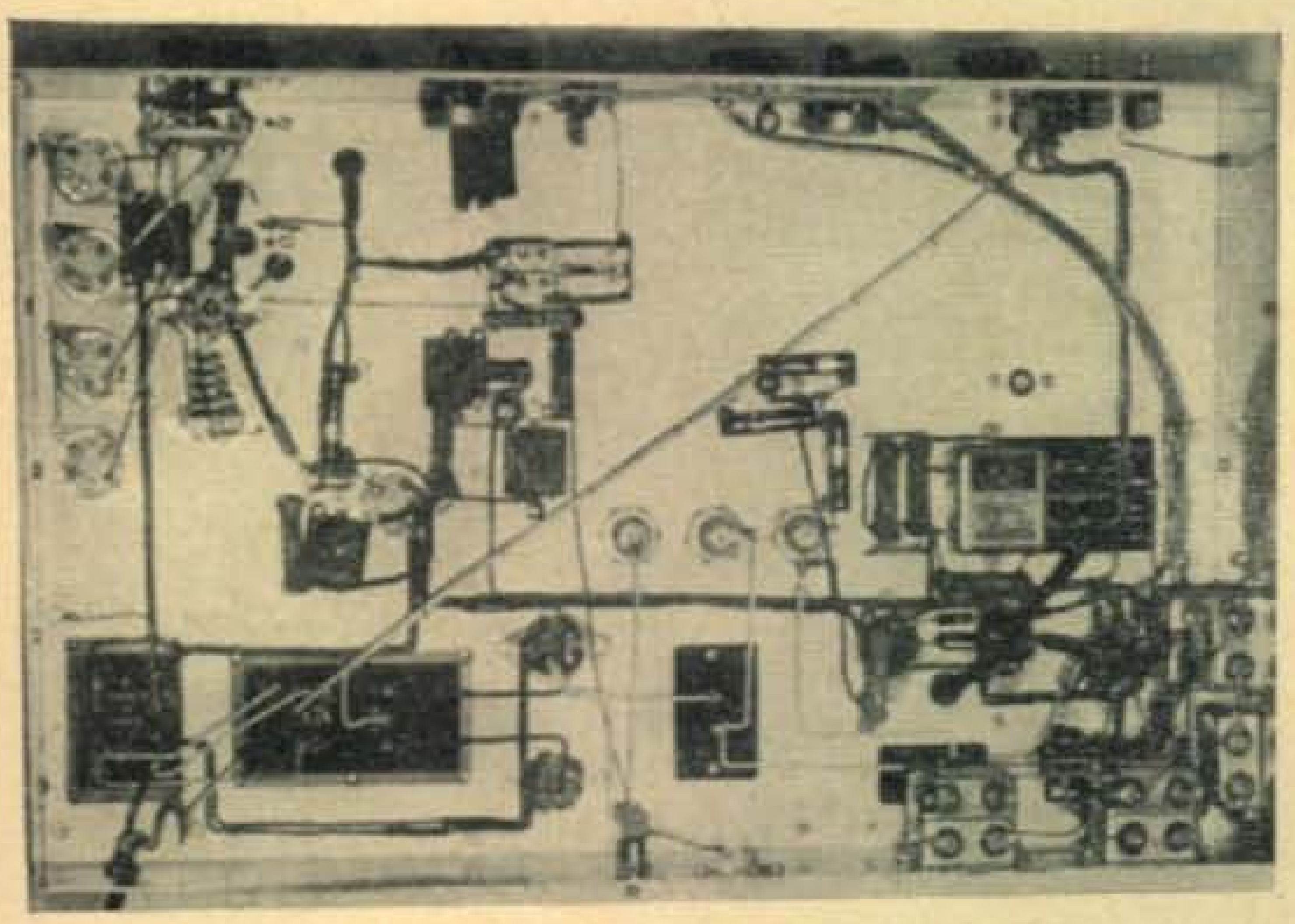


Fig. 6. Worm's-eye view of the transmitter. Short, direct wiring, with carefully engineered insulation, contribute to efficiency and service-free operation

The power amplifier, capacitatively coupled to the oscillator, is a Hytron HY61 run at maximum allowable input of 75 watts. The plate circuit is also band-switched, using a BL-160 air inductor for 160 meters, a BL-80 on 80 meters, tapped for 40 meter operation, while BL-20 and BL-10 air inductors take care of 20 and 10-meter operation. Plate tuning is with a Bud 190 $\mu\mu$f type 1536 capacitor, which, due to open construction, exhibits a sufficiently low minimum capacitance for 10-meter efficiency while satisfying the high-C requirements of 160-meter operation.

Separate fixed antenna coupling links are switched into the circuit for each power amplifier plate inductor. A panel switch permits the selected link to feed either of two antenna outputs atop the modulation transformer, or an antenna matching network made up of a tappable B. & W. air inductor and two Bud 340 $\mu\mu$f capacitors. As may be seen in *Figs. 4* and *5*, uncut loops of hook-up wire are soldered to the coil-tapping lugs of switch SW5; these loops to be cut and each free end soldered to appropriate turns of the antenna inductor upon installation. Thus all band switching, including even antenna matching is effected from the transmitter front panel.

Meter Switching

Two Simpson meters are seen in *Figs. 2* and *3*. The 0-10 ma. d.c. meter (left) is arranged with switch SW2 to read oscillator cathode current, amplifier grid and cathode current, modulator cathode current (for this transmitter handles voice as well as CW transmissions) and total plate potential. The panel indication of total plate voltage serves two worth-while purposes. The first is to allow estimation of power amplifier plate input through known values of current and volatge, and, possibly more important, to function as an instant indicator of filter capacitor failure or other troubles which invariably develop after long service. The 0-1.5 ampere Type 37 thermo-ammeter at the right of the panel measures feeder current. Switch SW7 shifts the meter from one feeder to the other to balance tune-up.

The break-in send-receive relay, at the left center of *Fig. 7*, derives d.c. for coil actuation from the power amplifier cathode current, the key serving to diminish operating bias on the power-amplifier when down. This is an unorthodox method of keying, intolerable in a congested area because of a small "back radiation," but okay in distant Tibet. It provides clean keying for break-in operation (on other than "spot frequency") through allowing the relay to work on d.c.

The modulator, seen at the left front of *Figs. 4, 5, 6*, and along the lower center of *Fig. 7*, is essentially conventional. Fed from a Turner crystal microphone, a 6J7 drives a 6J5, in turn driving a 6F8G

[*Continued on page 39*]

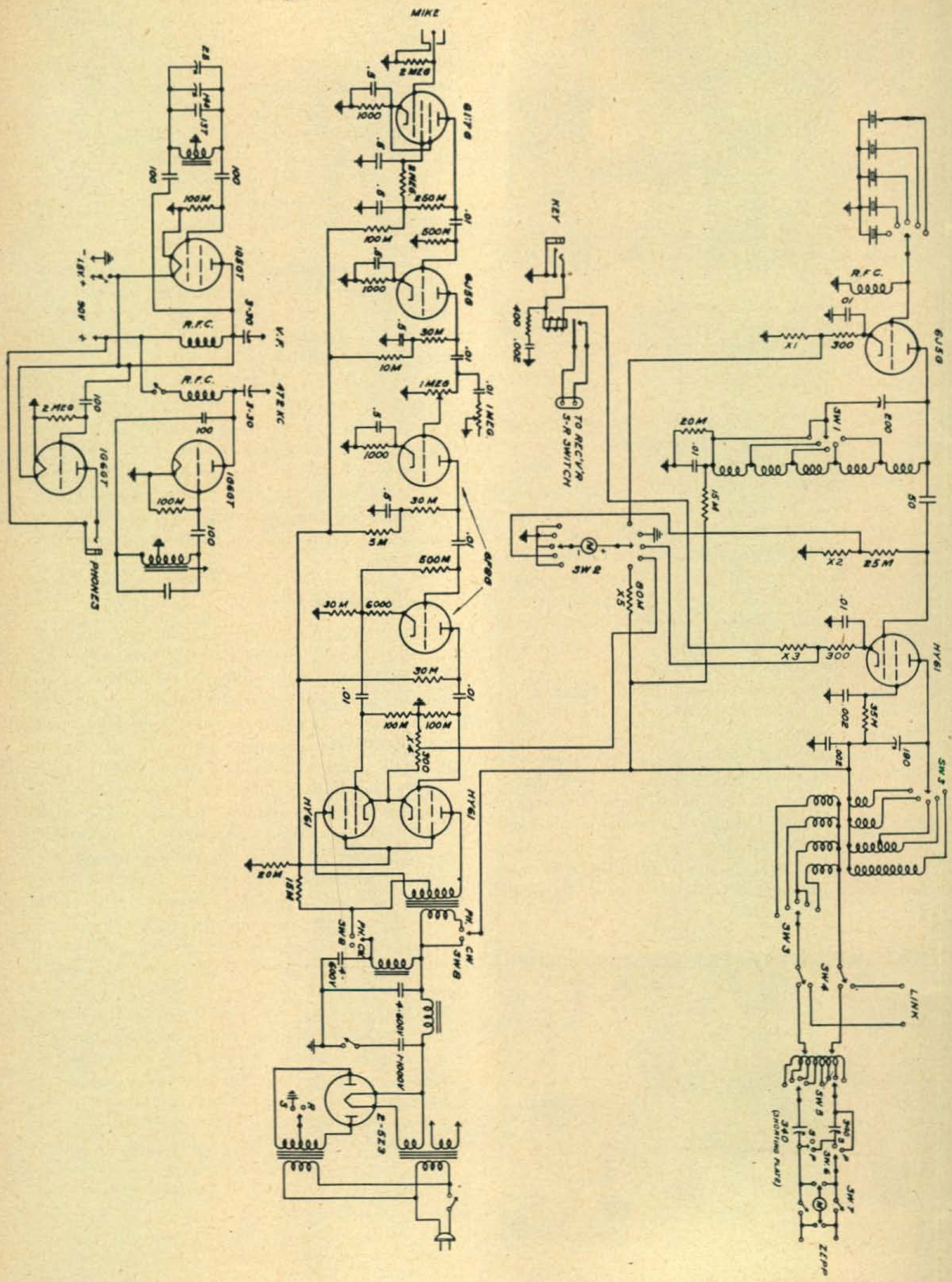


Fig. 7. The wiring line-up of the transmitter. It's a good job in rack-and-panel or furniture mounting—though the keying arrangement might be modified for domestic operation

GRIFFIN TRIPLE DETECTION SUPERHET

A receiver which offers unique possibilities in amateur radio for both phone and cw reception, featuring cw signals without bfo, and band width variable from zero to high fidelity without a crystal

A new patent in the electrical communication field has been issued to Dana A. Griffin, W2AOE, prominent in amateur and engineering circles. The patent, assigned to the Communications Measurements Laboratory, describes a triple detection superheterodyne which holds promise of considerable advance in radio receiver design. Several large manufacturers have already been licensed to produce receivers under this patent. CML will probably manufacture their own short-wave communications equipment embodying the principles described in this article.

THE RECEIVING system described in this article achieves improved radio reception, particularly in the considerations of variable selectivity and noise reduction. While the principles are especially well applied to radio communication, both cw and phone, they are applicable for other purposes. The triple detection receiver we are considering provides an extremely high degree of frequency selection, in which the selectivity is essentially rectangular, rather than the familiar shape of the usual resonance curve. The substantially rectangular characteristic of the curve results in band-pass selectivity; and the width of the band is readily controlled and varied as desired, from zero up to 10,000 cycles or more. Continuous-wave telegraph signals can be received with a pleasing tone which is not a function of receiver tuning, and which will not vary with frequency drift on the beat-frequency oscillator. The audio note of the telegraph signal is produced by frequency modulation of the conversation oscillator.

Disadvantages of The BFO

In the conventional superheterodyne, continuous-wave telegraph signals are received by mixing the beat-frequency oscillator with the incoming signal so as to produce an audible tone, and the highest degree of selectivity is obtained by employing a crystal filter circuit in the intermediate-frequency amplifier. There are several drawbacks to this type of re-

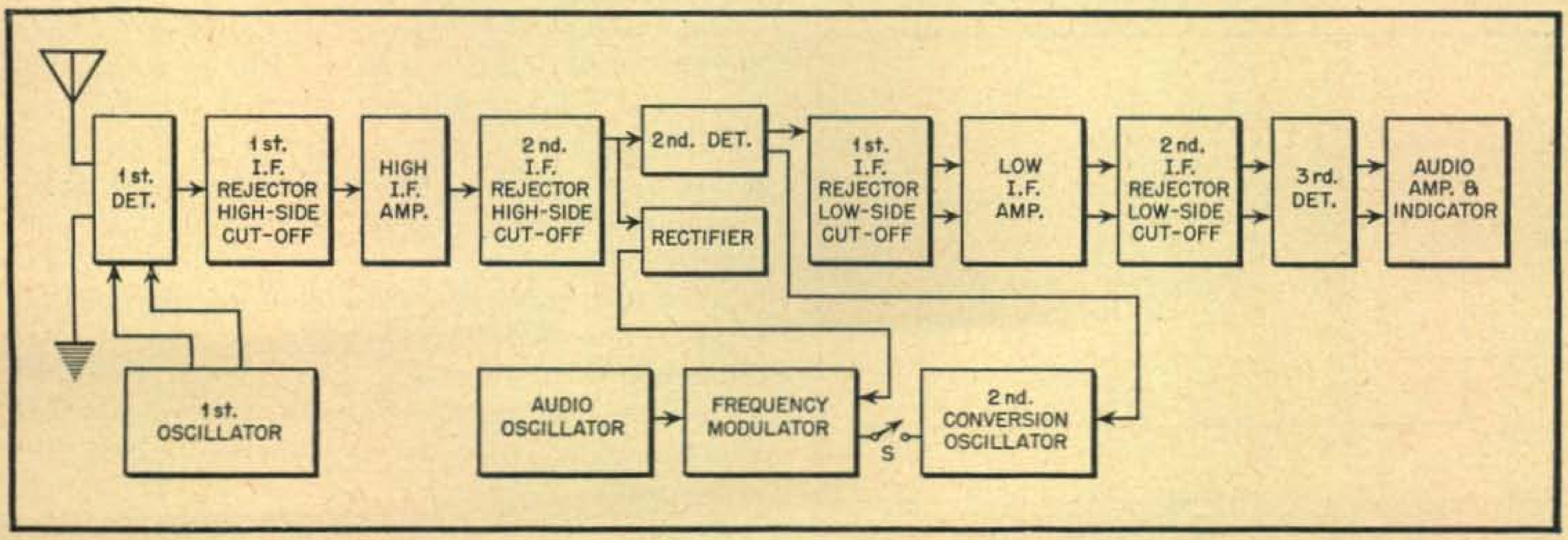


Fig. 1. Block diagram indicating the fundamental circuits of the triple detection superheterodyne

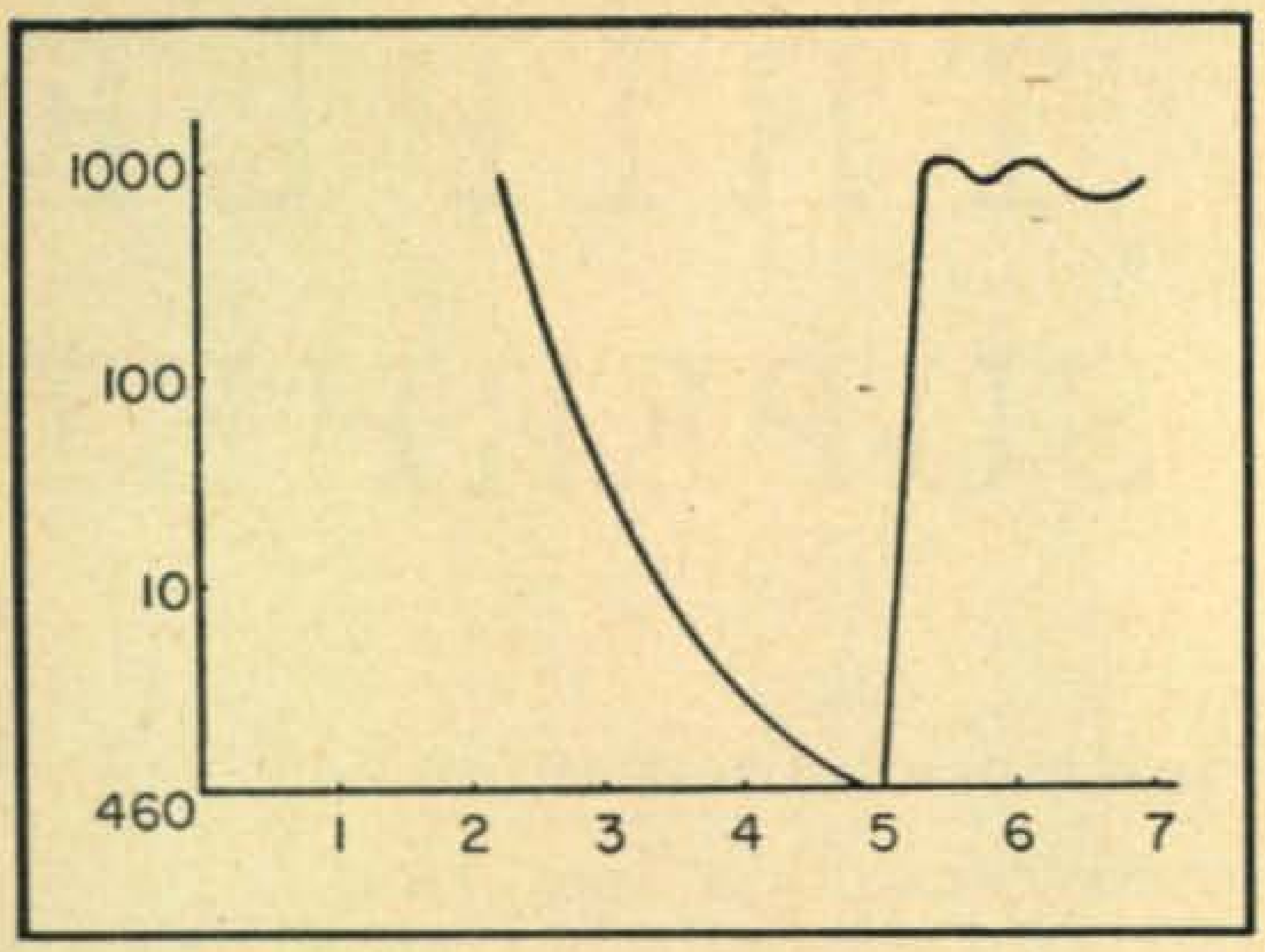


Fig. 2. Characteristic curve of a low-pass, high cut-off infinite rejection circuit

ceiver—with which all operators are familiar. It is critical in adjustment, and it is difficult to "lock" the signal note at the pitch preferred for copying, as it will vary with drift of the beat-frequency oscillator or the most minor change in receiver tuning. Furthermore, if the crystal is used in its most selective adjustment, set noises, in conjunction with the BFO, cause a continuous ringing which makes weak signals difficult to copy. With high-speed keying, the signal tones slur into the spaces due to the high Q of the crystal circuit. The crystal filter is not well suited to phone reception because the nose of its resonance curve is too sharp while the skirts are too broad.

BFO and Crystal Eliminated

The new circuit overcomes these difficulties by eliminating the beat-frequency oscillator and crystal filter, and by employing instead a triple detection system. The first conversion oscillator and detector produce the first intermediate frequency, a second oscillator-detector combination outputs a second IF, and a third detector produces the audible signal. For cw reception, the second conversion oscillator may be frequency modulated at an audio rate. Selectivity is obtained by use of infinite rejection circuits in the i-f stages which cut off on each side of the desired band. The width of the band is determined by controlling the frequency of the conversion oscillator (i.e., by varying its tuning, which may be effected at an audio rate for cw reception).

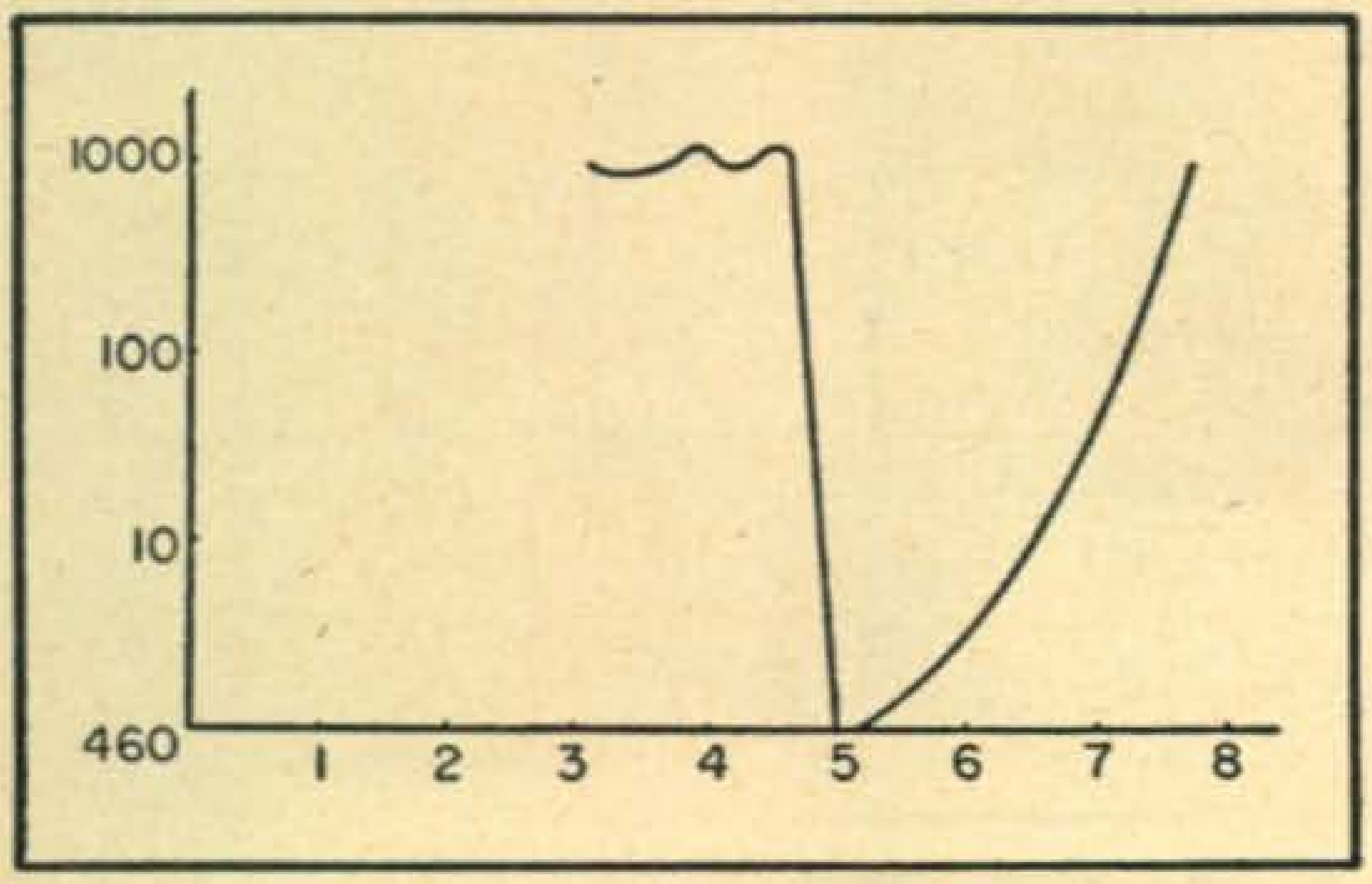


Fig. 3. A high pass, low cut-off infinite rejection characteristic, which is the opposite of Fig. 2

In a preferred form of the triple detection superheterodyne, infinite rejection circuits are employed both ahead of and following the second detector as suggested in the simplified drawing of *Fig. 1*. Infinite rejection circuits are well-known. In general, they use compound coupling, with inductive coupling opposing and neutralizing the capacitive coupling for one particular frequency at which attenuation of the circuit is practically infinite. Such circuits may have the frequency attenuation characteristics shown in *Figs. 2* and *3*, in which the ordinates represent attenuation and the abscissae frequency. The curve of *Fig. 2* is a low-pass or high cut-off circuit. The attenuation gradually decreases with increase in frequency until it reaches the critical point, at which attenuation rises almost vertically to practically infinity, remaining at this value for further increases in frequency. The high-pass, low cut-off characteristic, *Fig. 3*, is virtually the reverse of *Fig. 2*.

The recommended circuit employs a pair of cascaded low-pass or high cut-off filters to determine the upper frequency limit of the band, and a pair of low cut-off circuits in cascade to fix the lower frequency limit. The band of frequencies included between the upper and lower limits—that is, the band width—can be controlled solely by tuning the second conversion oscillator, necessitating no adjustment of the high or low-pass circuits.

Operational Analysis

Referring to *Fig. 1*, incoming signals are impressed on the first detector system along with heterodying oscillations from the first oscillator. The first detector system may include the conventional r-f amplifier of one or more stages. It will be assumed that an incoming signal of 1000 kilocycles is heterodyned by the first oscillator at 1465 kc to produce a first intermediate frequency of 465 kilocycles. This output is applied to the first infinite rejector circuit. This is a high cut-off system, and the critical or infinite attenuation frequency may be set at 465 kilocycles, or slightly higher. Under these conditions any signal within a few kc of 465, but lower than 465 kilocycles, will pass through the first infinite rejection circuit and be impressed on the high-frequency or first i-f amplifier. The output of this i-f amplifier is passed through a second low-pass (high cut-off) infinite rejection circuit, where undesired frequencies are further attenuated. Thus any intermediate frequency above 465 kilocycles (or whatever was the critical frequency chosen) is attenuated practically to infinity, and remains so. For example, a 990-kilocycle signal would be excluded, while 1001 kilocycles will pass through.

The output of the second infinite rejection circuit is applied to the second detector and second conversion oscillator, which latter may be frequency modulated at any desired audio frequency for cw reception. Switch (s) is closed for cw reception and open for phone. Again choosing an arbitrary value, a frequency of 400 kilocycles in the second conversion oscillator will provide a second intermediate frequency of 65 kilocycles which is passed respectively through a *low* cut-off infinite rejection filter, a second and low-frequency i-f amplifier and a final (low cut-off) infinite rejection circuit. The signal has now been subjected to four infinite rejection circuits—two high cut-off and two low cut-off—and only a signal of the desired band width remains to be passed on to the third detector system and audio amplifier.

Band Width Control

The effect of varying the frequency of the second conversion oscillator can now be demonstrated.

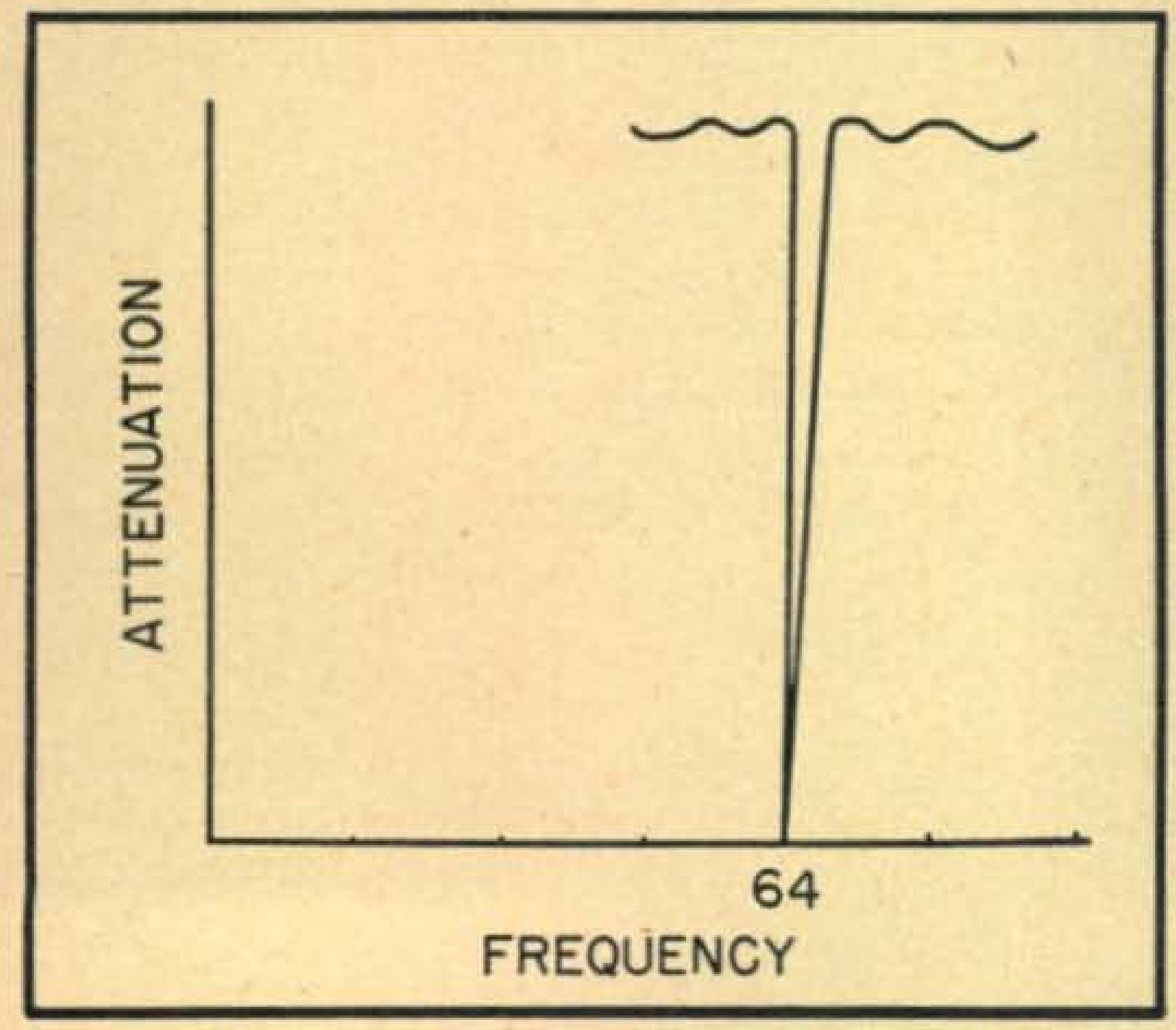


Fig. 4. Combine Figs. 2 and 3 and you obtain the attenuation characteristics of the triple detection super at high selectivity

Assuming that the high cut-off infinite rejection circuits have their critical frequencies adjusted to 465 kilocycles (or slightly above) and the low cut-off filters at the second intermediate frequency of 65 kilocycles (or slightly below), and that the receiver is tuned to a 1000-kc signal, only this signal will be passed through to the third detector. Any signal less than 1000 kilocycles will be eliminated by the high-side cut-off circuits while signals above 1000 kc will be similarly dealt with by the low cut-off infinite rejection circuits. This condition is pictured in the overall selectivity curve of *Fig. 4*.

If the second conversion oscillator is now tuned above 400 kilocycles, all frequencies which passed the high-side cut-off filters will be too low to navigate the low-side cut-off circuits, and nothing will be received. This may be visualized by assuming that the two curves which bound the band width in *Fig. 4* be moved toward each other and past each other until the space between them, which represented the

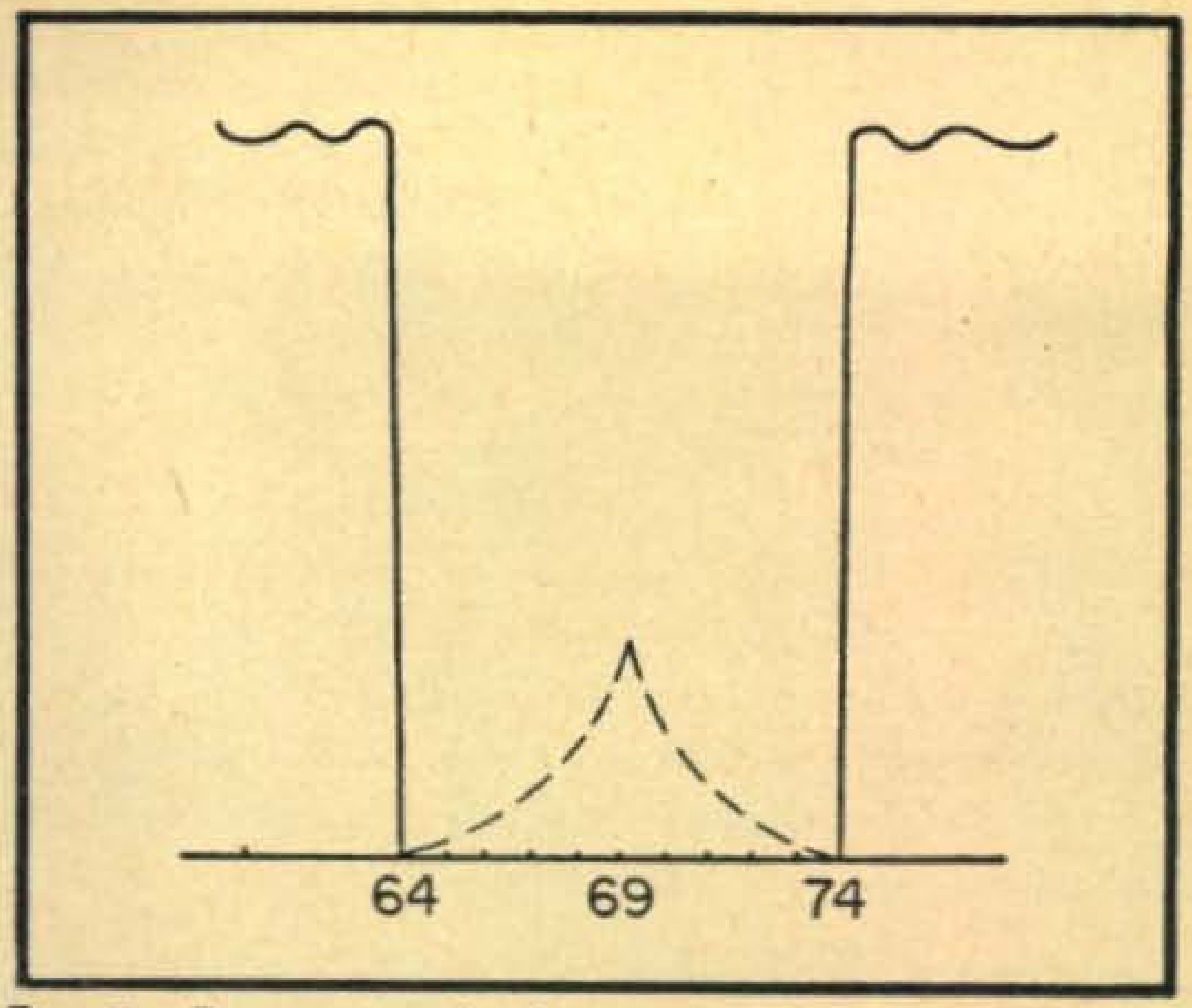


Fig. 5. By varying the frequency of the second conversion oscillator this rectangular bandspread pattern is obtained

band width, becomes zero. *The effect is just the reverse* if the conversion oscillator is tuned to a frequency *below* 400 kilocycles. The curves are moved farther apart, widening the admittance band, and resulting in the response characteristic of *Fig. 5*. (If the high and low cut-off circuits are interchanged, the conversion oscillator will be tuned above 400 kilocycles to expand the admittance.)

The admittance band can be broadened or narrowed at will, as a *continuous* and smooth function of the second conversion oscillator, and without making any changes in the tuning of the filter or rejection circuits. This is a feature of considerable value in both cw and phone reception. The band can be narrowed to a split hair for code signals under conditions of severe interference, or widened to 10,000 cycles or more for high-fidelity telephonic reception. The band width is always instantaneously adjustable to suit varying receiving conditions.

Variation in the tuning of the second conversion

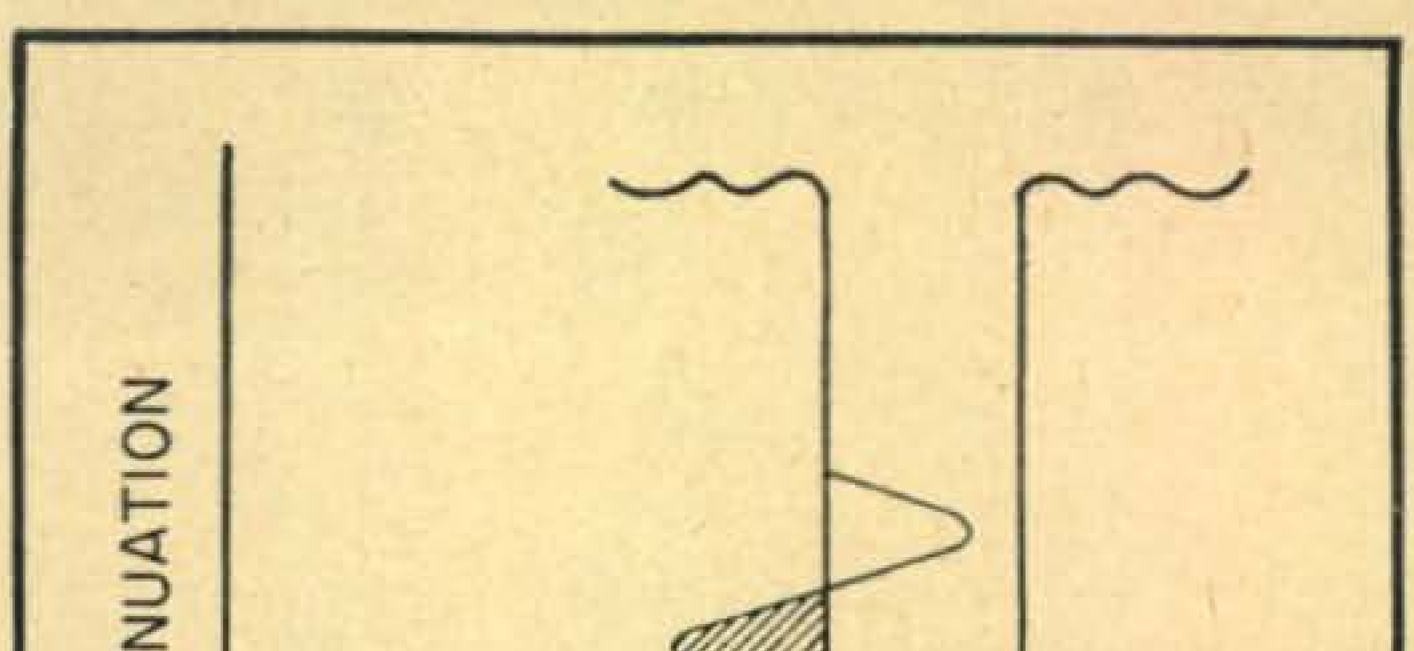


Fig. 6. Frequency-modulating the second conversion oscillator shifts the signal in and out of the admittance band at audio frequency for cw reception

oscillator to change the band width may necessitate a slight returning of the first oscillator to maintain the carrier frequency of the incoming signal, after conversion, in the center of the overall admittance band of the receiver. This is because tuning the second conversion oscillator does not alter the frequencies at which both high and low cut-offs occur, but only the low side. Referring to *Fig. 5*, changing the conversion oscillator frequency may be regarded as moving the low-frequency cut-off toward or away from the high-frequency cut-off—the latter remaining unchanged. Thus a signal which has its carrier frequency centered in the admittance band for one band width may require re-centering if the admittance band is altered substantially.

Continuous Wave Reception

For a further understanding of the circuit in the reception of cw signals in one mode of operation, the reader is referred to *Fig. 6*. The conversion oscillator is tuned to such a frequency that the admittance band extends from 64 to 66 kilocycles. The beat-frequency signal has a carrier frequency of 64 kilocycles (just at the lower extreme of the admittance band) and is deviated in frequency (by the frequency modulation impressed on the local oscillator) from 62.5 to 65.5 kilocycles. It is assumed that the amplitudes of both signal and local oscillations are constant, eliminating amplitude modulation effects.

If the deviation were less than 2 kc, and entirely within the admittance band, nothing would be heard except possibly key clicks of "mush." However, if the deviation, as shown in *Fig. 6*, is such that the frequencies swing in and out of the band, an amplitude modulation effect is produced by the passage or no passage of the signal. If the carrier is deviated, say 256 cycles-per-second, it is apparent that a 256-cycle note will be heard—this tone continuing as long as the transmitting key is depressed. In the above example, the mean carrier frequency is assumed at one edge of the admittance band (64 kc). This is not essential, however, and the mean carrier frequency may be within or without the band, so long as it is deviated into and out of the band once each cycle.

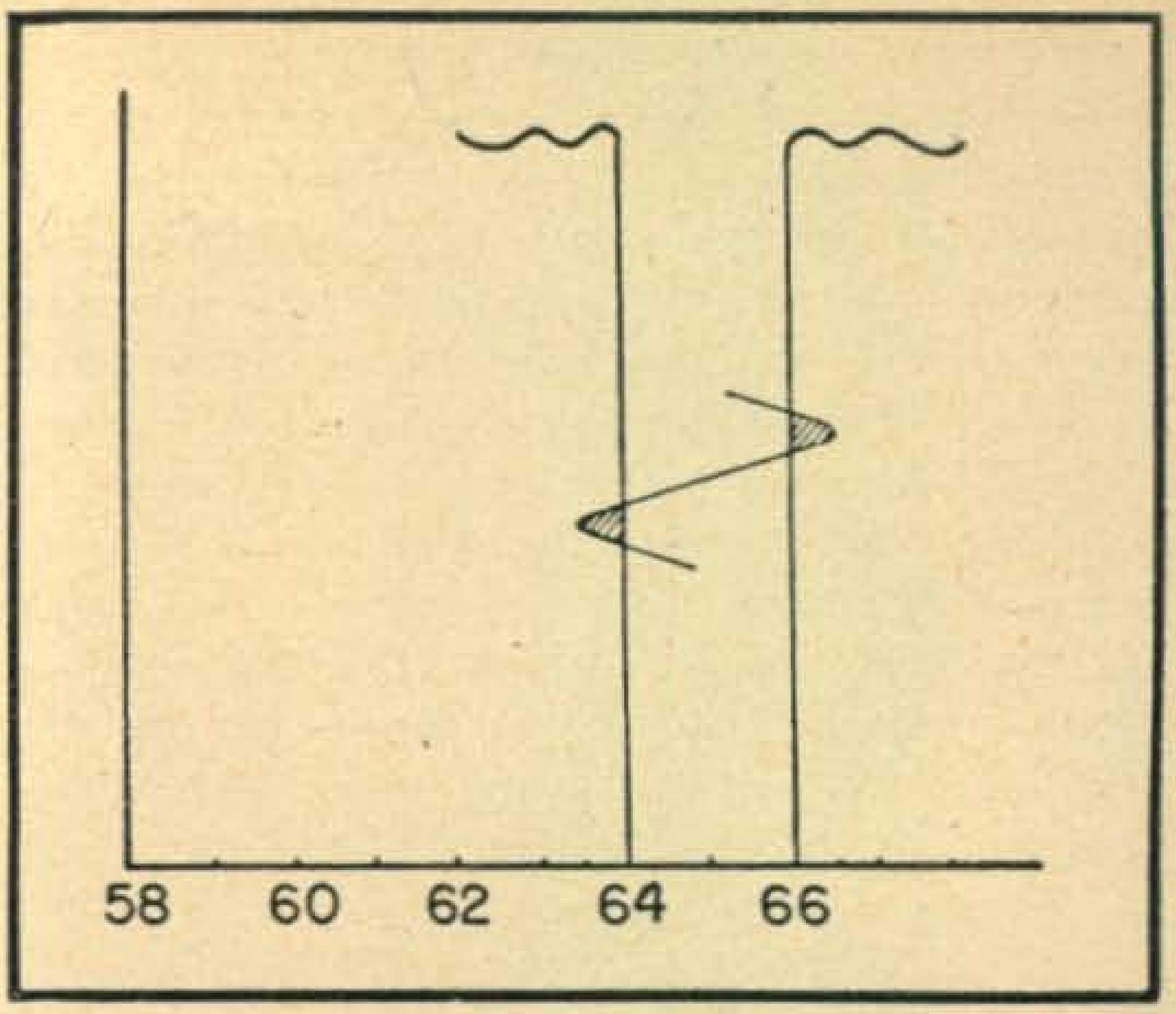


Fig. 7. By sweeping the signal completely across the admittance band a double tone is obtained. Shaded portions of Figs. 6 and 7 show the portion of the signal outside of the admittance band

For minimum noise on inter-character spacing, when employing the system as described, it may be

[*Continued on page 38*]

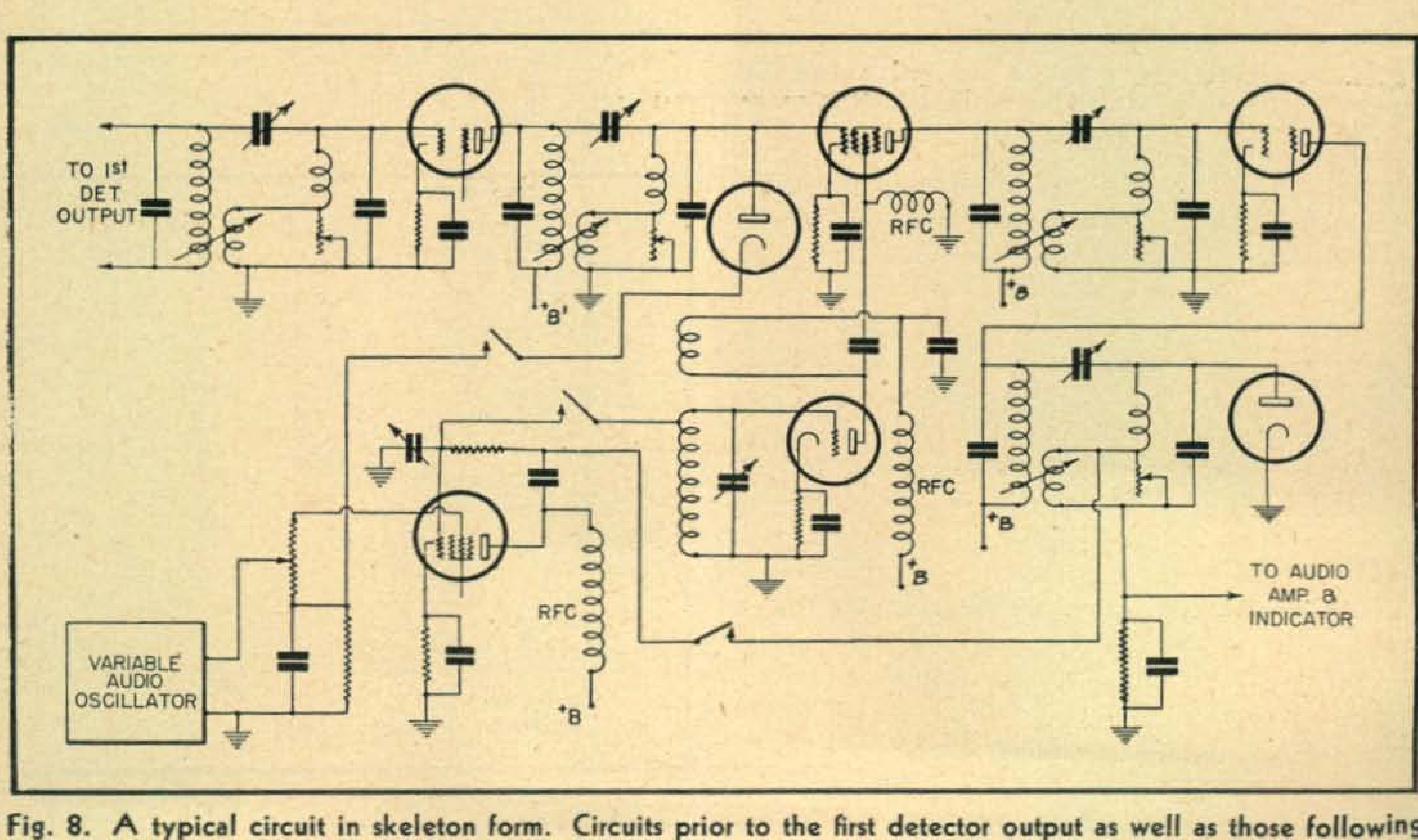


Fig. 8. A typical circuit in skeleton form. Circuits prior to the first detector output as well as those following the third detector have been eliminated. They have nothing to do with the unique triple detection action

Operating positions for medium power amateur radio station

150-Watt TRANSMITTER for 5-Band Operation

W. B. BERNARD, W4ELZ
(Lt. Comdr., U.S.N.R.)

THE transmitter described here operates on four or five bands with an input of about 150 watts on phone or cw. It may be used for an exciter for a final amplifier which may run up to the legal limit of power.

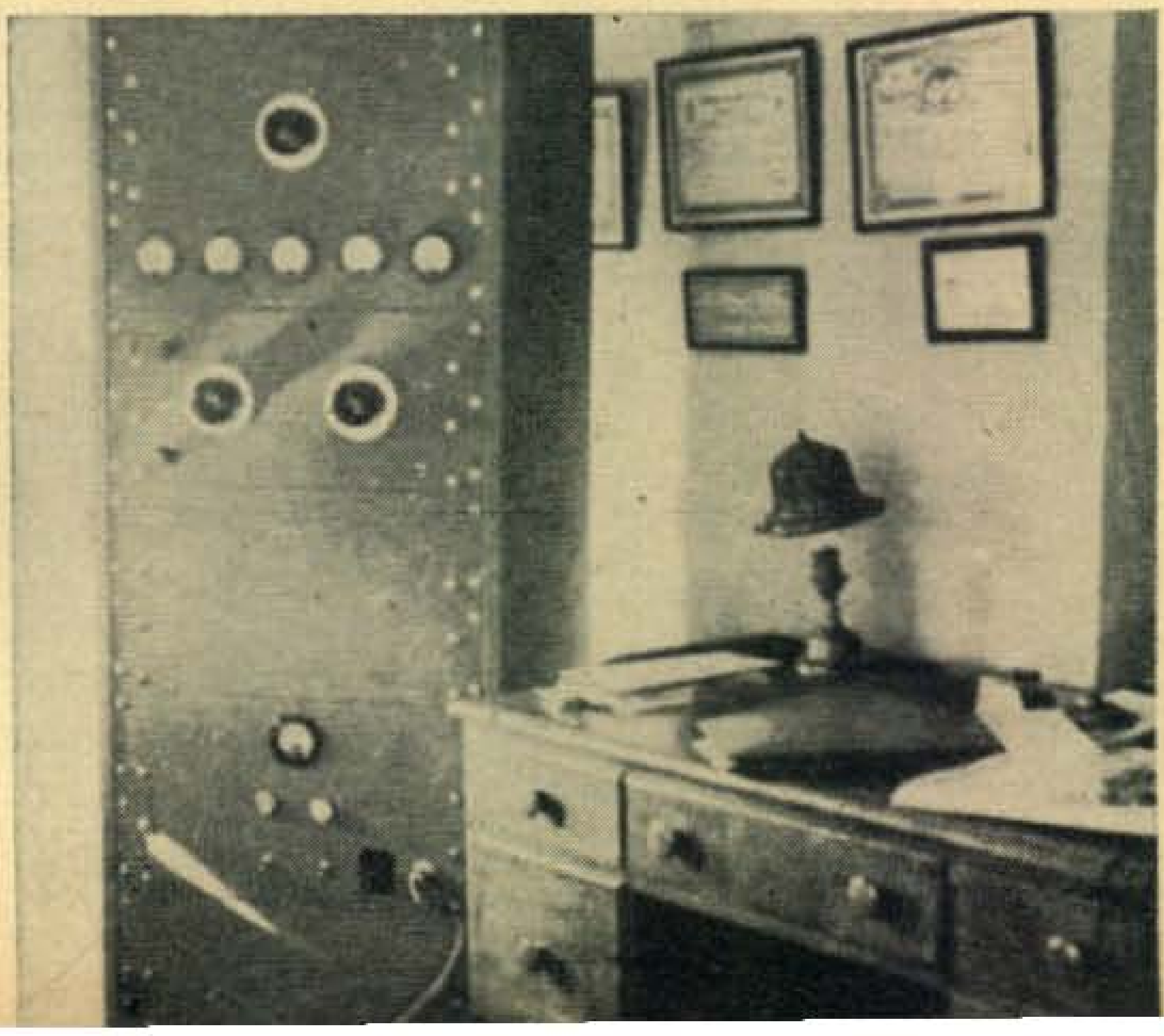
Due to war conditions the original transmitter is not available for photographs. This offers at least one advantage however, for it allows correction of one or two errors made in the first layout. Since everyone has parts on hand that he desires to use, and because everyone has his own opinion regarding methods of construction, this will not be written as a constructional article describing the building of the equipment down to the placement of the shortest wire but will instead place the emphasis on circuit details. (*Photos shown illustrate representative rigs.—ed.*)

The circuit permits operation on all bands from 5 to 80 meters with band-switching in all circuits except the plate tank circuit of the final amplifier. The tube lineup consists of a 6L6 oscillator, three 6L6 doublers, and a T-40 or similar tube for the final amplifier.

Oscillator

Two arrangements are shown for the oscillator, both of which permit operation from a remotely located VFO which furnishes 80-meter excitation. The oscillator shown in the complete diagram (*Fig. 1*) may operate as a 40 or 80 meter crystal oscillator, a neutralized amplifier on 80 meters, or a doubler to 40 meters. If only 4-band operation is required, the circuit in *Fig. 2* may be used. It is designed to operate as a 40 meter crystal oscillator or a doubler to 40 meters from the 80 meter VFO excitation.

If less than 4-band operation is desired one or more of the doubler stages may be omitted. All the tuned circuits may be moved down one octave in frequency, and band-switching may be incorporated in the final plate tank circuit or one of the National Company's continuously variable tanks may be used, if 5 meter operation is not desired. For 160 meter operation the final plate tuning condenser must be of a higher capacity than the one specified in the parts list. If the band in the vicinity of 21 mcs. becomes available to the amateurs the induc-



150-watt rack-mounted phone-cw station

tances $L4$ and $L9$ must be decreased to allow $V2$ to operate as a tripler to 21 mc. The tuning condensers $C4$ and $C7$ should be sufficiently large to tune the range from 14 to 22 mc and allow $V2$ to continue to double to 14 mc if the inductances are correctly adjusted.

In the long run, the added expense for the tubes and switches in a band-switching circuit is more than offset by the saving on the coil forms, sockets, and crystals necessary for multiband operation by other methods. Also it is necessary for the VFO to operate only on one output frequency. This makes possible the elimination of plug-in coils or switching systems in the frequency-controlling circuits, thereby doing away with one of the commonest sources of inaccurate and unstable calibration, which very often lead to "pink tickets."

Each exciter tube is capacitively coupled to the succeeding doubler stage and link-coupled to the final stage. $S1$ selects either VFO input or a crystal for frequency control. $S2$ selects the desired harmonic for excitation of the final stage and connects the proper grid coil in the final circuit. The cathode circuits of all the unused doubler stages are opened so that they pass no plate current and draw no r-f power from the doubler being used to excite the final amplifier. The link circuits are left connected at all times because the power absorbed by the link system is small when the associated grid coil is not tuned to resonance.

Tuning Controls

All the tuning controls are brought out to the front panel so that maximum efficiency may be obtained at any frequency within the band being used (see *Fig. 4*). In addition to the tuning controls the following controls are present on the front panel: oscillator screen voltage, exciter band switch, VFO-XTAL switch, meter switch, a-c power switch and high-voltage switch. The panel presents quite an array of knobs; however, the complexity is apparent rather than real and the availability of all the controls will be found quite worth-while.

Since tetrode tubes are quite sensitive to the amount of excitation furnished, some type of excitation control is quite essential to the proper operation of this transmitter. The easiest method of controlling the excitation is to vary the oscillator screen voltage. There is probably no rheostat now commercially available which is really well-suited to fill the function of $R4$, but a suitable substitute can be constructed with an 11-point switch and ten 10,000-ohm 5-watt resistors, as shown in *Fig. 3*. The resistors can be mounted on a board at the rear of the chassis to avoid overcrowding components near the front.

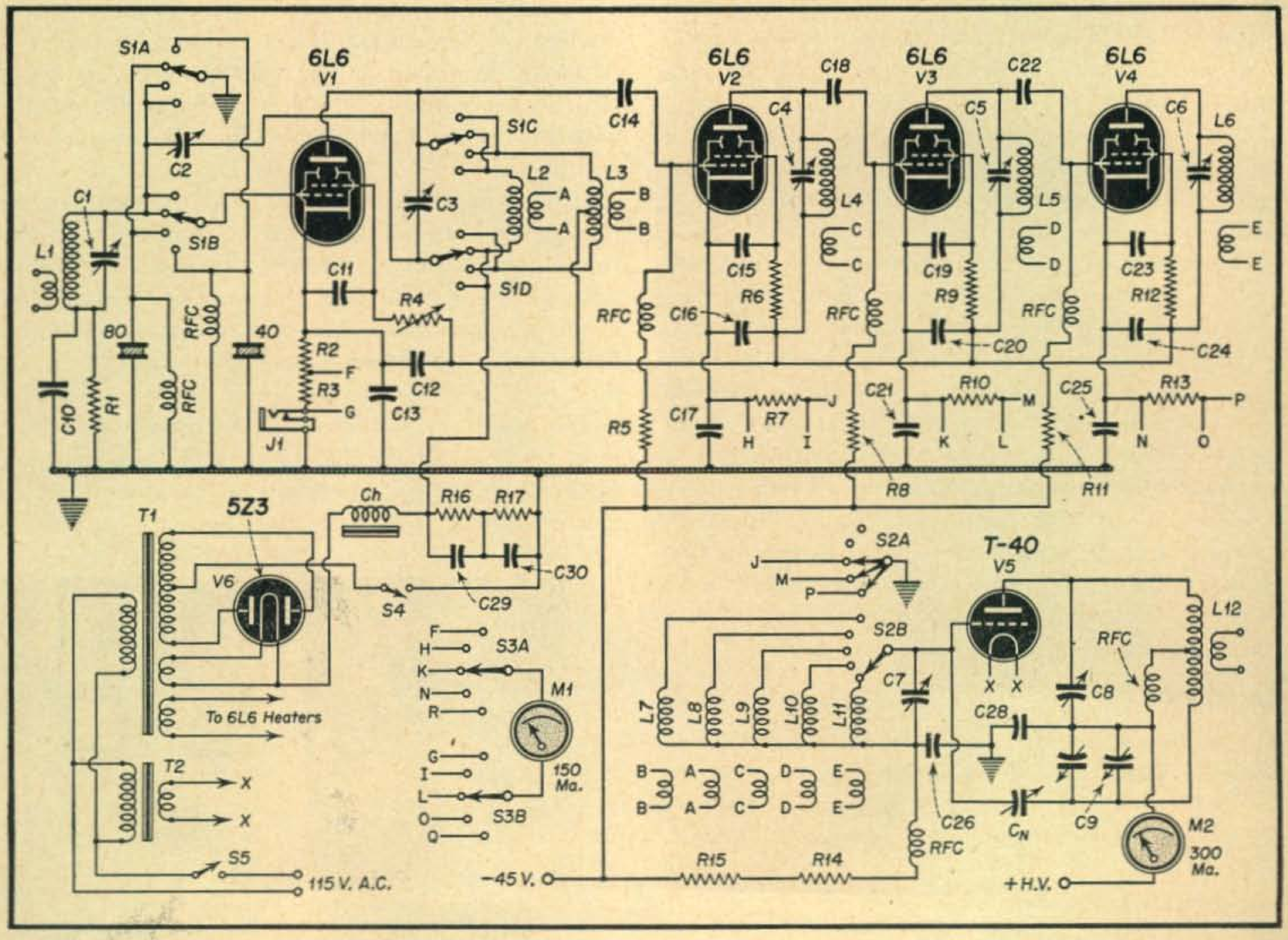
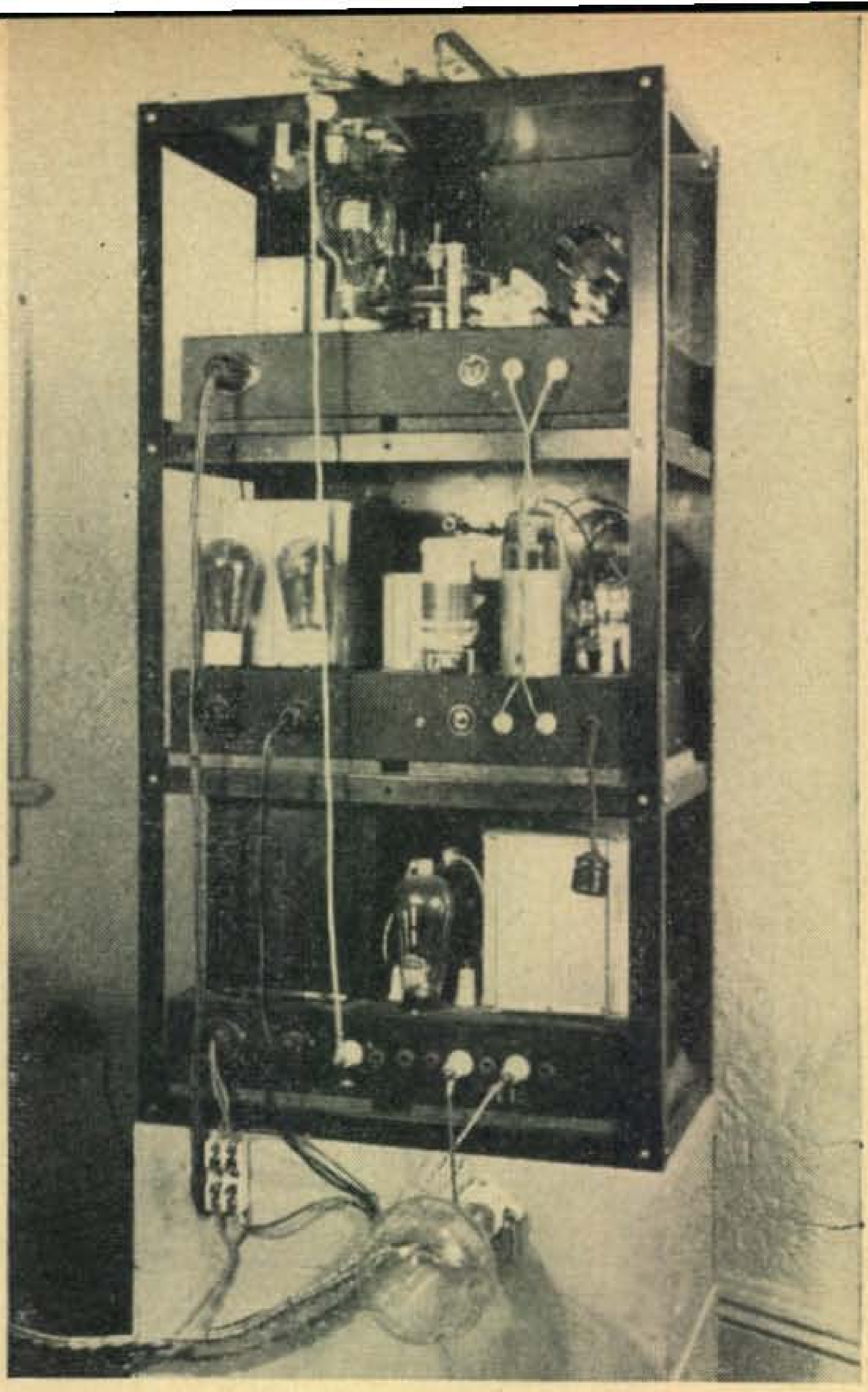


Fig. 1. Schematic of complete transmitter. (Parts list shown on page 17)

The final stage is quite conventional except that one side of the filament is grounded directly at the socket to improve performance at 5 meters. If the final grid is driven to saturation the 60-cycle modulation introduced by this method of filament return will be less than ½ of 1%, which cannot be detected by most a-c operated receivers. A 0.005 μf mica condenser is connected from the other filament terminal of the socket to ground to reduce further the inductance of the radio-frequency filament return circuit. A small variable condenser is placed across one-half of the plate tuning condenser to achieve a better balance of the neutralizing circuit. This condenser should have a voltage rating at least as great as that of the tuning condenser and should have a capacity slightly greater than the plate-to-filament capacity of the tube. The amplifier is first neutralized at 80 meters then, with the transmitter operating on 5 meters, the balancing condenser should be adjusted to give neutralization on 5 meters. If the amplifier has been carefully planned and constructed the neutralization should then be satisfactory for all bands.

Electrolytic condensers in series are used in the exciter power supply. The bleeder resistor is center-tapped and the junction between the two condensers is connected to the tap in order to equalize the voltage across them. Because the 6L6 heaters are furnished from the same transformer as the plate voltage it is necessary to insert a switch in the lead between the high voltage center tap and ground to allow the 6L6 cathodes to heat before the plate

SYMBOL	DESCRIPTION	
C1	100 μμf	midget variable
C2	3-12 μμf	mica trimmer
C3, 4, 7	50 μμf	midget variable
C5, 6	35 μμf	" "
C8	100 μμf per sect. .070" spacing	
C9	Balancing cond. See text	
C10, 26	.002 μf	500 volt mica
C11, 12, 13, 15 C16, 17, 19, 20 C21, 23, 24, 25	.01 μf	1000 volt paper
C14, 18, 22	50 μμf	1000 volt mica
C27	.005 μf	500 volt mica
C28	.002 μf	5000 volt mica
C29, 30	40 μf	450 volt electrolytic
R1, 5, 8, 11	50,000 ohm	2 watt
R2	500 ohm	2 watt
R3, 7, 10, 13, 14	20 ohm	1 watt
R4	Heavy duty compression rheostat	
R6, 9, 12	20,000 ohm	10 watt
R15	3500 ohm	10 watt
R16, 17	25,000 ohm	10 watt
T1	1200 v. ct.	200 ma, 5 v. 3a.
	6.3 v. 4a.	
T2	7.5 v. 2.5 a.	
Ch	5-25 h	0-250 ma
RFC	2.5 mh	125 ma



One-kw ham transmitter using 150-watt buffer which can be operated as a transmitter independently of the power amplifier

voltage is applied. In the original transmitter the bias supply consists of a 45-volt "B" battery, but a power transformer with a grid-bias winding or tap may be used to supply bias as well as plate and heated voltages. If such a bias supply is used it would probably be desirable to use a 2-watt neon lamp without the base resistor to stabilize the bias voltage on the exciter stages so that variation of final amplifier grid current will not react upon the doubler biases.

If a T-40 or equivalent tube is used in the final stage a high-voltage supply of 1000 to 1250 volts at 150 ma should be used. The modulator should be capable of furnishing 75 to 100 watts to an 8000-ohm load.

A 300 ma meter is placed in the positive plate supply lead to the final stage. Since the movement of the meter is above ground-potential, precautions should be taken to prevent the possibility of a fatal shock from the zero-adjusting screw. A 150-ma meter is connected to measure the exciter cathode and final grid currents. A 20-ohm resistor is placed in series with each of these leads and the meter is connected across any desired one by means of a two-circuit five-point switch.

Because there may be a large difference of potential between various circuits connected to the switch it was thought that one of the non-shorting type

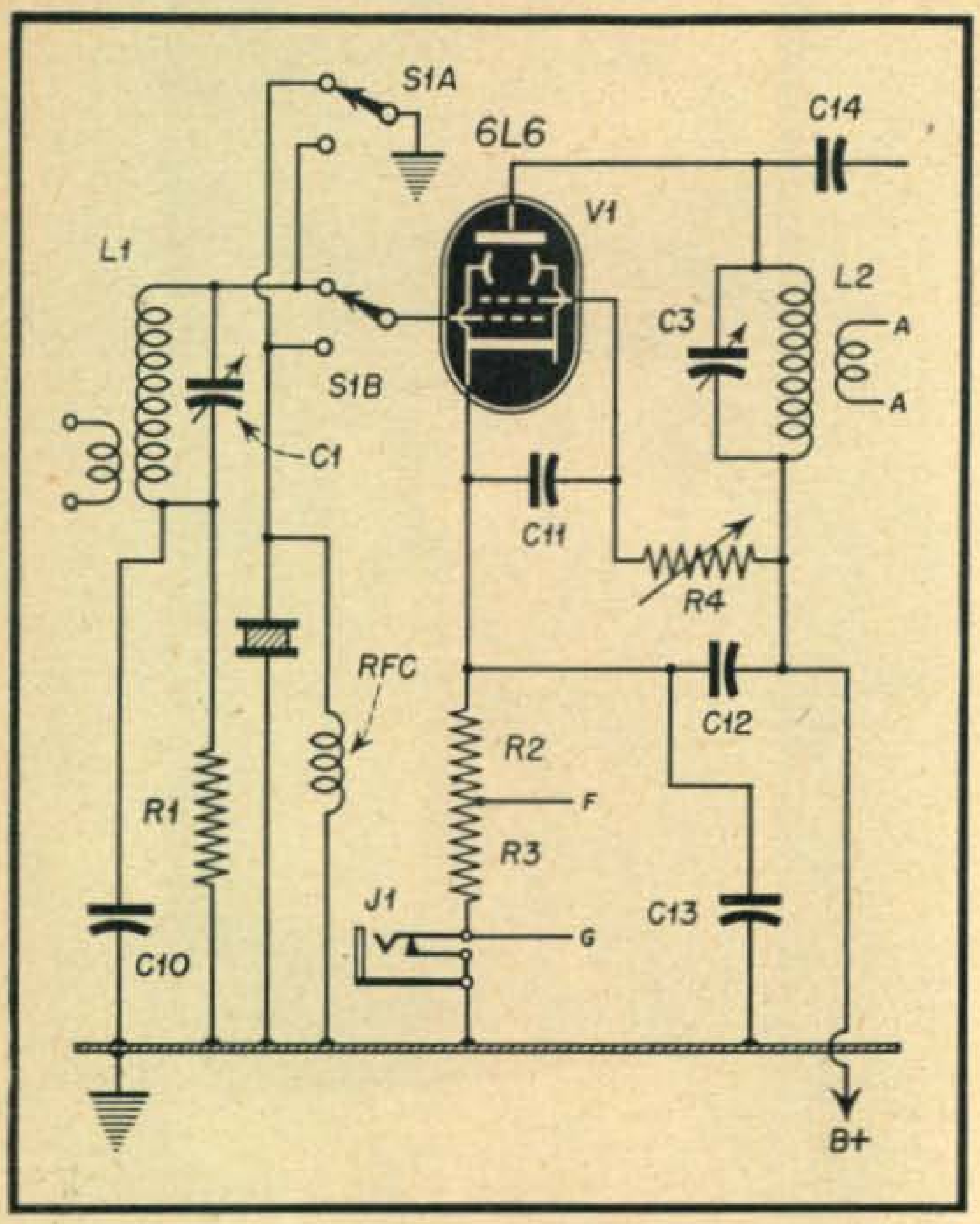


Fig. 2. Circuit for four-band operation

switches did not offer a sufficiently large factor of safety. Therefore a two-gang eleven-point switch was modified by removing every other contact and filling the detents associated with these contacts with solder.

Chassis

The entire unit is built on a 17"x13"x4" chassis (see *Fig. 5*). By the use of a chassis with a removable top almost all of the wiring can be accomplished before the chassis is assembled. The depth of 4" allows all of the exciter components except the tubes to be mounted under the chassis. The four 6L6's are placed along the front of the chassis, progressing from right to left so that the plate and grid pins are in the correct order when the cathode and heater pins are toward the rear of the chassis. This makes it possible to connect the interstage coupling con-

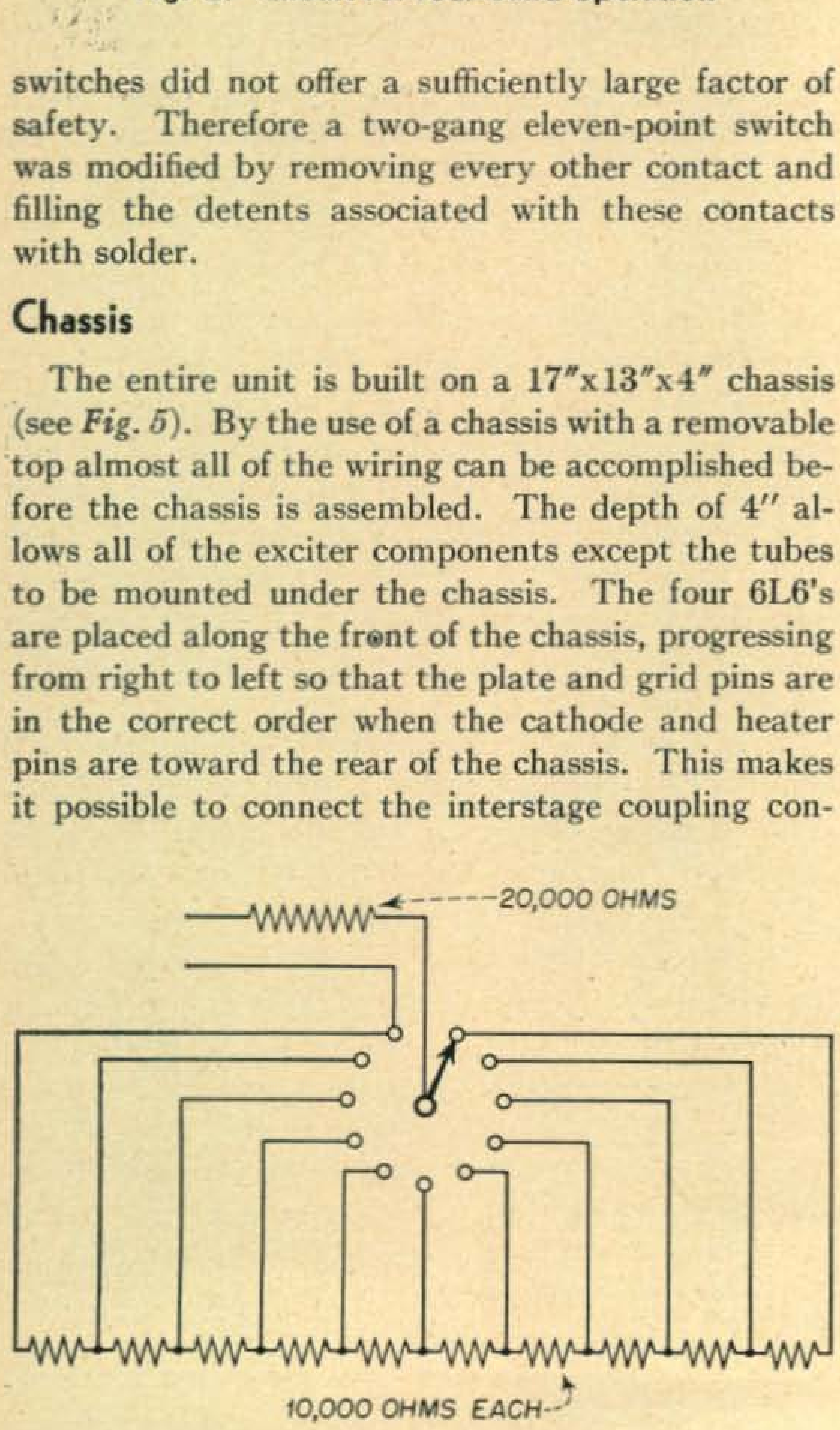
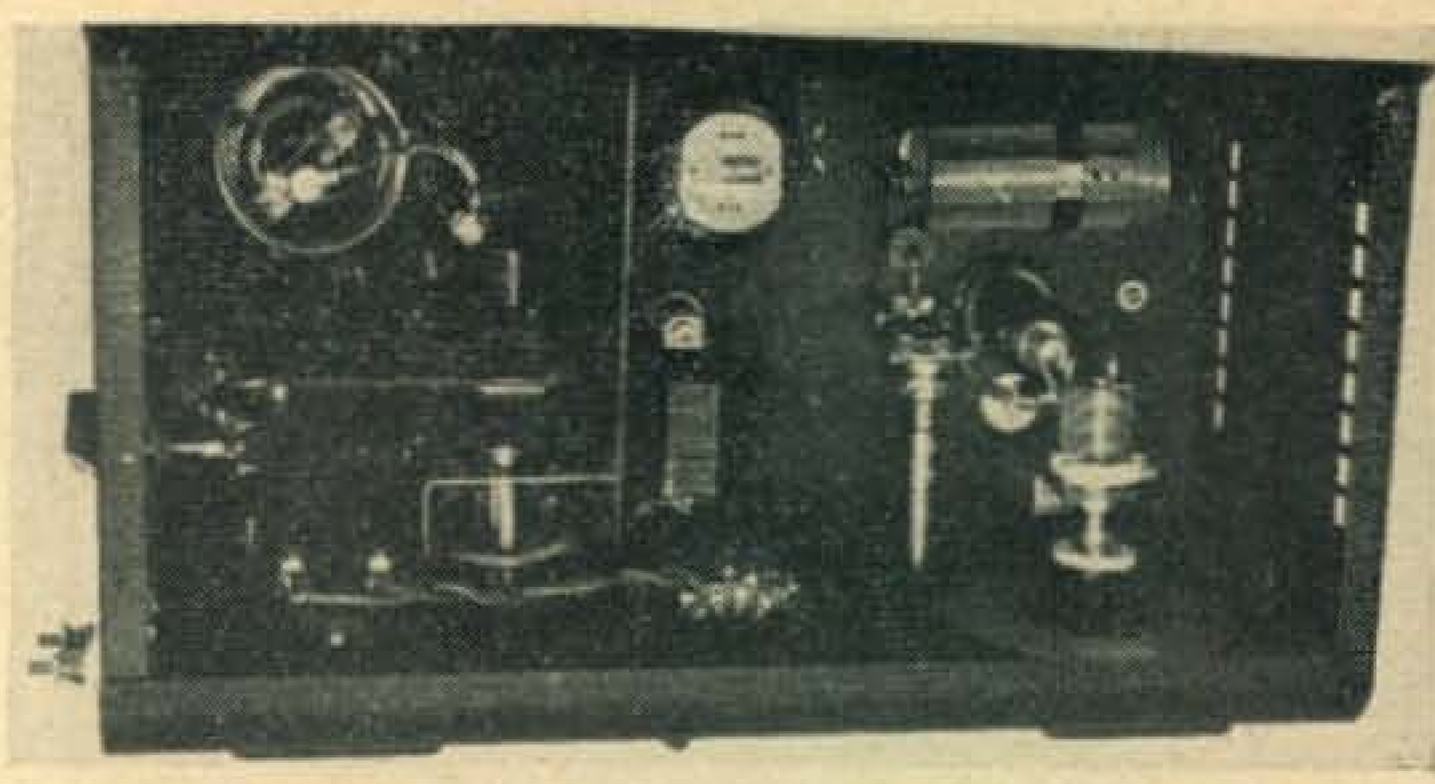


Fig. 3. Method of controlling oscillator screen voltage



Interior of 50-watt a-c/d-c cw transmitter

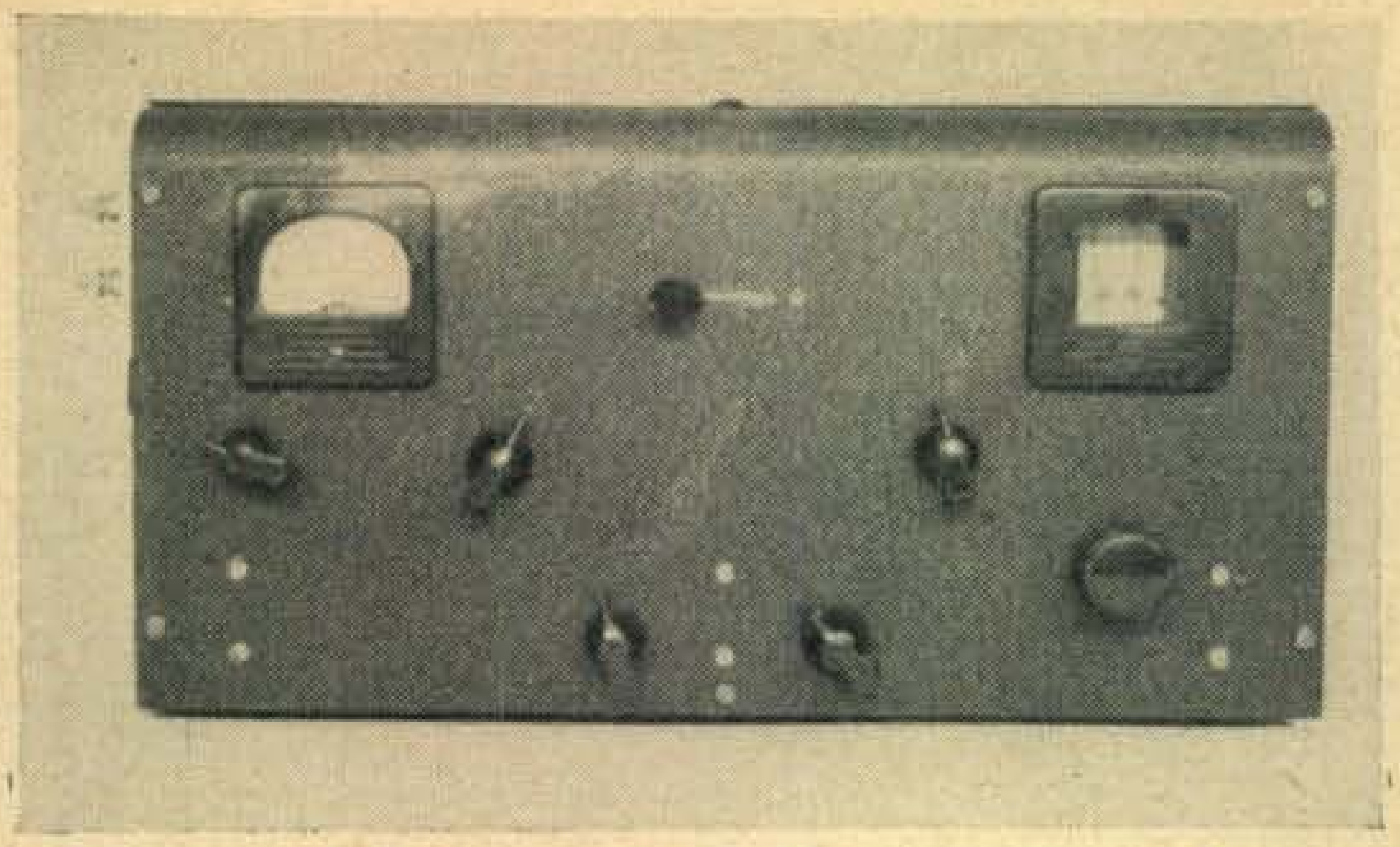
densers directly from one plate terminal to the next grid terminal. Series feed is used to all the tube plates because fewer RFC's and blocking condensers are necessary for series feed than for shunt feed. This greatly reduces the possibility of low-frequency parasitic oscillations. Successive shunt-fed stages with identical RFC's and blocking condensers are "set-ups" for such oscillations. It is also undesirable to use series feed with the condenser rotors grounded because the blocking condenser must carry the entire tank current which is many times as great as the r-f plate current and the I^2R losses in the condensers are proportional to the square of the current. Also, under these conditions, the tuning condensers must have a much higher voltage rating which necessarily makes them larger and less desirable for v-h-f use.

The one great disadvantage of series feed as used here is that the tuning condensers must be insulated from the chassis. *C3* must also be insulated from the chassis for r-f voltages. The condensers are mounted on the chassis top with steatite buttons to provide the necessary insulation. Bar knobs with well sunk set screws are used to protect the operator from the voltage on the condenser shafts.

The final amplifier and the exciter power supply are located at the rear of the chassis. The final plate tuning condenser is mounted upside down on the centerline of the chassis at the height which makes the lead to the plate of the tube as short as possible. Because the many controls associated with the oscillator occupy the right side of the panel, the final grid controls are put on the left side. These controls are mounted on a small subpanel mounted under the chassis and the shafts are extended to the front panel. The shaft extensions are made of insulating material because they pass near the exciter tuned circuits.

Tuning Coils

The tuning coils are all home-made. The 40 and 80-meter exciter coils are wound on 1" bakelite tubing. The 5, 10, and 20 meter coils are space-wound self-supporting coils, the 10 and 20 meter coils are cemented to three narrow celluloid strips to furnish additional support. These self-supporting coils are mounted directly on the tuning condenser terminals or, in the case of the final grid coils, on the



Five-band 50-watt a-c/d-c/battery operated cw transmitter

switch terminals. The final plate coils are also space-wound self-supporting coils with celluloid strips to give added support. These coils are mounted on polystyrene plug strips which plug into a polystyrene jack strip mounted on the final tuning condenser. This jack strip is supported by brass angles mounted on the stator terminals of the condenser,

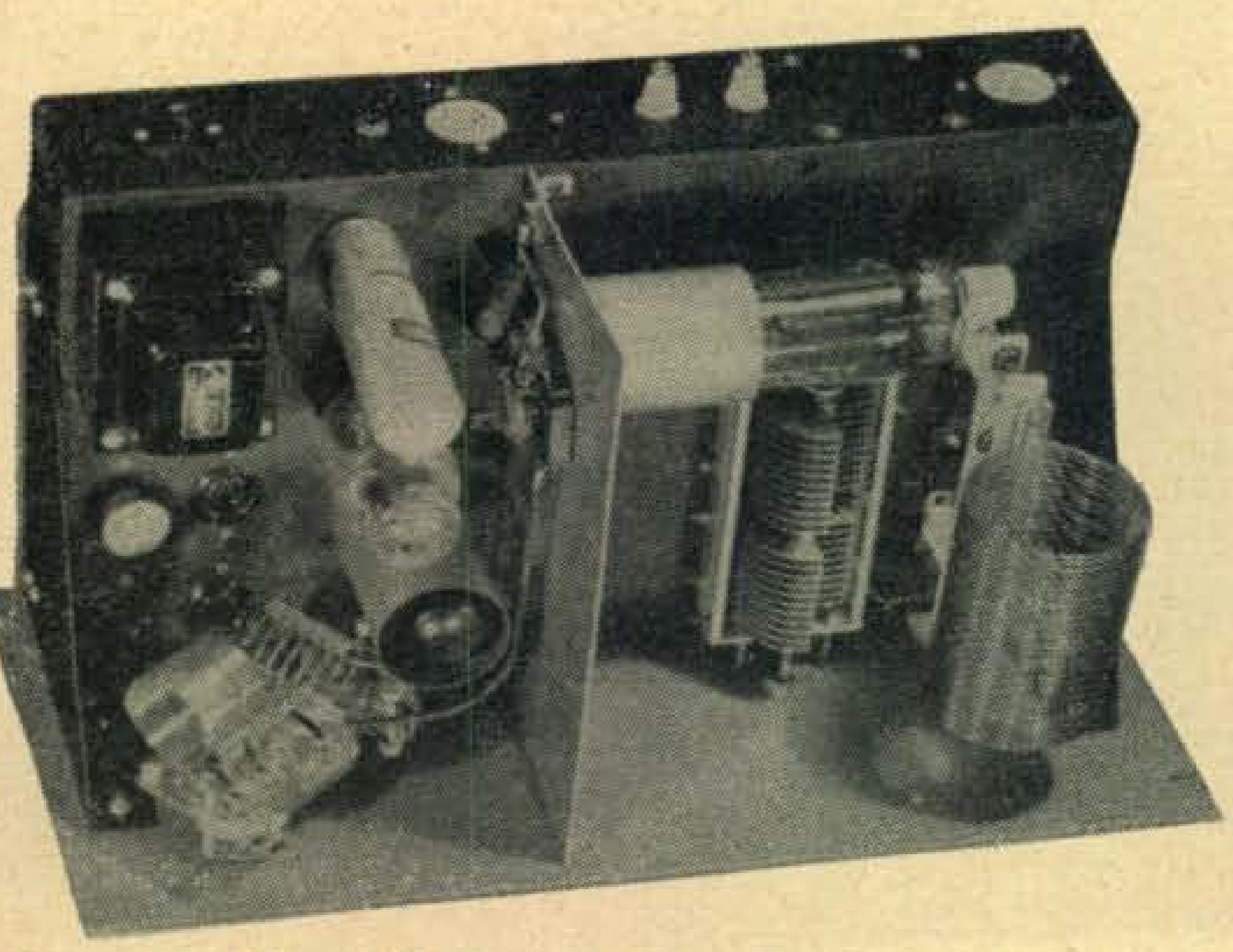
COIL DATA

Coils listed here are subject to change due to differences of mechanical construction of different transmitters.

L1	35T #20	enam.	on 1" dia. form close wound
L2, 8	22T	" "	" " " " " "
L3, 7	45T	" "	" " " " " "
L4, 9	12T #18	"	1" dia. 1" long space wound
L5, 10	7 "	"	" " ¾" " " "
L6	3 #14	"	" " spaced to tune
L11	4 "	"	" " " " " "
L12	5 meters	4T #14 enam.	1½" dia. 2" long
	10 "	9T	" " 2" " " " "
	20 "	14T	" " " " " " "
	40 "	24T	" " " " " 3" "
	80 "	45T #18	" " " " " 3½" "

the angles also serving as conductors connecting the stator terminals and the jacks.

The exciter links and connecting lines were made with low-loss r-f hookup wire. The number of turns



Interior of small transmitter, showing shielding

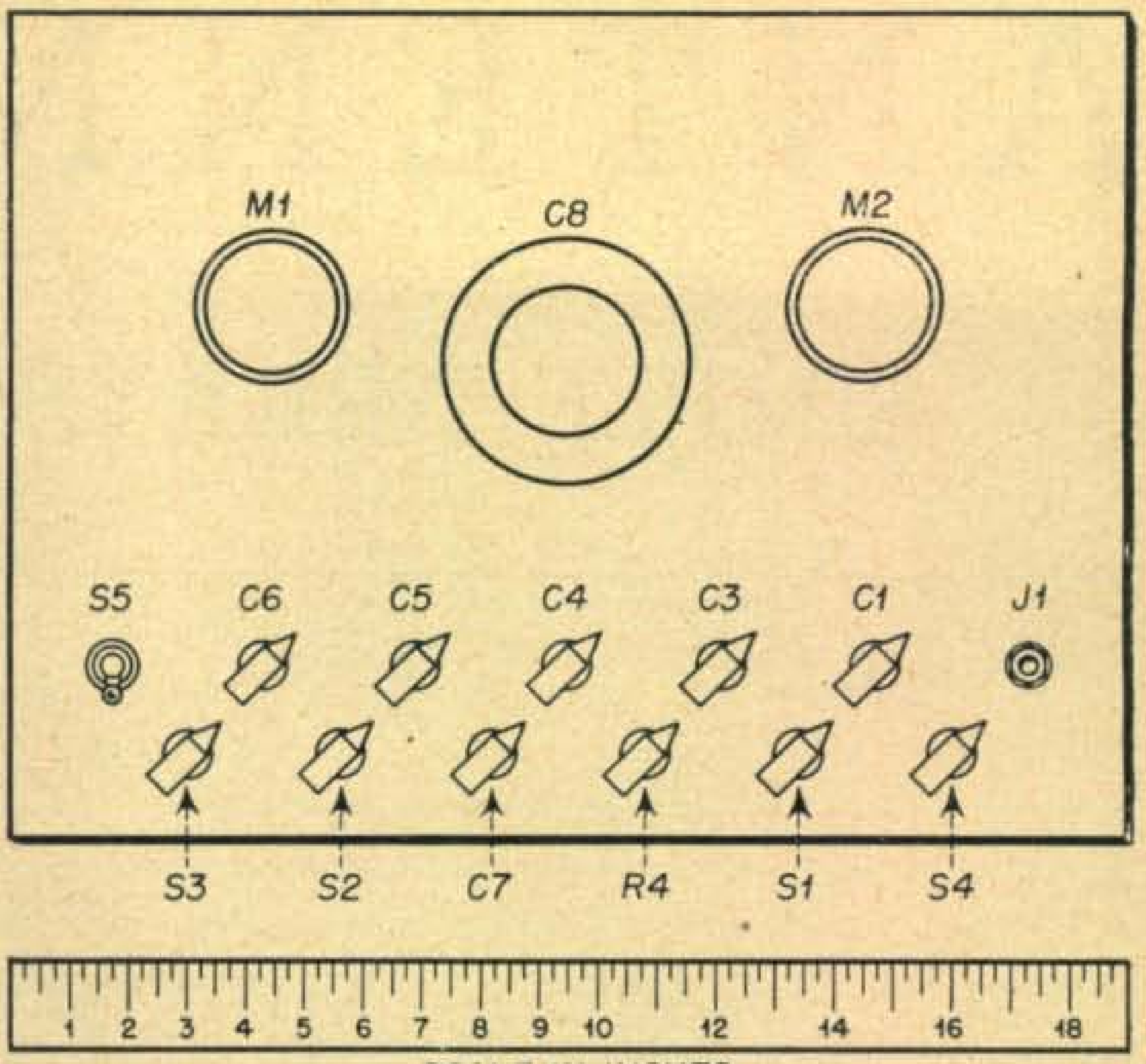


Fig. 4. Suggested panel layout of 150-watt transmitter

in the link coils and the coupling of the links to the tank circuits are adjusted to give the recommended grid current for the final amplifier. Two turns is sufficient for all these links except at 5 meters where the link line had to be tapped directly on *L6*.

Even though the plate cannot be seen to check up on operating conditions, the 6L6 is recommended for the 5 and 10 meter doubler stages because it has lower lead inductance than the 6L6G.

Although the paper by-pass condensers used in the original transmitter function satisfactorily, from an engineering standpoint it is suggested that they be replaced by mica condensers.

This article was written with the idea of introducing a few suggestions on transmitter design and construction. (*The opinions expressed by the writer are his own, and do not necessarily reflect those of the Navy.*)

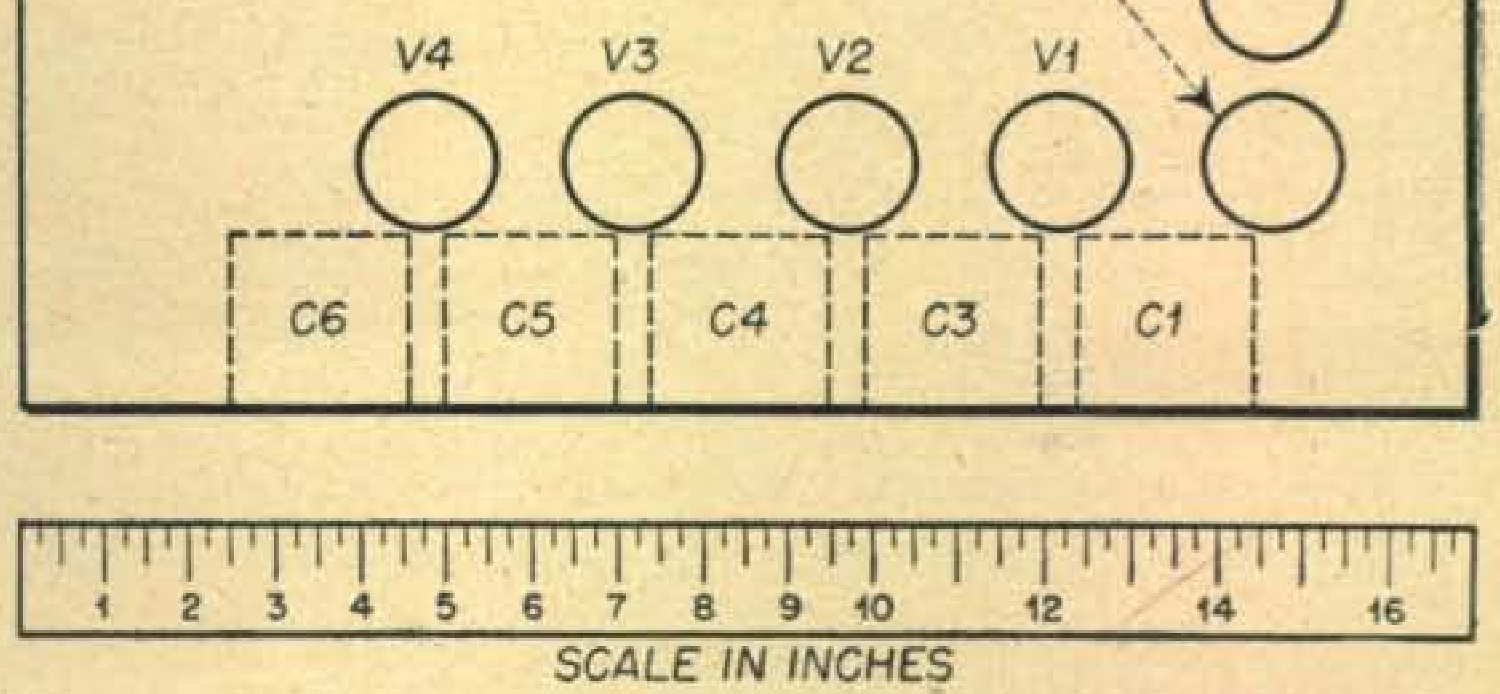


Fig. 5. How the author lays out the chassis

ANTENNAS — and

SIMPLE ARRAYS, BEAMS AND MASTS

LAST MONTH we gave consideration to two simple forms of antennas, for use in WERS operation between 112 and 116 megacycles. While the performance of the two units could be assumed to be almost identical under similar installation conditions, one might be very much more desirable than the other, where the mechanical conditions of construction are of importance. It is the purpose of this article to suggest various types of masts, which may be chosen for the manner in which they will best fit into the proposed set-up. If the antenna is to be erected on the flat roof of an apartment house, we have one group of conditions to consider; while a mast, designed to support the same sort of antenna may be a much more simple affair, if we are going to attach it to a house in the country.

A Few Fundamentals

Where operation is at a fixed location, and when communication is either to be carried on over comparatively long distances or where one is likely to encounter interference, the importance of getting the antenna as high as possible cannot be overemphasized. This consideration is the most important in any system—particularly where the power employed is as low as in the average WERS station. We must, of course, compromise between extreme height and fragility.

While most u-h-f operation at present is carried on with the simplest of antennas for the reason that the majority of networks operate within restricted districts and elaborate systems are not necessary, the difference between setting up an efficient and inefficient system amounts to so little, that it is generally wise to derive the benefit of preliminary planning. It is well to bear in mind, that, if the mast is substantial and ruggedly erected, it will carry almost any kind of an array (which the more elaborate antenna systems are called) we shall be likely to require in the future.

Down To Brass Tacks

Fifteen feet doesn't sound like much, but is just about all we care going in for, when it is to be added to some other structure. For some installations, even this height will be entirely too much. If it is at all possible to obtain a 15-foot length of thoroughly

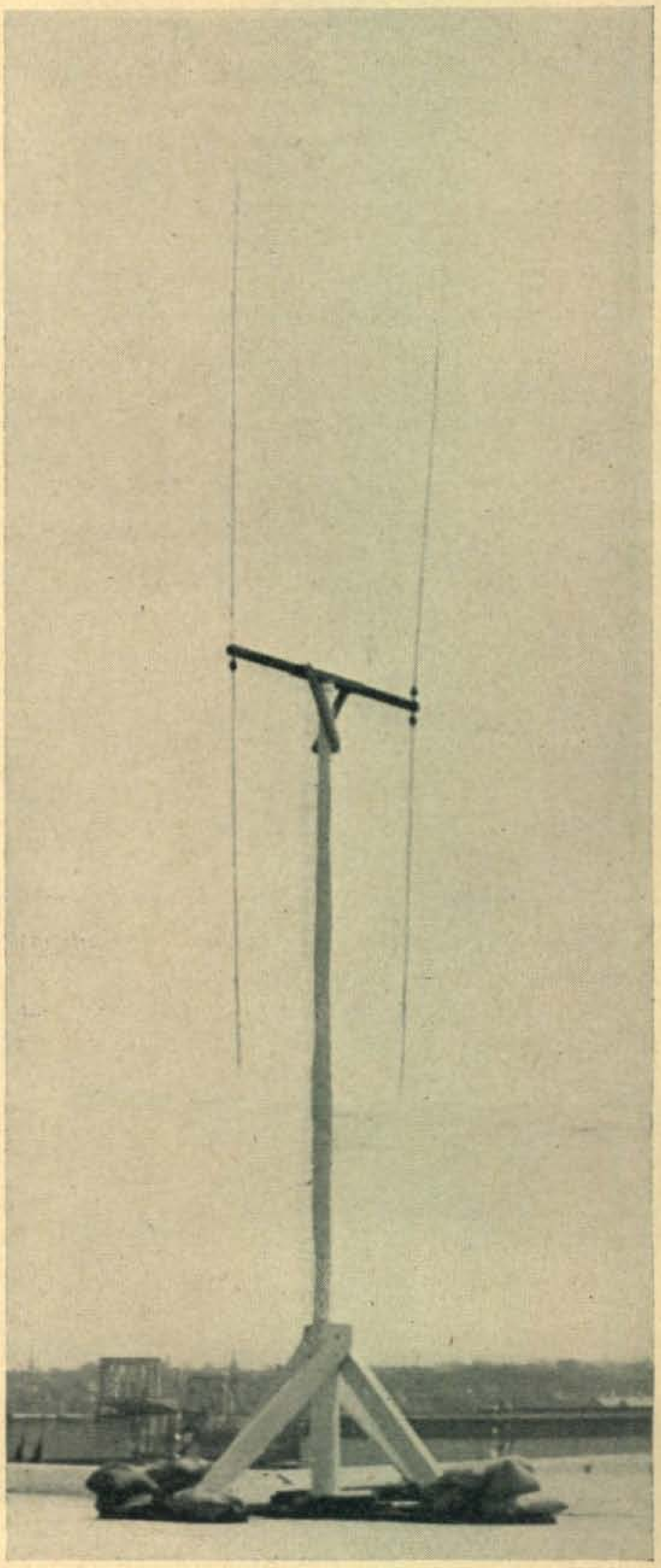


Fig. 4. Antenna used at W2USA

WHAT HOLDS 'EM UP

ARTHUR H. LYNCH, W2DKJ

seasoned 3 x 3-inch redwood, you will have just about as good a mast as you can find. In the absence of redwood, pine will do—but it's much heavier. In either case, the pole should be given two or three coats of a good grade clear outside ("spar") varnish. Such a mast was used at one of our locations for more than ten years. It lived through two of the worst hurricanes that ever struck Long Island. In the course of its life it supported so many antenna varieties that it is hard to name them. However, a single di-pole for 2½ meters and a six-element rotary beam, for operation on the ten meter band were among the collection. The latter was used horizontally and measured about thirty feet from tip to tip. We were lucky in locating a spot beside a chimney, which, we thought would aid in supporting the pole. It was found later that support at the chimney top was not necessary. But the chimney did render the installation a little less conspicuous. Where the pole can be erected on top of a tall building, or a house having the natural advantage of a hill-top location, it may be that the 10-foot length of 2 x 4, described in the preceding article, will be *sufficient*. However, almost everything said about the 15-footer goes for the smaller stick.

Some idea of the supportability of unguyed masts may be had from the accompanying illustrations. The three-inch stick, to which we referred above, is shown in *Fig. 1* with a six-element, ten-meter, close-spaced array. The antenna, operated in a horizontal plane, was made rotable by a very simple method, involving a couple of bread boards and some brass pulleys picked up at the "five and dime." Optimum height, in this case, was less than required for operation on the higher frequencies, so it was necessary to drop the entire pole by means of replacing the lag-bolts, which held it to the house. (This provided the additional advantage of letting us use the chimney as a seat during adjustments.)

Holes were bored in the main stick and lag-bolts were then inserted through the outside wall of the house and into one of the main risers, located, as luck would have it, alongside the edge of the

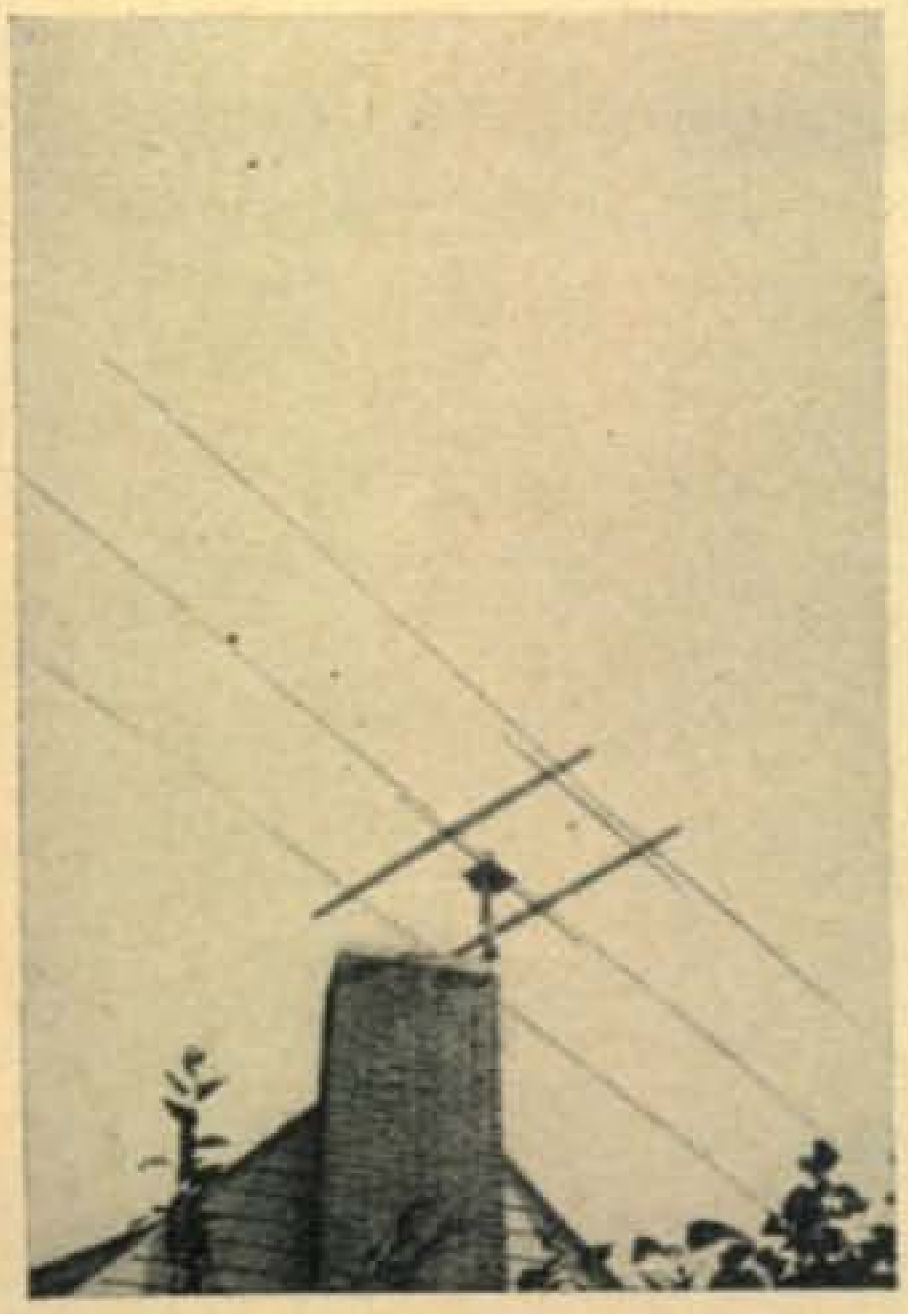


Fig. 1. Ten-meter rotary beam on an unguyed pole at W2DKJ

Fig. 2. Three-element 20 meter rotary beam designed by James Tynan, W2BRI

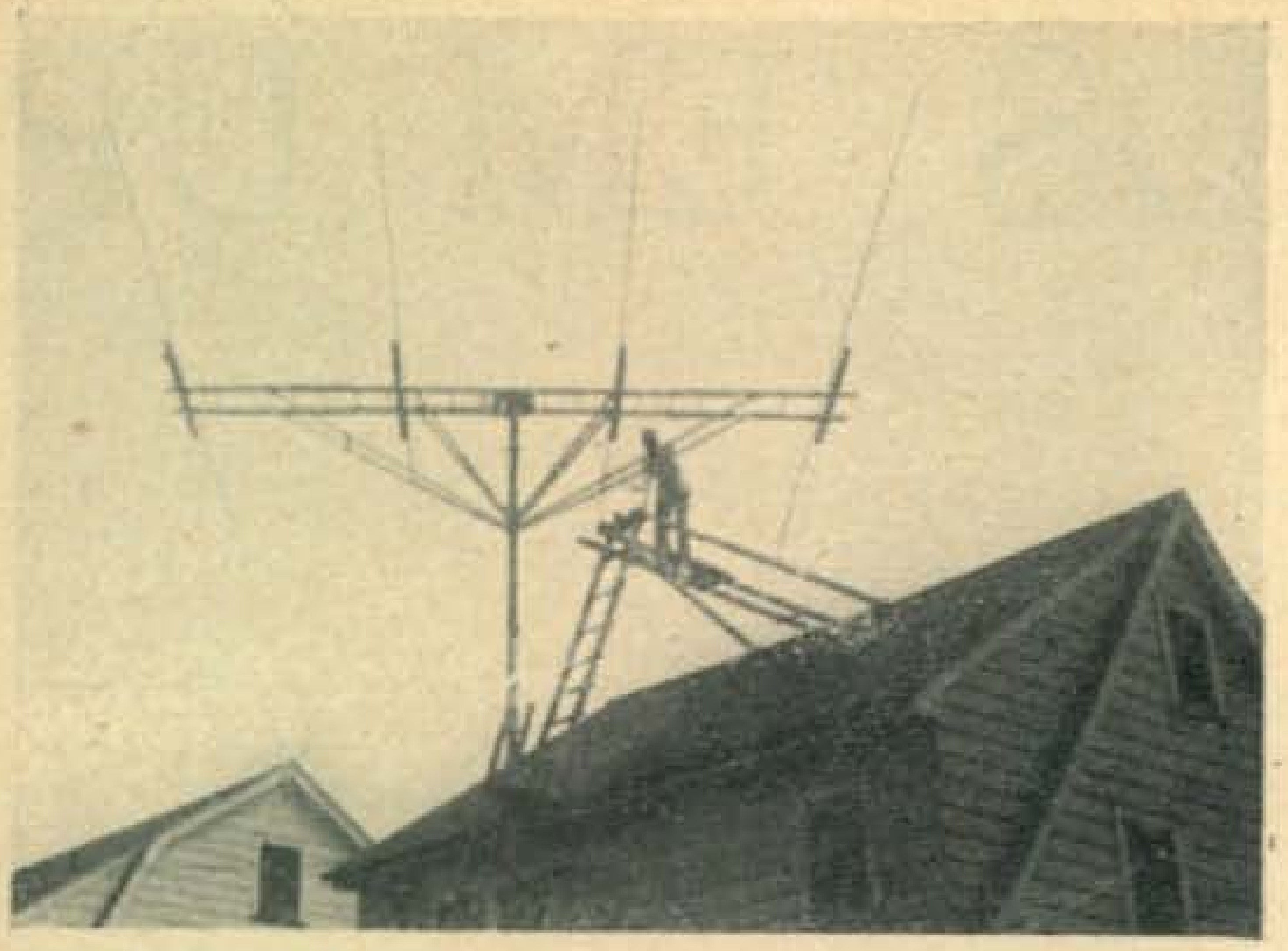


Fig. 3. Four-element beam designed and built by James Tynan, W2BRI, of the Garden City Radio Club

chimney. Several such bolts are desirable and their position will be indicated by individual conditions. The arrangement with the cross-stick on the top of the 3 x 3 was used for 2½-meter operation. The antenna, itself, known as an "extended lazy H," was made of four aluminum rods, two pointed up and two down from the cross-arm. With thirty watts input, we were able to carry on regular communication with stations up to seventy miles.

Some idea of just how much "spinach" you can tie to the top of such a stick may be had from the two photos (*Figs. 2* and *3*) showing the three and four-element 20-meter rotary beams designed and built by James Tynan, W2BRI, of the Garden City Radio Club. The trestle extending from the peak of the roof to the gutter, was provided with a movable platform, which could be slid into various positions. By changing one's position, and rotating the beam, the array could be checked and adjusted for peak performance. Our main point, here, however, is to show how far you can go with unguyed masts.

World's Fair Antenna

The arrangement, shown in *Fig. 4*, is a full-wave, close-spaced, bi-directional, vertical beam used at W2USA, the amateur station at the New York World's Fair. Stations in India and China were worked, even though the r.f. from the transmitter to the antenna was fed through 300 feet of ordinary twisted pair of outdoor electric-light wire. The

Fig. 6. Operating desk of W2USA

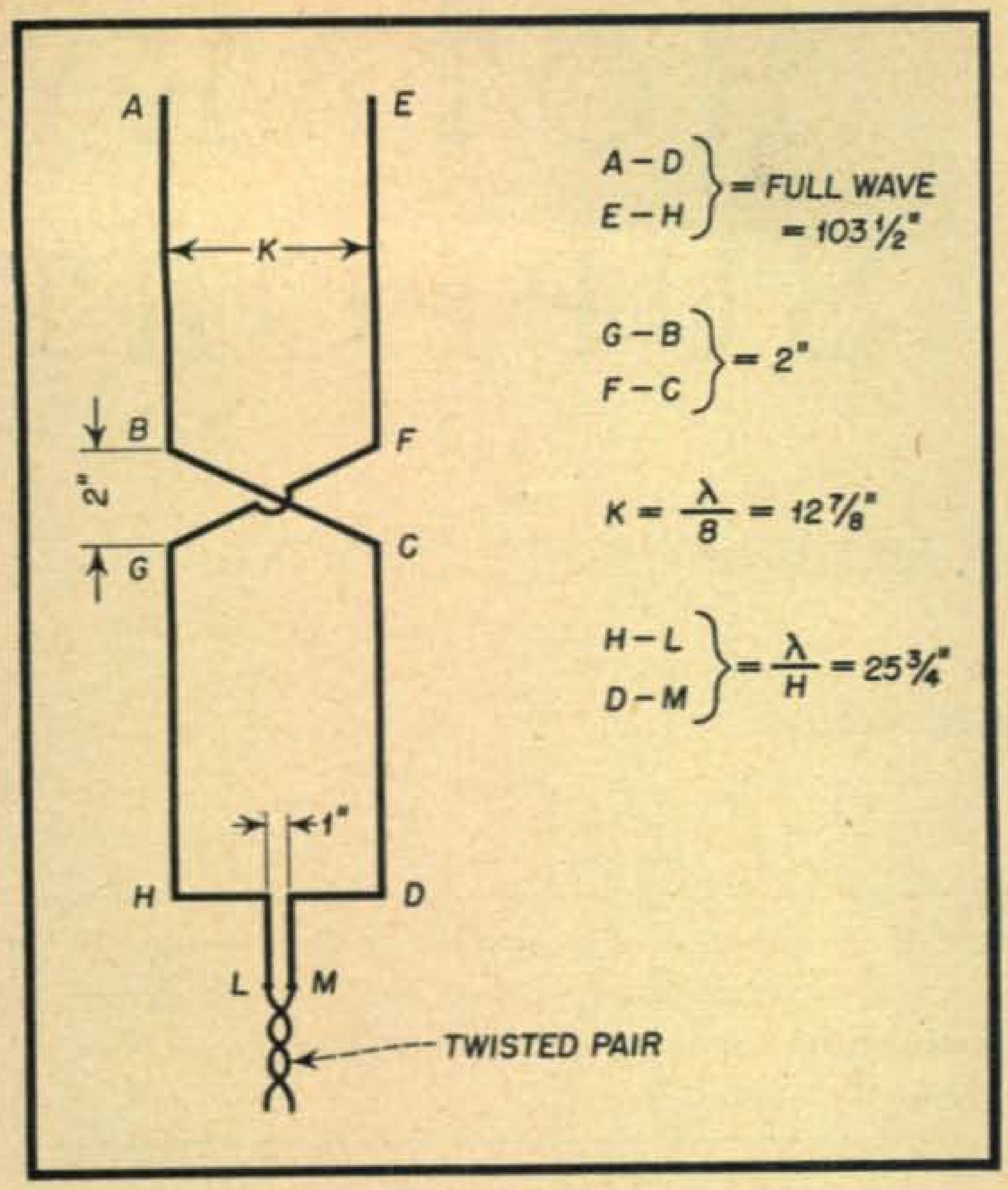


Fig. 5. The antenna photographed in Fig. 4 redimensioned for operation in the 2½-meter band

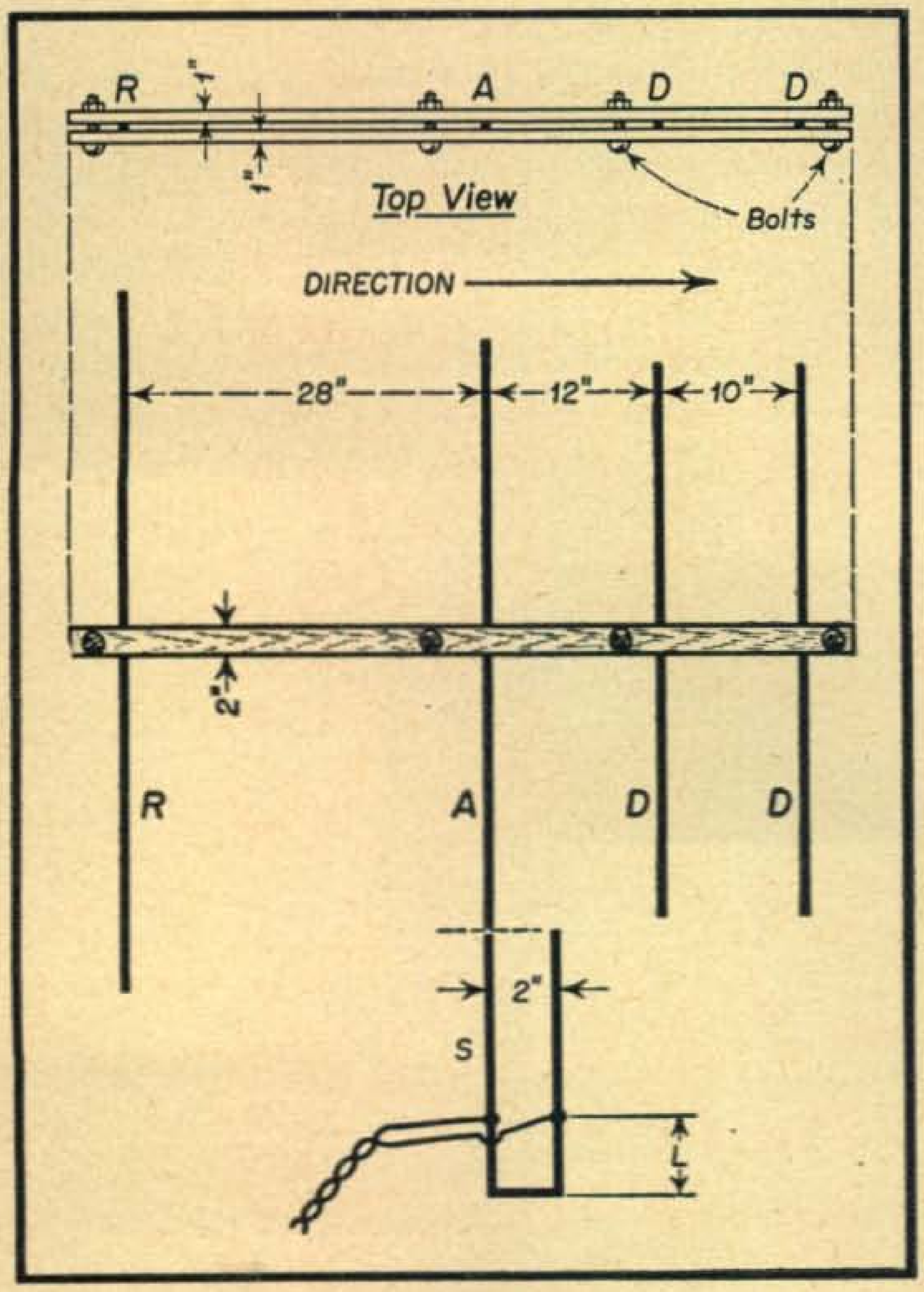


Fig. 7. Elaborating on the simple dipole. This array is particularly suitable for WERS work. The elements are ½-inch copper tubing. "L" will be approximately 6 inches for the average transmission line

dimensions for such a beam, for use on the 2½-meter band are given in *Fig. 5*.

A long feed-line, of the type mentioned, is not recommended. But for the record, it may be well to call attention to the "transmission-lines" running up from the operating desk (*Fig. 6*) at W2USA. The cord, on the left carried 600 watts of r.f. on twenty-meter phone. The line coming down behind the "scope" passed under the table to the 160-meter rig (not shown) while the right-hand pair, passing through the cards, Eighth District, was the five-meter lead-in. None of them was less than 150 feet long and all the transmitters got around in good shape. It is not to be thought that better results would not have been obtained if spaced pairs had been used for the transmission lines—particularly where the runs were so long. But with sixteen antennas on the roof of a single building, each having its own line, there would have been hardly enough wall space for them all!

Directors and Reflectors

In our preceding article we described two fundamental, single-element radiators with the implication that, while reasonably satisfactory in themselves, they could be used as the basis for more advanced and efficient designs. Increased efficiency can be obtained by concentrating the radiation in the direction we want it to go—beaming the antenna toward the station with which we are in communication—by means of a reflector and directors. Such a construction is shown in the drawing of *Fig. 7*. Calculation of the lengths of the various elements is in accordance with the formulae—

$$\text{Reflector } (R) = \frac{492}{f(\text{mc})} = \text{Feet}$$

$$\text{Antenna } (A) = \frac{468}{f}$$

$$\text{Directors } (D) = \frac{450}{f}$$

$$\text{Stub } (S) = \frac{R}{2}$$

—which gives us the following table of lengths for optimum operation in the 2½-meter band:

	112 mc	*113 mc*	*114 mc*	*115 mc*	*116 mc*
R	4'3½"	4'3"	4' 2½"	4' 2"	4' 1½"
A	4'1½"	4'1"	4' ½"	4'	3'11½"
D	4'1"	4' ¼"	3'11½"	3'10¾"	3'10½"
S	2'1¾"	2'1½"	2' 1¼"	2' 1"	2' ¾"

The construction is such that the spacing between the elements is adjustable, the dimensions given providing excellent results at the author's location. With adjustments finally completed the signal a quarter-mile away was *R*9 as compared with *R*4 for a simple half-wave dipole.

A Simple Rotary Antenna Support

Suitable for Light-Weight Arrays and Rods from 112 Mc Up

L. LeKASHMAN, W2IOP

The simplicity of welded construction is a feature in this mounting. Relatively few amateurs take advantage of welded design. Welds are strong, labor and time-saving, economical, and your nearest garage can usually accommodate you on big or little jobs.

AN EXTREMELY simple, yet highly effective rotary antenna support can be assembled for a few dollars. While the arrangement does not lend itself to motor drive or particularly heavy beam, it can perform admirably for such antennas as FM, television, etc. Constructional features are shown in *Figs. 1, 2,* and *3.*

Dimensions are not critical and may depend on the materials available. In the model illustrated, a piece of flat iron stock 16 inches in length, 3 inches wide and approximately ⅛-inch thick, forms the antenna support. This is welded to a 9-inch piece of hollow stock with an inside dimension of 2 inches. The bottom half consists of a 9-inch length of solid rod with an outside diameter just under 2 inches. This solid section is welded to a piece of the same flat stock forming the beam support. The bottom piece however, instead of being left flat, is bent into a U-shaped bracket whose dimensions allow a 4 x 4 length of lumber to fit snugly.

Close Fit Required

The only important dimension is the fit between the male and female pipes. Rather than trust to actual measurements it is desirable to test the fit before cutting the stock. While the top section should turn freely there should be no side play. The socket should be thoroughly greased when the unit is finally assembled. The entire antenna support should be rust-proofed with at least three coats of a good outside or metal-roofing paint.

A number of these units have been constructed utilizing various methods of controlling direction. The simplest, employed two pieces of a good-grade non-stretch rope fastened to the mounting brackets. This permitted 180-degree rotation, which is all that

[*Con'inued on page 39*]

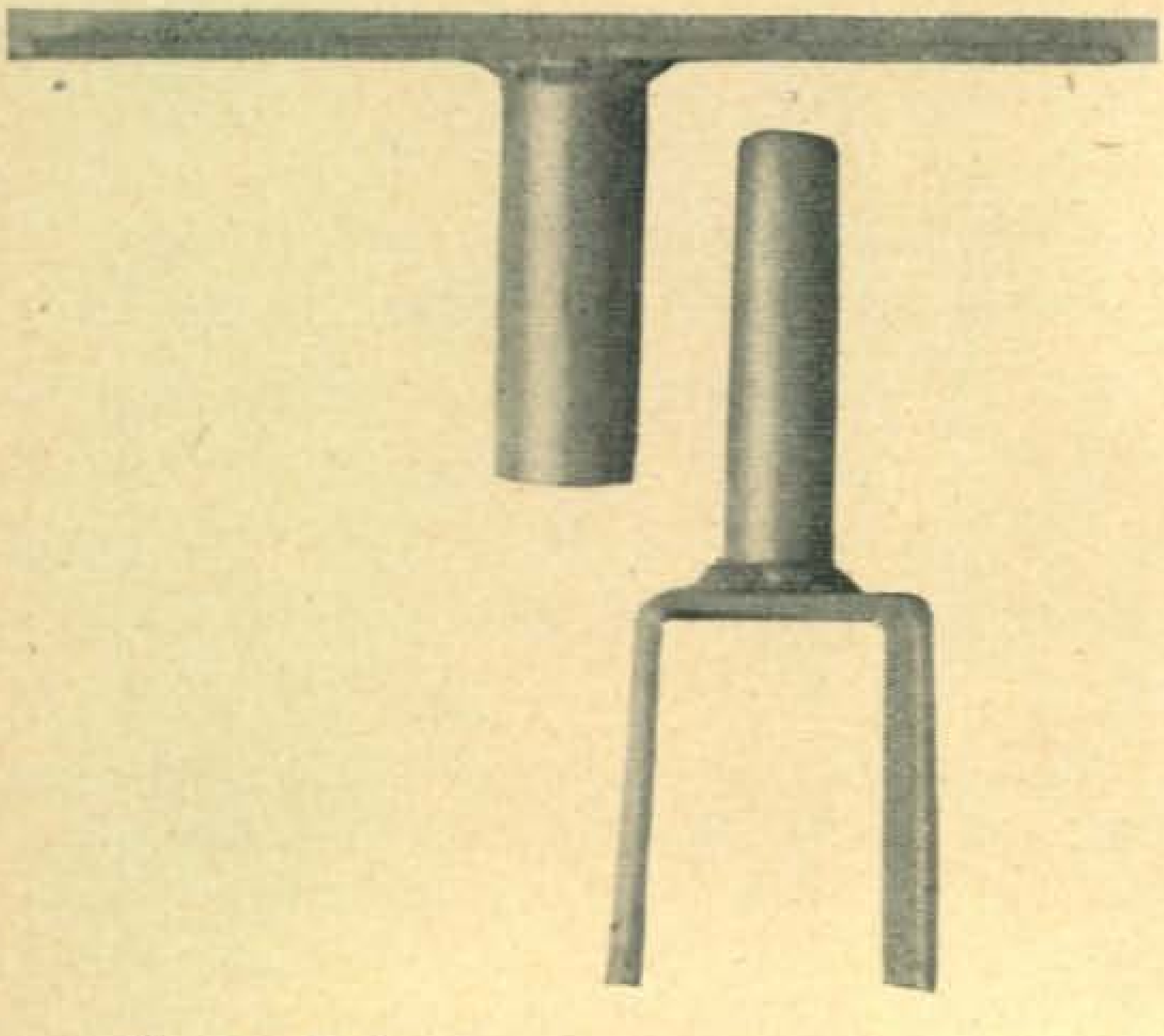
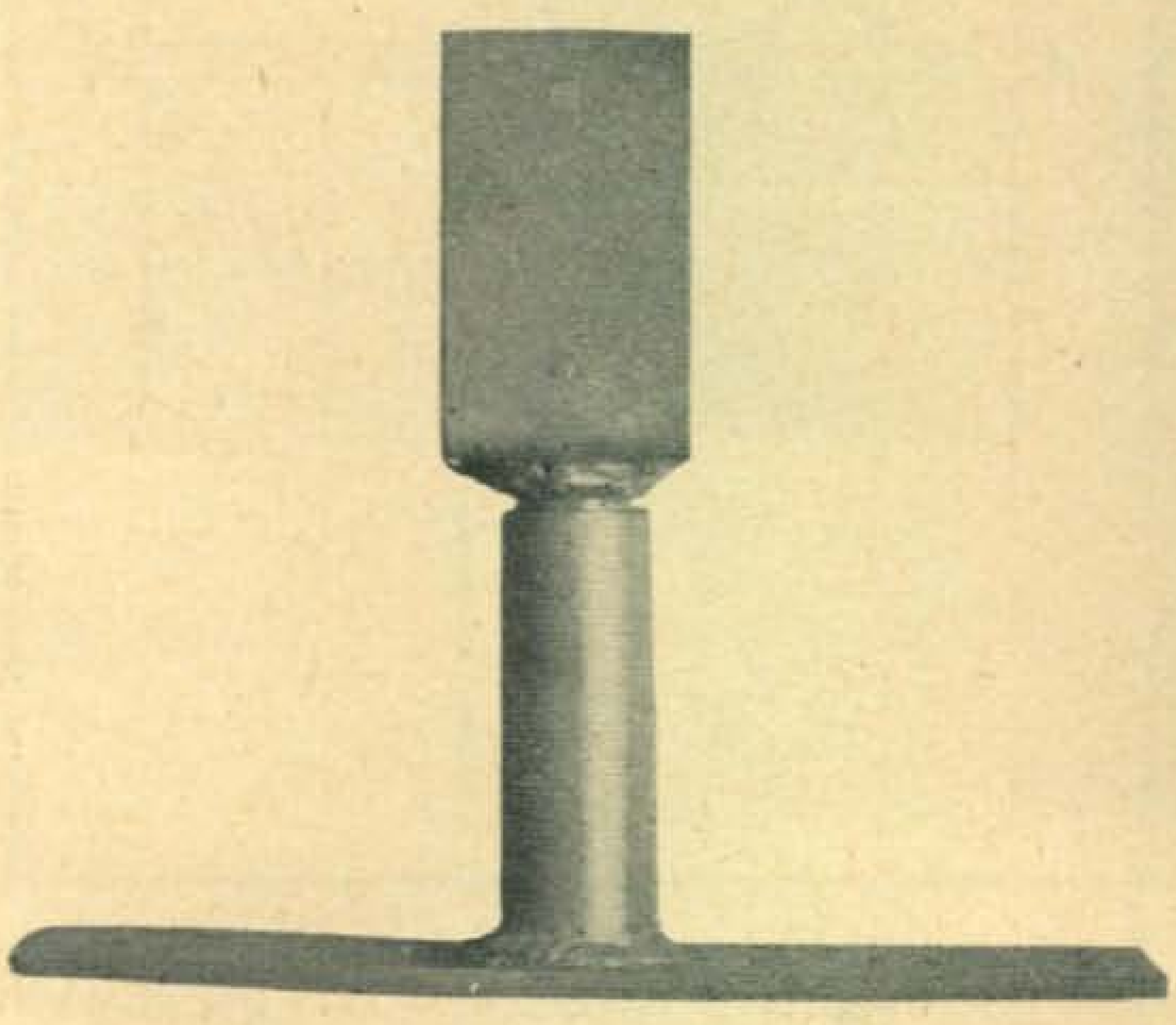


Fig. 2. A simple rotary antenna support.



The two sections fit together as illustrated in Fig. 3

WITH THE WERS

New York to Philly open for business . . . Maine—Florida route proposed . . . WERS in Connecticut . . . Inter-state traffic . . . Jersey news . . . WERS answers fire alarms

VIN KENNEY, Chief Radio Aide, New York City (who swivels his chair in the Office of The Mayor, City Hall) writes that the ECRA (Eastern Conference of Radio Aides, of which Vin is Chairman) has definitely established a traffic route between New York City and Philadelphia and Allentown, Pa., over different routes, with contacts in Westchester, Suffolk and Nassau Counties, N. Y. It is expected that Wilmington, Del., will soon link Philly with Washington. W2BGO writes—"We are co-operating closely with Dr. Woodward, State Radio Aide for Connecticut, handling the New England end of our traffic net. Westchester, WJQN, will endeavor to work Stamford, Conn., WJQA, with Huntington and Mineola, L. I. trying for Stamford or Bridgeport. These three New York stations are all within range of our control station WNYJ-150, and if any one of them comes through with a contact with Connecticut, we'll have a route from Boston to Philly. With the Philadelphia-Washington circuit working, I hope to stretch north and south until we cover from Maine to Florida."

- . . . -

Meet *Jacobus (Jack) Andriese,* W2LKU, and Chairman of Communications, Nassau County War Council, with mobile WKLR-65 as a back-drop. W2LKU, incidentally, is the artist who doped out the block diagram of the NYC WERS set-up in March CQ.

- . . . -

Connecticut has over 200 licensed WERS operators and completely blankets the state according to *Dr. R. W. Woodward,* State Radio Aide, and co-operates 100% with the other New England states. Relay systems are under consideration.

- . . . -

The idea of inter-state WERS co-operation, with present and post-war emergency service possibilities is also advocated by *Tom Mc Nulty,* State Radio Aide for Maryland, who is working for relay contacts with Pennsylvania and Virginia. Maryland is one of the most active states in the WERS. Governor O'Connor is a periodical host to some 400 WERS operators at the State Capitol—which includes eats after the business meeting. Maryland emphasizes the desirability of portable and portable-mobile rigs for flexible operation, with units located in public places, such as police and fire stations, rather than private homes.

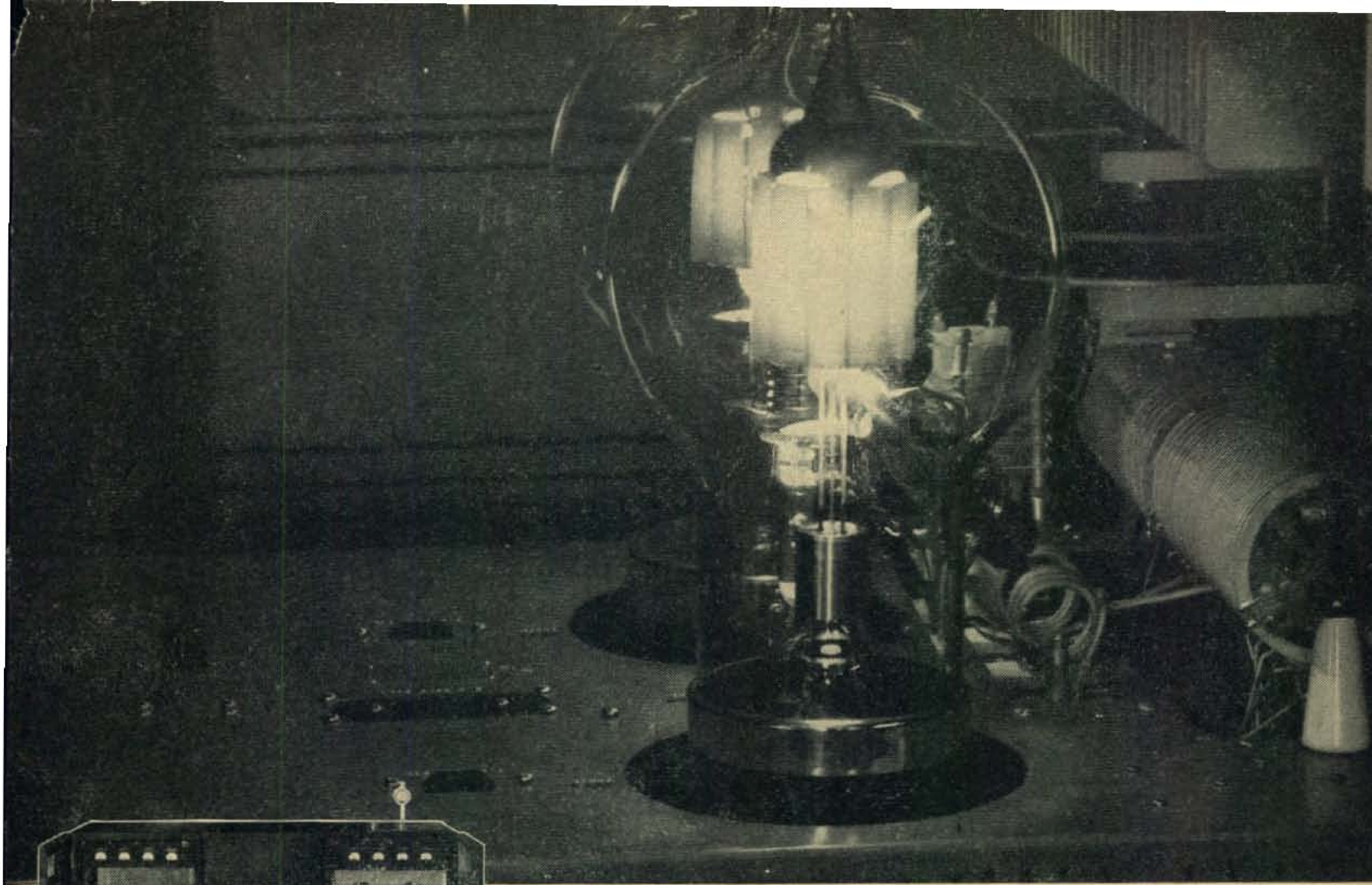
Mr. and Mrs. Athan Cosmas

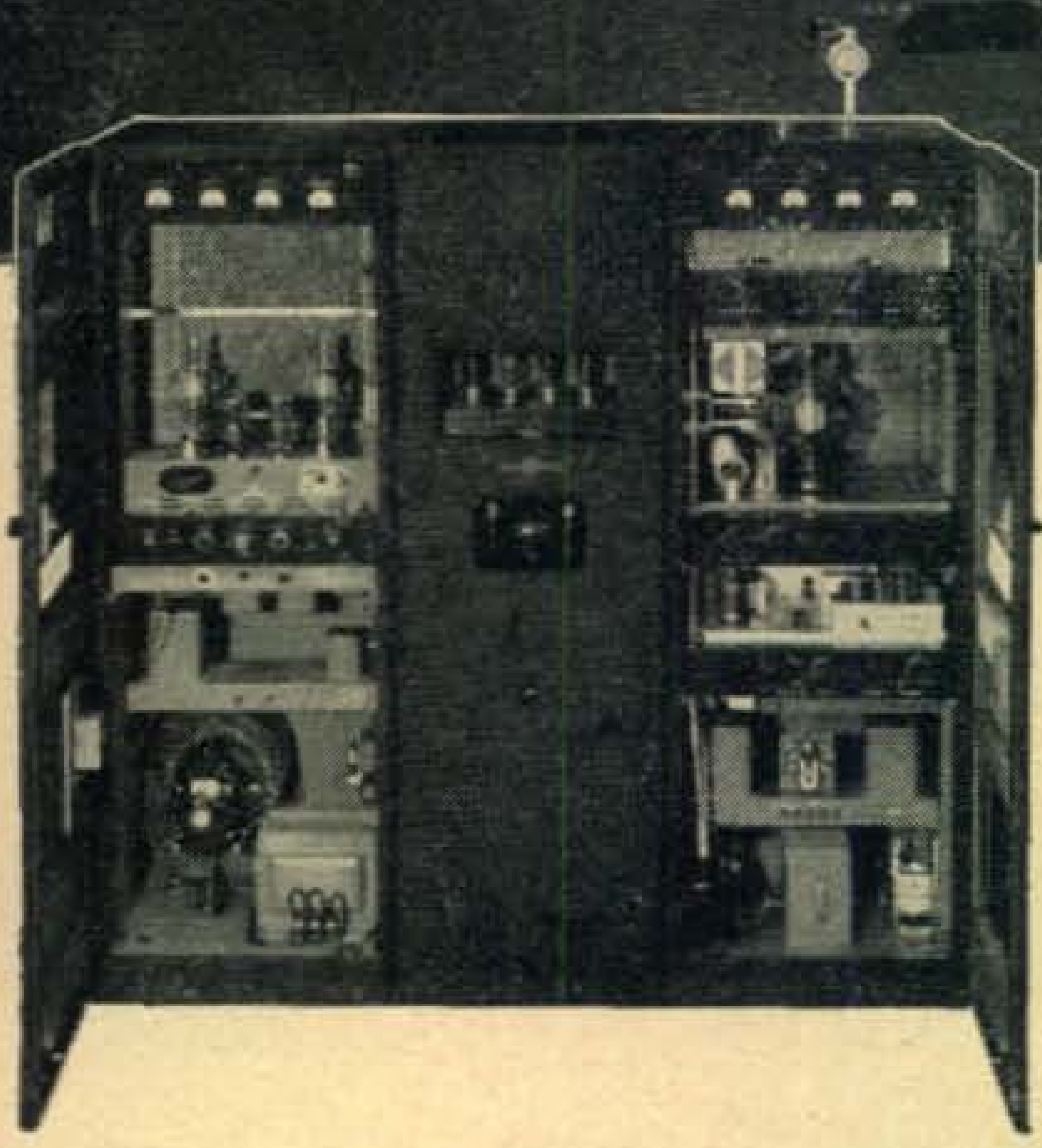
- . . . -

Handy and walkie-talkies—WNYJ-310 and WNYJ-221, respectively—with (Mrs.) *Louise B. Cosmas,* Operator 462, and (Mr.) *Athan Cosmas,* Operator 461, reporting depth charge (ash-can) just across the street. Photo by *Robert Cobaugh,* W2DTE, official photographer for the NYC WERS, and who did the pix in the March write-up. Cosmas is an engineer with WQXR, and, incidentally, has promised CQ an article on modernizing the 3.5-inch oscilloscope.

- . . . -

John A. Kiener, Chief Radio Aide for the WERS in Cuyahoga County, Ohio, has been elected a Director of the ARRL. Kiener is widely known for his work with the WERS radiophone network, WJJS,





Output CW—5 KW; Output 'Phone—3 KW 100% modulated with a pair of Eimac 450TL tubes in class "B" audio; continuous coverage from 2 MC to 18.1 MC with 11 preset channels in that range and complete manual coverage throughout whole range. Capable of completely unattended remote control operation and of A1, A2 and A3 type emission. Audio characteristics: plus or minus three DB from 150 to 3,500 cycles. Total harmonic distortion less than 10%. The transmitter can be terminated into a 50 to 1,200 pure resistive load at zero degrees phase angle. 70 to 850 ohm load at plus or minus 45 degrees and 100 to 600 ohms at plus or minus 60 degrees.

COLLINS ENGINEERING AND EIMAC TUBES *achieve outstanding results*

This Collins type 231D-11 (Navy TDH) radio transmitter is an outstanding demonstration of the value of capable engineering coupled with the intelligent choice and use of vacuum tubes.

It is the latest of a series of Collins Autotune, quick shift transmitters which were originally introduced in 1939, and which use Eimac tubes in the important sockets. In the 231D-11, two Eimac 750TL tubes in parallel make up the power amplifier, while a pair of Eimac 450TL tubes in class "B" are used as modulators for voice and MCW emission.

Mr. F. M. Davis, General Manager of the Collins Engineering Division, says: "Eimac tubes have been found to be reliable, rugged and capable of withstanding the severe overloads encountered during equipment tests, without damage." Statements like this, coming from such men as Mr. Davis, offer proof that Eimac tubes are first choice of leading engineers throughout the world.

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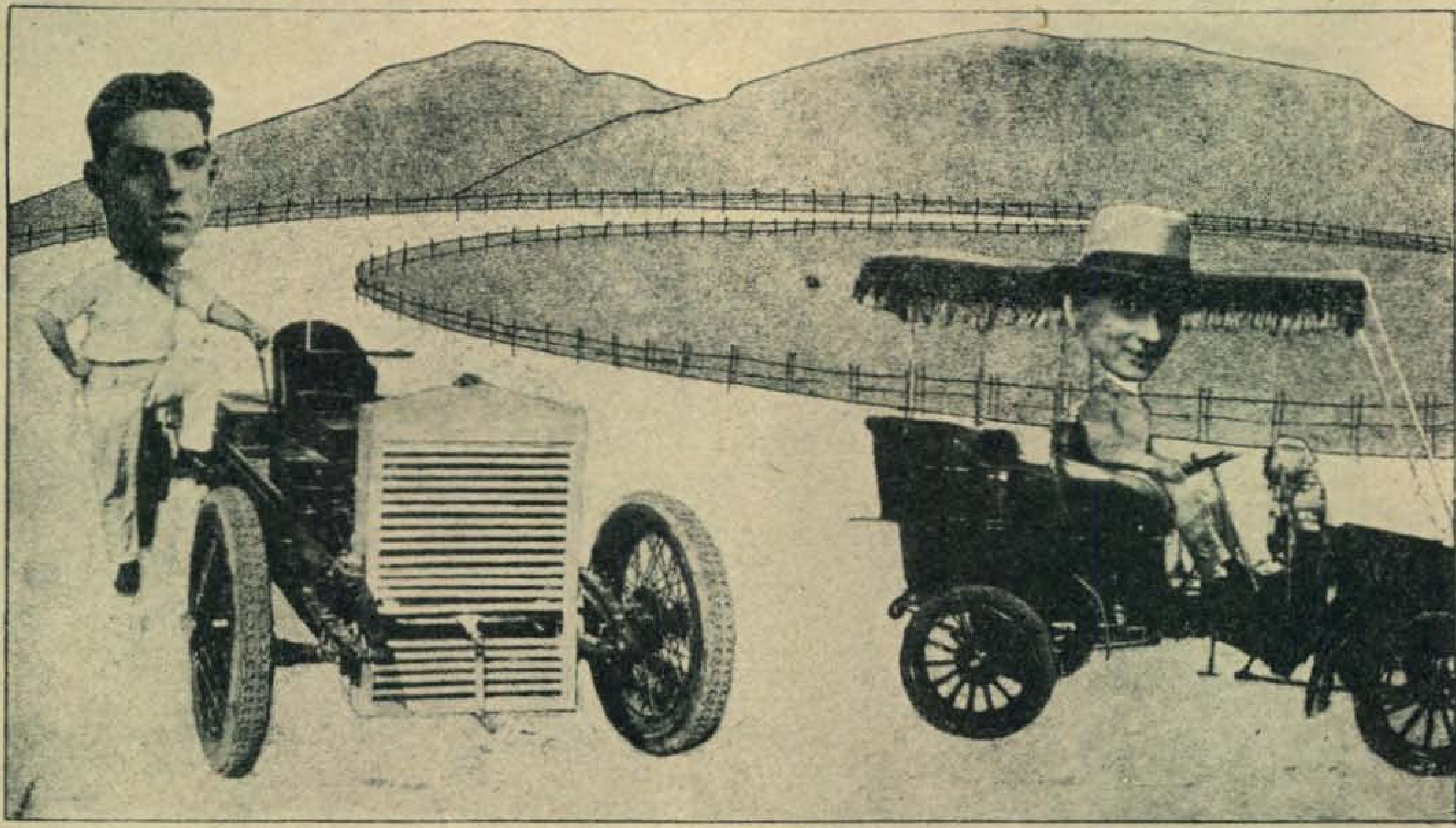
6 THE NEW YORK TELEGRAM RADIO SPECIAL Sunday, June 12, 1927.

Race of Century Slated for Chicago



McMurdo Silver (left) and Arthur Lynch and the machines they are arguing about.

By O. GODELPUS.

Did any of you ever sit in and listen to Arthur Lynch and McMurdo Silver fan each other with Munchausenistic vociferations, not to mention oscillations, on who has the best and fastest rolling stock? We might have said automobile, but neither of them comes under this category.

But whatever they call them, the gang has kept razzin' 'em so long that they had to challenge each other to keep out of limbo or was it some speakeasy? As usual Larry Nixon challenged the winner. What Larry will race is a vehicle too remote of antiquity for us to picture, notwithstanding the fact that the files of the Telegram go back to the pliocene age. We were just barely able to dig up a photograph of the model Lynch and McMurdo are to use.

Lynch's Daring.

We have to award the palm to Lynch for intrepidity, however. And we might throw in optimism as well. "Art" left New York for Chicago Sunday night last at 11:59 o'clock, and he should reach Chicago somewhere about the time Cortlandt street stops cutting prices. When last reported he was one mile west of Plainfield arguing with a cop about resistors. The latter had accused him of blocking, whereupon Lynch produced a leak made out of the well known long green.

On the way past Hasbrouck Heights he stopped at the Wright factory and borrowed a 200 horse-power engine, but that was not enough to move his Marmon and he supplemented it with three sails.

McMurdo got his Cadillac from the General Motors Company along about 1862, but has effectively disguised it with a well known synthetic fluid that produces what New Yorkers call a "Broadway Tan."

Race Conditions.

Conditions of the race (?) which will be staged at the Aurora race track provide that each of the contestants will not use any more mechanics than there are bootleggers in Chicago or employes in the Ford plant. (Ford needs that publicity.) Any kind of gas up to eighty-five specific gravity may be used, provided it is not reinforced with any "prewar" stuff.

The bomb and machine gun squads of Chicago have requested they be notified when Lynch passes through Pittsburg so that effective measures can be taken to safeguard the populace.

The race will take place on Saturday, June 18, provided there is no wind.

Two of our authors (both in this issue) and how they settled an argument back in 1927

The READER'S LOG

Where You Can Call The Shots As You See Them

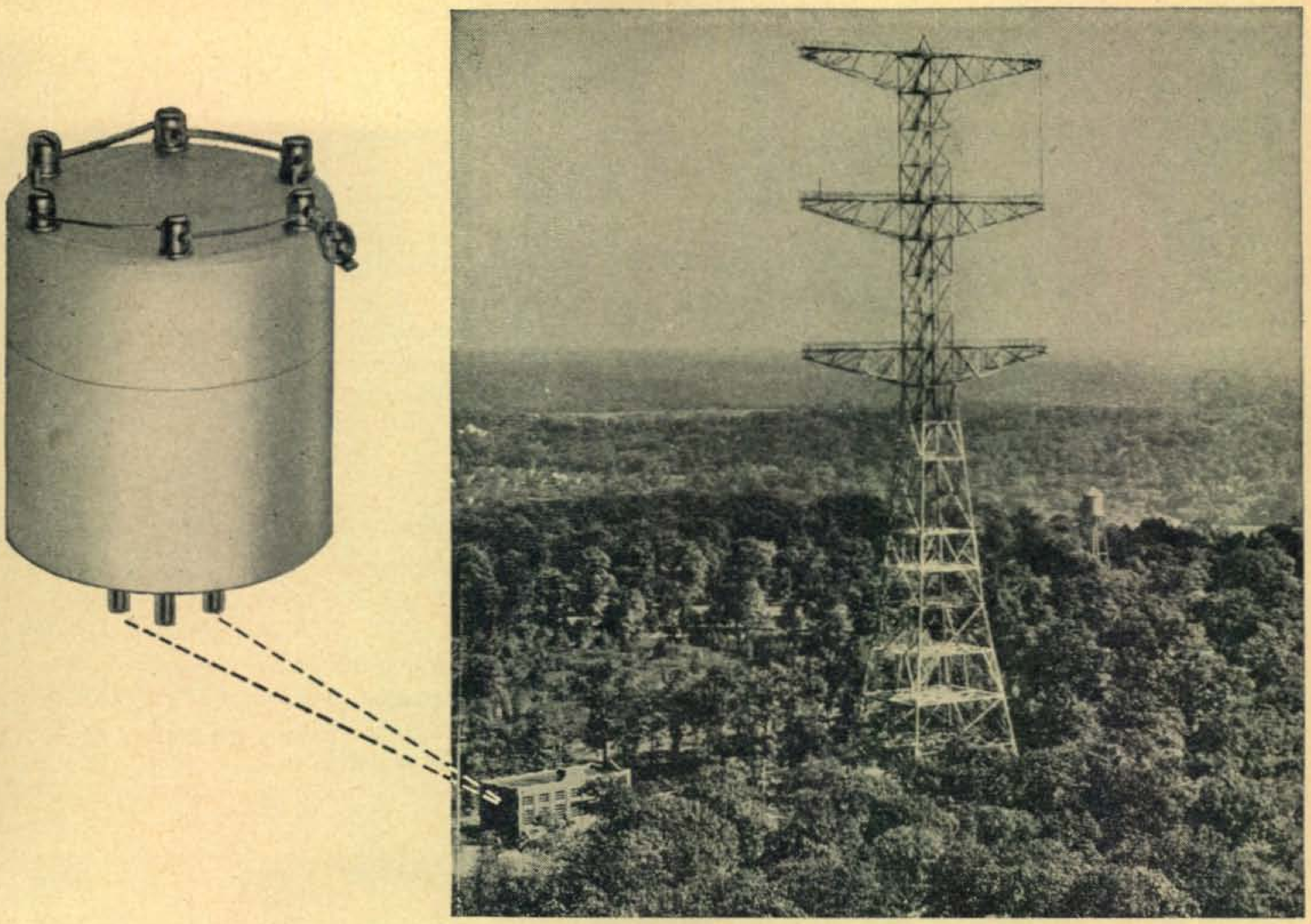
"Typical" Reader Reports

To the Editor of CQ:

In qualifying myself as a typical reader, I refer to a radio background that must be more or less representative of your future clientele—to wit: Amateur license in 1928, commercial ticket in 1932, five years in commercial air traffic control, and a naval commission after Pearl Harbor with its quietus on amateur radio. I've been hankering to get back on the air again ever since. This hunger for "the good old days" grows more and more acute as time passes, and this same feeling must be prevalent among thousands of other "ex" amateurs condemned to a sterile and nostalgic contemplation of what was formerly one of their greatest pleasures.

And that's where *CQ* comes in. Denied by wartime restrictions the actual consummation of his desires for hamming, the "ex" amateur must turn to the vicarious pleasure of reading about such activities. In my own case, I have purchased or subscribed to every publication even suggesting amateur radio. If you will keep *CQ* a hams' magazine, steer it in the right channels, you can do a great service.

The technical articles in the first issue were good—particularly McMurdo Silver's "Why 100% Modulation?" Recent technical developments and practices have made it evident that the way we did things in those "good old days" wasn't always the best procedure. So tell us how to do things. Transmitter construction articles may seem to be



Pioneer FM station uses BLILEY CRYSTALS

When Major Armstrong's station W2XMN went on the air from Alpine, New Jersey on July 18, 1939, radio history was in the making. This first FM transmitter to be put in service, built by REL, employed the Armstrong crystal-controlled phase shift modulation.

Bliley crystals are doing an excellent job in this outstanding FM installation.

For advanced engineering it is always worthwhile to specify Bliley crystals. An outstanding example of this is the discovery and development by Bliley engineers of ACID ETCHED CRYSTALS*. This technique was an established part of Bliley production before Pearl Harbor. It is now recognized as a prerequisite to dependable service in military equipment.

It is a good habit to consult Bliley engineers when new developments are in the making. Our specialized engineering can often be of real assistance toward solution of your design problems. This kind of service has made Bliley the foremost producer of quartz crystals for amateur and commercial radio in peacetime and for our armed forces in time of war.

**Acid etching quartz crystals to frequency is a patented Bliley process. United States Patent No. 2,364,501.*

ARMY E NAVY

Bliley CRYSTALS

Do more than before . . .
buy extra War Bonds

BLILEY ELECTRIC COMPANY
UNION STATION BUILDING • ERIE, PENN.

out of place at the moment, but I say let's have them! One of the war-time amateur's greatest pleasures is sketching up that post-war ether buster. Sure—we can't build it now, but we can dream. Give us more ideas!

Lieut. Court Matthews, USNR W6EAK
Naval Air Tech. Training Center
Ward Island, Corpus Christi, Texas
March 23rd 1945

Class C Licenses

To the Editor of CQ:

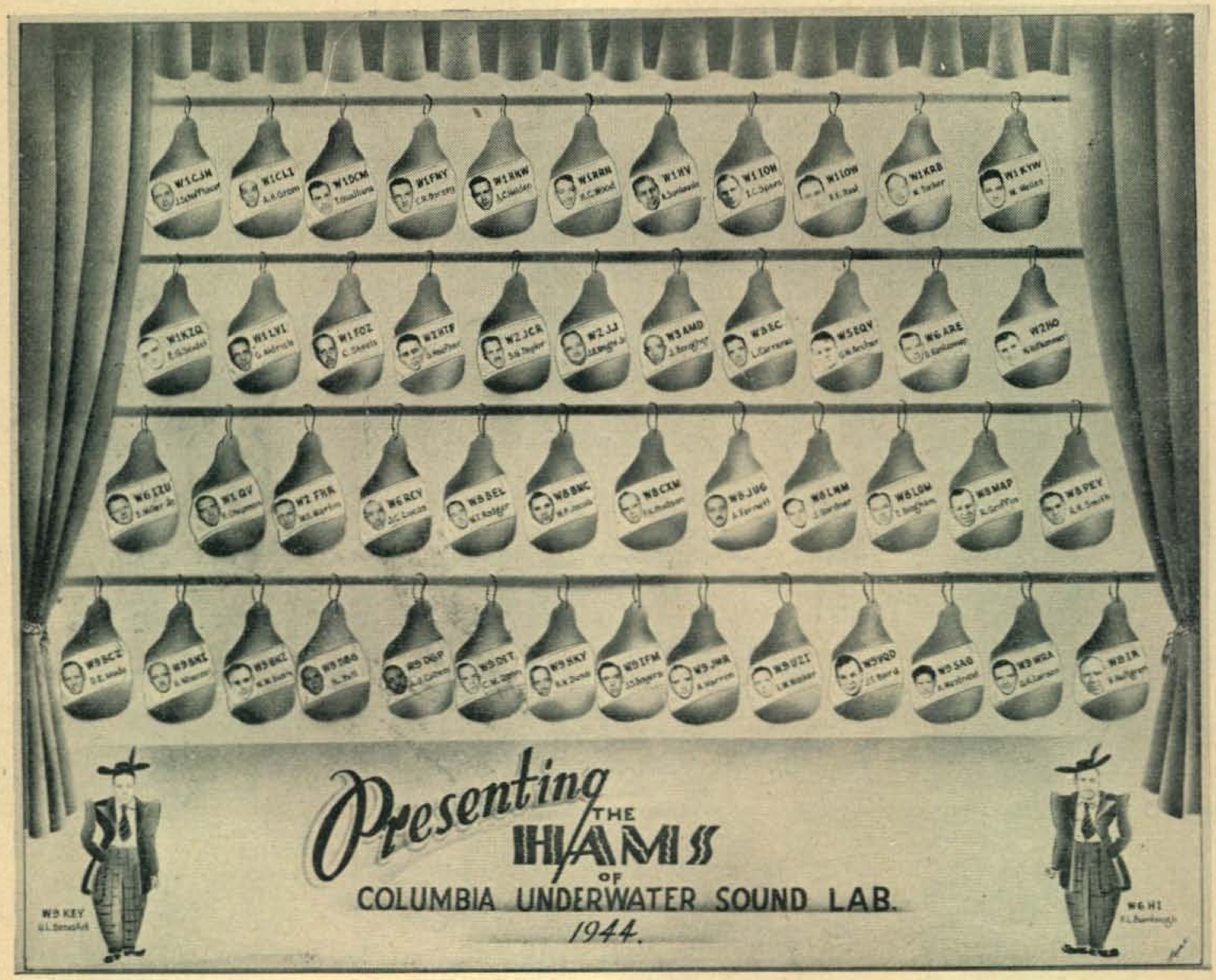
I have just received the February issue of *CQ*. While the few articles in your publication were fairly interesting, I feel I must differ with you on the sentiments expressed under *ZERO BIAS* in regard to Class C operation. First of all, you state that "there are many who would favor the elimination of the Class C ticket." I believe that the statement "there are many" is a subterfuge used by the writer of the article to hide his *own* sentiments. Certainly I have never come across any similar suggestion in any other reliable publication.

I consider this an unfair attitude to assume concerning a group to whom ham radio means much more than just a hobby. If a regulation were passed voiding Class C licenses, it would make it practically impossible for the majority of present Class C licensees to obtain any ticket at all. (This applies only to the physically incapacitated, of course.) The elimination of the Class C license would be a catastrophe to several friends of mine—and to myself. Furthermore, you would deprive many unfortunate veterans of the joys of amateur radio. Only those who are confined to a chair or bed for years on end obtain the real knowledge of what amateur radio means. It not only frees them from the prison of their surroundings, but it puts them on an equal footing with those who are more fortunate than they.

Brooklyn, N. Y. — George Boles, W2NBU
February 19th 1945 — (By virtue of Class C.)

W2NBU misinterpreted our editorial. But we appreciate his letter and the opportunity it suggests to clarify our stand. A Class C license is issued to an applicant who, because of distance or physical disability, cannot make a personal appearance at an FCC office for examination. However, he is required to pass the usual 13 words per minute code test and the written ex-

[*Continued on page 37*]



Plenty of points for these Hams

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LET'S GET THE ADMIRAL HIS HORSE!

Official U. S. Navy Photo

Admiral Halsey has his eye on a fine white horse called Shirayuki.

Some time ago, at a press conference, he expressed the hope that one day soon he could ride it.

The chap *now* in Shirayuki's saddle is Japan's Emperor—Hirohito.

He is the ruler of as arrogant, treacherous, and vicious a bunch of would-be despots as this earth has ever seen.

The kind of arrogance shown by Tojo—who was going to dictate peace from the White House . . . remember?

Well, it's high time we finished this whole business. High time we got the Emperor off his high horse, and gave Admiral Halsey his ride.

The best way for us at home to have a hand in this clean-up is to support the 7th War Loan.

It's the biggest loan yet. It's two loans in one. Last year, by this time, you had been asked twice to buy extra bonds.

Your personal quota is big—bigger than ever before. So big you may feel you can't afford it.

But we *can* afford it—if American sons, brothers, husbands can cheerfully afford to die.

ALL OUT FOR THE MIGHTY 7th WAR LOAN

CQ Magazine

This is an official U.S. Treasury advertisement—prepared under auspices of Treasury Department and War Advertising Council

USN-USL Hamfest, where our Advisory Editor, W1QV, was toastmaster

RUSTY RIGS

How they used to build them in the old days

MOST hams—even the pre-Pearl Harbor Young Squirts—know that OT stands for "Old Timer." But probably only the old timers themselves remember that, way, way back, OT was also an abbreviation for "oscillation transformer." The OT was an antenna coupler in a spark transmitter, with the primary (corresponding to the tank coil in a modern rig) connected in series with a rip-snortin' spark-gap. It was a hefty gadget, even on low powers, as will be appreciated from *Fig. 1*. The OT comprises the spirals of flat metal strips in the upper left-hand corner. The two miniature ash-cans just under the primary are transmitting condensers—Dubiliers, unless our memory is as rusty as this rig. The box in the center housed the rotary spark-gap—minimizing the stench of ozone and zinc oxide, while muffling the noise to a gentle roar. The half-kilowatt transformer is on the right, and the relays just above it controlled the contraption from the operating desk (*Fig. 2*) two floors above. (It always

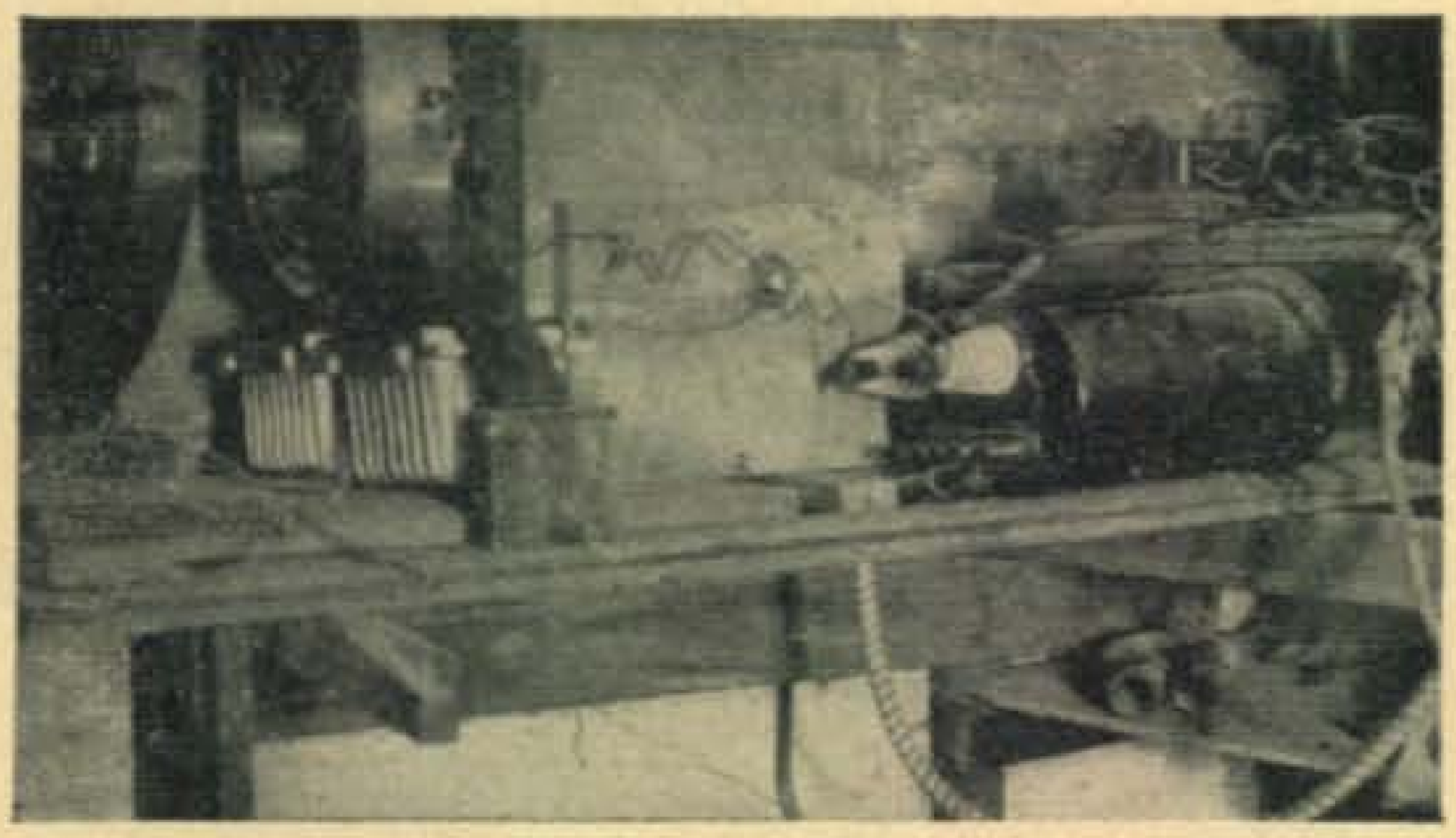


Fig. 1. The one-half kw transmitter at W2PF, vintage 1922. It was located in the cellar, the least inflammable section of the house

seemed safer with the pyrotechnics confined to the cellar.) The receiver is a Grebe CR-3, a variometer tuned regenerative, and the finest of its day. As we recall, it covered from about 200 to 900 meters. The detector and 2-stage audio amplifier are on the right.

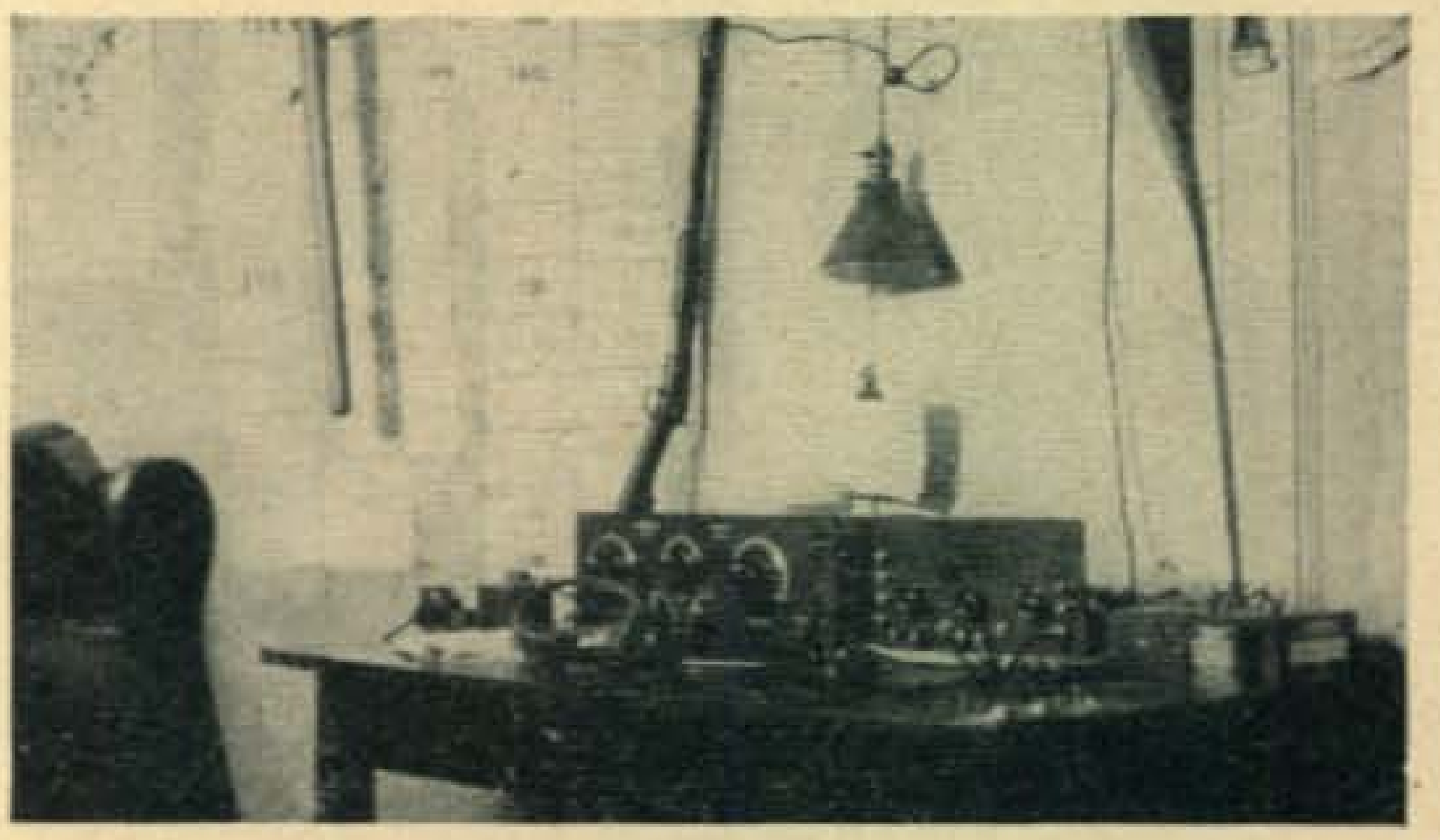


Fig. 2. The operating position at 2PF. The Grebe CR-3 was the aristocrat of receivers a quarter century ago. A variable condenser, on the left, was apparently added for additional antenna tuning

These photos show 2PF in 1922—and we mean 2PF. Those were the days before international regulations tacked on the "W." Cards on the wall show that 2PF, located in Brooklyn, N. Y., worked stations in the 1st, 3rd and 8th districts, which was real DX for a half-kw spark transmitter on 1500 kc—excuse us, 200 meters. Just what the artillery was for is anybody's guess—but is perhaps indicative of an early military leaning on the part of the station owner, David Talley, W2PF-WLNG, and formerly Radio Aide with the Army Amateur Radio System. Now Lieutenant-Colonel Talley, Dave is temporarily stationed at Fort Monmouth, N. J., after three years overseas.

MINIATURE U-H-F TRIODE

An important contribution by Raytheon tube design engineers towards the efficient generation of ultra high frequency power is a miniature triode designated as type 6N4.

This cathode type tube combines the desirable features of reduced interelectrode capacitances and lead inductances with high transconductance. Thus, the inevitable internal losses are minimized making the 6N4 particularly adaptable as an amplifier, doubler or oscillator at frequencies extending to approximately 500 megacycles.

The foregoing characteristics can be used to advantage in many types of equipment which are still unmentionable. However, such innocuous but important functions as performed by the local oscillator in a u-h-f television or fm receiver are readily visualized possibilities. Then there is the exciting probability that the Citizens Radio communication band recently proposed by the Federal Communications Commission will be approved. The contemplated frequencies are 460-470 megacycles.

[*Continued on page 36*]

WINDOW WITH BRAINS

The practical answer to many of the "dream" homes that architects have put on drawing boards for post-war building may have been found in a device which is now doing vital duty on every plane that's in the air today.

The Lear actuator is a simple device with a tiny motor for its power unit. This motor is connected to the spot where its power is needed by a direct telescopic arm which expands or contracts as desired; or by an arm which moves arcwise where needed. Where space is limited, the power is transmitted by means of Lear flexible power shafting to any part of the plane and there the power is translated to its original force by means of screw jacks.

Lear engineers have adapted one of these actuators to the task of opening and closing the windows in one of their testing rooms in the company's plant at Piqua, Ohio. The actuator, as shown in the illustration, is attached to the window sill. Outside the window is a moisture switch. Slight moisture striking this switch starts the actuator, which promptly shuts the window. A push-button switch

[*Continued on page 36*]

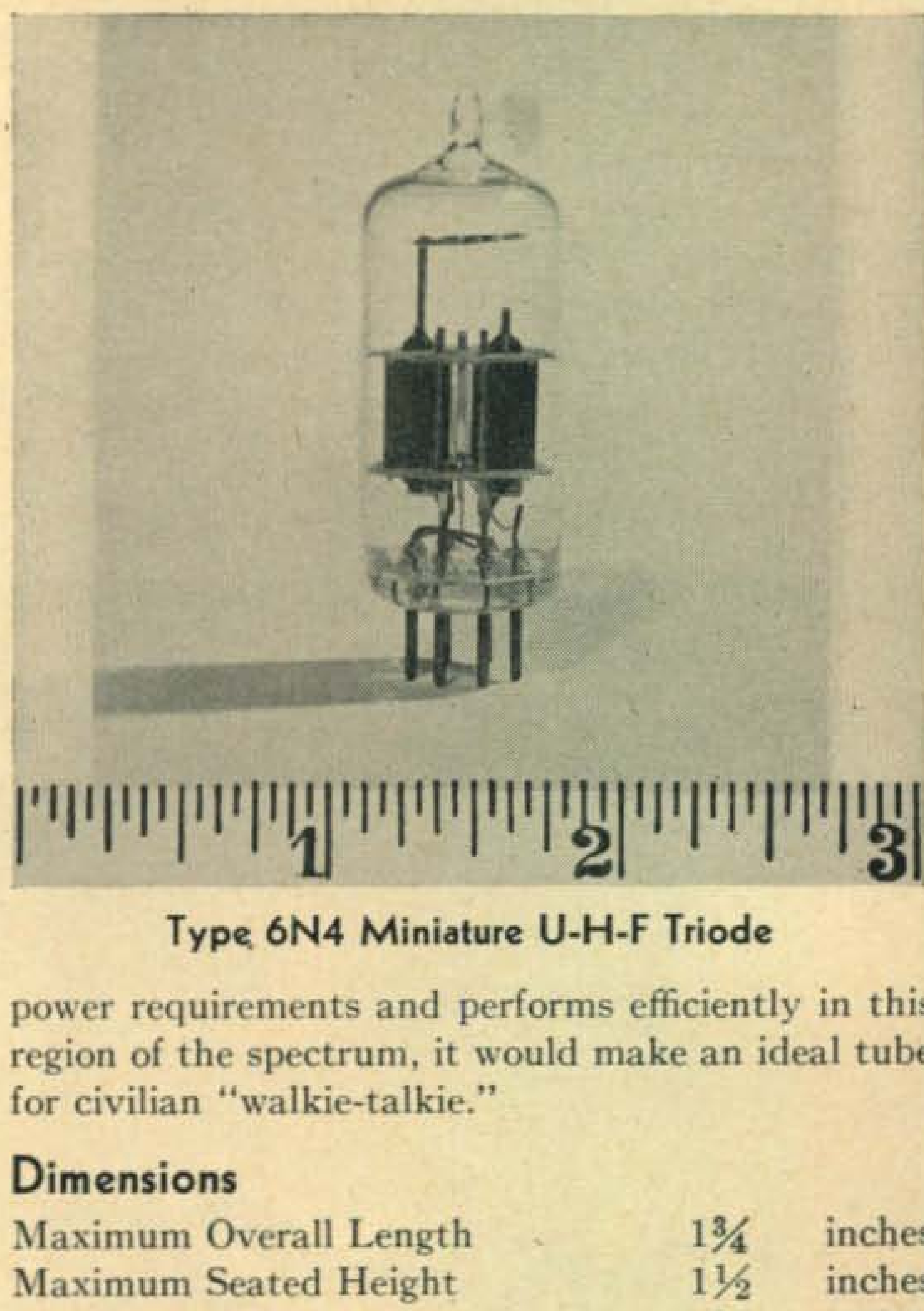
Window With Actuator

on a nearby table furnishes independent control of the device when desired.

Although the illustration shows the installation on a casement-type window, it can be just as readily installed on the regular sliding window, skylight or transom. The power unit can be concealed beneath the window sill, probably behind the radiator covering. One actuator, by means of Lear's flexible power shafting, can be used to operate a number of windows in the house, thus bringing the cost well within the means of the average homeowner. Similarly a bank of windows in a factory can be operated by a single Lear power unit with a single control.

[*Continued from page 34*]

There, private radio telephone equipment primarily portable in nature would very likely find considerable demand. Since the 6N4 has moderate heater



Type 6N4 Miniature U-H-F Triode

power requirements and performs efficiently in this region of the spectrum, it would make an ideal tube for civilian "walkie-talkie."

Dimensions

Maximum Overall Length	1¾	inches
Maximum Seated Height	1½	inches
Maximum Diameter	¾	inches

Ratings

Heater Voltage	6.3	volts
Heater Current	0.2	amperes
Maximum Plate Voltage	180	volts
Maximum Plate Dissipation	3	watts

Typical Class A Characteristics

Plate Voltage	180	volts
Grid Voltage	–3.5	volts
Plate Current	12	ma
Amplification Factor	32	
Transconductance	6000	μmhos

WITH THE WERS

[Continued from page 26]

Jacobus Andriese, W2LKU

which rendered such outstanding assistance after the explosion of liquid gas tanks in Cleveland, where 168 persons lost their lives. Cleveland is sold on the WERS—war or no war!

- . . . -

H. Dallas Fogg, New Jersey State Radio Aide, and Radio Aide of Hamilton Township, is allocating test periods for all stations in each county with the idea of perfecting a smooth-running, co-operative network. The N. J. Radio Aides meet regularly.

- . . . -

The City of Brotherly Love comes through with a good idea. *George Hautenchild*, Philly's Radio Aide, suggests that P.A. systems be made a part of every mobile WERS unit, so that messages can be broadcast to crowds. He states that it proved almost invaluable in a recent railroad wreck and in large fires. In Philadelphia, the WERS mobile units answer all three-alarm fires, and are on the job to render service to police and fire departments.

READER'S LOG

[Continued from page 30]

amination for a Class B license, each administered by a qualified individual. Our main point was that if an applicant and his examiner can be trusted in the matter of the former's qualifying honestly for Class B privileges, there is no logical reason why they should not be trusted similarly with a Class A examination. *In other words,* CQ *doesn't quite see the logic in restricting a "Class C" licensee to Class B privileges if he* *can pass the Class A test. Going one step further, why not drop the Class C altogether (which at present is actually Class B), and permit those applicants who can show reason for not appearing at an FCC office to qualify for Class B or Class A* in absentia? *A closer check on the operations of such licensees would be desirable—and that already is provided for under the present Class C regulations.*

GRIFFIN SUPERHET

[*Continued from page 14*]

desirable to adjust the average frequency of the second conversion oscillator until the admittance band is less than zero—until the curves of *Fig. 4* are pushed together and overlap as previously described. Then audio-frequency deviation of the second conversion oscillator will, in effect, widen and narrow the admittance band at an audible rate, introducing an audio tone whenever the carrier is present.

Double-Tone Reception

Under certain conditions it is possible and desirable to obtain a double-frequency note—for instance a 512-cycle pitch with the frequency modulator oscillating at 256 cycles per second. It is necessary to return the fourth infinite rejection circuit for high-side cut-off slightly above the cut-off frequency of the remaining low-side cut-off circuit—for example at 66 kilocycles. The admittance band width of the low-frequency i-f channel may be from 64 to 66 kc as suggested in *Fig. 7*. The band width of the first intermediate-frequency amplifier is not critical, because the second channel now provides both high and low-side cut-off.

Readjusting the first oscillator so as to move the second intermediate frequency from 64 to 65 kilocycles will produce a curious effect. The frequency deviation will now swing from 63.5 kc to 66.5 kc, causing the signal frequency to pass in and out of the admittance band (on both higher and lower sides) twice per cycle instead of once. Comparison of *Figs. 6* and *7* will show that a double-frequency component has been introduced under the operating conditions of *Fig. 7*. If either conversion oscillator is now slightly retuned so that the carrier crosses the admittance band limits on only one side, the fundamental tone of 256 cycles will be restored.

In the example just cited for obtaining the double tone, the mean carrier frequency has been within the admittance band, as indicated in *Fig. 7*. The same effect will be produced by adjusting the average carrier frequency to a point outside the admittance band, and then deviating it into and through (beyond) the band.

The double-tone frequency provides a new technique of securing selectivity which is advantageous when the desired signal is under a barrage of adjacent QRM. Under such circumstances, it is possible to deviate the desired signal for the double tone, while interfering signals will pass in and out of the admittance band only once per cycle. The experienced operator will have no difficulty in copying the 512-cycle signal while automatically rejecting the "spurious" fundamental.

In the foregoing, we have discussed deviating the frequency of the local oscillator to swing the resultant frequency within and without the admittance band. Obviously, a similar result can be effected by maintaining the frequency of the local oscillator constant and deviating the cut-off frequency of the third or fourth infinite rejector circuits—or both. Careful study of the wiring diagram, *Fig. 8*, will suggest this and other possibilities.

The minimum deviation which will satisfactorily modulate the signal should not be exceeded. Excess deviation has an effect of broadening the band, with an increase in noise and the probability of interference. In conclusion, it should be noted that adjustments of the conversion oscillator and deviation control do not have to be changed once properly made, unless it is desired to vary the band width. Signals are tuned in and out with the main tuning control of the receiver.

ROTARY ANTENNA

[Continued from page 24]

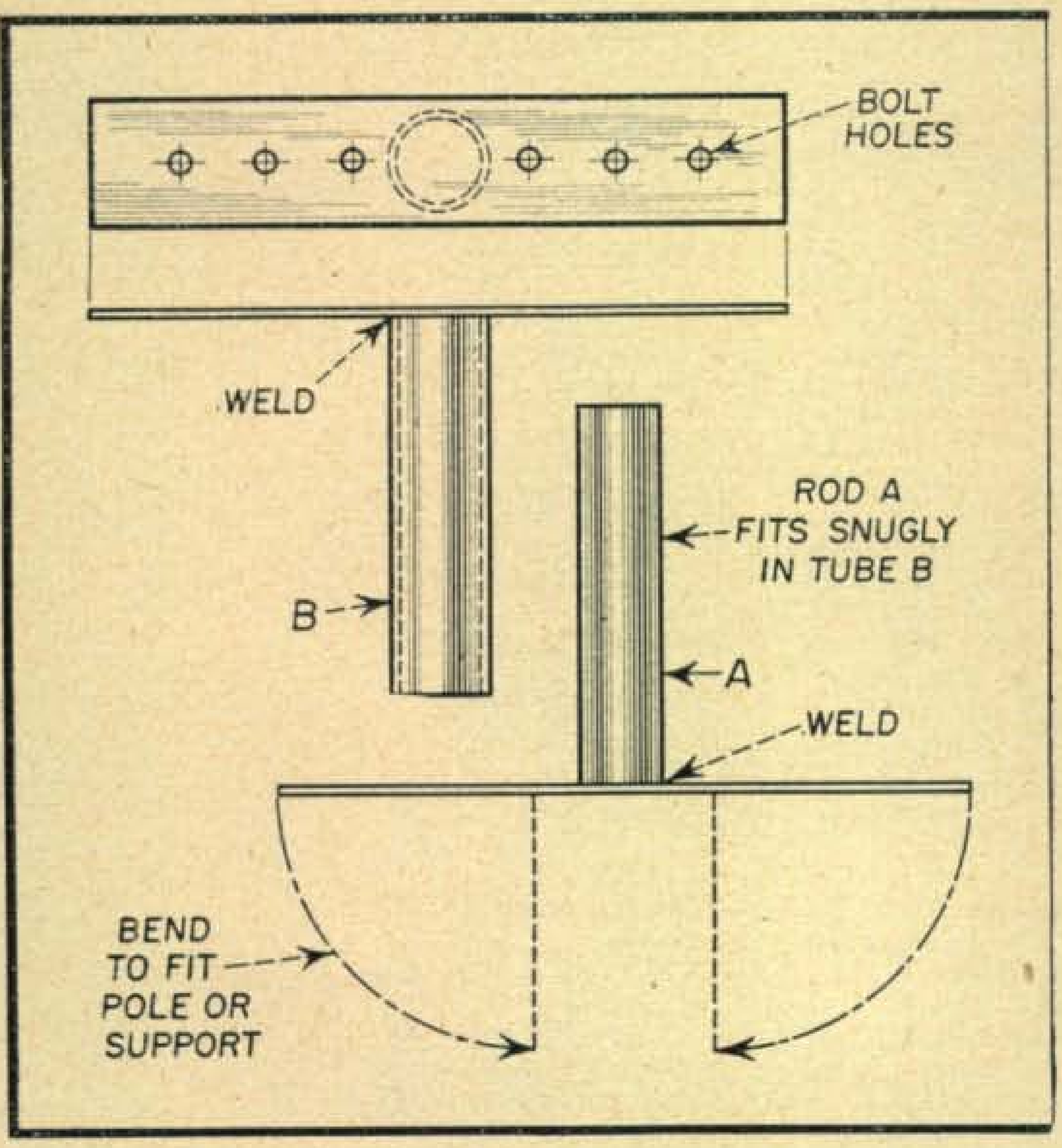


Fig. 1. The general idea. There is nothing hard and fast about dimensions, so adequate stock will be readily available

is required for a bi-directional beam. Another method used a bicycle sprocket and chain assembly to provide 360-degree rotation. For experimental work where no mechanical means of turning is required the antenna support is a handy gadget to have around.

AC4YN

[Continued from page 9]

which acts as a phase inverter and an additional stage of voltage amplification. Modulators are two HY61's—class A for best possible quality. The modulation transformer is a Kenyon T-493. Power transformer is Kenyon Y-656, first (swinging) filter reactor a T-501, the second reactor a T-154, and the filament transformer is a T-356.

Two parallel 5Z3 rectifiers are used in the power supply, normally operated with choke input, but which can be switched to condenser input by cutting in an extra 1 μf 1000-volt input capacitor when it is desired to squeeze out the last ounce of power (at the expense of temporary tube overload). The phone-cw switch cuts out the modulation transformer secondary in cw operation, as well as power to the modulator. The net effect is to raise the plate voltage to maximum rated input for cw operation.

The frequency meter and receiver i-f alignment oscillator at the lower left of *Fig. 7* are simple, straight-forward units built into the assembly to facilitate servicing in a location far from spare parts, test equipment, or help of any kind at all. The complete shipment included plenty of spare Hytron tubes and a Simpson "Hammeter" for receiver and transmitter servicing.

Ounces of Prevention

Such, then, is the "rig" which we may hear post-war on the air as AC4YN. As is to be expected of equipment engineered for operation remote from parts depots, design is sound and conservative, eschewing fancy tricks and gadgets in the interest of steady, dependable operation. This is reflected in the construction illustrated in *Figs. 3* through *6*. Panel and chassis are of 1/16″ aluminum alloy, satin etched by caustic soda and acid before application of a clear phenolic protective lacquer. Lockwashers are used under all nuts, wiring is glass-insulated and cabled, or heavy bus-bar where desirable. All fixed capacitors are Solar moulded mica or hermetically sealed oil units in soldered metal cans, no chances being taken with probable failures of the usual wax-impregnated tubular paper units.

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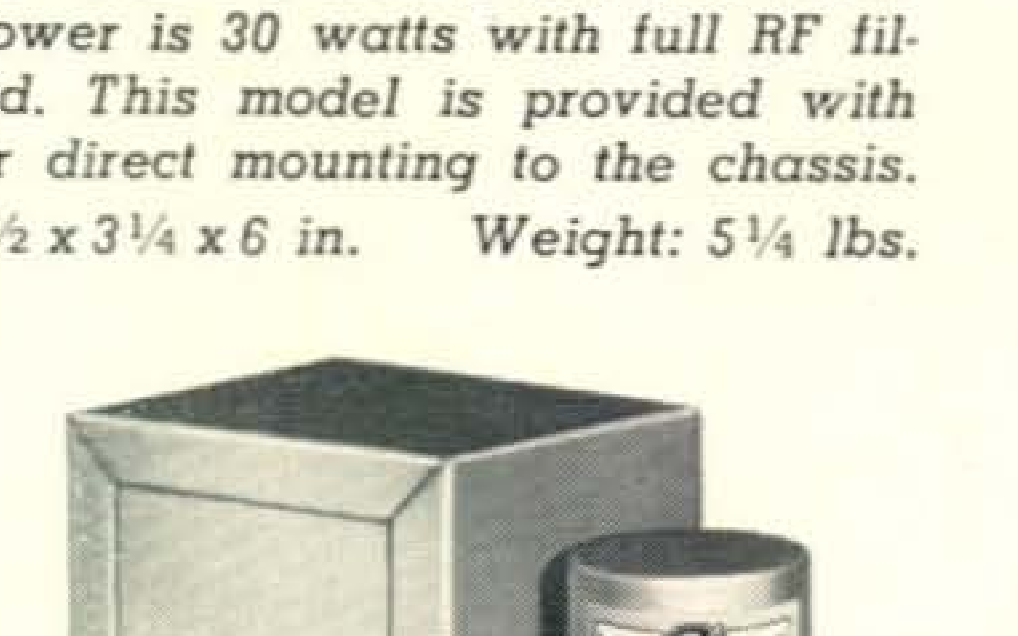
Second, there are E·L power units that can be incorporated as an integral part of your equipment for the operation of shortwave radio from either batteries or 110 volt AC outlets. These units are ideal for providing the plate and grid supply for radio receivers and transmitters, for stationary and mobile or portable applications.

E·L has developed many exclusive advantages both in the light- and heavy-duty power supply field. These include: constant output voltage despite wide fluctuations in input voltage; multiple input and output in one unit; power outputs up to 1000 watts, and any wave form including pure sine wave. When planning your new rig, consider the advantages that E·L Power Supplies offer.

E·L Standard Power Supply
Model 604

This typical Converter model is ideal as an initial component for your equipment. With a 6-volt DC input, it provides outputs of 225 volts DC at 50 ma; 250 volts DC at 65 ma; 275 volts DC at 85 ma, and 300 volts DC at 100 ma. The maximum output power is 30 watts with full RF filtering provided. This model is provided with spade lugs for direct mounting to the chassis.
Dimensions: 5½ x 3¼ x 6 in. Weight: 5¼ lbs.



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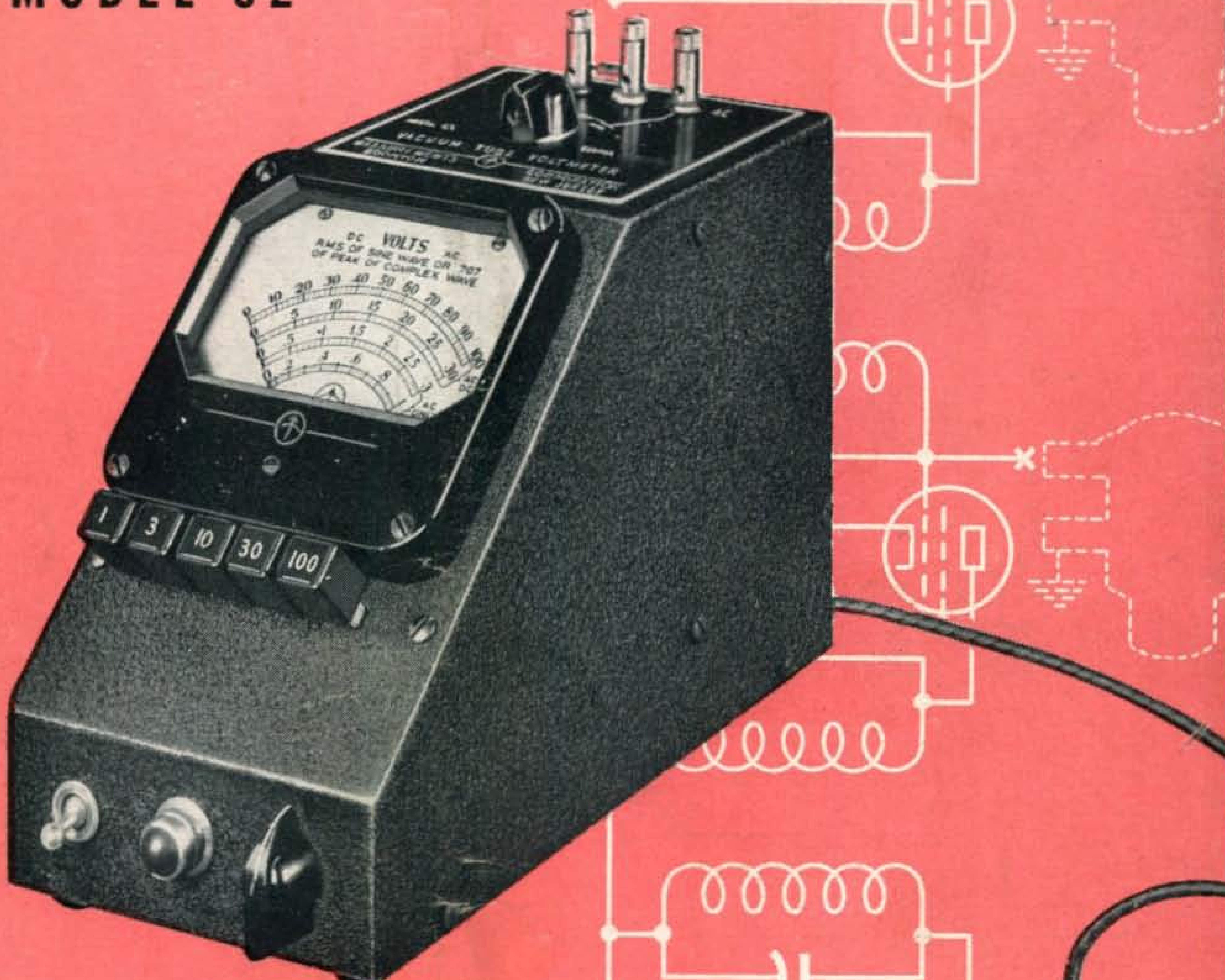
VACUUM TUBE VOLTMETER

MODEL 62



In addition to its use as a high impedance AC and DC voltmeter, the Model 62 VTVM is used for making stage gain measurements, resonance curves, standing wave determinations, amplitude-frequency characteristics, etc., from 30 cycles to beyond 150 megacycles. The extremely high input impedance of the DC voltage ranges facilitates leakage resistance measurements up to 50,000 megohms with 90 volt battery.

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