CQ

W2FX JANUARY, 1945

The Radio Amateurs' Journal

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CQ
The Radio Amateurs' Journal
Published by RADIO MAGAZINES, INC.

VOL. 1, No. 1 **JANUARY, 1945**

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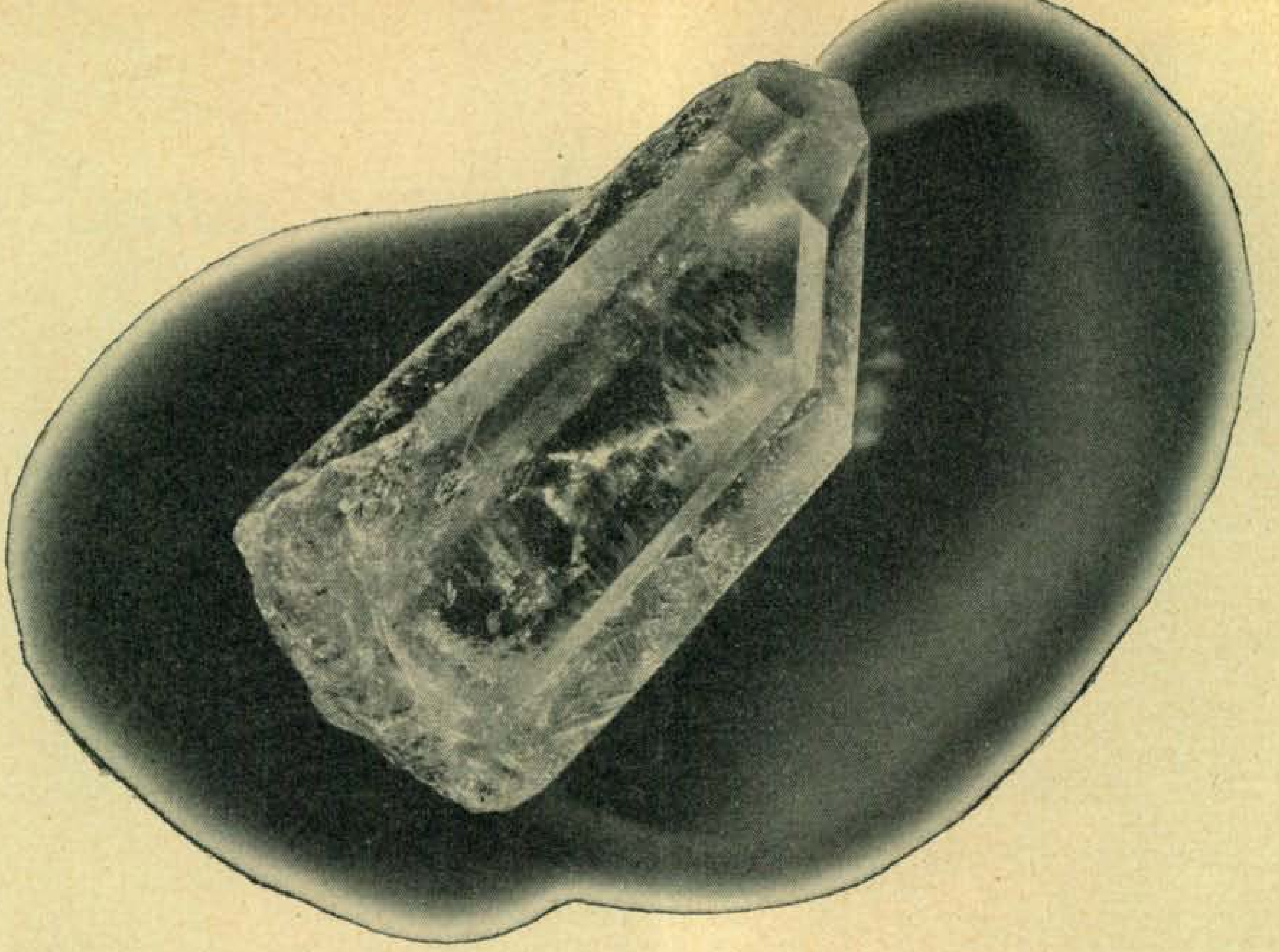
COVER

Communications equipment in action aboard a destroyer. *(Coast Guard photo)*

ARTICLES

MISCELLANEOUS



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QUA

Introducing CQ

Though this is Volume 1, Number 1, *CQ* is not a new magazine from the point of view of publishing experience and an intimate knowledge of amateur radio. Actually it is hoary with ham traditions dating back to World War I, when its companion publication RADIO made its debut as an amateur magazine. In those distant days, amateur wireless telegraphy was a large part of all things radio. There was little technical discrimination between the commercial and amateur services, and so it was natural that RADIO, while devoted primarily to the ham, should be dedicated to radio in the broader sense. And with equal logic it so continued for the next decade when the development of amateur radio closely paralleled the progress of radio in general and contributed so vitally to this advancement. The cross roads were never clearly defined, and RADIO, the magazine, growing up with radio the art, imperceptibly diverged to the engineering side, eventually being converted by its former publishers to a strictly enginering journal. And it will continue as such.

It is inevitable that new devotees should gravitate every year toward the greatest hobby in the world—amateur radio. The average rate of increase *over* mortality, between the two World Wars, was 3000 a year—the actual mean number of new hams per year being of course in excess of this figure. It is generally believed that the rate of enlistment in the amateur ranks will be greatly augmented when peace again lifts transmitting bans. Conservative estimates place the number of hams five years from V-Day at better than 200,000—contrasting with some 60,000 amateurs shortly prior to Pearl Harbor. Ex-servicemen who have learned enough from walkie-talkies, radar and field equipment to feel the nip of the amateur bug, will add to the normal civilian increment of youth and oldster similarly and perennially infected.

This, then, is the *raison d'etre for CQ*—a magazine for the radio amateur, with a particular invitation to the newcomer. It should not, however, be inferred that we shall confine ourselves to the ABC's of ham radio. We visualize *CQ* as a magazine that will stick with the ham long after the parts of his first rig are dust-laden in the junk box, and as a monthly refresher course for the old timer. While placing some emphasis on the elementary, we are still under obligation to carry through with articles on modern techniques and apparatus. Similarly, we shall follow up tradition (with which every true ham must be familiar) with all vital news of amateur radio today and tomorrow.

We have not hesitated in launching CQ while our country is at war and a quietus temporarily placed on all amateur transmissions excepting in the WERS (War Emergency Radio Service). By starting now, we shall be in the most advantageous position to cooperate with every individual and organization in securing adequate post-war recognition of the amateur and his requirements. Also, as we all get better acquainted, and *CQ* rounds out with additional departments and balanced features, we shall emerge from this shake-down period with the kind of a magazine *you* want just about the time the smoke and stench of TNT all over the world vanishes like the morning mist.

In radio transmissions, the letters "CQ" have somewhat different meanings in the commercial and amateur fields. With commercial wireless, "CQ" is in the nature of a general call announcing a broadcast. In ham radio it is most often a friendly invitation to get together and rag-chew. As a publication, *CQ* will similarly play a dual role—in the broadcast sense as a disseminator of what one should know to make the most out of ham radio, and in the less formal character as your own magazine, welcoming criticism as well as bouquets, and, above all, the cordial exchange of ideas that is so vital a part of ham radio on the air.

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In the little city of Mt. Carmel, Illinois — famous for music and electronics—the men of the Meissner Manufacturing Company are now devoting their skill and experience to speeding the final day of Victory. All were hand-picked for their jobs—many "grew-up" in the business, doing their share toward making the name Meissner stand for the ultimate in radio quality. They have had the pleasure of turning out perfect work—felt the thrill and satisfaction that comes with achievement. And in the bright, postwar world of tomorrow, it will be these same men of Meissner that add new fame to the name of Meissner radio and other electronic equipment.

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Fig. 1. The ham's first rig may be relatively simple and inexpensive, but it won't stay that way long

HAMS-- PAST - PRESENT - FUTURE

ZEH BOUCK, W8QMR-WLNG

A lot of folks are going to make the acquaintance of hams shortly after the smoke clears away over Berlin and Tokyo. Thousands of ex-GIs will want to carry on with the knowledge of radio they gained in the armed services. Manufacturers forced into some form of radio production in the war effort, will find their reconversion problem simplified by recognition of the expanding ham market. Here then is a brief introduction to the radio amateur.

THOUGH the radio amateur himself has long since lived down any derogatory implications in the epithet "ham," such connotations may well carry over to the uninitiate. Just why and when the term was first applied is open to conjecture. It is generally admitted that the "ham actor" displays an inferior grade of histrionics. He was supposed to have been so designated because in early times he wore a ham rind. Thus, to be termed a ham of any kind is a dubious compliment. According to tradition the radio amateur was first called a ham back in the old days of American Morse (1900 to 1912) by the early crop of commercial operators—who had been amateurs themselves only the day before! Hence the hams could never have been any worse than their professional brethren, and, in fact, often proved themselves a superior breed.

Just who the original amateur was is a moot question. It could have been Hertz, but Fessenden and Marconi are more conventional candidates for the honor. Fessenden certainly hammed it on the North Carolina beaches a half dozen years before he "turned commercial" and broadcast the first Christmas Eve program ("Adeste Fidelis" and all the trimmings) from Brant Rock, Mass., in 1906. Marconi always displayed a genuine interest in ham radio, and at the Century of Progress Exposition, Chicago 1933, stated frankly, "You know, I have always considered myself an amateur."

Other early amateurs have blazed their paths to the niche of fame. Alfred N. Goldsmith gave us our earliest radio textbooks. Pickard invented the crystal detector and contributed a goodly bit to our knowledge of radio wave propagation. DeForest thought up the vacuum tube and discovered, along with Armstrong, that the device could produce as well as detect oscillations—a phenomenon that is the basis

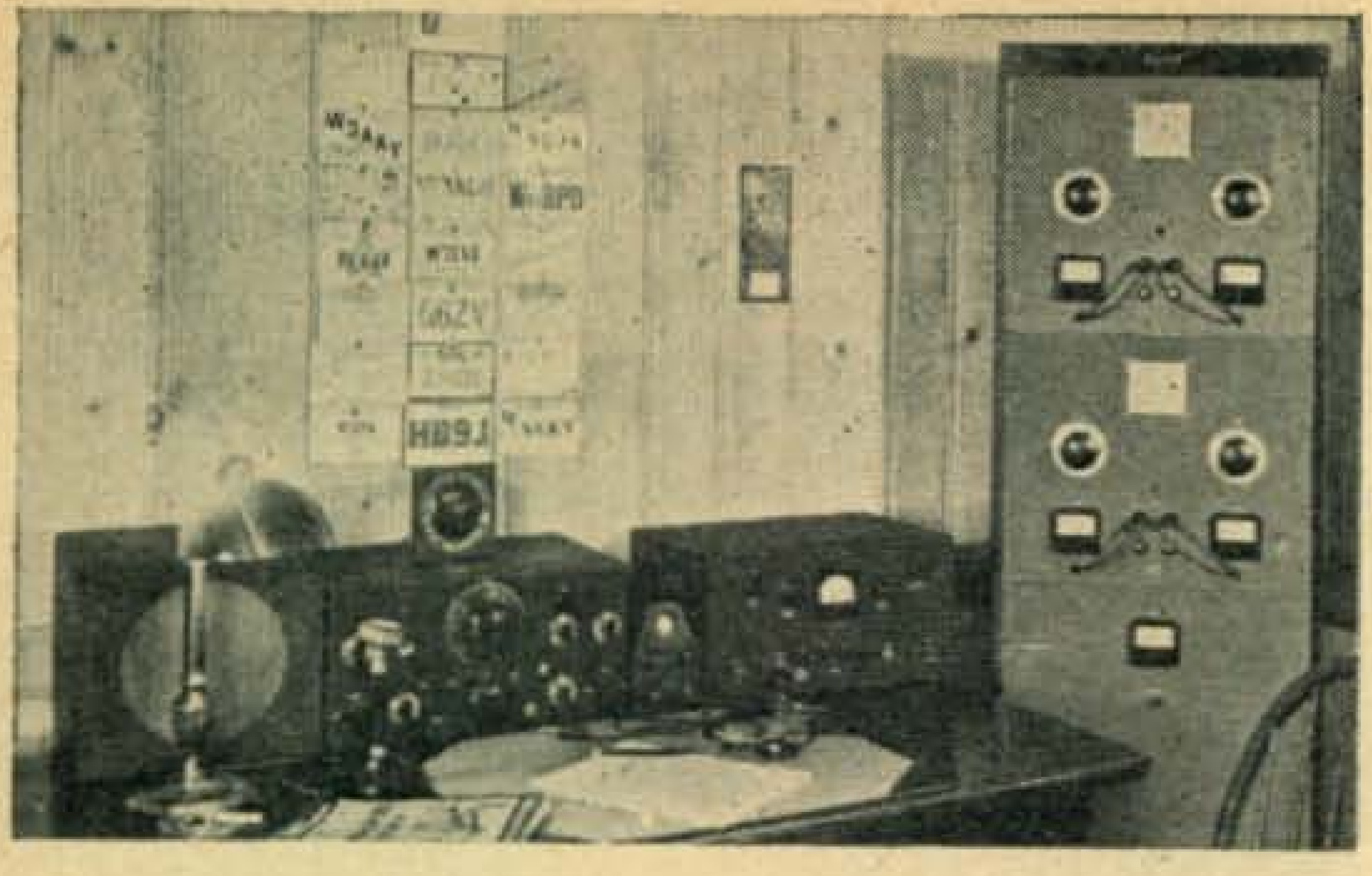


Fig. 2. A typical amateur installation. W1CTW's shack is clean-cut neat, and efficient

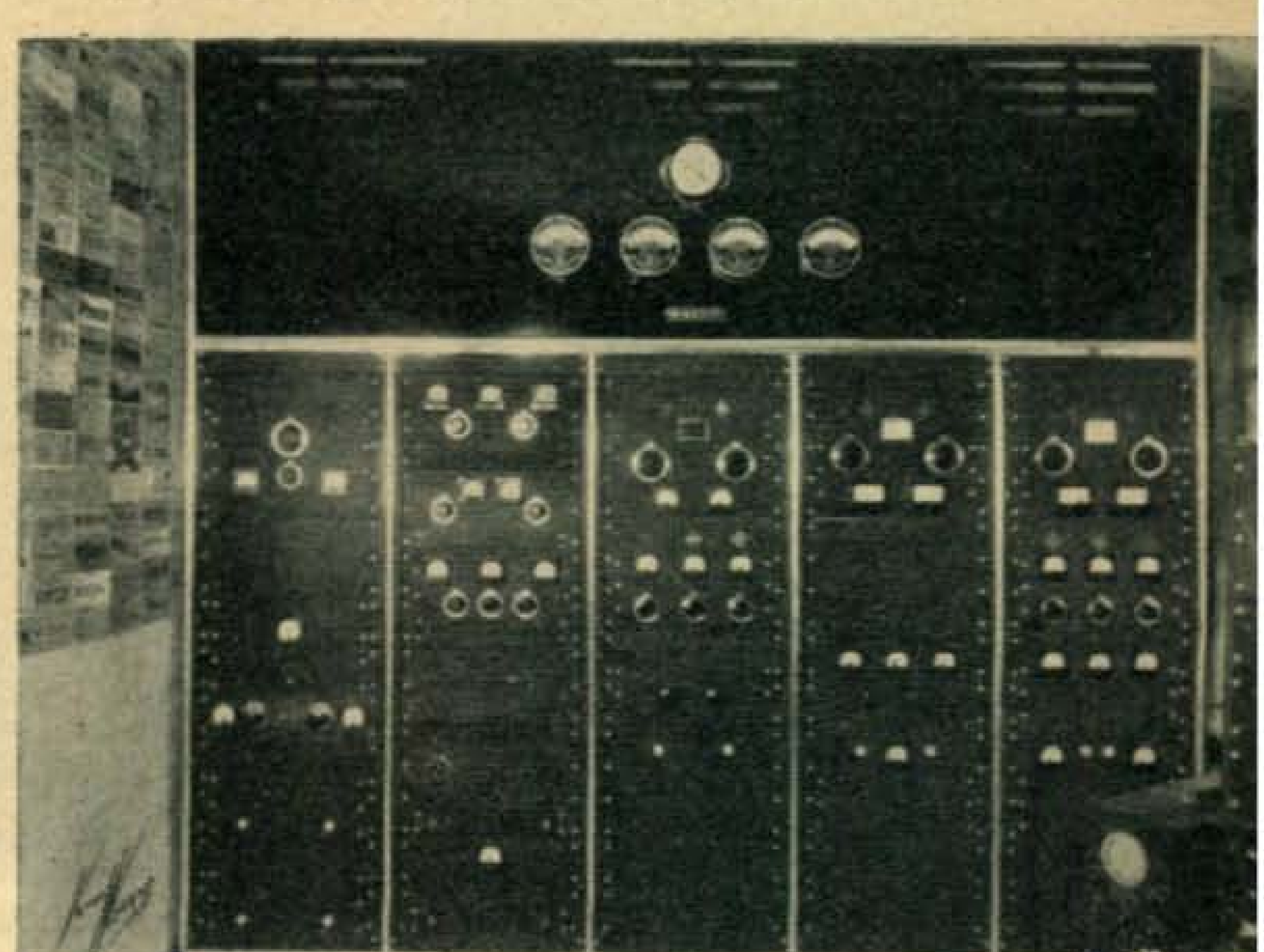
of all modern radio communication, from television to the walkie-talkie. And this same lad Armstrong (a member of the Junior Wireless Club, later the Radio Club of America) went on to invent the superheterodyne, the super-regenerative receiver and FM. Pioneer broadcast station KDKA was graduated from Dr. Frank Conrad's ham rig W8XK.

No one will deny that the amateur, legislated to supposedly worthless wavelengths, pioneered the high and ultra-high frequencies, and was thus directly responsible for the utilization of our present-day long-distance channels. And the ham promises to carry on in that misty region above 1000 megacycles. To stretch the above list in giving adequate credit to every amateur who has made notable contributions to the advance of radio would extend this article —this magazine—beyond the bounds of its covers.

Technical excellence is an outstanding characteristic of the ham, and this cannot be acquired overnight. The amateur therefore is no callow youth haphazardly hooking up coils and tubes with the particular goal of annoying his neighbors. The average age of the ham is thirty years. True, he may and often does start in as a youngster (if his old man can afford it) with simple and relatively inexpensive equipment such as shown in *Fig. 1.* Some time later the layout will be considerably more elaborate and costly. A typical ham rig at maturity is illustrated in *Fig. 2.* A few hams pour more money into their shacks than the individual cost of many broadcasting stations—as you may guess from *Figs. 3, 4 and 5.* Your full-fledged amateur may be your dentist, lawyer, garage owner, engineer, minister, college professor, broker, business executive favorite actor (or actress, Judy Garland is a ham), writer, editor or aviator. Put them all together and they form a group capable of supporting an industry of no minor magnitude.

Fig. 4. Control desk at W4EDD. The dots around the framed map are lamps showing the direction the motor-driven rotary antenna is beamed

Fig. 3. Sometimes the ham ends up like W4EDD of Coral Gables, Fla. The power supply panel for all five transmitters is across the top



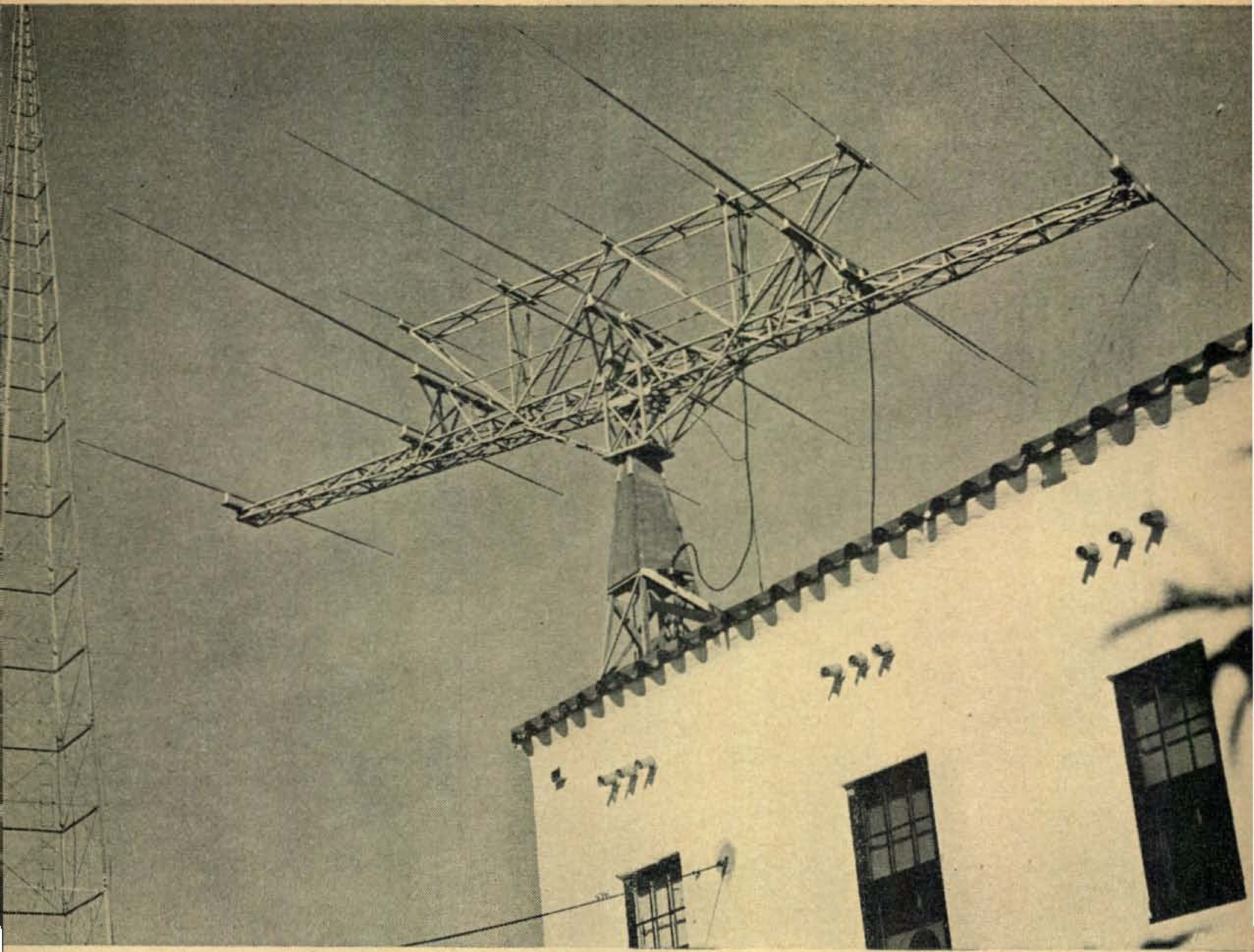


Fig. 5. Antennas at W4EDD. The motor-driven rotary beam antenna is shown atop the roof

The ham's contributions to society have by no means been confined to his scientific endeavors, creditable as these may be. The amateur is well organized in the NCR (Naval Communications Reserve), the Army Amateur Radio System (the AARS), the ARRL (American Radio Relay League), and by emergency hook-ups in both peace and war. The NCR is primarily interested in training naval operators, while the AARS and the networks of the ARRL are traffic-handling groups, the former employing Signal Corps procedure in the transmission of messages. It is not unusual for an amateur station to handle between 200 and 300 messages a month—free-of-charge and with remarkably fast and reliable service half-way around the globe. State fair stations clear as many as 2000 radiograms a week, and W2USA, the New York World's Fair shack, built up a total to NR23000 plus!

The work of amateur radio in emergencies is legend. When storm and floods strike, communication wires topple with the first trees, leaving the ubiquitous ham as the sole means of communication with the outside world. It's a job for which sham battles with the elements have long since prepared him. While operating conditions may not be so comfortable as on a practice "field day," his procedure is second nature, and the emergency rigs are quickly functioning where they will do the most good *(Fig. 6)* In the New England-Long Island hurricane of 1938, the Army Amateur Radio System alone handled more than 8000 messages vital to relief efforts and succor.

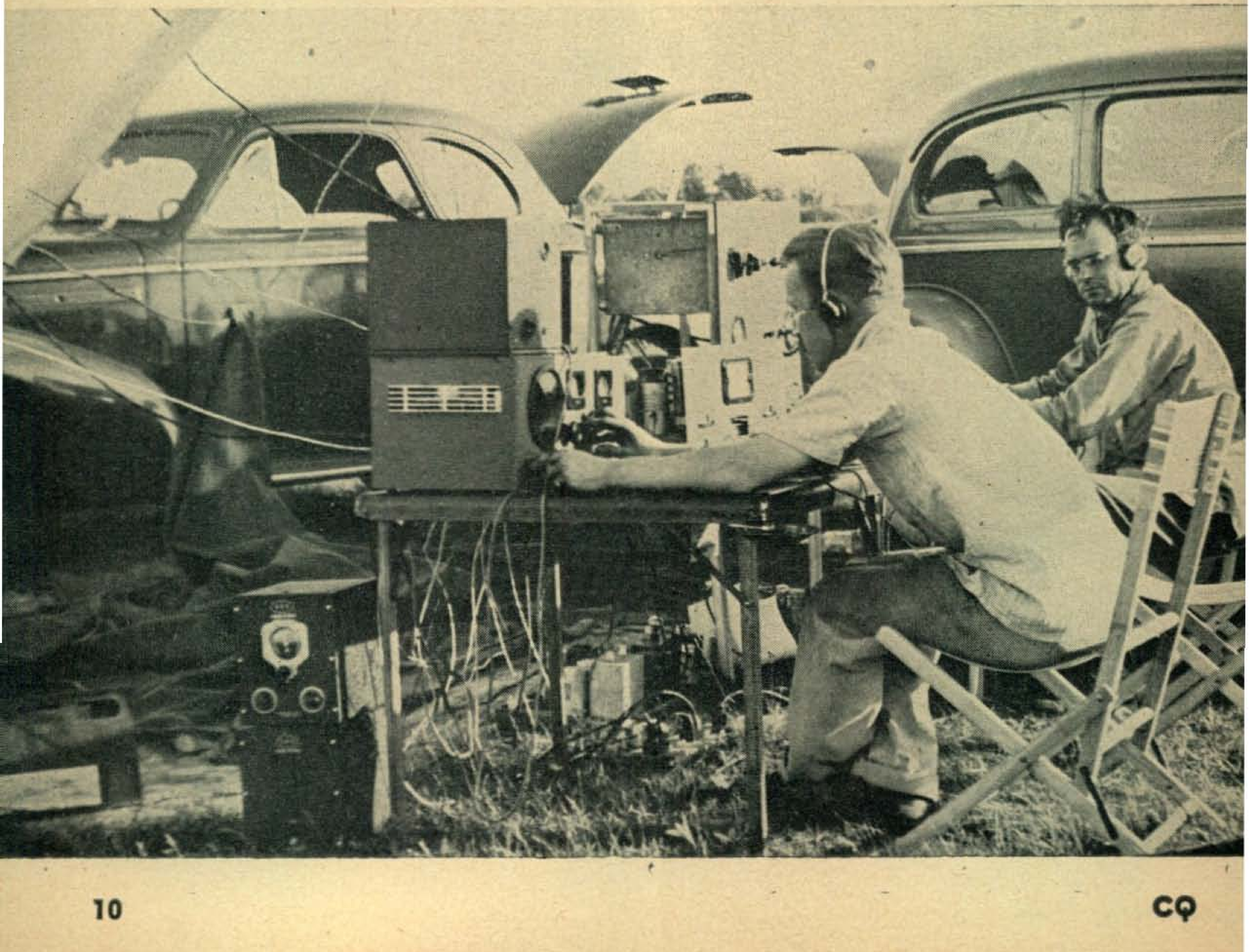
The ham has pounded brass from scientific expeditions to the far reaches of the earth. MacMillan on the *Bowdoin,* Bob Bartlett with the schooner *Morrissey,* Wilkins flying the *Southern Cross,* Wilkins and

Ellsworth on the submarine *Nautilus,* and Admiral Byrd on all his explorations toss laurels to the hams that accompanied them.

Shakespeare said something to the effect that men's evil deeds live in brass, their virtues we write in water. So be it with the ham who is blamed by his BCL neighbor for just about everything that afflicts the latter's radio—from diathermy machines to x-rays, natural static, fading, the neon sign down the block, the traffic light on the corner, sun-spot blackouts, automotive ignition, snow static, noisy resistors and tubes, poorly bonded bx, defective house wiring, electric razors, vacuum cleaners, elevator motors, light flashers, thermostats in gold fish bowl heating contrivances, oil burner ignition systems, flourescent lights, ultra-violet ray machines—and we could continue *ad nauseam.* And the ham (to quote a book once more), turning the other cheek, has been known to build and install a wavetrap for his neighbor so that the BCL can separate WGY from WJZ.

There's enough justification in the ham's peacetime activities to demand his perpetuation. And we all like to think that wars will end with World War II. However, it is generally agreed that some degree of national and international preparedness is in order for many decades to come. Amateur radio provides a vast reservoir of highly competent radio talent upon which our government has gratefully drawn in two emergencies. In the first World War, 3500 of our 6000 amateurs served in the armed forces. Prior to Pearl Harbor, when our ranks numbered some 60,000, 10,000 hams were already in uniform. Every amateur is today serving his country in some capacity, and the large majority of those who are not at Saipan, Leyte, Cologne, Ravenna, Athens or Guam, are in the factories building radar and other apparatus for the fighting hams—designing, building and testing equipment that might not even have approached the drawing board had it not been for a liberal education in ham radio!

Fig. 6. W9PKW with portable equipment in a "field day" set-up simulating an emergency



What You Can Do With MICROWAVES

M. G. BELL

THERE is no point in making whether or not the radio amateur will work in the new part of the spectrum where wavelengths are only a few centimeters long, and which has become generally known as the microwave band. He requires only two things to try only almost anything pertaining to radio, the availability of a few parts and a vista of interesting possibilities. He will surely get the parts once the demands of the armed forces really drop off because the whole electronic industry has expanded to the point to which it can and will supply even rather complicated items at a reasonable cost. The interest is also surely there because of the many things that are possible with these miniature waves. The amateur will, for example, find that at microwave frequencies he can have Q's of 10,000 or more instead of 10 or a 100, and that he can really know where his radiated energy is going instead of just sending it up to the antenna and then wondering.

This matter of control over radiant energy is really the heart of the whole microwave business. Radio waves of any kind are definitely a three-dimensional proposition. At broadcast frequencies a vertical half-wave antenna is a directional device of sort inasmuch as it transmits most of the energy out horizontally, but it does not do a very thorough job and, as everyone knows, the coverage of a given station is affected by all sorts of meteorological conditions, all the way from the night-and-day effect to the conditions of the soil near the transmitting antenna. If the ground is wet or covered with snow the energy striking it is reflected quite differently and the overall pattern of the transmitting antenna is radically changed. A single conductor a

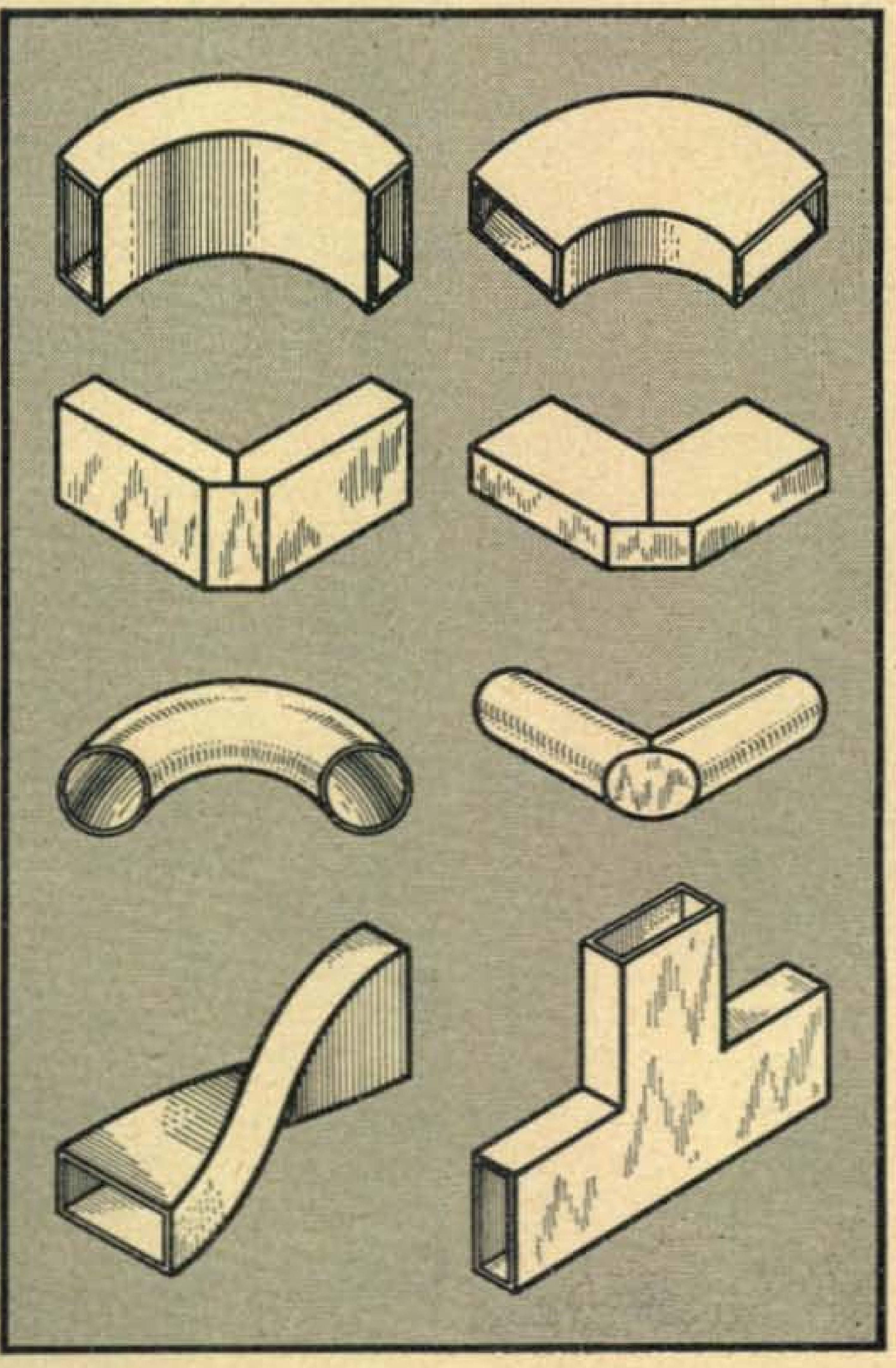


Fig. 1. Typical shapes of wave guide plumbing

half wavelength long, or even a combination of such conductors as they are used in arrangements such as the rhombic type of antenna, is simply not enough to give the control over radiant energy that we would like. With the very short waves of microwave radio, however, antennas can be built for the roof of any house and made several or many wavelengths big, not in just one dimension but in two or three. These same antenna schemes, if used with more ordinary radio, would be monstrous devices indeed. Because microwaves are things the size of small laboratory objects, they can be penned in and made to go where they are wanted. A hundred-meter radiant wave, on the other hand, can't even be gotten into the workshop to say nothing of handling it.

Because microwaves can be caged and handled in containers of reasonable size, there is much to be learned about how the actual waves work and what their properties are in space. Even if the "ham" never really gets on the air he may want to use these midget waves to set up dipole antennas and the like in order to make pattern measurements. It has been found, for example, that hollow pipe may be used to carry the radio waves around the laboratory. The attenuation in wave guides, as this hollow pipe is frequently called, may be exceptionally low. The size of the pipe must bear a definite relation to the wavelength but that relation is not critical. The wave guide must in general be large enough or severe attenuation is experienced but it may be any amount larger without very bad results, except that a condition analogous to turbulence is finally encountered and the efficiency of the wave guide goes down because waves get to traveling around inside in just every which way.

So, after the war when you build a microwave rig, you may be dealing with the hardware man a bit and buying copper pipe, one, two, or three inches in diameter. You'll do some of that just for the fun of it because you believe you can fix up a corner that will carry the energy around instead of reflecting part of it that is a little better than the stuff they try to sell. Also, however, you should be able to buy all sorts of prefabricated pieces of pipe and put it together with screws to suit yourself. The same pipe can without doubt be broadbanded enough to cover any amateur band

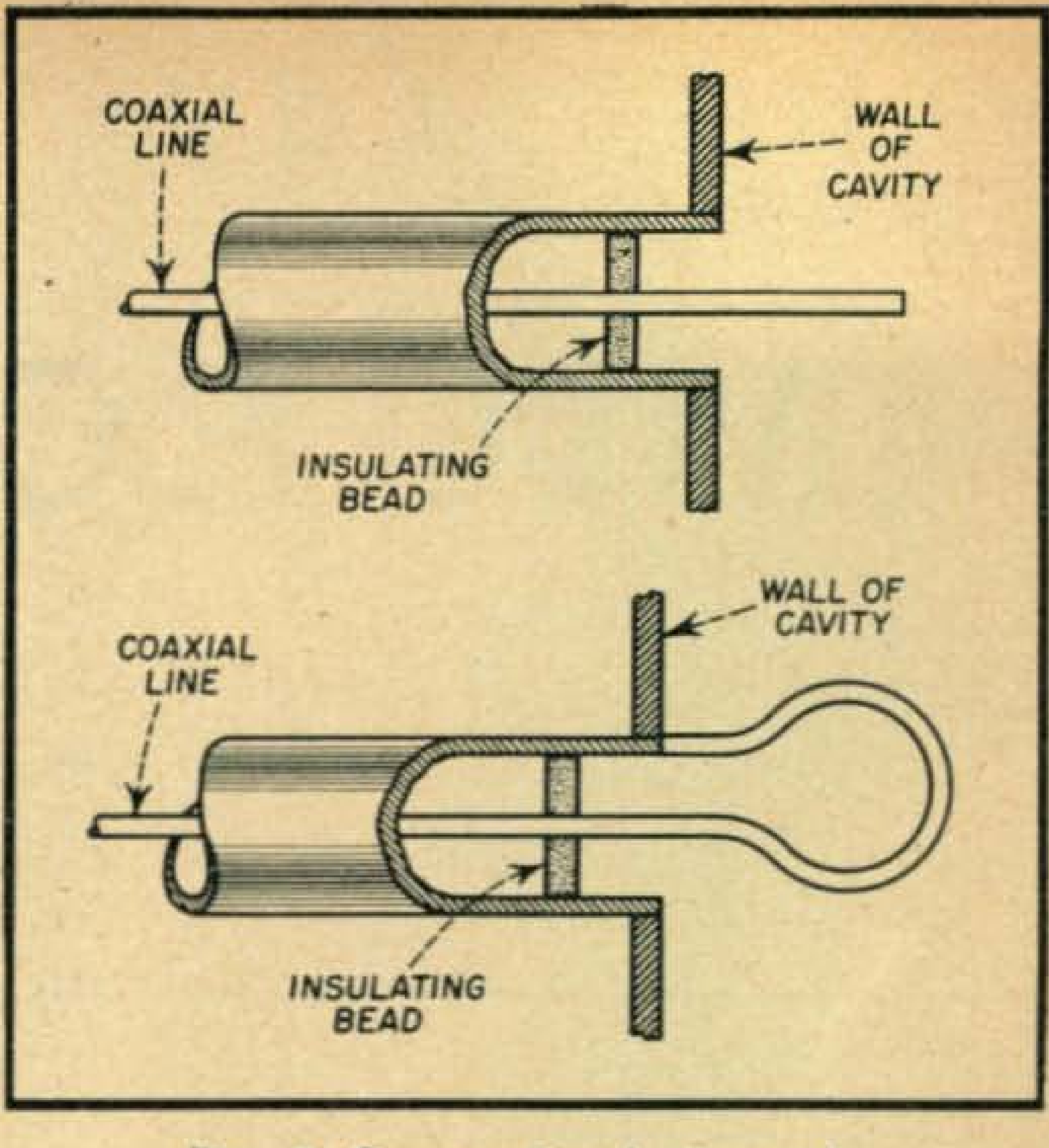


Fig. 2. Cross-sectional views of microwave coax and radiator

that is set up. First, of course, the band does have to be set and a few manufacturers have to get all these nice parts ready for that band so it will be a few days yet at the least.

The vacuum tubes that generate these microwaves are almost as much mechanical affairs as electric, too. When you work with waves small enough to keep perched on the work bench you have to have houses for them. They are not controlled with ordinary tank circuits strung out on the bench; instead the tank circuit has to be right in the transmitting tube and a whole wave is in there, too. You will probably tune by mechanically changing the tube. It's all going to be a mechanical job as much or more so than was television in the days of the spinning spiral card but the results will be better and the possibilities much, much greater.

Before going a bit further with what is so far quite a build-up for microwave radio we had better look at the other side of the picture. Two things come to mind which might be considered as discouraging. One of these has to do with the relative complexity of microwave transmission and the control of its frequency; the principles involved in the construction of the components are many and mostly unfamiliar. All this I discount considerably because of my confidence in the ingenuity of the average "ham". The other fact, however, may spoil the field for one completely. It is all tied up with the little phrase "microwaves follow line-of-sight transmission paths."

This seems to say that unless you can drum a contact with the man in the moon or a Martian ham, your chances for DX are pretty nil. The fact is that there is very strong evidence that these very high frequency waves can go only where light can go although they can, of course, travel in foggy and stormy weather as well as in clear. This doesn't quite mean that you can only transmit as far as you can see because there is some tendency for the waves to bend with the earth's surface, so you may get out a 100 miles and a lot more if you live on the side or top of a mountain. No trace of a true sky wave has ever been observed and there is theoretical reason to believe that the ionosphere doesn't do much of anything to microwaves but let them go right on through. Thus it seems likely that our signals do reach the moon, although calculations show them to be mighty weak upon their arrival. In order for them to reach the moon in enough strength to be reflected and then detected on their return to earth, an antenna of great size and a transmitter of considerable power is required even a microwaves.

Privacy

A much better way to work up enthusiasm for an amateur band at microwaves is to realize some of the advantages of line-of-sight transmission. Your microwave conservations will have almost the privacy of a telephone, not just because

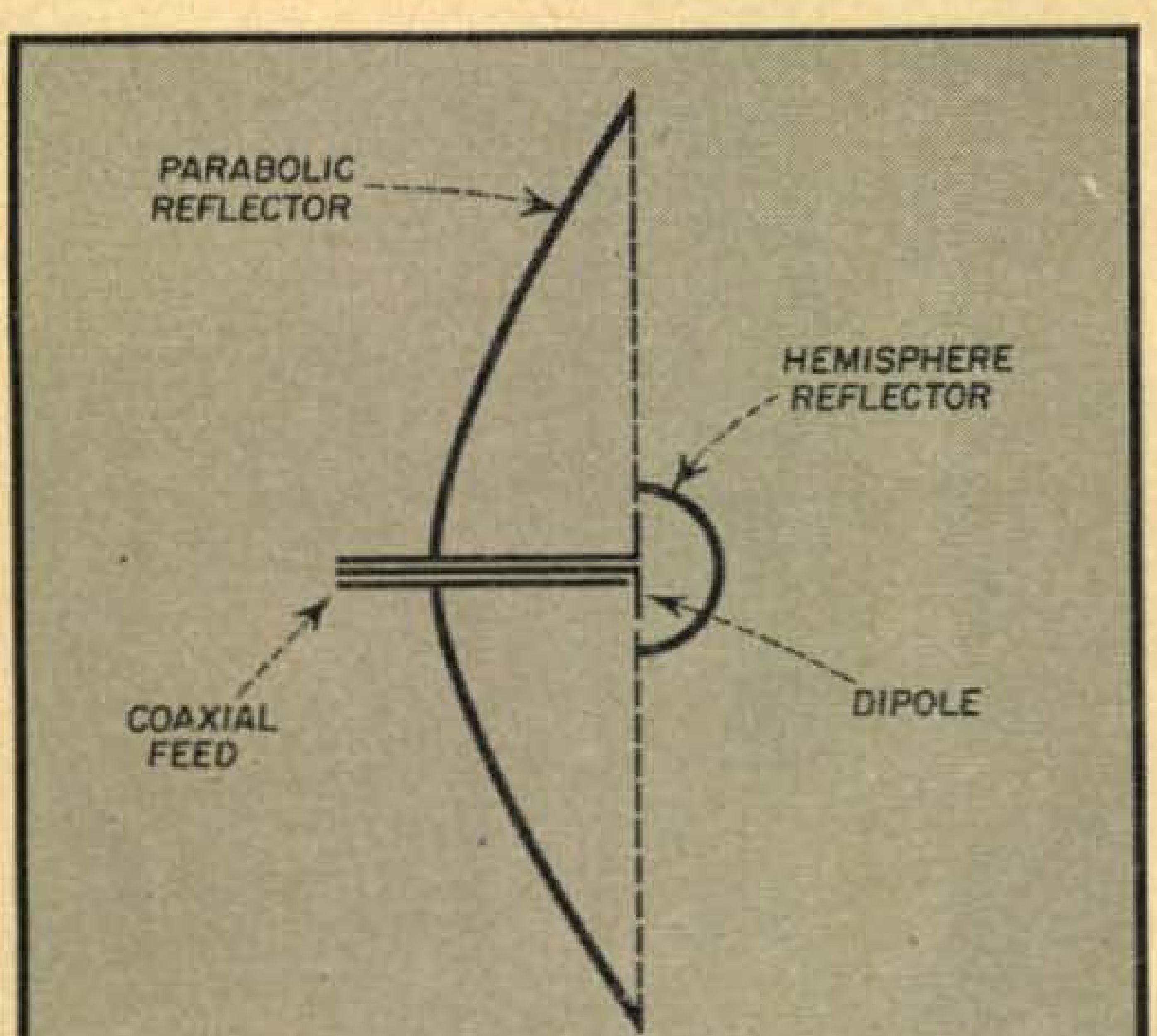


Fig. 3. A typical microwave radiator system. The hemisphere and parabolic reflectors make it highly directional and efficient.

your signal can't travel halfway around the world, but because you send your signal over towards Joe's house and no where else. Only Joe and the people living on a line betwen your stations can find your carrier at all. By this token you won't have to worry about there being too many stations on the band. In fact, you and all your friends may agree to use just one frequency. Then, if you all use pencil-beam transmitting antennas and non-directional receivers, calling a station may be only a matter of pointing at it and beginning to talk. Because your antenna has almost complete control of the radiated energy and doesn't allow any to be wasted by reflection from the ground and, because all evidence to date indicates that microwaves are completely free from both man-made and natural static, you will know that Joe is receiving you with the same signal strength as yesterday provided he has left his receiver alone. Again, to keep from painting too rosy a picture, however, it should be mentioned that violent temperature gradients in the atmosphere may bend the beam, but it is not believed that this will happen often.

Many questions may legitimately be initially asked by anyone who is thinking of taking up microwaves as a hobby or as a side line to his amateur's station at more common wavelengths. These include queries as to what sort of tube can produce such frequencies, how the frequencies can be controlled, what sort of modulation is used, what the receiver is like, and what sort of test equipment is needed. These are difficult to answer in a few words and some of the facts are covered up by military secrecy, but that which follows will give some indication.

Special Tubes

The transmitting tubes that are now at least partially free from secrecy orders and which can be made to perform at frequencies which are near or equal to those of the microwaves band includes the General Electric Lighthouse tube, the Sperry Klystron, and certain types of split anode magnetrons. All have some things in common and there are the distinguishing features that make such high frequencies possible. The crux of the situation lies in the fact that it is impossible to make ordinary tank coils of inductance and capacitance which will tune to frequencies of thousands of megacycles because distributed capacity in the vacuum tube elements of all ordinary tubes amounts to more than the total needed for the tank. An apparent step toward a solution may be made by redesigning the tubes in such a way as to reduce this capacity. This scheme has been carried to its logical limit in tubes such as the RCA acorn type and the Western Electric "door knob" series but does not get very far for the simple reason that as the tube elements are made smaller and smaller to reduce their capacity, their ability to absorb power also becomes smaller so that all too soon the point is reached where there may be a high frequency but if there is, there is practically none of it.

Resonant Cavities

The solution of this dilemma lies in the use of resonant cavities to take the place of coils and condensers. Their action may be interpreted in several ways. To keep from thinking of anything new we may even push the difficulties just described back into one corner of our mind and pretend that the cavities are only tank coils and capacities after all. We may define Q's, shunt resistance, and even inductance and capacitance for the cavities if we wish.

On the other hand, however, it is at least more interesting to jump into the middle of the thing and look at resonant cavities for what they are—hollow metal boxes which contain a microwave just as the space alongside a broadcast antenna contains a longer radio wave. The electron beam in the transmitting tube actually radiates microwaves much as does the charge moving up and down an antenna. These microwaves then move back and forth across the confines of the resonant cavity which is adjacent or coupled to the electron beam. The waves are multiply reflected at the walls of the cavity and in doing so they build up strong electromagnetic microwave fields which can be tapped off with a coaxial line or wave guide.

The thing is that a radio wave is generated whenever charge is suddenly accelerated. In ordinary radio this is thought of as occurring only at the antenna and the transmitter is described only in terms of current and voltages. At microwave frequencies this sort of logic runs into trouble at the transmitting tube because

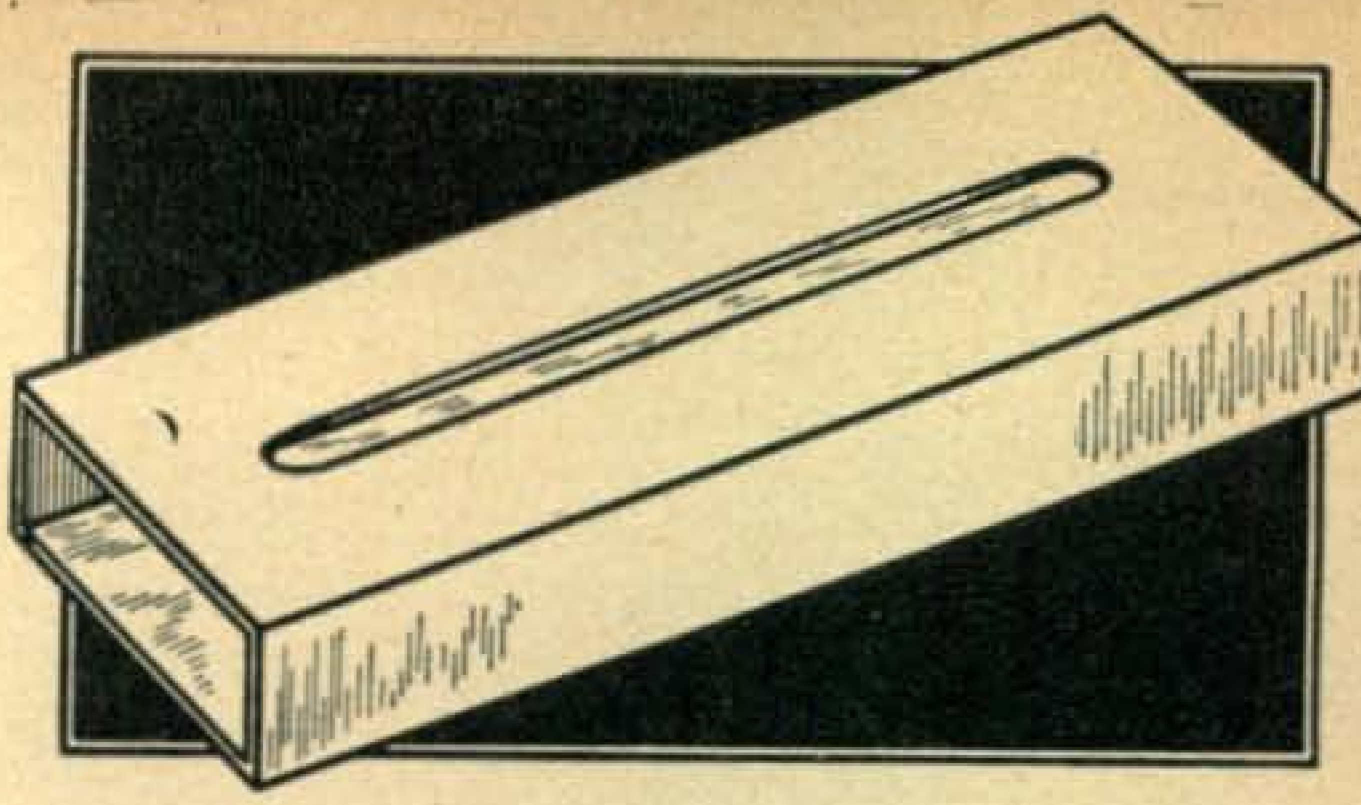


Fig. 4. A section of a wave guide slotted for measuring standing wave ratio

currents and voltages cannot be confined to wires at such frequencies. When, however, we allow ourselves to think of radio waves being created at the transmitting tube rather than at the antenna, we see how to overcome the difficulties. We manage to make the electron stream of the tube accelerate and slow down its electrons so as to generate the radio waves we want and then immediately it becomes possible to understand that various types of hollow box resonators may be able to store up this radiation and build it up to the level that is desired. All three of the types of tubes mentioned do this sort of thing in one way or another. The Klystron has the cavities built integrally with the tube and uses them not only to extract energy but also to give the electron beam a proper acceleration to cause the radiation. The Lighthouse tube may be operated with external cavities but is essentially a triode. The magnetron may be built to utilize roughly the same sort of idea but depends

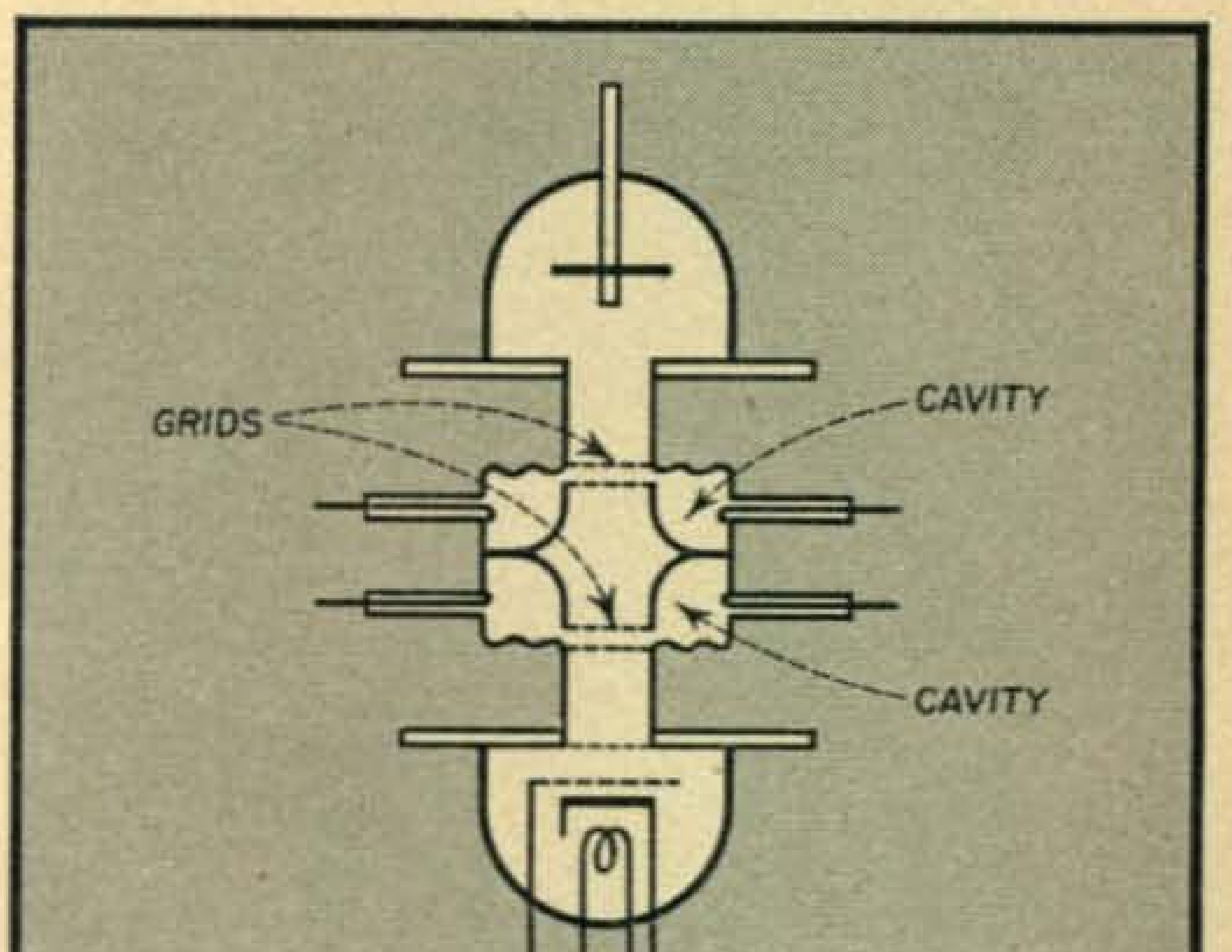


Fig. 5. Diagram of a double-cavity Klystron. You'll be using this type of tube in microwave rigs

upon a spirally rotating electron beam to generate the high frequency rather than a linear beam which changes only the velocity of the electrons which it contains.

Frequency Control

As for the control of these microwave frequencies to an accuracy in kilocycles that is equal to the present usage, less can be said for the common practice of the present. It is obviously impossible to use quartz crystals directly to approach any such frequencies and even with fairly "trick" systems that make the crystals vibrate in shear or torsion, it is possible to obtain only a few megacycles. The frequency of a quartz crystal depends in the main on its thickness. Above about 5 mc

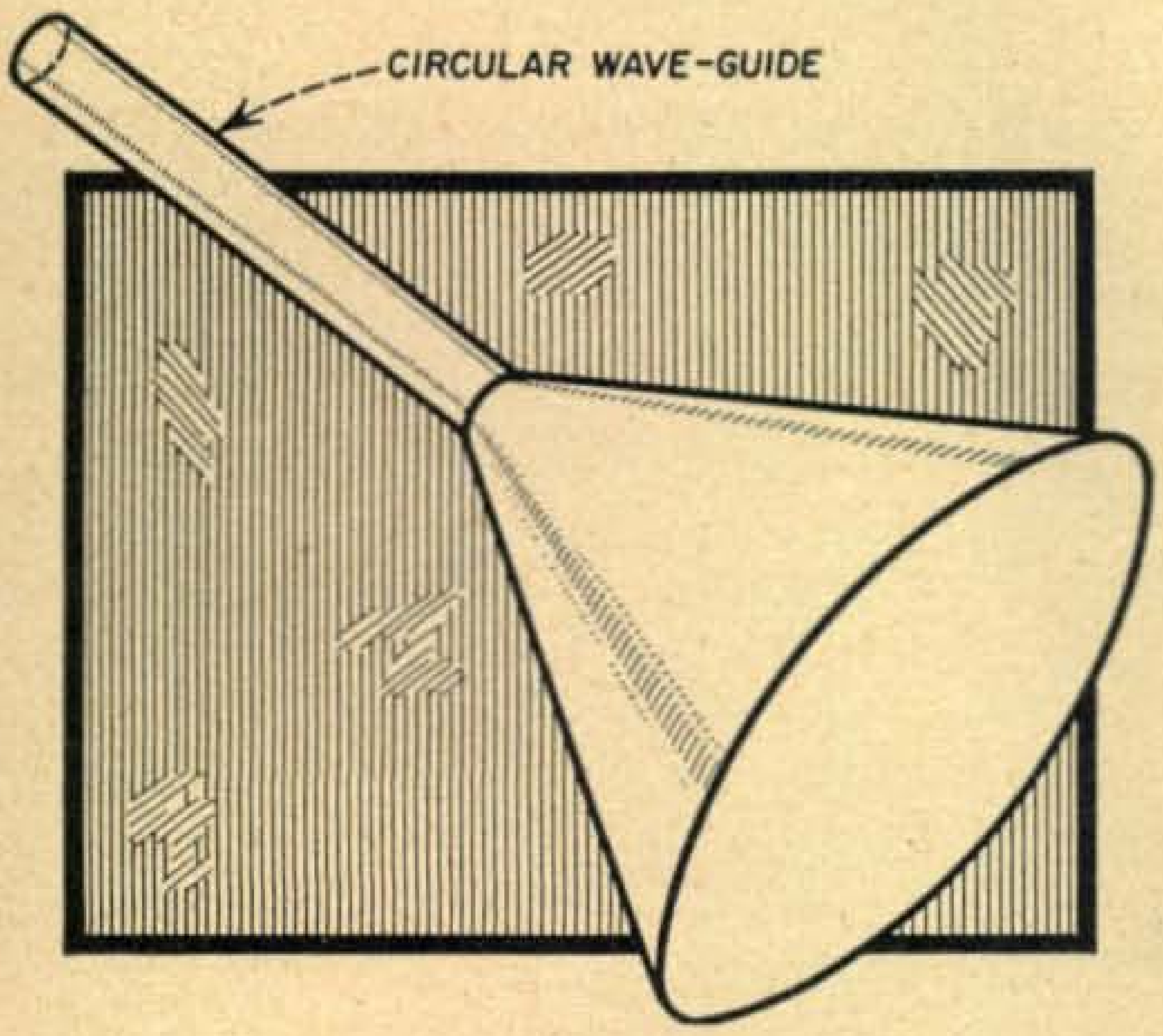


Fig. 6. A circular wave guide and radiator. Looks like a funnel, doesn't it?

the crystal becomes so thin that it is rather too fragile for most work. One scheme that is used with crystal control operates with the aid of frequency multipliers. The signal of only a few megacycles from the quartz crystal is fed through a series of vacuum tube circuits and is successively multiplied by a factor of two or three until the desired microwave frequency is obtained. The early multiplication stages may be ordinary tubes and the latter stages must of course be of the special type which we have mentioned. Unfortunately the process of multiplication also multiplies any error which may be present in the crystals. To combat this the crystal manufacturers have gone to great extremes to improve the accuracy and stability of their crystals and the results at the present are gratifying even at the microwave end.

More commonly the microwave frequency is determined only by the size of the resonant cavities proven very reliable in an absolute sense, still there has to date also been plenty of spectrum space so no one has been greatly concerned. The reason the cavities have not been generally made to determine frequency as accurately as quartz crystals is mostly because of the electrical and thermal changes that must always be encountered when a device is intimately connected with the electron stream of a vacuum tube. There is very little doubt but that circuits can be worked out to use external temperature stabilized cavities which will give remarkable frequency control.

Modulation

Either FM or AM can be used quite satisfactorily at microwave levels. If anything, FM is probably somewhat the easier of the two. Simply modulating the voltages applied to the transmitting tube will generally produce FM or in the case of the crystal controlled system the FM may be applied in conventional ways at a lower frequency point of the chain. AM is harder because the microwave tubes are apt to have limiting characteristics which effectively eliminate some of the modulation.

A microwave receiver is in principle just about the simplest thing imaginable. That is, it is essentially just an ordinary receiver plus a heterodyne microwave stage. Of course, there may be other better ways of doing business but at least a common procedure makes use of a microwave local oscillator, a resonant cavity as a mixer, and a rectifying crystal. The input from the antenna and a microwave frequency from a local oscillator are combined in the cavity. These two microwave frequencies are chosen to be a few megacycles apart. The crystal therefore responds to a frequency that is the difference between the two microwaves and since that frequency is in the range of ordinary receivers, it can be amplified and detected in the usual way.

As was pointed out before, the main thing about microwaves is that one deals with the actual radio waves right in the transmitter and right in the receiver rather than thinking only of current and voltage and permitting the radio part to be dele-

[*Continued on page 40*]

WHY 100% MODULATION?

McMURDO SILVER

Vice-President, Grenby Manufacturing Company

IT IS theoretically foolish and wasteful to modulate a c-w carrier less than 100%. There is no merit in paying for carrier power to push out also beyond the range at which the voice modulation ceases to be useful. There is also harm in such practice, since the carrier, even though not usefully modulated, can cause interference beyond the effective modulation distance range if the modulation percentage is significantly low.

What Is "Low"

But just what is "significantly low"? Considering only the question of how much effective loss of useful radiated power will occur if we decrease modulation below 100%, the curve of *Fig. 1,* prepared by Albert H. Carr, pre-war Chief Engineer of WTHT, Hartford, is illuminating. Plotted at the left are decibels "down" from the effectiveness of the 100% modulated signal versus percentage of modulation along the top. If we accept the good "rule of thumb" that a 3 db decrease is effective radiated power is just about audible to the distant receiving operator and then look at the curve, we see that dropping to 50% modulation will diminish our signaling effectiveness by only 3 db. But what a saving on modulator power in terms of the invariably over-strained pocketbook! Pursuing this heretical thought into *Fig. 2,* wherein percentage modulation is plotted vertically and the percentage of power needed to produce different percentages of modulation (in terms of that needed for 100% modulation) is plotted horizontally at top, we find that to effect 50% modulation of our carrier we require only 25% of the power needed to modulate it 100% (seen from the top horizontal figures).

Why Waste Money?

Despite the fact that it is today well recognized in engineering circles that 3 db power gain is ordinarily in loudness, it is still rather difficult to accept this unconventional thought. But lives there the ham or engineer who mainains that 1½ db means anything except money wasted in the seeking of it?

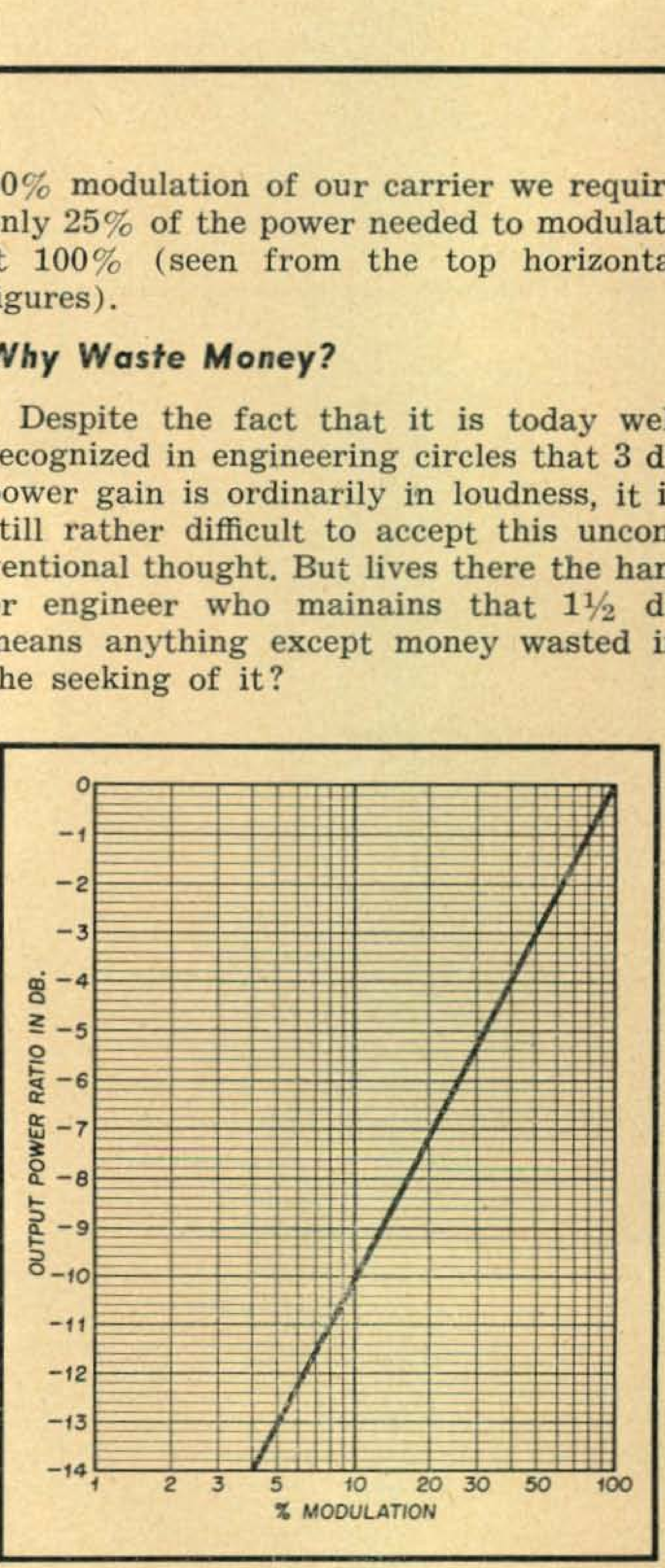


Fig. 1. Graph of output power vs. per cent modulation

Considering the possibility of spending fewer dollars to modulate effectively that post-war "dream" 'phone transmitter, no sensible amateur need lose sleep over the thought of abandoning that last 1½ db of modulation necessary to reach the theoretically ideal 100% modulation. The loss of 1½ db just simply isn't audible, and probably represents much less in the way of signal impairment than do the viccissitudes of signal travel such as practically constant slight fading, QRN, etc. Certainly it is a profitable thought to realize that by sacrificing this insignificant 1½ db of signal strength, we need, according to *Fig. 1*, to provide but approximately 71% modulation—especially when scrutiny of *Fig. 2* indicates that to get 71% modulation we require only *one-half the modulator power* needed to obtain 100% modulation. Never did the sacrifice of a substantially meaningless 1½ db buy as much as this before —a cut in half of required modulator plate input power to the modulated r-f.

In plate modulation, 100% modulation of the carrier requires that the modulator be able to supply 50% in a-f power of the amplifier or oscillator. The two curves show that, if the substantially inaudible 1½ db differential in modulated power (the net difference between 100% and 71% modulation) be sacrificed, the required modulating power drops to 51% of the 100% modulation requirements—to become but 25½% of the modulated Class C r-f amplifier plate power input (see upper horizontal figures, *Fig. 2)*. This means that one 6N7, good for about 10 watts audio output, can modulate 70% an r.f. plate input of 40 watts! Or a pair of 6L6's, operated Class AB, with cathode bias resistor

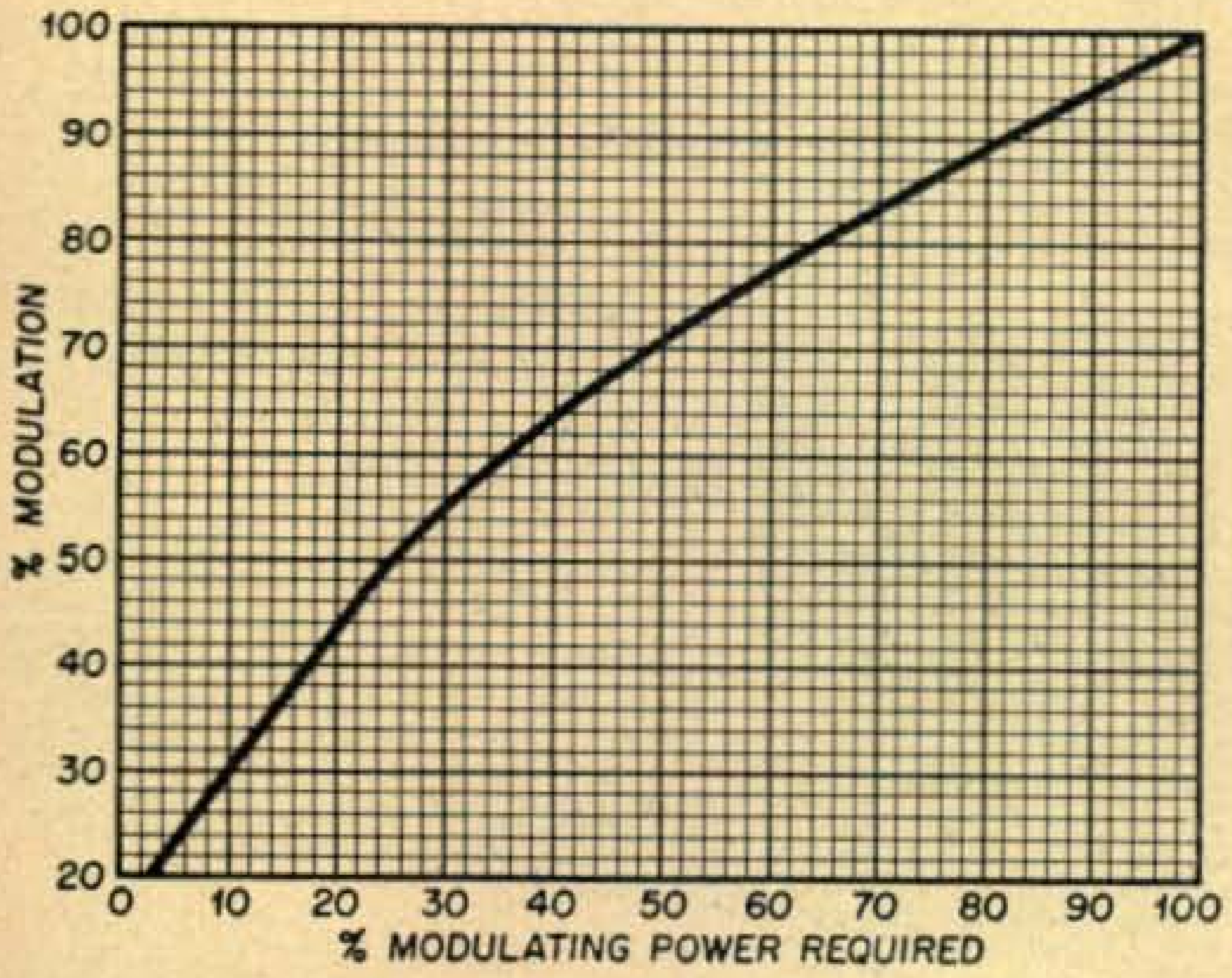


Fig. 2. This curve shows the modulation power required to produce various modulation percentages

and 26.5 watts of a-f output, can modulate 70% a plate input power of 106 watts to the final r-f amplifier. These two quick examples, plus the curves, should provide food for profitable thought during present-day silent amateur evenings.

Lest the above comments be considered as just plain heretical, it would be well to study the two curves in the light of present-day knowledge, bearing in mind that they were prepared by the former chief engineer of a well-known broadcasting station, whose business it was to know his decibels and all things related thereto.

Other factors, too, may be profitably considered. Among these are the question as to what the interference will be caused by this 70% modulation (30% "under modulation") to fellow operators. The answer appears to be that the un-usefully modulated carrier will cause 1½ db more interference that would be the same carrier reduced to that power which could be 100% modulated by the halved audio modulating power. This seems insignificant, though maybe F.C.C. has ideas upon the subject. When switching from phone to c.w., however, the full carrier power is useful, though what actual good the extra 1½ db does is most questionable—but see "Watts—Or Decibels," June, 1943, *QST*.

A possibly more important aspect is that, under conditions of 71% modulation, the possibility of over-modulation, with consequent hash, splatter, distortion, etc., is *materially reduced*. Further, it must not be forgotten that "100% modulation," using complex voice waves, of volume varying with the operator's emotions (and so rising with DX) is something of an abstraction anyhow. If average modulation percentage be about 25% on speech, then 100% modulation will be reached *on voice peaks only*, and will probably be *frequently exceeded* if the modulation capability be initially established on a 100% basis and the fond operator cranks the audio gain control up so he can be sure, by occasional plate current flickers, that he really is hitting the legally allowable 100% modulation. Under such circumstances he will probably over-shoot 100% modulation much more frequently than he will notice by plate current flicker.

It seems a good idea to establish modulator power required upon the basis of

[*Continued on page 40*]

A VOLTAGE-REGULATED

A good, dependable power supply unit is one of the handiest units to have around the shack. You can hook up experimental setups with the knowledge that, if they don't work out, it isn't the fault of the power supply.

IT IS OFTEN desirable and sometimes necessary to have available a source of dirrect-current power which is independent of the input voltage or the output load. By the use of electronic voltage regulators, voltages of almost any value can be obtained with excellent stability. It is not difficult to supply 300 volts, constant to within 1 volt for line or load changes of 25%.

There are several additinal features of an electronically regulated power supply. A regulator that eliminates sporadic changes in voltage will eliminate the ripple voltage and also reduce the internal impedence of the power supply. This latter quality is especially desirable in power fed to amplifiers having an extremely low frequency response, and when regeneration due to common B-supply impedance would be desirable. A well-regulated power supply is desirable for circuits in which pulsating direct current would effect frequency or stability.

It is advisable to review a few voltage stabilizing circuits and devices before describing the all-purpose voltage regulated supply.

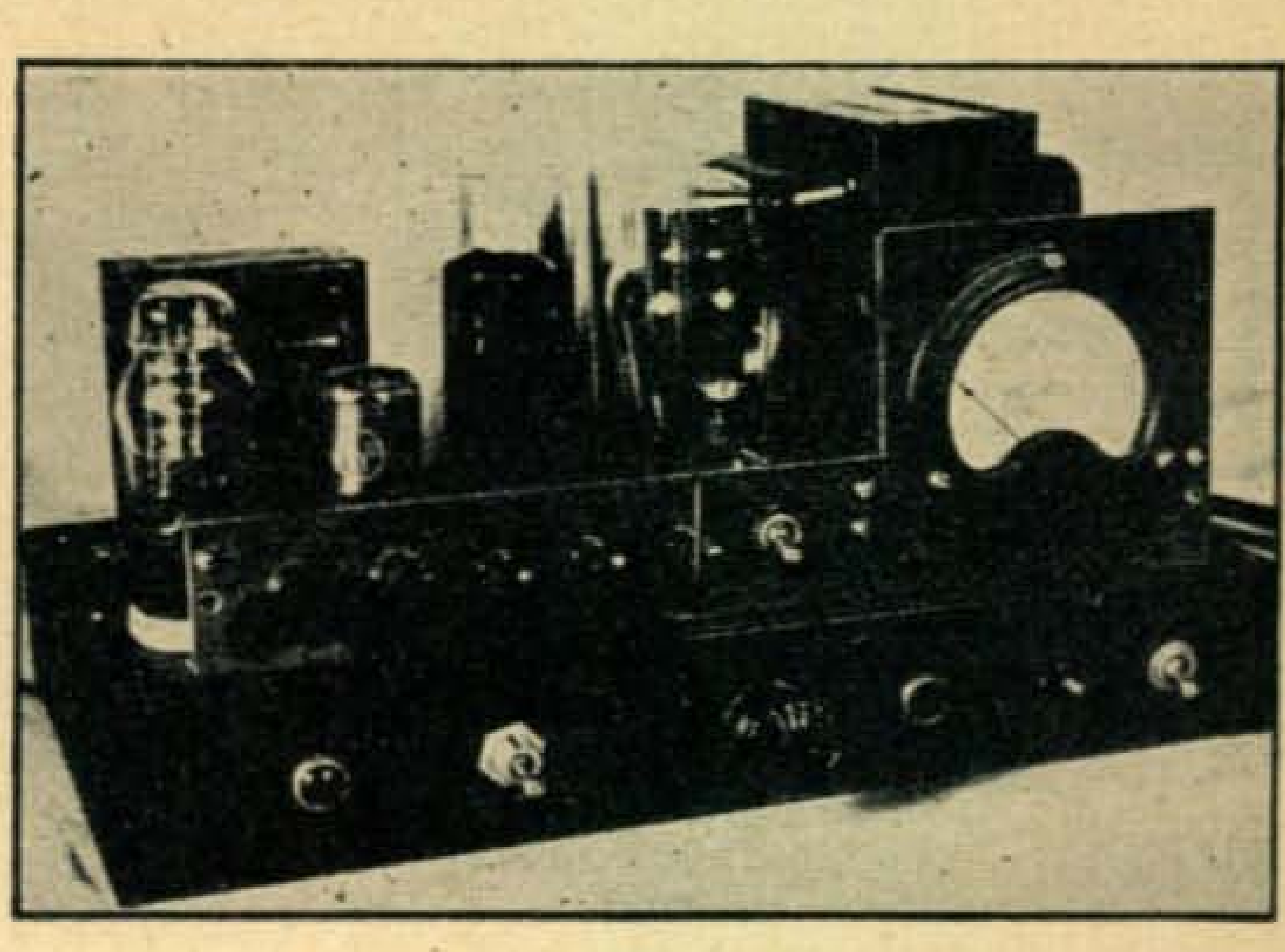
Gas Regulators

For small voltages and currents, glow tubes may be used. The glow tube, or gas tube, has, in its simplest form, two electrodes between which a self-maintained gas discharge takes place. The nature of the discharge through the gas in the tube is such that when the voltage across the electrodes tries to increase, more current passes through but the voltage drop across the tube does not change.

The simplest type of voltage-stabilizer circuit consists of a glow-discharge tube and a resistance as shown in *Fig. 1.* An increase of input voltage results in an increased IR drop through the series resistance due to increased current through the tube. The drop across the tube increases only slightly. An increase in current through the load results in an almost equal reduction of tube current at nearly constant tube drop voltage. Gas tubes VR-75, VR-105 and VR-150 are gas-filled cold cathode voltage regulators.

The voltage stabilizing feature of a gas tube is only true over a limited range of potentials for any one tube, so that various tubes must be used for stabilizing different voltages. For example, the VR-105/30 tube regulates potentials in the neighborhood of 105 volts. The number 30 refers to the maximum current in milliamperes which can be passed through the tube without damaging it. The maximum load current is 25 milliamperes.

If the series resistor R is as small as 3000 ohms, the voltage control of the



Front View of Power Supply

POWER SUPPLY

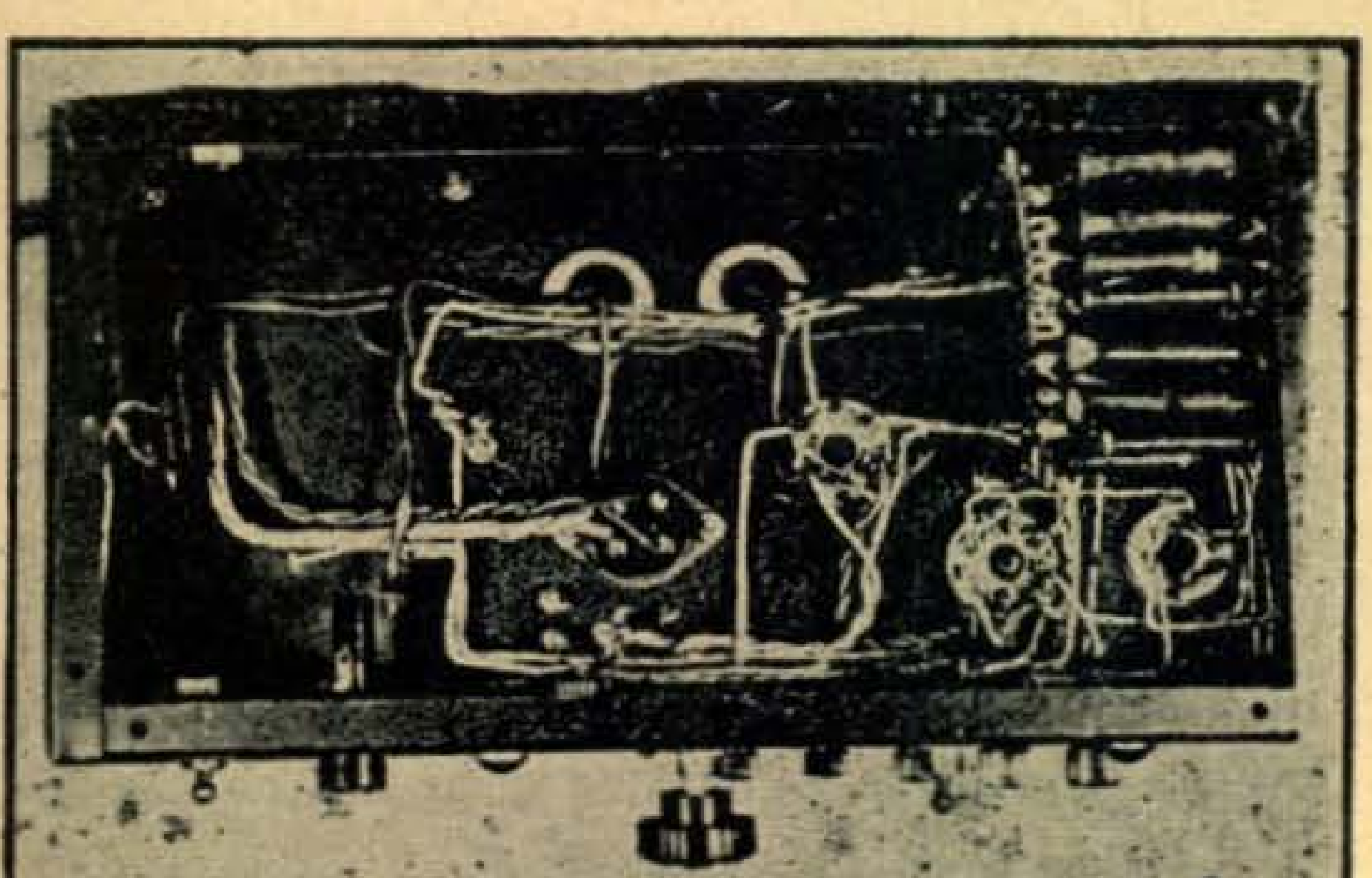
WILLIAM DONAWA

VR-105 will be limited. If R is 20,000 ohms or more, the control range around 105 volts will be much greater. The control feature is lost if the current through the tube falls below 5 milliamperes. The size of the series resistor should always be such so as never to allow an operating current of more than 30 ma. to flow through the tube in case the load is disconnected. A starting voltage somewhat higher than the operating voltage is required to initiate the discharge. This generally occurs automatically, as the heater-type tubes in the circuit connected to the power supply draw no current during the warm-up period and the voltage available will be high enough.

Two or more glow-tubes may be connected in series to handle higher voltages; taps may be taken off between the glow-tubes to obtain lower voltages. This circuit is illustrated in *Fig. 2.*

Vacuum Tube Regulators

Vacuum tubes may be employed to obtain stabilized voltages. The circuits generally fall into one of the four following types:



Under-chassis view of power supply

a. The single stage degenerative d-c amplifier type *(Fig. 3).*

b. The design derived from the bridge circuit for measuring the variational transconductance of tubes *(Fig. 4).*

c. The bridge circuit type that depends upon the variational amplification factor of a vacuum tube *(Fig. 5),*

d. A combination composed of one of the three basic circuits mentioned above with one or more stages of amplification.

The circuit to be described herein is a variation of the degenerative regulator circuit and is illustrated in *(Fig. 6).* Regulation curves are shown in *Fig. 7.*

Analysis of Action

The voltage applied to the regulating circuit is the voltage delivered by the ordinary power supply. Tube V_1 acts as a series resistor controlling the amount of current delivered to the load, and therefore, controls the voltage Ea. Tube V_2 amplifies the voltage applied to its grid by the voltage dividing network R_4, R_5, R_6 and R_7. Any change in the ouput voltage is amplified by V_2 and impressed on the grid of V_1 which either decreases or increases the current flowing through it. A detailed analysis of the action follows:

a. An increase in Ea will produce a corresponding increase in Eg which will be applied to the grid of V_2.

b. An increase in Eg will cause the grid of V_2 to become more positive.

c. If the grid of V_2 becomes more positive, the plate current will increase.

d. An increase in current through V_2 will increase the voltage drop across R_1, driving the grid of V_1 more negative.

e. When the grid of V_1 becomes more negative, the load current passing through it decreases, and Ea falls to its original value. Should the voltage Ea decrease, the opposite will occur.

The desire, therefore, is to amplify as much as possible the voltage fluctuations that appear across the output terminals of the power unit, and to impress these amplified fluctuations on the grid of the series resistor tube.

There are several items included in the circuit in order to obtain smoother and more complete stabilization of the load voltages. If a gaseous rectifier is used a low capacity, C_5 should be placed in the circuit to prevent "hash." Resistor R_2, V_3, and the voltage dividing network form the bleeder circuit which draws suffiicient current to permit operation somewhere in the "flat" portion of the rectifier output characteristic.

The resistance of R_2 should be of such a value as to insure a current of least 5 ma. through the R-105 when the potentiometer, R_6, is adjusted for minimum voltage, Ea, across the output terminals. For small changes in Ea, relatively large changes in V_2 plate current are in order. This means that we want to cause wide swings in the current through the VR-105. It is desirable therefore to operate the VR-105 with a low d-c ignition current so that a large current change is possible before saturation is reached.

Eliminating Ripple

Any variation in Ea due to ripple voltage is applied to the grid of V_2 by C_1. The reactance of C_1 is low and the a-c voltage applied to the grid of V_2 has the same effect as the d. c. variations applied to it through the voltage dividing network. The addition of the condenser results in the elimination of about 90% of any ripple voltage existing after the regular filter circuit.

The cathode of the amplifier pentode V_2 is maintained at a constant potential above the negative side of the line by the gas tube V_3, a properly aged neon lamp, or by battery. Under certain conditions oscillations may be started by the regulator tube. This may be prevented by condenser C_2.

Grid bias on the amplifier tube is obtained from the combination voltage divider and bleeder network across the output terminals. Screen grid voltage must always be higher than the control grid

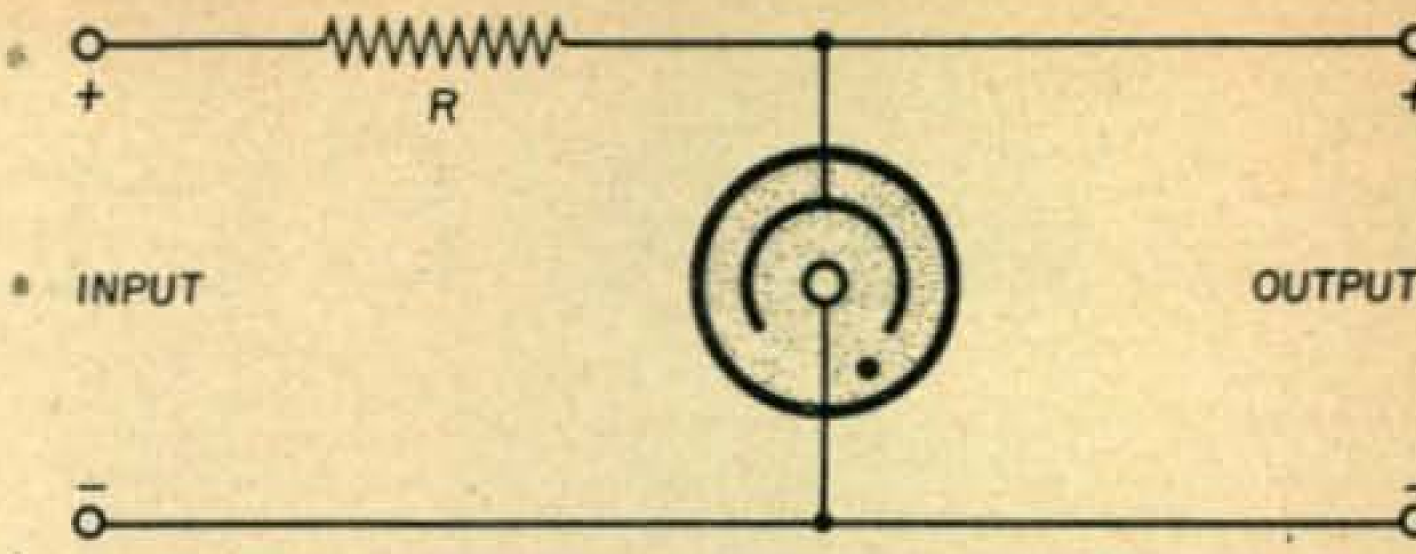


Fig. 1. Fundamental regulator tube circuit

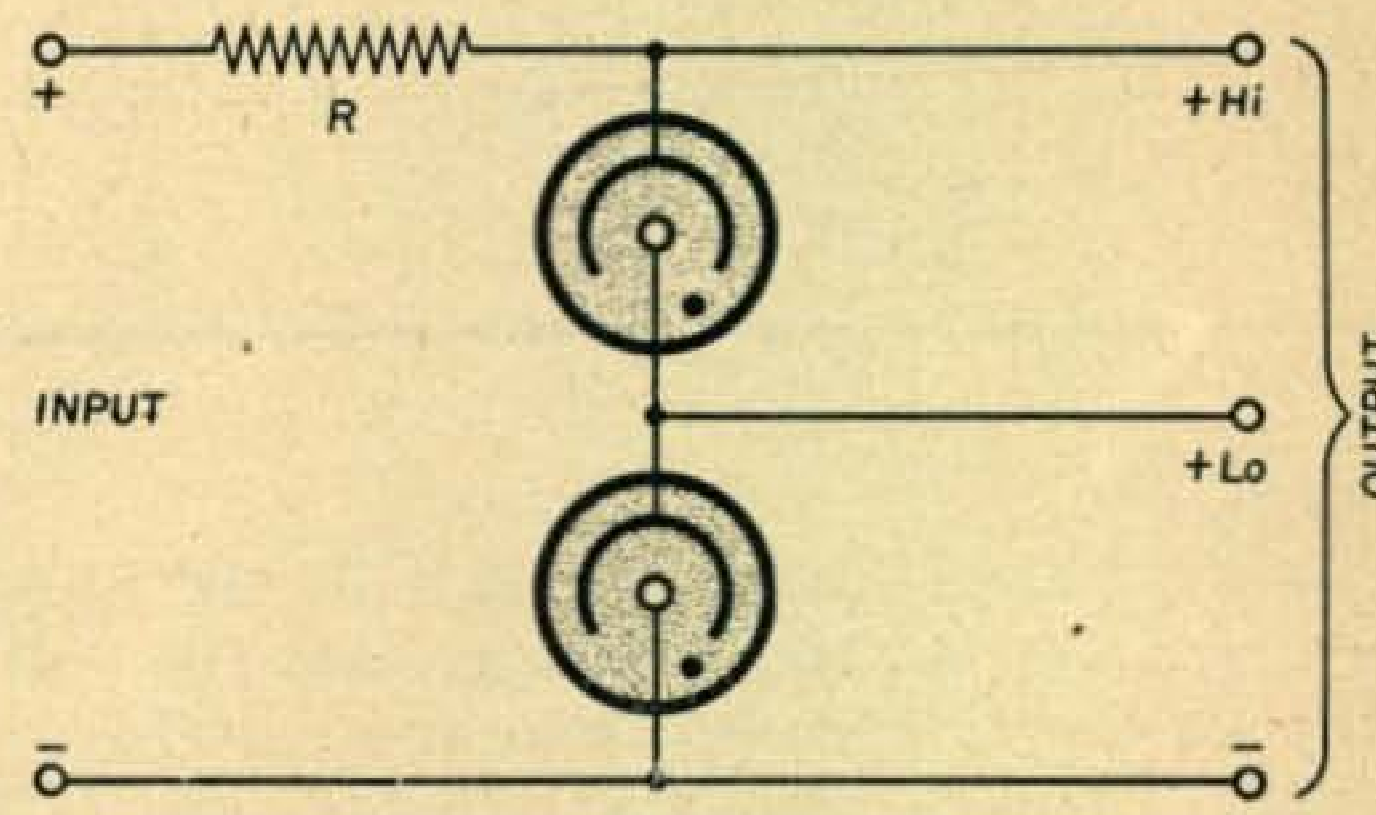


Fig. 2. Circuit with two tubes in series

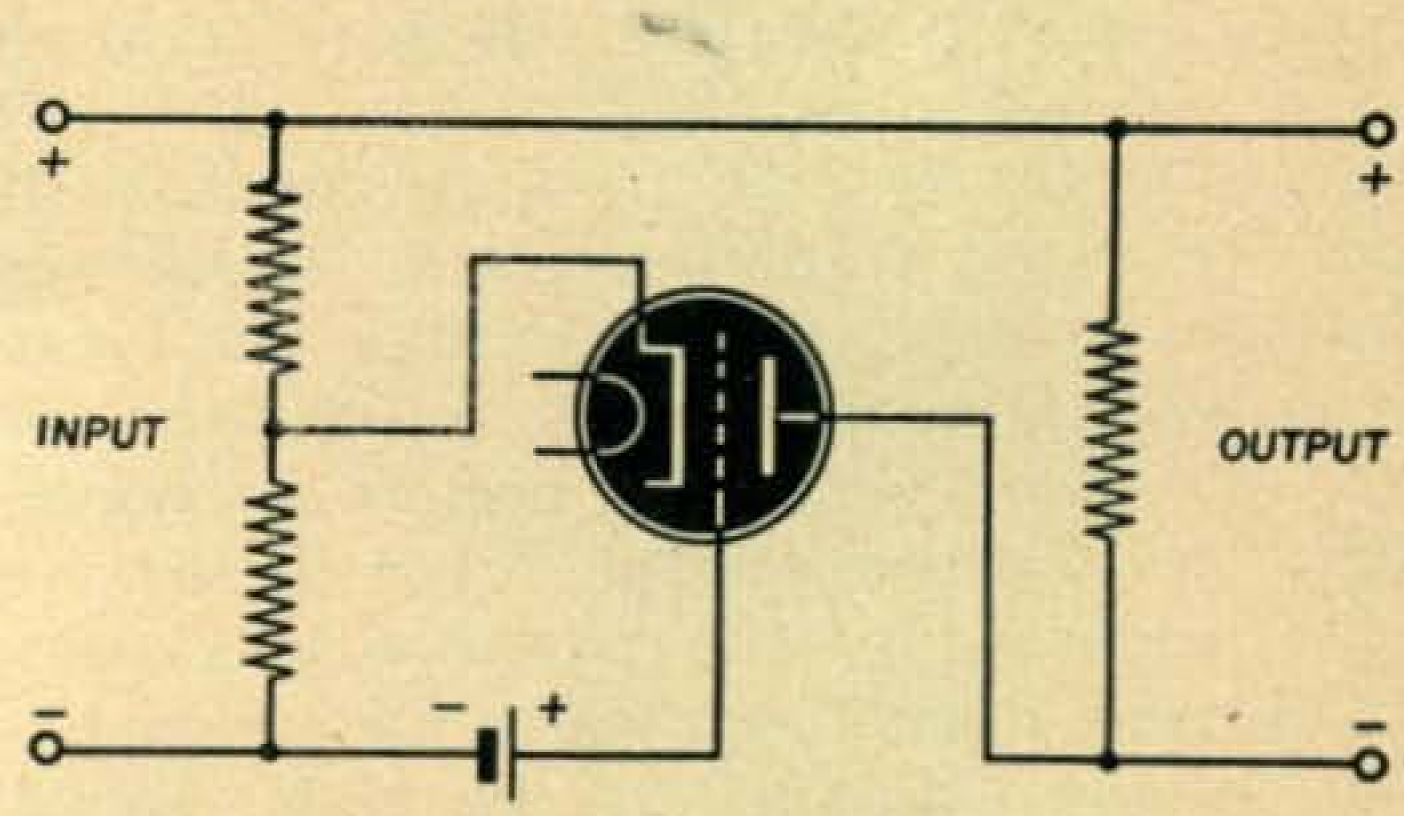


Fig. 3. Single-stage degenerative circuit

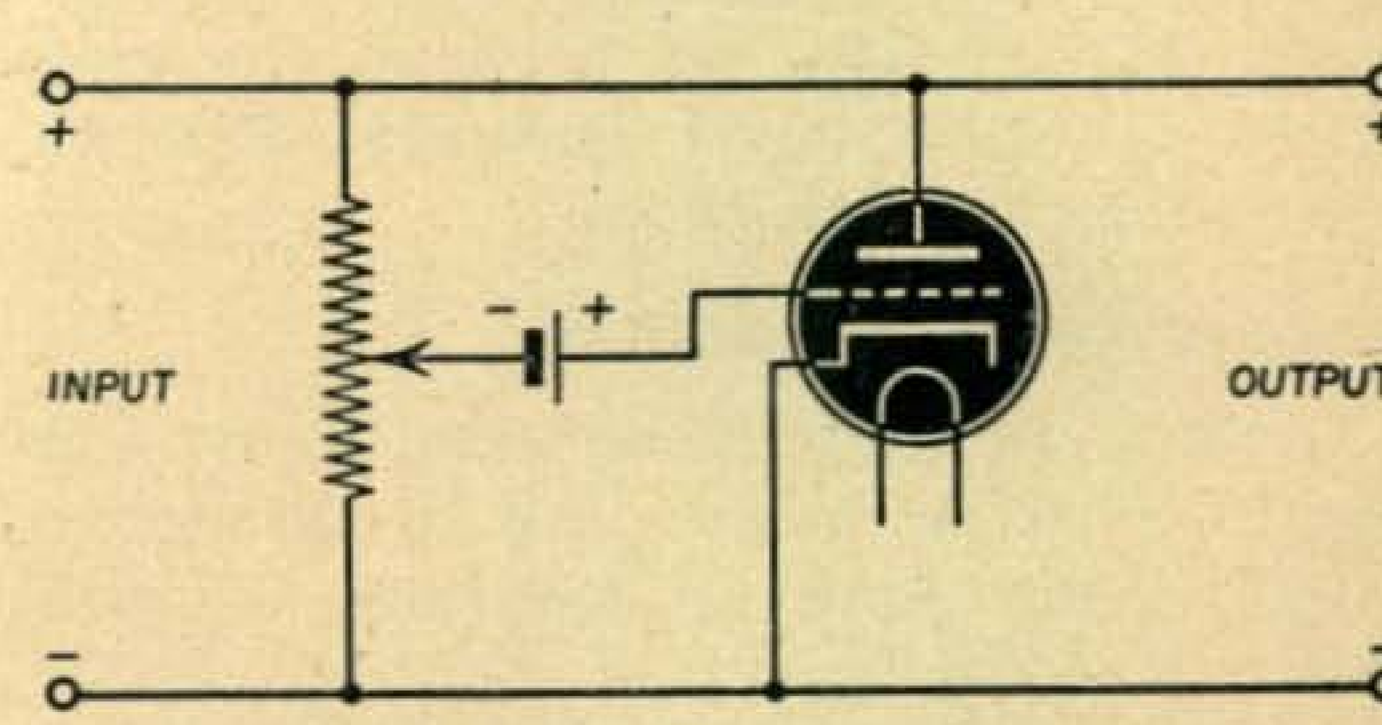


Fig. 4. Regulation is secured by using a circuit derived from tube bridge for Gm measurements

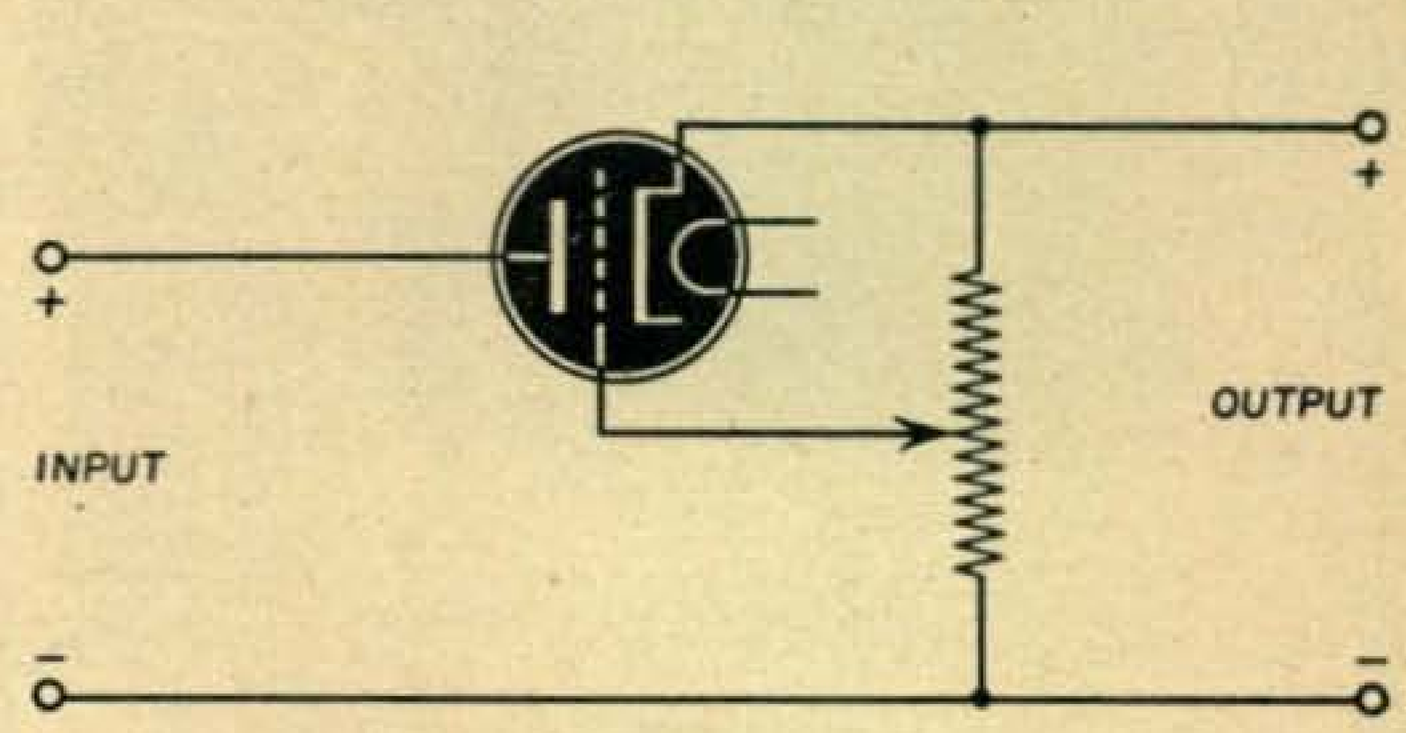


Fig. 5. It is likewise possible to obtain regulation by employing a tube bridge circuit used for measuring amplification factor

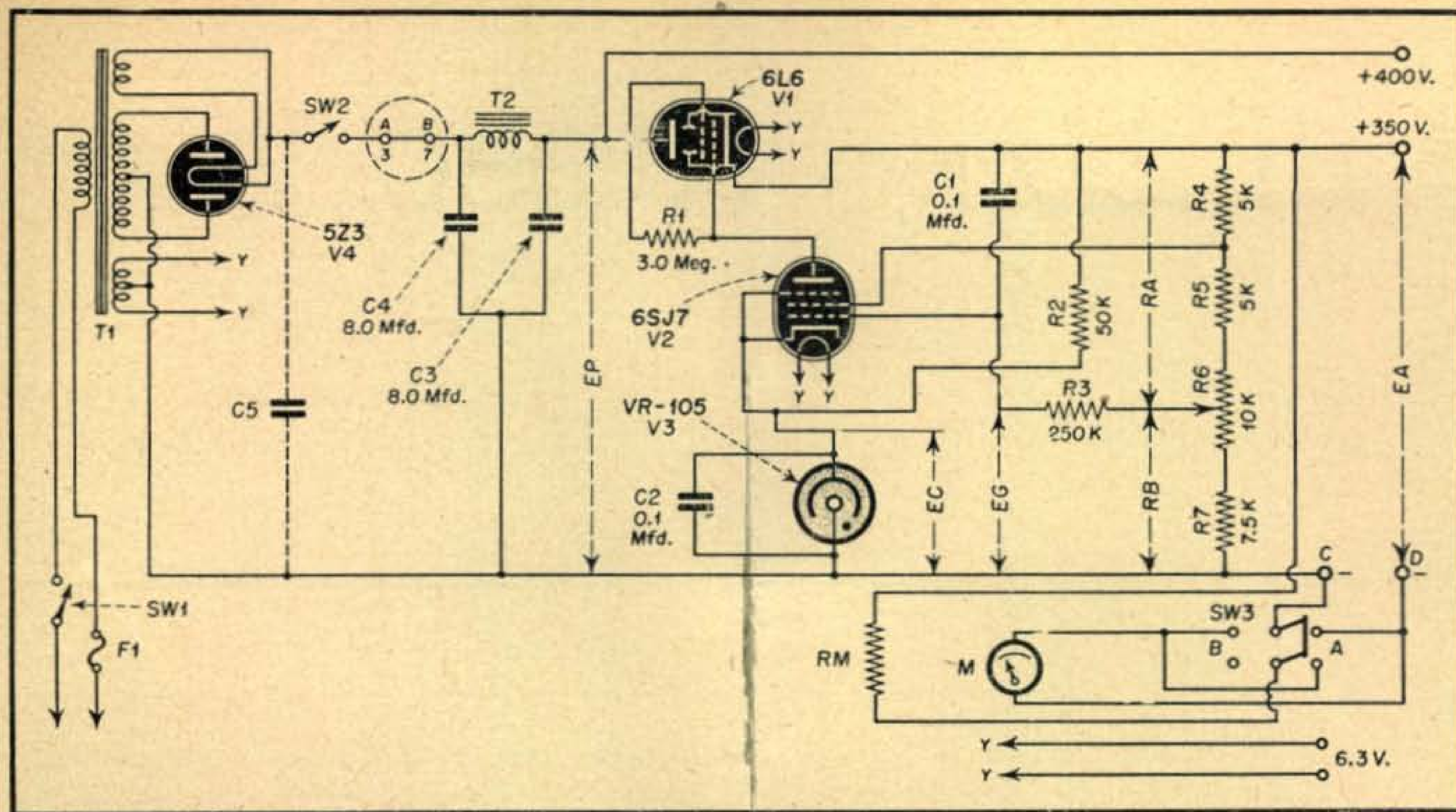


Fig. 6. Schematic of regulated power supply

voltage and is, therefore, obtained higher up on the voltage divider.

The exact amount of change in Ea that is applied to the grid of V_2 depends upon the ratio Ra to Ra+Rb. If this ratio is very small, poor regulation will result.

The potential about which the voltage will stabilize is determined by the value of Eg and the resistance circuit Ra and Rb. Since it is an advantage to be able to vary this potential, Ra and Rb are broken up into three fixed resistors and a potentiometer.

The value of Eg can be determined by making it a few volts less than the cut-off voltage for V_2. Eg is subtracted from Ec as the bias on V_2, because of V_3, is very high.

The following equations are used in computing the values of R_4, R_5, R_6, and R_7 for a particular range of voltage in which the regulating circuit is to operate.

$$Rb = \frac{R6}{(Ea\ max/Ea\ min) - 1}$$

$$Ra = Rb\ [(Ea\ max/Eg) - 1] - R6$$

Ra is then divided into two resistances in the following manner. Compute the value of the current flowing through the entire voltage dividing network. Calculate the resistance, with that value of current flowing through it which will produce the correct value of screen voltage must be at least 20 volts greater than the maximum bias voltage to be applied to the control grid by means of R_6. Subtract R_6 and R_7 from the resistance value obtained which

[*Continued on page 38*]

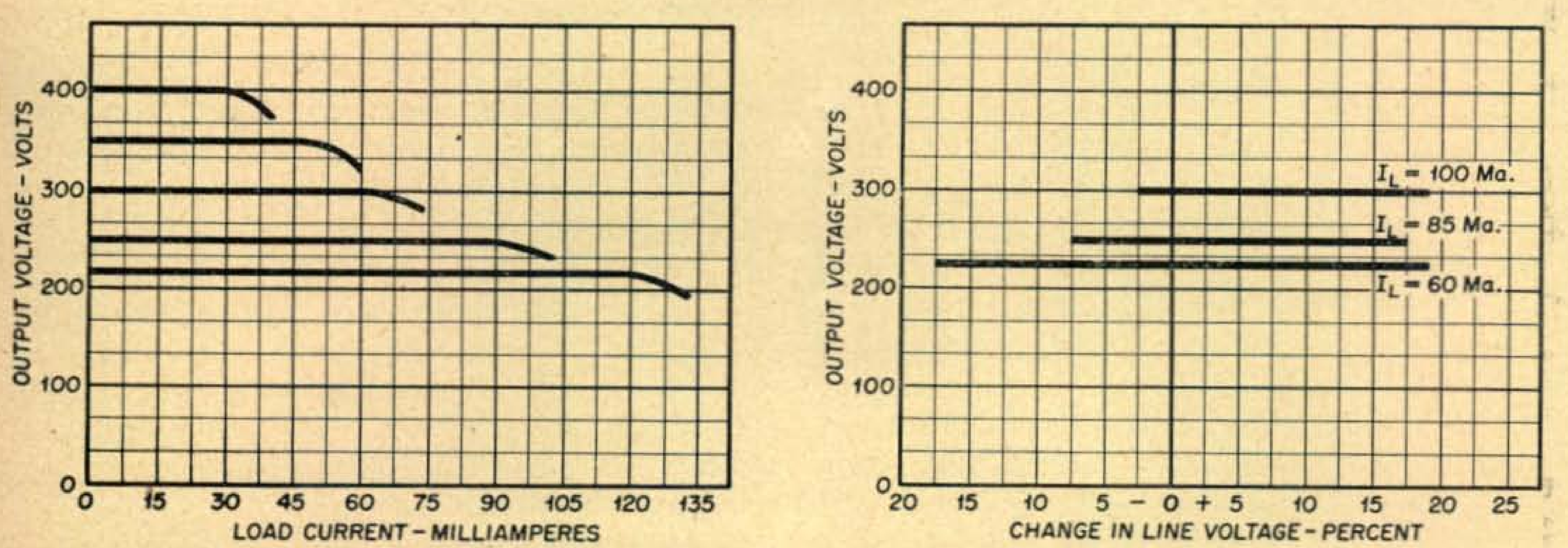


Fig. 7. Variation of output voltage with load (left) and (right) effect of line voltage changes on output

BUILDING A 250 WATT

JOSEPH ANLAGE, W9WVW/2

Like automobiles, it is probable that our first post-war rigs will closely approximate those of pre-Pearl Harbor days. Here's a transmitter that will fill the gap until the new-fangled gadgets invade hamdom.

THE pre-war transmitter herein described is capable of highly satisfactory rf energy emission. Properly operated, it is a convenient medium power, multiband transmitter for use on the ham frequencies from 30-mc down. This rig was operated right up until the news that December 7th Sunday afternoon when it was silenced to clear 14,153 kc channel for more important ham traffic direct from the Hawaiian K6 group. Since that time this station has been dismantled and transported half-way across the country. However, time and full occupation in war activity have not dimmed my memory of circuit and layout; and so in a few spare minutes between work and sleep the old mill is given a whirl to relate its outstanding merits. While its potential utility will depend somewhat upon the avilability of new and better types of tubes and circuit components, there is every reason to believe that it will hold its own in practicability and efficiency on the medium frequency amateur bands.

Versatile Band Range

The main bands of operation included the 7, 14 and 28-mc channels, though excellent results were also obtained in the 56-mc spectrum. It can be reasonably assumed that the post-war amateur allocations will not be greatly altered, with the possibility of an additional band in the 21.5 megacycle region—which new frequency would be right in the center of this transmitter's most efficient operating range.

The circuit in *Fig. 1* shows a conventional approach in the various branches, the layout having been developed through a series of experimental tests designed to realize the utmost per stage. A 6L6 crystal-controlled oscillator is employed with circuit components for 7 and 14-mc crystals. The oscillator is keyed, for break-in operation, and with proper tuning and loading provides a smooth, even signal at high speeds. For operation with a 7-mc crystal, the plate tank circuit may be tuned to the fundamental frequency of the crystal, or to double the frequency with good output available at the second harmonic. The 14-mc harmonic will in most cases provide more than ample power to the following buffer stage. With careful tuning, the 28-mc harmonic of the 14-mc crystal will be sufficient to excite the 807 amplifier to full output.

Buffer Stage

The loading to the succeeding stage is made by tapping along the oscillator plate inductance, providing an optimum means for all-around desirable oscillator control.

The buffer utilizes an 807 beam power pentode, operated either as a straight amplifier or as a frequency multiplier. Both fixed and self-bias are applied to the grid, the latter for protection when departures from resonance occur. The fixed bias was found advantageous when breaking excitation as a result of oscillator keying. While the 807 may appear to be overloaded when driving the push-pull 812s, the tube does

PHONE & TRANSMITTER

Here's a completely engineered rig, tried and proven in pre-Pearl Harbor days, for ham bands from 30 mc down

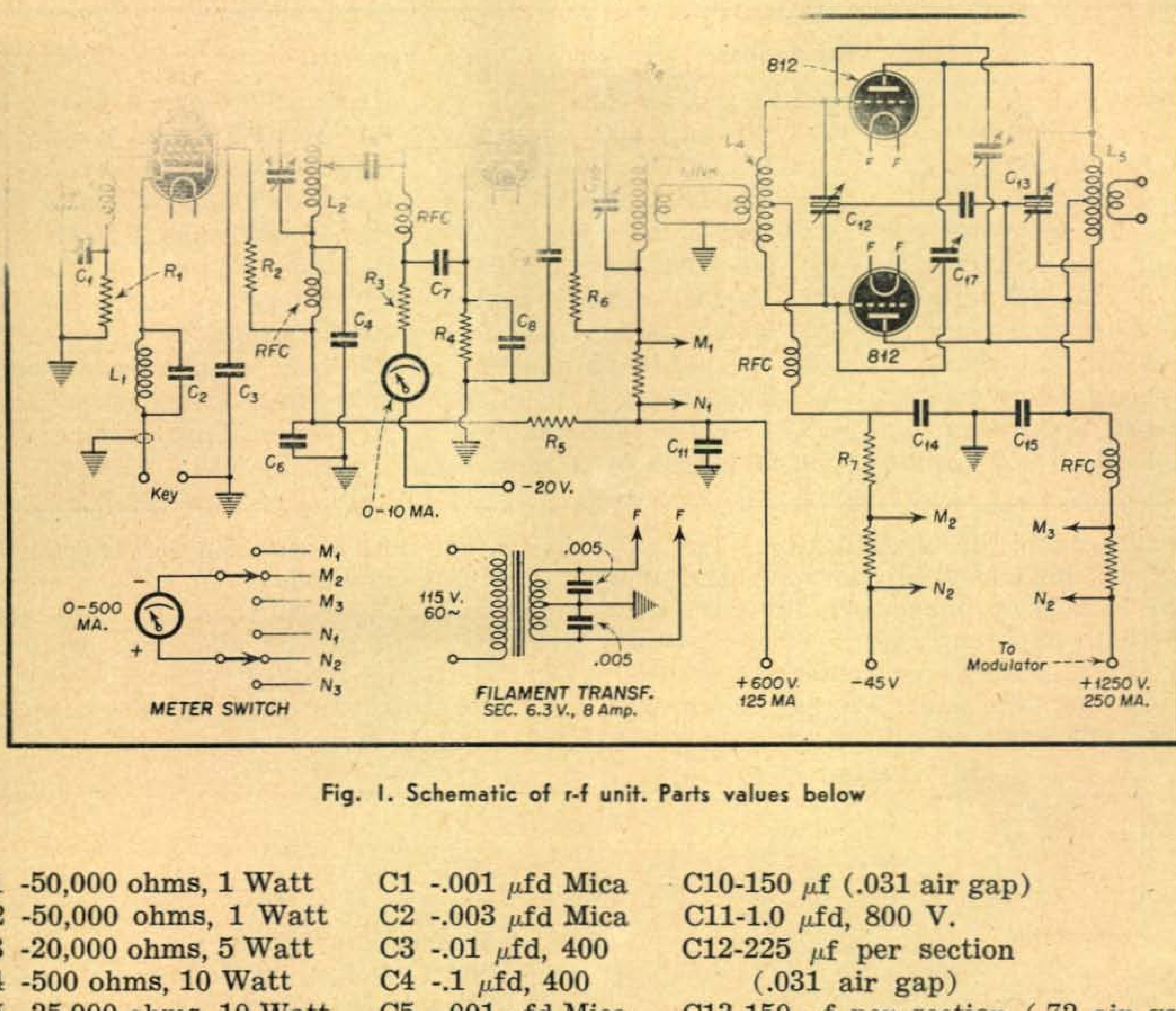


Fig. 1. Schematic of r-f unit. Parts values below

R1 -50,000 ohms, 1 Watt
R2 -50,000 ohms, 1 Watt
R3 -20,000 ohms, 5 Watt
R4 -500 ohms, 10 Watt
R5 -25,000 ohms, 10 Watt
R6 -25,000 ohms, 10 Watt
R7 -2,500 ohms, 10 Watt
Rs -100 ohms, 5 Watt, Parasitic Choke

C1 -.001 µfd Mica
C2 -.003 µfd Mica
C3 -.01 µfd, 400
C4 -.1 µfd, 400
C5 -.001 µfd Mica
C6 -.1 µfd, 400 V.
C7 -.01 µfd, 400 V.
C8 -.001 µfd Mica
C9 -µfd Mica

C10-150 µf (.031 air gap)
C11-1.0 µfd, 800 V.
C12-225 µf per section (.031 air gap)
C13-150 µf per section (.72 air gap)
C14-.001 µfd, mica
C15-.01 µfd, mica 3,000 V.
C16-Neutralizing capacity 2-10 µfd.
C17-Neutralizing capacity 2-10 µfd.

RFC-2.5 MH choke
L1 -1 MH inductance
L2 -Oscillator tank inductance (See text)
L3 -Buffer amplifier inductance (See text)

L4 -Final amplifier grid circuit inductance
L5 -Final amplifier plate tank inductance
X -Crystal

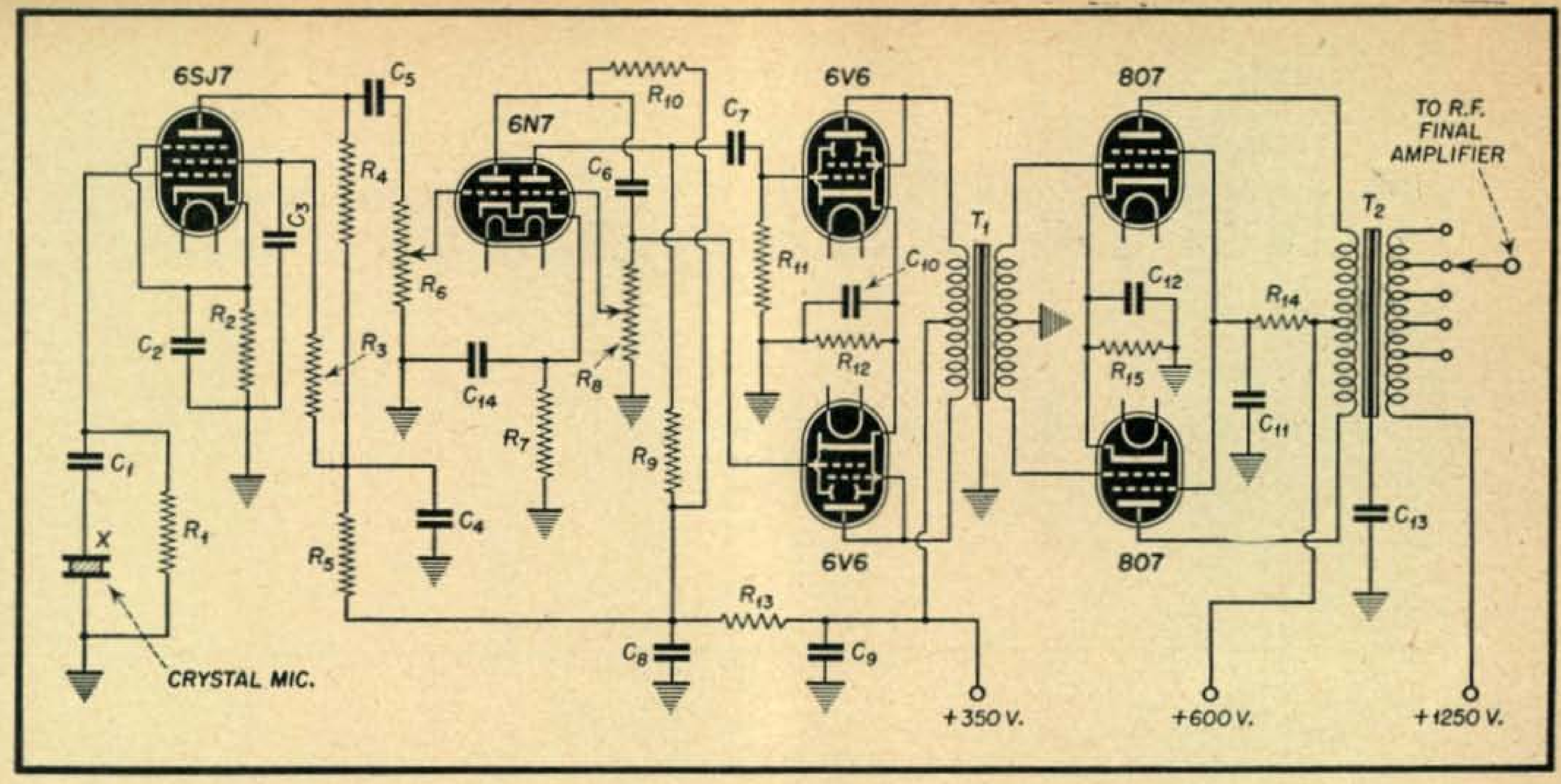


Fig. 2. Speech and modulator unit of transmitter

C18-100 μμf
C1 -.1 μfd, 300 volts
C2 -10 μfd, 300 volts
C3 -.1 μfd, 300 volts
C4 -4 μfd, 400 volts
C5 -.1 μfd, 300 volts
C6 -.1 μfd, 300 volts
C7 -.1 μfd, 300 volts
C8 -4 μfd, 600 volts
C9 -4 μfd, 600 volts
C10-25 μfd, 50 volts
C11-1.0 μfd, 800 volts
C12-25 μfd, 50 volts
C13-.05 μfd, 3000 volts
C14-10 μfd, 25 volts
R1 -1 megohm, 1 watt
R2 -1000 ohms, 1 watt
R3 -500,000 ohms, 1 watt
R4 -100,000 ohms, 1 watt
R5 -50,000 ohms, 1 watt
R6 -500,000 potentiometer
R7 -3,000 ohms
R8 -10,000 potentiometer
R9 -50,000 ohms, 1 watt
R10-50,000 ohms, 1 watt
R11-100,000 ohms, 1 watt
R12-200 ohms, 1 watt
R13-10,000 ohms, 5 watts
R14-25,000 ohms, 5 watts
R15-1,500 ohms, 10 watts
T1 -Interstage audio coupling transformer
T2 -Mod. output transformer, multi-imped-ance secondary
X -Crystal microphone

a very capable job of excitation. The 807 has been deliberately overloaded, and was found to hold up under such adverse treatment with apparently no ill effects. However, overloading is unnecessary for satisfactory operation under average conditions, as the efficiency established for amplifier excitation, with buffer and amplifier on the same frequency, is assured. When operated as an amplifier-multiplier on the higher-frequency bands, the efficiency drops off somewhat, and the 807 will not excite the amplifier fully for fone operation at 300 watts input.

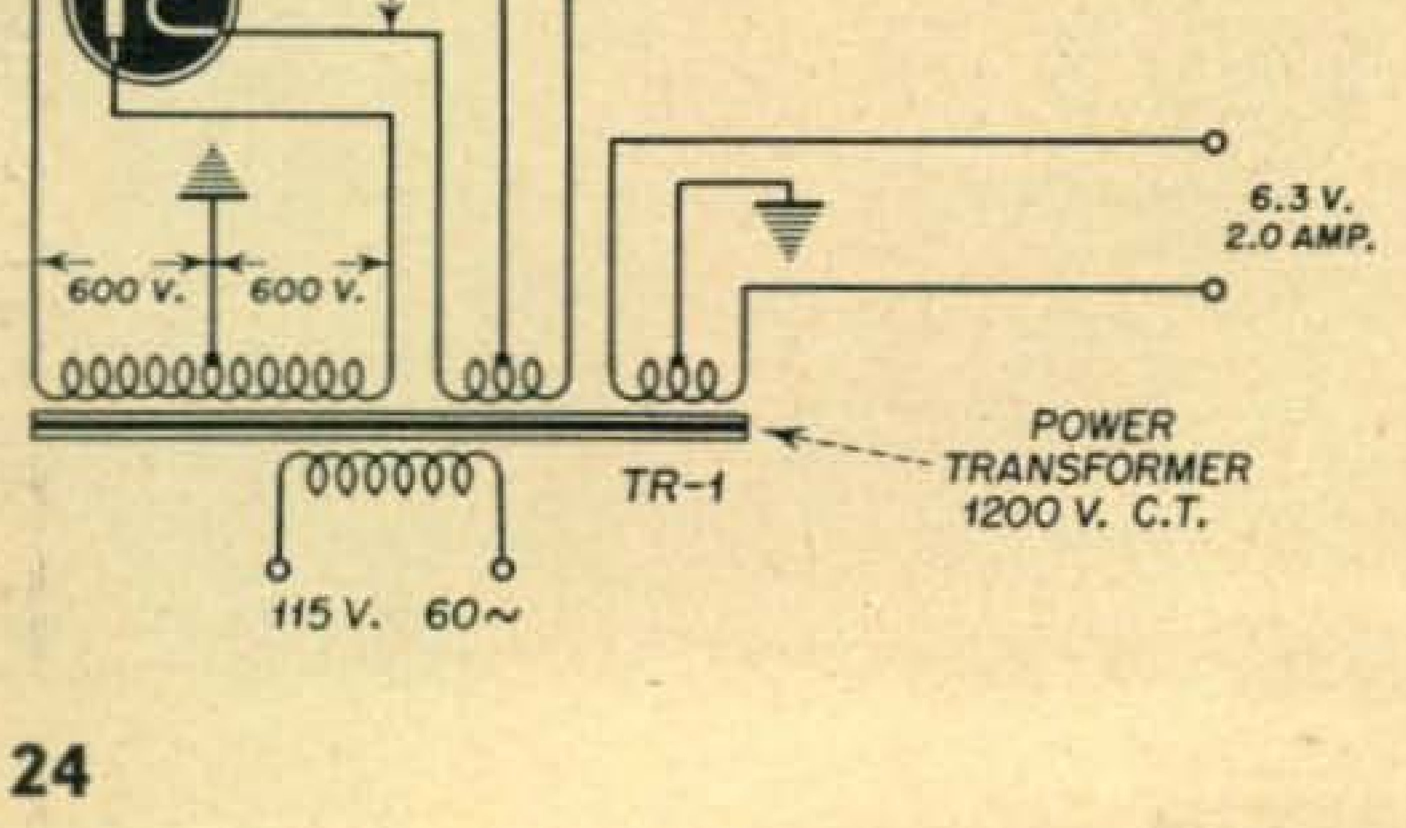


Fig. 3. Power supply for r-f exciter. A similar one is used for the modulator

TR-1 Power Transformer,
600 V. — 0 — 600 V., c-t.
filament windings for Rectifier and 6.3 V. for other filament requirements.
L1 — 25 H. 250 ma, choke
L2 — 15 H. 250 ma, choke
C1 — 4 μfd, volt capacitor
C2 — 2 mfd, 800-volt capacitor
R1 — 30,000 ohm bleeder, tapped, 100 watt
TR-1 Power Transformer, Tapped secondary,

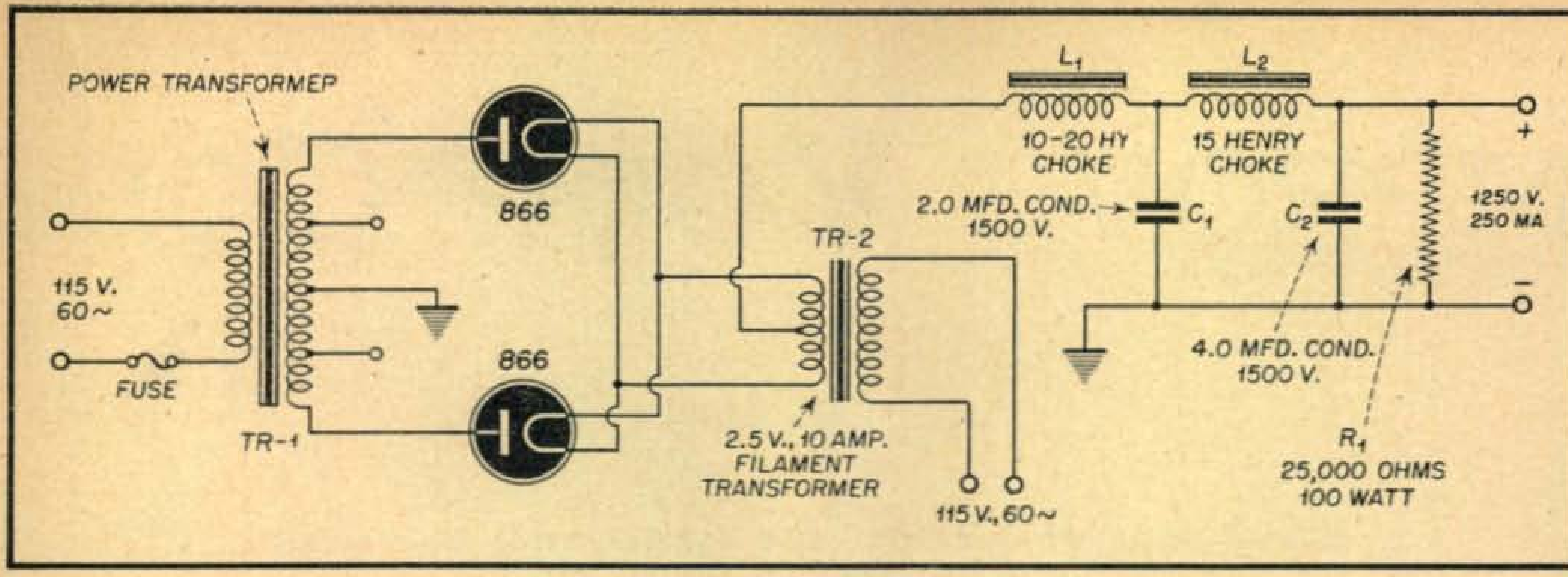


Fig. 4. Final r-f amplifier power supply. The power transformer is tapped at 1250 and 1500 volts each side of center tap

Uses Plug-in Coils

Plug-in type inductors are employed throughout the radio-frequency portion of the transmitter. This minimized mechanical and electrical problems, though plug-in coils may not be quite so convenient as the multiband switching units. The link coupling between the buffer and final amplifier must be adjusted individually for each set of coils. Home-made coils were constructed on readily obtainable commercial coil forms, thus allowing flexibility in adjusting the L/C ratios for top efficiency in the oscillator, buffer and final amplifier stages.

The 812 push-pull amplifier is operated on fone at a plate potential of approximately 1,250 volts from a power supply capable of furnishing 250 millamperes. The push-pull stage is easily neutralized, and once set requires no re-adjustment with band changes. The final amplifier is built around a Hammarlund PA-300 foundation unit—itself an efficient layout leaving little room for improvement. The "finals" are link-coupled to a remote antenna tunning circuit consisting of a parallel resonant circuit with two series variable condensers for antenna tuning.

The Speech Circuits

The speech amplifier and modulator are illustrated in the schematic of *Fig. 2.* The main features are relatively high gain and adjustable phase inversion. The choice of 807 modulators was a convenience rather than a planned calculation for the job. Though slightly overloaded on peaks, they nevertheless handled the power satisfactorily. A push-pull parallel scheme was tried with good results, but a heftier power supply is required for the additional load.

The modulation transformer is shown insulated from the common point of potential, and bypassed through a high-voltage condenser with low r-f impedance. The secondary of this transformer is tapped to facilitate matching the modulator load impedance to the final radio-frequency amplifier. The potentials set up during modulation make this a weak point, and extra precautions were in order.

Three Power Supplies Used

The circuit diagram of a 600-volt power supply is shown in *Fig. 3,* using an 83 mercury vapor rectifying tube with sufficient filter to reduce ripple percentage to negligible proportions. Two of these units are required, one for the r-f exciter with the bleeder tapped at 350 volts for the speech amplifier section. The second 600-volt supply takes care of the modulator alone. A third, 1250-volt power unit, with separate filament transformer, is used for the 812's. As shown in *Fig. 4,* a pair of 866's are combined in full-wave rectification. For cw operation, the modulator and

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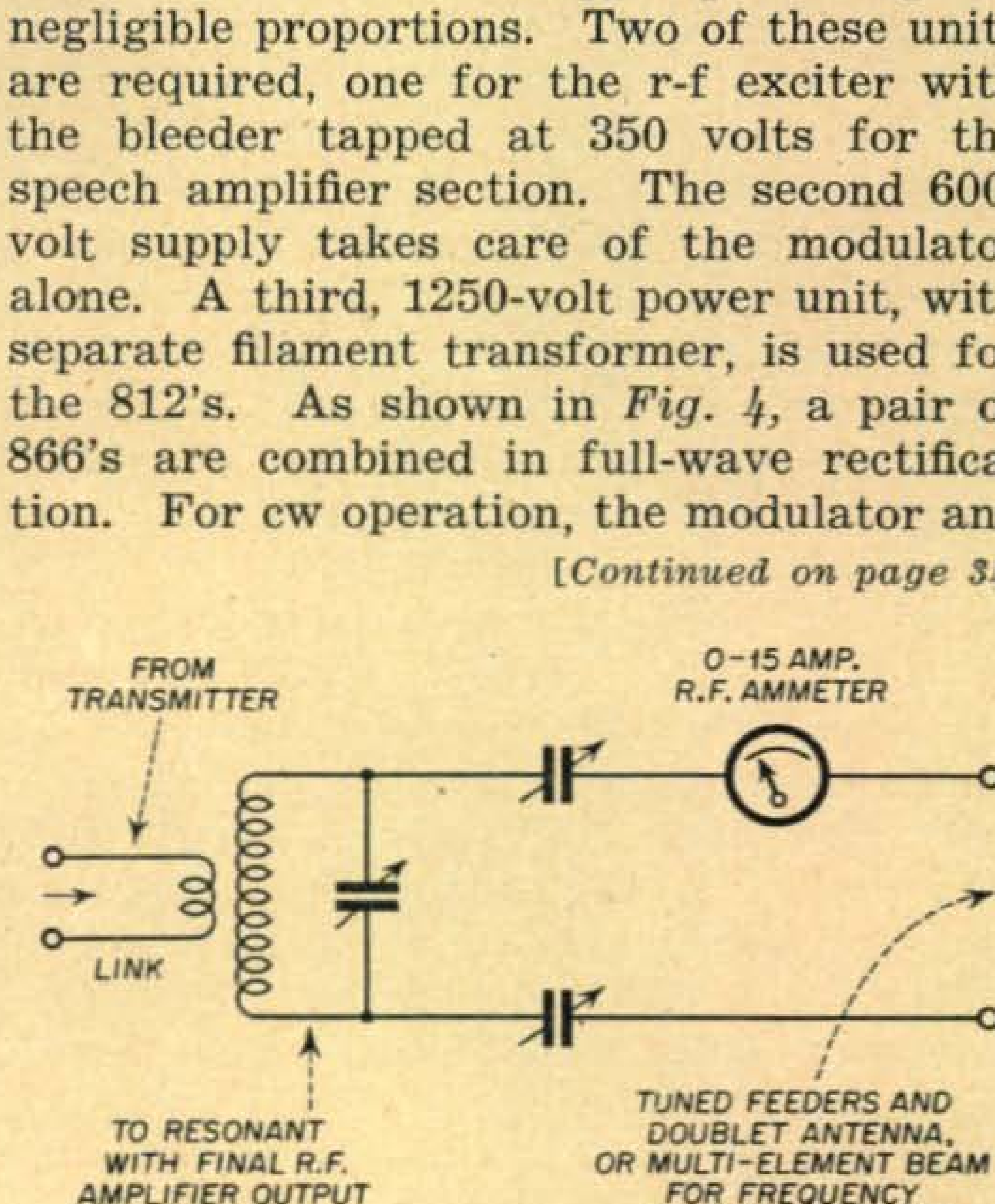


Fig. 5. Antenna coupling unit

IMPROVE YOUR CODE

JOHN M. BORST

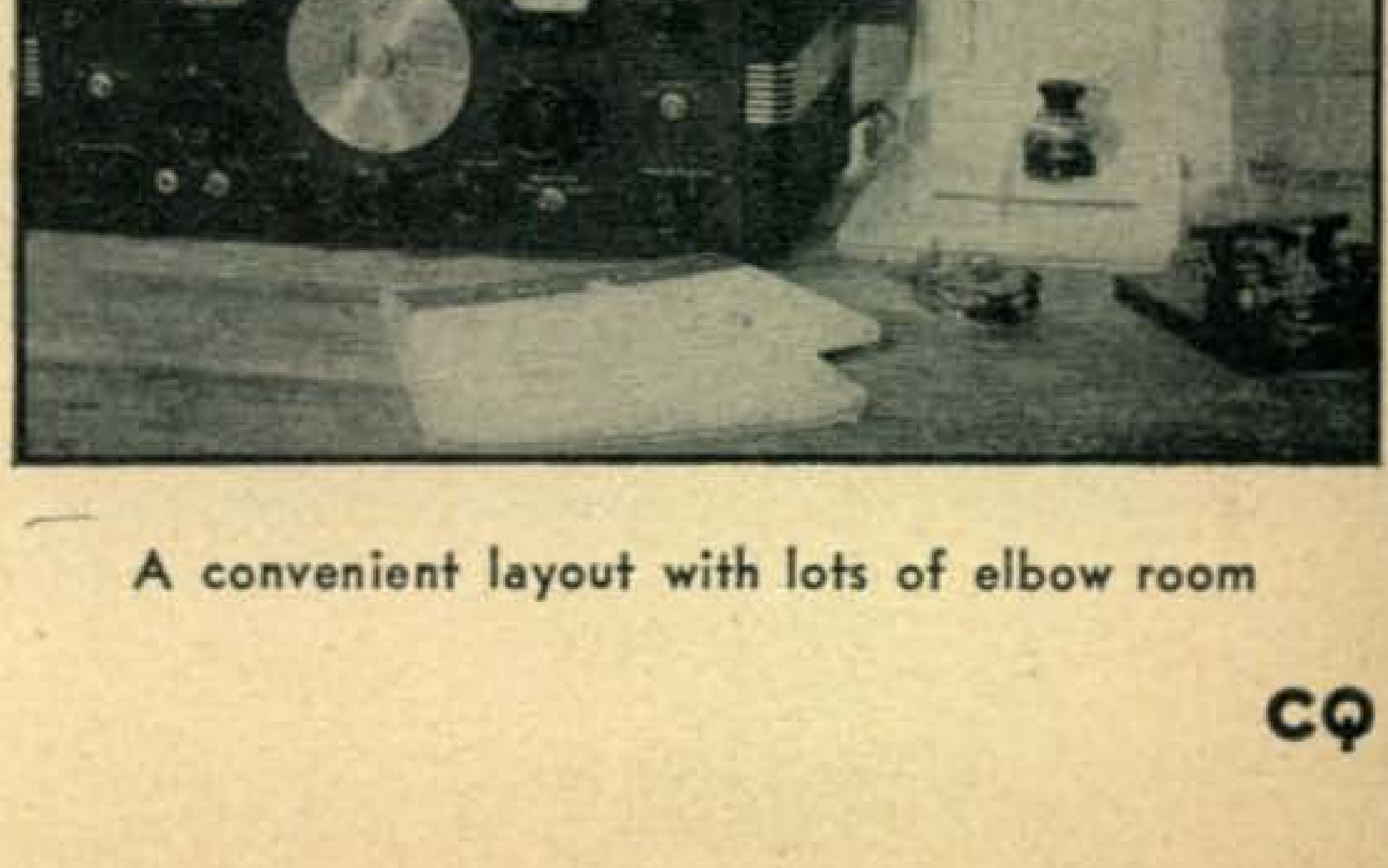
Useful dope on sending by a former code instructor

It is estimated that the ranks of amateur radio will be augmented immensely by returned and returning veterans who, in the armed force, have been associated with radio in some form or another. Many of these ex-GIs will have been taught just enough code to get by — and it is to these future hams, as well as the regular annual infiltration, that this article is directed.

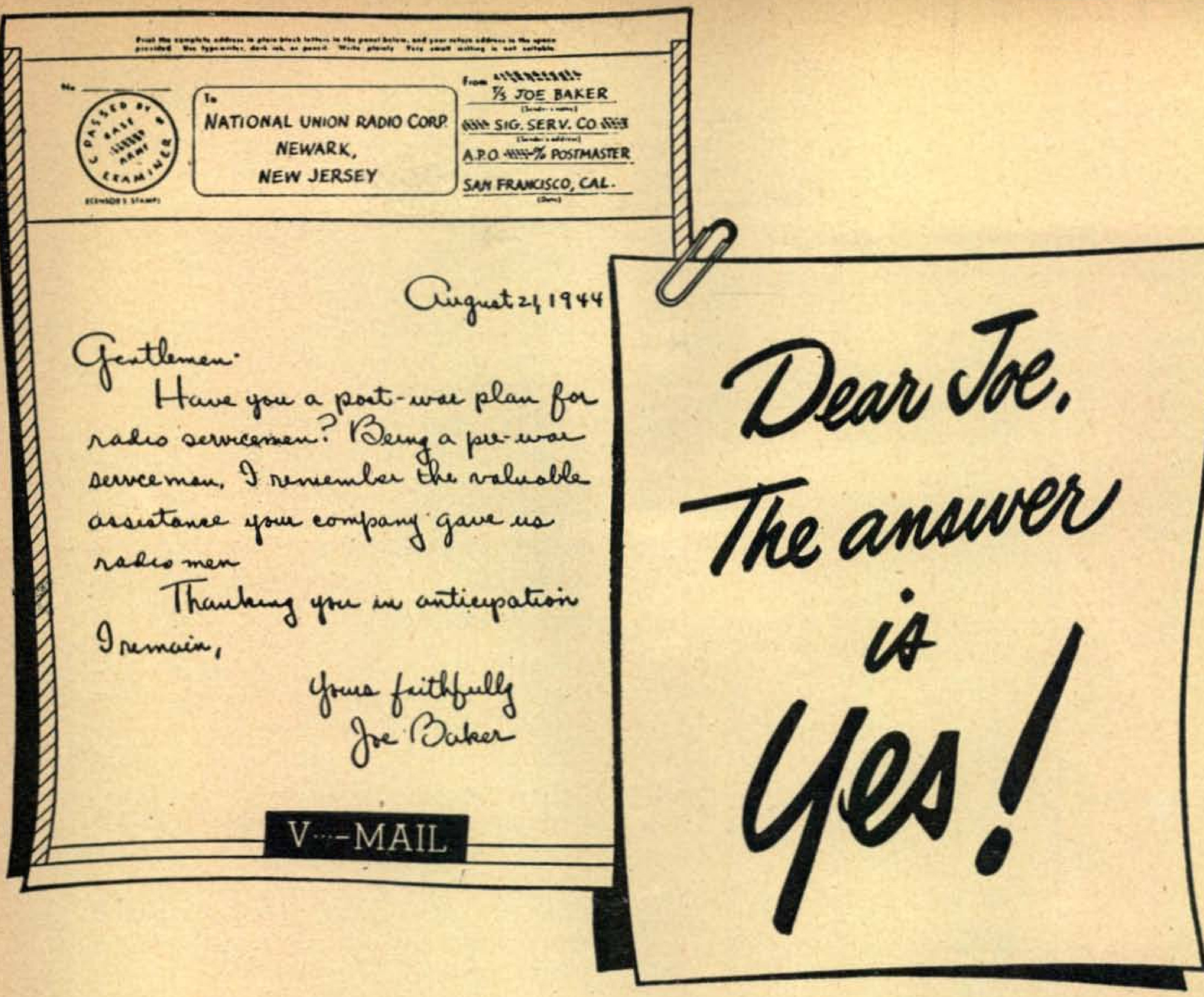
IN order that we shall know how to make the letters of the International Morse Code correctly, their formation has been defined by international agreement. At the Telcommunications Conference in Cairo, 1938, some minor code changes were made in punctuation characters. Not too much attention was paid to these revisions by amateurs prior to Pearl Harbor—from force of habit and because in formal communications "period" and "comma" are often spelled out. In rag chewing, punctuation is pretty much disregarded, except for the question mark (unchanged) and the exclamation point (ruled out completely, and the old ! is the new comma, (— — • • — —). However, there will be a vast new crop of post-war hams who will play the game strictly according to Hoyle, and it is therefore desirable that you get started off with the revised code. (But don't think that every MIM, that is — — • • — —, you will hear is a comma. Old timers, many who'll remember that it once meant "warning, high power," will still use it as an exclamation point.) Also, in improving your code, you are bound to encounter plenty of punctuation in copying the slower press dispatches—not to mention running into a bit of it when you're up before the R. I. ("Radio Inspector") for your code test. If your code symbol for period is • — • — • —, you have studied the revised code. (If you think • — • — • — is a comma, you're pre-1938, and are in for some exasperating unlearning.) Students studying code with the aid of an automatic transmitter, should make sure that the record or tape is transmitting post-Cairo morse.

Good and Bad Habits

There are definite relations between the lengths of dots and dashes and the spaces



A convenient layout with lots of elbow room



YES—and this National Union postwar plan for radio service men will be a bigger, better plan, with more of everything it takes to help you equip your shop and get the service business of your community.

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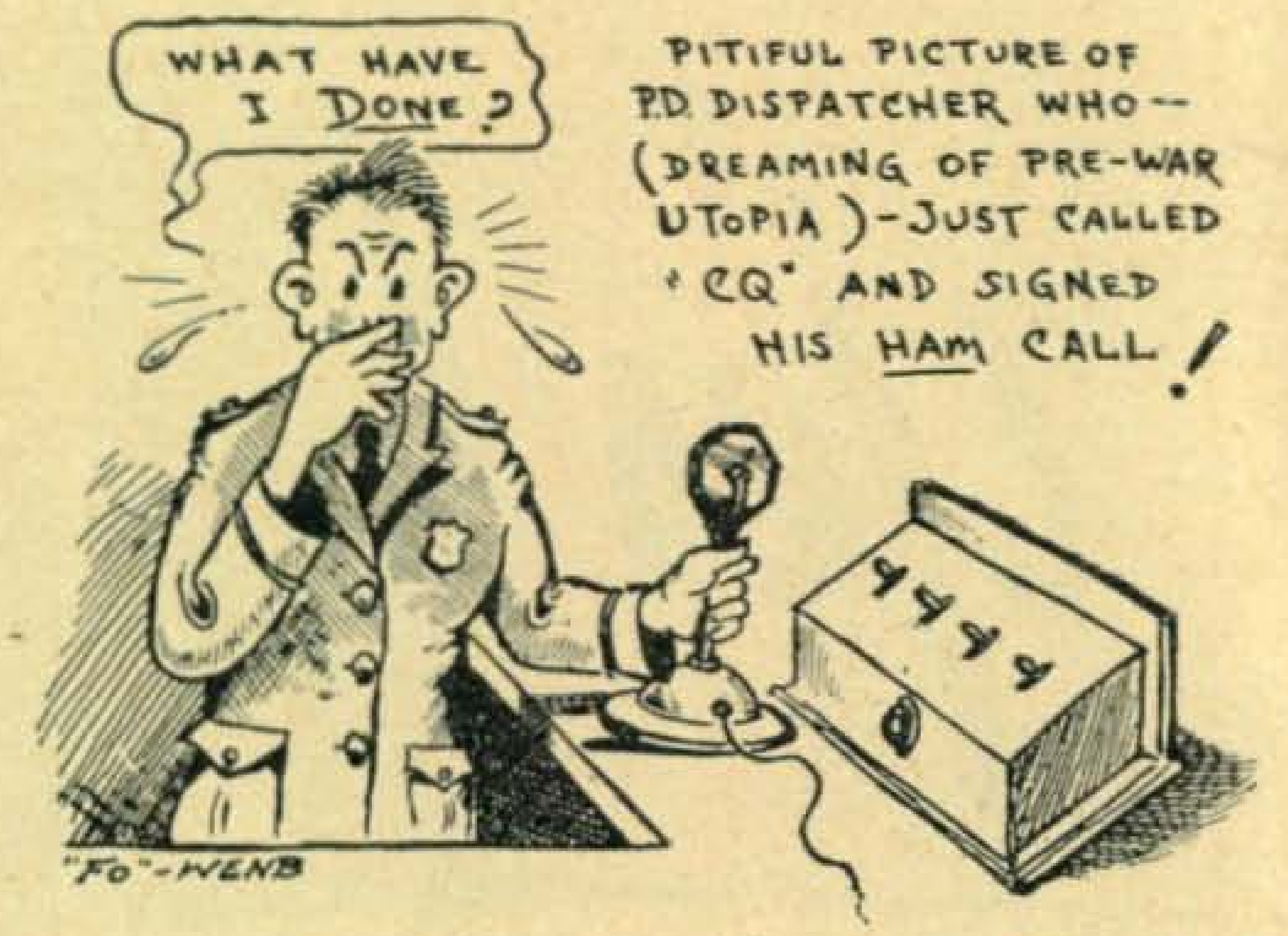
Good sending consists in maintaining these relations. Obviously, one must not, when sending the letter L for instance, hesitate after the dash. The operator on the receiving end will then not be sure whether one or two letters was sent, and he may copy it as AI.

Other typical faults are irregular lengths of dots and dashes, and poor spacing be-



(Courtesy APCO)

tween both letters and words. To avoid these errors, which can readily be solidified into iron-bound habits, it is permissible to exaggerate the correct spacing and the length of dashes in the early stages of the game. That is, make the spacing between letters much greater than the spacing between *parts* of a letter; similarly exaggerate the spacing between words, and stretch the dashes twice as long as they should be. Your sending will tighten automatically as you increase speed, and the chances are you'll end up transmitting excellent code.

Automatic Transmitters Help

As to equipment in code practice, either an inexpensive buzzer or a simple oscillator can be keyed. The latter is preferable because the tone is exactly the same as a radio signal. It is presumed that the reader has learned the code by the sound system, and is capable of recognizing individual letters, transmitted slowly, without writing down the dots and dashes of which they are composed. (The code should be memorized as simulated sound. Think of the letter A as "dit dah"—not as dot dash—and never write down the dots and dashes. This latter is an improper technique, and will hold you back—slow you up—because you'll simply have to unlearn it.)

In the beginning, it is a great help to have an experienced operator send to you, so that the sound of properly made characters can be impressed upon the memory. Automatic transmitters are not too expensive, and are also of considerable aid in the home study code. They will transmit perfectly formed characters at any desired speed. (Incidentally, always set the transmitter just a trifle faster than is comfortable.)

Key Technique

According to theory and the best texts, the key should be placed and handled in a certain way. It should be fastened to a table or a large board which can be positioned on the table so that the key will stay put. The key should be about 18 inches from the edge of the table. Grasp the knob by the thumb and two fingers (somewhat as one might hold a pencil), the elbow resting on the table. All motions are to be made with the wrist and forearm—not with the fingers.

Actually, most operators develop a technique at variance with the rules. It's like learning, in school, to write according to some special system—Palmer Method of Spencerian. In the end, you'll scribble your own way, and probably turn out perfectly good and individualistic script. Some of the best operators don't hold the key at all, and merely sort of tap on the top of the knob with the first and second fingers. In some commercial installations, the key is mounted at the edge of the operating table—which we definitely do not recommend. Many operators place the key at somewhat of an angle in a natural writing position. Begin with practicing a series of dots and dashes—and as the song says, "take it easy!" When this elementary transmission is no longer strange, try combining the dots and dashes into letters.

A Metronome May Help

As we have said, an exaggeration in the length of dashes and the proportionate length of space is tolerable in the early

[*Continued on page 32*]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WASHINGTON REPORT

ROBERT Y. CHAPMAN, W1QV

ON OCTOBER 6th, 1944, President George W. Bailey and Secretary-General Manager Kenneth B. Warner, representing the American Radio Relay League at the FCC hearings, did a yeoman job in presenting the future picture of the ham field, by and for the amateur. They both stressed things to come as concerning an estimated 250,000 amateurs five years after the war, and asked for more frequencies above 60 megacycles. George Grammer, also on deck, was briefly questioned by FCC General Counsel Denny on interference experienced by amateurs from automobiles and diathermy apparatus. These queries were in conjunction with the long-considered FCC's idea of legislation to prevent interference from such sources. George told them about the beating we used to take on the 14, 28, 56 and 112-Mc. bands.

Leland C. Quaintance, chief of the FCC amateur service section, placed on record a two-page statement concerning amateur radio, which he declared was one of the oldest radio services—its development paralleling that of the entire radio art.

New Band Requested

K. B. Warner asked the FCC for an additional band of 21,000 to 22,000 kilocycles, because he believed there would be a substantial post-war increase in foreign amateurs—particularly the English-speaking hams. *In toto,* the following bands were requested:

1750 to 2050 kc	224 to 230 mc
3500 to 4000 kc	448 to 480 mc
7000 to 7300 kc	896 to 960 mc
14,000 to 14,400 kc	1792 to 1920 mc
21,000 to 22,000 kc	3584 to 3890 mc
28,000 to 30,000 kc	7168 to 7680 mc
56,000 to 60,000 kc	14,336 to 15,360 mc
112 to 116 mc	28,672 to 30,720 mc

—and it was also asked that rights be shared above the 30,000-megacyle band.

Warner offered an alternative plan of allocations if military requirements make it difficult to provide the requested "harmonic family" in the amateur allocations. Mr. Warner admitted, as part of his conclusion, that the demand for frequencies was great, but added that the amateur allocation was small, and the elimination of the ham would in no way greatly contribute to any other particular service for any length of time. He pointed out the contribution of amateur radio to the welfare and security of the nation, and amply justified our use of the amateur frequencies.

I have tried to jot down the fundamentals as I saw them during my attendance at the hearings. There are many more things that could be related—conversations with others there, and the usual lunch-time discussions about the future of amateur radio. These last considered the possible loss of some frequencies and the support and non-support by certain groups. It is still too early to state that we are going to have amateur radio as we knew it in the past. But if and when we do, it should be remembered that it will be no one person or one group that made it possible. Credit can go to everyone, from the representative body of the ARRL to the sales manager of Dots and Dashes, Inc.

Post-War Planning

I know that ham radio is well enough established to support itself with the aid of continued representation which up to now has been most impressive. Let us all find time and make sure that Amateur

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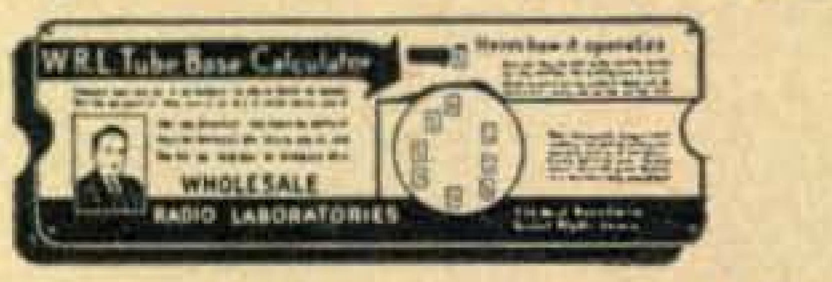

Here's just the calculator you've wished you had time and again. Designed especially for you by our engineers, this lightning-fast, slide-rule type indicator tells you in a jiffy tube characteristics that enable you to substitute available tubes for those hard to get. Send for your today. We pay the shipping expense. Mail 25c to LEO — Dept. CQ-1.

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Here's a gift from Leo that you'll want. It's a brand new reference map with amateur zones, short wave stations, major networks, etc. Printed in colors. Size 3½ x 4½ ft. It's yours. Send 15c to help with packing and mailing. Address Dept. CQ-1.

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CODE

[*Continued from page 28*]

stages of the game. However, exact timing can be practiced if the student has access to a metronome. For a dash, the key will be depressed during three beats or counts; then it will be up for one, three or five counts depending on whether the next space separates parts of a letter, letters, or words. For a dot, the key will be down for one beat. This method does not allow of much speed, but it does assist in obtaining the right timing, and has been successfully employed in some radio schools.

It's a good idea to send to a friend, especially in the beginning. If he can read the message there is that much more chance that the sending is okay. Regular practice is necessary to obtain speed and reliability. If a tape recorder is available, recording should be made at regular intervals. This shows visually such sending defects as exist, and the student will probably be surprised to see how bad his "list" is when he was under the impression that he was doing well.

When sufficient progress has been made, and some of the slowest material on the air can be copied, there is an unlimited opportunity for copying perfect sending. As a matter of fact you can start in almost at the beginning on a commercial station which, in a no-traffic period, keeps the channel open by sending a test signal over and over again. This test signal is usually the letter V or the sequence ABC, followed by DE (meaning "from") and the call-letters of the station repeated twice. You will quickly learn to recognize letters at surprisingly good speed with this practice. In addition, you can often locate a transmitter slowly sending coded code (cipher) in groups of five letters with each group repeated. Even if you do not possess a c.w. receiver, any all-wave radio will pick up a modulated (musical) code signal. When a letter is missed, don't try to think and recall what it could be. Doing this will prevent concentrating on the succeeding letters, and you may miss several words instead of just one letter. As we have suggested, it's an excellent idea to copy material which is not plain English —so that the coming letters cannot be anticipated (often a wrong guess!)

[*Continued on page 33*]

After attaining a copy speed of about fifteen words per minute, it will be difficult to increase speed without "copying behind." The inexperienced operator hears only one letter at a time, and writes that down. However, in order to keep up at higher speeds, it becomes necessary to recognize whole words as the unit, and not write down a letter of the word until the entire word has been understood. This technique will be acquired gradually—*and naturally*—as ability increases and one learns the often repeated short words such as "the," "and," "of," "for," "from," etc. Eventually, the good operator will copy several words behind.

To make fast and correct sending easier, many operators use an automatic or semi-automatic key—the "bug." But remember, the government examiner still requires sending with the "straight key. One type of bug consists of a weight and spring arrangement which will vibrate horizontally when a lever is pushed to the right. Dashes are made individually by actuating the knob to the left. The speed of the dots is adjustable by moving the weight—a pendulum effect. It is up to the operator to make his dashes at a speed correlated with the dotting speed. He must also connect the dots and dashes correctly—with smooth, even spacing.

Progress in code speed will appear erratic—but this is normal. There seem to be certain stages where an appreciable increase in speed takes a long time. But don't worry—you'll get by.

Universal Portfolio

"The History of Communications," interesting illustrated full page series of pictures and copy run in 1944 by the Universal Microphone Co., Inglewood, Calif. in radio magazines will be available in January as a pictorial portfolio with free distribution.

More than a dozen pictures will graphically show the advance of communications methods through the years with the creative work by Keith Thomas, Los Angeles artist. The scenes will include drawings from the Spanish-American as well as World Wars I and II.

Schools and colleges, and army encampments ahve used the series in cram courses and all of the illustrations will be of interest to ham ops.

They will be printed in size for framing for radio den or the ham shack, den or hobby room. A short descriptive of each stage in communications will be included.

TRANSMITTER

[*Continued from page 25*]

speech amplifier can be disconnected, and additional output secured by feeding the 812's from the 1500-volt position on the power supply.

New Taylor 813 Tube

Continuing the manufacture of beam power transmitting tubes under the RCA license, Rex L. Munger, Sales Manager of Taylor Tubes, Inc., 2312 Wabansia Avenue, Chicago, has announced that production has been started on the 813 tube.

The Taylor 813 is a beam power tube of extremely high sensitivity with a maximum plate dissipation of 100-watts. It requires less than 1-watt of driving power to produce about 260 watts when used on CW; and it need not be neutralized in circuits which provide adequate shielding. The tube utilizes low screen current and, when used as a frequency multiplier, is able to generate a high harmonic output at high efficiency. It can be operated at maximum ratings up to frequencies of 30 MC and with reduced ratings up to 60 MC. Maximum CW output is 360 watts, and plate modulated output is 240 watts, when operated in class C. Mounting is either vertical or horizontal, but in the latter case the filament must be kept in a vertical plane.

The tube is 7½ inches maximum overall length, and has a maximum diameter of 2 9/16 inches. It has a medium metal plate cap and is fitted with a giant 7-pin base of ceramic construction surrounded by an aluminum shell.

Electrical characteristics: Filament (thoriated tungsten) voltage—10 volts a-c or d-c at 5 amperes; transconductance for plate current of 50 ma is approximately 3750 umhos; interelectrode capacitances—grid to plate (with external shield)—o.2 (max.) mmf, input—16.3 mmf, output—14 mmf.

WASHINGTON

[*Continued from page 30*]

Radio has a post-war plan that is so sound and practical that the powers that be will recognize it as such. Let's make our biggest post-war program the assignment of good, practical frequencies. Rather not worry about whether they are for fone, television or fax. Let's get the frequencies first! After we have them, they should be used as the majority wishes—just as before.

You fellows no doubt know that pressure is on for certain spectra in our bands. The ole 160 band is having a tough struggle. Then there are the television and frequency modulation services banging the 56 and 112-mc sectors. The RTPB demonstrated these facts, and from such pressures came the new 21,000 to 22,000-kc band proposal.

One Class of License

This band would offer us a new field—one that would keep the dx boys happy on both code and fone. It would be an excellent international band, opening up many new opportunities for the gang, with very little conversion of the old rigs. I feel, in all fairness, that the new band (if and when we get it) should be open to the holder of a Class B ticket. As a matter of fact, I hope some day that we shall have only one class license—a ticket identifying us as amateur radio operators. The requirements would cover a specified code receiving and transmitting speed, and a practical examination. I hope that it stays within the range of the average fellow—below the grade of a senior engineer. And my reason is plain and simple. There will be youngsters who have not grown up with the radio industry, the ARRL, our ham traditions and training. Let's not require them to be graduated from an engineering college before they can pass the test for an amateur license.*

This is all post-war planning. Yes, gang, these were some of the subjects rag-chewed around the luncheon tables in Washington. It sure meed good to find everyone still interested enough to think and talk ham radio! And, brothers, I want to tell you right now, there's only a few of the gang who doesn't dream about the rig he's going to have as soon as this mess is squared away! New antennas, tubes, circuits, better receivers, more stable E.C.O.s, better power supplies, more watts per dollar, cheaper scopes. It's gonna be a great world!

* CQ does not agree 100% with W1QV on this issue. While we don't believe that breaking into ham radio should be made too difficult, the present Class B license takes care of the "entrance requirements." The more advanced Class A ticket has always been something for the amateur to shoot at in the perfection of his ability and technique. It has done much to minimize congestion on vital bands. And let us not forget that, in fighting for our privileges, our bands, our very existence on the air, we may, again and again, have to demonstrate our technical fitness on a higher and higher plane.

FCC Extends Ham Licenses

At a session of the Federal Communications Commission held at its offices in Washington, D. C., on the 28th day of November, 1944;

WHEREAS, The Commission has, pursuant to Order 115, adopted May 25, 1943, reinstated and extended for a period of three years from their expiration dates the terms of certain amateur radio operator licenses which by their terms had expired or would expire between Dec. 7, 1941 and Dec. 7, 1944; and

WHEREAS, The wartime conditions which made adoption of the said Order No. 115 necessary continue to exist;

IT IS ORDERED THAT:

1. Every amateur radio operator license which by its terms expired during the period December 7, 1941 to December 7, 1942, inclusive, but the duration of which has been extended by Commission Order No. 115 for a period of three years from the date of expiration provided therein, is extended for a period of one year from the date of expiration as extended by Order 115.

2. Every amateur radio operator license issued during the period December 7, 1941 to December 7, 1942, inclusive, is hereby extended for a period of one year from the date of expiration provided therein.

PROVIDED, However, That the provisions of this order shall not apply to any amateur radio operator license that has been or may hereafter be finally suspended by Commission order, or voluntarily surrendered by the licensee, nor to any amateur radio operator license who fails or has failed to comply with provisions of the Commission's Order No. 75 as amended.

3. The provisions of Section 12.26 of the Commission's Rules and Regulations to the extent such provisions are inconsistent with this order are hereby suspended until further order of the Commission.

POWER SUPPLY

[*Continued from page 21*]

will give R_5. Subtracting R_5 from Ra provides the resistance of R_4.

The theoretical minimum output voltage Ea is limited by the value of the bias on the amplifier tube, obtained by the drop across the gas tube. The grid voltage required to neutralize the voltage in this particular case must be at least 105 volts. If the grid voltage was tapped directly from the plus terminal, this voltage available at that point would have to be greater than 105 volts.

By shunting the gas tube with a voltage dividing network as in Fig. 8, and obtaining the cathode bias voltage from a potentiometer, the minimum output voltage can be made to approach zero.

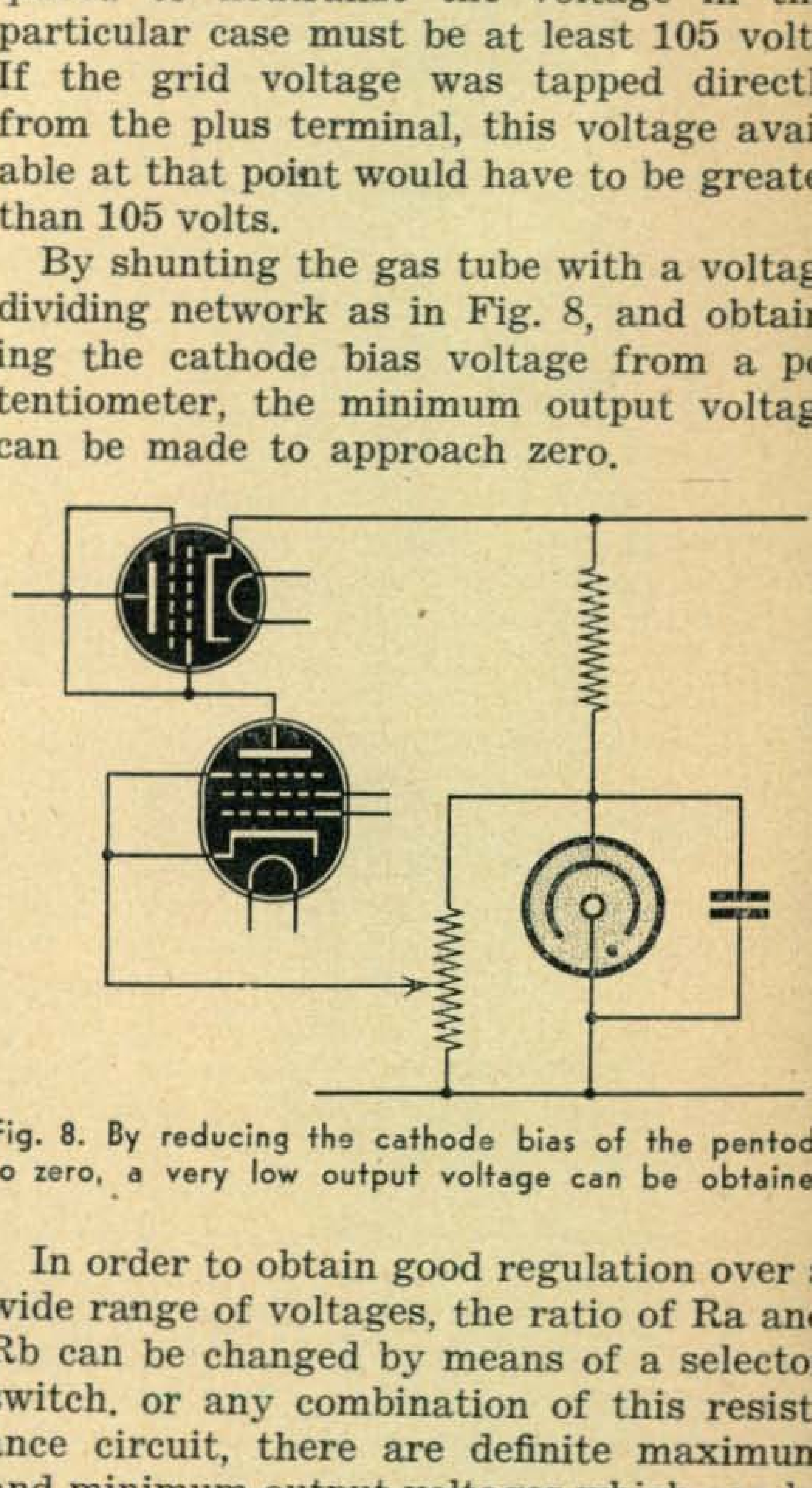

Fig. 8. By reducing the cathode bias of the pentode to zero, a very low output voltage can be obtained

In order to obtain good regulation over a wide range of voltages, the ratio of Ra and Rb can be changed by means of a selector switch, or any combination of this resistance circuit, there are definite maximum and minimum output voltages which can be obtained with some degree of regulation.

If a milliammeter is available, the addition of switch SW-3 and the proper multiplier Rm will permit the use of the meter to measure output voltage in switch position *A* and load current in switch position B. The value of the multiplier resistor Rm must be determined for the particular meter that is used.

The jumper A-B in the positive lead from the rectifier is contained in the base of the gas tube between pins 3 and 7. If the gas tube should be removed accidentally no bias would be applied to the grid of the series tube V_1 and possible damage to the load may result because of the increase in current V_1.

The following comments concern possible faulty operation of the regulator circuit.

1. *Excessive Hum:*
   a. Operation beyond the limit of the power supply.
   b. Line voltage less than 100 or more than 130.
   c. Defective tubes.
   d. Open filter condensers.
2. *Low voltage.*
   a. Defective rectifier.
   b. Defective series regulator tube.
3. *High Voltage:*
   a. Defective VR-05 or V_2.
   b. Defective resistors in the regulating circuit.
4. *Poor Regulation:*
   a. Operation beyond the limits of the unit.
   b. Change in the operation point of the tubes.
   c. Excessive line or load fluctations.

Hallicrafters Ham Shack

The Hallicrafters Company, Chicago, producers of the SCR-299, mobile radio communications unit, and other high frequency radio war equipment, saluted the wartime achievements of the nation's amateur radio operators with the official opening on Oct. 16 of a radio ham "shack" at 643 North Michigan Avenue, Chicago.

The "shack," fully equipped from the company's stock, was dedicated to the more than 25,000 radio hams in the military services. A service flag, commemorating the hams' military service, was presented by Chet Horton, member of the Hamfesters Radio Club of the Chicago area, to the American Radio Relay League, national organization of radio amateurs. Carol K. Witte, acting communications manager of the A. R. R. L., accepted the service flag for the League. More than 50 members of the Hamfesters Club were present at the ceremony.

The "ham shack on the boulevard" features, besides an exhibit of Hallicrafters electronic equipment, two detailed scale models as window displays. One shows a Pacific battle area and the other a small town and rural scene typical of what the nation is fighting to preserve.

MODULATION

[Continued from page 17]

70% to 71% modulation, and then install a compressor on the modulator which will permit raising the average modulation percentage to bring it up to what it would be were 100% modulation employed with no compressor—possibly even a bit further up for the average modulation percentage, which is what alone is really useful. But that's another story.

MICROWAVES

[Continued from page 15]

gated to whatever happens out in space between the antennas. Consequently, when you work with microwaves, you not only read currents and voltages on the various electrodes of your tubes, but you also plan to measure what goes on in the wave guide through which your radiant energy is traveling. You can do this by cutting slots in the guide at chosen points where they do no harm and inserting loops or probes. Probably a small rectifying crystal is connected to the probe and the results are read on a microammeter.

The thing that is usually desired in a wave guide is that there be a lot of energy there and that it travel in the direction that is desired. If everything isn't tuned up properly, this won't be the case. The energy will be reflected at various points along the way and head back to where it came from. If a probe is inserted into a wave guide and then moved along the guide this condition can be easily detected. If the energy is all moving in one direction the strength of the signal found by the probe will be uniform. If, on the other hand, there are waves traveling in both directions a standing wave is created and more energy is present at some points than at others. The ratio of the maximum signal that is observed in sliding a probe along a wave guide slot is called the SWR (standing wave ratio). This is an important measure of how a wave guide system is working and one you will hear more about. Unity SWR indicates optimum transmission while larger values indicate the presence of a reactive component.

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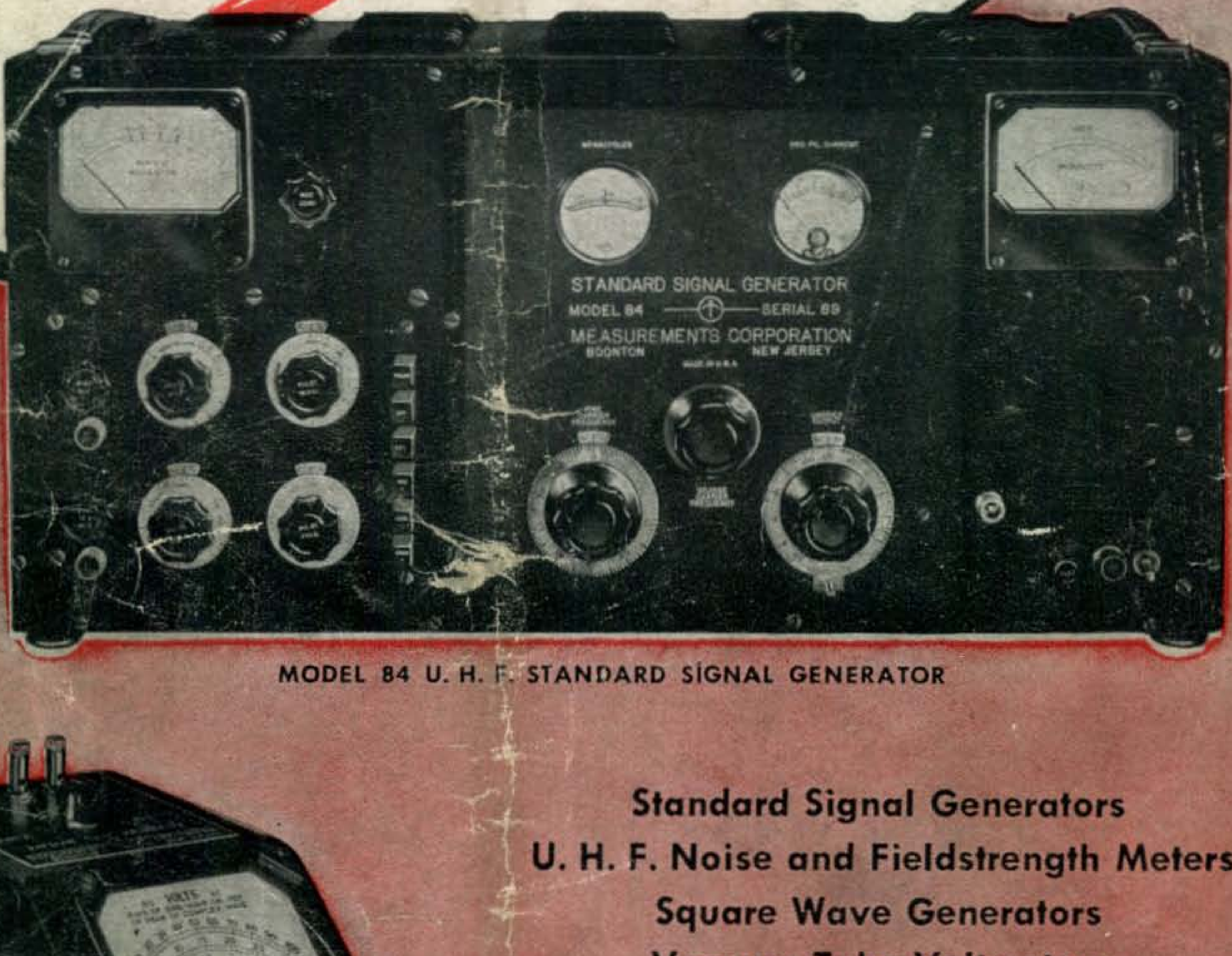

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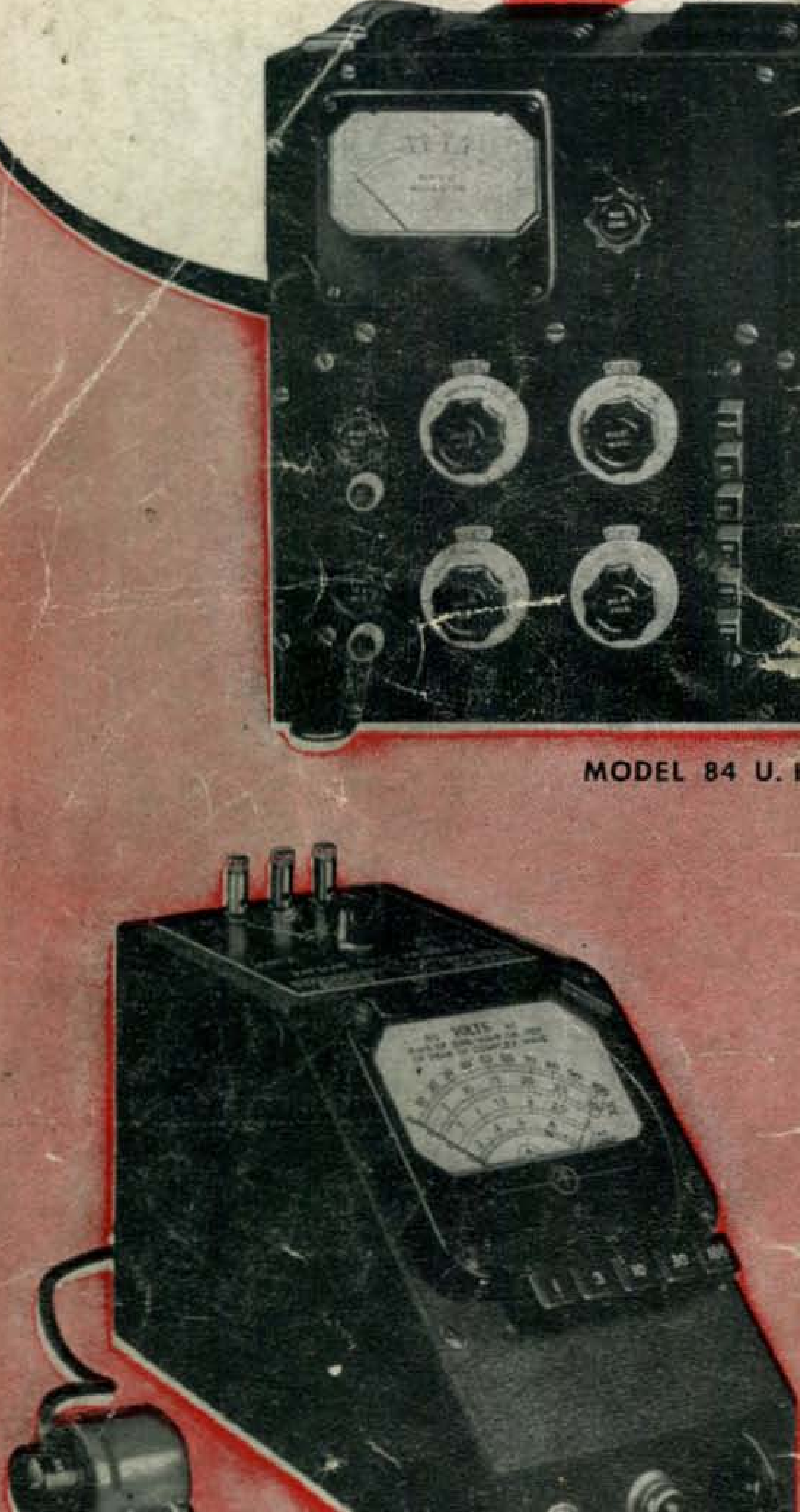

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