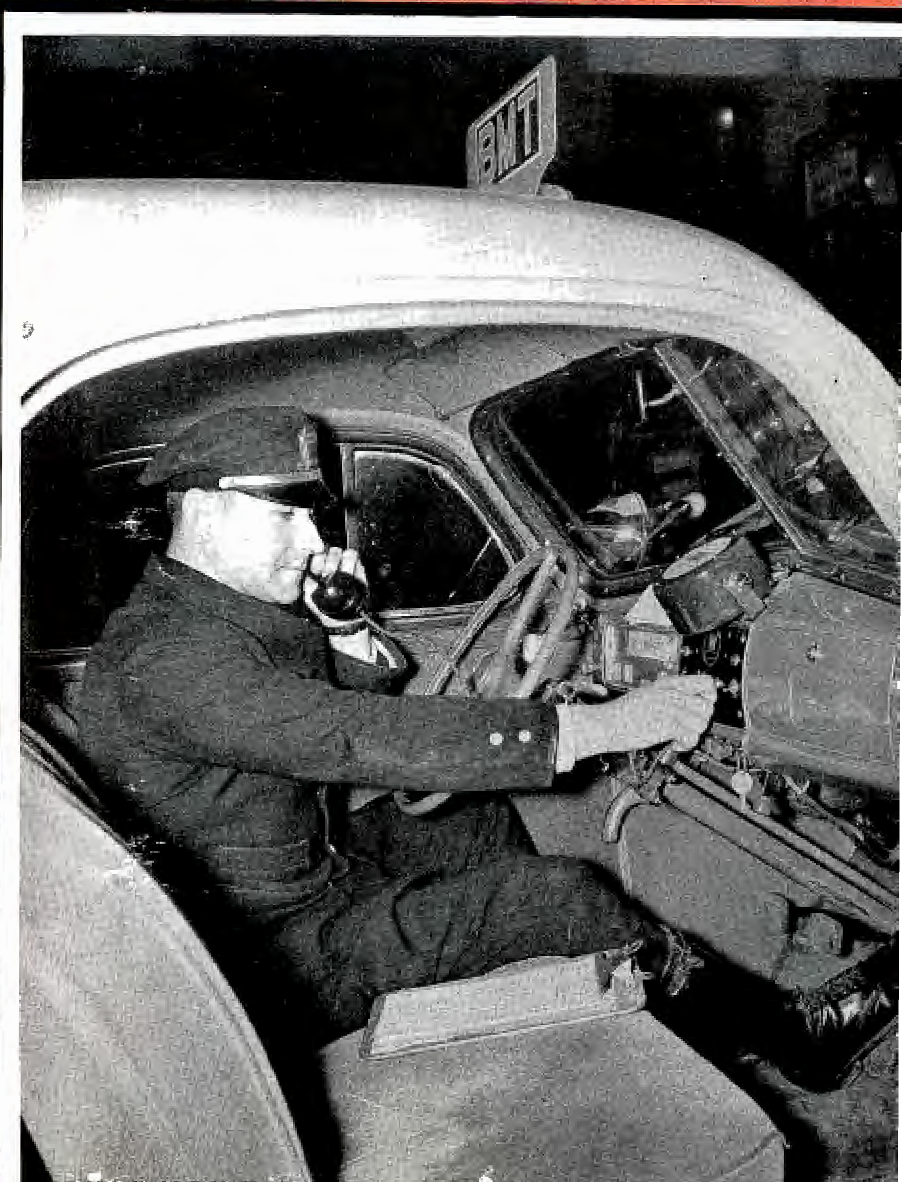
COMMUNICATIONS



BROADCAST
MEASUREMENTS

NATIONAL
DEFENSE

JULY

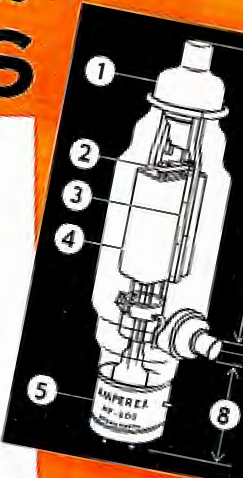
1941

For high power at ultra high frequencies

AMPEREX TUBES

At 60 megocycles 500 watts plate power output can be obtained from the Amperex HF-300. This tube, together with the HF-200 and HF-100, were developed by Amperex a number of years ago primarily for physiotherapy apparatus in which tubes capable of handling abnormally high currents at ultra high frequencies and at reasonably low voltage were required and none at the time available.

So universal was the recognition of the merits and efficiency of these tubes that now more than 70% of all diathermy ultra short wave generators are equipped with Amperex tubes and thousands more are in operation in almost every country in the world in broadcast, communication, amateur and industrial apparatus where they have replaced more costly or less efficient tubes.



Some of the design features which are responsible for the remarkable efficiency of these tubes at ultra high frequencies are as follows:

A high mu in combination with a high transconductance reducing requirements for grid excitation and grid power loss to a minimum.

Long insulation paths between electrodes, permitting the safe application of high voltages and reducing dielectric losses.

Extremely low interelectrode capacitances reduce the magnitude of circulating R.F. currents and permit more efficient circuit design.

① Large heat radiating area at plate terminal

② One insulating spacer between grid and filament only

③ Large area plate leads

④ Anode of graphite. The perfect heat radiating material

⑤ Standard 50 watt base

⑥ Long insulation path, grid to plate

⑦ Large heat radiating area at grid terminal

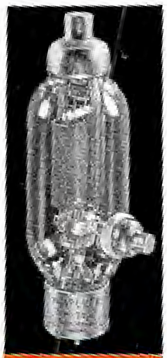
⑧ Long insulation path, grid to filament

Transit time power losses are reduced to a minimum in the AMPEREX high Gm planar filament structure without sacrificing the decided advantage of extremely low interelectrode capacitance.

300

nent voltage	11-12 volts
nent current	4 amperes
INTERELECTRODE CAPACITANCES	
to plate	6.5 mmf.
o filament	6.0 mmf.
to filament	1.4 mmf.
l conductance at 150 ma.	5600 micromhos
cation constant	23
ssipation	200 watts
wer output	500 watts

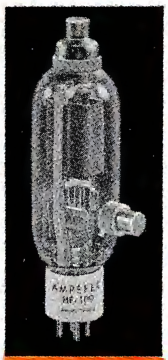
$35



HF 200

Filament voltage	10-11 volts
Filament current	3.4 amperes
INTERELECTRODE CAPACITANCES	
Grid to plate	5.8 mmf.
Grid to filament	5.2 mmf.
Plate to filament	1.2 mmf.
Mutual conductance at 150 ma.	5000 micromhos
Amplification constant	18
Plate dissipation	150 watts
Plate power output	350 watts

$24.50



HF 100

Filament voltage	10-10.5 volts
Filament current	2 amperes
INTERELECTRODE CAPACITANCES	
Grid to plate	4.5 mmf.
Grid to filament	3.5 mmf.
Plate to filament	1.4 mmf.
Mutual conductance at 150 ma.	4200 micromhos
Amplification constant	23
Plate dissipation	75 watts
Plate power output	170 watts

$12.50

Write for detailed engineering information

AMPEREX ELECTRONIC PRODUC
79 WASHINGTON STREET

COMMUNICATIONS

JULY
1941

Including Television Engineering, Radio Engineering, Communication & Broadcast Engineering, The Broadcast Engineer.
Registered U. S. Patent Office
Member of Audit Bureau of Circulations

VOLUME 21
NUMBER 7

RAY D. RETTENMEYER
Editor

•Contents•

COVER ILLUSTRATION

Radio speeds up 1,200,000 bus and trolley passengers along the streets of New York City every day. To streamline dispatching of trolleys and busses, the Brooklyn and Queens Division of the New York Transit System has equipped a fleet of 20 patrol cars with two-way police radios. Here, patrol car gets advance report on tie-up blocking a Brooklyn trolley line. Next step will be to re-route all trolleys approaching this area. The communications system was produced and installed by the Westinghouse Electric & Mfg. Co.

•Comments•

• • • • On July 1 commercial television broadcasting became a reality. Several stations are now on the air for approximately 15 hours per week, while a number of applications for construction permits have been filed with the Federal Communications Commission.

Contrary to what certain sources predicted, pioneer purchasers of television receivers will not be left out in the cold. Most television receiver manufacturers will soon adjust old sets to conform to the new standards without cost to the owner, dealer or distributor.

• • • • Plans are being made for the eighth annual conference of The Associated Police Communications Officers. The gathering will take place in Oakland, California, August 18, 19, 20 and 21. Further information will appear in our August issue.

• • • • A new type of subscriber broadcast service is proposed by Muzak Corp., New York City, in connection with a construction permit for a developmental f-m broadcast station which has been authorized by the FCC on an experimental basis. This organization now furnishes wired musical programs (without advertising) to hotels, restaurants, and home subscribers on a contract basis.

• • • • Appointment of a subcommittee of the Defense Communications Board to collaborate with a similar subcommittee of the Office of Civilian Defense has been announced by Chairman Fly of the DCB and FCC. Effective use of police radio systems during war or other emergency is one of the topics to be considered. Use of fire department communications systems will also be discussed.

• • • • Speaking before the Summer convention of the IRE, F. E. Terman, IRE president, described the enormously expanded work of radio engineers brought about by the Defense Program. Professor Terman pointed out that the extra demands upon the radio industry were accompanied by difficulties with Government regulation, and then made the excellent suggestion that the IRE be represented at future Government radio hearings.

Published Monthly by the
BRYAN DAVIS PUBLISHING CO., Inc.
19 East 47th Street
New York City
New York Telephone: PLaza 3-0483

BRYAN S. DAVIS
President

JAMES A. WALKER
Secretary

PAUL S. WEIL
Advertising Manager

A. GOEBEL
Circulation Manager

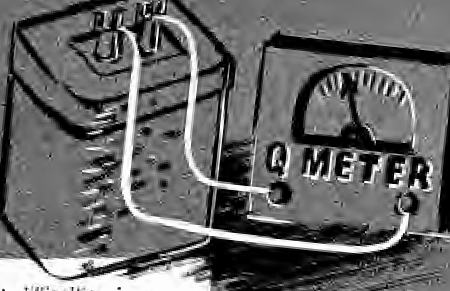
Chicago Office—608 S. Dearborn Street
Telephone: Wabash 1903

6

Wellington, New Zealand—Te Aro Book Depot
Melbourne, Australia—McGill's Agency

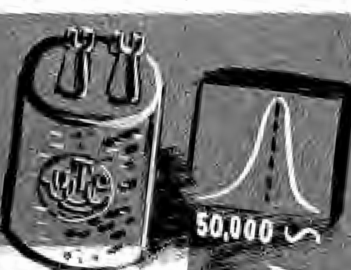
Entered as second-class matter October 1, 1937, at the Post Office at New York, N. Y., under the act of March 3, 1879. Yearly subscription rate: $2.00 in the United States and Canada, $3.00 in foreign countries. Single copies twenty-five cents in United States and Canada, thirty-five cents in foreign countries.

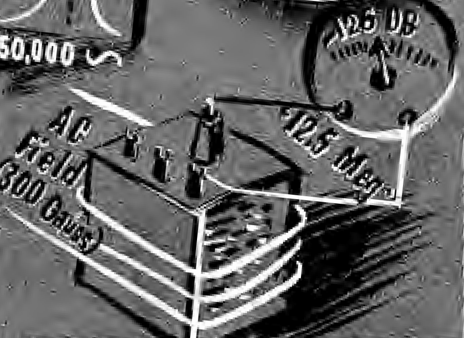
BELIEVE IT OR NOT



One of the greatest difficulties in producing high Q coils of compact construction lies in the variation of inductance with applied voltage. Considerable research at UTC has licked this problem. A good example is a solution to one customer's problem on a 1.5 Hy. coil having a Q of 85 at 2,000 cycles. While this coil weighs only four ounces, the change of inductance from 0 to 100 applied volts is only ¼ of 1%.

Light weight is one of the greatest problems in aircraft equipment. A typical UTC development along this line is an aircraft unit consisting of four complete band pass filters with a total weight of only 12 ounces.





One of the greatest problems in high Q coils is that of obtaining high inductance at high frequencies. The nature of one customer's application, however, led UTC to the development of a 1 Hy. coil having such low distributed capacity that the natural resonance frequency is 50 Kc. The Q at 10 Kc. is 150.

Few people realize the degree of safety factor in some submersion type transformers. One UTC test specification reads: The unit is submerged under hot salt water at 65 degrees C. This is followed by a submersion under cold salt water at zero degrees C. Following this it is submerged at room temperature for twenty-four hours. This cycle is completed five times. At the end of the week, the unit is cleaned off and the insulation resistance between windings must exceed one billion ohms.

High gain transformers with low hum pickup are a difficult problem. UTC developed a unit for one customer's application which is phenomenal in this respect. The transformer developed has a 500:1 ratio with a 50 ohm primary (secondary impedance 12,500,000 ohms). With this tremendous ratio and a rather compact structure, the hum pickup in a field of 300 gauss is limited to -126 DB.

UNITED TRANSFORMER CORP.

150 VARICK STREET ★ NEW YORK, N. Y.

EXPORT DIVISION: 100 VARICK STREET NEW YORK, N. Y. CABLES: "ARLAB"

Applying the
DYNAMIC SHIFT PRINCIPLE

By F. ALTON EVEREST and FREDERIC H. DICKSON

Assistant Professor, Electrical Engineering, Oregon State College

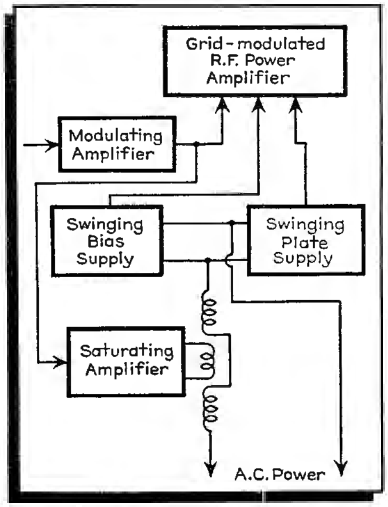
Junior Instructor, Radio Engineering, Air Corps Technical School

A description of the principles involved in applying audio-envelope-controlled voltages to a typical bias-modulated r-f amplifier to attain high operating efficiency and high output per tube.

THE advantages of conventional grid-bias modulation are well known, but the disadvantages of this modulation system are perhaps even more widely known. The advantages of negligible modulator power requirements are largely offset by the relatively low power output obtainable per tube. In the plate-modulated amplifier the side-band energy is provided by the modulator tubes, while in the bias-modulated amplifier the modulator has to supply only a share of the grid excitation (an insignificant amount of power) while the side-band energy is supplied by a change in the efficiency of the modulated amplifier over the audio cycle. This paper describes a method of placing the bias-modulated amplifier on a par (in many ways, at least) with the plate-modulated class-C amplifier.

The cause for the low output per tube lies in the fact that, to care for modulation peaks, the radio-frequency excitation of the stage must be materially reduced by the initial adjustment. While the tube is unmodulated, or modulated only lightly, a great proportion of the applied voltage exists as a voltage drop across the plate resistance, giving rise to a large plate dissipation. This is shown in the sketch of Fig. 1. The modulating signal is shown in Fig. 1 (a). An oscillogram of the voltage across the tuned load impedance of the modulated stage would look like Fig. 1 (b), which has the d-c axis restored. The voltage E_B is the d-c plate voltage applied to the stage. The radio-frequency is superimposed upon E_B and at any instance the instantaneous voltage existing on the plate of the tube is composed of two components, the load voltage appearing across the tank representing the useful signal, and the voltage appearing across the tube itself, which we will call E_{min}, reprenting the plate loss. In the conventional bias-modulated amplifier this minimum plate potential, E_{min}, is very large when the stage is not being modulated or only lightly modulated, as demonstrated by the resting condition of Fig. 1 (b). As the average percentage modulation of a typical broadcast program over a period of time is in the vicinity of 20%, it is obvious that the running efficiency is quite low. In other types of service there are long periods during which the stage is not modulated at all.

Fig. 2. Block diagram of dynamic shift transmitter showing means of expanding plate and bias voltages at syllabic frequency of modulating signal.



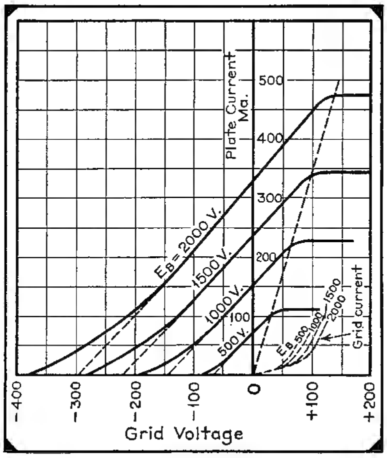
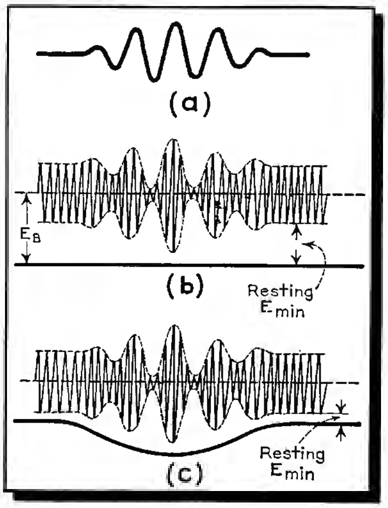


Fig. 3. Dynamic I_p-E_g characteristics for HK 154 tube for 4000 ohms load resistance, used in experimental transmitter.

The dynamic-shift principle is illustrated in Fig. 1 (c). Here the d-c voltage actually applied to the modulated stage varies, being quite low when unmodulated, rising to care for modulation bursts, and finally settling to some

Fig. 1. (a) audio modulating signal, (b) voltage across tuned load impedance of conventional modulated r-f amplifier, (c) voltage across tuned load impedance of expanding modulated r-f amplifier.



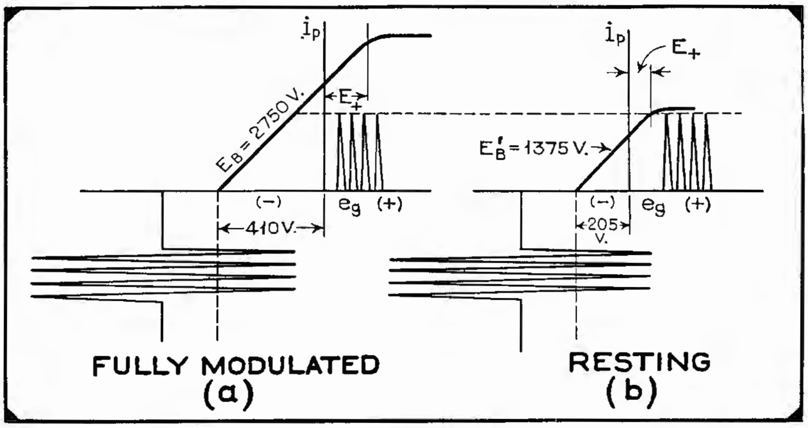


Fig. 4. Illustrating dynamic shift action. Note that carrier does not shift with changing plate voltage as long as portion of bias out to cutoff changes in like proportion.

resting condition that allows only a small value of E_{min}, thus resulting in high efficiency operation. This increase in efficiency results from lowering the power dissipated at the plate and for this reason the stage can be readjusted for greater output until the average plate dissipation approaches its rated value once more.

The plate voltage is shifted by means of control circuits actuated by the audio envelope at syllabic frequencies. Fig. 2 shows a block diagram illustrating this principle of operation. The audio voltage is passed through the modulator to the grid circuit of the r-f power amplifier for the modulation function. In addition to this, some of the audio signal is led to the saturating amplifier where it is rectified, and the syllabic signal whose characteristics are controlled by a suitable RC time-constant selection is amplified and passed through the d-c coil of a saturable-core reactor. The reactive drop across the a-c coils in series is determined by the amount of direct current flowing in the d-c coil. The a-c voltage applied to the primaries of the bias and plate supplies is therefore controlled by the envelope of the speech signal. When no speech signal is existing, a large drop occurs across the saturable reactor resulting in a low voltage on the power supplies' primaries and thus low plate and bias voltages on the dynamic shift power amplifier. As long as the ratio of the change in plate voltage to the change in bias remains equal to the amplification factor of the tube, the carrier remains constant.

Fig. 3 shows dynamic characteristics of a tube of the 50-watt class which was used in the experimental transmitter for a load impedance of 4000 ohms. Here it is seen that a shift in plate voltage causes the tube to act on a series of different dynamic characteristics, each having a different value of cutoff. It is obvious, then, that if the excitation and d-c bias remain constant while the plate voltage shifts, that the carrier power output will also vary. The advantages of the so-called "controlled-carrier" operation are somewhat doubtful, particularly in view of the manner in which the operation of automatic volume-control circuits of receivers are influenced adversely. The system here described enjoys *an absolutely constant carrier* by the expedient of having a bias supply which is controlled in the same manner as the swinging plate supply.

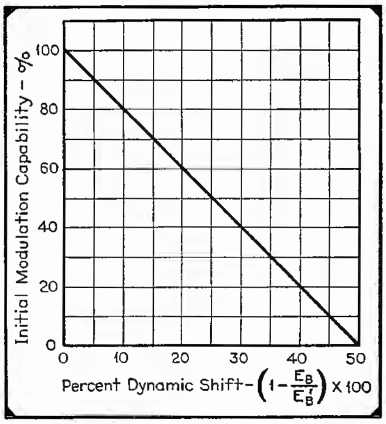
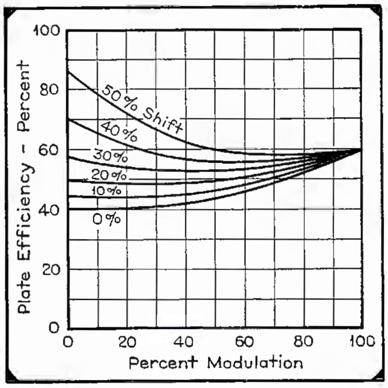


Fig. 5. Modulation capability from resting condition varies with amount of dynamic shift utilized.

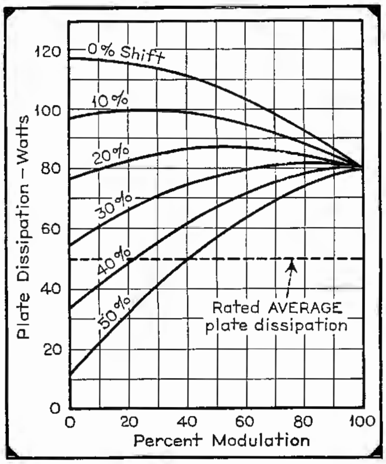
Fig. 6. Variation of plate efficiency with degree of sine-wave modulation for various degrees of dynamic shift for experimental transmitter.



The mechanism of keeping the carrier constant is shown in Fig. 4. Fig. 4(a) shows the dynamic characteristic fully expanded so that 2750 volts are applied to the plate of the bias-modulated stage. The bias out to cutoff is supplied by the swinging bias supply. In Fig. 4(b) the plate voltage has decreased to half which is termed a "50% shift." The swinging bias supply provides half the bias as before and therefore still furnishes bias to cutoff providing the same angle of plate-current flow as before and exactly the *same carrier power*. To insure this condition the ratio of change in plate voltage to change in bias voltage must always be equal to the amplification factor of the tube.

The major difference between the two conditions of Fig. 4 lies in the initial modulation capability. In Fig. 4(b) there is zero modulation capability until the plate and bias voltages have expanded somewhat, while at (a) 100% modulation is possible. Zero initial modulation capability (associated with 50% dynamic shift according to Fig. 5) is impractical at the present stage due to delays existing in the control circuits. That is, if the variable plate and bias voltages do not build up faster than the audio modulating signal, clipping of the signal will result with resulting momentary distortion. However, by using, say, 40% dynamic shift, one always has 20% initial modulation capability which, for many services, would be sufficient to avoid transient distortion on the steeper audio wavefronts. If the proper proportioning of swinging bias exists as explained in the preceding paragraph, the initial modulation capability is given by the following

Fig. 7. Variation of plate dissipation with modulation (experimental transmitter). Because high-modulation excursions are usually brief, *average* modulation percentage is of most interest.



$$\text{Initial modulation capability (percent)} = \left(\frac{2E_B'}{E_B} - 1\right) \times 100. \quad \ldots\ldots(1)$$

where

E_B = plate voltage under maximum shift conditions (100% modulation)

E_B' resting plate voltage.

Equation (1) is the equation of the graph of Fig. 5.

Speaking of this system in the transient aspect, i.e., over the modulation cycle, there are two factors which contribute to the variation of the instantaneous efficiency over this cycle. The first is that due to the increase in power output due to the modulation, and the second that increase in efficiency brought about by the dynamic shifting of the tube voltages. The increase in power output under modulation may be found by integration over an r-f cycle to find the average power. This integration shows that the average power output is related to the degree of modulation, m, by a factor of

$$k = (m^2 + 2)/2 \quad \ldots\ldots(2)$$

m	k
0.2	1.02
0.4	1.08
0.6	1.18
0.8	1.32
1.0	1.50

The above tabulation reveals the well known fact that under 100% modulation, the average power output is increased by 50%. In other words, the power output is increased by $m^2/2$ times. The figures to the right of the decimal point in the right hand column show the increase in power output.

There is an instantaneous change in plate dissipation over the modulation cycle also which must be considered. This relationship may be shown to be

Fig. 8. Comparison on basis of plate efficiency of same HK 154 tube (50-watt) used as dynamic shift and conventional grid modulated r-f amplifier. Carrier powers are 78 watts for dynamic shift compared to 35 watts for conventional.

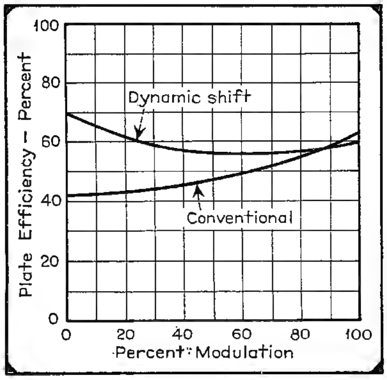
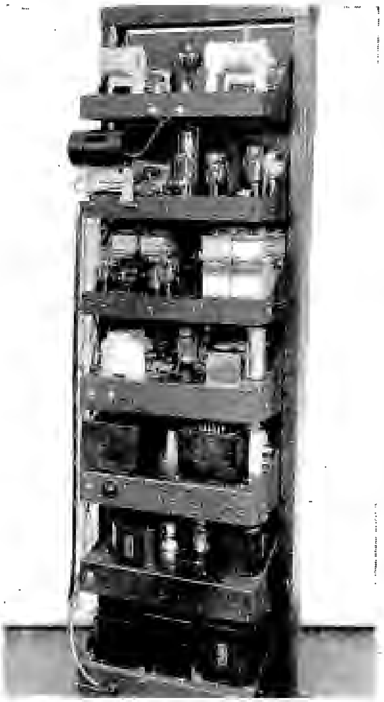


Fig. 10. Experimental low-power transmitter utilizing dynamic shift principle with oscillographic and other testing equipment.

• • •

Fig. 11. Rear view of experimental transmitter.



$$\frac{P_L}{P_L'} = 1 - \frac{nm^2}{2(1 - n)}, \quad \ldots\ldots\ldots(3)$$

where

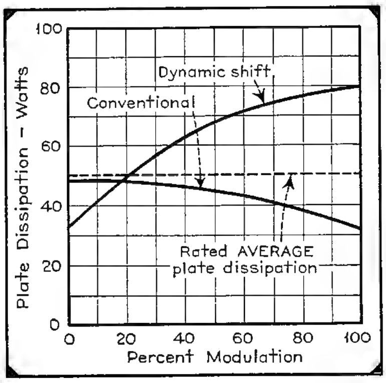
P_L = modulated plate loss

P_L' = unmodulated plate loss

m = degree of modulation

n = unmodulated efficiency.

Fig. 9. A comparison on the basis of plate dissipation of the two systems.



By using equations (2) and (3) and a conventional class-C amplifier analysis checked by graphical means, the families of curves of Figs. 6 and 7 were obtained for the tube for a load impedance of 4000 ohms and a fully modulated plate voltage of 2750 volts. Fig. 6 illustrates graphically the variation of plate efficiency with percentage modulation for values of dynamic shift from 0% to 50%. It will be noticed that all of the curves reach a common point at 100% modulation, but at lower modulation points there are much higher plate efficiencies for the larger percentages of shift. The values of plate efficiencies for zero or very low modulation percentages are most important because of the fact that the average modulation percentage over a period of time is quite low.

The companion to Fig. 6 is Fig. 7 which shows the variation of plate dissipation with modulation percentage. The *average* plate dissipation rated value is shown for comparison. For the particular combination shown, assuming a 40% shift, a percentage modulation of about 20% is possible without exceeding the average plate rating of the tube. Higher degrees of modulation may be cared for also, realizing that these high modulation excursions are normally of very short duration. In other words, if the percentage modulation averaged 21% over a period of time, the tube would be operated at its rated plate dissipation. The advantage of this type of operation is evident from the fact that for Figs. 6 and 7 a "50-watt" type of tube delivers 78 watts carrier capable of full modulation with practically no audio power required.

The comparison between the conventional and the dynamic-shift grid-modulated r-f amplifiers is brought out more fully in Figs. 8 and 9. Fig. 8 compares the plate efficiencies of the 40% dynamic shift case with a peak plate supply voltage of 2750 volts and a 78-watt carrier with a conventional bias-modulated amplifier having a plate voltage of 2100 volts, giving a 35-watt carrier. In addition to the more than 100% increase in power output, Fig. 8 shows the advantage the dynamic shift system enjoys in plate efficiency. The dynamic system has 70% resting efficiency while the conventional system has about 42%.

Fig. 9 compares the same two systems from the standpoint of plate dissipation. The dynamic system has a lower plate dissipation than the conventional system below 20% modulation, but higher dissipation for greater modulation percentages. The fact that the tube plate rating is exceeded momentarily bears little significance, for in usual service, the average plate dissipation would be about rated value.

In order that the severity of the clipping on the initial parts of suddenly applied audio signals of large amplitude be investigated, the oscillograms shown in Fig. 12 were taken. In each of these three oscillograms, the top trace is the d-c current which saturates the core of the saturable reactor. The strong 120-cycle component superimposed is due to the fact that in this particular reactor design, the windings are so arranged that little or no 60-cycle voltage is induced in the d-c coil, but nevertheless, the even harmonics are phased in such a way that their effect is aggravated. The presence of this 120-cycle component has no ill effects, however. The center trace is that of the swinging plate voltage, and it has a shape almost identical to the swinging bias voltage for both supplies utilize a two-section filter. The lower trace is a 200-cycle output wave which is obtained by rectifying some of the modulated radio-frequency energy taken from the final tank circuit.

In Fig. 12(a) it will be seen that no initial distortion or "clipping" occurs, for with no shift, the initial modulation capability is 100%. In (b) a 16% shift is used. Practically no clipping can be observed, although in the original oscillogram a slight change in waveform can be noticed. Fig. 12(c) demonstrates the momentary distortion resulting when a relatively great amount of shift (42%) is used. Here the distortion and "clipping" is clearly observed, but it is interesting to note that aural tests with shifts of this magnitude disclose a surprisingly small amount of noticeable distortion.

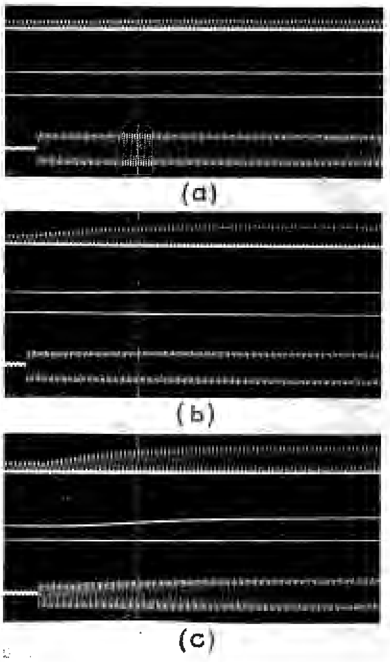
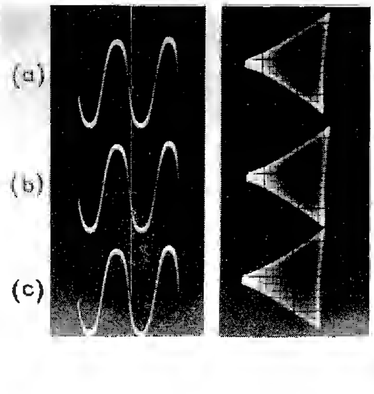


Fig. 12. Oscillograms showing degree of transient distortion as controlled tube voltages are caused to build up by sudden application of 200-cycle modulating voltage of sufficient amplitude to modulate final amplifier 100%. (a) 0% shift, (b) 16% shift, (c) 42% shift

The cathode-ray oscillograms of Fig. 13 were taken for the same conditions as those of Fig. 12 to show that once the initial period has passed, the waveshape and percentage modulation is the same for any degree of shift. The traces to the left show the constancy of the rectified output waveshape, while those to the right show modulation trapezoids for each of the three conditions of shift, which were obtained by applying modulated r-f to the vertical deflection plates, and the audio modulating voltage to the horizontal plates to show both the degree of modulation and the linearity of the modulated stage.

In conclusion it should be pointed out that any time delay will tend to clip the initial parts of the syllables, particularly for the greater percentages of shift. A careful oscillographic study of the delays existing in a typical laboratory transmitter of this type disclosed the fact that practically all of the delay existed in the power-supply filter. This power-supply delay can be decreased by the use of polyphase rectifiers which have smaller filtering requirements. Looking at the problem from another angle, a delay network could be inserted between the modulator and the modulated r-f amplifier to delay the audio signal long enough for the swinging voltages to arrive at the r-f amplifier to care for the modulation.

Fig. 13. Cathode-ray oscillogram comparisons to Fig. 12 showing constancy of rectified output waveshapes (left) and modulation trapezoid right for (a) 0% shift, (b) 16% shift, (c) 42% shift.



While this discussion has been based upon the saturable-core reactor as the control device, it is apparent that other methods would perform satisfactorily. For instance, grid-controlled rectifier tubes in the shifting power supplies should work very well. The ideal device would be one that would vary the d-c potentials directly rather than through the power supply. This would eliminate the delay in the power supply, but unfortunately, any such means of varying a direct potential directly which is known to the authors carries the disadvantage of a resistive power loss.

Appreciation of the early work of two former students in Electrical Engineering at Oregon State College, Messrs. Hugo Libby and Victor S. Carson, is gratefully acknowledged as well as the financial aid of the General Research Council of the Oregon State System of Higher Education.

References

(1) "A High Efficiency Grid-Modulated Amplifier Using a Saturable-Core Reactor," F. A. Everest, an unpublished Engineers thesis of Stanford University.

(2) "Dynamic Shift, Grid Bias Modulation," F. E. Terman and F. A. Everest, *Radio,* July, 1936, pp. 22-29, 80-82.

(3) "A New, High-Efficiency Linear Amplifier," J. N. A. Hawkins, *Radio,* May, 1936, pp. 8-14, 74-76.

(4) "Expanding Linear Amplifier Notes," J. N. A. Hawkins, *Radio.* June, 1936, pp. 63-67, 83-84.

• • •

SHORT-WAVE BROADCASTERS IN NATIONAL DEFENSE

Mobilization of America's most powerful short-wave broadcasting stations for national defense and the promotion of international good will was announced through the appointment of Stanley P. Richardson, veteran foreign correspondent, as international broadcasting coordinator for six leading companies in the field. Richardson has resigned his post as executive assistant to Chairman Joseph E. Davies, of the President's Committee on War Relief Agencies, to accept the appointment.

The announcement was made by a committee representing the National Broadcasting Company, the Columbia Broadcasting System, the General Electric Company, the Westinghouse Electric and Manufacturing Company, the World Wide Broadcasting Foundation and the Crosley Corporation.

FREQUENCY INDICATOR for R-F MONITOR

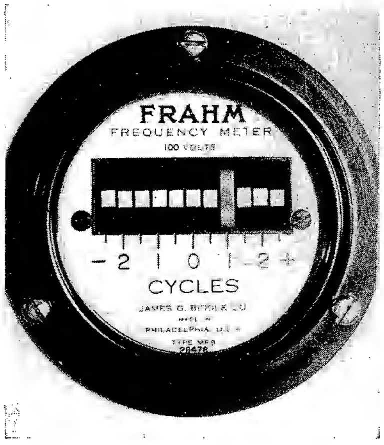
•*A continuously visible frequency indicator for a broadcast r-f monitor*

By LOUIS SUMNER BOOKWALTER

Director of Engineering
KOIN and KALE

ALMOST instinctively the chief engineer of the broadcast station plugged an ammeter in the ear phone jack of the r-f monitor. This told the operators at a glance that the transmitter was well within the specified limits, by the gentle swinging of the ammeter needle. The ear phone jack simply inserted the phone plug into the cathode lead of the detector tube. The detector tube had both the signal from the transmitter and the signal from the local monitor so the beat note was present. As the beat produced about a 5 millivolt swing, it was easily read on a d-c ammeter when plugged in this ear phone jack if the transmitter frequency was within a few cycles of the monitor frequency.

This procedure gave a very reassuring feeling that nothing had happened to the frequency of the station as the needle slowly beat before the operator's eyes. It was always a pastime of the crew to try to count the number of beats per second to ascertain the exact frequency deviation, as this method was more accurate than the official method employed by devices on the monitor. However, one never knew whether the deviation was plus or minus. Also when the transmitter was exactly on zero beat with the monitor, the ammeter would move so slowly that it was almost questionable whether the transmitter was exactly with the monitor or whether something had happened to cause the frequency to be so far off that the d-c ammeter needle could not follow the rapid pulsations. Even with these disadvantages, this device still relieved 99% of the worries of being off frequency between the half-hour periods that the operator was not actually reading the monitor in the approved method which is compulsory under the FCC regulations.



The frequency meter.

In complying with recent FCC regulations, the manufacturer has modified the monitor and sends an ammeter, a new name plate, and a sheet of instructions. The instructions state in detail that one must run the monitor 30 cycles below the transmitter frequency and also that a button must be pressed each time a reading is taken to determine the frequency of the transmitter. After analyzing the circuit, one can see that it is not practical to tie the button down to obtain a continuously visible frequency indication. The indication is obtained by the same relay and capacitor circuit that indicated the amount of deviation when the monitor was operating as the original model. The chattering noise of this relay operating would not do, as the relay was never intended for continuous operation; therefore the relay would probably get out of adjustment in no time.

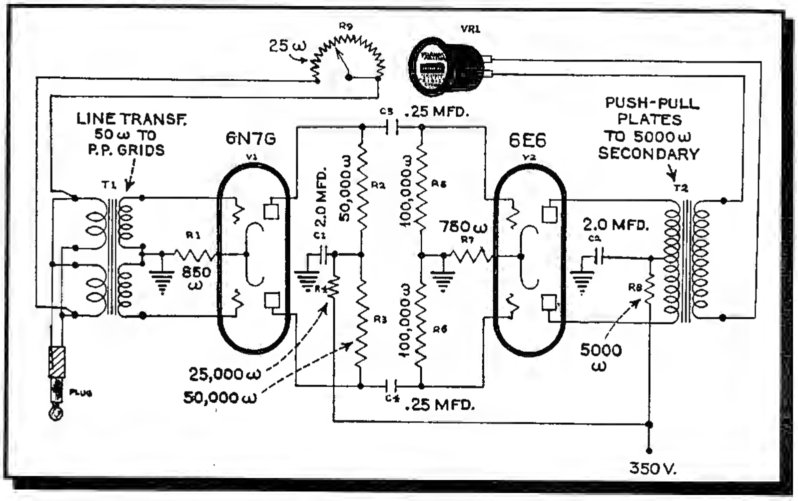
The ammeter in the detector circuit, of course, can no longer be used, as 30 cycles is too fast for the needle to follow.

I knew that everyone would be disappointed not to have something that would assure the operator at a glance that all was well without stepping to the monitor and pressing the button. I thought of all the ways that a continuously visible indicator could be made. The first thought, of course, is to use an oscillograph as the instructions recommend that one make the initial adjustments of the modification by comparing the patterns of the oscillograph when using a 60-cycle sweep. The disadvantage of this method lies in having to view a maze of lines crossing and weaving in and out to determine your frequency deviation. Also it takes close observation to determine whether it is minus or plus deviation. Then the question is always raised whether the power supply is always exactly 60 cycles.

The natural second thought was the many known circuits that will indicate frequency on a meter. These circuits usually require a well-regulated power supply and close routine calibration.

(INDICATOR—continued on page 26)

Circuit of the amplifier.



STRATOSPHERE

• *A laboratory chamber for reproducing stratosphere conditions*

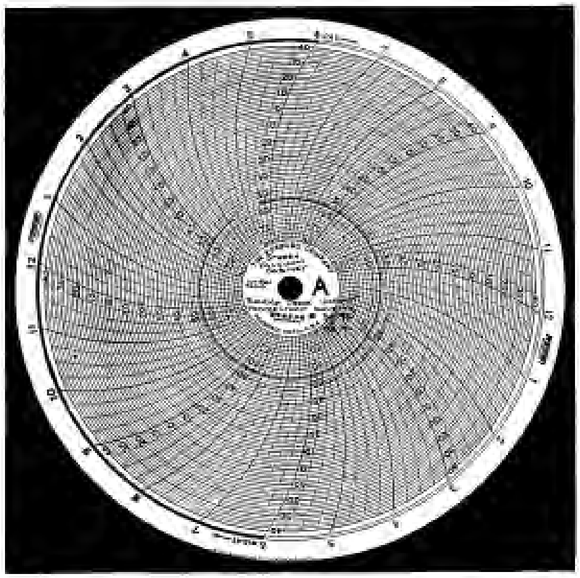


Chart A—Satisfactory trial run of humidity and high temperature control.

THE early experimenters in airplane construction had two major problems:

(1) To get the plane into the air
(2) To keep it there as long as possible.

Modern manufacturers while having these two prime difficulties solved for them, have advanced the science of aeronautics and thereby built themselves a new set of problems far more complex than any which beset such famous pioneers as the Wright brothers.

From the start it was realized that planes, to be commercially successful, must be capable of flying over natural and man-made hazards such as hills and roof tops. With the increase in range, it was demanded that planes be capable of crossing continent and ocean—capable of flying safely through the treacherous wind pockets in mountain ranges. With these advances, came new problems. In bad weather, ice began to form on the leading edges of wings and pilots found it necessary to have accurate instruments to guide them over new territory and save them from almost certain accident in "Ceiling Zero" weather. The manufacturers successfully overcame these difficulties as they arose and strove always to anticipate the troubles nature still had in store for them as they increased the speed and flying altitude of their planes.

Study and experiment have proved that there are many advantages in high altitude flying—sufficient, at least, to make the labor in solving the consequent difficulties well worth while.

During the last few years, attention has been focused on the sub-stratosphere—a rather vaguely defined area located between 20,000 and 50,000 feet. There are many reasons why it is desirable to fly within this range as any aircraft technician could more ably explain, but among his reasons he would surely include the greater speed attainable, the added comfort to passengers by flying above the stratum where air pockets and air sickness occur, the simplification of controlling schedules as delays caused by inclement weather would be reduced as the normal flying height is raised towards the permanent calm of the stratosphere. But more important is the added safety. The pilot's greatest hazard—ice forming into cakes on the leading edges of the wings is eliminated as he rises into the almost moisture-free atmosphere of 45,000 to 50,000 feet.

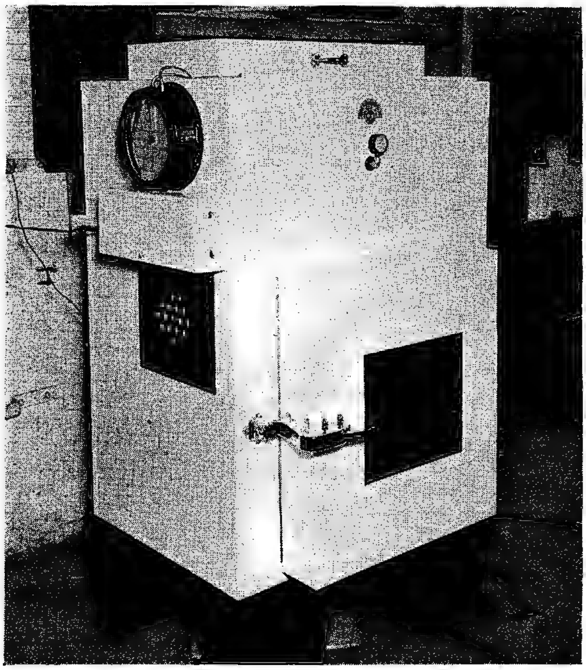
But with these advantages, we find many problems to be solved before sub-stratosphere flying becomes the normal form of transportation. Just as the Wright brothers did, we find ourselves with two major problems:

(1) The circumvention of the temperature condition existing in the sub-stratosphere. At 20,000 feet, a normal temperature of 24.6 degrees Centigrade below freezing may be expected, reducing to a constant of minus 55 degrees C between the altitudes of 35,000 and 80,000 feet.
(2) The circumvention of the vacuum condition which varies from 13.75" of mercury pressure at 20,000 feet to 2.132" of mercury pressure at 60,000 feet.

It is difficult to imagine any comfort in these conditions but warm clothing and efficient heating can easily make one feel comfortable irrespective of outside air temperatures, and oxygen tanks make breathing possible, if not comfortable.

Before considering comfort, however, it is more necessary to design the equipment which will make it practical to avail ourselves of the advantages of this cold but predictable stratum of rarified air. What type of carburetor will operate efficiently in an almost com-

Fig. 2. Modern simplified design of "stratosphere cabinets."



CHAMBER

By JOSEPH H. BURGES

Engineering Department
Tenney Engineering, Inc.

plete vacuum and also be capable of lifting the plane through the higher pressure regions? Do the electrical circuits function correctly? What machining tolerances should be allowed to prevent the jamming of moving parts as the temperature falls to minus 55 degrees C? Will the same directional control instruments operate accurately at high temperature as well as low? Is efficient radio communication practical under the conditions to be encountered? These are but a few of the many questions to be answered. The solutions can be economically determined only in especially designed equipment built to accurately reproduce at will, any condition likely to be encountered. This type of equipment is not limited in its usefulness to sub-stratosphere experimentation. Several manufacturers are also using equipment of this nature to test their normal production equipment.

The conditions normally to be reproduced in the "Stratosphere Cabinet" are:
1—Minimum Control Temperature.......... —40° C
2—Minimum Control Pressure................3" HG
3—Equivalent Altitude....................53,000 Ft
and normally included for flexibility of application are:
4—Maximum Control Temperature..........+75° C
5—Minimum Controlled Humidity..........Ambient
6—Maximum Humidity.......................95%

Fig. 1. "Stratosphere test chamber" as built two years ago.

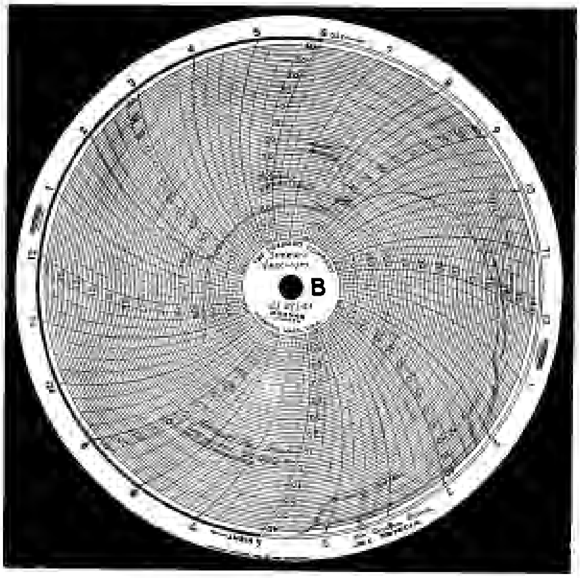


Chart B—Satisfactory trial run of high and low temperature control.

Maximum variations of temperature ±½ degree C dry bulb and humidity ±½ degree C wet bulb. Nos. 5 and 6 being controlled between room and 50 degrees C dry bulb temperature.

Although it is practical to attain temperatures below minus 40 degrees C with mechanical refrigeration, it is customary for reasons of operating economy to use dry ice as the cooling medium. A large finned tank situated over the working space in the vacuum chamber is partly filled with alcohol, kerosene or similar solvent into which broken dry ice is dropped from the top of the cabinet. The liquid quickly assumes the temperature of the solid CO_2 (minus 109° F). To one side of the working space is situated a blower which circulates the air through a duct, over an electric heater, operating only during high temperature runs, and over the cold fins of the dry ice tank and back into the working space. Automatic dampers cause the air to by-pass the cooling tank when required.

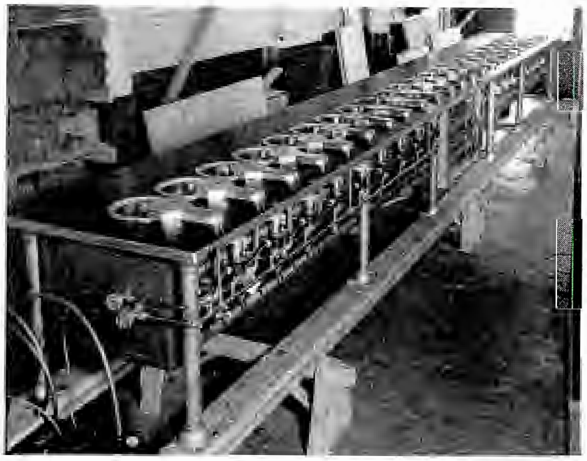
A specially designed water spray unit operating in conjunction with an automatically controlled water heater maintains any required humidity during high temperature tests.

During the last two years great strides have been made in the design of these cabinets as may be seen by comparing Fig. 1 and Fig. 2. The cabinet shown in Fig. 1 was built two years ago and is still working perfectly. Fig. 2 shows the latest design. The greater simplicity of the newer cabinet is immediately apparent.

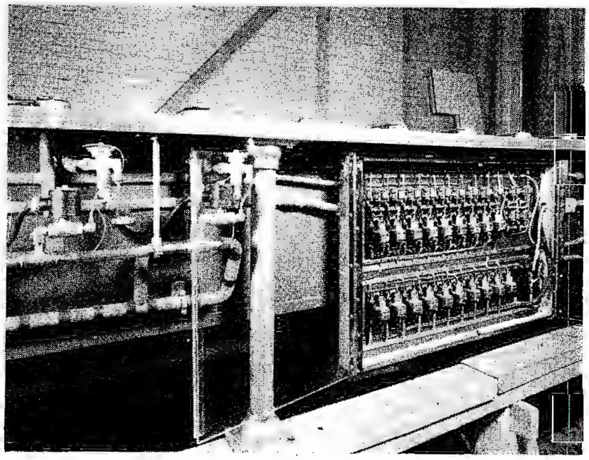
Temperature and humidity conditions are controlled by the instrument on the left-hand side of the unit, (Fig. 2) which enables the operator to preserve exact information relative to the test on removable twenty-four charts. The electrical switches have been assembled in a single box, below which is located a panel on which are mounted any required number of power rods. These rods project into the vacuum chamber through a ½" thick sheet of mycalex. In this way, the apparatus being tested may be wired to the inside terminals of the power rods and controlled in any desired manner from the exterior. A small panel heater maintains these power rods free from frost during cold runs.

Improved gasketing methods make it possible to use only one latch in place of the six bolts previously em-

Showing chambers in special table. See illustrations below.



This table runs in temperature from —40° to 160° F. Each chamber individually controlled.



Electrical and refrigeration equipment of special table.

ployed. In the center of the door is a window of sufficient size to readily inspect the entire working space. This window is constructed, to insure clear vision at low temperatures (—40° C), of five panes of plate glass, the inner-most one, which must withstand the vacuum, being ¾″ thick Herculite (heat treated plate glass) and four outer panes which, with air spaces between, act as insulation and prevent formation of frost.

These vacuum units are designed to safely withstand a continual pressure of 15 lbs. per sq. in. with a maximum deflection of 1/32″ on any member. A heavy steel plate inner shell amply braced on the outside with heavy structural channels prevents undue distortion. All seams are carefully welded and to safeguard against future troubles, all welds are checked for air tightness by pulling a vacuum on the cabinet when it is in the condition shown in Fig. 3. All slag is chipped off the welds to insure that no leaks will develop. The normal time required to evacuate the cabinets is shown in the table below. This rate of evacuation can be easily changed during construction by varying the size of the pump.

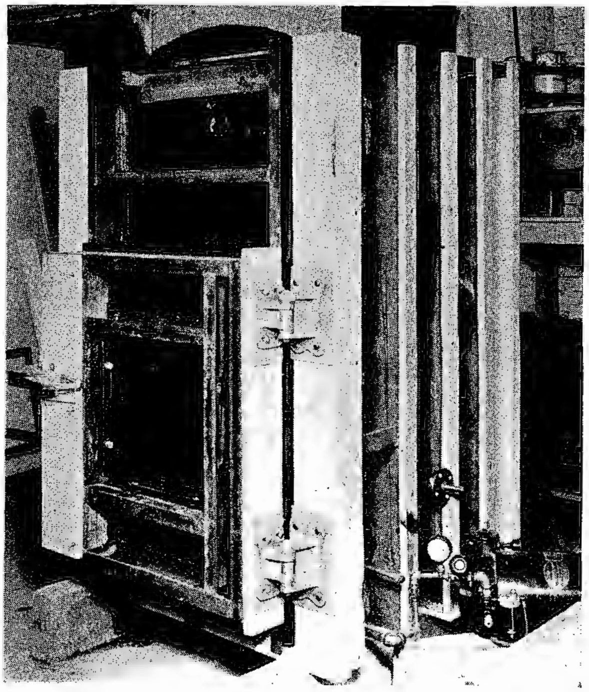
Time/Min	Pressure HG	Equivalent Altitude/ft
0	29.92	Sea level
3	20.58	10,000
7	13.75	20,000
12	8.88	30,000
17	5.54	40,000
19	3.436	50,000
20	2.987	53,000

After pulling a 28″ vacuum, the cabinet is allowed to stand with pump motor switched off, to check the regain period. (Leak back through pump—blower shaft—electric terminals—hand valves—etc.) A regain of 18″ HG in six hours is considered satisfactory, although even better results are frequently obtained. After this test, all seams are liberally brushed with a compound as an added precaution against future leaks. The cabinet is then insulated, the whole outside being painted with asphaltum, completely covered with roofing felt and again painted before the installation of the outside trim.

Once the insulation is in place, it is possible to check the temperature and humidity characteristics of the cabinet. The temperature is maintained, for about twenty-four hours, a few degrees higher than is actually required, and the humidity is raised to 95%. After a

(STRATOSPHERE—continued on page 12)

Fig. 3. Modern cabinet with steelwork and welds exposed during initial vacuum tests.



Averaging db measurements

By MICHAEL RETTINGER

RCA Manufacturing Co., Inc.
(Hollywood)

VOLTAGE, current, and power measurements are frequently expressed in decibels above some arbitrary reference level. For constant resistance, the db reading is given by

$$\text{Voltage level } L = 20 \log_{10} \frac{E_1}{E_0} \text{ decibels}$$

$$\text{Current level } L' = 20 \log_{10} \frac{I_1}{I_0} \text{ decibels}$$

$$\text{Power level } L'' = 10 \log_{10} \frac{P_1}{P_0} \text{ decibels}$$

where E_1, I_1, and P_1 are the voltage, current, and power readings and where E_0, I_0, and P_0 refer to the reference levels.

Now, when a number of voltage readings expressed in db, for instance, are to be averaged, it is necessary to average the respective voltage ratios and not the db-readings themselves. The same, of course, holds true for current and power measurements. For example, consider a voltage of 4.35 volts across 500 ohms. For a reference voltage of 1.73 volts across 500 ohms, this reading may be expressed as 8 db, as given by the equation

$$\text{Voltage level} = 20 \log_{10} \frac{4.35}{1.75} \text{ decibels}$$
$$= 8 \text{ db}$$

Likewise, a voltage of 17.32 volts across 500 ohms may be expressed as 20 db when referred to the same reference level. The arithmetic mean of the two db-readings obviously would be $(8 + 20)/2 = 14$ db, which would correspond to a voltage of 8.68 volts across 500 ohms, as given by

$$\text{volts} = 1.73 \text{ antilog}_{10} \frac{14}{20}$$
$$= 8.68 \text{ volts}$$

The arithmetic average for the two voltages, however, is $(4.35 + 17.32)/2 = 10.83$ volts. The db-reading corresponding to this voltage, therefore, is not 14 db but

$$\text{Voltage level} = 20 \log_{10} \frac{10.83}{1.73}$$
$$= 15.93 \text{ db}$$

It must be kept in mind that 15.93 db represents no more nor less than the db-reading for the average voltage of 10.83 volts; it does not represent the db power level for the corresponding average power. 4.35 volts across 500 ohms represents a power dissipation of $(4.35)^2/500 = 0.0378$ watts, and 17.32 volts across 500 ohms represents a power dissipation of $(17.32)^2/500 = 0.6$ watts. The average power being $(0.0378 + 0.6)/2 = 0.3189$ watts, the db power level representing this average power, therefore is

$$\text{Powel level} = 10 \log_{10} \frac{0.3189}{0.006} \text{ decibels}$$
$$= 17.25 \text{ db } (0.006 \text{ watts being the reference level, given by } (1.73)^2/500\,)$$

Fig. 1 gives the correct db average for the db difference of two voltages or current measurements expressed in db. The figure also gives the correct power level average for two db readings. Care should be exercised to consider whether one wants to know the number of db correpsonding to the average voltage of two db-readings or whether one desires to know the number of db corresponding to the average power pertaining to two

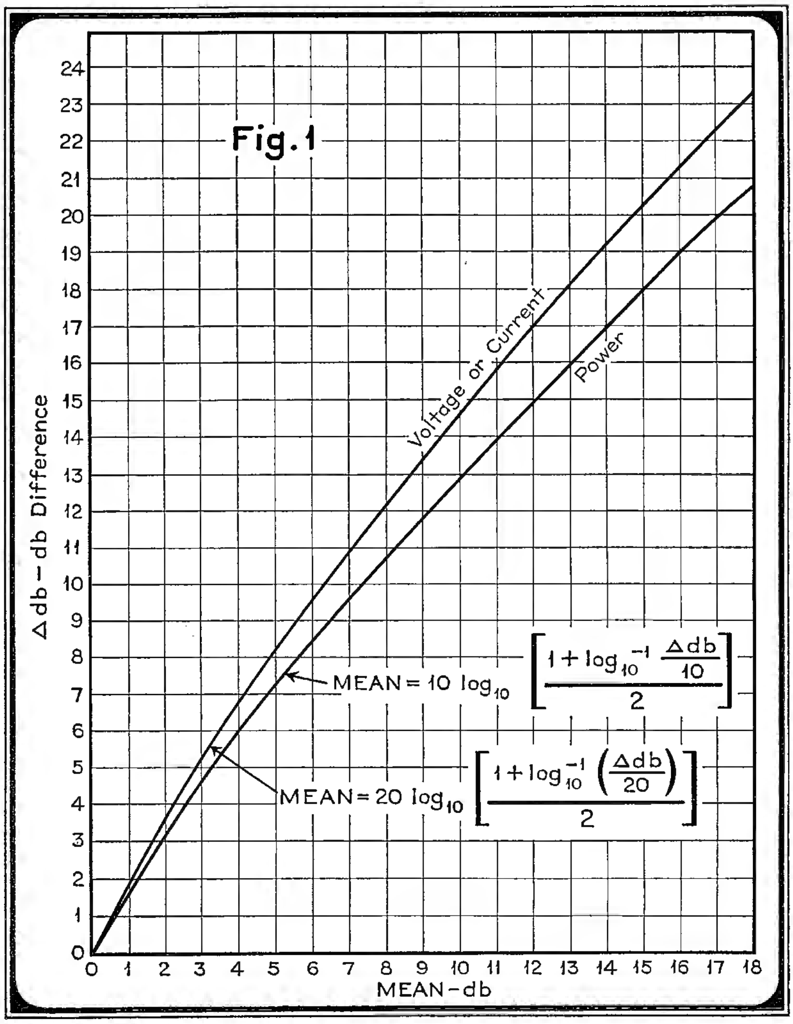


Fig. 1

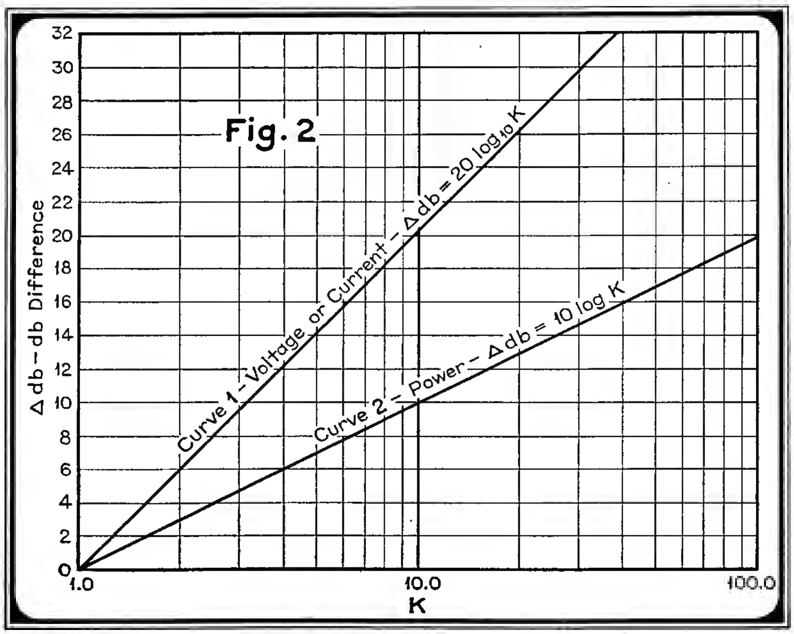
voltage or current measurements expressed in db. (For examples in connection with the use of this chart see addendum at end of article.)

It may be of interest at this point to draw attention to the fact that the arithmetic average of db readings represens the geometric mean of the original figures, when this mean is expressed in db. For instance if

$$20 \text{ db} = 10 \log_{10} 100$$
$$30 \text{ db} = 10 \log_{10} 1000$$

the arithmetic average of the db readings is $(20 + 30)/2 = 25$ db. The geometric mean of 100 and 1000 is $(100 \times 1000)^{1/2} = 316$, which when expressed in db becomes $10 \log_{10} 316 = 25$ db. This is so because

$$\frac{20 + 30}{2} = \frac{10 \log_{10} 100 + 10 \log_{10} 1000}{2}$$
$$= 10 \log_{10} (100 \times 1000)^{1/2}$$



Not infrequently, particularly in the making of acoustic measurements in rooms, it is necessary to make a number of observations and to average the results. Fig. 2 should be helpful when the logarithmic mean for either voltage or current ratios for a number of measurements is to be obtained and no logarithm table is readily available. The examples shown in the addendum of the article should prove self-explanatory, the averages being obtained by simple addition and division.

Curve 2 of Fig. 2 refers to the logarithmic mean for the power ratios of a number of observations.

Addendum

Example for Fig. 1

$N_1 = 64 \text{ db} \rightarrow 20 \log_{10} 1585$
$N_2 = 52 \text{ db} \rightarrow 20 \log_{10} 398$
db difference = 12 db

Mean for 12 db difference = 7.92 db (read off scale)

Mean for
$N_1 \; \& \; N_2 = 52 + 7.92$
$= 59.92 \text{ db} \rightarrow 20 \log_{10} \left(\frac{398 + 1585}{2}\right)$

Example 1 *for Curve* 1, *Fig.* 2

$N_1 = 40 \text{ db} \rightarrow 20 \log_{10} 100$
$N_2 = 46 \text{ db} \rightarrow 20 \log_{10} 200$
$N_3 = 50 \text{ db} \rightarrow 20 \log_{10} 316$
$N_4 = 60 \text{ db} \rightarrow 20 \log_{10} 1000$
$N_5 = 46 \text{ db} \rightarrow 20 \log_{10} 200$

There are 4 differences

$N_2 - N_1 = 6 \text{ db} \rightarrow 2.00$ (read off scale)
$N_3 - N_1 = 10 \text{ db} \rightarrow 3.16$ “ “ “
$N_4 - N_1 = 20 \text{ db} \rightarrow 10.00$ “ “ “
$N_5 - N_1 = 6 \text{ db} \rightarrow 2.00$ “ “ “
Add 1.00
18.16

$\frac{18.16}{5} = 3.632 \rightarrow 11.2 \text{ db}$ “ “ “

$\therefore$ Average $= 40 + 11.2$
$= 51.2$ db

$= 20 \log_{10} \frac{1816}{5}$

Example 2 for Curve 1, *Fig.* 2

$N_1 = 40 \text{ db} \rightarrow 20 \log_{10} 100$
$N_2 = 40 \text{ db} \rightarrow 20 \log_{10} 100$
$N_3 = 60 \text{ db} \rightarrow 20 \log_{10} 1000$

There are 2 differences:

$N_2 - N_1 = 0 \text{ db} \rightarrow 1.00$ (read off scale)
$N_3 - N_1 = 20 \text{ db} \rightarrow 10.00$ “ “ “
Add 1.00
12.00

$\frac{12.00}{3} = 4.000 \rightarrow 12 \text{ db}$ “ “ “

Average $= 40 + 12 = 52$ db
$= 20 \log_{10} \frac{1200}{3}$

Example for Curve 2, *Fig.* 2

$N_1 = 40 \text{ db} \rightarrow 10 \log_{10} 10{,}000$
$N_2 = 46 \text{ db} \rightarrow 10 \log_{10} 40{,}000$
$N_3 = 50 \text{ db} \rightarrow 10 \log_{10} 100{,}000$
$N_4 = 60 \text{ db} \rightarrow 10 \log_{10} 1{,}000{,}000$
$N_5 = 46 \text{ db} \rightarrow 10 \log_{10} 40{,}000$

There are 4 differences

$N_2 - N_1 = 6 \text{ db} \rightarrow 4.00$ (read off scale)
$N_3 - N_1 = 10 \text{ db} \rightarrow 10.00$ “ “ “
$N_4 - N_1 = 20 \text{ db} \rightarrow 100.00$ “ “ “
$N_5 - N_1 = 60 \text{ db} \rightarrow 4.00$ “ “ “
Add → 1.00
119.00

$\frac{119}{5} = 23.8 \rightarrow 13.76 \text{ db}$ “ “ “

$\therefore$ Average $= 40 + 13.76$
$= 53.76 \text{ db} = 10 \log_{10} \frac{1,190,000}{5}$

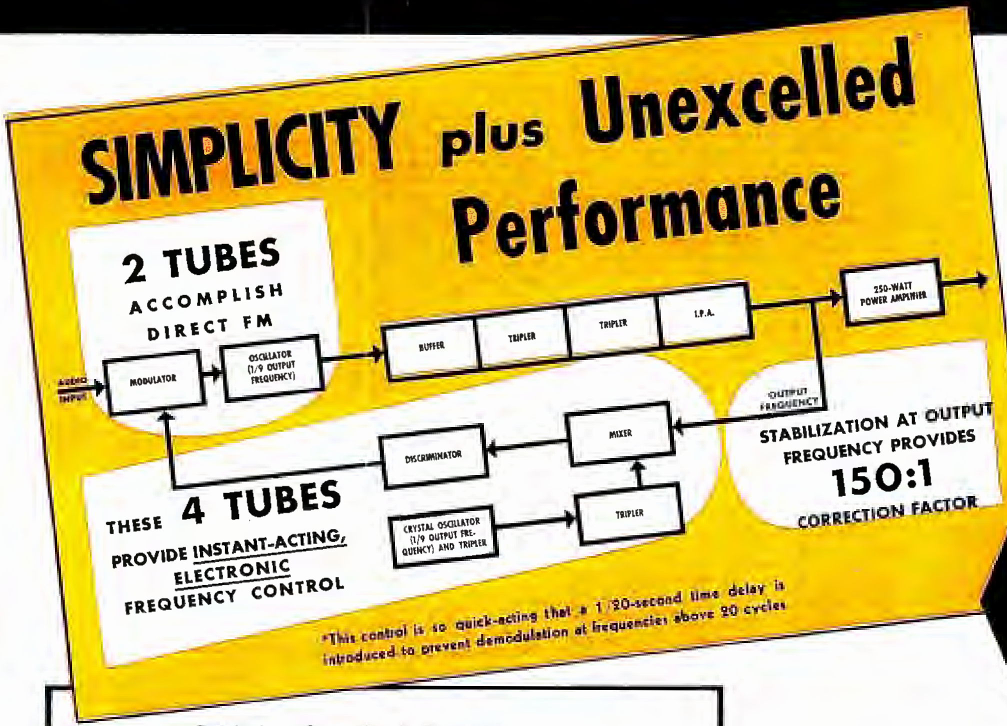
STRATOSPHERE—continued from page 10

satisfactory control period of at least four hours, the humidity is reduced to approximately 65% and controlled for several hours after which it is again raised to 95% for a final check on the humidification system. A typical high temperature test run is shown on Chart A.

Chart B shows the pull down from plus 60 degrees to minus 37 degrees at which point the instrument was set to control. Having controlled within plus or minus ¼ degree C for more than three hours, the control was released to carry the temperature below the required minimum of minus 40 degrees C. The rate of pull down was considerably increased on a re-run when the unit was maintained with ample dry ice.

With equipment of this kind built especially to fit their needs, airplane manufacturers and aircraft instrument and radio builders are solving their current problems and constantly improving their apparatus and approaching the solutions which will make stratosphere flying a thing of today.

Check Before You Choose



*This control is so quick-acting that a 1/20-second time delay is introduced to prevent demodulation at frequencies above 20 cycles

INSIST ON ALL THESE . . .

Continuity of Service

Automatic reclosing overload protection
Instant access to every tube (no shielding to remove)
Complete accessibility without disassembly
Only 2 tubes to produce *direct* FM
Only 4 tubes in stabilizing circuit
Single crystal control

Frequency Control

Instant-acting electronic (no moving parts; no overshoot)
Stabilization at *output* frequency
Temperature control of crystal only
± 1000 cycles stability
Voltage regulated power supply
New G-31 crystal unit
Temperature *compensated* oscillator and discriminator circuits

High Fidelity

Frequency response within ±1 db of RMA standard, 30 to 16000 cycles
Full dynamic range—noise level down 70 db
Linearity within 0.25% up to ±150 kc carrier swing
Harmonic distortion less than 1½% (30 to 7500 cycles) up to ±75 kc carrier swing; less than 2% up to ±100 kc swing
Cathode-ray modulation indicator
Square-wave testing of every transmitter

Economy

Based on G-E 1000-watt Transmitter, Type GF-101-B

Tube cost—only $287
Floor space—only 9.3 square feet
Ventilation—natural draft (no blower; quiet operation)
Power consumption only 3.75 kw

And you'll specify

SIMPLIFIED FM CIRCUIT DESIGN

For continuity of service, G-E design provides a small tube complement, conservatively operated, plus automatic reclosing overload protection and quick accessibility to every part and tube.

The frequency stability of G-E transmitters is maintained at within ± 1000 cycles by *instant-acting* electronic control so sensitive that even abnormal line-voltage fluctuations or *sudden detuning of the oscillator tank can have no effect on center frequency.*

The dependability is equal to that of the finest AM broadcast transmitters. *FM could ask no more.* G-E design centralizes frequency modulation and stabilization in one tube (the modulator), without impeding modulation capabilities or linearity. This fact is proved by performance measurements. No temperature control is necessary or used except within the crystal unit itself.

For true high fidelity—frequency response, linearity, freedom from distortion over wide carrier excursions—G-E transmitters are outstanding. These characteristics—inherent in the G-E simplified circuit—are assured by thorough factory adjustment and testing of *every* unit.

For economy, G-E simplicity assures low tube cost, ease of maintenance, and small operating expense. Small size and unit construction make installation easy and hold floor space to the minimum.

G-E simplified circuit design offers an unbeatable combination of advantages. Investigate them thoroughly. Your nearby G-E man has the story. Call him in without delay. General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

160-10

VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

W. J. McGONIGLE, President RCA BUILDING, 30 Rockefeller Plaza, New York, N. Y. GEORGE H. CLARK, Secretary

Hollis Receives Award

MR. WILLIAM B. HOLLIS, of Houston, Texas, veteran of the National Guard, the Navy and the Marine Corps, has won the annual Marconi Memorial Award for code proficiency in a contest held by the Army Amateur Radio System, the War Department announced.

The award, which is a gilded American eagle mounted on a wooden base, is sponsored by the Veteran Wireless Operators Association. To win it Mr. Hollis recorded radio telegraph signals at the rate of 65 words a minute, besting more than 800 other Army amateur radio operators in the contest. The proficiency of the average amateur radio operators with the International Morse Code is about 15 to 20 words a minute. Mr. Hollis is operator of Army amateur station W5FDR-WLJR.

In transmitting the award Major General J. O. Mauborgne, Chief Signal Officer of the Army, wrote to Mr. Hollis.

Above: VWOA-AARS broadcast. (Left to right) Bryson Rash, Major David Talley, Clyde Clarke, Ross Filion, Fred Shawn, F. P. Guthrie, and (seated) Major General J. O. Mauborgne.

Left: Marconi Memorial Award received by W. B. Hollis. Right: Major General J. O. Mauborgne.
Photos by U. S. Army Signal Corps.

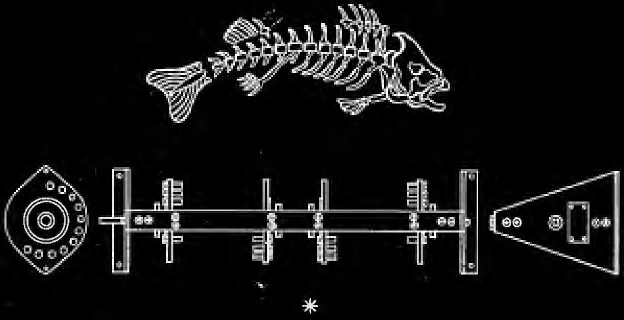
Below: (left to right) Jack Binns, George Sterling, W. J. Halligan, Charles Ellert, T. R. McElroy. Chicago VWOA meeting.

"I consider this presentation not only as a tribute to you as winner of the Army Amateur Code Speed Contest, but also to the vast body of amateur radio operators in our country upon whose services the Army will depend to a large extent in time of emergency."

Mr. Hollis was born in San Antonio, Texas, January 24, 1903. He is married, the father of 6 children. From October 1, 1919, to March 21, 1921, he was in the United States Navy and completed a course in radio and aircraft radio at the United States Navy Radio School, at Great Lakes, Illinois.

He was a commercial operator from June 18, 1921, to August 15, 1922. Then on

(VWOA—continued on page 25)



Perdix, Mechanical Engineer

Perdix, if you will remember your mythology, was an ingenious chap. ¶Inspired by the structure of a fish's spine he invented the saw, and by connecting two pieces of iron at one end with a rivet he made a pair of compasses. Sounds pretty crude now. But in his day it was truly remarkable. ¶Similar is the spirit of innovation that has made Collins world famous for the many mechanical refinements of its transmitters. Nothing is overlooked, whether it is as simple as a door latch or complicated as a network tap-switch* ¶Our mechanical engineering department is adroit and capable. Its sole duty is the designing and refining of all the mechanical features which make your Collins transmitter look better, last longer, and work more efficiently.

COLLINS RADIO COMPANY

CEDAR RAPIDS, IOWA NEW YORK, N.Y: 11 WEST 42 ST.

Guard Against Fire

By GEORGE S. WILLKINSON
Fire Marshal
RCA Manufacturing Co., Inc.

•*A few common sense rules and some notes on a new extinguishing method*

You recall the fire protection slogan that begins, "A match has a head, but no brains." In other words, *fire can't think* . . . any more than a rainstorm can think. And that is a fairly obvious fact. Don't ever forget it, however.

There are rules for fire, and fire must follow them. These are physical rules, governing the circumstances under which fires can start and the way they behave when they burn. Under these rules we can assume that oil will burn and that a brick wall won't. And, applying that rule, we will probably store dangerous flammable liquids in a brick building for safety's sake. The rules also tell us that a water stream will extinguish a burning woodpile, but won't do much good on a flowing gasoline blaze. So, we apply this rule and don't use water-type extinguishers where flammable liquids are being guarded.

The idea here is simply this—that, because fire follows the rules, we can pretty safely predict what fire is going to do under a given set of circumstances. Fire protection is getting to be a more accurate science. It is beyond the guesswork stage. By studying each fire hazard in our own shops each of us can set up the appropriate protective measures. An engineering review is made of each installation.

Perhaps the first of these rules is that there are three generally recognized forms of fire—in carbonaceous materials, flammable liquids and in "live" electrical equipment and wiring. Each of these fires has different characteristics and each requires different extinguishing methods.

A carbon dioxide portable and a big wheeled extinguishing unit guard the wax impregnating equipment at RCA.

In the RCA Manufacturing Company plant at Camden, N. J., we use many different types of extinguishing equipment, depending on the fire hazards which we encounter. On some of these hazards use is being made of a relatively new extinguishing method, employing carbon dioxide gas.

Described simply, a carbon dioxide fire extinguisher is a red steel cylinder, with a water faucet arrangement at its top, beneath which a flexible fabric-covered tube leads out to a long flat megaphone. The cylinder contains liquid carbon dioxide, stored under 850 lbs. pressure per square inch. The faucet is the valve control which releases the carbon dioxide on the fire. The "megaphone" is the discharging nozzle and it is shaped that way in order to distribute the gas without turbulence or entrainment of air which may spread the fire.

Photo courtesy Walter Kidde & Co.

Showing carbon dioxide nozzle used to guard flammable liquids in factory storage room.

The action of carbon dioxide in a fire extinguisher is a simple process of taking air away from the fire. It is a well known fact that a fire is smothered if it does not have a sufficient oxygen supply to support combustion. The atmosphere contains 21 per cent of oxygen. If we reduce that percentage to 14 or 15 per cent, we have reduced the oxygen content to a point where fire cannot exist. When carbon dioxide gas is released on a fire it tends to displace the air surrounding the fire and the fire goes out as soon as there is sufficient concentration of carbon dioxide at the fire to rob the fire of the oxygen which it must have.

The Underwriter's Laboratories and the Factory Mutual Laboratories approve carbon dioxide extinguishers for electrical and for flammable liquid fires.

On live electrical parts it is not only necessary to get the fire out but to do so without endangering the man who operates the extinguisher. The extinguishing stream cannot be an electrical conductor which will transmit a shock to the fire fighter. Carbon dioxide meets this requirement. Moreover the gas is clean and dry. It has no wetting effect on insulation or wiring, nor will it dissolve insulation or harm it in any way.

On flammable liquids the cleanliness of carbon dioxide is extremely important, since we have found that we can discharge an extinguisher into a mixing tank, for example, without the slightest danger of contamination. Anyone who has seen a small piece of dry ice melt away into nothingness has a good picture of how carbon dioxide acts. Dry ice, of course, is carbon dioxide in its solid form. The reader will recall that small particles of the ice seem to vanish without leaving a wet ring or a stain on the spot where they have been. By using carbon dioxide extinguishing equipment on processes which involve flammable liquids, no reclamation of the liquid is necessary, since the extinguishing medium disappears completely, without mess or soilage.

Two wheeled extinguishers (50 pounds capacity) at power transformer vault in RCA Camden plant.

Portable extinguishers are available in capacities of 4 lbs. to 20 lbs. of carbon dioxide. In our laboratory we have two 7½ lb. carbon dioxide extinguishers to protect small high voltage test equipment. Our transmitter testing operations require a heavier fire fighting coverage and we use four 15 lb. units and one 20 lb. extinguisher to guard this equipment. At our degreasing and cementing impregnating machines where highly flammable materials are used, we have one 7½ lb. and one unit of 15 lb. carbon dioxide capacity standing by in case of trouble.

In addition to the hand portables we also use larger wheeled-type extinguishers. These are a larger edition of the portable models and have a carbon dioxide capacity of 50, 75, or 100 lbs. of fire fighting gas. They carry 15 to 40 feet of hose; their nozzles are much larger and in some instances have a shut-off valve placed on the handle of the nozzle, so that the operator can control the discharge while he is maneuvering to fight the fire.

We protect our transformer vault with two wheeled carbon dioxide units each with 77 lbs. capacity and our wax impregnating machines where radio capacitors, coils, etc., are treated we protect with two 50 lb. wheeled units and one 20 lb. hand portable.

Careful safety practice dictates the use of higher concentrations of carbon dioxide gas to protect operations which involve more intense fire hazards. This is especially true where large volumes of flammable liquids are employed. In such cases we have come to rely on a built-in or fixed carbon dioxide extinguishing system.

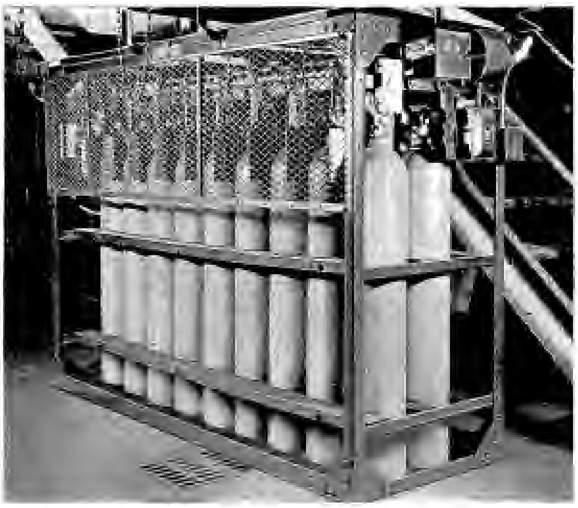


Photo courtesy Walter Kidde & Co.

A typical multi-cylinder installation embodying 900 pounds of carbon dioxide gas.

There are three more parts to a built-in carbon dioxide installation—the cylinders which provide the gas; the mechanism which controls the operation; and the pipes and nozzles which deliver the extinguishing charge to the hazard area.

Operation of these systems may be either manual or automatic. The automatic system involves the use of a fixed temperature thermostat, a fusible link or a diaphragm which operates on the rate-of-temperature-rise principle. This mechanism detects the fire and trips a mechanism which releases the carbon dioxide gas from the cylinders. The manually operated installation employs a break-glass pull-box usually located outside of the hazard area.

The cylinders which carry the carbon dioxide supply are likewise located in a safe spot out of reach of possible fire. When the release mechanism operates, the carbon dioxide is carried, by the force of its own expansion, through piping to nozzles located directly above the hazard which is being protected. Carbon dioxide is stored as has been pointed out under pressure of 850 lbs. per square inch. When the gas is released it expands to 450 times its stored volume and this tremendous expansion makes it unnecessary to employ any mechanical means to force the carbon dioxide through the pipes to the nozzles.

These nozzles are smaller editions of those used in the portable extinguishers, being shorter and stubbier. Their chief purpose is to effect an even distribution of the gas without violence or turbulence.

It should be noted here that it is perfectly sound practice to use one bank of cylinders to protect more than one fire hazard. This can be done through the use of directional valves which divert the discharge to whichever equipment is in distress. These directional valves, incidentally, may be either manually or automatically operated.

In RCA Manufacturing Company's Camden Plant we are using a two cylinder system of 100 lbs. carbon dioxide capacity to protect our stain and filler mixers where flammable solvents are used. We have another 40 lb. system—2-20 lb. cylinders—which guards our asphalt impregnating machines where radio transformers are treated.

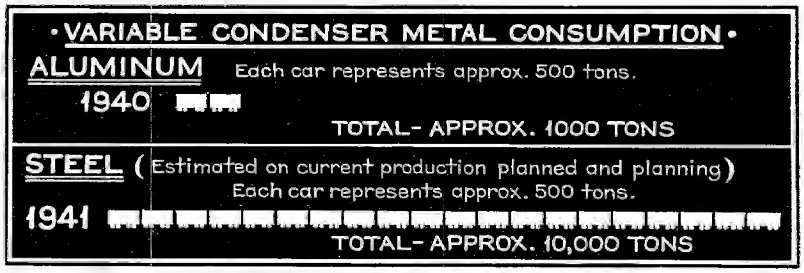
DEFENSE NEWS

•*Zinc Shortage Remodels Battery Plans*

•*Steel Condenser Problems Solved*

Reports
LEWIS WINNER
Market Research Engineer

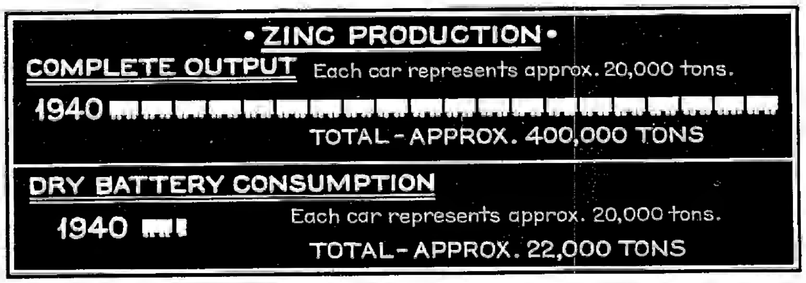
THE radio industry has just received another sharp challenge, for zinc has been placed under full priority control. Heretofore zinc has been subject only to partial control through a production pool, out of which the Director of Priorities has allocated to meet emergency situations. Now, however, it shall be necessary to fill all defense needs ahead of all other requirements and in addition an emergency pool to meet urgent needs will also be created.



The dry battery manufacturers, to whom zinc is a most vital metal, are already formulating plans to standardize and stylize design, so as to permit production of a minimum quantity of models for the greatest variety of uses. Many styles and types, now popular, will disappear from the scene, and in their place will be found units that will have a combination of applications.

Although the dry battery industry used but 5% of the entire output of zinc in 1940, or about 22,000 tons, present available figures indicate that the total needs for zinc for 1941 will be of such proportions that it will be difficult to spare even that small tonnage. According to the present production plans, the total supply of zinc in 1941 will approximate from 890,000 to 950,000 short tons. The estimated requirements for 1941, however, including military and civilian needs, are now estimated at 1,165,000 short tons. This indicates an over-all shortage of from 215,000 to 275,000 tons for 1941. This shortage is being caused by the fact that the total supply figures for 1941 include over 200,000 short tons which would be produced from foreign ores. And, approximately 450,000 tons of concentrates is required for this production. Any inability to get ships to move this tonnage from South America could naturally seriously reduce the estimated supply for the year.

Large quantities of zinc are used to produce military brass. As the potential demand for this brass continues, and increases with the expansion of cartridge facilities, the zinc problem will become greater.



Battery manufacturers have been effecting every economy in production long before these priority rulings came into effect, and, as a result, are able to produce a substantial quantity of cells, even with curtailed zinc production. This economy of production is particularly outstanding where the manufacturers have their own zinc rolling mill. Here the zinc cans are made, the waste trimmed off, remelted and brought back into the cycle of fabrication. Thus there is absolutely no waste. Serious thought is being given to the building of more of these mills for this and other purposes, to help the shortage situation.

The amount of zinc to be set aside for the emergency pool has risen from 5 to 22%, the latter the requirement for July pool, based on May production. This will approximate 16,000 tons.

In 1940, approximately 800,000,000 cells were produced in the battery industry and used for radio, telephone, ignition, flashlights, etc.

Although zinc is the most important dry battery metal that is on "watch your step" list, there are other metals and chemicals that are quite vital to battery manufacture, that have not been so seriously affected by priority control, although on the critical list. Among these is the depolarizing agent, manganese ore, of which 40,000 tons were used in 1940 for dry battery production. This is available from three sources: Montana, gold coast of Africa and Cuba. Graphite or acetelyne black, of which 10,000 tons were used in 1940, and is comparatively plentiful, is available from Mexico (natural graphite) and Canada (acetelyne black). There is, also, of course, the fabricated graphite, produced in this country. The chemicals, ammonium chloride and zinc chloride, of which about 10,000 tons (combined) were used in 1940, have also thus far escaped serious control. However, our little friends, the tinned copper wires, brass caps and solder, that form quite an important part in battery construction, are nearing the danger line, and substitutions may have to be invoked.

Aluminum, the metal that has captured more front-page mention than some of our greatest personalities, is losing its popularity as far as radio is concerned, and particularly in the variable condenser industry. It's steel now and plenty of it. Complete production lines of steel condensers are in full swing. According to the engineers of several of the largest producers, all of the bugaboos have been completely licked. One large manufacturer claims complete success, thanks to a soft steel that has been specially developed. Significant in this development is that experiments began almost a year ago, when priorities were little known.

On tests, this steel was subjected to a temperature study with the thermometer rising from room temperature to 250° F. There was less drift with this material than with aluminum. This new material is said to eliminate microphonics. In addition, it was found that, even though steel has a higher resonant point than aluminum, less microphonics were noticed in many instances, because of the resonant point of most speakers designed to fit on to chassis having aluminum condensers and associated parts.

Corrosion is averted by treating the steel with special liquid. This anti-rusting process eliminates one of the most disastrous problems, assuring consistent metallic properties and consistent results.

The special anti-rust treatment is, however, one of the reasons that these condensers are more expensive to produce. Another additional expense in manufacturing these condensers is caused by the extra wear given to dies. These expensive tools have to be kept exact to produce the precision parts used in condenser construction, and thus any strain placed on them demands close attention and servicing. In addition, because of the very characteristics of the steel itself, it is more difficult to straighten and calibrate. Thus, extra precaution is extremely essential when these condensers are placed before the capacity checker. Annealing, which would have added considerably to the

(DEFENSE—continued on page 25)

NEW PRODUCTS

FM/AM CENTRALIZED SOUND SYSTEM

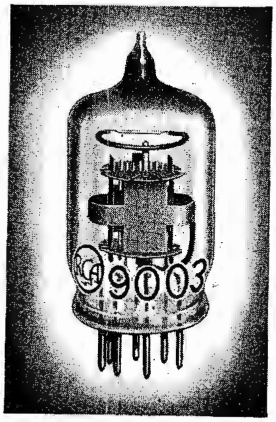
The new Hallicrafters Model RSC-2 is a unit which should find wide application in centralized radio systems in hotels, hospitals and industrial plants. Because it provides both f-m and a-m broadcast reception, it will offer special appeal to those institutions where high electrical noise levels have made ordinary radio reception unsatisfactory. In addition, the f-m feature provides the quality so desirable for distribution in the dining rooms or other public rooms.

The RSC-2 includes three units—an f-m and a-m tuner, a high-fidelity 25-watt amplifier and a monitor speaker, all inclosed in a single rack of the table-mounting type. The tuner provided a-m reception throughout the range of 540 to 1650 kc and f-m in the range of 40 to 51 mc. In addition the amplifier provides microphone and phono inputs, thus making these additional types of service available for distribution over the centralized loudspeaker or headphone networks. Wide operating flexibility is afforded by separate bass and treble equalization controls, separate control of volume from each input source, and provision for mixing and fading these sources. The Hallicrafters Co., 2611 Indiana Ave., Chicago.

RCA TUBES

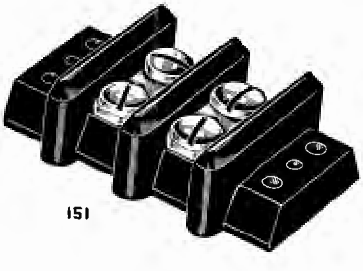
The RCA Manufacturing Co., Inc., Harrison, N. J., are making available a new series of vacuum tubes—RCA-9001, RCA-9002, and RCA-9003—designed for use by engineers, experimenters, and amateurs working in the ultra-high frequencies. These new types, known as midget tubes, are particularly well suit for f-m television, and other applications requiring high-efficiency, high-gain circuits at unusual frequencies. These midget tubes combine the bulb and base structure of miniature receiving tubes with electrode structures similar to those employed in unipotential-cathode acorn tubes. Each tube has two cathode leads to permit the completion of the plate and screen r-f circuits with a minimum of circuit inductance common to the grid circuit, and thus to provide increased gain at ultra-high frequencies. This double-lead feature is desirable because the effects of lead inductances increase rapidly as the operating frequency is increased. The single-ended design of the 9001, 9002, and 9003 has the added advantage of requiring a minimum of mounting space.

RCA-9001 is a sharp cut-off pentode intended for use as an r-f amplifier or detector. RCA-9002 is a triode with moderately high amplification factor useful as detector, amplifier, and oscillator. In addition to its two cathode leads, the 9002 has two plate leads. The 9003 is a remote cut-off petnode designed for mixer and i-f or r-f amplifier applications. The super-control features of the tube make it very effective in reducing cross-modulation and modulation distortion over the entire range of received signals.



BARRIER TERMINAL STRIPS

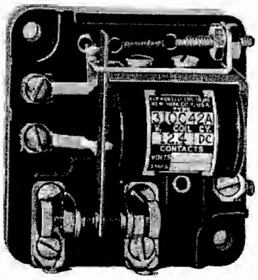
The intercommunication of electrical circuits in industrial equipment has required the use of sturdy, compact terminal strips, with maximum metal-to-metal spacing, in order to safely carry the required current. Howard B. Jones designed six barrier strip series to meet these requirements. The body is of heavy molded bakelite, with barriers between each set of terminals, following around the edge of the strip and terminating with the base. The new 150 series, comprising three sizes—150, 151 and 152—have been added to the 140 series line. The No. 150 have 10-32 screws, with ⅝″ metal-to-metal spacing; the No. 150 have 12-32 screws, with ¾″ metal-to-metal spacing, and the No. 152 have ¼″-28 screws, with 1″ metal-to-metal spacing. Complete information will be sent free upon request to Howard B. Jones, 2300 Wabansia Ave., Chicago.



Newly designed crystal holders molded from Durez by Bliley Electric Co.

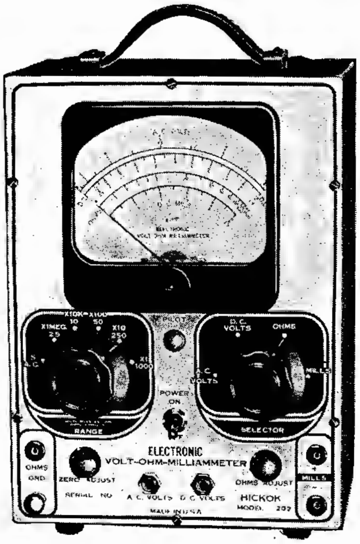
POWER RELAY

Model BK25, illustrated, is a recent development in sensitive relays, produced by Kurman Electric Co., 241 Lafayette St., New York City. Voltmeter accuracy from —24 to +99 degrees Centigrade. Moulded base, of Navy approved material. Silver contacts. Operates on .0018 watts. Complete data obtainable from the manufacturer.



A-C/D-C VOLT-OHM-MILLIAMMETER

The latest Hickok measuring instrument is said to permit measurements while the set is in operation without danger of damaging the test instrument through overload. Ranges: a-c voltage in five ranges to 1000 volts with input impedance of approximately 2.5 megohms; d-c voltmeter in five ranges to 1000 volts with input impedance of 14 megohms; five ohmmeter ranges to 1000 megohms; five milliampere ranges to 1000 milliamperes. The meter is a 5″ rectangular type. Pilot light is located on front panel. The power supply is self-contained and operates on 110-volt 50-60 cycle a-c. Manufactured by The Hickok Electrical Instrument Co., 10303 Dupont Ave., Cleveland, Ohio.



A-C/D-C COMMUNICATION RECEIVER

Howard Radio announces a new communication receiver, which can be operated from almost any power circuit: 105-117, 120-150 and 210-240 volts, alternating or direct current. Uses 6 latest type tubes.

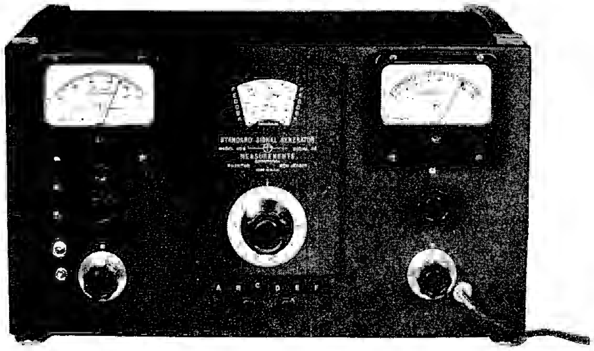
Has 3-gang tuning condenser and a stage of tuned-radio frequency on all bands. Tunes continuously from 540 kc to 43 mc (566 to 7 meters) on four overlapping bands with band spread on all bands. Literature on request from Howard Radio Co., 1735 Belmont Ave., Chicago, Ill.

MICROPHONES

The Turner Co., Cedar Rapids, Iowa, have announced two new microphones. One is a Cardiod microphone made up of a ribbon velocity element and a dynamic pressure element to obtain the desired characteristic. The other mike is a dynamic salt-shaker type utilizing a new type magnet structure and acoustic network. Literature on these new units may be secured from the above organization.

SIGNAL GENERATOR

The Measurements Corp., Boonton, N. J., have announced the Model 65-B standard signal generator. This unit has an individually calibrated, direct-reading frequency scale. Frequency range is 75 kc to 30 mc in six-push-button ranges. Modulation is continuously variable from zero to 100% either 400 or 1000 cycles or external source. The output voltage is continuously variable from .1 microvolt to 2.2 volts. Literature on request.



SOUND SYSTEM

An all-purpose sound system, complete in one compact unit including amplifier, controls and record player, has been announced for use in mobile, portable, or permanent installations by George Ewald, manager, Commercial Sound Division, RCA Mfg. Co., Camden, N. J. The new system operates from 105-125 volts, 60-cycle electric power, or from a 6-volt storage battery with very low drain. It delivers 15 watts output, making it suitable for such uses as sound trucks, advertising, amusement parks, sport events, political meetings, parades, fairs, carnivals, sales campaigns and picnics. Light in weight and easily moved by attached carrying handles, the unit measures 16½" long, 12" deep, and 12" high.

SAVE ALUMINUM

From H. H. Kynett, The Aitken-Kynett Co., advertising counselors for P. R. Mallory Co., comes a thought which should be of decided interest to every factor of the communications industry. In essence it's this—"Save your old aluminum parts—it is patriotic to contribute them to National defense."

Many of us in the rush of business are prone to forget our obligations to the defense program. Aluminum and certain other metals are scarce and badly needed for defense production. COMMUNICATIONS urges every one of its readers to get actively behind this idea. Individually your accumulation might be comparatively small, but collectively the industry can be of service along these lines.

STROBOSCOPES

National Recording Supply Co., Hollywood, is now packaging stroboscopes for the trade in 6½ inch size, ten to a box. The cardboard is of yellow hue.

COIL WINDING COUNTER

A high-speed coil winding counter, called the Clipper, is announced by the Production Instrument Company, 708-12 W. Jackson Blvd., Chicago. The clipper coil winding counter is designed for direct connection to the motor shaft or for operation through a flexible shaft. In actual service it is counting at speeds as high as 9000 turns per minute with motor wide open.

CRYSTAL PICKUP

A new low-cost 1-ounce crystal pickup with permanent sapphire point needle is announced by Shure Brothers, 225 W. Huron St., Chicago. This unit is said to have 1.4 volts output at 1000 c-p-s with one ounce needle pressure. An offset head is used to correct for tracking error. Set screw permits changing needle without removing cartridge.

OVER THE TAPE

AIR ASSOCIATES MANUAL

Air Associates, Inc., Bendix, N. J., have issued a 55-page loose-leaf manual on radio communication systems. It contains complete specifications, descriptions and price information on radio systems for private, commercial and military aircraft operation. Conveniently divided into six sections—long-range equipment, school and ultra-high-frequency equipment, interphone equipment, antenna systems, accessory equipment and units for light planes—the manual has full-page illustrations of each model. It is available to manufacturers affiliated with the airplane industry, recognized airport operators, and government department heads without charge.

TELEVISION RECEIVER PRODUCTION

In keeping with commercialized television broadcasting, television receiver production is being resumed by the Allen B. Du Mont Laboratories, Inc., of Passaic, N. J. Additional factory space has been acquired outside the company-owned factory building which is already crowded with cathode-ray tube and instrument production as well as National Defense contracts, so as to meet the anticipated demand for television receivers.

FARNSWORTH HONORED

Philo T. Farnsworth, who at the age of 22 had developed and demonstrated the first successful system of electronic television, was honored recently by the Institute of Radio Engineers. At a dinner in the Hotel Statler ballroom, which was one of the features of the institute's summer convention, Dr. F. E. Terman, president of the organization and head of the Department of Electrical Engineering at Leland Stanford University, presented the Morris Leibmann Memorial Prize for 1941 to the father of modern television.

The prize was a check for $390, representing the annual accumulation of interest on the Leibmann fund.

SOLAR LITERATURE

Among the new literature available from Solar Mfg. Co., Bayonne, N. J., is an interesting bulletin entitled "Defense and You," which discusses the priorities situation, material shortages and the readjustments necessitated by our Defense Program. Also available is Solar's latest catalog, No. 11, which gives data on their line of capacitors and capacitor analyzers.

TRANSMITTING TUBE GUIDE

RCA's finest and most complete engineering and amateur guidebook on transmitting tubes is now off the press. It contains comprehensive data on 69 air-cooled transmitting tubes, including the new important types 815, 816, 8000, 8001, 8005 and the midget tubes 9001, 9002, and 9003. Complete data supplemented by carefully proven circuits show how RCA transmitting tubes may be used to the best advantage. The book contains 150 circuits and illustrations and is twice the size of last year's edition.

The outstanding feature of the new guide is found in the transmitter designs which are shown in great detail. They were designed, constructed and tested specifically for inclusion in the book.

Among the transmitters is included complete constructional information on a plate-modulated RCA-815 transmitter operating from 2½ to 20 meters, a high-power single-control 813 transmitter, an 809 economy transmitter and others.

All of the equipment described represents a wide range of application and meets modern demands for ready transmitter simplicity coupled with efficiency, economy and flexibility. Price is 25 cents a copy. Copies may be obtained from all RCA Tube and Equipment Distributors or direct from RCA Commercial Engineering Section, Harrison, N. J. by enclosing the proper remittance.

SELENIUM REFINEMENT INCREASES

Another of the interesting sidelights of the National Defense Program is the marked increase in the refinement of pure selenium in the United States which, according to George Lewis, vice-president of International Telephone and Radio Manufacturing Corp., has increased one hundred fold this year over last.

Selenium is one of the lesser known of the physical elements, but is employed in the manufacture of red glass, certain pharmaceutical products and now in the I. T. T. selenium rectifiers which are being used by various National Defense suppliers. The application of selenium in rectifiers was developed by a subsidiary of the International Telephone and Telegraph Corporation in Europe and, Mr. Lewis says, that an impression has existed that selenium is a European material. The fact is, he points out, that practically all of the world's supply is obtained in the United States and Canada.

G-E APPOINTMENTS

H. V. Erben, an assistant manager of the Central Station department of the General Electric Company since January 1, 1939, has been appointed department manager, according to an announcement by E. O. Shreve, vice president. M. O. Troy, former manager, will continue as commercial vice president.

Bliley

Bliley Quartz Crystals and Mountings are precision-made for all frequencies between 20Kc. and 30Mc. Catalogue G-12 describes the complete line. Write for your copy.

QUARTZ CRYSTALS

FOR GENERAL COMMUNICATION FREQUENCIES

BLILEY ELECTRIC COMPANY

UNION STATION BUILDING ERIE, PA.

Direct Subway Entrance to all Points of Interest

New York's Popular

HOTEL

LINCOLN

44TH TO 45TH STS. AT 8TH AVE.

OUR CHOICEST ROOMS From $3

1400 ROOMS each with Bath, Servidor, and Radio.

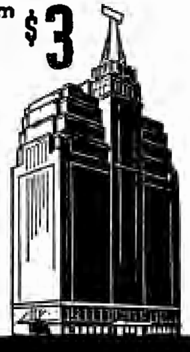
★ Four fine restaurants awarded Grand Prix 1940 Culinary Art Exhibition.

MARIA KRAMER
PRESIDENT

John L. Horgan
Gen. Mgr.

HOTEL EDISON
SAME OWNERSHIP

IN THE CENTER OF MID-TOWN NEW YORK



An Advanced Communications Design

THE Skyrider 32

The new 1942 Skyrider 32 is a moderately priced communications receiver that will deliver high quality performance. Covers everything on the air from 500 kc. to 40 mc. Thirteen tubes, six bands. Two stages preselection on bands 3, 4, 5, 6. Calibrated bandspread inertia controlled. Micrometer scale tuning inertia controlled.

Tone and AC on-off. Beat frequency oscillator. AF gain—RF gain. Crystal phasing. Adjustable noise limiter. Send-receive switch — AVC-BFO switch 80/40/20/10 meter amateur bands calibrated. Wide angle "S" meter. Push-pull high fidelity audio output. 6-step wide range variable selectivity.

Engineered by Hallicrafters, the Skyrider 32 will produce superior communications performance at a moderate price.

the hallicrafters co.
CHICAGO, U. S. A.
USED BY 33 GOVERNMENTS
SOLD IN 89 COUNTRIES

You and your associates can obtain a year's subscription to COMMUNICATIONS (12 issues) for only $1.00 each by using the Group Subscription Plan.

A regular yearly subscription to COMMUNICATIONS costs $2.00 — but when four or more men sign up at one time, each one is entitled to the half-price rate. (Foreign subscribers on the "G-S-P" only pay $2.00 each).

COMMUNICATIONS

19 E. 47th St., N. Y. C.

Please enter annual subscriptions (12 issues) for each of the undersigned for which payment is enclosed at the rate of $1.00 each. (This rate applies only on 4 or more subscriptions when occupations are given.) Foreign Subscriptions are $2.00 each.

Name ....
Street ....
City-State ....
Occupation or title ....
Employed by ....
Nature of business ....
(State if Manufacturer, Broadcast Station, etc.)
Product ....

Name ....
Street ....
City-State ....
Occupation or title ....
Employed by ....
Nature of business ....
(State if Manufacturer, Broadcast Station, etc.)
Product ....

Name ....
Street ....
City-State ....
Occupation or title ....
Employed by ....
Nature of business ....
(State if Manufacturer, Broadcast Station, etc.)
Product ....

Name ....
Street ....
City-State ....
Occupation or title ....
Employed by ....
Nature of business ....
(State if Manufacturer, Broadcast Station, etc.)
Product ....

RCA BULLETIN

The RCA Manufacturing Co., Inc., Camden, N. J., have issued bulletin MI-7186. It gives specifications and a description of the Type 1-K, 1,000-watt broadcast transmitter. Copies available on request.

JONES CATALOG

A new 20-page catalog, known as No. 11, has just been released by Howard B. Jones, 2300 Wabansia Ave., Chicago, illustrating and describing their complete line of multi-contact plugs and sockets, terminals, terminal panels, fuse mounts, etc. It includes their "300," "400" and "500" series plugs and sockets, hundreds of terminal panels for every interconnecting requirement, barrier strips, bulk terminals; and shows several new items recently added to the line.

OXFORD-TARTAK APPOINTMENT

Paul H. Tartak, president of Oxford Tartak Radio Corp., 915 West Van Buren St., Chicago, announces that Karl A. Kopetsky, formerly managing editor of "Radio News" magazine has joined the firm as a member of the executive staff.

G-E BULLETIN

A recent G-E bulletin contains specifications and descriptive data on Kon-Nec-Tor mercury-vapor switching devices. Copies may be secured by writing to the General Electric Vapor Lamp Co., Hoboken, N. J.

LITTELFUSE LITERATURE

Littlefuse, Inc., 4757 N. Ravenswood Ave., Chicago, have just released several bulletins dealing with their new aircraft products, such as Army Air Corp fuses, fuse pullers, pull mounting panels, mercury switches, low voltage Tattelite testers, etc. Catalog 8, just off the presses, includes all new Littlefuse items. Copies available on request.

RAYTHEON SALES MEETING

Raytheon Production Corp., makers of Raytheon radio tubes, held their annual midwestern sales meeting during the Radio Parts Manufacturers Show in Chicago. The meeting was presided over by Earl Dietrich and E. S. Riedel. Sales and advertising plans were outlined for the balance of 1941, and new advertising displays were exhibited.

ELASTIC STOP NUT BULLETIN

Elastic Stop self-locking nuts used for vibration-proof fastenings on aircraft, mechanical and electrical equipment, etc., are described in a new bulletin. To secure your copy, write to Elastic Stop Nut Corp., 2330 Vauxhall Road, Union, N. J.

VIBRATION CONTROL

A very interesting and useful 20-page bulletin on vibration control has been made available by the Lord Mfg. Co., Erie, Pa. It should be especially interesting to engineers engaged in the design of equipment for portable-mobile use—particularly aircraft equipment. Write to the above organization for Bulletin No. 104.

DISC BULLETIN

National Recording Supply Co., 1065 Vine St., Hollywood, Calif., have issued the revised 1941 catalog on recording discs, cutting and playback needles. Copies available on request.

RCAI, RADIOMARINE COOPERATE WITH CTC

Planning cooperation with the Civilian Technical Corps, Radiomarine Corporation of America and R. C. A. Institutes, Inc., will make their facilities in twenty cities in the United States available to the Corps for technical examinations of applicants, Charles J. Pannill, President of both Radiomarine and the Institutes, announced recently.

Opportunity of working at first hand with one of the most important radio developments in the world today, Britain's secret plane-spotting device known as the Radiolocator, is now open to American radio enthusiasts through membership in the newly organized Civilian Technical Corps.

Volunteers accepted for the Corps, organization of which was announced June 18, from the British Embassy in Washington, become paid, non-combatant employees, whose work consists solely in the servicing and maintenance of the highly technical equipment now in use by the British Army, Navy and Air Forces.

TURNER REPRESENTATIVE

Appointment of Irvin I. Aaron & Associates, 4028 North 16th St., Milwaukee, Wis., is announced by the Turner Co., Cedar Rapids, Iowa. Mr. Aaron's firm will be sales representatives for Turner on their complete line of microphones and microphone equipment, and the Turner push-pull vibrator. Territory to be covered by Aaron & Associates will include Minnesota, Wisconsin, and parts of North Dakota and Illinois.

G-E SHORT-WAVE STATIONS

General Electric's three short-wave stations, already among the most powerful in the world, will be made even more effective by new transmitting equipment now being installed in Schenectady and San Francisco, according to R. S. Peare, G-E manager of broadcasting. WGEA, Schenectady, and KGEI, San Francisco, formerly operating at 25,000 and 20,000 watts respectively, are both being increased to 50,000-watt power. WGEO, Schenectadty, licensed for 100,000 watts and long famous as the most powerful short-wave broadcasting station in the Western Hemisphere, is also receiving new equipment to increase further its effectiveness.

CANNON BULLETIN

Cannon Electric Development Co., 3209 Humbolt St., Los Angeles, Calif., have issued a bulletin and price sheet on their line of cable terminals. The bulletin contains descriptive data on both terminals and terminal accessories.

MARTY JOINS SHURE

S. N. Shure, announces that Joe Marty, formerly secretary of the Radio Servicemen of America, is now associated with Shure Brothers, Chicago, designers and manufacturers of microphones, pickups, cutters, and other acoustic devices.

WHEN YOU CHANGE YOUR ADDRESS

Be sure to notify the Subscription Department of COMMUNICATIONS at 19 E. Forty-seventh St., New York City, giving the old as well as the new address, and do this at least four weeks in advance. The Post Office Department does not forward magazines unless you pay additional postage, and we cannot duplicate copies mailed to the old address. We ask your cooperation.

LEAR BULLETIN

A recent Learadio bulletin is entitled "Eyes, Ears, Voice for the Pilot." Data is given on a radio direction finder, transmitter, receiver and power pack. Copies available on request. Lear Avia, Inc., Dayton, Ohio.

NEELY TO REPRESENT REL

Norman B. Neely Enterprises, with offices located at 5334 Hollywood Blvd., Hollywood, Calif., and 420 Market Street, San Francisco, Calif., has just been appointed to represent Radio Engineering Laboratories, Inc., in the sale of f-m broadcasting equipment on the Pacific Coast.

• • •

VWOA

(continued from page 14)

October 2, 1922, he joined the United States Marine Corps and served as operator and chief operator at the United States Naval Radio Station—NPP—at Peking, China. He left the Marine Corps and took employment with the Southwestern Bell Telephone Company at Houston, Texas, where he is now employed, but stayed in the Marine Corps Reserve until October 1, 1929.

From September 21, 1931, to December 4, 1935, Mr. Hollis was a member of the 111th Observation Squadron, Texas National Guard, serving as a radio operator.

Mr. Hollis has been a member of the Army Amateur Radio System since November 3, 1936, and won a similar speed contest in 1939. These contests have been held annually for ten years, but this is the first time that the Veteran Wireless Operators Association has provided a trophy for the winner.

Mr. Hollis is also a member of the American Radio Relay League, in which he has held several important positions. He is manager of its Trunk Line D, and has served it as alternate director and route manager. He is also a member of the following radio operators' organizations: A-1 Operators Club, Rag Chewers Club and Amateur Radio Telegraphers Association.

Chicago Meeting

During the Radio Parts Show the Veteran Wireless Operators Association held a Chicago meeting. Among those in attendance were Jack Binns, whose first "CQD" made history 33 years ago, George Sterling, Chief of National Defense Operations Sections of the FCC, W. J. Halligan, President of the Hallicrafters Company and Chairman of the Western Division VWOA, Charles Ellert of the FCC, and T. R. McElroy, World's Speed Champion Code Operator.

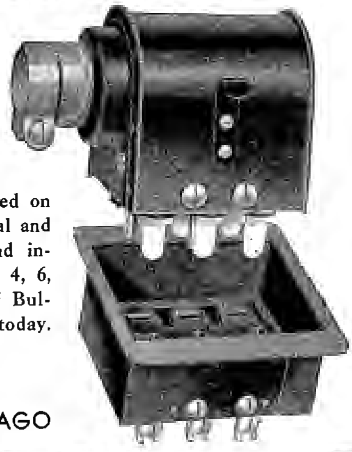
• • •

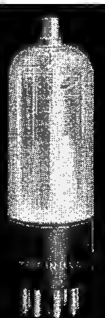
DEFENSE

(continued from page 19)

cost, too, has been avoided. It is said the strains are completely eliminated when the plates are staked and assembled into position.

These new steel condensers will naturally weigh more than their aluminum predecessors. Of course, it must be remembered that in most previous production condensers the base was formerly steel and still is, and as such constituted





almost 75% of the weight of the condenser. The 25% remainder constituted the aluminum pieces. Nevertheless, since the steel now used in the rotor and stator sections has about a 3 to 1 weight ratio to aluminum, there is quite an added weight with which to contend. The torque (ounces of weight) which is now more, makes it difficult to use these condensers with mechanical tuners. Counterbalances don't help much, either, for the rotors are just that much more difficult to swing. Thus receivers using mechanical tuners will, of necessity, have to dispense with variable condensers and use inductance tuning. Of course, there still are many manufacturers who use electrical tuning systems, and will thus still be able to incorporate these condensers.

In appearance, these new condensers differ slightly from the aluminum types. In fact, many of the models being made are even smaller than the aluminum models and thus further space economies will be effected.

Manufacturers expect to produce many more condensers this season than last, one large producer indicating that this production will be four times as great. This means that many extra millions of sections will flow off the line, and that accordingly the steel consumption in the variable condenser industry will increase by leaps and bounds. However, with the present steel production at a new time high, and additional plants being constructed to even further increase this flow, this increased variable condenser tonnage should not interfere with defense plans.

Magnesium, newest among our structural metals, is a forthcoming contender for honors in the radio industry. It is true that this new vital metal has been placed on the critical priorities list, but with the rapid expansion of plant facilities now under way, it is possible that this metal may be released in greater quantities for civilian use. Magnesium is extremely light, even aluminum being fifty per cent heavier, and steel, iron, zinc and brass being at least four times heavier. Where mechanical strength is required, magnesium is alloyed with such metals as aluminum, zinc and manganese, 10% or even less of this added metal being used. Thus the lightness is not affected. Magnesium die castings are ideal where light weight is an essential factor, and accordingly experiments are under way to find ways and means of incorporating such castings in communication equipment.

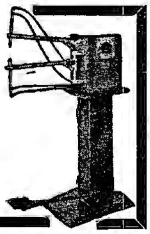
A capacity of 400,000,000 pounds annually of magnesium is the anticipated production. The present production is at the rate of approximately 30,000,000 pounds and plants already under way will raise that to 75,000,000 pounds. Since this important metal can be extracted from the unlimited reserves of the sea, and that accordingly a huge new plant on the Gulf of Mexico has been built to tap these natural resources, magnesium production should come well into its own soon. With the increased production of this interesting metal and its attendant use in bombers and other war implements, the strain on aluminum may be lightened. And with the succession of plants being added to produce aluminum, it may be possible to achieve that aim.

INDICATOR

(Continued from page 7)

This was too much folderol and its accuracy would always be questionable unless you went into an ultra precision device. What I wanted was something as fool proof as the ammeter in the detector of the monitor, and my requirements were fulfilled in a vibrating reed frequency meter. A vibrating reed meter, unless terribly mistreated, needs no routine checking of its calibration, will stand a wide range of voltages, has accuracy far better than is needed, and this accuracy is obtained and maintained by rugged methods and is not dependent upon the close tolerance of voltage and circuit adjustments.

As the whole idea is to replace the now obsolete swinging ammeter with some such similar external device, no thought has been given to building a device for FCC approval, but rather to building an external gadget that can be plugged in the listening jack to reassure the operator that all is well. In view of this, the device cannot consume enough energy from the monitor to alter in any way the normal operation of the monitor. This means that an amplifier that can be plugged into the listening jack must be used to obtain a negligible portion of the detector current and build this small power up to sufficient power to operate the reed meter. Tests indicated that one thousand ohms could be inserted in this circuit without any change in the normal operation of the monitor, so I selected a value far below this to be on the conservative side.



It was convenient to use a line-to-grid transformer that had a 50-ohm primary connection. This transformer also had a 500-ohm primary connection but very little gain was realized so I returned to the 50-ohm connection. I found that a 25-ohm pot connected as a shorting resistor across the input transformer primary served as the best volume control, as it could be taken to a convenient location and the amplifier could be mounted in any available location. This method required only one pair of wires for the volume control and a pair of wires for the meter from the output of the amplifier. In my case the meter and the volume control are mounted together on the operating desk. With the insertion of less than 25 ohms in the listening circuit I felt that no one could complain that the monitor was being altered by this device, and furthermore the device can be disconnected completely by simply pulling out the plug on the front of the monitor when the 30-minute compulsory readings are made.

The reed frequency meter that I used was a miniature model having eleven reeds. The reeds tune fairly sharply, so one-half cycle reeds are as far apart as it is desirable to make them. These eleven reeds give an indication of plus or minus 2.5 cycles. This did not seem like quite enough range at first, but after putting the instrument into operation, it was found that it was quite adequate. In fact, if the frequency deviated enough to go off the scale of the reed meter, it was high time to go over to the monitor and start looking for trouble.

The reed meter, of course, will indicate right down to a quarter cycle or even better. I had the manufacturer stamp the 30-cycle reed as zero, and indicate the 28-cycle reed as minus 2 and the 32-cycle reed as plus 2, etc.

The amplifier to use in operating the reed meter should be capable of delivering a little over a half-watt so that most any out-moded amplifier will do the job. Distortion means very little to a reed meter. The space where I wished to mount my amplifier was only 3½ inches on a standard relay rack, so I built a two stage resistance coupled amplifier using twin triode tubes. I have shown the circuit for those who do not have an available amplifier. It was found that one stage was a little too low on gain, and it was simple to make a two-stage amplifier in the same size can. A push-pull amplifier, as shown, has its advantages for this particular use as you can forget a filter on the B supply and just tap off the filament of any convenient power supply, as usually the filter section of a power supply is the only over worked part of the supply. If a little 60 or 120-cycle component gets into your amplifier, it will not hurt anything because the reeds will not have anything to do with any other frequency except that frequency to which they are tuned. This amplifier has a gain of around 40 vu and will deliver well over 1 watt depending on what plate voltage you use on the last tube. This amplifier with slightly higher resistance values in the plate and grids to obtain more gain makes an excellent preamp or studio amplifier. The output transformer to use on an amplifier should have something around a 5000-ohm secondary to match the reed instrument. An amateur Class B to r-f load transformer was used in my installation. The primary was 10,000 ohms and the secondary was adjustable from 3500 to 8000.

The manufacturers of the reed meter could not get it through their heads that the instrument was not to be used on 110 volts, so if you don't get much swing on your meter when you try it, open up the back of the meter and you will probably find a series resistor of several thousand ohms in each of the two leads to their coils. In fact they have stamped on my instruments "100 volts" on each face plate. The instrument with full swing of the reeds requires only 16 volts with the series resistors removed.

A hint to the boys that feel that the store bought reed meter is too expensive for their station. Take a discarded phonograph pickup and mount several lengths of small clock springs on a bar that connects to the needle receptacle. Solder a ball of solder on the end of each spring. File the solder until each reed tunes correctly. Connect the pickup head across the output of the amplifier. The head will vibrate all the reeds at the bottom, but the spring that hits resonance will show considerably more swing. Steel wires will also work. If you can't get enough reeds on one head, use several heads and feed them all from the same source. Every station has several discarded heads, or you can buy new ones for a few dollars. Two identical heads correctly phased with a bar between the two armatures to support the spring reeds should work, but be careful that the bar itself tunes well above 30 cycles. Make the springs all the same length and adjust the solder for resonance. The solder at the end is necessary for clear definition. While we were waiting for delivery of our factory meters, one of our operators made several satisfactory reed instrument experiments using phonograph heads. They require very little power to drive them.

LAMINATIONS
for Output TRANSFORMERS of Highest Permeability

Standard stocks in a wide range of sizes for Audio, Choke, Output and Power Transformers. Write for dimension sheets.

permanent MAGNETS
ALNICO (Cast or Sintered)
COBALT-CHROME-TUNGSTEN

Cast, formed or stamped permanent magnets for all purposes. Engineering cooperation backed by 38 years experience in magnet making.

TOOLS » DIES » STAMPINGS
HEAT TREATING

Thomas & Skinner
Steel Products Co.
1113 E. 23rd St. Indianapolis, Ind.

AUGUST
COMMUNICATIONS
the annual
APCO
CONVENTION ISSUE

●

Oakland, Calif.
August 18-19-20-21

●

Make your space reservation now. Complete coverage guaranteed.

●

FORMS CLOSE AUG. 8th

Index to Advertisers

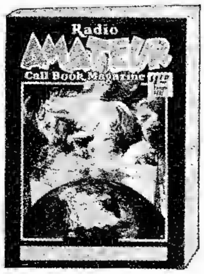
SECRETARY KNOWS BEST!

Only your secretary knows which make suits her style of typing best. So let her pick the new machine.

We'll gladly put a new Royal in your office on free trial. See for yourself that a Royal is easier to operate, means *better* work *faster*. Just call us.

ROYAL
WORLD'S NO. 1 TYPEWRITER

Royal Typewriter Co., Inc.
2 PARK AVE., NEW YORK, N. Y.
Branches and Representatives the World Over



Radio Engineers
who are
RADIO AMATEURS
buy a fresh copy today of the
RADIO AMATEUR CALL BOOK

The CALLBOOK is the only publication that lists all licensed radio amateurs in the United States and foreign countries.

Complete . . . Accurate . . . Up-to-Date

Issued Quarterly
MARCH . . . JUNE . . . SEPTEMBER and DECEMBER

Annual subscription $4.00
Single copies $1.25

Buy your copy now from your radio jobber or direct from:

Radio Amateur Call Book, Inc.
608 S. Dearborn St., Chicago, Ill., U. S. A.

FOR ULTRA-HIGH FREQUENCIES . . .
A NEW OSCILLATOR with Good Output

A—*Counter and dial reading direct in approximate wavelength; used with conversion chart to read frequency.*

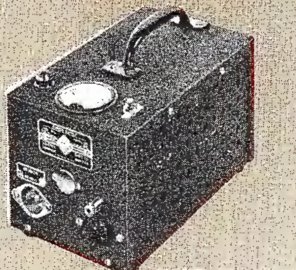
B—*Approximate wavelength readings in centimeters.*

C—*Conversion scale by means of which oscillator frequency can be determined to approximately 2½ per cent.*

D—*Short-circuiting piston which varies length of coaxial line and determines frequency.*

E—*Lead screw which drives plunger "D."*

F—*W. E. Type 316-A Oscillator tube.*



TYPE 757-P1
POWER SUPPLY

TO MEET the demand for a laboratory oscillator of good power output, with reasonably accurate frequency calibration, General Radio has developed and now announces the Type 757-A U-H-F Oscillator. This oscillator has adequate power output for laboratory and field-strength measurements at frequencies up to 600 megacycles. It uses a single tube which energizes a resonant coaxial line, the length of which determines the oscillator frequency. The effective length of the line is varied by means of a short-circuiting plunger which is driven by means of a lead screw. The output circuit is coupled to the main axis of the oscillator through a rod. This rod is so placed that the output impedance is approximately 75 ohms.

The oscillator is direct reading in approximate wavelength in centimeters. By means of a conversion-table scale permanently mounted on the oscillator housing, the resulting frequency in megacycles can be determined with an accuracy of approximately 2½ per cent.

ABRIDGED SPECIFICATIONS

FREQUENCY RANGE—150 to 600 Mc (200 to 50 cm)

OUTPUT POWER—3 to 4 watts up to 400 Mc, decreasing to 1 watt at 600 Mc

OUTPUT IMPEDANCE—approximately 75 ohms

OUTPUT TERMINALS—coaxial jack to facilitate connection by means of a coaxial line to instrument under measurement

CALIBRATION—by means of conversion chart, frequency is determined to 2½ per cent with no oscillator loading

FREQUENCY CONTROL—slow-motion, lead screw drive with a dial calibrated in divisions representing approximately 0.01 cm change in wavelength

POWER SUPPLY—filament: 3.65 amperes at 2 volts; plate 450 volts (maximum), 50 ma. The Type 757-P1 Power Supply is available to supply fixed filament and plate voltages for operation at 300 volts from 115 volt, 60 cycle power.

Type 757-A U-H-F OSCILLATOR	**$195.00**
Type 757-P1 Power Supply	**45.00**

Write for Bulletin 732 for Complete Data

GENERAL RADIO COMPANY
CAMBRIDGE
MASSACHUSETTS