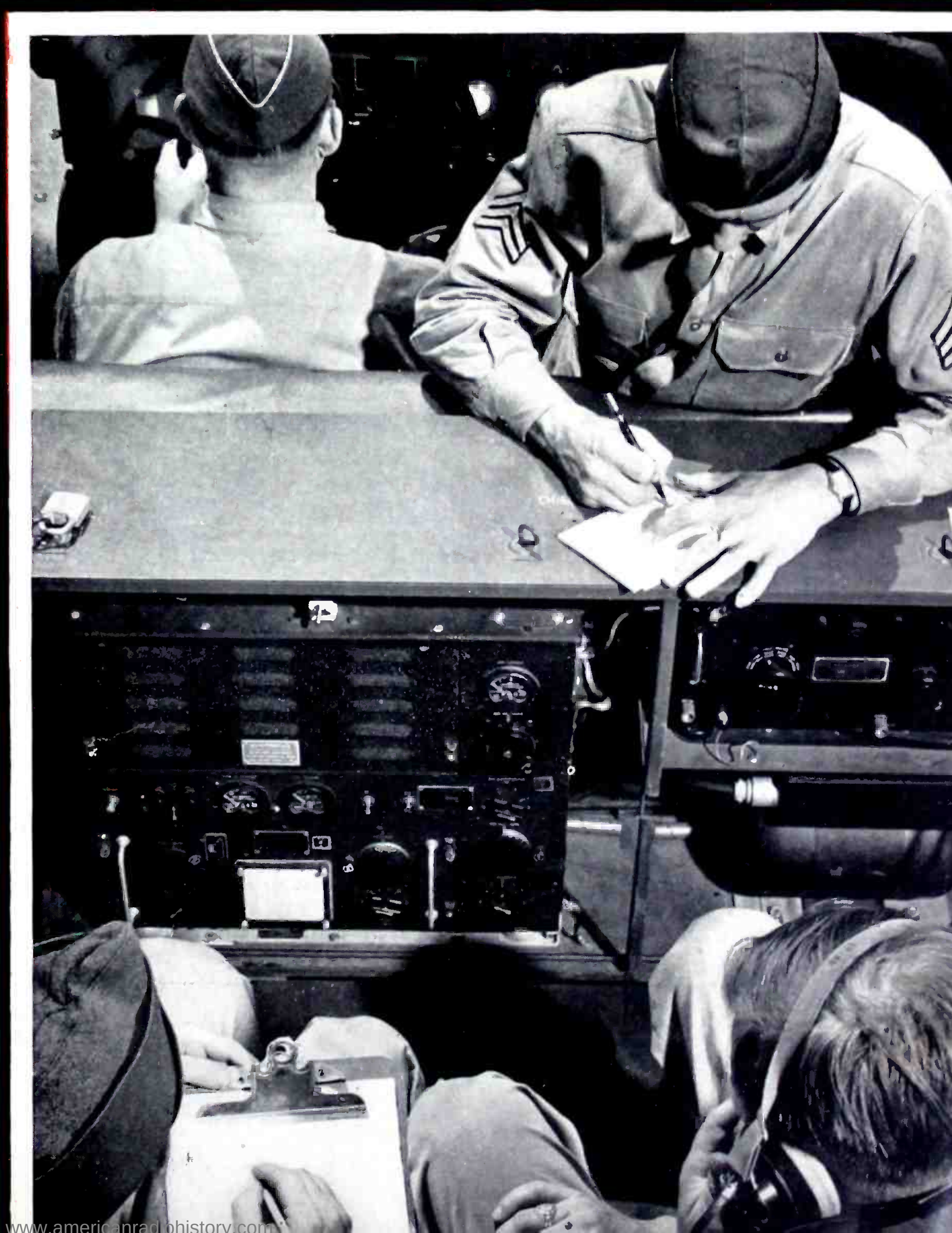
COMMUNICATIONS



COMMUNICATIONS IN WORLD WAR I AND WORLD WAR II

RESUME OF JANUARY I-R-E PAPERS

FLOOD AND FIRE EMERGENCY EQUIPMENT AND SYSTEMS

DECEMBER
1941

Odyssey of a Transmitter

Like Ulysses, Collins transmitters are subjected to great hardship and long journeys; like Ulysses they meet and pass each test, and then go on to the next. ¶Tutelary engineers accompany the transmitter through the final test department. They submit a Collins transmitter to every variety of climate, arctic cold, tropic heat, dryness of the desert, and the humid salt spray of the ocean. ¶They verify its mechanical structure through the ordeal of gruelling vibration and shock. They watch it through its electrical trials for distortion, noise level, carrier shift and frequency stability. ¶As Ulysses was compelled to face each adversity, so is a Collins transmitter taken on its journey in the final test department where it must meet specifications. Actual use of the equipment is anticipated and under simulated conditions the transmitter is put to the proof. After it has successfully passed each test, then, and then only, is your Collins transmitter shipped.

COLLINS RADIO COMPANY

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

LEWIS WINNER, Editor
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COMMUNICATIONS

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

We See...

NEVER HAVE COMMUNICATIONS received so dramatic, yet so conclusive a staging as in the past few weeks. Its impelling importance and critical necessity have roared it up to the front lines along with our guns and machines. Its overwhelming usefulness on the home lines, too, now becomes more predominant than ever before. Girded to the cooperative spirit of not only the technicians, but everyone in the industry, as well as those on the listening side, Communications should and will serve our Country in the truly American way . . . the winning way. And effectively presenting the broadcasting viewpoint, we have the following exclusive message from Neville Miller, president of the National Association of Broadcasters.

SAYS MR. MILLER, "Non-existent as a medium of mass communication in World War I, radio broadcasting has become one of the strongest arms of our present defense program, playing an increasingly important role in accelerating the tempo of our war effort, enlightening the people, maintaining national morale and unity, and preserving the stability of our economic life. Like a free press, a free radio has become at once a symbol of American democracy and a bulwark of protection to our free democratic institutions. Proud of the unique usefulness and service to their country, broadcasters are likewise keenly aware of their grave responsibilities to the Nation. To the discharge of these responsibilities, the radio broadcasting industry dedicates itself for the duration of the emergency."

FROM ARTHUR VAN DYCK, Manager of the RCA License Lab., and president-elect of the IRE, we have received the following exclusive message on the Communications industry in this emergency. "Everyone knows that the present war

(*Continued on page* 31)

DECEMBER, 1941

VOLUME 21 NUMBER 12

COVER ILLUSTRATION

Radio command car at field radio school, 3rd Signal Corps Replacement Training Center, Fort Monmouth, N. J.

(Photo by U. S. Army Signal Corps)

WAR AND COMMUNICATIONS

RECEIVER DESIGN AND APPLICATION

TRANSMITTER DEVELOPMENT

ENGINEERING CONVENTION RESUME

MONTHLY FEATURES

Published Monthly by the Bryan Davis Publishing Co., Inc.

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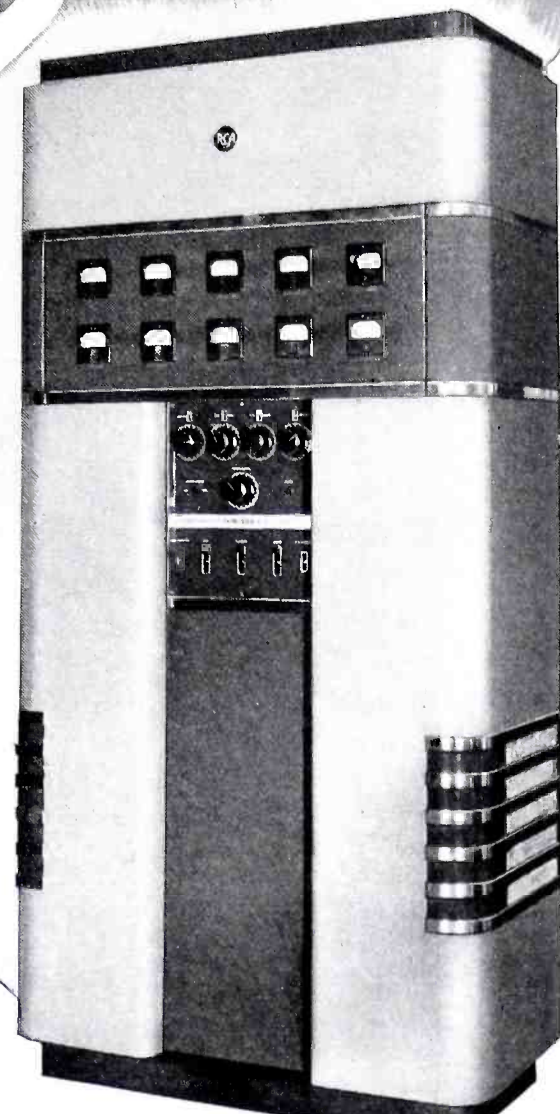
CHOICE OF *84* AMERICAN RADIO STATIONS

Why?



RCA 250-WATT
BROADCAST TRANSMITTER MODEL 250-K

On the market for less than two years, the RCA Type 250-K Broadcast Transmitter has already been accorded an acceptance far beyond that of any other 25-watter produced by *any* manufacturer! The initial production-order, incidentally, was sold out *sight unseen* before the first 250-K ever came out of the factory.

It's only natural to ask, "*Why—?*"

Part of the answer lies in the extreme flexibility of the 250-K. It affords outstanding operation at 100 or 250 watts—and is easily adapted to 1,000-watt operation at any time by the simple and inexpensive addition of RCA amplifier unit and power supply Type MI-7187.

Another part of the answer lies in the *economy* of the 250-K. For example, it draws only 1625 watts from your power-line at average modulation on a 250-watt carrier... economy that helps keep power-bills *low*, thanks to its RCA-engineered high-level Class B modulation. Tube-costs are low. And installation is economical—economical because *simple*.

Program quality is part of the answer, too—audio is flat within 1½ db. from 30 to 10,000 cycles.

Dependable—? Ask any of the 84 stations who have bought the 250-K! For the RCA way is to work for dependability from the first line on the drawing-board to the last bolt in the final assembly!

Write for complete data and literature ... *today*. As we go to press, the 250-K is still available for immediate delivery—but it may not remain so for long.

OUTSTANDING ACCEPTANCE!

These American Broadcasting Stations—including 1,000-watt stations using it as an exciter unit—have chosen the RCA Model 250-K ... all within the past two years. And the list does not include still others to foreign stations, American police installations, and stations now under construction!

KANA	KBIX	KBUR	KBWD	KFBG	KFIO
KFIZ	KFMB	KFPW	KFXM	KGLO	KHAS
KHON	KLS	KLUF	KRJF	KROD	KSKY
KSRO	KUJ	KVFD	KVOE	KWIL	KWRC
KYCA	KYOS	WAJR	WARM	WATN	WBIR
WBML	WBOC	WBTA	WCBI	WCED	WCRS
WDAK	WDAS	WDEF	WFDF	WFIG	WFPG
WGAC	WGOV	WGTC	WHBQ	WHKY	WHUB
WHYN	WINX	WISR	WIZE	WKIP	WKMO
WKPA	WKWK	WLAV	WLBJ	WLKO	
WMJM	WMOB	WMOG	WMRN		
WORD	WOSH	WSAV	WSGN		
WSLB	WSOC	WSOO	WSRR		
WTHT	WTJS	WTMA	WWNY		

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A Message from the Publisher

THE radio communications industry is now faced with a vital responsibilty. Not only must it furnish and maintain equipment of our armed forces, but it must also assure nore than adequate broadcasting and public reception, now of such paramount importance.

Demands upon the entire technical personnel of the industry will be tremendous. An even greater number will be called to active duty with the army, navy and air force, thus placing additional responsibilities upon those still engaged in commercial manufacture, operations and service work.

We, of COMMUNICATIONS magazine, fully cognizant of these grave issues, accordingly have placed into operation a stringent editorial policy dedicated to the interests of the National Emergency. We will continue to bring you timely, authoritative engineering data. We will also publish a variety of fundamental data of basic value to the young and new technical personnel, now being constantly added to the industry.

We are working closely with all branches of the Federal Government, with whose activities the communications and radio industry is allied. Much vital data which we would normally be able to publish must, of course, be omitted due to its actual or potential value to the enemies of the United States.

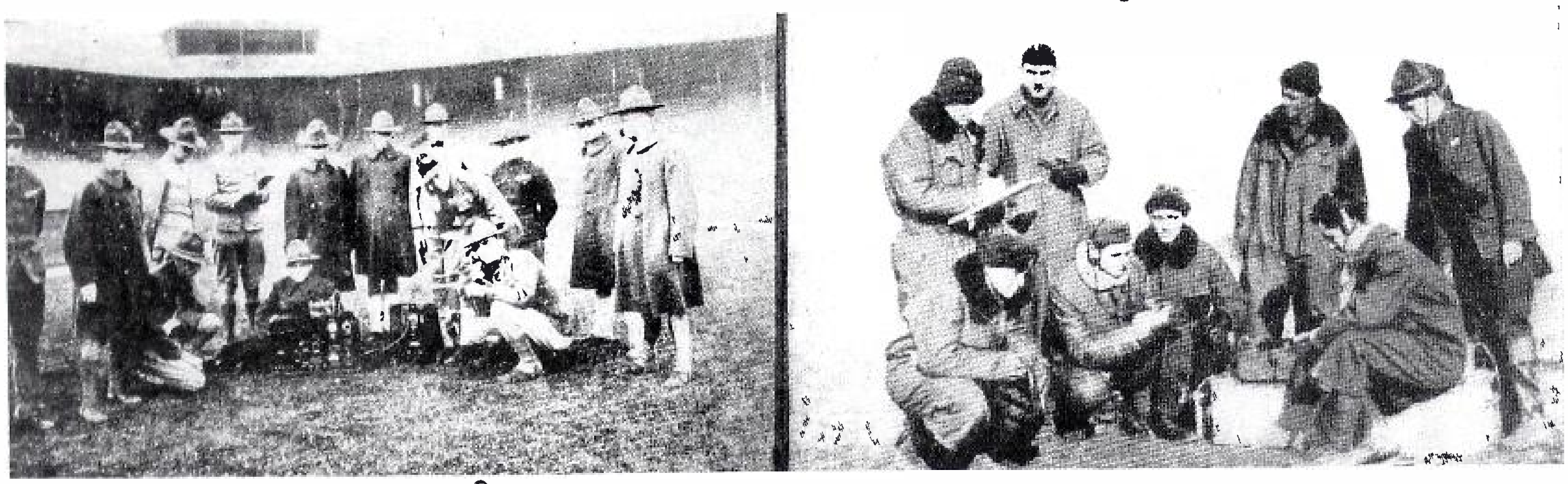
We propose to conserve paper and other supplies as far as possible — to eliminate all waste. We ask our readers to make their copies of COMMUNICATIONS available to their associates whenever possible—to make every copy do the work of two or more.

We want to help you in every way we can. If you need special information, don't hesitate to write or wire us. We may have it and, if not, we will try to get it for you.

Bryan S. Davis

COMMUNICATIONS

LEWIS WINNER, Editor



At left, U. S. Signal Corps field radio copying signals from an airplane in flight, 1918. At right, U. S. Signal Corps field radio telephone station, France, 1918.

Communications in

WORLD WAR I AND WORLD WAR II

by DONALD McNICOL

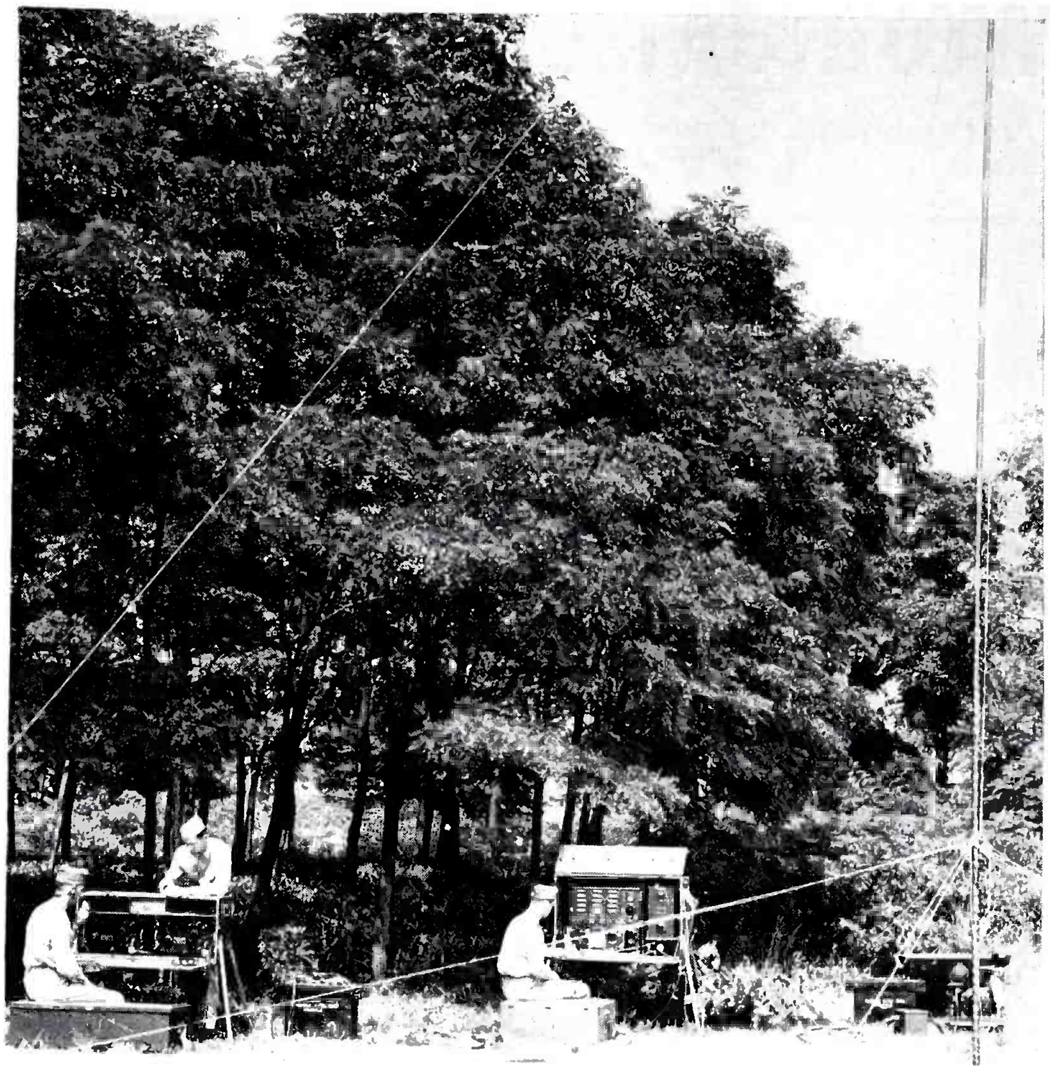
PAST PRESIDENT, IRE

NOW THAT appeasement, sanctions, neutrality, armed neutrality and lend-lease on the part of the Arsenal of Democracy have had their day, and a shooting war has been dumped in our laps, the great part *Communications* will play in the War effort is of prime importance. Not only will rapid communication permit the long arm of our government to reach out and maintain all-important contacts, but it will afford our armed forces, by way of radio, with the vital medium of conducting successful warfare, particularly with the new mobile units.

It is less than twenty-five years since the United States was engaged in another war of great magnitude. It is of present interest to refer to the rapid succession of events which then engaged the attention of communication services throughout the months preceding and following the declaration of war against Germany and her allies in the year 1917. At the time of World War I, of course there was no Federal Communications Commission in this country, charged with the regulation of the communication services. At the time of World War I, the Government secured for military purposes the full use of wire and radio services by direct cooperation on the part of the communication companies. In the initial, organizational stage of the war preparations a quasi direction and supervision of the wire and cable lines was invoked by commissioning one or more of the officials of the operating companies as majors and colonels in the army service.

In January, 1917, before American entry into the war, Major-General G. O. Squier, Chief Signal Officer of the army went from Washington to New York, where he held informal conferences with Theodore N. Vail, president of the A. T. and T. Co., Newcomb Carlton, president of Western Union, and with J. J. Carty, of Bell Telephone. War was imminent and it was recognized by the head of the Signal Corps that many hundreds of communication technicians would be required for service abroad. There was not sufficient time for the army to train enlisted men at army posts. It was thus decided that the telegraph and telephone companies select from their regular staffs men qualified for the duties as outlined by the Chief Signal Officer. The officials of the commercial communication companies subscribed whole-heartedly to this procedure. Thus the regular army establishment was relieved of the task of training and organizing telegraph, telephone and radio technicians to accompany the pioneer combat units of the A.E.F.

This direct procedure resulted in the despatch to Europe, in the first months of the war, of twelve battalions of men best trained for the work in hand, all in uniform, and officered by communication officials who had been commissioned as officers. Once the military draft was in full swing, sixteen training schools for telegraph, telephone and radio operators and technicians were established at army posts and at technical colleges. It was from this source that replacements were supplied, and from which field and telegraph battalions required for the combat forces



(Photo by U. S. Army Signal Corps)

General view of equipment at Field Radio School, 3rd Signal Corps Replacement Training Center, Fort Monmouth, 1941.

began to flow across the Atlantic.

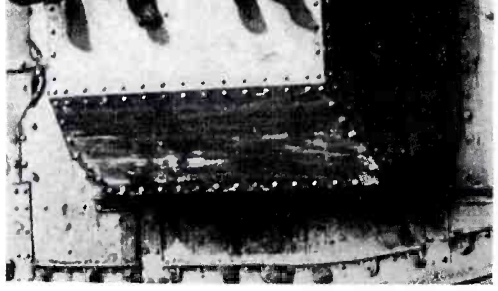
Early estimates made by the Signal Corps indicated that there would be required for use abroad one million cells of dry-battery, 285,000 vacuum tubes, 110,000 field telephone sets, several thousand telegraph sets, including printers, 350,000 miles of insulated wire, and large quantities of other communication equipment for installation and maintenance. In the months prior to our entry into the war, orders for communication equipment began to pour into the country's manufacturing establishments, and as this demand was simultaneous with the sudden huge demand for numerous other instruments and engines of war, it was not long before there developed a serious shortage of materials, as we have today.

Shortages in 1917

A shortage of dies and solvents caused a sharp rise in the price of insulating materials and compounds. The price of lake and electrolytic copper shot up from 15 cents per pound to 27½ cents, and to a high of 36 cents per pound. The certainty of supply and price became so unruly that early in 1917 the Government established a price of 23½ cents per pound for copper. Once basic prices of manufacturing products became stabilized, manufacturers were able to submit firm bids for finished apparatus.

Printers Used

The large increase of commercial and government telegraph business incidental to the business expansion, together with staff losses due to enlistments in the army and navy, produced a sharp demand for Morse telegraphers in all parts of the country. The Western Union Telegraph Company and the press associations reverted to the use of printers which could be operated by girls.



British tank in France, 1918, with U. S. Signal Corps men, carrying their communications equipment.

Telegraph Tests in 1916

On November 15, 1916, radio telegraph tests were successful between San Francisco and Japan, and early in 1917 the American Telephone and Telegraph Company carried out a three-days' test of communication facilities, in connection with a national resources survey, demonstrating the dependability of telephone communication between the offices of the Navy Department and all navy depots in continental United States. Captain C. C. Culver carried out tests of two-way radio between a ground station and an airplane in flight up to a distance of 119 miles. Tests also were made of communication between airplanes in flight. On September 29, 1917, direct radio telegraph communication was inaugurated between the Arlington, Va., station and Pearl Harbor, Hawaii, and the Pan American Wireless Telegraph Company (Marconi) made preparations for service between New York and South American countries.

Signal Corps in 1917

At the time of the outbreak of war the U. S. Signal Corps staff comprised 55 officers and 1,570 enlisted men. This force was at once enlarged to 17,892 officers, 179,802 enlisted men and 9,767 civilian employes, distributed throughout the United States and her colonial possessions, on duty in the office of the Chief Signal Officer, Washington-Alaska cable system and at general supply depots. In June, 1918, in Paris, France, a Division of Inspection and Research, Signal Corps, was set up to meet A. E. F. needs. It is of interest to record that among the American radio experts attached to this Division were E. H. Armstrong, H. W. Houck, J. H. Pressly, W. H. Preiss, W. A. MacDonald and Harold M. Lewis, each of whom contributed largely to the startling advances made during the war in radio transmission and reception by American, British and French radio experts.

La Tour's Developments

The French engineers under La Tour produced a 6-stage, 4-tube amplifier known as the L-3 Type. The British, under B. J. Round, turned out a 7-tube receiver, the No. 55. The American engineers, building on the L-3 receiver produced a receiving system which made radio history. It was out of the incidental experiments in connection therewith that Armstrong developed the superheterodyne receiver. For airplane, radio, air-driven electric generators were produced. The Telautograph and the recording phonograph were adapted to make permanent records of intercepted radio messages.

In France, the American telegraph and telephone engineers of the Signal Corps battalions found much antiquated and inadequate equipment in service, most of which, for A. E. F. needs, was discarded or supplemented by the installation of modern American apparatus.

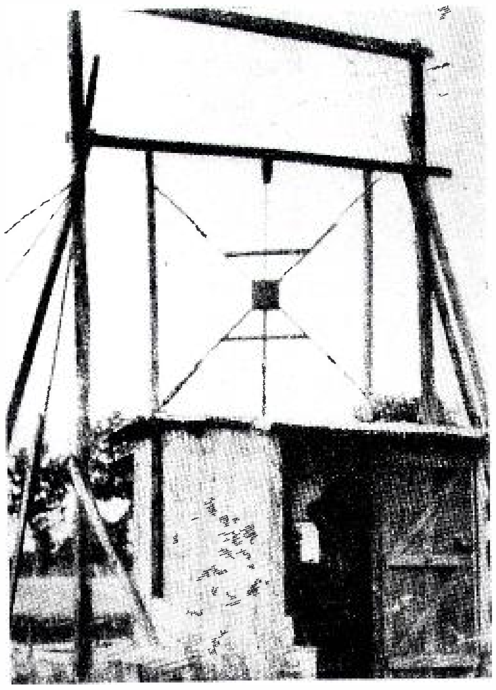
Naval Censorship in 1918

On May 21, 1918, shortly after the declaration of war, a naval censorship was established over submarine cable operation from offices in the United States, censors being stationed in all of the operating rooms. On July 5, the House passed a Bill authorizing the President to take over and operate the commercial telegraph, telephone and radio systems in the United States, and on November 2, the President ordered the Postmaster-General to assume control of the submarine cable systems. Six weeks later Postmaster-General Burleson appointed U. N. Bethel, F. A. Stevenson, G. M. Yorke and A. F. Adams as an operating board, to administer the telegraph and telephone systems under government control. Newcomb Carlton was appointed to manage the submarine cable systems, with George Clapperton representing the Commercial Cable Company. Directly under the President, David J. Lewis, Congressman from Delaware, was appointed Director of the Wire Control Board.

The Signal Corps battalions serving in France with the combat forces functioned with remarkable effectiveness. Within two months after the American engineers went to France to install communication facilities, a call came to America for the immediate despatch of seven hundred Morse operators and four hundred radio operators. These drafts were met by draining operators from the commercial telegraph companies and radio men from the Signal Corps schools.

Government Control, 1918

Government control of the American commercial communication companies continued for nearly nine months after

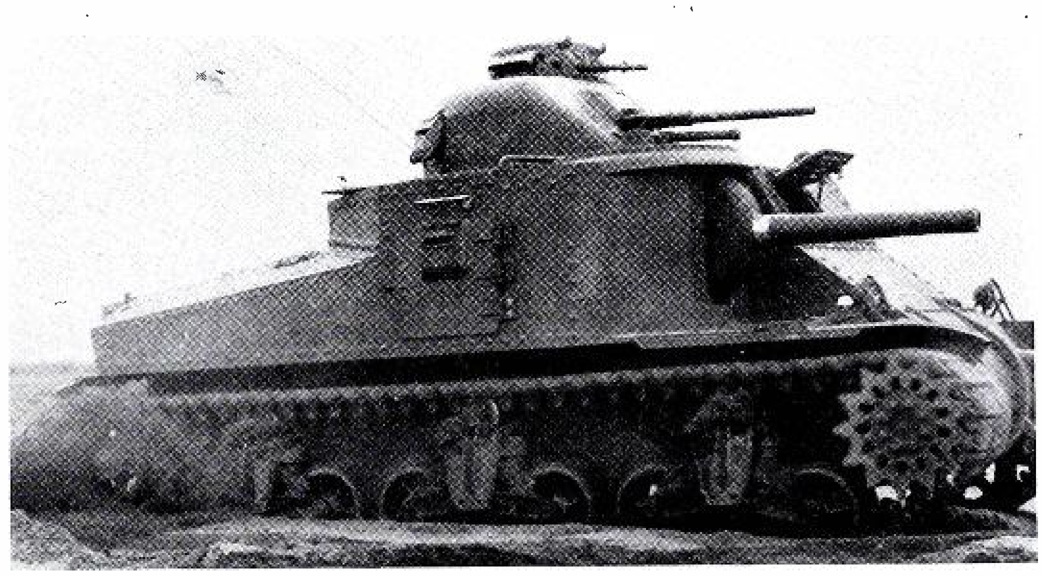


U. S. Signal Corps Ground Goniometric Station, France, 1918.

the conclusion of the war on November 11, 1918, notwithstanding that Bills were introduced in Congress having, in view, permanent government retention of these facilities.

The foregoing review of what happened before and after the first World War, with regard to communications, may be contrasted with the situation in 1941. Today the Federal Communications Commission, through orders determines rather narrowly what the commercial companies, their staffs, and employes may do and may not do. On the afternoon of December 7, last, following the early reports of Japanese assaults on Pearl Harbor naval station and airport, the chairman of the Federal Communication Commission at Washington, D.C., probably functioning through the Defense Communication Board, held telephone conversation with the presidents of the principal commercial communication companies, and received assurance that the Government would be accorded full and complete cooperation on the part of the wire and radio services. Immediately following the Japanese bombing attacks censorship was established at Honolulu and Manila by the navy, and before 9 p.m., on December 7, censorship was set up at San Francisco, New York and Miami. In anticipation, the navy has had in training at communication centers, six hundred officers and four hundred enlisted men who were ready to sit in when the order came. At once also, a ban was placed on the operation of amateur radio stations in the United States, its territories and possessions. On December 8, following a meeting of the FCC and DCB the ban imposed on amateur radio was tightened to include "all amateurs except those who may be permitted to function in a special national defense category upon specific recommendation of the DCB." It is likely that these include the members of the Army amateur Network and amateurs connected with the Office of Civilian Defense.

The FCC is studying the situation with respect to broadcasting; whether, or at what stage of the war effort, some degree of censorship may become desirable. No one doubts the seriousness of this, associated as it is with "Freedom of the Press." In any event, "for the duration," no American will object to any step or steps deemed necessary by the Government to bring certain and complete victory to the American arms.



(Photo by U. S. Army Signal Corps)

The 1941 medium tank M-3, at Aberdeen Proving Grounds, with its self-contained radio equipment. In most of these tanks, f-m units are being used effectively.

Multiple Receiver Response in

STRONG R-F FIELDS*

by R. N. PLANK

Chief Engineer, Radio Manufacturing Engineers, Inc.

RECEIVER characteristics contributing to multiple response in strong fields are varied and legion. Although the superheterodyne type of circuit is generally more productive of spurious responses than, for instance, the so-called tuned radio frequency type of receiver, the latter does respond to other than the desired signal in certain situations and therefore can not be considered as entirely immune. In fact, almost every type of circuit has its weaknesses and the efforts of the engineer in the design of receivers are generally best rewarded by superior performance when they are directed along lines of reducing the effects of the inherent weaknesses. This particular factor in receiver design is unhappily not always closely associated with efforts to keep the costs down. It is the latter effort which, though sad but true, dominates the picture in some cases.

It might be well to consider the more probable difficulties encountered in a receiver when operating in a strong radio frequency field by types, in the order of their appearance in the radio field. In 1926, or thereabouts, there appeared in great profusion the type known as the t-r-f. In those days, fortunately, the situation in which a number of high-powered stations were operating did not exist. But, nevertheless, and most of you have found it out in your own experience, there still remains in use a significant number of sets of that era. Those of you who are charged with the operation of our broadcast stations, and those of you who are engaged in maintaining in proper working order the receivers of the listening public, know this from experience.

Figure 1 shows the circuit of one of these early types of receivers, with the grid lead with leak resistance and grid condenser acting as a miniature, though very effective, antenna. There were no shields in this receiver. Nor was there a chassis, except an r-f coil mounting.

Several weaknesses of this type of set have been brought to light in recent times when broadcasting has changed a little from the period of 1925. There are more and stronger signals in most every area. The first weakness, due to lack of shields is the antenna effect of the grid leak and condenser which was almost always large, exposed and unshielded. Under the influence of strong fields these sets could be operated on somewhat of an economy basis. All tubes ahead of the detector could be removed without reducing the signal, and in addition the necessity for tuning was eliminated. The only way to get rid of the strong local was to turn the receiver filament off or remove "B" voltages. Unhappily this state of affairs could exist even though the receiver was intended for broadcast reception and the all-pervading signal was on 56 megacycles or higher. The only requisite was that the field strength from the transmitter be great enough to operate the detector, and this was not always necessarily very high in level. The action, of course, was, in effect, by-passing of the tuning elements of the receiver due to the large space coupling capacity of the grid lead and its associated mounting. And since the detector was not a selective device any modulated carrier of sufficient magnitude would produce a response in the same manner as a signal given to the detector from the r-f amplifier. Although the

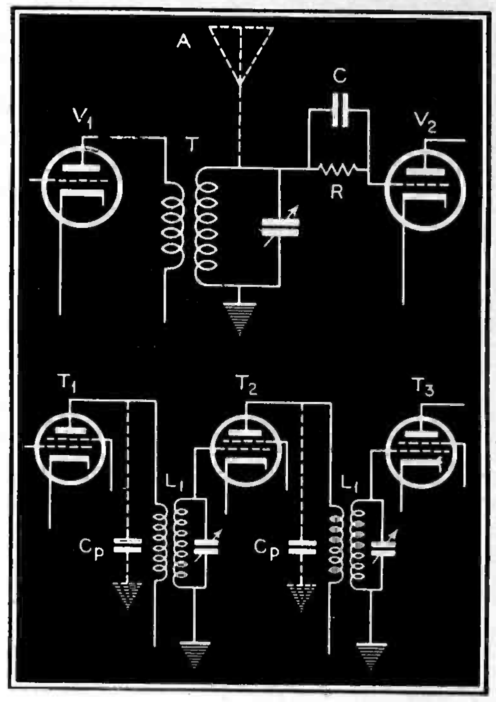
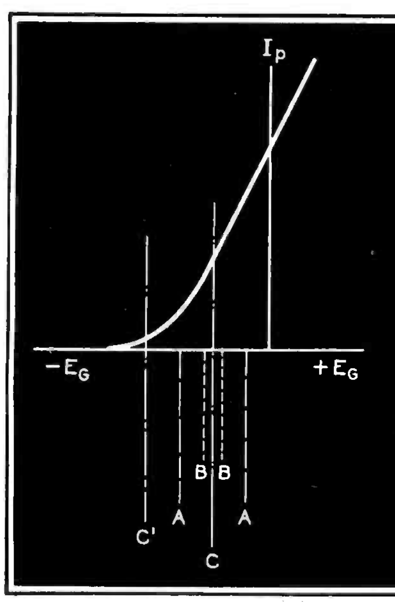


Figure 1 (top) Figure 2 (bottom)
Circuits of early type receivers with interference 'aids'.



DESIRED SIGNAL $E_B = B \sin 2\pi f_B t$

UNDESIRED SIG. $E_A = A\left(1 + M_A \sin 2\pi f_M t\right) \sin 2\pi f_A t$

$$E_G = E_B + E_A$$

$$I_p = C_1 E_G + C_2 E_G^2 + C_3 E_G^3 + \cdots$$

$$I_{p(f_B)} = \cdots + \frac{d^3 I_p}{d E_G^3}\left[\frac{1}{6} B^3 \sin^3 2\pi f_B t + \frac{1}{2} A^2 B \left(1 + M_A \sin 2\pi f_M t\right)^2 \sin^2 2\pi f_A t \times \sin 2\pi f_B t\right] + \cdots$$

$$I_{p(f_B)} = \cdots + \frac{1}{4} \frac{d^3 I_p}{d E_G^3} E_A^2 E_B \left(1 + 2 M_A \sin 2\pi f_M t\right) \times \sin 2\pi f_B t + \cdots$$

Figure 3
The grid volt-plate current characteristic of a typical tube that may cause cross-modulation.

*Presented before Radio Interference Conference held May 11th at the University of Illinois.

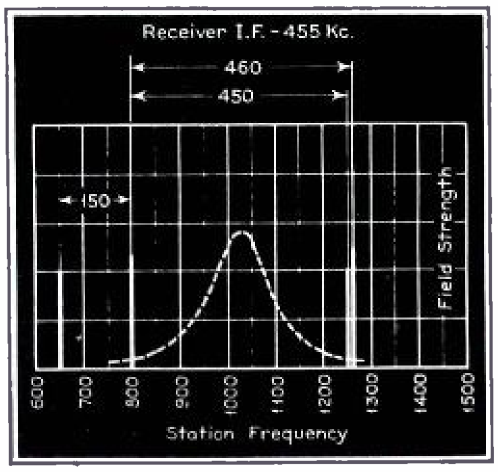


Figure 4

A graphical representation of interference problems in a superheterodyne.

regular stations could be received, the interfering station was always present.

Another rather interesting type of response appeared in the early 1930 t-r-f mantle receivers. The particular difficulty encountered in this instance was the continued interference by amateur stations using the frequency between 3.9 and 4.0 megacycles. All receivers of the make involved were bothered when they were subjected to a strong field in this frequency range. Figure 2 shows a simple diagram of the r-f circuits. Here the plate circuits were feeding r-f transformer primaries having considerably smaller inductance than the tuned secondaries and these primaries were being tuned to approximately 3.95 megacycles by the plate capacity of the tubes. The signal level was sufficient to override the attenuation, due to the tuning of the secondaries, and the result was a constant response due to the 3.9-4.0 megacycle stations in the vicinity.

We come now to the screen grid type of tube, or the tetrode as it is called. In early types, such as the type 24, there existed considerable grid voltage—plate current characteristic curvature—so that at no point on the characteristic curve of these tubes did a completely suitable linearity exist. Moreover, they were quite sharp in cut off and consequently when a strong signal was impressed continually on the grid of one of these tubes, used let us say as a first r-f amplifier, due to its overriding the rejection characteristic of the input tuned circuit, this signal appeared with all other signals whenever they were tuned in. This, of course, occurred in t-r-f receivers and also in superheterodyne receivers.

This particular type of interference is due to the cross modulation factor. The value of this factor is determined by the degree of non-linearity of the grid voltage—plate current characteristic over which the signal excursions occur. Figure 3 shows grid voltage—plate current characteristic in a typical tube which causes this type of response, and with it are briefly given some of the mathematical analyses which makes it possible to determine definitely the cause of this particular difficulty. One term in the expression, as you will see, includes the desired signal carrier modulated with the audio frequency component of the undesired signal. Although to a certain degree this difficulty can be encountered with practically all types of tubes, the newer types of tubes which have either a tapered grid mesh or two complete grid structures (one of fine and one of wide mesh) have, over the major portion of the characteristic, a linearity to a degree which reduces to a practical minimum the tendency to produce cross-talk. In addition to improvement made in tubes of recent design to reduce the tendency to produce cross-talk, certain factors in design can also be used to reduce the tendency to cross-talk by eliminating the tendency of the strong signal to ride over the rejection characteristics of the preselection elements of the tuning system. In other words, the greater the selectivity provided ahead of the radio frequency amplifier tube, that is between the signal gathering element such as an antenna and the first amplifier tube, the less will be the tendency for a strong signal to produce modulating excursions of the grid voltage. And the tendency to produce cross modulation is therefore reduced as the tuning is caused to depart from the strong interfering station. In practice, the closer the desired signal comes to the undesired signal the greater will be the tendency to cross-talk, due to the fact that

STRONG SIGNAL FREQ. 1400 kc.
RECEIVER I.F.—465 kc.
RECEIVER TUNED TO 1402.5 kc.

F_{s1} — 1400	F_{o1} — 1867.5
F_{s2} — 2800	F_{o2} — 3735.
F_{s3} — 4300	F_{o3} — 5602.5

F_{s3} — F_{o2} 465 k.c.

Figure 5
Tabulation of frequency variations caused by heterodyne actions.

the selectivity of the input circuit is not as effective on small frequency displacements as it would be on large frequency displacements, or when the two signals are widely separated.

Another difficulty can arise in the case of superheterodyne receivers where insufficient preselection is provided between the antenna and the first radio frequency amplifier grid circuit. Several results can evidence themselves in the form of interference in cases where in any one given receiving area, such as in a large metropolitan center, where there are numerous broadcast stations of relatively high radiation powers separated from each other in frequency by the intermediate frequency of the receiver being used. Figure 4 shows graphically the condition from which this effect may arise with a station at 800 kilocycles, and two other strong stations, one at 1250 kilocycles and one at 1260 kilocycles, in the same localized areas, as examples.

The intermediate frequency of 455 kilocycles on which this case is based, was selected since it is the intermediate frequency most commonly used at the present time. Assuming a re-

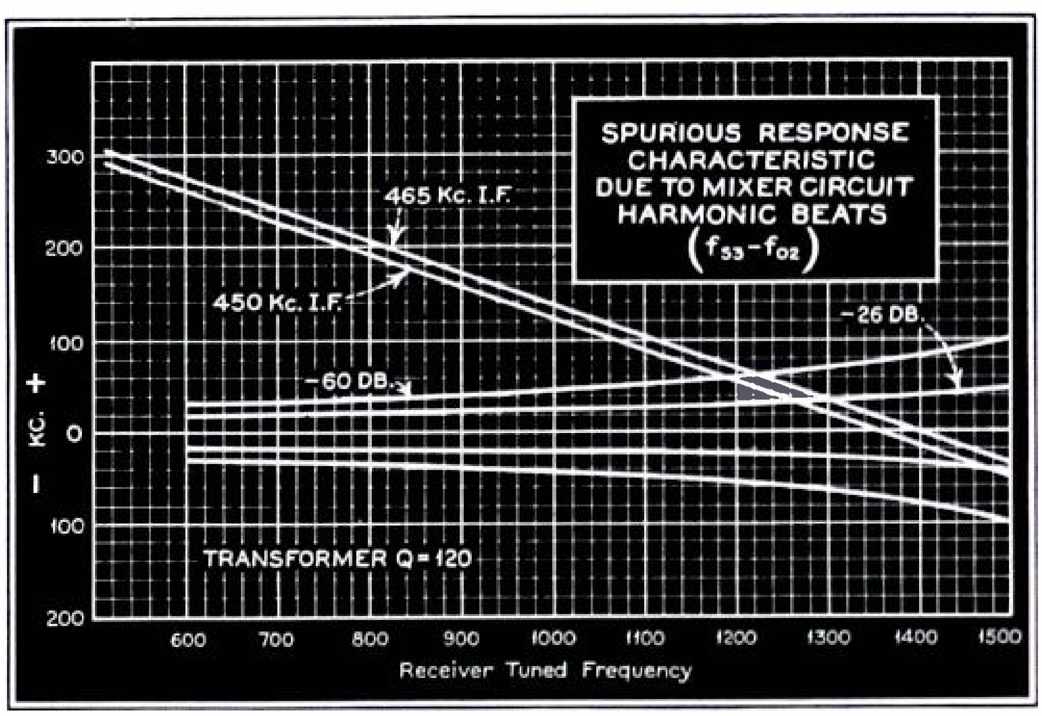


Figure 6
In these curves illustrating the response effects, the attenuation prompted by assorted mixer beats are also shown.

so that signals 5 kilocycles off of resonance may produce a response in the system, then these three stations will produce beats of 450 and 460 kilocycles. These values are ±5 kilocycles of the i-f frequency of the receiver. If the receiver is responsive over that wide a band, then without any tuning of the receiver at all, either one or both of the two higher frequency stations, depending upon their relative amplitude with respect to the 800 kilocycle signal, will produce the intermediate frequency and thereby the result will be a reproduction of either two or three stations; in the extreme case over the entire range. However, since the responce is proportional to the product of the amplitudes of the signals involved, as the receiver is tuned to the extreme lower or the extreme higher frequencies of the band, this effect will probably disappear due to the rejection characteristics of the selectivity curve indicated in the dotted line in Figure 4. The optimum response would probably occur whenever the receiver was tuned midway between these stations and sufficient energy was present in the antenna to feed through the r-f amplifier regardless of the preselecting components. If the selectivity curve, as indicated by the dotted line in Figure 4, is sharpened considerably and the attenuation thereby increased, this effect will disappear. On Figure 4 is also drawn a line at 650 kilocycles in order to show the effect as it formerly was in years gone by when low intermediate frequencies were used in receivers, some being around 150 to 250 kilocycles. In this particular case this type of interference would be more prevalent due to the fact that the two signals are closer together and the selectivity would have to be considerably greater in order to eliminate the combined effect of two signals at the mixer grid simultaneously. A remedy for this again is improved or increased preselection between the antenna and the first r-f grid circuit and also frequency allocation can be made so that the standard intermediate frequency cannot be produced by any combination of stations in one area. It, of course, is most noticeable on receivers lacking tuned radio frequency amplification and having a low value of i-f.

In superheterodyne receivers where frequencies are combined in the first detector or mixer tube for the purpose of generating an intermediate frequency, and this is usually done by means of combining an incoming radio frequency voltage with an oscillator voltage by a great many different systems, a number of undesirable effects can result. One of these is the spurious response produced by higher order combinations of the signal and the oscillator beating together to produce the intermediate frequency. Of course, a desired signal can provide only one combination which will be acceptable to the intermediate frequency amplifier. However, if the receiver is tuned to a given frequency and the selectivity between the antenna and the mixer tube is inadequate to exclude signals in the vicinity which have very high amplitude, a very common effect is produced. In Figure 5 is a brief tabulation based on several assumed values which will show this effect. Here we have a receiver which is tuned to 1402.5 kilocycles, the receiver having an intermediate frequency of 465 kilocycles. Impressed in the antenna system is a very strong signal having a frequency

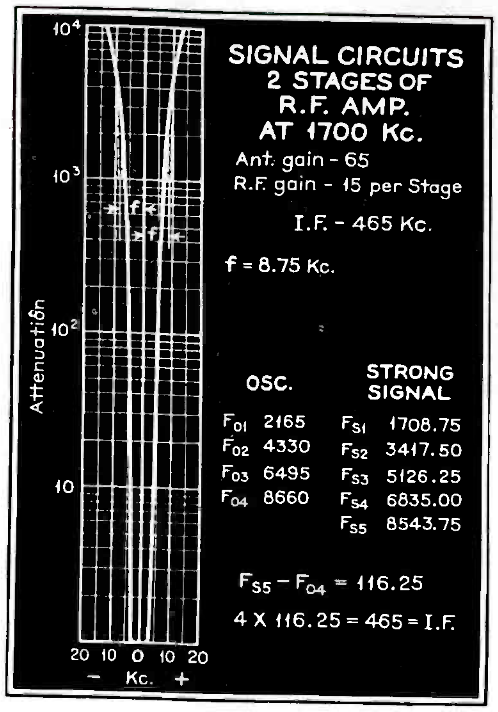


Figure 7

The effects prevailing when the i-f amplifier operating the AVC, and producing AVC feedback voltage, provides a signal very close to the i-f because of the selectivity of the i-f amplifier channel.

of 1400 kilocycles. If the receiver is tuned to 1402.5 you will have an oscillator fundamental frequency F_{01} of 1867.5, which is determined by adding the intermediate frequency to the tuned frequency of the signal circuits which track with the oscillator tuning. There will also be present in the mixer tube higher order combination frequencies of the signal and oscillator which may produce the intermediate frequencies. Consequently we have, in addition to the fundamental F_{01}, F_{02} equal to 3735 kilocycles and F_{03} of 5602.5 kilocycles generated as plate current components. In addition to this the strong signal impressed in the antenna is not sufficiently excluded by the selective circuits between the antenna and the mixer, and the fundamental of the strong signal at 1400 kilocycles produces F_{s2} at 2800 kilocycles and F_{s3} at 4300 kilocycles, the second and third harmonics of the strong signal respectively, at components of resultant plate current. By combination it can be shown that a component term of the expression involving the mixed frequencies, contains the difference frequency (F_{s3}-F_{02}) and this is exactly 465 kilocycles. A response will thus be obtained due to the strong signal when the receiver is set at 1402.5 kilocycles. Of course in practice this is usually within the acceptance curve of selectivity of the receiver and would not be due to an inherent lack in the receiver. These calculations can be carried out to show that when the receiver is tuned to 975 kilocycles and a strong signal is impressed having a frequency of 1100 kilocycles, and sufficient voltage reaches the mixer tube to produce the necessary grid excursion to produce harmonics, that the signal of 1100 kilocycles will respond when the receiver is tuned to 975 kilocycles. For the same reason, when the receiver is tuned to 1552 kilocycles, a 1500 kilocycle signal will appear at that frequency. Figure 6 shows graphically these effects.

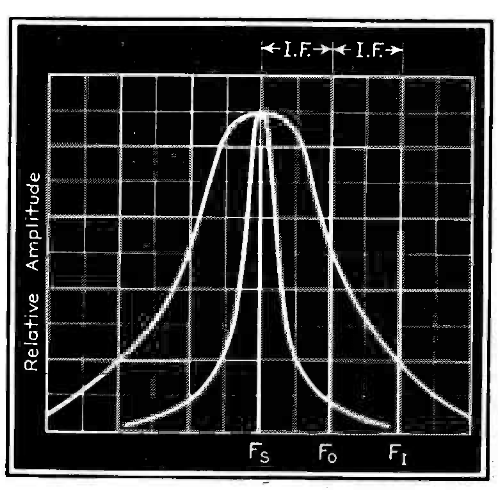


Figure 8
Image response characteristics.

In this curve, the abscissa of the receiver's tuned frequency are plotted against ordinates in kilocycles above and below a zero value. At first consider the two straight parallel sloping lines, designated as 465 kilocycle i-f and 450 kilocycle i-f. Let us choose, for example, a receiver tuned frequency of 1000 kilocycles. At this value of receiver tuned frequency (the receiver having an intermediate frequency of 465 kilocycles) the 465 kilocycle i-f line crosses the 1000 kilocycle ordinate at +135 kilocycles approximately. This is to be interpreted as meaning that when the receiver is tuned to 1000 kilocycles and a signal 135 kilocycles higher in frequency is present, having sufficient energy to produce some voltage at the detector tube, even though the receiver is detuned from that frequency, it will produce a signal in the loudspeaker. In other words, a strong signal at 1135 kilocycles, producing some voltage in the grid of the mixer tube when the receiver is tuned at 1000 kilocycles, will produce a response due to that strong signal. In addition to this, other responses can be obtained at other frequencies in this region due to higher order combination components of the signal and the oscillator. They, of course, will be at various displacements from the tuned frequency of the receiver and will depend for intensity upon the relative amplitude of the various distortion components of the plate circuit needed to produce these higher order harmonics. The additional multiple responses will in practice be somewhat weaker than those produced by the third order term. In order to complicate the graph, but retain the compactness so that several things could be pictorially represented on one sheet, several other horizentally placed curved lines have been drawn. The outer curved lines form a pair and the inner curved lines form a pair. If this figure were rotated 90° clockwise you would see that these lines would stand more or less vertical and approximate curves which would appear to be very much like typical selectivity curves. And since they are intended to represent just that, the picture is more or less complete. The outer pair is indicated by —60 db. In other words a typical r-f transformer having a Q of 120 will be, for instance, at a tuned frequency of 1000 kilocycles, approximately 90 kilocycles wide for an attenuation of 60 decibels from the exact tuned peak of the pass characteristic. At a point —26 decibels from this peak, and at a tuned frequency of 1000 kilocycles, this same tuned circuit would be approximately 45 kilocycles wide. As the frequency of tuning decreases the band width becomes narrower for the same attenuation, and as the frequency of resonance increases the band width at these attenuations increases. Therefore at 1000 kilocycles, and with a transformer having a Q of 120, and a receiver having an intermediate frequency of 465 kilocycles, it would not be expected that any (F_{s3}-F_{o2}) beating would occur, due to the fact that the response characteristic lies outside of the selectivity or attenuation characteristics of this transformer. This is assuming, of course, that an attenuation of the strong signal of 60 decibels, or greater, is adequate to prevent a response. If a greater attenuation is required than these selectivity curves pro-

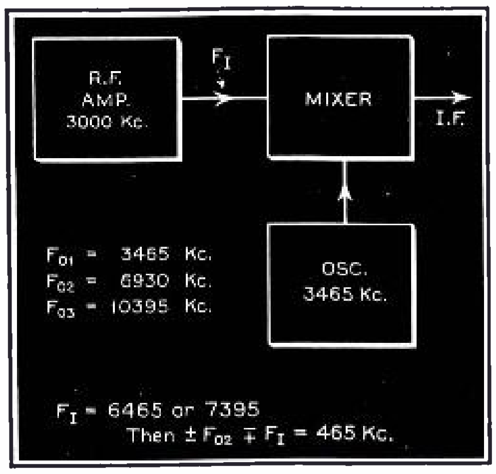


Figure 9
A lack of shielding may cause a multiple response condition as shown here.

vide, more selective circuits must be provided to prevent response of this type. It seems therefore that if in a particular receiver an attenuation of 60 decibels or greater is required in order to suppress this type of response; with a receiver having an intermediate frequency of 465 kilocycles, and the transformer Q 120, no interference of this type would be experienced below 1220 kilocycles, or the point at which the 60 decibel attenuation characteristic of the tuned circuit crosses the 465 kilocycle response characteristic. The area, in which the curves are intermingled, which is principally above 1220 kilocycles for the 465 kilocycle i-f, and 1185 kilocycles for the 450 kilocycle i-f, is the area of greatest probable response. For a receiver having the same intermediate frequencies as indicated, but another tuned circuit in the form of an r-f amplifier head, the area of intermingling is considerably reduced and the possible interfering range is raised in frequency, since the attenuation characteristic curves of the resonant circuit are compressed as additional selectivity is added. It is interesting to note that for each intermediate frequency the response is caused to shift above and below the line at a certain critical frequency. In the case of the 465 kilocycle i-f this happens at 1380 kilocycles; for the 450 kilocycle i-f at 1350 kilocycles.

The effect just discussed is aggravated, of course, when the interfering strong signal is sufficient to present itself at the detector with such a high amplitude that grid current flows continually in the grid circuit of the detector. This effect can be productive of another difficulty which is somewhat related to the one just discussed, but in certain ways different. Let us consider now a receiver which is caused to remain on one particular frequency and very strong signals are impressed upon it. Aside from the effects just produced, due to lack of selectivity between the antenna and the mixer tube, we will assume now that we have adequate selectivity to prevent the effects just mentioned. One other difference, however, will exist in this particular hypothetical receiver. Although there is considerable preselection the difference in the degree of selectivity between the r-f amplifier and the i-f amplifier is considerable. In other words, the intermediate frequency amplifier is a very selective type of amplifier and the r-f amplifier, although being extremely selective for the frequency at which it is used, is not of course comparable in selectivity to that of the intermediate frequency channel. The intermediate frequency amplifier, of course, operates the a-v-c circuit so that in order to produce any significant a-v-c feedback voltage to the grids of the r-f amplifiers it is necessary to provide a signal which will fall very closely to the intermediate frequency, due to the extreme selectivity of the intermediate frequency amplifier channel. Figure 7 shows the effects.

Here we have a receiver which is tuned to 1700 kilocycles and allowed to remain at that frequency. It has two stages of r-f amplification and rather good selectivity at this frequency of 1700 kilocycles; an antenna gain of 65 and an r-f gain per stage of 15. The intermediate frequency amplifier pass characteristic is shown and will be observed to possess considerable selectivity. When a selectivity measurement of this receiver is made from the grid of the first detector the curve indicated in the heavy line will be produced. When a selectivity curve is run on the over-all receiver the superimposed dotted response peaks, as indicated, will also be produced, and will, in effect, if they are not considered and carefully measured, produce a much broader selectivity characteristic than that indicated by measurement of the intermediate frequency amplifier itself. This can be explained on the following basis: Suppose the signal normally at 1700 kilocycles is displaced slightly from this value. Whenever this frequency departs by more than 6 kilocycles from the set frequency of 1700 kilocycles the receiver will no longer respond to the changed frequency insofar as the i-f channel is concerned since the i-f channel attenuation is very great at this frequency or at one of greater variance. Therefore the automatic volume control circuit is deenergized due to a lack of i-f voltage and the r-f stages again operate at maximum gain. Due to the fact that they are not as selective as the intermediate frequency amplifier, they will still be pass-

(*Continued on page* 26)

Central station KFCD in Los Angeles.

SPECIAL EMERGENCY SERVICE

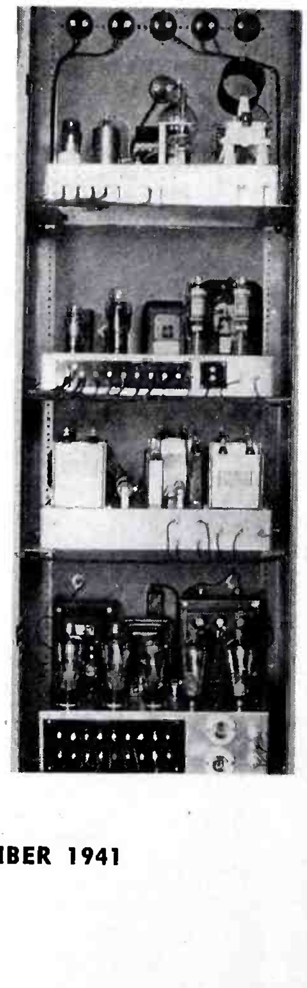
by MAURICE E. KENNEDY

Communications Engineer, Los Angeles Flood Control District

The maintenance of communication between fixed locations during periods of wire line failure, or between a central office and a fleet of portable radio stations associated with emergency repair crews is very often of vital importance to the safety and protection of life and property. Accordingly numerous public utility companies, highway maintenance departments, pipe line operators, isolated mines without wire communication, flood control, and various emergency organizations have adopted emergency communication maintenance systems and are now operating radio stations in special emergency service with considerable success.

Frequencies Used

The Federal Communications Commission has established the frequencies of 2292 kc, 2726 kc, 3190 kc, and 4637.5 kc, for the use of special emergency stations. In addition to these medium frequencies, the following high frequencies are designated as special emergency channels: 31,460, 31,740, 33,060, 33,820, 35,140, 37,180, 37,820, 39,340, 39,660, 39860, 116,650, 117,850, and 159,825 kilocycles.



Rear view of a 100 watt transmitter used in the district dams. This unit was designed and built by the author.

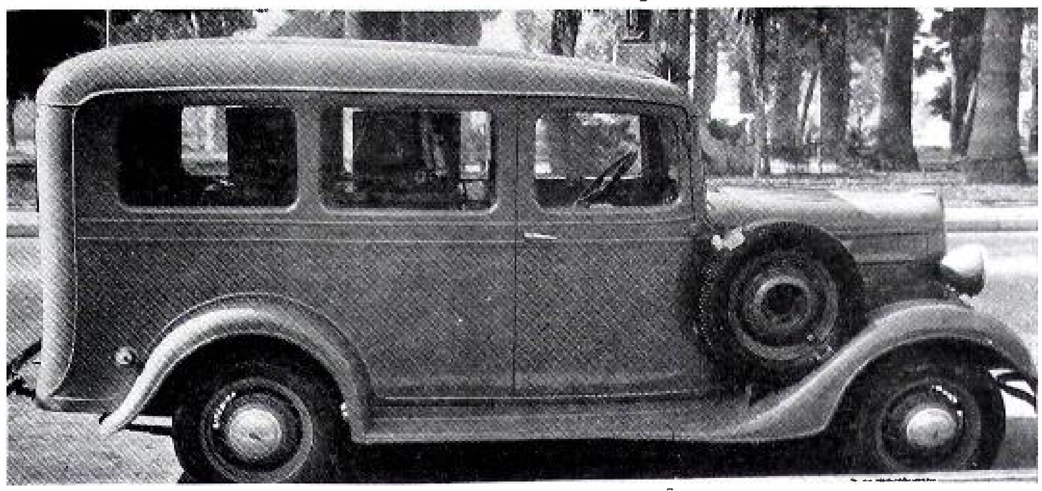
The use of these channels by special emergency stations is limited to actual periods of emergency when other forms of communication fail, or communications relative to an emergency, or where other forms of communication do not exist. Except for routine tests, stations in this service are not permitted to conduct routine business or handle non-emergency communications.

An example of effective emergency system application prevails in the special emergency network of sixteen radio stations now in use by the Los Angeles County Flood Control District.

Two Stations at Start

From the small beginning of two stations for emergency communication between an isolated dam and the district's central office, the use of radio has been increased to the present total of sixteen two-way communication units, and a fleet of 48 radio receiver equipped trucks and patrol cars.

Seven of the radio stations are located on flood control dams in the mountainous back country of Los Angeles County. These stations offer emergency communication with the central dispatching office in Los Angeles. In this application of radio units, the emergency radio circuit parallels the district's private telephone circuits in the mountains. Wire lines sometimes fail during the peak of storms, when communication is of greatest need.



Two portable radio stations, as illustrated above are in use. They are of 50 watts power, and have the call letters . . . KIPP and KINT. These stations were also designed and built by the author.

KFCD, Main Station

The district's main station (KFCD, 500 watts) is located, in connection with the Hydraulic and Emergency Dispatcher's offices, in the Flood Control Building in the business district of Los Angeles. This station functions as control center for two-way communication with field stations and as a one-way dispatching station for emergency crews in trucks. In addition to these duties, the central station transmits on schedule during storms with weather reports, rainfall data from key rain stations, stream flow measurements for the use of Hydrographers in the low country, and general storm data to engineers and emergency crews in the field.

Other Locations

Radio transmitters are also located at the District's central warehouse, the field patrol offices, a pumping station, and in portable units. The portable stations are complete with a-c power supplies and are maintained in readiness for instant service from trucks or emergency field headquarters.

In a rugged mountain area 1592.1 square miles and the densely populated valleys with 1165.5 square miles, the Los Angeles County Flood Control District has built and now maintains an elaborate system of flood control dams, debris basins, channels, and the basins in which to spread storm waters for conservation.

The dispatching of emergency crews and trucks by radio has greatly increased the efficiency of dealing with storms and floods. The time interval between the telephone call from a person reporting a clogged storm drain or a broken levee, and the actual arrival of an emergency truck with repair crew has been reduced to a matter of minutes.

Numerous instances are on record of radio directed emergency crews reaching broken levees or defective storm drains in time to save large sections of commercial and residential property from the destructive flood waters.

Patrol Cars

The patrol cars driven by hydraulic field engineers are equipped with police type radio receivers for reception of the airway weather stations as well as the District's stations. General storm information and river elevations are transmitted to these cars by the central station. These men can also be directed at any time during a storm to make investigations and report damage or dangerous conditions to the dispatcher.

The transmitting equipment in use by the District is composite, except for one 175 watt transmitter, and was built in the district's radio service shop. The central station with 500 watts of power is shown on page 12, top.

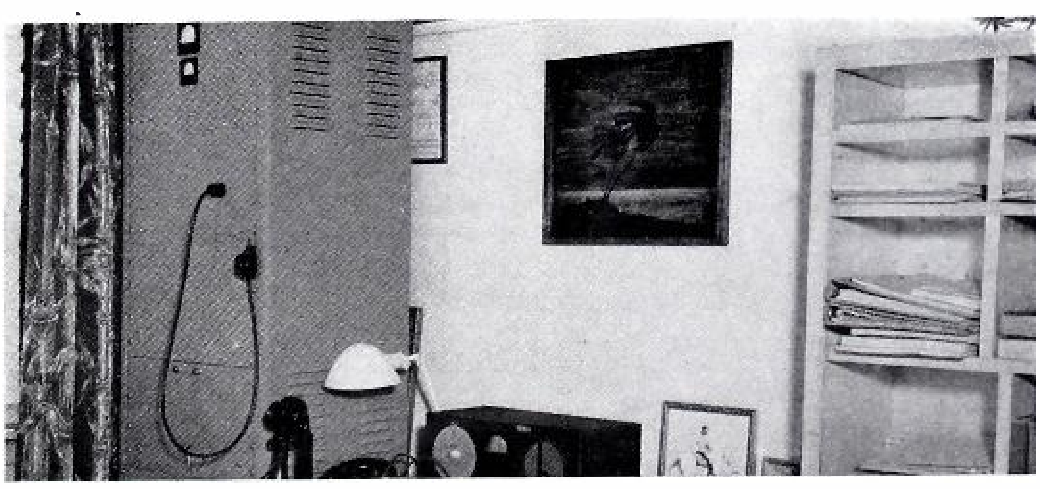
Experimental Work

Extensive experimental work has been conducted with the equipment and radiation systems in use in difficult locations, so that greatest efficiency is obtained from each station installation. We have found the intermediate frequencies best suited to our service because of the mountainous topography of the country in which our stations operate.

Attenuation Problems

Considerable difficulty has always been experienced in radio reception at our central station in down-town Los Angeles. The high attenuation period of the day corresponds with the high induction noise period of the city electrical devices. This condition has just been overcome by the development of a receiving-repeater station on an isolated mountain peak. This repeater station is fixed tuned to the operating frequency of the District's stations, and may be placed in operation for re-transmission on 310 mc. by a dial tone on the carrier of the central station.

Reception on 310 mc. with special directional equipment is very satisfactory. In this manner it is possible to realize the ideal reception of the distant mountain top at the central station in the heart of the city.



A view of station KAOP at Puddingstone Dam.

F-M and A-M

TRANSMITTERS OF THE MONTH

by LEWIS WINNER
Editor

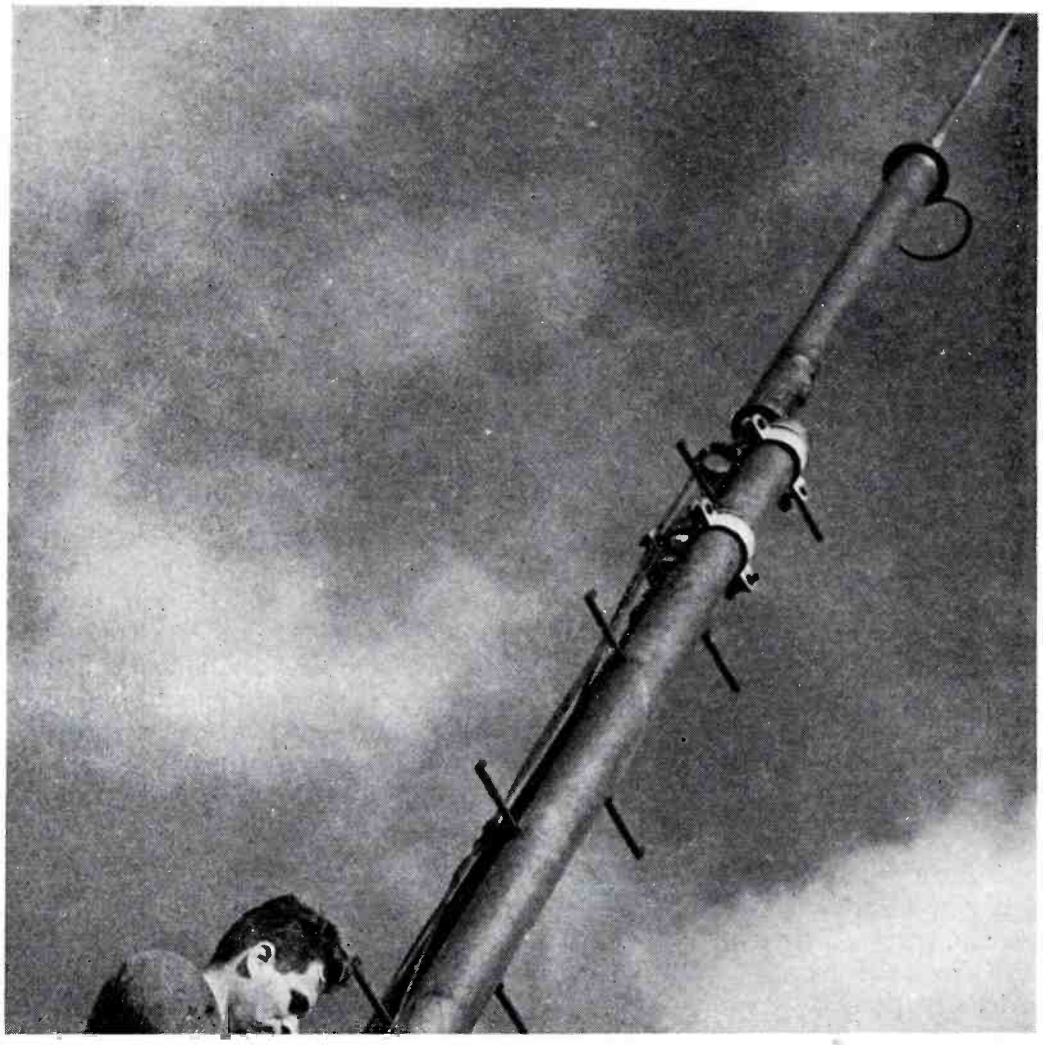


Figure 1
The vertical coaxial antenna used by W71NY.

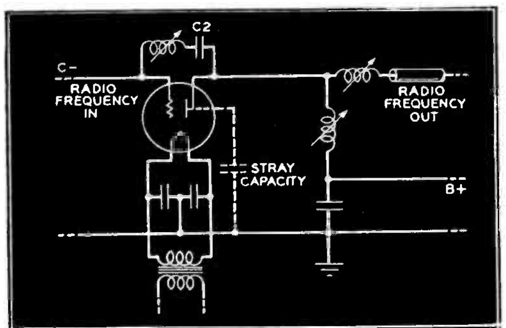
THE two schools of thought on the most effective system of broadcast transmission today hung up their respective flags of victory last month, when independent station WHN went on the air with a new 50 kw a-m transmitter, and network station W71NY went on the air with a new 10 kw f-m transmitter. Both installations are 'firsts', too, since this WHN is the first independent a-m station to operate on a clear channel, with such power, while the W71NY transmitter is the first of its kind in the country.

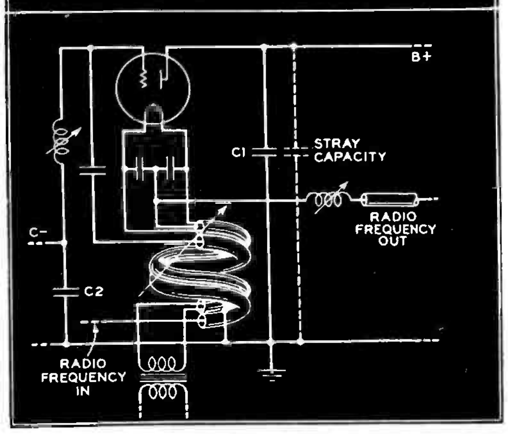
The f-m station, which is owned by WOR, key station of the mutual broadcasting system, has many new features, the most important of which is a radically new type of amplifier circuit affording the use of a single tube in the final amplifier. This is accomplished by grounding the plate in the final phase, and using an air cooled tube specifically designed for this type of installation; the 389AA. The novel circuit arrangement is based on a suggestion by W. H. Doherty, of Doherty circuit fame.

In developing this f-m method, according to A. A. Skene of the Bell Laboratories who delivered an interesting paper on this new f-m design at a recent IRE meeting, air cooled tubes in place of water cooled tubes were an acknowledged necessity, but the air cooled tubes have larger plate structures than water cooled tubes. Thus, a 10 kw. transmitter would require two tubes of a previously existing type. With the large capacity-to-ground characteristics of such a combination, effective design would be hampered. However with the new single type of tube, it is possible to reduce the capacity-to-ground of the plate. But even with this tube, said Mr. Skene, it was found that there would be sufficient stray capacitance from plate to ground to result in a rather large loss in the plate tuning coil. And in addition, the tuning would be undesirably sharp. Since a total band width of over 150 kc. is required at the output of the f-m transmitter, unless the tuning is very broad there is distortion because of the increasing attentuation and phase shift of the signals towards the sides of the frequency band. These obstacles were overcome in the grounded-plate amplifier circuit.

In Figure 2 we see a customary amplifier circuit in which the filament rather than the plate is grounded. In this method, large stray capacitance between plate and ground results not only in large tuning coil losses, according to Mr. Skene, but in sharpening the tuning. This introduces distortion. However, when the stray plate capacitance to ground is in parallel with the grounding condenser, C1, which is used to block the d-c path to ground of the plate supply, there is no effect on the operation of the circuit. With this arrangement, as illustrated in Figure 3, only the capacitance of the filament to ground need be considered, and this capacitance is much smaller than that between the plate and ground.

Since the filament of the tube is at a high r-f potential, continued Mr. Skene, it should be possible to supply filament current without requiring operation of the filament transformer at this high





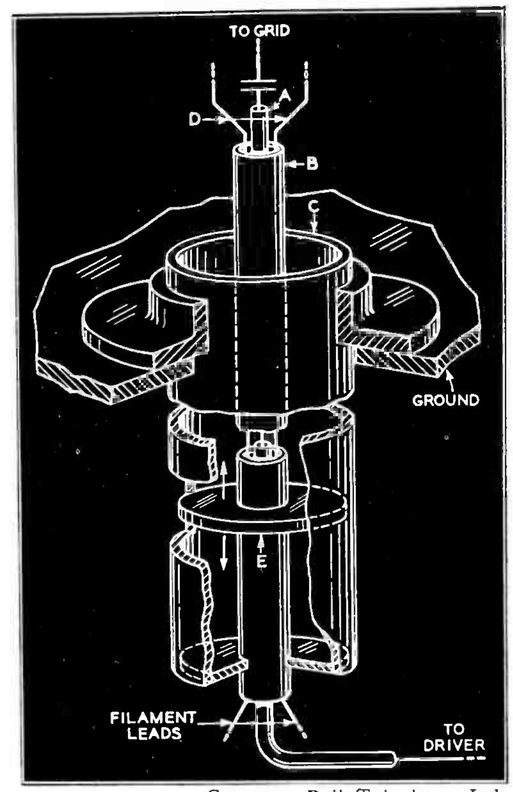
Courtesy Bell Telephone Labs

Figure 2 (top), Figure 3 (bottom)

The usual form of radio amplifier is shown in the top diagram, while below we have a grounded-plate amplifier.

Figure 4

A closeup of a section of the W7INY f-m transmitter.



Courtesy Bell Telephone Labs

Figure 5

The concentric structure used for tuning in the f-m unit.

potential above ground. In addition it is necessary to supply r-f driving potential between the grid and filament from the driver unit, one side of which is grounded, points which are also illustrated in Figure 3. In this new circuit, the plate tuning coil shown in Figure 2 is replaced by a coil between filament to ground. If a pair of copper tubes in parallel are used to form this coil, the filament leads may then be threaded through the bore of one of the tubes. Thus the grid driving potential can be supplied through an inner conductor of the other, according to Mr. Skene. The copper tubes are connected to the filament through condensers at the filament end of the coil, while the other end of the coil is grounded. In this way it is possible to deliver the filament current and grid driving voltage at the required circuit points, while the sources, viz., driver and filament transformers, are maintained at ground potential. Since it is essential to be able to adjust the reactance of this inductance, mechanical difficulties would be invited if the coil shown schematically in Figure 3 were used. By using a coaxial transmission line less than a quarter wave in length, which is short circuited by an adjustable bridging connector at the far end, this difficulty may be avoided. This section of line has a positive or inductive reactance, which is variable with an adjustable bridging connection. In Figure 5 appears the arrangement of a structure used to replace the tubing coil of Figure 3, which consists essentially of two concentric systems. Here the innermost conductor carries the f-f driving potential, while its upper end is connected to the grid through a blocking condenser. The tube surrounding this lead marked A and corresponding to the unshaded tube of Figure 3, is connected electrically at both ends of a tube to a

(*Continued on page* 24)

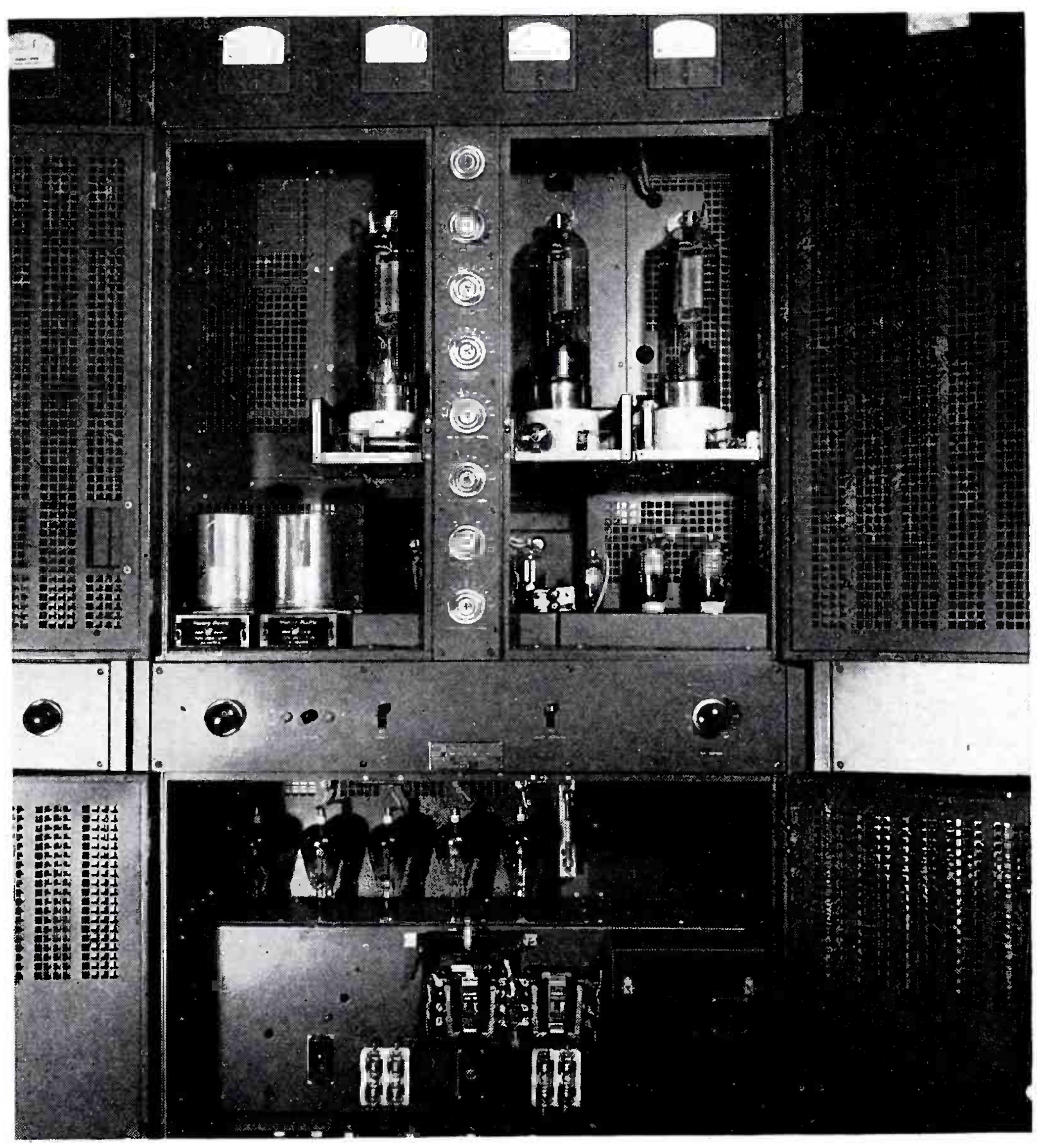


Figure 6

The oscillator-amplifier, audio, r-f buffer and driver stage unit of the new WHN 50 kw transmitter.

VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

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

The VWOA Award Received by Lt. Petersen

IT IS with deep regret that we learned of the untimely death of one of our most illustrious members, Norwegian born Carl O. Petersen; Lt. U.S.N., Communications Officer of the U. S. Navy Aircraft Carrier Ranger, at the time of his death. His was an outstanding example of high devotion to his adopted country. We reprint the obituary which appeared in the New York Times of November 12, 1941.

"Lieutenant Carl O. Petersen, United States Naval Reserve, explorer, radio engineer and moving picture technician and camera man, was a member of the first two Antarctic expeditions headed by Rear Admiral Richard E. Byrd.

"For his exploits, which included flights with the expedition's leader over perilous icy wastes during snowstorms, camping with Bernt Balchen, pilot, as Little America's 'first settlers,' and participation in the first ascent of the Edsel Ford Mountains in the Antarctic, he received notable awards.

"Of him Admiral Byrd wrote, in 1931, as follows:

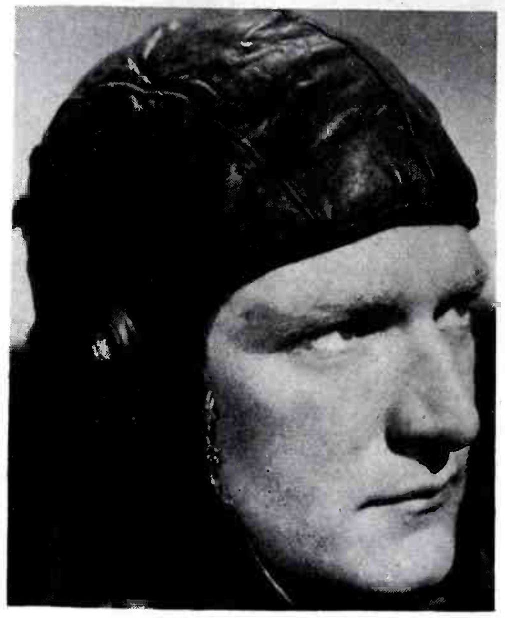
"'Carl Petersen was one of the ablest and most valuable members of our expedition to the South Pole. I consider him one of my very best friends. I cannot speak too highly of him. He is loyal, able, efficient and industrious. For particular duties of the expedition I am sure we could not have found a better man. His outstanding characteristic is his fine sense of loyalty, one of the prime requisites of a good citizen.'

"Lieutenant Petersen was born in Borre, Norway, on July 14, 1897.

"He came to this country in 1926 and served for a time thereafter as a sergeant in the 319th Attack Group, United States Army Air Corps. His home before the First Byrd South Pole Expedition was in Chicago. Later he lived in Queens and after that in Freeport, L. I.

"Late in 1928 Lieutenant Petersen sent to The New York Times the first radio message from Antarctica.

"When, in 1929, Admiral Byrd returned temporarily to his ship after choosing his Little America base site, Lieutenant Petersen and Mr. Balchen remained at the new base as first settlers, living in a small tent. In a few days many other members of the expedition joined them, bringing with them the expedition's dogs. In 1929 also Lieutenant Petersen was radio operator of a dog-sled expedition which went about seventy-five miles south of Little America.



Lt. Carl O. Petersen

"He was a participant in the setting of a world's record in radio and aviation on Jan. 25, 1929, when the expedition's airplane, the Stars and Stripes, in a flight 3,000 feet over the Bay of Whales, conducted two-way communications direct with The New York Times radio station in Times Square, 10,000 miles distant. It was the first time that a flying plane had sent and received messages over such a long distance.

"In 1932 Lieutenant Petersen and Thor Solberg nose-dived into Newfoundland waters in an unsuccessful effort to fly the Atlantic. They were not injured.

"On the second Byrd expedition Lieutenant Petersen again distinguished himself. He was a member of the first expedition to leave the base camp in Little America to try to reach the hut in which the admiral had secluded himself and became ill. Lieutenant Petersen, with John L. Herrmann, both employed by Paramount Pictures, made a moving picture record of the second expedition amounting to 150,000 feet of film. When cut and arranged the films were released in 1935 under the title "Little America." The picture received warm critical praise.

"The first Marconi Memorial Gold Medal for Valor established by the VETERAN WIRELESS OPERATORS ASSOCIATION went to him in 1938. In 1930 the same association had presented to him a testimonial for his work with Byrd."

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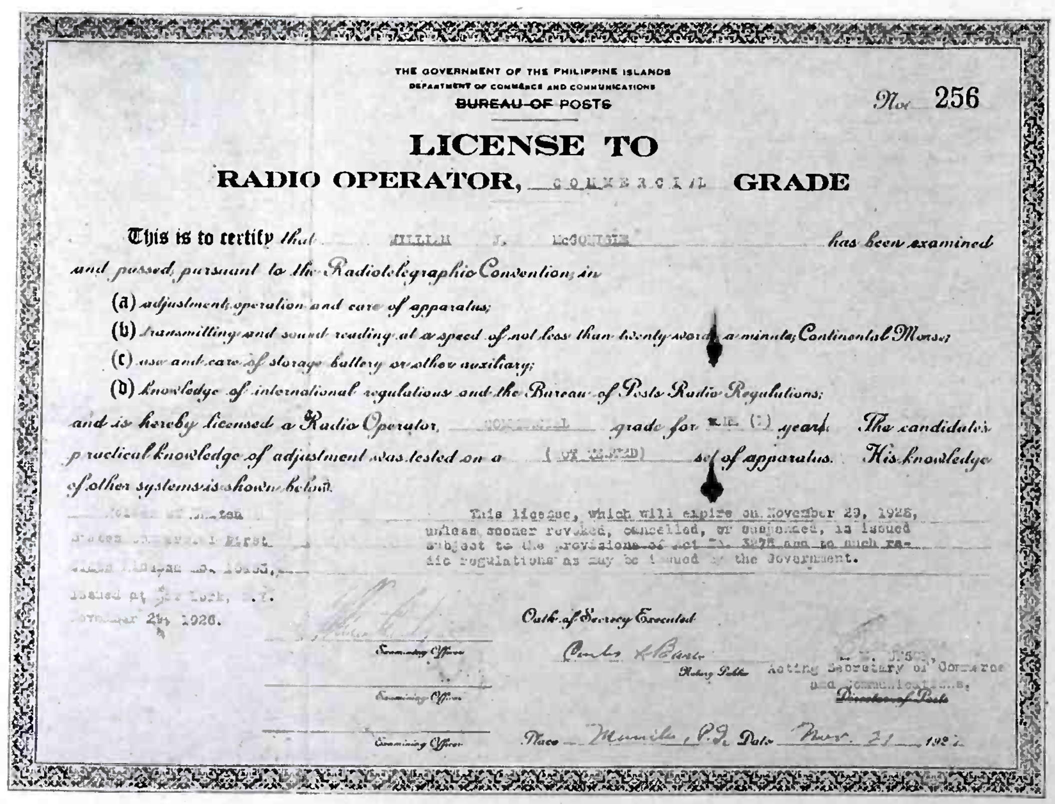

THE GOVERNMENT OF THE PHILIPPINE ISLANDS
DEPARTMENT OF COMMERCE AND COMMUNICATIONS
~~BUREAU OF POSTS~~

No. 256

LICENSE TO
RADIO OPERATOR, COMMERCIAL **GRADE**

This is to certify that WILLIAM J. McGONIGLE has been examined and passed pursuant to the Radiotelegraphic Convention in

(a) adjustment, operation and care of apparatus;
(b) transmitting and sound reading at a speed of not less than twenty words a minute, Continental Morse;
(c) use and care of storage battery or other auxiliary;
(d) knowledge of international regulations and the Bureau of Posts Radio Regulations;

and is hereby licensed a Radio Operator, [illegible] grade for [illegible] years. The candidate's practical knowledge of adjustment was tested on a [illegible] set of apparatus. His knowledge of other systems is shown below.

This license, which will expire on November 29, 1928, unless sooner revoked, cancelled, or suspended, is issued subject to the provisions of Act No. 3278 and to such radio regulations as may be issued by the Government.

Issued at New York, N.Y.
November 29, 1926.

Examining Officer
Examining Officer
Examining Officer

Oath of Secrecy Executed
Notary Public

Acting Secretary of Commerce and Communications,
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Place Manila, P.I. Date Nov. 21 1927

1927 Philippine Islands operator's license of president William J. McGonigle.

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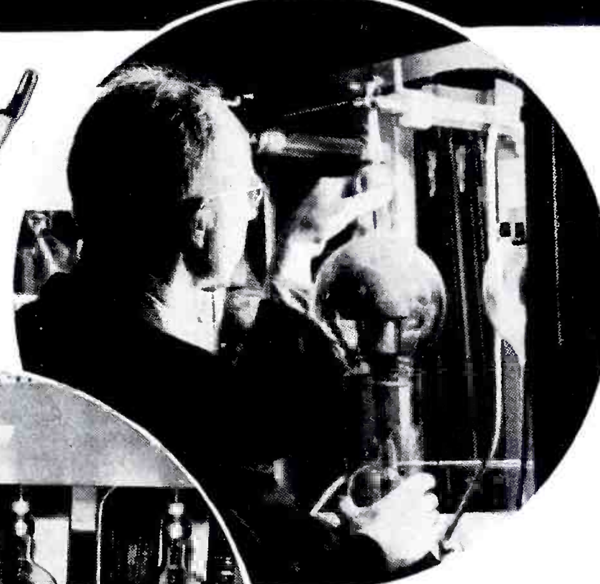
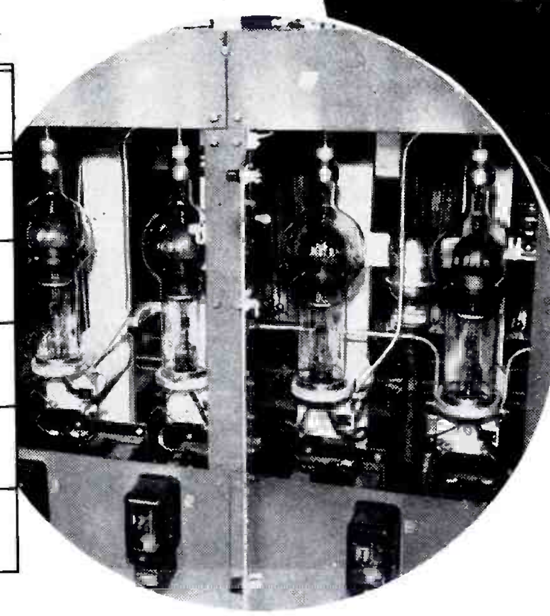




CIRCUIT	MAXIMUM A-C INPUT VOLTS* (RMS)	APPROXIMATE D-C OUTPUT VOLTS TO FILTER	MAXIMUM D-C LOAD CURRENT AMPERES
SINGLE-PHASE FULL-WAVE (2 tubes)	7750	7000	20
SINGLE-PHASE FULL-WAVE (4 tubes)	15500 total	14000	20
THREE-PHASE HALF-WAVE	9000 per leg	10500	30
THREE-PHASE DOUBLE-Y PARALLEL	9000 per leg	10500	60
THREE-PHASE FULL-WAVE	9000 per leg	21000	30

*For maximum peak inverse voltage of 22,000 volts

THE exceptionally rigid filament structure in this tube assures long cathode life. Arcback has been greatly reduced. The low voltage drop and low power loss between electrodes—characteristics inherent in this type of tube—assure peak efficiency and great dependability.

The GL-857B was made possible by General Electric's pioneer work. After developing the hot-cathode mercury-vapor rectifier tube, G-E engineers built the first high-voltage mercury-vapor rectifiers, soon accepted as standard throughout the industry. They introduced the 857, and later this 857B.

When you sign your next tube order specify General Electric tubes—proved in the laboratory, checked at our own broadcast stations, and verified by the long list of satisfied users throughout the radio industry. For your requirements in standard broadcasting, FM, or television see your G-E representative first, or write General Electric, Radio and Television Department, Schenectady, N. Y.

GENERAL ELECTRIC

The New York City

1942 IRE CONVENTION

TWENTY-FIVE papers of an unusually diversified nature will be presented at the Thirtieth Anniversary Convention of the Institute of Radio Engineers on January 12, 13, and 14, 1942 at the Commodore Hotel in New York City.

Discussions will cover such subjects as direct reading r-f wattmeters, color television, absolute sensitivity of receivers, direction finding, variable frequency bridge-stabilized oscillators, automatic u-h-f relay systems, aural and panaromic reception, high powered f-m transmitters, dual course u-h-f radio range, commercial television, radio and war, etc.

In analyzing the absolute sensitivity of radio receivers, D. O. North of the RCA Manufacturing Company will reveal a method of rating and measuring noise in complete receiving systems, antenna included. This system is based on the fact that the total random noise originating in a receiver has been customarily described in terms of equivalent noise voltage at the receiver input terminals. A comparison of the signal-to-noise ratios of two receivers working out of indentical antennas is thereby facilitated, but only so long as the coupling between the antenna and receiver input is extremely loose. The proposed rating should be particularly applicable to ultra-high-frequency services, and more generally to any service in which signal-to-noise ratio is made a prime consideration in receiver design and operation.

Direction finders of many types have been generally available on the market; however, all of these were possible only because they used long waves which propagate directly from the transmitter to the receiver via the great-circle path. Aircraft, however, (in order to obtain long-distance transmissions with low power and low-efficiency antennas) utilize medium high frequencies which reflect from the ionosphere. Since this ionosphere is continually undergoing changes, it is difficult to take bearings on waves propagated via this medium. The characteristics of the ionosphere

Arthur F. Van Dyck, president-elect of the I.R.E.

and its effect on the propagation of radio waves will be discussed by P. C. Sandretto and E. P. Buckthal of the United Airlines. In addition, they will tell of the action of these waves on various direction finders and the United Air Lines equipment designed specifically for taking bearings on these peculiarly propagated waves.

Of the many methods proposed for the measurement of phase angle, none has combined in one instrument all that may be desired of an ideal measuring instrument. A close approach has been achieved by J. E. Shepherd of Harvard University, who will tell of his instrument which, by using a time ratio as a parameter, delivers a direct current proportional to phase angle. The resulting instrument has the advantages that it performs over a wide range of frequencies and magnitudes of voltages without requiring adjustment, involves no null balance, has a linear scale, exhibits no quadrantal ambiguity, and is readily adapted to the operation of direct-reading meters, recording instruments, and servo mechanisms. Furthermore, it is self calibrating in that no external standards are required for calibration.

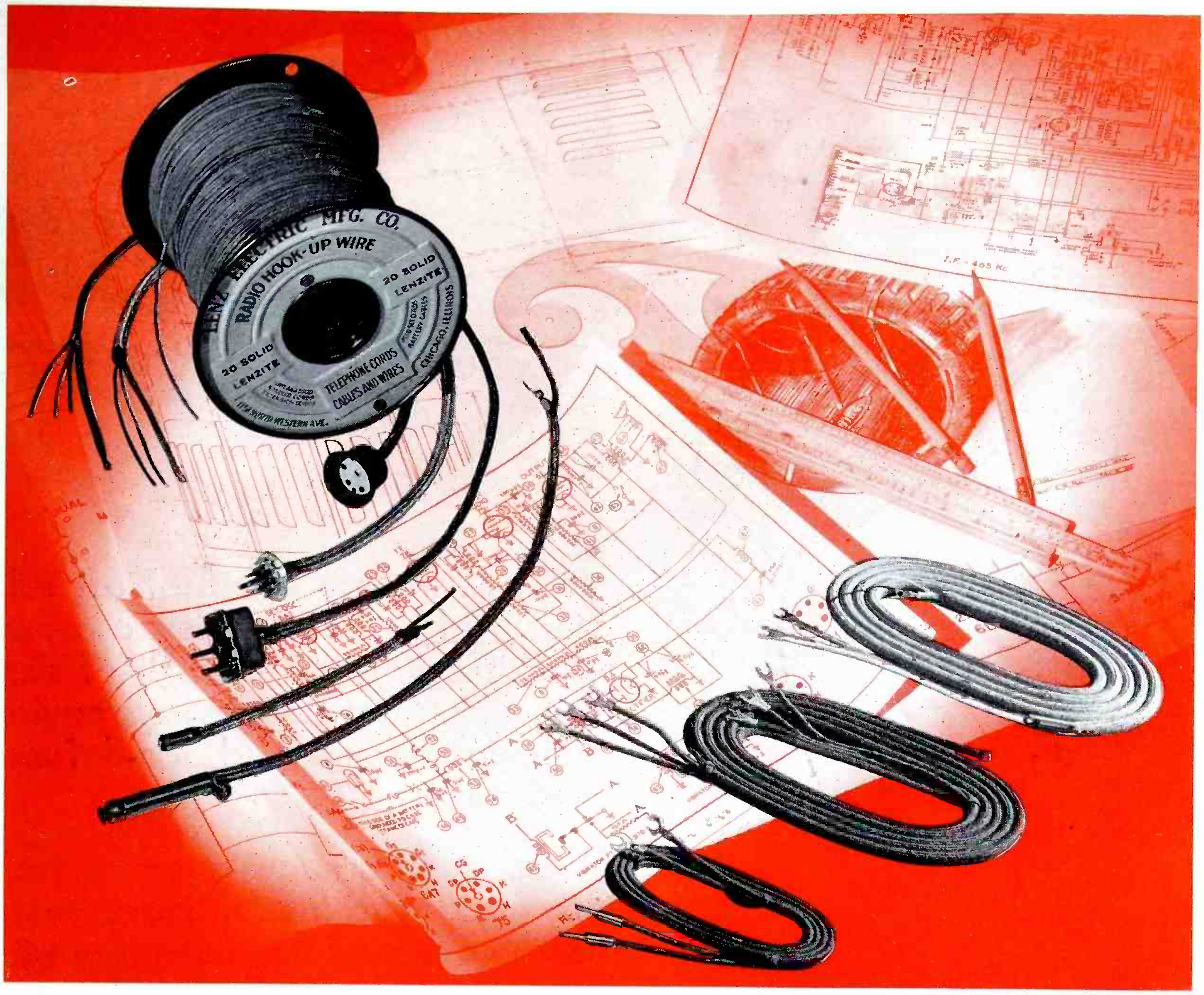
A rotating body may be statically and dynamically balanced by the addition of weights in two arbitrarily chosen planes perpendicular to the axis of rotation. A velocity-type electromagnetic pick-up that measures the vibration at each bearing, will be described by M. P. Vore of Westinghouse. The output of the pick-ups is fed into a network which separates the effects of unbalance in each plane and then into an amplifier and meter which indicates the amount of unbalance. The angular position of the unbalance is shown either by a stroboscopic light or by means of a dynometer-type meter whose field is excited by an adjustable-phase alternator directly coupled to the rotor. Production and portable balancing machines have been developed. Their principles of operation and design features will also be described.

A complete amplifying and cathode-ray-tube system suitable for most bioelectric research applications will be described by Harold Goldberg of Stromberg-Carlson. The system using three independent amplifying channels, working into a three-trace cathode-ray tube allows the recording of three independent, simultaneous phenomena. The three traces may be partially or wholly superimposed as desired. Each amplifying channel consists of a battery-operated three-stage direct-current amplifier coupled to a power-line-operated direct-current output stage, all channels operating from a common battery and power-line supply.

The unit includes cathode-ray-tube sweep circuits that are direct-current coupled and entirely power-line operated, individual control of centering and sweep speed for each trace, and associated stimulating circuit, synchronized with the sweep for biologic specimens under study. Because of the direct-current amplification employed throughout the system, any event, with any given setting of the controls, will always appear at the same position of the cathode-ray-tube screen whenever repeated.

Also described will be the amplifier input which may be single ended or differential as desired. The response is said to be flat within 1 decibel from

(*Continued on page* 34)



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WHICH WIRE TO USE?

Any one of several different types of insulated wire *might do* for your definite requirement—yet only one certain wire is *best* for that use. The wire you use in the equipment you build should be that "best" wire—especially today when so much is dependent upon the successful operation of your product.

Lenz engineers know insulated wire—how it is made, how it will perform, which wire is best suited for your need. They are ready to help you solve your problem—with a line of insulated wire of various types to suit a wide variety of conditions.

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Yes . . . we are proud of our submersion type units. They are now available in a wide range of sizes to cover practically every requirement in defense and non-defense applications.

These units are designed to take the most extreme of Navy tests, which consist of five complete submersion cycles under salt water over a very wide range of temperatures.

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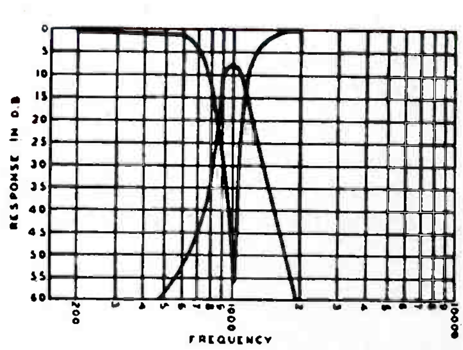

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NEWS BRIEFS OF THE MONTH . . . —

RADIO OPERATORS AND MONITORING OFFICERS NEEDED

There is a continuing and urgent need for High-Speed Radio Equipment Operators in the Signal Service of the War Department. Over 200 positions paying $1,620 a year are now open at various Army posts throughout the United States and its Territories. In an effort to secure men for these positions, the experience and operating requirements of the *Junior Communications Operator, High-Speed Equipment examination* (Announcement No. 20) issued by the Civil Service Commission, January 20, 1941, have been amended to read as follows:

"*Experience.*—Applicants must have had at least one year of experience as a radiotelegraph operator in commercial or government communications system, which must have included at least three months' experience in the operation of high-speed radio communication equipment.

"*Operating Requirements.*

(a) Reading and transcribing to typewriter syphon recorder tape in continental Morse code at a sustained speed of 40 words per minute.

(b) Operating transmitting perforator at a speed of 40 words per minute.

(c) Copying audio English to typewriter at a speed of 30 words per minute and audio code groups at a speed of 20 words per minute.

(d) All applicants must produce evidence on forms to be provided by the Commission for this purpose, that they are qualified touch typists capable of a sustained speed of 50 words per minute.

"*Substitution.*—Training in radio operation at a service school may be substituted month for month for the required radio operator experience except that in any case applicants must have had the three months' experience in the operation of high-speed radio communication equipment as described in (a), (b), (c), and (d)."

Further information regarding the examination is contained in Announcement No. 20, available at any first or second-class post office or the Civil Service Commission in Washington, D. C. Proper application forms Nos. 6 and 4006-ABCD, and Supplemental Form 3629 may also be obtained from these offices. Qualified persons are urged to file their applications at once with the Civil Service Commission.

An opportunity for radio "hams" and technicians to serve their country in Class V-6 of the United States Naval Reserve and, at the same time, receive valuable training, is being offered by the Navy Department, which is seeking several thousand recruits for one of its newest operations branches.

Qualified applicants will be enlisted immediately as Radiomen, Second Class, which is equal to four full promotions over original enlistments as apprentice seamen. Radiomen Second Class receive a base pay of $72 per month and allowances while on duty as technicians and Radar maintenance men. Applicants must be high school graduates and must hold, or have held, Amateur Class "A" or "B" licenses. If applicants lack the license qualifications, they must be actively engaged in radio repair or service work, or have had experience with high frequency design, transmission or reception. They do not necessarily have to be familiar with Morse or other codes.

Men enlisted west of the Mississippi River will be ordered to the Naval Radio Training School at Los Angeles, California, for a course in Naval Communications. Those enlisted east of the Mississippi River will be trained at the Naval Radio Training School at Noroton, Connecticut. After February 1, students will be sent either to the San Francisco Radio Material School or to the Radio Material School at Bellevue, D. C., until the capacities of the two institutions are filled.

After training, students will have a chance for advancement in rating up to that of Chief Radioman, which carries a base pay of $99 per month.

"Radar" men will operate the newly perfected radio device which locates planes in flight, the delicate and complicated instrument developed in England and used with such meritorious success by the Royal Air Force. The patents have been turned over to the United States by Great Britain. Details of the device are being kept a deep secret, but it is said to have been used both on the ground and in the air, and is a vital addition to the nation's defense armory.

Within the past year there has been considerable expansion of the radio monitoring activities of the Federal Communicatons Commssion. Even further expansion is anticipated in connection with natonal defense. To secure qualfied people to do this work, the U. S. Civil Commission has just announced an examination under the title "Radio Monitoring Officer." The positions pay $2,600 and $3,200 a year.

Radio monitoring officers are assigned to monitoring and direction-finding stations of the FCC where they stand watches at any time of the day or night, including Sundays and holidays. They provide surveillance of all communication channels by listening to and recording transmissions. Copying radio-telegraphic transmissions is also a part of the work. Monitoring officers investigate complaints alleging subversive uses of radio and secure evidence leading to the prosecution of operators of unlicensed stations. They are required to travel a great deal and to drive direction-finder cars.

No written test will be given for these positions. To qualify for the full-grade position ($3,200 a year), applicants must have at least 2 years of responsible supervisory experience in installation, testing, inspection, laboratory development, or responsible maintenance of commercial or Government radio transmitters. In addition, they must have either similar experience, not necessarily supervisory, or have completed appropriate college or technical study. Applicants for the assistant grade ($2,600 a year), may qualify on appropriate study or experience such as that of studio engineer supervising high-fidelity recording of aural programs and their reproduction. For some positions, applicants must also meet certain license and code receiving and transmitting requirements.

Applications may be filed with the U. S. Civil Service Commission, Washington, D. C., until June 30, 1942. However, interested persons are urged to secure a copy of the announcement and application forms at once from the Commission's representative at any first or second-class post office or from the Commission's central office in Washington, D. C.

* * *

RCP 1942 CATALOG

The 1942 line of radio and electrical test instruments manufactured by Radio City Products Co., Inc., 88 Park Place, New York City, is presented in a 20-page, illustrated catalog just released. This new line includes more than 40 models of 22 basic test instruments.

Approximately half of the models are general-purpose electrical multi-testers, each providing a variety of measurement ranges equivalent to those of 12 to 35 individual meters. These models are available in various types from the tiny pocket size to larger bench and portable units. Other instruments listed include vacuum tube testers, radio circuit analyzers, a radio signal generator, an electronic multi-tester—with 26 vacuum-tube operated ranges for measuring a-c and d-c voltages to 6,000 volts, resistance to 1,000 megohms, capacitance to 1,000 mfd, etc.—electrical appliance testers, and combination units which perform the functions of two or more of these others. Of particular interest to technical training schools is a series of five tube tester and multi-range instruments kits including everything necessary to enable students to build up their own test equipment.

* * *

RMA TRANSMITTER SECTION MEETING AT ROCHESTER

Under the chairmanship of C. A. Priest of Schenectady the RMA Transmitter section (shown below) met at the recent IRE Rochester meeting and listened to a discussion by Dr. W. R. G. Baker on the importance of their work to the industry at this time.

(*Continued on page 32*)

(At head table) Left to right: R. P. Harmon, of Westinghouse, chairman committee on Standard Broadcast Transmitters; C. A. Priest, of GE, Schenectady, chairman Transmitter Section; Dr. W. R. G. Baker, v-p of GE, Bridgeport, chairman of committee on F-M Transmitters; P. J. Herbst, Farnsworth Radio, Fort Wayne, chairman Television Trans. committee.

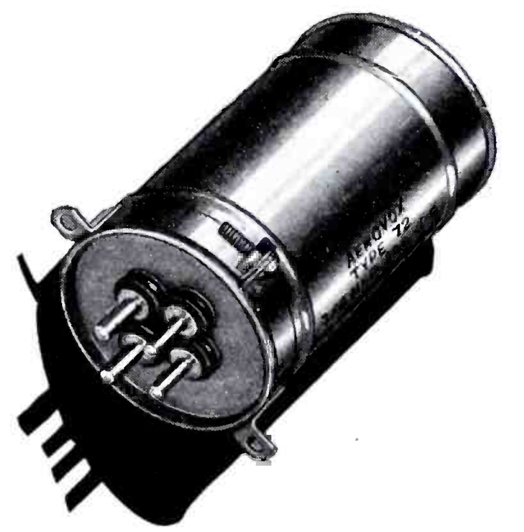
THE INDUSTRY OFFERS . . . — . . . — . . . —

AEROVOX DEVELOPMENTS

In step with the growing use of the plug-in capacitor technique, already widely used in the electrolytic and wax-filled paper types, the Aerovox Corporation of New Bedford, Mass., announces a new Series -72 oil-impregnated oil-filled capacitor with four-pin base that fits into a standard UX socket, as distinguished from the octal base of other plug-ins.

An aluminum-sprayed tin-plate round can comes in 2, 2½ and 3" diameter sizes, and from 2½ to 4¼" high. It is provided with a mounting ring with lugs, so as to be held securely in place and in accordance with Underwriters requirements. These oil-filled plug-ins are available in single-section units up to 16 mfd., and up to 4-4-4 mfd. in multiple-section units, in both the 400 and 600 v. D.C.W. ratings.

For ultra-high-frequency radio transmitters, television and FM transmitters, as well as in miscellaneous applications in the ultra-high-frequency range, Aerovox also announces a Type 1860 transmitting capacitor. Its losses are said to be extremely low because of the highly refined sulphur compound utilized as the dielectric, the elmination of corona, etc. The aluminum case, which is grounded, is 2" in diameter by 2" or 2½" high, is provided with a mounting base with 2 holes for 10-32 screws, and a single high-tension mica-insulated brass terminal. These units are available in .0001 and .000025 mfd. in 10,000 volts and .00005 mfd. in 5,000 volts.



* * *

TUNABLE WHIP ANTENNA

A high-gain antenna with a tuning coil assembly consisting of a weatherproof high Q coil enclosed in a metal shield and surmounted by a short whip is now available from Jefferson-Travis of New York. Flexibility of mounting is provided for by a base stud, by means of which the tuning coil assembly can be supported on a tubing or pipe of appropriate length. The assembly may also be supported on a base insulator, in which case, wire would be employed as the "radiator" portion of the antenna. The tuning coil assembly provides a means of matching the transmitter to the antenna at the operating frequency. A resonant antenna, thus provided, is said to eliminate extensive power losses which may occur through application of "loading," introduced within the transmitter itself to compensate for lack of length of antenna.

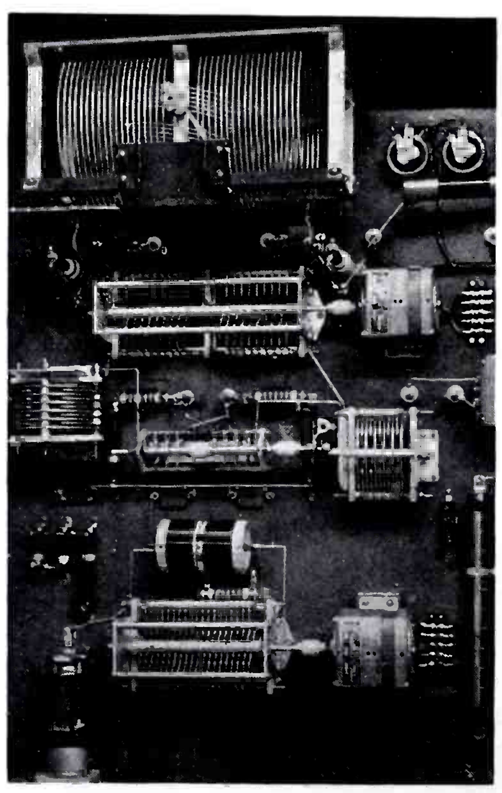
GATES DESIGNS NEW TRANSMITTER

Integrated design—a simplified style of building transmitters, introduced and originated by the Gates Companies, Quincy, Ill., is featured in their latest 250 watt unit. Integrated design takes advantage of the natural operational sequence of radio circuits in its evolution and as a consequence the placement of parts is simplified, which is a direct contribution to stability and efficiency. All parts are on a single panel extending from top to bottom of the transmitter cabinet. Power supplies are placed at the bottom. Next comes the exciter amplifier for the final r-f amplifier and then the final r-f amplifier and modulator come side by side at the top.

The r-f circuit consists of the final r-f amplifier and driver stages in the main transmitter cabinet externally excited. The final r-f stage is a push-pull Class "C" high level modulated amplifier incorporating all the well known advantages of simple adjustment, economical operation and low maintenance common to this type of amplifier. Motor tuning, in the condenser adjustments of the final stage and the final stage loading to the antenna has been incorporated. Only one control is actually used in the tuning procedure and that is the reversing switch used to operate the tuning motors. The motor to be used in the adjustment is quickly selected by another switch adjacent to the tuning switch on the front panel and all operations are clearly designated above each one. Air dielectric padding condensers are used across the final r-f amplifier tuning condenser. The tubes used in the final amplifier are the well known type 810. The driver stage uses one type 813. Link coupling is used to couple the output of the frequency control unit to the input of the 813 driver stage.

In the a-f circuit is a Class B stage using a pair of 810 tubes capable of modulating the final amplifier 100%.

The final tank of the transmitter terminates in a low impedance coupling coil capable of adjustment for feeding any impedance line from 30 to 100 ohms.



The RF circuit.

ISOLANTITE MINIATURE TERMINAL BUSHINGS

Miniature terminal bushings, suitable for transformers, condensers, and similar applications in the radio and electrical industries, has been placed on the market by Isolantite, Inc., 233 Broadway, New York, N. Y.

The bushings are supplied complete with hard copper tinned terminals and nickel-plated copper flanges. Flanges may be spun or eyeleted into 1/16-inch or thinner metal panels and cases, according to the manufacturer. Terminals are slotted to accommodate leads, or leads may be soldered into center eyelets of terminals if desired. Insulator bodies are of glazed Isolantite.

Bushings are supplied in two terminal lengths and two insulator lengths, making a total of four combinations. Full details of construction are given in Bulletin No. 104-A, available on request from the manufacturer.

* * *

DAVIS' LAMINATED SOLENOID

A new laminated type solenoid for the control of production machinery, the operation of hydraulic valves, and many other industrial applications has been announced by Dean W. Davis and Company, Inc., 549 West Fulton Street, Chicago, Ill. It is for constant or intermittent duty on alternating current, and is furnished with either push or pull type plungers. The field coil is paper section wound, taped and specially treated to be impervious to cutting oils.

It measures 2" x 2" with a plunger stroke of ¾" and can be had for any voltage. This solenoid has a minimum push or pull of 5.5 pounds at full line voltage, and 3.75 pounds at 85% of line voltage.

* * *

PRESSURE CASTING MACHINE

A pressure casting machine, the B-K die-caster, designed for accurate and economical production of small and medium size zinc base die castings, is now being made by Burrows-Kahn Company, South Bend, Indiana. It lends itself equally well to long or short runs, affording fast changing of dies while the machine is hot. For relatively simple castings, universal die mounting blocks can be arranged for even further simplification.

The speed of casting production is determined by the size, weight and design of the casting. Small castings that do not

(*Continued on page* 25)

F-M AND A-M TRANSMITTERS

(*Continued from page* 15)

larger diameter B.

A short circuited coaxial structure is also used for the neutralizing inductance shown in Figure 2, connected between the grid and plate in series with a blocking condenser, according to Mr. Skene. This coil carries a large current and must be continuously variable and adequately shielded. To meet these conditions with a grounded-plate is fairly simple, since only an inductance-to-ground is required with a blocking condenser to isolate the d-c grid bias potential, as in Figure 3.

The new f-m transmitter uses a vertical coaxial that is 25 feet in length and located 630 feet above sea level or 44 floors above street level in New York City.

The distortion at the transmitter is less than one per cent. The audio characteristics are flat, plus or minus 1 decibel, 30 to 15,000 cycles. Frequency stability is better than 1,000 cycles at the carrier, while the lineal modulator has a 75 kilocycle swing.

The WHN a-m transmitter uses a three stage audio frequency amplifier; quartz crystal controlled oscillator operating into a three stage radio frequency amplifier having a power output of about 100 watts; a modulating amplifier stage using two 232B's; a power amplifier stage using two 298A's (100kw) connected as a high frequency amplifier, and a high voltage rectifier using six 255B mercury vapor rectifiers.

In this transmitter we again find Mr. Doherty's name, for it is this circuit that also contributes to the efficiency of this transmitter.

The Doherty circuit resembles a standard push pull circuit, in that it has an even number of tubes. At the instantaneous peaks of a completely modulated waves, the operation is similar in some respects to that a conventional amplifier, in which each tube is fully loaded, but at smaller instantaneous outputs, the portion of the power contributed by one of the tubes is reduced. With no modulation the power contributed by that tube is further reduced so that practically all the power is obtained from the carrier tube. A fundamental characteristic of power amplifiers is that maximum efficiency is obtained only when the tube is delivering the maximum possible r-f to its load. Since the maximum possible voltage is delivered only on occasional momentary modulation peaks, the normal or carrier voltage being only half of the maximum value, the average all-day efficiency of such amplifiers is only about 30 per cent. In the Doherty circuit, this difficulty has been solved.

(*Continued from page* 22)
require exceptional finish can be run as high as 350 to 400 "shots" per hour. Castings with surface areas as large as 20 square inches and weighing several pounds can be cast.

* * *

B-L METALLIC RECTIFIER VOLTAGE REGULATOR

A voltage regulator, for use with standard metallic rectifier electroplating units, has been developed by the Benwood Linze Co., St. Louis, Mo.

The regulator is available in a wall mounting cabinet so it may be installed adjacent to the plating tank within convenient reach of the operator and away from the rectifier units. It has 64 steps of adjustment, giving a voltage range from maximum down to one volt. The coarse control covers the full range in eight steps while the fine control provides eight steps for each step of the coarse control.

In addition, the regulator provides a start-stop station permitting remote control for starting and stopping the rectifier, thereby giving the operator control of each tank.

Incorporated in the front of the unit are two meters, a voltmeter and one ammeter to record current and voltage of each individual rectifier. These are sealed to protect against moisture and dust.

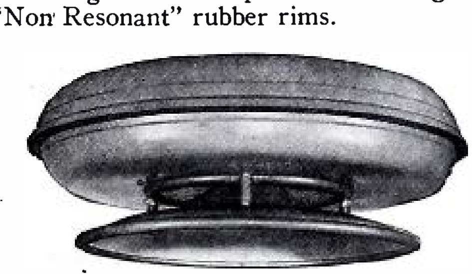
* * *

UNIVERSITY RADIAL PROJECTORS

Radial cone speaker projectors for 8" and 12" cone speakers designed for uniform sound projection in all directions are announced by University Laboratories, New York City.

An "infinite baffle" sealed acoustic chamber in the Model RBP is said to afford added bass response.

Flat top design affords ceiling or single suspension mounting; waterproof for outdoor use, all steel construction with "Floating Rubber" speaker mounting and "Non Resonant" rubber rims.



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AMPULE SEALING MACHINES

Several sizes of Ampule Sealing Machines are now being made by the Eisler Eng. Co., 740 S. 13th St., Newark, N. J.

This machine is adaptable for various
(*Continued on page* 30)

MULTIPLE RECEIVER RESPONSE

(*Continued from page* 11)

ing with considerable amplification for, let us say, a 1706 kilocycle signal or a 1694 kilocycle signal to the extent that whenever the amplitude of these signals is increased to a value where the resultant r-f gain will be high enough to produce extreme voltages at the mixer grid, grid current will flow with no possibility of the AVC controlling this strong signal. This produces grid detection and grid distortion to produce higher order combination frequencies of the signal and oscillator frequency, and spurious responses can result. It will be found in this particular case, where a receiver is tuned to 1700 kilocycles and allowed to remain at that frequency. With a receiver i-f of 465 kilocycles, and the amplitude of a 1708.75 kilocycle signal increased to a point where grid current will flow in the mixer grid, a beat component containing the fifth harmonic of the signal voltage and the oscillator fourth harmonic exists to produce a frequency of 116.25 kilocycles. This in turn is also distorted by plate distortion in the mixer tube to produce its fourth harmonic which will be the intermediate frequency. This will evidence itself when a selectivity curve is made over all of a receiver of this type by sharp peaks 8.75 kilocycles above, and approximately that value below the exact frequency of 1700 kilocycles. In practice this type of response could occur if a signal occurs at 1708.75 kilocycles in a receiver having these characteristics and tuned to 1700 kilocycles. This will happen in a similar manner to all frequencies in the vicinity of 1700 kilocycles and the effect will be exaggerated as the radio frequency is increased due to the lowering of the selectivity factor as the frequency of the radio frequency amplifier is increased. In practice where it is absolutely necessary to have a combination of extreme i-f selectivity in receivers for special application, it is also necessary to make the r-f amplifier as selective as it is possible to make it in order to minimize this effect. In order to make the picture complete it might be well to state that other responses farther away can be obtained with increasing values in frequency of the strong signal, and with stronger amplitude required of that signal due to the beating of higher order harmonics.

No discussion of multiple response in superheterodynes would be complete without making reference and comment on the old stand-by and possibly the leading cause of all interference in this type of receiver. I have reference particularly to image interference. Some years ago one of the characteristics which was commonly published concerning receivers of that day was the image ratio of the receiver. Oddly enough today that figure is never spoken of, especially in regard to receivers for broadcast purposes. When superheterodynes first appeared it was seemingly a matter of pride for a manufacturer to consider the image rejection ratio of first importance and receivers were built accordingly. Image ratios of 100,000 to 1 were not uncommon and, of course, it was almost impossible to get any type of image interference in receivers having a rejection ratio of that value. Today, however, after the depression period when receivers were cheapened in order to meet the demand for lower prices, less attention has been paid to this fact (out of necessity probably in an attempt to reduce costs) and consequently it seems that present day sets are more susceptible to this difficulty than receivers were 10 years ago. This is particularly true in the broadcast band where receivers today are using intermediate frequencies of 455 kilocycles, and there are numerous stations operating in the frequency range between 1600 kilocycles and 2500 kilocycles, many of them in areas where a great number of broadcast listeners are located. These stations utilize transmitters having a significient radiation power so that rather high levels of field strength are laid down in the listening areas. In Figure 8 the mechanics of image response are shown.

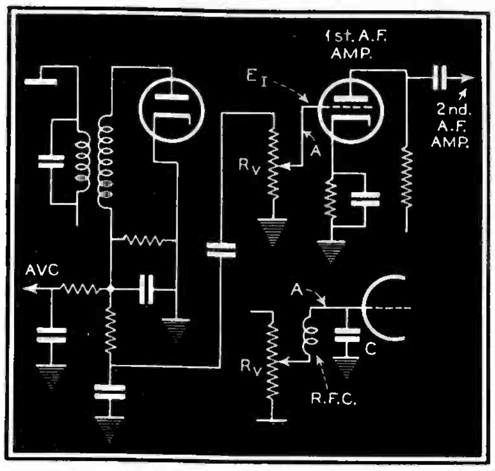


Figure 10
A characteristic present day circuit in which interference may prevail because of a lack of shielding.

At F_s is indicated a signal, let us say, at 1000 kilocycles. If the receiver has an intermediate frequency of 455 kilocycles the oscillator frequency F_o will be 1455 kilocycles. When a signal appears at F_s the oscillator at 1455 kilocycles will beat with the signal at 1000 kilocycles and produce the difference or intermediate frequency of 455 kilocycles. Now, if another signal at F_I, 455 kilocycles on the high frequency side of the oscillator, appears at the grid of the mixer tube, a similar difference frequency will be produced and a response will be obtained from F_I the image. Since both the signal and the image are 455 kilocycles displaced from the oscillator frequency it will be seen that the image always is displaced twice the intermediate frequency from the signal, or in this case 910 kilocycles. In this particular case where the oscillator is higher in frequency than the signal frequency the image will be 910 kilocycles higher in frequency than the signal. If the oscillator frequency were 455 kilocycles lower in frequency than the signal, then of course the image would appear 910 kilocycles lower than the signal frequency. As before mentioned, there are a number of stations operating in the frequency range between 1600 and 2500 kilocycles. Among these are amateur operators, police and broadcast pick up services, many of which stations produce considerable field strength in the locality in which they are located. Therefore if for instance in this particular case there is a broadcast station at 1000 kilocycles and a receiver is used having a selectivity indicated by the broader of the two selectivity curves indicated, and there is a station operating at 1910 kilocycles, a response will occur depending upon the relative amplitude of the two signals. In one case if the amplitude of the image signal as injected into the mixer tube is very low, probably the only response will be a beat note, or so-called "birdie". If the relative amplitude of the image signal, with respect to the signal frequency voltage, is high, it is possible that the two signals will appear simultaneously with their respective modulations and cause considerable interference. Of course interference is not the only resultant of this type of combination. If there is no signal, let us say, at 1010 kilocycles but a strong signal at 1920 kilocycles and insufficient selectivity to completely eliminate the appearance of the image frequency at the mixer tube then the 1920 kilocycle signal will appear at 1010 kilocycles, using the i-f frequency specified above.

Now if in this particular receiver, which for the sake of explanation we have assumed is responding to the

(*Continued on page* 27)

image frequencies, a selective characteristic is provided similar to the sharper characteristic indicated in Figure 8, then the image frequency will fall outside of the selectivity characteristic or in the region of extreme attenuation for this particular characteristic and no significant amount of voltage due to the image will appear at the mixer tube and consequently no response will result. This detail has been explained and the frequencies have been indicated because of the fact that today this is probably the most common source of interference. I know it is the cause of considerable feelings between broadcast listeners and amateur radio operators who are being blamed for interference in the broadcast band but who, in all fairness, cannot be justly blamed for it, since it is due entirely to a lack in the receivers themselves.

Two factors, of course, will be immediately observed as remedies for this particular difficulty; either an increase in the intermediate frequency or an increase in the selectivity in the antenna and the first detector.

A multiple response condition may be produced by a lack of shielding, or due to the fact that even with suitable shielding, and in the field of intense signals, a response occurs to produce considerable interference. An arrangement detailing the conditions which may exist and the results produced is shown in Figure 9. We have an r-f amplifier operating into a mixer or first detector tube which is modulated by means of an oscillator to produce the intermediate frequency. In order to give an example we shall assume the intermediate frequency at 465 kilocycles. Under these conditions the oscillator will operate at 3465 kilocycles. Produced in the detector system, or the mixer tube, due either to oscillator harmonic content or to plate circuit distortion, is also the second harmonic of the oscillator which is, let us say, F_{o2} equal to 6930 kilocycles or twice the oscillator fundamental frequency. Now, if in the presence of extremely strong signals sufficient energy is present at the grid of the detector tube, or in the case of a receiver lacking adequate shielding, even moderately high field strength, a voltage will appear at the grid of the detector. We shall call its frequency F_I. If this frequency is 465 kilocycles higher or lower than the oscillator second harmonic it will produce a beat of 465 kilocycles. This, of course, is a special case of image interference, in which the shielding is inadequate or the field strength is so high that the

(*Continued on page 29*)

Defense Savings Pay-Roll Allotment Plan

How company heads can help their country, their employees, and themselves

voluntary pay-roll allotment plan	helps	workers provide for the future
	helps	build future buying power
	helps	defend America today

This is no charity plea. It is a sound business proposition that vitally concerns the present and future welfare of your company, your employees, and yourself.

During the post-war period of readjustment, you may be faced with the unpleasant necessity of turning employees out into a confused and cheerless world. But you, as an employer, can do something *now* to help shape the destinies of your people. Scores of business heads have adopted the Voluntary Pay-roll Allotment Plan as a simple and easy way for every worker in the land to start a *systematic* and *continuous* Defense Bond savings program.

Many benefits . . . present and future. It is more than a sensible step toward reducing the ranks of the post-war needy. It will help spread financial participation in National Defense among all of America's wage earners.

The widespread use of this plan will materially retard inflation. It will "store" part of our pyramiding national income that would otherwise be spent as fast as it's earned, increasing the demand for our diminishing supply of consumer goods.

And don't overlook the immediate benefit . . . money for defense materials, quickly, continuously, *willingly*.

Let's do it the American way! America's talent for working out emergency problems, democratically, is being tested today. As always, we will work it out, without pressure or coercion . . . in that old American way; each businessman strengthening his *own* house; not waiting for his neighbor to do it. That custom has, throughout history, enabled America to get things done *of its own free will.*

In emergencies, America doesn't do things "hit-or-miss." We would get there *eventually* if we just left it to everybody's whim to buy Defense Bonds when they thought of it. But we're a nation of businessmen who understand that the way to get a thing done is to *systematize* the operation. That is why so many employers are getting back of this Voluntary Savings Plan.

Like most efficient systems, it is amazingly simple. All you have to do is offer your employees the convenience of having a fixed sum allotted, from each pay envelope, to the purchase of Defense Bonds. The employer holds these funds in a separate bank account, and delivers a Bond to the employee each time his allotments accumulate to a sufficient amount.

Each employee who chooses to start this savings plan decides for himself the denomination of the Bonds to be purchased and the amount to be allotted from his wages each pay day.

How big does a company have to be? From three employees on up. Size has nothing to do with it. It works equally well in stores, schools, publishing houses, factories, or banks. This whole idea of pay-roll allotment has been evolved by businessmen in cooperation with the Treasury Department. Each organization adopts its own simple, efficient application of the idea in accordance with the needs of its own set-up

No chore at all. The system is so simple that A. T. & T. uses exactly the same easy card system that is being used by hundreds of companies having fewer than 25 employees! It is simple enough to be handled by a check-mark on a card each pay day.

Plenty of help available. Although this is *your* plan when you put it into effect, the Treasury Department is ready and willing to give you all kinds of help. Local civilian committees in 48 States are set up to have experienced men work with you just as much as you want them to, and no more.

Truly, about all *you* have to do is to indicate your willingness to get your organization started. We will supply most of the necessary material, and no end of help.

The first step is to take a closer look. Sending in the coupon in no way obligates you to install the Plan. It will simply give you a chance to scrutinize the available material and see what other companies are already doing. It will bring you samples of literature explaining the benefits to employees and describing the various denominations of Defense Savings Bonds that can be purchased through the Plan.

Sending the coupon does nothing more than signify that you are anxious to do *something* to help keep your people off relief when defense production sloughs off; *something* to enable *all* wage earners to participate in financing Defense; *something* to provide tomorrow's buying power for your products; *something* to get money *right now* for guns and tanks and planes and ships.

France left it to "hit-or-miss" . . . and *missed.* *Now* is the time for *you* to act! Mail the coupon or write Treasury Department, Section A, 709 Twelfth St. NW., Washington, D. C.

FREE - NO OBLIGATION

Treasury Department, Section A,
709 Twelfth St. NW., Washington, D. C.

Please send me the free kit of material being used by companies that have installed the Voluntary Defense Savings Pay-Roll Allotment Plan.

Name ______________________

Position ______________________

Company ______________________

Address ______________________

GPO 428498

MULTIPLE RECEIVER RESPONSE

(*Continued from page* 27)

signal arrives at the first detector grid without benefit of r-f amplification or reduction provided by selectivity. The image interference is at a much higher frequency than would normally be expected since it is determined by the second harmonic of the oscillator. Obviously it will be immediately apparent that depending upon the amplitude of the higher order harmonics of the oscillator a great number of multiple responses can occur at much higher frequencies than those mentioned.

This discussion would not be complete unless some mention was made of a very common present day ailment, which I have personally observed in a number of cases where broadcast interference was reported. This is a case very similar to the first point mentioned in this discussion, except that now we are dealing with a modern day broadcast receiver, possibly in a large fine console with very elaborate audio reproducing equipment, but sadly lacking in shielding, specially with reference to the audio amplifier channels. Figure 10 shows the elements involved in such an arrangement. We consider in

(*Continued on page* 35)

(*Continued from page* 25)

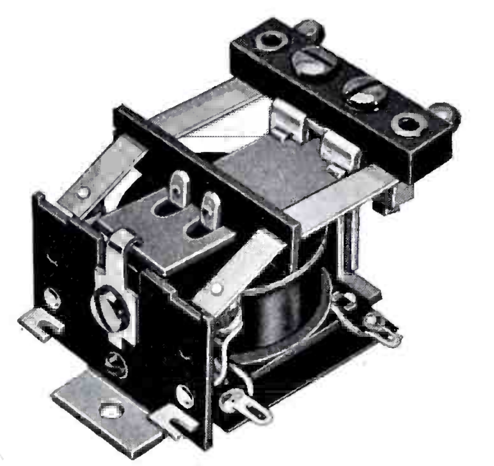
sizes of ampules by placing larger or smaller bushings into the chucks. The chucks are continuously rotating at approximately 100 rpm. The fires are adjusted vertically by means of a handwheel. This machine seals-in 5 ampules at one time; one operator can seal-in approximately 2,000 to 3,000 ampules per hour. This machine can also be utilized for sealing-in the ends of small diameter glass tubing.

* * *

GUARDIAN VIBRATION-RESISTANT RELAY

Specifically designed for applications having a serious vibration problem such as aircraft, generator mountings, etc., Guardian Electric, Chicago, announces the series 165, 24 volt DC Relay (also available for AC in the series 160).

The manufacturer states that tests conducted by the laboratory of one of the leading U. S. airlines substantiated earlier findings that the series 165 Relay, with two normally open contacts, would withstand a vibration test of 16.2 times gravity without making contact when the coil was de-energized, or breaking contact with the coil energized. The company claims that 16.2 (G's) is not the maximum vibration resistance of the relay, representing the maximum obtainable on the testing machine. These relays are said to be entirely insulated from ground with insulation withstanding a minimum of 1,500 volts. The field piece and armature are of annealed magnetic iron. Tinned phosphor bronze blades carry heavy fine silver points. All contacts are connected to tinned solder lugs.



* * *

NEW MEGABRIDGE

To check up leakage resistance, particularly in production test routine and in the field when equipment must be exceptionally rugged and operable by average working personnel, the series MB megabridge has been developed by Industrial Instruments, Inc., 156 Culver Ave., Jersey City, N. J.

The megabridge uses the Wheatstone bridge principle, a single-dial knob, with an electron ray null indicator (magic eye) replacing the delicate galvanometer. To obtain precise resistance measurements, the knob is simply rotated until the dark angle of the null indicator remains unchanged with the "detector" button depressed. The reading is taken directly off the dial. Meanwhile, fluctuations of the a-c line on which the instrument is operating are said to have no effect on the accuracy of the readings. Also, the high-voltage terminal assembly is guarded against any leakage over the surface of the terminals, and likewise the internal wiring, so that high humidity conditions do not affect the readings. The accuracy is said to be within 5% from 1 to 15 on the scale, and as close as readable for the remainder of the scale. The instrument measures 8 x 5¾ inches high.

* * *

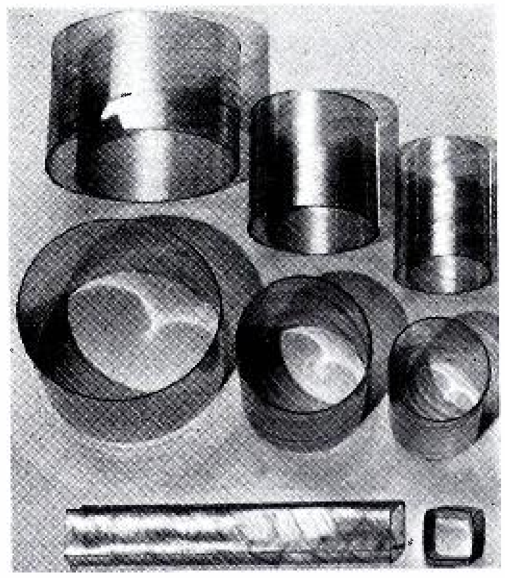
METAL CABINETS FOR IRC RESISTOR ASSORTMENT

Assortments of IRC of ½, 1 and 10 watt resistors in most frequently needed resistance ranges, are now available in handy metal cabinets.

(*Continued on page* 31)

LUMARITH INSULATING TUBING

Spiral wound Lumarith Protectoid (cellulose acetate) tubing in round, oval, and square shapes, from 1/16" to 3" ID in varying wall thicknesses and in continuous lengths that can be cut to required sizes as it emerges from winder, is announced by Precision Paper Tube Co., Chicago.



We See . . .

(*Continued from page 2*)

differs from the previous ones by being highly mechanized, but more than that is involved. War today is highly mobile and speeds of all fighting units are now greatly higher. Therefore higher speeds and efficiency of Communication are now necessary. Even speed of Communication to civilian population, previously unimportant, is now vital, because the enemy can attack cities within a few minutes of the first sign of his approach. A city can be destroyed or a fleet sunk before resistance can be offered, if Communication depends upon old means or old procedures. Therefore every technician and every manager in the Communication field has a duty much greater than before. Previously, ships and troops could be used with at least some effectiveness even when Communication with them was completely absent. Today, we might as well not build ships, planes and tanks, if they are not equipped with apparatus and procedures which give them instantaneous Communication. Furthermore, the apparatus and techniques developed recently for radio, and therefore thoroughly known only to Communication experts, have been used to provide other than Communication devices; plane detectors for example. Therefore the Communications industry has a further duty and service to perform in supplying and operating such devices. These two characteristics of the modern "total war" give new and extraordinary importance to the Communication industry. Communications is vital to the fighting forces in the field, and to civilians at home."—L. W.

NEWS BRIEFS

(*Continued from page* 21)

TUITION-FREE RADIO ENGINEERING TRAINING OFFERED BY GOVERNMENT

Because of the present extreme shortage of radio engineers, the University of Maryland and the University of Chicago are offering under their engineering defense training program, in cooperation with the U. S. Office of Education, a course in Radio Engineering. The class at the University of Maryland is planned to convene January 5, 1942, provided a sufficient number of applicants are accepted, and will continue through August 7, 1942. It will be a full-time day course and the curriculum will cover advanced theory and practical radio engineering, the student spending a minimum of forty hours per week in lecture room and laboratories. The classes at the University of Chicago are already under way.

All tuition expenses, other than text books and student supplies, will be borne by the government. The student will pay his own living expenses. To qualified students it may be possible to offer positions prior to commencement of the course and subject only to its successful completion. Judged by past experience, it is expected that all other students who complete the training will also receive offers of employment.

The requirements for admission at the University of Maryland include a degree in electrical engineering from a recognized college or university or a minimum of three years of electrical engineering training at such an institution.

All men with the necessary qualifications who desire to enroll for this training may obtain application forms, and a brief outline of the proposed curriculum from Dean S. S. Steinberg, College of Engineering, University of Maryland, College Park, Maryland.

Admission to the University of Chicago course was made on the basis of competence and intelligence plus evidence of past and present employability. The objective of the intensive training is to qualify men as personnel supervisors, time and cost clerks, pay-roll clerks, job and motion study analysts, inspection supervisors and accounting, traffic and purchasing assistants. The first group of one hundred men were selected from over seven hundred applicants. More complete information for the employment of these men may be obtained from the School of Business, University of Chicago, Chicago, Illinois.

* * *

ERIE RESISTOR APPOINTS

Erie Resistor Corporation, Erie, Pa., announces the appointment of Industrial Production, Inc., 738 East Third St., Los Angeles, Calif., as their representatives. Industrial Production will represent the Molded Plastics Division of Erie Resistor Corporation, which produces custom injection and extrusion moldings in the West Coast area.

* * *

NEW HYGRADE TUBE PLANT

A new radio tube plant for the manufacture of special purpose radio tubes will be constructed for the Hygrade Sylvania Corporation in Montoursville, Pennsylvania. The property comprises some 16 acres of land on Broad Street, just east of Williamsport on the Harrisburg highway. Plans for the new plant in the Williamsport area call for a building with a total floor space of approximately 50,000 square feet.

* * *

HARVEY-WELLS EXPANDS

Harvey-Wells Communications, Inc., Southbridge, Mass., have recently purchased the Precision Crystal Laboratories of Springfield, Massachusetts.

* * *

SOLAR ISSUES NEW CATALOGS

Two new catalogs, No. 12 section F and No. 12 section G, have been issued by the Solar Manufacturing Corp., Bayonne, New Jersey. In section F, the complete line of

Elim-O-Stat radio nosie suppressors is described, while in section G, Capacitor Analyzers are described.

* * *

HAZELTINE AND ZENITH SIGN LICENSE CONTRACT

An agreement has been reached by the Hazeltine Corp., New York, and Zenith Radio Corp., Chicago, whereby all existing litigation between the two companies has been terminated.

Under the terms of the agreement, Zenith receives a Hazeltine standard license in the broadcast receiver field for a period of ten years as well as the standard Hazeltine license in the commercial communication field.

Both companies are planning an efficient coordination of their respective facilities in the production of radio equipment for national defense.

* * *

FRANK CONRAD DIES

Dr. Frank Conrad, the first man to broadcast regular radio programs and one of the first to see the possibilities of radio as an advertising and entertainment medium, died recently. His world-renowned experiments in transmission led to the founding of KDKA. In 1921 he was appointed assistant chief engineer of Westinghouse Electric and Manufacturing Company, a post he held until his death.

* * *

INTERNATIONAL TELEPHONE MOVES SELENIUM PLANT

The International Telephone and Radio Manufacturing Corp. has moved its selenium rectifier manufacturing facilities from 137 Varick Street, New York City, to a new plant at East Newark, New Jersey.

* * *

NEW FORMICA BULLETIN

Formica parts for airplanes are illustrated and described in a new bulletin issued by the Formica Insulation Company, Cincinnati, Ohio. Charts and drawings of pulleys, bushings, and other important pieces are also included.

* * *

HIGH FREQUENCY CERAMIC DATA

An anaylsis of the electrical properties of high frequency ceramics by Dr. Ing. E. Rosenthal, as it appeared in the September, 1941 issue of Electronic Engineering of London, England, has just been reprinted and included in a booklet by the American Lava Corporation, Chattanooga, Tenn. The booklet also contains charts and curves of a variety of ceramic insulating materials of American Lava.

* * *

DUMONT'S ISSUES TENTH ANNIVERSARY BOOKLET

The advances in the art of cathode ray and television are effectively described in a 10th anniversary booklet published by the Allen B. DuMont Laboratories, Inc., Passaic, New Jersey. A wealth of historical and technical data is included.

* * *

NEW BEARING CATALOG ISSUED

Radial, pivot and special bearings in miniature precision sizes, are effectively described in a new catalog, number 41, just issued by Miniature Precision Bearings, Keene, New Hampshire. The samllest radial ball bearings in the world are shown and described in this new booklet.

IRE IN NEW YORK

(Continued from page 28)

0 to 7,000 cycles with a maximum voltage gain of 131 decibels, a maximum voltage gain of 126 decibels being attained with a response flat within 1 decibel from 0 to 14,000 cycles. The sweep amplifiers are said to provide an undistorted output of approximately 700 volts, sufficient for full-scale deflection of the Western Electric 330C cathode-ray tube operating at 3 kilovolts accelerating voltage, sweep frequencies ranging from 1 per minute to 30,000 per second.

The primary purpose of a radio range for aircraft use is to provide a reliable aural or visual indication to the pilot of an airplane as to his location with respect to a predetermined course. In addition it is very desirable to identify quickly and positively the sector in which the airplane is at any given time, i.e., whether he is east or west of an east-west radio range.

A radio range design with a two-course localizer used in instrument landing, is the basis of the paper to be presented by A. Alford and A. G. Kandoian of International Telephone and Radio Labs. By using this instrument, it will be shown that a group of three loop radiators provide the two overlapping mirror-image patterns modulated at 90 and 150 cycles, respectively. A cross-pointer instrument, the vertical pointer of which is actuated by the 90- and 150-cycle modulation, provides the pilot with the necessary information for orienting his plane.

A second set of similar radiators, but at right angles to the first group, provides the keyed signal for aural sector identification. Except for the carrier radiation, which is common to both the aural and visual signals, the two systems are entirely independent.

The theory of the antenna system will be discussed in this paper, paying particular attention to the problem of interaction between the aural and visual radiating systems. Experimental and flight data on the installation at the Civil Aeronautics Administration experimental station in Indianapolis will also be presented.

The principle and design of automatic multi-frequency ionospheric equipment developed by the Carnegie Institution of Washington, Department of Terrestrial Magnetism will be the topic of H. W. Wells. This equipment affords a sweep through a frequency range of 16.0-0.516 megacycles per second every fifteen minutes and automatically records the radio reflections which are returned from the different layers of the ionosphere. Three complete units of this type are now in operation under the auspices of this Department; at Huancayo, Peru, at Watheroo, Western Australia, and the last, which has recently been installed at College, Alaska.

Monday, January 12, 1942

9:00 A.M. Registration and Opening of Exhibition.

10:30 A.M.-12:30 P.M. Opening Session.

Address of welcome by the Convention committee chairman, I. S. Coggeshall; message of the retiring president, F. E. Terman; remarks of the incoming president, A. F. Van Dyck.

"The Mobilization of Science with Special Reference to Communication," Dr. F. B. Jewett, president, National Academy of Sciences and Member, National Defense Research Committee of the Office of Scientific Research and Development.

2:30 P.M.-5:30 P.M. Technical Session.

"Half a Year in Commercial Television," Moran E. Kersta, National Broadcasting Company, Inc., New York, N. Y.

"Automatic Radio Relay Systems for Frequencies Above 500 Megacycles," J. Ernest Smith, RCA Communications, Inc., New York, N. Y.

"Automatic Frequency and Phase Control of Synchronization in Television Receivers," K. R. Wendt and G. L. Fredendall, RCA Manufacturing Company, Camden, N. J. (Demonstration.)

"Simultaneous Aural and Panoramic Reception," Marcel Wallace, Panoramic Radio Corporation, New York, N. Y. (Demonstration.)

6:30 P.M. Exhibition Closes.

7:30 P.M.-8:30 P.M. Exhibition Open.

8:30 P.M.-10:00 P.M. Technical Session.

"Color Television," P. C. Goldmark, J. N. Dyer, E. R. Piore, and J. M. Hollywood, Columbia Broadcasting System, New York, N. Y. (Demonstration.)

Tuesday, January 13

9:00 A.M. Registration and Opening of Exhibition.

10:00 A.M.-12:30 P.M. Technical Session.

"Direct-Reading Wattmeters for Use at Radio Frequencies," G. E. Brown, J. Epstein, and D. W. Peterson, RCA Manufacturing Company, Inc., Camden, N. J.

"The Use of Vacuum Tubes as Variable Impedance Elements," H. J. Reich, University of Illinois, Urbana, Ill.

"The Absolute Sensitivity of Radio Receivers," D. O. North, RCA Manufacturing Company, Inc., Harrison, N. J.

"A Wide-Range, Linear, Unambiguous, Electronic Phasemeter," J. E. Shepherd, formerly Harvard University, Cambridge, Mass.

"Variable-Frequency Bridge-Stabilized Oscillators," W. G. Shepherd and R. O. Wise, Bell Telephone Laboratories, Inc., New York, N. Y.

2:30 P.M.-5:00 P.M. Technical Session:

"Space-Charge Relations in the Magnetron with Phase Electrodes," E. A. Condon, Westinghouse Electric Manufacturing Company, East Pittsburgh, Pa.

"Bioelectric Research Apparatus," Harold Goldberg, formerly University of Wisconsin, Madison, Wis., now Stromberg-Carlson Telephone Manufacturing Company, Rochester, New York.

"The Dynetric Balancing Machine," H. P. Vore, Westinghouse Electric and Manufacturing Company, Baltimore, Md.

"Ionospheric Investigations at Huancayo Magnetic Observatory (Peru) with Applications to Wave-Transmission Conditions," H. W. Wells, Carnegie Institution of Washington, Washington, D. C.

"The Velocity of Radio Waves Over Short Paths," R. C. Colwell, H. Atwood, J. E. Bailey, and C. O. March, University of West Virginia, Morgantown, W. Va.

7:00 P.M. Exhibition Closes.

7:00 P.M. Thirtieth Anniversary Banquet.

President Van Dyck, Toastmaster; presentation of Medal of Honor to Dr. A. Hoyt Taylor; presentation of Fellows Diplomas, remarks by Adolph T. Cosentino, Director of Communications of the Argentine, retiring vice-president.

"Radio's Expanding Role in Hemispherical Solidarity," by Don Francisco, Director of Communications, Office of the Co-ordinator of International American Affairs.

Wednesday, January 14

10:00 A.M. Registration and Opening of Exhibition.

10:00 A.M.-12:30 P.M. Student Session.

10:00 A.M.-12:30 P.M. Sections and Membership Committees Meeting.

2:30 P.M.-5:00 P.M. Technical Session:

"The Fort Monmouth Laboratory of the Signal Corps," Major Rex Corput, United States Army, Fort Monmouth, N. J.

"Note on the Sources of Spurious Radiations in the Field of Too Strong Signals," A. J. Ebel, WILL, University of Illinois, Urbana, Ill.

"RCA 10-Kilowatt Frequency-Modulated Transmitter," E. S. Winlund and C. S. Perry, RCA Manufacturing Company, Inc., Camden, N. J.

"A Stabilized Frequency-Modulation System," R. C. Pirracci, Collins Radio Company, Cedar Rapids, Iowa.

7:30 P.M.-10:00 P.M. Technical Session:

"An Analysis of the Signal-to-Noise Ratio of Ultra-High Frequency Receivers," E. W. Herold, RCA Manufacturing Company, Inc., Camden, N. J.

"Direction Finding at Medium-High Frequencies and the United Air Line Ground-Station Direction Finder," P. C. Sandretto and E. P. Buckthal, United Air Lines Transport Corporation, Chicago, Ill.

"A New Direct Crystal-Controlled Oscillator for Ultra-Short Wave Frequencies," W. P. Mason and I. E. Fair, Bell Telephone Laboratories, Inc., New York.

"An Ultra-High-Frequency Two-Course Radio Range with Sector Identification," Andrew Alford and A. G. Kandoian, International Telephone and Radio Laboratories, New York.

MULTIPLE RECEIVER RESPONSE

(*Continued from page* 29)

this particular case a diode second detector, the rectified output of which is fed into an audio amplifier tube (let us say the first audio amplifier tube of an audio channel), and there is no shielding of significance provided so that the grid lead "A" from the volume control "RV" is considerably exposed to any r-f field which might be present. This often happens in the case of neighborhood interference from amateur stations. The evidence of the difficulty will be the presence of the interfering station modulation all over the dial of the receiver which is affected, and of course will continue to appear even though every tube in the receiver is removed prior to the first audio amplifier. This is a simple case of radio frequency voltage being applied to the first audio amplifier. When the volume control is about middle scale, in this particular circuit, the impedance to ground for radio frequency voltage is considerable. Depending upon the amount of exposure or coupling to the radiating field, a sizable voltage can be caused to appear on the grid of the first audio amplifier. This, of course, is a radio frequency voltage and depending upon its amplitude it may swing the grid positive and possibly to cut off and cause rectification in the first audio amplifier tube. In this case, modulation components, if the carrier is modulated, will appear in the plate circuit and be passed on to subsequent audio amplifier.

Index to Advertisers

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 Group Plan only pay $2.00 each.)

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

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Employed by ....
Nature of business ....
(State If Manufacturer, Broadcast Station, etc.)
Product ....

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Occupation or title ....
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Nature of business ....
(State If Manufacturer, Broadcast Station, etc.)
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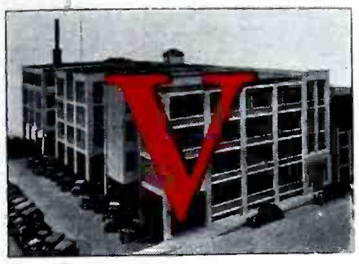
Nature of business ....
(State If Manufacturer, Broadcast Station, etc.)
Product ....

We Don't Want To Grow Too LARGE!



VISITORS to the laboratories and factory of General Radio are very often surprised at our size. Some think we must occupy a hole-in-the-wall, others that we are spread out over acres.

Happily, we occupy a position between both of these undesirables. Our total floor space is 75,000 square feet, divided between three four-story buildings and occupying about a half a city block. Our total personnel is 287, of which number 30 are engineers.

G-R does not want to grow large; only by following the basic idea upon which the company was founded in 1915 can we continue to serve our customers in the instrumentation field. That idea was to have an organization large enough to get instruments turned out, in peace time, in sufficient quantity to satisfy our customers and give us a reasonable profit; and at the same time small enough to enjoy the flexibility essential to adapting research, engineering and manufacture to the ever rapidly changing developments in the electronic art.

The type of equipment manufactured by G-R does not lend itself to production-belt methods; G-R design will never be cheapened to make mass production possible.

As soon as we grow to be a large company, we lose most of the essential direct contact between engineers and customers, and between engineers and the shop; ideas when diluted by eighteen in-betweens in an organization lose some of their sparkle and much of their originality.

Fundamentally we have only one thing to sell; engineering ideas wrapped up in cabinets with control panels. Many concerns can manufacture more economically than we; few have such a large percentage of idea-developing engineers.

If G-R grows large . . . if it grows so large that to change a machine screw from a 6-32 to an 8-32 requires a design conference, a thousand dollars in drafting time and a month's delay for tooling . . . we will cease to perform the function for which the company was established: to design and manufacture precision electrical measuring apparatus at a price consistent with both the quality of the product produced and the type of persons employed.

GENERAL RADIO COMPANY

CAMBRIDGE, MASSACHUSETTS

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