COMMUNICATIONS

APCO
CONVENTION

FREQUENCY
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RADIO

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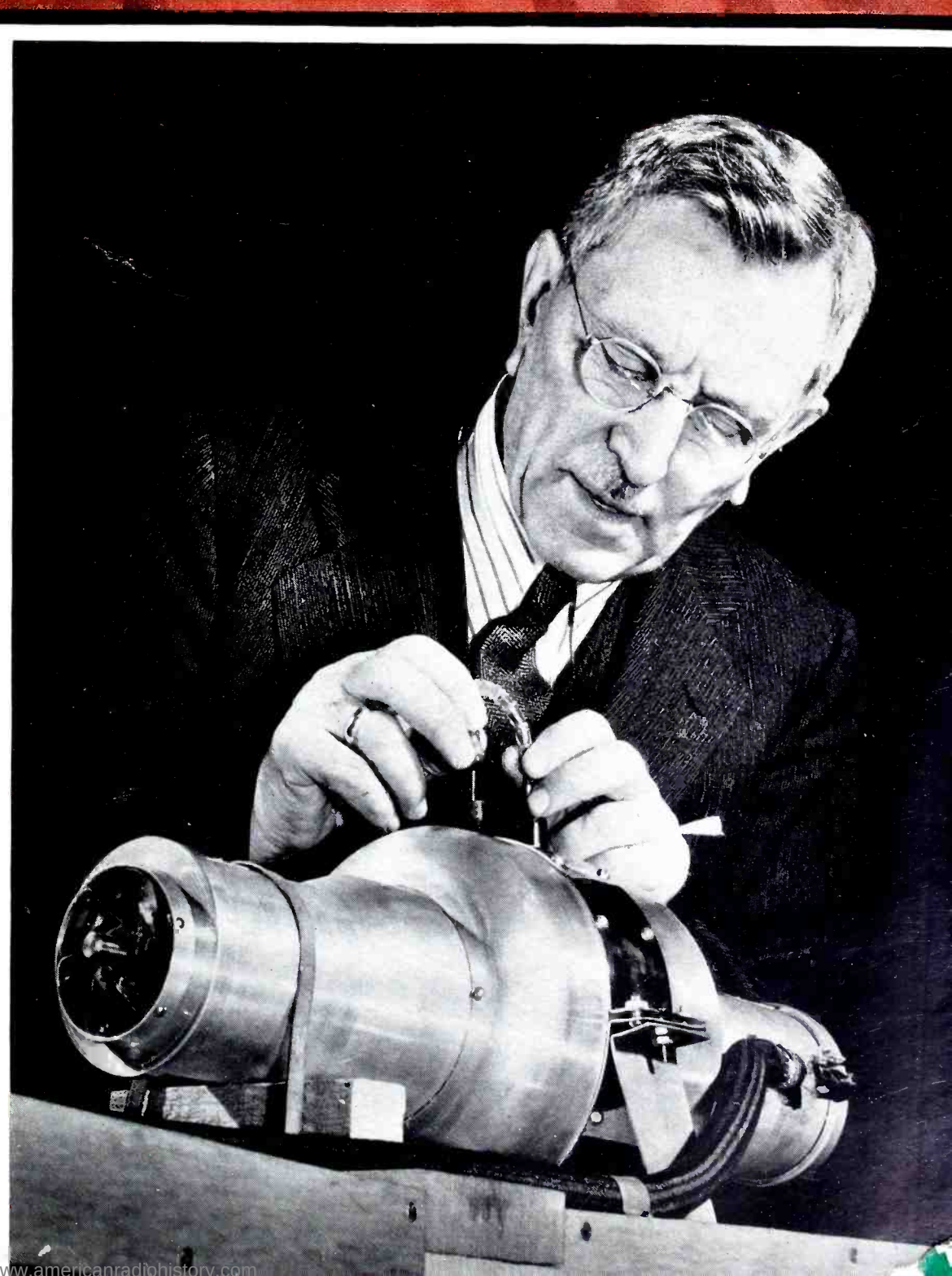

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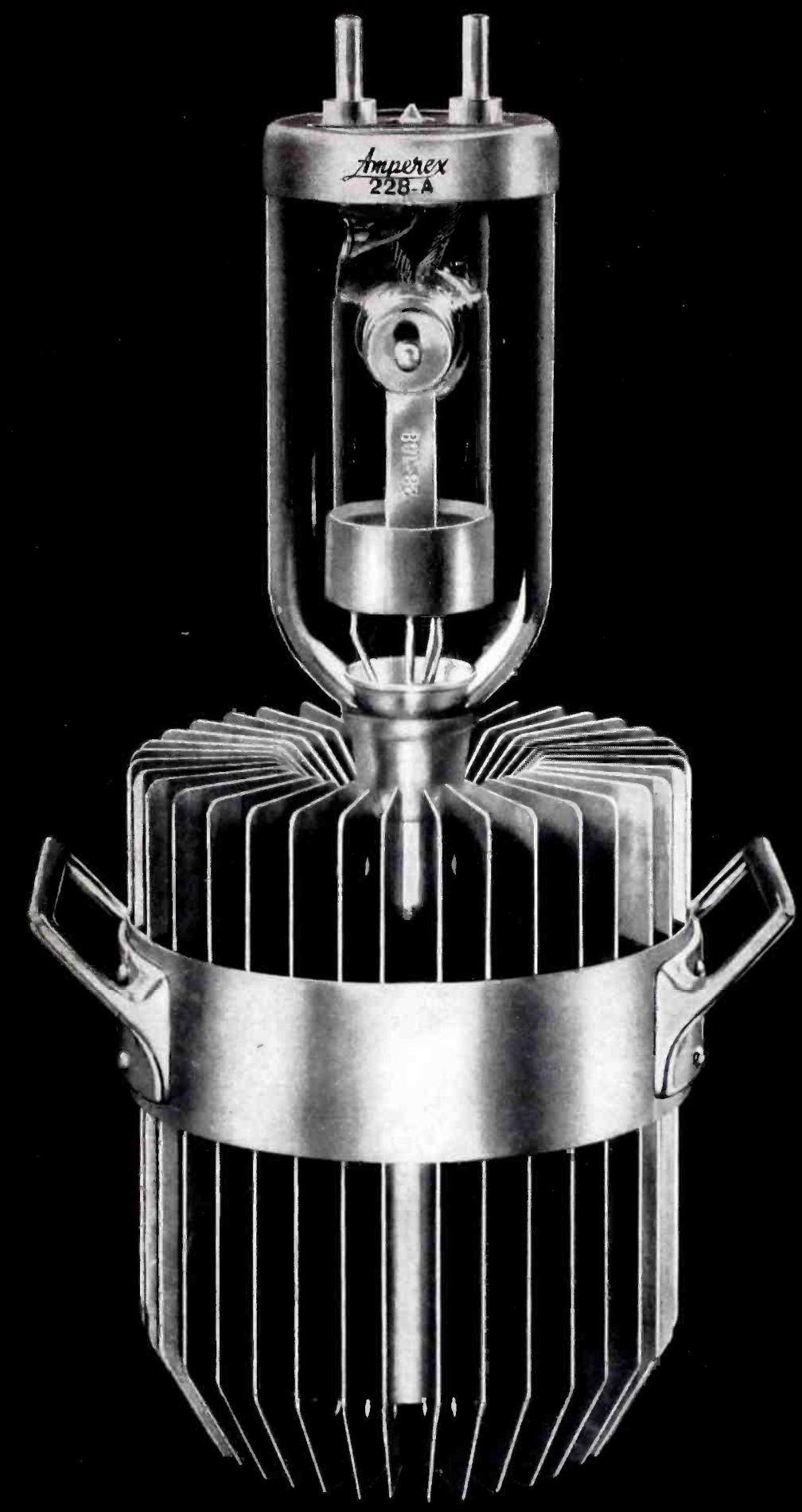

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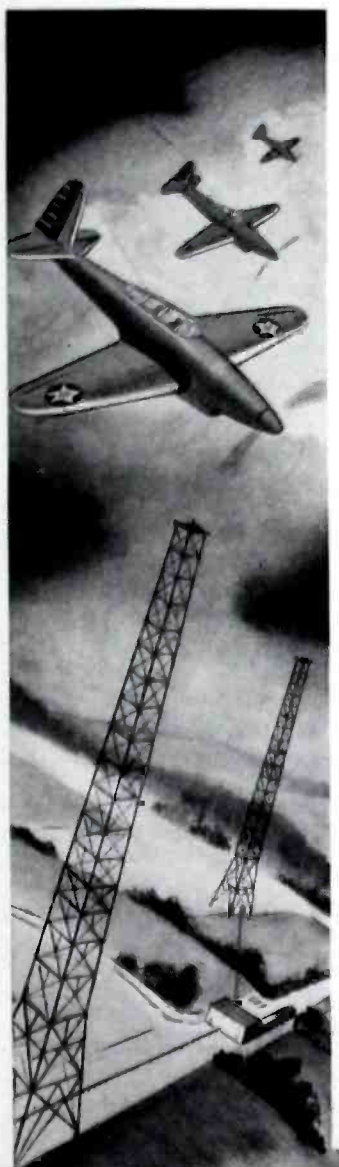

THE RADIO INDUSTRY has answered the call to national defense with an "all out" acceleration of creative activities. In research, in operation, in production—from blueprint to wavelength—the watchword is Service for the Needs of Uncle Sam!

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Using all the resources at its command, the Radio Corporation of America is meeting every demand for service—with expanded facilities, increased production, with smooth functioning speed.

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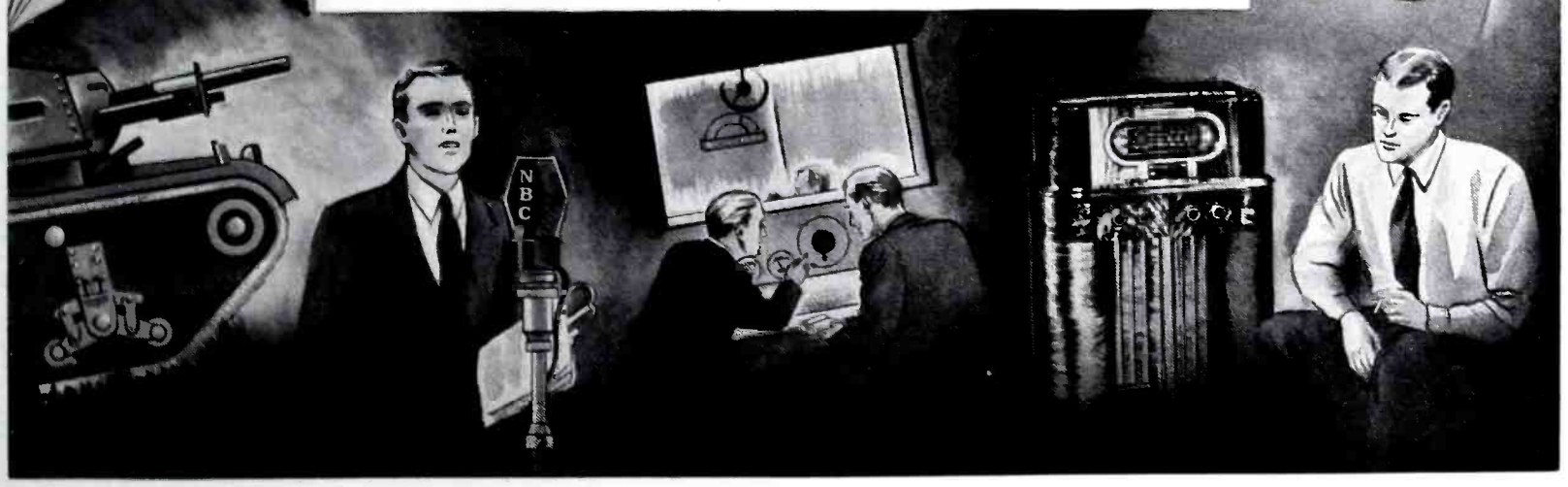

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VOLUME 20
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RAY D. RETTENMEYER
Editor

• Contents •

COVER ILLUSTRATION

I. E. Mouromtseff, Westinghouse research engineer, makes adjustments on a Klystron, a newly developed electronics tube that generates 40-centimeter radio waves at a power output of some 150 watts.

• Editorial Comment •

THE Annual Convention of the Associated Police Communication Officers is being held in Orlando, Florida, December 2, 3, 4 and 5, at the Colonial Orange Court Hotel. As promised last month, details of the gathering appear in this issue (page 13).

From all indications, this should be the best meeting in the history of the APCO. Among the subjects to be covered are: "Frequency Modulation," "Revision of APCO Constitution," "The Police Communications Services—The National Defense," "The FCC and The Police Services," "Police Communications and The IACP," "National Motor Vehicle Trace Program," "Emergency Power and National Defense," "Uniform Police Radio Legislation," "Are Motor Car Engineers 'Radio Conscious'," "Formation of Advisory Council," "A Code of Ethics," "Municipal Systems," "The County System," "State Systems," "Aircraft in The Police Service," "The Teletypewriter in Our Picture," "Recording—Its Aid in Our Services," "Antennae—New Designs—New Results."

Every police communication officer who can attend is urged to do so. It should be well worthwhile.

COMMERCIAL frequency-modulation broadcasting had its official start on October 31, when the Federal Communications Commission granted fifteen applications for F-M stations. Approval was given to four stations in the New York area, with Chicago, Detroit, Los Angeles, Milwaukee, Salt Lake City, Columbus, and Schenectady represented among the large centers of population. The official action of the FCC authorizes the new type of broadcasters to operate "on a commercial basis as soon as they are able to do so."

IT now appears that television may be placed on a commercial basis early in 1941. W. R. G. Baker, Chairman of the National Television Systems Committee, in reporting to the RMA membership states: "It is hoped to complete the work of NTSC by January 1, 1941."

The analytical work of the NTSC is handled by nine panels consisting of 138 members from 41 organizations.

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COMMUNICATIONS CONTRIBUTES TO NATIONAL DEFENSE

THE subject of greatest interest to the American people today is our National Defense. Those engaged in radio and allied fields are naturally concerned with the part radio communications will play in preparing our country for defense.

In one form or another, communication has long been a primary factor in war. One of the first types of electrical communication, the telegraph, was used during the conflict between our states, and combined with the telephone, still plays an important part in the communication system of our armed forces. Then came the World War and the new medium of radio was used to a limited extent for the transmission of intelligence. Since 1918, however, radio has indeed made rapid progress—so rapid in fact that today radio communications represents one of the most important links in our chain of defense.

For example, in addition to the normal uses of radio communication (a-m and f-m) for transmitting intelligence between both fixed and mobile points, there are many devices such as radio direction finders, radio altimeters, sound detectors, radio-controlled sea drome lights, to mention a few, which are of great value. The application of facsimile for sending drawings, maps, etc., should also have much in its favor . . . and, too, the possibilities of using television for scouting purposes should not be overlooked.

Although much remains to be done, many large orders have been placed by the Army and Navy, and plans at least are under way to coordinate the industry. On September 24 the Defense Communications Board was created by Executive Order "to coordinate the relationships of all branches of communications to the national defense" (Page 5, October, 1940, COMMUNICATIONS). Members of the DCB include: James L. Fly, Chairman, Rear Admiral Leigh Noyes (Director of Naval Communications), Maj. Gen. J. O. Mauborgne (Army Chief Signal Officer), Herbert E. Gaston (Assistant Secretary of the Treasury), and Breckenridge Long (Assistant Secretary of State).

The Defense Communications Board has had several meetings and, according to NAB Reports has appointed the following committees to assist in carrying out its functions and to provide for continuing studies and for contact with other government agencies and with the civil communication industry: Coordinating, Law, Labor Advisory, Industry Advisory, Amateur Radio, Aviation Radio, Cable, Domestic Broadcasting, Interdepartment Radio Advisory, International Broadcasting, Radiocommunications, State and Municipal Facilities, Telegraph, Telephone, and United States Government Facilities. It is understood that additional committees may be appointed from time to time as the Board may deem necessary.

As can be seen from the accompanying illustration, the DCB is likely to be very extensive in its final set-up. It is obvious, then, that the entire communications industry will be called upon to contribute its share towards our defense program. This will apply to large and small organizations alike, to everyone from the suppliers of raw materials and parts manufacturers to the manufacturing organizations who will assemble the parts into the finished radio products. It also applies to broadcasting and international broadcasting stations as well, who will be called upon for accurate news of developments and in helping to create hemisphere solidarity.

However, it should be borne in mind that the communications industry will not be called upon only to supply communications equipment. The industry must also contribute the products of its research and development facilities; it must supply a certain amount of specialized personnel to the armed forces; and it must train new men to replace those called to arms.

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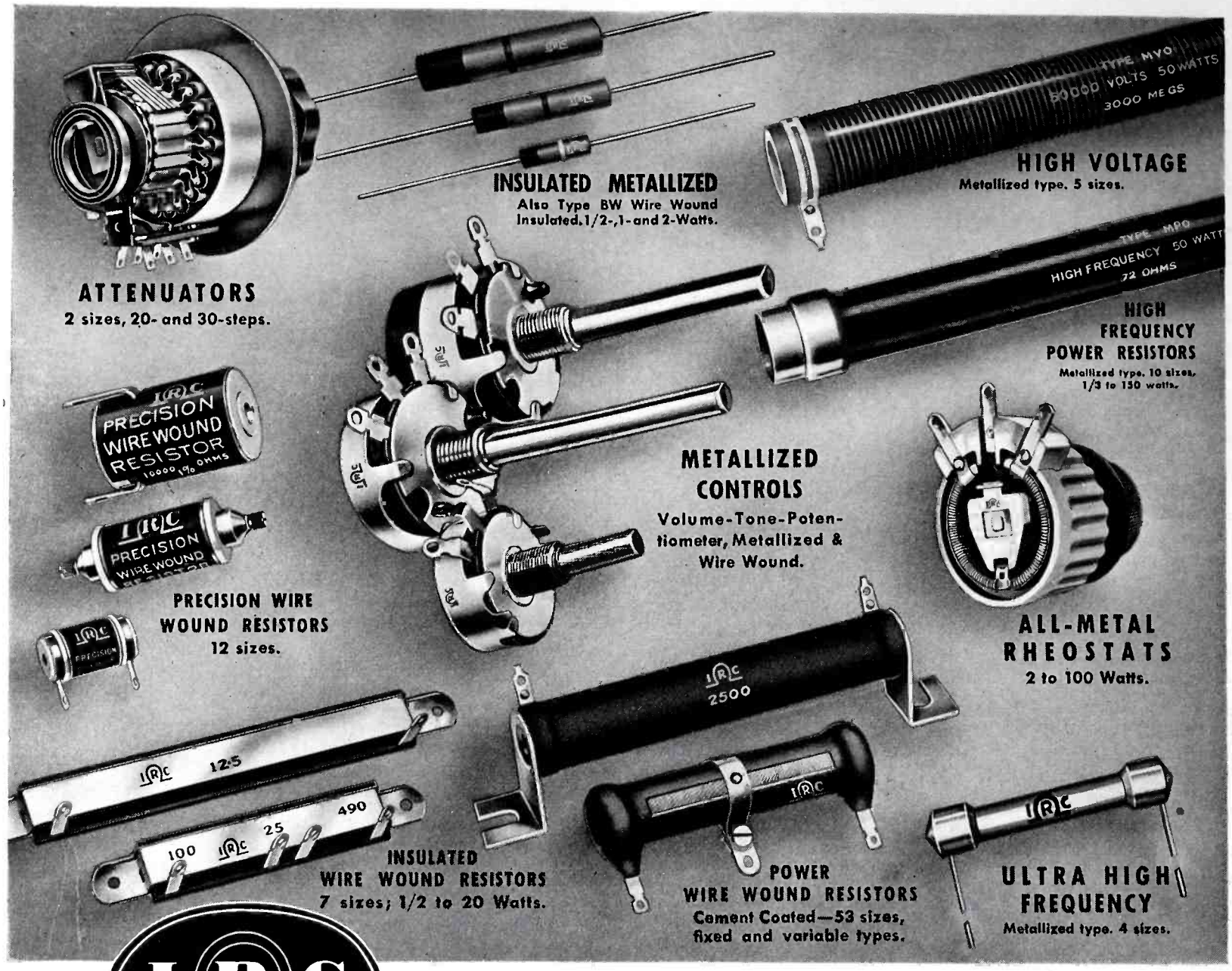

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TRAVELING WAVES IN ELECTRON BEAMS

By Dr. SIMON RAMO
General Engineering Laboratory
General Electric Co.

A non-mathematical exposition of a traveling wave theory of ultra-high frequency electronics which has proved useful in designing velocity modulation tubes and many be expected to find increasingly greater application in the future to other transit-time electronics problems.

Introduction

AS the frequencies used in radio approach the centimeter-wave range, it becomes increasingly difficult to understand and design vacuum tubes. The theory of even a simple diode and triode must take into account the time of transit of an electron between the electrodes and the resulting complicated equations for the tube characteristics have required long studies by experts[1, 2]—even for small signals. Ordinarily, engineers are quite content to allow the specialist to study the difficult theory, asking only a satisfactory general picture of the analyses so that the results can be used intelligently. But in this respect, too, the field of transit-time electronics has not been too promising, for it is far from easy to visualize the changes in performance of tubes when the frequency increases to the transit-time range.

Recently, an effort to simplify the study of ultra-high-frequency electronics by separating the various transit-time effects has led to the design of tubes of the velocity-modulation type[3, 4] in which transit time forms a basis of operation instead of an undesirable, uninvited guest. In this paper an attempt will be made to describe a traveling wave picture which is becoming increasingly useful in understanding and designing velocity-modulation tubes. While essentially mathematical in character, it presents a point of view which is not abstract, but rather decidedly physical. It is not often that a theory founded on a rigorous and broad foundation carries with it a physical picture that can be appreciated without a detailed mathematical study. When such a theory enters the field of transit-time electronics, with its involved high-frequency space-charge equations, then it is indeed worthy of close attention. This new way of looking at transit-time electronics may be expected to become more widely applicable in the future and no one who will have occasion to work with ultra-high-frequency tubes need wait upon a tedious study of the mathematical derivations to become acquainted with it.

The theory to be described here was conceived and worked out by W. C. Hahn[5, 6] * in the course of studying the characteristics of velocity-modulation tubes such as have already been described in the literature[3]. In the descriptive article by Hahn and Metcalf, simple derivatives were given of the important characteristics of the tubes, such as input impedance and transconductance. In view of the simplicity of these derivations it is fitting to ask why the more detailed theory reported here should have been worked out. To answer this it is first necessary to discuss briefly the operation of these tubes as

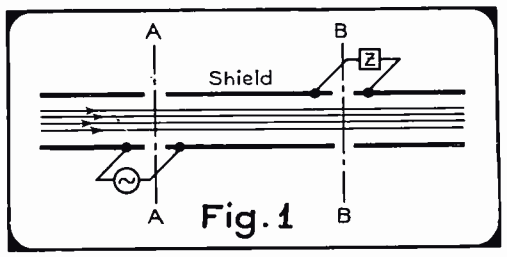

Fig. 1

it has usually been described in the literature.

Simple Theory of Velocity Modulation

Velocity-modulation tubes applicable to the generation, amplification, and detection of ultra-high frequencies may be represented by the basic tube structure of Fig. 1. Here an electron beam is directed into a grounded cylindrical shield coaxial with the beam. The electrons have been accelerated before entering the cylinder and will be collected after leaving it. The gun and the means for collecting the beam after it has passed through the cylinder are quite independent of the radio-frequency effects and need not concern us further in a discussion of the high-frequency theory. The tubes will differ in details of construction and arrangement of input and output systems according to the expected application of the tube, but in general the diagram of Fig. 1 is appropriate. Across a gap in the cylinder (A-A) is placed a signal voltage. This serves to increase or decrease alternately the velocity of electrons as they pass that point. As a result of this velocity modulation experienced by the beam, pulsations of density or conduction-current modulation will build up along the beam's length until at some later point in the cylinder (B-B) output current may be withdrawn by again introducing a gap in the shielding cylinder and placing across it this time an output impedance, Z.

With the simple theory, the effect of the electrons on each other having been neglected, it was easy to explain how the conduction-current modulation at B-B occurred as a result of the velocity moulation at A-A. Thus the increments in velocity imparted at A-A could be regarded as a means for causing faster electrons (those which happened to pass A-A during the positive half of the cycle) to catch up with slower electrons (those that happened to pass A-A during the negative half of the cycle) from the preceding cycle. This is shown diagrammatically in Fig. 2. Fig. 2(a) shows the continuous homogeneous stream of electrons passing A-A and B-B in the absence of signal. Fig. 2(b) shows the effect on the stream from A-A to B-B due to the injection of velocity modulation at A-A.

Inadequacy of the Simple Theory

It becomes necessary now to examine the importance of space-charge effects. Does the fact that electrons repel each other necessarily mean that they will exert forces tending to oppose the conversion of velocity modulation into conduction-current modulation? If so, is the effect large enough to detract materially from the capability of the tubes? It soon becomes evident that space

*Some extensions and reformulations of Hahn's work have been made by Dr. L. Tonks and the author. (See bibliography.)

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charge must be taken into account if one is interested in knowing to what theoretical limits the trans-conductance may be carried. With no space-charge forces, the trans-conductance would appear to have unreasonably high limits. For instance, by continually decreasing the average velocity of electrons as they enter gap A-A, the relative effect of a signal applied at A-A becomes increasingly greater. With sufficiently low average velocity, electrons passing A-A during the negative half of the cycle

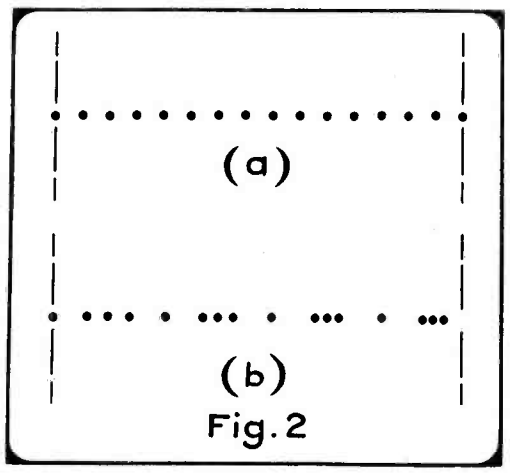

Fig. 2

could be slowed down almost to a standstill, an easy prey for overtaking by the faster electrons of the subsequent cycle. In an extremely short length of drift tube the beam could be completely modulated by a very small input signal.

Another way in which failure to include space-charge forces leads to erroneous results is the boundless trans-conductance apparently attainable by use of a very long drift tube. An infinitesimal signal applied at A-A must finally result in the same conduction-current modulation at some point sufficiently far removed from A-A as a larger signal would produce at some point not so far removed. With a decreasing signal compensated for in this way by an increasing length of drift tube, the output signal could be maintained constant and the trans-conductance would approach infinity.

Evidently, if the mutual repulsions of electrons are overlooked, very large errors, if not complete miconceptions, will be formed in studying the performance of velocity-modulation tubes. An obvious way to estimate the effect of space charge is to assume as a first step that the simple theory holds. Then an alternating electric field in the drift tube is computed by summing the contributions to the total electric field at each point due to the groups of charges distributed over the entire drift tube. Such an analysis was made early in the study of velocity-modulation tubes. To be reasonably close to the true situation this computation must include the cylindrical boundary and is quite tedious to make. However, if made carefully, the analysis yields some results that are useful, especially if the final result indicates that space charge may truly be neglected; this naturally turns out to be the case for extremely high voltages and low currents. Most often, however, if the result indicates that space charge is an important factor, as is the case if the drift-tube voltage is not high and the currents become appreciable, then this analysis has proven quite inadequate.

The Wave Concept

A scheme of analysis has been proposed[5, 10] which accounts for the effect of space charge in velocity-modulation tubes and is at once broader in scope and more rigorous than any system of repeated corrections to the simple theory could be. The theory (in reality a general small-signal theory of high-frequency effects in electron beams with space charge and transit time as leading parameters) may well be expected to prove of value in other fundamental studies in the field of ultra-high-frequency electronics. It was suggested that since the beam consists of traveling electrons with alternating effects superimposed upon this motion, it would be well to discard completely the "particle" theory of the drift tube and substitute instead a "traveling wave" theory.

A disturbance created in the beam by a voltage at A-A must propagate down the tube, for the moving electrons react to this disturbance and the reaction is carried forward by them. This disturbance, in propagating down the tube, must undergo changes so that ultimately the altered disturbance may be made available to the output impedance as an induced output current. The problem becomes that of finding what kind of disturbances or waves can propagate along an electron beam in a conducting cylinder, how these waves may be started by a signal voltage across a gap in the cylinder, and how they cause conduction-current modulation to build up as they propagate.

The idea of analyzing the operation of a vacuum tube by the use of propagating space-charge waves may at first seem to be as vague as it is new. However, a few purely physical considerations will show that it is really a simpler way of looking at high-frequency electronics in those special cases to which it applies. As a rule, whenever effects are transmitted from one end of a comparatively long system to the other the concept of waves has proved convenient, be the problem electrical, mechanical, hydraulic, etc. Consider ordinary transmission lines, for example. In Fig. 3 is pictured a coaxial transmission line (which looks much like the tube of Fig. 1 with the inner conductor replacing the electron beam but the outer conductor remaining the same). The effect of the voltage applied at some point in the transmission line is to start electromagnetic waves which travel along the line and ultimately produce current flow in an impedance connected somewhere farther along its length. The equations of electricity and magnetism which lead to the characteristics of transmission line waves, telling us how much current is induced in the load impedance of a transmission line for any given input voltage, would be expected to yield the characteristics of waves that can propagate down a hollow tube in which there exists a coaxial electron beam. Of course, we shall have to take proper account of the fact that the space inside the shield is not filled entirely with air or vacuum but contains a core of moving space charge. Consequently, we shall have to add some equations from mechanics to relate the electric and magnetic forces to the accelerations of the electrons.

To understand how this core of moving space charge can serve as a medium for traveling waves of current and voltage requires giving some attention to the "elastic" properties of a region filled with space charge. Of course, space charge waves have been studied before in connection with plasma oscillations[7] and some of these concepts may be extrapolated to the case of electron beam waves. Consider a region filled with stationary space charges, as pictured in Fig. 4. Suppose that along C-C we apply an accelerating electric field as shown by the arrows for just an instant. The electrons in the region of C-C will be accelerated by the field and will tend then to "run into" the stationary electrons situated in their path say at D-D. The increasing density at D-D will produce an electric field acting

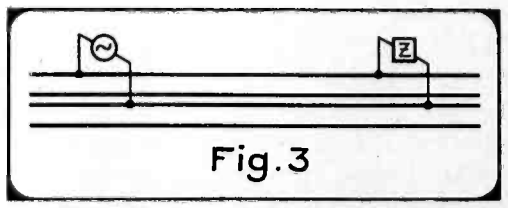

Fig. 3

on electrons beyond D-D at F-F. Thus the electric field impulse is transmitted through the region (although it may suffer some distortion) accompanied by a wave of charge density and velocity alterations in the space charge. Of course, there will also be a similar disturbance starting from C-C and traveling in the opposite direction to that which has been considered.

Consider now the cylinder of stationary space charge (forgetting for the moment how it might be obtained) pic-

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tured in Fig. 5(a) and suppose that at a certain time an electric impulse of short duration is applied at G-G. As we have already seen, this adds an increment of velocity to the electrons at G-G so that it could just as well have been said that a "velocity impulse" was applied at G-G. This velocity impulse must be divided up into two parts, each of which is associated with one of the two waves started at G-G and traveling in opposite directions. Accompanying the velocity impulse must be a density impulse with a less sharp wave front since the density can not alter instantaneously, having to wait until the electrons have had time to move from their initial positions. As a little consideration of the direction of field caused by a density impulse will disclose, the density impulses will have opposite signs when the velocity impulses have the same sign. This is pictured in Fig. 5(a) by showing the impulses already somewhat removed from their initial coincident starting points for clarity. The impulses

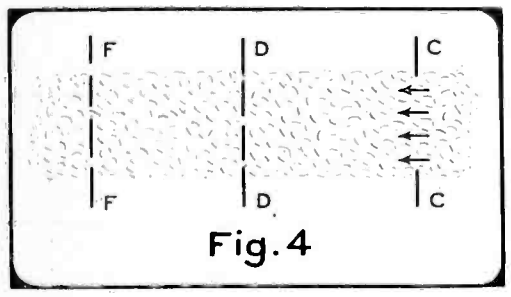

Fig. 4

traveling to the right are shown in full lines and those traveling to the left are shown dotted; the density impulses are shaded.

Fig. 5(b) shows the waves of Fig. 5(a) at some later time. (The distortion of the impulse has been conveniently overlooked). Now, we are interested in waves in a moving space charge region, which by virtue of its motion causes different sections of the region to receive alternate accelerating and decelerating fields at the gap. As a first step in approaching this actual situation, consider Fig. 5(c) in which a new impulse is shown as applied at J-J, but with the electric field and, therefore, the velocity impulse in the opposite direction to the earlier one. Fig. 5(d) shows a still later time in which the waves traveling to the right as the result of the second impulse have met with the waves traveling to the left as a result of the first impulse. Note that at the point of meeting, the velocity impulses cancel but the density impulses add.

It is easy to extend the above pictures to the case of a sinusoidal applied electric field such as pictured in Fig. 6. Here the stationary electron region is swept by the periodic electric field applied across the gap A-A between the two permeable conducting planes assumed to be moving with a much higher velocity than the waves it causes. As the gap A-A sweeps the beam it leaves behind a constant flow of many wave fronts, those traveling in the direction of the gap catching up with waves from later cycles traveling in the opposite direction. The result, as pictured in Fig. 6, is that in the trail of the moving gap will be regions alternately dense and rarified. Associated with the spacing between the points of optimum density will be a certain "wave length," this wave length depending partly on the frequency of the gap voltage but also upon the velocity of the gap and the parameters of the space charge.

Consider now an electron beam—in other words, a space charge region like that we have been studying, but in motion. We can retain the picture of Fig. 6 by simply making believe that the gap stands still and that the space charge moves. It will not be surprising then when in the next section we learn that the important characteristics of velocity-modulation tubes can be explained largely by the existence of two "space charge" waves; one travels forward with respect to an observer moving with the beam and the other travels backwards as seen by this moving observer. Of course, this so-called "moving observer" is simply that fellow who is still reading the last few paragraphs and thinks that the gap really is moving because to him the space charge appears stationary. But for a true observer who stands on the truly stationary gap, the space charge is in motion and the waves of the space charge are not seen as moving in opposite directions with equal velocity, but rather as two waves both traveling in the same direction as the beam, one wave exceeding the beam velocity and the other having a velocity less by approximately an equal amount than that of the beam.

The Small Signal Theory[5, 6]

The mathematical analysis of these waves assumes an infinitely long conducting cylinder containing an infinitely long coaxial homogeneous electron beam. By homogeneous it is meant that in the absence of signal the beam has everywhere the same density of electrons and the same velocity as well as the same cross-section. Actually, of course, such a condition is not strictly possible since quite apart from radio-frequency effects there are the d-c space-charge forces which would tend to make the voltage different at different parts of the drift tube and thus alter the structure of the beam along its length. This complication can be handled if desired, but it turns out that the lack of homogeneity due to d-c space-

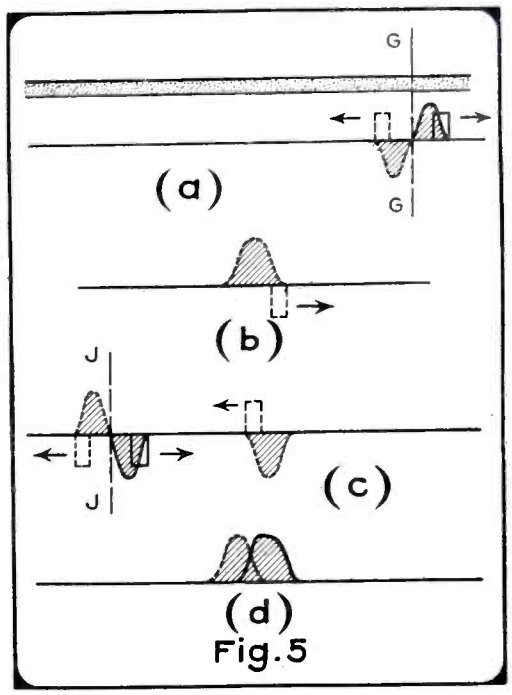

Fig. 5

charge effects is not very large anyway.[5]

It will be convenient to express some of the results of this analysis in terms of rotating vectors because of the familiarity of this method of expressing a-c signals to the engineer. As already stated, it was found that study of the performance of the velocity-modulation tubes becomes an investigation of the characteristics of the two slow space-charge waves which travel with nearly beam velocity. The two waves differ in one way by their velocities, one being faster and the other slower than the beam. This means that the faster wave does not undergo so much of a phase change in traveling a given distance as does the slow wave. Thus if the two velocity-modulation waves start out in phase at A-A in Fig. 7, by the time they have traveled to B-B the phase delay of the fast wave V_f will be less than the phase delay of the slow wave V_s.

One way in which the two waves differ then is in their phase velocities. Another important difference is in the phase angle that exists between the velocity modulation of a wave and the corresponding conduction-current modulation of that wave. For the slow wave these two modulations are in time phase. For the faster wave they are exactly 180 degrees out of phase.

In addition to knowing that two such waves can exist when once started and that if started they will travel down the tube without attenuation (if a perfect conductor is assumed for the shield) it is important to know just how much of each of the two waves is started at a gap by an ordinary signal-input system. Then, by knowing the amount of and the relative phase between each of the two waves, we can follow them down the tube to the output gap and discover how much current is induced by the

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waves in the output impedance. It is easy to see approximately how much of each wave must be started at the input gap by a given applied signal. The beam when entering the gap has no conduction current or velocity modulation. Just under the gap it feels the effect of

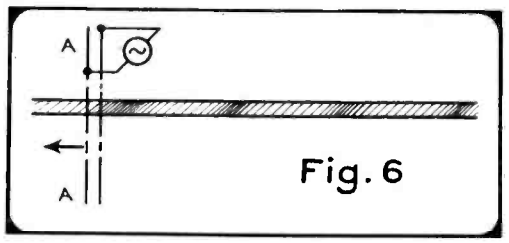

Fig. 6

the alternating electric field and the beam is velocity modulated. Just as it leaves the gap, then, it has a certain amount of velocity modulation, but the electrons have not yet had time to do any drifting from their previous relative positions so that the total conduction-current modulation existing in the two waves at A-A (Fig. 1) must be zero. This tells us that some of each of the two waves must have been started at A-A. There must have been such an amount of each and they must have had such phases that the sum of the two conduction-current modulation waves will give zero at A-A; moreover, the amplitude of the waves must be such that the two velocity-modulation components of the waves will be equal to the voltage applied across the gap at A-A.

This situation is depicted in Fig. 8. In this diagram it is also shown that because of the difference in the phase velocities of the fast and slow waves there will be some point along the tube at which the two velocity-modulation components, V_f and V_s, will just cancel and the conduction-current modulations, I_f and I_s, will add directly. There will evidently be recurring points along the tube for which this condition will again be true. These points are separated by a spacing of twice the "optimum drift tube length,"[6] i. e., the length of tube for which the ratio of conduction-current modulation to velocity modulation is maximum. This optimum drift-tube length is a function of frequency, beam velocity, beam current and the geometry of the tube. Methods for computing it have been given in earlier papers.[5, 6]

The conduction-current component of the wave at any point along the beam's length is the amount of current that is available for induction in the output impedance. (This is well explained in reference 8.) Thus from a knowledge of the amount of velocity modulation applied at any point of the beam and the wave characteristics we can compute the induced current in an impedance placed across a gap in the shielding cylinder at any other position along the beam. There are obviously many possible arrangements of input and output systems for all of which the transconductance is computable by the wave technique. It is important to note that even for small signals, the space charge places a limit on the transconductance by introducing the "optimum" drift-tube factor. After drifting the optimum length there is a decrease in the conduction-current modulation in the beam according to a sine-wave distribution through zero current and then through maximum again, etc.

Other Possible Traveling Waves in Electron Beams

There are other possible slow space-charge waves in addition to the single pair to which we have devoted most of our discussion.[9] In general we may speak of higher "order" and higher "rank" waves, of which the pair of most importance in velocity-modulation tubes is classified as of zero order and zero rank. By "order," we do not mean a time harmonic; the theory is concerned for the present only with the fundamental frequency in all waves. We refer, rather, to the order of the vibration as concerns variation of the vibration with azimuthal angle around the axis. The zero-order wave is one in which the vibration is symmetrical and this is the most important wave because symmetrical gaps are used which tend to start only symmetrical waves. A wave of first order is one in which different parts of the cross-section of the beam are out of phase with each other; if we examine the phase of the vibration with angle about the axis, we would find one complete cycle.

"Rank" also refers to distribution of vibration over the cross-section, but this time with radius rather than angle. Just as in the case of alternating-current distribution in a wire, the current at the

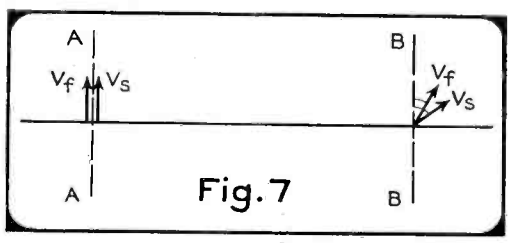

Fig. 7

center may be out of phase with the current at the surface, so it is possible to have higher "rank" velocity-modulation waves in which the outside of the beam has electrons traveling instantaneously faster than the average velocity while the electrons near the center may be traveling slower at that same instant than does the average. The zero "rank" wave is most important because the starting mechanisms that are being used are such as to deliver the accelerating field across the gap quite uniformly with respect to radius.

There are other possible waves in the electron beams which differ markedly from the slow space-charge waves we have been discussing. It is known that electromagnetic field waves will propagate down a single hollow conducting tube provided the frequency of the waves is sufficiently high. Tubes used in this way have been called "hyper-frequency wave guides."[11] We might expect that the addition of an electron beam along the axis of a wave guide will not prevent such waves from being possible, but will simply have a more or less marked effect on the wave characteristics, depending upon how much of the tube is filled with the space charge.

We may further recall, from Heaviside-Layer theory, for example, that an ionized region will allow the transmission of electromagnetic field waves in much the same way as does free space except that the apparent dielectric constant depends upon the density of the

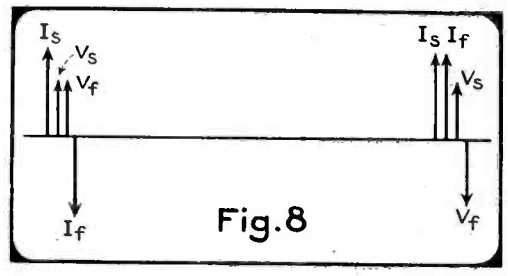

Fig. 8

ions. The motion of the beam being always quite small compared to that of light, these fast field waves will probably not be altered very much by that motion. Thus we should expect that the electron beam in our hollow conducting tube will simply act to the electromagnetic field like a medium of dielectric constant somewhat different from that of a vacuum and the problem is reduced to that of finding what kinds of waves can travel down a wave guide possessing a co-axial dielectric rod. These field waves have been analyzed and will not be given more description here since this particular type of wave is not very important in velocity-modulation tubes. (Even if they do exist in the tube, they are almost independent of the other more important waves of which we have spoken.) This is because for these fast field waves (phase velocities of the order of that of light) the wave energy is almost entirely in the electromagnetic field and little is in the kinetic energy of the electrons. As a means for transmitting energy from one end of a tube to the other, the field waves, if the frequency is high enough, will be as

(*Continued on page* 24)

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Fig. 6. A view of the car showing the separate transmitting and receiving antennas.

Note the "Voice of Safety" speaker mounted on top of the car.

A MOBILE POLICE TRANSMITTER

INTRODUCTION of new tubes having instant-heating thoriated-tungsten filaments permits the design of transmitters which require no power during stand-by. The new Hytron HY69 and HY31Z tubes permit designs in mobile equipment which have high operating efficiency plus increased power output.

While the use of thoriated-tungsten filament tubes is not new for power-line operated transmitters, their use is new in mobile applications. Of outstanding importance is the fact that the filament power drain for these instant-heating tubes is low. Through the use of new manufacturing processes and technique, it has been proved practical to use a 6.3-volt filament having a 1.5-ampere rating where a total emission capability of up to 120 ma may be required in r-f applications. Although similar filaments have been incorporated in triodes, the HY69 and HY31Z are the first beam tetrodes and twin triodes specifically adapted to mobile communications.

As the outstanding feature of a transmitter having instant-heating type tubes, is reduced filament drain; it is naturally essential that the reduction in battery drain during stand-by is not offset by greatly increased filament drain during transmission periods. In the case of the HY69 tube, a filament drain of 1.5 amperes is required as compared with 0.9 amperes for the cathode equivalent HY61/807 tube. This increase of 0.6 amperes during transmission is inconsequential.

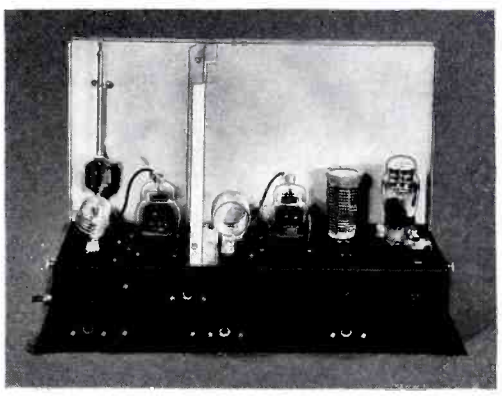
The zero-bias, twin triode, HY31Z tube likewise has an instant-heating thoriated-tungsten filament. This tube was designed specifically for modulator applications, since when filament type tubes are employed, the use of bias may somewhat complicate the circuits. Previous instant-operation transmitters have employed HY69 tubes in push-pull, but the plate circuit efficiency is considerably lower than when the Class B tube is used and also provision for bias must be made.

Another feature of the Hytron HY69 tube is that it has a plate dissipation rating of 40 watts as compared with 25 watts for the equivalent cathode type HY61/807. The higher plate dissipation means that the tube will deliver approximately 50% more output when 100% modulated than the cathode type, since the capability of the tube is not limited by plate dissipation when the HY69 is employed. Accordingly, the HY69 is to be recommended for replacing the cathode-type tube when greater power output is required.

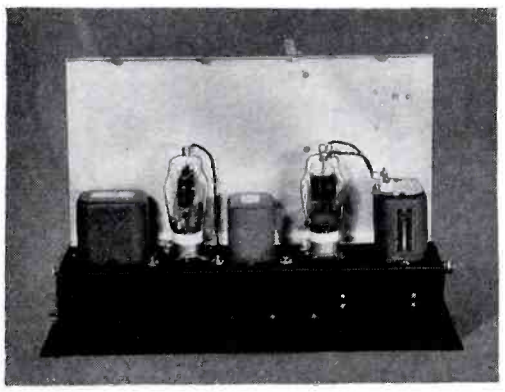
The A69-1 radiotelephone transmitter, as it is known, was designed by the Experimental Radio Division of the Hytron Corporation at the request of the Salem (Mass.) Police Department. In view of the very hilly nature of certain outlying parts of Salem, reliable communication was difficult in some locations. The use of this new transmitter, having a power output of approximately double that of previous equipment, has eliminated all dead spots.

As it will be noticed from the illustrations, care and attention have been given to lay-out and construction. The apparatus has been arranged and wires and cables so placed that utmost accessibility of parts and freedom from interruptions and service result.

Economy of operation and of maintenance are factors which make this transmitter desirable for mobile applications. Among these factors are low power consumption and low tube cost; a total of only 5 tubes being necessary to provide 42 watts 100% modulated r-f power output and 35 watts audio power output for public address. A particular advantage of this amplitude-modulated transmitter is that audio power is available for the "voice of safety."



Above: Fig. 1. Top-side view of r-f channel. Note adjustable link (left) which slides inside final amplifier tank coil. Below: Fig. 2. Top-side view of a-f channel.



Electrical Circuit

A low temperature co-efficient quartz plate is used in connection with a Hytron 6A4 as an orthodox pentode oscillator. The 6A4 tube, which has an oxide-coated filament, comes up to operating temperature somewhat slower than the HY69 but still as rapidly as the motor generator comes up to operating speed.

As shown in the accompanying circuit diagram, this oscillator is capacity-coupled to an HY69 tube used as a frequency quadrupler. A quadrupler was employed rather than a tripler since the manufacturers of crystal find it preferable to use a crystal having a lower frequency as the stability and temperature co-efficient is superior. The HY69 tube performs efficiently as a quadrupler and the power output is more than adequate to drive the final amplifier.

So as to increase the efficiency of the quadrupler tank circuit, a split-stator condenser was employed and the grid to the final tapped at the opposite end from the quadrupler plate. The split-stator circuit and method of coupling more or less balances the capacity from each side to ground. If both the plate and grid were tied to the same end of the tank circuit, a definite unbalance would result.

The final amplifier is an HY69 operated as a Class C r-f amplifier with both the plate and screen circuit modulated.

While the transmitter is designed to operate at any frequency within the band of 30 to 41 megacycles, coils and condensers for other frequency ranges up to 60 megacycles can be used. By choice of coil and condenser combinations, various bands can be covered by using the second stage as a straight amplifier, power doubler, power tripler, or power quadrupler. The final amplifier stage requires but 3 ma d-c grid current and the r-f shielding of the tube is complete so that neutralizing is not necessary at frequencies up to 60 megacycles, the highest frequency at which maximum rated input to the plate of the tube is allowable.

Control System

Of interest is the system of controls incorporated in the transmitter. When the microphone is lifted, a relay controlled by the hook switch automatically turns on the filaments and primary to the plate supply generators. Push-to-talk operation is achieved through the use of a relay connected up with the push button on the

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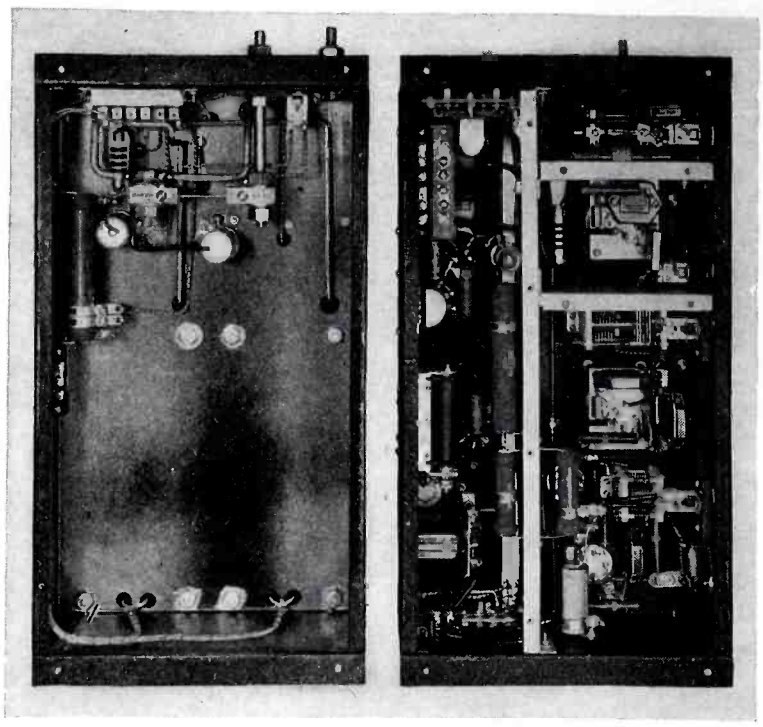

Fig. 3. Bottom views of the power-supply chassis (left) and r-f and a-f chassis. Note shielding between stages and location of parts in accessible positions. Terminal strips with movable links are provided so that the circuits can be properly changed when battery polarity is reversed.

microphone. This particular relay closes the secondary circuits of the motor generators and applies the plate potentials to all tubes.

When it is desired to operate the "voice of safety" feature, a switch is thrown which automatically shuts off the primary power to the r-f plate supply and the filaments to the r-f tubes. Another relay operated by this same switch changes over the modulator output from the r-f amplifier to the loudspeaker. Since considerably less than the full power output is necessary to operate a loudspeaker, another relay switches in a separate volume control which attenuates the audio level to the desired degree. In this way, two separate audio levels are automatically maintained, one for transmitting and one when using the "voice of safety" public-address system.

The power supply shown in the accompanying photographs is comprised of two genemotors, each filtered and supplied with a starting relay. In order to isolate the r-f amplifier from varying potentials during modulation, it was deemed desirable to have a separate plate supply for the modulator. Also, it eliminates the need for dropping a higher Class C amplifier voltage to the required value of the modulator. A further advantage which has already been explained is that only the modulator plate-supply genemotor is in operation when the transmitter is employed as a public-address system.

On the underside of the power supply, it will be seen that all connections are made to the genemotors with ¼" copper rod. This, along with an exceptionally heavy cable, have been used so as to minimize the voltage drop from the battery to the generators and tube filaments. The voltage drop is approximately 0.1 of a volt. Since the HY69 and HY31Z tubes are actually centered for 6-volt operation, a filament potential as low as 5.7 volts (—5%) can be tolerated. It has been found from repeated measurements that when the battery is capable of delivering the required 50 to 75 amperes, it has a terminal potential of approximately 6 volts.

To help make adjustments to check the operation of the transmitter, meters are provided which permit the technician to read the primary amperage (shunt in power supply unit) and all necessary currents to the various tube elements. For protection of these meters and to prevent loss of the tuning tools, a small wooden cabinet is used which houses these important accessories.

Description

Equipment

Two 17" wide x 10" deep x 13" high, steel 14-gauge cadmium-plated black crackle-finish cabinets—one housing the entire power supply, the other the complete audio and r-f units. Both units are dust and moisture proofed.

Connection cables and remote-control switchbox. Hanger-type microphone of heavy-duty communications service type.

Muting relay for receiver for duplex operation of radiotelephone.

Primary Power

The A69-1 transmitter is designed to operate from 6-8 volts direct-current source capable of supplying at good regulation, a maximum instantaneous peak input of 500 watts. The average input power requirement at 100% modulation is approximately 300 watts. The transmitter can be changed over for 12-volt operation by using tubes and dynamotors designed for 12-volt operation. For 12-volt operation, types HY1231Z and HY1269 tubes are used.

Output

The nominal output rating of the transmitter is 36 watts to comply with FCC established methods of measuring power at the antenna, whereas the measured power output into a dummy load approximates 42 watts. These figures approximate 60 and 70% efficiency, respectively.

In addition, provision is made in the transmitter to supply up to 35 watts of audio from a high-level, single-button microphone of low-impedance input source, such as a phonograph pick-up or tuner. For modulation purposes, approximately 35 watts of "Class B" audio is developed. Relay switching selects both input and output circuits for the audio channel for use as a modulator or audio amplifier.

Installation

The transmitter and power supply can be mounted side by side, end to end, or one above the other, provisions being made for variable lengths of connection cables. The arrangement of tuning controls for operation gives complete access to the apparatus and eliminates the hazard of damage to the cabinets or controls during installation. Provision must be made for heavy-duty battery connection leads and suitable bonding to establish good grounds.

The antenna connection lead is brought out at such a point to make convenient, connection to any standard whip antenna mounted from the trunk body of the car or cabin bulkhead. Dimensions of each unit are 17" wide, 10" deep, and 13" high. One-inch mounting flanges are used, weighs approximately 115 lbs. complete.

Control System

Toggle, hanger and push-button switches control the application of power through remote control by means of relays. All controls can be conveniently located for coordination of transmitter and receiver in any particular application. The incorporation of the instantaneous-heating filament-type tubes make time delay for cathode preheating unnecessary.

Electrical Characteristics

Frequency Response

Essentially flat within +2.0 db from 100 to 5000 c-p-s with pre-emphasis above and below these frequencies. Audio tone compensation for high-frequency cut-off is incorporated in the speech amplifier circuit.

Typical measurements of r-m-s audio-frequency harmonic distortion show less than 5% total within the specified fre-

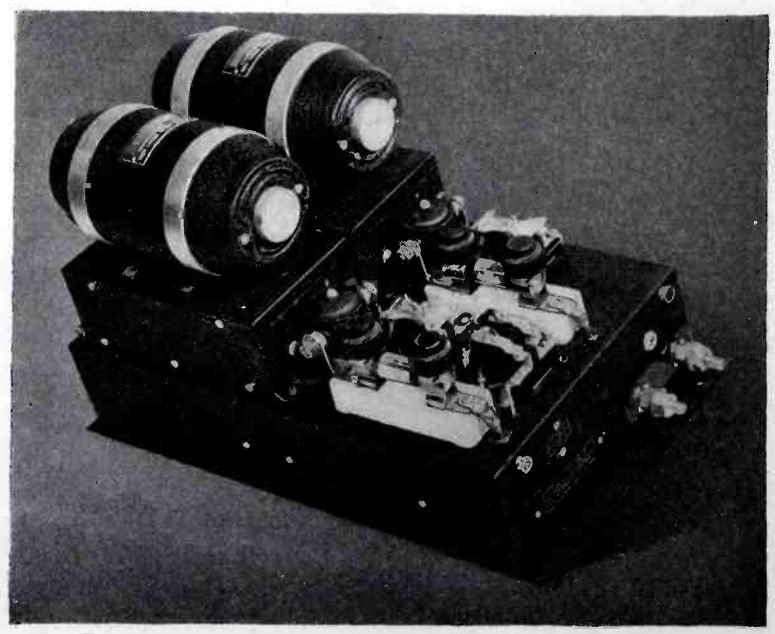

Fig. 4. The top-side view of the power-supply chassis showing the two filtered motor generators with starting relays and associated relay controls.

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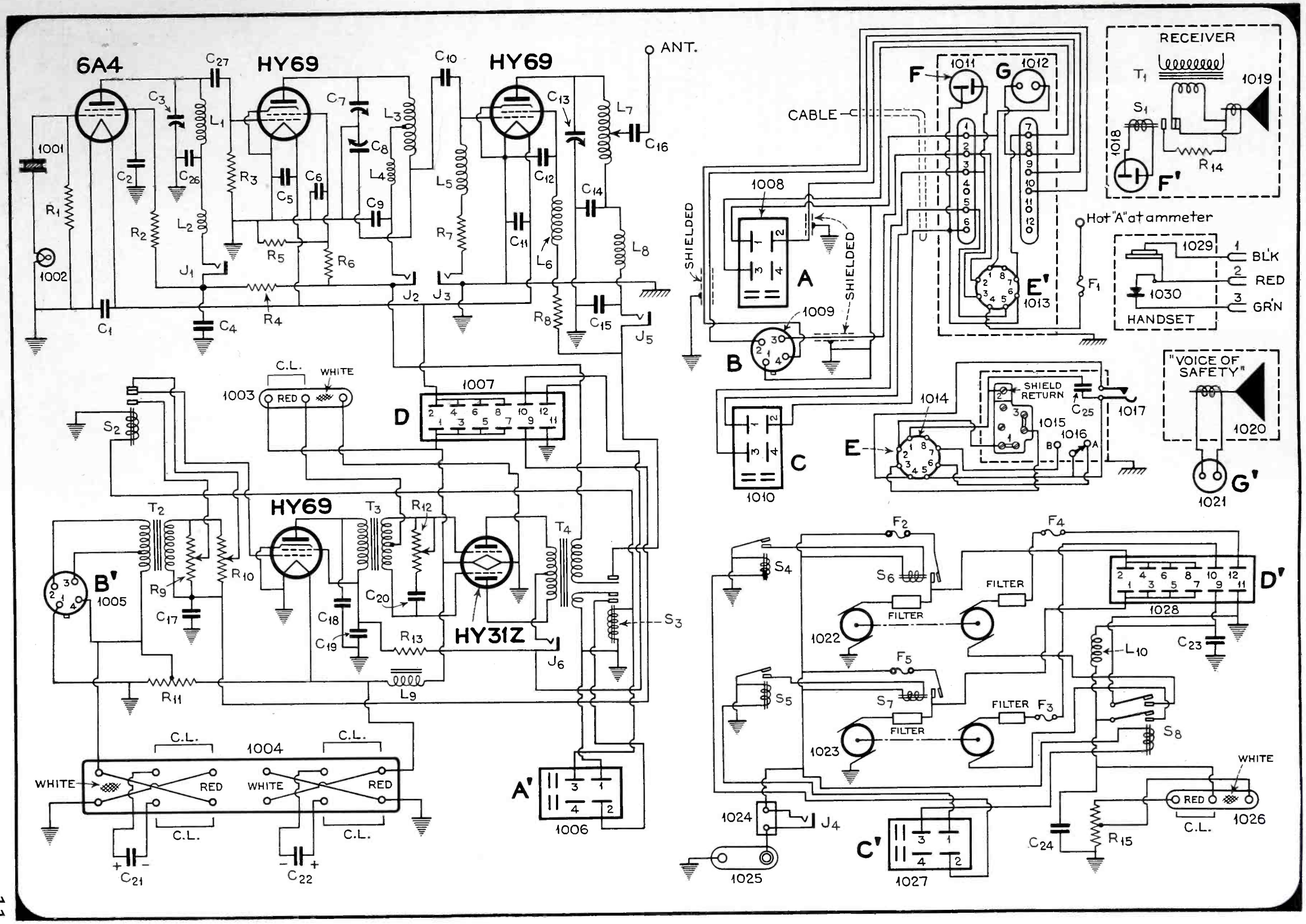

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quency range and less than 10% between 30 and 7000 c-p-s.

Audio Channel

The modulated amplifier is designed to carry over modulation peaks without a sharp increase in distortion and with absolutely no damaging effect to circuit components or tubes. With normal input signals, 100% modulation is afforded.

Noise Level

The r-m-s noise level is 60 db or better unweighted, 70 db weighted, below signal level at 100% modulation using a sine wave audio signal.

Harmonic Radiation

No radio-frequency harmonic greater than 0.03% (voltage) of the fundamental is radiated. This corresponds to better than 70 db below the output in the fundamental frequency.

Frequency Stability

The carrier frequency is maintained well within +.03% of the specified frequency between ambient temperature limits of —10° C. and +50° C. The exact frequency stability depends upon the value of multiplication of the crystal frequency.

Antenna Coupling

Variable coupling to the final amplifier tank coil is accomplished through a contactor capable of operating through 50% of the tank coil inductance.

A number of antenna coupling arrangements are available.

(1) Direct connection with the antenna coupling unit to a single, shunt-fed or series-fed (20 ohms or more) radiator; tuned or untuned to carrier frequency.

(2) Coupling through a co-axial transmission line or an unbalanced open-wire line to a shunt or series-fed radiator; tuned or untuned to carrier frequency.

(3) Coupling through two co-axial transmission lines to a two-element directive array involving shunt or series-fed radiators (phase shifting and current ratio adjusting equipment must be provided separately).

(4) Coupling to a line branching and phase-shifting element for multi-element antenna arrays.

Mechanical Characteristics

The Hytron A69-1 radiotelephone transmitter follows the modern practice where simplicity of control and accessibility of parts have been developed. All electrical components are assembled on the central structure of laterally-mounted etched alloy plates and are free of complexity of arrangement from the underside of the chassis. The central structure, both above and below the chassis deck, provides all necessary shielding. Much consideration has been given to the design, especially in the matter in which the apparatus is mounted, so as to permit quick removal and replacement of a component when necessary. Each component is easily accessible for servicing without interferring with any other associated part. Practically all wiring is on flat surfaces where each wire is easily accessible.

Both the top-cabinet cover and bottom-chassis cover are supplied with standard self-locking nuts for quick removal of the covers and assurance of freedom from loosening through vibration.

All tuning and operating controls are mounted in front, with the exception of the two audio level controls and the audio tone compensator, which are accessible from the top surface of the chassis deck. In all cases, the controls are directly coupled to

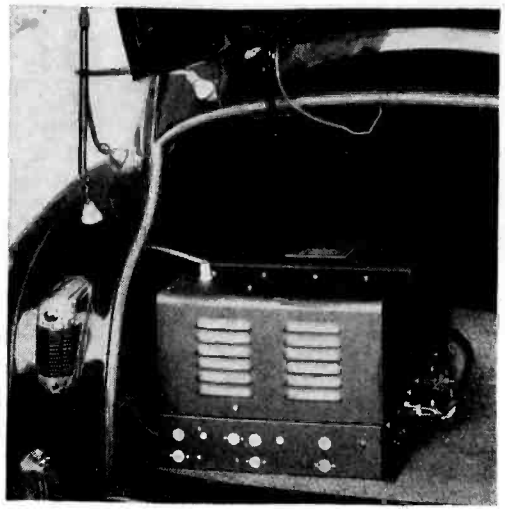


Fig. 5. Installation of transmitter in rear trunk of police car. R-f unit directly grounded to chassis below antenna with flexible strap.

the associated apparatus and are provided with self-aligning adjustment tools. Metering jacks for all critical circuits necessary for tuning of the transmitter are also provided on the front panel and the necessary test meters and tuning tools provided.

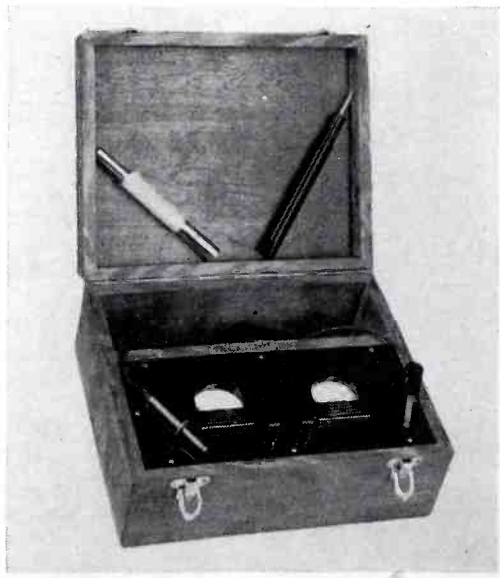
The controls are divided into three groups according to their function and a special tool is necessary for the tuning of each group in order to eliminate confusion. A group of controls, consisting of the plate tuning circuits for the oscillator, frequency multiplier, and final amplifier, are tuned and locked through openings provided in the front panel. Another adjustment consists of the variable coupling link to the first amplifier tank coil which is accessible through the dust cover and is adjusted using a special insulated wrench provided.

Power Supply

Two separate heavy-duty dynamotors are utilized for converting primary power from low voltage to high voltage for plate supply. One dynamotor supplies power for the audio channel and the second for the radio-frequency portion of the transmitter.

These dynamotors are constructed in such fashion as to insure the minimum wear and to prevent, through normal use, electrical or mechanical failure. All bearings are double sealed, grease-packed ball-

Fig. 7. Provisions are made for measuring the primary amperage and current in all important circuits with the equipment shown below.



bearings and, under normal use, do not require servicing oftener than every 1,000 hours. Brush inspection and cleaning is recommended every 200 hours of service.

Ventilation of the power supply is afforded through louvres provided in the metal cabinet and air propulsion is supplied by fans built into the armatures of the dynamotors. Ventilation of the transmitter unit is afforded by convection of air currents through louvres provided in the top cabinet cover.

Polarity Reversal

Inasmuch as the positive terminal is grounded in some automobiles while the negative in others, provisions have been made in the transmitter to take care of all situations.

After the polarity of the primary power supply has been determined, the jumpers on the color-coded terminal blocks should be properly connected. Terminals indicated by red dots are joined together when the positive terminal of the battery is grounded and terminals marked with white dots are connected together if the negative terminal of the battery is grounded. Also, provisions are made inside the motor generator filter box for reversing its polarity. Naturally, once the proper connections are made, they need not be disturbed unless the transmitter is re-installed in a car having other polarity connections.

In actual field tests in Essex County, Massachusetts, this transmitter was found to provide great range. The A69-1 transmitter, when operated at 50-watts input, provided communication over a distance as great as 30 or 40 miles airline through hilly country. In fact, the signal from the car when it was operated in Salem was sufficient to disturb communications in Cambridge, a city from 15 or 20 miles airline. Accordingly, the power input to the transmitter was reduced considerably below that allowable on the license. With this reduced power, the transmitter still provided adequate signal throughout the city of Salem.

PARTS LIST

Capacitors

C1—.002 mfd. 600 v.—Cornell-Dubilier 1W-5D2
C2—.002 mfd. 600 v.—Cornell-Dubilier DT-6D2
C3—75 mmfd.—Cardwell #EU75ASP
C4—.25 mfd. 600 v.—Cornell-Dubilier DT-6P25
C5—.002 mfd. 600 v.—Cornell-Dubilier 1W5D2
C6—.002 mfd. 1200 v.—Cornell-Dubilier 9-22020
C7 C8—Dual 50 mmfd. per section—Cardwell EER50ADP
C9—.006 mfd. 1200 v.—Cornell-Dubilier 22060
C10—.00005 mfd. 2500 v.—Cornell-Dubilier 4-54050
C11—.002 mfd. 600 v.—Cornell-Dubilier 1W-5D2
C12—.002 mfd. 1200 v.—Cornell-Dubilier 9-22020
C13—30 mmfd.—Cardwell ET30ASP
C14—.006 mfd. 2500 v.—Cornell-Dubilier 9-52060
C15—.002 mfd. 2500 v.—Cornell-Dubilier 9-52020
C16—.02 mfd. 2500 v.—Cornell-Dubilier 9-51020
C17—.1 mfd. 400 v.—Cornell-Dubilier DT-4P1
C18—.001 mfd. 1000 v.—Cornell-Dubilier MD-12D1
C19—8 mfd. 500 v.—Cornell-Dubilier B2-850
C20—.05 mfd. 600 v.—Cornell-Dubilier DT-6S15
C21—250 mfd. 25 v.—Cornell-Dubilier Special
C22—1000 mfd. 12 v.—Cornell-Dubilier Special
C23—40 mfd. 150 v.—Cornell-Dubilier Special
C24—250 mfd. 150 v.—Cornell-Dubilier Special
C25—.1 mfd. 400 v.—Cornell-Dubilier DT-4P1
C26—.002 mfd. 600 v.—Cornell-Dubilier DT-6D2
C27—.00005 mfd. 800 v.—Cornell-Dubilier 1WP

Resistors

R1—50,000 ohms 2 watt—I.R.C. Type BT-2
R2—50,000 ohms 2 watt—I.R.C. Type BT-2
R3—100,000 ohms 2 watt—I.R.C. Type BT-2
R4—7,500 ohms 25 watt—I.R.C. Type DHA
R5—50,000 ohms 2 watt—I.R.C. Type BT-2
R6—250,000 ohms 2 watt—I.R.C. Type BT-2
R7—25,000 ohms 2 watt—I.R.C. Type BT-2
R8—25,000 ohms 25 watt—I.R.C. Type DHA
R9—250,000 ohms volume control—I.R.C. Type CS 13-130
R10—250,000 ohms volume control—I.R.C. Type CS 13-130
R11—100 ohms tapped at 30 ohm 10 watts—I.R.C. Type ABA
R12—100,000 ohms tone control—I.R.C. Type CS 13-128

(*Continued on page 33*)

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APCO CONVENTION

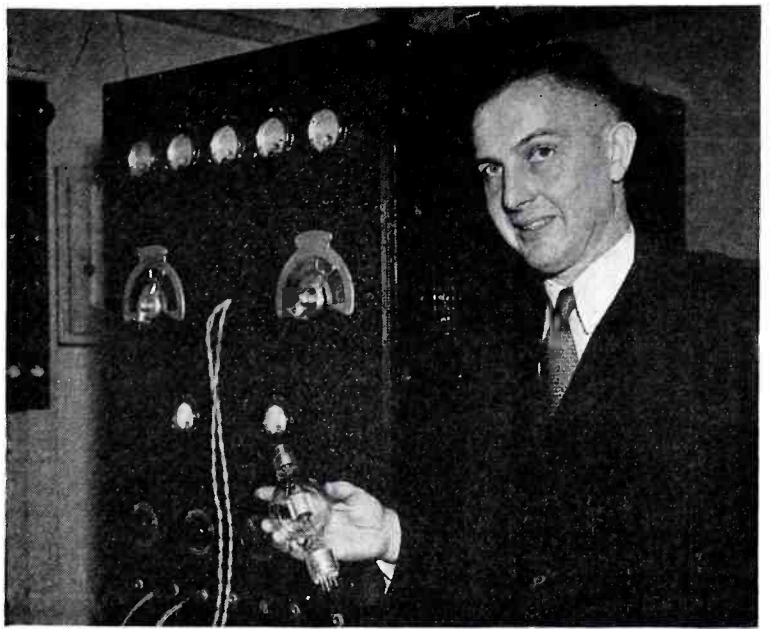
Orlando, Fla. Dec. 2, 3, 4, 5

WHEN, on December 2, 3, 4 and 5 the Associated Police Communication Officers, Incorporated, convenes at the Colonial Orange Court Hotel in Orlando, Florida, for its Seventh Annual National Conference, the occasion will mark a period of fifteen months of intensive activity under President Herbert F. Wareing, who is the Radio Supervisor for the Milwaukee, Wisconsin, Municipal Department.

The unusual length of the present administration having been occasioned by the establishment of the late date of the conference, in deference to the desire of the organization that the body convene in the Sunny Southland has served to provide a period of exceptional activity, which has been high-lighted by several important factors.

Chief among these factors has been the intensive increase in interest, not only in the organization, but in the profession generally through the highly impressive issues of the monthly *A.P.C.O. Bulletin,* which is now concluding its second year of piloting under the capable hand of Captain J. M. Wherritt, Communications Officer of the Missouri State Highway Patrol, at Jefferson City, Missouri.

Herbert F. Wareing, Radio Engineer, Police Department, Milwaukee, Wisc., President APCO.



Charles B. McMurphy, Radio Technician, Sheriff's Office, Alameda County, California, First Vice-President APCO.

Much credit for this improved trade publication must go also to Sergeant J. W. Bryant, of the Headquarters Staff of the Missouri Patrol, for his own unceasing efforts toward the promotion of the welfare of the profession generally, while serving as the Chairman of the all important Operating Proceedures Committee of the organization.

Above: J. M. Wherritt, Captain, Officer in Charge, Radio Division, Missouri State Highway Patrol, Editor *APCO Bulletin.*

Below: Frank W. Morrow, Sergeant, Chief Communications Officer, Indiana State Police, APCO Secretary-Treasurer.

Through the pages of this monthly journal of the police communications field there have been disseminated scores of articles upon vital points of interest, not only to the radio operator, or his chief, but to men in all phases of the field as well.

Also, in the past year, the National Offices of the Association, located at Room 126 in the State House at Indianapolis, Indiana, in the very heart of one of the largest police communications services in the nation, have become a center for hundreds of questions, and scores of visitors, from all parts of the nation. Sergeant Frank W. Morrow, Chief Communications Officer for the Indiana State Police, serving his second term as Secretary-Treasurer of the organization, has devoted many hours each week to the service of the organization.

Here too is located the Chairman of one of the most important Committees, the Engineering Report and Research group, in the person of Arnet A. Curry, Chief Transmitter Engineer for the Indiana State Police, who has accumulated a wealth of data and information for the future structure of the profession.

Robert L. Batts, former A.P.C.O. President and present Chairman of the vital Frequency Allocations Committee group, is also located in Indianapolis, where, as Deputy Inspector in Charge of the Municipal Police Communications service, he has been in position to maintain an active hand in the program.

Truly, in 1939-40 the Administrative Officials of A.P.C.O. have carried out the mandates of both the Houston, Texas,

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and the Kansas City Conferences, by "providing business-like programs for the Association."

During this period, there have been added to the already imposing list of A.P.C.O. accomplishments, which included:

(a) Formulation of distinctive organization for the advancement and planned progress of all forms of the profession of police communications.

(b) Coordinated efforts of town-city-county-state, and Federal law enforcement communications services.

(c) Conception and planning of the vitally necessary "National Police Radio-telegraph Service."

(d) Cooperation with officials of the F.C.C. in the selection of frequencies and the preparation of a manual of operating proceedure for the new cw service.

(e) Obtaining official extension of time, for systems not yet prepared, in matter of starting use of the cw service.

(f) Participation, with more than thirty representatives, headed by Captain Donald S. Leonard, Chairman of Communications Committee of the International Association of Chiefs of Police, in the informal "All Services" Conference at the F.C.C. offices in Washington in 1936.

(g) Collaboration with F.C.C. Engineers in the Conferences preparatory to the Havana and Cairo International Conferences, where highly important frequency shifts were agreed upon.

(h) Representation of police operating personnel at conferences with F.C.C. regarding new rules and regulations pertaining to the term and procurement of radio operator's licenses and permits. Effectively secured the five year license term, and other points favorable to the efficiency of the art.

(i) Proposal of re-draft and revision of the radio-telegraph proceedure manual, which had become inefficient through progress of the service. This redraft later approved and published by the F.C.C.

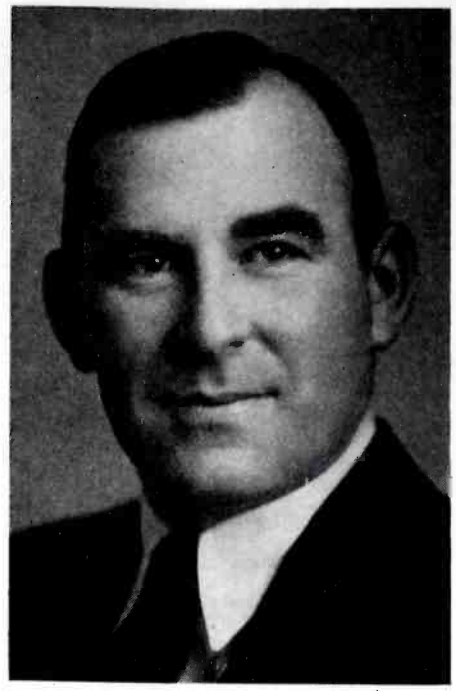
(j) Incorporation of Organization, with establishment of National Offices, and strengthening of structure of the Association.

(k) Issuance of National Survey Questionnaire, to 1500 departments, with replies and information still being received and filed at the National Office.

(l) Approval of frequencies for the cw service to replace group released to amateurs under Havana Agreement.

(m) Proposal of numerous revisions of rules and regulations of the F.C.C., chiefly those covering radiophone operations.

(n) Successful promotion of campaign to relax the provisions of the "Telephone Relay" rule, to provide a practical basis for carefully regulated



D. C. Bailey, Communications Officer, Police Department, Tampa, Florida, APCO Sergeant-at-Arms.

"Relay Channels" or "Routes" to improve the police service generally.

(o) Proposal of preparation of a standard manual of radio-telephone operating proceedure, to be published after approval by I.A.C.P. and the F.C.C. and the Organization instructed to prepare suggested form for same.

(p) Collaboration, through Secretary-Treasurer, with the State Police Executives section of I.A.C.P. in studies relating to the development of the State Police and Highway Patrol Communications.

(q) Formation of chapter organizations under the parent Association, in an effort to encourage the stimulation of local effort in each state or area of the nation.

(r) Preparation, and official presentation, to the F.C.C. of protests against the assignment by that body of any frequency allocated to the Police Services to any interest other than stations and (or) systems owned and operated by a duly authorized governmental body or subdivision. This specifically applied in instance of two applications for construction permits on police frequencies by a commercial radio burglar alarm system.

(s) Through efforts and accomplishments in past years of operations occasioned the enactment of resolutions in States and in the National Conventions of the International Association of Chiefs of Police and the Federal Communications Commission commending such services rendered, and approving the program for the future.

Now, as the A.P.C.O., prepares for its journey down into the deep Southland, its members and executives face a program of gigantic proportions, and perhaps the most important sessions in the history of modern police communications.

The fact that the organization is officially recognized by both the Federal Communications Commission and the International Association of Chiefs of Police have been factors for inspiration and progress of its every ideal.

Among those subjects and features tentatively set for the Orlando Conference, as prepared by President Wareing, Secretary Morrow, and James E. Virden, Supervisor of Radio in the Host City Police Department, and Convention Committee Chairman, are:

1. *Frequency Modulation*—With a specially prepared two hour address by Professor Daniel E. Noble, who has recently completed the new f-m system for the State of Connecticut.

2. *Revision of A.P.C.O. Constitution*—This is a most important feature, as the efficiency of future operations hinges upon the character of this work.

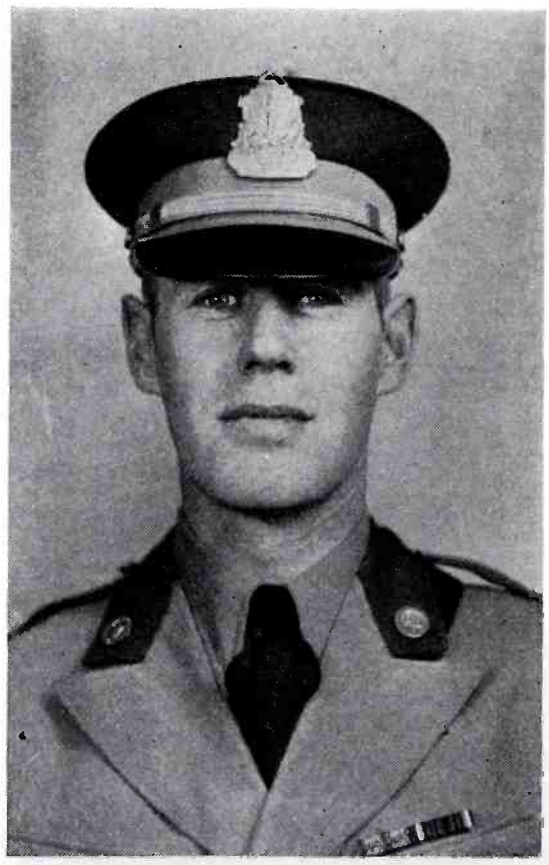
3. *The Police Communications Services—the National Defense*—In all probability this subject will be treated by Staff officers of both Army and Navy.

4. *The F.C.C. and the Police Services*—E. M. Webster—Asst. Chief Engineer, Federal Communications Commission.

5. *Police Communications and the I.A.C.P.*—Captain Donald S. Leonard, 1st Vice-President I.A.C.P. and Chair-

(*Continued on page* 23)

Martin W. Joyce, Lieutenant, Officer in Charge of Communications, Massachusetts State Police, Second Vice-President APCO.



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Speech Power for

POLICE COMMUNICATION WORK

By DOUGLAS FORTUNE
Thordarson Electric Mfg. Co.

IT is the purpose of this article to discuss speech operation of the popular 6A6 tube with a view to obtaining approximately 40 watts of peak power for police car transmitter use. This is in line with the recent RCA information on the intermittent commercial application of tubes, which states that it is permissible to increase the plate voltage somewhat above normal in order to obtain maximum power output for minimum size and weight such as that required for police car transmitter use. A small tube operated with the intermittent ratings will, in the case of police work, better meet the requirements than a larger tube operated with the normal ratings. Although no specific mention of the 6A6 was made in the RCA information, nevertheless it seems logical to assume that this tube may be operated at 400 volts since it is used quite extensively in amateur work where it is plate modulated at 300 volts and under these conditions subjected to peak voltages of 600 volts.

Modulator Requirements

The principal requirement of the modulator is that it deliver a peak power equal to the input of the Class C modulated stage for 100 per cent modulation. This statement holds true regardless of the wave form of the modulating voltage. Since the standard wave form for designating power is the sine wave in which the average power

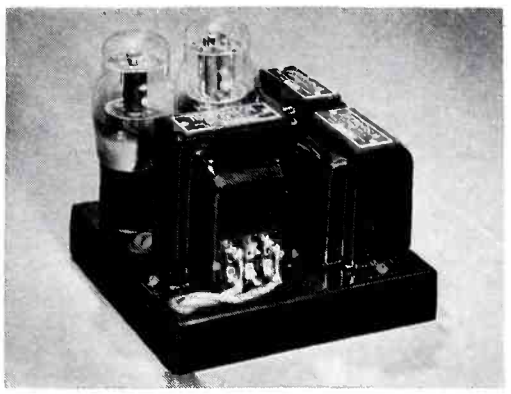

Fig. 3. View of unit described in accompanying text.

is one-half the peak power, this has given rise to the popular statement that the required audio power for 100 per cent modulation must be one-half the Class C input. It must be borne in mind, however, that this statement is true only for the sine wave: it is not correct for wave forms such as speech or any wave form different from the sine wave. The average power for 100 per cent modulation may be more or less than one-half the Class C input and in the case of speech the average power is considerably less than one-half the Class C input.

Speech Versus Sine Wave

The speech wave form is entirely different from the sine wave. The speech wave, for the purposes of measurement, may be considered equal to two simultaneously equal amplitude tones of different frequencies having a total amplitude equal to that of the sine wave with which the speech is being compared. This in effect means that the speech wave has only one-half the average power of a sine wave of the same amplitude. The required average speech modulator power for 100 per cent modulation is then one-quarter the Class C input. This does not mean, however, that an audio power of 10 watts based on sine wave calculations will modulate an input of 40 watts 100 per cent. It does mean, however, that a modulator capable of 10 watts of sine wave power may, by proper adjustment and operation, 100 per cent speech modulate an input of from 30 to 40 watts.

Modulator Considerations

The limiting factors in determining the peak power output of a modulator are average plate dissipation and peak plate current. The average plate dissipation for a given amount of peak power is determined by the wave form of the applied signal. Since the average power of speech is only one-half that of the sine wave on which the modulator design was originally based, it follows that for a given amount of peak power the average plate dissipation of the modulators is only one-half the permissible value. The modulator may then

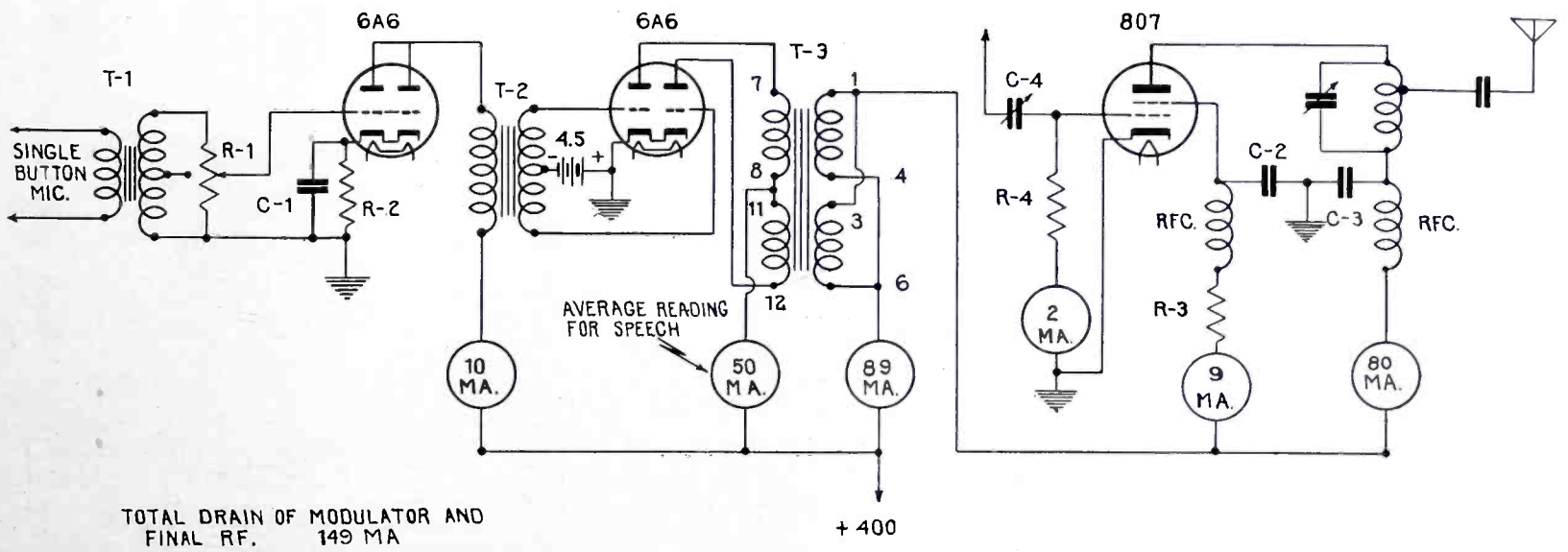

Fig. 2. Circuit diagram of the unit.

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be adjusted until the plate dissipation approaches the permissible value, provided of course, that the peak current does not become excessive. This will give considerably higher peak power for a given amount of average plate dissipation.

In a Class B modulator there are two ways of obtaining higher peak power, one is to simply reduce the plate-to-plate load, the other, to increase the plate voltage at the same time adjusting the plate-to-plate load. The first method of decreasing the plate-to-plate load has the disadvantage that power output is rather limited for a given amount of driving power. However, by increasing the plate voltage and by adjusting the plate-to-plate load a considerable amount of peak power may be obtained with a reasonable amount of drive.

Class B Peak Power Calculations

Peak power is developed in a Class B modulator circuit by virtue of the peak current which flows through the Class B load. It can easily be seen from this that for a given amount of plate voltage the lower the plate-to-plate load the higher the peak current and consequently the power output. However, since the lowering of the plate-to-plate load requires considerably more driving power, which is also a consideration in an over-all economical design, the best solution is to increase the plate voltage and adjust the plate-to-plate load accordingly.

Before giving the necessary calculations for higher peak power it may be well to review the normal Class B operating conditions. These calculations will be given for the normal operating condition of the 6A6 and afterwards, for higher peak power. The normal conditions of operation for the 6A6 are as follows:

Plate voltage.....300 volts
Average plate dissipation..10 watts
Plate-to-plate load.....10,000 ohm
Power output.....10 watts

The plate family of curves for the 6A6 is shown in Fig. 1. The normal load line is shown at AB and is one-quarter the plate-to-plate load, or 2,500 ohms. One end of the load line is placed on "300 volts" (point B), and the other is determined on the plate current line by dividing 300 by 2,500 or 120 ma at point A. The load line AB gives the instantaneous relationship between the voltage across the load and the voltage across the tube. In other words, at point C where the grid voltage is +30 the voltage across the load had a peak value of (300 — 80) or 220 volts. Similarly the peak plate current at the same point is approximately 86 ma.

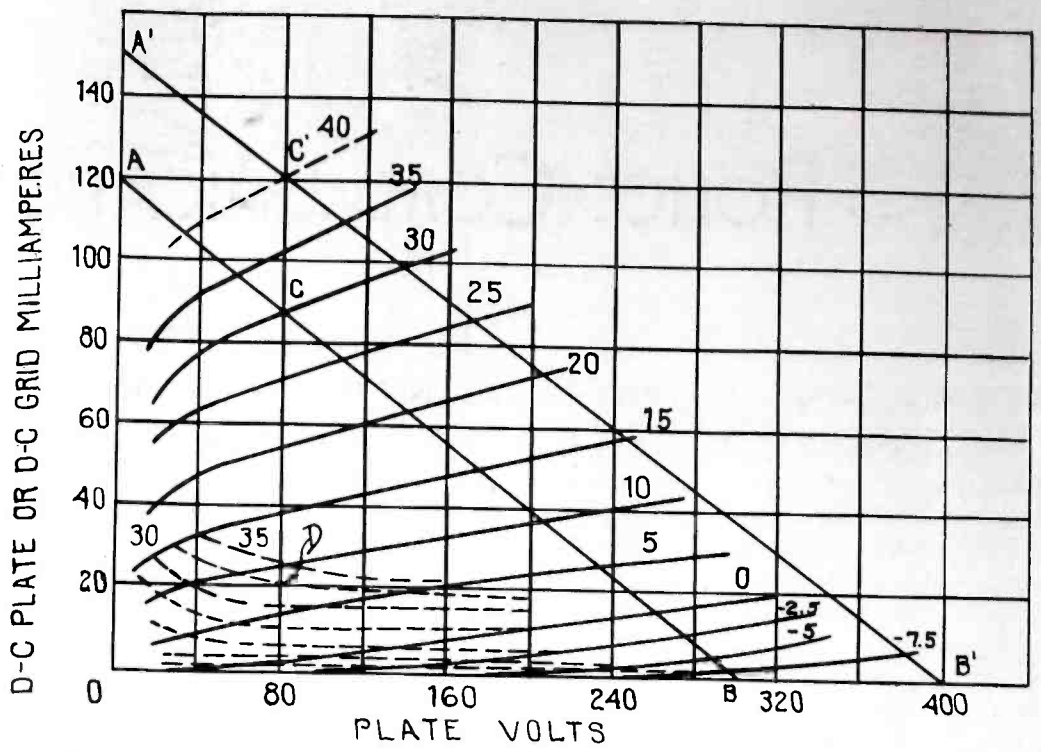

Fig. 1. Family of plate curves of 6A6.

The peak power output is thus the product of .086 × 220 or 18.9 watts. The average value of power for the sine wave is one-half this value or 9.45 watts.

For the general condition: if the peak current is I, the peak voltage across the load E, and the peak power P, then

$$P = EI.$$

However $E = IR$ where R is one-quarter the plate-to-plate load,

and $P = I^2R$

However, for the sine wave the average power is one-half the peak power,

and $P_o = \frac{I^2 R}{2}$, which is the familiar equation for Class B power output.

Driving Power

Referring again to Fig. 1 the peak driving power for the above condition may be calculated as follows: the peak grid voltage is 30 volts and the peak grid current as indicated at point D is 21 ma. The peak driving power is then the product of 30 × .021 or .63 watts. Although the average value of driving power for speech is only $\frac{.63}{4}$ or .157 watts, nevertheless the driver must be capable of delivering the peak power.

The driver calculations may be made as follows, assuming that the driver is a 6A6 operating under the following conditions:

Plate voltage.....300 volts
Plate Current.....7 ma
Grid bias.....—6 volts
Plate load.....As high as possible

Since the 6A6 with the elements connected in parallel, has an amplification factor of 35 and since the operating conditions call for a bias of 6 volts the peak signal which can be developed in the plate circuit with an infinite load is 6 × 35 or 210 volts. This 210 volts is distributed across the plate resistance of the tube and the plate load in the plate circuit. The plate load must be calculated to deliver the peak driving power and supply the losses in the driver transformer. The peak driving power is .63 watts and since an efficiency of 85 per cent may be assumed for small driver transformers of this type the peak power which the driver must deliver is $\frac{.63}{.85}$ or .74 watts. If the plate load is R_L and if the plate resistance of the 6A6 is 11,000 ohms the peak signal current I is

$$\frac{210}{11{,}000 + R_L}.$$

The peak signal voltage across R_L is

$$\frac{(210)\,R_L}{11{,}000 + R_L}$$

and the peak power is

$$\left(\frac{210}{11{,}000 + R_L}\right)\left(\frac{(210)\,R_L}{11{,}000 + R_L}\right)$$

or

$$\left(\frac{210}{11{,}000 + R_L}\right)^2 R_L$$

This equation is then equal to the peak power or .74 watts which must be delivered by the 6A6 driver. The value of R_L may then be calculated as follows:

$$\left(\frac{210}{11{,}000 + R_L}\right)^2 R_L = .74$$

$$44{,}100R_L = .74\,(R_L + 11{,}000)^2$$

$$66{,}000R_L = R_L^2 + 22{,}000R_L + (11{,}000)^2$$

(*Continued on page* 34)

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And the Proof Rolls In!

W·E·B·C

DULUTH
SUPERIOR

HEAD OF THE LAKES BROADCASTING CO.

WEBC BUILDING
DULUTH, MINNESOTA

August 26, 1940

Mr. W. R. David
Radio and Television Department
General Electric Company
Schenectady, N. Y.

Dear Mr. David:

The Head of the Lakes Broadcasting Company has had a 250-watt General Electric Frequency Modulated transmitter in operation for the past 5 months. Recent frequency, distortion and noise level measurements show that no change has taken place in those characteristics since the installation of the transmitter. The general performance of the transmitter has been excellent with no interruptions to the program due to equipment trouble.

Public acceptance of FM broadcasting in this locality has exceeded expectations. Listeners equipped with good FM receivers are very enthusiastic over the high fidelity performance of FM. It is our opinion that the listening public needs only a demonstration of FM to completely sell them on the noise free, high fidelity advantages of this new system.

The Head of the Lakes Broadcasting Company was one of the first organizations to put an FM transmitter on the air and at present operates the only FM station west of Chicago. It is our aim to continue to set the pace in FM broadcasting in this part of the Northwest.

Very truly yours,

W. C. Bingay

General Manager
The Head of the Lakes Broadcasting Co.

WCB/rk

Chief Engineer C. B. Persons at the controls of WEBC and W9XYH. At the extreme right is the 250-watt General Electric FM transmitter.

Proof of the SIMPLIFIED Circuit Design of GE FM Broadcast Transmitters

SIMPLIFIED FM circuit design was introduced by General Electric because of its many advantages and economies which no other system offers.

G.E. produces *direct* FM with only *two* tubes; G-E *instant acting* frequency control requires only *four* tubes (including crystal oscillator and the following tripler stage). There are no trick, hard-to-adjust circuits . . . no complicated, multi-tube networks . . . no moving parts.

G-E design is truly simplified. The resulting performance speaks for itself. Consult our local representative. Call or write him today. General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

160-9

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VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

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

Medal of Honor

WE have received an inspiring message from "The Father of Radio." Addressed to all members of the VWOA, it states:

"I wish to thank you from the depths of my heart for the award conferred upon me last Saturday in San Francisco of the beautiful and inexpressibly valued Medal of Honor of the Veteran Wireless Operators Association.

"I shall cherish this trophy among my most valued and dear possessions. It shall always occupy a prominent position in my home; and the sentiments and affection which it symbolizes shall always rest within my heart.

"I have been proud, and conscious of a deep sense of contentment, that from the very beginning of my work I have been in constant contact with Wireless Telegraph Operators. It was with profound satisfaction that I first heard of the founding of the Veteran Wireless Operators Association. I have been proud to have been associated with it from its beginning, and highly honored when you made me your Honorary President.

"Now comes this latest testimony and evidence of your confidence and affection, the full significance of which I scarcely realize.

"I have been happy indeed to have played a part in the recent organization of the Hollywood Chapter of VWOA and gratified to observe the interest and enthusiasm with which candidates here have applied for membership therein.

"So long as such interest in the aims and traditions of VWOA is evidenced by the oncoming generation of younger veterans, I shall have no fear that this splendid institution shall perish or in any way fall from the high ideals which animated its founders.

Fraternally and 73,
LEE DE FOREST."

Photo

Hal Styles, Los Angeles, writes as follows:

"I am enclosing herewith a photo, taken at a corner of the table in the Brown Derby Restaurant in Hollywood, of myself, David Sarnoff and Dr. de Forest. A few days ago we learned that Brother Sarnoff had arrived in Los Angeles on a more or less quiet mission and I immediately extended an invitation (in person through our Secretary, Leroy Bremmer) to be our guest at a special luncheon.

"Brother Sarnoff readily assented and although he was invited to speak before numerous groups he turned them all down in favor of fraternizing 'with the boys.' Secretary Bremmer immediately got busy on the telephone and invited 50 of our members (all the Colonial Room of the Brown Derby would hold) and the attendance was 100%.

"Although this photo—due to the cramped quarters at the Speakers Table—does not show all of the guests, also in attendance were our three honorary members, Lewis Allen Weiss, general manager of Don Lee and a vice president of MBS, Don Thornburgh, Pacific Coast CBS prexy, and Don Gilman, West Coast v-p of NBC. 'Dave' delivered a particularly inspiring talk, really relaxing to reminisce with his former cronies, among whom were Fred Sammis, whom he frankly confessed 'gave him his first job,' Tom Stevens, recently appointed FCC Monitoring Officer, Harry Lubcke, television director of Don Lee, Les Bowman, chief engineer of Columbia (West Coast), A. H. Saxton, chief of NBC (West Coast), Dick Stoddard, former chief of Hughes Aircraft, and now vice-president of Lear-Avia (Dick flew around the world with Howard Hughes), Jack Dunn, of Mackay Radio, Roger Bunce, Globe Wireless, Frank Kennedy, chief eng. of Don Lee, Harry Myers, chief of KFWB, Carroll Hauser, chief of KMTR, Ed Hansen, chief engineer 20th Century Fox, and many others.

"Dave told of his early struggles and rise to the presidency of RCA and paid tribute to VWOA. During the luncheon we presented him with an honorary membership in our Chapter and upon its conclusion he chatted for some time with Dr. de Forest about things in general. In passing, it is worthy of note to say that he also paid great tribute to the 'Father of Radio' and his invention of the vacuum tube.

"I might add that we are still rounding up 'old-timers' out here, pointing up the value of membership in VWOA, and already, within a few days after this dinner, we received six new applications.

"And now I'd also like to say that it was a pleasure to officiate at the Presentation of the Marconi Memorial Award over MBS several months ago. I presume you heard this and I trust it came through at your end okay. Incidentally, if you heard the broadcast from San Francisco (De Forest Day) I trust you enjoyed it. It was a difficult job to crowd in all of the messages that came at the last minute. While "De Forest Day" was a lot of hard work, for which Secretary Bremmer deserves a special posey, we all enjoyed it immensely and it was great, meeting the 'old-timers' in the San Francisco Bay area. I trust things are looking up in your neck of the woods and when you find time, I'm always glad to hear from you.

With kind regards and 73,
HAL STYLES, *Chairman*,
Los Angeles-Hollywood Chapter."

Left to right: Hal Styles, Chairman, Los Angeles-Hollywood Chapter, VWOA; David Sarnoff, President, Radio Corporation of America; Dr. Lee De Forest—during the informal luncheon at the Brown Derby.

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The Word Is Getting Around...

"For national defense or private industry . . . where dependability and adherence to specifications are essential . . . transformer users turn to UTC."

THERE IS NO SUBSTITUTE FOR EXPERIENCE

Whether STANDARD or SPECIAL

UTC has a transformer for every purse and purpose

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OVER THE TAPE . . .

NEWS OF THE COMMUNICATIONS FIELD

GATES EXPANDS

The Gates Radio & Supply Company of Quincy, Illinois, manufacturers of radio transmitting equipment, has announced the purchase of the modern all daylight factory of the Noel Hauworth Company of Quincy, Illinois. This announcement has been withheld pending the formal announcement that the Noel Hauworth Company has discontinued its manufacturing business.

The new Gates plant is located on Hampshire Street, is entirely on one floor with modern overhead daylighting constructed of fire brick and steel superstructure. A spacious warehouse located directly behind the factory building is included in the transaction. The new Gates factory provides 10,000 square feet of modern manufacturing facilities including complete availability for assembly line production when required on larger orders.

Work will be started early next week on complete adjustment of the building to fit into the technical requirements for the manufacture of radio broadcasting equipment, police and marine transmitters, portable field radio transmitters and dispatching amplifiers for railroad service. A complete spray paint and baking department must be installed. New offices and sales rooms will be constructed, indirect lighting will be provided over all assembly benches.

The Gates companies consist of the Gates Radio & Supply Company who manufacture what is known as audio equipment under which fall radio station studio apparatus, public-address systems and theatre equipment, and the Gates American Corporation who manufacture under contract all types of radio transmitters for every field of radiotelephone and telegraph communications.

SUMMERILL TUBING BULLETIN

"Taking 'Specials' in Stride" is the title of the latest bulletin issued by the Summerill Tubing Co., Bridgeport, Pa. This bulletin not only describes Summerill seamless tubing, but gives data on actual applications. To secure copies write to the above organization.

INDUSTRIAL CONSULTANT

Harold B. Thomas, one of the founders of the Elastic Stop Nut Corporation, Union, New Jersey, and vice-president in charge of sales, has resigned to enter consulting work in industrial product analysis and market research. He remains active as a director and member of the executive committee of the corporation.

PRECISION PAPER TUBE BULLETIN

Precision Paper Tube Co., 2033 West Charleston St., Chicago, have just issued a new bulletin, with bobbin data sheet, illustrating and describing their line of dielectric paper coil bobbins. Manufacturers of coils, relays, solenoids, small motors, photo-electric devices and other electrical actuated equipment using coils, will find this bulletin most interesting.

WARD LEONARD OFFICE

Ward Leonard Electric Co. announces the opening of a Branch Office in Rochester, N. Y. The new office, located in the Lincoln Alliance Bank Building, 183 Main Street East, will be managed by Mr. J. K. Savage, sales engineer.

ALL AMERICA CABLES SELECTIVE SERVICE POLICY

Mr. Frank W. Phelan, president of All America Cables and Radio, Inc., and president of the Commercial Mackay Corp., which comprises the Commercial Cable Co., Mackay Radio and Federal Telegraph, has announced that any American citizen, who is a regular employee of these companies or subsidiaries, who is called into or voluntarily enters active service in the National Guard, Army, Navy or Marine Corps for a period of one year and 40 days or less, will be re-employed in his former position or an equivalent position upon satisfactory completion of such service. An employee entering any of these services for this period of time will be granted a leave of absence and will be given credit in his record of service with the company. The company will give one month's pay to any employee who has been with the company for over one year and will carry his entire group insurance for him for the period.

BRUSH STROKES

The September, 1940, issue of *Brush Strokes,* published by the Brush Development Co., 3322 Perkins Ave., Cleveland, Ohio, contains a very interesting article by B. A. Coss on "The Measurement of Surface Finishes." In addition to describing how surface finishes may be measured by means of the Brush Surface Analyzer, typical charts are given for various materials.

KOOLOHM CATALOG

A new Koolohm wire-wound resistor catalog, for industrial users, and illustrating the features and design possibilities of this resistor type, has just been issued by Sprague Products Company, North Adams, Mass. Copies are available on request.

FEDERAL TELEGRAPH BULLETIN

The Federal Telegraph Co., 200 Mt. Pleasant Ave., Newark, N. J., have made available a bulletin giving a great deal of technical information on their FT-300 (3 kw) and FT-500 (5 kw) transmitters. These units are designed for use in aeronautical, point-to-point, marine land stations, police and other fixed services. Copies are available on request.

ALPHA WIRE BULLETIN

The Alpha Wire Corp., 50 Howard St., New York City, have just released their catalog, No. 41, covering their line of stock items, although this organization also produces a wide line of wire and cable products to specifications. In addition to detailed information, each product is described so that the general purpose of the wire and cable are known.

DR. FRANK CONRAD COMPLETES 50 YEARS WITH WESTINGHOUSE

Dr. Frank Conrad, who began his career in science as a bench-hand with the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., and became internationally known as "the father of radio broadcasting," has completed 50 years of achievement which brought him to his present position as assistant chief engineer of the company. Dr. R. E. Hellmund, chief engineer, presented to his colleague a diamond-studded gold lapel emblem, token of the company's recognition of Dr. Conrad's half-century of service. The award was presented within a month of the twentieth anniversary of the first regularly scheduled radio broadcast, for which he was responsible.

"CHET" WALKER JOINS UTAH

C. L. ("Chet") Walker, radio engineer for years with United American Bosch Corp., has just been appointed assistant chief engineer of Utah Radio Products Company, according to an announcement by O. F. Jester, general sales manager.

Mr. Walker's experience and background in radio engineering and development work makes him well fitted for his new duties with the Utah organization.

RECORDISC BROCHURE

"Snapshots in Sound," a new brochure issued by The RecorDisc Corp., 395 Broadway, New York, N. Y., manufacturers of home recording blanks, lists three grades of discs, the semi-professional, the economical and the amateur lines, in both nitrate and non-inflammable coatings. Accessories include playback needles, cutting styli and mailing envelopes, together with hints on recorder operation.

G-E BULLETIN

One of the latest bulletins issued by the General Electric Co., Schenectady, N. Y., gives a great deal of data on the new G-E 3000-watt F-M broadcast transmitter, Type GF-103-B. Copies may be secured by writing to the above organization.

JENSEN DATA SHEET

Jensen Radio Mfg. Co., 6601 S. Laramie Ave., Chicago, have just issued a new data sheet (No. 199) fully describing a group of new extended-range high-fidelity loudspeakers. The New type "J" dual loudspeakers and eight-inch and twelve-inch single speakers are fully described and illustrated. The units are available separately or as complete reproducers in the well known Jensen Bass Reflex cabinets.

INTERNATIONAL NICKEL BULLETIN

Bulletin T-17, issued during October by the International Nickel Co., Inc., contains a great deal of technical information on the fabrication of Monel, Nickel and Inconel seamless pipe and tubing. Copies of the booklet maybe obtained by writing to the Development and Research Division of the above organization at 67 Wall Street, New York City.

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I. T. & T. SELECTIVE SERVICE POLICY

Colonel Sosthenes Behn, president of the International Telephone and Telegraph Corporation, announced the Company's policy in regard to employees who enter the active military service of the United States.

Leave of absence up to one year will be granted to any such employee. Upon application within 40 days of the conclusion of such period employees will be reinstated by the Company in previous positions or positions of comparable status unless the Company's circumstances are so changed that it will make it impossible to do so.

Employees of more than one year's standing will receive one month's regular pay. Under the Company's pension plan these employees will receive full credit for the previous term of employment plus such period. The Company will pay the employee's present Group Insurance premiums for him during such period of service and during this time the employee will be entitled to the Company's regular death benefit under its pension and benefit plan less that which is paid by the Government.

PHILCO SELECTIVE SERVICE POLICY

All monthly employees of Philco Corporation having more than one year's seniority who volunteer or are drafted for military service will be paid one month's salary following their induction into the service, it was announced by James T. Buckley, president.

Weekly salaried employees and hourly rated employees will receive four week's pay. Employees who have been with the company less than a year will receive one-half of this additional compensation.

The company has announced its intention of paying the group life insurance premiums of all employees who enter the service for a period of one year and forty days. Seniority will be credited while employees are serving with the armed forces of the United States.

At the conclusion of the one-year service period, Philco will re-employ all those called to the service in accordance with the Selected Service and Training Act of 1940.

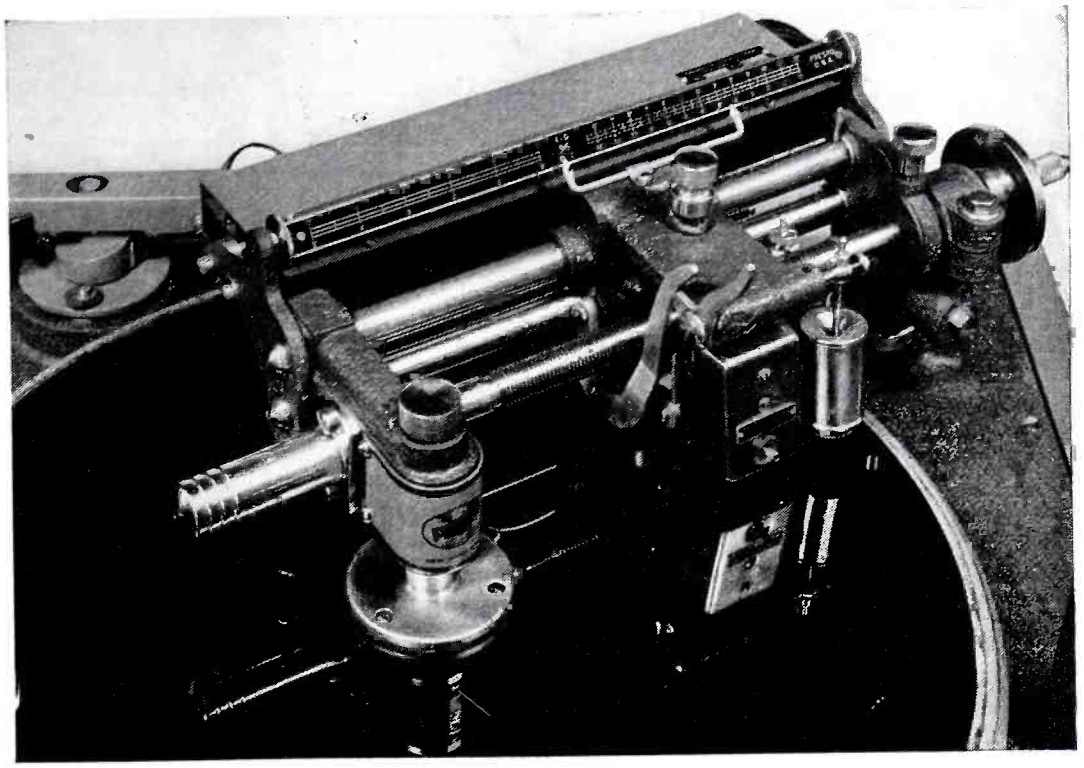
WESTINGHOUSE DATA SHEET

A new two-page data-sheet on high-voltage inerteen-filled capacitors, for direct-current service, has just been announced by the Westinghouse Electric & Manufacturing Company. Designed especially for filter applications in transmitters, resonant shunts, etc., units are available for operation on voltages from 600 to 100,000, and in capacitance ranges from .01 microfarad to 50 microfarads; the higher microfarad ratings being in the lower voltage ratings.

Numerous applications are listed and use of capacitors in each explained. Copies of descriptive data 49-225 may be obtained upon request from department 7-N-20, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

AMERTRAN BULLETIN

The American Transformer Co., 178 Emmet St., Newark, N. J., have made available a bulletin covering their line of Tpye TH Transtat voltage regulators. In addition to the usual technical data this bulletin contains a 9-page technical article explaining methods of connecting voltage regulators for various applications. Write for Bulletin 51-2.



MODERNIZE YOUR RECORDING INSTALLATION WITH THIS NEW PRESTO TURNTABLE

Here is a new turntable designed to replace the famous Presto 6-C and 6-D recording turntables which have been standard equipment in United States and Canadian broadcasting stations for the last four years.

Mounting and operating dimensions are identical with the previous equipment but the performance has been greatly improved.

NEW FEATURES OF PRESTO 6-N TABLE:

1. **Less Vibration.** Records made on the 6-N table reproduce on the highest fidelity playback equipment without a trace of flutter or rumble.
2. **Wider Frequency Response — Higher Sound Level.** Presto 1-C cutting head records useful range of 50-8000 C.P.S.— gives 6 to 8 D B higher playback level than previous heads.
3. New cutting head mounting spaces grooves more accurately, facilitates quick change of feed screws.
4. New overhead cutting mechanism redesigned to simplify alignment with the turntable, can be removed for transportation by loosening one screw.
5. Standard table includes spiralling feed screw, vertical damper, cam lever for lowering cutting needle, 4 pitch time scale, automatic equalizer and Presto 1-C high fidelity cutting head.

LIBERAL TRADE-IN ALLOWANCE TO STATION OWNERS WHO WISH TO REPLACE EITHER 6-C or 6-D TABLES WITH THE NEW PRESTO 6-N TABLE. Write giving type and serial number for cost of exchange.

PRESTO RECORDING CORPORATION
242 West 55th Street, New York, N. Y.
World's Largest Manufacturers of Instantaneous Sound Recording Equipment

www.americanradiohistory.com

RCA EXPANDS

David Sarnoff, president of the Radio Corporation of America, has announced that the research and production facilities of the company are being expanded to speed national defense orders for radio equipment and to accommodate demands of increased business. In order to execute this expansion program, arrangements have been completed to obtain temporary funds from a group of banks.

These borrowings aggregating $15,000,000 will be for a term of five years at 1½ per cent interest, but with the privilege of payment in whole or in part at any time prior to maturity. A portion of the sum, Mr. Sarnoff announced, will be used to retire the company's currently outstanding bank loans of $2,000,000, which carry an interest rate of 1¾ per cent, and are due April 8, 1941.

The number of employees of RCA and its subsidiary companies at the end of September totalled 26,595 as compared with 22,640 in the corresponding month of 1939, an increase of 3,955 employees. The new program will further increase employment in the RCA organization.

EMERSON PLAN FOR ENLISTED MEN

In a statement posted in its factory for the information of all workers affected by the selective military act, the Emerson Radio and Phonograph Corp. has outlined a plan which insures the preservation and continuation of employee benefits during the period of their national service.

According to the plan, during the first two months of the employees' military service they will receive the difference between what they earn in army pay and their regular wages from Emerson, based on average earnings for six months prior to their release from the company. The regular one week's vacation pay will be given to each employee in addition to the two-month wage grant.

Emerson's group insurance policies will be kept active and the premiums ordinarily paid by these employees will be absorbed by the company for a period of one year. Reinstatement to their former positions will be given to those employees who return to the Emerson Company within 40 days after expiration of their one year of military service.

ALEXANDER FIFTEEN YEARS WITH AEROVOX

Louis Alexander has just celebrated his fifteenth anniversary with the Aerovox Corporation, in the capacity of sales engineer. One of radio's old-timers, "Alec" traces his radio career back to the early days of the industry when Doc DeForest was producing audions and radio equipment at the High Bridge Plant in the Bronx, New York City. "Alec" was purchasing agent for the DeForest organization from 1918 until 1920, when he joined the Dubilier Condenser Corporation at first in an executive capacity and later on outside sales. In January, 1926, he became associated with Aerovox, and for the past fifteen years he has been contacting and serving radio set manufacturers and other large users of condensers.

RCA BULLETIN

A new bulletin available from the RCA Manufacturing Co., Inc., Camden, N. J., describes the 69-B distortion and noise meter which has been designed to meet F-M requirements. A description of the 89-B attenuator and measuring panel is also included. This latter unit is for use with the 69-B equipment.

CLAROSTAT APPOINTMENT

The appointment of I. J. (Jim) Youngblood as sales engineer in the Indiana territory is announced by Clarostat Mfg. Co., Inc., of Brooklyn, N. Y. Jim needs no introduction to the radio industry. As one of the old-timers, his radio career dates back to the Radio Communications service of the U. S. Navy in the first World War. Subsequently he engaged in radio engineering work with two leading organizations. Jim will work out of temporary quarters at 1002 W. 5th St., Marion, Ind., but will shortly locate in Indianapolis.

SHALLCROSS BULLETIN

A new Shallcross bulletin, No. 500-G, describes rotary instrument switches for use in the electrical industrial, radio and instrument fields. To secure copies, write to Shallcross Mfg. Co., Collingdale, Pa.

AUDAK BULLETIN

The Audak Co., 500 Fifth Ave., New York City, have released an interesting new bulletin. This bulletin contains data on the Audax compensated microdyne pickup, relayed-flux microdyne pickup, as well as on their line of high-fidelity cutters.

WILLIAM BRAND BULLETIN

William Brand & Co., 276 Fourth Ave., New York City, have issued an interesting bulletin on Turbo varnished tubing. Copies may be secured by writing to the above organization.

BASSETT BULLETINS

Rex Bassett, Inc., Star Bldg., Niles, Michigan, have released bulletins covering their line of police radio equipment. Data is included on their 50, 100, 250, 500 and 1,000-watt transmitters.

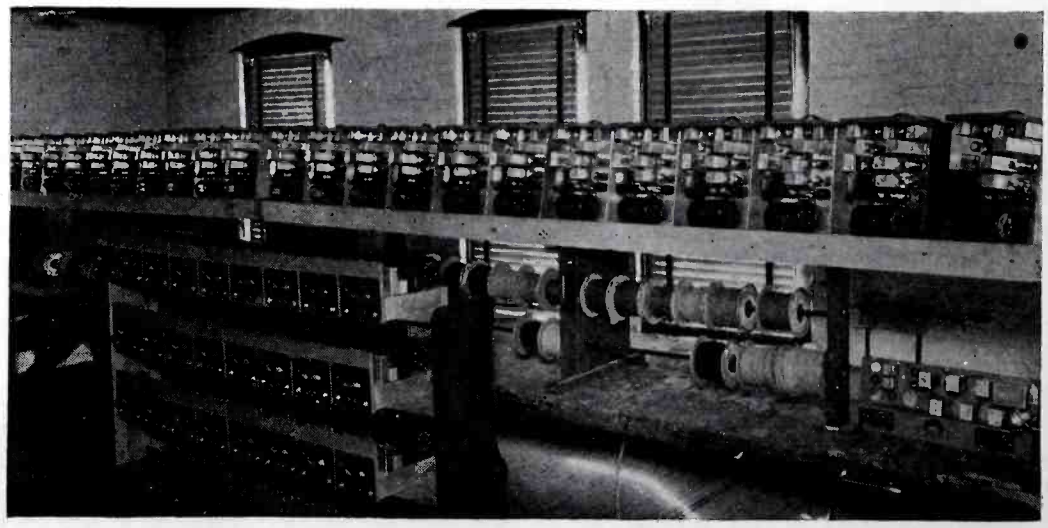
CHANGE OF NAME

We have been informed that the Federal Sales Co., 24-26 S. Jefferson St., Chicago, have changed their name to Federal Screw Products Co. According to the announcement this is a change in name only and does not affect personnel or policies of the company.

CARTER BULLETINS

The Carter Motor Co., 1608 Milwaukee Ave., Chicago, have issued a number of bulletins containing information on dynamotors for aircraft, marine, police, sound systems, etc., as well as on heavy-duty genemotors and rotary converters. Copies are available on request.

A group of quantity production f-m transmitters and receivers of portable-mobile type for military and police service. Radio Engineering Labs.



R. C. P. CATALOG

A new 16-page catalog in two colors covering its complete line of "Dependable" radio and electrical test equipment for 1941 has just been released by Radio City Products Co., Inc., 88 Park Place, New York City. Copies are available on request.

RCA PROMOTES SEVEN

Seven promotions in the executive personnel of RCA Manufacturing Co., Inc., have been announced by Robert Shannon, executive vice-president. They are:

E. W. Ritter, former general manager of radio tube manufacturing, elected vice-president in charge of all the company's manufacturing and production engineering activities.

H. L. Sommerer, former manager of manufacturing, appointed assistant to Mr. Ritter. His responsibilities will cover all manufacturing activities in connection with national defense program activities.

E. W. Engstrom, former director of general research, appointed manager of all research activities for the company.

E. E. Lewis, appointed assistant vice-president as executive head of accounts and finance.

H. L. Beisswenger, I. T. Kitzmiller, and E. M. Moore, appointed assistant controllers in respective charge of budgets, taxes and insurance; works accounting and costs; and general accounting.

TRANSMITTER GUIDE

A new edition of the popular Transmitter Guide has just been released by the Thordarson Electric Mfg. Co., 500 W. Huron St., Chicago. A wide selection of transmitters is presented, ranging from 20 to 1,000 watts, in addition to a portable and emergency unit and two band switch exciter units.

Complete building and operating instructions are furnished including over 100 illustrations to help build transmitters of modern design. This new guide contains many new circuits and ideas on ham transmitter equipment and technical articles covering class B output calculations, driver transformer ratios, matching class C loads to modulators and other information of importance to the amateur. Available at 15 cents postpaid from Thordarson.

JOHNS-MANVILLE BULLETIN

The latest Johns-Manville data sheet contains information on their line of Transite conduit and Transite Korduct fittings. To secure a copy write to the above organization at 22 E. 40th St., New York City.

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APCO CONVENTION

(*Continued from page* 14)

man I.A.C.P. Communications Committee.

6. *National Motor Vehicle Trace Program*—Discussion and request for uniform adoption of this plan, which has been approved by National Auto Theft Bureaus in all sections of the nation.

7. *Emergency Power and National Defense*—A frank discussion of the vital importance of auxiliary power sources in police services in a national emergency.

8. *Uniform Police Radio Legislation*—Discussion and examples of legislation planned and now in effect to curb lawless use of police signals and information.

9. *Are Motor Car Engineers "Radio Conscious?"*—Discussion on the problems faced by police technicians which could be "whipped" in the designing rooms of motor car plants.

10. *Formation of Advisory Council*—Discussion and planning for the creation of a National Advisory Council on Police Communications to provide for dissemination of related problems and data through known and representative channels in the art and industry.

11. *A Code of Ethics*—As the police communications function continues its progress toward the status of a profession there is an ever increasing need for a simple statement of purpose and ideals—a brief but forceful "Code of Honor" to which every man who aspires to the title of Police Communications Officer may subscribe—to honor and respect in his daily operations.

12. *Municipal Systems*—Discussions on the Municipal Systems in general—with detailed agenda prepared in advance.

13. *The County System*—General discussion on the services in counties as represented.

14. *State Systems*—General discussions—reports of progress.

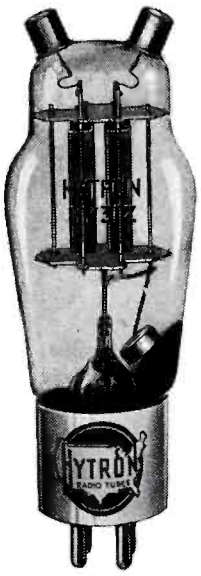
15. *Aircraft in the Police Service*—There is a constantly growing demand for the introduction and use of aircraft in the police services. This period will produce much valuable information as to results—problems involved—etc.

16. *The Teletypewriter in Our Picture*—The steady development of all services brings to the force new and greater demands for the use of the teletype, in one or another of its forms. There is need for thorough understanding by all police services of the value of this facility to the field. This problem will be discussed by men of our own organization, and by representatives of the wire companies.

FOUND!

MORE RELIABLE COMMUNICATION WITH INSTANT HEATING TUBES

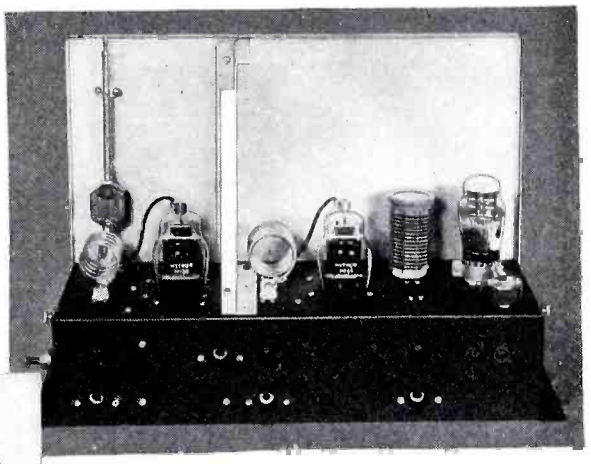
HY69
$3.50 Net



HY31Z
$3.50 Net

Top: *View of R.F. Channel*

Below: *Transmitter installed. Note sending and receiving antennae and "Voice of Safety" speaker.*



HYTRON had one thing in mind when it engineered the HY69 and the HY31Z and that was to provide tubes for mobile communications work which would provide greater power output with less battery consumption, thus assuring more reliable communications. Instant-heating tubes were the answer because their use eliminated filament drain during standby.

Proven by over a full year of service in the field, there is no longer any doubt as to their superiority. Thousands of HY69's are in use in mobile transmitters from Coast to Coast. Take, for example, the Radio-Telephone Transmitter (illustrated above) which was designed for the Salem, Mass., Police Department. This transmitter, which has given astonishing results beyond anything hitherto used by the Department, was made possible solely through the use of the Hytron HY69's and HY31Z's.

Dozens of other Police Departments, too, are changing over their old types of transmitters using cathode type tubes, so that they may use the Hytron instant-heating types.

You, too, can solve your mobile communications problem with these amazing tubes pioneered by HYTRON.

Hytron transmitting tubes are licensed by Radio Corporation of America for both the manufacturers' and users' protection.

Available in 12-volt series for aircraft and marine installations.

HYTRON CORPORATION
HYTRON RADIO TUBES
25 N. DARBY ST. SALEM, MASS.
MANUFACTURERS OF RADIO TUBES SINCE 1921

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HEAVY-DUTY

Mica Capacitors

● To meet the ultra-critical requirements of designers and builders of commercial-grade transmitters, television equipment and electronic apparatus, Aerovox now offers the outstanding choice of mica capacitors. All types—cast-aluminum cases (shown above), stack-mounted units, bakelite-case units, molded-in-bakelite capacitors, etc.

What were special mica types yesterday now become standard Aerovox capacitors, for convenience and saving, when you are building equipment which must last and which must safeguard an enviable reputation.

Ask for Copy . . .

New Aerovox Transmitting Capacitor Catalog lists all heavy-duty mica, paper, oil, and plug-in electrolytics.

Copy available to professional designers and builders of commercial-grade equipment, writing on business letterhead.

AEROVOX

CORPORATION

NEW BEDFORD, MASS.

IN CANADA: AEROVOX CANADA, Limited Hamilton, Ont.

17. *Recording—Its Aid in our Services*—As the processes of our routine facilities continue to grow in their scope, and as the values of police communications practically applied become more apparent, we shall find unlimited demands for newer and more efficient methods! In the field of instantaneous recording great things have been taking place in the past year! We shall see—hear—and be convinced!

18. *Antennae—New Designs—New Results*—Ever the crux of the engineers' problems when service range and field strength are the part labelled x—the last word in antennae designs and performance if of great interest indeed!

Planned with a view to giving equipment manufacturers a most excellent opportunity to present, to the practical communications men of the nation the headline items of their new 1941 lines, the Orlando Conference has attracted many highly interesting displays, and will be well worth while from the standpoint of offering the "cream of the crop for 41!"

Apparently the men who build the equipment of today are now looking ahead, to those systems which our cities, counties, and our states must have, if they are to assume their full share in the Total Defense of these United States!

With one of the greatest years in A.P.C.O. history behind us, and with the greatest Conference Program in history ahead—it's all aboard—for Orlando!

• • •

ELECTRON BEAMS

(*Continued from page 8*)

prominent as they are in any transmission-line problem. But in a discussion of waves that can be started in an electron beam and that will ultimately take kinetic energy from the electrons so that the output energy will exceed the input, these waves are of secondary importance.

The Effect of Magnetic Focusing Field

The analysis described above has assumed that a satisfactory beam is obtainable. When used, a magnetic focusing field is the result of a desire to form the electron beam most effectively. The collimating field does, in addition, influence the high-frequency effects. If this field is very strong, then the electrons are restrained to move in only the axial direction and the picture of a beam of unchanging radius with length under zero-signal conditions remains accurate even for the passage of a wave.

If the magnetic field is not used or else is not very intense, then the passage of a wave down a beam can be expected to cause electron motions in a

ZOPHAR

WAXES

AND

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FOR

INSULATION and WATERPROOFING

of ELECTRICAL and RADIO COMPONENTS

● such as transformers, coils, power packs, pot heads, sockets, wiring devices, wet and dry batteries, etc. Also WAX SATURATORS for braided wire and tape and WAXES for radio parts. The facilities of our laboratories are at your disposal to help solve your problems.

FOUNDED 1846

Zophar MILLS, Inc.

120-26th ST., BROOKLYN, N. Y.

Found

The Answer to Dirt and Dust-ruction

IDEAL JUMBO

"3-in-1" Portable Electric Cleaner

Hundreds of broadcasting and communication stations have standardized on the Ideal Cleaner!

Here's why—

1. Blows—Vacuums—Sprays
2. Cleans dirt from equipment, behind panels, etc.
3. Super-powered—full 1 H.P. motor
4. Blows dry air—prevents rotting of insulation
5. Air velocity 24,200 ft. per minute
6. Safe—low pressure air prevents damage to delicate electrical equipment
7. Many attachments available to meet your individual requirements

Blows . . . Vacuums . . . Sprays

Ask for Free Trial Demonstration

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plane perpendicular to the direction of motion as well as axially. The grouping of electrons at points along the beam will, of course, cause electric fields to exist radially as well as axially. Thus, in addition to finding the velocity of electrons and the conduction current pulsating along the beam length, we will also observe variations in the radius of the beam. Depending upon the operating parameters, such as voltage and current and the strength of the magnetic field, these traveling pulsations in the beam size may be quite large—enough, perhaps, to overshadow some of the other modulation effects that have been discussed. W. C. Hahn has shown,[5] for instance, that in the case of no magnetic field the charge density modulation is small compared to the conduction-current modulation. Rather than to think of a uniform radius beam passing the output gap with alternate dense and rarified regions, the correct picture with no magnetic focusing field seems to be to regard the modulated beam passing the output as one of fairly uniform density with a widely pulsating beam radius.

Acknowledgment

The author is indebted to Mr. W. C. Hahn for his willingness to clarify the wave theory by many discussions.

Bibliography

(1) F. B. Llewellyn, *Proc. I. R. E.*, V. 23 (1935), page 112.

(2) D. O. North, *Proc. I. R. E.*, V. 24 (1936), page 108.

(3) W. C. Hahn and G. F. Metcalf, *Proc. I. R. E.*, V 27 (1939), page 206.

(4) R. H. Varian and S. F. Varian, *J. App. Phys.*, V 10 (1939), page 321.

(5) W. C. Hahn, *G. E. Review*, V. 42 (1939), page 258.

(6) W. C. Hahn, *G. E. Review*, V. 42 (1939), page 497.

(7) L. Tonks and I. Langmuir, *Phy. Rev.*, V. 33 (1929), page 195.

(8) A. V. Haeff, *Electronics*, V. 12 (1939), page 30.

(9) S. Ramo, *Phy. Rev.*, V. 56 (1939), page 276.

(10) S. Ramo, *Proc. I. R. E.*, V. 27 (1939), page 757.

(11) C. Southworth, *B. S. T. J.*, V. 15 (1936), page 284.

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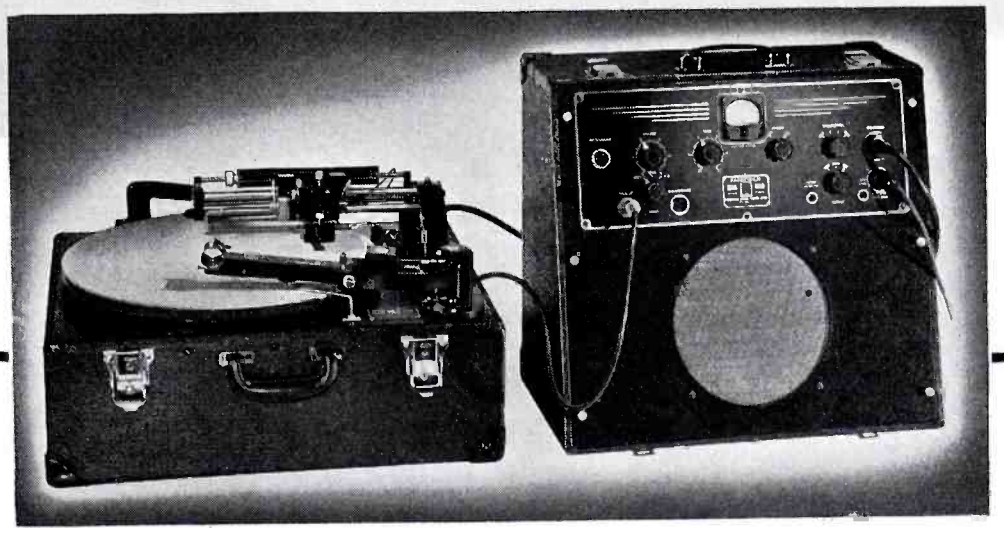
G-E APPOINTMENT

Dr. C. Guy Suits, 35-year-old research physicist, has been appointed assistant to the director of the General Electric Research Laboratory. The post is a new one and will permit Dr. Suits to continue his research while assuming some administrative duties, explained Dr. W. D. Coolidge, director of the Laboratory, in making his appointment. Dr. Suits has been a member of the Laboratory staff since 1930.

HERE'S RUGGED DEPENDABILITY PLUS...

STUDIO QUALITY RECORDINGS From FAIRCHILD PORTABLE RECORDER



Why Pamper Your Portable Recorder? Here's Precision Equipment that Laughs at Trouble!

Gone is the day when transcriptions cut in the field had to sacrifice tone-quality and brilliance . . . and gone, too, is the superstition that precision construction cannot stand hard use! Better performance has caused dozens of stations to standardize on Fairchild's F-26 Recorders, both for studio and field use. And they've turned in thousands of higher-fidelity transcriptions without repairs! Here's why *station men you know* boast of their Fairchild Recorders:

1. ***High Gain Amplifier*** *permits use of microphone without a pre-amplifier!*
2. ***Instantaneous Speed Change*** *(33⅓ RPM or 78 RPM) through push-button control.*
3. ***Floating Motor Mount*** *eliminates all possibility of objectionable motor vibration.*
4. ***Split-Second Timing*** *through synchronous speed gear and worm drive at 33⅓ RPM assures wow-free recordings.*
5. ***Variations*** *of pitch and direction of cut provided for in the recorder itself. No expensive, troublesome additional feed screws needed.*
6. ***Dynamically-Balanced*** *16-pound castiron turntable.*

Write for illustrated folder today!

"...it had to satisfy Fairchild first"

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Sound Equipment Division

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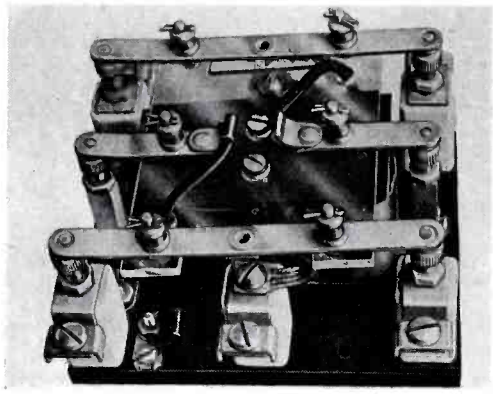
THE MARKET PLACE

NEW PRODUCTS FOR THE COMMUNICATIONS FIELD

HEAVY DUTY BREAK-IN RELAY

Ward Leonard Electric Co., Mount Vernon, N. Y., announces a new break-in relay in 'phone transmitters for push-to-talk operation. When the relay coil is energized the antenna is switched from the receiver to the transmitter position. The oscillator is turned "On" and the receiver plate circuit is opened. High test



insulating materials used in the new heavy duty type consist of a Lucite cross arm carrying the contact fingers and Isolantite blocks mounted on a Bakelite base support the contact posts. All contacts are rated 25 amperes. These relays are described in a supplementary data sheet, Circular 507B, which will be sent on request.

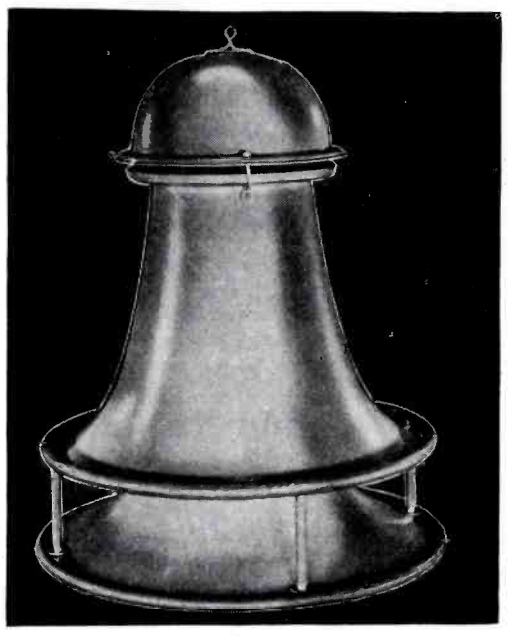
DYNAMIC REPRODUCER

A new reproducer built on the electro dynamic principle has been introduced by Sound Apparatus. The specifications are as follows: Frequency response essentially flat from 30 to 9,000 cycles; needle pressure approximately 1 oz. or less; output level is 5 volts per 1 cm/sec; needle impedance about 12 gr. for an amplitude of .065 mm; electrical impedance is 200 ohms, which in lower impedance can be furnished

upon request. Further information is available from Sound Apparatus Co., 150 West 46th Street, New York City.

CONE SPEAKER PROJECTOR

University's new Model RLP cone speaker projector, is a newly designed radial speaker with added bass response. Its striking resemblance to a lighthouse has earned it this descriptive name. It differs from University's previous radial cone projectors due to the fact that double the usual acoustic length is used in the projector, which makes for good low-frequency response. It has all the usual features of University cone speaker reproducers, among which are: three non-resonant rubber tire rims, heavy gauge aluminum spinnings, floating rubber cone speaker mounting, and radial acoustic breather. Due to design of the bells, uniform 360° sound projection is said to be assured. Bell diameter 24 inches, overall height 28 inches. For all models of 12 inches cone speakers. University Laboratories, 195 Chrystie St., New York City.

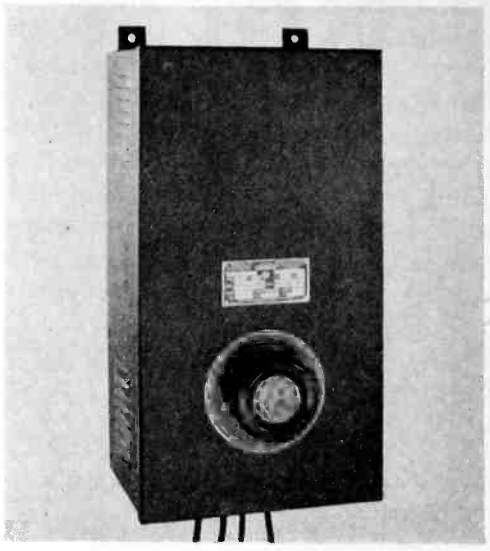


SQUARE-WAVE GENERATOR

A new square-wave generator for the study and recording of the response of electrical circuits was described by Dr. E. H. B. Bartelink of the General Electric general engineering laboratory, to the communications section of the American Institute of Electrical Engineers recently. The generator has a frequency range from below 2 to above 200,000 cycles per second. This is covered in 10 ranges by a selector switch while a coarse and vernier control provide continuous adjustment in each range. It is completely self-contained and requires no outside power supply or oscillator. A terminal is provided to permit synchronizing with an external source. The waveform is materially square up to 50,000 cps. The output is 5 volts in 1000 ohms. A switch permits selection of 10 or 50 per cent pulse width, while a vernier is provided for finer adjustments. General Electric Company, Schenectady, N. Y.

LINE-VOLTAGE COMPENSATOR

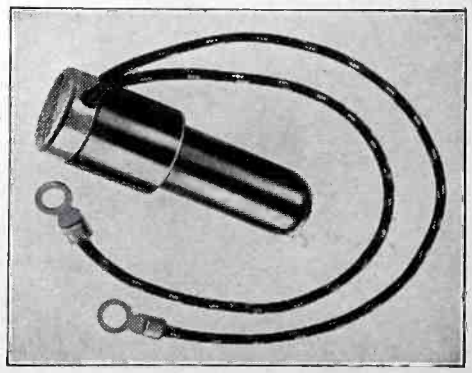
The American Transformer Co., 178 Emmet St., Newark, N. J., have recently announced their Type LC Transtat. It is a manually-operated unit designed to permit compensation for small voltage variations in alternating-current circuits. Standard types permit full correction over a range of plus and minus ten percent and



are available for service in 115-, 230- and 460-volt, 50- to 60-cycle, circuits. Equipment for single-phase and polyphase service is made in ratings from 2.5 kva to 85 kva output. The Type "LC" Transtat, being a transformer, has characteristics which approximate a transformer of like rating. In other words, its electrical efficiency is of the order of 95 to 98 percent, regulation is from 2 to 4 percent in changing from no load to full load, and exciting current is from 1 to 6 percent. Moreover, it is said to have practically no effect upon the power factor of the circuit, there is no arcing at the contact, and it does not cause either wave-form distortion or interference to radio receivers.

MERCURY SWITCHES

Durakool, Inc., Elkhart, Ind., announces two new mercury switches. One bears catalog No. A-5M; the other takes catalog No. A-10Z. Both switches have new in-



ternal construction characteristics that enable them to carry substantially greater currents than the regular Durakool

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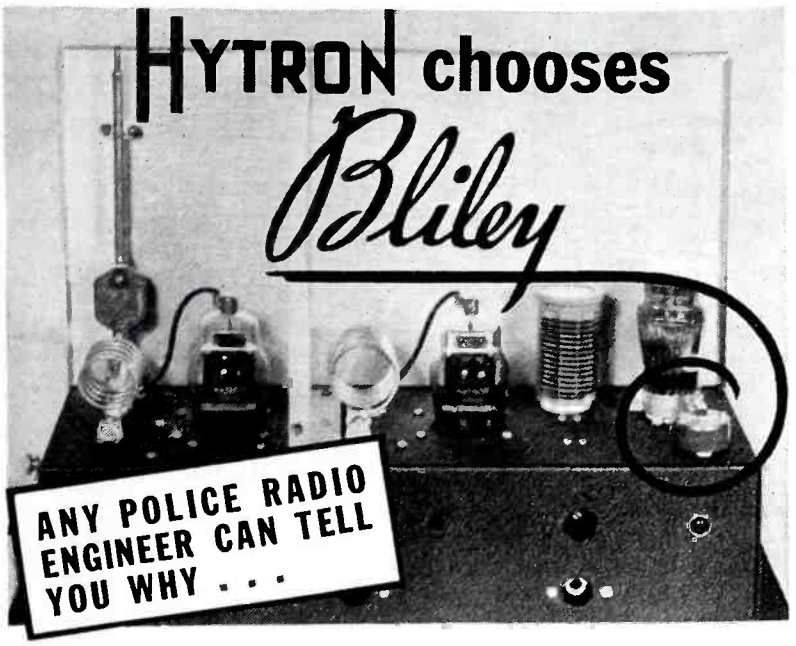

Hytron Engineers developed a series of instant heating tubes for push-to-talk operation of mobile police transmitters. They went further, however—they designed and constructed a transmitter using these tubes. They knew that demonstrated performances of any product is the best proof of what it really can do.

Quartz crystals play a prominent part in the overall performance of mobile radio transmitters. Hytron Engineers realize this—police radio engineers appreciate it too. That's why Bliley Crystal Units are chosen when reliability counts. Ask any experienced police radio engineer, he knows! Catalog G-11 contains complete information; it's yours on request.

BLILEY ELECTRIC COMPANY
UNION STATION BUILDING — ERIE, PA.

POLICE . . .
MARINE . . .
AERONAUTICAL
RADIO EQUIPMENT

COMMUNICATIONS CO., Inc.
CORAL GABLES - - - FLORIDA

TAYLOR

VULCANIZED FIBRE
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TAYLOR INSULATION

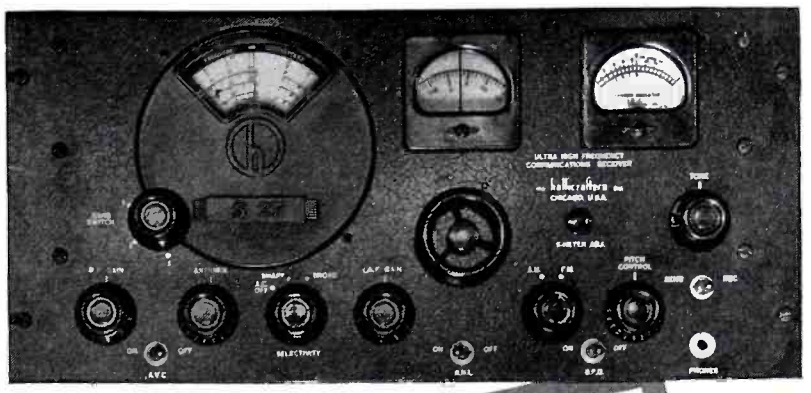
TAYLOR FIBRE CO., Norristown, Pa.

JACOBS ADJUSTABLE SEPARATOR

U. S. Patent No. 1,950,170—March 6, 1934—others pending.

Made of plastic, this improved Separator provides efficient and split-second adjustment of oper. 2 wire R. F. feedlines of any spacing from 2" up to 8". Used in conjunction with Hertz, Zepp and Beam antennas; also vertical radiators. Weigh less; no tie wires; unbreakable. Price: $1.50 for a set of 6.

CHARLES F. JACOBS (W2EM). 270 Lafayette St., New York, N. Y.



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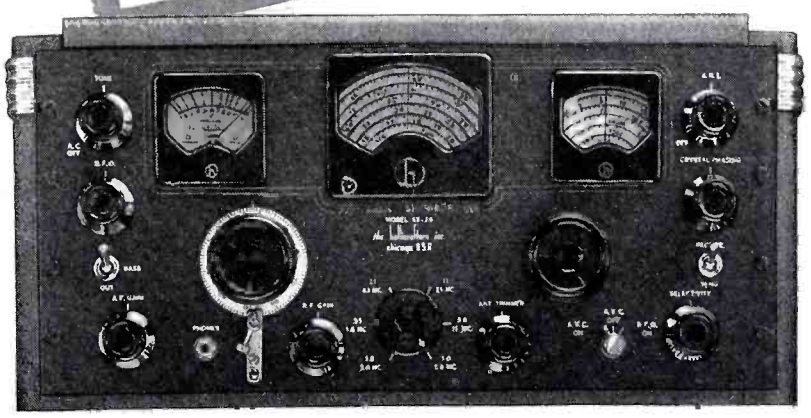

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★ Yes, there IS a satisfaction for engineers interested in FM to know that they can turn to Lingo for proven, factual information on planned antenna systems. The famous (patented) Lingo Turnstile Antenna was developed at the very "birthplace" of FM at Alpine, N. J. Today, it provides proven performance and an adaptability that affords its use either on towers or buildings.

★ We will be pleased to estimate on complete Turnstiles comprising the essential tubular steel mounting pole, elements, insulators, wires and bands. ***Inquiries should indicate planned frequency, number of turnstile bays desired, location and height of building or supporting tower, etc.***

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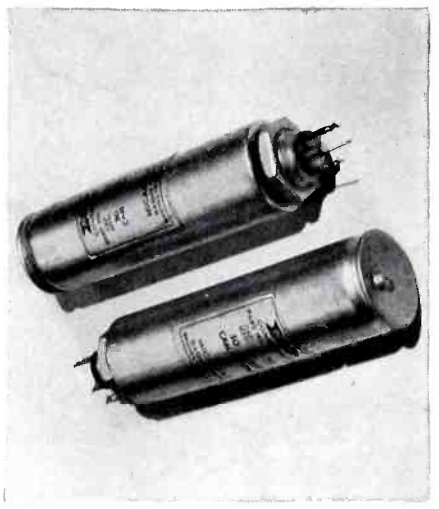
switches with the same dimensions. A standard A-5 Durakool mercury switch is rated for 200 watts a-c lamp load at an operating speed not to exceed 20 times per minute. The A-5M, although having the same physical dimensions as the A-5, has successfully withstood 750,000 operations on a 500-watt a-c lamp load at an operating speed of 5 times per minute 24 hours a day, it is said. It has also taken 50,000 operations on a 1,000-watt d-c lamp load at a rate of 25 times per minute. The performance of the A-10Z is equally impressive when compared to a standard A-10 Durakool switch. These two switches are also identical in dimensions.

DRY ELECTROLYTICS

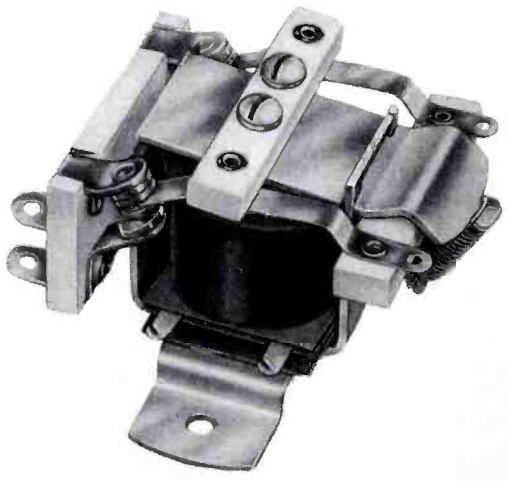
Micamold Radio Corp., Flushing and Porter Ave., Brooklyn, N. Y., announce the addition of a complete line of Type



MP dry electrolytics. They are available in sufficient capacity and voltage ranges to care for practically all replacement requirements. Standard lug mountings with both 3 and 4 terminals; both 1 inch and 1⅜ inch diameters. Literature on request.

RELAYS

Allied Control Co., Inc., 227 Fulton St., New York City, have announced a new series of relays designed to meet requirements for a small, rugged unit of high-current capacity and low coil wattage operation. Applications are in mobile, marine, and aircraft fields, as well as for in-



dustrial uses where compactness is a factor. Insulation is alsimag, bakelite or high-frequency bakelite. Contacts are ¼" silver with wide spacing sufficient to handle 15 amps at 110v a-c and 7 amps d-c at 110v. Contacts available from 2-pole

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double-throw to 4-pole, double-throw. Coil operation can be had from 6v to 250v a-c and from 2v to 115v d-c.

SOFT FACE HAMMERS

A complete new line of soft face hammers has been developed by Stanley Tools, New Britain, Connecticut. These hammers are for use on assembly jobs requiring a hammer which will not mar finely finished surfaces or delicate machine parts. The tips are made of "Stanloid," a tough, resilient, non-metallic substance. The hickory handles are securely wedged in a steel center body. Various shaped tips—regular face, ball pein, cross pein, straight pein, offset pein, square tip, and regular face with brass insert make these hammers ideally suited for mechanics, machinists, sheet metal workers, motor builders, service men, and for workers in defense industries. All tips are renewable.

CUTTING NEEDLE PACKAGE

The Recoton flat shank steel cutting needle, hitherto sold 10 to a package, is now available in a new card envelope containing 5 needles. Complete literature on this company's many products may be had by writing Recoton Corp., 178 Prince Street, New York City.

U-H-F TRANSMITTER

In the accompanying illustration is shown Communications Co. Model 80 ultra-high-frequency transmitter. This 50-watt self-contained unit is designed for airport traffic control, aeronautical ground stations and other services in the 100 to 150 mc band. The transmitter can be completely remote-controlled over a single-pair telephone line. This line is used for a-f input to the transmitter and by simplexing also serves to turn on and off the transmitter and for the press-to-talk circuit. Provision is also made for metering all essential circuits if desired at the operating position when the transmitter is used remote. A multi-pair telephone cable is used for this purpose. Complete information may be secured from Communications Co., Inc., 2700 Ponce de Leon Blvd., Coral Gables, Fla.

"CHASSIS-LOCK" SOCKET

An improved standard type moulded bakelite tube socket, mounted and locked by folding down metal lugs in the chassis, thus eliminating rivets, retainer-springs and other auxiliary parts, has been developed by American Phenolic Corporation, 1250 Van Buren St., Chicago. The new

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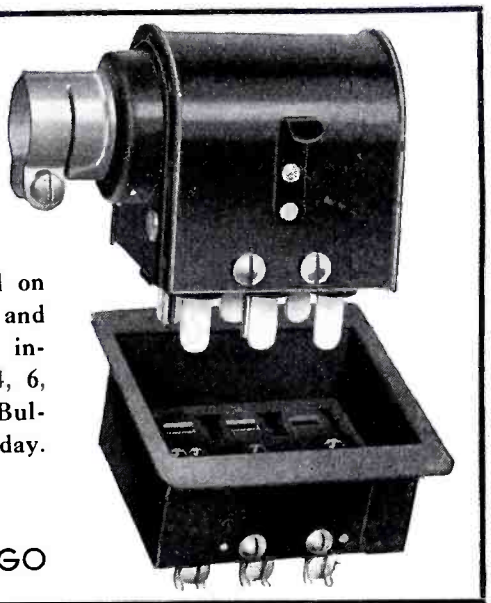

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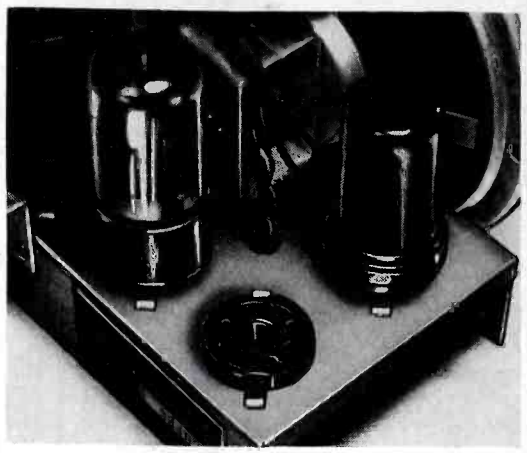
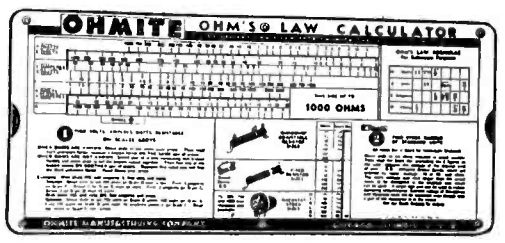


have been developed which permits as many as eight sockets in any one chassis to be fastened in place in one operation.

OHM'S LAW CALCULATOR

A unique, new, convenient Ohm's Law calculator has been designed by Ohmite for engineers, servicemen, amateurs, experimenters, salesmen, countermen, electricians, laboratory men, maintenance men, purchasing agents, teachers, students, etc. It gives the answer to any Ohm's Law problem in a jiffy, with one setting of the slide. No decimal points to worry about.



All values are direct reading. It does not require any knowledge of a slide rule to operate.

The Calculator has scales on both sides so as to cover the range of currents, resistances, wattages and voltages commonly used in both radio and commercial work. It covers the low-current high-resistance radio, sound and electronic applications. Also the commercial higher current range for motors, generators, lamps, electrical appliances, and other applications.

The Ohmite Ohm's Law Calculator can be obtained from the Ohmite Manufacturing Co., 4835 Flournoy St., Chicago, for only 10c in coin to cover the cost of handling.

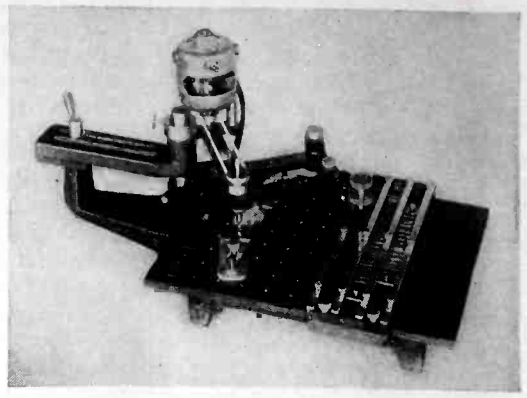
PHONO PICKUP

The Electrovox Company, 424 Madison Ave., New York City, manufacturers of the Walco sapphire needle, have announced a "feather-weight" phonograph pickup with a permanent sapphire needle, for installation on any manually operated phonograph. The point is said to be good for 15,000 records. Dropping the arm will not injure the jewel or record, it is further stated. Further data may be secured from the above organization.

ELECTRONIC COUNTER

A newly designed electronic counter has been announced by Shallcross. This unit is capable of counting at rates up to 2,000 per minute, following all variations in the

—MICO— ENGRAVER



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speed of the supply, it is said. It operates from 110-120-volt, 60-cycle supply lines. Detailed specifications of the No. 457 electronic counter may be secured from Shallcross Mfg. Co., 10 Jackson Ave., Collingsdale, Pa.

OSCILLOGRAPH

This Hickok oscillograph is designed for frequency-modulated, amplitude-modulated and television servicing. It has self-contained wide-band f-m, oscillator for f-m and television receivers and narrow band f-m oscillator for amplitude modulated re-

ceivers. Also, demodulator, video amplifiers, signal tracer, and visual a-c vacuum-tube voltmeter 0.2 to 1,000 volts. For complete information write The Hickok Electrical Instrument Co., 10303 Dupont Ave., Cleveland, Ohio.

RADIART VIPOWER

Of interest to police communications officers is Radiart's Vipower, Type 4201-B, which is designed to furnish vibrator power in replacement of motor generator sets. Three vibrator power units are available. A feature of Types 4201-B2 and 4201-B21 is dual vibrator equipment which permits switchover from one vibrator or fuse to second vibrator or fuse. Complete information from The Radiart Corp., Cleveland, Ohio.

NEW ORGANIZATION

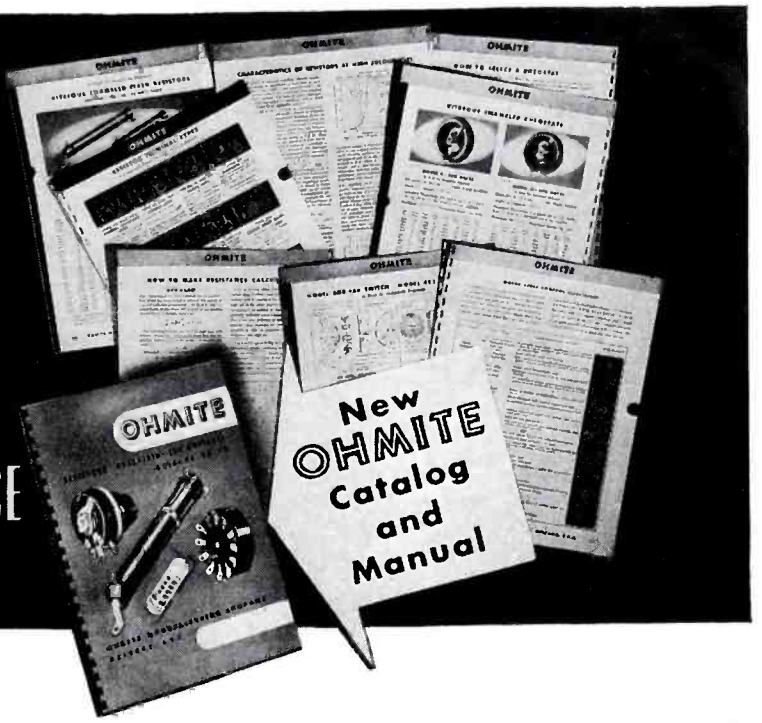
Lavoie Development Laboratories were recently organized to engage in the development of ultra-high-frequency oscillators, receivers, wavemeters, and associated equipment. Several models of wavemeters operating up to 3,000 megacycles, and useful also as receivers, are being placed upon the market. These wavemeters are so designed as to be totally enclosed electrically and are fed by means of a transmission line. They are entirely portable and adapted to many uses in and about the laboratory.

A new line of ultra-high-frequency oscillators, either fixed or variable, operating up to 850 megacycles, highly stabilized in frequency will be ready for the market shortly. These oscilators will find many applications in the laboratory for the purpose of ultra-high-frequency investigation. They may also be applied to u-h-f superheterodyne receivers operating up to 850 megacycles. Further details may be secured from the Lavoie Development Laboratories, 2534 Fairmont Avenue, Dayton, Ohio.

NBC TELEVISION STATION IN WASHINGTON

The establishment of a television center in Washington by the National Broadcasting Company was assured October 3

96 PAGES OF VALUABLE DATA ON RESISTANCE PROBLEMS



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This new Ohmite Catalog and Engineering Manual No. 40 really works for you! It's an invaluable guide on the use of Resistors, Rheostats, Tap Switches, Chokes and Attenuators in radio and electronic equipment — in products, machine tools and special applications—in the control of motor speed, of generator fields, of heat and light, of signal and supervisory circuits —in instrument rooms, maintenance and production — in laboratories and electrical equipment. You'll want it for ready reference—and you can have it without charge! Write us today on company stationery giving your name and position. Catalog 40 will be sent to you at once.

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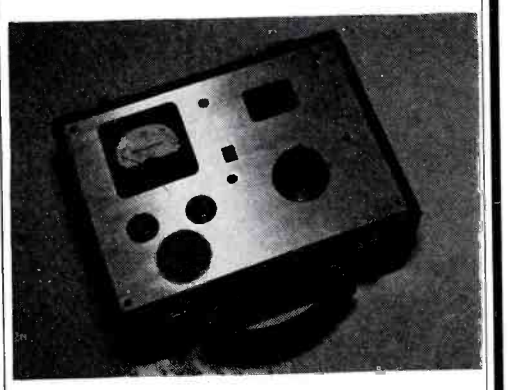

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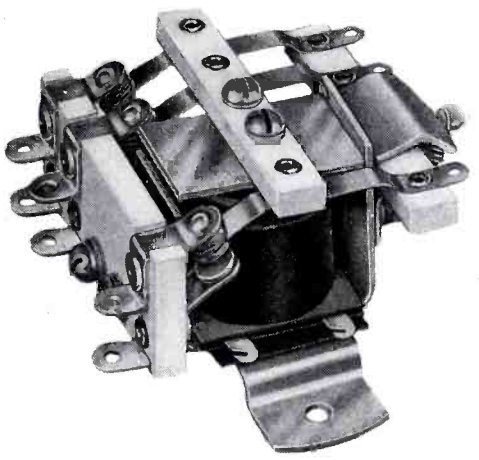

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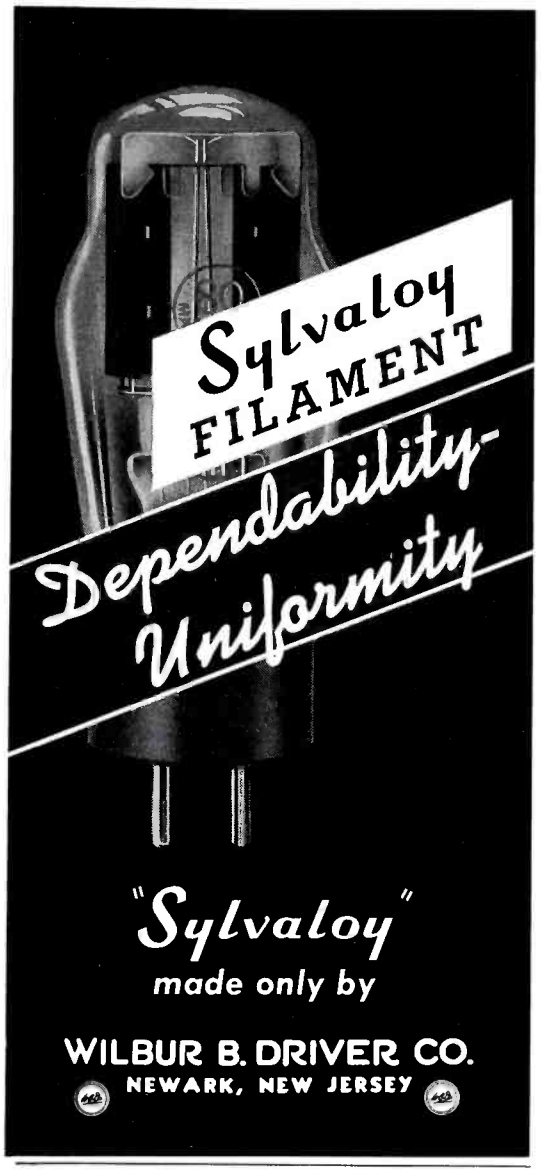

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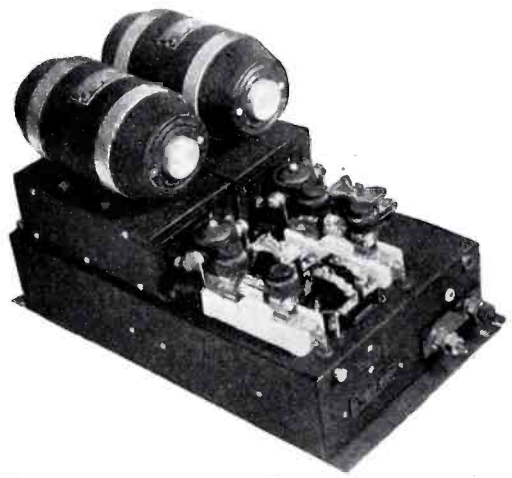

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Carter a well known name in Radio since 1922

when Niles Trammell, president of the National Broadcasting Company, signed a lease with the Wardman Park Hotel for television station and studio facilities.

The National Broadcasting Company plans not only to present television service of varied programs of sports and other entertainment features to residents of the capital area, but when relay facilities are developed to syndicate to other parts of the country the visual as well as the oral stories of its government at work.

• • •

RCA TUBE PREFERENCE LIST IS REDUCED FROM 36 TO 31

THE RCA Preferred Type Tube Program passes its first anniversary this month with the announcement that the number of receiving tube types it covers has been reduced from 36 to 31, and that two other types have been replaced to coincide with today's receiver design trends.

L. W. Teegarden, manager of the RCA Tube and Equipment Division, made the announcement after pointing to the Program's first year of results, and to its reception by a total of 19 radio set manufacturers.

Three types, 1G4G, 1G6G and 6N7G, have been eliminated from the preference list as the result of a swing away from type "B" audio systems by design engineers. Type 2A3 is becoming less and less popular with engineers, too, so that it has been dropped. The fifth deletion was accomplished by the program itself. It was found necessary to include both types 6J5

RECEIVING TUBE TYPES
PREFERENCE LIST

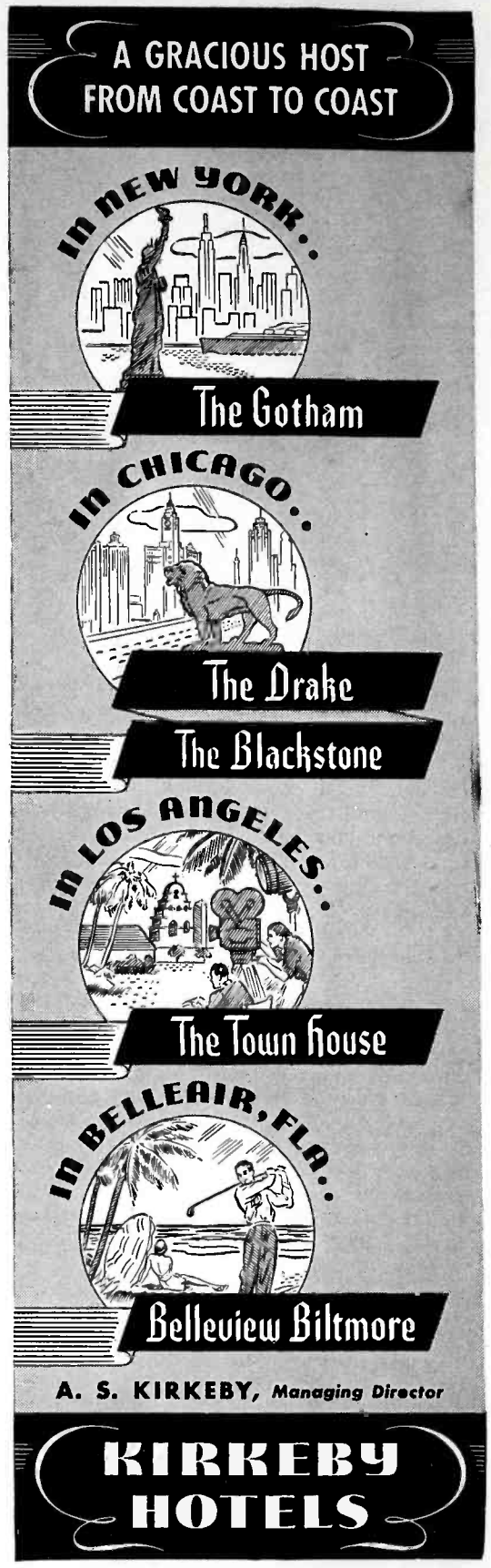
RECTIFIERS	INDICATOR TUBE	CONVERTERS	VOLTAGE AMPLIFIERS Single	VOLTAGE AMPLIFIERS Twin	VOLTAGE AMPLIFIERS with Diode(s)	DIODE DETECTOR	POWER AMPLIFIERS
		1A7-GT	1N5-GT		1H5-GT		3Q5-GT
5U4-G 5Y3-G 6X5-GT	6U5/6G5	6SA7	6AB7 6J5 6SF5 6SJ7 6SK7	6SC7	6B8-G 6SQ7 6SR7	6H6	6F6-G 6K6-GT 6V6-GT
25Z6-GT 35Z5-GT		12SA7	12SA7	12SC7	12SQ7		25L6-GT 35L6-GT 50L6-GT

and 6J5GT in the original list because of a price difference. Increased volume of orders for the 6J5 has made possible manufacturing economies to bring its cost into competition with the 6J5GT, which has been deleted from the list.

Two changes of types on the list were caused by a growing tendency in the a-c d-c set field for seven and eight-tube receivers. The tube complement for such a receiver, if drawn from 150-milliampere tubes on the preference list, adds up to a greater heater voltage than the normal line voltage. So 6.3-volt 300-milli-ampere tubes must be substituted, although there have been no power output and rectifier types on the preference list useful for this purpose. Thus it is that types 25L6GT and 25Z6GT have been substituted on the list for types 12SJ7 and 12C8.

Mr. Teegarden said that currently nearly three-quarters of all receiving tubes produced by RCA are concentrated in the preference list. Tube parts are now produced by mass production methods never before possible, and such parts as bases, shells, heaters, and cathodes have been standardized to effect further economies. In addition, manufacturers endorsing the program have watched their own costs go down substantially as they were able to standardize on tube sockets and other component parts, he said.

A GRACIOUS HOST FROM COAST TO COAST



A. S. KIRKEBY, *Managing Director*

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RCA INDIANAPOLIS PLANT EXPANSION

The RCA Manufacturing Company has completed plans for enlarging its plant at Indianapolis, Ind., by the addition of one building unit of 100,000 square feet of space, the first of a total of some 400,000 square feet which the Company will need to meet requirements under the National Defense Program for products now manufactured at Indianapolis. The new building will be rushed to completion so that it may be in service by Jan. 1, 1941.

• • •

POLICE TRANSMITTER

(*Continued from page* 12)

R13—2500 ohms 25 watts—I.R.C. Type DHA
R14—3.5 ohms 10 watt—I.R.C. Type AB
R15—500 ohms tapped at 100 ohms 25 watt—I.R.C. Type DHA

Transformers

T1—Audio output transformer (not part of transmitter)
T2—Input transformer—U.T.C. A-11
T3—Class B input transformer—U.T.C. S-8
T4—Output and modulation transformer—U.T.C. #49289

Inductances

L1—Oscillator tank coil, 15 turns #16 enameled solid copper on 1½" ribbed form 2" long
L2—RF choke—Millen #34100
L3—Frequency multiplier, plate tank coil, 5 turns #10 tinned solid copper 1½" inside diameter, 1¾" long, self supporting
L4—RF choke—Millen #34100
L5—RF choke—Millen #34100
L6—RF choke—Millen #34100
L7—RF amplifier plate tank, 5 turns #10 solid tinned copper 1" inside diameter, 1⅝" long, self-supporting
L8—RF choke—Ohmite Z-2
L9—Filament "A" choke—U.T.C. #49290
L10—RF choke—Millen #34100

Relays

S1—Single pole double throw relay—Staco T25E Type MB
S2—Single pole double throw relay—Staco T25E Type MB
S3—Double pole double throw relay—Staco AMD
S4—Single pole single throw relay normally open—Potter & Brumfield #PRA-1
S5—Single pole single throw relay normally open—Potter & Brumfield #PRA-1
S6—High current relay (part of dynamotor assembly)—Carter Motor Co.
S7—High current relay (part of dynamotor assembly)—Carter Motor Co.
S8—Double pole single throw relay normally open—Potter & Brumfield #PRA-4

Plug-in Jacks

J1—Oscillator plate current—Yaxley #A-2
J2—Frequency multiplier plate current jack—Yaxley #A-2
J3—Final RF amplifier grid current jack—Yaxley #A-2
J4—Primary power ammeter jack—Yaxley #A-2
J5—Final RF amplifier plate current jack—Yaxley #A-2
J6—Class B modulator and speech amplifier plate current jack—Yaxley #A-2

Fuses

F1—35 amp.—Buss fusetron
F2—45 amp.—Buss fusetron
F3—¼ amp.—3AG Littelfuse
F4—¼ amp.—3AG Littelfuse
F5—2 amp.—3AG auto fuse in-line type

Miscellaneous

1001—Crystal—Bliley type MO-2
1002—150 ma. pilot lamp—Mazda
1003—3 terminal polarity reversing strip—Yaxley #114
1004—12 terminal polarity reversing strip—4 Yaxley #114 strips
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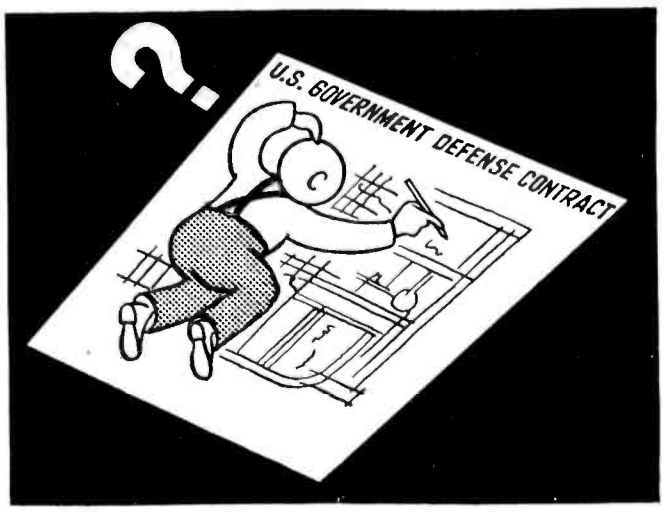
1006—Voice of Safety connector socket transmitter unit—Howard B. Jones #S308AB
1007—Power supply input plug, transmitter end Howard B. Jones #P412AB
1008—Voice of Safety connector plug, cable end—Howard B. Jones #S308CCT
1009—Input connector plug, cable end—Amphenol #MC4M
1010—Relay connector plug, cable end—Howard B Jones #S308CCT
1011—Muting relay connector socket polarized—G. E. #2711
1012—Voice of Safety output socket—Amphenol #PC2F
1013—Remote control connection socket—Amphenol #88-8



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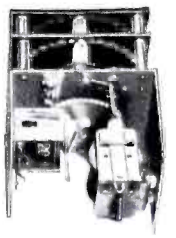

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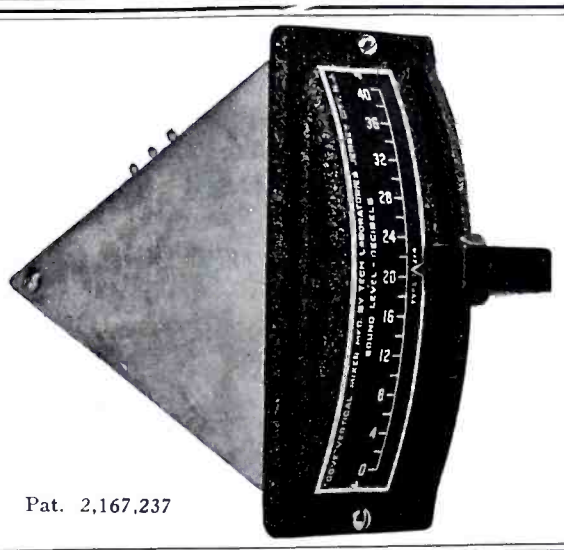

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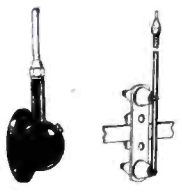

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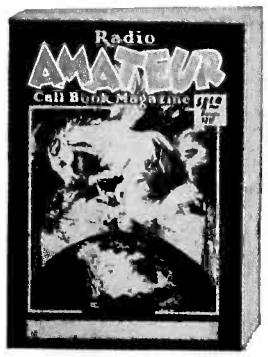

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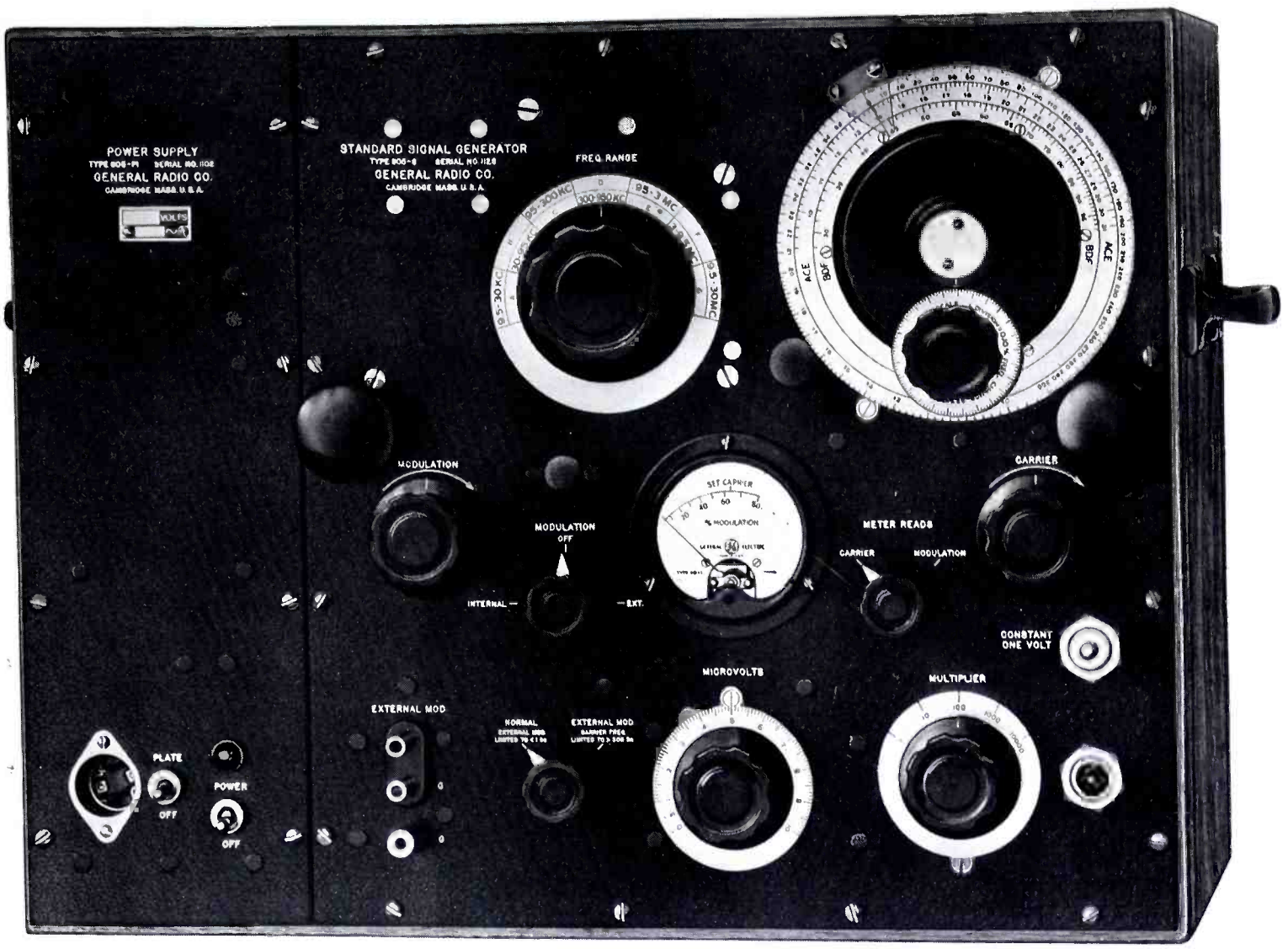

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