COMMUNICATIONS

- ★ RADIO ENGINEERING
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- ★ AN IMPROVED LIMITING AMPLIFIER
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- ★ CRYSTAL PRODUCTION
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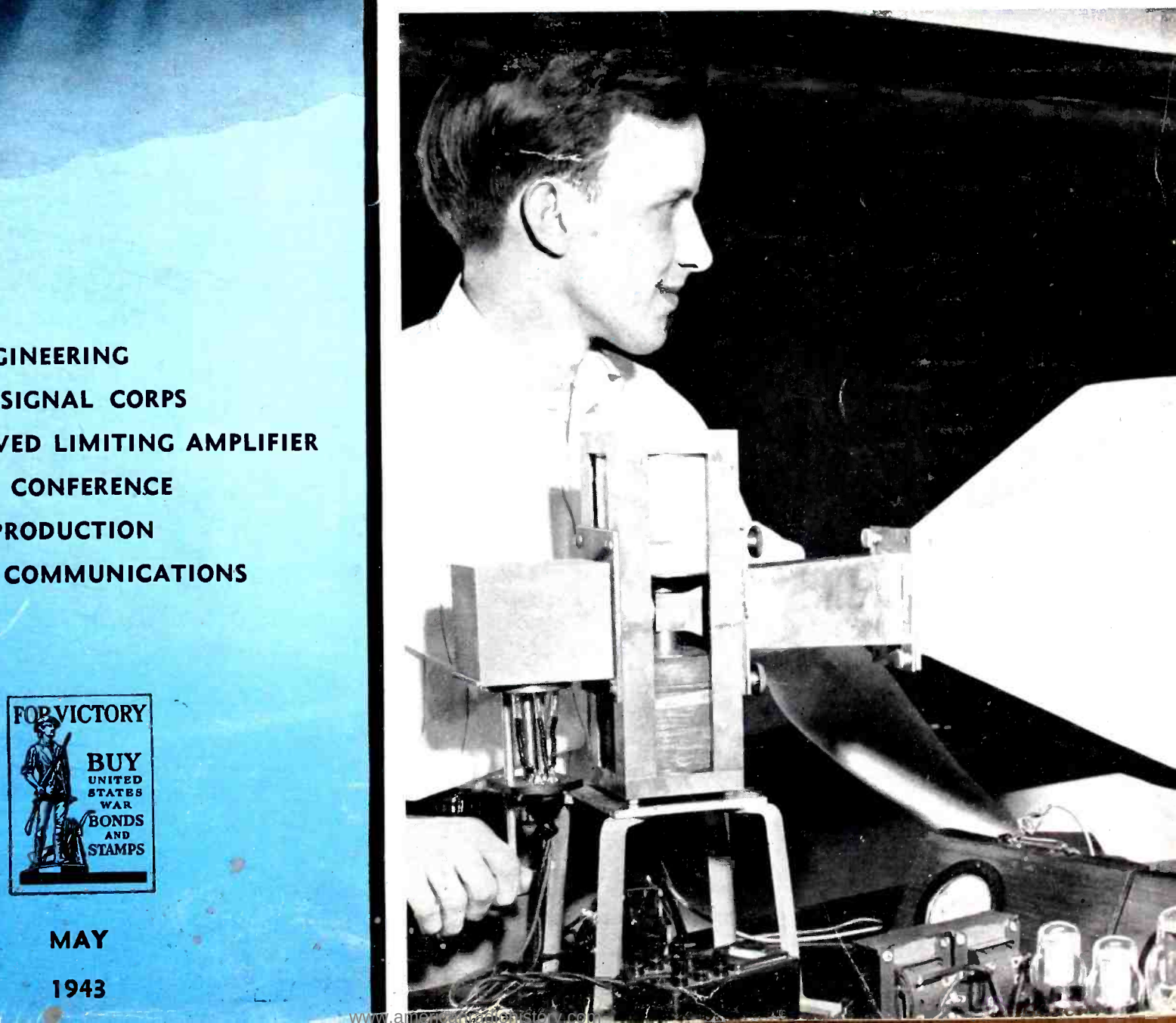

MAY

1943

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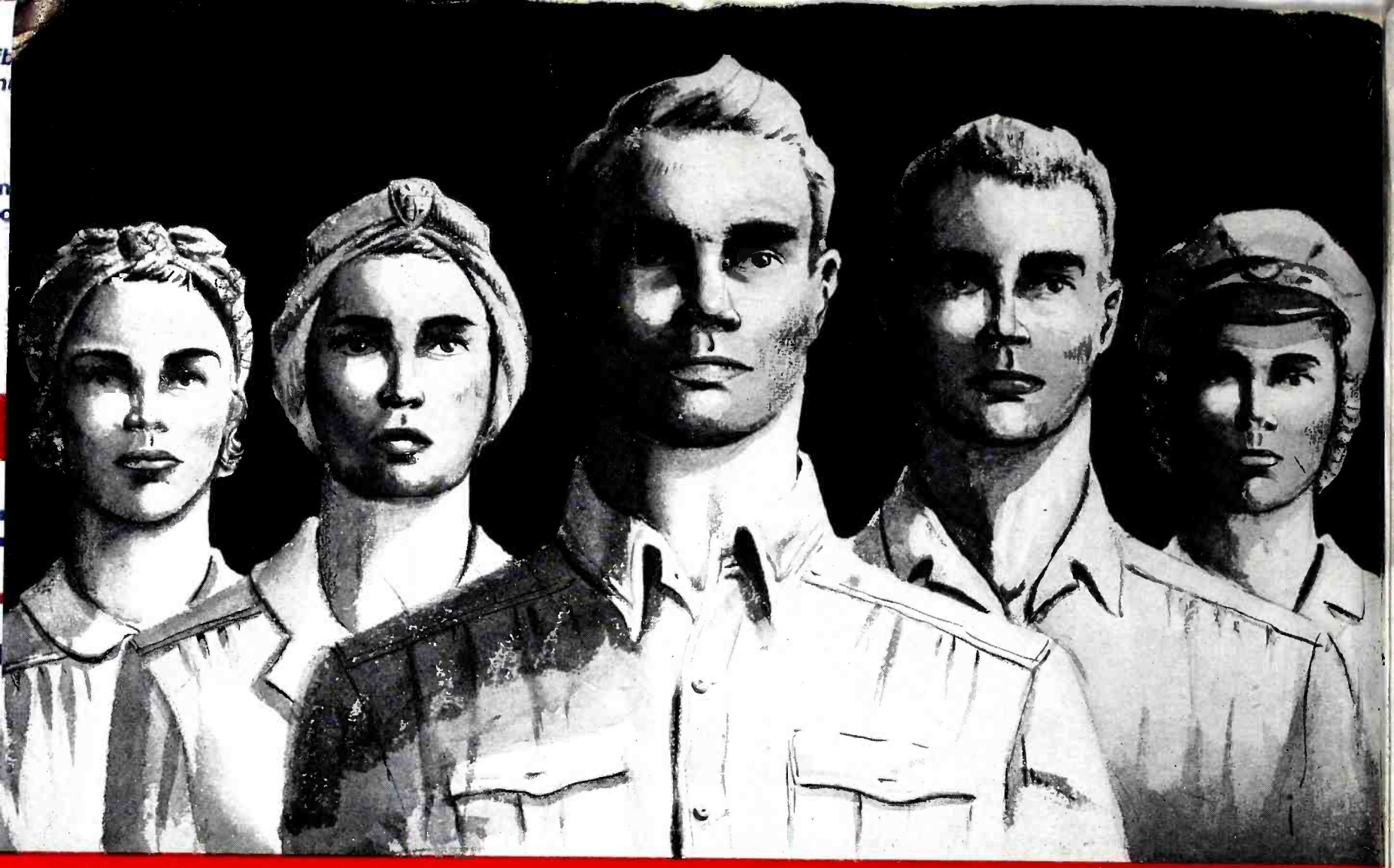

One hundred years old

One solution to the present production problem would be through an increase in manpower . . . made available by prolonging the productive span of human life. Eventually, perhaps, medical science may succeed in accomplishing this "miracle".

Accelerated by war emergencies, Amperex laboratory developments have *already* multiplied the life spans of transmitting and rectifying tubes. These major advancements are *reducing tube replacement requirements and effecting substantial economies in critical fabricating materials, man hours and transportation facilities.*

By building *longer* life into our radio and military electronic tube designs, we are contributing to the solution of the all-important production problem.

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2008 Wartime Essentials

We do stamping, screw machine work, moulding, and general Radio and Signal Corps communications assemblies. Illustrated are but a mere handful of the 2008 wartime essentials which we are now manufacturing. Your inquiries will receive prompt attention.

Now, more than ever, it is important that you keep on buying War Bonds and Stamps.

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PL-122
J-38

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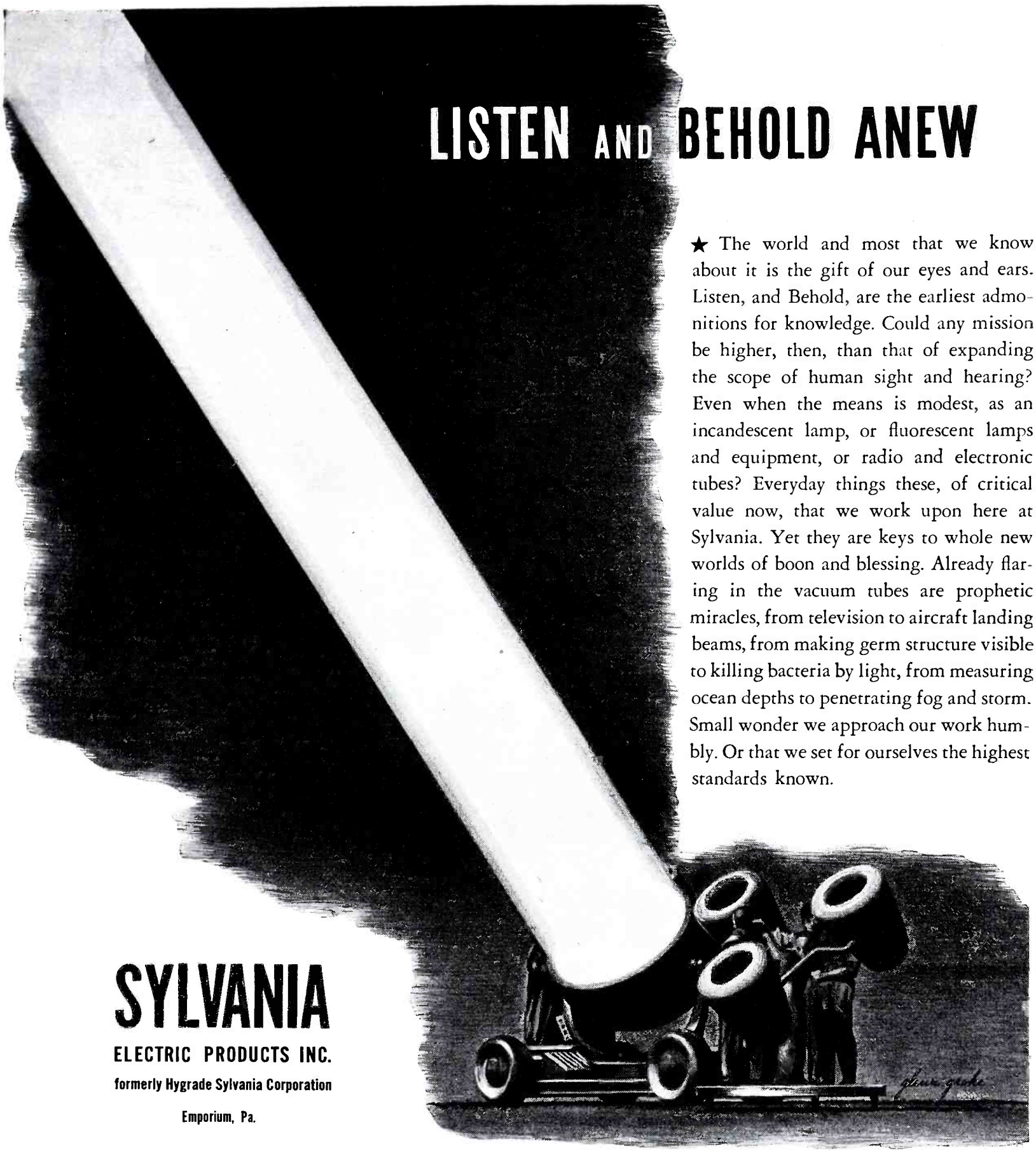

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ELECTRIC PRODUCTS INC.

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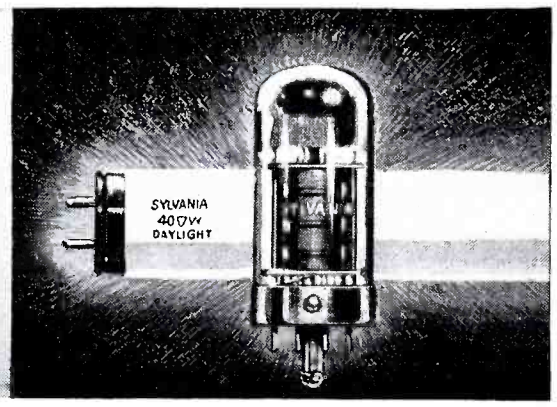

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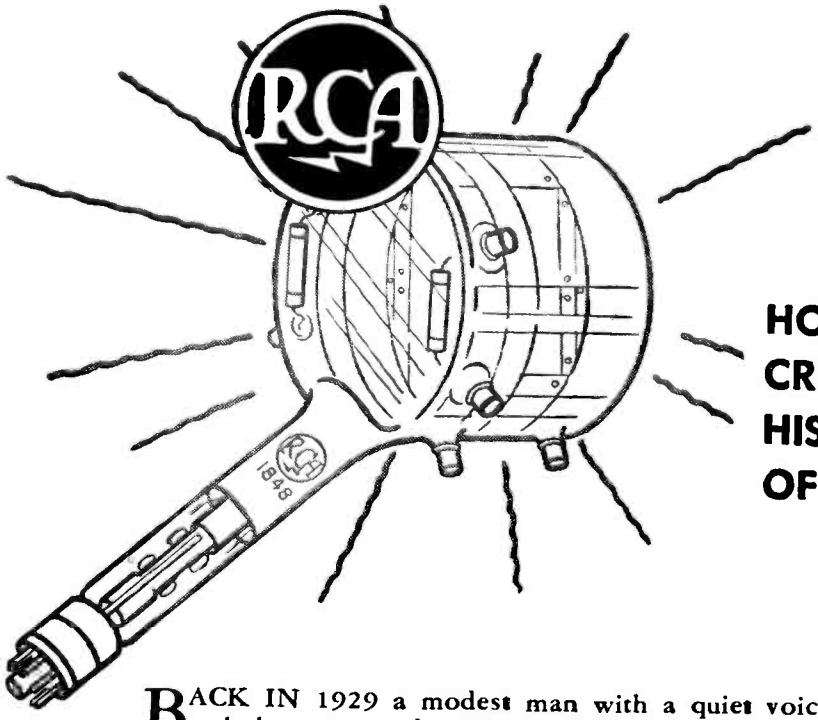

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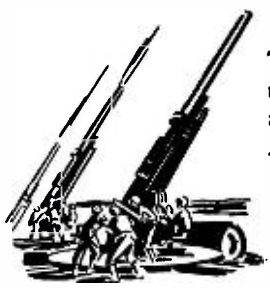

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Yet, from the discoveries, developments and inventions made under the urgency of war, will come greater wonders for the Better Tomorrow of a peacetime world.

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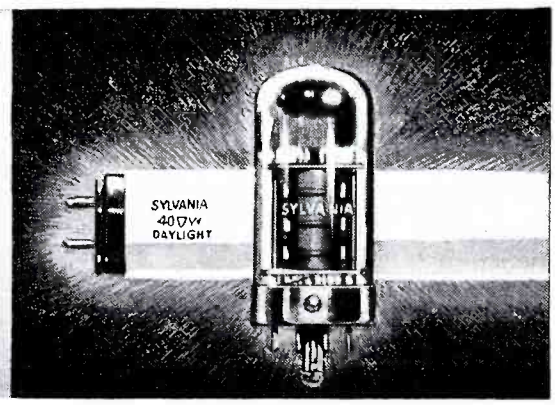

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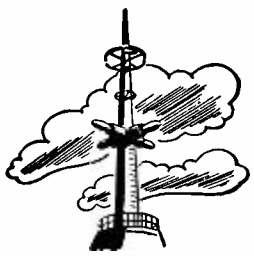

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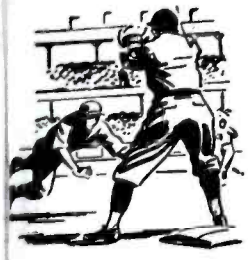

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But you may be certain that as the results of IRC's wide-ranging research are brought from the files they will be found applicable and pertinent to the many challenging demands for new resistance units.

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If you are up against a problem involving resistances, please feel free to call upon us for assistance. Because IRC makes more resistors of more types, in more shapes, for more applications than any other manufacturer in the world, you can depend upon receiving unbiased engineering counsel.

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"Survivors sighted . . proceed to rescue"

Through the blue comes the message that tells men in the air what to do . . . where to go. These messages must not, *cannot,* fail, for the whole operation of our Army and Navy Air Forces depends upon the vital artery, Communications.

Streamlined for this most exacting job, ROLA is devoting all of its facilities and its energies to the production of wartime electronic equipment — transformers, headsets, choke coils, and related devices. And, thanks to its long experience in this field, ROLA has been able to develop machines and methods to speed production, prevent spoilage and improve performance . . . all to the end of better communications for our fighters in the air.

Today, all these developments belong to the War Effort. Later, we are confident, they will be of great significance in the field of peacetime Electronics.

Rola has done an outstanding job, both as prime contractor, and as subcontractor for other manufacturers and it can further utilize its expanded plant equipment, its increased knowledge and skill, in the War Effort. If you have a subcontracting problem, we suggest you write us, or ask our representative to call. THE ROLA COMPANY, INC., 2530 Superior Avenue, Cleveland, Ohio.

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TO HIT 'EM H-A-R-D-E-R

THE year 1943 promises to be the grimmest, hardest year this country has ever faced. Every effort, and every dollar of national income not absolutely needed for existence, should go into war work and War Bonds.

In the Pay Roll Savings Plan, America finds a potent weapon for the winning of the war—and one of the soundest guarantees of the preservation of the American way of life!

Today about 30,000,000 wage earners, in 175,000 plants, are buying War Bonds at the rate of nearly half a billion dollars a month. *Great as this sum is, it is not enough!* For the more dollars made available now, the fewer the lives laid down on the bloody roads to Berlin and Tokio!

You've undoubtedly got a Pay Roll Savings Plan in your own plant. But how long is it since you last checked up on its progress? *If it now shows only about 10% of the gross payroll going into War Bonds, it needs jacking up!*

This is a *continuing* effort—and it needs *continual* attention and *continual* stimulation to get fullest results.

You can well afford to give this matter your close personal attention! The actual case histories of thousands of plants prove that the successful working out of a Pay Roll Savings Plan gives labor and management a common interest that almost inevitably results in better mutual understanding and better labor relations.

Minor misunderstandings and wage disputes become fewer. Production usually increases, and company spirit soars. And it goes without saying that workers with substantial savings are usually far more satisfied and more dependable.

And one thing more, these War Bonds are not only going to help win the war, they are also going to do much to close the dangerous inflationary gap, and help prevent post-war depression. The time and effort *you* now put in in selling War Bonds and teaching your workers to save, rather than to spend, will be richly repaid many times over—now and when the war is won.

You've done your bit  **Now do your best!**

This space is a contribution to victory today and sound business tomorrow by COMMUNICATIONS

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G. E. builds FM's future on these four facts

TRANSMITTERS

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ELECTRONIC TUBES

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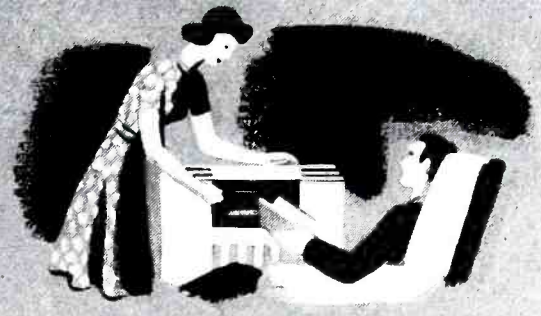
NO OTHER MANUFACTURER OFFERS SO MUCH FM EXPERIENCE

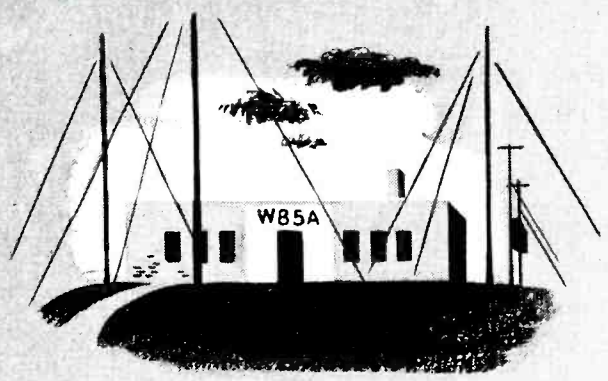
COMPLETE STATION EQUIPMENT

FM · TELEVISION · AM



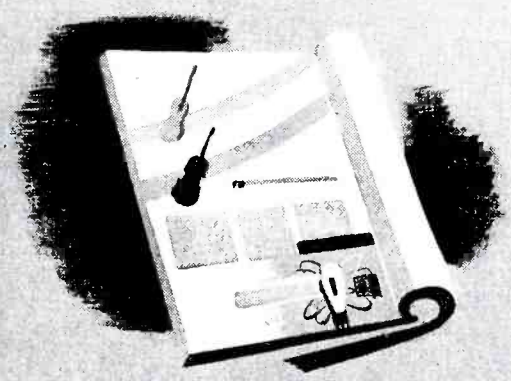
G. E. Builds Both FM Transmitters and Receivers

G.E. is the *only* manufacturer with experience in building the complete FM system — FM broadcasting equipment and FM home receivers. Radio research and volume production for war are yielding new possibilities for further improving FM equipment.



G. E. Has Program and Equipment Experience

Three years of broadcast experience in its own proving-ground Station W85A, Schenectady, will enable G.E. to help new FM stations get started quickly. General Electric's experience also includes equipping more than a third of the 36 commercial FM broadcast stations now in operation.



G. E. is Telling Public the Advantages of FM

A powerful G-E advertising campaign in the nation's big-circulation magazines and the thrice-weekly nation-wide G-E program over C.B.S.—Frazier Hunt and the News — are pre-selling the public on the advantages of FM — and are steadily building an expanding post-war market.

Survey Proves Vast Increase in FM Acceptance

An independent consumer survey reports that: The public already strongly approves FM; 85% call it a definite improvement over conventional broadcasting; present owners of G-E FM receivers are the most enthusiastic of all FM owners! . . . *Electronics Department, General Electric, Schenectady, N. Y.*

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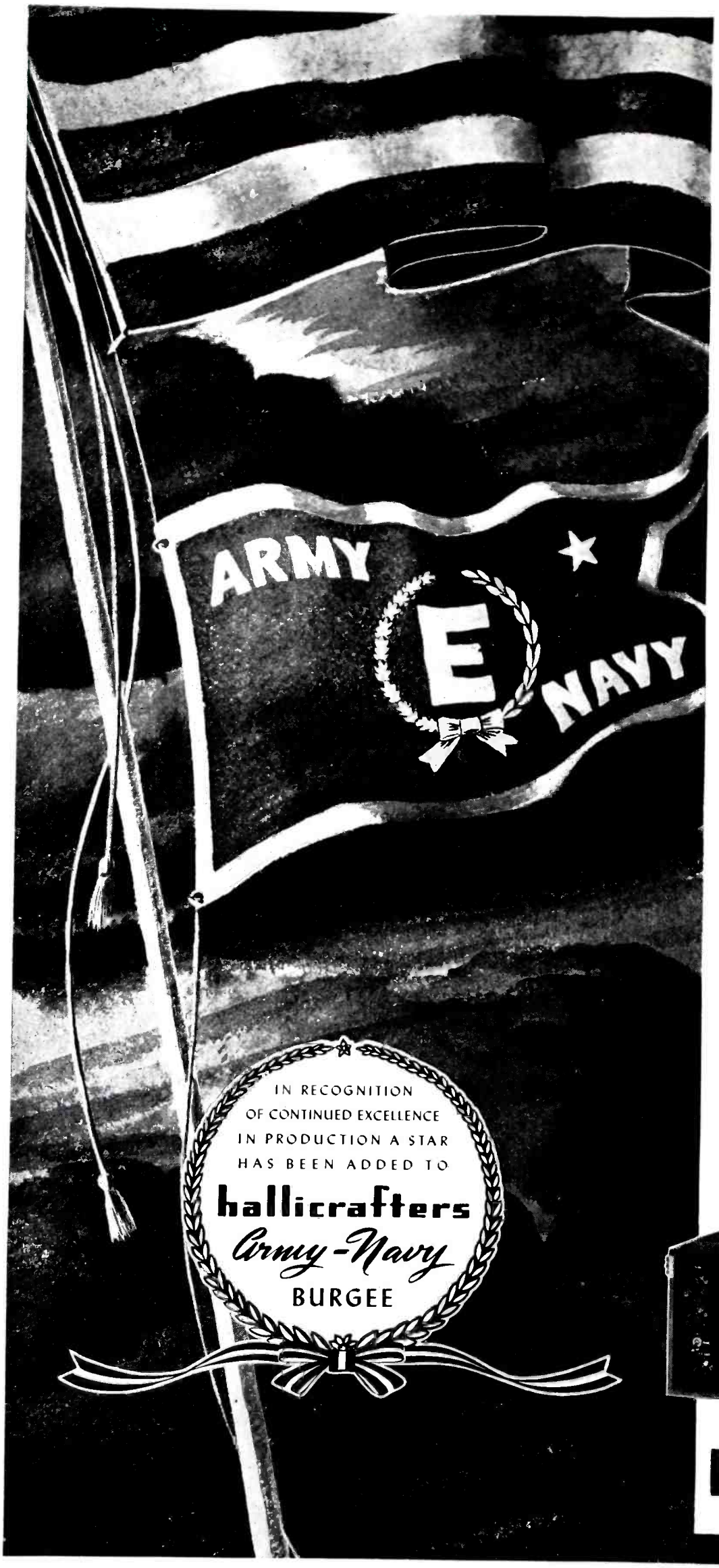

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. . . freedoms that are uppermost in the heart of every American. Workers in industry have toiled unceasingly to build peak production to enable their country to be the world's best equipped fighting forces to protect these freedoms.

The Hallicrafters employees have twice been cited by their country for excellence in production . . . once with the Army-Navy "E" Burgee . . . and now the addition of a star to this Burgee for continued excellence in producing communications equipment so vitally needed by our boys on all fronts.

This new honor will serve as an additional incentive to greater production.

BUY MORE BONDS!

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COMMUNICATIONS

LEWIS WINNER, Editor

* * MAY, 1943 * *

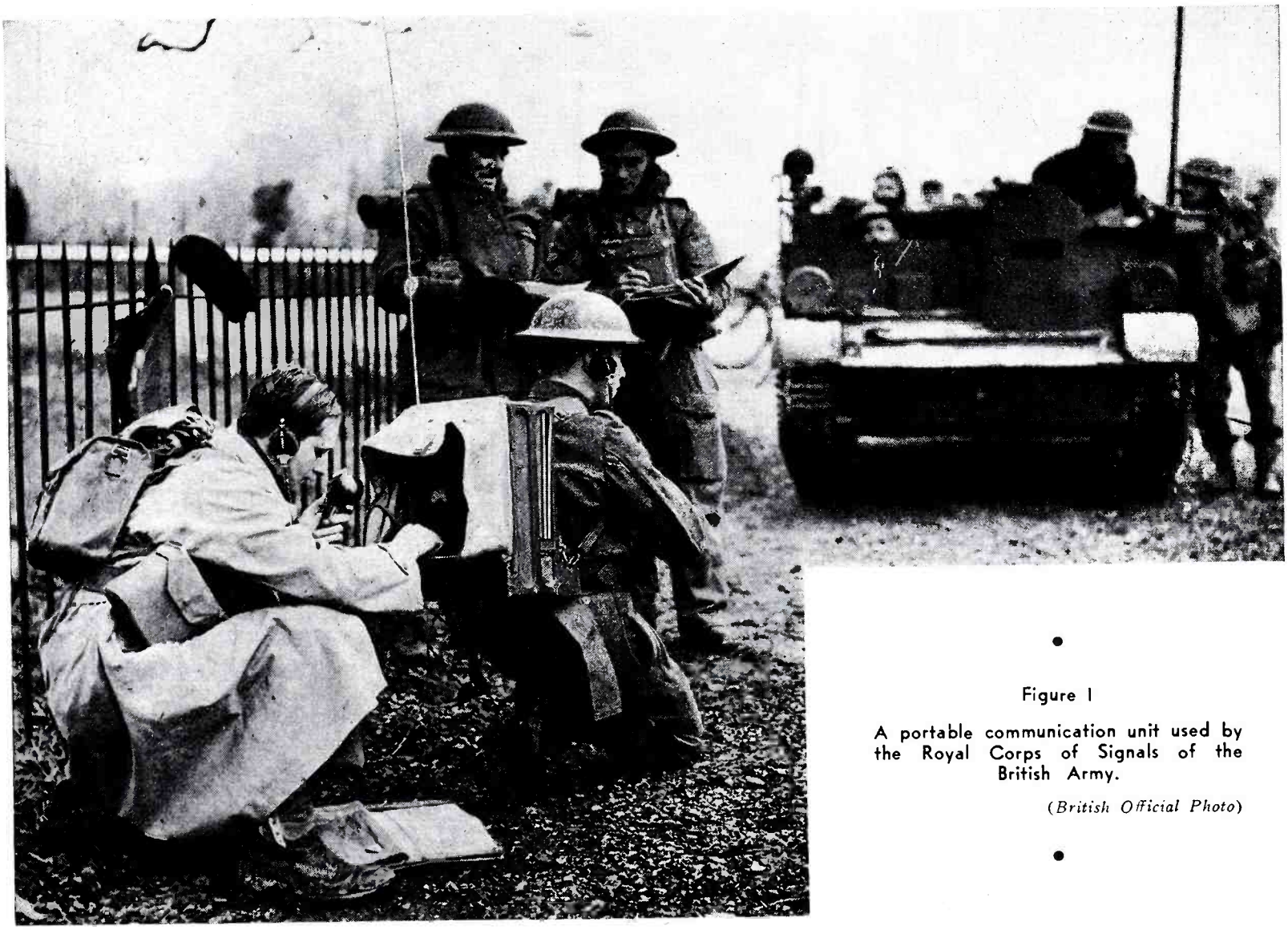

Figure 1

A portable communication unit used by the Royal Corps of Signals of the British Army.

(*British Official Photo*)

BRITAIN'S RADIO SYSTEM

For the Armed Forces

by ROY C. NORRIS

General Editor, Radio Engineering, London, England

IN little more than two years Britain has built up a military radio communication system which enables a general in Whitehall to communicate with Chungking or an officer in Tunisia to direct his paratroops in action.

Army communications in Britain are the responsibility of the Royal Corps of Signals. This corps provides the communications throughout the Army, from the War Office to bases and GHQ overseas, and on through the headquarters of armies, corps, divisions and brigades to the tank regiments, artillery batteries, a-a gun sites, infantry battalions, paratroops and beach landing parties.

The Royal Corps of Signals

The Royal Corps of Signals controls the maintenance and first line repairs of all this equipment, major overhauls being performed at base by the Royal

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(British Official Photos)

Figures 2 (left) and 3 (top)
In Figure 2, we see an infantryman, with the B.E.F. in France, equipped with a pack unit. A communications van, Figure 3, that is used in the new Reconnaissance Corps unit of the British Army.

Electrical and Mechanical Engineers. The Royal Corps of Signals also provide, operate and maintain all land-line equipment for the RAF at headquarters and on airfields. They run a world-wide radio chain to supplement civil communications with Allied capitals, the British Dominions, Colonies and certain outposts. There are further jobs the Royal Signals do, but which are necessarily secret.

Flexible Equipment

Many types of equipment are necessarily used in this huge communication system. Excluding large units corresponding to commercial high-speed long distance equipment, all equipment is made so that it can be operated while on the move. It is manufactured so that easy transportation and manhandling make it suitable for use anywhere on the globe. The largest units are of portable size and every part can withstand either polar cold or tropic heat and humidity.

Equipment is not designed for use by the expert but rather by a man who has been trained in less than six months and has at the same time become, say, a driver or gunner.

Divisional Setup

The complexity of radio communications in the field can be appreciated by a brief outline of a divisional set-up. The commander of the division has his own radio communication vehicle. For safety the many branches of his organization, the engineers, service (supplies) corps, artillery, medical corps and so on, are dispersed over, possibly, an area of several miles.

House Telephone

Each branch of its radio vehicle and all, are in two-way radio telephony contact with the commander's vehicle, by what is called the *house telephone*. At the same time the commander maintains two-way communication with his infantry or tanks and each branch is similarly in control of its units in the field. In one of these vehicles there may be as many as half-a-dozen specialists listening in.

Armored Division Units

To a single division there are several hundred radio sets in an armored division. Allocation of channels is no simple task when an army of several divisions is on the move. In addition, there is the other complicated problem but equally important, of charging and maintaining the hundreds of batteries.

One unit in general use in armored fighting vehicles and reconnaissance regiments consists of three sections. There are an *A* set comprising receiver and transmitter; a *B* set, receiver and transmitter, working on the very high frequencies, and an inter-communicator for the vehicle crew. In a tank the commander uses set *A* for contact with his squadron leader or high officer, or talks over *B* to other vehicles in the troop.

Seven-Watt Unit

The *A* transmitter radiates some 7 watts and has a range of twenty to thirty miles. Incidentally, the African desert is notorious for blind spots. In the unit are a modulator amplifier, master oscillator, frequency-changer, buffer and r-f amplifier stages. The receiver includes an r-f as well as two i-f stages and has a double-diode-pentode for demodulation, avc and small power output.

H-F Transmitter

The high-frequency transmitter in set *B* uses two tubes as oscillator and modulator. These also come into use in the receiver, which by the way is of the super-regenerative type. The receiver contains an oscillating detector followed by quench oscillator, a-f amplifier and output stage. In the inter-

(*Continued on page* 58)

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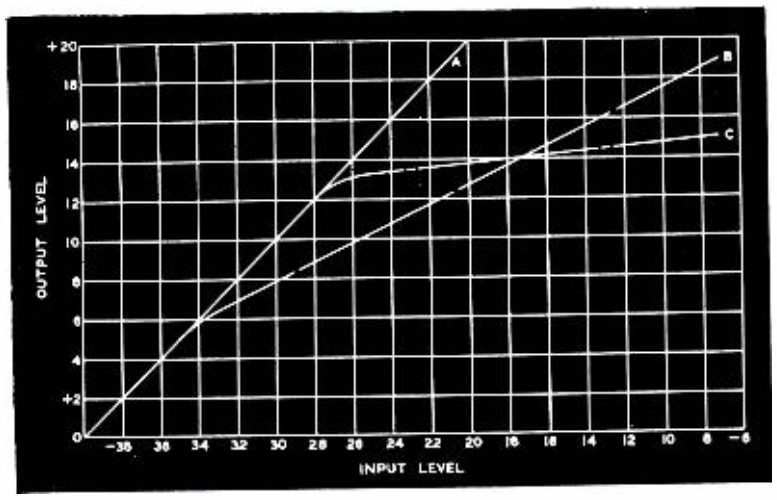

Figure 1

In securing a satisfactory signal-to-noise ratio, the slope of the input versus the output curve beyond the point where limiting or compression takes place is important. Here we see input-output curves for a linear system (A); a two-to-one compression ratio (B), and a ten-to-one compression ratio (C).

A LIMITING AMPLIFIER

With Peak Control Action

by JOHN K. HILLIARD

Altec Lansing Corporation

OF the designing of limiting amplifiers, as of the writing of articles about them, truly there is no end. This paper does not pretend to describe the amplifier to end all amplifiers, but it does describe one in which the principal defects of previous amplifiers have been greatly reduced. These defects are excessive intermodulation or amplitude distortion, and very bad transient characteristics.

In the past, the occurrence of occasional very high momentary peaks in the program material has forced the mixer operator to run at a very low average power level, with correspondingly poor signal-to-noise ratio. If the mixer is sufficiently familiar with the program and sufficiently alert, he can anticipate these peaks and can compensate for them to some extent, but successive recordings of identical material by even the best operators will show variations in level of several db due to the change in delivery effort by the artist.

Imperfection of Human Operator

This imperfection of the human operator has forced the development of apparatus which will suppress the high peaks while causing the least possible distortion of the remainder of the program. A peak clipper, such as a biased full-wave rectifier across the circuit, will prevent overmodulation without distorting the signal *except during the peak.* But in so doing it generates a sudden blast of high-frequency components, so that the remedy of peak-clipping is far worse than the disease of overmodulation. Another solution of the problem is the compressor, with its conjugate the expander, which compress the whole useful volume-range by a factor of two or three; but for most purposes a useful degree of compression demands a corresponding expansion before reproduction, and it is not usually convenient to incorporate an expander into each reproducing system. For recording and broadcasting, at least, we need a device which will act as a true linear amplifier up to within a few db of overload, and then will compress the rest of the possible input volume range into those few db, while introducing as little distortion as possible.

Signal-to-Noise Ratio

Where the signal-to-noise ratio is important, the slope of the input versus output curve beyond the point where limiting or compression takes place, is important. In Figure 1 appears the input-output curve for a linear system *A,* a 2:1 compression ratio *B,* and a 10:1 ratio *C.* With the load characteristic of curve *C,* it is possible to increase the average modulation without danger of overmodulation as compared with curve *B.* This sharper limiting action provides better protection against absolute overload than the lower compression ratio curves.

In Figure 2 we have the diagram of the limiter amplifier. The first stage contains variable-mu tubes of the 6L7 or 1612 types; the second is a conventional pentode resistance-coupled stage; and the third, or power stage, is beam-powered, using 6V6GT tubes.

There are several reasons for the selection of the 6V6GT as an output tube in preference to other tubes such as the 6L6, 6F6, 1622 or equivalent tubes. Exhaustive tests of this series of tubes have proved that the 6V6GT has several superior features not found in other tubes, and yet it has approximately the same maximum power for class *A* operation. Where some amplification is desirable after the power stage, the 6V6GT is 10 to 20 db quieter than any of the other tubes in terms of tube hiss, cathode sputtering, and general microphonics.

Tube Uniformity

It has been observed also that the uniformity among tubes as to plate-current balance is exceptionally good. This tube will settle down in approximately 1 to 2 minutes after the power is applied, whereas other tubes of the group will require approximately 10 to 15 minutes to become stable, from the standpoint of hiss and general quietness of the mechanical parts that produce random pops. The manufacturer of these tubes has recently indicated that many important changes have been made in their design that tend to produce this outstanding qual-

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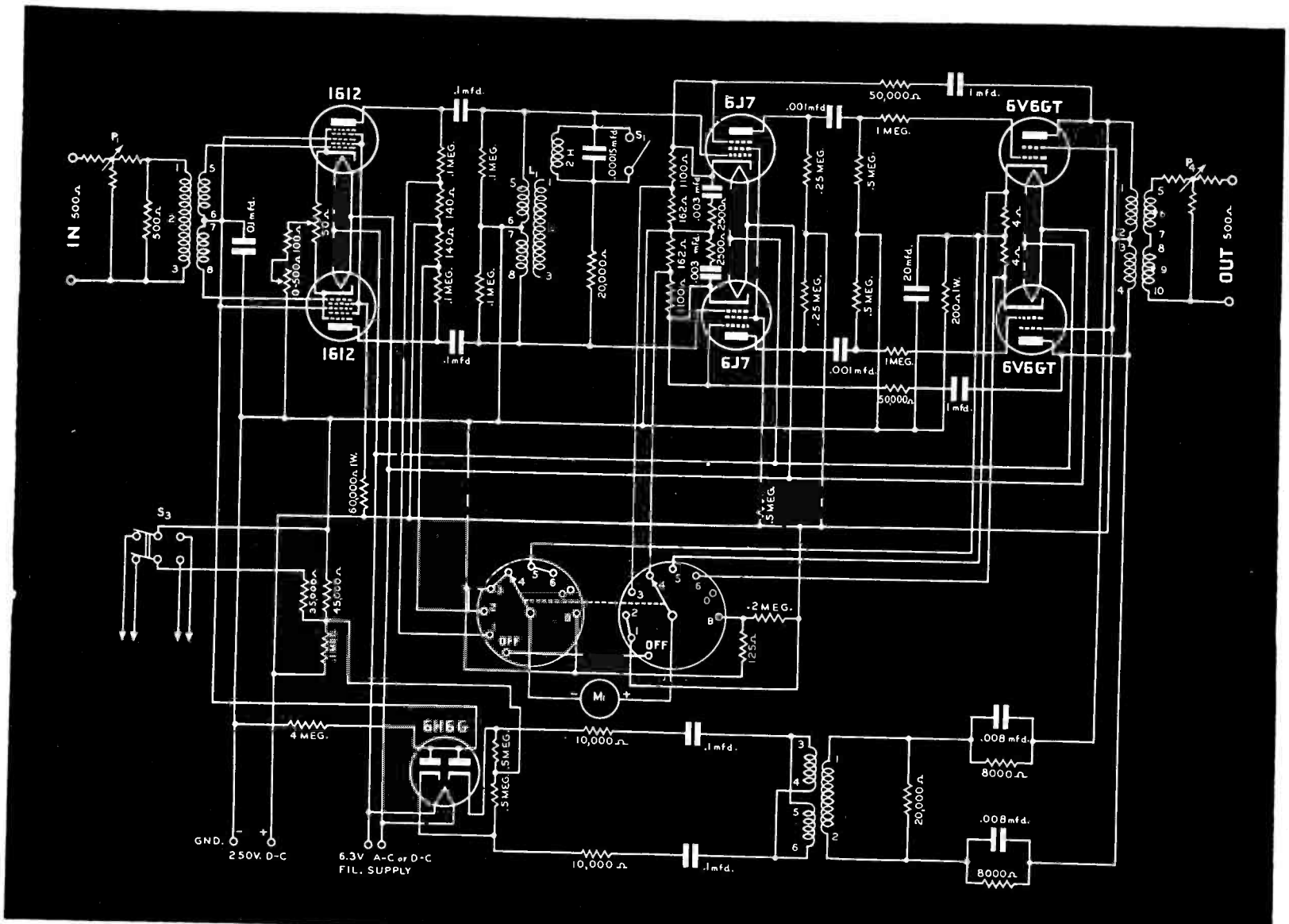

ity. The gain of the amplifier is approximately 64 db.

The rectified control-voltage is supplied by a 6H6G tube. It has been found necessary to use the glass equivalent where the rectifier is intended to operate at an impedance greater than one megohm. The metal equivalent has sufficient leakage above one megohm to change the threshold bias normally used.

Tube Balance

A balancing potentiometer has been provided in the cathodes of the variable-gain stage so that the tube characteristics may be accurately balanced in a dynamic state. Between the variable-gain stage and the second stage of amplification inductances are provided from each grid to ground, mutually coupled to each other. Thump frequencies, introduced by the action of the rectifier circuit in changing the gain of the system, are then cancelled by the mutual action of the coil. This is possible because the thump frequencies are longitudinal and so appear with the same polarity on each grid. This coil, for best cancellation, should be well balanced, with low effective

Figure 2

The limiter amplifier. P_3 and P_4 are 500 ohm potentiometers with 30 steps, 1 db each. S_3 links to the threshold control relays. All resistors are of ½ watt, unless otherwise indicated.

winding resistances. For the transmission of the wanted signal, the inductance coil is a series-aiding shunt from grid to grid, and gives no appreciable bridging loss. The thump component is also reduced by using a high threshold voltage on the rectifier.

Oscillograms

Oscillograms showing release times for limiting interval are shown in Figure 4. The time required for limiting to take place when the amplifier is subjected to a 5,000-cycle tone 10 db beyond the limiting point as indicated by the meter, is shown in *A*. It will be observed that the first cycle has an overshoot of approximately 3 db. At the end of the third cycle the amplitude is approximately 90 per cent of the final value. Each cycle is relatively free from any objectionable transient, which indicates its ability to transmit a square-wave signal.

High A-F Frequency Selected

Since the time of operation is extremely short it was necessary to select a frequency as high as 5,000 cycles so that the operating condition could be accurately estimated. This condition was measured with a 40-volt threshold bias, which corresponds to a 10:1 compression ratio.

C, in Figure 4, corresponds to a 2:1 compression ratio, which is approximately a 5-volt threshold bias. More overshoot is observed with a superimposed low-frequency component than that of the higher threshold bias.

In *B* is a measure of the release time of the amplifier, obtained by supplying 500 cycles, 10 db, into compression and then instantly changing the gain to zero compression. Each vertical white line indicates a .01-second.

D shows the release time for a 2:1 compression ratio, which indicates a higher superimposed low-frequency thump.

Since the degree of balance in the push-pull stages determines the cancel-

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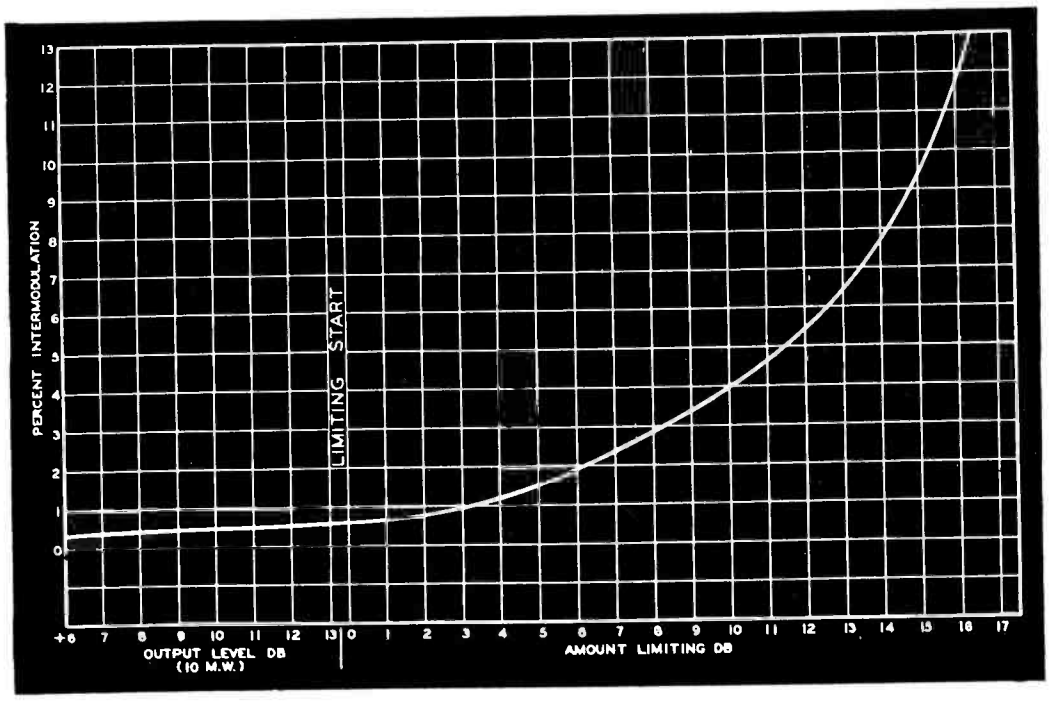

Figure 3

Intermodulation curve of the limiter amplifier, which has a gain of 64 db.

lation of the rectifier components, measurements must be made at frequent intervals. The simulation of the transients occurring in the signal is produced by a test unit.

For the test, a 7,000-cycle oscillator is keyed at a 2-cycle rate by an electronic switch (Figure 5). The output of this interrupted 7,000-cycle generator is transmitted through a 5,000-cycle high-pass filter which removes all frequencies below the filter cut-off. The limiter amplifier under test is then provided with sufficient 7,000-cycle power to operate the limiter into 5 db of limiting. The output of this amplifier is then passed through a 200-cycle low-pass filter to remove the 7,000 cycles. The remaining signal is then amplified and measured on a volume indicator. With a properly adjusted limiter, these components, set up by the 7,000-cycle transient, are a measure of the unbalance. An average value of 55 db below the limiting point, is maintained for operation up to 5 to 10 db of limiting.

Meeting RMA - NAB Standards

The use of the pre-equalized channels for film and disk recording using the *NAB-RMA* orthoacoustic standard, involves certain changes to avoid overloads at the higher frequencies when their amplitudes become excessive.

Pre-equalizer Placement

If the pre-equalizer, which raises the high frequencies, is placed ahead of the limiting amplifier, the signal-to-thump ratio is less than can be achieved by placing the pre-equalizer after the limiting amplifier. The thump energy, being composed principally of very low frequencies, is introduced into the main circuit at a point where the maximum low-frequency amplitudes are being transmitted. And for

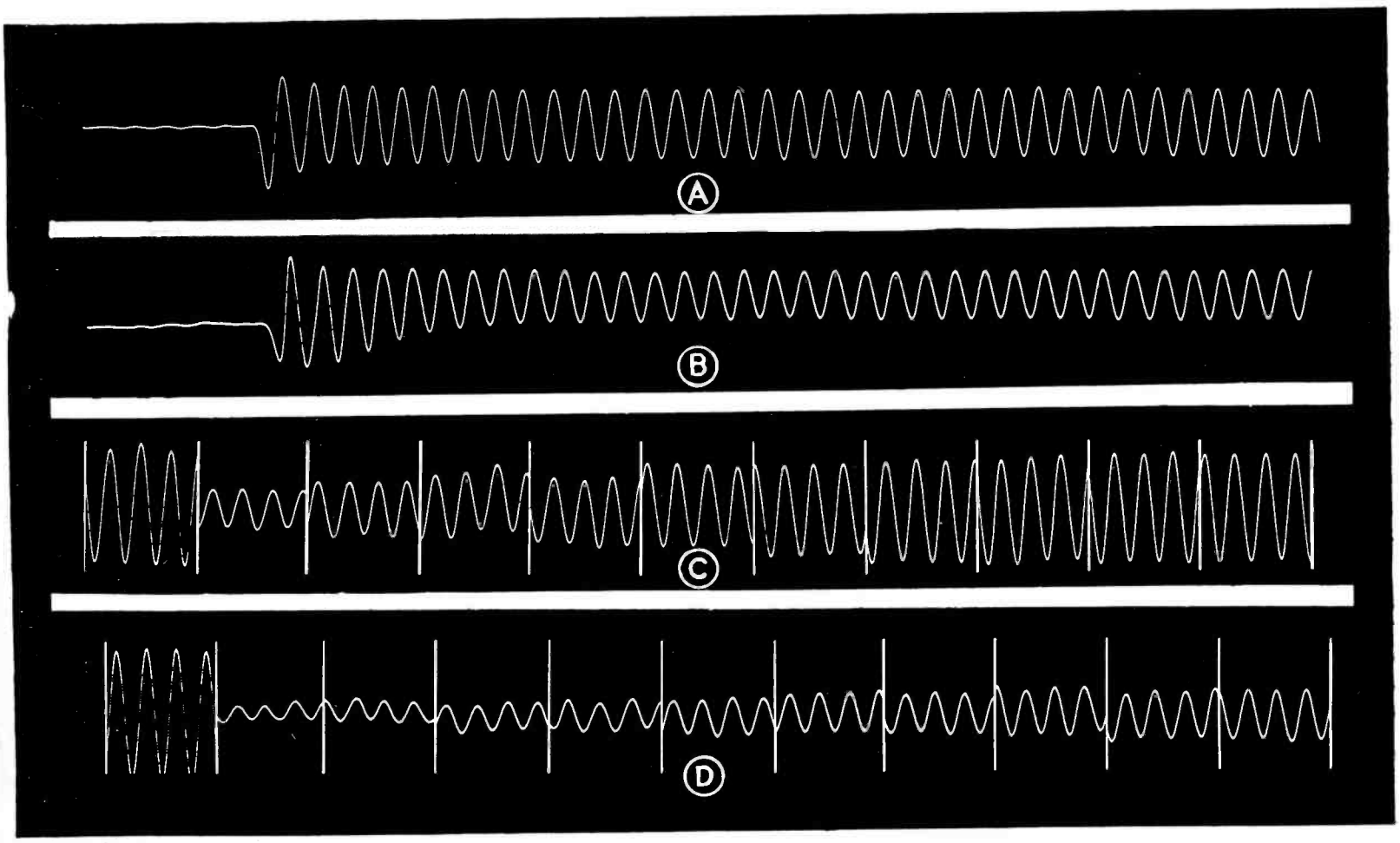

Figure 4

Oscillograms, showing release times for limiting intervals. At (A), the time required for limiting to take place when amplifier is subjected to a 5,000-cycle tone, 10 db beyond limiting point. In (B), we have a measure of release time at 500 cycles, 10 db; (C), a two-to-one compression ratio, and, (D), release time for a two-to-one compression ratio. Each vertical line indicates a .01 second.

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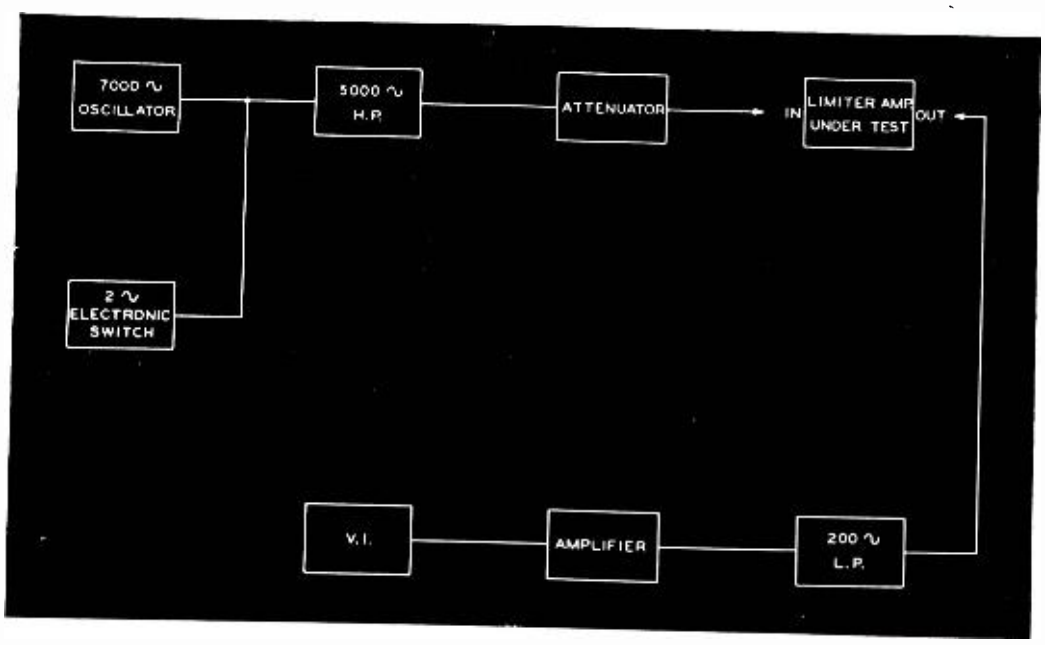

Figure 5

To test the amplifier, a 7,000-cycle oscillator is keyed at a 2-cycle rate by an electronic switch. The output of this interrupted 7,000-cycle generator is transmitted through a 5,000-cycle high pass filter which removes all frequencies below the filter cut-off. Sufficient 7,000-cycle power is provided to the amplifier under test to operate the limiter into 5 db of limiting. Amplifier output is passed through a 200-cycle low-pass filter to remove 7,000 cycles. Remaining signal is then amplified and measured.

this reason the ratio of signal-to-thump is as high as possible.

Insertion Loss Correction

With the equalizer after the limiting amplifier, additional carrying capacity is needed to overcome the insertion loss of this equalizer at low frequencies, and the ability to limit all frequencies to conform with the 100 per cent modulation point is lost. In order to provide sufficient margin from signal to thump, so that the 50-db range can be maintained without critical balancing, this equalizer has been placed between the variable-mu stage and the second stage (Figure 2).

Compensating Equalizer

An equalizer is provided also in the rectifier circuit to compensate for the characteristic of the recording modulator so that the rectifier current would have the same characteristic as the modulator for all recorded frequencies. In this manner peaks in light-valves, galvanometers, and recorders may be compensated for, so that under no condition will it be possible to overload the modulator.

Interrelated Amplifier Properties

The design of a peak-limiter amplifier is complicated by the fact that three fundamental characteristics of the amplifier are interrelated in such a way that a change of one modifies the others. These characteristics are: (*1*) The operate time, or time required to reduce the gain. (*2*) The release time, or time required to restore the gain to normal. (*3*) The shape of the input versus output curve after compression begins.

Reducing Thump

Thump is rendered negligible by making the loss in the audible frequency band of the rectifier circuit as high as possible. This is accomplished by arranging the condenser charge and discharge circuits of the rectifier so as to assume the proportions of a low-pass filter. As a result, the loss through the circuit varies with the product of the operate and release times.

Stability Problems

Stability of the unit is provided by the input balancing potentiometer, the shunt inductance interstage, and the electrical balance of the input and output transformers. Thirty-db feedback is provided in the last two stages, which reduces the gain to the minimum, so that the signal-to-thump ratio at the input will be as great as possible.

Peak-Controlled Action

The action of the limiting amplifier is peak-controlled. This means that the gain change is proportional to the peak voltage from the rectifier in the same manner as in a peak-operated volume indicator, whereas the ordinary volume indicator is average-operated. The peak factor, or the ratio of peak-to-average value in a sound signal, may be as high as 8 to 10 db. For this reason this unit will show limiting action 8 to 10 db before non-peak indicators, even though they are set up to read alike on a sine-wave calibrating voltage. In general, peak operation in d-c control circuits is achieved by allowing the rectifier to charge a condenser from low-impedance source, so that the grid-leak and grid-condenser combination has a large R/X ratio.

Benefits of Amplifier

The use of the limiting amplifier over the past year in large-scale productions has shown the benefits to be gained. The mixer operator can now concentrate his efforts upon other important phases of his work, such as balance and acoustical conditions, without the constant worry of overmodulation. As a result, mixing to anticipate changes that may or may not come is avoided and the maximum signal is always recorded.

High Peak Factors

Material having a high peak factor, or transient, such as applause, gun shots, noises of kitchen utensils, and general sound-effects, shows a very distinct improvement with this device. The modulator is not subjected to peaks 10 to 20 db beyond its rated capacity, and as a result damage to it is now negligible.

Peaks and the Ear

Peaks up to 5 db can be limited without being apparent to the ear, which makes possible the full use of pre- and post-equalization without the high-frequency overload that might otherwise occur from time to time. One has only to compare recordings made with and without the limiter amplifier to realize instantly the benefits obtained. And now the long-dreamed-of day has arrived when it is not necessary to *ride gain* constantly and to have *mixer's itch,* to perform the duties of turning in well recorded material.

As we stated earlier, this device is equally applicable to recording or broadcast station, requiring of course such mechanical and electrical adjustments peculiar to either of these systems.

The amplifier has a particular advantage today, since it requires a minimum of attention and can be operated effectively by those who might not have too complete a technical education.

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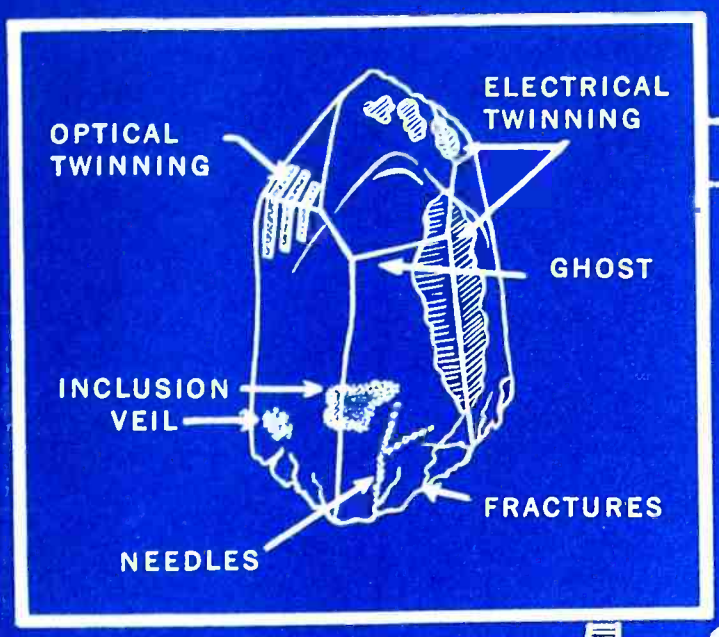
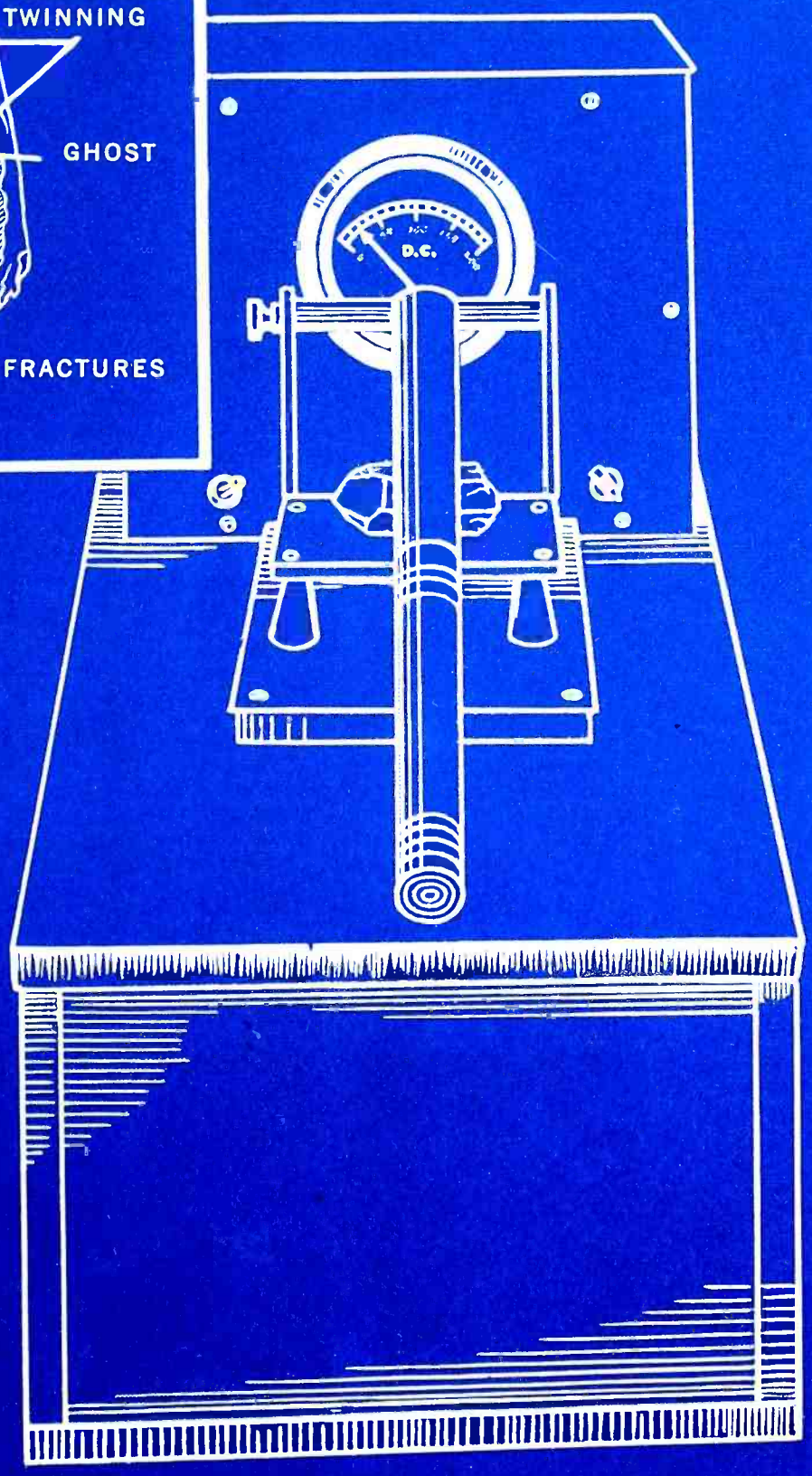
DETERMINING THE POLARITY OF THE X-AXIS OF A CRYSTAL



COMMON IMPURITIES IN THE MOTHER OR NATURAL CRYSTAL CAN BE DETECTED WHEN A LIGHT IS PASSED THROUGH THE CRYSTAL.



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A REPORT ON THE NAB

by LEWIS WINNER

Editor

THE sombre business of war headlined the annual NAB Conference that was held at the Palmer House in Chicago, April 27 to 29. Engineers and sales executives from stations, large and small, and from hundreds of cities and towns, crowded the meeting rooms to hear about the state of the industry, today and tomorrow. They listened to such authoritiies as Lawrence A. Appley, Lieutenant-Commander P. H. Winston, Lindsey Wellington, Frank McIntosh, Elmer Davis, James Lawrence Fly, Brigadier-General E. E. Stoner and W. M. Newton discuss manpower . . . materiel . . . censorship and our needs of tomorrow. They heard of many problems we face, problems which may curtail many a *as-usual* procedure, particularly insofar as manpower is concerned.

Discussing the acute problem of manpower, Lieutenant - Commander Patrick H. Winston, assistant executive of Selective Service, pointed out that the industry must not be lulled into any false sense of security by the mere fact that it is considered an essential activity. Broadcasters must train new employees, particularly women, as their contribution to the war effort, he added.

The seriousness of the manpower shortage was also described by Lawrence A. Appley, executive director of the War Manpower Commission. He described the immediate problem as one of distribution requiring, accordingly, a source of labor supply.

The methods used by the British Broadcasting Company to solve the manpower problem were discussed by W. M. Newton.

He pointed out that England has found women to be exceptionally effective in all types of posts, ranging from technicians in the studios, to the more difficult positions at the transmitters. According to Mr. Newton, the maintenance and operations division of the BBC now have over 25 per cent of their staff filled by women, whereas before the war, not a woman was employed in any of these posts.

It has not been too difficult either, to train the women, Mr. Newton pointed out. There are several procedures that are followed. An initial course, a very simple four-week affaiar which is basic and covers fundementals, is first given. During this period the elemental principles of electricity and magnetism are taught. At the conclusion of this course a more advanced schedule of study is given. This program covers specialized study of work at transmitters or recording or studio control. At the conclusion of these

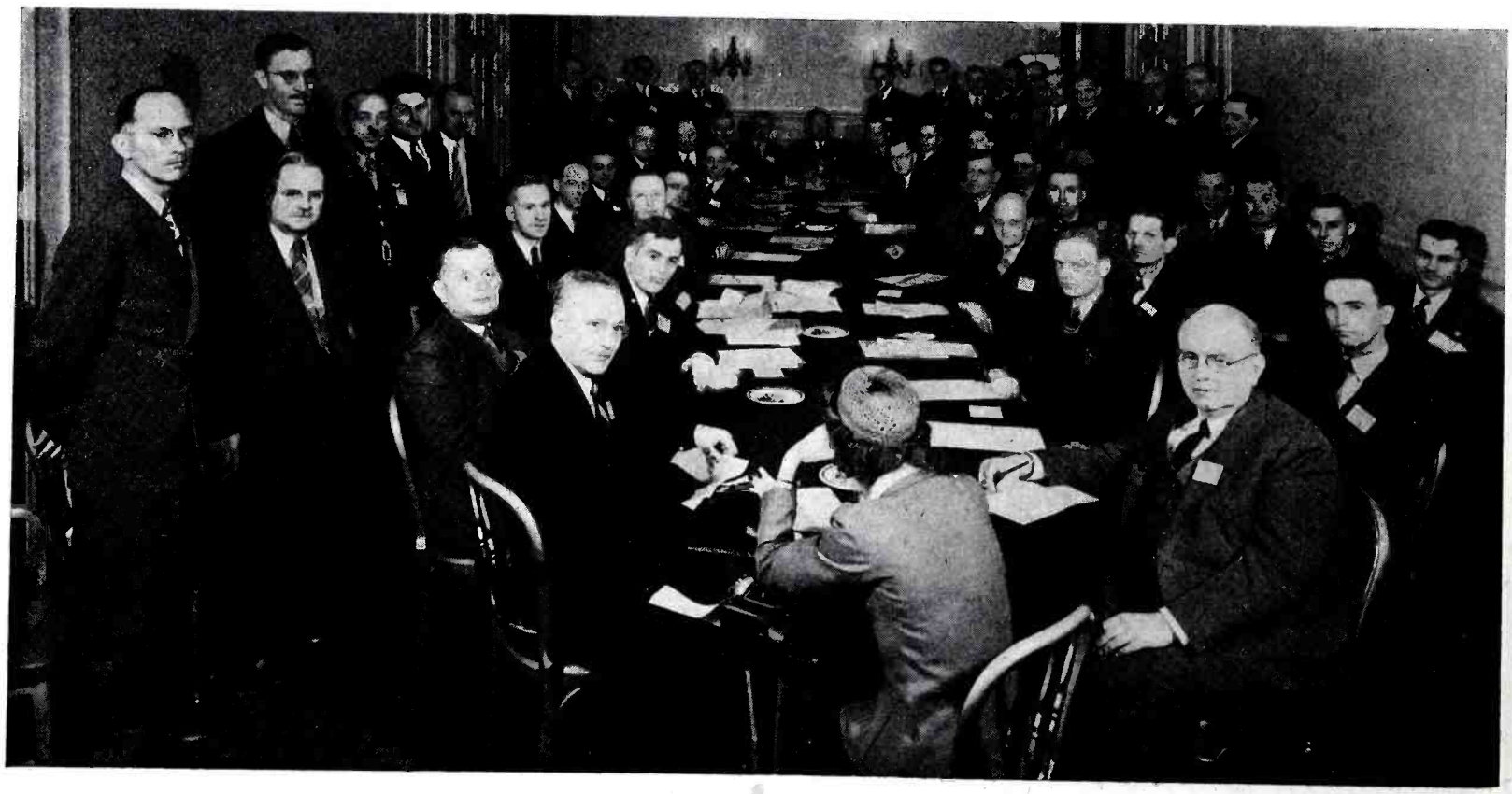
•

At the NAB engineering meeting in Chicago, held in conjunction with the War Conference. Standing in first column at left, from front to rear: E. L. Gemoets, KTSM; M. R. Mitchell, WJR; Wilbur E. Hudson, WAVE; Lt. Col.L. McC. Young, A.C., KMOX; J. F. Novy, WBBM; Harry Harvey, KMOX; Charles F. Quentin, WMT; Frank A. Dieringer, WFMJ; Kirby Smith, KBUR; Herbert F. Tank, WWJ.

Second column, seated, front to rear: George J. Podeyn, WHJB-KQV; Roy C. Corderman, OWI; John Creutz, WPB; F. H. McIntosh, WPB; H. S. Frazier, NAB; Harry E. Adams, WIBC; Herman D. Taylor, WTIC; Italo A. Martino, WDRC; O. B. Hanson, NBC; J. J. Beloungy, WBT; E. K. Cohan, CBS; Charles W. Wirtanen, WIBM, Inc.; Ted A. Giles, WMBD.

Third column, seated, front to rear: Franklin M. Doolittle, WDRC; Robert Morrison, WMRN; Ernest L. Adams, WHIO; C. F. Daugherty, WSB; Karl B. Hoffman, WGR-WKBW; N. J. Richard, WISN; George P. Rankin, Jr., WMAZ; L. L. Lewis, WOI; G. P. Adair, FCC; A. Friedenthal, WJR; Fay Gehres, WGBF; Robert J. Sinnett, WHBF; A. D. Ring, Secretary, Committee IV—BWC.

Fourth column, front to rear: Robert A. Dettman, KDAL; Victor H. Voss, WIND; Walter F. Meyers, WJJD; Leonard T. Carlson, WKBB; George M. Lohnes, Jansky & Bailey; Royal V. Howard, KSFO; C. M. Jansky, Jr., Jansky & Bailey; D. W. Gellerup, WTMJ; EdwardW.Jacker, WAIT-WGES-WSBC; Cecil E. Smith, KUOA; William J. Harris, WCHS; Perry W. Esten, WGRC; Wayne N. Cook, WCAR; Bernard C. O'Brien, WHEC.



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WAR CONFERENCE

riods of training, full time duties e assumed by the women. However, certain portion of their working urs is devoted to additional train-g. Mr. Newton explained that women om 25 to 35 proved most able for this ork.

nerican Woman Power

The American *womanpower* situa-on was discussed by Judith Waller NBC in Chicago. Miss Waller, one radio's veterans, having been in dio since 1922, pointed out that the aining of women in America has ined much momentum during the st six months. She has been co-erating with Northwestern Univer-y where special courses are being ven for the training of women tech-cians. She pointed out that Stan-rd University and the University of lifornia will probably also set up milar courses. At Northwestern niversity, courses run six days a eek and six hours a day for approxi-ately six to eight weeks.

The successful women training ograms of many stations were also scribed by various members of the oadcast industry. Many stations ve already employed women as tech-cians, operators and even engineers, ite successfully. As a matter of fact, two stations, women are now oper-ing 5-kilowatt stations.

AB and FCC Manpower Programs

To assist stations in solving their anpower problem, both the NAB and e FCC have introduced interesting ograms. The NAB, for instance, has gun recruiting technicians, not pres-ntly employed in the broadcast in-stry. Persons who are available r employment as broadcast techni-ans have been asked to write to the ngineering Department of NAB and ate their qualifications. Thus far substantial list has been compiled. tations who are in need of replace-ent technicians and who cannot find em locally have been urged to write the NAB Engineering Department r names of several available appli-nts. The NAB information on each plicant includes radio background, ducation, age, sex, draft status, avail-bility for full or part-time work, op-rator licenses, and geographical pref-rence.

The FCC may soon publish a list of perators licensed. Such lists may ap-pear monthly. This information will be available to stations and will include the names of operators licensed during the past five years.

Frank McIntosh (left), assistant director, Radio and Radar Division, WPB, discussing matériel problems with your Editor at the War Conference.

Home Receiver Repair

Another manpower problem discussed concerned the repairman engaged in servicing home receivers. Since home receivers constitute an important factor in the broadcast program, their maintenance is quite an essential element. While in some areas receivers are being maintained satisfactorily, there are many locations where receiver maintenance is poor due to the lack of manpower. To solve these problems, broadcast stations may have to become service stations. It is not the desire of the stations to enter this business but in view of critical conditions in certain areas they may have to introduce some program to alleviate servicing problems. Some stations have already introduced programs involving receiver exchange, routing the defective receiver to either a staff mechanic or repairman in another area not within easy reach of the consumer.

Materiel Situation

The surprise news at the conference was that the materiel situation was quite favorable. In analyzing the situation, Frank McIntosh, assistant director, Radio and Radar Division, WPB, said that the cooperative efforts of everyone has resulted in a very satisfactory status of materiel. The authorization of reduction in power has materially reduced requests for such components as condensers and resistors and tubes, he explained.

Shortages of copper and molybdenum are, of course, still curtailing production of some type tubes such as the 893 and 893R. Another hard-to-get tube mentioned was the 889 used for ultra-high frequency work in frequency modulatiou units. However, tube repair activities have increased in scope and solved many of the tube problems including those concerning the 893, etc.

While the situation at present is

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favorable, emergencies may cause new problems. Accordingly, the broadcasters were warned to maintain a close watch on all maintenance, and conserve as much as possible.

John Creutz, chief of the transmitter unit, WPB, who participated in the discussions, pointed out that tube repair programs have been extended in many cases to include even the smaller type tubes, such as 205D.

The exchange-of-parts plan between stations was discussed at length. Many stations have been participating and securing the required replacements through this means. The 1,200-page FCC compilation of available tubes and parts for exchange or sale has proven quite effective in providing a source of supply. The NAB "swap program" has also proven to be an effective agent in this respect.

Receiver Tubes

The importance of the home receiver was again stressed during a discussion on the receiver tube program. According to Frank McIntosh, the two-million tubes to be made every month, will hereafter be diverted to civilian channels. Heretofore the military have been using some of the civilian distributor sources of supply. All efforts will now be made to channel military requests directly to the manufacturer, with only emergency requests being handled by distributors. This procedure, it is believed, will greatly reduce the critical state of the tube problem.

Tubes that do not measure up to the high standards of the military will also be passed on to the civilian, such tubes carrying a designation *M-R*. Although these tubes will not have passed the military specifications, they will nevertheless serve effectively in home receivers. While this plan has already begun, it is expected that at least sixty days will pass before the program becomes completely effective.

Farm Batteries

Batteries will be produced for farm receivers, in view of the importance of radios on the farm, said James Lawrence Fly, FCC chairman, in discussing materiel. He said that the farmer is dependent on radio for market and crop reports, for news and information, and for entertainment. He, too, is engaged in a battle of production, continued Mr. Fly, and thus needs and deserves the many benefits of radio, if his efficiency is to be maintained.

The problems of post war were accented by many, particularly Commissioner Fly, who announced the formation of a radio technical planning board that will discuss and devise solutions. Sitting on such a board would be members of engineering and manufacturing groups of private and government agencies.

Brigadier-General F. E. Stoner, Assistant Chief of the U. S. Signal Corps, who discussed military communication problems at the War Conference.

New Development Shown

On the materiel discussion front appeared an interesting new development . . . a development that has been used very effectively on the battlefront. It was described by Colonel Edward M. Kirby, U. S. Army Radio Public Relations Chief. The device is the wire recording unit developed at the Armour Institute of Technology. It affords instantaneous recording and playback on a spool of steel wire, and has proven very successful in providing eye witness recordings on the front line of battle. In view of the compactness and comparatively light weight of the spool of wire carrying the messages, it can be flown back easily to transmitter quarters or recording studios for broadcasting or permanent recording purposes. A spool, four inches in diameter, carries almost two hours of conversation. The messages can be quickly erased and the wire used over again for recording.

Military Problems

The problems of the military were effectively analyzed by Brigadier-General F. E. Stoner, Assistant Chief of the U. S. Signal Corps. He pointed that there are four major assignments of the Signal Corps . . . supply of signal communication and other electrical equipment for the entire Army, training and equipping of troops for signal companies and battalions in the field, the operation of the Army's world-wide communication network, and the photo and motion picture service.

"The Signal Corps is responsible in the field for the installation and eration of communications equipm down to and including the regimen echelon," said Gen. Stoner. "It a operates lateral communications amo adjacent units of the same echel Forward or assault units below regimental echelon operate equipm with their own personnel, but di sional Signal Corps specialists are sponsible for equipment issue and pair.

"To each division is attached a vision signal company. Each Ar corps has a signal battalion. In ad tion, each field army is allotted a hea quarters signal service, a signal co struction battalion, a signal operatio battalion, a radio intelligence co pany, a signal depot company, a sign repair company, a signal pigeon co pany, and a signal photographic co pany. To supplement these Sign Corps units of the field army, the arm commander can also call upon GHQ reserve, from which Sign troops of various categories may drawn by the army requiring the services. There are eighty-one di ferent types of special signal units.

"During the remainder of the ye 1943, the Signal Corps will be require to secure the services of a conside able number of highly skilled techn cians who are qualified as radio e gineers—men who are experienced i the design of fixed radio facilitie etc., their construction, maintenanc and operation—with the capabilities acting upon their own initiative whe the necessity arises, utilizing avail able equipment.

"The number of such individuals i unfortunately, very limited and as th military requirements of the Arme Forces increase, there develops a drai upon industry for this type of person nel. Visualizing the present and fu ture needs of both Armed Forces an industry to sustain communications, i is vital that personnel should be sys tematically drawn from industry t meet the needs of the service. It i believed that the radio industry i willing to extend full cooperation i making available to our Armed Ser vices a reasonable number of this typ of personnel.

"It is hoped that the NAB will con tinue cooperation by the appointmen of a committee to work in conjunctio with the Officer Procurement Service Its function would be to recommend individuals who meet the requirements for temporary appointment in a commissioned grade in the Army of the United States for assignment as radio engineers."

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Photo, Courtesy Mid-Continent Airlines showing current Wilcox installations

Uninterrupted Service
IS Vital to Safe Air Transportation

Dependable communications are the keynote. There must be no failure. For years, Wilcox has made radio equipment to help carry on flight control safely. Today, the "know-how" of Wilcox facilities is entirely devoted to manufacture for military needs. After peace is secured, the marvels of radio development will be working for better living.

There MUST Be Dependable Communications

Communication Receivers — Aircraft Radio
Transmitting Equipment — Airline Radio Equipment

WILCOX ELECTRIC COMPANY

Quality Manufacturing of Radio Equipment

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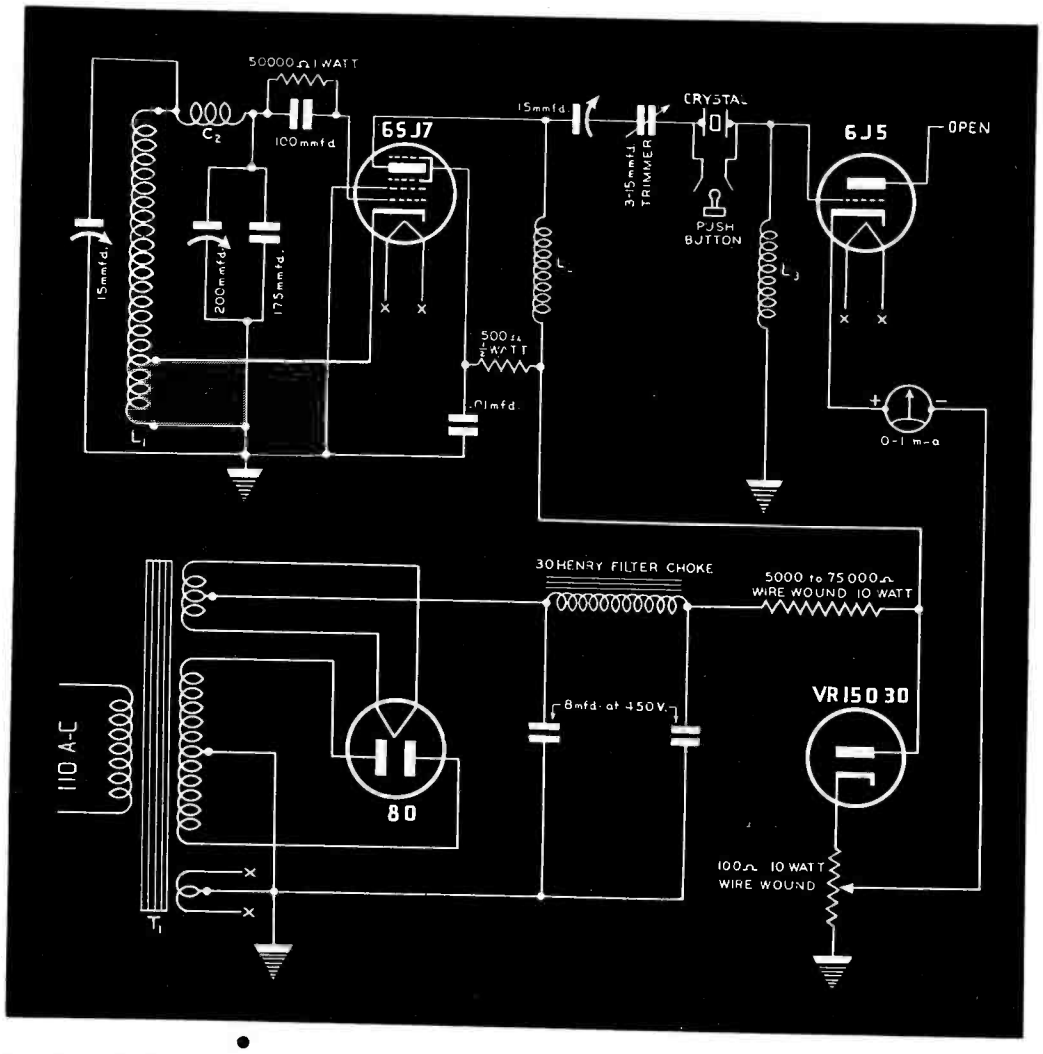
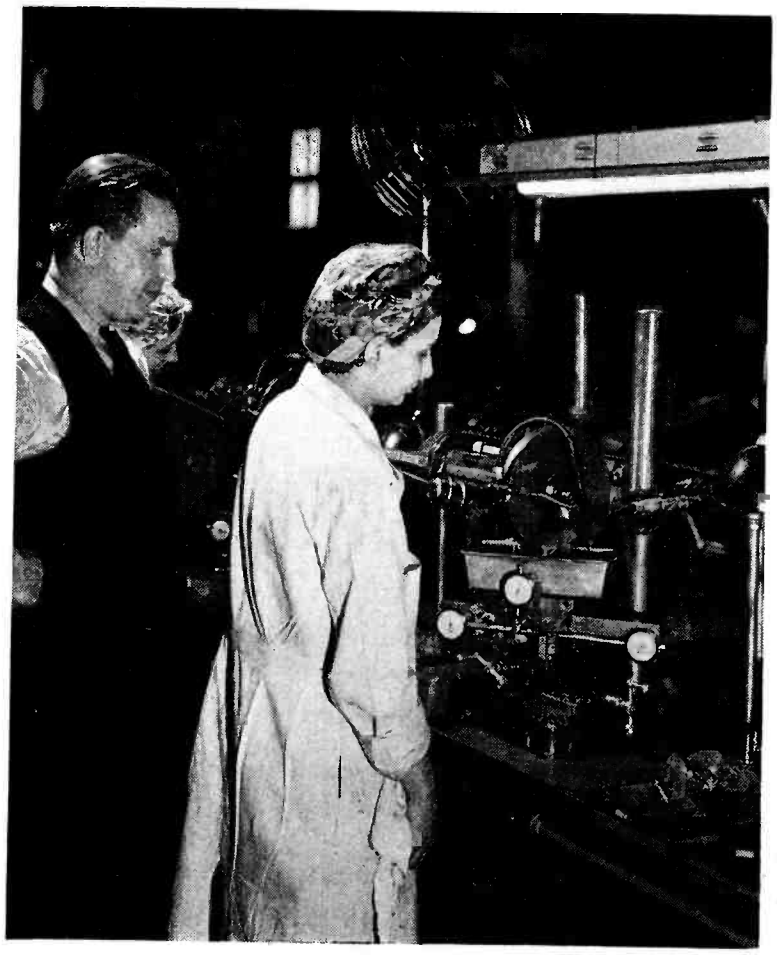


Equipment shortages caused by demands of war have prompted the development of many effective alternate methods of production. Two contributions of this nature appear below; at left, we see quartz cutting with a converted drill press, and at right, abrasive mixers, that were once dough mixers.

(Top) . . . analyzing the mother quartz in an oil bath with mercury vapor light.

(Left) . . . a Q meter channel selector used to approximate the frequency of crystal blanks before issuing to final finishers. The frequency of the blank can be determined even though it will not oscillate in the standard circuit.

*THE PRODUCTION



*[All photos and diagrams are presented through the the courtesy of the DX Crystal Company]

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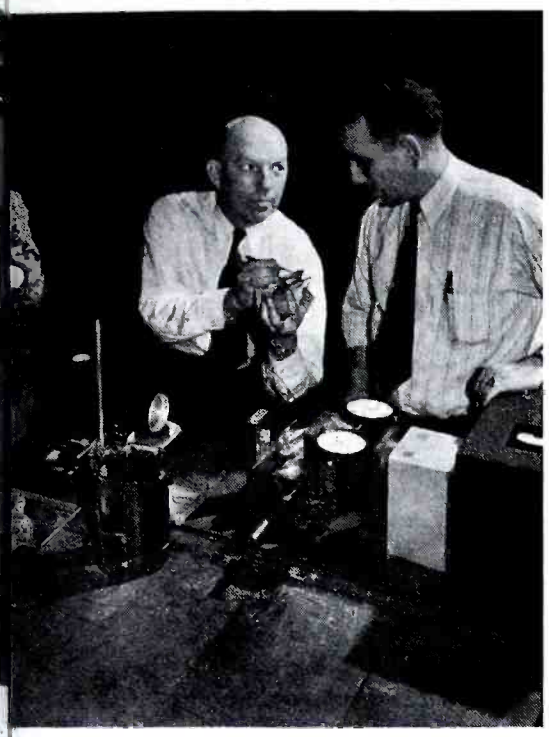
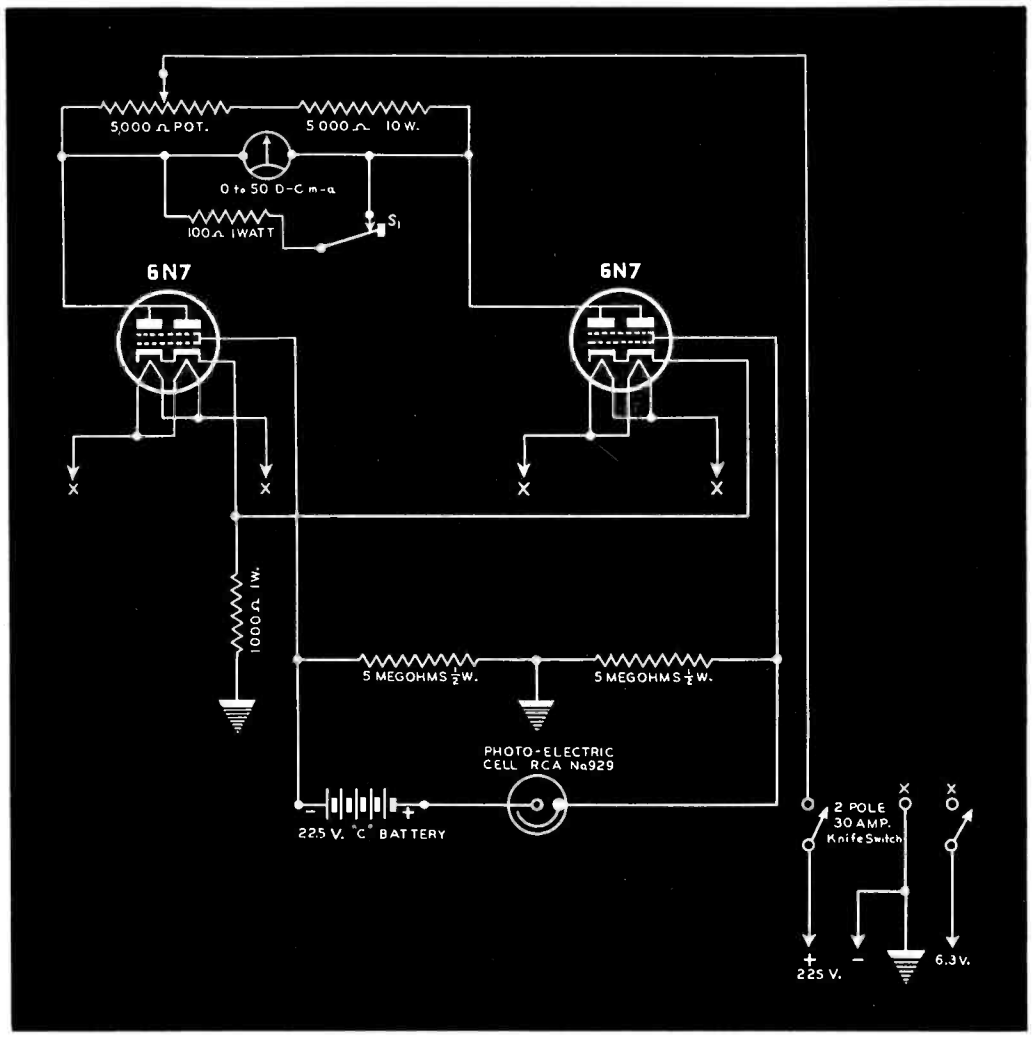


(Top) . . . optical-electrical orienting unit that checks optical axis in preparation for orientation.

(Right) . . . a d-c bridge amplifier used in conjunction with the planoscope for orientation of quartz in all its stages. This instrument is capable of accurately orienting mother quartz without any preparation of the faces to within about 5 minutes of an arc.

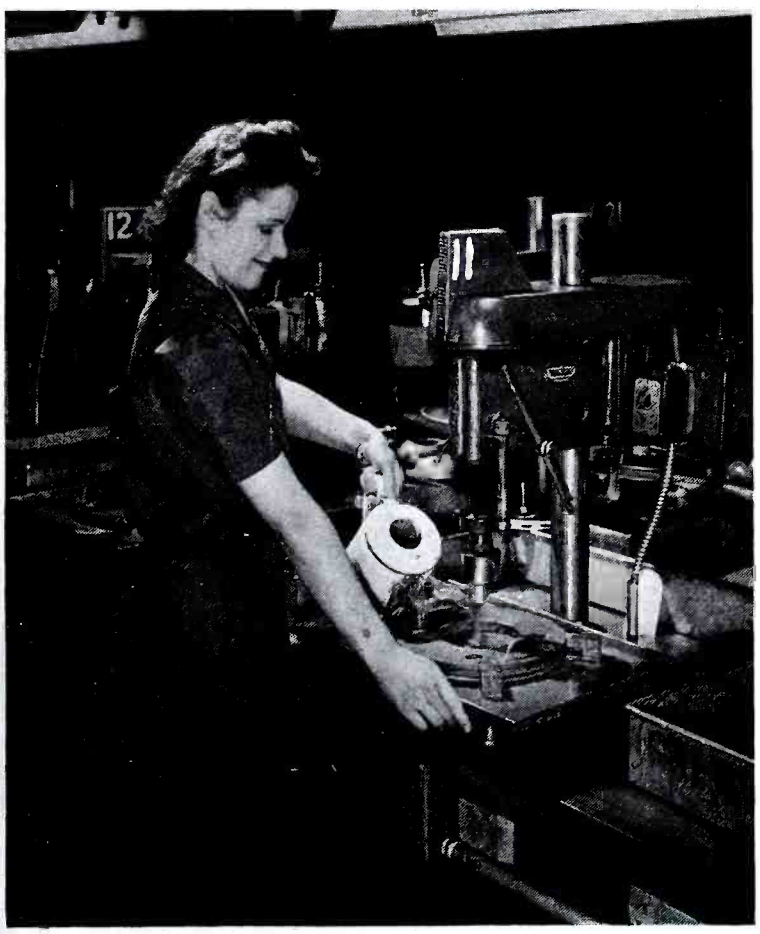


OF QUARTZ CRYSTALS

(Below, left) . . . close-up of a lapping machine in operation.

(Below) . . . diamond wheel edge grinding machines used in dimensional step.

(*Continued on page* 64)



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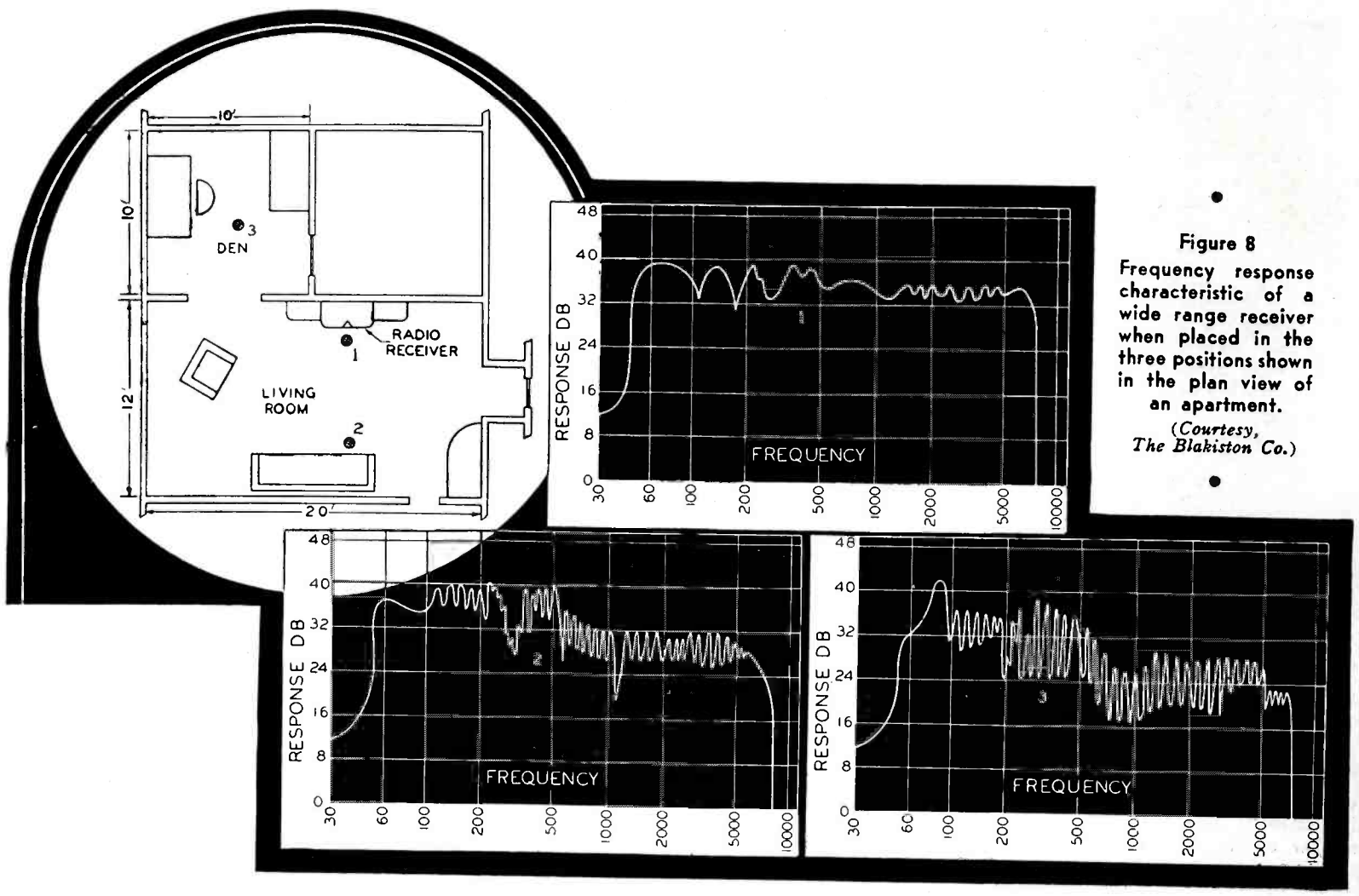

Figure 8
Frequency response characteristic of a wide range receiver when placed in the three positions shown in the plan view of an apartment.
(Courtesy, The Blakiston Co.)

HIGH FIDELITY SYSTEMS

(PART TWO OF A TWO-PART PAPER)*

by A. JAMES EBEL
Chief Engineer, WILL

EVER since people have been gathering in enclosed spaces the acoustics of the area have been noted either consciously or unconsciously. Some attempts toward uniform acoustics were made in the ancient Greek theatre, but it remained for Professor Sabine in 1895 to start his scientific investigation on the acoustical properties of rooms. Since the advent of high fidelity transmission systems, room acoustics development and design have become a vital consideration.

The block diagram in Figure 1 (Part 1) left out two important components, the room in which the sound waves were generated and the room in which they were produced. If we assume that the quality of sound heard in the originating location will be satisfactory and that the transmission system will be capable of reproducing this same effect in the receiving room, the acoustics of the originating room may be disregarded as far as fidelity is concerned. However, since all practical listening rooms have acoustical properties—other than complete absorption of sounds—those characteristics must be considered a part of the listening system which will alter the fidelity of the sounds being heard.

The acoustic problem outlined above is the result of monaural transmission rather than binaural. As was stated in the first part of this paper, the ear is a highly directive listening device and can focus its attention on the direct sound to the partial exclusion of the reflected sound. If a binaural system were used with microphones located in the ears of an *Oscar* and two complete channels to a pair of headphones on the listener, the listener would be able to listen just as if he were part of the audience present at the point of origination. The acoustics of the listening room would be immaterial because the headphones would eliminate all but the direct sounds. There are, however, many difficulties besetting binaural systems. The requirement of two channels is difficult if not impossible of attainment in many systems. Listeners would not like to be tied down to the headphones while listening. An finally, it is impossible to transmit bass tones faithfully with headsets since part of the sensation is one of feeling. The last two objections would be eliminated by the use of a sterophonic system but that would require at least one more channel and is not particularly adapted to the small room.

*Part 1 appeared in April COMMUNICATIONS.

Studio Characteristics

If the originating studio were made perfectly absorptive, i.e., reverberation equal to zero, then the sounds from the studio could be transplanted by the transmission system into the receiving room. Assuming then the acoustic properties of the room are satisfactory for listening to the type of sound being considered, the system

(Continued on page 26)

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Designs for War...
Hermetic Sealing

The hermetic sealing of transformers covers a wide range of problems, and an equally wide range of applications. The two units illustrated at the left, for example, represent a high voltage transformer for high altitude operation, and an audio unit weighing approximately one ounce.

There is more to hermetic sealing than meets the eye. The illustrations below show some of the factors contributing to the high quality of UTC hermetically sealed units.

May we design a war unit to your application?

For obvious reasons, the units illustrated are not actual war items.

Engineering . . . PRODUCT

Engineering starts with research, continues through the conference table, and then goes through the proving of electrical design, sealing methods, vibration test, etc.

ENGINEERING CONFERENCE

DESIGN PROVING . . . AUDIO

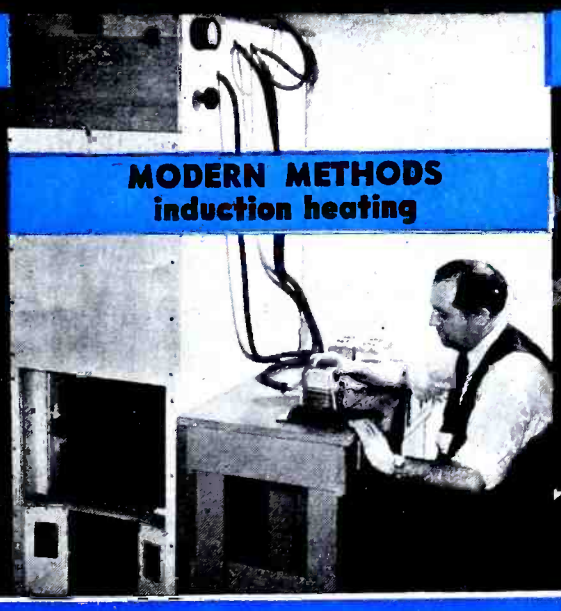
DESIGN PROVING . . . POWER

Engineering . . . PRODUCTION

The production of war units generally requires precise control. This requires the scientific choice of workers for specific operations . . . the use of modern methods throughout . . . and continuous control of quality and production flow.

APTITUDE TESTING assures worker suited to operation

MODERN METHODS induction heating



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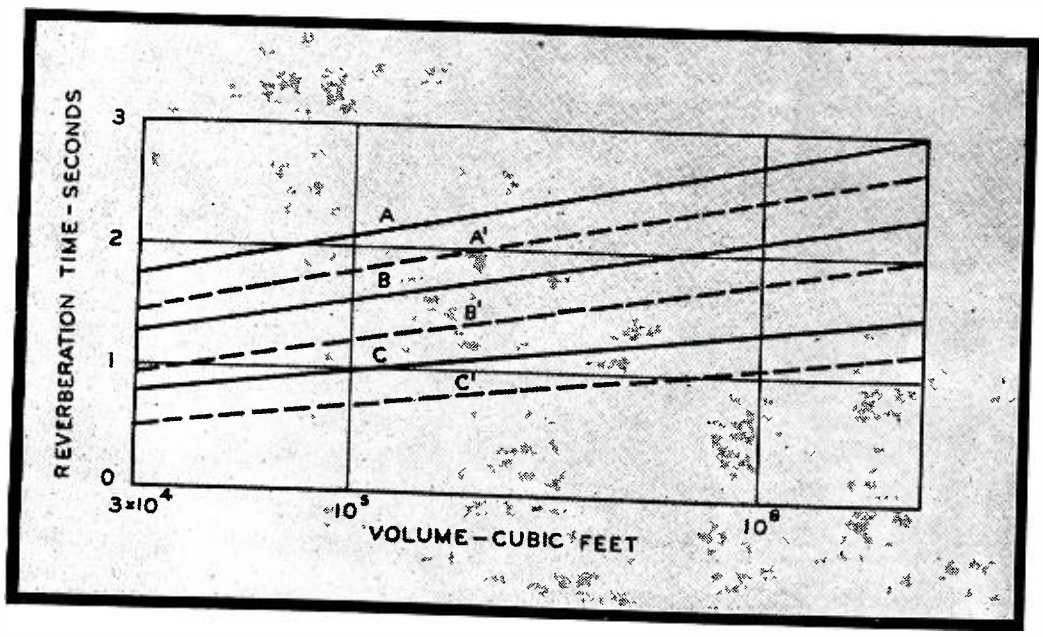

Figure 9
Recommended reverberation times for listening situations; solid curves for motion picture theatre, dotted curves for average home. A = 100 cycles; B = 250 cycles; C = 500 to 2500 cycles.

might be considered an ideal reproducing system. However, there are two major drawbacks to this system. In the first place the performers, operating under unnatural conditions, would not be able to reproduce accurately the sounds they intended to produce. And secondly, the music would lack a spatial characteritic; that is the sound of a whole orchestra coming from a point source, the loud speaker. The very fact that the studio has reverberation tends to create the illusion of space. The longer the reverberation time, the larger the studio seems to the listener, and the more he feels transplanted into the originating location. Unfortunately there are limitations on the amount of allowable reverberation before other undesirable effects become apparent.

On the other hand, if the listening room could be made completely dead, then only the acoustic characteristics of the originating room need be considered. If, as stated above, these are comparable to the actual situation, the result would be a satisfactory situation. The erection of rooms completely dead—reverberation time equal to zero—is, of course, entirely out of the question so that the best that could be done is to treat the rooms as much as possible. Fortunately, in homes the rugs, drapes, and furniture provide for considerable absorption. In theatres the acoustic treatment plus the absorption due to the audience, makes for fairly desirable listening conditions.

Monaural System

If the monaural system must be used, the best that can be hoped for is an acoustical compromise. Getting down to more concrete material, the effect of the room acoustics on the sound received at the ear may be analyzed into *(1)*—a change in the frequency response of the system, *(2)*—a change in the damping characteristic of the system, *(3)*—a change in the over-all noise level and *(4)*—a possible amplitude distortion increase.

Figure 8 shows the variation of frequency response observed at three different points in a typical room setup. This data was gathered by Olson and Massa[1], using a standard broadcast high fidelity receiver and a cathode-ray level recorder. The frequency response distortion is due to, *(a)*—standing waves within the room and *(b)*—variation of absorption with frequency on the reflecting surfaces.

Damping Characteristic

The damping characteristic is directly proportional to the reverberation time of the room. From our previous discussion of the damping factor, it would seem that the reverberation time should be as close to zero as possible. Listening tests at the University of Illinois have shown this to be true in the case of reproduced music, though not in the case of live music. The ideal is practically impossible of attainment, however, and therefore a compromise must be accepted. Figure 9 shows the reverberation time recommended for various types of listening situations. The increase in absorption in a room also decreases the variation of frequency response due to standing waves and in the ideal room ($T = O$) standing waves should be completely eliminated. The reverberation time is not a true indication of how well the standing waves will be surpressed, since there is a very important distribution factor in the location of absorptive material.

The addition of acoustic absorbing material to the reflecting surfaces of a room also lowers the average noise level of the room which will have an important effect in determining what the dynamic range of our system should be. There are two possible sources of amplitude distortion due to the surrounding room and its fittings. The most important is sympathetic vibrations set up in some vibrating system in the room such as loose windows, nick-nacks on shelves, etc. The second possibility is the introduction of distortion due to the acoustic coupling of the receiver changing over wide ranges when standing waves are set up.

The above discussion points to the importance of the acoustic characteristics of the listening room. This importance is minimized somewhat by the directional listening properties of the ears. Some investigators have thought that the ears were not responsive to a certain amount of frequency response distortion—say three to five db, plus or minus. It is the author's opinion that the ear by its directional listening properties, listens to the direct sound from a loud speaker to the partial exclusion of the reflected sound so that the frequency response distortion due to standing waves and variable reflection does not actually become as serious as is measured by a nondirectional microphone measuring device. The whole problem of adjusting the acoustic properties of the source and receiving locations is one that doesn't lend itself to an accurate scientific analysis since so much is dependent on listener opinion.

In the first part of this paper, the allowable noise level for high fidelity transmission was discussed, and limitations set forth. A more practical aspect of the problem is in devising means to combat certain inherent noises which seem to be present in all transmission systems. All of the noise types mentioned will be found in transmission systems to a certain extent, and generally in amounts greater than that specified as allowable for high fidelity. Pre-emphasis is an important step in the solution of this problem. Equation *(4)** outlines the factors which determine the fidelity of an electro-acoustic system. It was stated that the values of all the constants such as K_{ae}, K_a, K_e, etc.,

(*Continued on page* 28)

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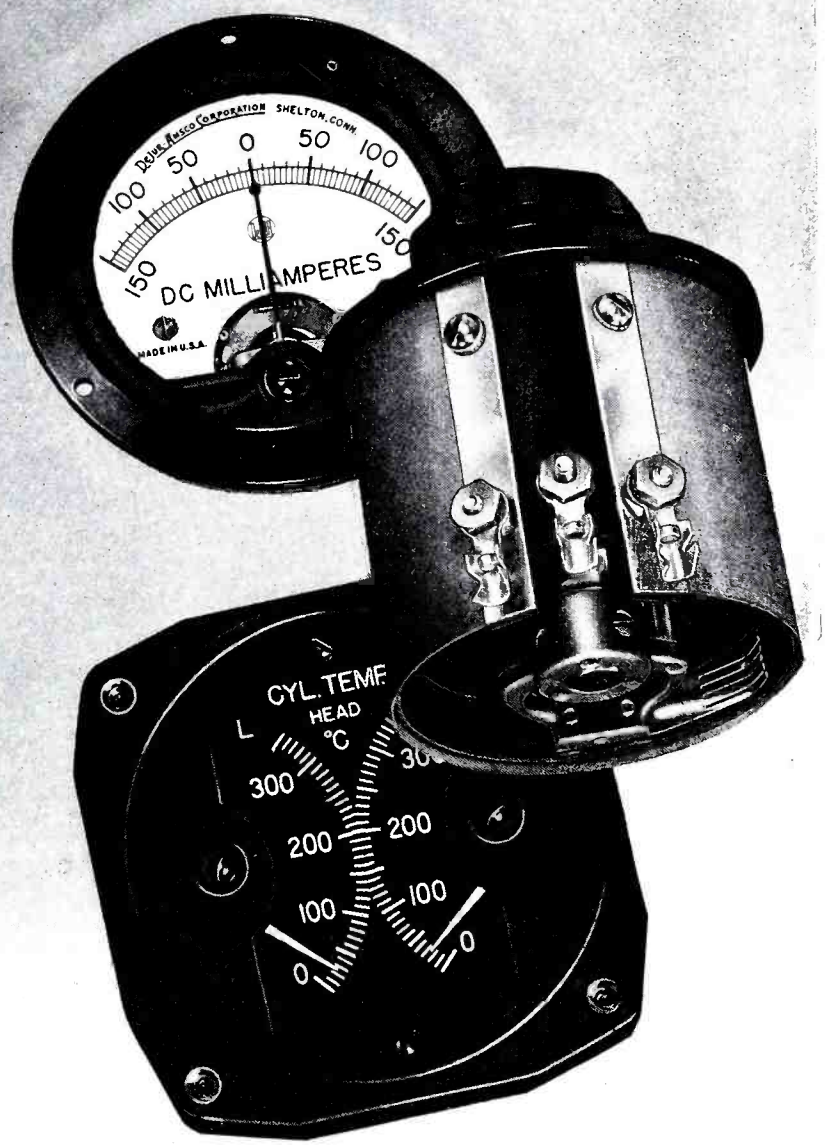
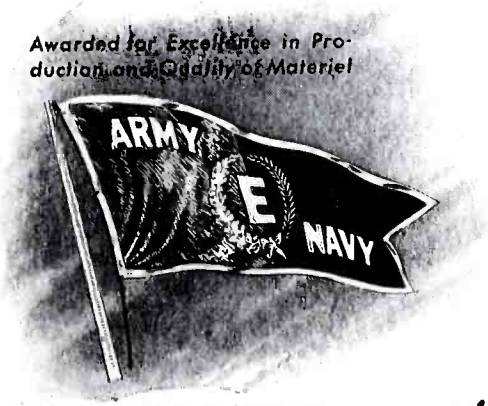
More than ever



With *the struggle* becoming increasingly fierce . . . now, more than ever . . . the quality of American men and equipment stand out in bold relief. We cannot tell you where . . . but we do know that somewhere on all the fronts . . . the quality of DeJur Aircraft and Electrical Instruments, Potentiometers and Rheostats is being subjected to the severest of tests. Thanks to 25 years of experience and research, our products will not be found wanting.



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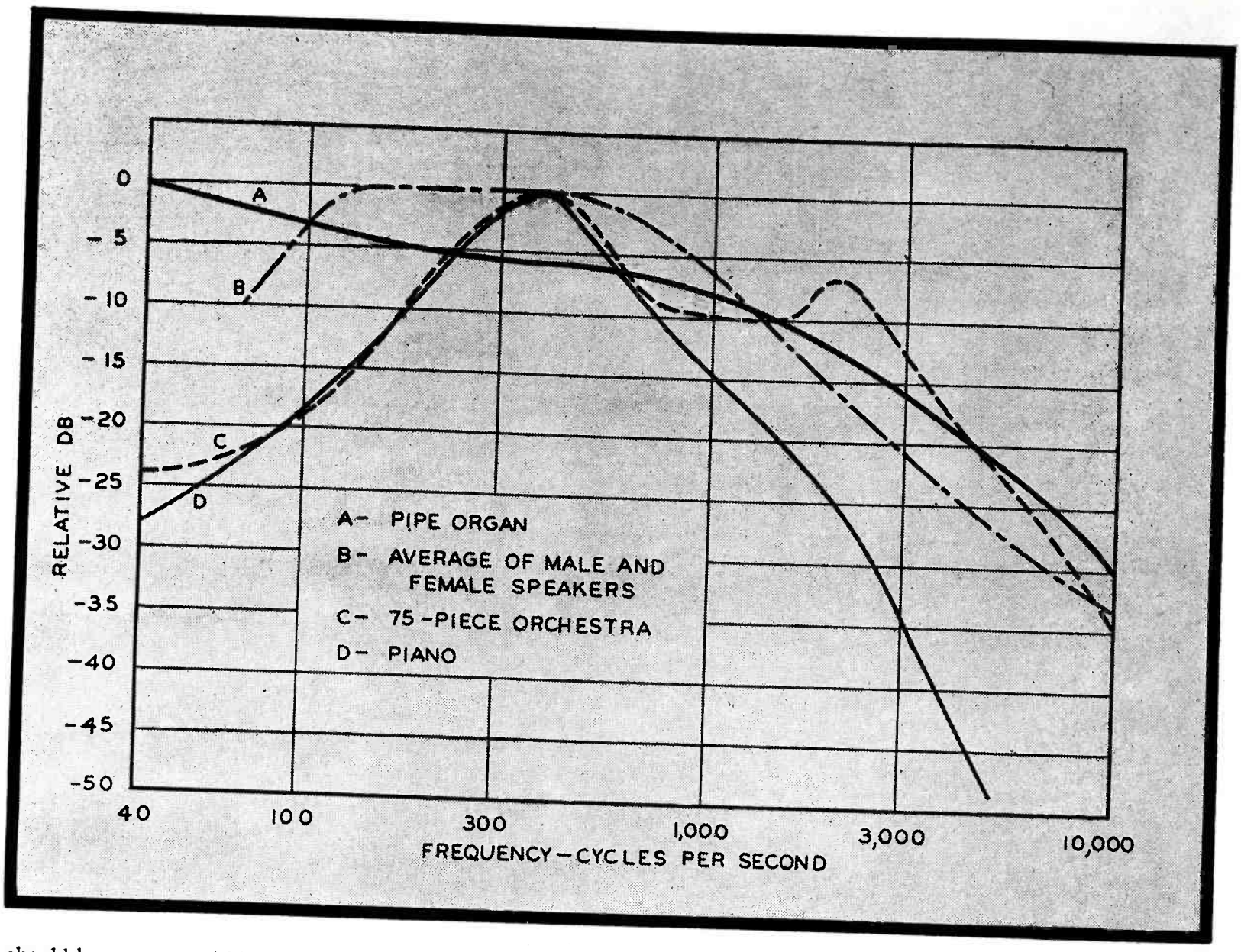

should be constant within the range of frequencies and amplitudes to be transmitted, if the system were to transmit faithfully all tones within this range.

An analysis of the frequency distribution of the various noises present in transmission systems, shows that most of the energy is concentrated at the ends of the response spectrum. The noise increases with frequency from about 2,000 cycles up to the upper limit and increases with decreasing frequency from 100 cycles down. We may therefore seek to improve the signal-to-noise ratio in these areas. The over-all response of the system will not be altered if the gain constant of the amplifier becomes:

$$K_A = K_A' F(f) \qquad (5)$$

and the gain constant of the restorer:

$$K_R = K_R' \frac{1}{F(f)} \qquad (6)$$

where K_A' is the gain without pre-emphasis of amplifier, K_R' is the gain of the restorer and its associated amplifier, and $F(f)$ is the pre-emphasis function; a function which relates the amplitude to the frequency of the waves being transmitted with the particular type of pre-emphasis being used.

The use of pre-emphasis is possible only because the energy in most of the program material to be transmitted by the electro-acoustic system is con-

*Eq. (4)

$$i = a_1E_1 \cos \omega_1 t + a_1E_2 \cos \omega_2 t + \frac{a_2E_1^2}{2} + \frac{a_2E_1^2}{2} \cos 2\omega_1 t + a_2E_1E_2 \cos (\omega_1 + \omega_2)\, t + a_2E_1E_2 \cos (\omega_1 - \omega_2)\, t + \frac{a_2E_2^2}{2} + \frac{a_2E_2^2}{2} \cos 2\omega_2 t$$

where E_1 is the amplitude of the frequency ω_1;
where E_2 is the amplitude of the frequency ω_2; and
where a_1 and a_2 are the coefficients of the first two terms of the power series of the non-linear element.

Figure 10

Energy distribution of several types of popular sound sources.

centrated in the middle range and falls off rapidly at both ends.

Analysis of Figure 10

Figure 10 shows the energy distribution of several types of sound sources. It may be seen from this that all sources have low intensity at high frequencies while all but the pipe organ drop off also at low frequencies. In choosing a $F(f)$ ideal for transmission systems a number of factors must be considered, besides the distribution factor illustrated in Figure 10. Some mediums impose other limitations on the amplitude versus frequency curves. All systems using disc recordings must be mechanically constant amplitude below the cross over point if cross-cutting is to be avoided. Electrically this gives rise to a characteristic falling off at the bass end of

(*Continued on page 62*)

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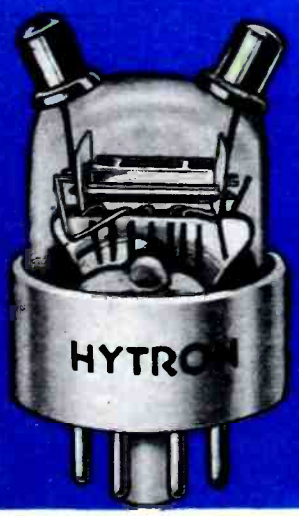
DEDICATES *the* PRESENT *to* PRESERVATION *of the* FUTURE

HYTRON'S SOLE PURPOSE for the duration is to maintain an always-increasing flow of tubes into the radio and electronic equipment which is playing a vital part in winning this Radio War. It is our firm conviction that the torch of Liberty which Hytron is helping to keep burning will light the way to the unconditional surrender of our enemies and to an electronic age which will amaze a freed world.



HYTRON CORP., Salem and Newburyport, Mass.

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BY F. A. GIFFORD
New England Tel. & Tel. Co.

IT is probably not well known that in the 1880's, Alexander Graham Bell, the inventor of the telephone, transmitted speech over a beam of light, using reflectors in much the same way that u-h-f are directed today. He called the system the *photophone* but it was later called the *radiophone* because it employed frequencies not limited to the visible range. Here we have the earliest use of the word *radio* in the sense employed today. It was many years before Marconi developed practical wireless telegraphy or radiotelephony became a reality. The first public telephone service by radio by the Bell System was in 1920 between Catalina Island and Long Beach, California. In 1927 the first transatlantic telephone circuit was established. Since that time the extent of use of radio by the System to supplement its wire network and to provide types of service for which wire lines are not well adapted has been constantly expanding. Telephone service to ships and vehicles, of course, falls in this latter category, since radio is the only means available at present for providing this type of communication.

We followed these developments with considerable interest and established the first radiotelephone service in our own territory in 1932. This is a service to ships at sea, officially termed a coastal-harbor service by the Federal Communications Commission. The usefulness of this service to the original subscribers caused a rapid increase in business, and in 1941 our shore station handled communications with 568 different vessels. Of course, in 1942 such communications were materially reduced.

Having acquired some experience in the methods for using radio in connection with wire lines for telephone service, and trained radio operating personnel for this service and for setting up radiotelephone circuits in case of failure of wire lines during emergencies, such as hurricanes, sleet storms, fires, etc., we began to give serious consideration to the establishment of a radiotelephone service to vehicles. We had been giving some thought to such a service for several years, but the equipment to furnish a service of a grade considered suitable was not available. It was apparent that the users of a service involving vehicles would in most cases be those accustomed to wire line telephone service, which we consider to be high grade. The contrast between wire line transmission and the transmission over radio systems available for mobile use at that time appeared too great to justify offering it to telephone subscribers. However, when the f-m system of radio transmission was made available this difficulty appeared

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(At left) . . . the rack and panel u-h-f unit at Massachusetts State Police containing the 250 watt f-m transmitter, car receiver, station receiver and power supply. (Below) . . . antenna on 3,000-foot mountain used by the State Police. **(See page 32.)**

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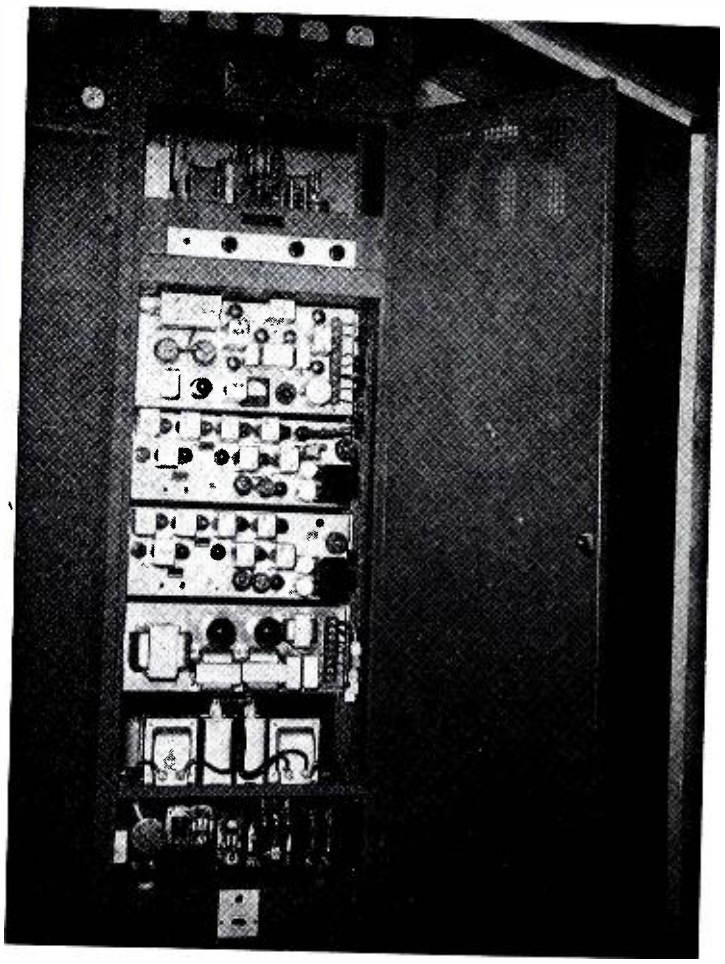

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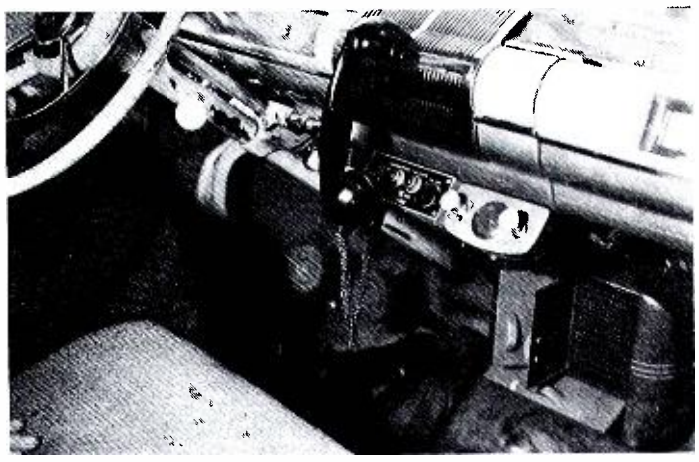
AIRCRAFT NOISE PROBLEMS

District AIEE Meeting

solved, and definite plans to proceed were formulated in 1940.

In accordance with the rules and regulations of the Federal Communications Commission, it was planned to offer an emergency radio service to organizations which could qualify under the rules for such service. In this classification would be included public utility companies and other public service organizations requiring communication during emergencies jeopardizing life, public safety, or important property.



Closeup of car control, showing microphone - receiver unit and hang-up box, used by the Massachusetts State Police. (See page 32.)

F-M Transmitter

The equipment arrangements agreed upon included a 250-watt f-m transmitter to operate on a carrier frequency of 39,860 kilocycles; five or six f-m receivers to receive a carrier frequency of 35,140 kilocycles from cars; one car equipment for test purposes and several more to be obtained later for maintenance trucks and a control terminal to connect the radio channel with the wire network. Arrangements were also planned at a special switchboard position to permit connections to be established between cars and any telephone subscriber. The arrangements for signaling cars provided for dialing individual cars if equipped for selective signaling or for calling by voice. The former method eliminates the necessity for keeping a loudspeaker turned on at all times in the car, but, of course, requires additional equipment. This system is of particular value to those companies who wish communication between cars and any one of many telephones. It eliminates the necessity for the user providing fixed transmitter equipment and having a group of licensed operators for coverage at the control point. To us, it also appears a quite advantageous arrangement for those who wish to share the operating expense and the investment in a fixed transmitter.

Unfortunately, due to the War, we have been unable to put all of these plans into execution. However, one of our transmitter units is substantially complete. We have one auxiliary receiver at one site, and we have built a control unit which will not provide the universal service originally planned but will permit communication between cars within a radius of approximately 12 miles from our main office and selected stations such as PBX extensions and also between cars. The remainder of the equipment appears unobtainable at present.

Coverage Area

One of the first items to determine in engineering our system was the transmitter coverage area. Since we could not know definitely in advance who besides ourselves might use the service and the areas in which they might desire to operate, it appeared logical to plan on as large a coverage area as possible centering about our main office, but without undue expense. Since there were obvious cost and maintenance advantages in having the equipment located in telephone company buildings, the highest company owned building in the vicinity, was selected as the transmitter location and a fifty-foot iron pole was erected on the roof to support the coaxial antenna. The total height of the antenna above sea level is approximately 280 feet.

In connection with the selection of a site for our coastal-harbor station in 1931, a number of so-called synthetic surveys were made. That is, computations of field strength at various points on the coast which it was desired to serve were made, assuming several possible station locations. Actual test results checked very well with estimated field strength values, but in this case, the medium frequencies (2 to 3 megacycle band) were involved and most transmission paths were over water. The problem of accurately computing transmission over rough surfaces, particularly at the frequencies at present employed for vehicular service is impracticable although test results may be explained by taking reflection, diffraction and refraction into account. Therefore it was decided to conduct a coverage survey using the same fixed equipment to be employed in providing service and a typical mobile equipment. This type of survey is qualitative only, of course, and we obtained no actual field strength or noise measurements. Another method which was suggested was to climb the antenna pole to the midpoint of the antenna and sight in all directions, the horizon to be considered as approximately the limit of transmission. This idea, of course, is based on the theory of optical transmission limits, i. e., no intervening terrain between transmitting and receiving antennas. On a conservative basis this theory would hold in practice but we know that on account of u-h-f transmission phenomena, transmission may be extended beyond the optical limits or may be reduced in the presence of noise. These various phenomena were observed in the course of the tests.

Phonograph for Tests

The fixed transmitter input for the tests was a phonograph with a record of a technical discourse, and station identification announcements were made every fifteen minutes. The observations were made in a car which was driven away from the transmitter to the approximate limit of transmission. Then, this distance was used as a radius in order to approximately trace the limit of commercial transmission. The determination of this outer limit, of course, depended upon avail-

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able roads. The work was done with some care as the plan for tests provided for two limits . . . (*1*)—good transmission and (*2*)—fair transmission. At the conclusion of each day's work, the return trip was made over a different radial route with observations continuing until the arrival at the transmitter. The approximate transmission limits were thus traced. Within the area enclosed by the limiting lines, the transmission was observed along about ten radials and at various other points where because of topography or the possibility of the presence of man-made noise, it was thought that transmission might be difficult.

Observation Standards

At this point, it might be well to define in general terms the standards used in observations of "good" and "fair" transmission. Transmission was considered good when a conversation could be carried on or the signal heard with about the same ease as over a normal wire line connection. Fair transmission was slightly lower in grade with perhaps a slight amount of background noise necessitating an occasional repetition or failure to clearly receive a few words of the record. The transmission grade designated as fair is reasonably good. It appeared necessary to set a fairly high standard because in the vehicular system as planned, connections may be established involving telephone subscribers who have seldom if ever talked over a radio circuit and would require practically as good transmission as over wire line circuits to carry on satisfactory conversations. The situation in the case of two operators who customarily transact business over a radio channel in quite different. They become proficient in talking over noisy and distant circuits which would be entirely unusuable for the uninitiated. The purpose of this explanation is to emphasize that the coverage to be described is probably much more limited than would be assumed if the system were not to be used by the public.

Optical Transmission Paths

The approximate average distance from the transmitter was 25 miles.

It might be interesting to compare these limits with the optical transmission path. Theoretically, in accordance with the formula $d = 1.23\sqrt{H}$ where d = the distance to the horizon and H = the antenna height, an object at sea level should be visible from the midpoint of the antenna for a distance of 20 miles. Since an object at an elevation above sea level should be visible for a greater distance and since the terrain covered in the tests was for the most part considerably above sea level, the theory appears to hold in general but with some variations which will be described.

In general, the terrain surveyed resembled the approximate shape of a shallow bowl or basin with the lower edge tipped down along the sea coast and the upper edge west of the city at an elevation of about 500 feet. To the north and south, the slope toward the ocean is fairly uniform, except for an area which rises to a peak of over 600 feet. The outer edge of this bowl is not a continuous ridge, but at least in part, particularly along the northern edge, consists of an irregular series of hills with gentle slopes. The limit of fair transmission was well in the rear of many of these hills up to 400 feet in elevation. In many cases, the road followed in tracing the fair transmission limit wound between hills of 400 to 500 feet in height. However, the fairly abrupt elevation of the hills area surrounded by comparatively low land caused the signal to be completely lost on the road running along the far side of the range. On roads to the south, the signal was again audible within a distance of less than a mile. Although our survey could not be termed exhaustive, we did endeavor to locate "dead spots," even driving through a tunnel where the signal was received for a distance of approximately 100 feet in from each entrance. But the two cases cited constitute the only "dead spots" found within the area of fair transmission.

With the completion of the transmitter coverage survey, the next step was the determination of auxiliary receiver locations. In order to permit cars, with their much shorter transmission range than the fixed transmitter, to talk back from any point within transmitter coverage area, it was apparent that a number of these auxiliary receiver installations with wire like connections to the control point would be necessary. For reasons previously mentioned, it was desired insofar as possible to locate these receivers in telephone central offices. Unfortunately, many of our offices are located on comparatively low ground.

In testing these locations, the procedure followed in the transmitter coverage survey was reversed, that is, the signal to be observed, consisting of practically continuous talking by the operator, was transmitted from the car and observations were made at the point under test as a possible receiver location. The results of these tests, insofar as a correlation of transmission and topography was concerned, approximated the results of the transmitter coverage survey. The fixed transmitter point was not selected as a receiver location, as it early became evident that there would be too much interference from nearby transmitters. The main receiver was located in a building 150 feet in height. The approximate average range of the receiver at this point as determined by transmission from a car with a 25-watt transmitter was 12 miles. The test results at other locations indicated that four or five additional receivers would be necessary to enable reception from any point in the transmitter coverage area.

In both the transmitter coverage and receiver location tests, very little noise was encountered and none within the coverage area which seriously interfered with transmission except occasional diathermy noise. This latter interference effectually blanketed transmission at times, but was of such short duration that we were unable to locate its source. Some automobile ignition noise was experienced, but never in sufficient volume to interfere with transmission. Other man-made noise was not an important factor in transmission, even though we conducted tests in locations considered likely to be difficult from a transmission standpoint such as under the elevated railway line.

In general, transmission results were better than anticipated.

THE MASS. STATE POLICE SYSTEM

BY GORDON MAC LEAN

Massachusetts Department of Public Safety

AFTER two years of research and planning the Massachusetts State Police have reached the final stage of its installation of a state-wide 250 unit f-m radio system.

It is a radical change-over from the hodge-podge of isolated stations that operated on 1666 kc in a hit-or-

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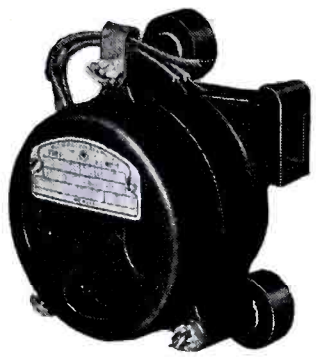

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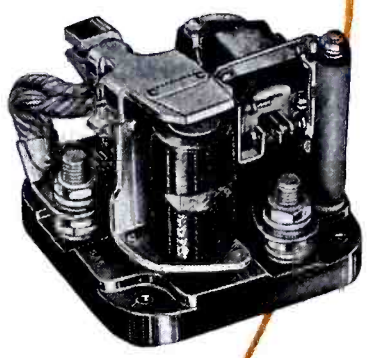

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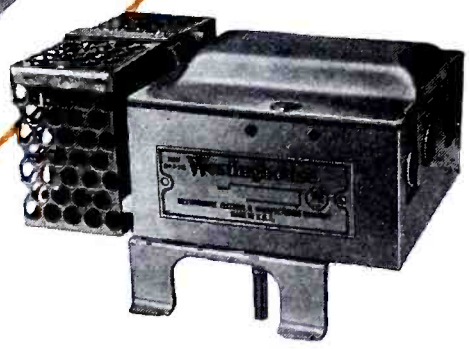

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miss fashion, with signals overlapping into and from the several other police agencies that shared the same wavelength. In its place is an all-encompassing two-way system that covers the entire state with a signal that remains almost constant.

With the aid of a state-wide survey made by John A. Doremus, radio engineer and Massachusetts Institute of Technology instructor, and Sergeant William T. Armstrong, officer in charge of the State Bureau of Communications, the necessary data for the system were made available.

108 Equipped Cruisers

There are 108 police cruisers equipped with mobile units. One-way receivers will be installed at the 120 local police, federal agency, fire department and medical examiner offices which are served by the state police radio system.

Mountain Problems

The variable terrain of Masschusetts, with 3,500-foot mountains in the far western section, the high hills in central Massachusetts and the sea-level sands of Cape Cod presented a difficult problem. Before the survey was completed the investigators covered close to 4,000 miles and recorded over 5,000 meter readings.

Today seven 250-watt stations are in operation. These stations are controlled by eight control units within the four troop areas, with a control at general headquarters. Two island posts are equipped with 25-watt stations.

State troopers can now easily converse from station to station, station to cruiser, cruiser to station, and from cruiser to cruiser.

Telephone Control

The main stations are controlled by telephone land lines located at remote, geographically strategic points. As soon as they are available, 2-kilowatt gasoline-driven generators will be installed to serve as emergency power in case of failure of commercial power. The generators will be equipped with self-starting controls that will start the generators whenever normal voltage drops below a pre-determined level. An automatic cut-off will function when commercial power is restored to its normal level.

Coaxial antennas, ranging from 90 to 125 feet, have been erected on the highest points in the state to insure optimum reception and transmission. Seamless steel tubing was used for the antennas. Two of the antennas were guyed to withstand a wind velocity of 175 miles per hour.

The antennas operate with 7/8 inch, gas-filled transmission lines adjusted to operate on a fixed station frequency of 35,900 kc, while mobile units have a frequency of 35,780 kc. A small relay in the mobile transmitter, that changes only the crystal, permits a close grouping of the frequencies to allow the mobile units to operate on the fixed station frequency, although there is a slight deviation of frequency.

A standard 7/8 inch, gas-filled, copper, coaxial transmission line is also used to connect the antennas at the top of the tower with the transmitter located in a building at its foot.

Use of Concrete Blocks

In locations where new structures had to be erected to house equipment at remote points, concrete blocks were used because they are non-essential materials and it was also discovered that they stand up better in the variable climate of the New England section. Transite was used for added insulation and, as a measure of fire prevention, asbestos board was used in the construction of rooms where generators are housed. Considerable thought was given to proper ventilation.

The 250-watt fixed stations' transmitters are crystal controlled. The assigned frequency is maintained with .01 per cent under an approximate range of 25 below zero to 100 degrees. Normal modulations produce a frequency of plus or minus 15 kc. Audio pre-emphasis is used to produce increased deviation as the modulating frequency increases. The deviation is 15 db in the range from 500 to 3,000 cycles.

Beyond 3,000 the audio response is greatly attenuated to prevent the generation of undesired side frequencies. Audio limiting is provided to prevent excessive deviation when the audio level is abnormally increased. The audio circuits have a sufficient gain to produce a full-rated deviation when operated from a telephone line delivering the speech input at zero db level.

The transmitter is housed in a single-welded steel cabinet which contains all power and control equipment for two-wire remote-control operation.

The receivers are crystal controlled or frequency drift compensated to the same tolerance as the transmitter. The input circuit matches the impedance of the coaxial transmission line of the main antenna. The radio frequency section of the receiver passes a band width of about 40 kc and also provides an adjacent-channel discrimination of approximately 30 db.

The stations are controlled from both the transmitter building and the remotely located points. Control functions include a main power switch; provision for silencing one receiver and opening the squelch of the other; and a means of silencing both receivers and turning on the transmitter.

Two types of antenna are used on cruising cars. Those in the lowlands have antennas attached to the left rear of the car, while those in the hilly sections are equipped with the roof-top type.

RADIO NOISE IN SMALL AIRCRAFT

BY D. K. KINSEY

Staff Electrical Engineer, Consolidated Vultee Aircraft Corp.

THE reduction of radio noise levels in aircraft has found a champion in the radio engineer. A great deal of energy has been expended in the past few years upon this subject by engineers of various aircraft manufacturers, equipment manufacturers and members of the armed forces.

As a result of these studies, research data, application methods and special equipment are available to the aircraft radio engineer for use in his constant attack upon radio noise in aircraft.

This paper concerns "small aircraft" or those in which the maximum seating capacity is three persons. In this type of aircraft various factors in the problem of noise reduction, usually of less importance, become major considerations, and it is believed that specific reference to these problems will be helpful.

It is worthwhile at this point to review briefly the principal factors which cause radio noise and the corrective

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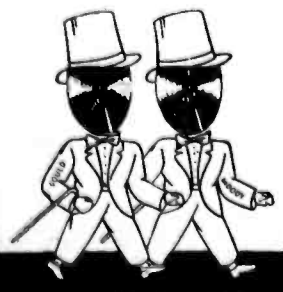

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measures commonly used to reduce the radio noise level to an acceptable value.

Radio noise in a receiver is caused chiefly by the electrical coupling of the induction component of any noise field to the receiver. This coupling may occur through electric induction, magnetic induction, or conduction between the antenna system or power supply of the receiver and the electrical system.

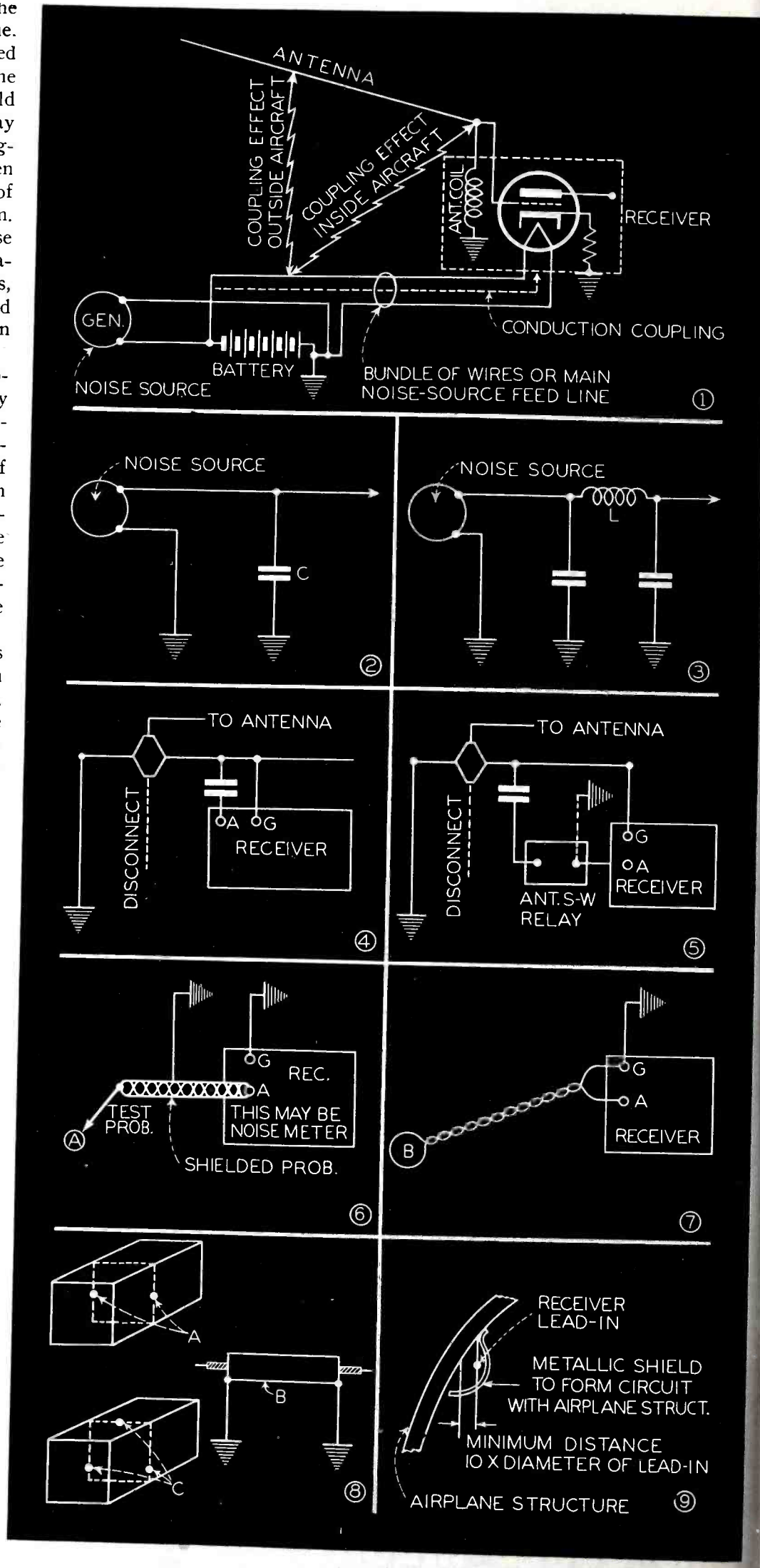
Adequate reduction of radio noise may be obtained by prudent application of electrical and magnetic shields, electrical bonds, electrical filters and engineering principles in the design of electrical and radio systems.

A radio noise level of 50 microvolts or less throughout the frequency range of 200 kilocycles to 20 megacycles may be used for design purposes. In any case the performance of a receiver in an actual installation should determine the ultimate reduction in radio noise level required. The actual noise level will probably have a range of between 2 and 100 microvolts depending upon the nature of the noise source.

The present *small aircraft* presents many problems to the radio engineer in regard to the reduction of radio noise.

Basically, the physical size of the aircraft dictates that the major portion of the radio and electrical systems be closely confined within one compartment, the fuselage, along with hydraulic, pyrotechnic, photographic equipment, flight and powerplant controls, instruments, and the members of the crew. This fact very greatly limits the design, location, weight and size of

(*Continued on page* 71)



1—Chief causes of noise in aircraft. *2*—Simple filter unit. *C* is a capacitor with very short leads. *3*—Typical filter where current carrying capacity must be considered. *L*, the inductance, increases weight and size of filter in proportion to current requirements. In *4*, *5*, *6* and *7* are shown methods of checking noise. In *4*, the noise coming through power supply can be used to test effect of filter units. In *5*, a noise coupling check through lead-in system. The test probe *A* in *6* may be placed in vicinity of noise-source. In *7*, for magnetic noise source detection, *B* may be placed near suspected noise-source. *8*—Shielding methods. *A* shows bond of shield in box to form complete circuit for electrical shield. *B* shows metallic cover over power supply for electrical shield, and *C* shows a bond of shield in box for magnetic shielding at three points. *9*—Layout of antenna lead-in.

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CLOSED-FORM STEADY-STATE RESPONSE OF NETWORKS

For Periodic Applied Voltages

*(PART TWO OF A TWO-PART PAPER)**

by SIDNEY FRANKEL

Radio Engineer, Federal Telephone & Radio Corp.

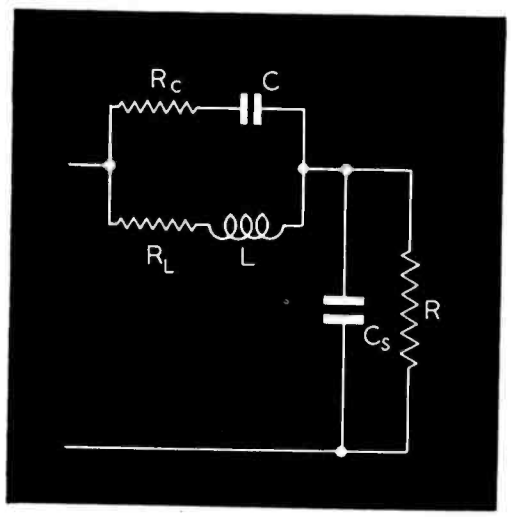
This paper covers a discussion of the application of a simple but very useful theorem representing an extension of Laplace-transform methods in which the solution for the response of an electrical system is written as a Bromwich integral by virtue of the Mellin inversion theorem.[1] To the best of the writer's knowledge, the extension used here was first presented by Professor A. Hazeltine of the Stevens Institute of Technology. He described the method in a lecture course on operational methods, given at the Institute during 1939-1940.

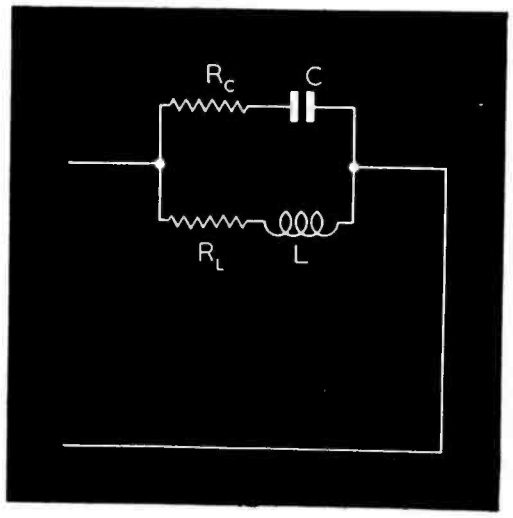
IN recent years there has been a tendency to employ single-phase main supplies in telegraphic transmitters of higher power output. As the output of telegraphic transmitters is increased, the design of the associated single-phase power supplies becomes increasingly difficult. In contrast to three-phase full-wave supplies the total rms ripple is 48.3%[13], thus requiring much better filtering. Larger chokes and capacitors are required for a given amount of filtering because the fundamental ripple frequency is one-third that for the three-phase supply. High input impedance to the filter is an important consideration from the point of view of regulation because, with insufficient impedance a theoretical regulation of 57.3% is possible[13].

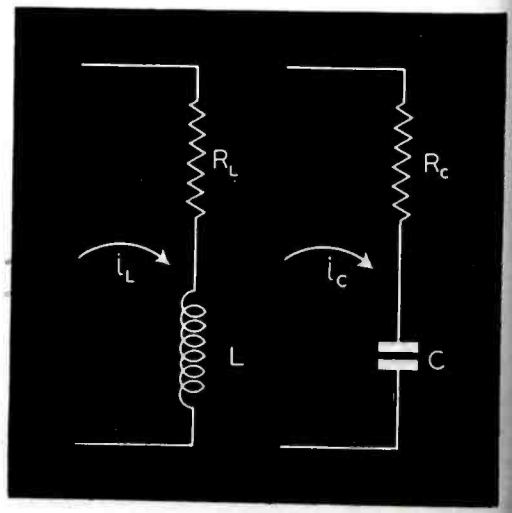
Thus if conventional choke-input types of filters are used, the large inductances used result in serious keying (or voice) transients, unless very large shunt capacitors are used. Eventually, a point is reached where it becomes economically unfeasible to employ this type of filter, or else the space requirements of large capacitors become prohibitive. Under such circumstances, the designer is often led to the use of a tuned-choke type of filter indicated in Fig. 7.

Here L is the inductance of the usual filter choke, R_L its resistance, C the capacitance of the choke tuning capacitor, R_C the resistance of the surge resistor which is used to limit starting surge currents, C_S is the capacitance of the usual shunt capacitor, and R is the effective resistance of the load, including the bleeder resistor. In determining circuit constants to insure sufficient input impedance, the maximum effective load resistance

*Part 1 appeared in April COMMUNICATIONS.







Figures 7 (left), 8 (center) and 9
In Figure 7 we have a tuned choke type of filter, used to minimize keying transients in radio transmitters. Figure 8 is a simplification of Figure 7, to a two-mesh network for purposes of analysis. Figure 9 illustrates a reduction of the two-mesh network of Figure 8 into two single-mesh networks.

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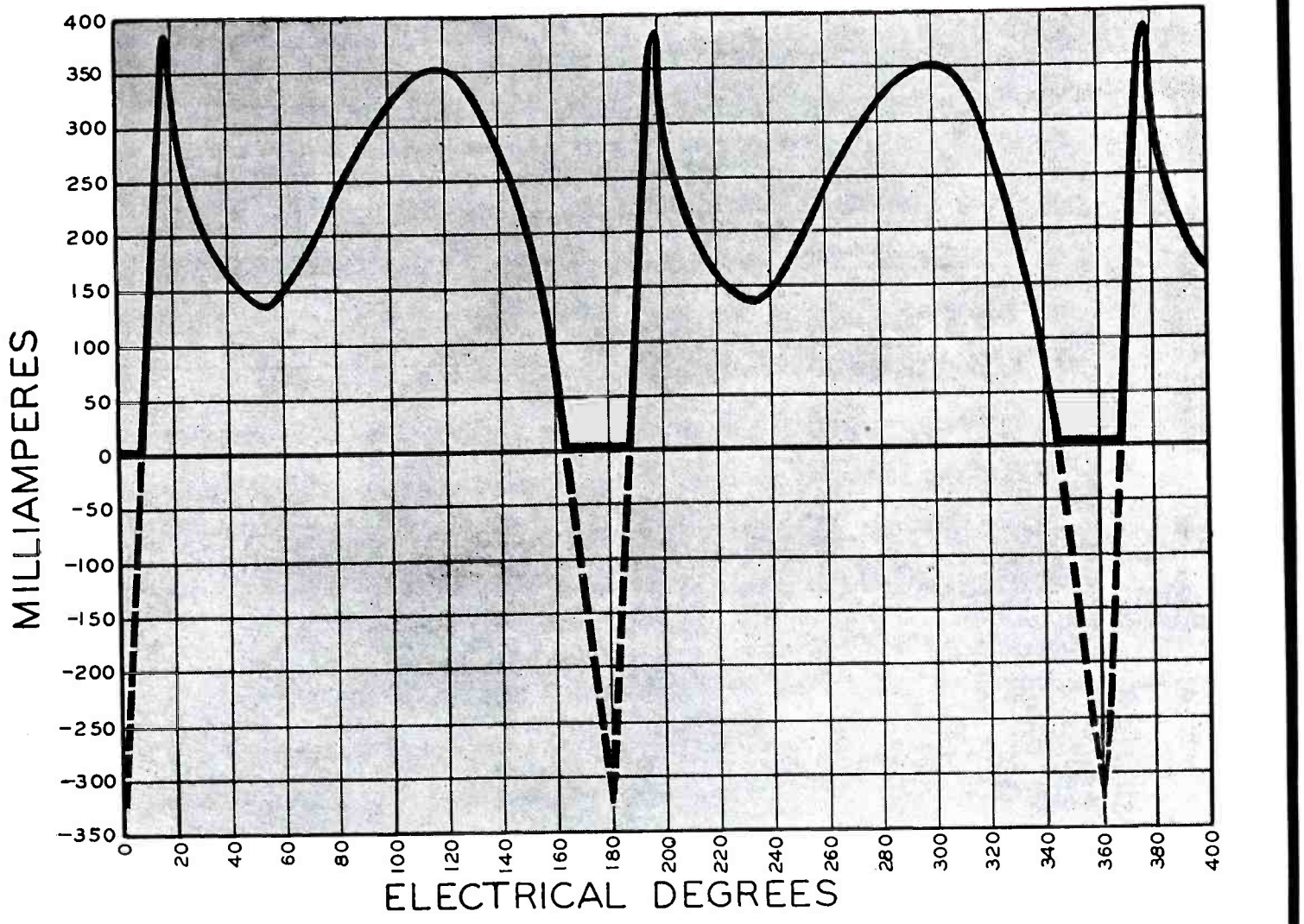

likely to be encountered in actual operation is used, since this represents the severest condition for regulation. Often this means that *bleeder load* only must be used for the determination.

Fundamental Ripple Frequency

The tuned circuit consisting of L, C, R_L and R_c, is tuned to the fundamental ripple frequency. For example, for a single-phase full-wave rectifier operating from a 60-cycle source the circuit would be tuned to have maximum impedance at 120-cycles per second. By this means a high-impedance can be obtained at fundamental ripple frequency with considerably less inductance than in the untuned case.

Untuned Filters

In the case of untuned filters, the higher-frequency ripple components are of negligible importance since the input impedance increases linearly with frequency, while the magnitudes of the harmonics vary inversely ap-

Figure 10

Instantaneous current flow in tuned-choke type of filter used with single-phase full-wave rectifier. The dotted portion indicates the calculated (but physically impossible) backward current flow through the rectifier.

proximately as the square of the frequency recording to the Fourier anaysis.

$$e = \frac{2E}{\pi} - \frac{4E}{\pi}\sum_{n=1}^{\infty}\frac{(-1)^n}{n^2-1}\cos 2n\omega t \qquad (34)$$

where
e = instantaneous volts
E = crest volts
$\omega = 2\pi f$
f = frequency, cycles per second
t = time, seconds

In the case of the tuned-choke filter, however, these higher harmonics need no longer be negligible, and, in fact, may become sufficiently objectionable to make this type of design unusable. As the frequency increases the impedance of the tuned circuit becomes smaller and smaller and, eventually, is limited only by R_c.

Whether or not these harmonics are objectionable can be determined in any particular case by calculation, or by experiment, or, as is usually the case, by a combination of both.

Determining Design

By making certain assumptions in the case of Figure 7, we can easily arrive at a solution for the input current to the filter and so determine the feasibility of a particular design.

First, we assume in advance, that we have so chosen the circuit constants that rectifier tubes will not cut off during any portion of the cycle. This is permissible because we hope to achieve a design that will insure this. Second, we neglect the impedance of the rectifier itself which includes a small resistance drop in the tubes, and a small reactive and resistive drop in the plate and filament transformers. Third, we assume that the impedance of C_s is much less than that of the tuned circuit for all frequencies (excepting, of course, the d-c

(Continued on page 42)

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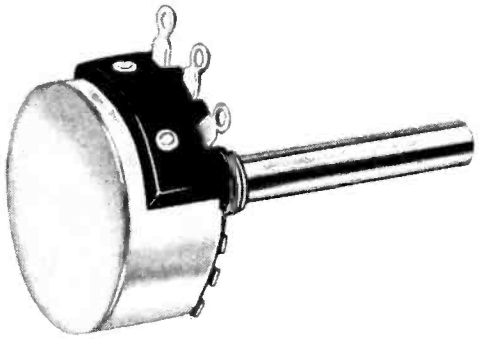
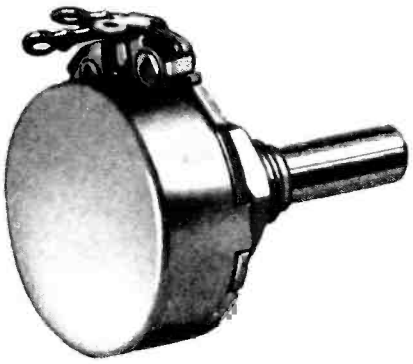
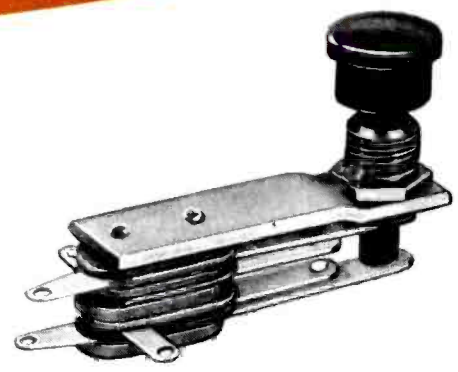
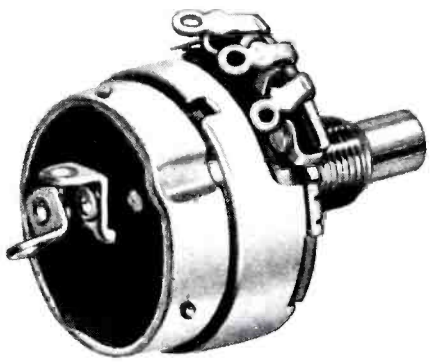
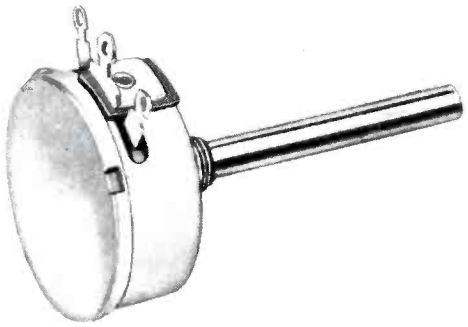
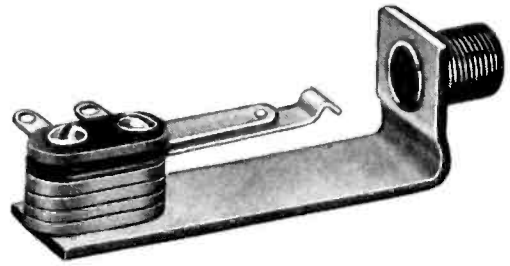
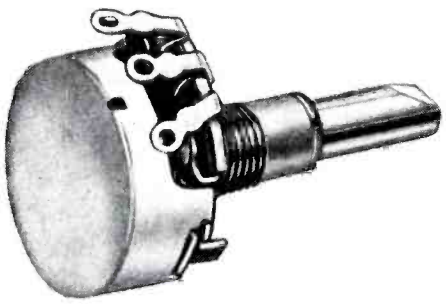
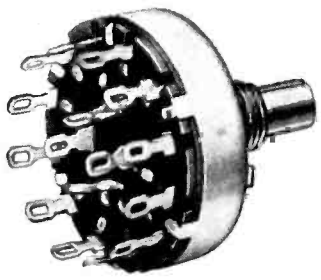
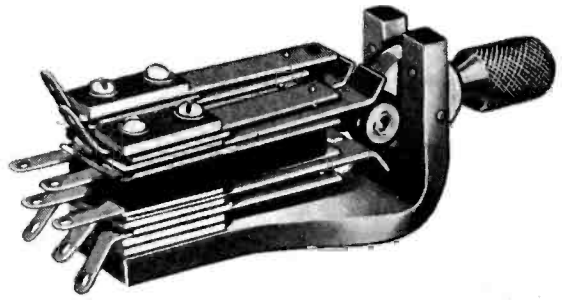
Chicago Telephone Supply Company products have been synonymous with quality workmanship and dependable performance for 46 years. From the engineer's blueprint to the craftsman's finished product, Chicago Telephone Supply products are planned to give maximum operating efficiency and trouble-free long life.

Variable resistors (carbon and wire wound), switches (separate and in combination with variable resistors), plugs, jacks, key switches, push switches, telephone generators and ringers and similar electronic components. Also other devices not illustrated here.

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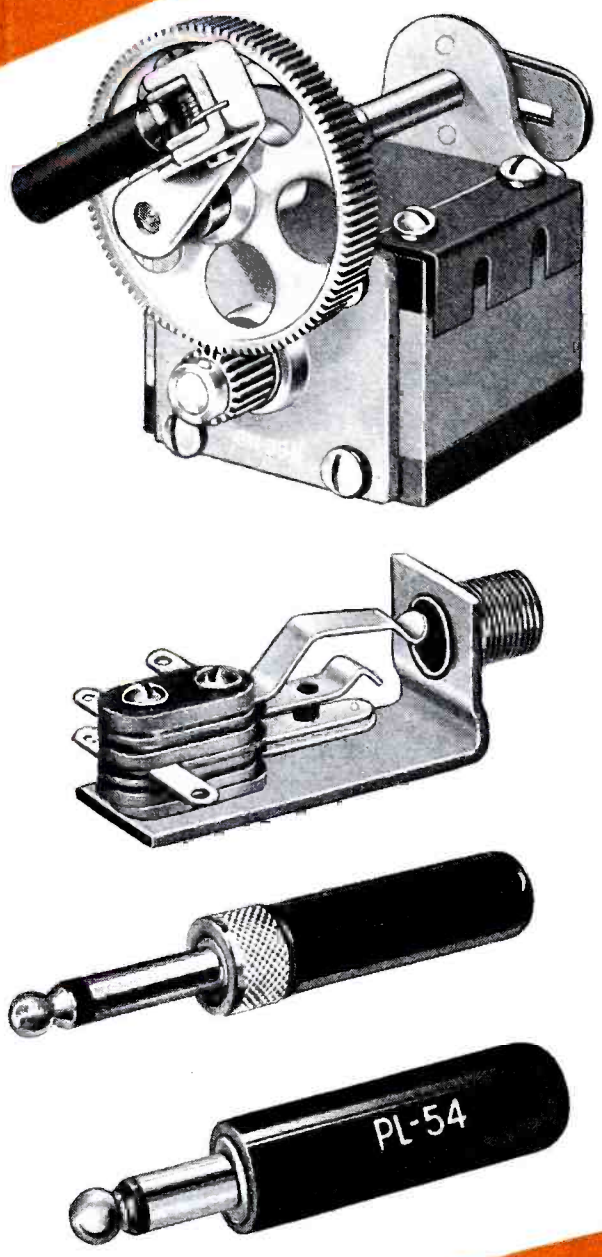

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(*Continued from page 39*)

component). Thus the approximate circuit of Figure 8 has the same current response as that of Figure 7 except for the d-c component. It is clear that if we analyze Figure 8 in place of Figure 7, then the correction for the d-c component is

$$i' = E_{d\text{-}c}\left[\frac{1}{R_L+R} - \frac{1}{R_L}\right] \qquad (35)$$

The circuit of Figure 8, however, can be broken up into two simple separate circuits as in Figure 9, and these circuits are readily solved for the individual steady-state currents i_L and i_C. From these, the input current to the filter of Figure 7 is

$$i = i_L + i_C + E_{d\text{-}c}\left[\frac{1}{R_L+R} - \frac{1}{R_L}\right] \qquad (36)$$

The currents i_L and i_C will now be obtained. Taking first i_L we have, from Table I, pair 12 (part 1, of this paper)

$$(Lp+R_L)\,\bar{i}_L = \frac{2\pi E}{T}\,\frac{\left(1+\epsilon^{-p\frac{T}{2}}\right)^2}{p^2+\left(\frac{2\pi}{T}\right)^2}\cdot\frac{1}{1-\epsilon^{-pT}}$$

$$= \frac{\omega E}{p^2+\omega^2}\,\frac{1+\epsilon^{-p\frac{T}{2}}}{1-\epsilon^{-p\frac{T}{2}}}$$

where, as before, $\omega\tau = 2\pi$, and E is the crest value of the fully-rectified sine wave applied to the filter. Thus

$$i_L = \frac{\omega E}{j2\pi}\int_{Br}\frac{\left(1+\epsilon^{-p\frac{T}{2}}\right)\epsilon^{pt}\,dp}{\left(L_p+R_L\right)\left(p^2+\omega^2\right)\left(1-\epsilon^{-p\frac{T}{2}}\right)}$$

The actual current in the first half period is

$$(i_L)_a = \frac{\omega E}{j2\pi L}\int_{Br}\frac{\epsilon^{pt}\,dp}{(p+\alpha_L)\left(p^2+\omega^2\right)}\quad,\ \alpha_L = \frac{R_L}{L}$$

and on evaluating the residues at the poles of the integrand

$$(i_L)_a = E\left[\frac{\omega L\,\epsilon^{-\alpha_L t}}{R_L^2+\omega^2L^2} - \frac{\omega L\cos\omega t - R_L\sin\omega t}{R_L^2+\omega^2L^2}\right]$$

$$0 \le t \le T/2 \qquad (37)$$

The transient component is

$$(i_L)_t = -\frac{\omega E}{j2\pi L}\int_{-\alpha_L}\frac{\left(1+\epsilon^{p\frac{T}{2}}\right)\epsilon^{pt}\,dp}{(p+\alpha_L)\left(p^2+\omega^2\right)\left(1-\epsilon^{p\frac{T}{2}}\right)}$$

$$= -\frac{E\omega L\left(1+\epsilon^{-\alpha_L\frac{T}{2}}\right)\epsilon^{-\alpha_L t}}{\left(R_L^2+\omega^2L^2\right)\left(1-\epsilon^{-\alpha_L\frac{T}{2}}\right)} \qquad (38)$$

Furthermore since $E_{d\text{-}c} = \frac{2E}{\pi}$ by eq. (34), the correction term represented by eq (35) is

$$i' = \frac{2E}{\pi}\left[\frac{1}{R_L+R} - \frac{1}{R_L}\right] \qquad (39)$$

Combining equations (37), (38) and (39) we get for the periodic current in the inductive branch

$$i_L = E\left\{\frac{2}{\pi}\left[\frac{1}{R_L+R} - \frac{1}{R_L}\right] + \frac{R_L}{R_L^2+\omega^2L^2}\sin\omega t - \frac{\omega L}{R_L^2+\omega^2L^2}\cos\omega t + \frac{2\omega L\epsilon^{-\alpha_L t}}{\left(R_L^2+\omega^2L^2\right)\left(1-\epsilon^{-\alpha_L\frac{T}{2}}\right)}\right\}$$

$$,\ \alpha_L = \frac{R_L}{L} \qquad (40)$$

To obtain i_C we have the transformed equation

$$\left(R_C+\frac{1}{pC}\right)\bar{i}_C = \frac{\omega\left(1+\epsilon^{-p\frac{T}{2}}\right)E}{\left(p^2+\omega^2\right)\left(1-\epsilon^{-p\frac{T}{2}}\right)}$$

or

$$\bar{i}_C = -\frac{\omega Cp\left(1+\epsilon^{-p\frac{T}{2}}\right)E}{\left(p^2+\omega^2\right)\left(1-\epsilon^{-p\frac{T}{2}}\right)\left(R_C\,Cp+1\right)}$$

whence

$$i_C = \frac{\omega E}{j2\pi R_C}\int_{Br}\frac{p\left(1+\epsilon^{-p\frac{T}{2}}\right)\epsilon^{pt}\,dp}{\left(p^2+\omega^2\right)\left(1-\epsilon^{-p\frac{T}{2}}\right)\left(p+\alpha_C\right)}$$

$$,\ \alpha_C = \frac{1}{R_C C}$$

The actual current in the first half period is

$$(i_C)_a = \frac{\omega E}{j2\pi R_C}\int_{Br}\frac{p\,\epsilon^{pt}\,dp}{\left(p^2+\omega^2\right)\left(p+\alpha_C\right)}$$

$$= \frac{\omega E}{R_C}\left[\frac{-R_C C\epsilon^{-\alpha_C t}}{1+\omega^2C^2R_C^2} + \frac{R_C C}{1+\omega^2C^2R_C^2}\left(\cos\omega t+\omega R_C C\sin\omega t\right)\right],\ 0\le t\le\frac{T}{2} \qquad (41)$$

The transient component is

$$(i_C)_t = -\frac{\omega E}{j2\pi R_C}\int_{-\alpha_C}\frac{\left(1+\epsilon^{p\frac{T}{2}}\right)\epsilon^{pt}\,dp}{\left(p^2+\omega^2\right)\left(1-\epsilon^{p\frac{T}{2}}\right)\left(p+\alpha_C\right)}$$

$$= \frac{\omega E}{R_C}\left[\frac{R_C C\left(1+\epsilon^{-\alpha_C\frac{T}{2}}\right)\epsilon^{-\alpha_C t}}{\left(1+\omega^2R_C^2C^2\right)\left(1-\epsilon^{-\alpha_C\frac{T}{2}}\right)}\right] \qquad (42)$$

Combining eqs (41) and (42) we get for the periodic current in the capacitive branch

$$i_C = (i_C)_a - (i_C)_t = -\frac{2\omega CE\epsilon^{-\alpha_C t}}{\left(1+\omega^2C^2R_C^2\right)\left(1-\epsilon^{-\alpha_C\frac{T}{2}}\right)} + \frac{\omega CE}{1+\omega^2R_C^2C^2}\left(\cos\omega t+\omega R_C C\sin\omega t\right) \qquad (43)$$

Thus the total input current to the filter is

$$i = i_L + i_C$$

$$= E\left\{\frac{2}{\pi}\left[\frac{1}{R_L+R} - \frac{1}{R_L}\right] + \left[\frac{R_L}{R_L^2+\omega^2L^2} + \frac{\omega^2C^2R_C^2}{1+\omega^2C^2R_C^2}\right]\sin\omega t + \left[\frac{\omega C}{1+\omega^2C^2R_C^2} - \frac{\omega L}{R_L^2+\omega^2L^2}\right]\cos\omega t + 2\left[\frac{\omega L\epsilon^{-\alpha_L t}}{\left(R_L^2+\omega^2L^2\right)\left(1-\epsilon^{-\alpha_L\frac{T}{2}}\right)} - \frac{\omega CE^{-\alpha_C t}}{\left(1+\omega^2C^2R_C^2\right)\left(1-\epsilon^{-\alpha_C\frac{T}{2}}\right)}\right]\right\}$$

$$,\ 0\le t\le\frac{T}{2} \qquad (44)$$

Equation (44) may be used to compute the response of any given filter of the configuration of Figure 7. By the assumptions made in deriving this equation, the calculations are not valid if the current becomes negative during any part of the cycle. Physically, this is impossible. However, if the calculations show that the current would

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attempt to go negative for only a small fraction of the cycle, then it may be assumed that during this small fraction the current is zero, and the consequent regulation may be computed approximately. To cite a typical example, let

E = 2,800 volts
ω = 377 radians per second (60 cps)
L = 3.44 henry
R_L = 107 omhs
R_c = 300 ohms
C = 0.5 microfarad (selected to resonate L at 120 cps)
R = 20,000 ohms
C_s = 8 microfarads

$$\tau = \frac{2\pi}{\omega} = \frac{1}{f} = \frac{1}{60} = 0.0167 \text{ second}$$

The response curve is shown in Figure 10. The dotted portion of the curve shows the range in which the current attempts to go negative, this range being fairly small.

Now this current can be thought of as a steady value which flows into R, and an alternating value which flows back and forth through the shunt capacitor C_s. If this alternating component is permitted to flow freely the output voltage across R is $\frac{2}{\pi} \times 2{,}800$ = 1,780 volts minus the d-c voltage drop in the choke. When the alternating component cannot flow freely, as in the case of Figure 10, we can get an approximation to the additional regulation due to cut-off by reasoning as follows: The integrated negative current which cannot flow freely remains as a residual charge on C_s which gives rise to an additional emf:

$$E' = \frac{\int i\,dt}{C_s}$$

the integration being taken over the period that the current is "negative." In Figure 10, the current varies so steeply in this region that the integral can be taken as the area of the dotted triangle. When this is done we get

$$E' = \frac{\frac{1}{2} \times \frac{18}{360} \times .0167 \times 0.325}{8\,(10)^{-6}}$$

= 170 volts

The percent regulation due to cut-off is, therefore, approximately

$$\% \text{ regulation} = \frac{170 \times 100}{1780} = 9.55\%$$

The extreme dip in the filter input current is obviously due to insufficient

(*Continued on page 72*)

● Although everything we make today goes to war, it is going to work for you just as surely as though we could deliver it for your own use in your own plant. For today *all* of America is in business for Victory, and whatever helps the war effort helps us all. ✓ ✓ ✓ Right now "Connecticut" equipment is hard at work all around the globe — precision electrical products, different in detail, but not in basic design, from the ones you'll be using after victory. ✓ ✓ ✓ Once this war is won, and present military secrets become open knowledge, you'll know about "Connecticut" products from your partners, the boys who are using them today. Chances are you'll be using many electrical devices, born of this war, to speed and control peacetime production. We hope to continue working with you then.

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CONNECTICUT TELEPHONE & ELECTRIC DIVISION

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NEWS BRIEFS OF THE MONTH...

LOW LOSS PLASTIC RESINS

Thermo plastic resins known as *Polectron,* said to have unusual high softening temperatures, low dielectric loss and excellent water resistance, have been announced by the General Aniline and Film Corporation. Their properties are said to make them useful in dielectrical materials for replacement of mica in radio condensers. Impregnation of electrical coils, windings and capacitors where high insulation values must be maintained at elevated temperatures, water and moisture seals for various types of electrical equipment, are among the indicated uses.

"Polectron" products are now available in limited quantities. However, facilities to provide a supply for industrial applications are said to be in the offing.

In tests of "Polectron" products by standard methods, the following data have been obtained . . . (*1*) heat distortion temperature, 140-160° C; (*2*) power factor (one kilocycle to one megacycle at 25° C), 0.10% or less; at one kilocycle from 25° C to 100° C, 0.10% or less; (*4*) specific resistivity at 400 volts, more than 10^{15} ohm cms; (*5*) dielectric constant (one kilocycle to one megacycle), 3.0; (*6*) dielectric strength, more than 1000 volts per mill.

* * *

PECK OF WCCO JOINS COLUMBIA UNIVERSITY

Arthur G. Peck, studio engineer for CBS at WCCO, Minneapolis-St. Paul, has resigned to become a member of the staff of the Airborne Instruments Laboratories of Columbia University on Long Island.

* * *

O'CONOR NOW FORMICA ASS'T CHIEF ENGINEER

D. J. O'Conor, Jr., has been appointed assistant chief engineer of the Formica Insulation Company, Cincinnati, Ohio.

O'Conor has been with the company for several years and is the son of D. J. O'Conor, president and co-founder of the company.

* * *

PARTS AND EQUIPMENT MANUFACTURERS HONOR SHURE

At its April meeting, the Association of Electronic Parts and Equipment Manufacturers (formerly the Sales Managers Club, Western Group) presented to one of its charter members and past presidents, S. N. Shure, general manager of Shure Brothers, a large decorated cake commemorating the recent Army-Navy "E" production award to that company. The presentation was made to Mr. Shure by Jerome J. Kahn, chairman of the Association.

RCA MORSE CODE ALBUM

A streamlined system of instruction in International Morse Code has been incorporated in an RCA Victor six-record album.

Prepared by John N. Cose, director of instruction at the RCA Institutes, the album and accompanying booklet are designed to acquaint students with the actual sound of the morse code letters as they would be sent over the air and to provide them with specially prepared practice transmissions.

A novel feature of the morse code album is the incorporation of instructions on the records themselves, with the handbook as a check on all practice messages transmitted.

* * *

WHITE STAR WON BY RCA AT HARRISON

A white star has been added to the Army-Navy "E" flag at the RCA plant in Harrison, New Jersey.

The Army-Navy "E" flag awarded to the RCA Victor plant at Camden, New Jersey, now has two stars. The Army-Navy "E" pennant also has been presented to the workers of Radiomarine Corporation of America, which in addition has been awarded the U. S. Maritime Commission's "M" pennant and Victory Flag.

* * *

BIERWIRTH NOW ON W. E. BOARD

Frederick W. Bierwirth, vice president and telephone sales manager of Western Electric, has been elected a member of the board of directors. Mr. Bierwirth joined Western Electric in 1912.

* * *

STRATTON ENGINEERS SURVEY UNIVERSAL

Engineers from D. V. Stratton and Co., San Francisco industrial managers, are making a time and motion study survey of the Inglewood plants of Universal Microphone Company, to utilize existing facilities and provide for immediate expansion for maximum production.

* * *

MICROPHONE DROP TEST MACHINE

A testing machine that picks up and drops microphones *on their heads,* 20,000 times, to check durability, has been devised by O. C. From, in charge of the experimental laboratory in the telephone division of Federal Telephone and Radio Corp., Newark, N. J.

Five microphones can be tested at a time.

WMC ASKS FOR ENGINEERS

If you have professional training or experience in engineering and/or related fields or physical sciences and unemployed because construction work has been stopped or for other reasons; employed in less-essential activity and seeking a transfer to war work, or working, but feeling that your abilities are not fully used on your present job, the WMC would like you to write them.

Address the letter to the National Roster of Scientific and Specialized Personnel, War Manpower Commission, Attention: Qualifications Section, Washington, D. C. In your letter state: *1.* Whether you are now available for employment; *2.* Types of work you are qualified to do; *3.* Conditions under which you will accept employment; *4.* Whether you are or are not already registered with the Roster. If you are not already registered with the Roster, state your field or fields of specialization and request registration papers.

Even if you are already registered, the Roster, now a part of the Bureau of Placement, War Manpower Commission, needs to know whether you are *presently available* for employment.

* * *

SUMMER COURSES AT B'KLYN POLY

The Polytechnic Institute, Brooklyn, N. Y., has announced a schedule of summer courses to be given by the Graduate Electrical Engineering Department under the Engineering, Science and Management War Training program. The courses cover . . . Introduction to Microwave Theory; Introductory Experiments in Microwaves; Theory of Cathode-Ray Circuits; Experiments in Cathode-Ray Circuits; Experiments in Ultra-High Frequency Generators and Receivers; Measurements at Ultra-High Frequencies, and Advanced Theory of Ultra-Short Electromagnetic Waves.

* * *

FEDERAL TEL. LAB. DIVISION WINS "E"

Formal presentation of the Army-Navy "E" to the Laboratories Division of Federal Telephone and Radio Corporation, Newark, was held recently at 67 Broad Street, New York City.

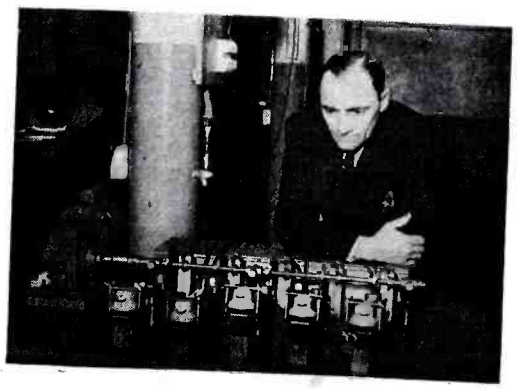
Colonel Ira H. Treest was the principal speaker.

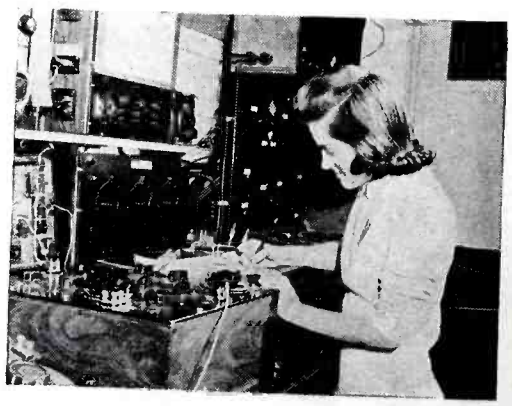
* * *

21-YEAR-OLD GIRL, ENGINEER AT G.E. BRIDGEPORT WORKS

To 21-year-old Margaret Allen goes the honor of being the first woman to work in General Electric's radio receiver engineering section at Bridgeport, Conn.

(*Continued on page* 46)





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Messages like these, crackling through the ether enable our flyers to meet and defeat attacking enemy forces. The efficiency of aviation radio communications has played a major role in our air victories, and the engineers who design and produce this equipment deserve their share of the glory.

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The Lenz wire engineers are always ready to consult with the designers of communications equipment on their wire and cable specifications. No matter how stringent and exacting the requirements, how severe the conditions under which the equipment must operate, Lenz engineers will help you find just the right wire for the job.

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Moisture Meters
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MEASUREMENTS CORPORATION

Boonton, New Jersey

NEWS BRIEFS

(*Continued from page* 44)

Miss Allen joined G. E. at Schenectady, N. Y., in August, 1942, when the company started a special training program for women college graduates similar to the company's training course for graduate men engineers.

* * *

HEATRONIC PLASTIC MOLDING

A molding process, the *heatronic* method, utilizing high-frequency heating by generating current in an electrostatic field, has been developed at the Bakelite Corporation. In this process, a preform or rough shape of the plastic article to be molded is placed between two plates of the *heatronic* equipment just before it is to be put into the mold. The plates themselves stay cool, it is said, but a rough preformed "pill" of plastic becomes uniformly warm all through as the radio current is generated. Thus, evenly heated throughout its thickness, the plastic preform, transferred to the mold, is said to flow into all of the corners and sections to produce a finished plastic part with much less pressure and in much less time.

In addition to the time saved, two other advantages are claimed: First, plastic parts can be molded in thicknesses and sizes hitherto impractical with standard molding methods and conventional equipment. Second, existing molds and molding press equipment may be used to produce plastic parts which, before the introduction of *heatronic* molding, would have required a long wait for the manufacture of high-pressure presses.

* * *

MINIATURE BEARING BULLETIN

A 4-page bulletin describing radial and pivot type bearings from 1/8 to 5/16 inch outside diameter in both steel and non-magnetic beryllium has been published by Miniature Precision Bearings, Keen, New Hampshire. A double spread tabulation provides dimensions and load ratings at varying speeds for each size and type of bearing as well as showing them in actual size.

The bulletin is available to engineers and designers on request.

* * *

FIRST INTO LIBYA

Sergeant Bud Welsh, formerly counterman for J. V. Duncombe Company, National Union tube and parts distributor of Erie, Pennsylvania, bears the distinction of having been the first American soldier to land a jeep on Libyan soil.

* * *

BALLANTYNE NOW PHILCO PRESIDENT

John Ballantyne, who has been serving as vice president in charge of operations of Philco Corporation, has been elected president. James T. Bulkley was elected chairman of the executive committee. M. W. Heinritz, formerly general manager of the storage battery division, was named vice president in charge of the division, and Charles F. Steinruck, Jr., assistant secretary, was elected secretary in place of George E. Deming, who died April 15th.

* * *

GLASS WORKING EQUIPMENT CATALOG

A 94-page catalog with about 750 illustrations, covering data on designing and engineering of gas burners, mixers and glass rollers for all kinds of glass working by hand or by machinery, has been published by Eisler Engineering Company, Newark, New Jersey.

* * *

MOLDING TECHNIQUE DATA

A 16-page booklet entitled *Technique of Molding Low Loss Phenolics* has been published by the Bakelite Corporation, 30 East 42d Street, New York City.

* * *

DUAL GONIOMETER X-RAY CRYSTAL UNIT

An x-ray quartz analysis machine equipped with *two* goniometers, with a newly-designed natural face orientation table as optional equipment, has been announced by Phillips Metalix Corporation, 419 Fourth Avenue, N. Y. City. Bulletin 202 describing the new apparatus is available.

* * *

WARD LEONARD WINS "E" RENEWAL

The Navy Board for production awards has notified Ward Leonard Electric Co., Mount Vernon, N. Y., of the Army-Navy "E" award renewal for their continued volume production.

* * *

COLLOIDAL GRAPHITE LUBRICANT DATA

A 4-page illustrated bulletin, 423-W, on "dag" colloidal graphite as a high temperature lubricant has just been released by the Acheson Colloids Corporation of Port Huron, Michigan. This bulletin discusses liquid and semiliquid lubricants in high temperature applications. It also gives case study information on the use of "dag" colloidal graphite for foundry

(*Continued on page* 50)

TOOLS • DIES
STAMPINGS
HEAT
TREATING

LAMINATIONS

For Output Transformers of highest permeability
•
Standard Sizes for Audio, Choke, Output and Power Transformers in Stock.
Write for dimension sheets.

PERMANENT MAGNETS

Alnico
(cast or sintered)
Cobalt, Chrome or Tungsten, cast, formed or stamped. Engineering co-operation backed by 40 years experience insures quality, dependability and service.

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

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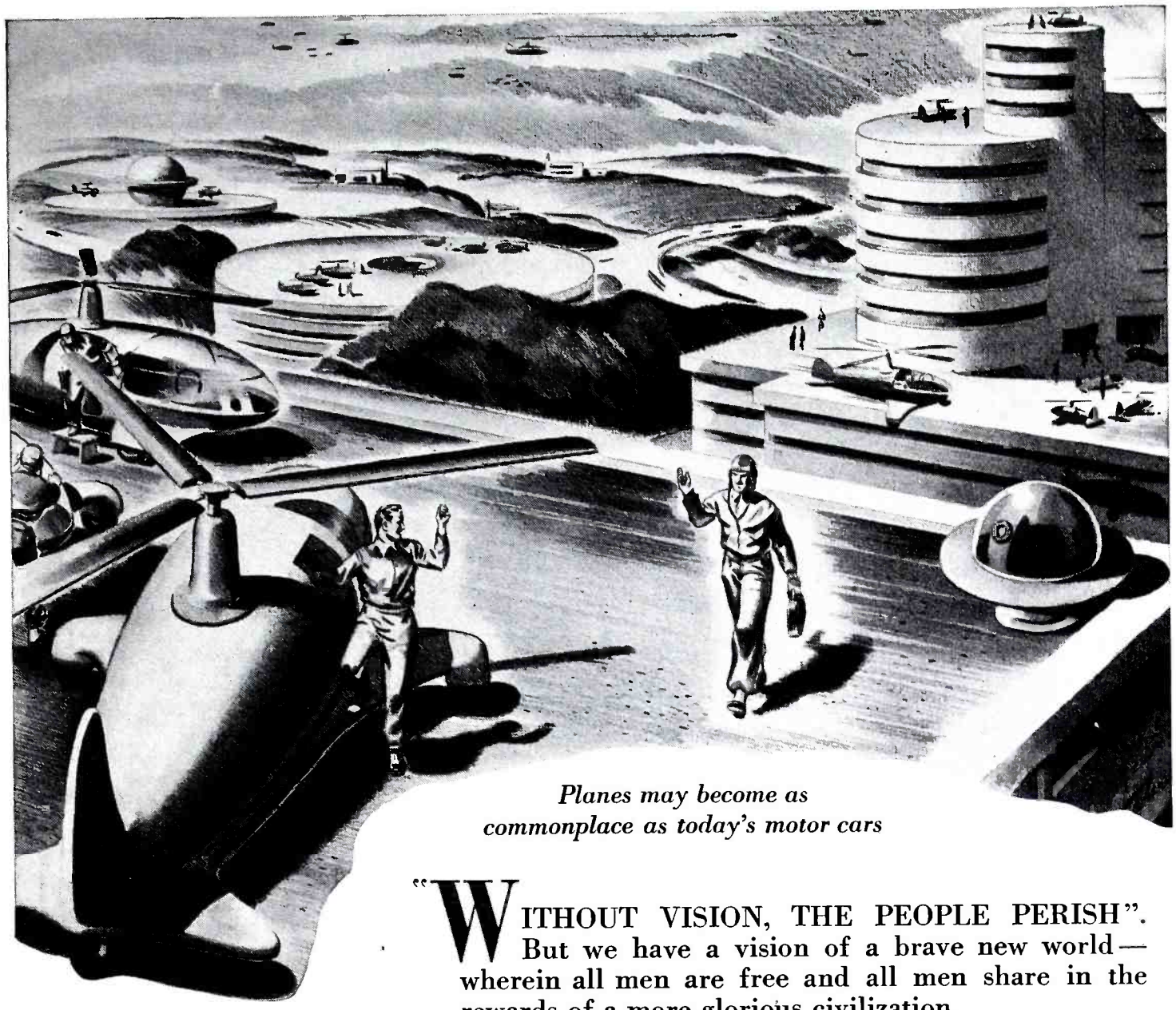
SALUTE TO THE WORKERS OF TOMORROW!



Planes may become as commonplace as today's motor cars

"WITHOUT VISION, THE PEOPLE PERISH". But we have a vision of a brave new world—wherein all men are free and all men share in the rewards of a more glorious civilization.

What the face of this world will be like, none can know. Will factories be of revolutionary design—lighted by the health rays of artificial sunlight? Will the workers travel to and fro in their own planes—with ample leisure for education and relaxation?

This much we know. Out of modern, forward-looking industries such as Small Electric Motors (Canada) Limited, will come electrical equipment, for ships and planes, for factories and homes, of revolutionary design.

For here is a new company in Canada—with new ideas and ideals. Now engaged solely in original designing and precision making of essential war equipment, Small Electric Motors (Canada) Limited looks confidently to a brilliant post-war future.

DESIGNERS
AND MANUFACTURERS
of all types of precision electrical apparatus including

D.C. & A.C. Motors for specialized purposes
Aircraft Generators
Aircraft Engine Starters
Alternators
Motor Generators
Electric Pumps
Motors with Governors
Gyros, etc.

Small Electric Motors (Canada) Limited

and its subsidiary

Semco Instruments Limited

1-43

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AT "E" AWARD PRESENTATIONS

(Top) . . . at the Shure Brothers Army-Navy "E" ceremonies. Left to right: Marion De Block, Shure employee, who accepted the "E" pin award; Lt. Col. Nathan Boruszak, and S. N. Shure, general manager of Shure Brothers.

(Top) . . . at Sprague Specialties Co. ceremonies. R. C. Sprague, president, at left, holding "E" pennant, presented by Brig. Gen. A. A. Farmer, U. S. Signal Corps. Flags were presented to both plants of Sprague, in a double ceremony.

(Left) . . . the White Star "E" pennant won by the Hallicrafters. Left to right: R. W. Durst, Marcia Davis, advertising manager, and W. J. Halligan. (Right) . . . the White Star Army-Navy "E" presentation at IRC. Left to right: George Berry, president of Local 105, UER and MWA; Harry Ehle, IRC vice-president; Dan Fairbanks, IRC jobber sales manager, and Alice Flannery, union secretary.

(Below) . . . the Army-Navy "E" ceremonies at Thordarson. The pennant was presented to R. E. Onstad, president of Thordarson, by Lt. Col. John M. Neihaus of the U. S. Signal Corps. Others who attended the ceremonies were Dr. C. F. Burgess and members of the board of directors, as well as officials of the Army, Navy and private industry.

(Below) . . . the Army-Navy "E" award ceremonies at the Laboratories Division of the Federal Telephone and Radio Corp. Left to right: Maj. Gen. George S. Gibbs, vice-chairman of Federal Telephone and Radio Corp.; W. E. Boehle, representing the employees, and Col. Ira H. Treest, U. S. Army Signal Corps.

(Below) . . . at the Sickles Company "E" ceremonies. Left to right: Roy F. Sickles, president; Lt. Col. Kenneth D. Johnson, who made the flag award; Monte Cohen, general manager; Lt. Jesse M. LaFollette, USNR, who awarded the "E" pins, and Wm. Meserve, president of the employees' Association.

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RCA 849

R-F and A-F POWER AMPLIFIER, OSCILLATOR, MODULATOR

$120

LONGER LIFE
instead of increased ratings

Ordinarily, when a Transmitting Tube has been improved, its ratings are raised—*but not in these extraordinary times!*

Today, it is long life that counts—not spectacular "peak" performance.

That is why, when the RCA-849 was materially improved over a year ago by use of the famous RCA zirconium-coated anode, you heard nothing about it—even after months of actual use had shown that the improvement was such as to warrant a substantial rating increase in normal times.

Instead of reflecting such an improvement in terms of higher tube ratings we utilized it to make conservative RCA tube ratings still more conservative. This program, we felt, was far more in keeping with the war effort because it assures longer life for tubes that are difficult to replace. This has been done, not only with the RCA-849, but with other RCA tubes as well.

The war has not stopped RCA engineering progress. It has only intensified it—a fact to which the thousands of hours of additional potential life now built in to many RCA Transmitting Tubes offer the most convincing proof.

RATINGS*
FILAMENT VOLTAGE, 11 VOLTS
FILAMENT CURRENT, 5. AMPERES

RCA

PLATE VOLTAGE, 2500 VOLTS, MAX.
PLATE DISSIPATION, 400 WATTS, MAX.
*For class C telegraph service

HOW TO MAKE TUBES LAST LONGER ON THE JOB . . .

RCA advertising, for months past, has been devoted to operating tips on making tubes last longer. This valuable material has now been collated into a booklet, copy of which will be sent upon request to Radio Corporation of America, Commercial Engineering Section, Harrison, N. J.

RCA TRANSMITTING TUBES

PROVED IN COMMUNICATION'S MOST EXACTING APPLICATIONS

RADIO CORPORATION OF AMERICA, RCA Victor Division, *Camden, N. J.*

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Designed for
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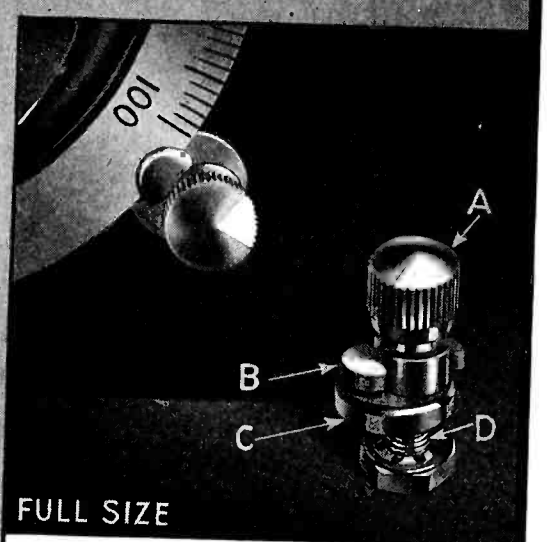
Application



FULL SIZE

The No. 10050 Dial Lock

Designed for application! Compact, easy to mount, positive in action, does not alter dial setting in operation! Rotation of knob "A" depresses finger "B" which firmly pinches dial between "B" and "C" *without imparting any rotary motion to Dial.* Single hole mounted by means of shank "D". Made of brass —Standard finish Nickel.

JAMES MILLEN MFG. CO., INC.

MAIN OFFICE AND FACTORY
MALDEN
MASSACHUSETTS

M

NEWS BRIEFS

(*Continued from page* 46)

oven conveyors, kiln cars, hot punches and piercing tools, forging dies, etc., with references to die casting machine and wire drawing die lubrication.

* * *

SUMMERILL TUBING BULLETIN

A 12-page booklet, bulletin 443, has been issued by Summerill Tubing Company, Bridgeport, Pa.

Data on tapered and formed tubes and a wide variety of special shapes are given. It also has a guide chart giving rather complete detailed information on the chemical composition of twenty-five different metals in regular production, together with size range available for each, and mechanical properties and physical properties.

The bulletin is available on request on business letterhead.

* * *

GHIRARDI TROUBLESHOOTER HANDBOOK

A revised 744-page edition of Ghirardi's Radio Troubleshooter Handbook has just been issued by Radio and Technical Publishing Company, 45 Astor Place, New York City.

Featured are 404 pages of trouble *case histories* giving all the common troubles and their remedies for over 4,820 receiver and automatic record changer models, a complete tabulation of i-f peaks and alignment data for practically every known superhet receiver, tube characteristics, a basing data chart, 52 specially prepared reference graphs, charts, tables and other compilations. Receiving tube types recommended for substitution, special purpose tubes, tube testing, receiver modernization, i-f transformer troubles, servicing and replacement data are also presented.

The price of the book is $5 in the U. S. A.

* * *

ROSE HILLIARD NOW PRIORITY DIRECTOR AT V. J. ANDREW

Rose Hilliard has been appointed priority director of the Victor J. Andrew Company, Chicago, Ill.

Miss Hilliard was formerly with the Columbia Broadcasting System, where she served as a technician in the engineering department.

* * *

RALPH HULTON JOINS CROLITE

Ralph Hulton has been appointed field engineer of Henry L. Crowley & Co., Inc., West Orange, New Jersey. He will cover Ohio and Michigan and will make his headquarters in Detroit.

* * *

SOLAR STANDARDIZED CAPACITORS

Standardized capacitor listings, technical data and illustrations, appear in new catalogs V-1 and V-2 just released by Solar Capacitor Sales Corporation, Bayonne, New Jersey.

* * *

SALES MANAGERS CLUB, WESTERN GROUP, CHANGES TITLE

The Sales Managers Club, Western Group, a trade association of radio parts manufacturers which has been in existence for over ten years, has changed its name to the Association of Electronic Parts and Equipment Manufacturers. The Association has over fifty members.

The group meets on the second Thursday of each month in Chicago. T present chairman is Jerome J. Kahn.

* * *

RCA DEVELOPS AIRCRAFT RADIO TEST CHAMBER

To permit checking of aircraft rad equipment under conditions duplicati the stratosphere seven and one-half mil up, the RCA Victor Division of the Rad Corporation of America have develope an altitude test chamber. This chamb is built of transparent Plexiglas, a plast developed by the Rohm and Haas Con pany. Because of the transparent co struction, it makes possible the comple testing and inspection of any piece radio apparatus by several engineers one time. The chamber is cone-shape about four feet high and five feet i diameter at its base. It is just less tha one-inch thick and capable of withstan ing tremendous shocks and pressures.

* * *

SPATES AND WOOD OF LITTELFUSE PROMOTED

Ash Wood, sales manager at the E Monte, California, plant of Littelfus Inc., and Gerald E. Spates, general man ager of the Chicago plant, have bee elected vice presidents. Irene Mueller secretary to E. V. Sundt, president, wa elected assistant secretary.


G. E. Spates


Ash Wood

* * *

STUPAKOFF CERAMIC WINS "E"

The Stupakoff Ceramic and Manufacturing Company, Latrobe, Pennsylvania, have won the Army-Navy "E."

* * *

WESTINGHOUSE PROMOTES LUTZ, MEGATHLIN

Cedric William Lutz has been appointed purchasing agent and Earle Megathlin assistant purchasing agent in the Radio Division of Westinghouse.

* * *

WIRING MATERIAL REPS. APPOINTED BY G. E.

New wiring material field representatives have recently been appointed by General Electric. S. D. Hopper has been promoted acting manager of the Cleveland office, and E. O. Callander becomes the field representative in this area.

H. O. Dodson is the new representative in Indianapolis. The Wisconsin territory with headquarters at Chicago will now have K. K. Crook as representative. The new Philadelphia representative is H. C. Maccubbin and R. O. Snyder is now the new representative in the St. Louis, Missouri, area.

* * *

WAR ORDER DIVISION AT LAFAYETTE RADIO

A special division to facilitate prompt deliveries and procurement of war materials has been inaugurated by Lafayette Radio Corporation, Chicago.

The new division will be in charge of

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David Muir, according to an announcement made by S. W. Berk, vice president.

David Muir and S. W. Berk

* * *

LATHE CATALOG

A new 48-page catalog, 100-C, describing the entire line of South Bend engine lathes, toolroom lathes, and turret lathes has just been published. The engine lathes are made in five sizes ranging from 9" to 16" swings. The toolroom lathes are available with swings from 10" to 16". The turret lathes are made in two sizes, having 9" and 10" swings.

* * *

SYLVANIA TUBE BULLETINS

Bulletins covering types 1R4/1294, 3B7/1291, 3D6/1299, 7C4/1203A and 7E5/1201 have been issued by Sylvania Electric Products, Inc., Emporium, Pa. The tubes are now double-branded and carry the new RMA type numbers as well as the old familiar 1200 series numbers. The sheets include new information and data regarding performance at ultra-high frequencies.

The 1R4/1294 is a cathode type high-frequency diode of *lock-in* construction similar to 7C4/1203A except for lower heater rating and reduced physical size of tube mount. The 3B7/1291 is a filament type double triode of the *lock-in* construction, especially designed for modern ultra-high frequency applications.

Type 3D6/1299 is a filament type beam power amplifier tube of *lock-in* construction employing the same type of filament as is used in the 3B7/1291, allowing it to be operated over a range of from 1.4 to 1.75 volts. When employed as a class *C* amplifier, 3D6/1299 will provide power output ranging from 2 watts at 20 megacycles to approximately 0.5 watt at 200 megacycles.

Type 7C4/1203A is a cathode type diode especially designed for modern ultra-high frequency applications. This tube will successfully operate up to 600 megacycles as a detector.

The 7E5/1201 is a cathode type triode designed for modern ultra-high frequency applications. Type 7E5/1201 can be used as a signal source or local oscillator up to a frequency of 750 megacycles when used in a double ended transmission line circuit. This type of operation is facilitated by a symmetrical arrangement of double grid and plate leads.

* * *

ANGUS BECOMES ENGINEER OF G. E. ELECTRONICS DIVISION

W. M. Angus, formerly designing engineer of the receiver division of the General Electric Electronics Department at Bridgeport, Conn., has been named engineer of the division.

In 1940, Mr. Angus received the Coffin

(*Continued on page* 54)

CONQUERORS OF THE Sky

. . use Consolidated Radio Headphones

The superior flying skill of American pilots demands split-second response of all of their equipment. Rugged, dependable Consolidated Radio headphones are helping American flyers gain mastery of the air on the battle fronts of the world.

Consolidated Radio is proud that the Army Air Force is using its products to aid in the defeat of the enemies of world peace. We pledge to continue to devote all our energy and engineering skill to the production of headsets with built-in dependability.

Consolidated Radio's Modern Mass Production Methods Can Supply Signal Corps and Other Headphone Units in Quantities to Contractors

CONSOLIDATED RADIO PRODUCTS CO.

SPECIALISTS IN MAGNETIC AND ELECTRONIC DEVICES

350 W. ERIE ST., CHICAGO, U. S. A.

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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

The board of directors of the VWOA. Standing, left to right: W. S. Fitzpatrick, Wm. C. Simon, J. R. Poppele, George H. Clark, A. J. Costigan. Seated, left to right: William J. McGonigle, Cmdr. Fred Muller, C. D. Guthrie.

PERSONALS

WE had a pleasant visit with Lieutenant Commander A. F. Wallis, Executive Officer of the Maritime Training Station at Huntington, L. I. The complement of this new station includes hundreds of embryo wireless operators and almost two hundred administrative personnel. Included on the staff of instructors are many old timers in the field of wireless. The outstanding success of the training program thus far is in a large measure due to Commander Wallis' efforts in rounding up personnel and equipment in the months preceding the opening of the station. . . . Had a pleasant chat on the phone with Frank Orth, one of the mainstays of the Columbia Broadcasting System's technical staff. Frank is anxious for another get-together in the near future. Watch for a notice in the mails. . . . Henry Steinberg, commercial representative for Cornell-Dubilier, continues traveling about the country with always an eye open for VWOA prospects. He is unquestionably one of our most enthusiastic boosters. . . . A recent phone conversation with Bill Simon, our hard-working treasurer, found him busy day and night with his duties as general manager of the Tropical Radio Service Company. . . . Some of the Chicago members should contact George Martin of Radiomarine in Chicago, who would like to arrange a meeting there. . . . Guy Entwistle, president of Massachusetts Radio School, continues active in Association affairs in the Boston area. Let's have some news of the doings up there *GE*. . . . Ran into G. B. Rabbitts, one of the real pioneers in the field of wireless, who continues active. He has recently returned from an eleven-months trip as Radio Officer of an American vessel to the Near East. Our prexy sailed as fellow Radio Officer with *GBR* on four different ships, perhaps a record of some kind. Congratulations *GBR* on your record of over thirty-five years continuous service as Radio Officer aboard some of the finest ships under the American Flag. That, too, is probably some kind of a record. . . . How many of you have thought of dropping a note, or perhaps a few packages of cigarettes to 'Doc' Forsyth, Radio Officer at Sailor's Snug Harbor, Staten Island, N. Y.? 'Doc' is now totally blind. A message of greeting from some of those who knew him years ago will be read to him by his *Leader*. We know it will do much to relieve the monotony for one, who has in his day, visited most of the ports of prominence in the world to receive word from his former associates. So please take time out to do this.

FROM William J. Halligan, president of the Hallicrafters, has also come a letter of thanks for the Marconi Memorial Medal of Achievement award, of which we are proud.

Says "Bill" Halligan: "Words to describe my feelings in accepting the Marconi Memorial Medal of Achievement are difficult for me to find.

"Twenty-seven years ago I went to work as a wireless operator for the Marconi Wireless Telegraph Company. I continued at sea as an operator for a number of years after that. These years as an operator have left an indelible impression upon me and I can truthfully describe them as the happiest years of my life.

"I think, therefore, that I am understating it to say that I am supremely happy that the Veteran Wireless Operators Association should see fit to present me this Medal and in this way elevate me to such illustrious company

(*Continued on page* 75)

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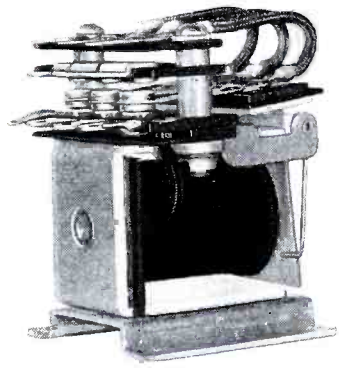
FROM "HAM" TRANSMITTER RIGS TO INTER-PLANE COMMUNICATION

RELAYS BY GUARDIAN

★ Today they are off the air . . . voices stilled . . . home-built rigs carefully covered. For most of yesterday's "hams" are lending their experience, knowledge, and ingenuity to the war effort . . . creating and perfecting new communication devices . . . the amazing new flight recorder, for instance . . . or Radar. But whether they work in a wartime lab or have their "office" in a Fortress, they are still close to one of their early friends—"Relays by Guardian".

One of the newer developments is a multi-purpose aircraft radio relay pictured at the right. It is built in contact combinations up to three pole, double throw. Coils are available in resistances from .01 ohm to 15,000 ohms. At 24 volts DC it draws 0.12 amperes. This relay is also built for AC with a contact rating of 12½ amperes at 110 volts, 60 cycles. Standard AC voltage is 92-125 volts but coils are available for other voltages.



Aircraft Radio Relay
DC Model—Bulletin 345
AC Model—Bulletin 340

Write on your business letterhead for these new bulletins: B-8, Six pages of Aircraft Contactors—195, Midget and Signal Corps Relays — B2A, Aircraft Relay — SC65, Solenoid Contactor.

GUARDIAN ELECTRIC

1623-G WEST WALNUT STREET — CHICAGO, ILLINOIS

A COMPLETE LINE OF RELAYS SERVING AMERICAN WAR INDUSTRY

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LONGER LIVES...

FOR MEN AND EQUIPMENT

..due, in part, to extensive research being undertaken in the N-Y-T Sample Department

THE development of new-type transformers to diversified and extremely critical specifications . . . their perfection for accurate and dependable functioning under varying operating conditions . . . mechanical and dimensional designing to meet physical limitations of the applications—all these make up the work of the N-Y-T Sample Department. And all are tremendously important in safeguarding our Armed Forces, and increasing the life-span of their machines and equipment.

The N-Y-T Sample Department is prepared to give immediate consideration to your special problems and make deliveries within a matter of days. Send us your inquiries.

NEW YORK TRANSFORMER COMPANY

28 WAVERLY PLACE, NEW YORK, N. Y.

NEWS BRIEFS

(*Continued from page* 51)

Award, highest honor bestowed upon a G. E. employee, for the execution of an idea for the automatic winding of coils used for touch-tuning of radio receivers and transformers.

* * *

W. E. TELEPHONE CABLE BOOKLET

A 37-page booklet on telephone cables has been published by Western Electric, 195 Broadway, N. Y. City. It describes lead-covered, jute-protected, wire-armored, tape-armored, and switchboard cable. The booklet also describes new materials which replace such critical products as silk and tin in the "CL" type of switchboard cable.

* * *

PATCH NOW CROLITE SALES HEAD

Earl S. Patch has been appointed sales manager of Henry L. Crowley & Co., Inc., West Orange, N. J. Mr. Patch was formerly with the Moraine Products division of General Motors in Dayton.

* * *

THORDARSON ELECTS ONSTAD PRESIDENT

R. E. Onstad, formerly vice president and general manager of Thordarson Electric Manufacturing Company, Chicago, has been elevated to the post of president and general manager, following the resignation of C. H. Thordarson as president. Mr. Thordarson, who founded the company nearly a half century ago, and who is now nearly 76 years of age, will act as technical consultant.

L. G. Winney, former treasurer, was named vice president and treasurer and W. R. Mahoney, formerly connected with Arthur Anderson and Company, was elected assistant treasurer.

* * *

DEMING, OF PHILCO, DEAD

George E. Deming, vice president and secretary of the Philco Corporation, died at his home recently. He was 55 years of age.

Mr. Deming joined Philco in 1917 as assistant superintendent of the factory. He became successively superintendent of the factory, executive vice president, vice president in charge of production, and in 1941 was named vice president and secretary.

* * *

EAST-WEST PARTS S-M TO MEET IN CHICAGO

There will be a joint meeting of the Eastern group of the Sales Managers Club, and the Western group now known as the Association of Electronic Parts & Equipment Manufacturers, on the morning of June 10th, at the Palmer House, Chicago, in connection with the RMA Convention.

In view of the recent WPB Order L-265, the setting up of the Electronic Research Supply Agency, and other current problems, all sales executives in the radio parts industry are urged to be present at this joint meeting.

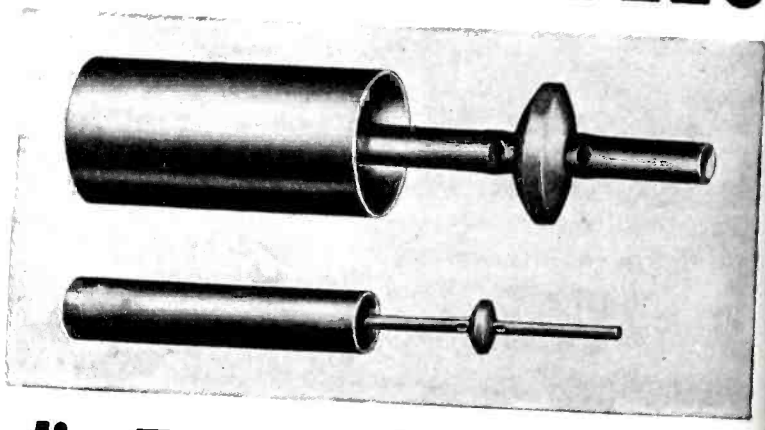
* * *

RCA WINS SAFETY TROPHY

The Camden plant of RCA Victor was awarded the Liberty Bell for excellent

ANDREW

COAXIAL CABLES



...for Radio Transmission Lines

The VICTOR J. ANDREW CO., pioneer manufacturer of coaxial cables, is now in a position to take additional orders, in any quantity, for all sizes of ceramic insulated coaxial cables and accessories. The Andrew Co. engineering staff, specialists in all applications of coaxial cables and accessories, will be pleased to make recommendations to meet your particular requirements.

"Attention!"

If coaxial cables are your problem . . . write for new catalog showing complete line of coaxial cables and accessories.

ANDREW

VICTOR J. ANDREW CO.

363 East 75th Street, CHICAGO, ILLINOIS

ANTENNA EQUIPMENT

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afety record in 1942. The presentation as made on the "Ghost Shift" network rogram, and was based on the plant's ecord of 22 per cent reduction of time ost through accidents last year.

* * *

OPETZKY AND ARNT IOW OXFORD-TARTAK V-P

Alexander M. Arnt and Karl A. Kopetzky have been elected vice presidents of Oxford-Tartak Radio Corporation, 3911-929 South Michigan Avenue, Chicago, Ill., according to Paul H. Tartak, president.

Mr. Arnt is in charge of production, while Mr. Kopetzky, besides continuing his executive duties, will take charge of electronic developments occasioned by the firm's war conversion and expansion.

Karl A. Kopetzky

* * *

S-T RELAY ANTENNA

A radio relay antenna for studio-to-transmitter service has been developed by G. E. engineers. It is designed for relaying f-m programs from studio to the main transmitter via any one of the 23 assigned channels centering on 337 megacycles. One of the new antennas is in operation at Schenectady, where it is installed atop a building to relay programs of f-m station W85A, with studios in the building, to the station's main transmitter in the Helderberg Mountains, 12 miles away.

According to M. W. Scheldorf, G. E. electronics engineer, "the antenna concentrates its radiation in a narrow beam in the desired direction only, in accordance with well defined and narrow limitations of the Federal Communications Commission. The antenna consists essentially of five sets of simple dipole antennas, properly mounted and connected electrically in a manner to achieve the necessary radiation pattern. The entire electrical system is mounted within a nonmetallic housing which protects it from rain, snow and ice. It is made to mount easily on a single metal pole."

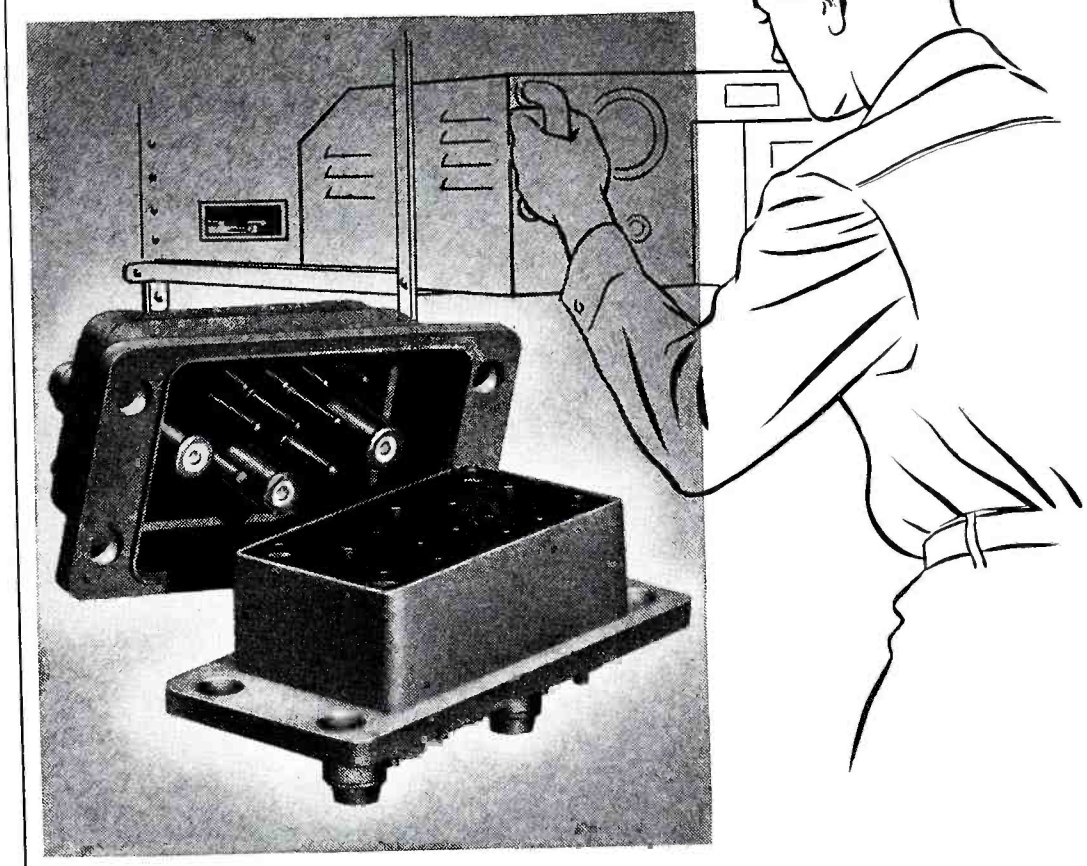
* * *

CROWLEY MAKING COMPACTED-METAL UNITS

Compact metal fabrication of a variety of pieces, using fine metallic powders, has been begun by Henry L. Crowley & Company, Inc., West Orange, New Jersey. The process begins with the compressing of the powders in dies under tremendous pressures into given shapes and sizes, followed by sintering to con-

(*Continued on page* 59)

EXCLUSIVE WITH CANNON "DP" CONNECTORS



The creation of the "DP" Series of connectors, designed with rectangular shell for special application to rack and panel equipment, is *strictly* a Cannon development . . . carried out in collaboration with airline engineering personnel.

Originally designed for aircraft use, the "DP" family of connectors is finding wide application in many fields where space is limited . . . where varied circuits must be plugged in and out with a minimum of effort.

There are many styles of "DP" connectors. Among them the "DP-D" for rack type equipment which covers a maximum of thirty contacts. In this unit there are insert arrangements for taking 10, 15 and 40 ampere contacts, and many variations are possible.

SEND FOR YOUR COPY OF CANNON BULLETIN ON "DP" CONNECTORS. This 24-page bulletin gives complete data, photographs and dimensions of the various "DP" connectors. Drop us a line on your letterhead and we'll gladly send you a copy. Address Department T, Cannon Electric Development Co., Los Angeles, Calif.

CANNON ELECTRIC

Cannon Electric Development Co., Los Angeles, Calif.

Canadian Factory and Engineering Office: Cannon Electric Co., Ltd., Toronto

REPRESENTATIVES IN PRINCIPAL CITIES—CONSULT YOUR LOCAL TELEPHONE BOOK

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ele

Eimac

ENGINEERING

The cornerstone in Eimac's existence has been their advanced electronic engineering. The development of the gas-free tube, pioneering in the use of new materials, radical changes in existing tube design... all these things are the results of their research. During today's accelerated business situation Eimac engineers have developed and put to work many outstanding innovations. Number one on this list is the actual achievement of mass production of a product that heretofore was hand-made in a scientific laboratory. Today the most interesting of the other developments must be kept secret but the heads-up engineering is going forward apace. The services of this organization are available only for war problems now but will be offered to industry at large when peace comes. If you have a problem, the solution to which might involve vacuum tubes, write direct to factory.

EITEL-McCULLOUGH, INC. • SAN BRUNO, CALIFORNIA

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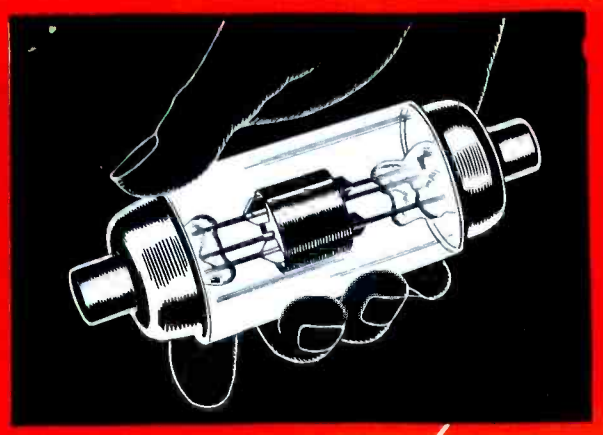
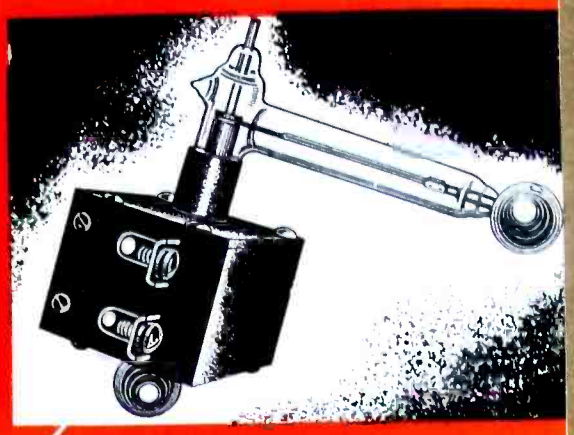




tronic telesis*

*** Progress conciously planned and produced by intelligently directed effort.**

— Century Dictionary and Cyclopedia

Eimac Tubes in the Ground Stations of the Major Airlines. The economy, stamina and superior performance capabilities of Eimac tubes helped make the operation of complex multi-frequency transmitters practical for aircraft ground stations. Eimac 450T tubes are in use by practically every major airline today.

Eimac Tubes in Instrument Landing Equipment. Airline pilots no longer need fly "by the seat of their pants" for blind landing equipment is in regular service. There are several of these systems in existence which use Eimac tubes.

Eimac Tubes and Frequency Modulation. Close cooperation between Eimac and the leading engineers throughout the world has made Eimac first choice in the important new development in radio. FM and Eimac tubes have been close companions from the very start of Major Armstrong's experiments.

Eimac Tubes in Police Radio Communications. Where dependability, stamina and superior performance are extremely vital you'll find Eimac tubes every time. Police radio engineers from Connecticut to California are loud in their praise of the service of Eimac tubes.

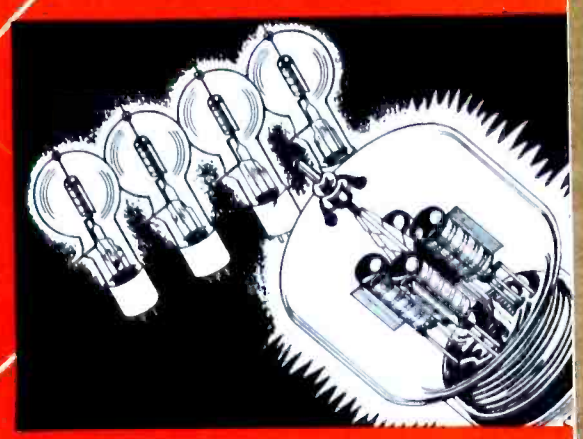
Eimac Engineered the Vacuum Condenser. Small, compact tank circuits made possible with the Eimac vacuum condensers helped increase the efficiency of many types of radio transmitters. Since plate spacing is determined by mechanical rather than voltage limitations, actual plate area is reduced to the very minimum.

Eimac Developed the Vacuum Relay. Over two years ago Eimac developed this single pole double throw vacuum relay. It handles 20,000 volts of RF potential without internal breakdown. Air pressure and humidity have no effect on it. Actually flashover will occur across outside terminals first even though contact spacing is but .015". A tribute to Eimac engineering.

Eimac Developed the Multi-Unit Tube. Triode units so nearly perfect that two or more can be placed in a single envelope. Power capabilities are determined by multiplying the capabilities of the single triode unit by the number of units employed in the tube. A revolutionary vacuum tube typical of Eimac's engineering leadership.

Power Transmission with Vacuum Tubes? In the days to come many new uses for Eimac tubes will be announced. The use of vacuum tubes for power transmission may be one of them. Of one thing you can be sure, Eimac engineering and development will be in the forefront.

Eimac Tubes have gone to War. With almost machine gun rapidity, Eimac tubes have been adopted by one after another of the peacetime services. Naturally Eimac was among the first to be drafted into war. The important job they are accomplishing today must remain secret for the duration. When the shooting is over, you'll find out why the armed services turned to Eimac so quickly.



Coveted Army-Navy "E" award for high achievement in production for war.

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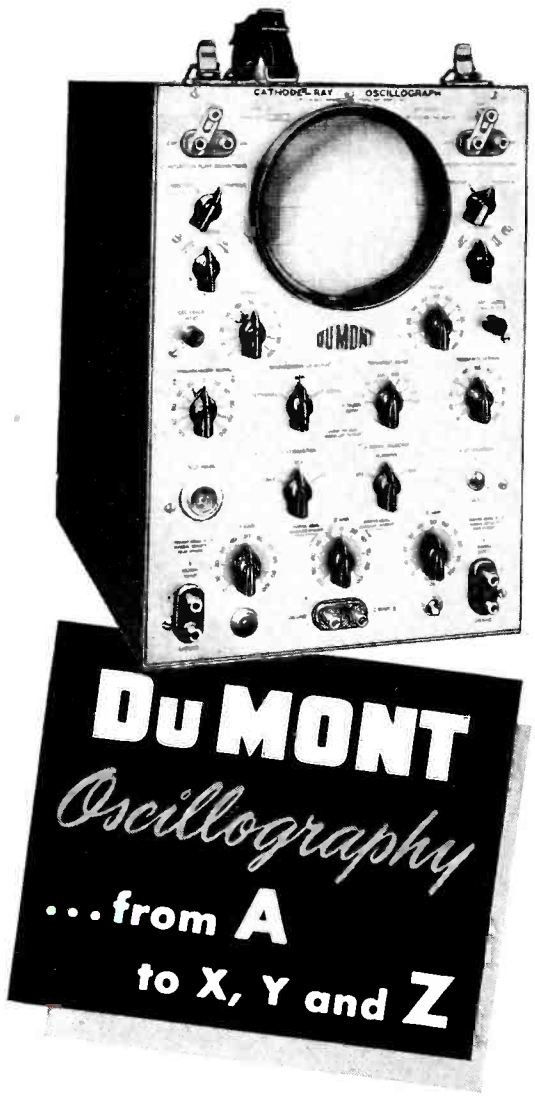

★ **The new Du Mont Type 241 oscillograph is literally an enlarged version of the 3-inch Type 224 already meeting highly critical requirements. The 5-inch tube means larger oscillograms. The added Z-axis amplifier for beam modulation permits timing signals or blanking impulses for further applications. Also:**

DuMont Type 5JP1 intensifier-type tube for brilliant, easy-reading oscillograms.

Y-axis or vertical deflection response uniform from 20 c.p.s. to 2 mc. Comparable faithful square and sinusoidal wave response.

Test probe and shielded cable reduce input capacitance and eliminate usual stray pickup.

X-axis or horizontal deflection amplifier with uniform response to 100 kc.

Both amplifiers have input attenuators and distortionless gain controls.

Wide choice of panel connection for extreme flexibility in applying signals to cathode-ray tube.

17½" h.; 10¾" w.; 21" d. 65 lbs.

★ *Write for literature . . .*

DUMONT
ALLEN B. DU MONT LABORATORIES, INC.
Passaic, New Jersey
Cable Address: *Wespexlin, New York*

BRITISH ARMY COMMUNICATIONS

(*Continued from page 12*)

communication system unit are two a-f stages.

A second equipment familiar in the field is a one-man pack set, with a four-mile range. Weighing 34 pounds complete with dry batteries, headgear and rod aerial, the set is worn on the back. Two-volt tubes are employed.

In the superheterodyne receiver of the unit are the r-f, oscillator-detector, i-f, and output tube for demodulation and avc. It is possible to make the output tube perform as an oscillator for cw reception. The output tube also comes into use in the transmitter which comprises a modulator, master oscillator and amplifier.

Baby of the series is the patrol set for infantry and paratroops. It measures 7" x 4" x 6" and weighs 22 pounds complete with batteries. Instead of the usual microphone a laryngaphone is used. This is energized by the paratrooper's throat, leaving mouth and hands unimpeded.

On the small power of a quarter-watt, coverage is three-quarters of a mile or so. In the transmitter are modulator, oscillator and amplifier stages. Tubes in the receiver are an r-f amplifier, separate mixer and oscillator, an i-f amplifier and a metal demodulator. The i-f stage is reflexed for output also.

Miniature tubes are employed in this set and the general construction is such that it withstands water and mud.

Land-line duties and equipment of the Royal Corps of Signals are considerable and radio technique is increasingly employed in this branch. During the pursuit of Rommel through hundreds of desert miles, it was possible to keep in touch with base by only one or two lines. Over these, however, many channels were operated by use of high-frequency carriers.

Figures 4 (right) and 5 (bottom)
British signal man in Tripolitania testing ground cable junction (Figure 4). A communications switch well, in the Western desert of Africa, protected by a trench (Figure 5).
(*British Official Photos*)

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NEWS BRIEFS

(*Continued from page* 55)

vert such pieces into solid metal masses. Gears, cams, bearings, either simple or intricate, are thus obtainable. The department is under the direction of Earl S. Patch.

* * *

WILSON PROMOTED BY OPERADIO

Fred D. Wilson has been recently appointed sales manager of the commercial sound division at the Operadio Manufacturing Company, St. Charles, Illinois.

Mr. Wilson is devoting his efforts to the application of music and voice-paging in the manpower conservation campaign.

* * *

LIGHTWEIGHT LIMIT SWITCH

A lightweight, dust tight limit switch for aircraft applications has been announced by G. E. This small switch has a contact mechanism of the snap-action, double-break type which gives it a high current rating and makes it desirable for applications where severe vibration conditions are encountered.

Designed for use in a wide range of ambient temperature, from 95° C to minus 40° C, the switch is said to be corrosion-proof, meeting 200-hour salt water tests as stipulated by various government agencies, and is suitable for use at altitudes from sea level to 40,000 feet.

The new switch is a spring-return, plunger-operated type with a 7/32-inch overtravel. It can be mounted either on the cover side or on the opposite side, thus facilitating the operation of the plunger from either the right or the left.

The switch is available in three different contact arrangements, single-circuit, normally open; single-circuit, normally closed; and two-circuit, normally open and normally closed.

* * *

SURFACE FACERS

An adjustable tool for surface facing in horizontal or vertical milling machines, lathes, and other spindle machines has been announced by Robert H. Clark Company, 3424 Sunset Boulevard, Los Angeles, California. It consists of a tapered (or straight) shank and body with three adjustable high speed bits, which may be set for any diameter within the range of the tool. A measuring gauge is provided with each tool.

* * *

SHURE BOOKLETS ON PLANT ACTIVITIES

Two booklets describing plant facilities and end-use of products in our war effort have been released by Shure Brothers, 225 West Huron Street, Chicago, Ill.

The Communication Systems *Must Not Fail*

AS the convoy of vital cargo inches its way toward sea, communication between patrol planes and the ships must be kept open. The communication systems must remain operative at all times for instant warnings of danger.

This is another service requiring transformers fitted to the job—and the long experience of Jefferson Electric in the field of radio and communication systems has been applied to the production of the porticulor types of transformers required for "walkie-talkies", Naval and airplone communicotion systems.

Realizing that foilure of but one transformer moy cause the loss of men, ships, planes and vitol corgoes, our engineers ond production force have token additional steps to safeguard the traditional ond uniform high quolity which is more necessary today than ever before. JEFFERSON ELECTRIC COMPANY, Bellwood (Suburb of Chicago), Illinois. Canadion Factory: 60-64 Osler Avenue, West Toronto, Ontario.

Vital War Jobs for
JEFFERSON
Transformers

Gun-firing Transformers, radio and communication system Transformers,—Ballasts used with fluorescent lamps that light our war factories,—Fuses to protect electrical equipment and systems,—ML Transformers to insure good mercury lamp performance,—Power-Circuit transformers that save copper and provide the circuit voltages desired,—Control Transformers,—all are widely used in our War production effort . . . Jefferson Electric engineers offer recommendations based on a quarter of a century of specialization in the small transformer field.

★

JEFFERSON ELECTRIC

TRANSFORMERS

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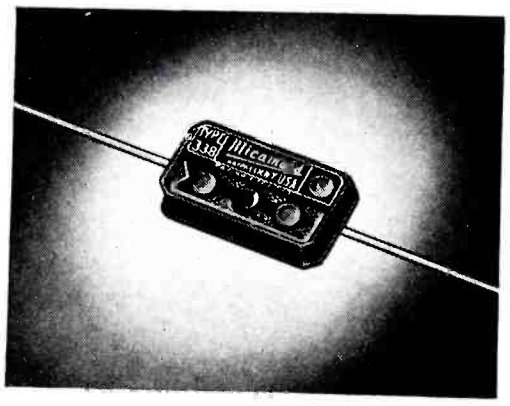
THE INDUSTRY OFFERS

MICAMOLD SMALL-SIZE MOLDED PAPER CAPACITOR

A small size paper capacitor, molded in bakelite, available in capacities up to .01 mfd, with a rating of 120 volts d-c working, has been developed by the Micamold Radio Corporation, 1087 Flushing Avenue, Brooklyn, New York.

The capacitor, known as type 338, is hermatically sealed. It is ¾" long x 7/16" wide x 7/32" thick.



* * *

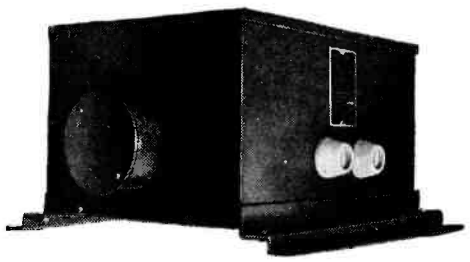
MEGOHM DECADE BOX

A single dial box consisting of ten 1.0-megohm resistors, connected in series and mounted on steatite insulators, has been developed by Shallcross Manufacturing Company, Collingdale, Pa. The resistors are said to have an accuracy of plus or minus .05% at 74° F. Each resistor is said to be capable of dissipating 2 watts; however in work requiring closer tolerance the dissipation should be held to 1 watt per unit.

The unit may be immersed in an oil bath for work demanding extreme accuracies, increased dissipation or both. A maximum of 10,000 volts may be applied across the binding posts, it is said. The boxes are housed in metal and may be furnished completely shielded.

COLD CATHODE LIGHTING TRANSFORMER

For lighting tubes employing cold cathodes, the Acme Electric and Manufacturing Company, Cuba, New York, has developed a special transformer. It has a capacity of 120 milliamperes with 3,000, 4,000, 6,000, 9,000, 12,000 or 15,000 volt secondaries.



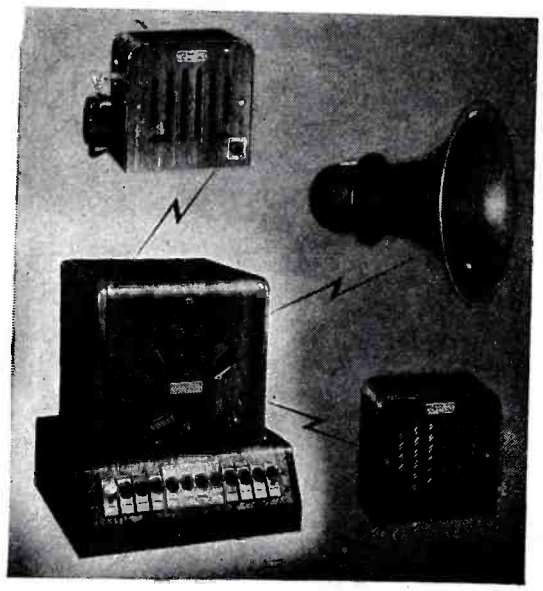
* * *

ANNUNCIATOR SELECTOR IN COMMUNICATION UNIT

A central control master station, equipped with an annunciator selector, having a buzzer and name tabs which illuminate to identify incoming calls, has been developed by Executone, Inc., 415 Lexington Avenue, New York City. Built into a detachable base which can be easily replaced with larger-capacity selectors for future expansion, this new unit enables the user to talk individually to, up to eleven other remote stations in the system, or page them all simultaneously. Likewise any other station in the system can signal and register its call on the master station's annunciator selector.

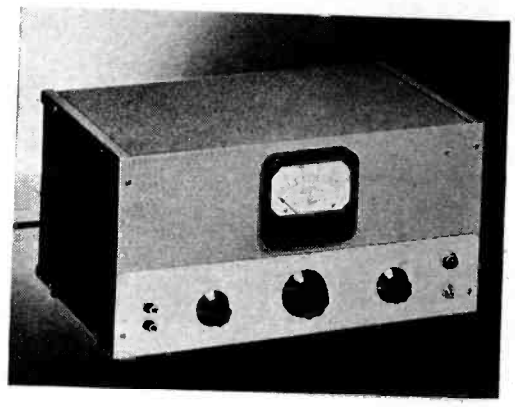
Each of the eleven name tabs lights up to identify the incoming calls and remains illuminated until each call has been received. A manual buzzer, which sounds to signal that another station is calling, can be cut off during conversations by flipping a toggle switch.

This special selector unit is also provided with a tone signal controlled by a lever on the side of the cabinet. This signal, which can be transmitted selectively or simultaneously to all other stations in the system, serves as an alarm, dismissal signal, or method of calling other stations by tone instead of voice.



A-C FREQUENCY MEASURING DEVICE

To measure the frequency of an alternating voltage of from 0 to 50 kc, the Hewlett-Packard Company, 693 Page Mill Road, Palo Alto, California, have developed the 500 A frequency meter. The instrument is said to be particularly suitable for crystal grinding work where it can be used to measure the frequency deviation from the standard. It is, of course, also useful in other frequency laboratory measurement work.



* * *

RCP 3-INCH OSCILLOSCOPE

A 3" cathode-ray oscilloscope, model 553, is now available from Radio City Products Co., 127 West 26th Street, New York City.

Switching arrangement permits applying input either directly to deflection plates or to input of the amplifier. Position and stable locking of the image can be obtained with either the vertical signal or any external signal. Deflection sensitivity through either amplifier (max. gain) is said to be .6 rms per inch, and without amplifier, 35 rms per inch.

The amplifier frequency response is said to be plus or minus 3 db at 20 to 100,000 cycles. Frequency range is said to be 15 to 22,000 cycles.

A horizontal amplifier switch has been included. This switch connects the hori-

(*Continued on page* 76)

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"Quick Deliveries on Radio, Sound and Electronic Parts"

HIGH FIDELITY

(*Continued from page 28*)

the response spectrum, so compensation must be included in the pre-emphasis characteritic.

Several pre-emphasis curves have been standardized for application to the amplifier link of electro-acoustic transmission systems. These curves are shown in Figure 11. The over-all reduction in apparent noise level due to the application of these curves varies from 8 to 15 db, depending upon the application. There is no doubt that the use of pre-emphasis is a great aid to a fuller realization of high fidelity. With each system utilizing pre-emphasis there must also be a de-emphasis circuit with a characteristic 1/F (f). Very often the restorer also has to have other compensating characteristics. Even so, the over-all curve should be the reciprocal of the over-all pre-emphasis curve such as one of those of Figure 11.

In all transmission systems there are limitations imposed on the dynamic range of the material to be transmitted. The f-m system, which has the widest possible range is limited only by adjacent channel interference. An a-m system is limited by noise at low levels and 100% modulation at the upper limit. Disc recording is limited by noise at low levels and groove spacing at high levels. Sound on film recording is limited likewise by noise and available track width. If it were possible to introduce some sort of amplitude pre-emphasis as con-

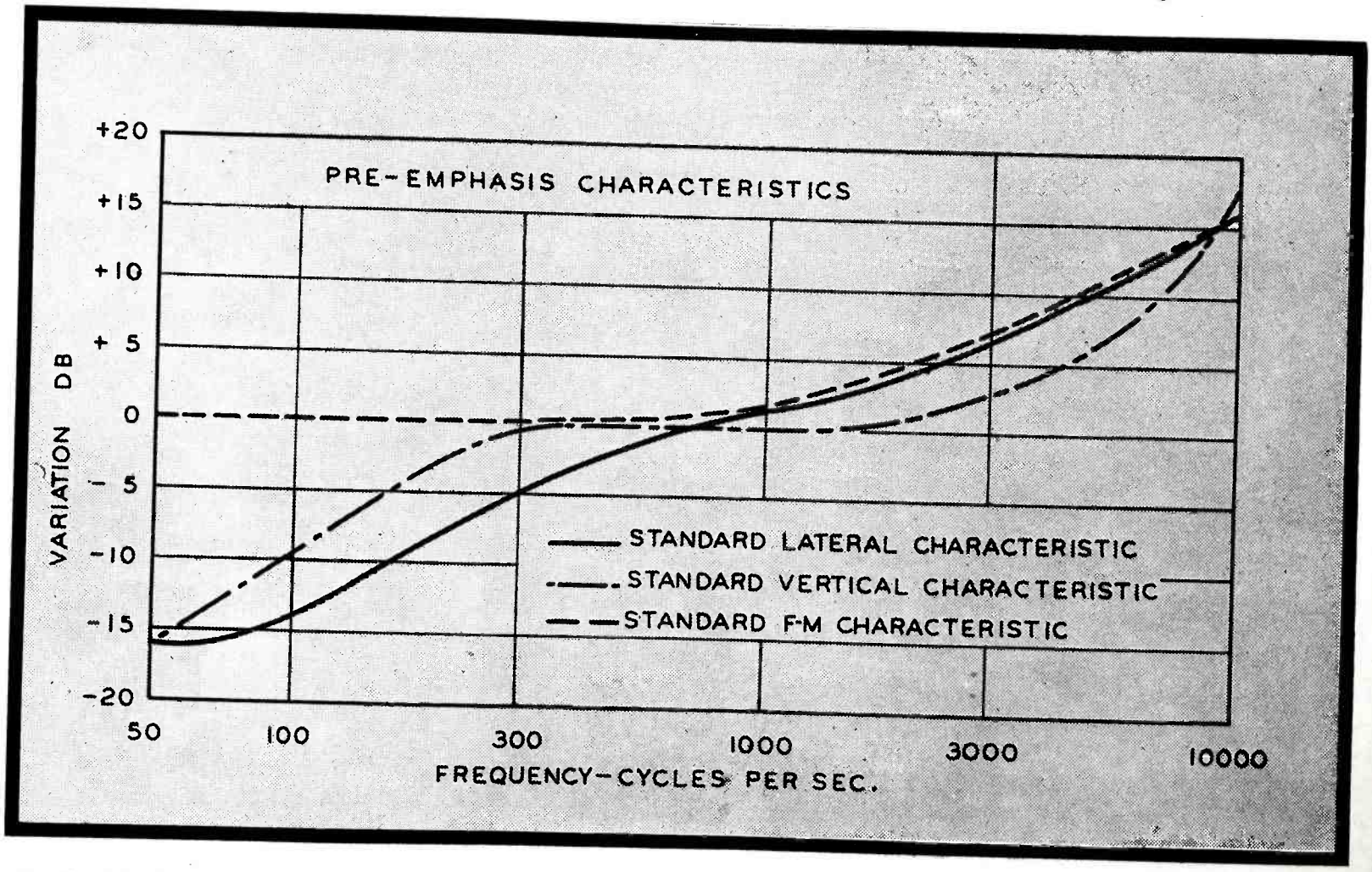

Figure 11
Standard pre-emphasis curves.

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trasted to frequency pre-emphasis just discussed, the dynamic range limitations might be extended.

Such amplitude pre-emphasis would take the form

$$K_A = K_A' F(A) \qquad (7)$$

and the de-emphasis the form

$$K_R = K_R' F(A) \qquad (8)$$

where *F(A)* is the function relating the output amplitude to the input amplitude. It is apparent from equation 7 that the application of this type of pre-emphasis will introduce into the system many new frequencies because the system is non-linear. However, if all these distortion components were preserved in their proper proportion, and in the same phase relationship, the de-emphasis circuit should introduce distortion components which would cancel them out. Such a system would be extremely sensitive to any frequency, amplitude, and especially phase distortion introduced between the pre-emphasis and de-emphasis circuits. If the pre-emphasis can be made to have a time lag, so that the wave form of no one cycle is altered, then the system will be no more critical as to frequency, amplitude, and phase distortion than the normal systems. Such type of pre-emphasis is applied in systems by *gain riding,* limiting amplifiers, and mike technique. The restorer very rarely has any such de-emphasis. When it is used, such as in volume expanders, it bears no exact relationship to the pre-emphasis. The system is at best very haphazard and dependent to a large extent on the human element introduced by those involved in effecting the pre-emphasis. It might be interesting to mention here that amplitude—pre-emphasis is really compression where de-emphasis is expansion; the reverse of frequency pre-emphasis. The operation of time-lag amplitude pre-emphasis circuits might be improved greatly if a standard compression and expansion characteristic were developed so that manual adjustments would be unnecessary.

In the first part of this paper the ultimate of high fidelity was defined by the following specifications: *(1)*—frequency response, 20-15,000 cycles; *(2)*—distortion, 1% rss max.; *(3)*—dynamic range, 75 db; *(4)*—noise level, 75 db below peak level, and (5)—damping, critical.

If the present state of high fidelity is to be determined, the characteristics of available equipment should be examined in the light of the above specifications. The first link, the acousto-

(*Continued on page* 66)

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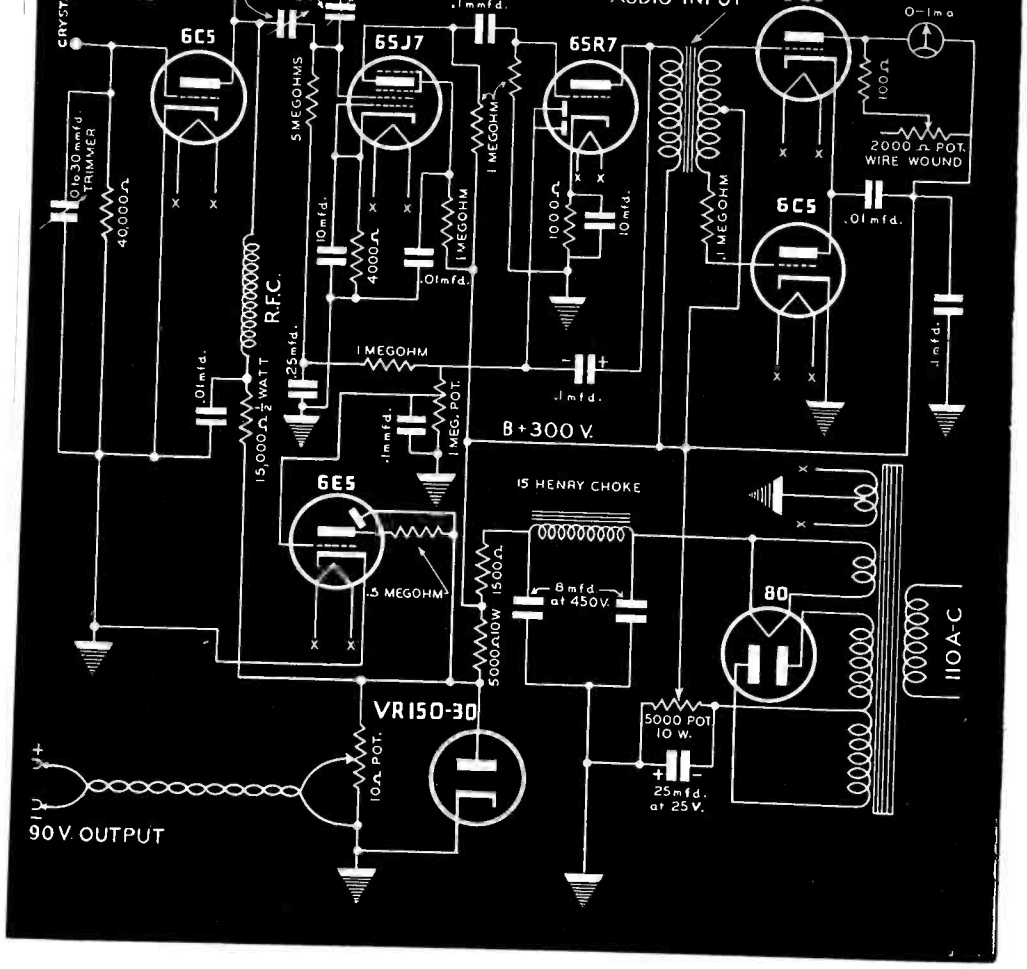
QUARTZ CRYSTAL

(Continued from

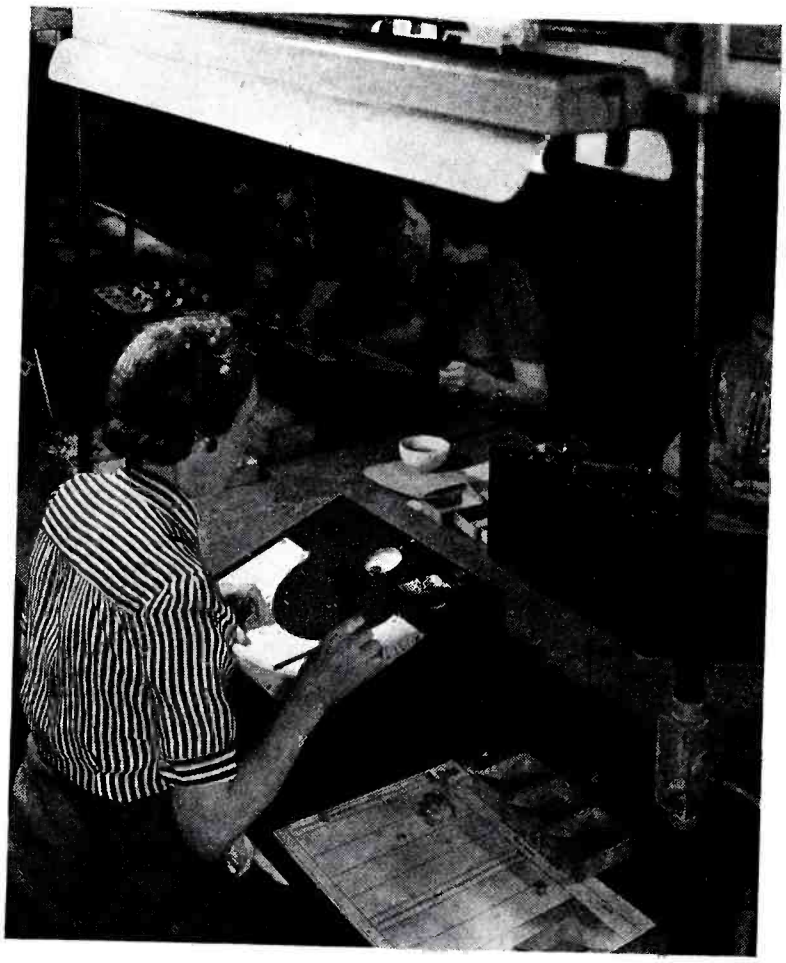


(Top) . . . a deviation meter that is used with a standard activity test set and refrigerated box to test the activity and frequency deviation of the finished crystal at the various temperatures ranging from minus 60° to 110° Centigrade. Its frequency range is from 0 to 2000.

(Below) . . . frequency classification of crystals.

(Top) . . . the final test for checking the frequency and activity of crystals at temperatures ranging from —30° to + 130° F.

(Below) . . . electrode inspection operation for checking of air-gaps.



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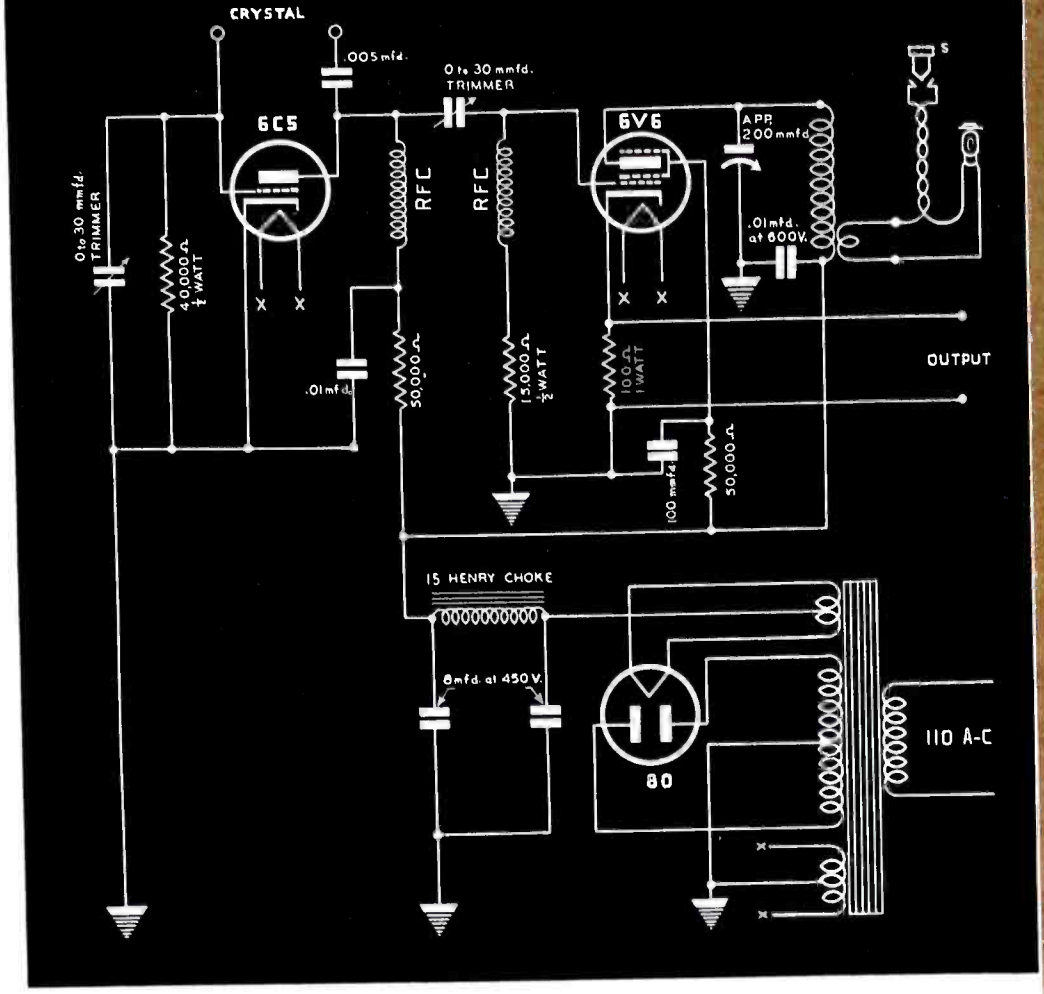
PRODUCTION

page 23)

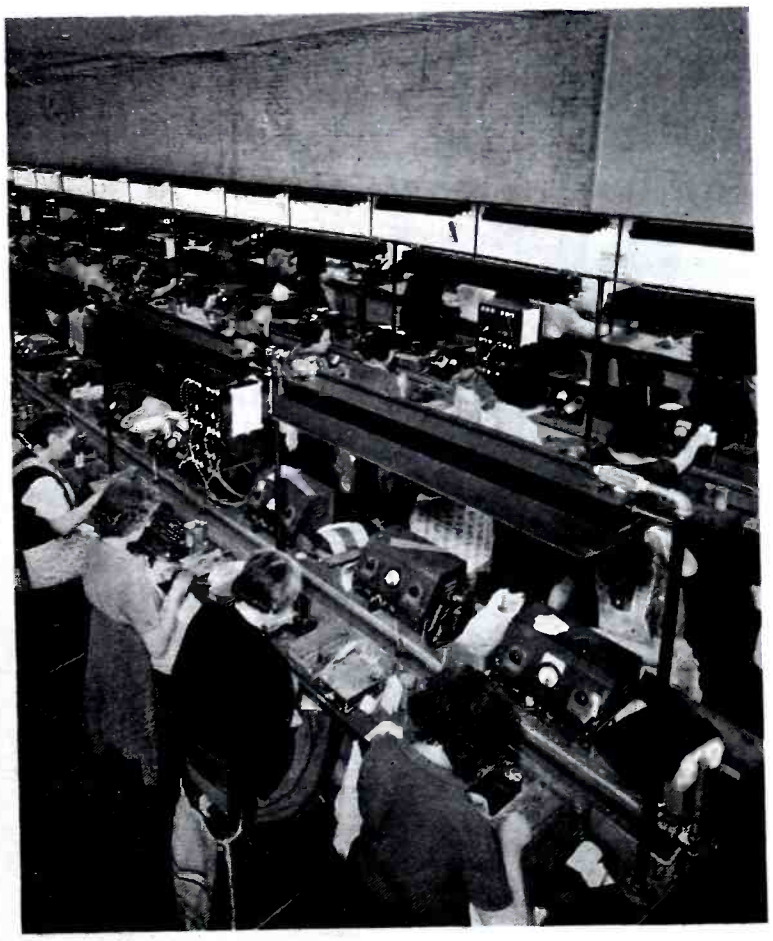
(Top) . . . laboratory for electronic and optical instrument developments and servicing.

(Below) . . . final hand lapping process line. Crystals are worked to exact frequency in this step. Master oscillators are used here.



(Top) . . . the master oscillator that is used with the finishing position deviation meter. The unusual feature of this unit is that six finishing position instruments can all operate from one standard. A flash light bulb with push button is used to check resonance. No meters are required.

(Below) . . . assembly and testing of crystals following the hand lapping operation.



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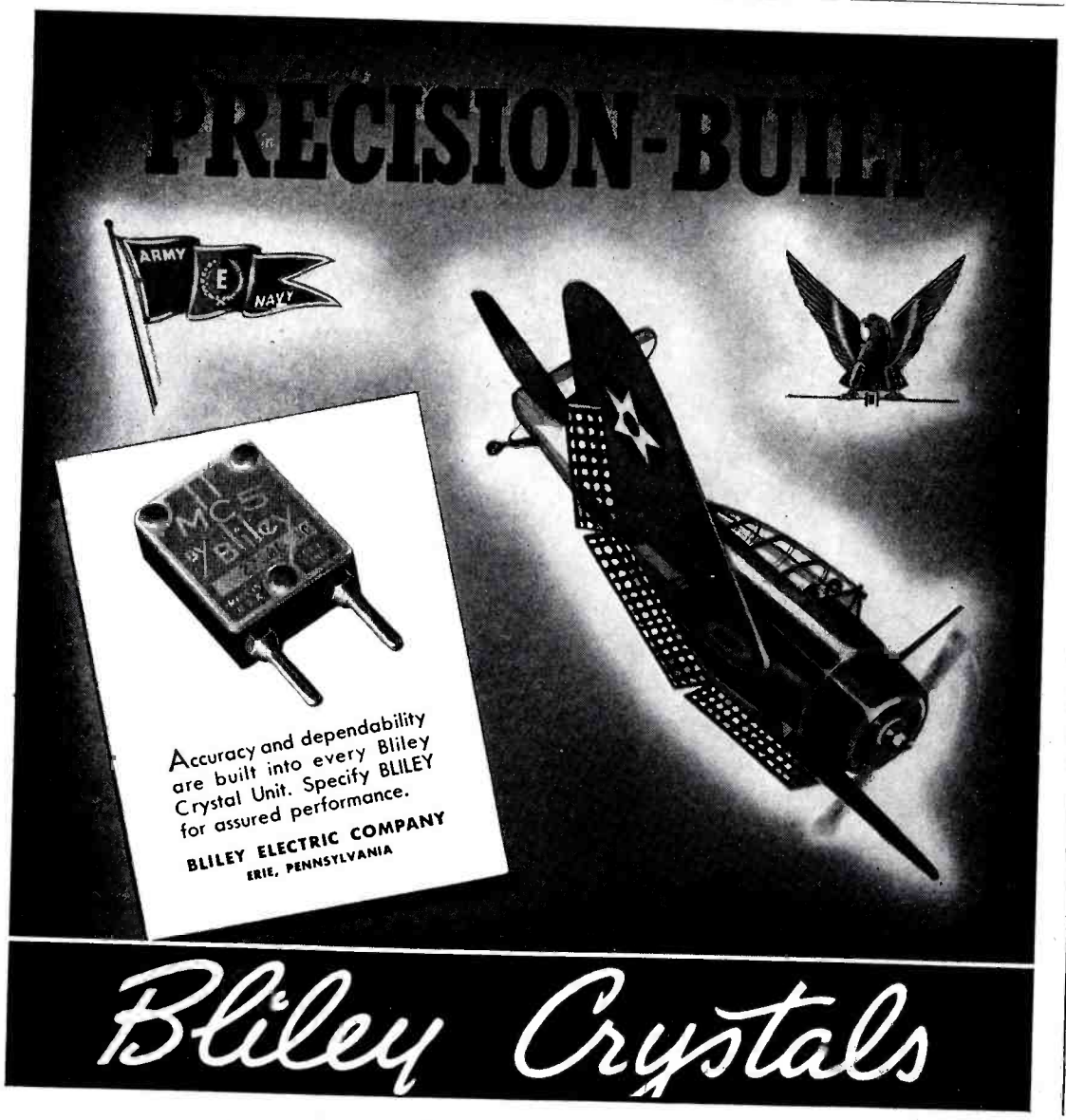

(*Continued from page 63*)

electric transducer (see Figure 1, Part 1), stands up very well to the specifications. There are high quality velocity, dynamic, and crystal microphones available which approach the requirements very closely. Amplifiers, the second link of the system, can be made with characteristics even more severe than the above requirements so that they present no problems to the system.

Converter Characteristics

Converters vary rather widely in quality. Frequency modulation transmitters can be made to meet the specifications. Amplitude modulation transmitters can meet the frequency response, distortion, and damping characteristics. They approach the noise-level requirement and should approach by the same amount the dynamic-range level, but due to their particular application in the system they cannot be operated in such a manner. Many of the disc recording heads and their associated cutting elements do not meet the frequency response requirement unless compensation is considered and even then the high frequency end is offtimes weak. And most heads will not meet the distortion requirement especially at the higher levels. The noise level, dynamic range, and damping of the head can be such as to come within the limits. What has been said for disc recording heads is also approximately true for sound track recording heads except that they are on the average of a little better design.

F-M Meets Requirements

Of the mediums only f-m waves meet the requirements. The most important deficiency of the medium is the inherent noise level. This in turn tends to limit the dynamic range possible with the system. A dynamic range of 45 db is the maximum possible with a-m waves, and roughly 50 db is the best that can be obtained in any type of recording medium (wax, film, etc.) even with pre-emphasis.

The restorers have widely varying characteristics which are similar to those of their corresponding converters. The f-m radios are satisfactory—if tone controls are not used, and a-m radios can be made to approach the requirements, but rarely do because of conflicting design problems. Phonograph pickups are very difficult to make with a uniform frequency response, low distortion, and good damping characteristics. Whether the

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loss of high frequencies caused by the radius of the pickup point aproaching the radius of curvature of the waves on recording discs should be charged to the pickup or the medium is a question. The over-all result is well known. It is more difficult to record high frequencies on the inside of the record and impossible to record the required range without tremendous compensation any place on the record.

Probably the weakest link in the system is the last link, the electro-acoustic transducer. It will not meet the frequency, distortion, or damping requirement. It is on this part of the high fidelity system that the most work is being done at the present time. The advent of a high fidelity system in the form of f-m transmission that is very nearly perfect from a monaural standpoint, has brought this problem into bold relief. If will be noted in all the links of the system that wherever an electro-mechanical unit is employed the characteristics are invariably poorer. This results from the inherent mechanical inductance of any moving part with a finite mass, the inherent mechanical capacitance of any stiffness element used to restrict the motion of the moving element and the non-linearity of any mechanical resistance.

A complete survey of the above material will show that there are high fidelity systems that approach the requirements and that the obstacles in the way of complete high fidelity are not impossible of achievement within the limitations of the monaural system. The limit of development along this line is being approached in some of the systems and is far from attainment in others. When the limit is reached—then what? The answer in the light of the material presented seems to be in a change over to a binaural system.

This will not take place until the listener demand for higher fidelity than now available, becomes great enough to warrant the tremendous reorganization of transmission systems to accommodate it. The question of listener demand for fidelity is purely a psychological one. Yet, it is important in determining the trend of design as the purely technical considerations.

The factors which affect the listeners' desire for high fidelity are, *(1)*—his knowledge of and familiarity with the music to be transmitted, *(2)*—the degree of his attention given to the music, and *(3)*—previous conditioning. Of these the third is probably the most important as far as change

(Continued on page 68)

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toward high fidelity is concerned.

Inquiries were made of faculty members of a prominent school of music to determine which factor in *high fidelity systems,* i.e., frequency response, distortion, dynamic range, noise level, or damping, was most important to them. The majority opinion was for dynamic range. Evidently because of their complete knowledge of music, as long as all the fundamental tones are present, the lack of overtones does not bother them. Because they listen so intently for the musical construction, noise and distortion do not bother them. The dynamic range is written in the music, however, and if it is not reproduced the musician feels that the system has altered the fundamental character of the music. A group of control operators surveyed, felt that frequency response was most important with distortion and noise running a close second. They were not familiar with the music and enjoyed a system that seemed to be technically functioning properly. Therefore, the interests of the listener must certainly be considered in the design of any transmission system compromise.

The second factor carries a varying amount of weight depending upon the system being considered. In the case of sound motion pictures, or any reproduction for large assembled groups, the attention is good and the fidelity of the system must be correspondingly good. In the case of radio reception or record reproduction in the home, the attention factor takes on much importance. By and large the American listening public are very poor listeners insofar as the radio is concerned. The radio is often used as an accompaniment to other activities, not as an end in itself. Many radio programs are designed for a below-average intelligence level. Whether lack of concentration on the part of the listener caused the program standard to be such or whether the program standards have led to the lack of concentration, is not known. This is not a criticism of the entertainment value of present day programs which is very high; it is rather a statement of the limitations a program producer must observe because of the lack of attention. A transmission system to be used for background accompaniment should not transmit frequencies above 4,000 cycles, and should have a limited dynamic range, and should have little noise or distortion. Frequency-modulation reception has demonstrated that full fidelity has bothered those who wanted to carry on the usual conversations while the

(*Continued on page* 70)

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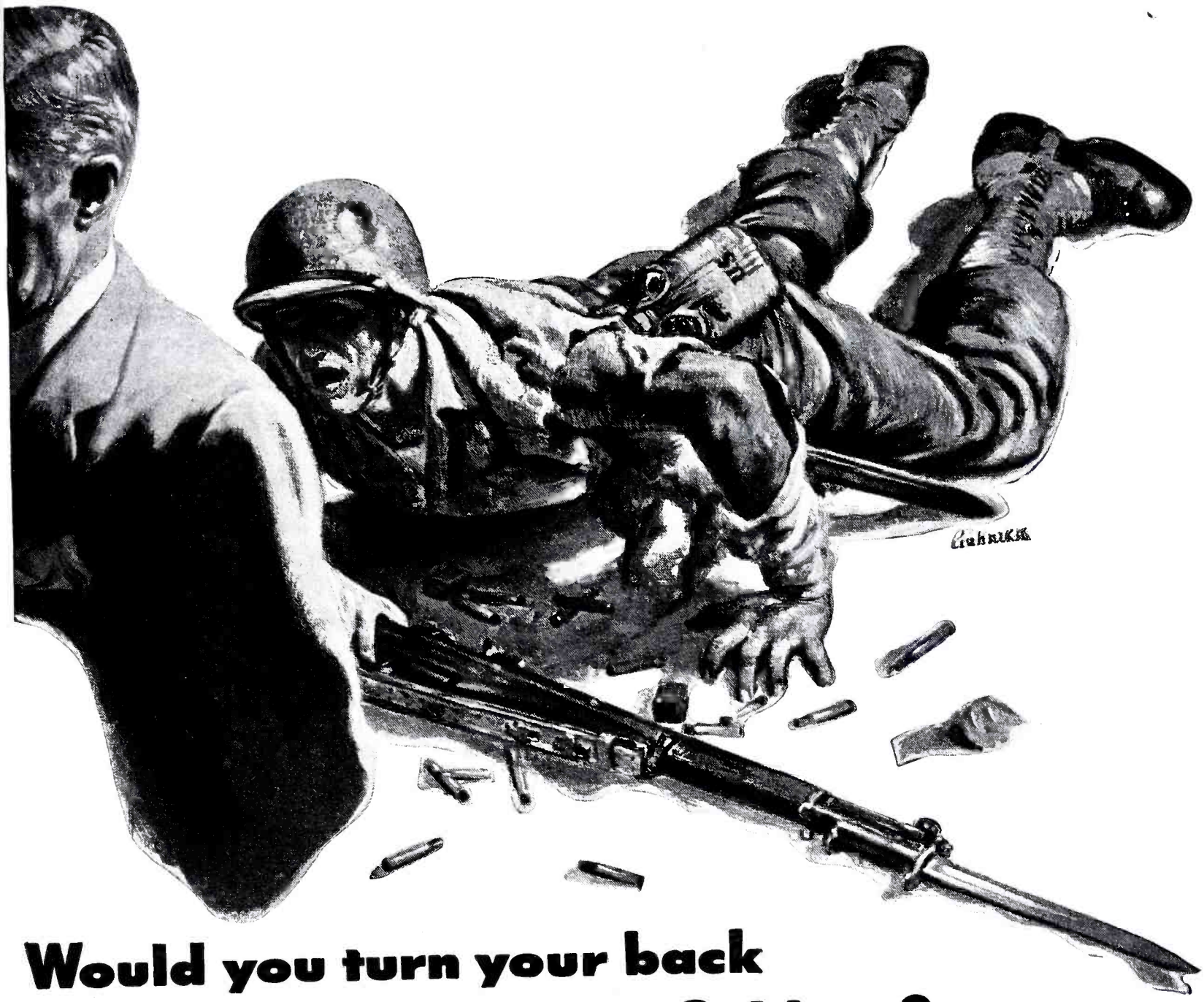

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(*Continued from page* 68)

radio was operating. High frequency response seems to attract attention to the music being presented while the wide dynamic range makes it impossible to set the radio at a soft background level and expect it to stay there. Where the listener concentrates on the presentation, the demand for fidelity goes up. It is this factor which receiver manufacturers have wrestled with for years and which has made the tone control a standard component of all receivers, even those designed for the high fidelity.

The third factor, previous conditioning, has impeded progress toward high fidelity more than anything else. A listener to a transmission system who has listened to a certain quality for a long period of time is reluctant to accept a change for the better, until conditioned to it. There are still people who swear by their old horn speakers as producing a *nice tone*. Many are sold on the quality of their midget sets. On first hearing f-m, many average listeners are unimpressed by the tone quality; the lack of noise always impresses. It is only after listening for a time that they become accustomed to the improved quality. Then they will prefer it to any other reproduction. This very factor requires a tremendous promotional campaign when any improvement is made in the fidelity of the system. Radio dealers will attest to the fact that push-buttons, tuning eyes, etc., are much easier to sell than fidelity.

The present demand for high fidelity is definitely on the upgrade. Recent improvements have been largely responsible. Frequency modulation and high quality record players, as well as increased fidelity in sound reproduction in many theatres, have contributed greatly. A survey[2] of f-m listeners published recently shows that 79% of those surveyed were satisfied with f-m quality, 85% considered it superior to regular a-m broadcasting, and 91% would recommend f-m to friends. It is also interesting in the light of the above discussion that 45% believed that improved tone quality, frequency response, distortion, and dynamic range was the outstanding advantage; 41% favored the freedom from noise and 14% other advantages. Since f-m is quite new to many of the listeners this survey indicates a rather rapid acceptance of the improvement.

While there is a light degradation in the quality of many transmission systems due to the necessity to conserve on equipment during war time,

(*Continued on page* 71)

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AIRCRAFT NOISE

(*Continued from page* 36)

shields, bonds or filters employed for radio noise reduction.

In order to reduce labor and material costs, facilitate servicing, and reduce vulnerability, the electrical system should be unshielded wherever practicable. This fact requires careful attention to the design of shields and filters.

Since December 7, 1941, increasing emphasis has been placed upon the substitution of materials in aircraft in order to conserve the nation's vital resources. These substitutions have been in many cases non-metallic for metallic materials. This fact has further complicated the problem of shielding, wherein the shielding element must be of a conducting material.

Design Steps

The design of the radio and electrical systems in a *small aircraft* should incorporate the following steps in order of their importance.

(1)—Physical arrangement with respect to function and operation.

(2)—Routing of the electrical system as far away as possible from the radio receiver and its lead-in. This routing should avoid structural openings and take advantage of the "shadow effect" of channels, corners, floors and similar metallic parts. Care should be exercised in the use of shields to make certain that a complete circuit is formed through the shield and associated parts. In the case of magnetic shielding, the shielding should be grounded to the structure at a minimum of three points, equally spaced about the shield.

(3)—Layout of antenna lead-in as short as possible and within a minimum distance (not less than 10 times the diameter of the lead-in conductor) of nearby structure. If possible, a shield should be designed over the lead-in, using the structure as a portion of the shield loop.

(4)—Complete shielding by conduit or shielding braid of the power supply to the receiver. The power supply lead should, if possible, be separately routed directly from the storage battery, in order to utilize its filter effect.

(5)—Isolation of alternating current systems from the direct current system by conduit or shielding braid.

(6)—Incorporation of filtering units at possible noise sources, generators, motors, inverters, dynamotors, contactors and other equipment capable of producing radio noise in the receiver. The necessity for these filters should be determined by simple mock-up procedure. It should be kept in mind that the simpler the filter unit, the less will be its cost in weight, space, labor and material. Where a single capacitor will produce the desired noise reduction, it is impractical to go further. In the use of capacitors to ground plane as filters, it should be noted that the shorter the leads the better the filter action.

(7)—Incorporation of bonding to major parts of the aircraft, such as ailerons, flaps, elevators and similar parts. These bonds will prevent radio noise which would otherwise occur as

(*Continued on page* 73)

HIGH FIDELITY

(*Continued from page* 70)

the listener trend is still forward and manufacturers will find them in the future more receptive to any improvements in the quality of transmitted sound.

[The author wishes to express his appreciation to Stanley H. Pierce for his fine assistance in the preparation of the curves and his helpful comments on the general content of this paper.]

[1]H. F. Olson and Frank Massa, "Applied Acoustics," The Blakiston Co., p. 406.
[2]"What the Consumer Thinks of FM," a pamphlet published by General Electric.

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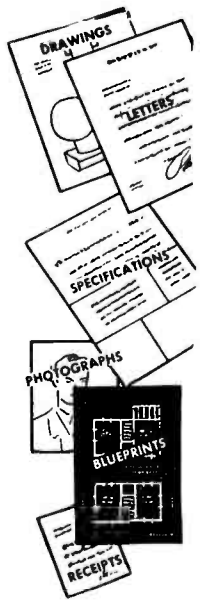

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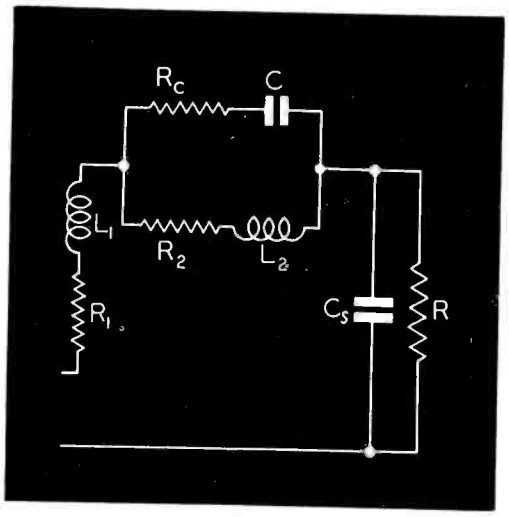
STEADY-STATE RESPONSE

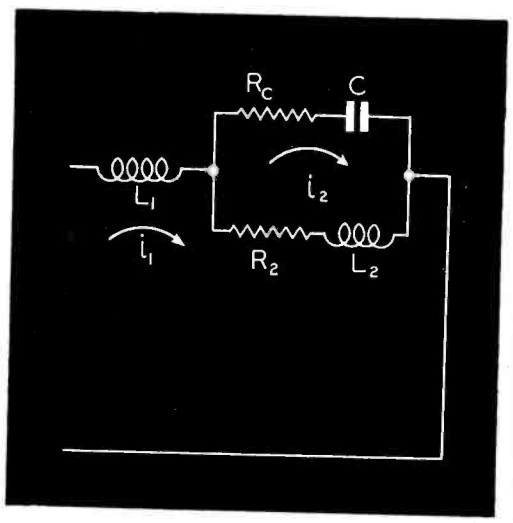
(*Continued from page* 43)

impedance to higher frequency components in the output of the rectifier. When this dip produces excessive regulation, the magnitudes of the higher frequency components can be reduced by using an additional choke as shown in Figure 11. For purposes of analysis this can be simplified as in the previous case, to be represented by Figure 12. This gives a single two-mesh network to solve, which is a little more laborious, but not much more complicated than the previous case. The general solution for this network will not be given here.

The scheme of simplification which requires insertion of a d-c correction term after calculation, while theoretically correct, has one disadvantage which should not be overlooked. The removal of the load resistor, R, from the circuit results in a tremendous increase in the direct current, which is then limited only by the resistance of the choke. This is subsequently corrected by subtracting a term equal to the difference between choke current and choke-plus-load-resistance current. This results in a small difference between two large quantities. Thus, unless great accuracy is used in certain parts of the calculations, the results are worthless. Clearly, one term which must be computed accurately is the d-c correction term (equation (39)). The other terms are those corresponding to the residues of the pole on the negative x-axis, both in computing the actual current in the first half period and in computing the transient component.

[1] N. W. McLachlan, "Complex Variable and Operational Calculus with Technical Applications," Cambridge University Press (Macmillan); 1942.





Figures 11 (left) and 12

In Figure 11 we have the further development of the tuned-choke rectifier filter. The configuration is that of Figure 7 with the addition of a series untuned choke L_1 and its associated resistance R_1. The disadvantage of the filter of Figure 7 is that insufficient impedance to high order harmonics, may result in partial current cutoff with attendant poor regulation (See Figure 10). The high-order harmonics are reduced by proper selection of L_1 and the current and regulation computed by the methods outlined in the text. This type of filter has been found to give excellent results in practice. Figure 12 shows a simplification of Figure 11 for purposes of analysis.

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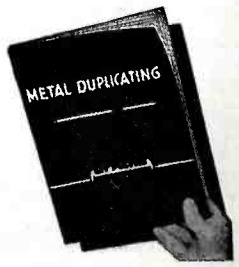

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AIRCRAFT NOISE

(*Continued from page 71*)

a result of precipitation discharges and at the same time act as a counterpoise for the antennae.

(8)—Incorporation of bonds to electrically isolated parts to prevent the building up of electrostatic charges which is a potential source of radio noise. The extent to which bonding of this type should be carried is a subject of quite varied opinions. Perhaps the best criterion is the process of elimination on a given type airplane. However, one thing should be kept in mind: the noise-energy produced by an isolated part must be capable of being electrically coupled to the radio receiver or its components to cause a radio noise. The noise produced might not be objectionable if the level is sufficiently low.

The value of any methods used in arriving at an acceptable radio noise level in an aircraft receiver is determined by the operation of the receiver under service conditions. The use of various type meters at the present time for obtaining values of this radio noise level is limited to comparative analysis and their use is optional for that purpose. It is not within the scope of this presentation to discuss the relative merits of radio noise level meters.

Checking Noisy Receiver

In the check-out of a noisy receiver, the following steps should be helpful in localizing the interference present.

(1)—Disconnection of the antenna lead-in at the receiver antenna binding post and the substitution of a capacitor to ground (50 to 100 micro-micro-farads). Noise still present in the receiver is probably being introduced through the power supply to the receiver.

(2)—Disconnection of the antenna lead-in at the lead-in insulator or equivalent point, and substitution of a capacitor as noted above. If the noise level was satisfactory in the above test but is now objectionable, the noise source is in the vicinity of the lead-in between the receiver and the insulator. A check of the shielding and general arrangement of the equipment should show the cause of the subject noise level.

(3)—Final check-out of the receiver should be made in flight if possible, as various factors will often change in relationship under these conditions due to vibration, localized stresses and similar disturbances.

(4)—In the use of radio noise level meters as probes for the location of noise-sources, care should be taken to ground the unit to the ground airplane, insure an anti-capacity probe lead, and to adequately shock-mount the unit. Usually, the instructions furnished with such a meter, if followed carefully, will insure satisfactory results.

In conclusion, it should be noted that by following certain fundamental concepts of the causes for radio noise and the use of practical means for the reduction of this noise level to an acceptable value, satisfactory results should be realized in the resultant radio noise level in the receiver of *small aircraft*. By far the greatest single factor embraced in *practical means* noted above, is the use of common sense in the application of shields, bonds and filters and in the arrangement of the radio and electrical equipment in the aircraft.

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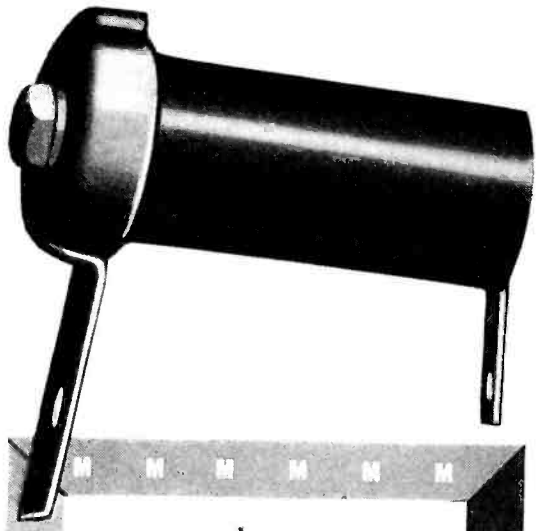

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In the transmitter a 7C7 is used as the crystal oscillator. The crystal is cut for 1245.625 kc. This frequency is fed into a pair of 7A8 modulator tubes. The output from the 7A8's goes to the first quadruple stage—a 7C7, bringing the frequency up to 4982.5 kc. The output from the first quadruple is then quadrupled again through another 7C7 bringing the frequency up to 19,930 kc.

This latter stage is fed to the 6V6 double driver to provide the operating frequency 39,860 kc. The output is fed to a pair of 807's, which are connected in parallel. The power amplifier (807) operates at 600 volts, 100 mills, and estimating 50 per cent loss to the antenna, provides 50 watts.

100-Foot Tower

The tower, which is located on a five-story building, is 100 feet high, while the transmitting rod on top is 15 feet. This antenna is end fed and is about 223 feet above sea level. Tower lights are manually controlled at the transmitter. A co-axial line feeds the output of transmitter to the antenna.

Transmitters on the mobile units differ from the main transmitter only in the operating carrier power. The output carrier power (*max.*) on mobile units is 30 watts, and one 807 is employed in the power amplifier stage.

Receivers in the mobile units and main station are the same.

Frequency Meter

A micrometer frequency meter is used at our station to measure the frequency deviation of the station and mobile units. This meter consists essentially of a band-spread, calibrated oscillator for measurement of frequency by heterodyne, or beat-note, method.

Dynamotors are used in the mobile sets. Vibrators have given us more or less trouble at times. To overcome this, the fuse clips were soldered to make a better electrical connection. When the vibrator sticks, it blows this fuse, which, of course, puts the receiver out of operation.

Tubes that have been replaced are few and far between. The 807 tubes in the output stand up well. Some tubes were replaced in the transmitters; namely, 7A8's and 7C7's in the first quadruple stage.

Some trouble was due to water and dampness in the cables that run from

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the control head to the receiver and transmitter across the floor of the truck. Due to the shortage of floor mats, we have covered these cables with a piece of metal. This cover saves the cables from water and wear from feet.

At four pumping stations we have installed a receiver and transmitter at each. The speaker is remote from the receiver on three of the above cases. Due to the fact that large gas holders are in the vicinity of the antenna, we thought that transmission would be poor; however, signals sent out are good in spite of this. Some of these sets work beter without grounding the antenna, while others work well with the antenna grounded.

Our coverage is approximately 20 miles, although during tests this has been exceeded.

The radio is in use throughout the twenty-four hours daily dispatching the mobile units on incidents that are classed by us as emergencies and has been the means of giving quicker service to our customers than by the previous method of dispatching by telephone. The former method was expensive, since the men covering this type of service would call at least once every hour or more often if the work assigned had been executed or information was referred back to the office.

The portable units at our pressure stations were installed to supplement the telephones in the event of a major catastrophe when it would be very necessary to be in constant communication with them through the station. The units are tested three times daily to be sure they are in readiness for instant use.

VWOA NEWS

(*Continued from page* 52)

as David Sarnoff, J. R. Poppele, E. K. Cohan, O. B. Hanson and the other pioneers who have received similar awards in the past.

"As the years go on, I shall try to measure up to all that this Medal implies."

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General Mauborgne writes: "Please convey to the membership of the VWOA my heartiest thanks for asking my presence at the recent Dinner-Cruise which I enjoyed to the utmost. Another Dinner-Cruise has gone down into history commemorating the exploits of wirelessmen."

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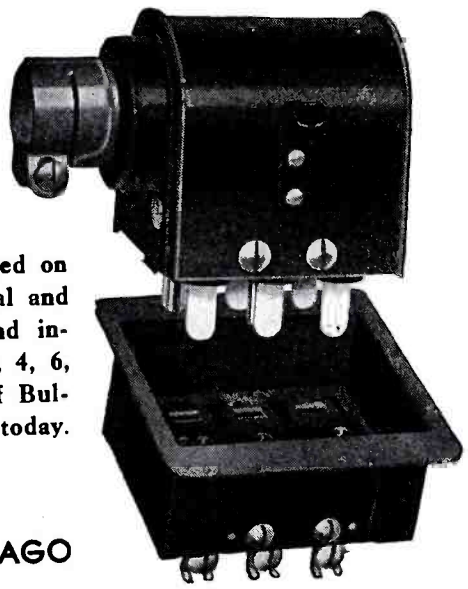

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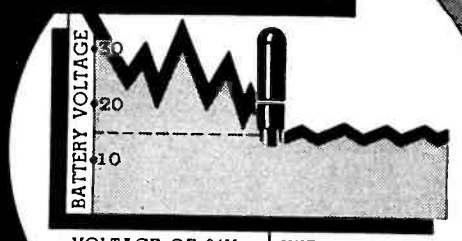

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(*Continued from page 60*)

zontal amplifier either to the internal time axis generator or to the external sweep. It furthermore permits internal or external synchronization. In its most clockwise position, it connects the "horizontal input" binding posts directly to the deflecting plates.

* * *

COIL-TURN COUNTER

A coil-turn counter for laboratory or factory use in determining with precision the number of turns in wound electric coils has been announced by the special products section of G. E. Employing the same circuit as its predecessor, the new counter is more compact in design and incorporates a magnetizing current control box which greatly simplifies the installation. The counter is capable of checking or determining the effective turns of coils ranging from 1 to 11,110 turns, at a rate of from 80 to 100 coils of like specifications per hour.

In addition to the magnetizing current control box, the new coil-turn counter comprises a portable light-beam galvanometer, two yoked test rods, a galvanometer control panel, and a foot-operated switch, assembled for operation on a table or bench.

* * *

PORTABLE GASOLINE DRIVEN GENERATOR

A portable gasoline driven generator, for rapid battery charging, has been announced by Hunter-Hartman Corp., St. Louis, Missouri. This new unit is said to eliminate many of the problems accompanying the use of storage batteries in operations where electric current and conventional equipment for charging are not conveniently available.

The equipment is designed to charge 6, 12, or 24-volt batteries, at 10 to 300 amperes, and consists of a specially designed generator driven by a 6 hp single cylinder, air cooled, gasoline engine which is equipped with air cleaner, gasoline filter, magneto, self-starter, rope starter, gas tank and remote stop control.

For easy portability, the entire unit is mounted on a skid-type base, equipped with 5-inch wheels. When the unit is in use the wheels are raised from the ground, thus preventing creeping.

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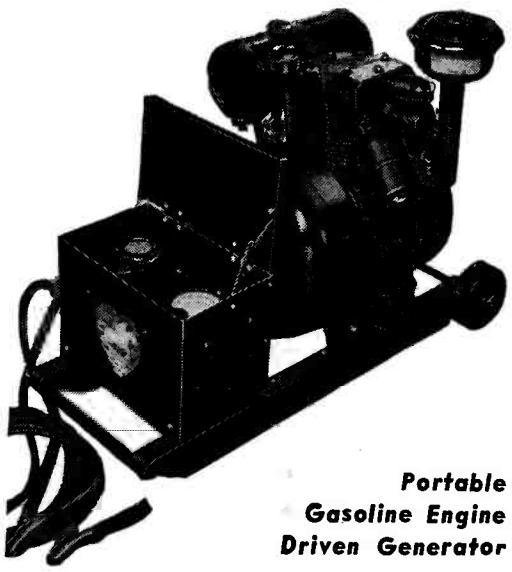

Portable Gasoline Engine Driven Generator

* * *

AIRCRAFT TIME-DELAY RELAY

For aircraft applications where time-delay drop-out is required, G. E. has designed a time-delay relay. It is available in two sizes, one providing up to 0.4 second time delay, and the other up to 0.3 second time delay. On many applications, this relay can be used directly to control the desired device, while on others it may be desirable to have the relay actuate a contactor.

The new relay employs a familiar principle to accomplish the accurate time-delay it provides. This principle consists of delaying the decay of flux in a magnetic circuit through the use of a single-turn, low-resistance copper jacket around a section of the magnetic structure.

Designed for use in a wide range of ambient temperature, from plus 95° to minus 40° C.

The normally closed, double-break, silver contacts of the relays are said to carry 20 amperes continuously at altitudes up to 40,000 feet above sea level. Also, the operating coils can be furnished for operation on either a 12- or a 24-volt ciruit.

* * *

GARNER FREQUENCY METERS

Four new models of frequency meters have been announced by the Fred E. Garner Company, 45 East Ohio Street, Chicago, Ill. All models are crystal-controlled and, by means of a class "C" harmonic amplifier circuit embodied in

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A-C CALCULATION CHARTS

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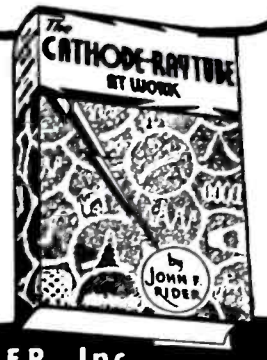
A-C CALCULATION CHARTS are designed for use by civilian engineers and engineers of the armed forces who operate in the electrical—communication—power—radio—vacuum tube—telephone—and in general, the electronic field. Invaluable for instructors as well as students, and also executives who check engineering calculations.

CATHODE RAY TUBE AT WORK

The Cathode Ray Tube at Work is the accepted authority on the subject. The cathode ray tube in the Oscillograph and its application to electronic and industrial work is fully discussed. Profusely illustrated. 338 pages $3.00



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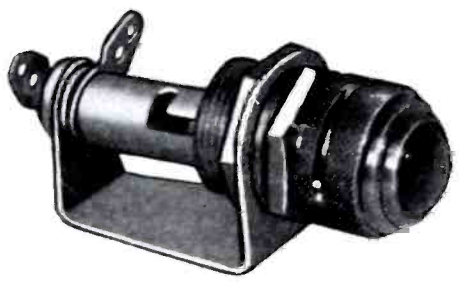
Now a VARIABLE INTENSITY— *Shutter Type* PILOT LIGHT



Gothard No. 430 (Faceted Jewel) and No. 431 (Plain Jewel) Pilot Lights are particularly adapted to aircraft, marine, signal and similar applications where various intensities of light are desired under constantly changing conditions. Permits gradation from bright light thru intermediate glows to total dark within a 90° rotation of the shutters. Also available with polarized lens. Red, green, amber, blue or opal lens.

Request complete information and prices.

Gothard MANUFACTURING COMPANY

1335 North Ninth St. Springfield, Illinois

the units, frequency carrier signals are said to be provided every 10 and every 100 kc from one-hundred cycles to forty-five megacycles. A carrier signal is also said to be produced every 1,000 kc from 1 megacycle to 120 megacycles.

Special models designed for use under adverse conditions are also available. These are equipped with two precision crystals that have been ground to produce exact frequencies of 100 and 1,000 kc and tested for operation at temperatures from 35° to 55° Centigrade.

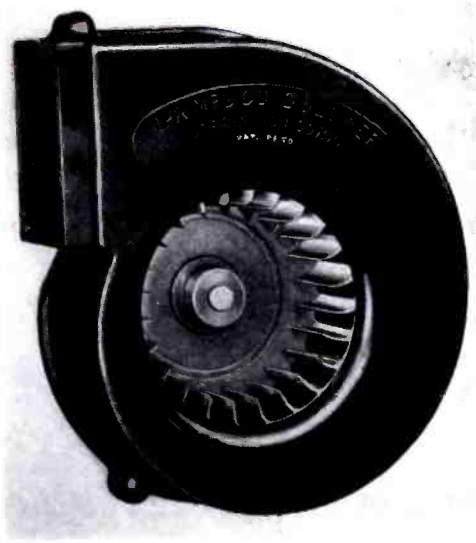
Models are available for either a-c or portable battery operation.

* * *

COMPACT BLOWER

A light-weight blower (housing and wheel) mounted in a single piece high impact plastic, said to be capable of withstanding 110° C, has been developed by the L-R Manufacturing Company, Torrington, Connecticut. The wheel in this blower is of the turbo type, 3" in diameter where zinc plated. Housing and wheel weigh 12 ounces. Models are made for clockwise or counter clockwise operation.

To obtain the necessary data for the speed and power necessary to produce a specified output at a given static pressure with this device, a special chart has been prepared. This chart appears in a circular, available gatis.



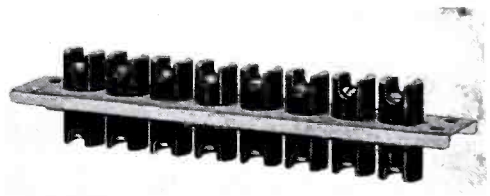
* * *

FEED-THRU TERMINAL BLOCK

A multiple terminal block, for subpanel and chassis use with feed-thru terminals, has been announced by the Curtis Development & Manufacturing Company, 1 North Crawford Avenue, Chicago, Illinois.

The block consists of individual feed-thru terminals mounted in bakelite, which are permanently held in a metal strip in any combination desired. Factory production now includes blocks having any number of units between 1 and 10, but, because of their design, blocks can be supplied with any number of terminals needed.

Terminals have ample clearances and leakage distances for circuits carrying up to 300 volts, 20 amperes. Center to center distance between terminal units is 5/8". The two mounting holes at each end of the terminal base take No. 8 machine screws.



* * *

ELECTRONIC ADJUSTABLE SPEED DRIVE

An electronic adjustable-speed drive, the Mot-O-Trol, that provides close speed regulation over a 20 to 1 speed range for d-c motors operating from an a-c source, has been developed in the laboratories of Westinghouse Electric Manufacturing Co., East Pittsburgh, Pa.

Features of the electronic drive include stepless speed control, automatic close speed regulation over wide load fluctuations, full torque at extremely low speeds,

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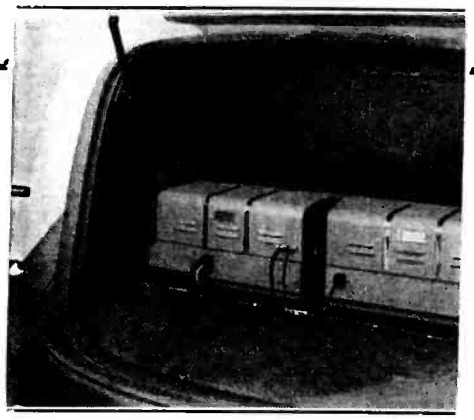

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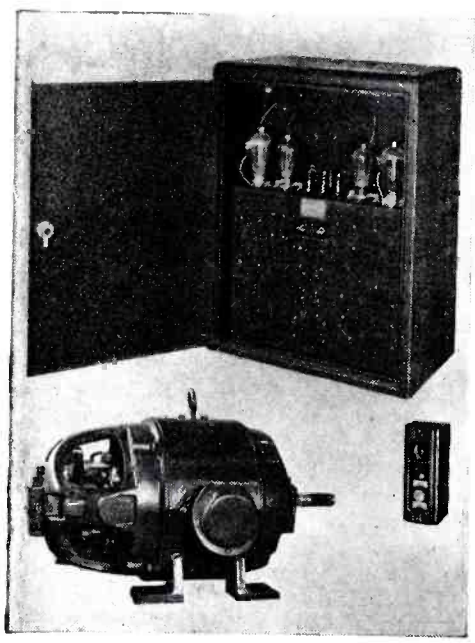
THE INDUSTRY OFFERS . . .

(Continued from page 77)

stepless acceleration and deceleration and dynamic braking. At present a standard drive is available for ratings up to 1 horsepower for single phase operation on 110 or 220-volt, 60-cycle systems. Special drives of larger horsepower rating can be designed to suit particular application requirements.

This new drive has four parts. These are, (1)-power transformer for separate mounting, (2)-Mot-O-Trol cabinet with the thyratron-tubes and the current limiting and speed regulating control, (3)-control station with potentiometer to vary the voltage supplied to the armature and field circuits and with start and stop push buttons, and (4) shunt-wound d-c motor.



* * *

PARTS CABINETS

A variety of small handy cabinets for parts are being made by W. C. Heller & Company, 43 Weil Street, Montpelier, Ohio. Sizes range from several compartment units to multiple units that are close to twelve feet long and over six feet tall.

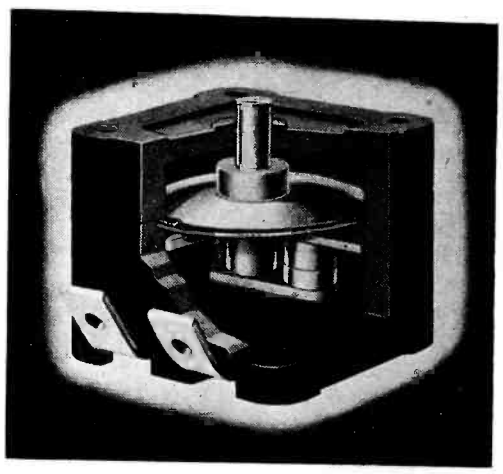
Many of the cabinets are of the sectional type, thus providing structure to any size required. Compartments available are of the small drawer or intermediate draw type, as well as the large drawer and letter size file. Available, too, are shop desks, storage cabinets and shop walks. Catalog available on request.

* * *

ALLIED CONTROL SEALED SWITCHES

Two sealed type switches, one with a double break when normally closed (type A3), and another with a double break when normally open (type A5), are now being made by the Allied Control Company, 2 East End Avenue, New York City.

The switches are of the single-pole, single-throw type, with non-inductive contacts, rated at 50 amperes at 12 and 24 volts d-c and 110 volts a-c. The travel differential is said to be .006 to .012 of an inch. Operating pressure is 1½ to 3½ pounds; vibration is 10 G for either horizontal or vertical position. Five ounces in weight, it is 1 15/16″ x 1 15/16″ x 1 19/32″.



* * *

ELECTRONIC METER

An electronic time-interval meter for accurately measuring extremely short intervals, as low as 100 microseconds, has been announced by the special products section of G. E. Specifically, the meter is designed for measuring the time interval between two events which can be converted into electrical impulses, such as the elapsed time between the closing of two controls; between two impulses to a phototube, and between an electrical

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On all Fighting Fronts, Onan Electric Plants are doing a winning job in critical War Communications Work and all other tasks requiring electricity.

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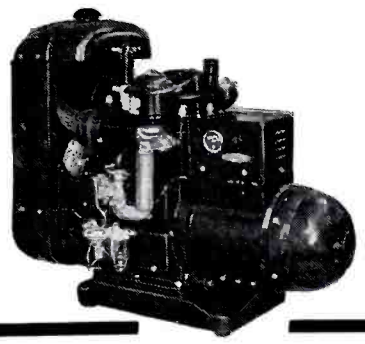

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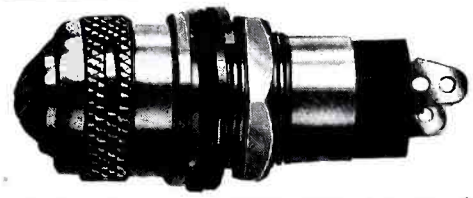

Preferred where variable light intensity is required: Series D.V. uses superior mechanical shutter; Series D.P. uses polaroid discs.

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impulse and a light impulse.

Consisting of two units, an electronic panel and a phototube with its preamplifier stage, the meter has eight ranges, selected by means of a tap switch so that any time interval of a length between .0001 second and 3 seconds can be measured. A standard indicating instrument calibrated in milliseconds gives a direct reading of the time interval measured.

The normal input signals consist of changes of light intensity falling on the phototube or the making of external electrical contacts. In the former case, light values as low as 1/100 lumen, or an intensity of approximately 1.4 footcandles, can be used on the phototube and still result in satisfactory performance.

The unit operates from a 115 volt, 60 cycle lighting circuit.

* * *

WESTINGHOUSE GEARMOTORS

Horizontal-parallel shaft type gearmotors to meet speed reduction requirements for a wide variety of industrial applications over a range of 1 to 75 hp has been announced by the Westinghouse Electric and Manufacturing Company.

The use of adaptor castings between motor and mechanical parts allows the use of all standard Westinghouse NEMA frame motors with each type of unit. Types of motor construction can therefore be readily changed to suit varying service conditions if necessary in the field. The design of the motor-adaptor assembly being common between unit types, such assembly can be readily shifted between unit types to meet changes in speed requirements. Many working parts including gear sets being common to all three unit types of a given rating, replacement part programs are held to a minimum.

Gears and pinions in the new gearmotors are of .40-.50 carbon steel, and are given special heat-treatment before hobbing. This process produces a tapering hardness from surface to core, and results in tough, impact-resisting teeth. Gears and bearings are lubricated by a positive splash system. A new case design allows oil to circulate freely at all times.

Descriptive folder available gratis to engineers.

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IN DAYLIGHT
AT NIGHT TIME
BY "BLACK" LIGHT
AND
NO LIGHT

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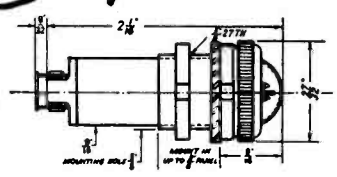

Indicates by reflected light, visible light, "black light," and by fluorescent-radio-active luminenscence. *Operates* by solenoid. When activated, "butterfly" opens instantly showing signal. *No blur*, no dimming. *Non-shatterable* protection. Plastic cap withstands severest tests. *No burn-outs* as with lamps; no delicate parts to break from shock or shell explosion; no spare lamps required. *Uses about ½* current of filament lamps.

Wire or write for Signalette Bulletin. Ask about samples for test.

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COMMUNICATIONS—MAY, 1943

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You may need this largest Variac for controlling voltage on motors, heaters, flood lights, transmitter tube filaments, rectifier systems, or process equipment. Wherever line voltage varies and operating voltage must be correct, you will find this manually operated, continuously adjustable autotransformer gives smooth control and good voltage regulation at high efficiency. Designed for circuits of moderately high power, the Type 50 Variac is rugged, dependable and convenient.

Prompt delivery can be made on priority rating of A A 3 or better.

TYPE 50 VARIAC SPECIFICATIONS

Input Voltage: Type 50-A, 115 volts, and Type 50-B, 230 volts.

Output Voltage: Voltages up to 117% of line voltage can be obtained. Connection can also be made for maximum output voltage equal to line voltage.

Load Rating: 5 kva for the 115-volt model; 7 kva for the 230-volt model. Ratings are for 50° C. rise.

Rated Current: 40 amperes for the 115-volt model; 20 amperes for the 230-volt model.

Maximum Current: 45 amperes for the 115-volt model; 31 amperes for the 230-volt model.

Regulation: At output voltages ranging from 17% below to 17% above line voltage the full load regulation is less than 4%.

Losses: No load losses are about 1% of full-load power; full-load losses are about 2%; losses at half maximum output voltage are about 4%.

Driving Torque: From 1 to 2 pound feet.

Net Weight: 85 pounds.

Dimensions: Approximately 12 inches high x 16 inches diameter overall.

Price: $100.00 F. O. B. Cambridge.

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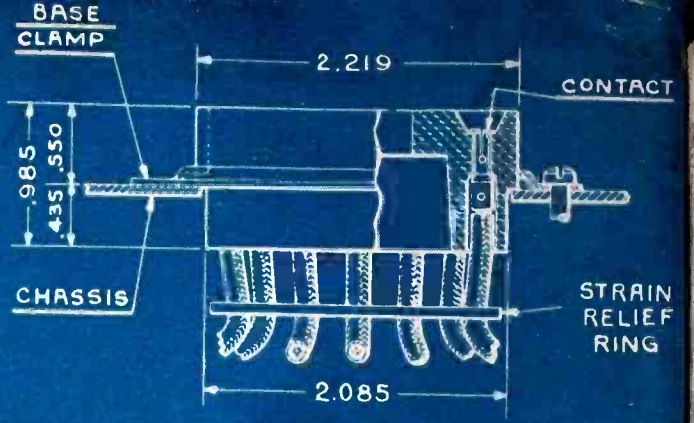

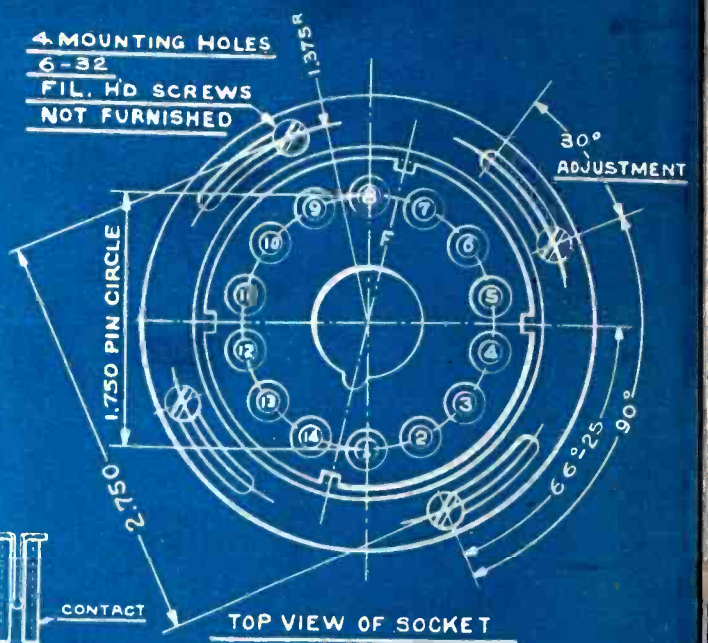

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- . . . to completely enclose and seal contacts against temperature and humidity conditions
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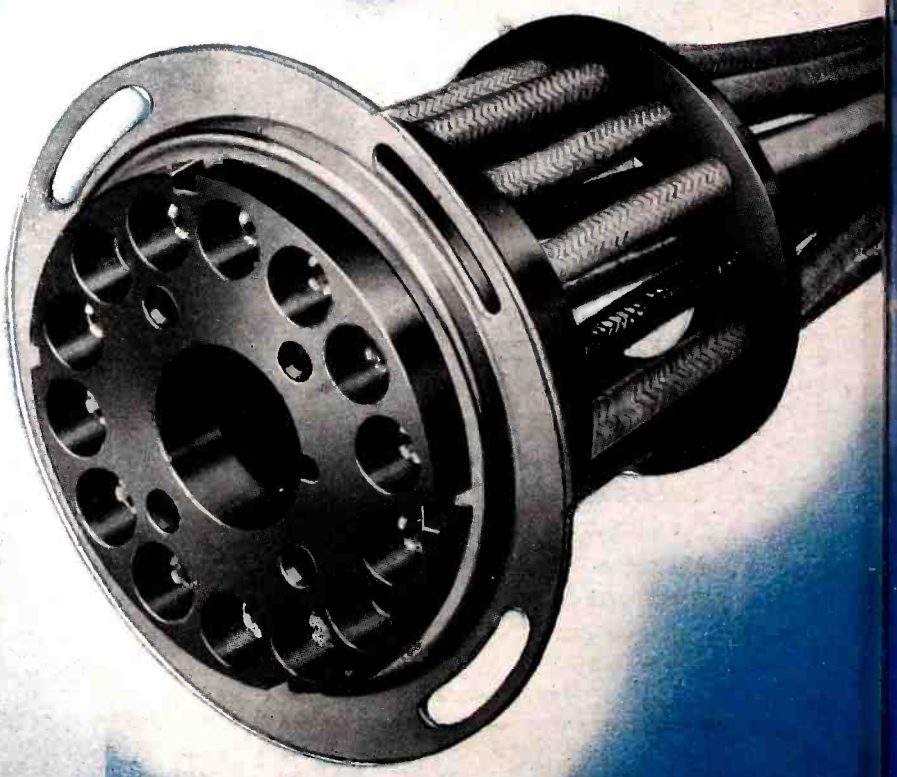
An added feature of the Franklin Socket is a Strain Relief Ring; this ring protects the soldered joints against vibration, pull or twist of the wires.

Franklin Sockets can be supplied unassembled or complete with cable to your specifications.



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