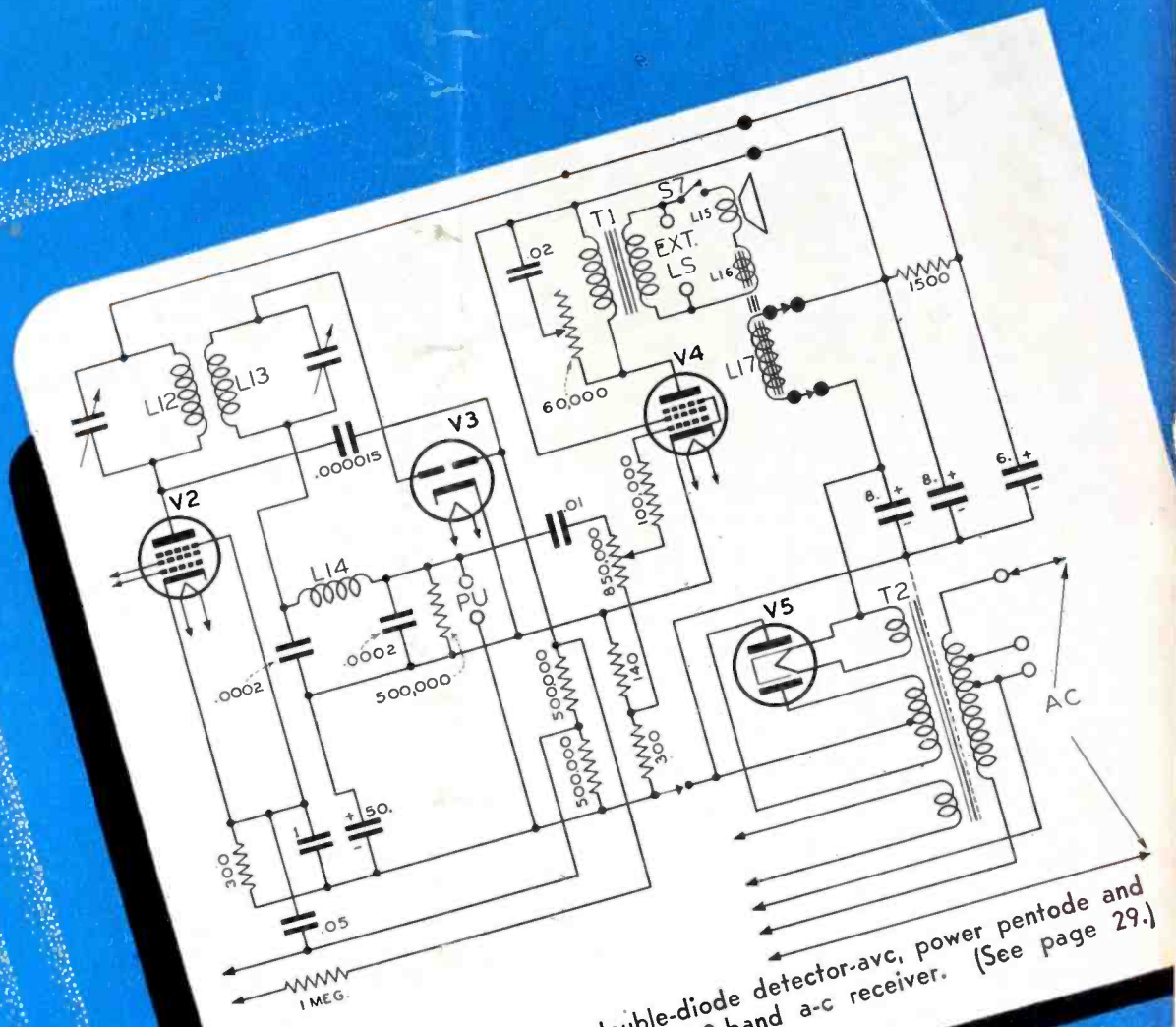
SERVICE

A MONTHLY DIGEST OF RADIO AND ALLIED MAINTENANCE



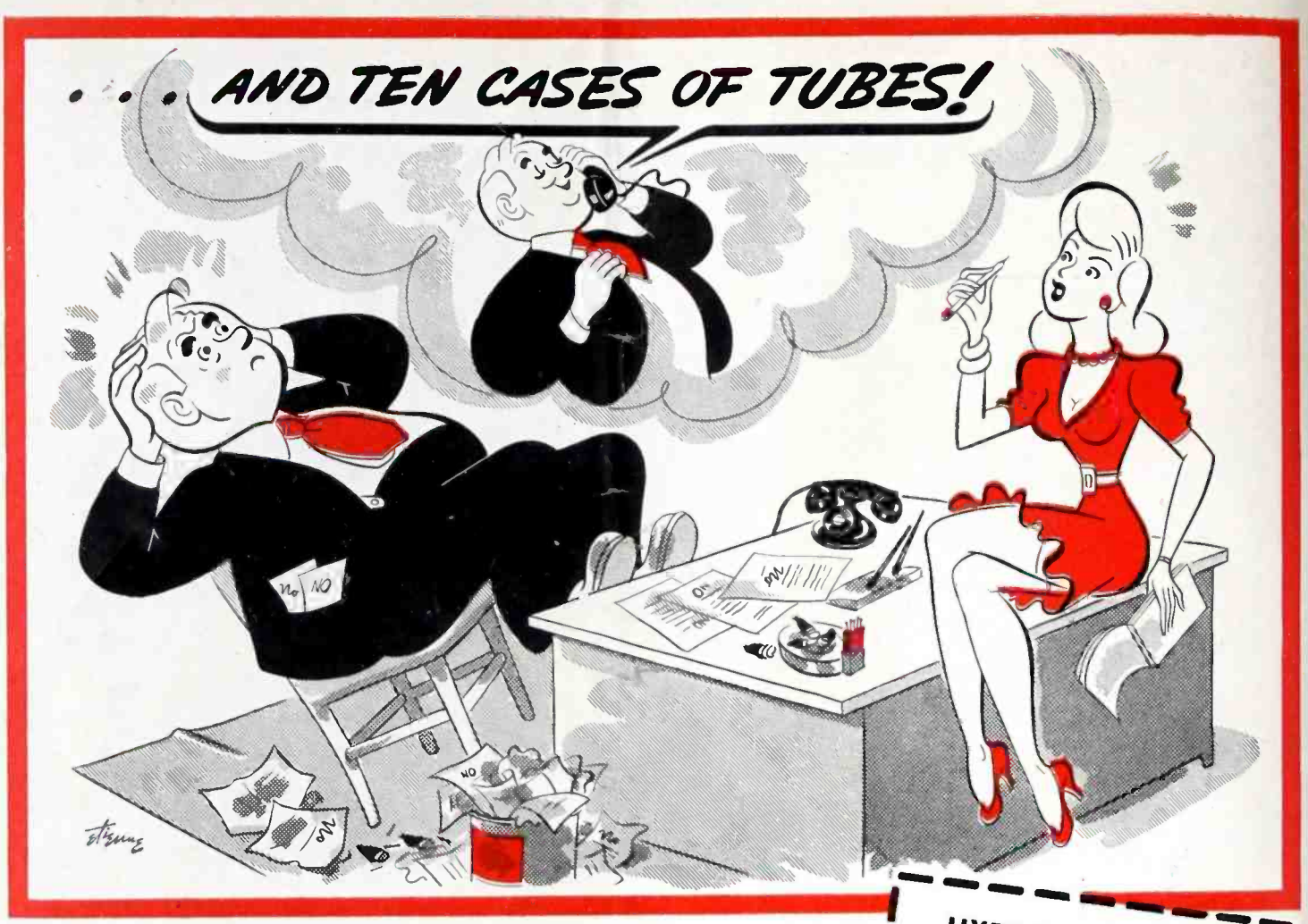
The variable mu i-f pentode, double-diode detector-avc, power pentode and rectifier portion of a British 4-tube, 2-band a-c receiver. (See page 29.)

RADIO

TELEVISION

ELECTRONICS

February
1944



Pardon us a moment of nostalgic reminiscence. It is our guess that you, too, like to lean back occasionally, and daydream of the "good old days." Remember when all you had to do was reach for the 'phone — call Hytron — and those tubes you needed *at once* were rushed to you on the double?

Those "good old days" will be with us again soon — just as soon as our number one customer, Uncle Sam, settles a little score with Hitler and Tojo. Only they will be still better days; first, because electronics is on its way to big things; and second, because Hytron has learned much about making tubes during this war.

Here's to the future and peace — when Hytron's wartime experience will become a peacetime moneymaker for you.

HYTRON HYLIGHTS

Easy To Understand

When the facts are known, it is easy to comprehend why there are not enough receiving tubes for civilian use.

Replacement Tube Sales

1941 actual	35,000,000
1943 actual	19,000,000
1944 potential	70,000,000

All agree the Armed Services come first; civilian demands must wait. Although Hytron and others are already running at capacity, military demands are still increasing. Despite repeated expansion, there just are not enough tubes to go around. There will come a day, though, when we shall meet that tremendous civilian demand too.

OLDEST EXCLUSIVE MANUFACTURER OF RADIO RECEIVING TUBES

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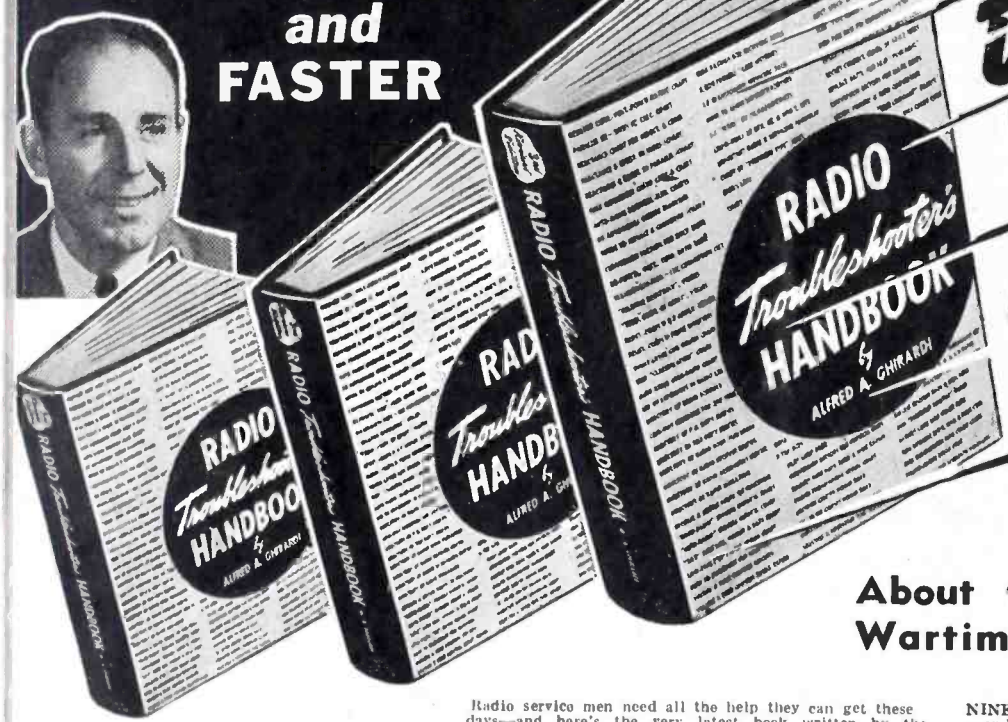

SPEED UP.. DO MORE WORK... MAKE MORE MONEY!...

FACTS
About GHIRARDI'S Big New Wartime Service Handbook

"IT'S NAMED WRONG!" says John Davidson

"Ghirardi's RADIO TROUBLESHOOTER'S HANDBOOK is named wrong," *writes Serviceman John C. Davidson of Opelousas, La.* "It should be called the Radio Serviceman's Savior!"

"Time saved on only two repair jobs paid for the book. I wouldn't be without it." *Burton V. Selle, Elyria, Ohio.*

"I've learned more in one hour from this book than I have in the last 11 years of my radio career! No radio man will ever go wrong in buying it. It's the best I've ever had!" *Pvt. Evert Halbach, Ft. Benning, Ga.*

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"It's best by test! Fellow servicemen: you are losing 1000-to-1 in dollars if you haven't got the 3rd edition!" *S. Ray, Durham, N. C.*

Radio service men need all the help they can get these days—and here's the very latest book written by the master servicing expert, Alfred A. Ghirardi, to give you EXACTLY the help you need WHEN YOU NEED IT! Don't waste time in complicated testing of every receiver! Simply turn to the Case History "Trouble" data on that particular model in Ghirardi's new edition RADIO TROUBLESHOOTER'S HANDBOOK. Nine times out of ten, you'll find exactly the clue you need to repair it promptly—and without any elaborate testing whatsoever!

GOODBYE TO GUESSWORK—

Don't let work pile up on your bench while you fuss around trying to find a hard-to-get replacement tube or part for a job. Turn to the Data Sections in the TROUBLESHOOTER'S HANDBOOK—and you may be pleasantly surprised to learn that some easy-to-get tube or part can be substituted according to the directions that this new Handbook supplies!

STOP WASTING TIME!

In brief, why bother to spend your valuable time figuring out anything for yourself that has already been figured out for you and recorded in easily-found, quickly-understood style in this big new 710-page manual-size book! Smart servicemen everywhere say this big new volume is helping them turn out from 50% to 100% more work in a given time—and make more money accordingly.

NEW—COMPLETELY REVISED

Don't confuse this Handbook with previous editions. This is Ghirardi's big NEW wartime edition—completely revised—bigger than ever—more helpful—CONTAINING NINE MORE SECTIONS OF VITAL NEW MATERIAL—and giving complete data on 75 subjects absolutely essential to your every day service work.

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EDITORIAL

AUTO ignition noise is now being studied with extreme thoroughness by the engineering-allocation committee of FM Broadcasters, Inc. The Society of Automotive Engineers and the Radio Technical Planning Board have been asked to assist in prescribing remedies to minimize and eliminate this nuisance factor.

Let's hope that the FMBI, SAE and RTPB find the solutions real soon!

IN two papers presented before the IRE Winter Technical Session, *servicing* was a featured subject. One of the papers, entitled "Design Technique Versus Service Requirequirements," presented by Irwin W. Stanton of the RCA Service Company, analyzed the relative responsibilities of the engineer and the Service Man. Receiver design that will facilitate servicing is an important phase of engineering for the engineer to consider, pointed out Mr. Stanton. Such design, complemented by a carefully prepared servicing program will provide a maximum of efficiency from receivers and associated equipment, stressed Mr. Stanton.

The second paper, entitled "Radio in Service of Home and Nation," presented by Arthur Stringer of the NAB, emphasized the need for thorough studies of circuit fundamentals. Such knowledge, explained Mr. Stringer, can't help but facilitate servicing and provide improved receiver results on a consistent basis.

DON'T forget to enter the SERVICE contest. Send in your ideas on how you have repaired or rebuilt a radio receiver, phonograph, or sound system, where parts shortages have been a factor. First prize is a $100 War Bond. Contest closes March 1st, so act quickly!

SERVICE

A Monthly Digest of Radio and Allied Maintenance

Reg. U.S. Patent Office

Vol. 13. No. 2 February, 1944

Published monthly by Bryan Davis Publishing Co., Inc.
19 East 47th Street, New York, 17, N. Y. Telephone PLaza 3-0483

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Entered as second-class matter June 14, 1932, at the Post Office at New York, N. Y., under the Act of March 3, 1879. Subscription price: $2.00 per year in the United States of America and Canada; 25 cents per copy. $3.00 per year in foreign countries; 35 cents per copy.

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Even before all our soldiers and sailors are home again, RAYTHEON—through the nationwide network of jobbers, dealers and servicemen—will be supplying civilian needs for quality electronic tubes for the many applications in the coming era of electronics.

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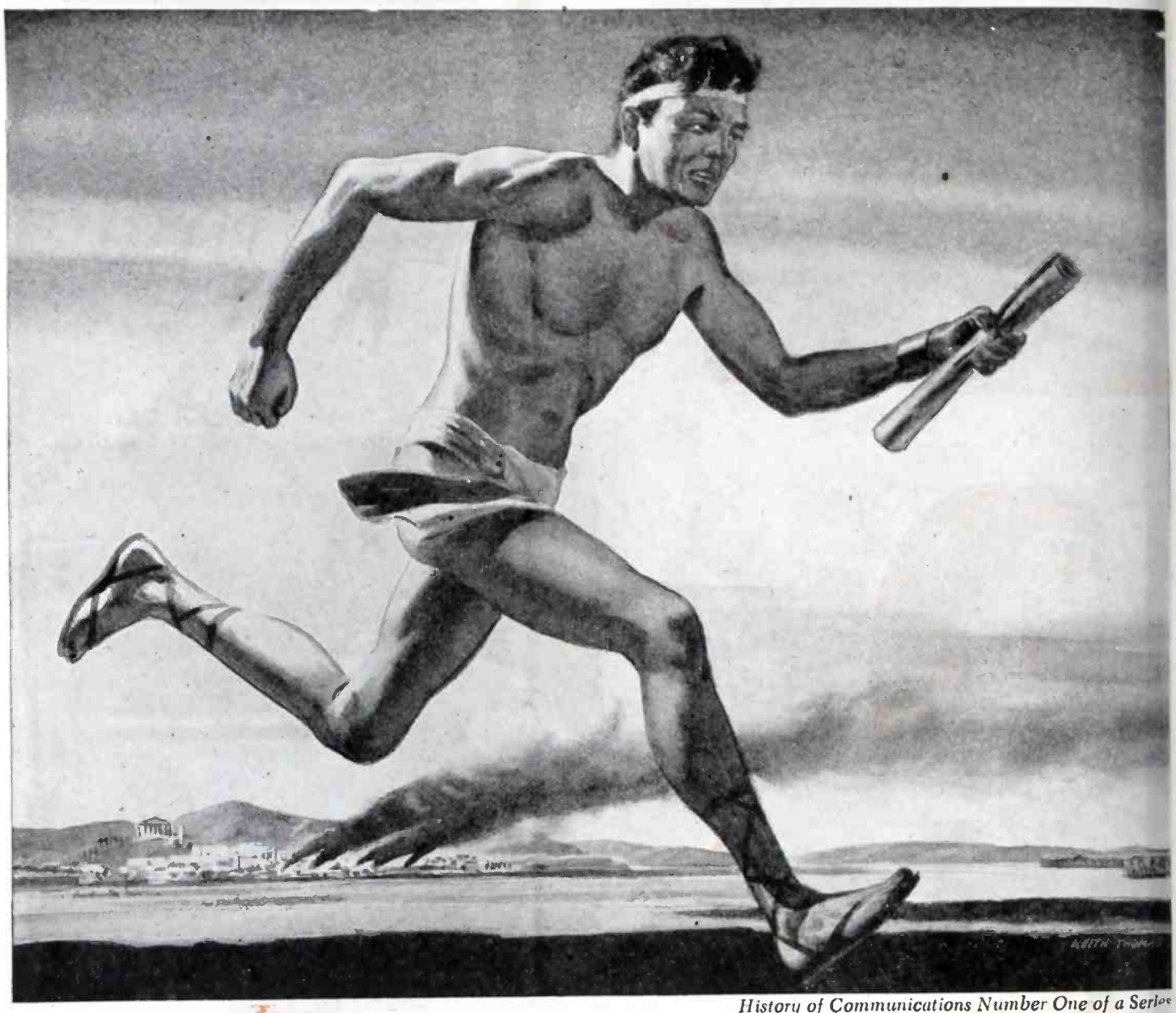

History of Communications Number One of a Series

A FORERUNNER OF MODERN COMMUNICATIONS

One of the first known channels of message carrying was by runner, and annals of Grecian and Phoenician history describe the nimble lads who firmly grasped rolls of parchment and sped hither and yon. Clad in typical running gear of the period, they covered amazing distances with almost incredible speed. That was the forerunner of today's modern communications where scientific electronic devices are "getting the message through" on every war front. Universal Microphone Co. is proud of the part it plays in manufacturing microphones and voice communication components for all arms of the United States Armed Forces, and for the United Nations as well. Other drawings in the series will portray the development of communications down through civilization and the ages to the modern era of applied electronics.

< Model 1700-UB, illustrated at left, is but one of several military type microphones now available to priority users through local radio jobbers.

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. . . YOUR 4TH WAR LOAN QUOTA

WHETHER your plant meets its quota, or fails, lies largely in *your* hands. Your leadership can put it over—but if you haven't already got a smooth running, hard hitting War Loan Organization at work in your plant, there's not a minute to lose.

Take over the active direction of this drive to meet —*and break*—your plant's quota. And see to it that every one of your associates, from plant superintendent to foreman, goes all-out for Victory!

To meet your plant's quota means that you'll have to hold your present Pay-Roll Deduction Plan payments at their all-time high—plus such additional amounts as your local War Finance Committee has assigned to you. In most cases this will mean the sale of *at least* one $100 bond per worker. It means having a fast-cracking sales organization, geared to reach personally and effectively every individual in your plant. And it means hammering right along until you've reached a 100% record in those *extra* $100 —or better—bonds!

And while you're at it, now's a good time to check those special cases—*growing more numerous every day*—where increased *family* incomes make possible, *and imperative*, far greater than usual investment through your plant's Pay-Roll Deduction Plan. Indeed, so common are the cases of two, three, or even more, wage-earners in a single family, that you'll do well to forget having ever heard of '10%' as a reasonable investment. Why, for thousands of these 'multiple-income' families 10% or 15% represents but a paltry fraction of an investment which should be running at 25%, 50%, or more!

After the way you've gone at your wartime *production* quotas—and topped them every time—you're certainly not going to let anything stand in the way of your plant's breaking its quota for the 4th War Loan! Particularly since all you are being asked to do is to sell your own people the finest investment in the world—*their own share in Victory!*

LET'S ALL BACK THE ATTACK!

This space contributed to Victory by

SERVICE

This is an official U. S. Treasury advertisement—prepared under auspices of Treasury Department and War Advertising Council.

You are going to be a bigger man

Keep this fact clearly in mind: *electronics* is the growing art of harnessing electron tubes —in many cases, familiar types of radio tubes —to new applications; and it means everything to your future.

Big as the radio and communications industry has been, it is only *one phase* of electronics. Hitherto your opportunities have been practically limited to that one phase—transmission of sound. At the start of the war, television—transmission of sight—was just opening up.

When the war is over, television will arrive —but *it won't be alone.* RCA electron tubes will be put to work on thousands of *new jobs*—new electronic devices.

As a Tube and Equipment Distributor and Serviceman *YOU* will service these devices—sell replacement tubes they will require.

YOU will draw income from this vastly widened field. You will be a *bigger man*—expanding, reaching out, grasping opportunity. RCA Engineers and RCA Tube and Equipment Distributors and Servicemen, working together, can help enormously to make electronics the biggest industry, and the greatest public service, this country has ever known!

RCA

RADIO CORPORATION OF AMERICA

Camden, New Jersey

Each day General Electric produces nearly one million dollars' worth of electronic equipment

This means a better electronic tube for you after the war

ALL of General Electric's gigantic production of electronic equipment—*nearly one million dollars' worth every day*—now helps fight the war.

The famous G-E electronic tube is everywhere—in plane, tank, ship—demonstrating under fire it has the engineering excellence which only General Electric's long leadership in electronics makes possible.

Because military demands come first today, G-E tubes are scarce. When they are again available in quantities, electronic production of equipment in industry and the great consumer need for replacements will offer a huge tube market. Then, you, the radio service man of today, will be the electronic maintenance man of tomorrow, serving the expanded needs not only of radio, but also of television and electronic equipment. Electronics Department, General Electric, Schenectady, N. Y.

Tune in General Electric's "The World Today" and hear the news from the men who see it happen, every evening except Sunday at 6:45 E.W.T. over CBS. On Sunday evening listen to the G-E "All Girl Orchestra" at 10 E.W.T. over NBC.

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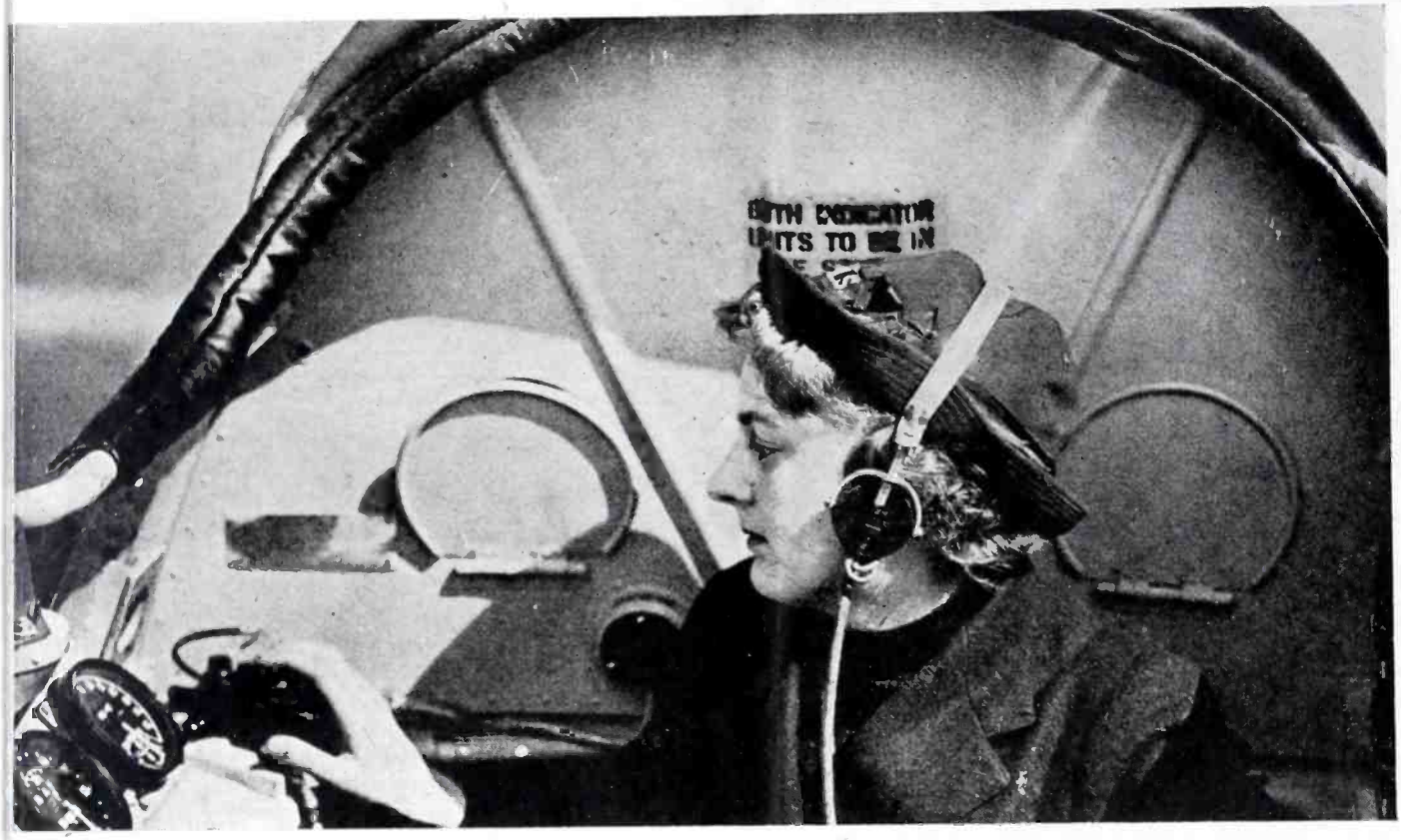
SERVICE
A Monthly Digest of Radio and Allied Maintenance



THE WRENS

BRITAIN'S GIRL RADIO MECHANICS

by H. W. BARNARD
Wireless World, London

A YEAR ago I saw the first raw recruits of Britain's Women Royal Naval Service starting their intensive course of training to become radio mechanics.

Recently I revisited them at a Royal Naval Air Station, and they were servicing and maintaining many types of radio apparatus installed in fighters, torpedo bombers and reconnaissance aircraft of Britain's Naval air arm.

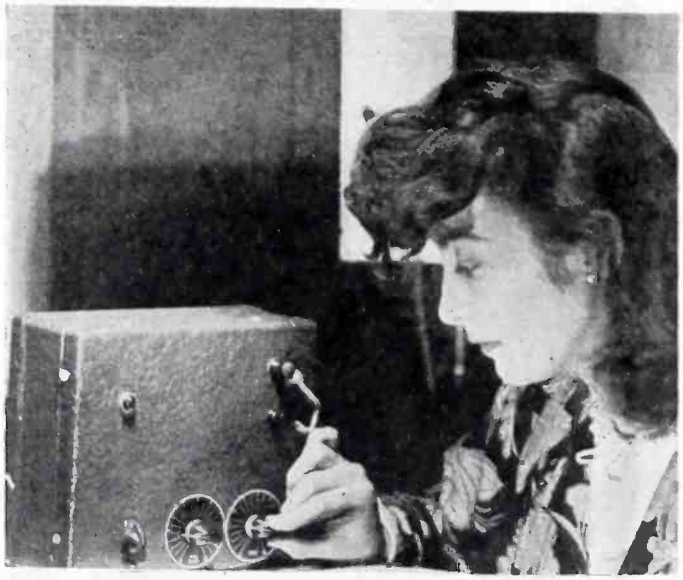
When I first saw them at the school, some sixty Wrens—as members of the WRNS are called—were undergoing a course, which in peacetime would probably have been spread over two years. As the senior instructor pointed out, all the frills had to be cut out. They were, and the intensive training has proved to be exceptionally effective.

Illustration at top shows one of flying Wrens testing radio set in a torpedo-carrying ship. Illustration at right shows a typical Wren radio mechanic preparing for flight.
(British Official Photos)

The training is divided roughly into three sections. During the first period students are taken over the subjects of elementary electricity and magnetism, so that they become familiar with the nature, effects and laws of electric currents.

The next period is taken up with the study of the basic principles of radio. And during the last period students learn something of the fundamentals of high frequency and ultra-

(Continued on page 30)



SIGNAL

by M. E. HELLER

A-C operated multivibrator with adjustable pitch control.

A MULTIVIBRATOR or other form of relaxation oscillator, having a waveform approximating a square wave, is capable of creating signals over a very wide frequency band including r-f, i-f and a-f ranges. This property allows such an oscillator to be used for a wide variety of signal tracing applications in radio receivers, audio amplifiers, and similar equipment. It is particularly handy in locating dead stages.

Principle of Operation

The common variety of multivibrator consists of a 2-stage resistance coupled amplifier in which the output of the second stage is fed back to the first in such a manner that oscillation occurs. The waveform is usually approximately square and is consequently very rich in harmonics. The fundamental frequency is determined by the time constants of coupling condensers and grid-leaks, tube characteristics and voltages employed. Oscillation is produced by charging and discharging the coupling condensers through the grid-leak resistors.

A typical multivibrator circuit is shown in Fig. 1. A 6SN7 dual triode is used, each section acting as a separate amplifier. The triode at the bottom acts as the first stage, the top triode as output stage. The 10,000-ohm rheostat in *No. 1 grid* is used to control the frequency, while the 10,000-ohm potentiometer on top is used as an output attenuator. The oscillator then has an output impedance of approximately 10,000 ohms maximum, a good range for feeding grid and plate circuits of vacuum tubes.

The multivibrator may be considered to be a type of trigger circuit which is self-excited. Oscillations are started in much the same manner as in more familiar circuits. That is, some sort of fluctuation causes a small disturbance on grid *No. 1;* this is amplified by the second tube, a part of the output being fed back to *No. 1* grid, reamplified over and over until full amplitude is obtained. All this occurs in a fraction of a second. Each tube introduces a phase shift of 180° so the output of the second stage is 360° out of phase with the input grid. This is another way of saying that the output of tube *2* is in phase with the grid of *1* so that, if they are connected, the feedback must reinforce the voltage

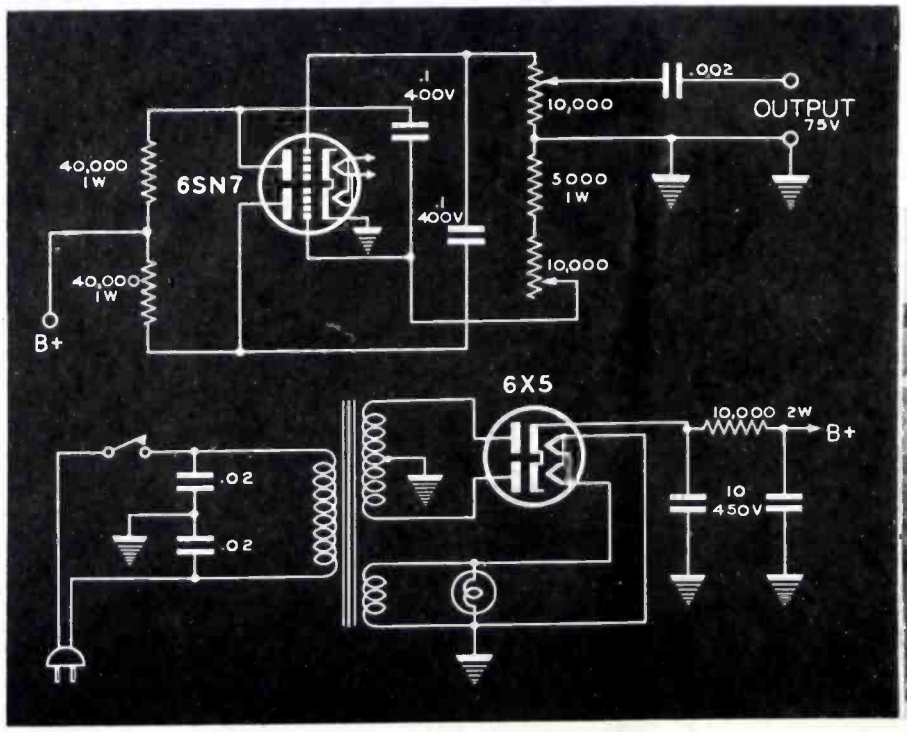
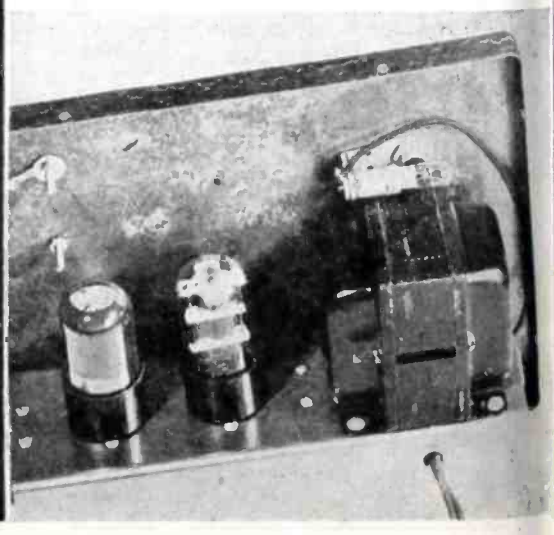
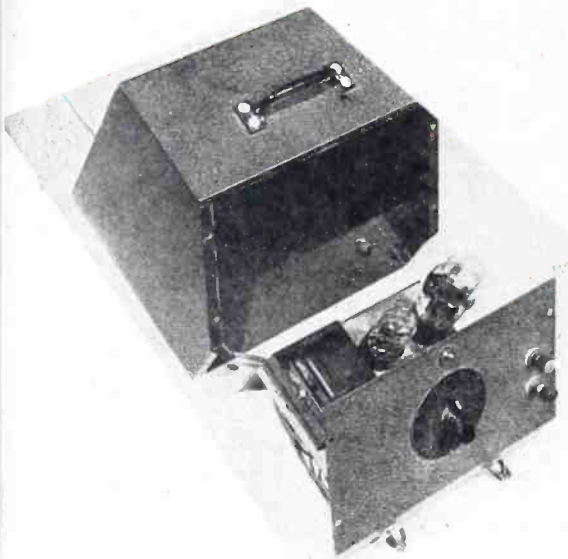
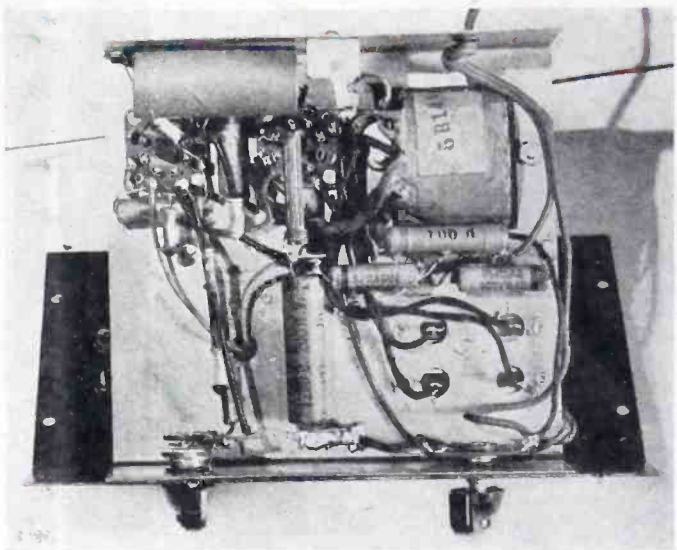


Fig. 1 (left), circuit of multivibrator illustrated at top, left, and below, right. In this circuit the 6SN7 dual triode operates as a dual amplifier. This multivibrator uses the trigger circuit. Below we see the rear view of multivibrator.



TRACING WITH MULTIVIBRATORS



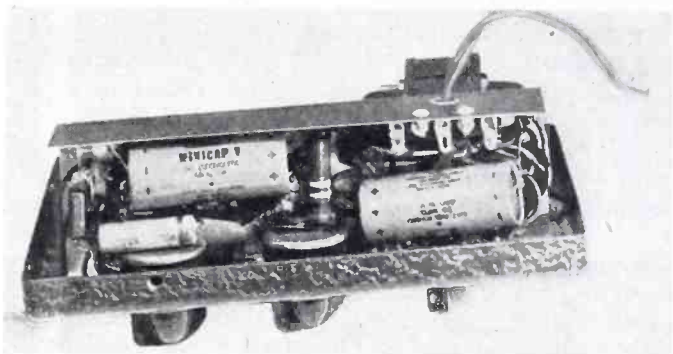


on *No. 1* grid, causing oscillation. The frequency is determined primarily by the .1-mfd coupling condenser from plate 2 to grid 1 and the value of *No. 1* grid leak.

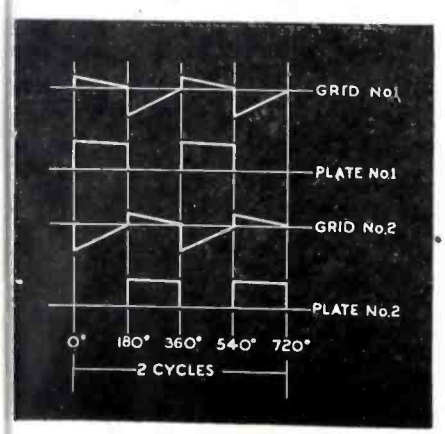
The waveform at various points in the circuit is shown in Fig. 2. Note the approximate square wave which is present at the plates of both tubes and therefore at the output. Note also the 180° phase displacement between the tubes. The grid voltages have a different waveform, sort of a compromise between a sawtooth and square wave. The positive and negative portions are unequal. This is a positive indication of high amplitude even harmonics.

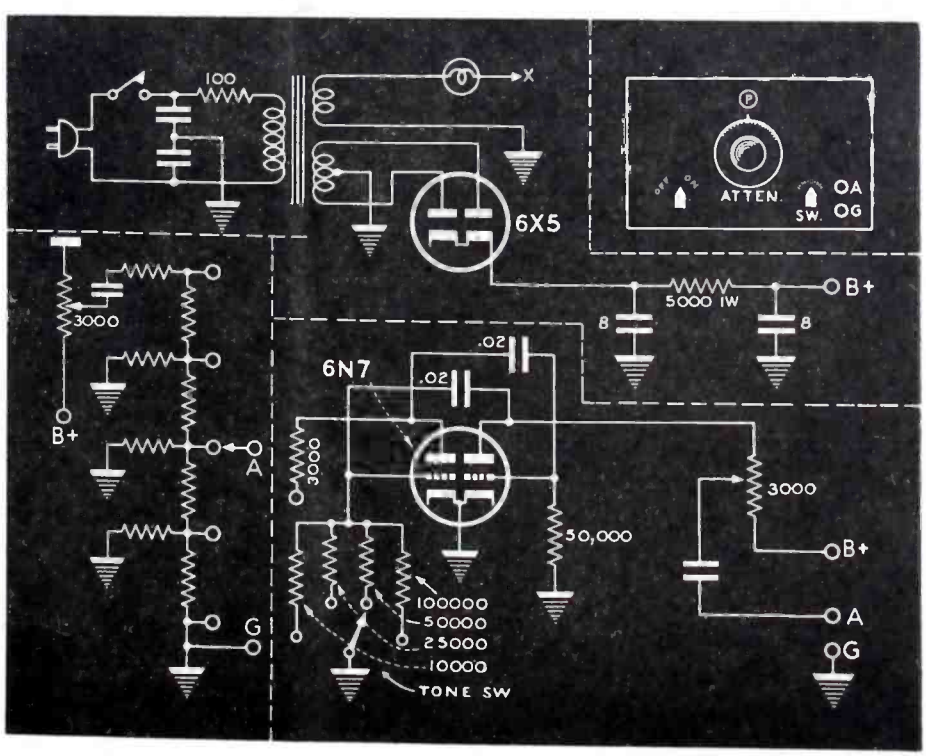
If the r-c product of the coupling condenser and grid leak of tube *1* is

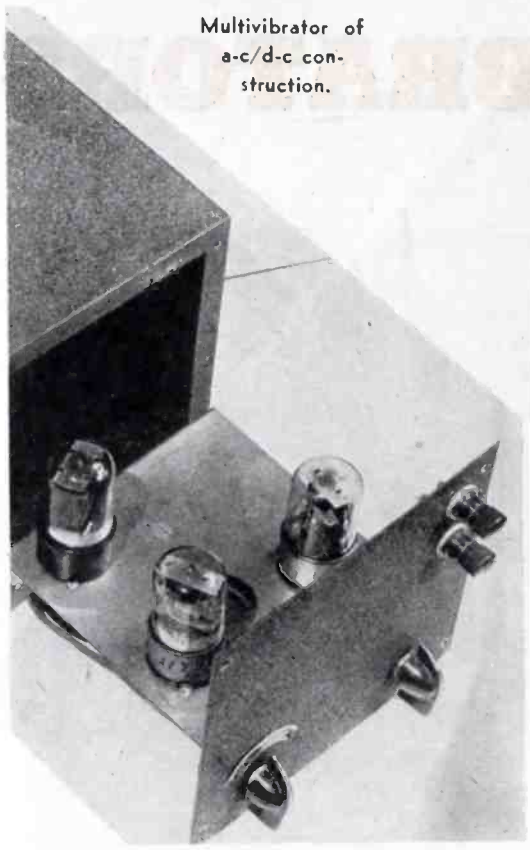
Above we have two views of multivibrator shown in Fig. 3 below, at right. This vibrator has a matched step attenuator. At right, an underside view of multivibrator diagrammed in Fig. 1.



Figs. 2 (below) and 3 (right). In Fig. 2, the waveform at various points in the output of a multivibrator circuit. Fig. 3, a multivibrator arranged for four spot frequencies.







Multivibrator of a-c/d-c construction.

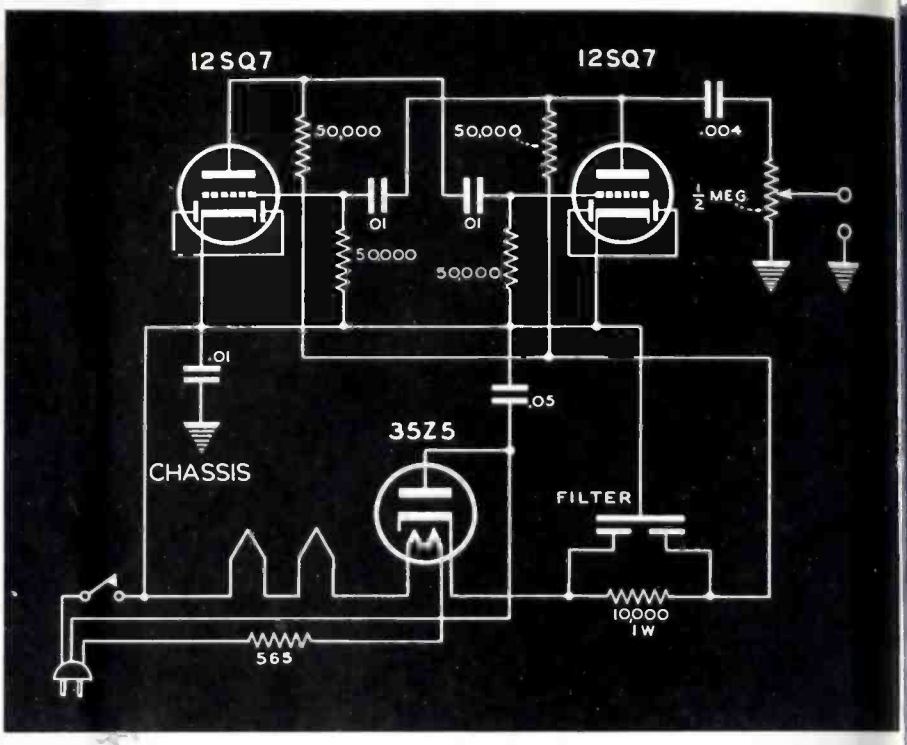


Fig. 5. Circuit of a-c/d-c multivibrator illustrated at left.

very different from that of tube *2*, the time of cutoff of each tube will be different. Instead of a balanced, or symmetrical square-wave output the waveform will look more like a series of pulses which are handy for cutting off amplifiers or oscillators, blanking out traces and a variety of other uses. Multivibrators may be easily synchronized to some standard frequency or harmonic by introducing a small voltage into the first grid circuit in applications requiring standardization. This is not necessary in signal tracing.

Another version of an a-c operated multivibrator is shown in Fig. 3. This oscillator is arranged for four spot frequencies obtained by the use of four different grid-leak resistors. Note the bypass condensers at the line input for preventing disturbances from the oscillator from filtering into the line. These multivibrators must be operated carefully, for they can cause interference to receivers in the vicinity if handled carelessly. The output impedance of the Fig. 3 oscillator is 3,000 ohms maximum, making it suitable for low- and medium-impedance applications. An alternative type of attenuator is shown at the left. This may be adjusted for fixed ratios as required.

Figs. 4 and 5 illustrate a-c/d-c versions of multivibrators using 150-mil tubes. If 300-mil tubes are preferred (which is very likely just now because of tube shortages) the line resistor should be about 270 ohms for a 25-volt rectifier. When making measurements on a-c/d-c oscillators, it is advisable to reverse the line plug if a hum is heard. These units have rather high-output impedances, compared with the first two circuits. With a ½-megohm load the peak voltage output is approximately 75 volts.

Another type of relaxation oscillator, the basic sweep oscillator for cathode-ray time bases, is shown in Fig. 6. This is often referred to as a neon tube oscillator. While many different types and sizes of neon lamps will oscillate in this circuit, not all of them will, and, certainly none with resistance in the base. The frequency of operation is determined by C, R and V according to the formula:

$$f = \frac{1}{R\,C \log \frac{V - E_o}{V - E_i}}$$

(*Continued on page* 31)

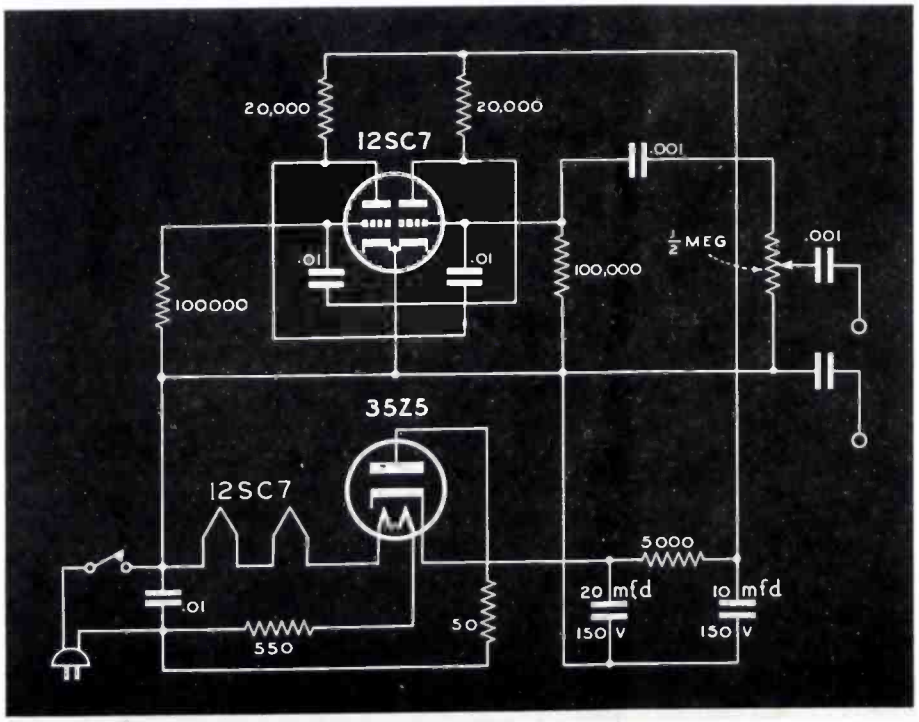
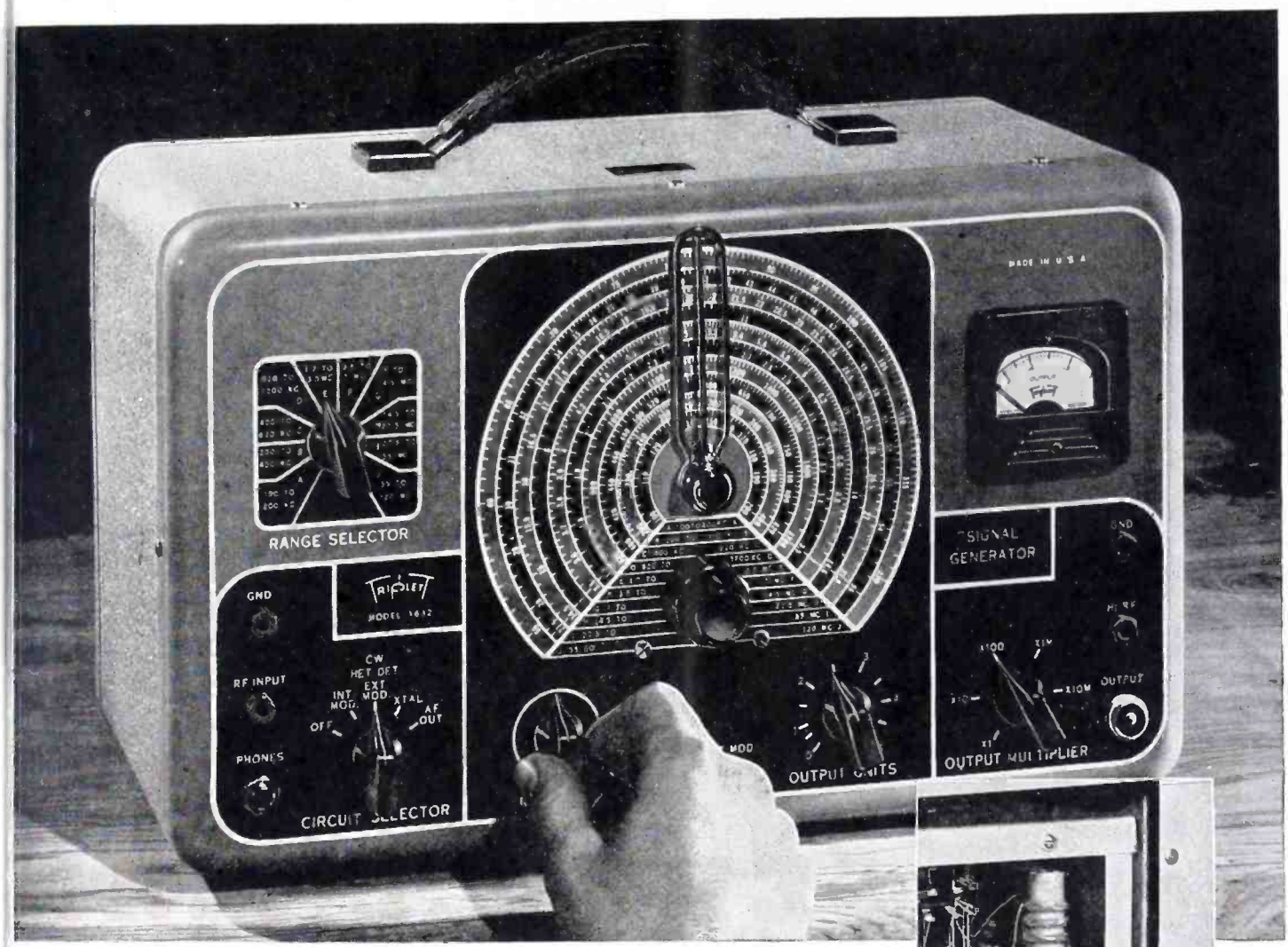


Fig. 4. Multivibrator using dual function 12SC7; pulse peak output approximately 60 V.



MODEL NO. 1632

Signal Generator

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A complete wide-range Signal Generator in keeping with the broader requirements of today's testing. Model 1632 offers accuracy and stability, beyond anything heretofore demanded in the test field, plus the new high frequencies for frequency modulated and television receivers, required for post-war servicing. Top-quality engineering and construction throughout in keeping with the pledge of satisfaction represented by the familiar Triplett trademark.

Of course today's production of this and other models go for war needs, but you will find the complete Triplett line the answer to your problems when you add to your post-war equipment.

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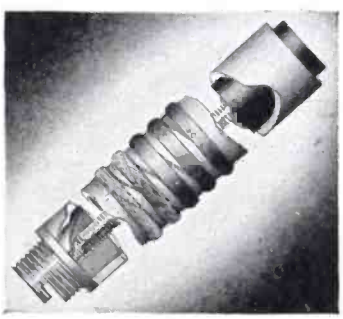
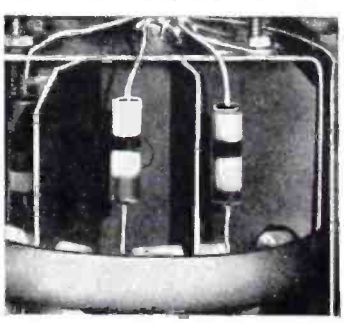
BLUFFTON OHIO ★ ★ ★

STANDARDS ARE SET BY TRIPLETT

• Triple shielding throughout, Steel outer case, steel inner case, plus copper plating.



• All coils permeability tuned. Litz wire wound impregnated against humidity with "high-Q" cement.



• Note sections individually shielded with pure copper. Entire unit encased in aluminum shield.

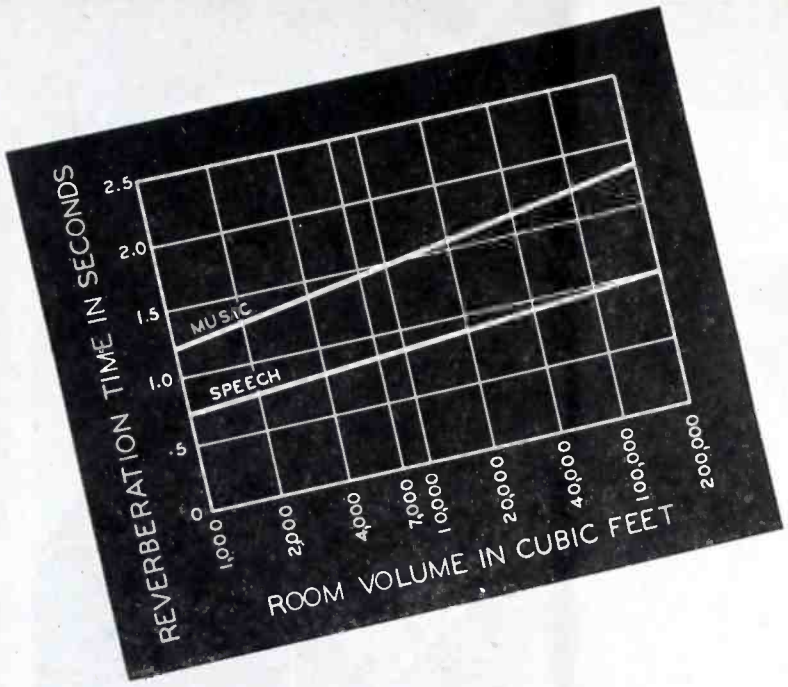


Fig. 1. The relationship between room volume and desirable reverberation times for speech and music are shown in this graph. Desirable reverberation time for music is longer than for speech. If the reverberation time is too short, music loses its dynamic quality. A room with too short a reverberation time constant may be considered dead.

WHAT SOUND MEANS TO THE SERVICE MAN

by SIDNEY HARMAN

David Bogen Co., Inc.

This is the first of a series of articles on sound, in which the opportunities this field offers the Service Man will be discussed. The phenomenon of sound is analyzed in this presentation. In subsequent articles the practical aspects of laying out and installing the sound system will be covered. A thorough treatment of sound equipment specifications will also be offered.

IT is no more than five years ago that writers in the field of sound were optimistically saying, "sound has passed the creeper stage, is now toddling and will soon be walking rapidly." The man who wrote that has been proved a conservative prophet according to the history of the past few years.

Audio amplification equipment has developed so rapidly and represents so important an industry today, that many of our techniques and much of our success in the war is directly attributable to the advances made in sound equipment. By the same token, many new advancements that will contribute to postwar progress, will be in this very field. Sound is no longer an infant. It is a full-grown, vital industry—and new applications are being developed daily.

Today and in that new world to come, there is a vital place for the Service Man in the field of sound. Significantly, recent studies have shown that the majority of our large war plants have applied sound distribution to the all important problem of maintaining worker morale and efficiency at a high level. The equipment used in war plants for the distribution of music, announcements, pep talks, broadcasts, etc., is fundamentally the same type of equipment used just a few short years ago in the simple mike-amplifier-speaker systems, which served so many varied purposes—often splendidly—but so often inadequately. The point, here, is that the principles are basic. The application of those principles has broadened, however.

In practically every case with which the author is familiar, the management of the war plant has wisely deemed it necessary to maintain continuous service on its vital new production tool. And to insure this continued service, he has contracted with a local service organization, to pay periodic visits to the plant, to check the sound system, and to keep it in perfect operating condition. The relationship between the Service Man and the plant has been much like that existing between the Chinese doctor and his patient. You get paid to see to it that the patient doesn't become ill, not just to cure him when he runs into trouble.

Many a Service Man has been called upon to make the survey which is so essential to an intelligent determination of the system's requirements, and to recommend the equipment needed to meet those requirements. It is usually only a short step from the survey to the sale, today.

Thousands of plants and offices have recognized the advantage, yes even the need for efficient intercommunication equipment, and it is frequently the Service Man who is called upon to make the installation—if not the survey and sale as well. Installation and maintenance of this type of equip-

(Continued on page 16)

all i want is sym-pa-thy

by don herold

I'm a typical, everyday, bother-some customer of your radio shop. We have 3 radios at our house, and sometimes one of them goes hay-wire—although they usually work wonderfully—considering the beat-ing we give 'em.

I know there's a war on, and I know you radio fellers have a heck of a time getting parts and help. I know you're on a spot. So I don't expect you to fix my radio as fast or as good as you usta.

But—this war is on my nerves, too. I'm thinner-skinned than usual! I'm sensitive! I'm tender!

So please be a little kind to me, mister. Please explain a little why you can't do this or that—and I'll stand for most anything!

I quit one radio man because he barked at me and kept putting off my repair job and didn't tell me why. I've gone over to another radio feller who isn't any faster than the first one, but who takes the trouble to always rub my fur the right way.

This is the shop that's going to get my repair business after the war, and I'm hoping to buy a new FM set and a television outfit and a lot of electronic gadgets some day—and this shop'll be tops with me for all that business . . . and maintenance on it.

Incidentally, I like to know you are using famous parts in my jobs—such as International Resistance Units —whenever you can get 'em.

No. 1 *in a series of special messages prepared by America's famous business writer, humorist and cartoonist, Don Herold. . . . In sponsoring these Don Herold "broadcasts," IRC pays tribute to the thousands of Radio Service Men who, whenever possible, specify and use IRC resistance units in their work.*

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ment represents highly remunerative and interesting work both today and for after the war. The Service Man should not lose sight of the fact that many an organization has become familiar with sound equipment for the first time during the war, and has only just begun to recognize its great value. The majority of these organizations will want that equipment maintaned in tip-top shape later. And the men who have come to recognize how sound helps their business will want more of it later.

Composition of Sound

Before proceeding to the practical aspects of sound system layout, let us first consider the phenomenon with which we are working, for the more the sound man knows of the character of sound, the more efficient his installations will be, and the more quickly will he be able to solve the problems peculiar to audio-work.

The visual form of sound is that of wave. Its three major components are loudness, frequency and quality. These components are vital technical considerations, and the Service Man who has sold, knows that they are the labels upon which the customer has been trained to evaluate the equipment he wants to buy or rent.

Loudness is the amplitude of vibration of the sound wave. Frequency is the number of vibrations that take place in a second, and quality is the form which those vibrations assume. A musical note, for example, has a uniform curve, whereas noise has an irregular curve which produces a disagreeable effect on the listener.

To the person who is listening, sound is just as loud as he hears it. The same sound (of the same intensity) may appear to be louder to one person than to another. (The difference is a difference in the hearing mechanisms of the persons involved.) Strictly speaking, the intensity of sound varies inversely with the square of the distance from the source.

Intensity of Sound

The intensity of any sound which can be detected varies with frequency. The greatest sensitivity of the average human ear is to those frequencies around 1,000 cycles, and the American Standards Association has recommended that 1×10^{-10} microwatts per square centimeter, be used as the unit of sound intensity. At a frequency of 1000 cycles per second, this corresponds to the minimum intensity of sound which can be heard (the so-called *threshold of audibility*). The threshold at higher frequencies (for example: 3500 cycles) is 2×10^{-11} microwatts per square centimeter. This means that to be able to detect a signal of 3500 cycles, the signal must be stronger than one of 1000 cycles. These figures, it should be understood, are only working reference levels. The threshold of audibility may vary considerably from one person to another, and it may be noted that the most familiar characteristic of the deafened ear is a high threshold of audibility.

There is also, of course, a maximum intensity of sound to which the ear can respond without the sensation of pain. This is called the *threshold of feeling*. Fortunately, the ear is of such construction that it can respond to a truly tremendous range of sound intensity. Consider that a symphony orchestra creates one million times more sound energy, when playing at its maximum, than it does on a soft passage. We do not hear the loudest section one million times more loudly than the softest, but only 60 times louder. The ear, then, responds to sound energy, logarithmically — not linearly.

Measurement of Intensity

The measurement of sound intensity is simple but important. Intensity is actually a function of velocity, of pressure and of density in this ratio

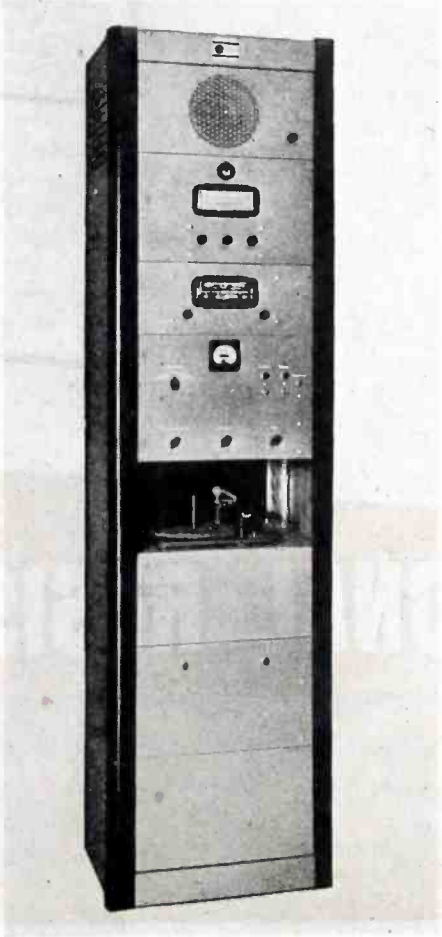
$$W = \frac{P^2}{DV}, \text{ where}$$

W = microwatts per square centimeter.
P = pressure (in dynes per square centimeter)
D = density of the medium in which the sound wave travels—in grams per cubic cm
V = velocity of sound in the medium

Transposing this formula, we obtain the formula $P^2 = WDV$. From this it can be seen that as density or velocity increases, W must be decreased to maintain the same sound pressure. As density or velocity decrease, W must be increased to maintain the same pressure. Thus at high altitudes, where density is low and velocity is decreased (because of the low temperatures), greater power is required to achieve an equivalent pressure.

Sound travels approximately 1,100 feet per second in dry air at 0° C, and the rate at which it travels, increases app. 2′ per second for each C degree of temperature rise. Thus if the temperature of a large hall is 24° C, sound travels in that hall at the rate of 1,148 feet per second. Sound ranging altimeters and other types of detection equipment operate on the principle that the distance between the plane and earth can be learned in terms of the determined velocity of sound and the time it takes for a signal to travel to earth and back to the plane.

Fig. 2. A typical control rack used in war plant sound systems. Provided are a monitor speaker, a-m/f-m tuners, output level meter and switch panel, automatic record changer, and power amplifiers.



Wavelength of Sound

Sound waves consist of alternate compressions and rarefactions of the air molecules which make up the atmosphere. A single wave consists of one compression and one rarefaction. The exact length of this wave is called the wavelength of the sound wave, and is measured in feet. The wavelength is the function of the velocity of sound and its frequency in this ratio

$$\text{Wavelength in feet} = \frac{\text{velocity}}{\text{frequency}}$$

The wavelength of the sound wave created by a speaker vibrating in dry air at 0° C at a frequency of 400 cycles per second is

$$\frac{1100}{400} = 2.75 \text{ feet}$$

It can be seen from the formula, that the higher the frequency, the shorter the wavelength.

Frequency

Frequency is a measure of the number of vibrations that take place in

one second. The lowest frequency that can be detected by the ear as a sustained note is 16 cycles. Below that frequency, only pulses can be followed. The upper limit of frequency, audible to the human ear, varies from person to person. Some people can hear signals as high as 20,000 to 22,000 cycles per second. A good average would be about 18,000 cycles.

Pitch is the subjective response to the frequency of sound and the pitch of a sound is dependent upon the number of waves that reach the ear in any one second. Each of us has undoubtedly stopped at one time or another to listen to the approach and passing of a speeding train, and inthat listening, there has been demonstrated, a very important sound phenomenon, the *Doppler Effect*. As the train nears the position of the listener, the pitch of the locomotive whistle, rises to a shrillness, reaching the maximum point when it is nearest the listener. A lowering in pitch is noticed as the locomotive moves away. Putting this phenomenon another way, we can say that as the ear approaches the source of sound, the pitch rises and as the ear recedes from the source of sound, the pitch falls.

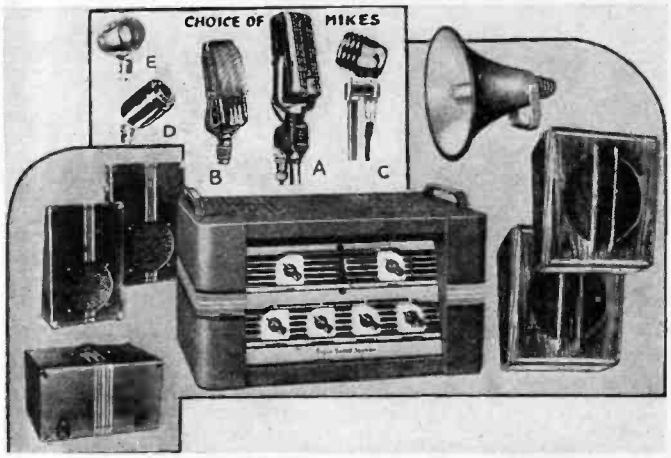


Fig. 3. Assortment of microphones and indoor and outdoor speakers used with a commercial amplifying system.

Quality of Sound

Quality is the component of sound which permits the distinction between different notes of the same frequency and intensity. A number of factors modify the harmonics of any fundamental frequency, and these various harmonics are responsible for the differences between men's voices, between middle *C* on a violin and middle *C* on a piano or between middle *C* on a new violin and middle *C* on an old violin.

Quality of sound reproduction implies considerations of distortion. The more nearly undistorted the reproduced signal is, the generally better is the quality. Distortion can be considered as a failure of the amplifying unit. It may also, often, be considered as a failure on the part of the sound-man to properly consider the limitations of the medium in which sound is being distributed, and to properly compensate for those limitations.

The output of the amplifying system may fail to reproduce the input as a result of frequency, amplitude or phase distortion. Frequency distortion occurs when different frequency components are not equally amplified. Amplitude distortion occurs when frequencies are present in the output signal which did not exist in the input voltage. Phase distortion exists when the relative phases of the components being amplified are not the same in the output as in the input. Phase distortion causes the output wave shape to differ from the wave shape of the applied signal even though both may contain exactly the same frequency components in the same relative magnitudes.

The two most important acoustic considerations of distortion are reflection and reverberation.

Reflection

Reflection is probably the most frequent acoustical liability. It consists of undesired reflections of sound power which produce echoes, so immediate to the direct sound that the result is a confusing pattern of the original direct sound. Very often these reflections of sound energy *beat* with the original direct waves, effectively cancelling them, and producing dead spots. Many a theatre has presented just such a peculiar problem. Certain spots are *dead* in the sense that sound created on the stage and presumably amplified and distributed throughout the theatre is not heard in those areas.

Reverberation

Probably the most common type of distortion is that which is produced in reverberant or *live* rooms. There are two factors operating here to reduce the articulation of the received signal. The first involves the continual reverberation of the sound waves back and forth until the room is filled with sound which gradually decay. This phenomenon, the persistence of the amplified signal considerably after the original signal has ceased is sometimes called the *hangover effect*. The second factor is the selective absorption properties of the room itself which result in more efficient reproduction of some frequencies than of others.

Reverberation time, by definition, is the time required for the mean energy density in the room to drop 60 db. In simpler language, it is the number of seconds which must elapse after the source of sound has been shut off, before the sound has decreased in intensity by 60 db (one millionth of its original intensity).

Reverberation time is a function of frequency, and satisfactory time varies with the nature of the sound and the size of the room. Desirable reverberation time for music is longer than for speech and if the reverberation time is too short, music will lose its dynamic quality. A room with too short a reverberation time is considered dead. Fig. 1 shows approximate curves of satisfactory reverberation time for music and speech for different room volumes.

Draping a room, filling it with people, cushioning the chairs, hanging drapes and employing sound absorbent materials for wall and ceiling construction are various devices employed to reduce reverberation time (highest in bare rooms with plaster walls) by increasing the absorption of sound energy. Different materials have different absorption values (or absorption coefficients), and the approximate reverberation time for a room can be determined by the formula

$$T = 0.00161 \frac{V}{a}$$

Where V is the volume of the room in cubic centimeters and a is the total room absorption. Obviously, when the reverberation time is too long, it can be reduced by increasing the sound absorption of the room, a.

The sound absorbing properties of materials vary with frequency, dictating a careful selection of materials in order to obtain the desired reverberation over the frequency range. Heavy curtains and rugs, for example, absorb higher frequencies much more than low frequencies. Certain acoustic materials are highly absorbent of low frequencies.

Recently, a considerable amount of

(*Continued on page 28*)

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THAT MAKES THE RCA CHANALYST SO IMPORTANT IN MANPOWER CONSERVATION

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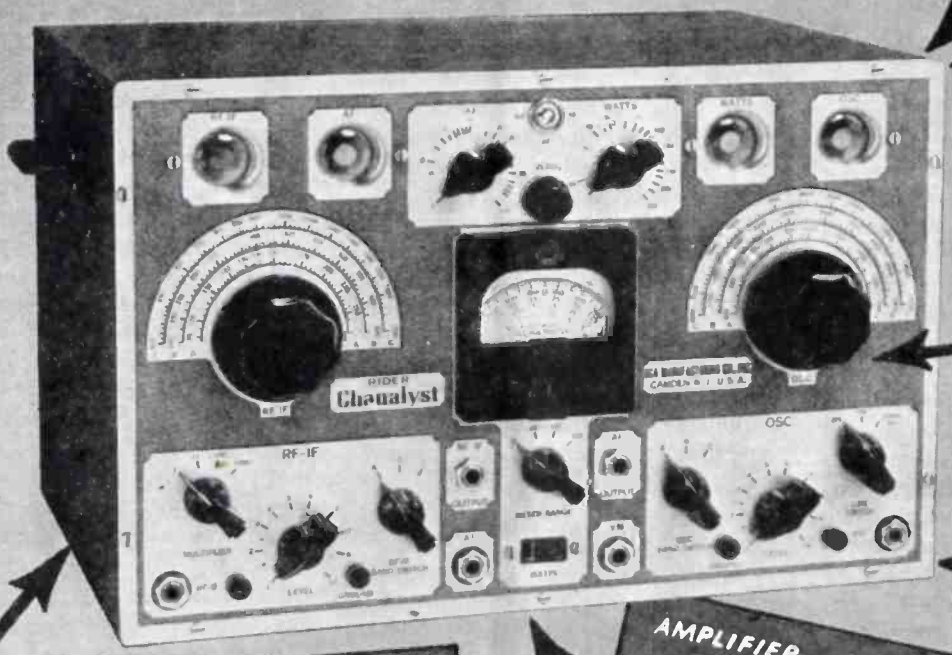
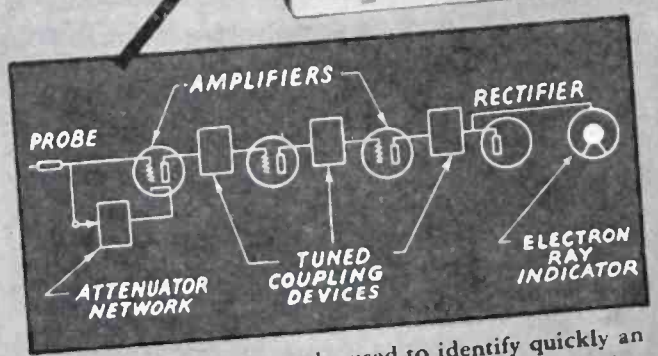
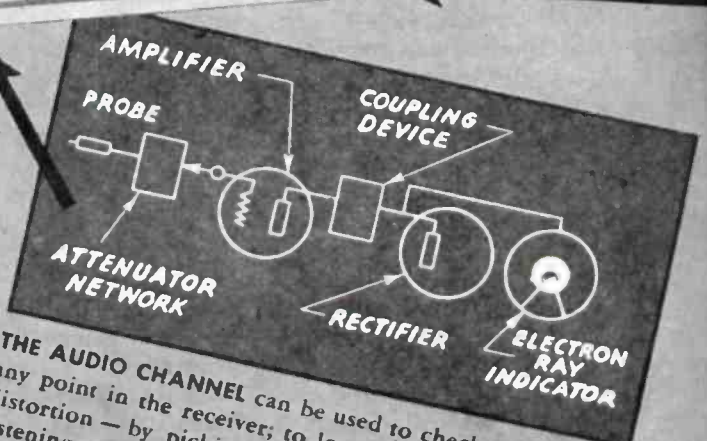


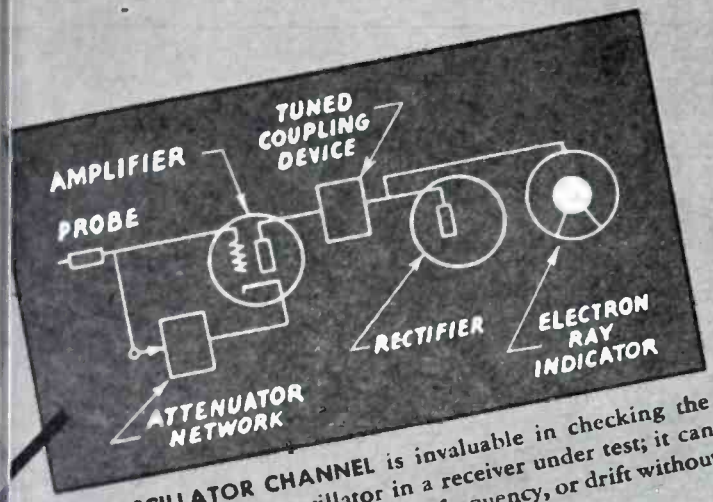


THE RF-IF CHANNEL can be used to identify quickly an oscillating r-f, mixer, or i-f stage; to check noise, distortion, and gain in r-f and i-f stages; to check r-f and i-f bypass condensers without removal from chassis; to determine intermediate frequency; and in general check any part of the rf-if circuits of a receiver.

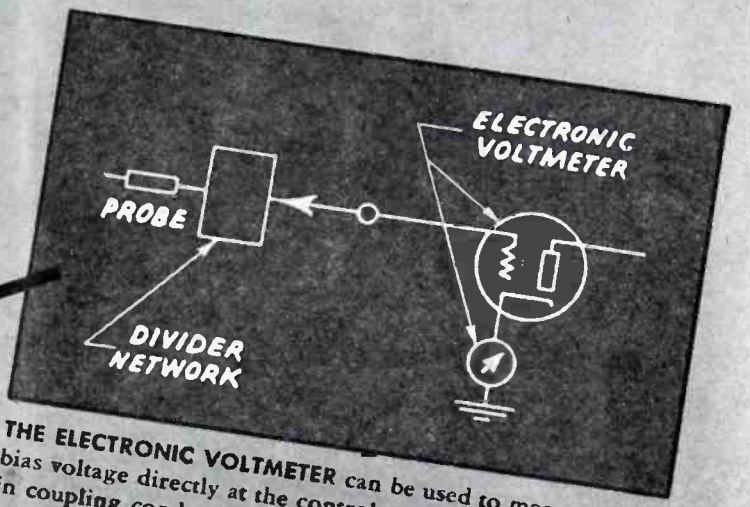


THE AUDIO CHANNEL can be used to check a-f voltage at any point in the receiver; to locate the origin of hum or distortion — by picking the signal off at any point and listening to it on headphones or looking at it on an oscilloscope; to check signal level, gain, or loss in tubes and coupling units.

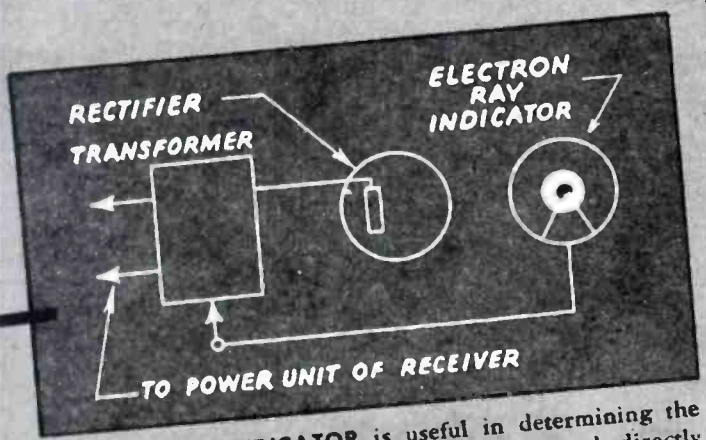
BUY MORE WAR BONDS



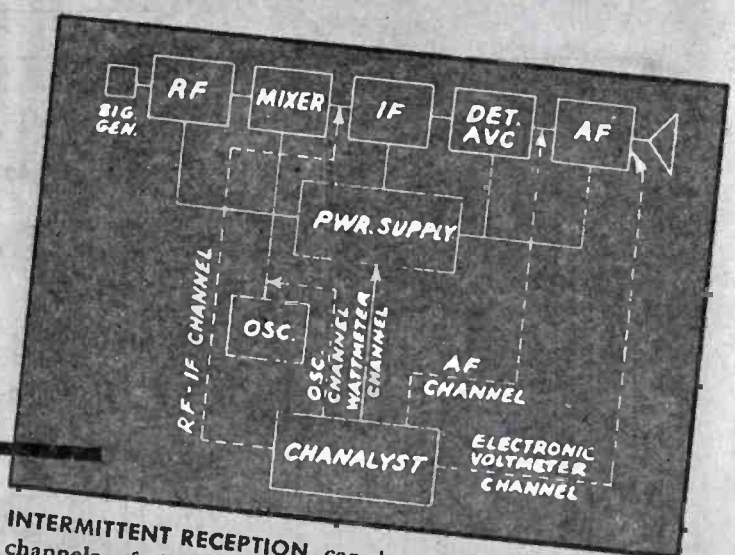
THE OSCILLATOR CHANNEL is invaluable in checking the performance of the oscillator in a receiver under test; it can be used to check oscillator output, frequency, or drift without disturbing operation of the receiver.



THE ELECTRONIC VOLTMETER can be used to measure AVC bias voltage directly at the control grid; to measure leakage in coupling condensers; to check overloading in audio circuits; to measure d-c operating potentials without interfering with receiver performance; as an output meter for alignment purposes.



THE WATTAGE INDICATOR is useful in determining the amount of power consumed by the receiver. It reads directly in watts—indicates any trouble, such as transformer breakdown, which places an abnormal load on the line.



INTERMITTENT RECEPTION can be analyzed by using all channels of the Chanalyst simultaneously. In solving the toughest service problems, use of the Chanalyst is the best, the most convenient and the quickest way.

Please Note: Deliveries of the Chanalyst are subject to the regulations of WPB Limitation Order No. 265.

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Test and Measuring Equipment

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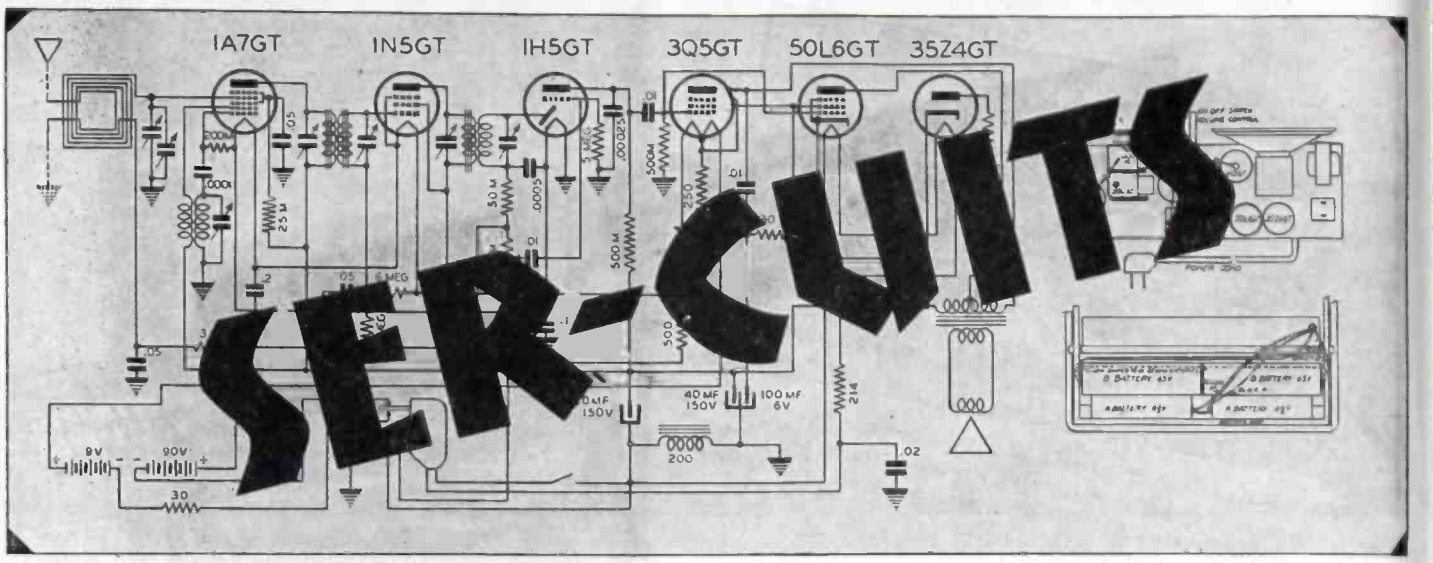


by HENRY HOWARD

IN six- and thirty-two-volt battery receivers engineers have paid particular attention to the design of the heater systems. The 3-band receiver shown in Fig. 1, Sentinel 239, is an interesting example of this special design. Heaters are run conservatively, two parallel strings adding up to 37.6 volts being employed. A pair of 25L6's are used on the output. Each tube is placed first in the string from the positive end, to obtain correct balanced bias by means of a grid return to ground. A 6J5 audio driver with a degenerative cathode circuit feeds the push-pull stage through a transformer. A 2-megohm degeneration resistor is connected from first audio plate to the driver plate. The tone control is also connected to the driver plate. A r-f filter is included in the power circuit here, to prevent noise from riding in as *wired wireless*.

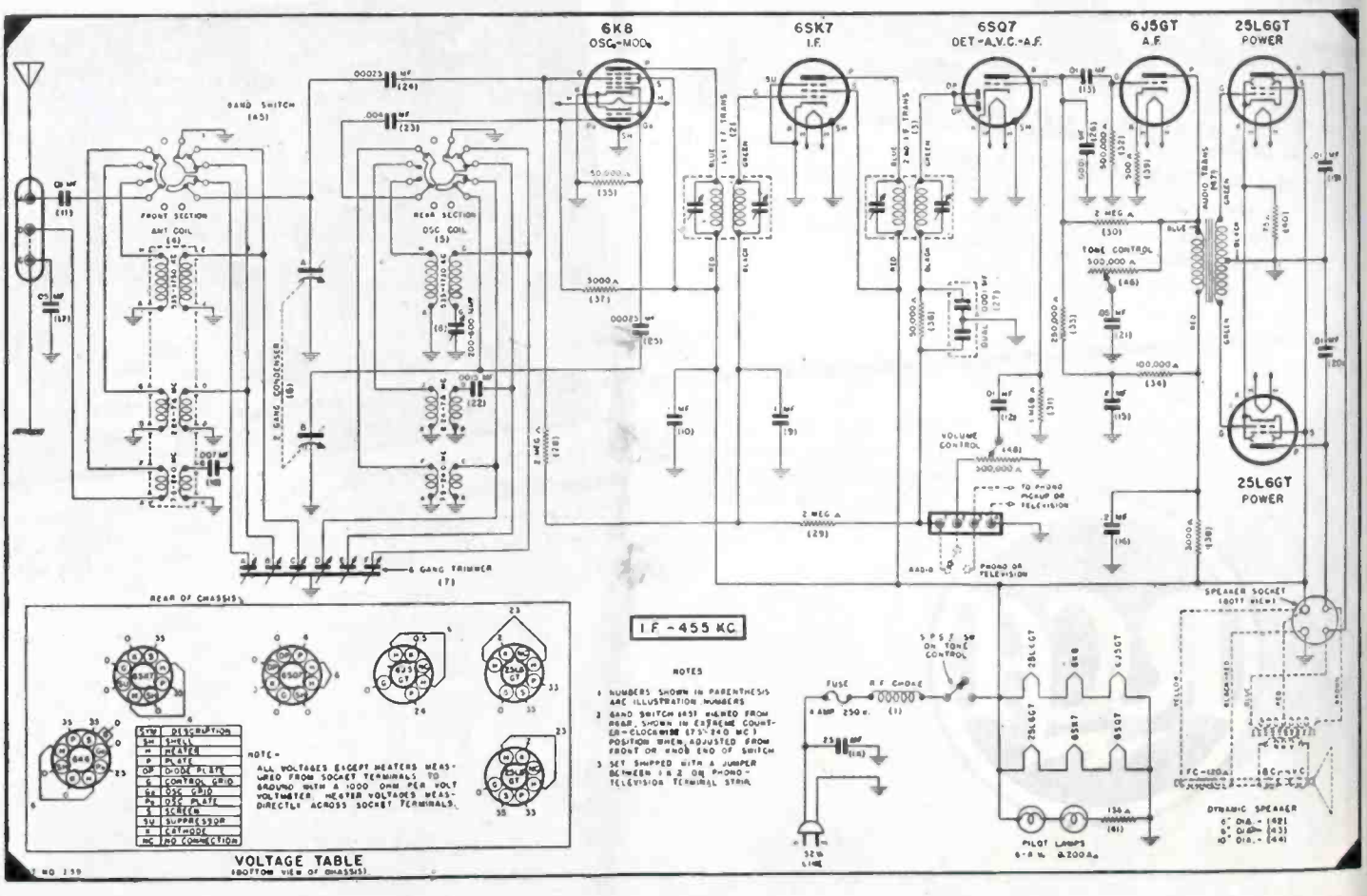
Postwar receivers will probably be designed around the new aviation tubes designed for aircraft 24-29-volt battery systems, such as the 28D7 twin beam power tube. The small difference in filament voltage would be made up by a 1 or 2-watt resistor.

Fig. 1. Sentinel 239 six-tube three-band 32-volt receiver.

Sentinel 236

The Sentinel 236 is a 6-volt 3-band battery receiver, with a synchronous vibrator rectifier.

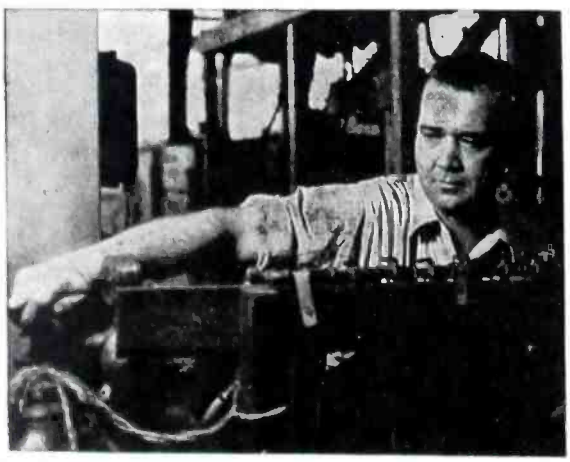
Provision is made for a doublet antenna on the short-wave band, but the primary coil is grounded as are the other primaries. The waveband switch switches the antenna and the 6K8 signal grid, shorting the unused secondaries. A shunt-fed plate tickler type oscillator is similarly treated. A 6L5G is used as a diode.



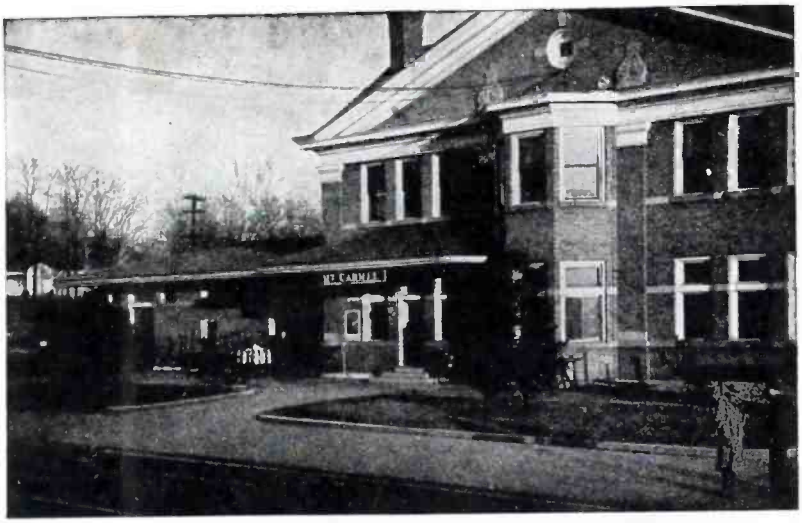
OUR ROVING PHOTOGRAPHER VISITS MT. CARMEL ...WHERE ELECTRONICS IS KING!

A thousand miles from New York — more than 200 from Chicago — is a little city of 7,000 that's very much in the news these days. For Mt. Carmel, Illinois, is the home of the Meissner Manufacturing Company. And Meissner's laboratories are humming with great electronics secrets, its shipping platforms busy with precious cargoes destined for the far corners of a fighting world. Meissner is *in* the news, because it's *making* news!

Pleasant Smile, Skilled Fingers: The whole industry's talking about Meissner's gilt-edged personnel. And here's one of the reasons why every Meissner product is a quality product.



Precision-EI Is The Word: So trained and alert are the workers, so slight the turnover, that the envious in the industry are already calling Meissner personnel ... "Precision-EI" ... and the term fits like a glove!



This Is Mt. Carmel... and what a station for a city of its size! But wise heads say it's a hint of big things to come as Meissner daily rises in stature as one of the world's most progressive companies in one of the world's most progressive fields ... *electronics!*

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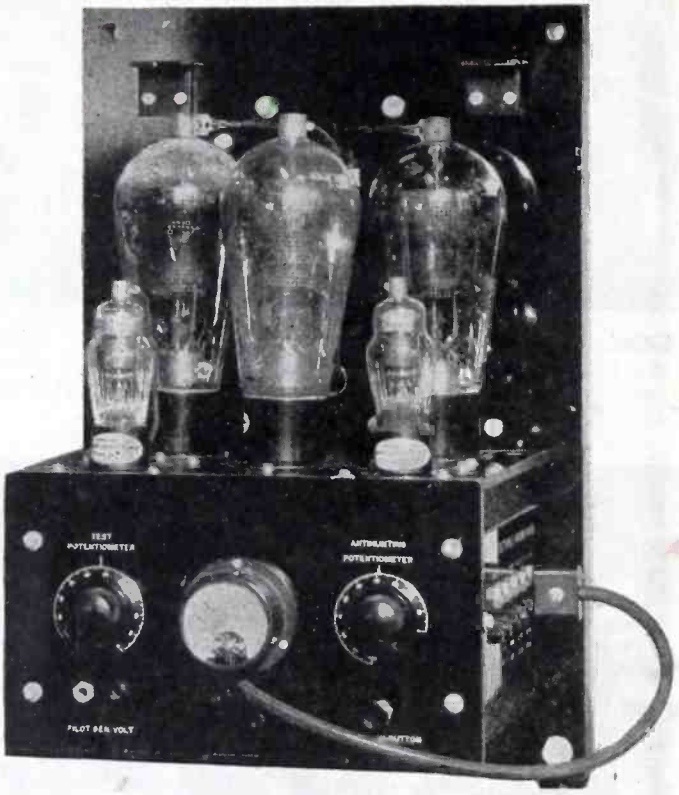
ADVANCED ELECTRONIC RESEARCH AND MANUFACTURE

ELECTRONIC VOLTAGE AND SPEED REGULATORS

PART ONE

by S. J. MURCEK



Commercial version of an electronic voltage regulator. (*Courtesy Westinghouse*)

AN application to which the electronic control device is peculiarly well adapted is the regulation of generator and alternator output voltage. A closely allied application is the electronic control of motor speeds.

Numerous machine and processing applications require the precise regulation of generator output voltages. Among these is processing of moving picture film, wherein the positive film strips are made through contact printing with the negative at high speed. The lamp, in this operation, must maintain a very constant illumination level, which requires that it be operated from a constant voltage source. It is known that the illumination from such a lamp varies as the square of the filament voltage. Consequently, a change in the filament voltage during the printing process could possibly mean the loss of several hundred feet of processed film.

Another application is in the processing of sheet linoleum. Here, several drive motors are operated from the same power supply. In order that the motors all operate at constant speed, it is necessary to operate these motors from a constant voltage source.

Accordingly, it was necessary to design a series of electronic regulators capable of a high degree of precision. The major portion of such design was centered about suitable electronic voltage regulating devices, for either a-c or d-c applications, having a wide application range.

Essentially, the electronic voltage regulator is a thyratron rectifier, which supplies the d-c power to a generator or alternator field winding, a control preamplifier, and a voltage analyzing system. The major difference between the a-c and the d-c generator voltage regulators lies only in the voltage analyzing circuit arrangement.

The circuit arrangement of a d-c generator voltage regulator is given in Fig. 1. In this system, d-c generator *2* is driven by a three-phase a-c power motor, *1*, the d-c power out put of the system appearing between d-c terminals. Three-phase leads supplying the a-c energy to the drive motor, also furnish single phase power to the primary winding of the voltage regulator power transformer.

Initially, the field switch, *4*, is open, the voltage across the generator output terminals being near zero. A small voltage readable across these terminals at this time is evidently due to generator field structure residual magnetism. Further, since the generator output voltage is nearly zero, we find that the control grid of pentode preamplifier tube *30* is approximately 75 volts negative with respect to its cathode. This condition is due to the 75-volt stable potential or pilot voltage appearing across the glow regulator tube, *21*, electrodes, which places the cathode of the pentode 75 volts positive with respect to the negative lead of the d-c power supply. It is evident that the plate resistance of pentode *30*, under these conditions, is exceedingly high with respect to the resistance of plate resistor *24*. Thus the voltage across resistor *24* is nearly zero, putting the plate of the pentode approximately 125 volts positive with respect to its screen grid.

The cathodes of the thyratron rectifier tubes *9* and *10*, are common with the screen grid of pentode *30*, whereas the grids of these tubes are effectively common with the pentode plate. Consequently, the control grids of thyratrons *9* and *10* are positive with respect to their cathodes, placing these tubes in a conductive state.

Once the field switch, *4*, is closed, the d-c generator *builds up*, the output voltage rising sharply. The speed of this voltage rise is limited only by the generator field inductance, which limits the rate at which the field current may rise. The output voltage rise continues until the voltage between the slider arm and the negative terminal of the voltage level potentiometer, *28*, is equal to that appearing between the electrodes of the voltage pilot or stabilizer tube *21*. At this

(*Continued on page* 24)


GALVIN
RCA
UNITED STATES STEEL
SYLVANIA ELECTRIC PRODUCTS INC.
Admiral.
BELL TELEPHONE SYSTEM
DUMONT
CARDWELL CONDENSERS
Gates
WESTERN UNION
ASTATIC
STEWART-WARNER CORPORATION
BUSINESS INTERNATIONAL MACHINES
ALTEC
PHILCO CORPORATION
CURTISS WRIGHT Corporation
CROSLEY
FAIRCHILD
REPUBLIC AVIATION
The GENERAL INDUSTRIES Company
RAYTHEON
HAZELTINE ELECTRONICS CORPORATION
Grayhar
Meissner
STROMBERG-CARLSON
Federal Telephone and Radio Corporation
Westinghouse
GM ARMS FOR VICTORY
GENERAL MOTORS
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UTC
A TRANSFORMER SOURCE FOR LEADERS OF INDUSTRY!
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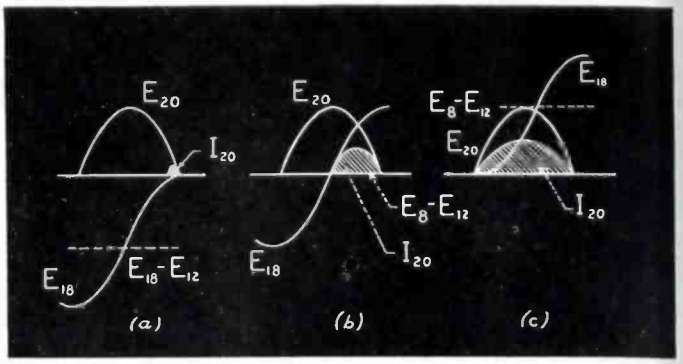
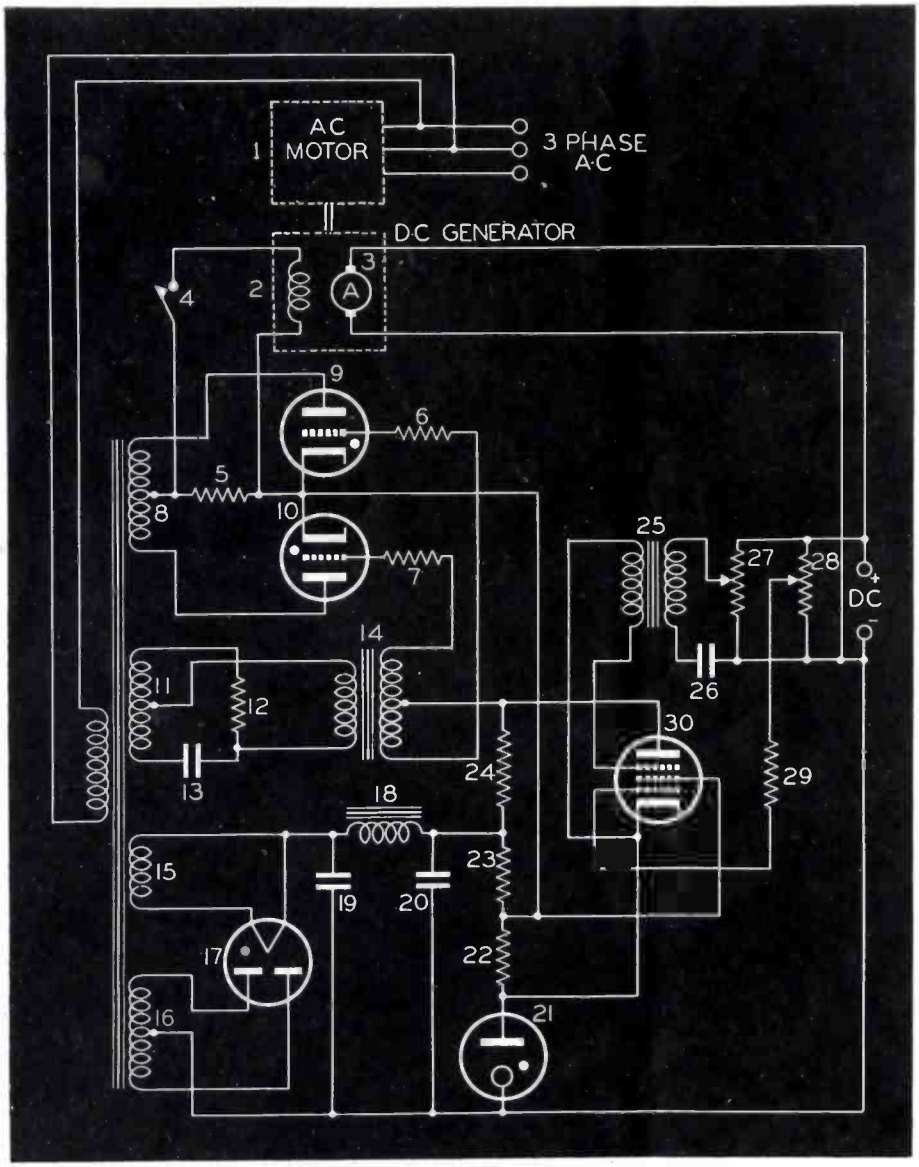
THE DAVEN COMPANY
THE INVISIBLE CREW
Bendix Aviation Corporation
BROWN
WILCOX ELECTRIC COMPANY
HAMMARLUND
ARMA
ELECTRONIC CORP. OF AMERICA
FARNSWORTH
oPERADIO
hallicrafters
BUNNELL
DETROLA
Western Electric
SPERRY
GYROSCOPE COMPANY, INC.
Brooklyn, New York
Division of the Sperry Corporation
AIR COMMUNICATIONS, INC.
ZENITH RADIO
BRUSH
WESTON
McElroy
PRESTO RECORDING CORPORATION
Delco Radio DIVISION OF GENERAL MOTORS
TRAILER KARENOLA RADIO AND TELEVISION CORPORATION

Figs. 1 (below) and 2 (right). In Fig. 1 appears the circuit arrangement of a d-c generator voltage regulator. In this system the d-c generator is driven by a three-phase a-c motor. Note that the cathodes of the thyratron rectifier tubes are common with the screen grid of the pentode, whereas the grids of these tubes are effectively common with the pentode plate. As a result of this, the control grids of the thyratrons are positive, thus placing these tubes in a conductive state. In Fig. 2 the effect of a-c voltage is illustrated. At (a) E_{20} is the voltage impressed between the anode and cathode of thyratron *9*, and $E_{18} - E_{12}$ is the d-c component between the grid and cathode of this thyratron. In Fig. 2(b) we have the condition when the fall of the armature voltage adjusts the grid of the pentode with respect to its cathode. A continued fall in the generator armature voltage brings about full forward conduction by the thyratron as shown in Fig. 2(c).





time, the control grid of pentode *30* is at zero volts with respect to its cathode, decreasing the plate resistance of this tube to a value which is small in comparison with the resistance value of the resistor *24*. By reason of the increased pentode plate current, the voltage across resistor *24* is now approximately equal to that appearing between the positive d-c voltage divided terminal and the cathode of pentode *30*. The plate of the pentode is then approximately 125 volts negative with respect to its screen grid. Here, we note that the control grids of the thyratrons, *9* and *10*, are now 125 volts negative with respect to their cathodes, which causes the tubes to cease conduction.

With the cessation of field supply current from the thyratron rectifier, the self-induced voltage appearing across the winding terminals of the generator field winding circulates a sustaining current through the resistor *5*. This resistor also prevents the rise of the self-induced voltage to dangerous levels. However, the field magnetization begins to fall off, as does the generator output voltage.

The decrease in the generator output voltage obviously places the pentode grid negative with respect to its cathode, once again permitting conduction by the rectifier thyratrons. Here, it is obvious that, unless a means is provided to circumvent it, the regulation system will provide an oscillatory form of regulation, the generator voltage being held to a constant *average* value. Briefly, the generator output voltage will be held constant, but will be modulated by a pronounced ripple.

Introduction of the phase-shift control voltage from grid transformer *14* in series with the thyratron grids is a first approach toward the elimination of the generator armature voltage modulation. The effect of this a-c voltage is clearly illustrated in the graphs shown in Fig. 2. From these graphs, the current in the circuit consisting of resistor *12* and capacitor *15*, lags the voltage across the winding *11* by 90°. Therefore, the voltage between the junction of these two components and the center tap of the transformer winding *11* also lags the voltage across winding *11* by 90°. This is equally true of the voltage across transformer secondary winding, *14*, this voltage being subdivided into two opposing components, each being introduced in series with a rectifier thyrathron grid.

Because these particular transformer windings are mounted on the same transformer core, and are wound in the same direction, their voltages are naturally in phase. In Fig. 2(a), E_{20} is the voltage impressed between the anode and cathode of thyratron *9*, and $(E_{18}—E_{12})$ is the d-c component between the grid and cathode of this thyratron. In addition, E_{18} is the a-c voltage component introduced in series with the d-c grid voltage component, modulating the d-c voltage component. It is observed that this a-c grid component lags the thyratron anode voltage (E_{20}) by 90°.

When the voltage across pentode *30* of Fig. 1 is at a minimum, as is the case in Fig. 2(a), the control grid of the thyratron *9*, is driven positive with respect to its cathode late in the positive half-cycle, E_{20}. Thyratron *9*

(*Continued on page 26*)

SPRAGUE TRADING POST

A FREE Buy-Exchange-Sell Service for Radio Men

SETS FOR SALE — One Hallicrafters S-20R Sky Champion, 9-tube comm. receiver in excellent condition, 1941 model; one Zenith highboy, 11 tubes, 16" speaker, 16 push-buttons, all-wave, etc., 1942 model; one G-E 2-volt wet cell portable, 1942 model, AC-DC or battery with self-contained aerial and bat. charger. Fine condition. Paul F. Tapp, 2102 W. 35th St., Austin 21, Texas.

WANTED—Following tubes: 2—2SA7; 2—12SG7; 1—25B5; also a small AC-DC radio, not less than 5 tubes, in good condition. M. L. Grisby, Granger Radio Service, Granger, Iowa.

FOR SALE—Supreme tube tester #589 in perfect, almost new condition. M. C. Ball, Boyd, Oregon.

WANTED—One range switch and one 8000 ohm volume control for Meissner Analyst, new or used. Thomas Lusher, 1529 Lincoln St., Charleston 2, West Va.

SELL OR TRADE—Juke box type auto record changer and amplifier, only slightly used. Made by Automatic Inst. Co., holds 10—10" records, has 20 push buttons, 15" speaker, etc. Also have tube & set tester #535A and C-B signal generator OMA. Sig. generator may need slight repairs. Will trade for new tubes, parts, table radios, record blanks, 3" scope, chanalyst, etc. Don T. Arata, 14—10—D, Denson, Ark.

SALE OR TRADE — DeWald auto receiver 6-tube complete; Jackson counter type checker to test all late tubes; #1130 Superior signal generator; also complete mfg. service manuals for RCA, Crossley, G-E, and others. Robert Newman, 1701 Quentin Road, Brooklyn, N. Y.

WANTED—Superior utility tester. Will trade parts such as phono motor, turntable, pick-up, new tubes, small parts, etc. George H. Hague, 6 Carver St., Fall River, Mass.

EQUIPMENT WANTED by Signal Corps operator for vital use: one first class speed key. Sgt. Allon Wolsey, 20307287, Signal Det. C.B.S., Camp Ashby, Virginia Beach, Va.

WILL TRADE—12 Underwood and 12 Royal black typewriter ribbons and a $2 telegraph key (new) for a wireless phono oscillator in working condition, with or without tubes. Carl V. Seibert, Jr., RM3/c USNR, 729 W. 34th St., Norfolk, Va.

FOR SALE OR TRADE — Triplett #1232 signal generator; also #1241 condenser checker, with instructions, nearly new, $30 ea. Want good multitester or tube checker, also ohmmeter, and Rider's manuals. Jolly Radio Service, Gulrock, Hyde Co., N. C.

WANTED — Good Million model DF tube tester. Have V-O-M outfit in good cond. to trade. Frank M. Miller, 117 E. 9th St., Hutchinson, Kans.

FOR SALE — Hallicrafters Sky-Champion S-20-R, practically new and in very good condition. $40. P. Cambron, 1034 Glenn Ave., Wilkinsburg 21, Pa.

'SCOPE FOR SALE—RCA Model 122B oscilloscope, $65. Wm. Kuss, 261 Main St., Hackensack, N. J.

FOR SALE—Portable record player in leather carrying case, built-in amplifier & speaker, crystal pickup, 33 r.p.m. motor, $25, or will sell motor separate. Also have 32V Crossley table radio, $10, and Rand electric shaver, $5. W. L. Thiel, 39th & Division Sts., Manitowoc, Wisc.

TESTER FOR SALE — Precision Model #510 tube tester in A-1 shape, tests all types up to 35 volts. Direct reading scale. Bench type case, $25 cash. Stanley Lewis, 3416 Haverford Ave., Philadelphia 4, Pa.

FOR SALE—Jensen M20-14", 400 ohm, auditorium speaker, new—also heavy 2500 ohm 10". Want Garrand changer, late Scott or Philharmonic, RCA 30A; also H.F. 75 tube, new or used. J. Cooper, 445 E. Grand Blvd., Detroit 7, Mich.

FOR SALE OR SWAP—Will sell Rider's I-V abridged 7 to 13 manuals in new condition for $75, or trade for 12V tubes or 6V octals. Will trade for good sig. generator such as Hickok with O.P. meter. Chambers & Son, 5856 Market St., Philadelphia 39, Pa.

WANTED — Signal generator in good condition. Harry Dishler, R.F.D. #2, New Brighton, Penn.

WANTED — Aerovox Model 95 L/C checker. Wire price and condition. Standard Piezo Co., Carlisle, Pa.

WANTED FOR CASH — Rider's manuals 6, 7, 10, 11, and 13. Must be perfect. Gilbert Radio Shop, 1296 Sheridan Ave., Bronx, New York 56, N. Y.

WANTED — Stancor super pack 6V power supply, model 132. Red Springs Radio Service, Box 585, Red Springs, N. C.

FOR SALE — One New Products Co. 6-N recorder & playback with changer, crystal pickup, and sapphire cutter, but minus case, mike, and amplifier units. New, unused. $55. Also have about 50 new and 20 "test good" tubes, some hard-to-get types. Write for list. Kenneth J. Halpin, 314 Humphrey St., New Haven, Conn.

FOR SALE — Following tubes: 6K8G; 76; 39/44; 38; 33; 27; 6R7GT; 1R5; 1S4; 155; 1T4; 1H5GT. Factory sealed. Sell or trade. Also have used tubes, amplifiers, and parts. What do you need? Morton Thurman, 897 Bryant Ave., Bronx, N. Y.

WANTED — Precision 920P tube and set tester; Supreme 599P tube and set tester; Rider's manuals 10 to 13. Stanley Galaski, 223 50th St., Brooklyn 20, N. Y.

WANTED FOR CASH — Tube checker, preferably a Million-Model D.F. or a Radio City 308P, but will consider others. All letters answered. W. T. Brown, 1506 W. Lynn St., Owosso, Mich.

WANTED — V-O-M and signal generator. State age and condition. Lt. Ben D. Piro, Naval Air Station, St. Louis, Mo.

WANTED by several central Sig. Corps school students, an Ecophone EC-1 in good condition. Cash. Pfc. Donald G. Brossman, Co. H, 800th S.T.R., Camp Crowder, Mo.

FOR SALE—Readrite tester #710; three meters, 0-700 V. AC, 0-600V. DC, 0-150 mills. Also one Jewell 8" meter, excellent as foundation meter for panel mounting. Both for $20. L. R. Collins, Test Pilot, 2nd Ave., Huntingburg, Ind.

FOR SALE—Six Cinematone penny jukeboxes in modernistic illum. table cabinets, less amplifiers and speakers. Good for adaption into long playing time recorders, etc. Good condition. $40 ea. Frank M. Kelly, 949½ W. Jefferson St., Los Angeles 7, Calif.

FOR SALE — Numerous EM7 and other electrical fittings; also many hard-to-get tubes and parts. Write for list. Want 3" or 5" 'scope and Hickok oscillator. Radio Electronic Labs, Hudson, Wisc.

WANTED—Table or counter type tube checker, also voltohmmeter. Cash waiting. Howard W. Kelley, 6300 Pearl St., Jacksonville 6, Fla.

WILL SWAP—Have transmitting eqpt. for sale or trade for service eqpt. of all types. Roland Stelzer, Apt. 1, 1st Natl. Bank, Mitchell, S. Dak.

WANTED—Rider's manuals Nos. 6 to 13, also 6-12-25-50-70 Volt tubes. Castle Hill Radio Shop, 2228 Newbold Ave., Bronx 61, N. Y.

FOR SALE — A pair of Eimac 150T's and filament trans. for same. Tubes unused — in orig. cartons. Jos. J. Wojcila, 7538 Rugby St., Philadelphia 19, Pa.

WANTED—Superior sig. generator #1230; Superior channel analyzer, and Superior set tester #1280 or other test eqpt. Sieg Fleishmann, 19979 MacArthur, Detroit 19, Mich.

WANTED—All types of radio testing eqpt. Give full details in first letter. W. Thorson, Bralorne, B. C., Canada.

FOR SALE OR TRADE—Peerless DC motor, 1/3 h.p., double shaft, ball bearings; Lafayette rotary converter 110 V. DC to AC 60-cy. 200-watts; Electronic inverter 110 V. DC to AC 60 cy. 150 watts—all foregoing scarcely used. Want good 0-1 milliammeter and radio parts. R. H. Bates, Rt. 2, Box 228, Sarasota, Fla.

WANTED—A 5 to 30-watt amplifier in good condition. Roberts Electric Shop, Bucklin, Mo.

FOR SALE — Tested used tubes, 50c ea., 15 each of following types: 42; 45; 47; 6F6; 6F6G; 5Z4; 71A; and 26. Also following Thordarson units; new: 1—#69R35 power trans.; 2—#74C29 filter chokes; 1—#64C49 ditto; 1—#67S54 output trans. Wm. McKibbin, Augusta, Ky.

USED INSTRUMENTS FOR SALE —Jewell, Hickok, Confidence, Burton, Rogers, Weston, etc., oscillators, meters, testers of many types. Write for complete list. LeRoy E. Sherman, 323 State St., Carthage, N. Y.

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ELECTRONIC VOLTAGE AND SPEED REGULATORS

(*Continued from page 24*)

therefore conducts over a very small portion of the complete positive half-cycle, the average conducted current I_{av} being quite low. Here, it is evident that the generator voltage is falling, this current being insufficient to maintain the desired armature voltage. Eventually, this fall of the armature voltage adjusts the grid of the pentode with respect to its cathode to cause the condition shown in Fig. 2(b).

This condition is brought about by the increase in the pentode anode-to-cathode voltage, to equal the potential across resistor *22*. The grid d-c component at this time is zero volts, which enables the grid a-c voltage component to fire thyratron *9* at approximately 90° in the positive half-cycle. Here, the average current I_{av}, conducted by thyraton *9*, is greater than is the case in Fig. 2(a).

A continued fall in the generator armature voltage brings about *full forward* conduction by the thyratron, as in Fig. 2 (c). Here, the voltage across the pentode *30* anode and cathode is at the maximum, driving the grid of the thyratron positive at the inception of the positive half-cycle. Since the thyratron now conducts over the entire half-cycle, it is evident that the conducted current I_{av} is at its maximum, which would cause maximum d-c generator armature voltage.

Introduction of the a-c phase-shift control component in series with the thyratron control grids eliminates sudden conduction by the thyratron rectifier tubes. And we thus prevent the increase of the generator field voltage to maximum excitation voltage. For the same reason, sudden cessation of the field current is prevented, obviating excessive decline of the armature voltage. Accordingly, a fundamental cause of the system oscillation is removed.

A second cause of oscillation in the voltage regulation system is due to the generator field winding inductance. An appreciable length of time elapses between increase of generator field current and the subsequent rise in the armature voltage. This effect is quite similar to the delayed rise in current conducted through a dynamic reproducer field winding. Therefore, in the regulation system of Fig. 1, the increase of the thyratron current does not immediately raise the generator armature voltage. Hence, the increased field current is conducted by the thyratrons for a longer period than is required to effect the desired change in the armature voltage. As a direct result, the armature voltage rises above the desired value, whereupon the pentode seeks to reduce the generator voltage through a decrease in the field excitation current. Here, again, the decreased excitation is continued for too lengthy a period, requiring an upward readjustment of the armature voltage. Thus, the system oscillates at a low frequency, the latter being dependent on the inductance of the generator field.

This oscillation of the regulation system is circumvented through the application of the inverse feedback principle to the circuits of the regulator. In Fig. 1, a portion of the voltage appearing across the armature of the generator is admitted to the primary winding of the feedback transformer *25* in series with the capacitor *26*, through the limiting potentiometer

7. On the rise of the armature voltge, capacitor *26* charges in series vith the primary of the transformer '5, the charging current developing a roportionate voltage across the prinary winding of this transformer. The secondary winding of the feedack transformer is connected in eries with the suppressor grid of the entode *30*, in such polarity that, with rise in the armature voltage, the uppressor grid is driven positive with espect to the tube cathode. However, a rise in the generator armature oltage swings the grid of pentode *30* ositive with respect to its cathode. Since the suppressor grid is aiding the ontrol grid of the tube, the effect is imilar to that caused by twice the ndicated change between the grid and athode of the pentode. The rectifier hyratrons, then, are caused to con'uct much later in each positive halfycle, considerably decreasing the enerator field excitation.

After a short period of time, howver, the capacitor *26* ceases to harge, and the voltage between the uppressor grid and cathode of the entode returns to zero. Here, the rmature voltage, by reason of the nomentarily decreased field excitaion, begins to decrease, causing the apacitor *26* to discharge, which, in urn, swings the suppressor grid of he pentode negative with respect to ts cathode. Thus, the positive swing n the control grid of this tube is effectively neutralized, returning the ield excitation to the previous level. Complete discharge of capacitor *26* is ccompanied by disappearance of the eutralizing voltage between the supressor grid and the cathode of the entode. Meanwhile, the armature oltage decrease has been accomlished, so that the loss of the suppressor grid positive voltage swing inds the control grid of the pentode t the correct voltage relationship with he cathode. No further change in he field excitation is necessary.

On long continued decreases in the rmature voltage, evidently, the corection in the field excitation is aplied as a series of field current ulses. The regulation system effecively stops correction, between imulses, to determine whether the sysem is in regulation balance.

A decrease in the armature voltage rings about the inverse of these phenomena, the correction in field excitation being applied as a series of ulsating increases in the generator ield current. In either case, the proportion of inverse feedback voltage ntroduced into the pentode pre-ampli-

(*Continued on page* 28)

ELECTRONIC REGULATORS

(*Continued from page 27*)

fier system may be controlled by adjustment of the feedback control potentiometer *27*, which functions as a variable voltage divider.

The voltage level to which this regulation system holds the armature voltage is varied by means of the potentiometer *28*. If the slider arm of this potentiometer is adjusted to the center of its resistance element, the voltage between the slider arm and its negative terminal is near 75 volts, where the regulator is in equilibrium, and the voltage across the potentiometer is twice this voltage. Adjustment of the slider arm nearer its negative terminal requires a still higher potential across the resistance element to provide the 75-volt equilibrium potential. Conversely, adjustment of the slider arm toward the positive terminal of the resistance element requires a reduced voltage level across the resistance element to produce this equilibrium voltage.

The balance of the voltage regulation system in Fig. 1 is similar to conventional radio systems.

[To Be Continued]

SOUND SYSTEMS

(*Continued from page 17*)

work has been done in a somewhat new direction. Whereas, the principle in the past was to control reflection and reverberation by the use of wall padding and the techniques mentioned above, the new technique involves the design of the surfaces of the room so that sound striking those surfaces is diffused throughout the area of the room in ideal decay relationships. As a result walls with parabolic paneling are used in place of the conventionally flat and well draped ones. Instead of absorbing energy, these walls diffuse it where it does the most good! This has the additional advantage of greater power efficiency as well, for acoustic energy is used, not absorbed.

It will be appreciated that the problems of room acoustics which the sound-man will face for quite a number of years to come, will concern themselves with conventional rooms and not with parabolic panels. As a consequence it is well to remember that when a room or hall has been treated to reduce reverberation and reflection, more power will be required to produce the desired level of sound.

BRITISH DUAL-BAND A-C RECEIVER*

(See Front Cover)

TWO-BAND, 4-tube a-c receivers have proved to be very popular in England. They provide coverage of medium and long waves and usually have a low i-f of 126.5 kc. The model, diagrammed on the cover of this issue, is typical of this small receiver type of design. It is known as the EKCO AC77 and is also supplied in console style (CT77).

The four tubes include an octode 6-grid electron-coupled frequency converter, a variable mu i-f pentode, a double diode detector—avc tube and a pentode power tube. Note the absence of a first audio stage, a practice unknown in America.

The assembly comprises a main chassis, separate power pack and speaker unit. The power transformer is built for a wide frequency range; 40-80 cycles at 200-250 volts with three voltage taps. Instead of the usual miniature dial lamp, a 12-watt, 200-volt scale lamp is used. The lamp is permanently connected across the 200-volt tap of the transformer.

The set is designed for an external antenna which is coupled to the first tube by means of a band-pass double-tuned input transformer on both bands. This necessitates a 3-gang tuning condenser. To guard against image interference, an image rejector circuit is used rather than a tuned resonant circuit wave trap. The adjustment is made in trimmer condenser C20. Thus operation is dependent upon proper phasing.

The antenna is tapped down on the broadcast-band input transformer similar to many American receivers but inductive coupling is used on the long-wave band. The primary coil helps to load the aerial system to a long wavelength, giving more energy transfer. The converter tube is biased by a 250-ohm cathode resistor, plus full avc. Anode tickler coils are used in both oscillation transformers with tuned grid circuits. The i-f stage is conventional except for the dual output circuit. The usual double-tuned i-f transformer feeds the detector diode, but a 15-mmfd coupling condenser feeds the avc diode. The i-f stage is fed partial avc. The converter tube is a Mullard metallized FC4 while the i-f tube is a Mullard metallized VP4B. The dual diode is a Mullard metallized 2D4A.

Note the use of a real pi section i-f filter using two 200-mmfd condensers and a real r-f choke. A-f voltage, free of i-f demodulation products, is developed across R7 (½ megohm) and fed to a 850,000-ohm volume control. The signal then travels through a 100,000-ohm grid resistor to the output tube's grid. A 300-ohm and a 140-ohm resistor are connected in the cathode circuit, bias being obtained from the latter. A 50-mfd bypass is used, avoiding degeneration. The avc diode is given a delayed action by biasing the cathode positively. The condenser-resistor tone control runs from the output plate to screen (B+) rather than plate to ground, putting less dielectric strain on the condenser.

The old, familiar hum-bucking winding on the speaker is employed; also, posts for connecting an external speaker and a switch for muting the internal speaker. Provision is made for a *gramophone* pickup in parallel with the detector output. There is no provision for silencing incoming signals when using the phonograph connection. The rectifier and filter circuits are entirely conventional.

*Courtesy *The Wireless and Electrical Trader, London*

THE WRENS

(*Continued from page* 9)

high frequency radio technique.

At regular intervals an examination is held in which the prospective radio mechanic has to obtain fifty per cent in each subject, with a sixty per cent aggregate. The latest figures for these courses show that eighty-four per cent of the students pass out as proficient radio mechanics.

Each week during the training period has forty-one working hours in school, plus three hours for physical training. The weekly time-table allows fourteen hours for lectures, twenty-two hours for laboratory work and five hours in the workshop. Here training is concerned mainly with soldering and carrying out temporary repairs to Service apparatus.

An interesting feature of the training is that Wrens are, as far as possible, given the opportunity of handling actual Service apparatus. Students are not, as is so often the case with special trainees, simply turned out as *production line* testers, they are taught the technique of fault-finding and are themselves quite capable of carrying out running repairs.

On completion of the very comprehensive course of training the girls pass on to one of Britain's Royal Naval air stations to learn the intricacies of installing apparatus in aircraft and of testing and mintaining the gear whilst in position.

In peacetime maintenance staff of the station consisted entirely of male naval ratings; now half the staff is Wren ratings. In the case of radio mechanics the proportion of Wrens is considerably greater—three to one.

Wren radio mechanics do the major part of the routine testing and undertake a considerable proportion of the mechanical and electrical repairs. The repair workshop is, with the exception of a chief petty officer, entirely staffed by Wrens.

When repaired apparatus has been refitted in aircraft, it may be necessary to test it in flight. This is undertaken by volunteers, nicknamed *Flying Wrens*. They wear flying suits, a leather helmet fitted with earphones and microphone, fur-lined flying boots, and white silk gloves under thick leather guantlets.

Wren radio mechanics have proved thoroughly competent fault-finders and repairers. They have attained a high technical standard and are efficiently undertaking duties previously carried out by men.

MULTIVIBRATORS

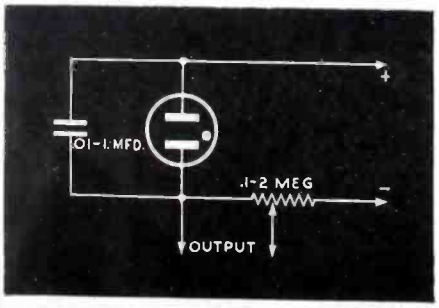
(*Continued from page* 12)

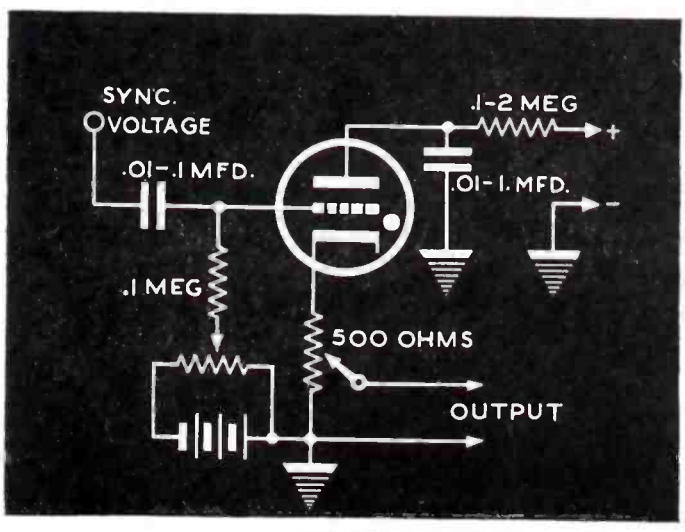
where E_1 is the ignition, or breakdown, voltage of the neon lamp and E_2 is the extinction voltage.

Oscillation is due to the difference in ignition and extinction voltage. The d-c voltage supply must be considerably higher than the ignition voltage of the lamp being used; otherwise, oscillation will not occur, or will be very feeble. The circuit operates in a simple manner. The d-c voltage charges the condenser *C*, through the series resistor, *R*, until the ignition potential of the lamp is reached. At this instant the tube breaks down, becoming a conductor and discharging *C* until the voltage drops to the extinction point where the action stops. The condenser then starts to recharge and the cycle repeats. Thus, there is a slow charge and a rapid discharge, giving a sawtooth waveform rich in harmonics. The voltage output of this oscillator is quite low, making it less satisfactory for trouble shooting than the previous types. Somewhat higher output may be obtained by substituting a thyratron for the neon lamp, as in Fig. 7. The bias control gives a variation in frequency and the grid permits the easy introduction of synchronizing voltage, if required.

Multivibrators can be used to locate dead stages in a receiver or amplifier. In this method, a complex signal is introduced to the plate of the power tube; then we work back towards the input. That is, if a signal is heard in the speaker, the oscillator is fed to the power tube grid, previous plate, then grid, detector, i-f, converter, until the point is reached where no signal is heard. This immediately locates the inoperative stage and the faulty part can be easily found.

If the circuit impedance is high compared to the oscillator output impedance, the gain per stage can be roughly noted as in other types of signal tracers. The multivibrators are also useful for checking and aligning padders in both broadcast and short-wave receivers and for locating dead spots or insensitive regions in all-wave receivers.





Figs. 6 (left) and 7 (right). In Fig. 6, relaxation oscillator using a neon tube. Fig. 7, a relaxation oscillator with the thyratron substituted for the neon lamp. The bias control provides a variation in frequency.

NEWS

"E" TO UTAH RADIO PRODUCTS

The Army-Navy "E" pennant was awarded recently to Utah Radio Products Company of 812 Orleans Street, Chicago, Illinois. Presentation of the award was made by Lieut. Col. Nathan Boruszak of the Dayton Signal Corps, Procurement Division, to Fred Tuerk, president of the company.

Fred Tuerk, Utah Radio Products president, receiving congratulations from Lt. Col. Nathan Boruszak of the Dayton Signal Corps.

* * *

RADIO RECEPTOR AIRWAYS BOOKLET

Radio's contribution to the safety of human life and property in air transport is told in a booklet *Highways of the Air*, published by Radio Receptor Company, Inc., 251 West 19th Street, N. Y. 11, N. Y. The booklet outlines the function of radio navigational aids and airport traffic equipment. With the aid of diagrams and illustrations, it tells what the *beam* is, and how it operates.

* * *

KEN-RAD EFFICIENCY AWARDS TO EMPLOYEES

Twenty-eight employees of Ken-Rad Tube & Lamp Corporation, Owensboro, Kentucky, recently received awards for suggestions leading to the improvement of production and efficiency in the operation of the plant.

H. S. Dunning, General Manager of Ken-Rad, distributing award checks

* * *

TELEVISION ASSOCIATION ELECTS OFFICERS

The newly formed Television Broadcasters Association met recently in N. Y. City to elect its officers and directors. Allen B. DuMont of Allen B. DuMont Laboratories, Inc., and Lewis Allen Weiss of the Don Lee Network, were named president and vice president respectively.

Directors of the Association include: F. J. Bingley, Philco, Inc.; Robert L. Gibson, G.E.; O. B. Hanson, NBC; C. W. Mason, Earle C. Anthony, Inc.; E. A.

Hayes, Hughes Tool Co.; Worthington Miner, CBS; Paul Raibourn, Television Productions, Inc.; Lewis Allen Weiss, Don Lee Network; and Allen B. DuMont, Allen B. DuMont Laboratories, Inc.

Also appointed were the following committees: Postwar Planning with Paul Raibourn as chairman; Program with Worthington Miner as chairman; Engineering with E. J. Bingley as chairman; Membership with Jack Poppelle as chairman; and Publicity and Promotion with Robert L. Gibson and Paul Raibourn as co-chairmen.

The TBA will become a contributing sponsor to the Radio Technical Planning Board.

* * *

CONNOR TO WEST COAST FOR SYLVANIA

George C. Connor, field engineer with Sylvania Electric Products, Inc., for the past ten years, has been appointed manager of the California division of Sylvania's equipment tube sales. Mr. Connor's headquarters will be in the Los Angeles office, 555 South Flower Street.

* * *

AEPEM MEET IN CHICAGO

Members of the Association of Electronic Parts and Equipment Manufacturers met recently at the Electric Club of Chicago. Included in the program was a talk by Paul V. Galvin, president of the Radio Manufacturers Association and head of Galvin Manufacturing Corporation. Mr. Galvin offered a forecast as to future business conditions in the electronics industry, and discussed the organization and functions of the newly created Radio Technical Planning Board.

* * *

BURWELL OF SOLAR NOW SIGNAL CORPS MAJOR

Henry Burwell, formerly Southern representative for Solar Manufacturing Corp., has been promoted to Major in the Army Signal Corps Service of Supply. Coverage of the Southern area is now under the direction of the Major's wife, Mrs. Abby Burwell, with offices at 105 Forrest Avenue, Atlanta, Georgia.

* * *

MITCHELL OF UTC RECEIVES EMPLOYEES PLAQUE

Employees of United Transformer Company recently awarded their "boss," president I. Allen Mitchell, a plaque in appreciation of his fine and cooperative spirit.

* * *

MALLORY 1944 CATALOG

A 36-page edition of the 1944 catalog, covering the complete line of Mallory radio, electrical and electronic parts is now being distributed by P. R. Mallory & Company, Inc., 3029 East Washington Street, Indianapolis 6, Indiana.

The catalog illustrates and describes dry electrolytic condensers, paper condensers, fixed and variable resistors, rheostats, potentiometers, volume controls, cable connectors, dial and pilot light assemblies, variohm resistors, vibrators, battery chargers, etc.

Base diagrams, replacement vibrator specifications, and replacement vibrator charts for auto radio and battery operated receivers, are also included in this new edition.

* * *

MEISSNER POSTWAR PLANS

Combination receiver and record players, with unique tone control systems will be made by the Meissner Manufacturing Companay, Mt. Carmel, Illinois, according to G. V. Rockey, vice president.

Entry of Meissner into the radio-phonograph market represents a new development. Only one set had been completed when the United States entered the war. This set was recently demonstrated in New York before a professional audience.

Besides the tone control feature, the set is also said to have a new record-changing device that permits continous operation for two hours or more. The record-changer may be set to play all records on one side, with automatic reversal. Or, it may be set to play both sides of each one before going on to the next. It is also possible to reject any record in the series whether the machine is set to play on a straight run or on a work and turn basis. When the entire magazine of records has been played off,

(*Continued on page* 34)

the records are returned in the same order and rotation.

* * *

NATIONAL UNION WINDOW DISPLAY

A new National Union window display set for Service Men is now available on request through N.U. distributors. The display features a sailor, soldier and marine saying goodbye to girl friends, to emphasize the theme: "Don't Kiss Your Radio Set Goodbye—Let Us Fix it!"

* * *

LIP MICROPHONE DATA IN BAKELITE REVIEW

The January issue of the *Bakelite Review*, published by the Bakelite Corporation, 30 East 42 Street, N. Y. 17, New York, contains an article on the lip microphone. The feature entitled *A Magnifying Moustache* reveals the use of this differential microphone, which is shock-resistant, on the war front.

* * *

NEWS

(Continued from page 33)

OLIVER TO OPEN CHICAGO DISTRIBUTING UNIT

A. R. Oliver, field sales manager of renewal tube sales for Sylvania Electric Products, Inc., will soon open the Pilgrim Distributing Company at 600 West Jackson Boulevard, Chicago, Illinois, as exclusive wholesale distributor of Sylvania tubes in the area.

* * *

TALK-A-PHONE CATALOG

An eight-page catalog describing fifteen different models of inter-communication systems has been released by Talk-A-Phone Manufacturing Company, 1219 West Van Buren Street, Chicago 7, Illinois.

Among the instruments listed is the new C-410 Coordinator, which consists of one master station working with up to a total of ten substations. Systems may be built up progressively beginning with one master station and one substation, with additional stations added as needed. It is available for 20, 30, 40, 50, etc., stations.

The master station is said to deliver an output of 2¼ watts, and operates on 110-115 volts a-c/d-c.

* * *

HENRY JOHNSON NOW SENIOR LT. IN NAVY

Henry C. L. Johnson, former advertising manager of the radio division of Sylvania Electric Products, Inc., has been promoted to the rank of full lieutenant in the United States Navy.

* * *

B. & W. HEAVY-DUTY CONDENSER BULLETIN

Bulletin 75C, describing type CX variable condensers for heavy-duty work, has been issued by Barker & Williamson, 235 Fairfield Avenue, Upper Darby, Pennsylvania. These B&W condensers have built-in neutralization features with short lead coil mountings.

* * *

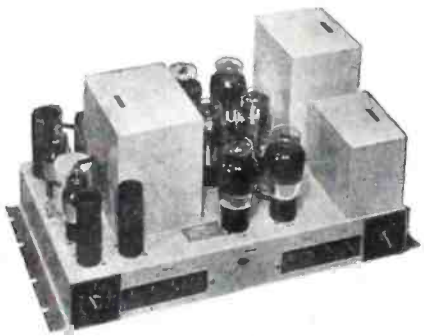
ISHAM OF SYLVANIA TALKS TO S-M

George Isham, New England and New York State division manager of the Sylvania renewal sales department, spoke to Service Men in Buffalo recently about postwar problems. He said that postwar radio will require more technical ability and better merchandising practice. He advised Service Men to organize so as to stabilize market conditions and raise the general level of service work.

NEW PRODUCTS

LANGEVIN AMPLIFIER

A new amplifier, type 101A, has been announced by the Langevin Company, Inc., 37 West 65th Street, N. Y. 23, N. Y. Its inherent noise level is said to be 68 db unweighted below full output of plus 47 vu at 2% rms harmonic distortion. With the input impedance of 600 ohms, the gain is said to be 60 db; using bridging input, the gain is 46 db. Output impedance is adjustable 1 to 1,000 ohms. Gain versus frequency, and power output versus frequency characteristics available upon request.



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REINER WIDE RANGE OSCILLOSCOPE

A 5" oscilloscope, equipped with a direct reading voltmeter for measuring the input signal, model 556, has been developed by Reiner Electronics Company, 152 West 25th Street, N. Y. 1, N. Y.

The sweep generator in this instrument is said to have a frequency range of 1,000 kc, 20 cycles to 1 mc. The horizontal amplifier as well as the vertical amplifier is said to be practically flat to 2 megacycles. The Z-axis amplifier has been designed for use up to 6 megacycles, permitting blanking and marking.

* * *

FLUXED WIRE SOLDER

A fluxed wire solder, Fluxrite, which contains flux in longitudinal grooves on the surface rather than in the conventional core, has been developed by National Lead Company, 111 Broadway, N. Y. 6, N. Y.

The new material is said to overcome an inherent disadvantage of regular cored solders which supply flux and solder to the surface simultaneously. Since the flux in the new product is outside rather than inside, it liquefies and flows onto the work before the solder melts.

The new product comes in the same diameters as regular cored solder. It is available in two compositions; *red stripe* and *green stripe*.

JOTS & FLASHES

GLAD to hear that Service Men in certain parts of the country are holding meetings once again to discuss present problems and do a bit of postwar planning . . . that's a healthy move and bound to pay dividends . . . better start getting your local group together for practical discussions if it hasn't already been done. . . . G. V. Rocke, v-p of Meissner Mfg. Co. reveals that his company will manufacture record players and radio set combinations after the war . . . another White Star for production excellence awarded to RCA Laboratories, Princeton, N. J. . . . D-X Crystal Co. now located at 1200 N. Claremont Ave., Chicago . . . Sylvania appoints George C. Connor as manager of their California equipment and tube sales division with headquarters in Los Angeles . . . congrats to H. L. Dalis, Inc., N. Y. City radio parts distributor, on completing 20 successful years in business . . . C. L. Sly, v-p of Universal Microphone Co., on an extended business trip to important mid-west and eastern cities . . . Dr. Lee deForest, inventor of the audion, predicts that television receivers will "flood the market" within a year after the war . . .I. L. Arkin Co., Chicago sales reps for Hytron and other manufacturers, moves to 43 E. Ohio Street . . . Lt. Colonel Bruce Burlingame, former manufacturers' rep in New York City, reported as being "somewhere in India" . . . Les Willyard appointed chief engineer by Universal Microphone Co., Inglewood, Calif. . . . congrats to "Hank" C. L. Johnson, on leave from Sylvania, on his promotion from Lieut. j. g. to a full Lieutenancy in the U. S. Navy . . . new factory in Brooklyn (near Ebbetts Field) acquired by Tung-Sol . . . Army-Navy "E" for production excellence awarded to L. F. Grammes & Sons of Allentown, Pa. . . . White Star for continued production achievements to General Instrument Corp., Elizabeth, N. J. . . . Mrs. Martha Kinzie elected assistant secretary of Radio Technical Planning Board . . . if you haven't already sent in your entry to the SERVICE contest as announced in the January issue, better get busy on it . . . contest closes March 1st . . . American Radio Hardware Co. formally opened new plant on February 12, to take care of increased production demands . . . located at 152-4 MacQueston Parkway So., Mt. Vernon, N. Y. . . . Reau Kemp appointed sales director of Warwick Mfg. Corp., Chicago, Ill., makers of Clarion radios and electronic equipment.

ADVERTISERS IN THIS ISSUE

SERVICE—FEBRUARY, 1944

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Catalog Number	Capacity Mfd.	Dimensions, Inches Diameter	Length	List Price
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S-0211	.001	3/8	1-3/16	.20
S-0212	.002	3/8	1-3/16	.20
S-0215	.005	3/8	1-3/16	.20
S-0221	.01	7/16	1-3/16	.20
S-0224	.02	7/16	1-5/8	.20
S-0230	.05	9/16	1-5/8	.25
S-0240	.1	9/16	2-1/8	.30
S-0257	.25	3/4	2-3/16	.45

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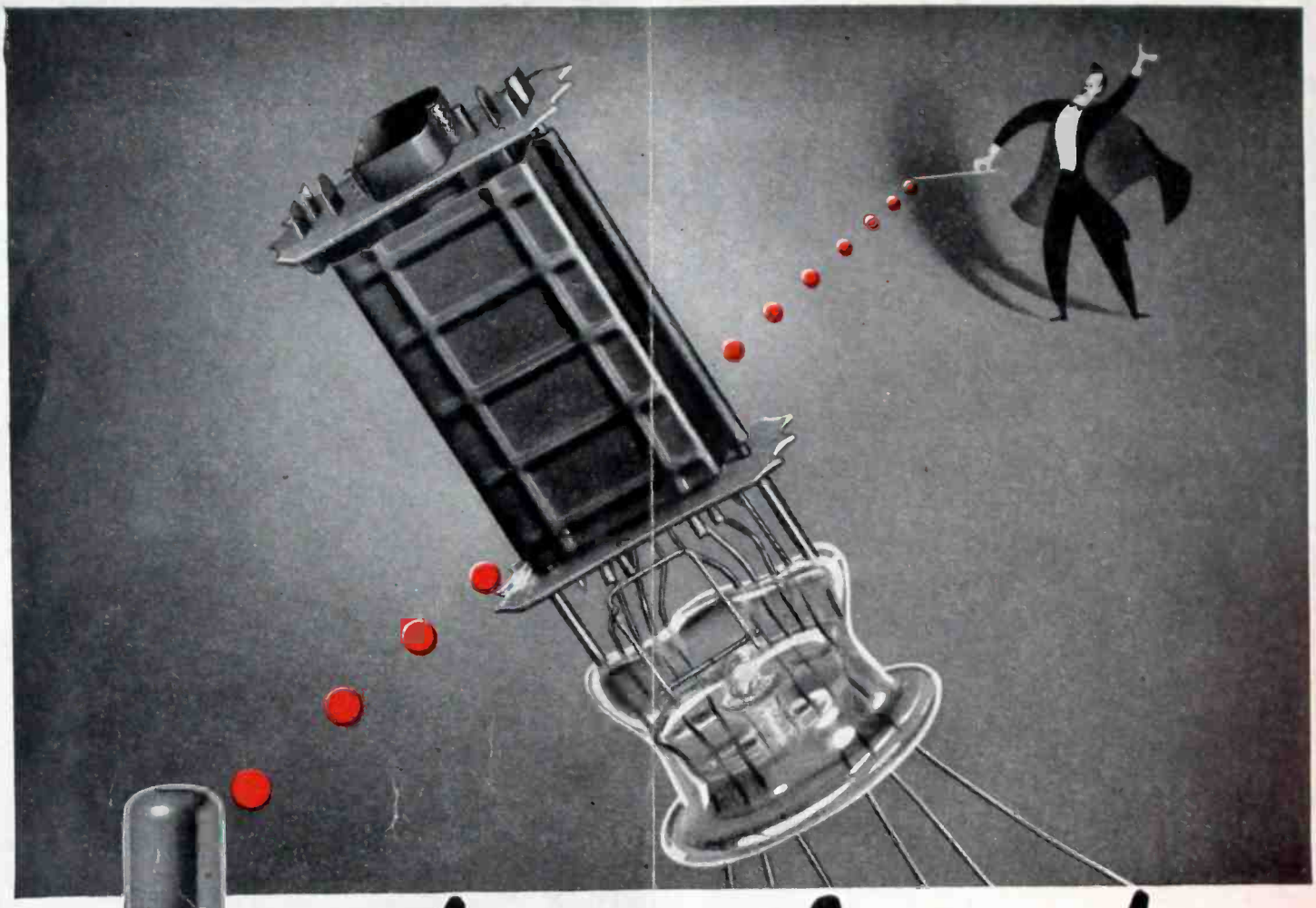

Metal Magic!

Long ago National Union engineers had to strike out for themselves in search of new metals, alloys and coatings. The extremely high temperatures employed in tube making—brazing, for example, at 2 to 5 times the heat customarily used—ruled out the use of metals common to most industries.

For this reason and for others peculiar to the needs of tube manufacture, there has come from the nation's electronic tube laboratories a whole new group of metals and combinations of metals. Here are special alloys for filaments, coils, grid wires, getters, electron guns and many other uses. And as these metals have provided characteristics not previously available, they have literally pulled wonders out of the magic hat of electronics.

In metallurgy, as in other sciences related to tube making, National Union is helping to push back the frontiers of electronic knowledge. This research is helping, also, to provide for service engineers a broad, profitable post-war franchise. *Count on* N. U. to be ready with better tubes for every important service need.

NATIONAL UNION RADIO CORPORATION, NEWARK, N. J.
Factories: Newark and Maplewood, N. J., Lansdale and Robesonia, Pa.

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