RADIO NEWS

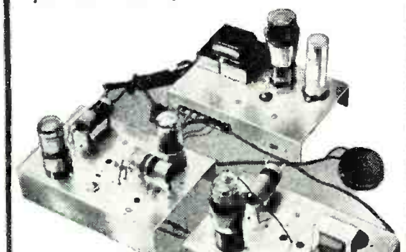
DECEMBER 1944
35c
In Canada 40c

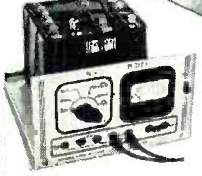
J. E. SMITH, PRESIDENT
National Radio Institute
31st year of Training Men for Success in Radio

I WILL TRAIN YOU TO START
A SPARE TIME OR FULL TIME
RADIO SERVICE BUSINESS WITHOUT CAPITAL

You Build These and Many Other Radio Circuits with 6 Kits of Parts I Supply

By the time you've conducted 60 sets of Experiments with Radio Parts I supply, made hundreds of measurements and adjustments, you'll have valuable PRACTICAL Radio experience for a good full or part-time Radio job!

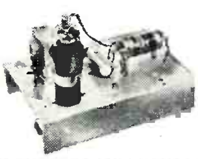




You build the **SUPERHETERODYNE CIRCUIT** above containing a preselector oscillator-mixer-first detector, i.f. stage, diode-detector-a.v.c. stage and audio stage. It will bring in local and distant stations. Get the thrill of learning at home evenings in spare time while you put the set through fascinating tests!

You build **MEASURING INSTRUMENT** above early in Course, useful for Radio work to pick up EXTRA spare time money. It is a vacuum tube multimeter, measures A.C., D.C., R.F. volts, D.C. currents, resistance, receiver output.

Building the **A. M. SIGNAL GENERATOR** at right will give you valuable experience. Provides amplitude-modulated signals for test and experimental purposes.



The men at the right are just a few of many I have trained, at home in their spare time, to be Radio Technicians. They are now operating their own successful spare time or full time Radio businesses. Hundreds of other men I trained are holding good jobs in practically every branch of Radio, as Radio Technicians or Operators. Doesn't this PROVE that my "50-50 Method" of training can give you, in your spare time at home, BOTH a thorough knowledge of Radio principles **and** the PRACTICAL experience you need to help you make more money in the fast-growing Radio industry?

Right now you haxe excellent opportunities to get a good job in this busy field with a bright peacetime future! So mail the Coupon and I'll send you FREE my 64-page, illustrated book, "Win Rich Rewards in Radio." It describes many fascinating types of Radio jobs, tells how N.R.I. trains you at home in spare time—how you get **practical** experience building and testing Radio Circuits with SIX BIG KITS OF RADIO PARTS I send!

Bright Future for Well-Trained Radio Technicians, Operators

Keeping old Radios working is booming the Radio Repair business. Profits are large, after-the-war prospects are bright too. Think of the **new** boom in Radio Sales and Servicing that's coming when new Radios are again available—when Frequency Modulation and Electronics can be promoted — when Television starts its postwar expansion.

Broadcasting Stations, Aviation Radio, Police Radio, Loudspeaker Systems, Radio Manufacturing all offer good jobs to qualified Radio men—and most of these fields have a **big backlog** of business that has built up during the war, **plus** opportunities to expand into **new** fields opened by wartime developments. You may never see a time again when it will be so easy to get a start in Radio!

Many Beginners Soon Make $5, $10 a Week EXTRA in Spare Time

The day you enroll for my Course I start sending you EXTRA MONEY JOB SHEETS that help show how to make EXTRA money fixing Radios in spare time while still learning. I send you SIX big kits of Radio parts as part of my Course. You LEARN Radio fundamentals from my illustrated, easy-to-grasp lessons—PRACTICE what you learn by building real Radio Circuits—and use your knowledge to make EXTRA money.

Find Out What N.R.I. Can Do for YOU

MAIL THE COUPON for Sample Lesson and my 64-page book FREE. My book "Win Rich Rewards in Radio," is packed with facts—things **you** never knew about opportunities in Broadcasting, Radio Servicing, Aviation Radio, other Radio fields.

Read the details about my Course—"50-50 Training Method"—6 Experimental Kits—EXTRA MONEY JOB SHEETS. See the fascinating jobs Radio offers and how **you** can train at home. Read many letters from men I trained telling what they are doing, earning. No obligation. Just MAIL COUPON in an envelope or pasted on a penny postal!—**J. E. SMITH, President, Dept. 4NR, National Radio Institute, Washington 9, D. C.**

I Trained These Men
SPARE TIME RADIO BUSINESS

"I really don't see how you can give so much for such a small amount of money. I made $600 in a year and a half, and I have made an average of $10 a week — just spare time." — JOHN JERRY, 300 So. H. St., Exeter, Calif.

"I am engaged in spare time Radio work. I average from $5 to $10 a week. I often wished that I had enrolled sooner, because all this EXTRA money goes come in handy." — THEODORE K. DUBREE, Horsham, Pa.

"I am still attending school and do spare time work in my radio shop at home. I earned about $427 in spare time while taking your course." — DIETER HESS, 72 Worth Avenue, Hudson, N. Y.

I Trained These Men
FULL TIME RADIO BUSINESS

"For several years I have been in business for myself making around $200 a month. Business has steadily increased. I have N.R.I. to thank for my start in this field."—ARLIE J. FROEHNER, 300 W. Texas Ave., Goose Creek Texas.

"Thought I would drop a line to let you know how well I have done in Radio. You certainly tell the truth in your advertising. for this year my income has run about $3,000. I have taken in a total of about $5,000 but my parts bill will run about $1,700."—BERYL DICKEY, 1331 P. Ave. New Castle, Indiana.

"I am now operating a radio shop for myself and own all my equipment. For over a year I have only repaired radios due to the fact there have been no radios to sell. In 1942 I averaged $200 a month and in 1943 $250 a month." — J. M. SCRIVENER, JR., Aberdeen Miss.

SAMPLE LESSON FREE

I will send you a FREE Lesson, "Getting Acquainted With Receiver Servicing," to show you how practical it is to train for Radio at home in spare time. It's a valuable lesson. Study it—keep it—use it—without obligation! Tells how Superheterodyne Circuits work, gives hints on Receiver Servicing, Locating Defects, Repair of Loudspeaker, I.F. Transformer, Gang Tuning Condenser, etc. 31 illustrations.

My Radio Course Includes
TELEVISION • ELECTRONICS
FREQUENCY MODULATION

GOOD FOR BOTH 64 PAGE BOOK SAMPLE LESSON FREE

J. E. SMITH, President, Dept. 4NR
National Radio Institute, Washington 9, D. C.

Without obligating me, mail your Sample Lesson and 64-page book FREE. I am particularly interested in the branch of Radio checked below. (No salesman will call. Please write plainly.)

- ☐ Radio Service Business of My Own
- ☐ Service Technician for Radio Stores and Factories
- ☐ Spare Time Radio Servicing
- ☐ Government Civilian Radio
- ☐ Aviation Radio
- ☐ Operating Broadcasting Stations
- ☐ Army, Navy Radio Jobs
- ☐ Operating Police Radio Stations
- ☐ Operating Ship and Harbor Radio

(If you have not decided which branch you prefer—mail coupon for facts to help you decide.)

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RADIO NEWS
Reg. U. S. Pat. Off.

DECEMBER • 1944

VOLUME 32, NUMBER 6

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DEPARTMENTS

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COVER PHOTO
By Frank Ross
(Staff Photographer)

Perry S. Smith, of RCA, shown operating latest model Electron Microscope. Complete description of its design and operation was published in the November, 1944 issue of RADIO NEWS.

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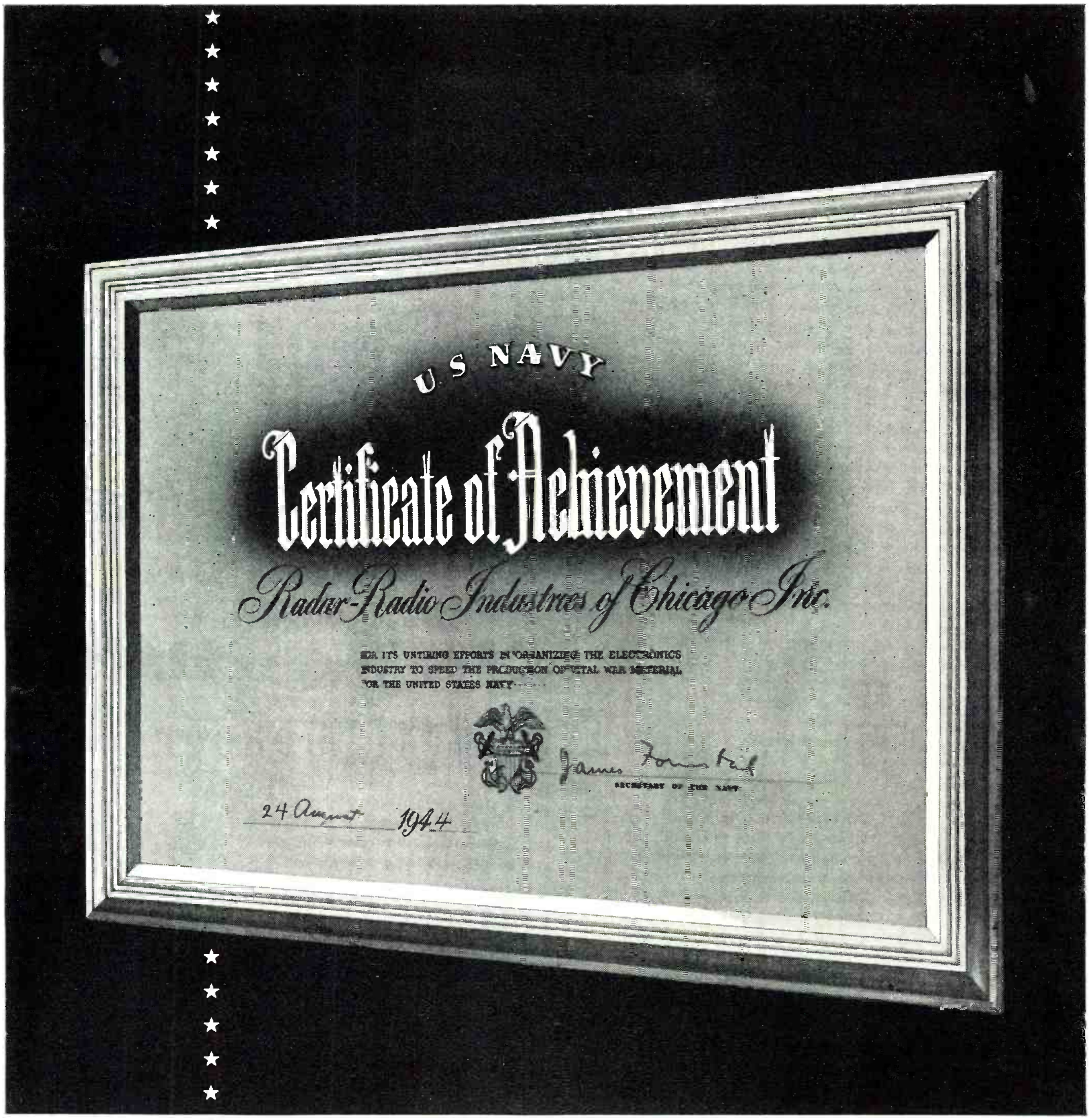

U S NAVY

Certificate of Achievement

Radar-Radio Industries of Chicago Inc.

FOR ITS UNTIRING EFFORTS IN ORGANIZING THE ELECTRONICS INDUSTRY TO SPEED THE PRODUCTION OF VITAL WAR MATERIAL FOR THE UNITED STATES NAVY

James Forrestal
SECRETARY OF THE NAVY

24 August 1944

The United States Navy has awarded the men and women of Hallicrafters a special "Certificate of Achievement"... first award of its kind... for outstanding service with the radar-radio industries of Chicago in speeding vital war material to the Navy. Added to the four Army-Navy "E" awards, this makes five times Hallicrafters workers have been cited for distinguished service. They promise that this kind of service will be continued until total victory is ours.

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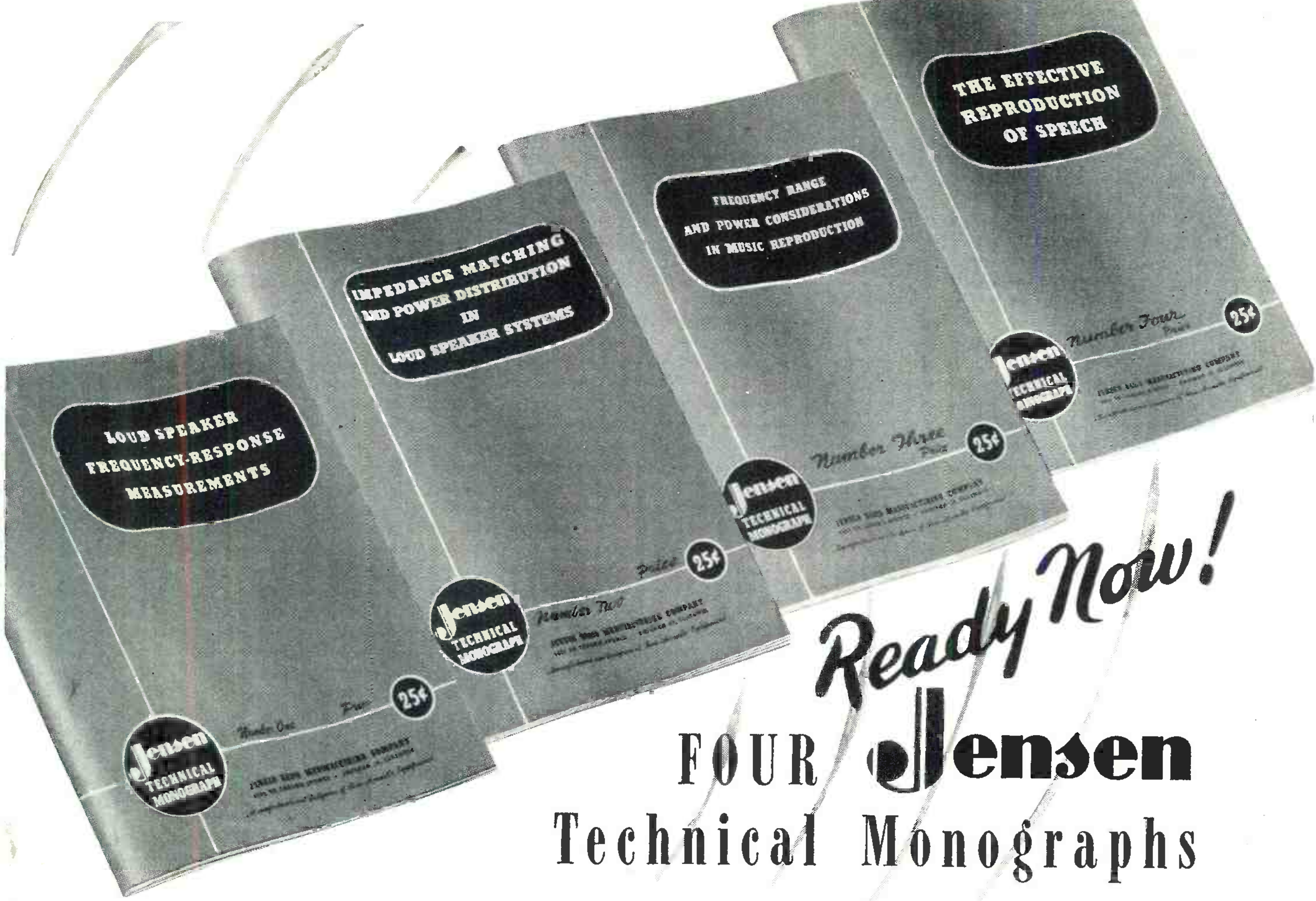

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FOUR Jensen Technical Monographs

EVERYONE interested in the reproduction of sound — engineer, tradesman, instructor, student or layman — should own these four Monographs. Published by the Jensen Technical Service Department in the interest of improved sound reproduction, they are the first four numbers of *a series*. Up-to-date in factual information, replete with useful charts, graphs and tables, they supply a world of data, heretofore unobtainable, to guide in the selection, installation and operation of loud speakers. You will want *not only these four* numbers *but the rest of the series* as announced from time to time.

MONOGRAPH No. 1: "*Loud Speaker Frequency-Response Measurements.*" Deals with one of the most interesting and controversial subjects in the field of acoustics. Discusses, among other topics, frequency response of the human ear, the influence of environment on frequency response, the practical aspects of frequency-response measurements. Amply illustrated with charts and graphs.

MONOGRAPH No. 2: "*Impedance Matching and Power Distribution.*" Discusses such subjects as multiple speaker connection, volume control, design of efficient transmission lines, and conversion of volume levels to power and voltage. The text is supported by twenty-eight drawings and tables. More than a score of questions are described, illustrated and solved, including a comprehensive sound system for a military installation.

MONOGRAPH No. 3: "*Frequency Range in Music Reproduction.*" What frequency range is needed for high fidelity reproduction? What are the maximum, useful audio frequency ranges under actual listening conditions? What are the practical limitations on high fidelity reproduction even if perfect transmission, reception and reproduction were possible? How much change in high frequency cut-off is required to be just noticeable to the listener? All these and many more questions are answered in this Jensen Monograph.

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War's end! . . . A thick wedge of Mom's never forgotten apple pie instead of K Rations . . . Civies instead of Skivies . . . A table model radio instead of a walky-talky. Whatever war-born miracles may be reflected in tomorrow's radio, you can depend upon Fada to maintain its 25 year tradition for advanced design and dependable performance.

PLACE YOUR FAITH IN THE

FADA
Radio

OF THE FUTURE

Famous Since Broadcasting Began!

FADA RADIO AND ELECTRIC COMPANY, INC., LONG ISLAND CITY, N. Y.

FOR THE RECORD

by the editor

A NEGATIVE attitude very often accounts for the financial predicament in which many technicians find themselves. C. F. Kettering of General Motors says "Tell me just why it can't be done. Once you have mentioned all the reasons in sufficient details, you have the problem more than half solved."

Too many engineers and technicians take the basic negative approach to any new idea. While it is true that the average technically-trained man knows the inherent technical difficulties in a particular technical situation almost at a glance, he knows why it *can't* be done. That is his first reaction. Usually he makes no attempt whatsoever to do anything further about it. He rears up at the very first technical objection. In three short years Yankee ingenuity has caught up with and surpassed Axis powers in production, even though the latter had a twelve year start. Many war plants have placed signs in strategic spots stating: "The difficult we do immediately; the impossible takes a little longer."

Faced with the problem of providing adequate military equipment, particularly radio, engineers in our field have trained themselves almost overnight to do the "impossible." During their employment, they have had little occasion to study the business aspects of their livelihood from a postwar viewpoint. They work under direct orders from engineering, business and sales departments, and when extra financial rewards are to be divided, technicians usually come in at the very tail end, if at all.

The postwar salaries of technicians will eventually come out of sales. We know that a business lives and dies by its income and yet many technicians are not even slightly interested in the selling end of a business. To be a successful technician it is imperative that he be *sales minded.* Before the war only a very few technically-trained engineers were found in executive positions. This is not the fault of those who run things from the front office. It is simply due to the fact that the engineers have failed to appreciate the importance of being business minded. It is necessary for them, if they hope to fatten their pay envelopes, to develop a commercial viewpoint together with their technical outlook.

If they take a negative attitude and assume a "can't be done" frame of mind, we will in the future lose our Yankee ingenuity to produce things that "can't be done." Wartime production achievements such as jet-propelled planes, radar, flying robots, sulfa-drugs, penicillin, etc., are existing proof that it "can be done."

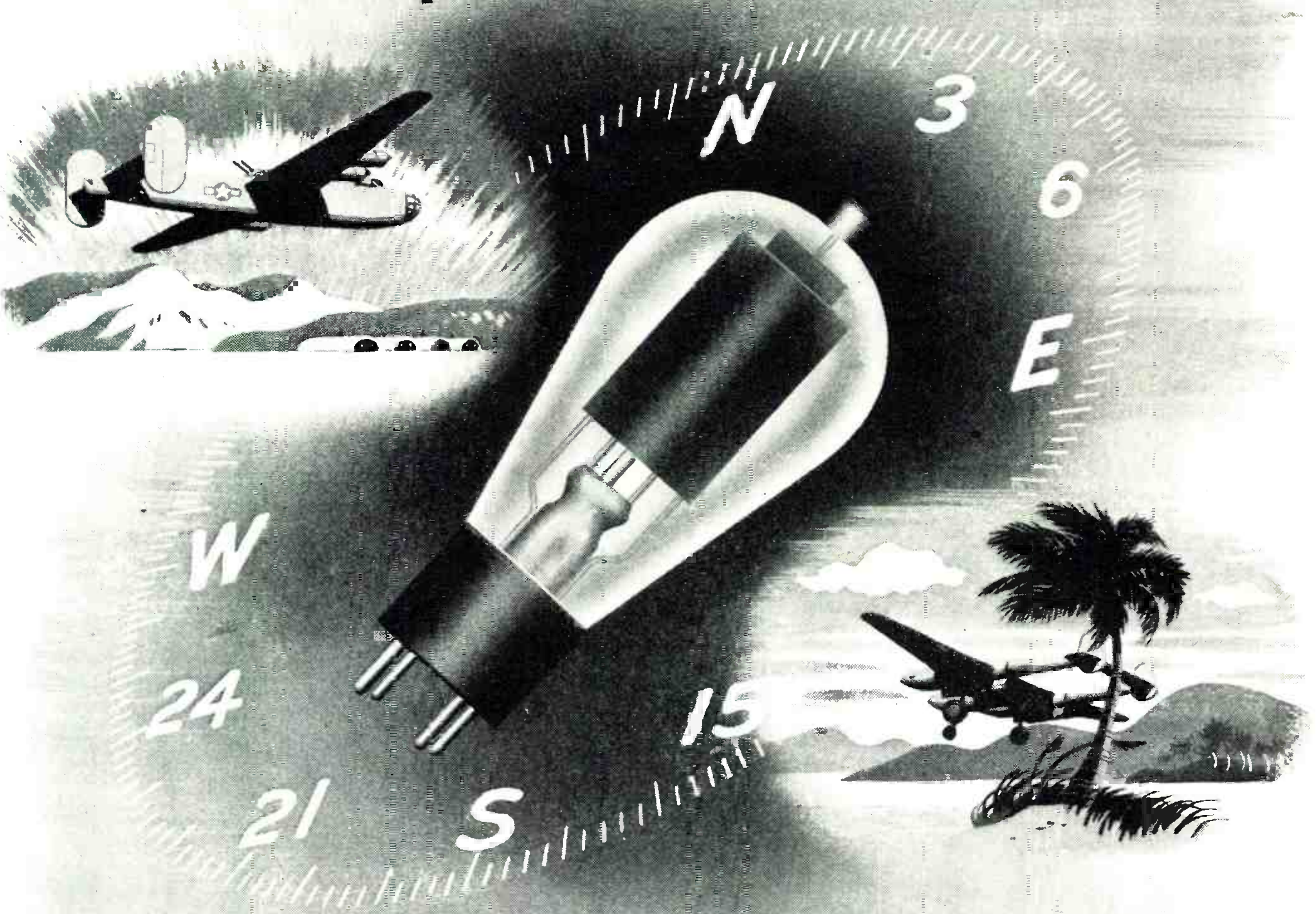
There has been announced, recently, a postwar radio which will retail at $6.00. It is a four-tube job and will be mass-produced. Radio service-dealers will be faced with the problem of competing with such merchandise and it will be imperative that their technicians begin now to educate the customer and to point out that even though such sets do have "price appeal" they cannot possibly offer quality reception.

Every effort should be made now to train service technicians in the art of selling. They'll need it! There is plenty of opportunity for them to do a great deal of missionary work which, in later years, will help to *raise* the standards of radio instead of lowering them. Nothing can be done to prevent mass production of $6.00 sets, but the very existence of these receivers should not cut too deeply into quality merchandise providing the features of better sets are stressed to potential customers long before the technician is faced with the problem of the inevitable competition.

And don't kid yourself about thousands of GI's not being qualified to enter the radio service business when they come back. Many have received specialized training courses. They have learned more about electronics in eighteen-month courses than the average technician acquires in many years. Thousands of them will be highly qualified to sell and service television. They, too, must become sales-minded. When they do, our postwar industry will have a valuable asset.

GI Joe has learned that a "negative attitude" can't win a war. Industry knows it can be done—and they've set production records that are the envy of every other nation on earth. Established radio service-dealers at home have kept sets in operation by a sheer positive attitude. If they keep this frame of mind, all will be well. If not—competition will force them to retreat.

Even though there will be literally thousands of highly-trained technicians in industry after the war, there will be very few who will reach the top if they fail to recognize the importance of becoming sales and business minded in future years. . . . . . . O.R.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Perfection is Our Aim!

In every industry there are various methods of turning out products for similar use requirements. Usually there is *one best way* — a way based on developing and following certain tested techniques — proved processes that in themselves guarantee uniform quality every step of the way.

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Twenty seven years ago she started work at C-D.

That was in our first plant.

She is still with us. But the scene has changed. Equipment undreamed of in 1917, now speeds millions of capacitors to the great names in American industry.

Here at C-D long service is not unusual. In our six plants we have many old-timers.

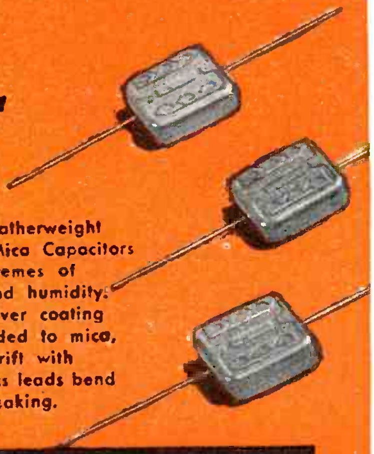
Their love for the job, their fierce pride in perfection, their insistence on maintaining quality standards is an "extra" you get from C-D. An "extra" that means long, stable capacitor life.

Engineers know this. That's why there are more C-D's in use than any other make.

If you have a capacitor problem, one of our basic innovations in design, engineering or manufacture may be the answer.

Write to Cornell-Dubilier Electric Corporation,
South Plainfield, New Jersey.

other plants: New Bedford, Brookline, Worcester, Mass., and Providence, R. I.



These tiny featherweight 1R Silvered Mica Capacitors withstand extremes of temperature and humidity. Extra heavy silver coating thoroughly bonded to mica, practically no drift with time. Tinned brass leads bend easily without breaking.

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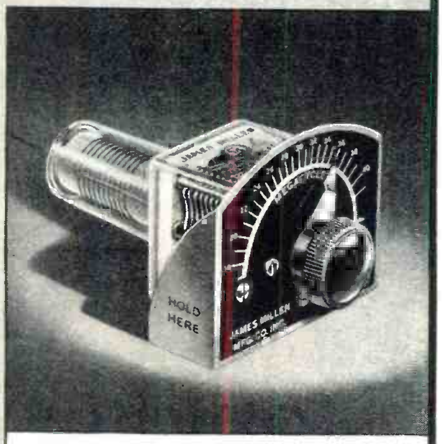

Spot Radio News

By RADIO NEWS Washington Correspondent

Presenting latest information on the Radio Industry.

PORTABLE TRANSMITTERS, ROLLED INTO the thick of invasion waves, carried the invasion news from the beaches along the southern coast of France. NBC correspondent, Chester Morrison, reported the activities of the invading troops from a landing craft. His broadcast was relayed to Rome and Algiers. From those points it was transmitted to this country.

Since June 13, a mobile transmitter has been used to transmit programs from France. This station has the call letters PX and is operated by Press Wireless.

In the Far East mobile and fixed transmitters are serving to provide entertainment to the boys there and news to the world at large. Reporting from New Guinea, Lt. Col. K. R. Dyke, Information Education Officer, U. S. Army Forces in the Far East, says that an eight station "jungle network" is in operation from one end of New Guinea to the other. The stations consist of a 1000 watt, 450, 250, and several 50-watt stations. The network, of course, is unlike the line hookups we have here. Instead a master schedule is used. Col. Dyke, who was with NBC before he entered the service, has quite an assortment of radiomen in his group. They include D. Wells, of WHO, John Dietrick, WOSU and many others from NBC, CBS, Mutual, and some independent stations. Another Far East network that is gaining fame is the "mosquito network" that operates in the same fashion as the "jungle network."

Operating under tremendous handicaps these networks have initiated services that have won the admiration of those in and out of radio. And when the full story can be told, many new pages of epochal progress in science will be recorded.

THE STORY OF BROADCASTING IN THE YEARS TO COME was told effectively by scores of government and industry experts at the historic FCC allocation hearings in Washington. While no decisions were reached, as this column goes to press, it appears as if many proposals affecting broadcasting in various theaters of operation would be adopted.

The importance of the hearings was stressed by FCC chairman James Lawrence Fly who opened the sessions. He pointed out that we face one of the greatest responsibilities which has fallen on the shoulders of any group. These hearings, he said, should provide data which will aid in determining what frequencies or bands of frequencies should be allocated to various classes of nongovernmental service.

The standard broadcast band was among the first of the topics to be discussed by specialists present at the hearing. Included in this broadcast expert group were: Howard Frazier, director of engineering of NAB and chairman of RTPB panel 4; C. H. Owen, FCC broadcast engineer; Paul Godley, consulting radio engineer; Harold Ryan, NAB President; and W. F. Cotter, of Stromberg-Carlson. Mr. Frazier recommended that the present standard broadcast band be lowered from 550 to 520 kc. This would provide, he pointed out, three more channels at the lower end of the broadcast band affording wider coverage, better service in areas where it is now needed, and elimination of present interference between stations. He also indicated that the frequencies of 200 to 400 kc. for rural area service are also under study. Paul Godley declared that the 520 to 540 band is unsuitable for use of clear-channel service since it introduces secondary nighttime coverage over wide areas. The added bands, he said, should be used to make possible a very few regional stations or 100 to 150 new local channel stations or a combination of both. Mr. Godley also indicated that there is a possibility of interference from ship-to-shore signals and auto-alarm systems on board ships. Thus, he said, it would be wise to use these channels for local radio service. Discussing the set manufacturer's view on these additional bands, Mr. Cotter said that less than 1% of the present receivers are equipped to receive 520- or 530-kc. bands, although most sets can receive on 540 kc. He indicated that it might be too costly to attempt to convert present receivers to include the new frequencies. The problem of interference on the 520-kc. band also was discussed. Paul Godley declared that the conversion objection of the receiver manufacturers was trivial in view of the advantages of an expanded standard broadcast band.

An interesting breakdown of listening habits was offered by Harold Ryan. He pointed out that radio is listened to by 83.7% of all urban families on an average of five hours and four minutes each day, while rural listeners tune in on an average of five hours and eighteen minutes a day. Mr. Owen declared that during the nighttime 17.4% of the population and roughly 56.8% of the land area of the country do not receive primary service. However, he said, almost every section of the country gets secondary service or skyway signal transmissions from at least one and more probably several broadcast stations. The daytime primary service does not go to 8.7% of the population

(*Continued on page* 16)

Thanks
MR. TROUBLE-SHOOTER

Thanks, Mr. G. I. You're close to our thoughts. All of us in radio know the world-wide job you're doing in the Signal Corps.

We know who you are. You're the radio ham across the street, the boy home from college who burned the midnight oil in the attic and rigged his aerial from the highest mast. You're the telephone man. You're the obliging young fellow from the lighting company. You're the serviceman who fixed our radio set the day before the World's Series. You're the radio engineer who added brains to that set.

We don't know where you're *seeing* action but we know that you are *helping* it. Crawling out ahead of artillery. Scrambling from one fox-hole to another. Rolling up telephone wire almost to the muzzles of enemy guns. Operating and servicing communication systems so that the attack may roll forward. Hunting booby traps. Saving lives.

Come back, Mr. G. I., just as soon as your trouble-shooting is done. Radio will need you—your skill—your sureness. Radio will not forget your part in victory. Solar Manufacturing Corp., 285 Madison Ave., New York 17, N. Y.

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Federal's "Multiple Testing" adds up to longer tube life . . . uniform electrical characteristics . . . and lower cost of operation. Radio men acknowledge that "Federal always has made BETTER Tubes."

Radio Ranges and Instrument Landing Systems manufactured by Federal mark the principal air routes of the nation and control the landing at many leading airports. Pioneers in the development of Aerial Navigation Equipment, Federal has made spectacular contributions to aviation progress.

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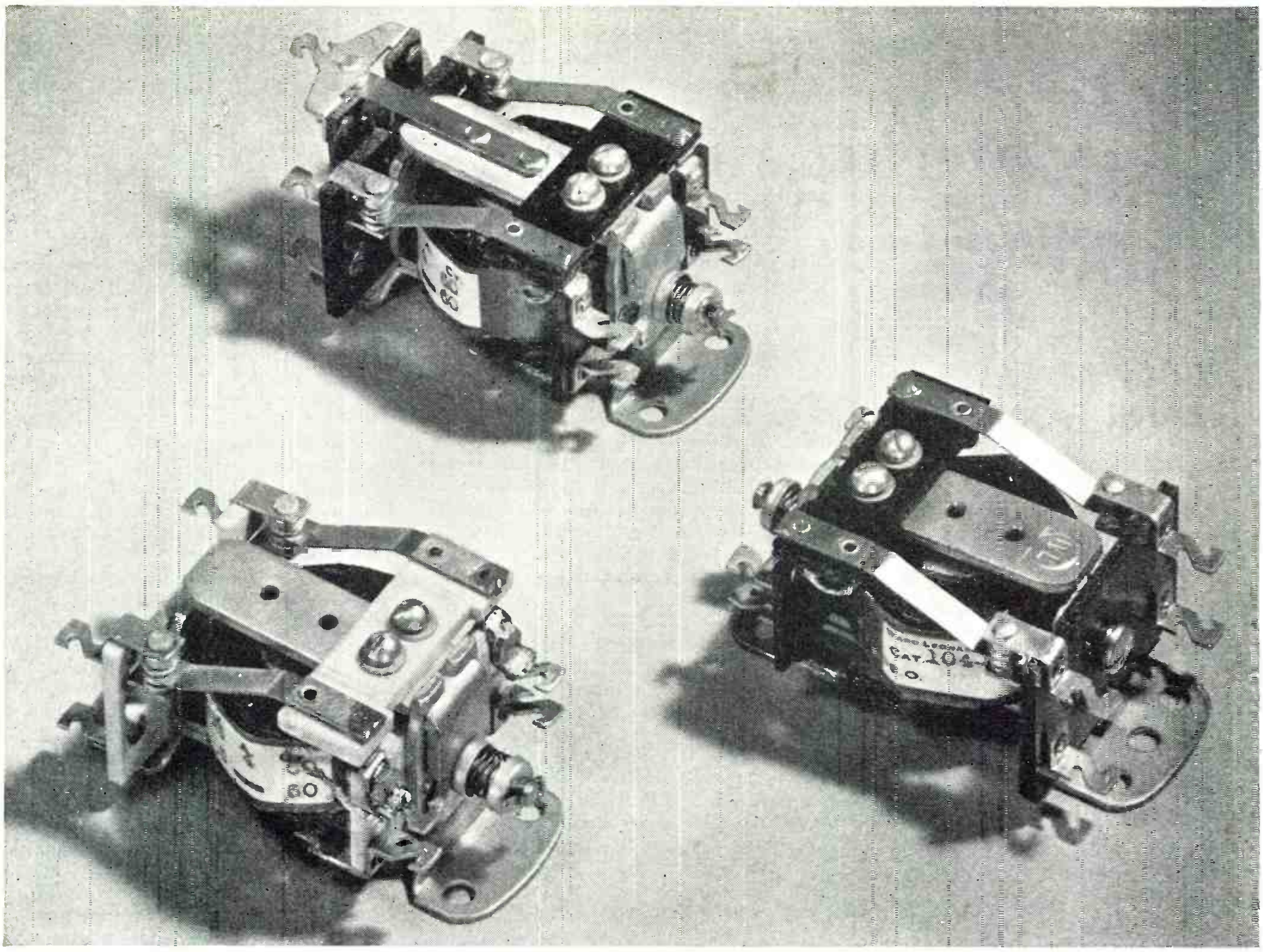
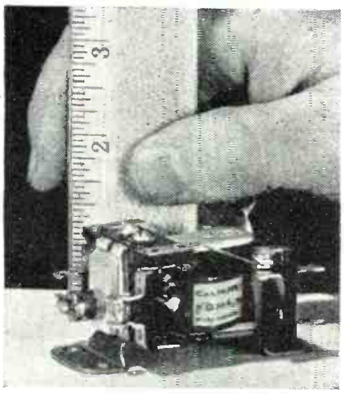


ADAPTABLE...

FOR MANY PURPOSES



Only 1¼ inches in height. For continuous operation on AC and DC voltages up to 110-115. Double pole, double throw. This Relay described in data Bulletin 104. Send for a copy.

The Ward Leonard Midget Metal Base Relay has proven so satisfactory and dependable that several adaptations have been made in it to give it even wider application. The relays shown above are the original relay, one with auxiliary contact and one with porcelain insulation. These relays may be furnished with studs in place of metal bases.

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RELAYS • RESISTORS • RHEOSTATS

Electric control (WL) devices since 1892.

WARD LEONARD ELECTRIC COMPANY, 47 SOUTH STREET, MOUNT VERNON, NEW YORK

(*Continued from page* 12)

and 33% of the land area. Incidentally, primary service is that service free from consistent interference or fading from even one broadcast station.

The distinguished scientist, Dr. L. P. Wheeler, who is now chief of the Technical Information Division, Engineering Department, FCC, was also a witness at these hearings. He submitted a report on very-high-frequency field strength measurements, which disclosed that the FCC had conducted 32,000 hours of continuous automatic field strength tests during the past two years. Commercial and experimental stations were used, and four monitoring stations served to make recordings during the tests. According to the report there are three distinct kinds of signal records which can be distinguished in the recordings made. One is the type found when the transmitting station is at a moderate distance from the recorder; that is, when the field strength is sufficient to give satisfactory continuous aural reception. In the next type, we find a signal whose field strength usually is not sufficient to provide good reception but nevertheless has burst characteristics; that is, frequent bursts of signals of very short duration and great relative intensity appear. The third kind of signal is that found when the transmitting station is at such a great distance that the field strength at the recorder normally is insufficient to give any aural reception aside from bursts. Occasionally, at certain seasons of the year and time of the day, this signal has a prolonged period of abnormally high field strength. Dr. Wheeler pointed out that the transmission paths associated with the first type of record are believed to lie entirely within the lower atmosphere or troposphere. The path associated with the second type is probably by reflection or refraction in the upper regions of the atmosphere known as the ionosphere. According to Dr. Wheeler, the origin of these bursts has not yet been determined definitely, although there seems to be a close relationship between their occurrence and the incidence of meteors in the upper atmosphere. The "E" layer was associated with the third type of transmission path. Reflection or refraction from one of the lower of the recognized layers in the ionosphere, which is the "E" layer, was linked to the third type of signal. Dr. Wheeler pointed out that these tests should be quite useful in judging recommendations on locations of services in the frequency spectrum.

Former FCC commissioner T. A. M. Craven, who is now vice-president of the Cowles Broadcasting Co., offered some interesting proposals on frequency allocation. He pointed out that the band of 60 to 100 megacycles should be reserved for FM broadcasting, utilizing channels 100 kilocycles wide and providing 400 channels. He said that there will be a demand for at least 2000 commercial FM stations during the next ten years and that 2000 educational services will use FM during the next ten to fifteen years. Commander Craven also indicated that at the beginning no more than ten stations probably will be able to operate efficiently on one channel. He said that he realized that it may be more difficult to manufacture a receiver to operate between 60 and 100 megacycles than 42 and 50 megacycles, but automatic-frequency control could solve that problem.

Paul Kesten, executive vice president of CBS, recommended 100 channels for postwar FM to accommodate up to 5000 stations, and at least ten nationwide networks. The coverage of a single market area rather than several separate markets also was proposed by Mr. Kesten. Such provision, he said, will increase the supply of FM facilities by permitting the same frequency to be used more often. Mr. Kesten pointed out that although CBS has filed application with the FCC for a multiple-market super-FM station on Mount Annebumskit, they are perfectly willing to forego these plans, which would provide coverage of several market areas in New England, if the FCC approves the plan of limiting FM licensees to a single market area.

The channel-width problem also was analyzed by Major Edwin H. Armstrong during one of the sessions at the hearing. He said:

"Disregarding for the moment the practical consideration of the frequency drift in the oscillator and the problems of maintaining alignment of the i.f. transformers and discriminators, and assuming that all factors are reduced in proportion, it is standard practice in the 200-kc. channel using a deviation of plus and minus 75 kc. to adjust the shape of the over-all resonance curve to be down to one-half its value in the extremities of the swing. Taking the same case for the 100 kc. channel and using a deviation of plus and minus 37½ kc., the resonance curve of the receiver will be down to one-half its value at the extremities of the swing. Under these conditions the third harmonic phase shift distortion in the receiver is doubled.

"Two procedures are open to bring the greater distortion on the narrow band down to the same value as the wider band. One is to reduce the swing until the distortion is the same and the other is to widen the resonance curve which, of course, defeats the original purpose. A reduction to ± 30-kc. swing at the least is mandatory both to reduce distortion and to allow for oscillator drift which is, of course, the same regardless of bandwidth. Disregarding the fact that the phase distortion is still higher than with the 150-kc. swing and that the fluctuation noise ratio in favor of the wider band is nearly doubled, the point of principal importance to examine is the ratio of the ignition noise interference. This is the most troublesome type of interference of all, and the ability of the system to reject it in the common case where it exceeds in level the carrier signal strength, depends on the ability

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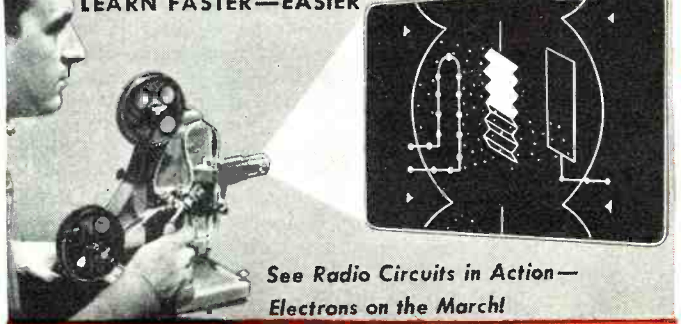

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to center the frequency of the balance point of the receiver. This centering is relative, and a drift of 15 kc. or thereabouts must be tolerated.

"Comparisons have been made of the ratios of ignition noise obtained under conditions where the frequency has drifted 12½ kc. from the center point, using receivers having bandwidths of 150 and 75 kc., respectively, each down 6 db. at the edge of the band. For equal signal outputs at the full swing of 150 kc. in the wide band and 60 kc. in the narrow band, the noise voltage level in the narrow band was approximately 3½ times that of the wide band. This gives a noise power ratio of approximately 12 times in favor of the wide-band system. It should be noted that where the level of the ignition peaks is high, the matter cannot be cured or the disturbance in the narrow band equalized with the wide one by any increase in the power of the transmitter within reason. For example, if the ratio of the ignition powers were 10 times the carrier level, a case of common occurrence, then an increase in the power of the transmitter of fifty-fold would not suffice to reduce the interference to the level of the wide-band system.

"In this consideration of the effect of oscillator drift, all the other elements of the receiver, that is, the intermediate-frequency transformers and the discriminator, were carefully centered with respect to each other. Any long-time change in their constants will further change the ratio to the detriment of the narrow band.

"I also would like to point out that the adoption of a 100-kc. channel will make the use of any multiplexing service a practical impossibility."

Supporting the 200-kc. channel width, W. F. Cotter of Stromberg-Carlson said that the continuance of this width is even more important than the actual position of FM in the radio spectrum. Incidentally, he said, moving FM to 100 megacycles would mean higher manufacturing costs and increased difficulty in receiver design. These costs would be increased from 30 to 50%. It would take about a year of development before the higher frequency type of receiver could be made, he declared. However, it is possible to design a receiver to accommodate operation between 80 and 100 megacycles or 90 and 110 megacycles.

J. E. Brown, assistant vice-president of Zenith Radio, also declared that 100-megacycle FM would be expensive. He pointed out that Zenith plans to produce an FM set for about $40, after the war.

The subject of quality also came in for a bit of debate. Worthington Lent of Bell Laboratories asserted that although the present upper limit of the audio-frequency range described for FM is 15,000 cycles, the hearing deficiencies of 75% of the population make that high degree fidelity useless. Mr. Lent declared that the point of 8,000 cycles, far under the maximum of 15,000 cycles described in FM fidelity, represents the point of diminishing return in broadcast sound services. He said that the sound values actually heard by most people can be achieved on FM channels as narrow as 100-kc. wide.

The general construction of high-fidelity receivers was impractical according to Mr. Lent. He said that few people actually hear or appreciate high fidelity, and a really high-fidelity FM set would cost a minimum of $200. Under questioning by the Commission, Mr. Lent did agree that inability of many people to hear or appreciate the very-high audio frequencies was no reason why others should be deprived of getting the best fidelity features possible with FM.

One of the most intriguing proposals of the hearing came from Joseph L. Weiner, representing a new group, some of whom are associated with Muzak Corp. Mr. Weiner proposed a new system of broadcasting without advertising known as "Subscription Radio." In this service, three types of programs, transmitted over as many channels covering classical music, light music and talk, would be available to listeners, at a rental service of 5c a day. So that this service would be available only to those paying for it, the signals transmitted would be "marked" with a squeal which could be eliminated only by a special filter made available to the users of the service. This filter, incidentally, is a patented device. According to Mr. Weiner, FCC granted a development license for such a system in 1941 but construction could not be completed because of material shortages. The frequencies asked for would be located at one end of the dial so as to avoid listeners cruising up and down the dial.

Mr. Weiner pointed out that the service would be available to any home with an FM receiver located in either of three major markets selected. He said that no advertising would be permitted at all, all revenue coming from the rental of the filter devices.

Supporting this service, according to Mr. Weiner, are William Benton, chairman of the Board of Encyclopedia Britannica, Inc., and Beardsley Ruml, chairman of New York Federal Reserve. It is possible that Chester Bowles likewise will serve on the board. Mr. Weiner said that estimated budgets on the cost of operation on the new system in three major markets have been set at approximately $1,000,000 for the first year, and approximately $10,000,000 for the first five years of operation. He declared that the subject had been discussed with many people. They are entirely satisfied that the operation is sound from an economic and engineering basis.

Mr. Weiner was questioned by Commissioner Jett about the monopolistic situation, citing that one company in a market area would be a monopoly. Mr. Weiner replied that he only asked for three channels in that he did not feel justified in requesting additional channels for long periods. Three chan-

T-30

T-45

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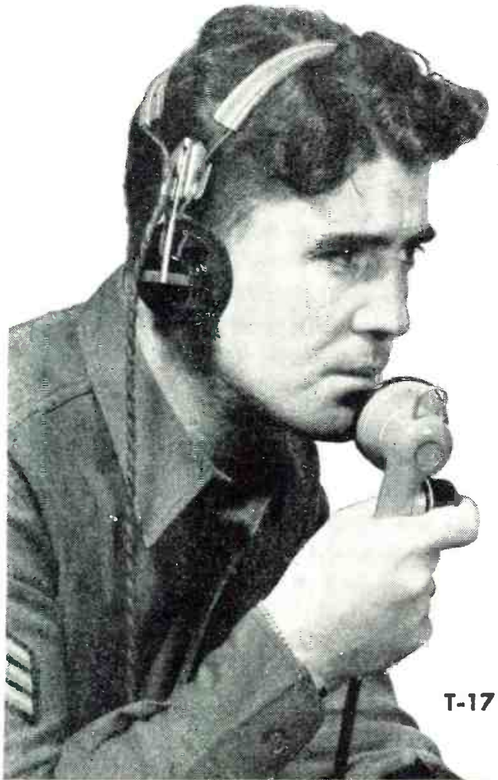

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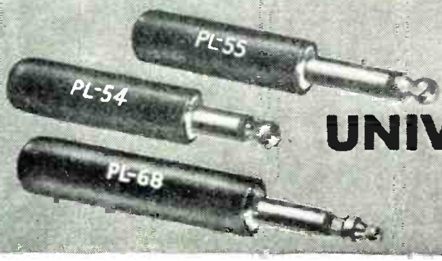

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nels should at the present time serve the purpose, he said. Another legal point was brought up by FCC counsel Denny who cited that present Commission rules limit FM station ownership in one area to one station. The present system according to Mr. Denny will require licensing of three channels to one station in the same area.

The general consensus was that the idea has great merit and should be given every consideration.

Educational units also showed great interest in the allocation subject at the hearings. Representing the National Association of State Universities and the Association of Land-Grant Colleges and Universities, Dr. Howard L. Bevis, president of Ohio State, declared that radio has become a formidable ally of colleges and universities. He said that public supported colleges and universities need broadcasting facilities to serve adequately the educational needs of their constituent populations. Such institutions, he said, will support future broadcasting activities of both AM and FM, with improved equipment, personnel, and finance. His recommendations included a group of medium-distance channels in the vicinity of 2500 to 3500 kilocycles for statewide coverage on 10-kc. channels, with power to 5000 watts for those stations using AM, and 15 FM channels in the 41- to 56-mc. band for exclusive educational use of universities, school systems and state departments of education. At the present time television is not being generally considered, he said, although universities are interested in its future possibilities.

International broadcasting, ousted by IRAC from the allocation listing at the recent State Department hearings, came to the full glow of life at the current hearings. Testifying in behalf of NBC and RCA, Raymond Guy, radio facilities engineer of NBC, said that RCA and NBC feel that the IRAC proposal is completely unsound. Direct international broadcasting should be continued, declared Mr. Guy. He said that according to the IRAC proposal hereafter no country would broadcast to another country, except to rebroadcast by stations located in the latter country. Mr. Guy pointed out that the IRAC proposal runs counter to the newly emerging American policy of international free speech.

Testifying as chairman of committee 3, panel 8 of RTPB, Mr. Guy presented a plan calling for 10 transmitters on the Pacific Coast and 16 transmitters on the East Coast. These transmitters would have frequencies of 10, 20, 25, 50, 75, 100, 150, and 200 mc. Directional antenna patterns were also presented. From the patterns shown, worldwide coverage was evident. Such coverage included beams directed to areas within program patterns. These program patterns would, according to Mr. Guy, be produced in the languages spoken in the areas being served. As an example, he cited the map of Latin America. Since Brazil is the only country in this area where Portuguese is spoken, a special program service would be set up for them. A beam directed to Buenos Aires would serve that portion of the Continent. However, the Western Coast of South America would be served by another beam, and so on. Areas covered by the beams included the Philippines, Borneo, Russia, Alaska, China, etc. Discussing the frequencies that will be suited best for such a service, Mr. Guy pointed out that over a late night totally dark path, 6000 kilocycles may be the best frequency to use. As dawn approaches, this frequency may become poor and a frequency of 9,000 kilocycles serve better. At dawn, he declared, 11,000 kilocycles may be found to be the best frequency, and as the day wears on, the frequencies used will become higher and higher, going up to possibly 25,000 kilocycles, after which the cycle would begin all over again. Because of this wide difference of frequency efficiency, not only throughout the day but for the season and year-cycle, Mr. Guy said that international broadcasting requires assignments in the 6, 9, 11, 15, 17, 21, and 26 mc. bands.

Mr. Guy also pointed out that time differences throughout the world permit an economy in frequency utilization. He said that the favorite listening hours for Europe, Latin America and the Far East occur at different times. And therefore a station may serve Europe during its preferred listening hours and then shift its beams to Latin America and serve that area during its preferred hours. At the conclusion of this period, service can be cut down and the time relinquished to a West Coast transmitter serving the Pacific area during preferred hours. Since these periods are in consecutive order, only one group of frequencies is required, cited Mr. Guy; thus there is no simultaneous operation and interference does not exist.

Paul Keston of CBS and Elmer Davis, Director of War Information concurred in the belief that international broadcasting is essential and that sufficient frequencies should be allocated for this important service.

The use of radio by the canning industry was also revealed at the hearings. L. P. Shirley of Libby, McNeil & Libby described 300 radio stations that are operated by the canning industries in Alaska, at canneries, fishing stations and fishtraps. These stations, he said, are important for the protection of lives and property. The Libby Co. has 60 stations and expects to expand after the war, he declared. The canning companies will require not only the present allotment of frequencies, but more, because of the projected expansion on the industry.

The amateurs were also represented at the hearings. George Bailey, president of the AARL, speaking in behalf of the "hams" said that "ham" activities in peace advance improvements in the radio art, support a manufacturing industry and serve many emergency

(*Continued on page* 96)

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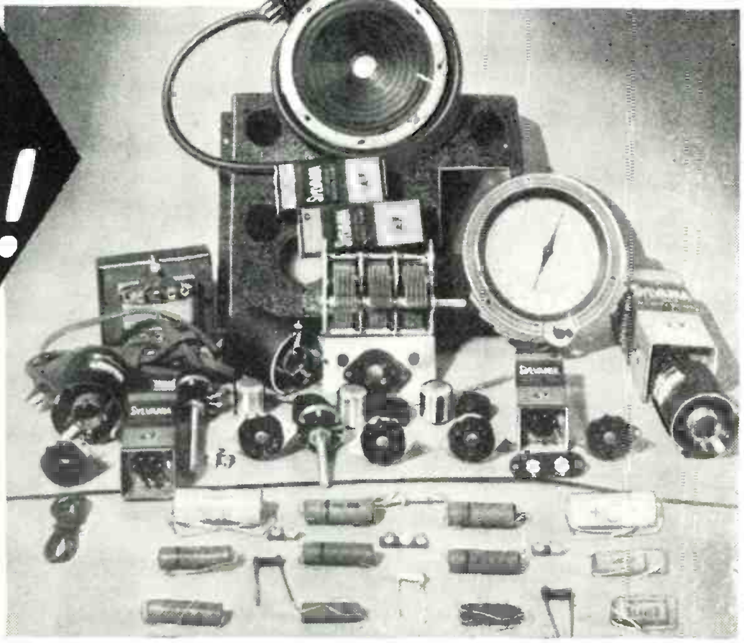

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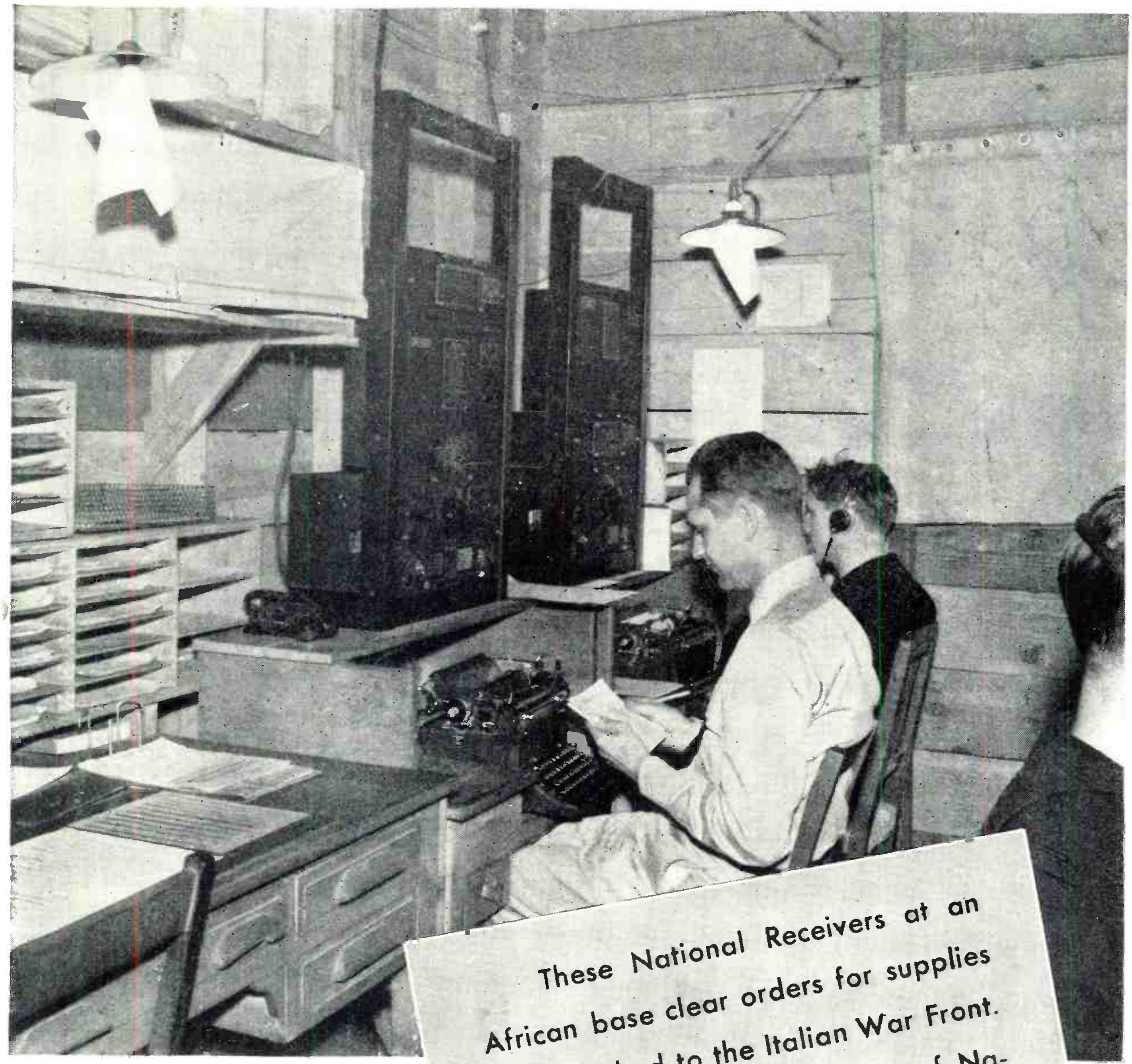

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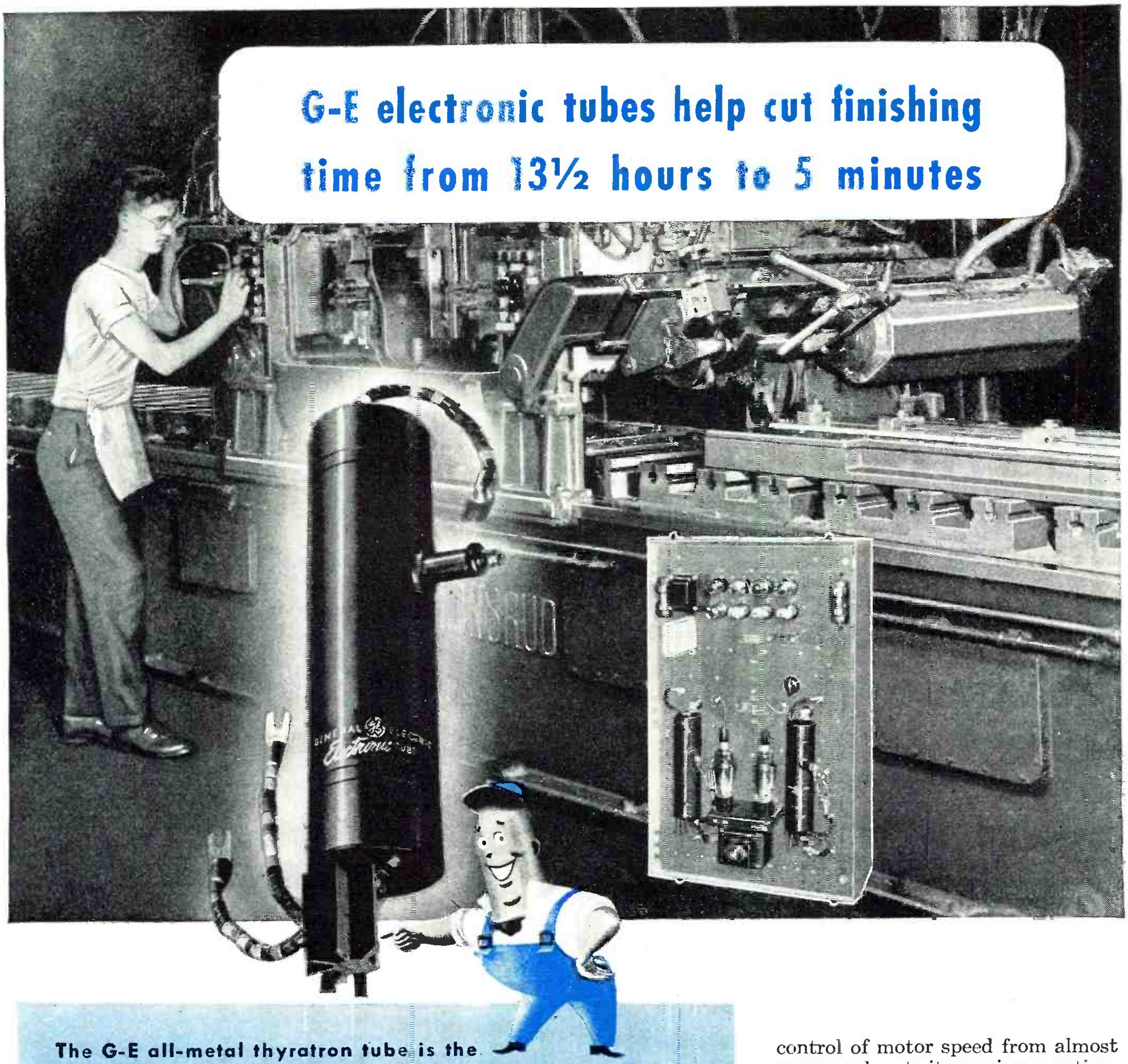

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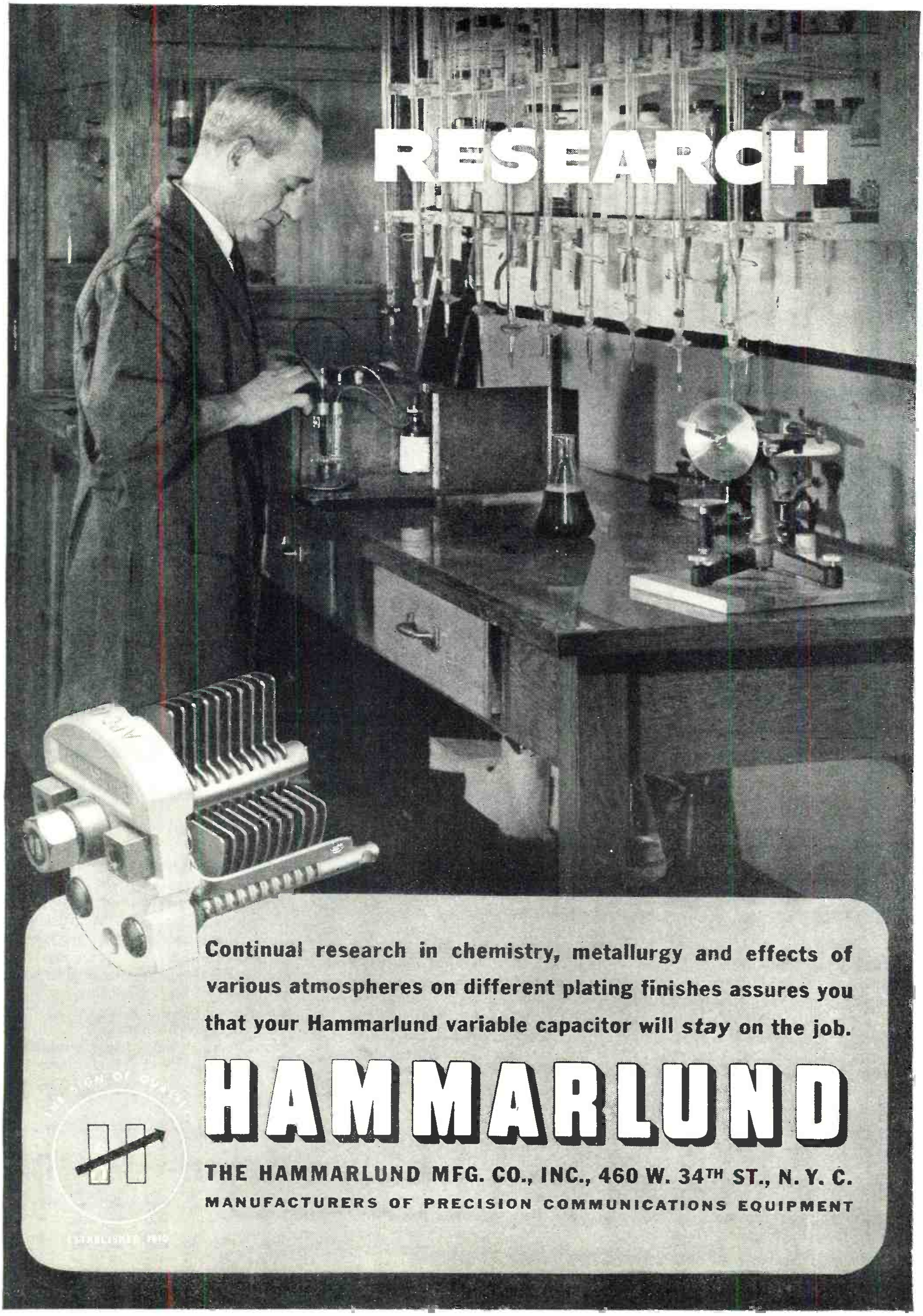

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APPROACH CONTROL FOR AIRCRAFT

By GLEN A. GILBERT
Chief, Air Traffic Control Div., CAA

Increasing volume of air traffic requires that airport traffic control towers regulate arriving and departing aircraft during instrument or contact weather.

AN EFFICIENT air traffic control system demands that pilots must be able to land and take off at airports with minimum delay due to traffic congestion. When the weather is unrestricted (contact flight rule conditions), the volume of traffic flow is dependent largely on the efficiency of the airport design and the effectiveness of the airport traffic control tower in regulating the movement of aircraft visible to the control tower personnel. When weather is restricted (instrument flight rule conditions), additional factors are encountered which have a bearing on the speed with which landings and take-offs can be accomplished.

Under conventional air traffic control procedures in effect today, only four or five aircraft are able to land at an airport in an hour when instrument approaches are required. Since the number of departures at a given airport over a period of time will equal the number of arrivals, it can be seen that at the present time conventional control procedures limit the capacity of an airport during instrument weather to approximately eight to ten aircraft movements per hour.

This limited capacity means that aircraft frequently are subject to considerable delay awaiting clearance to land or to depart. There is now a monthly average of 5100 instrument approaches at airports under the jurisdiction of the Civil Aeronautics Administration air traffic control service. Cumulative delay to the aircraft making these approaches, caused by traffic congestion, averages approximately 220 hours per month. In addition to this delay to landing aircraft, a comparable or even greater delay is caused to departing aircraft.

It is not uncommon for air carrier companies today to cancel flights because of the length of time they know an aircraft will be delayed awaiting its turn to land at airport of destination. Excessive delays to arriving aircraft cause missed connections for mail, express, and passengers, resulting many times in serious inconveniences and losses to passengers and shippers. Likewise, aircraft ready to depart frequently are held on the ground for long periods because of traffic congestion. At times, passengers are required to wait in the passenger terminal,—at other times the delay is encountered while the airplane must stand with its motors idling at some point on the airport. All of these delays mean not only inconveniences and annoyances to passenger and shipper, but also definite and large losses in operating costs of the aircraft. These losses are incurred by the air carrier companies as well as by the Army, the Navy, and the private pilot.

Far greater, but more intangible, are the losses to passenger and shipper due to cancelled conferences, missed business transactions, delays awaiting necessary equipment and

Douglas Skymaster, Army and Navy four-motored transport, with flaps lowered preparatory to landing.

other similar causes. The costs of the salaries of high military officials, business executives, and other persons suffering such delays also are a part of the total monetary losses attributable to these interruptions in air transportation. Delays in the movement of essential military aircraft and cargo are most serious and cannot be measured in dollars and cents.

Considering all of the various difficulties enumerated above, it is apparent that inability of aircraft to move to and from airports in great volume and with high frequency, during restricted weather conditions, is becoming a problem of serious proportions. As traffic increases, this problem will more than proportionately increase, and it is obvious that corrective action must be taken with least possible delay.

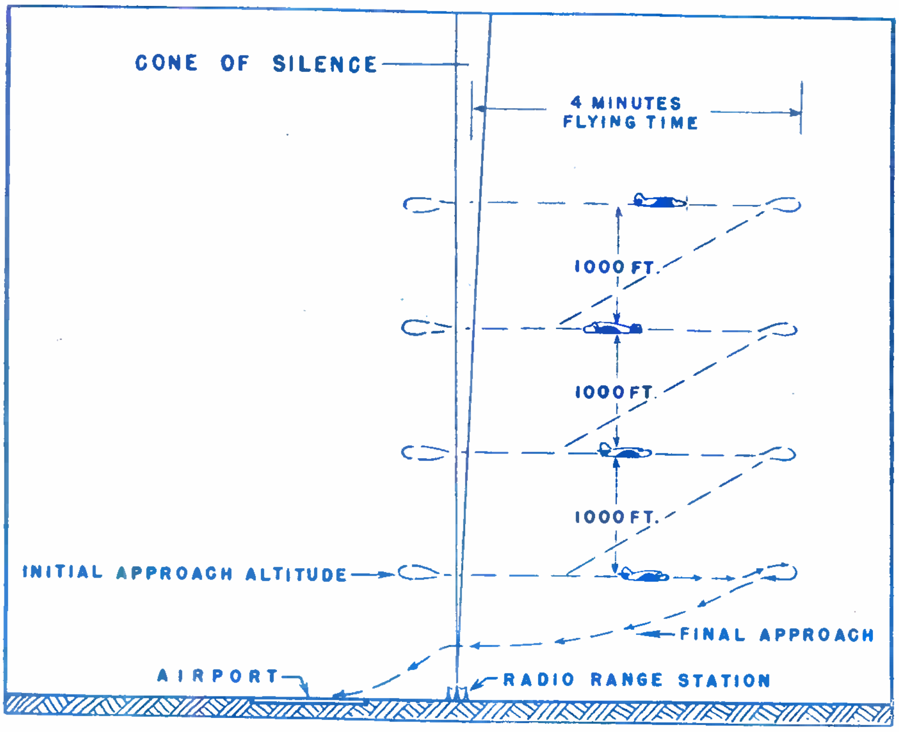
Remedial Actions

What actions are necessary to remedy the situation just described?

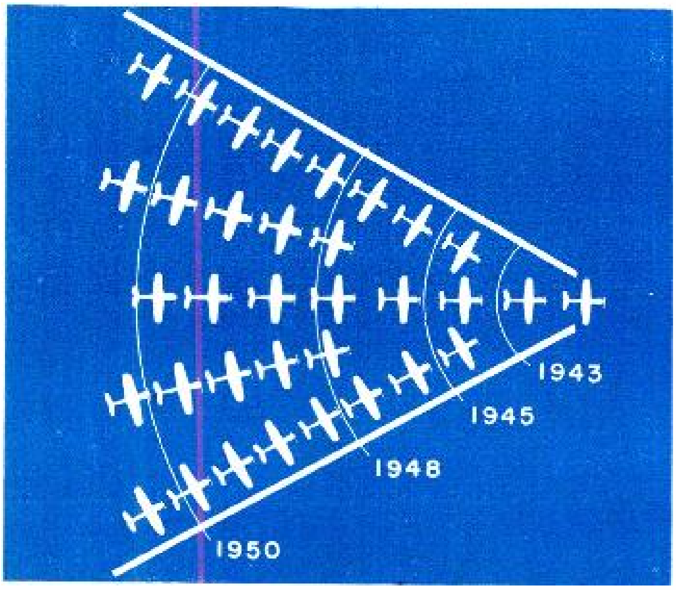
The answer to this question is a big one and one that will require considerable development and expenditure of funds in its attainment. However, one of the most important steps which can be taken immediately in improving air traffic control and reducing delays due to traffic congestion, is the establishment of "approach control" procedures by airport traffic control towers. These procedures merely involve the delegation of a certain amount of authority for the control of instrument traffic from an airway traffic control center to an airport traffic control tower. In effect, this delegation means that an airport traffic control tower is in charge of a "local airport control area" having a radius of approximately 15 to 25 miles, and having a ceiling of perhaps 6000 or 7000 feet above the ground. All aircraft in this local area are under the control of the airport traffic control tower, and the pilots receive their traffic control instructions directly from the control tower over its radio facilities. This is in contrast to the relay of instructions required under conventional procedures in which the airway traffic control center is responsible for aircraft during instrument weather conditions until the pilot has completed his instrument approach.

Approach control by airport traffic control towers, with proper arrangement of navigational facilities, means that Air Traffic Control can increase the capacity of an airport practically overnight from approximately 10 aircraft movements per hour to approximately 24 movements per hour. As experience in approach control is gained and technique is improved, by both ground and aircraft personnel, the hourly volume of air traffic at a given airport during instrument weather conditions should be increased to between 40 and 60 movements per runway in use.

The Civil Aeronautics Administration realized early in its development of the Federal Air Traffic Control Service that some form of decentral-

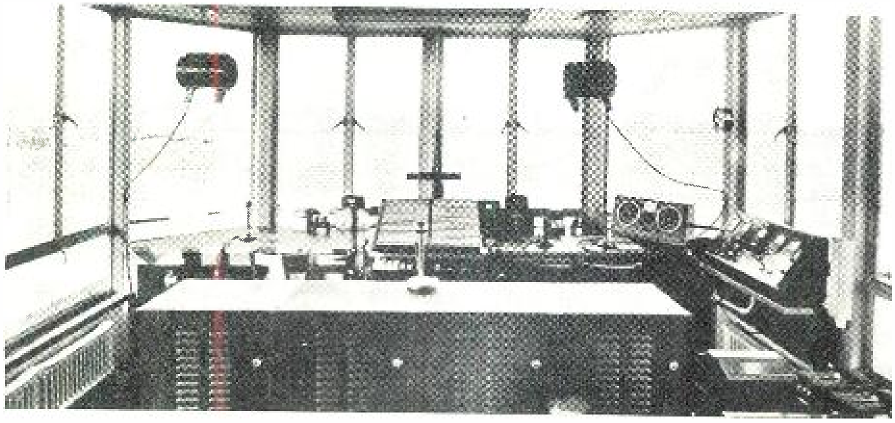


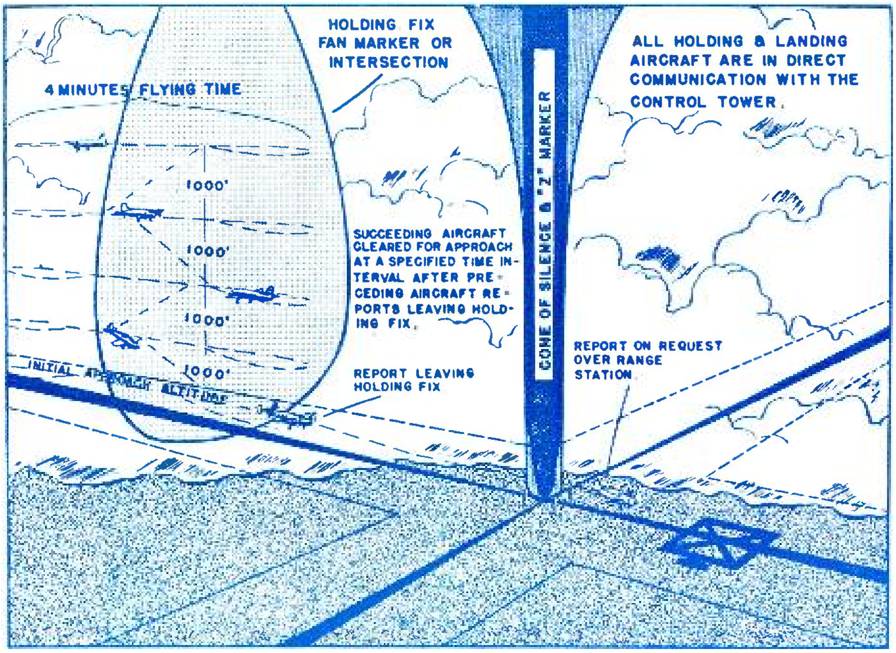
Holding (stack) at an airport in which the airway traffic control center clears aircraft for an approach, after the preceding aircraft has completed its approach.



Symbolizing expected increase in capacity of air traffic control to handle traffic to and from airports, based on anticipated improvements in facilities and techniques.

Airport traffic control tower equipped for approach control. Microphone in center operates voice channel of radio range. Other microphones operate low-frequency and u.h.f. transmitters. Instrument landing system monitor panel is shown at right, directly above the voice recorders.





Depicting approach control procedures, using the low-frequency radio range and a holding fix on the approach leg.

ization in the control of air traffic ultimately would be required. The first step in such decentralization obviously involved departing from the cumbersome method of controlling landing and departing aircraft by relay of all instructions to pilots to and from airway traffic control centers through various communication facilities. These facilities included air carrier radio stations, Civil Aeronautics Adminstration airway communication stations, military radio stations in some instances, and airport traffic control towers.

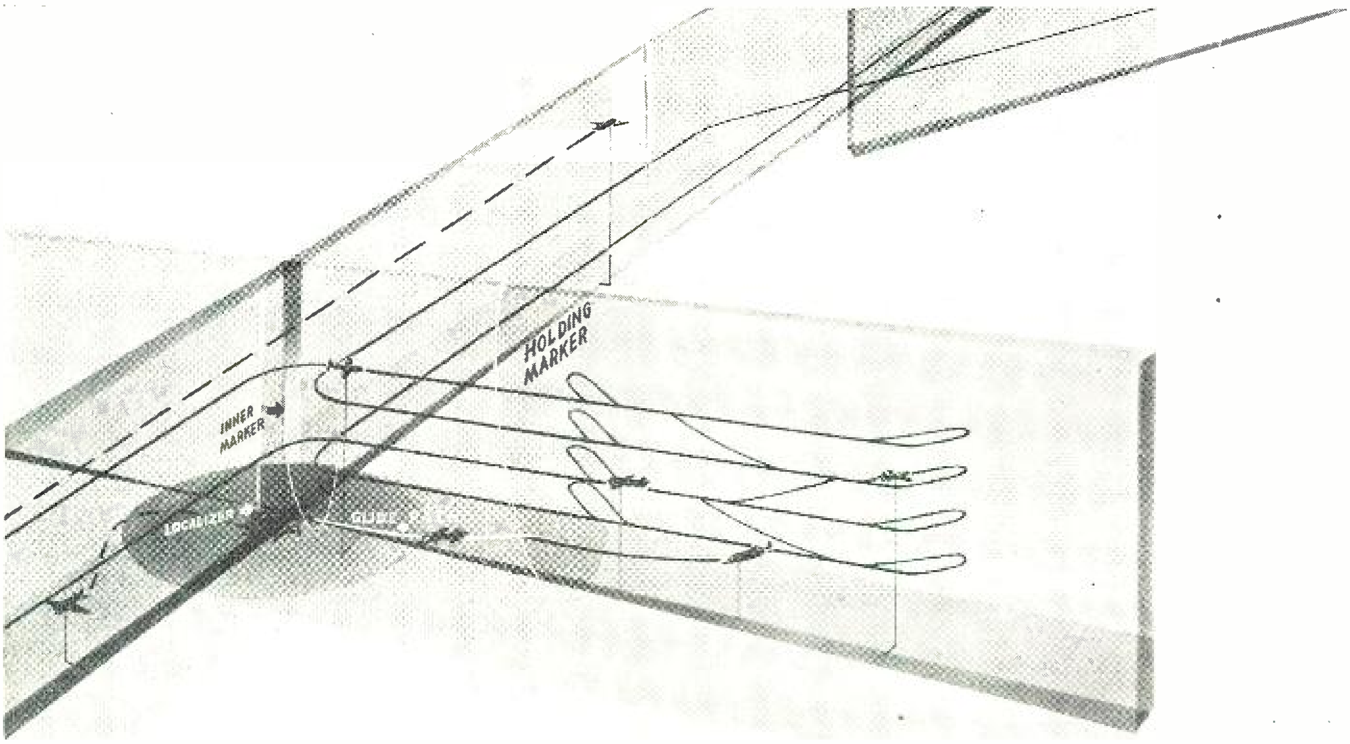
Two fundamental obstacles had to be overcome. First, communication delays due to the relay of instructions between pilot and airway traffic control centers had to be eliminated. Second, navigational facilities and instrument flight techniques had to be such as to permit aircraft to make instrument approaches at frequent intervals and in close succession. This was in contrast to the standard instrument approach technique which required aircraft to be held at assigned altitudes in a "stack" awaiting their turn to approach while each preceding aircraft made its approach one after the other. Since standard instrument approaches require approximately 15 minutes to execute, the time interval between aircraft landing during instrument approach conditions under such procedures of necessity must be approximately 15 minutes.

Thus it was that in the spring of 1940 the Civil Aeronautics Administration proposed at a joint conference attended by representatives of the Air Transport Association, the Airline Pilots Association, the War and the Navy Departments, together with supervisory personnel of its own air traffic control service, that a program identified as "approach control" be inaugurated. One of the main difficulties in the accomplishment of this program at that time, however, was the fact that airport traffic control towers then were under the jurisdiction of the individual municipality operating the airport. This introduced some problems in connection with delegation of authority, and it finally was decided that Civil Aeronautics Administration airway traffic control personnel would be on duty in each control tower at any time that approach control procedures were in effect. Another difficulty, and one which is still a problem today, was the provision of a satisfactory communication channel for approach control instructions from the control tower to all pilots under its jurisdiction.

After formulating the tentative pro-

(*Continued on page* 126)

One possibility for arranging v.h.f. airway ranges and instrument landing systems. Note that through and departing traffic will not interfere with holding and approaching traffic.



THE DISPERSION TRANSMITTER

By
H. W. KLINE

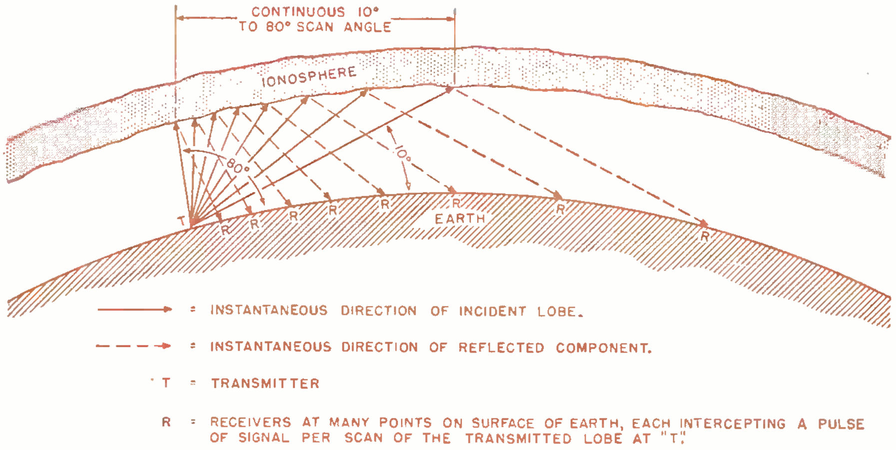


Fig. 1. This system is designed so that the radiated field load is swung to all possible vertical angles, as shown, so that skip distances can be avoided.

When planning that postwar rig, amateurs will do well to employ this antenna system to eliminate skip distance effects caused by ionosphere variations. Radio transmissions will be greatly improved.

THE following describes a radio-transmitting system developed to distribute nonfading signals to all radial points distant from the transmitter, without skips and regardless of shifts or vagaries of the ionosphere. The system is designed to swing the radiated field lobe to all possible vertical angles between the extreme incident angles of a composite antenna in the manner indicated in Fig. 1.

By continuously changing the resultant vertical incident angle of the radiated field lobe, dispersion of the reflected components from the ionosphere is accomplished and these components are caused to reach all regions on the earth's surface that otherwise would be skipped when the incident lobe is fixed, as in the case of the more common transmitting antenna in use today.

Transmissions of this characteristic also enable getting the signal into the greatest number of receiving antennas, all having different optimum angles of receptivity.

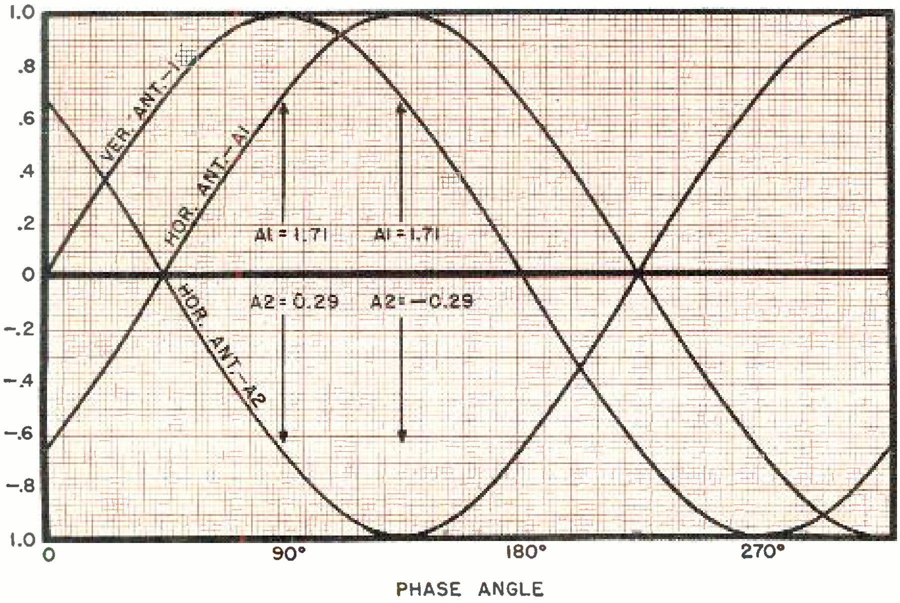
To enable this scanning of the ionosphere, an antenna having the capability of vertically swinging the incident field lobe at a supersonic or at a high-frequency rate, must be used. A simple form of antenna for doing this is described, wherein the scanning rate is synchronized with the carrier frequency. It was particularly designed to enable simple modification of existing transmitters. Its employment has resulted in reports from remote points of unusually strong, nonfading signals, while with no indications of skip transmission from nearby points.

Although the system was initially designed to operate on a carrier frequency of 7.15 megacycles, there is the possibility that it opens a path for long distance transmission of ultra-high-frequency carriers where emitted lobes are relatively sharp and depend on exact incident angles, during scanning sweeps, to produce signals at distant points, particularly if there is but one critical angle that must be found.

Although there are many other possible forms, the antenna system described actually consists of a combination of two antennas, a vertical radiator and a horizontal radiator in composite form. The incident lobe radiated from the vertical antenna, alone, is at lowest angle in respect to the earth's plane or about 10 degrees rise. The incident lobe radiated from the horizontal antenna, alone, is at highest angle in respect to the earth's plane or about 90 degrees.

The incident angle of the resultant, or combined field lobes of these two antennas, for all angles lying between the extreme angles, is regulated by varying the excitation between the two antennas. In order to do this at the carrier frequency, it was found necessary to obtain a phase displacement of 90 degrees between the energies fed to the antennas. How this was done is

Fig. 2. 45° phase displaced waves producing unbalance of heating currents in the thermoammeters. A1 will read high while A2 will read low.



explained in complete detail further on.

The transmitting antenna consists of a half-wave, horizontal dipole, open-center fed with a tuned feeder line approximately one-quarter wavelength long. The dipole was erected one-quarter wavelength above the earth so that the incident angle from it, alone, would be at a very high angle or about 90 degrees in respect to the earth's plane. This same dipole, together with its feed line, was employed as a top-loaded, vertical antenna, with an excitation phase shift 90 degrees from that of the horizontal section. As a vertical radiator, alone, the current maximum occurs at the top end of the feed line or at the junction of the feed line with the horizontal top section. This makes its operation analagous to that of a half-wave, vertical radiator with current maximum at one-quarter wavelength above the earth. The angle for a radiator of this type is very low or about 10 degrees rise above the earth's plane.

Referring to Fig. 6, the operation of the composite antenna as a vertical radiator will be considered. In the sketch the horizontal antenna coupling circuit L_1C_1 is shown decoupled from the amplifier tank for the purpose of more clearly considering operation of the antenna as a vertical radiator. The direction of the charging currents are as indicated by the arrows adjacent to the circuit elements.

A leading antenna current is obtained by utilizing the natural, equivalent antenna capacitance to earth represented by the capacitors dotted and marked as C. Both of the vertical wires radiate as a single, vertical antenna conductor. At any point along the parallel vertical wires, the instantaneous current or voltage is of the same polarity and amplitude in either wire. The top-loading arms are each one-quarter wavelength long and since the currents flow in opposite directions in these arms, the magnetic field from the top section during the vertical mode of operation is substantially cancelled.

Radiation from the parallel wire vertical is approximately ninety percent as efficient as that from an antenna having a physical height of one-half wavelength. Current maximums occur at the junction of the vertical wires with the top-loading arms and at the ground ammeter A3. The antenna has an effective resistance of about 62 ohms and the current due to vertical excitation at A3 is of the order of two amperes.

It should be noted from the foregoing that as far as operation is concerned, the feeders or vertical wires could be shorted at any point or along the entire height without in any way affecting the operation as an efficient, vertical radiator. The coupling circuit L1-C1, used for coupling in energy for horizontal antenna excitation, does not interfere with operation of the vertical radiator for reasons of phasing which are explained later, and for the following reasons:

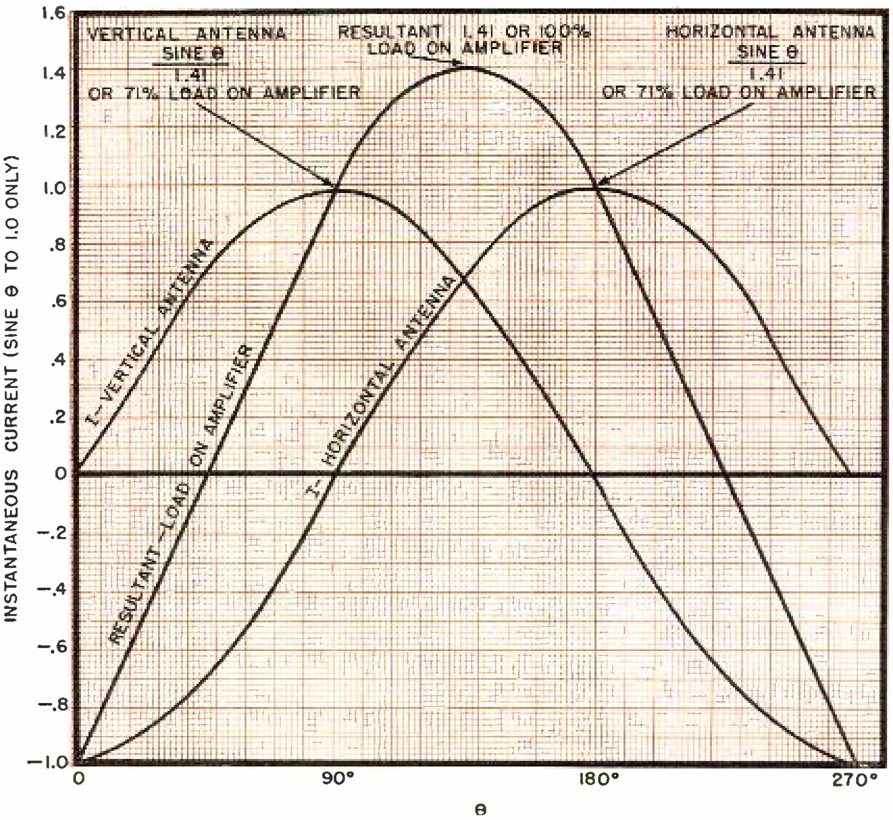


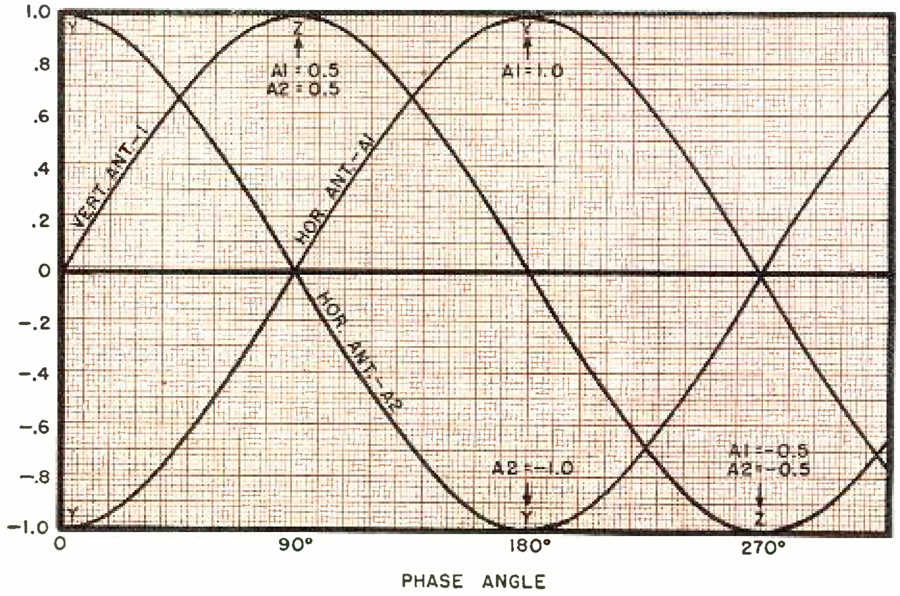
Fig. 3. Curves used to determine the permissible loading of the power amplifier by two simultaneous loads displaced by 90 degrees.

Since the vertical antenna currents flow in opposite directions in this coupling coil, the effective inductance is close to zero. This being the case, the reactance is negligible and only an insignificant component of effective resistance remains in series with the vertical members. In view of this, the horizontal antenna coupling circuit L1-C1 offers little if any impedance in the path of the vertical antenna currents.

The point on the amplifier tank circuit to which the vertical antenna clip is fixed, depends on the antenna circuit impedance at this point and ground and the 71 percent load limit on the amplifier. The amplifier is loaded by this antenna until 71 percent of the maximum d.c. plate volt-amperes are drawn. The d.c. plate supply voltage and plate current are used as an index of this degree of loading.

From the foregoing, it can be seen that it is definitely not intended for the vertical feed line to be used as a transmission line during those instantaneous periods of vertical antenna excitation. It is intended to operate as a twin-conductor vertical radiator. There are many types of vertical radiators

Fig. 4. Showing the rising of the horizontal-antenna currents as lagging the rise of the vertical-antenna currents by 90 degrees.



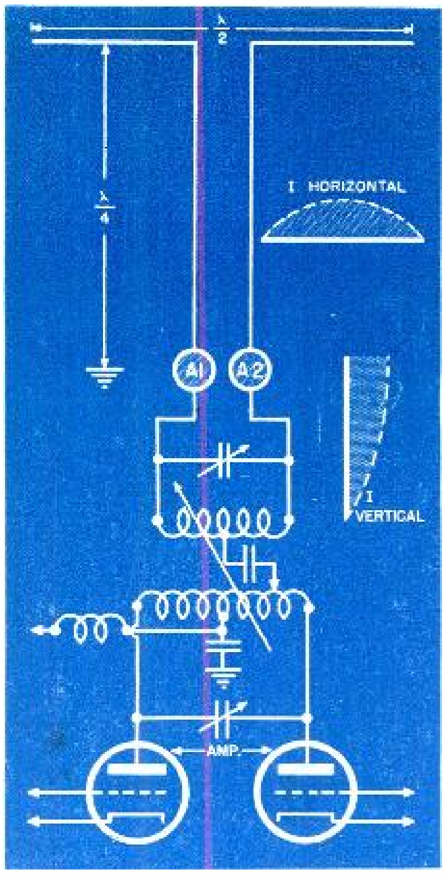


Fig. 5. Wiring arrangement, showing method of energizing the antenna. The half-wave dipole antenna is erected one quarter of a wavelength above ground.

that operate with more than one conductor in the vertical member. There are the cage, fan, pyramid, umbrella, and others. Operation is to be considered in this case as similar to these types except that there is a standing wave on the system one-half wavelength long as shown to the right in Fig. 6. In this instance, the currents

Fig. 6. Illustrating the operation of the composite antenna as a vertical radiator.

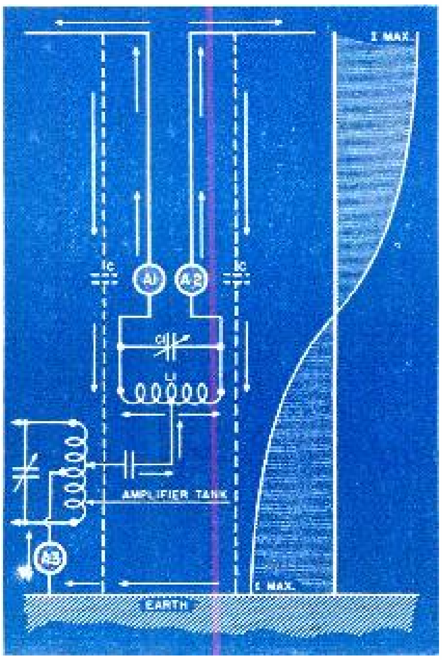


TABLE I

ANTENNA SYSTEM

Horizontal dipole	Center, Zepp fed; ½ wavelength long.
Height of horizontal above earth	40 feet.
Vertical Antenna	Same but center tapped and operated against earth as a top-loaded Marconi antenna.
Length of horizontal dipole	65 feet.
Length of vertical line	40 feet.
Incident lobe angle of horizontal ant.	Approximately 90°.
Incident lobe angle of vertical ant.	Approximately 10°.
Operating frequency	7.15 megacycles.
Hor. line currents with vert. "off"	0.45 ampere.
Hor. line currents with vert. "on"	0.45 ampere.
Phase angle between hor. and vert. ant. cur.	90 degrees.
Horizontal coupling to amplifier	Inductively coupled.
Vertical coupling to amplifier	Auto coupling from center tap of hor. cpl'g coil, through d.c. block capacitor to amplifier tank and to ground.

AMPLIFIER

D.c. plate power at full load	360 watts.
R.f. output power at full load	257 watts.
Plate efficiency	71.5 percent.
Plate current with vert. ant. only	0.213 ampere.
Plate current with hor. ant. only	0.215 ampere.
Plate current with both antennas	0.300 ampere.
Plate Voltage	1200 volts.

Summarizing the amplifier- and antenna-system operating conditions during a period in which initial long-distance tests were made.

flowing in the horizontal arms due to vertical excitation have been neglected because these currents are opposite and the radiated magnetic fields substantially cancel. The design is such that the current maximums are at the junctions of the vertical wires with the horizontal arms and at the ammeter A3.

Since the top-loading section is one-quarter wavelength above ground, the current supplied to the antenna at the ammeters A1-A2, is a small power charging current due to the reason that the antenna at this point is at highest impedance level and therefore must be voltage fed.

It will be attempted now to show how the composite antenna operates as two independent antennas, with noninterfering excitations as both a horizontal and a vertical radiator in which the excitation rises in one while it falls in the other and why this condition is obtained with a phase displacement of 90 degrees between the two exciting energies.

To begin with, it must be realized that the current in the vertical antenna is unidirectional while that in the feeders due to horizontal excitation is bidirectional. The ammeters A1-A2, average the effective values of all the increments of instantaneous current summations resulting in their respective legs. The characteristics of the instantaneous values of current involved are most important for analyzing results in this application.

Let us first consider a condition where the bidirectional, horizontal-antenna currents through A1 and A2 lag in rising by 45 degrees behind the unidirectional, vertical-antenna current. This condition is pictured in graph form in Fig. 2. The instantaneous value of current through either ammeter, at a time interval equivalent to the phase displacement along the X scale, is the sum of the current due to horizontal excitation and that due to vertical excitation. The vertical-antenna current splits in half, regardless of polarity, and flows in the same direction through each instrument. At instants when the horizontal-antenna current bucks the vertical-antenna current through either instrument, that instrument will, if the effective average is maintained, read low. On the other hand, the instrument operating in the adjacent leg will be forced to read high. A study of the graph, Fig. 2, will show that with a phase displacement of 45 degrees, the difference in current readings between A1 and A2 will be of the ratio of 1.27 to .566 based on r.m.s. values of the current waves. This was checked during actual phasing of the equipment. The phase shift is accomplished by the tuning of C1, Fig. 6.

It should be noted that there is much interference between the currents involved and it is doubtful if operation is correct with this phase displacement. This condition also is obtained with any phase displacement other than 90 degrees.

When the effective average of all the instantaneous values of currents flowing through ammeter A1 are equal to the effective average of all the instantaneous values of currents flowing through A2, the horizontal-antenna currents must be rising at a point which lags the rise of the vertical-antenna current by 90 degrees. Addition of the graphs in Fig. 4 will show the r.m.s. values of currents to be equal in both instruments, or approximately .997 amperes. The combinations of currents will be different when this phase displacement is other than 90 degrees and the ammeters A1 and

(*Continued on page 84*)

LOW-FREQUENCY TRANSMITTERS FOR ARCTIC USE

Low-frequency communications equipment designed and constructed to meet the rigorous requirements of northern climates

By H. P. MILLER, Jr.

Federal Telephone and Radio Corp.

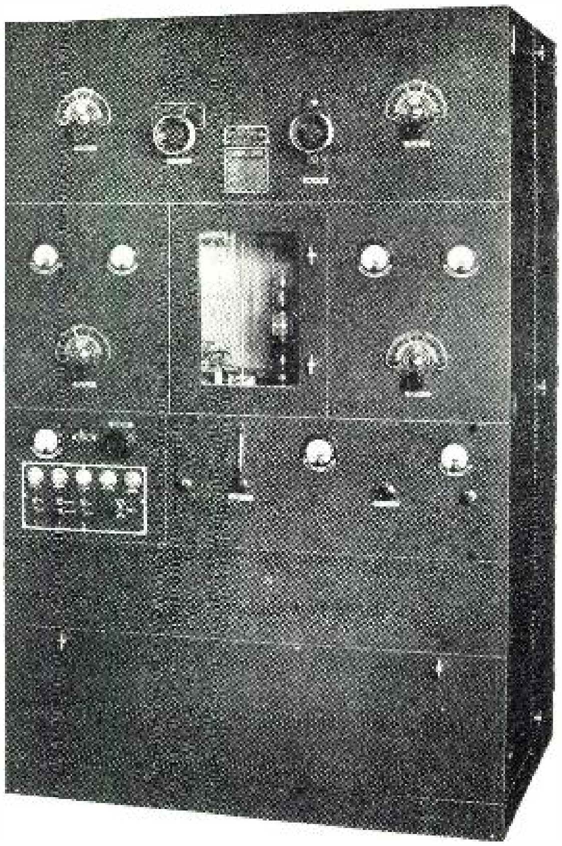


Fig. 1. The exciter unit is a complete continuous-wave transmitter in itself and can be used independently of the power amplifier and main rectifier unit. It delivers 500 watts on any frequency between 80 and 200 kilocycles.

PROBLEMS mastered in the pioneer days of radio are now helping present-day pioneers in the Far North to overcome the difficulties encountered in maintaining reliable communications inside the Arctic Circle. Improvements of the low-frequency or long-wave radio equipment that were considered by many radio engineers to be outmoded by high-frequency developments have made possible the solution of the unusual communication problems caused by the electrical phenomena in the proximity of the magnetic pole.

With the advent of improved transportation facilities in the Far North the question of communications has become increasingly important. The airplane has opened up new fields of exploration and exploitation which could not be utilized with old transportation methods, and has necessitated the establishment of thoroughly reliable communication systems both with the ground and between airports.

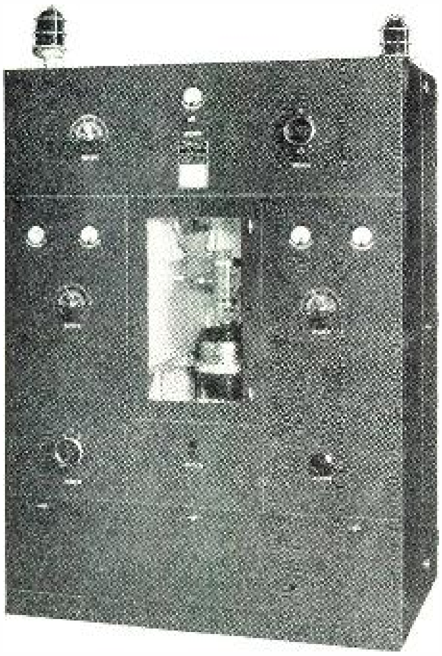


Fig. 2. Power amplifier unit of the 10-kilowatt low-frequency transmitter. A single-type 892R tube, air-cooled, is used.

Conditions of terrain which make traveling on the ground so difficult also complicate the maintenance of wire communication lines, so that radio is often the easiest method of communication. Between the plane and ground, radio is the only practical type of communication. In either case the radio facilities must be of a type to insure reliable communications.

The first radio transmitters installed in the Far North about 30 years ago operated on frequencies below 1500 kilocycles. The use of these frequencies resulted mainly from the state of the radio art rather than from any known advantage over higher frequencies. Satisfactory transmitters for higher frequencies were not available and in addition their development was discouraged because of the poor communications obtained at 1500 kilocycles.

In those days, theory, backed up by a limited number of experimental observations, claimed that all radio waves followed the surface of the earth with the wave intensity varying inversely as the distance from the transmitting station. Also, at a given distance from the transmitter, low-frequency waves were found to be stronger than those of a higher frequency. The result of these theories was a tendency to go to lower frequencies for long distance transmission. Very-low frequencies, however, required large antennas and high power to give good radiation, with the result that transmitting stations became enormous in size. One of the last low-frequency stations was erected by Federal for the U. S. Navy at Bordeaux, France, less than twenty-five years ago. It operated on 23 kilocycles with about 450 kw. of c.w. power delivered to an antenna supported on eight 820-ft. steel towers. This station was considered capable of providing reliable communication across the Atlantic Ocean.

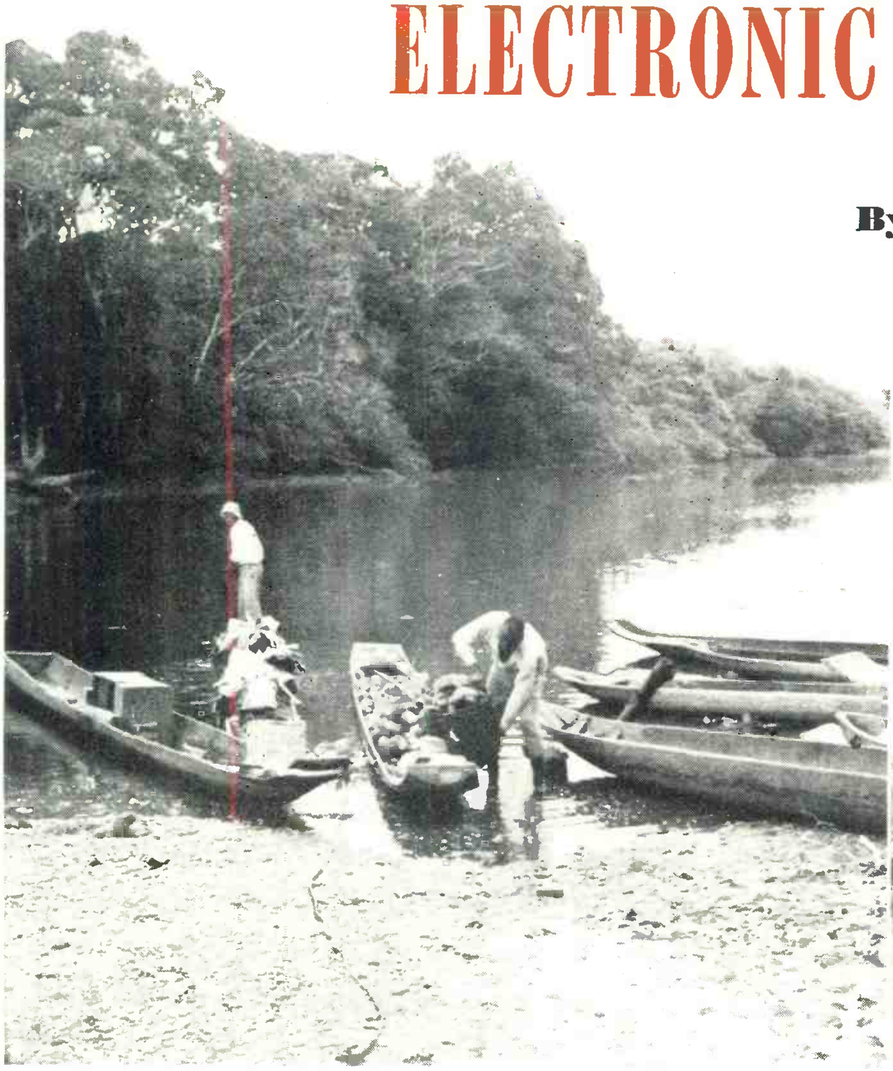
Some years later, with the advent of the vacuum tube, many amateurs, operating transmitters on frequencies above 1500 kilocycles. attained extremely long distance communications with the use of low power outputs. Evidence, obtained by a study of these frequencies and their use, proved conclusively that high-frequency waves did not follow the surface of the earth but instead were radiated into space and reflected by a region, called the Heaviside layer, back to earth. Knowing the approximate height of this layer by experimental observations the area where the waves were reflected back to the earth could be estimated without much difficulty. With properly selected frequencies it was found possible to communicate over long distance with less than one-tenth of the power that would be required with low frequencies. Furthermore, the antennas and equipment required for the higher frequencies were relatively small, much more efficient and could be made directive in order to radiate most of the power in a narrow beam.

It was natural that higher frequen-

(*Continued on page 82*)

Tropical Factors Affecting ELECTRONIC PRODUCTS

By DR. L. F. DYTRT



Chepo, Panama, where the author compiled the data presented in this article.

The design and construction of electronic equipment to prevent its destruction by conditions prevalent in tropical climates.

IN THE design, construction and application of electronic products that are destined for use in certain regions, such as the Central American portion of the tropics, the need sometimes arises to take into account besides fundamental factors certain nonfundamental ones. By these are meant those somewhat abstract regional elements and characteristics which are brought about by natural, economic and other causes, and which can affect both the performance of standard products and the capacity to utilize them. Exercising greatest influence thus in Central America are the factors: moisture; temperature; detrimental plant and animal life; and transport and communications. Each in what follows is commented on in a way to show forth its essential nature, its effect on electronic products, and its susceptibility to control or to having its harmful effects mitigated.

Moisture

Moisture in this part of the tropics is a factor to be looked upon as having both a high order of magnitude and a general effectiveness. Its order of magnitude may be appreciated through consideration of figures on annual rainfall and relative humidities common to many settled parts: such rainfalls, for example, not infrequently exceed 120 inches; similarly, relative humidities ranging from 80 per cent to 90 per cent may be regarded as fairly representative. Its general effectiveness, in turn, results from the largely unavoidable exposure of products to its influence. Placement of a product indoors, to illustrate this last point, is no safeguard against the ravages of moisture for most buildings in the region have large, screened openings to permit of cooling and ventilation; consequently, indoor and outdoor humidities are palpably the same. Furthermore, moisture is aided at times in its destructive efficacy[1] by salt particles that are deposited by the almost continually-blowing northeast trade winds.

The action of moisture on electronic products may for present purposes be viewed as both direct and indirect. By the former is meant here any action where moisture operates substantially alone to produce certain effects; by the latter, any action wherein effects are ascribable to cooperation of this factor with others or with other chemical compounds. Illustrative of direct action are absorption of moisture by most common dielectrics, this leading to reductions in the dielectric properties [2,3,4]; permeation by moisture of oxide and similar coatings used on such devices as dry-type rectifiers, a process which eventuates in device failure; condensation in enclosed spaces as wiring troughs, conduits, device housings, unfilled concentric cable transmission systems, etc.; and the subsequent flow of condensate to damageable or contaminable parts. Exemplifying the indirect action of moisture again are rusting of devices and parts made of iron, as happens in the case of equipment chasses and enclosures; corrosion of copper conductors in various coils and transformers [5,6]; dissolution of some of the elements that become deposited on various circuit components, as on resistors, condensers, and insulators, the resulting products sometimes laying the foundation for circuit instability; swelling and distortion of some bodies compounded of different materials, a result occasionally noted in the case of laminated insulators and metal die castings; fosterage of the growth of a few types of plant life on certain equipment parts that are made of organic materials; and the like. Plainly the field of activity of moisture is a large one.

One of several old, abandoned ant hills on a field in the interior of Panama presents mute evidence of the presence of pestiferous animal life.

Solutions to the problems presented by this factor, as might be surmised, are of various kinds. Nevertheless, an approximate resolution of them may be made in terms of those applicable to products having largely exposed surfaces, and those applicable to products that are confined within enclosing structures.

Generally speaking, solutions of the first kind consist in either the adoption of materials having inherently self-protective qualities or the utilization of particular surface finishes. They would be resorted to, therefore, in cases having to do with such apparatus or parts as cabinets, chasses, device housings, power machines, dry-type rectifiers, etc. However, since the adequacy of these solutions, mentioned so far only in general terms, is dependent upon choice of materials, extents to which finishing processes are carried, and the like, it is desirable at this point to review several specific practices that have proved reasonably successful.

Foremost among these is painting. When properly done upon prepared surfaces it generally assures a high degree of protection being afforded them. Its capacity to render this protection, though, should be perceived as resident in appropriateness of both the paints and the painting process. Seemingly fulfilling this requirement quite well is a practice comprised of the following steps: cleaning thoroughly all surfaces of rust, grease, scale, dirt or other foreign substances; applying to surfaces as soon thereafter as practicable a priming coat of paint, using thus a paint with a zinc chromate, aluminum powder, or similarly effective base; covering the primer when dry with one coating at least of a paint of intermediate or reserve quality; and, finally, overlaying the intermediate stratum with the desired outer finish. Paints forming the several coatings described, in order to be enabled to exhibit intrinsic qualities to the utmost, must evidently be coordinated among each other.

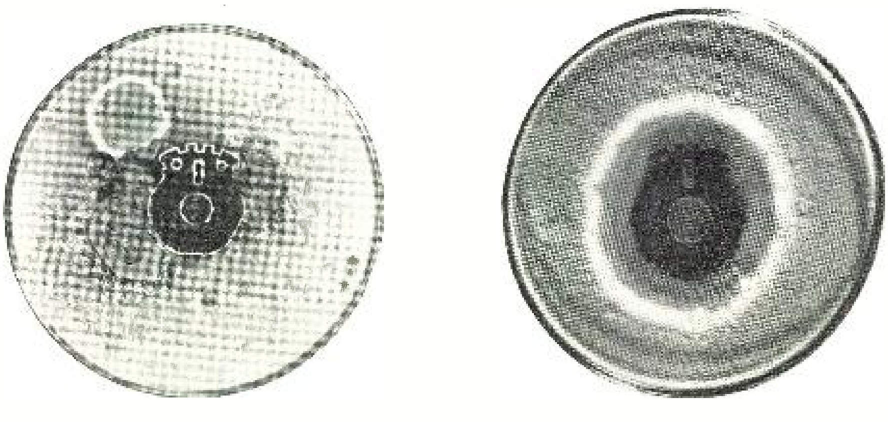
Another often-used solution to the problems begotten by moisture is the metallizing of exposed bodies with corrosion-resistant elements. Figuring generally in coats of this kind are zinc and tin, the former element being quite widely utilized. Significant about these metals is the observation that the effectiveness of both in the protection of bodies is seemingly high, irrespective of the method whereby they are deposited; in other words, electroplating, hot-dipping or galvanizing, and the like, all work out well. Presupposed in this last statement, of course, is that the thickness of any zinc or tin deposition be more than sufficient to insure its own continuance for a long period, and that the deposition were initially made under conditions favoring a good bond to the base metal.

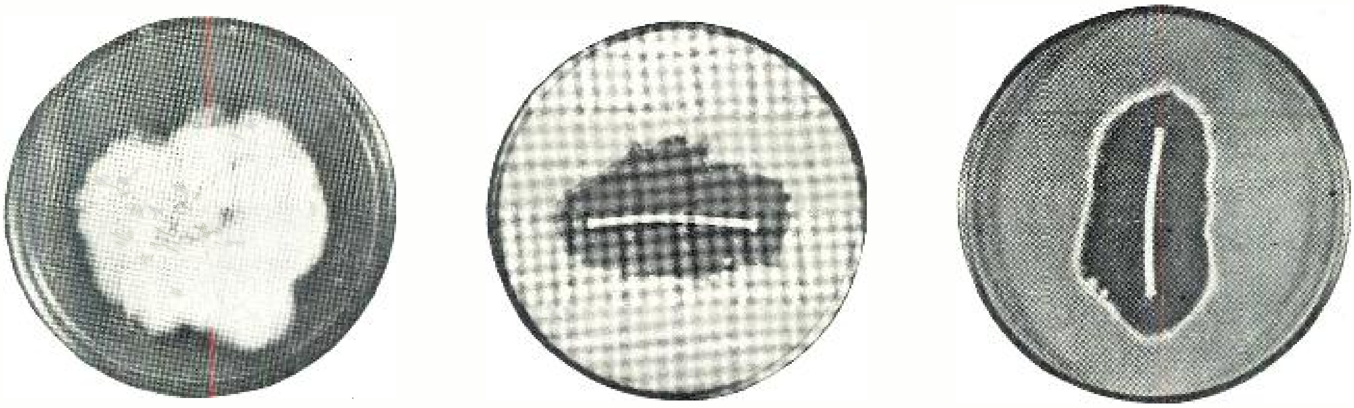
A third form of surface-protecting finish, a form resorted to for excluding moisture from damageable parts of such products as dry-type rectifiers, is obtained with certain varnishes. These, when applied to form a fairly heavy film over a surface, exhibit rather good moisture-excluding properties. Adequately heavy surface films may be formed as a rule by three treatment cycles of the product to be protected, each cycle involving brief immersion in the varnishes of such products and subsequent drying thereof.

A seldom-used, though potential expedient to prevent damage by moisture to exposed parts is the fabrication of them from special alloys. Numerous ones offer a high resistance to corrosion, so occasionally recourse to them may be justifiable.

Devices and parts mounted inside housings, because of shape, service, etc., can be given only partial protection from adverse moisture action by surface finishes. Additional protection usually has to be obtained through depression of the relative humidity of the air in the enclosed space, this being done by elevating the temperature of that air 15°F to 30°F beyond the ambient. Means for effecting such humidity changes vary, of course, with apparatus and circumstances. During

(Left) Bakelite that has not been treated properly with a fungicide; growth inoculation with Aspergillus niger No. 6277 spores. (Right) Similar bakelite piece that was properly treated with a fungicide, showing no growth over a wide zone; spore suspension of Trichoderma koningi.





Photos show treated and untreated wire that has been subjected to fungus growths. (Left) Untreated, showing heavy fungus growth; inoculation with Chaetomium globosum No. 6205 spores. (Center) When properly treated with a fungicide, showing no growth, with wide zone of inhibition; spore suspension 1 of Chaetomium globosum. (Right) Properly treated with a fungicide, showing wide zone of inhibition; spore suspension of Trichoderma koningi.

regular operating periods of most equipment, for example, sufficient heat to depress the relative humidity of the circulating air an appropriate amount is produced by electrical losses in devices; at other times it becomes necessary to derive the heat from auxiliary sources.

Provision of sources of this kind is now regularly made in the apparatus supplied by manufacturers of large power equipment (rotating machines, switchgear, etc.); but until recent years, at least, no comparable practice had been followed by electronic equipment manufacturers. To the former class of equipment there have been adapted, as such auxiliary heat sources, a few types of flat or tubular resistance units, known as space heaters. Electronic equipment, on the other hand, has had to be provided in large measure with heat sources improvised by the equipment purchasers themselves. Of possible interest are the following examples of such individual efforts: mounting within the enclosing structure of a resistance-type heater or lamp; attachment to the main unit of a subbase wherein heaters are housed; and placement of equipment over mouths of warm air ducts.

Any such auxiliary heating source, since it otherwise would contribute to the heat evolved from the apparatus to which it had been adapted, so exposing component devices to possibly excessive temperatures, should be rendered inoperative by a lock-out switching arrangement during periods when the main apparatus is functioning. For portraying the nature of a possible switching arrangement of this kind one will be considered with reference to a radio receiver in which is contained a space heater. Proper switching of the heater in this illustration could be effected evidently by making the main power-control mechanism include a multipoint switch so connected that: in the initial position of the switch both the radio and the heater would be completely disconnected from the power supply; in the second position of the switch the radio would still remain disconnected but the heater would be brought across the power circuit; and, finally, in a third position of the switch the radio could be energized while there the heater would be disconnected from the system.

Besides the steps described to depress relative humidities others have been taken to prevent inevitable moisture depositions and migrations[7] from reaching damageable parts. Two typical steps are: isolation of audio-transformer primary windings from direct potentials by operating the associated amplifier tubes on a shunt-fed basis through special reactors; and alteration of the relative potentials between circuit elements and mounting structures.[6]

Temperature

A proper appraisal of temperature requires that this factor be not regarded as an absolute and unitary influence. To be sure it acts at times wholly apart from other conditions, but most often it has a collaborative character. If regarded alone it hardly would appear as a factor of abnormal significance, and its actual capacity might easily be underestimated. Evidence to support this view may be found in figures representing values of temperature.

Such figures show that, for most places in the region under comment, the highest temperatures reached are not appreciably different from those experienced by many communities in the continental United States during summer months. Furthermore, these same figures disclose that the temperatures prevailing in any given locality of this tropical section vary but slightly about an annual mean. In the Canal Zone, to illustrate the last point, it is seldom that a day's record exceeds 90°F or falls below 70°F.

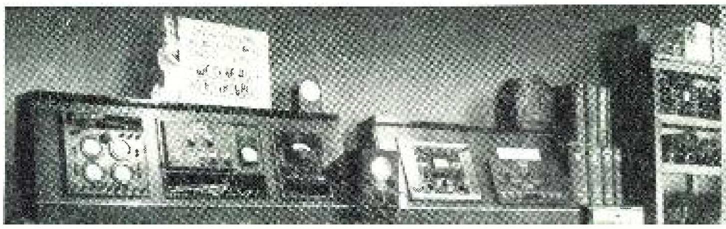
Untreated linen spiders for speakers, showing heavy growth; spore suspension of Trichoderma koningi.

Regarded so that all its active aspects become apparent, that is, in its status as a lone agent and again when acting in conjunction with other circumstances, temperature becomes an item of moment. It is then perceived: as a major obstacle in many cooling problems; as an influence tending to promote destructive plant and animal life; as a force restricting certain materials to limited use or excluding them altogether; as a phenomenon discouraging proper maintenance of apparatus; as a part of the cause of exudations of internal compounds in some insulated conductors as well as of migrations by intercalated lubricants in vertically suspended, varnished-cambric-covered leads; as a stimulant of corrosive reactions[8]; etc. It, indeed, appears to enter into just about every life-reducing, efficiency-lowering, and restriction-imposing process wherewith devices must contend. Seemingly harmless—potent actually, is perhaps the best brief description of this factor.

Most solutions to problems created here by temperature hinge upon simple physical principles as applied to specific situations. Machines and devices, for example, normally should be literally proportioned, and provided with adequate ventilating and heat-dissipating means. If such design is not possible for some reason an expedient such as water cooling of the air used to take up apparatus heat and subsequent recirculation of the air should be considered. Another desirable practice, one aimed to prevent the aforementioned lubricant migration from spreading to contaminable parts beyond the cable proper, is the use of cable terminators. Fitting of these in the form of potheads to most large power cables, in fact, is almost essential. Deducible from much of this and from the variety of appearances presented by temperature problems is the need for attacking each on an individual basis.

Fungi such as mildew, a short,

(*Continued on page* 89)



LET'S TALK SHOP

By JOE MARTY

Field Editor, RADIO NEW

This month the author discusses the problems of organization and licensing of servicemen

ONE of the problems that has bothered radio servicemen for a long time is the one of organization. Since most servicemen are rugged individualists, the idea of organization is not an easy one to settle. In view of the fact that servicemen are essentially small business men, and are individually without much influence, some type of organization would be a good thing.

There have been, in the past, numerous attempts to organize both on a local and a national basis. All of these attempts fell short of their original goal. There are today a few local organizations in operation. These local organizations in some instances have had a very successful career. There is only one national organization and that is in a state of suspended animation for the duration of the war. The above-mentioned national organization, the RSA, was organized in 1937 as a consolidation of 3 other groups that had some claims to national status.

The benefits of organizations are many. In the first place, it offers a means of getting together for the exchange of information and ideas. Since business men in any one community have common problems, a local organization provides a means of concerted action which helps materially in these matters. An organization further offers a means of settling differences which continually crop up in the course of everyday business. It acts as a stabilizing influence and results in the controlling of bad practices which were prevalent before the war, such as chiseling by customers, unfair competition, and other evils.

Manufacturers are very willing to cooperate with organized local groups in the matter of supplying speakers. In fact this is the best means for the individual serviceman to keep up to date on new developments. The manufacturers are enabled by these contacts to know more accurately what the serviceman wants and can then offer better service to him. Local groups have done much to raise the quality of service offered to the public. Standards of operation and conduct have been increased materially.

All good servicemen realize that they are in a minority and are in probably one of the most maligned groups in the country. Local service organizations can do much to help sell the serviceman to the public. Constant advertising is necessary to win back for the serviceman the esteem and respect which has been lost to him through the operation of "gyp-artists." It is unfortunate that the radio serviceman has been singled out for criticism by various individuals and publications when he is no more to blame than service personnel in other fields.

It is also unfortunate that the individual serviceman continues to be his own worst enemy in this respect. Up until the time of the war, the feeling was almost universal amongst servicemen that it was impossible to get the customer to pay a decent price for time used in repairing the radio set. The war has proved how fallacious is this theory and it is to be hoped that this lesson has been learned well by the serviceman. The serviceman then resorted to all sorts of subterfuges in order to get a sufficiently high price to enable him to show a profit on the job. This, of course, was fundamentally wrong. A laborer is certainly worthy of his hire and servicemen should take steps to see that they are compensated adequately by the public for the time and material that goes into a repair job. Unfortunately, the serviceman for all these years has been giving away the only thing he has to sell and that is his time. It is folly to expect to make a decent living only on the profit on the parts that are used in the repair of a radio receiver.

Many arguments have been advanced against organization. One of the first that comes to mind is that local and national groups can be used as pressure groups. This argument fails of its own weight since no one group or combination of groups represents enough business to dictate either to the manufacturer or jobber. There also seems to be a fear in the minds of some servicemen and of some local groups, particularly those which are affiliated with some national organization, that regimentation will automatically take place.

Another factor that has militated against the formation of local and national organizations is the jealousy among servicemen. Many groups have been organized only to fold up at the first hint that 5 or 6 men in the group were attempting to run it. The operation and maintenance of the organization has in the last analysis rested upon the shoulders of the more cooperatively minded members of the group. This minority seems to be the only ones in the organization who are willing to sacrifice their time and money to make the organization tick.

Were it not for these few men, there would be no successful organization.

"That reminds me, when are you going to repair the oscillator on the radio?"

Licensing

Some remarks regarding licensing are certainly in order here since the licensing of a group of men is in effect an organization. This problem has been discussed pro and con for a great number of years. It seems to be the feeling among a large number of servicemen that the mere fact of licensing would eliminate at once most of the troubles encountered in present-day organization.

The writer made a detailed study of licensing as it existed prior to the war, with the following results. In most cases where licensing was in effect, we found that the servicemen did not benefit to any great degree simply because the licensing arrangements were, in the first place, much too unwieldy, secondly, they were quite badly complicated, and third-

(*Continued on page* 100)

SOUND

A high-fidelity audio amplifier must be used. It is located on the lower shelf directly behind the frequency-modulation tuner.

By WILLIAM A. STOCKLIN

Assoc. Editor, RADIO NEWS

Constructional details of a sound reproducer, covering a frequency range of 80 to 14,000 c.p.s.

OF CONSIDERABLE interest to many RADIO NEWS readers was an article entitled, "Unique Sound Reproducers," which appeared in the November, 1943 issue. From the volume of correspondence received regarding this article, it was apparent immediately that additional information on both design and construction was desired by the readers.

In view of these requests, members of the staff of RADIO NEWS undertook the construction of a sound reproducer designed for frequency-modulation reception and exhibiting a tonal quality far surpassing present-day AM reception.

During preliminary discussions, it was decided that the completed unit should meet two definite requirements:

1. Both the low- and high-frequency response must be extended well over that possible to obtain with a standard home receiver.
2. The unit should be so constructed that its appearance would permit its use in any home with modern furnishings.

Present-day sound reproducers, regardless of type, do not extend the high-frequency range materially. However, this portion of the audio-frequency spectrum can be improved by using either a speaker designed for high-frequency response, or by using two speakers, one used exclusively for the higher frequencies (this speaker to be identical to the tweeter speaker used in many types of home receivers).

Prior to the war, many manufacturers had begun development work on the dual speaker. This unit consists of a 12-inch permanent magnet speaker with a five- or six-inch tweeter mounted directly in front of the cone. Some of these speakers reached the market before civilian production was discontinued, but such units are extremely difficult to obtain at the present time.

A single 12-inch permanent magnet speaker with a curvilinear cone was used for this installation. This speaker possesses a high-frequency response within 2 db. up to 10,000 cycles and then gradually drops off at 14,000 cycles. Since present-day home receivers utilize speakers with a range up to 7000 cycles, this arrangement represented an improvement and did much towards achieving the first requirement for the reproducer.

As dual speakers most likely will be made available shortly after the war, present plans call for the replacement of this 12-inch single speaker with a unit which will provide high-frequency response up to approximately 14,000 cycles.

Since the low-frequency response of the unit must also be taken into consideration, there are three definite variables which must be considered:

1. The resonance of the speaker, which should be as low as possible.
2. The construction of the cabinet, which must be as sturdy as possible.
3. The height of the column, which is determined by the distance that sound at a particular resonance frequency must travel before returning to the speaker cone.

Assuming that the cabinet is well constructed, the most important single characteristic in determining the low-frequency response becomes the height of the column itself. Sound waves emanating from the back of the speaker cone must travel down the length of the column and travel at right angles to the opening, finally returning at a diagonal to the top of the speaker.

When a single sound pulse travels this distance during the time of a single cycle, it will return to the top of the speaker in phase with the next pulse, thus aiding the response at that particular frequency.

Original plans called for a resonant

REPRODUCER for F.M. . . .

frequency of approximately 80 cycles per second. If this value were lowered, interference might arise from the 60-cycle hum which is present in most amplifiers. Since sound waves travel at 1130 feet per second, a column height of approximately 6 feet was selected. This height in no way detracted from the appearance of the unit, and proved adequate, as final tests indicated that the resonant peak was approximately 80 cycles per second. The first requirement, that of a high-quality sound reproducer, was fulfilled, with a total range of from 80 cycles to over 10,000 cycles per second.

As mentioned in the title, this unit was designed for FM broadcast reception. Amplitude-modulation reception should not be used to judge the final performance of the cabinet, as there is usually considerable distortion above 7000 cycles on present-day AM home receivers.

Construction

The construction of the unit is not quite as complicated as the photograph might indicate. Some knowledge of cabinet-making will, of course, be helpful. Besides the usual woodcutting tools, a circular saw is the only tool needed. For those who do not have access to tools such as the circular saw or bandsaw, it would be wise to lay out the various pieces and have the nearest mill shop cut them out according to the builder's directions. This is not costly and much time can be saved in construction.

Referring to Fig. 1, it will be noted that all individual pieces are pregrooved and glued to conform with good construction procedures. Nails were eliminated entirely and, where necessary, dowels were used. When the column itself was first constructed, four pieces of ⅝-inch plywood were used to make up the four sides. Each corner was made from a piece of wood 3¼ inches square. The outside corners were planed, filed, and finally sanded to produce the rounded edges. The corners protruding on the inside of the cabinet were cut as close as possible to reduce the total weight of the column. All four sides and four corners were properly pregrooved and glued the entire 6-foot length of the column, the bottom portion being cut off and used on the right-hand side of the cabinet, as shown in the side view of Fig. 1.

The shelves, shelf supports, top cap, bottom molding and lower speaker molding were constructed individually and glued to the cabinet.

The cabinet was constructed of white pine with the exception of the two shelves and cap. After the unit was completely assembled and sanded, it was covered with a reproduction of actual wood grains in a plastic veneer, manufactured by the *Meyercord Company* of Chicago. This plastic veneer is applied in sheet form and is cemented in place. Various designs can be obtained with such construction, including the refinishing of old, sturdily-built furniture to give a new luster of walnut or mahogany. In viewing the photograph or the original cabinet itself, one would not be able to determine from its appearance that it was constructed in this manner. The all-over effect is excellent.

The process, at present, is available only commercially, as highly-skilled craftsmen are required to apply this type of finish. However, plans are being made for the development of a simplified method of applying this material, which will enable the home constructor to make use of it early in the postwar era.

It may be well to mention at this point that in the period prior to the war, much of the furniture for the home, including radio cabinets, was constructed in this manner. With the simplified process being planned, no doubt the postwar era will find more applications of this material.

The two shelves and top cap were made of walnut, as they would receive more abuse and would be damaged easily if the plastic veneer was used. The home constructor can build the entire cabinet of walnut, mahogany, or any other wood that is easily obtainable. The attractive appearance of the original unit can be reproduced in this manner and the construction is simplified, therefore this method is preferable for the home builder. The constructor may prefer to use a soft wood of any variety and finish the cabinet

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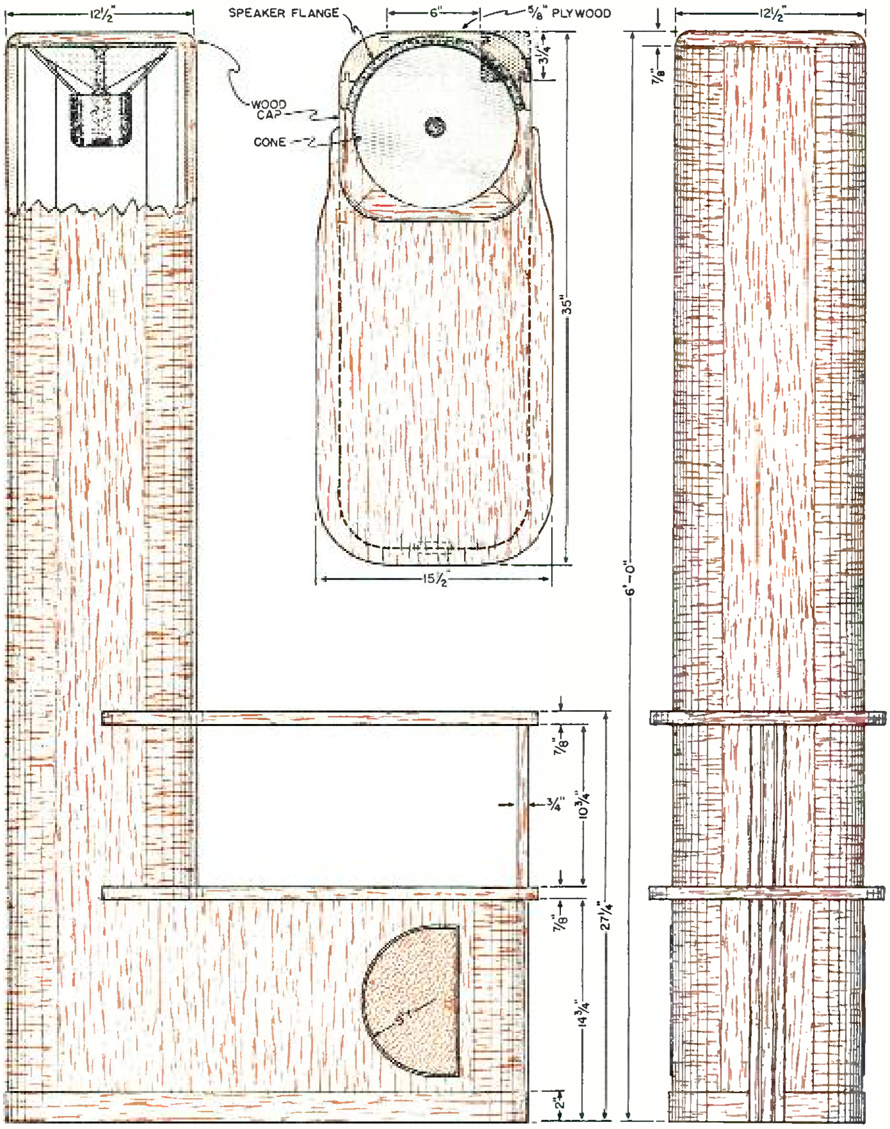


Fig. 1. Mechanical layout of the unit, showing all necessary dimensions.

Modulating Class "C" Amplifiers

By M. DEAN POST

Senior Instructor, AAFTTC

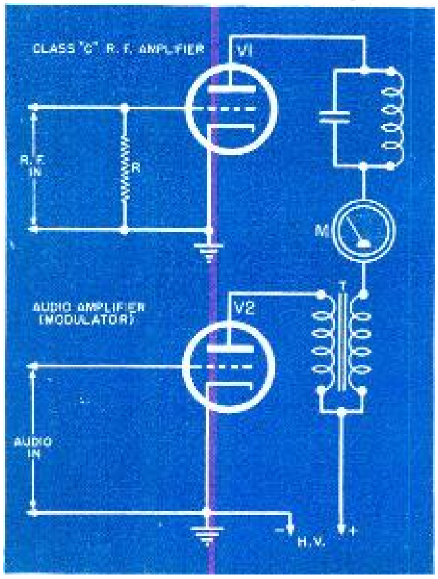
Important factors to be considered when employing amplitude modulation in class "C" plate modulated r.f. amplifiers.

ENTHUSIASM for frequency modulation is sweeping the nation, but amplitude modulation has not yet outlived its usefulness. It is, in fact, still the most common method of inserting intelligence into a carrier wave. From some of the questions asked by radio men, it is apparent that the subject is none too thoroughly understood even at this late date, and so long as such modulation is used, it deserves as much understanding as possible. There are some excellent texts on this type of modulation, but it is intended here to present some succinct facts without digressing too much into the realms of abstract theory.

There are several means of amplitude modulating a class "C" amplifier among them being plate modulation, grid modulation, cathode modulation, and combinations of all three. The first type will be used here for purposes of discussion, since all types accomplish essentially the same thing. Fig. 1 shows a typical schematic diagram, simplified for explanation.

The r.f. class "C" amplifier is so designed that the r.f. driving voltage appearing across the grid resistor *R* is rectified by grid-cathode current flow and causes a large d.c. voltage to appear between grid and ground, negative at the grid end. The amplitude of this potential is such that the amplifier is biased from two to four times cutoff. The audio signal is amplified by the modulator tube V2, and this signal appears across the secondary of the modulation transformer *T*. Conditions now have been set up for modulation.

Fig. 1. Diagram showing method of plate modulating a class "C" r.f. amplifier.



The audio signal has been inserted in series with the d.c. high voltage supplying the plate of the r.f. amplifier, so that it will alternately add and subtract from the total voltage appearing on the plate of V1, as shown in Fig. 2. It is apparent that, if the audio signal is of sufficient amplitude, it can be made to raise the total plate voltage to twice its normal value, and lower it to zero. This condition will result in 100% modulation of the carrier wave. Thus, an important requirement has been revealed: the peak output voltage across the secondary of *T* (Fig. 1) must equal the d.c. voltage applied to V1 if 100% modulation is to be realized.

The result of such efforts is to vary the carrier output in the manner of Fig. 3. For ease of drawing, this figure is a graph of the envelope of modulation, and does not include the individual cycles of r.f. energy that make up the body of the envelope. This curve is that of either current or voltage—not power—and is the one shown on the face of a cathode-ray oscilloscope when r.f. energy is applied to the vertical plates. The percentage modulation can be obtained from the expression

$$m = \frac{(E_{max} - E_{min})100}{2E_o}$$

where the voltages are as shown in Fig. 3. (It should be noted that the envelope above and below the zero axis is symmetrical and sinusoidal, since a sine wave was used initially as the audio signal. Thus, for detection purposes it is only necessary to remove the lower half of the envelope to obtain the original signal.)

The envelope of Fig. 3, however, does not tell the entire story. There remains, among other things, the problem of determining how much power is required to accomplish 100% modulation, and what happens to the radiated power.

The above envelope follows the curve

$$E = E_o\,(1 + m\sin \omega t) \dots\dots\dots\dots (1)$$

where m is the modulation factor (1 for 100%). This expression simply states that the carrier E_o is being modulated by a sine wave. Now, if it is remembered that power is proportional to the square of voltage, it can be stated that

$$\begin{aligned} E^2 &= E_o^2\,(1 + m\sin \omega t)^2 \\ &= E_o^2\,(1 + 2m\sin \omega t + m^2\sin^2\omega t).(2) \end{aligned}$$

If equation (2) is plotted over one cycle, the *envelope* of modulated *power* will be obtained as in Fig. 4. This curve seldom is seen in plotted form, since the voltage envelope is more readily adaptable to percentage-modulation measurements. However, Fig. 4 gives a clearer picture of the power relations than otherwise can be obtained, and serves to illustrate actual operating conditions. For convenience in calculating, values have been assigned—a carrier power of 300 watts being taken for a basis.

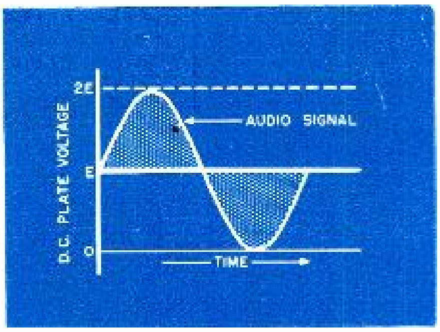


Fig. 2. Audio signal which is inserted in the plate of the r.f. amplifier tube.

The curve of Fig. 4 is striking in its dissimilarity to the voltage envelope of Fig. 3. Note the wide space of practically no power between cycles. This vacancy is caused by two things:

1. The negative voltage peaks of modulation have reduced the r.f. peak power greatly.
2. The time that each cycle of r.f. power flows has been narrowed, since the pulses of r.f. energy are very narrow at their tips.

The cumulation of these two items results in the extreme necking out of the envelope. The strangeness of the remainder of the curve is accounted for by referring back to equation (2), which tells us that there are three components present: the steady carrier, the modulating signal, and a double-frequency component which is represented by the $\sin^2\omega t$ portion. Apparently the process of modulation has added something new to the carrier—sidebands.

These sidebands are composed of sum and difference frequencies (carrier plus audio, carrier minus audio) and convey all the intelligence of the modulation. Thus, the carrier is truly named, since it contributes nothing towards the information contained in the wave. The carrier could be removed without loss to the intelligence conveyed, and in some types of transmission this is done.

It is interesting, at this point, to determine how the total power has been altered by modulation. Fig. 4 shows that the peak power is four times the unmodulated power—and this we would have known previously, since the plate voltage was doubled and this means in itself four times the power. If the total area (power) under the curve is compared with the total area enclosed by a full cycle of unmodulated carrier, it will be apparent immediately that the total energy has increased by half. Thus the total modulated power is 1.5 times the unmodulated power. Now, if the total modulated energy is ½ greater than the unmodulated power, the additional energy must have been supplied by the modulator. Again an important item comes into view—for 100% modulation, the audio system must be capable of supplying a power which is half the r.f. power. Furthermore, all the modulator supplies is sidebands.

The expression for the entire waveform of the modulated r.f. voltage is

$$E = E_o \left[\sin \omega_c t + \frac{m}{2} \cos (\omega_c - \omega_s) t - \frac{m}{2} \cos (\omega_c + \omega_s) t \right] \ldots\ldots\ldots (3)$$

This slightly formidable-appearing expression is really quite simple. It consists of the carrier power ($\sin \omega_c t$), the lower sideband which has a maximum amplitude of $m/2$ and is composed of the carrier frequency ω_c minus the signal frequency ω_s, and an upper sideband with the same maximum amplitude but whose position in frequency is the sum of ω_c and ω_s. The equation says that the amplitude of the sidebands is ½ that of the carrier when $m = 1$. Since power is proportional to the square of the amplitude, the sideband power is ¼ plus ¼, or a total of ½ that of the over-all power. It has been shown already that the total power increase at 100% modulation is ½; therefore the two sidebands must contribute the extra ½. Thus the ratio

$$\frac{\text{sideband power}}{\text{total modulated power}} = \frac{1/2}{3/2} = \frac{1}{3}$$

This proves that the sideband power is 33⅓%; therefore, the carrier must contribute the remaining 66⅔% of the energy.

From equation (2), it is apparent that the maximum *power* of the sidebands is proportional to m^2. It is thus important to keep the modulation as high as possible, since the total energy in these sidebands will decrease rapidly as the percentage modulation is reduced. For example, if the modulation were reduced from 100% to 80%, the intelligence-bearing sideband power would be reduced to 64% of its former value. This clearly shows that a high-power carrier poorly modulated would be no louder at the receiver than a weak carrier fully modulated

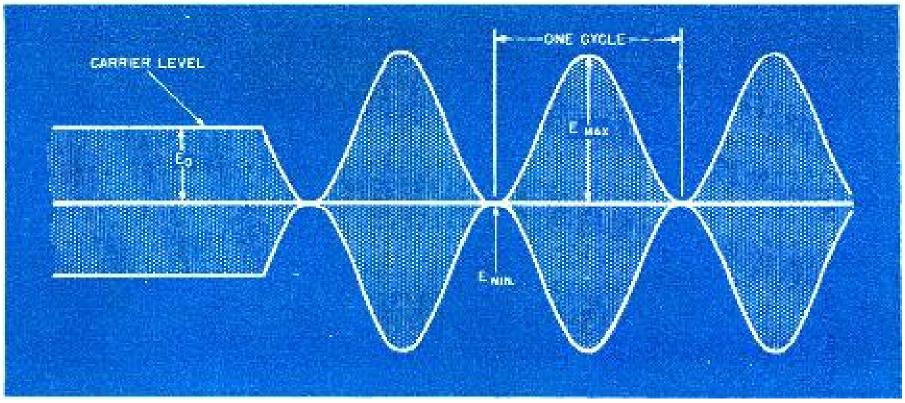


Fig. 3. Voltage envelope of the r.f. carrier when 100 percent modulated.

Fig. 4 is somewhat puzzling at first glance in that the carrier has been engulfed entirely in the total energy under the envelope, and is no longer distinguishable. As a matter of fact, it is impossible to state from such a curve that the carrier is actively engaged in producing 66⅔% of the total energy. This conclusion must be drawn from knowledge of the sideband situation: if the sidebands supplied by the modulator are accounting for 33⅓% of the total energy, the carrier *must* therefore be supplying the remainder.

The dotted line marked 450 watts in Fig. 4 represents the power to which the carrier would have to be raised if the continuous unmodulated power were to equal the 300-watt carrier fully modulated, and is the average value of energy over one cycle of modulation. It thus is evident that the class "C" amplifier, under modulation, is subjected to heavier loads. If the r.f. tube is to be modulated 100%, it must be operated at lower plate voltages than at telegraph or unmodulated conditions, since the plate dissipation is increased. The tube must be capable of handling twice the peak modulating voltage—otherwise, tube saturation will be reached and exceeded, causing overheating and overmodulation.

This brings up other items—those of downward modulation and overmodulation. When the class "C" amplifier is 100% modulated, the average d.c. current, as indicated by the meter M in Fig. 1, will not change its reading, or will just barely flicker upwards. This can be seen from Fig. 2; when the peak modulating signal is just equal to the d.c. voltage applied to the r.f. amplifier plate, the *average* increase (over one cycle) of voltage is zero. Therefore the average d.c. current flow produced will be independent of modulation. If the modulating signal is too large, it will drive heavily in the positive direction, and be cut off at the negative portion, thereby increasing the over-all d.c. voltage and causing more d.c. current to flow. This results in cutting off the modulated power for excessive periods between cycles, which causes distortion and the production of spurious sidebands. Many operators have operated their transmitters with considerable increase in d.c. plate current on modulation, thinking they were just "hitting it harder." They were—but with negative results. When a lamp load was coupled to the output coil, they were surprised to see the power

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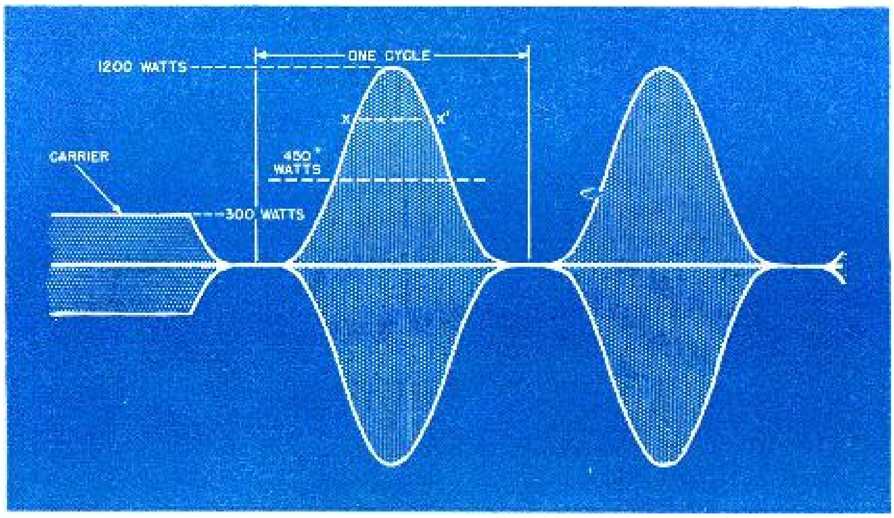
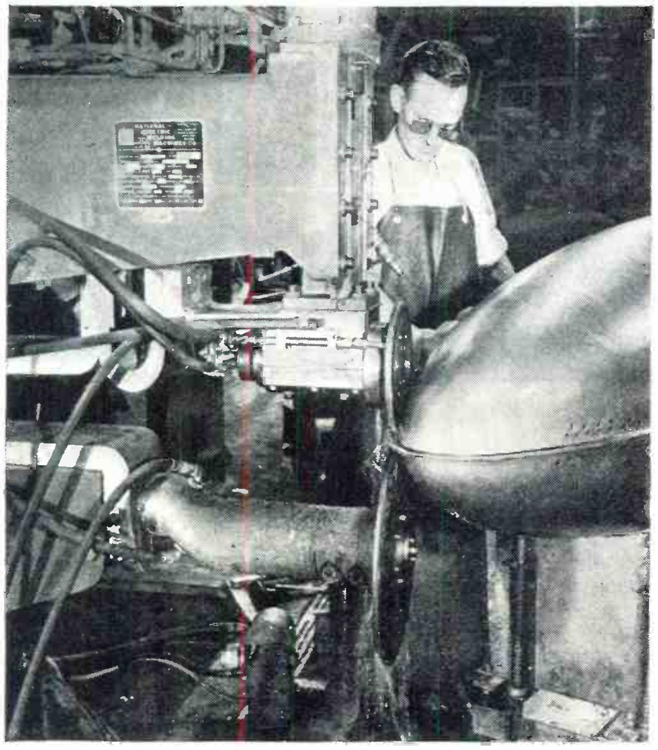
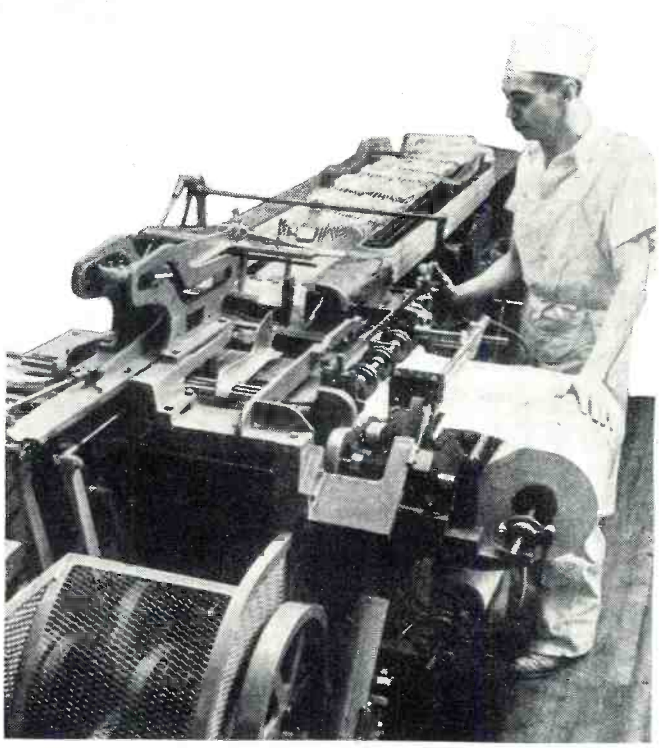
Fig. 4. Power envelope of the r.f. carrier when 100 percent modulated.





Seam welding a gas tank, similar to that used on many of our present fighter planes. Timing control of this process by electronic tubes insures a stronger and neater weld.



Register regulator used on a bread-wrapping machine. A photoelectric element, which is actuated by a contrasting spot printed on the wrapper, controls the cutters.

ELECTRONICS AT WORK

The part that electronic equipment is playing on our civilian front, both in industry and in the home.

By

HAROLD J. HAGUE

Electronics Eng.,
Westinghouse Elec. & Mfg. Co.

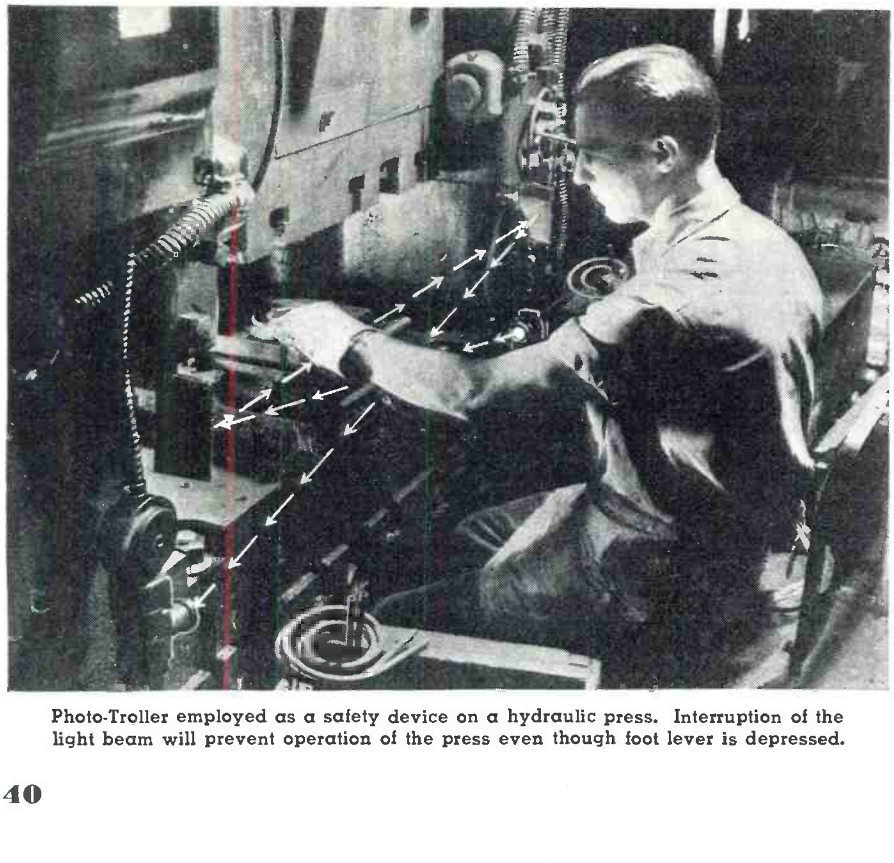
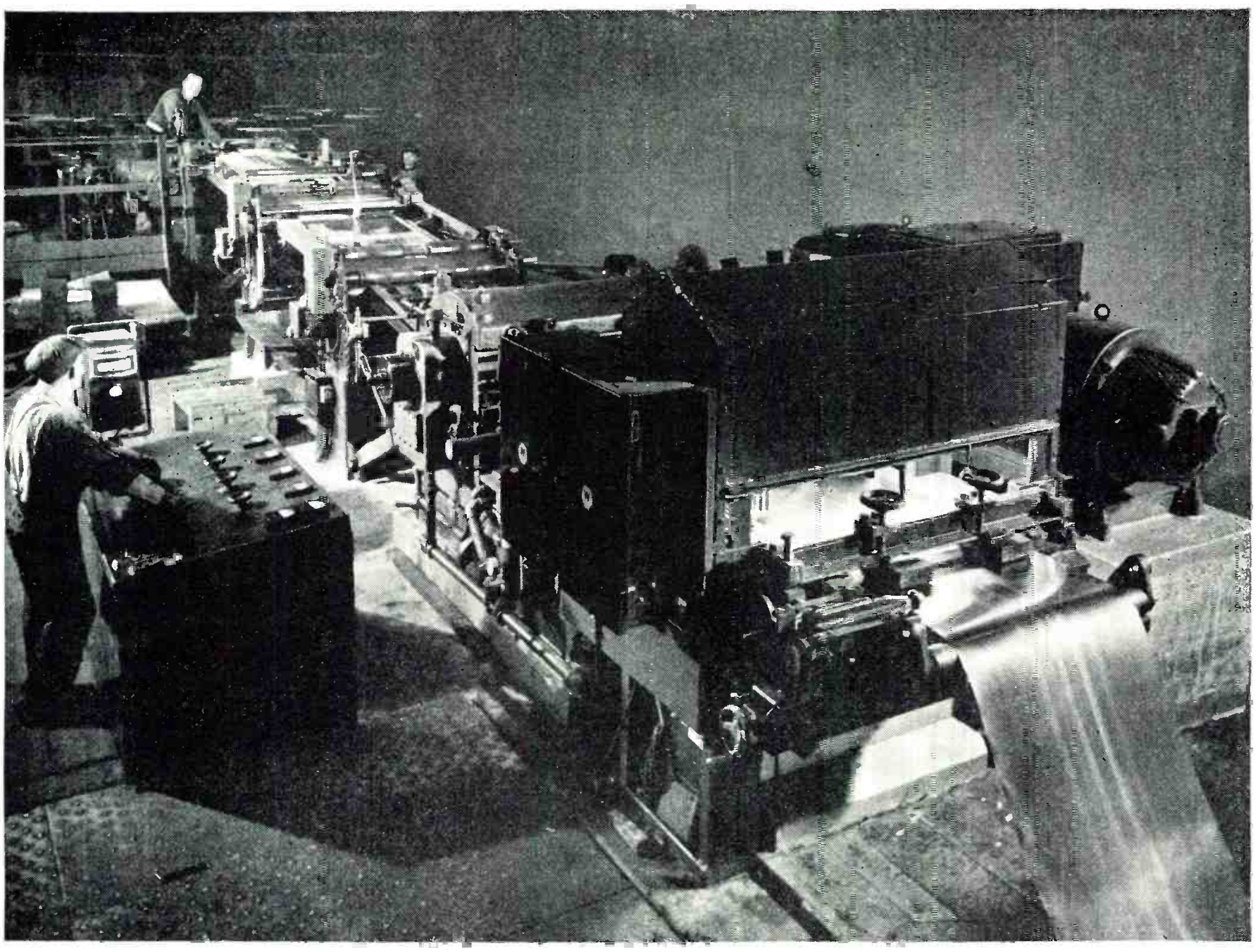


Photo-Troller employed as a safety device on a hydraulic press. Interruption of the light beam will prevent operation of the press even though foot lever is depressed.

FROM the advertising now being placed before the public in newspapers, periodicals and on radio programs, we are led to believe that electronics is a new-born babe. The same advertisements also lead us to believe that we must wait until "tomorrow" to enjoy the wonders of electronics. We do not have to wait until "the future" to see and feel the effects of the new electronics era. As a matter of fact, many of the wonders of electronics are already with us in our homes, offices, factories and yes, even in our places of amusement.

It is true, we cannot deny, that many new and startling developments have been made in the field of electronics as a result of the present conflict between nations, but in many cases we are already enjoying the wonders of electronics. For instance, today we sit in our easy chair and listen to the world's greatest melodies from our electronic phonograph; from our radio we hear the latest in the world's news, the World Series or even the campaign speeches of the politicians that we as citizens elect to run our government; the room is illuminated by what we call fluorescent light; we go to a res-



Photoelectric detector used to detect pin holes in metal strips at speeds up to 1000 feet per minute. Light shining through holes as small as one sixty-fourth of an inch will operate this detector. This type of control is used either to mark defective strips or to classify strips automatically.

taurant and we see small tubes, with the ability to destroy bacteria, used to sterilize the utensils; we go to a movie and we hear authentic reproductions of our favorite artists's voice from a small wavy line inscribed on the side of the film; we go to the local bank and the doors open automatically with absolutely no effort on our part, all we do is walk through a small beam of light. Yet, we still continue to think in terms of electronics as being something new and something very mysterious.

Actually, the science of electronics can be traced back to the time when the scientists recognized the fact that all matter consists of separate particles or atoms. Scientific records inform us that scientists performed many experiments to verify this theory way back in the early part of the 19th Century.

Today, we find that many industries have adopted electronics since electronic control developments have advanced to such a point that it can help increase production, reduce operating expense, do many things better than older methods, and can do many things

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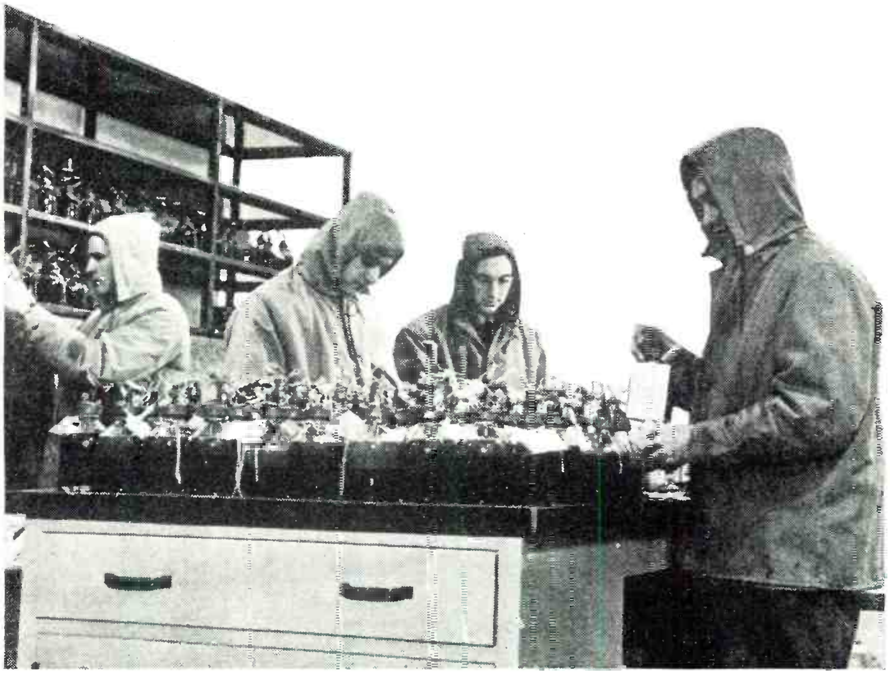


Sterilamp being used to kill bacteria. This lamp finds wide use wherever perishable products, pharmaceutical, or medical supplies are prepared, processed, or stored.

Amateur's Frequency-Deviation Meter

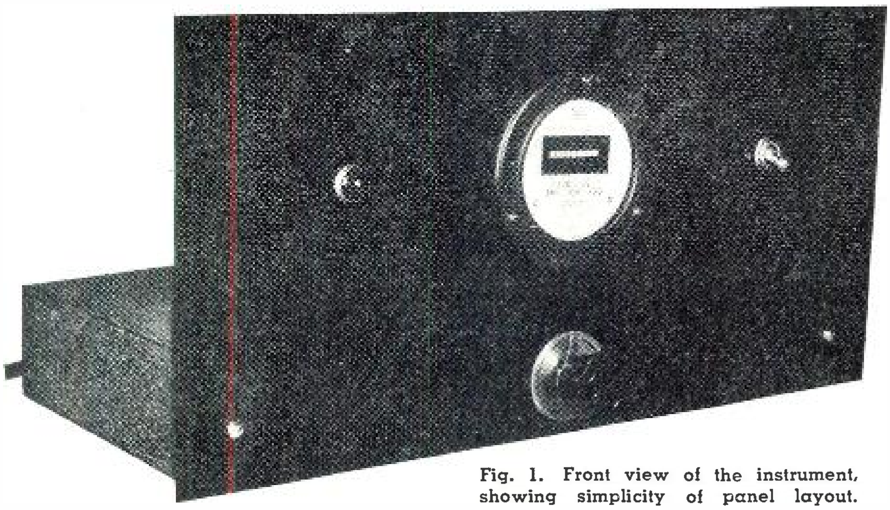


Fig. 1. Front view of the instrument, showing simplicity of panel layout.

By
RUFUS P. TURNER
Consulting Engineer, RADIO NEWS

Constructional details of a vibrating-reed-type deviation meter, for use with transmitters and oscillators

DEVIATION of a transmitter carrier in either direction from its assigned frequency value is indicated continuously and automatically by some type of *frequency-deviation meter*. Positive and negative shifts are shown plainly by the indicating meter of this instrument. When the transmitter is operating upon its assigned carrier frequency, the pointer of the meter assumes a central zero position.

The automatic frequency-deviation meter is a type of monitor, being operated continuously and requiring no manipulations for the taking of readings. This type is most often seen in the operating rooms of standard broadcasting stations where it shows deviation values up to 20 cycles above and below assigned carrier frequencies. It is usually so arranged that its direct readings are visible from a number of points in the operating room.

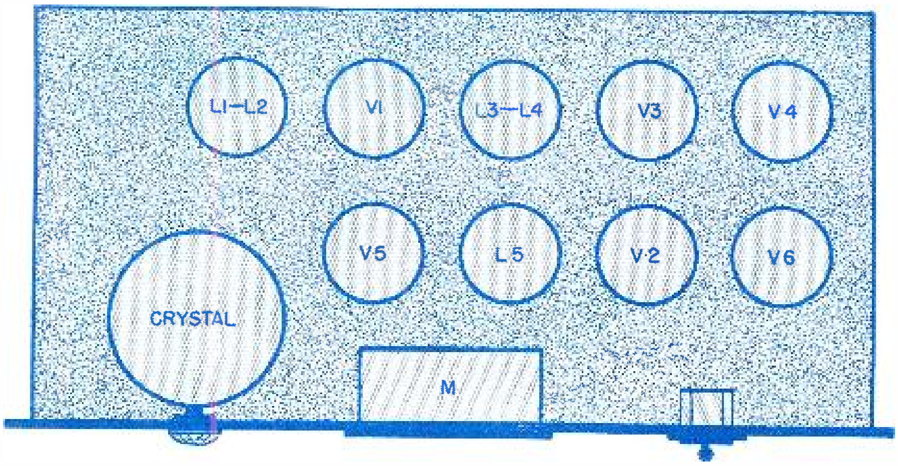
Principle of Operation

The mode of operation of automatic frequency-deviation meters is illustrated by the functional block diagram of Fig. 3. The transmitter signal is picked up by an antenna (generally a small vertical rod extending from the meter, or a short length of insulated wire) connected to the radio-frequency amplifier fix-tuned to the carrier frequency. The output of this amplifier is presented to one grid of the pentagrid demodulator.

A steady signal from the internal crystal oscillator is applied to another grid of the demodulator. The crystal controlling the oscillator stage is ground precisely to a frequency equal to the assigned transmitter carrier frequency (f) minus a value (k) which will establish a relatively low audio-frequency beat note between carrier and oscillator signals. The demodulator output voltage has the beat frequency f-k and is amplified by the a.f. amplifier stage to actuate an audio-frequency meter. The latter is capable of indications directly in cycles-per-second.

The value of k is so chosen that f-k will equal the midscale frequency deflection of the a.f. meter. Whenever the carrier f is upon its assigned value, the beat note delivered to the meter will be exactly f-k and center-scale meter deflection will be obtained. The meter scale, consequently, may be marked 0 (zero deflection) at this point. If the carrier frequency drifts below its assigned value, the beat note delivered to the indicating meter will be somewhat lower in frequency than the midscale value and the pointer accordingly will fall proportionately. Conversely, a rise in the carrier frequency above the assigned value will cause the f-k beat note to increase from the midscale frequency and the pointer will be deflected proportionately upward from the center readings. As a result of this action, the meter scale may be graduated further to show cycles-per-second above and below the midscale zero point, and thus to indicate *directly* carrier-frequency deviation.

Fig. 2. Chassis layout, showing proper placement of component parts. Trimmers are mounted below chassis directly under coil assemblies.



As a practical example, consider a carrier frequency of 1000 kc., and let us assume that the indicating audio-frequency meter has a 980-to-1020 cycle scale and will show 1000 cycles per second at midscale. The local oscillator frequency then must be 1000 cycles less than 1000 kc. (or 999 kc.) in order for zero carrier-frequency deviation to produce the midscale meter deflection of 1000 cycles.

A 20-cycle upward shift of the carrier frequency will then set up a higher beat note (1,000,020,-999,000) and the pointer will assume full-scale positive deflection at 1020 cycles. This point accordingly may be marked 20 cycles.

A 20-cycle downward shift of the carrier frequency will lower the beat note (999,980-999,000) and the pointer will assume a proportionately lower position at 980 cycles. This point accordingly may also be marked 20 cycles. But unlike the previous 20-cycle graduation, this point indicates deviation 20 cycles *lower* than the assigned carrier frequency. The first shows 20 cycles above. Intermediate-frequency points between 0 and 20 on both upper and lower halves of the scale will show the indicated scale values of carrier-frequency deviation.

Any other convenient frequency meter scale might be employed in the same manner. For example, a 480-520-cycle instrument will read 500 (zero deflection) at center scale, and the local oscillator crystal must be ground to a frequency 500 cycles lower than the assigned carrier frequency. A carrier deviation of − 20 cycles will be indicated in this case by a deflection of 480 cycles, and a + 20-cycle deviation by 520 cycles. Likewise, the 20-0-20 scheme necessary to indicate broadcast tolerance need not be adhered to in the case of other stations. Stations in the police, aviation, and experimental services, for example, might make use of frequency meter scales showing from several hundred to several thousand cycles on each side of zero.

Practical Considerations

It is desirable to keep the automatic deviation meter as simple as possible, both with respect to circuit and to the matter of adjustment. The input circuit must possess sufficient sensitivity to enable adequate carrier-signal voltage pickup some distance from the transmitter, with a reasonably compact antenna and without physical connection to the transmitter. The indicating frequency meter must be as stable in operation as practicable, and the internal crystal oscillator of extremely low drift. The instrument must be self-contained for best ease of operation, installation, and maintenance. And it is desirable that each of these conditions be satisfied with a minimum of tubes and circuits.

Most of the deviation meters in present use employ electronic-type indicating frequency meters. Such instruments require relatively elaborate subcircuits within the instrument, and these employ additional tubes—particularly small thyratrons. A series of adjustments is necessary to the initial setting of the indicating circuit and of checking periodically its calibration. Moreover, a reliable calibrating source, such as a high-grade variable-frequency audio oscillator, is necessary to such maintenance. Considerable simplification has been achieved in the deviation meter described in this article through the use of a reed-type frequency meter. Substitution of this instrument for the electronic indicating circuit has resulted also in an instrument which requires no periodic calibration and resetting and very little maintenance of any other sort. It may readily be duplicated by the shop or transmitter lab having limited facilities.

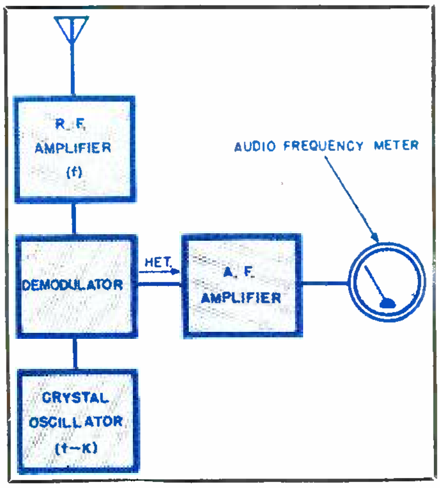
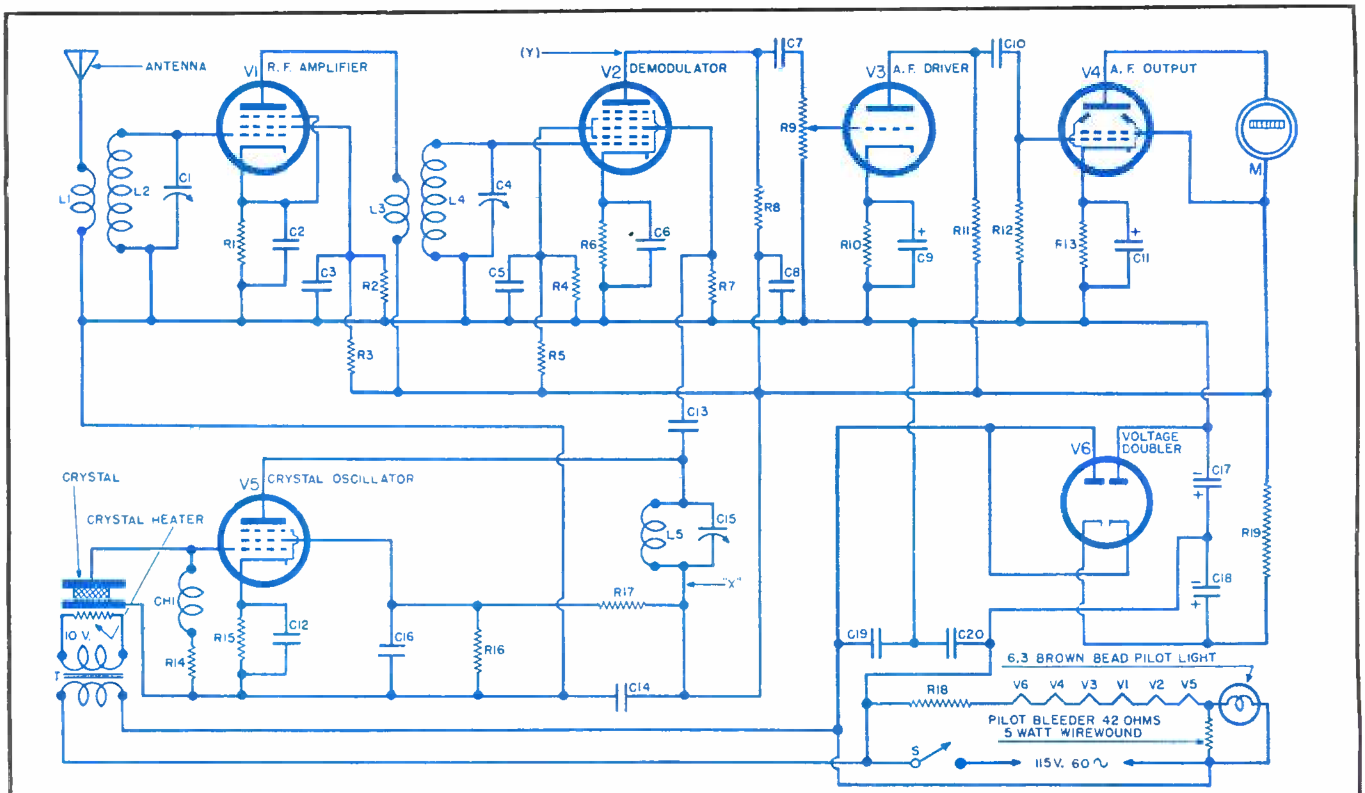


Fig. 3. Functional block diagram of instrument, illustrating principles of operation.

General Features

Basis of this deviation meter is the vibrating-reed-type indicating frequency meter. The actuated portion

Fig. 4. Schematic diagram of frequency-deviation meter. At some carrier and oscillator operating frequencies, it is advisable to insert a low-pass r.f. filter at the point indicated as Y in the diagram.



C_1, C_4, C_{13}—See Text
C_2, C_6 C_{12}—.1 µfd., 200-v. tub. cond.—Acrovox 284
C_3, C_5, C_8, C_{14}, C_{16}, C_{19}, C_{20}—.1 µfd.. 400-v. tub. cond.—Aerovox 484
C_7, C_{10}—.01 µfd. mica cond.—Aerovox 1467
C_9, C_{11}—20 µfd., 50-v. elec. cond.—Aerovox PRS
C_{13}—.005 µfd. mica cond.—Aerovox 1467
C_{17}, C_{18}—Sections of dual 16 µfd., 450-d.c.w.v. elec. cond.—Aerovox PRS
R_1, R_{15}—300-ohm, 1-w. res.—Aerovox 1098
R_2, R_4, R_{16}—40,000-ohm, 1-w. res.—Aerovox 1098
R_3, R_5, R_{17}—60,000-ohm, 1-w. res.—Aerovox 1098
R_6, R_7—1000-ohm, 1-w. res.—Acrovox 1098
R_8—.1-megohm, 1-w. res.—Aerovox 1098
R_9—1-megohm pot.—I.R.C. Type CS
R_{10}—1500-ohm, 1-w. res.—Aerovox 1098
R_{11}—50,000-ohm, 1-w. res.—Acrovox 1098
R_{12}—.25-megohm, ½-w. res.—Aerovox 1097
R_{13}—150-ohm, 5-w. res.—Ohmite
R_{14}—10,000-ohm, ½-w. res.—Aerovox 1097
R_{18}—112-ohm line cord res.—I.C.A.
R_{19}—2500-ohm, 50-w. res.—Aerovox 954
CH_1—2½-mh. r.f. choke—National R100
L_1, L_2, L_3, L_4, L_5—See Text
M—380 to 420-cycle Vibrating-Reed Freq. Meter J.B.T. Model 33-F
S—S.p.s.t. toggle switch—Arrow
T—10-v. fil. trans.
V_1—6SK7
V_2—6L7
V_3—6J5
V_4—25L6G
V_5—6SJ7
V_6—25Z6G

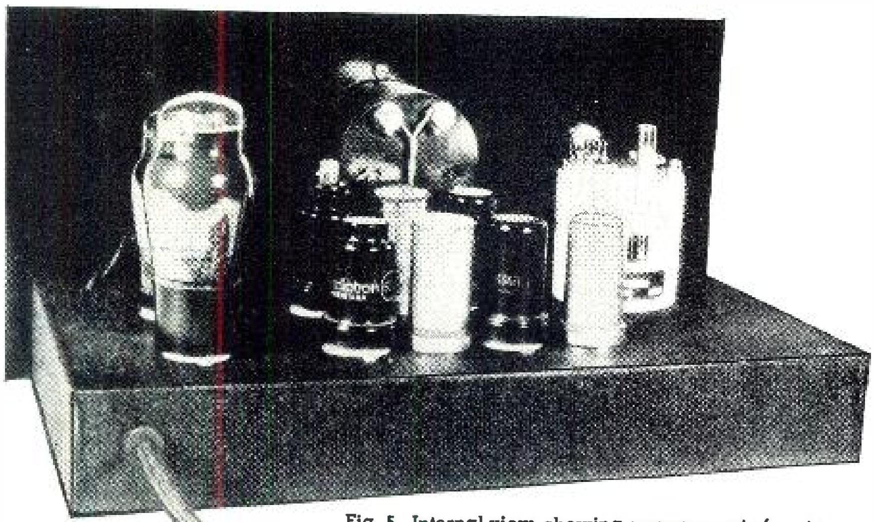
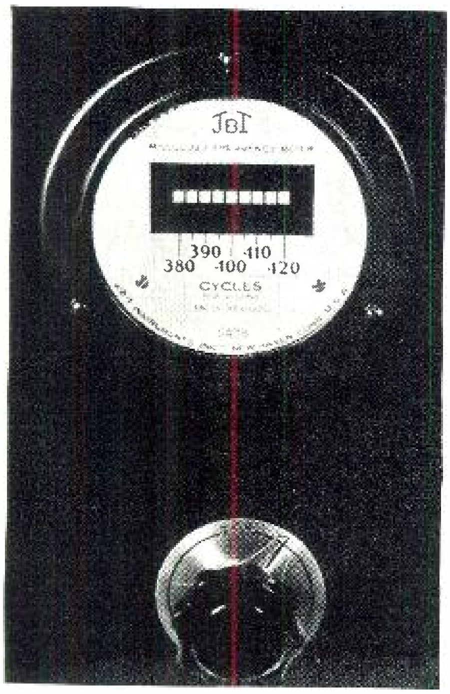


Fig. 5. Internal view, showing arrangement of parts on chassis. The ceramic-cased Bliley BC46-T crystal oven-frequency control unit is at extreme right.

of this meter consists of a number of visible metallic reeds arranged within a magnetic field. The reeds are so cut and adjusted that their natural periods of vibration differ by a small amount. When an alternating current passes through the magnet winding, the reed vibrating with the greatest amplitude is the one whose natural frequency corresponds to the frequency of the current. The dial card is labelled just below each reed to show the reed frequency, and a signal frequency, therefore, may be determined simply by noting the figure below the most rapidly vibrating reed. These instruments are now being manufactured in the United States by J-B-T Instruments, Inc., New Haven, Conn.

The vibrating-reed meter is very compact, having a flange diameter on the front of the panel of only 3½ inches. It is entirely self-contained. Its compact size does not hamper its utility, however, since the deviation meter (see photograph, Fig. 6) is readable across the operating room.

Fig. 6. Closeup of front panel, showing meter and gain control.



Operation of the reed-type meter is independent of waveform, normal temperature changes, and external magnetic fields. Its accuracy is plus or minus 0.3% on full-cycle increments; plus or minus 0.2% on half-cycle increments. Absence in this meter of delicate jewels, pivots, and pointers contributes to sturdiness and stability.

The vibrating-reed meter selected for the indicator in our deviation meter is the J-B-T Model 33-F. The scale of this meter is graduated in frequencies every 5 cycles apart from 380 to 420 cycles-per-second. The 400-cycle point as at the center of the range, and the 20-cycle range above and below this point corresponds to the carrier-frequency tolerance of standard broadcast stations. The meter is specially supplied to operate in the presence of the d.c. component of plate current in the output circuit of a power-amplifier tube.

With 400 cycles as the *zero deviation* point, the crystal controlling the internal oscillator is ground to a frequency 400 cycles lower than the assigned carrier frequency of the transmitter to be monitored. Fixed-tuned coil-condenser combinations are employed in both the crystal oscillator and signal amplifier circuits, since these circuits will require tuning-up only once for a given carrier frequency.

The crystal oscillator is built around a Bliley BC46-T precision, temperature-controlled crystal unit. The latter device is supplied with a precisely ground, low-drift crystal to the builder's order, and derives its oven voltage (10 v.) from a small transformer mounted within the deviation meter. The quartz plate supplied with this unit has a maximum drift of only 1 cycle per megacycle per degree centigrade.

The only front-panel adjustment, except the on-off line switch, is a gain control in the audio circuit. This control does not require regular resetting, and was included mainly as a convenience in locating the deviation meter at various distances from the transmitter. It need only be set once for a transmitter of fixed power and a stationary location of the instrument, and does not influence the reading of the meter.

The conventional transformer-type power supply was dispensed with, since the writer discovered that a 25L6G tube will actuate the vibrating-reed meter efficiently The simple power supply is a voltage doubler embracing a 25Z6G. Other combinations are permissible. For example a 50L6 output tube and 25Z5 rectifier, 25A6 output and 50Z7G rectifier, etc. The main tube lineup in the instrument would remain the same. Individual builders, if they prefer, may employ a 250-volt transformer-type power supply with a 6V6G output tube and the same "front-end" tube line-up.

Electrical Construction

The complete circuit diagram of the frequency deviation meter is shown in Fig. 4.

The carrier amplifier is built around V1 and is a simple fixed-tuned stage. The crystal oscillator comprises the 6SJ7 tube (V5), tuned circuit (L_5-C_{15}), and the Bliley BC46T oven-controlled crystal unit. The thermostatic heater unit of the crystal oven is connected to the secondary of a miniature 10-volt transformer (T).

The amplifier output is coupled to the No. 1 grid of the 6L7 demodulator; the crystal oscillator output to the No. 3 grid of the same stage. The demodulator, in turn, is resistance-capacitance coupled to the grid of the audio driver, V3. The driver stage delivers the beat-note signal to the output amplifier (V4) which actuates the vibrating-reed meter (M).

The tuned circuits (L_1-L_2-C_1, L_3-L_4-C_4, and L_5-C_{15}) must be proportioned according to the operating frequency. For the broadcast band, the coils may be simple r.f. or detector coils designed for radio receiver replacement. The capacitors are standard compression-type mica trimmers of appropriate capacitance for the operating frequency. For other frequencies, standard-sized coils may be wound or purchased, and matched with trimmers of proper size. The coils should be mounted in shield cans, although the trimmers may be mounted under the chassis below the coils. For best convenience, coils and trimmers will be mounted in cans, in the manner of i.f. transformers, with the trimmer adjustment being made by means of a screwdriver or alignment tool. Once the trimmers C_1, C_4 and C_{15} are set for a particular carrier frequency, they ordinarily require no adjustment until the carrier is changed to a new frequency.

The driver stage is a simple resistance-capacitance-coupled circuit embracing a single 6J5 tube, V3. The gain control (R_9) in its grid circuit is operated by the adjustment knob seen

(*Continued on page* 90)

Repairing Defective Tropically-Designed
TRANSFORMERS

By CAPT. JOHN S. ANDERSON

A solution to the serviceman's problem of repairing those defective transformers designed originally for use in tropical climates.

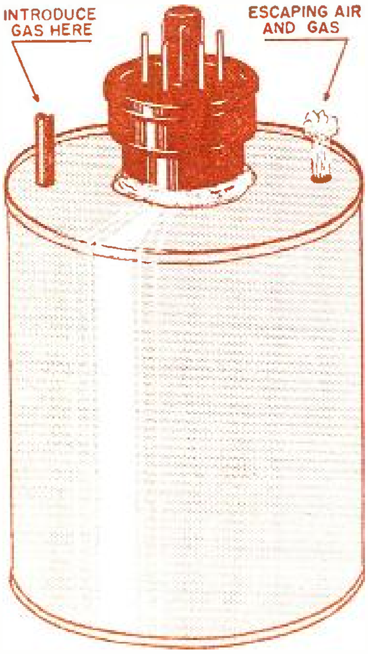


Fig. 2. The base of a defective metal tube is used to extend transformer leads through the can.

THE problem of repairing and keeping power transformers and iron-cored chokes in operation is one of the most difficult for the radio repairman and experimenter. This is particularly true in warm, humid climates such as are encountered along the Gulf coast and the southern Atlantic states. There, in normal times, many replacements of burned-out transformers were encountered. The usual difficulty was that moisture found its way into the winding of the transformer or choke coils, impairing the paper insulation, causing corrosion of the conductors and eventually causing open circuits or short circuits in the windings. Those with short-circuited turns then would overheat and result in a burned-out unit.

Practically all of the usual commercial types of radio power transformers and filter chokes are subject to trouble of this sort, unless special tropical impregnation is used. One burned-out power transformer of the enclosed type was found to contain about a tablespoon full of water when opened for inspection. Radio servicemen are inclined to prefer the open type of transformer on the grounds that if it absorbs moisture more readily, it can also dry out more easily than can the enclosed type. Some even go so far as to drill ventilating holes in the transformer cases. It has been observed, however, that the open type of construction permits mold to attack the paper insulation and exposes the windings to attack by insects. Cockroaches in particular are very fond of the "spaghetti" tubing with which many transformer leads are insulated, and waxed sleeving is attacked by mold.

Since transformers and chokes of any type are difficult to obtain for replacement purposes, and those with tropical impregnation are reserved for military use, the only way to keep some equipment in service is to rewind the defective units using the original cores. Some wire may be salvaged from the defective units, some may be recovered from the field windings of junked dynamic loud speakers, and new wire can occasionally be found by a thorough canvassing of stores, garages, and repair shops.

The problem of adequate insulation is by no means solved by rewinding a defective unit. In fact, it is difficult or nearly impossible to equal that of the original factory job, due to lack of facilities for vacuum impregnation, and lack of special paper and varnish.

A different approach to the problem is to use oil as insulation. Amateur experimenters have discovered that the power ratings of small transformers and chokes can be considerably increased by placing them in a container filled with transformer oil. The same thing could be done with home-wound transformers. This would be a particular advantage if, in order to wind the same number of turns as were on the original winding, it was found necessary to use a smaller size of wire on the home-made coil.

Tests on transformer oils show even a small amount of moisture impairs the insulating properties of the oil. This means that the container should be sealed, to prevent entry of moist air and to keep the oil from spilling. The most difficult part of this procedure and one which has discouraged the use of oil-filled transformers is the lack of an airtight and oiltight seal for bringing out the leads from the windings. Such a seal is at hand and readily available in the form of discarded metal radio tubes. The top of the tube can be cut off by means of a hack saw as shown in Fig. 1. The tube elements are then cut away and wires attached to the leads inside the tube. Care must be taken not to damage the seal during this process.

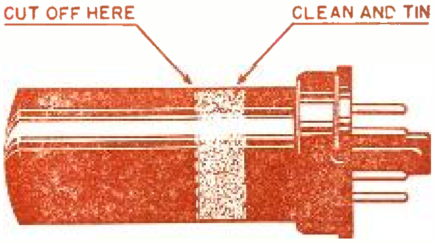


Fig. 1. The shell of the metal tube should be cleaned, tinned, and cut as shown.

A tin can large enough to hold the transformer or choke coil is then selected. Small syrup cans with tight-fitting lids are particularly suitable. A hole is cut in the lid just large enough to allow the tube to be inserted, upside down. The outside of the tube must then be cleaned down to the metal by the use of a file, steel wool, or sand paper, and the clean metal surface tinned. The tube can then be soldered in place as shown in Fig. 2.

The rewound coil or transformer should then be dried as thoroughly as possible. A suggested method is to place it in an oven and apply low heat for several hours. An oven which is free from gasses of combustion is preferable; electric or coal-fire, for example. Care must be taken to keep the temperature low enough to prevent charring the paper used in insulating the coils. A temperature of 160° Fahrenheit is suggested inasmuch as it is as high as can be used without danger of damaging the insulation. Lower temperatures may be used but the drying time will be considerably longer. Commercial practice is to heat in a partial vacuum, thus assisting the drying process. Since this seldom is feasible for the home constructor or small repair shop, the final drying can be done by placing the coil in a tightly closed container with a chemical desicant such as calcium chloride or silica jel. The chemical clothes-closet dryers are suitable for the purpose, and readily obtainable at drug or department stores.

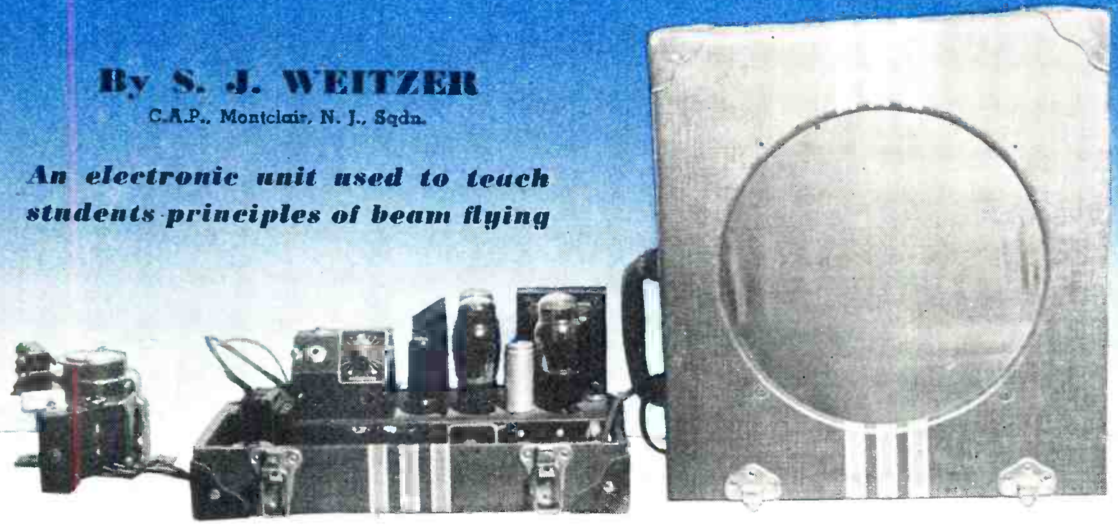
After drying, place the coil in the

(*Continued on page* 108)

RADIO-NAVIGATION TRAINING in the C.A.P.

By S. J. WEITZER
C.A.P., Montclair, N. J., Sqdn.

An electronic unit used to teach students principles of beam flying



Units shown separated. Motor and cam unit (left) is mounted upside down in the speaker case. The amplifier is a modified Setchell-Carlson using a pair of 6V6's in the output. The input stage is rewired and an interstage transformer is added to provide positive regeneration between plate and grid of this stage, resulting in audio oscillation.

THE Civil Air Patrol is engaged in a program of instruction for Air Cadet Reservists. While radio code is, of course, one of the principal subjects taught in all squadrons, the Montclair, N. J., Squadron has gone a few steps further and includes radio-navigational subjects.

This article will deal with beam flying and discussion of a machine for simulating the range transmissions. In this course, the first three lectures are devoted to descriptions of the civil airways system, marker systems, C.A.A. regulations, and the general theory of beam transmission. For the fourth lecture a low-frequency receiver tunable from 200 kc. to 400 kc. is set up in the classroom and actual signals from range stations are tuned in. For the latter lectures, we give the students a unique form of practice in simulated blind range flying. As far as the writer is aware, no such teaching method exists elsewhere, except in a Link Trainer.

A device to automatically transmit the "A-N" signals over a public address system is set up. The "A" and "N" signals are varied in relative intensity by a fader arrangement operated manually from a small control box in the hands of the instructor. A 4-foot by 4-foot square of white paper backed with beaverboard is set up at the head of the classroom. The student wears a pair of goggles equipped with crimson lens. The instructor then locates on this white board the range courses in *red* crayon and indicates the "A" and "N" quadrants. The red crayon markings of the beam are completely invisible to the student looking through the red goggles, but are visible to everyone else. The student is then handed a heavy *black* crayon, the markings of which will be visible to him, as to everyone else, and told to set it down somewhere away from the center of the board. The instructor then starts his beam signal to correspond with the position of the student's black crayon. If, for example, the student starts somewhere in the center of the "N" quadrant, then the instructor starts his machine with a clear "N" signal. The student then moves his crayon in any direction and the instructor follows with the proper change in signal. As the student attempts to orientate himself, there will be changes in the signal to guide him.

Portable control box. Central dial is the "A-N" fader. The dial graduations on this control have no relationship to its function. The right dial is the over-all volume control. The left dial is for increasing the speed of the motor by adjusting the field current, because this particular machine utilizes a 33⅓-r.p.m. motor. This control would be unnecessary with a 78-r.p.m. motor. The jack in the lower center of the cabinet is for a key in order to utilize this equipment as a regular code practice set. For code training the motor is stopped and the fader turned to either the "A" or "N" side, depending upon which contact the motor happened to come to a stop.

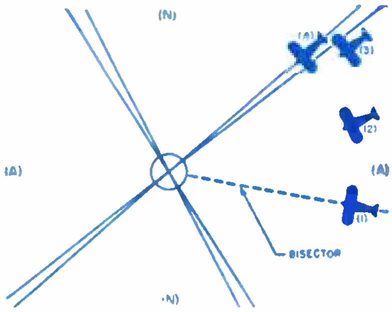
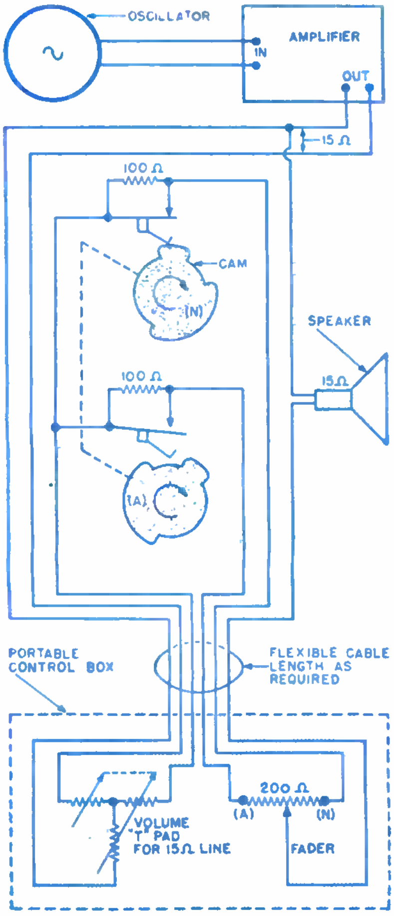
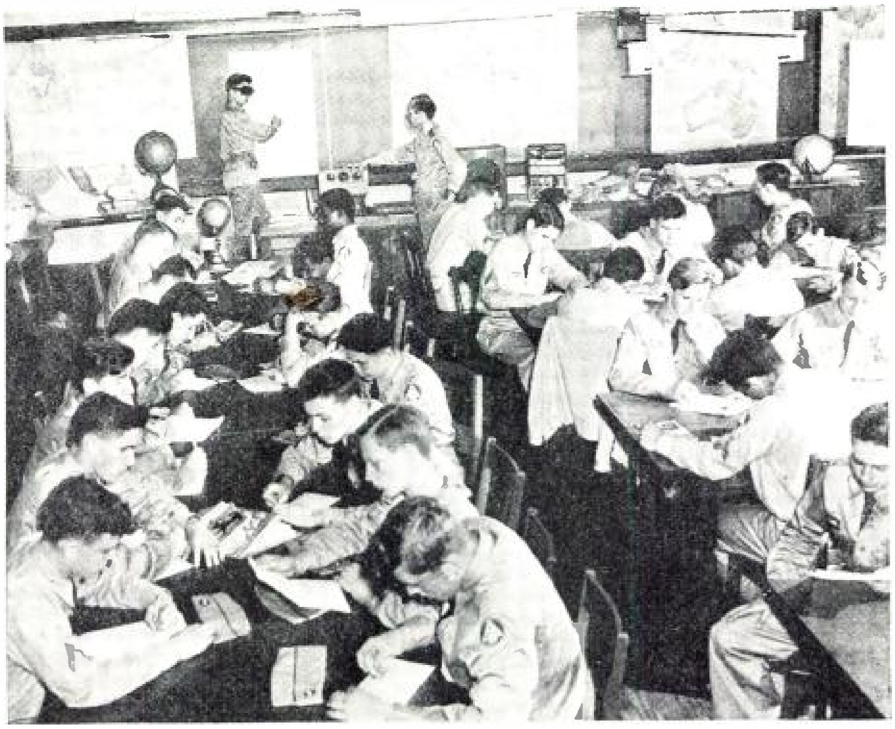


Fig. 1. Proper signal for plane No. 1 which is coming down the center of the "A" quadrant, is a strong "A" signal with absolutely no background tone filling in the spaces of the "A" signal. Plane No. 2 also hears a distinct "A" signal, only slightly weaker than plane No. 1, but there is a very faint background tone between the spaces. Plane No. 3 hears an "A" signal which is beginning to blend into the background tone, since the "A" has decreased in volume and the background tone has increased. Within the beam itself the two signals are of exact uniform strength, resulting in a steady monotone. Plane No. 3 is not observing traffic regulations because pilot is not keeping to the right of the beam. Plane No. 4 is approaching the station correctly. He hears more or less of a monotone, but by careful listening, he detects that the "N" signal is just distinguishable through the monotone. This is known as riding the "feathered edge."

Fig. 2. Schematic for simulated range transmitter. Values shown are for 15-ohm output voice-coil line.





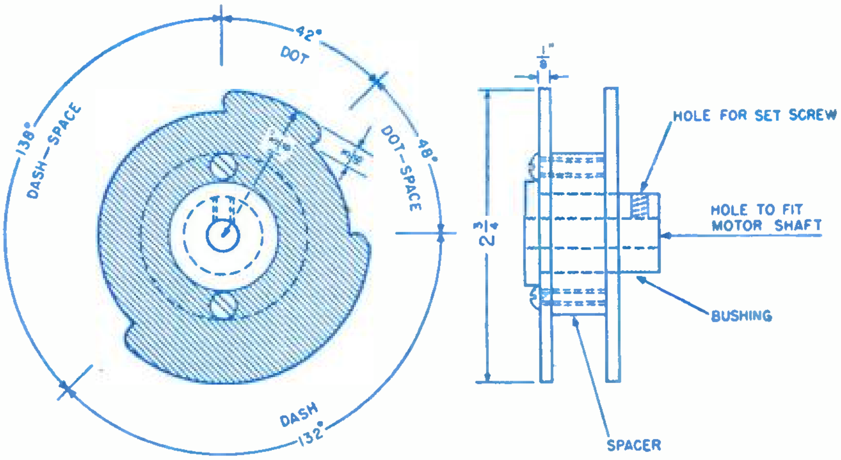
Students receiving instructions in flying the beam. Note special goggles worn by student so that only the black markings on map are visible to him.

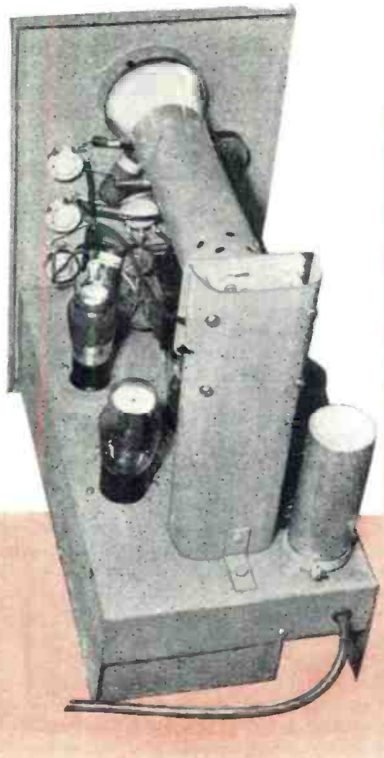
As he comes close to the course, the "N" becomes weaker and the "A" is heard as a faint background slowly building up. When he crosses the center of the range course, the "A" and "N" become of uniform strength, and because of the interlacing of the dots, dashes, and spaces of the two signals, the usual continuous tone is heard. Should the student successfully bracket the beam and fly in towards the station, the continuous tone becomes gradually and smoothly louder, indicating his correct approach. As he crosses the station, the transmission is abruptly stopped, indicating the cone of silence.

The black crayon in the hands of the student leaves a path which is visible to all, and indicates the course made by his plane. Clearly, this practice is amusing to the rest of the class as they follow the gyrations on the white board. However, the job to the student is not as easy as it looks to the remainder of the class, and it gives nearly genuine experience in flying the

(*Continued on page* 122)

Fig. 3. Layout and assembly of cams. Two identical cams are cut as shown above. By mounting them back to back with a separator between them, one becomes "A" and the other "N." The width of the separator will depend upon the dimensions of the two switches whose levers bear against the cam edges. Note that the lobes or actuating surfaces of the cam are shorter in length than their corresponding space. That is, the dot is 42° and the dot-space is 48°; the dash is 132° and the dash-space is 138°. This is necessary because otherwise the switch lever which bears against the cam, because of its tension, will follow into the space area, making contact ahead of the precise lobe edge, and also breaking contact slightly after the trailing edge of the lobe should clear.





MODERNIZE Your Oscilloscope

By A. D. MAYO

The reconstruction of obsolescent oscilloscopes. Sufficient information is presented for those who desire to build a new 'scope.

Top inside view of the reconstructed 'scope.

ANYONE who has tried to buy a complete oscilloscope recently will know that it is very difficult to get one either with or without a priority rating. On the other hand, it is possible to find a number of the earlier models which can be bought. The so-called "basic" oscilloscopes, consisting of only a tube and power supply without amplifiers or sweep circuits, were once quite popular for use in "ham" stations to produce trapezoidal modulation patterns. This is, incidentally, about all these oscilloscopes were ever any good for.

Here are the details relating to the reconstruction of one of the National 3-inch scopes. The original oscilloscope had a 906 tube mounted in a case with a power transformer, rectifier tube and little else. There was an intensity control and a switch to change from 60-cycle sweep to an external sweep circuit. There were no controls to position the spot on the screen.

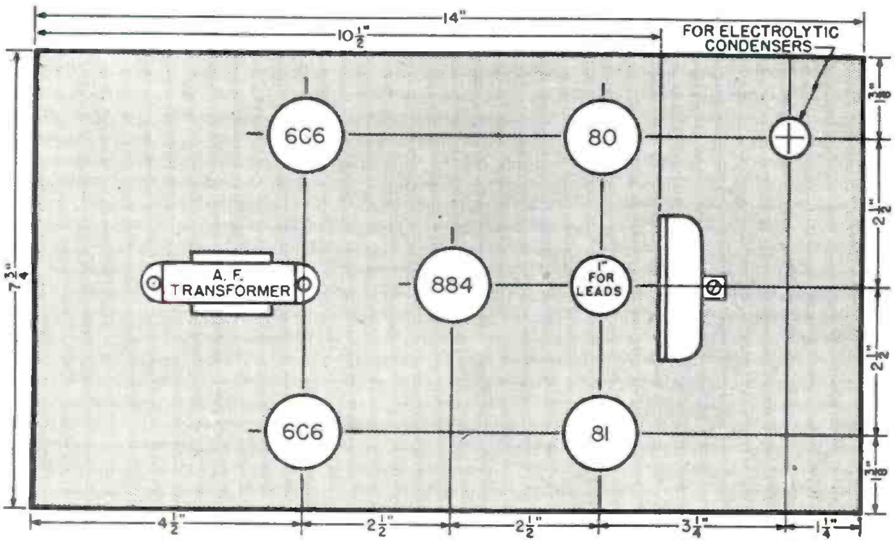
In the new model it was deemed advisable to have centering, intensity, focus, vertical and horizontal gain controls, as well as switches to select various input combinations and to vary the frequency of the sweep circuit. An 884 thyratron tube was used as an oscillator to produce a saw-tooth wave for the sweep circuit. 6C6 tubes were used for vertical and horizontal amplifiers. These particular tubes were used because they were on hand and their characteristics are entirely satisfactory for this use.

The original power supply consisted of a half-wave rectifier, a type 81 tube, fed by the power transformer which also had two filament windings to supply the rectifier and the 906. Another winding was included which was used originally to supply the 60-cycle sweep voltage to the 906. This latter winding was not used in the present design. Filter for this power supply consisted of a .5-μfd oil-type condenser rated at 1500 volts. This small amount of filter was sufficient considering the small amount of current drain of the cathode-ray tube.

In order to operate the various accessory circuits to be affixed, a separate power supply was added. This consisted of a midget 5-tube transformer with an 80 rectifier and condenser input filter. One of the things to watch out for in a job of this type is magnetic coupling from the power transformer to the cathode-ray tube. There is a magnetic field around the outside of a power transformer and if the transformer is mounted near the tube it will be impossible to get the spot steady on the screen. The magnetic field will deflect the electron beam, and therefore the spot, at a 60 cycle rate and in a direction depending on the axis of the magnetic field.

To minimize the above effects the power transformers were both mounted underneath the chassis. The National transformer was all right from this standpoint since it was totally enclosed inside an iron case in the first place and no doubt originally was designed with the idea of keeping the flux density down to a low level. The first one of the midget broadcast transformers tried in this spot was a new one with only a half-shell shield on it. This transformer had considerable effect on the electron beam and it was replaced

Chassis layout showing placement of various component parts.



with a completely shielded transformer taken from an old broadcast receiver of reliable make, about 10 years old. The transformers in older receivers were considerably better made than the present ones from several angles. It is important to select a transformer which is not only well shielded but which has a relatively large number of primary turns for the core size. If it is possible to select a transformer out of a group for this use one should be selected which has a low exciting current when the primary is energized.

Sometimes it is possible to minimize any movement of the spot by rotation of the power transformer when it is mounted. The beam can be noted as the transformer is turned to various positions. If it is absolutely necessary to use a transformer which reacts on the electron beam, as a last resort a section of fairly thin walled steel pipe can be mounted around the cathode-ray tube as a magnetic shield.

Inspection of the circuit diagram will show that a part of the voltage from the added power supply is used in series with the old power supply to operate the cathode-ray tube. Since controls were added for centering, focusing and controlling the intensity of the beam, a little higher voltage than optimum was necessary to give some leeway on the controls. It was easy to add these voltages since the positive side of the cathode-ray tube power supply is operated grounded while the negative of the conventional power supply is grounded.

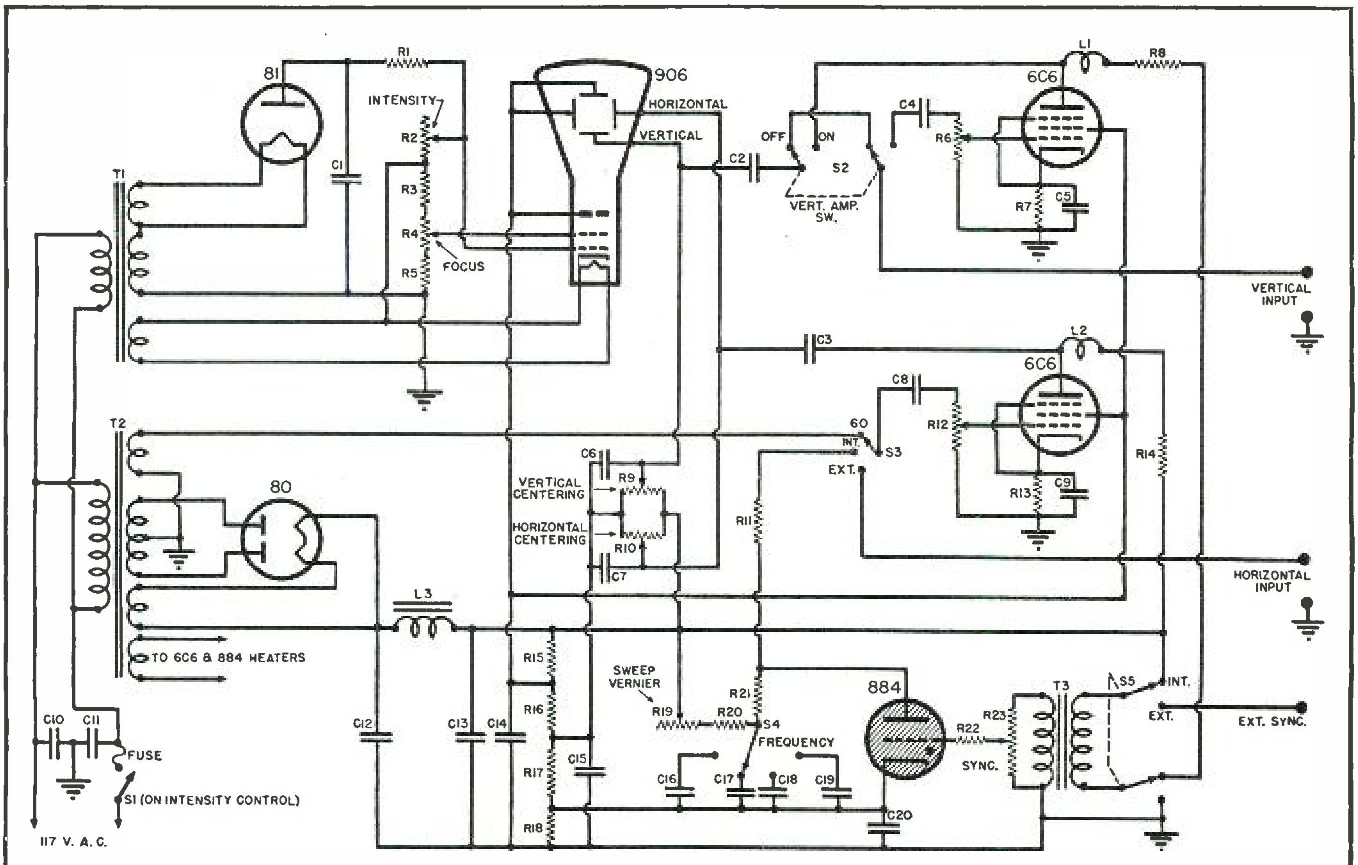
The 6C6 amplifiers are ordinary pentode voltage amplifiers similar to those in the input stage of a speech amplifier. Since they sometimes are used at frequencies in the upper audio range the plate loads consist of chokes in series with 100,000-ohm resistors. This combination insures better response to higher frequencies. The cathode bypass condensers are small for the same reason. Both stages are working into fairly high capacitive loads presented by the necessarily long leads and the input capacitance of the cathode-ray tube. The saw-tooth sweep wave contains considerably higher frequency components and it is desirable to have good-high-frequency response.

Without the amplifiers, full deflection on the screen of the 906 will be secured with about 90 volts peak on the deflecting plates. The amplifiers have a voltage gain of about 60 and with them in the circuit full deflection will be secured with an input voltage of only 1.5-volts peak. This is desirable for both vertical and horizontal input circuits. Vertical deflection becomes very sensitive, allowing waveforms to be examined in low-level audio stages. An amplifier following the sweep oscillator is necessary since its output is kept low to insure good waveform.

A switch is provided to switch the vertical amplifier out of the circuit when it is desired to put r.f. or other very-high frequency on the vertical plates. There is also a switch to throw the grid circuit of the 884 to an external binding post for external synchronizing voltage.

A third switch selects any one of three types of sweep voltage: 60 cycle, internal saw-tooth, and external. The horizontal amplifier is left in the circuit at all times. For 60-cycle sweep it is only necessary to feed a little a.c. from the filament supply into the amplifier. For saw-tooth sweep the amplifier grid is connected to the output of the 884 oscillator. For external sweep the amplifier grid is switched to the horizontal input binding post and

Wiring diagram of the oscilloscope. Sufficient controls have been added to conform with present-day professional units.



C_1—.5 μfd. @ 1500 v. cond.
C_2, C_8, C_4, C_6, C_7, C_8, C_{16}—.25 μfd. @ 400 v. cond.
C_5, C_9—.004 μfd. @ 200 v. cond.
C_{10}, C_{11}—.01 μfd. @ 400 v. cond.
C_{12}—2 μfd. @ 200 v. elec. cond.
C_{13}, C_{14}—16 μfd. @ 400 v. elec. cond.
C_{15}—8 μfd. @ 400 v. elec. cond.
C_{17}—.03 μfd. @ 400 v. cond.
C_{18}—.005 μfd. @ 400 v. cond.
C_{19}—.0015 μfd. @ 400 v. cond.
C_{20}—.001 μfd. @ 400 v. cond.
R_1—40,000-ohm, 1-w. res.
R_2—50,000-ohm pot.
R_3, R_8, R_{11}, R_{14}, R_{20}, R_{22}—100,000-ohm, ½-w. res.
R_4. R_9, R_{10}—250,000-ohm pot.
R_5—250,000-ohm, ½-w. res.
R_6, R_{12}, R_{23}—1-megohm pot.
R_7—1250-ohm, 1-w. res.
R_{13}—1500-ohm, 1-w. res.
R_{15}, R_{16}—20,000-ohm, 2-w. res.
R_{17}—10,000-ohm, 1-w. res.
R_{18}—1200-ohm, ½-w. res.
R_{19}—9-megohm pot.
R_{21}—200-ohm, ½-w. res.
T_1—Power trans.—National
T_2—Power trans.—5-tube BC rec. type
T_3—Audio freq. trans. (1:1)
S_1—S.p.s.t. switch
S_2, S_5—D.p.d.t. switch
S_3—S.p.3.p. switch
S_4—S.p.4.p. switch
L_1, L_2—60-millihenry r.f. choke
L_3—40-hy. 25-ma. filter choke
1—81 tube
1—80 tube
1—906 cathode-ray tube, 3-inch
1—884 tube
2—6C6 tubes

Completed unit, showing its similarity to professionally-constructed models.

the external voltage connected to this post. The horizontal gain control, being in the grid circuit of the horizontal amplifier, is left in the circuit at all times. Therefore, the length of the pattern in a horizontal direction is adjustable under all conditions.

The original case was not large enough to contain all of the necessary parts and controls. Therefore a new case and chassis were made. Considering the fact that ordinary scrap sheet metal was used for the new case, the whole assembly is very strong. The sheet metal was laid out and marked. Then it was taken to a tin shop and bent to shape on a brake.

The chassis is 4-inches high, greater than the average chassis height but necessary to contain the power transformers and other parts. The front panel is secured to the chassis and the two pieces become one unit. A flange, consisting of a piece of sheet steel bent to a cylindrical shape, is soldered in the hole for the window of the cathode-ray tube. The inside is lined with thin felt to cushion the tube. Black felt is used to cut down reflected light coming in from the side.

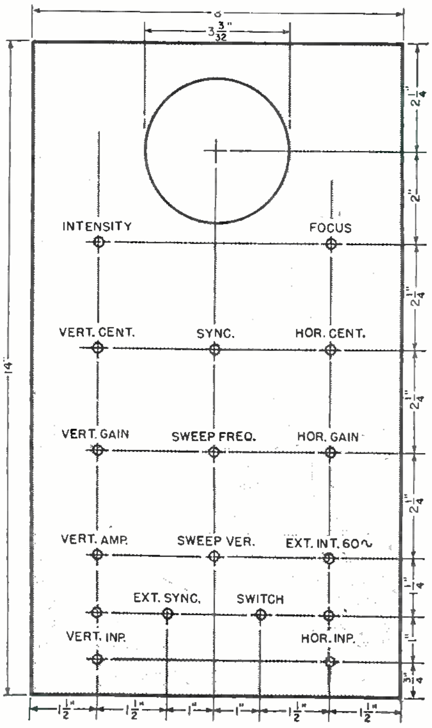
The rear end of the cathode-ray tube is supported in a 7-prong socket, the old one, and the socket is held in place with a bracket fashioned from sheet metal. The bracket was made up and the proper height for positioning the socket on it was determined by holding the tube in place. The cover slips on from the back. Since the back of the cover comes up to the back of the chassis there is a hole in the cover to allow the line plug to pass.

When first turning the unit on it is best to leave all of the tubes out except the two rectifier tubes. Check both power supplies for d.c. voltage and make sure that the filter condensers and circuit are all right. The unorthodox connections used in the power supply connections, that is, a 1000-volt supply with the positive ground and with interconnections between the two, will give rise to the possibility of surges and other troubles. The filter condensers are subjected to higher peaks than they would be in broadcast receiver operation. It is important that their leakage be fairly low in this application due to the small current drain on the power supply.

It should be possible to center the beam with the two horizontal and vertical centering controls if the values of divider resistors and controls shown in the circuit diagram have been used. The spot probably will not be small and well defined on the initial try. In this case it can be adjusted to a small, sharp spot by manipulating the focus and intensity controls. The focus and intensity controls interlock to some extent so that it is necessary to alternately adjust one and then the other until the desired shape of spot is obtained. When the spot is once adjusted and centered, its brilliance probably can be controlled by the intensity control alone. Since the line switch is on the intensity control, this control always will need to be readjusted when the unit is turned off and back on.

When adjusting the size of the spot be sure there is no voltage being fed into either the horizontal or vertical deflection plates. Without the 6C6 tubes in place there should be no deflection of the spot. Any deviation from a sharp spot on the screen indicates that there is either a voltage being fed onto the deflection plates or else there is a magnetic field acting on the beam. When the 6C6 tubes are put in place the vertical and horizontal gain controls should be returned to the minimum setting.

Panel layout, showing the placement of various operating controls.



With the amplifier tubes in place, turn the sweep selector to 60 cycles. It should be possible to get a horizontal line on the screen by gradually turning up the horizontal gain control. It should also be possible to get a similar line by turning up the control with the sweep turned to "internal" and with the 884 in place. If horizontal sweep can not be obtained in either one of the above cases there is probably something wrong with the horizontal amplifier stage.

Next, check up on the vertical deflection. Feed a little a.c. voltage into the vertical input binding posts and increase the vertical gain control setting. There should be deflection of the beam vertically, and the deflection should increase as the control is increased. With the amplifier switch thrown to the "off" position the deflection should be much less and the voltage input will have to be increased greatly to get full deflection on the screen.

With 60-cycle input on the vertical plates, turn the sweep to "internal" and set the sweep frequency-selector switch to the first position. With the vernier sweep control knob it should be possible to get one, two, or three sine waves on the screen. Try the sweep lock control with the switch on "internal" indicating internal synchronization control. By advancing the lock control it should be easy to lock the sweep oscillator in with the 60-cycle input and make the traces stand still on the screen.

If the finished oscilloscope stands all the above tests satisfactorily it will be useful for many different testing applications.

Probably the most common use of the oscilloscope is in the testing of audio amplifiers and equipment. Most a.c. power mains supply a wave shape that is almost pure sine wave. By observation of this wave shape on the screen of the oscilloscope it is easy for one to fix in his mind the approximate shape of the desired sine wave. It is useful for testing an amplifier which is operating with a sine wave input. If any distortion of the sine wave shape is noted in any amplifier stage one will know that something is haywire in that stage. With the 'scope left attached and the wave shape under observation changes can be made in the particular stage in question and its response characteristics improved. By this method the signal can be traced visually through an amplifier and the performance of each stage studied.

The input terminals of the oscilloscope will load the circuits to which it

(*Continued on page* 132)

PRACTICAL RADIO COURSE

By ALFRED A. GHIRARDI

Part 29. Covering intermodulation and direct intermediate-frequency interference in AM superheterodyne receivers. Antenna-circuit wave traps for eliminating narrow-band interference are discussed.

As WE have learned from previous lessons, several types of spurious responses capable of causing undesirable interference can occur in AM superheterodynes. The cause of image-frequency response (one of the most important of these), and the use of adequate preselection and/or a comparatively high i.f. value for minimizing it, have already been explained. Other spurious responses which may, or may not, be troublesome depending upon the locality and the design of the particular receiver, will now be discussed.

Cause of Intermodulation Interference

When two signals of sufficient strength and of frequencies differing by the amount of the receiver i.f. (or a value within a few kc.) are received simultaneously, they may combine in one of the early stages of the receiver, forming a "difference" beat frequency equal (or nearly equal) to the particular i.f. This combination is accomplished without the aid of the local oscillator—one of the signals acts (at the modulator) as the local oscillator for the other signal. This action usually occurs in receivers in which insufficient preselection is provided and the first tube is the mixer stage. It is not uncommon, however, for such an undesired i.f. signal to form in an r.f. stage, or possibly later in the i.f. stages, if the r.f. or i.f. tube is operated near cutoff on the curved portion of its characteristic curve (detection condition) and the two interfering signals are of sufficient intensity—or if the wiring and components of the later circuits are not completely protected against direct signal pickup.

The presence of this additional i.f. signal causes *intermodulation* interference, which sounds like a background of garbled speech, at every dial setting. It also causes a "whistle" or "birdie" to be reproduced whenever tuning to signals not related in carrier frequency to the interfering signals over extensive sections of the tuning range. The "birdie" is created by the audible beat resulting from mixture at the second detector of the normal i.f. and the extra i.f. signals. The latter is a *constant* frequency (since the carrier frequencies of the two interfering stations are constant), while the former *varies* while the receiver is being tuned to the desired signal. Therefore, an audio note of variable pitch is produced while tuning, and either zero beat (no "birdie") or a "birdie" of constant pitch is obtained when the desired station has been exactly tuned in. The following example will illustrate this:

Suppose a receiver employs an i.f. of 180 kc. and has either no preselector or else one with inadequate selectivity. Further assume that when this receiver is tuned to receive a desired 1,000-kc. station, two *undesired* signals, one at 1,100 kc., and one at 920 kc., also pass through to the mixer. This condition is illustrated in Fig. 1. One of the *undesired* signals will then be acted upon by the other one, in the mixer, to produce an undesired i.f. beat of 1,100 — 920 = 180 kc. Since the carrier frequencies of these two undesired stations are constant, this beat frequency is constant, regardless of the tuning dial setting. Now, as the tuning dial setting is varied about 4 kc. either way from 1,000 kc. in order to adjust to the exact setting that will tune the desired station in sharply, we will be varying the local-oscillator frequency from about 1,184 kc. through 1,180 kc. (the correct setting for the 1,000-kc. signal) to about 1,176 kc. and back again. During this operation, the beat frequency of the desired station will be varying from 184 kc. to 180 kc. (the correct value) to 176 kc. These frequencies, along with the constant 180-kc. beat frequency produced by the two undesired stations, will go straight through the i.f. amplifier and react with each other at the second detector to produce an audio beat frequency which varies in pitch from 4,000 cycles

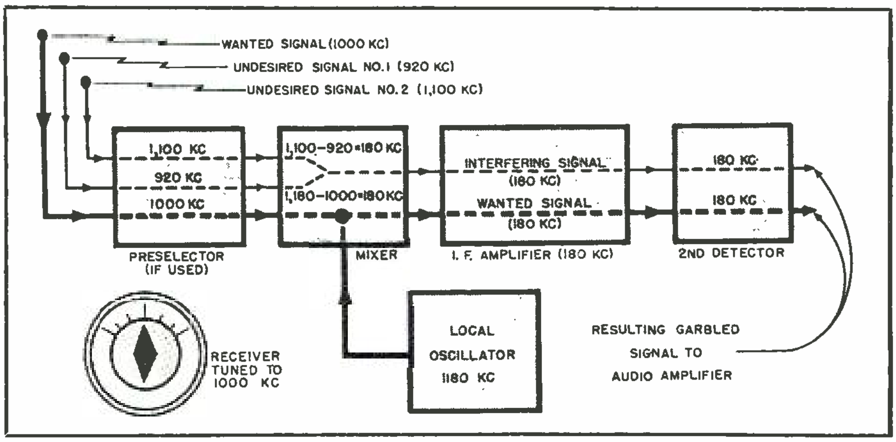
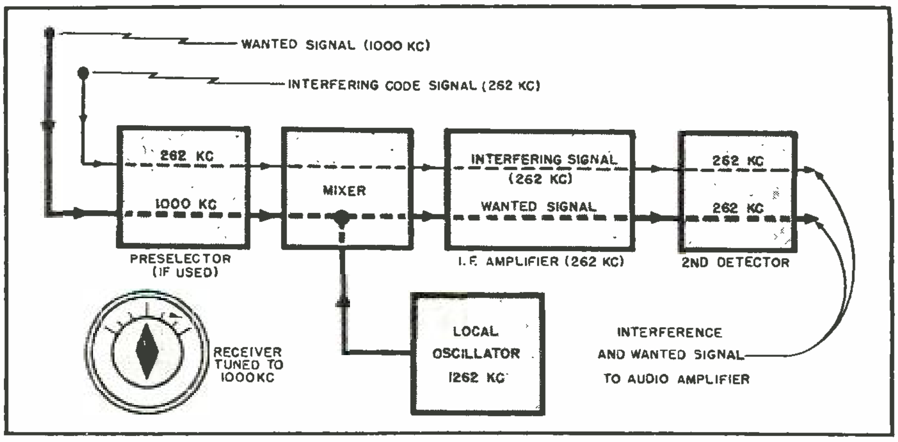


Fig. 1. How intermodulation interference can be produced by the reception of two unwanted signals whose carrier frequencies differ by an amount equal to the i.f. employed in the receiver, if they are not rejected by the preselector.

Fig. 2. How interference from a strong code signal, having the same frequency as that to which the i.f. amplifier is tuned, may result if it is received by the antenna and is not rejected by the preselector tuned circuit.



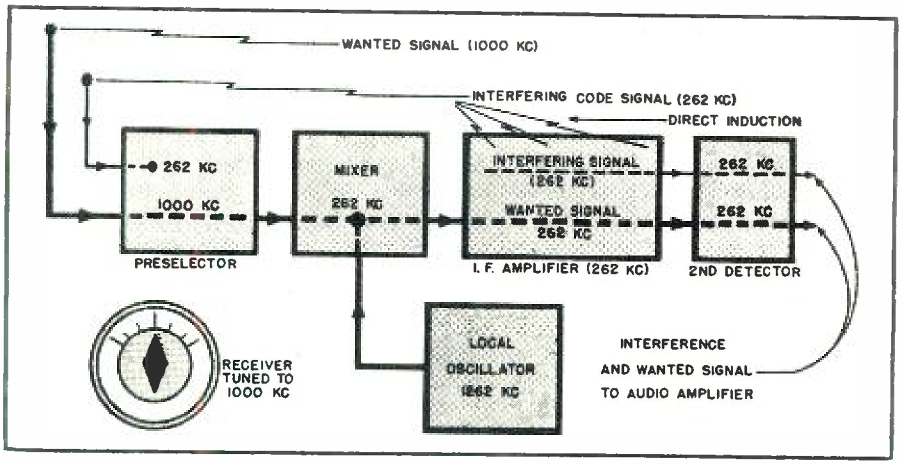


Fig. 3. How interference from a strong code signal, having the same frequency as that to which the i.f. amplifier is tuned, may result if it is picked up directly by the i.f. amplifier wiring or components, even though the portion picked up by the regular antenna is rejected by the preselector tuned circuit.

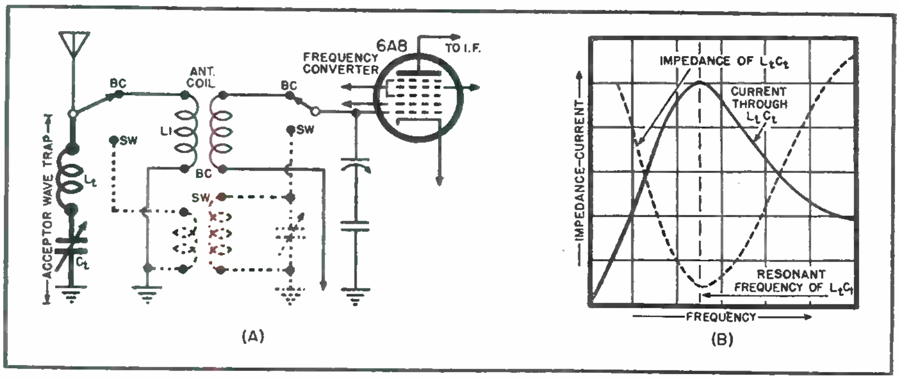


Fig. 4. (A) A series-tuned "acceptor"-type wave trap used in the antenna circuit of many of our present-day receivers. This wave trap acts as a low-impedance short-to-ground for the one unwanted signal to whose frequency it is tuned. (B) Impedance and current characteristics of this type of wave-trap circuit.

(when the receiver tuning dial is 4 kc. off tune) to 0 cycles (when it is exactly tuned to the desired station signal). This will be heard in the loudspeaker as an annoying squeal of varying pitch as the tuning dial is rocked back and forth about the correct-tune position. Zero beat is obtained at the point of exact tuning.

If the two undesired station signals happen to be of such frequency that the beat their combination produces is not exactly equal to the i.f. of the receiver, but is a few kc. off from it (say it is 178 kc. from the receiver we are considering) then even when the receiver has been exactly tuned to the desired signal there will be a beat frequency of 180 — 178 = 2 kc. resulting, and there will therefore be a steady 2 kc. (2,000 cycles) squeal in the background of the desired program.

Remedies for Intermodulation Interference

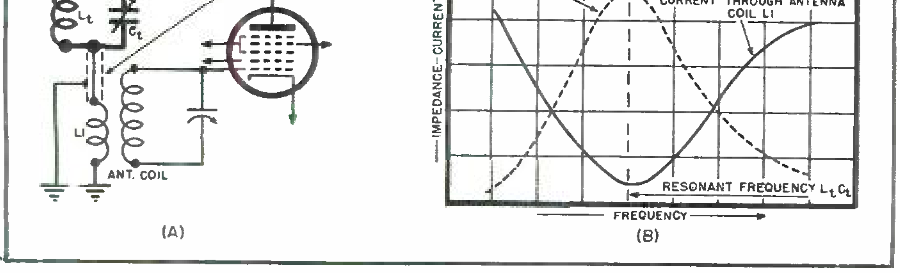
This type of spurious response is particularly troublesome in localities where two strong signals exist, differing in carrier frequency by an amount equal to the i.f. of the receiver, for the interference they cause will be heard throughout the tuning range of the receiver. Obviously, one of the design remedies for such intermodulation interference is the same as that for doublespot tuning and for image-response interference, i.e., to provide adequate selectivity *ahead* of the receiver stage which is susceptible to this "mixing" phenomena, so that at least one of the two undesired signals will not reach it. This calls for a selective preselector. Also, the higher the i.f. employed in the receiver, the less the likelihood of such interference being encountered. This is true because signals that can cause such interference must differ in carrier frequency by an amount equal (or almost equal) to the i.f. employed in the receiver. Consequently, the higher the i.f. employed, the greater must be the frequency *difference* between the interfering signals and hence the greater is the likelihood that either one, or both, of them will be sufficiently attenuated by the preselector tuning circuits so that this interference cannot result.

As we shall learn later when studying the reasons for the choice of the best i.f. values to employ, the possibility of intermodulation interference resulting is one of the practical reasons why intermediate frequencies that are integral multiples of 10 (say 400. 450. 460, 470, etc.), are not generally used in broadcast-band receivers. In the United States, AM sound broadcasting stations are located in 10-kc. frequency channels. Since most of the stations in the standard broadcast band are assigned carrier frequencies that are integral multiples of 10 (such as 950 kc., 1,110 kc., 1,450 kc., etc.) the frequency "difference" between the carriers of any two stations also will be an integral multiple of 10. Consequently. by using i.f. amplifiers designed for operation that are *not* integral multiples of 10 (such as 455 kc., 456 kc., 465 kc., etc.), the possibility of intermodulation interference occurring is reduced in broadcast-band receivers since the beat frequency produced by two unwanted signals can never be within 5 kc. of the i.f. for which the receiver was designed and is adjusted. The use of sharply selective i.f. tuned circuits with an acceptance band approximately 10 kc. in total width will succeed in greatly attenuating this undesired beat before it can reach the second detector to mix with the desired-signal i.f.

When intermodulation interference persists in an existing receiver even after the tracking of the preselector tuning circuits has been checked, additional discrimination can be provided at the frequency of one of the interfering signals (preferably the strongest one), by addition of a wave trap or attenuator circuit tuned to that particular frequency so as to suppress its strength at the input of the susceptible stage. Practical wave traps for this purpose will be discussed later.

(*Continued on page* 102)

Fig. 5. (A) A parallel-tuned "rejector"-type wave trap which offers a high impedance to signals of the undesired frequency to which it is tuned, thereby preventing them from reaching the input circuit of the receiver. (B) Impedance and current characteristics of this type of wave-trap circuit.



COMMUNICATION OPERATORS

QTC

By CARL COLEMAN

VICE Admiral Emery S. Land, of the War Shipping Administration, recently told merchant marine steamship operators that even after the fall of Japan they would have at least six additional months of "busy times." If the ship-operating companies have good shipping for at least a few months in the postwar period it surely will help matters along all around. Admiral Land spoke at the Victory Day ceremonies in New York and saw 1,000 trainees for the merchant marine from the United States Maritime Service Training Station at Sheepshead Bay parade down lower Broadway. Land read messages from President Roosevelt and Admiral Nimitz, lauding the work of the U. S. Merchant Marine.

U. S. Maritime's Kings Point Marine Academy held a two day celebration in late September on the occasion of its first anniversary. It was also announced that the C. R. Holmes estate at Sands Point, N. Y. has been turned into a convalescent home for men suffering from convoy fatigue.

A. L. SHAPIRO is with the Alcoa Lines and called in at the East Coast recently. R. Doodward has taken out a freighter. M. Gordon resigned his shore berth and we understand the lure of the deep blue sea has taken its effect. No word has been received from W. Glazar. L. Barbeau is still pounding brass ashore up beantown way and getting the urge to write yarns about some of his past experiences. E. Hawkins was in for a visit recently to the "big city" and has shipped out again. H. Bannister has been assigned to a freighter.

WE STILL are receiving many requests from members of various branches of the Armed Forces inquiring about how to get into commercial radio after the war. Most of these requests favor the marine end of radio and it seems that there are a good many men who have been introduced to radio operating since the war began and who are very much interested in making it a lifetime job. Of course, at this time, it is nearly impossible to have any definite ideas on just how things are going to go along after the present conflict is won. For those of you who are really sincere in your desire to get into marine radio I would suggest that you obtain a copy of the "Marine Radio Manual" by M. H. Strichartz, published by Cornell Maritime Press in New York, the price of which is $4.00. It is one of the best texts that has come to our attention in the past few years. Incidentally it is a new one—just put out this past summer—and has a complete arrangement for beginners, students, or experienced operators to really learn the "know how" of the marine radio-operating business and the latest regulations and information from USMC. The book starts off with a brief history of maritime radio and covers everything one could ask for, including data on the ship's station, laws affecting operators, radio navigational aids, maintenance and trouble shooting, direction finders, and all the other equipment carried by the average ship, and concludes with a general information section, which alone is worth the price of the book. Mr. Strichartz certainly has filled a long-felt void and is to be congratulated on a job well done, which will be appreciated by marine radio operators.

C. B. HARRIS is still with his same old freighter with Cosmopolitan Lines and reports that they have been on the same run for some time. "CB" would like to get the war over with so that he can convince the "old man" to take the craft to a few different ports for a change. F. Engebeth has taken out a freighter assignment from the East Coast. S/Sgt. S. Kaplan "somewhere in England" sends a nice letter requesting information as to licenses, airways, etc. Would suggest among other things that you get a copy of the book mentioned previously. Letter is being forwarded to you concerning the other details that you have inquired about. H. Hasdal has gone fishing for a change. L. E. Hansen was in with his craft recently and had a short stay along the East Coast and is now out on a long voyage again. "LE" is with the Silver Line. H. Meisinger finally came across with the news that he is at Kingman, Ariz. That's a strange location for a man that's usually found working aboard ship—or are they building a canal down that way?

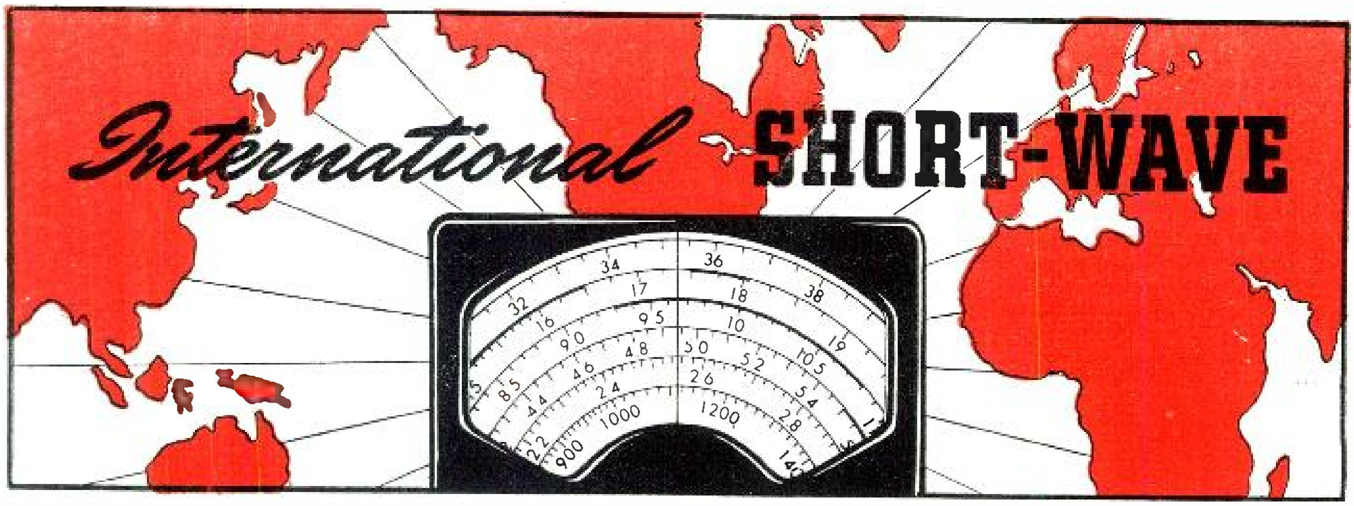
C. Amato has not been seen around the big town in the past many weeks and we suspect that he has been transferred from that soft berth near home. L. Hviasten finally was released from the hospital where he has spent a goodly portion of his time since being called to the Army. Leif also managed to obtain a furlough home for a couple of weeks to see the new daughter which arrived at the Long Island "estate" of grandpa Hvidsten. "LH" has really been active lately—among other items which count, he obtained a radiotelephone license while down Texas way. Has anyone heard from A. Vandenburgh lately, or W. Glazar and P. B. Johannessen?

WE ARE in receipt of a letter from Mrs. M. L. Smith regarding her son in the merchant marine, who is Chief aboard a Liberty and is at the present time only 19 years old. Mrs. Smith brings out a point with an inquiry as to just why her son is not permitted to take the exam for a first class radiotelegraph license. Radio Officer Smith is an Ensign in the USMS and has been in the service for about two years. Before any consideration of this problem (men under 21 taking 1st class exam) FCC would be called upon to set aside the details of the existing international radio regulations.

The Cairo, Egypt international radio communications conference, of which this country is a signatory to the laws, treaties, etc., established at that time the rule that a person who wishes to qualify for a First Class Radiotelegraph License must be 21 years of age, must have a minimum of one year's service aboard a ship whose radio station is open to general public correspondence or the same period of time in a marine coastal station open to general public correspondence, and must be able to send and receive the

(*Continued on page* 80)

"Can I have it repaired for you by four o'clock! Of what day and month?"



International SHORT-WAVE

Compiled by **KENNETH R. BOORD**

THROUGH the courtesy of The American-Swedish News Exchange, Inc., we are pleased to furnish readers of RADIO NEWS this month with the following late information concerning Swedish short-wave broadcasts to America:

SBP, 11.705 megacycles, weekdays—2:45 a.m., general program; 7 a.m., general program; 12 noon, general program; 1:30 p.m., war news; 2 p.m., general program; and 9 p.m., for Swedes abroad. Sundays—2:45 a.m., general program; 7 a.m., general program; 12 noon, general program; 1:30 p.m., war news; 2 p.m., general program; 5:20 p.m., for Swedes abroad; and 9 p.m., for Swedes abroad.

SBT, 15.155 megacycles, weekdays—7 a.m., general program; 11:00 a.m., for U.S.A.; 12:35 p.m., general program; 1:30 p.m., war news; 2:00 p.m., general program. Sundays—3:45 a.m., general program; 10:00 a.m., for South America; 11:00 a.m., for U.S.A.; 12 noon, general program.

SBU, 9.535 megacycles, weekdays—2:30 p.m., general program; 9 p.m., for Swedes abroad. Sundays—2:30 p.m., general program; 5:20 p.m., for Swedes abroad; and 9 p.m., for Swedes abroad.

* * *

ZQI, A GOOD "CATCH"

We are pleased to pass along details of the broadcasting activities of ZQI, The Government Broadcasting Station, 2 Seaview Avenue, Half Way Tree, Jamaica, British West Indies, as furnished us by Denis M. Gick, station manager. With studios in Kingston, ZQI operates on 4.70 megacycles (approximately 63 meters) daily, 5:30 to 7:30 p.m. EWT, and has newscasts scheduled at 5:30, 6:20 and 7:27 p.m. EWT.

Mr. Gick writes us: "The regular broadcasts from this station are given in English, although special programs for Chinese listeners are given in Chinese from time to time. A regular daily period commencing at 5:33 p.m. EWT is devoted to AFRS transcriptions.

"It is regretted that on account of the low power of the transmitter—200 watts—reception in the eastern half of the United States and Canada is only possible after dark during the winter months."

Your short-wave editor has been hearing ZQI with a "fair" to "good" signal from 6 to 7:30 p.m. EWT almost daily the past several weeks. This is a really good "catch" because of its low power.

* * *

AUSTRALIAN CHANGE

Effective October 7, the evening transmission beamed from Australia to the East Coast of North America has been using the frequency of 11.840 megacycles (VLG4), replacing VLC4 on 15.315 megacycles.

* * *

BBC'S NORTH AMERICAN SERVICE

Since several changes have been made recently in the BBC's North American Service, we list below the operating times of these stations as this goes to press:

11.93 mcs., GVX, 5:15-6:45 p.m.
9.64 mcs., GVZ, 5:15-8:45 p.m.
9.825 mcs., GRH, 5:15 p.m.-12:45 a.m.
7.26 mcs., GSU, 5:15 p.m.-12:45 a.m.
6.11 mcs., GSL, 6:00 p.m.-12:45 a.m.
2.88 mcs., GRC, 9 p.m.-12:45 a.m.
9.78, Via Leopoldville, Belgian Congo, 9:30 p.m.-12:45 a.m.

* * *

WEST INDIAN RADIO NEWSPAPER

Sponsored by The Anglo-American Caribbean Commission, The West Indian Radio Newspaper is heard daily from 6:15 to 6:45 p.m. EWT over WRUL, 11.73, and WRUW, 15.35 megacycles, Boston.

Programs, which are subject to change without notice due to war conditions, are patterned as follows:

Sundays: The West Indian Radio Newspaper Symphony Concert; *Mondays:* Letters from Listeners, Creole Cook, Science in the News; *Tuesdays:* Quiz Show, Health Chat, Featurette; *Wednesdays:* Stamp Club, Poets' Corner, Agricultural Chat; *Thursdays:* Americana, Popular Concert; *Fridays:* Vagabond Traveller, Caribbean in History; *Saturdays:* Caribbean News and Music. In addition to the above features, each weekday program contains musical selections and closes with a review of the news of the Caribbean.

This is one of the most interesting programs on short-wave today, your editor feels, and recommends it to listeners throughout the Western Hemisphere and abroad. Any comments on these programs should be addressed to The West Indian Radio Newspaper, Washington, D. C., U.S.A.

* * *

CANADA'S NEW TRANSMITTER

Howard Landry, Detroit, Michigan, sends along the following information about the soon-to-be installed short-wave transmitter of "Radio Canada":

"Radio Canada" will start its broadcasts by short-wave to Europe through its Sackville, New Brunswick, short-wave station the first of January, 1945, it is believed. This is according to information from Aug. Frigon, general manager of "Radio Canada." Starting the 18th of January, programs will be on schedule.

It is Mr. Frigon's opinion that it will be unnecessary to "import" personnel as the Society already has at its disposal several "polyglots" to broadcast in foreign tongues. It is not known how many countries will be able to be contacted by this station before it has been "proved." Many programs will be easy to reach due to rebroadcasting by the BBC. (This is taken from an article in "Evangeline," a weekly, published in Moncton, New Brunswick, and which was translated from the French for RADIO NEWS readers by Mr. Landry.)

* * *

WEST COAST REPORT

From the West Coast, August Balbi, veteran Los Angeles monitor, sends us the following report this month (EWT):

VLC7, 11.84 mcs., Shepparton, Australia, is heard 9:45-10:45 p.m. to East Coast, replacing VLC4 in the 19-meter band. VLC7 (which may announce as VLG4 on same frequency) is heard R-5.

VUD6, 9.63 mcs., Delhi, India, is

(*Continued on page* 132)

WORLDWIDE LOG OF SHORT-WAVE BROADCASTING STATIONS

(Numbers and letters at start of each item indicate frequency in megacycle and station call letters. To convert frequency to meters divide 300.000.000 by the frequency in cycles-per-second. Unless otherwise indicated, all times are EWT.)

PARTS I AND II OF THIS LOG APPEARED IN THE OCTOBER AND NOVEMBER ISSUES RESPECTIVELY

11.700 GVW LONDON, ENGLAND (BBC). To Central and South Africa, 11:30 a.m.-5 p.m. (African Service). To West Africa, 2-5 p.m.

11.700 HP5A PANAMA CITY, PANAMA. "Radio Theatro Estrella de Panama y la Voz de la Victor." Weekdays, 7 a.m.-11 p.m.; Sunday, 9 a.m.-9:30 p.m.

11.705 CBFY MONTREAL, QUEBEC, CANADA. (CBC). (Not in operation at present.) (7,500 w.)

11.705 HP5A PANAMA CITY, PANAMA. Heard evenings.

11.705 SBP STOCKHOLM, SWEDEN. Heard, 11-11:58 a.m. irregularly. Also heard 2:45 a.m., 7 a.m., 12 noon, 1:30 p.m. (war news), 2 p.m., and 9 p.m. daily, with 5:20 p.m. Sundays.

11.710 VLG3 MELBOURNE, AUSTRALIA. Australian Broadcasting Corporation. Beamed to Western North America, 1:10-1:40 a.m. News, 1:10 a.m. Beamed to Tahiti, 1:55-2:40 a.m. (French). Beamed to Britain, 2:55-3:25 a.m. Beamed to North Asia, 3:30-3:55 a.m. (Japanese).

11.710 WLWK CINCINNATI, OHIO. The Crosley Corporation. European beam, 6:30-8 a.m. English news, 7 a.m.

11.710 WLWO CINCINNATI, OHIO. The Crosley Corporation. European beam, 2:45-5:15 p.m. English news, 3, 4, 5 p.m.

11.720 CKRX WINNIPEG, MANITOBA, CANADA. Transcanada Communications, Ltd. Sunday, 8 a.m.-11:30 p.m.; Monday through Friday, 6:30 a.m.-12 midnight; Saturday, 6:30 a.m.-1 a.m. (2,000 w.) (Times listed are local.)

11.720 PRL8 RIO DE JANEIRO, BRAZIL. To North America, 10-11 p.m. daily (English). News, 10 p.m.

11.725 JVW3 TOKYO, JAPAN. 9-10:40 a.m. daily. News in English, 9, 10 a.m. Also heard, 11 a.m.-2:40 p.m. News on the hour.

11.730 GVV LONDON, ENGLAND (BBC). To Southeastern Europe, Austria, and Italy, 2 a.m.-5 p.m. To Europe, 5:45-6 a.m. (Special Clandestine Press.)

11.730 WRUL BOSTON, MASSACHUSETTS Worldwide Broadcasting Corporation. Mexican beam, 7:30 p.m.-2 a.m. (Spanish-Portuguese).

11.740 DXC2 BERLIN, GERMANY. Heard irregularly.

11.740 JVW3 TOKYO, JAPAN. Heard irregularly. This station is also heard on 11.725 and 11.825.

11.750 GSD LONDON, ENGLAND (BBC). To Far East, 1:45-4 a.m. To Italy, Central Mediterranean, Algiers, North Africa, 1 a.m.-4:30 p.m. To South America, 5:15-10:15 p.m. To West Indies and Central America, 5-10:15 p.m.

11.760 —— PRAGUE (PRAHA), BOHEMIA (CZECHOSLOVAKIA). Heard at 7:58 p.m. in English.

11.770 DJD BERLIN, GERMANY. A daily German transmission is heard over the German Home, Overseas, and Danish networks—on this frequency it begins at 1 p.m., shutdown is reported as 4 p.m. The transmission is chiefly music. Heard in Asiatic languages, 1-2 a.m.

11.775 R.S. RADIO SAIGON, SAIGON, INDO-CHINA. 5-11:30 a.m. News, 10 and 10:45 a.m., sometimes 7:15 a.m.

11.780 GVU LONDON, ENGLAND (BBC). To India, Ceylon, Burma, and Malaya, 12 a.m.-4 a.m. and 10:45 a.m.-1:30 p.m. To West Indies and Central America, 7-8 a.m. To South America (South of Amazon), 7-10 p.m.

11.780 HP5G PANAMA CITY, PANAMA "Radio Panamericana." Weekdays, 8 a.m.-11 p.m.; Sundays, 9 a.m.-10 p.m.

11.790 WGEX SCHENECTADY, NEW YORK. European beam, 2:15-2:30 p.m., and 4:30-4:45 p.m. Also reported heard during mornings.

11.790 WRUA NEW YORK, N. Y. European beam, 3:30-3:45 p.m.

11.800 GWH LONDON, ENGLAND (BBC). To Spain and Portugal, 4-4:30 a.m. To Scandinavia, Europe, Africa, 3:30 a.m.-4:30 p.m. To France, 11:30 a.m.- 5:45 p.m. (ABSIE).

11.800 JZJ TOKYO, JAPAN. 11 p.m.-4 a.m. News at 11:40 p.m., 1, 2, 3 a.m.

11.820 GSN LONDON, ENGLAND (BBC). To Pacific Area, 3:45-5 a.m. To Near East and East Africa, 2-5 p.m. (African Service). To Near East, 8:15-8:30 a.m. (Arabic and Turkish). To South America, 6-6:15 p.m. (Radio Splendid).

11.825 JVW3 TOKYO, JAPAN. Heard irregularly. This station is also heard on 11.74 mcs. and 11.725 mcs.

11.830 WCRC NEW YORK, N. Y. Columbia Broadcasting System. Western South American beam, 5:30 p.m.-12 midnight (Spanish-Portuguese). European beam, 1-1:15 p.m. and 3:15-3:30 p.m.

11.840 —— PRAGUE (PRAHA), BOHEMIA (CZECHOSLOVAKIA). Heard on East Coast signing on at 6 p.m. News, 6:03 p.m. Bells chime from 7:30 to 7:32 then signs off. No English heard. Also 2:45-3:15 p.m.

11.840 VLG4 MELBOURNE, AUSTRALIA. Australian Broadcasting Corporation. Beamed to New Caledonia, 4:10-5 a.m. (French). Beamed to Forces in the Southwest Pacific, 5:30-6:15 a.m. (English). Beamed to Asia, 6:15-7:45 a.m. (Chinese, English, Malay, Dutch). Now also beamed to Eastern North America, 9:45-10:45 p.m.; Gen. MacArthur's communique, 9:45 p.m.; war news, 10:30 p.m.

11.847 WGEX SCHENECTADY, NEW YORK. European beam, 10:45-11 a.m.

11.8475 WGEA SCHENECTADY, NEW YORK. General Electric Co. Beamed to Brazil, 5-11:30 p.m. (Portuguese).

11.855 CB SANTIAGO, CHILE. Heard 8-.? 11 p.m.

11.860 GSE LONDON, ENGLAND (BBC). To West Africa, 3:15-5 p.m. To Gibraltar, 6 a.m.-2:45 p.m. and 3:15-5 p.m.

11.860 XMHA SHANGHAI, CHINA. At intervals, 1-10 a.m.

11.870 VLC3 SHEPPARTON, AUSTRALIA Australian Broadcasting Corporation. Used irregularly.

11.870 VLI2 SYDNEY, AUSTRALIA. Australian Broadcasting Corporation. Used irregularly.

11.870 WBOS BOSTON, MASSACHUSETTS. European beam, 4:45-5:15 p.m.

11.870 WNBI NEW YORK, N. Y. National Broadcasting Company. Eastern South American beam, 7 p.m.-12 midnight (Spanish-Portuguese).

11.870 WOOW NEW YORK, N. Y. European beam, 10:45-11:15 a.m. and 2:45-3 p.m.

11.880 LRR ROSARIO, ARGENTINA. Heard, 7-10 p.m.

11.885 —— RADIO MOSCOW, MOSCOW, U.S.S.R. All-English program, 7:40-8:25 a.m. daily. (News is generally given at start of broadcast.)

11.893 WRCA NEW YORK, N. Y. European beam, 5-9:45 a.m. and 3-4:45 p.m.

11.895 —— "RADIO ELECTRA DE MONTEVIDEO," MONTEVIDEO, URUGUAY. Heard, 6-7 p.m. Transmission in Spanish, mostly music.

11.897 JZU3 TOKYO, JAPAN. To North America, 9-10:40 a.m., 6:15-8:15 p.m. Also heard 11 p.m.-4 a.m. News in English, 9, 10 a.m.; 6:20, 7:20 p.m.

11.900 CXA10 MONTEVIDEO, URUGUAY. Heard, 7-10 p.m.

11.900 KWIX SAN FRANCISCO, CALIF. Associated Broadcasters. (UNITED NETWORK.) Latin America beam, 6:45 p.m.-12 midnight (English). News or commentary every hour on the hour.

11.900 XGOY CHUNGKING, CHINA. The Chinese International Broadcasting Station. "The Voice of China." Summer schedule: To Allied Forces in the Far East, 8-9 p.m.; to Asia, Australia, and New Zealand, 6-6:30 a.m. To East Russia, 6:30-7 a.m. To Japan, 7-7:30 a.m. (Also reported on 11.915 mcs. now.) English news, 8:15-8:30 p.m., 6-6:15 a.m., 10-10:15 a.m.

11.930 GVX LONDON, ENGLAND (BBC). North American Service, 5:15-8 p.m. To North Africa, 4:30-5:15 a.m., 5:30-7 a.m., 7:15-9:30 a.m., 9:45-10 a.m., 10:30 a.m.-4 p.m. To France, Spain, and North Africa, 5:15-5:30 a.m. (Radio Polskie: For Polish Forces). To France, Spain, and North Africa, 7-7:15 a.m. (French). To North Africa, 9:45-10 a.m. To Italy, 2-2:15 p.m. To North Africa, 10:30-10:45 a.m., 12:30-12:45 p.m. To Near East, 5:30-6 a.m.

11.947 WGEA SCHENECTADY, NEW YORK. European beam, 2:15-2:30 p.m. and 4:30-4:45 p.m.

(Continued on page 118)

THEORY AND APPLICATION OF U.H.F.

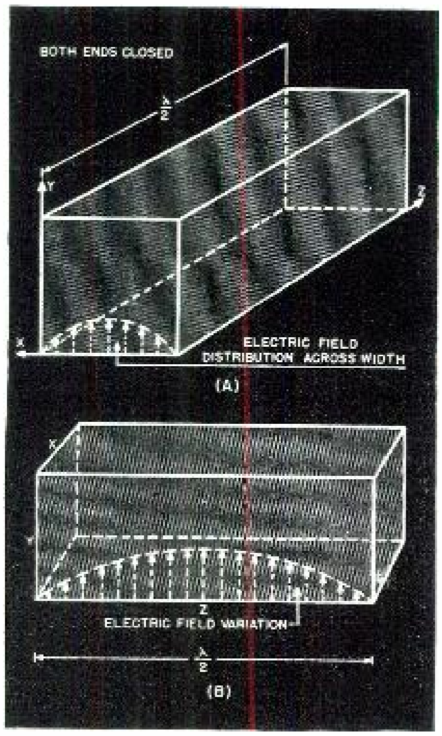
By MILTON S. KIVER

Part 8. The theory and application of cavity resonators as tuning units of Klystron and Magnetron oscillators, operating at u.h.f.

IT HAS been noted in previous articles that the trend in tuning apparatus was from lumped circuit elements at the low frequencies to distributed elements at the ultra-highs. The necessity for using lines arose from the fact that at the wavelengths generated by the Klystron and Magnetron, the size of coils and condensers would have been too small to be of any use. Also, the Q of these circuits would have been very low, not at all comparable to what can be obtained from resonant lines. Now, as the frequency is raised to 3,000 megacycles, even the length of tuned lines becomes a little impractical to use. For example, a quarter-wave line at a wavelength of 10 centimeters is only 2.5 cms. long or roughly one inch. A transmission line this long would be very critical to adjust and we would end up finally with the same sort of situation that occurred with regular tuning coils and condensers.

Thus, the time was ripe for modifications of the existing equipment which, it was hoped, would lead to more efficient means of solving this problem. The result of further experimentation led to the development of the cavity resonator which, if you recall, was mentioned as the tuning device on the Klystron oscillator discussed in Part 2. It is the purpose of this article to investigate this new tuning device and see just how its properties stand up against the resonant circuits that preceded it.

Fig. 1. (A) Cavity resonator, showing the electric field distribution along the X axis. (B) the same resonator as in (A), showing how the electric field varies as the wave travels down the enclosure.



There are two possible means whereby cavity resonators may be explained. One deals with tuned lines, which is derived from conventional ideas on electric current flow, while the other uses the wave guide as the basis. It might be instructive to analyze each method since it is believed that a better insight into cavity resonators will be attained in this way.

To start with the tuned transmission line, consider the quarter-wave section shown in Fig. 6(A). If a generator is coupled to it, then the familiar voltage and current distribution shown will be obtained. (The circuit is being reproduced here for convenience.) At the shorted end of the line, the current will be a maximum and the voltage value will be zero or at least very low. At the open end the reverse will take place resulting in low current and high voltage. These are the conditions that must exist if this line is to operate as a resonant circuit.

Now suppose that it is desired to excite two of these quarter-wave lines instead of one. Then they could be placed in parallel across the generator as shown in Fig. 6(B). This combination would now have a higher resonant frequency because essentially the inductances in each line are being placed in parallel with each other, and like resistances in a similar situation, the end result is smaller than any of the components. Continuing this process would result finally in a container having a shape such as shown in Fig. 7. At the center would still be the generator exciting all the infinite number of units that now have been blended into one. This, then, is the final product—the cavity resonator.

It might be mentioned that in this process the capacitance has changed very little. In the Klystron oscillator, instead of actually having a generator at the center of this cavity resonator, it will be recalled that holes or openings were made at the center and then bunches of electrons were sent through and these excited the cavity resonator and started its operation. But whether an actual generator is located at the center of the cavity resonator or bunched electrons are sent through, the end result is the same, namely, excitation of the resonator.

The reader will note, at this point, that the electron itself assumes greater importance at the ultra-highs than at the lower frequencies. This does not arise because the electron has different functions at the shorter wavelengths, because it has not. Rather, it is due to the fact that the phenomena can be explained more easily when the individual electron and its effect are considered.

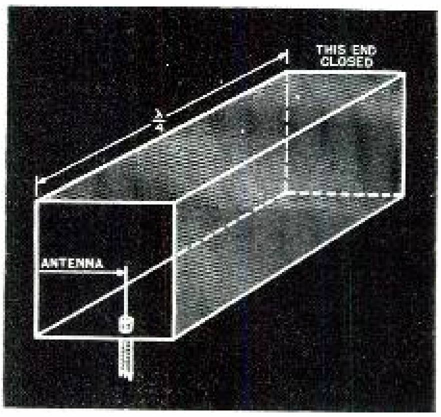


Fig. 2. A quarter-wave section of a wave guide used to set up standing values of electric and magnetic fields.

Thus, from the above analysis, it may be argued that the cavity resonator is essentially the same as the former quarter-wave tuning lines placed in parallel except that this process was carried to the limit. Remember the voltage distribution on the quarter-wave line as shown in Fig. 6(A), for this will help tie in the cavity as obtained by the above process to that resonator which will be derived now from a wave-guide analysis.

The easiest way to begin this is to deal with a small section of wave guide, such as pictured in Fig. 2. One end of the wave guide has been blocked and the other end left open so that by means of a small antenna waves can be sent down the guide. These waves will travel unmolested until the end that has been closed is reached. Upon striking this solid wall, a reflection of energy will take place whereupon there will be waves travelling now in two directions, something quite similar to the situation on a transmission line when a change occurs along its length. In order to have the reflected waves reach the opening and arrive there so as to reinforce the electric field previously set up, the end-blocking wall may be made movable and adjusted so that this reinforcement does take place. Standing values of electric and magnetic fields are now set up and this situation is very similar to the quarter-wave tuning line.

To complete the above picture, take another such section of a wave guide and place it on the other side of the transmitting antenna as shown in Fig. 3. Waves from the antenna will travel in both directions away from the radiator and both will be reflected when they strike the two closed ends. If the lengths of both guides are equal and correctly adjusted, then the standing waves set up will reinforce at the center and a continuous pattern will be obtained. This is also shown in Fig. 3. By placing the open ends of the sections together, a cavity resonator is the result. Naturally there is only one fundamental frequency that will give the correct electric field distribution as described above. However, by means of other frequencies that are integral multiples (harmonics) of this fundamental, a full wave, a wave and a half, etc., can be placed into the same space. More about this will follow. Meanwhile the reader should notice the marked resemblance between the standing values of electric-field and magnetic-field distribution here with the standing waves of voltage and current encountered on transmission lines under similar conditions. Thus, both methods of deriving cavity resonators are very much alike and it may begin to dawn upon the reader that although it has not been specifically mentioned before, the wave guide (and hence the cavity resonator) may be considered as a transmission line carried to the limit. The relationship between voltages and currents and electric and magnetic fields will be more fully explained in a later article.

From the foregoing discussion it is possible to arrive at the minimum length that a cavity resonator must possess in order to function properly at some given frequency. They should be at least a half wave in length. This fact can be understood quite simply, for it will be remembered that in order to derive a resonator, the distance from one end of one wave guide section to the generator was ¼ wavelength. To go on from the generator to the opposite end of the other wave guide section meant another ¼ wavelength, giving the sum total of ½ wavelength. Naturally, if one ½-wavelength cavity resonator will work, so will a resonator that is any whole number multiple, such as a full wavelength, one and a half, etc. This same sort of situation holds true when considering ordinary transmitting antennas where a half-wave Hertz, a full-wave Hertz or any multiple of a half-wave antenna will work. The basic principle remains the same. The object in having the length of the resonator exactly an integral (or whole number) multiple of the first half-wave unit is quite obvious. Any wave sent out, say from the antenna, must be reflected and returned so that the maximum amplitude or strength of the standing wave is obtained. This will occur for only one distance or, as stated above, multiples of this distance. The minute any change occurs in the distance, the forward and backward (or reflected) waves no longer will act so as to aid each other and weak standing waves will be set up, resulting in inefficient operation of the resonator as a tuning unit. The distance from the antenna (or generator) to where the wave is reflected is quite sharp and must always be adjusted carefully.

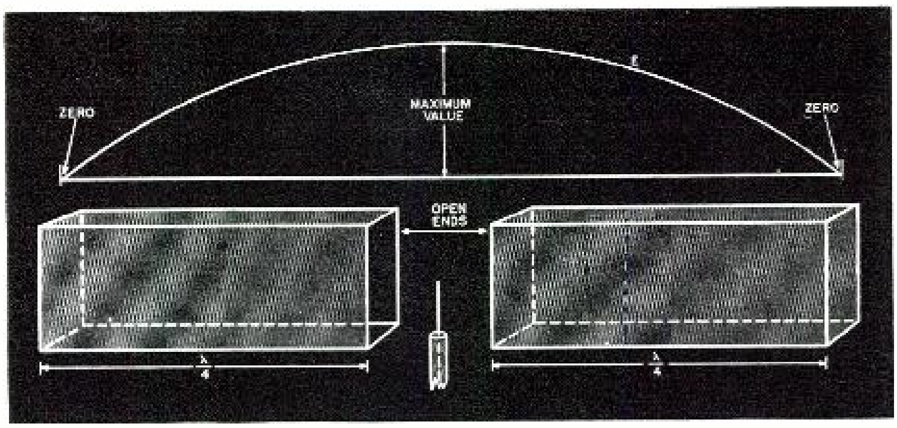


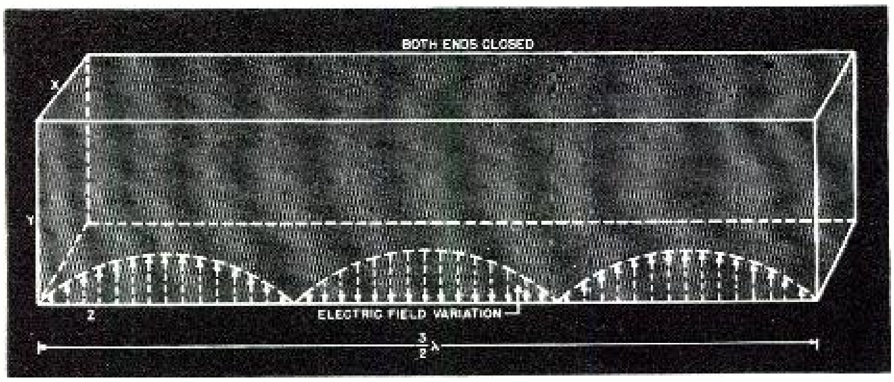
Fig. 3. By using two quarter-wave sections of wave guides, a closed cavity resonator may be had. The above curve gives the electric field distribution inside the guides.

Now that the length of a cavity resonator has been determined, it would be best to investigate the distribution of the magnetic and electric fields in a resonator. This will prove helpful when methods for extracting the energy from a resonator are considered. An investigation of the way the electric and magnetic fields are distributed in a cavity resonator should not be too complicated if the facts mentioned in the chapter on wave guides are remembered. It was here that the various wave intensities were shown and explained for wave guides and, as just pointed out, a cavity resonator may be considered as essentially derived from a wave guide. To begin, consider the small rectangular cavity resonator shown in Fig. 1(A). Any electric wave set up must be so arranged that at any of the walls its intensity will be zero. If this condition is not adhered to, then currents due to this electric field will flow at these boundaries and distort the whole waveform. This specification was likewise demanded in the wave guide. In order to satisfy this condition, a wave will be set up across dimension *X* (the width of this rectangular box) so that it is maximum in the center and gradually tapers off to zero at the sides. This is also illustrated in the above figure.

The next point in the electric field distribution to consider will be the length of this cavity resonator, the dimension *Z* in Fig. 1(B). A three-dimensional picture is being dealt with here so that not only will the electric field vary along the *X* axis as mentioned above, but it will also change as it moves down the length of this enclosure. And as the wave travels down the length of the resonator, it must reach the end wall of the resonator so that its electric field is again zero. This is depicted separately in Fig. 1(B) and the length of the resonator has been adjusted so that it is one half-wave long. Thus, if the three-dimensional picture is to be visualized, there would be a half-wave variation in electric-field intensity along dimension *X* and one half-wave distribution along *Z*.

To illustrate another situation, see Fig. 4, where the electric-field intensity along the *X* axis is still the same, but now the length is longer and there is a full wave and a half distance. No matter how long or wide these resonators may be, even in different forms, the rules as laid down in previous articles regarding the distributions of electric and magnetic fields still hold.

Fig. 4. An example of a cavity resonator one and one-half wavelengths long. The arrows represent the directions of the electric field set up within the resonator.



This explanation has dealt exclusively with electric fields, but of course there are magnetic fields present also. These have been omitted purposely in order to simplify this discussion, else a complicated diagram drawn in three dimensions would have been necessary to obtain the desired effect. For the present it is merely necessary to remember that the fields are at right angles to each other. And, as in wave guides or just plain electromagnetic waves in space, the r.f. energy oscillates between the magnetic and electric fields. One instant it is in the electric field, the next it has smoothly changed over to the magnetic field. The rate at which the changes occur is the same as the frequency of the wave itself. And, as pointed out before, it is through this interchange of energy that the wave sustains itself and moves forward. Whether in a cavity resonator, a wave guide, or just in ordinary space, the same things happen in the exact same manner. The only differences refer to the minor restrictions imposed by the confining walls of the enclosure.

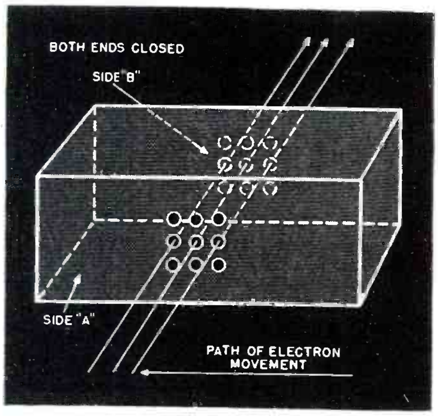
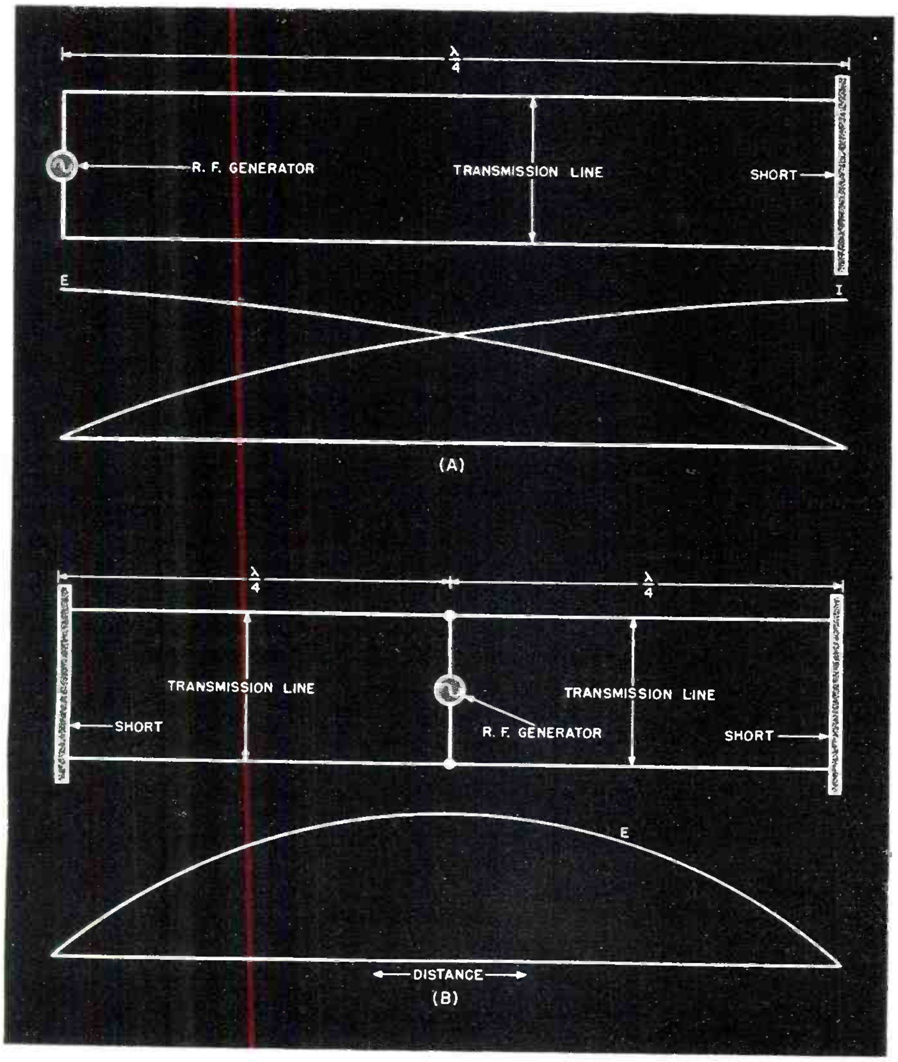


Fig. 5. By allowing electrons to pass through the cavity resonator, it is possible to excite the resonator and cause large values of electric and magnetic fields to be formed.

The above resonator was excited by an antenna placed inside the box. For some applications of these devices, this is the method used. But there are many more places where electrons are the exciting agency. To understand this method of operation, consider the chamber shown in Fig. 5. This is similar to the other cavity resonators described above, except that the sides have been altered slightly. Now at the center of the sides a series of holes have been drilled so as to allow the passage of a stream of electrons through the center of the resonator. Every time an electron approaches side A, there is a movement or displacement of negative electrons away from this side, repelled, of course, by the charge on the approaching electron. As this electron swings through the openings in the resonator itself, the induced positive charge may be thought as moving with it, only this positive charge is confined to the surface of the metal. When the electron leaves the resonator through side B, the electric charge that it induced may be considered as released and now it moves back to its starting point. Thus, there is a flow of current in one direction when the electron passes through and a flow in the opposite direction when the induced charge returns to its previous rest position. This may be compared to a pendulum that is pushed aside every time something passes it and then returns to its former position when the disturbance has gone. In both cases oscillations will occur, which is the desired effect in the cavity resonator. If the exciting electrons swing through the cavity resonator at definite times, then the oscillations set up in the resonator will continue just as in the case of an ordinary oscillating circuit. Needless to say, the definite frequency mentioned in the last statement must bear a direct relationship to the resonant frequency of the cavity resonator.

Fig. 6. (A) The familiar ¼-wave transmission line, showing its voltage and current standing waves. (B) Two ¼-wave lines in parallel across one generator.



In the Klystron tube described several issues back, this whole unit (Fig. 5) is connected to and made part of the tube. The section that was drilled full of holes to allow passage of the electrons acts as the first two grids or the bunchers. A similar arrangement is set further back in the tube and these constitute the catcher grids and catcher resonator. The electrons coming from the cathode are first speeded up and focused by a control grid and then these electrons pass through the buncher. The action from here on has already been given and will not be mentioned again. Comparison of the resonator described in this chapter with the one used on the Klystron shows that the construction is not the same. The Klystron resonator has been reprinted in Fig. 8(D) and alongside of this has been placed the rectangular resonator outlined above Fig. 8(E). This difference is immediately discernible, for the distance that the electron must travel through the center portion of the Klystron resonator is much less than the distance through the same point of the rectangular resonator. There is a definite reason for this and it all comes down to electron-transit time. The electron travelling from one side of the resonator to the other takes a certain definite time. Now, it is desirable that this time should be very short in comparison to the frequency of the alternating voltage on these grids. If this is not so, then the electron, while in the space between the sides of the resonator, will

(*Continued on page* 128)

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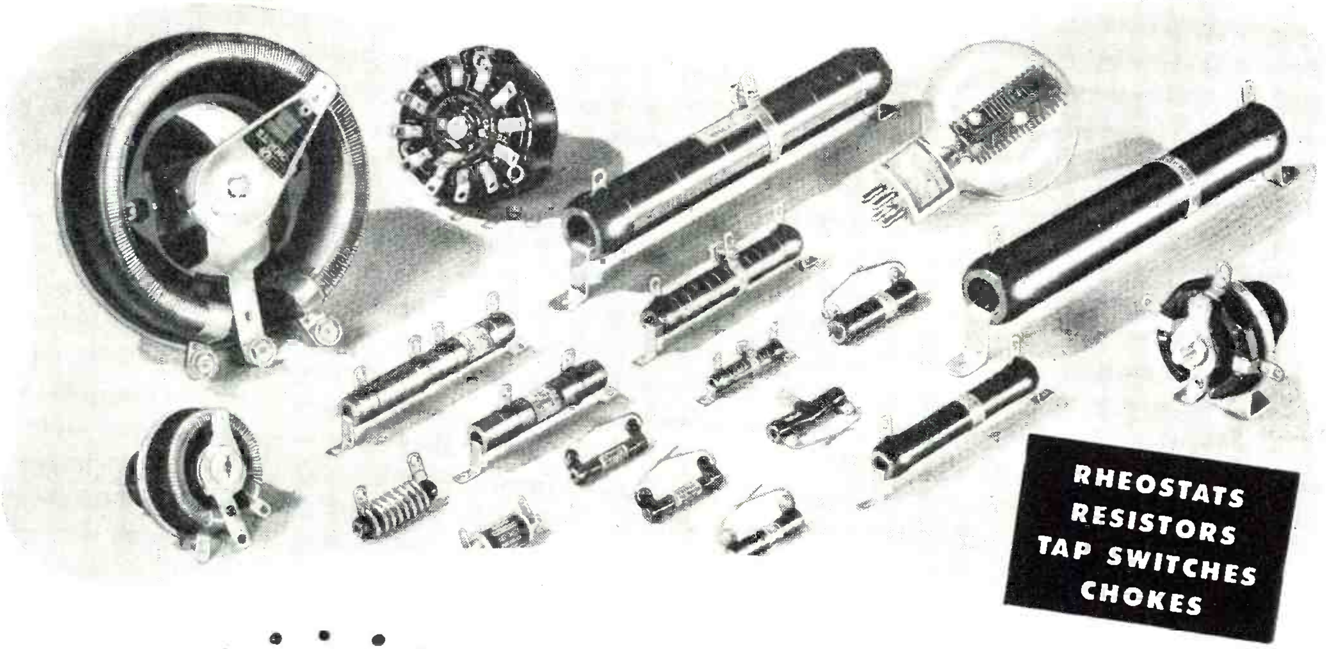

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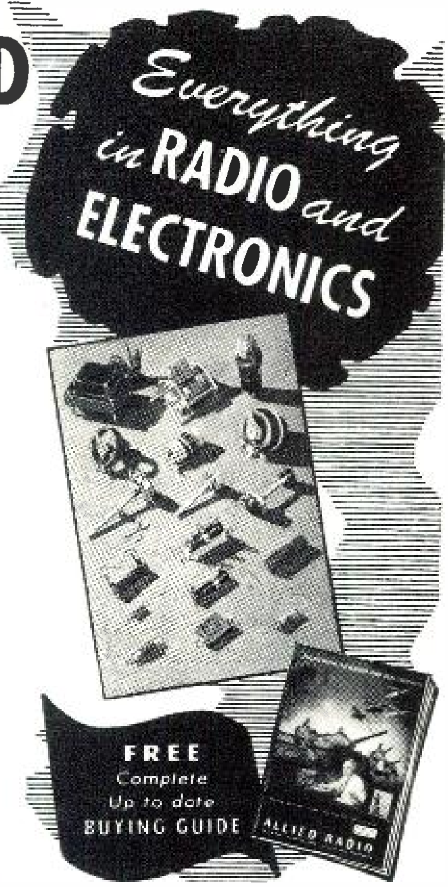


TECHNICAL BOOK & BULLETIN REVIEW

"ELECTRONICS, TODAY AND TOMORROW," by John Mills. Published by *D. Van Nostrand Company, Inc.,* New York. 172 pages. Price $2.25.

This is the primer of electronics for the layman. Written by John Mills of the Bell Laboratories, the material treated in this book is technically accurate but presented in an elementary and nonmathematical manner. Mr. Mills, who is the joint author with Dr. R. A. Milliken of Chicago University of several physics texts, uses everyday analogies to present electronic theory.

The style of the book is informal, easy and interesting. To those in the electronics industry who know Mr. Mills, the style is typical of his speaking personality.

The author has covered the electron theory, the motion of electrons, vacuum tubes, and various electronic devices in everyday use. As the publishers point out on the jacket of the book, this is not intended for the specialist in electronics but rather to give the layman the ability to "discuss a cathode ray tube on the 5:19 for Squeedunk."

In the second part of the book, where the author discusses electronic devices, the subject of electron guns and television, the ultra-high frequencies, and the use of the science of electron optics are cleverly treated for easy understanding.

Too much emphasis cannot be placed on the fact that this is truly an elementary text as the technician or engineer would find the concepts as presented too basic, but for the purpose of instructing the layman, the book serves a useful purpose.

"DIRECT-CURRENT CIRCUITS," by Earle M. Morecock. Published by *Harper and Brothers,* New York. 381 pages. Price $3.25.

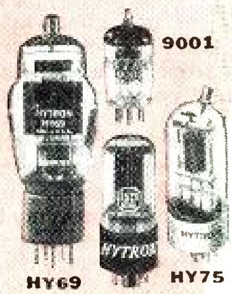
This book is one of a series of texts prepared by members of the faculty of Rochester Athenaeum and Mechanics Institute for use as teaching material at the school. The book starts with the most elementary concepts of electricity and magnetism and explains atomic structure and the electron theory, the analogy between electrical and mechanical concepts, and then goes on to discuss basic circuits.

Each chapter is concluded with laboratory and homework questions for the student. The answers to the problems are included as a part of the text in order that those wishing to do so may use this as a home study text.

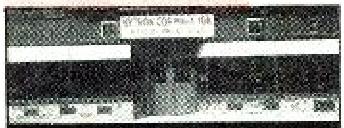
The mathematics in this text is confined to arithmetic and elementary algebra, with many problems worked out for the student, as examples.

The subjects covered include elementary electric circuits, magnetism and electromagnetism, instruments and methods for measuring voltage, cur-

Some INTERESTING FACTS ABOUT HYTRON



- ★ Hytron is the oldest manufacturer in the United States specializing on radio receiving tubes. The first Hytron tube was made by hand in 1921.
- ★ The now standard BANTAM GT receiving tube is a Hytron origination. Hytron designed and developed over 70 of the popular GT types. These small glass receiving tubes contributed to the development of the miniature table radio and to large scale production of radio and radar equipment for the Services.
- ★ The tiny BANTAM JR. tubes originated by Hytron were the first subminiatures. They made possible hearing aids and pocket radio sets. Similar Hytron tubes serve in wartime electronic devices.
- ★ Hytron has pioneered transmitting and special purpose tubes for the radio amateur and for police radio. Its very-high-frequency tubes and its instant-heating r.f. beam tetrodes for mobile communications, have also become extremely popular with the Services.
- ★ Hytron combines long experience in high-speed receiving tube techniques with the know-how of special purpose tube engineering. The result is economical mass production of special tubes.
- ★ First of the receiving tube manufacturers to convert 100% to war production, Hytron will be just as alert in serving the post-war market.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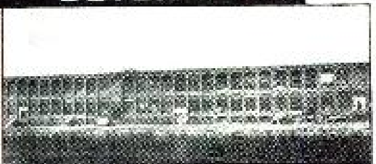

LAWRENCE


NEWBURYPORT


SALEM

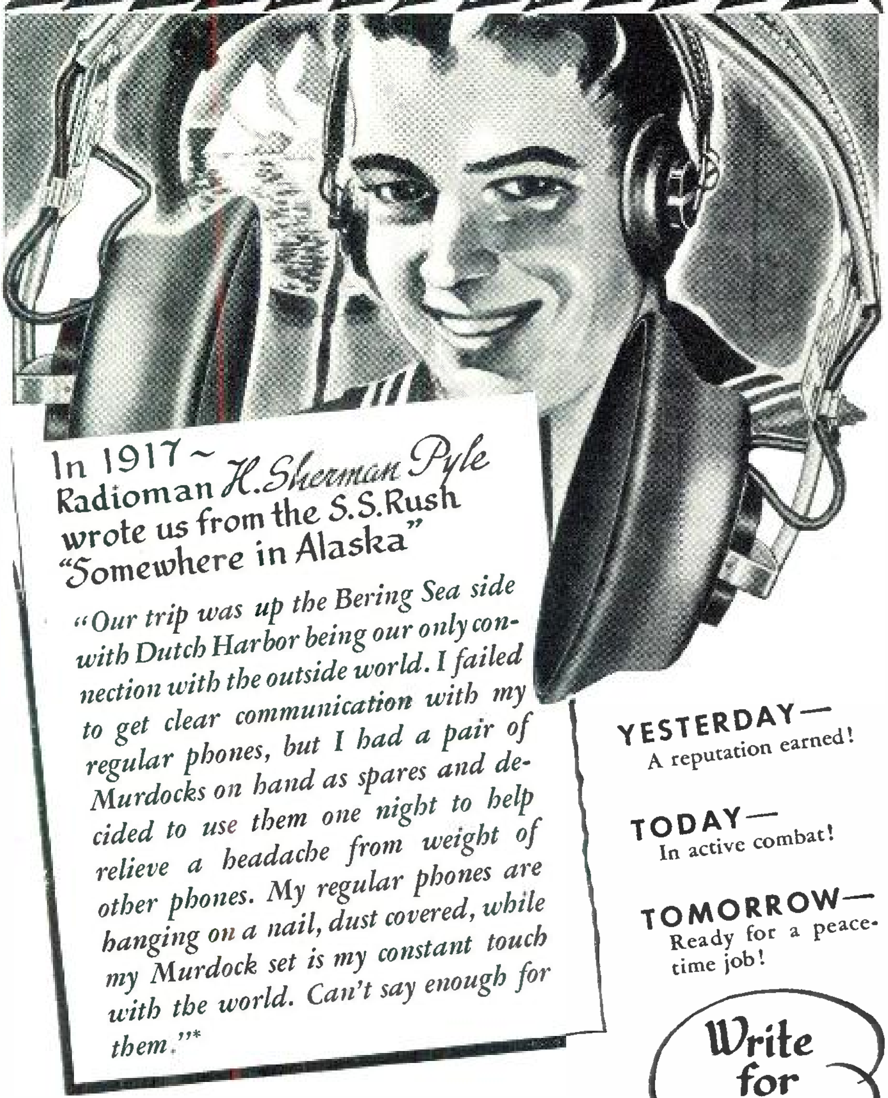
CONSULT HYTRON regarding your needs for these tubes: receiving, ballast, hearing aid, very-high-frequency triodes and pentodes, miniatures, medium and low-power transmitting triodes, r.f. beam tetrodes (particularly instant-heating), r.f. pentodes, gaseous voltage regulators, and rectifiers.

OLDEST EXCLUSIVE MANUFACTURER OF RADIO RECEIVING TUBES

HYTRON CORPORATION ELECTRONIC AND RADIO TUBES

SALEM AND NEWBURYPORT, MASS.

BUY ANOTHER WAR BOND



rent and resistance, power and energy, conductors and insulation, batteries, magnetic circuits, electromagnetic induction, and capacitance.

"RADIO SERVICING COURSE BOOK," published by *Supreme Publications*, Chicago. 224 pages. Price $2.50. Sixth Edition.

This is a compilation of twenty-two home study lessons on repairing and servicing radios as prepared by the technical staff of Supreme Publications.

The course is designed for easy understanding of the material. The explanations are clear and abbreviated. Excess verbiage has been scrupulously avoided in order to give the maximum amount of information in the minimum of space.

The book is well illustrated with photographs and cut-away diagrams of various pieces of commercial equipment in order that the student may become thoroughly familiar with component parts of the circuits with which he will work.

Except for essential formulas, mathematics has been avoided in this treatment of the subject. Tube characteristics have been included to provide an easy reference source when the student begins his work of servicing receivers; tube base charts are also included in this section.

The book covers various subjects, including television and hints on the successful operation of a radio repair business. This is a good course for radio beginners who want to know the what's, why's and how's of radio repairing.

—30—

TROUBLESOME TUBES

An interesting item has been received from William L. Fields, of Louisville, Kentucky, concerning defective tubes which can not be detected with the ordinary tube tester.

As a first example, he considered the elimination of hum in an old set, such as an RCA 17. This can be due to light falling on the second detector tube if the tube is a 27 tube with the cathode visible. Replace the tube with another 27 tube or exchange with another 27 tube in the set.

In other cases where the filter and coupling condensers are known to be good, distortion may be due to the beam power amplifier, although the tube may check perfect. Numerous cases of this have been observed, especially with radios using 50L6 and 35A5 tubes.

A 35Z5 tube can cause many troubles. Mr. Fields mentioned an instance where a set would not light up, although the tubes and filament circuit were checked. The trouble was in the pilot light taps on the 35Z5. That section of the filament had a high resistance which was enough to show open when properly tested.

Flat tubes are known by many servicemen; however, for the sake of completeness they should be mentioned. These are the oscillator tubes which usually check normal but will not oscillate.

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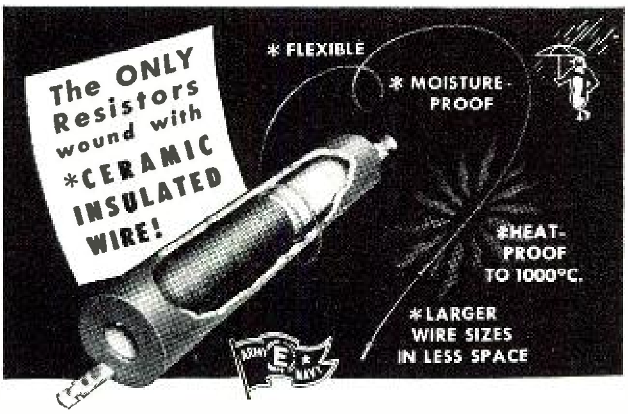
SPRAGUE TRADING POST

A FREE Buy-Exchange-Sell Service for Radio Men



As a radio serviceman, no one has to tell you that a wire wound resistor is no better than its insulation—or that that is why Sprague Koolohm Resistors are "tops" by any test you care to name. Koolohm ceramic insulation is applied directly to the wire and the assembly is then DOUBLY protected by an outer ceramic tube. Koolohms operate so cool you can use them at full wattage ratings. They are highly resistant to both moisture and heat. They give you higher ratings in smaller sizes. KOOLOHMS will not let you down!

FOR SALE—3-48 tubes; 3-12SC7; 5-31; 3-58AS; 6-7B5E. All new at wholesale ceiling prices. Also Gernsback Manual #1 fair condition, $2.50; Vols. II, III, IV very good, $3.50 each; Philco station setter, $8. Wikoff Radio Service, Polo, Illinois.

WILL SWAP—Craftsman planer and bench saw with motors for radio test eqpt., preferably good sig. generator and/or channel analyzer. Cash difference. Howard Spovek, Waverly Ave., Medford, L. I., N. Y.

FOR SALE—4-1LH4; 1-12SC7; 1-80 tubes, all for $9.12 plus postage. Robert C. Dole, 10 Clinton Ave., Rutland, Va.

SELL OR TRADE Supreme Std. Diagnometer, Rider "Manuals XII and XIII." Want two good make AC-DC V-O-M, Jr. or Sr. voltohmyst, Chanalyst, Supreme audolyzer or other sig. tracing instrument. Also want for cash large or small lots of tubes, and 3" 'scope. Re-Tel Radio Service, 414 S. Broadway, Rochester, Minnesota.

FOR SALE 12, 25 cycle, 110-120v, 1425 rpm record player (juke box) motors, $10 each. Forest Radio & Appliance Service, 148-150 Forest Ave., Buffalo 13, N. Y.

WANTED—Hickok oscillator model OS-12 instruction book. Will pay $2. Pinkney's Radio Service, 9 Duncan St., San Francisco 10, Calif.

FOR SALE—Supreme #502 set & tube tester, modernized at factory this year at cost of $30. Perfect condition. T. E. Grimes, 1209 W. 4th St., Wilmington 34, Del.

FOR SALE—One G-E record player, seldom used, perfect condition. $15 f.o.b. Lee C. Spragle, Star City, Ark.

WANTED—Four each: 35L6GT; 12SA7; and 35Z5 tubes. S. M. Watts, Room 542, YMCA, St. Paul 2, Minn.

WILL TRADE—RCA 561A29 50-cycle turntable with matching magnetic pick-up, two pairs 2P 2000 ohm earphones; Radiola #33 on legs with speaker for any good test eqpt. or will pay cash. Ralph Hedson, 1342 Carmona Ave., Los Angeles 35, Calif.

FOR SALE Three 2½ meter Abbott transmitter receiver TR4's, incl. Mallory vibrapack 552's, with aux high voltage filters, and Mallory battery chargers, microphones, and cables included, like new. Holden Radio Service, 405 Farklin Hill Rd., New Bedford, Mass.

WANTED—Tuning condenser for Truetone Radio D-920, No. 10283. Mrs. Gordon Constantine, 10 Edward St., St. Albans, Vt.

WANTED—Two 2½ meter xmitter or transceiver, also recording units. Have tubes 1.4v to 117v, many 1A7, etc. B. F. Peyton, 319 Line St., Topeka, Kans.

WILL TRADE—Hickok AC51 tube tester, good condition, for late Sky Champion receiver. J. P. Hyde, Box 191, Fairfax, Virginia.

FOR SALE—One Hoyt meter (never used), Type 531-L milliamperes D-C, reads 0-150, $5.50 plus postage. P. R. Hoogezand, 832 Ohio St., Redlands, California.

FOR SALE—Confidence #36 tube & vibrator tester; Supreme #333 deluxe analyzer; Hickok 4995S AC-DC V-O-M (4" meter, ½ ma. movement); 1" cathode ray tube; RCP #417 appliance tester (AC-DC volts, amps, or watts); also misc. meters. Will trade for rectifier and mixer tubes, equal value, list price. Harold Harding, 206 Main St., Huntington Beach, Calif.

FOR TRADE—Two Sigma sensitive relays for one mil. meters. R. B. Rose, 1132 Roy Ave., San Jose 10, Calif.

FOR SALE—Philco Osc. a-c operated & a model 1400A American pocket tester, also large turntable & motor with magnetic pick-up. Will trade for Solar Capacitor analyzer (CB) or BF-50 or RCA 165 Jr. Voltohmyst. I. F. Gregg, 404 N. Jefferson St., Iola, Kans.

FOR SALE OR TRADE—Printing press complete, prints up to post card size. Want modern tube tester, V-O-M, or other modern test eqpt. D. N. Coble, 5422 Hyde Circ., Norfolk 2, Va.

WANTED—Complete set of Rider's manuals. Benj. Sakowitz, 74 E. 52 St., Brooklyn, N. Y.

WANTED—One 50L6 and/or 12A6 tube. Also want cheap panel meters, all sizes and ranges a-c or d-c; also small V-T-V-M and V-O-M. Don Anderson, 917 East Kemp St., Watertown, S. D.

URGENTLY NEEDED—Will pay cash for reliable V-O-M, sig. generator, and tube tester to handle recent tubes. Edgar L. Woody, 615 Oglethorpe Ave., Albany, Ga.

WANTED—Xmas tree lamps, sets and bulbs, any make or quantity. Will pay cash or trade radio tubes & parts. Star Radio, 3352 So. Halsted St., Chicago 8, Illinois.

FOR SALE McMurdo Silver Masterpiece II, 1934 model, 12-tube, Jensen 54 lb. auditorium speaker with 25′ remote cable & tuner; good condition; matched aerial, 15-watt 2A3 amplifier power transformer burned out, $60. Good buy for expert transformer rewinder. D. F. Crinkley, 1701 Michigan Ave., Winter Park, Fla.

WANTED—Abbott TR-4, TR-3—no more than $35 new, or $25 used. Have 1-1S4; 2-954; 1-6D6; 2-42; 1-HY615; 3-80 to trade. Billy T. Rhoades, 2406 Rosemont Blvd., Dayton 2, Ohio.

FOR SALE—38 copies Radio News, 15 Radio, 23 Radio Today, 9 Radio Retailing, 10 Radio Record dating from 1928 to 1942, also 3 yrs. of Radio Service-Dealer. Also Green Flyer turn table, motor, good condition; 10-12" records. Also 30, 32, and 34 used tubes that are good. J. J. Kadletz Radio Shop, Box 298, Chatfield, Minn.

WANTED—Weston 72-A set tester or similar, and Hickok 510X tube tester or similar. R. J. Rech, 815 E. Theodore St., Banning, Calif.

FOR SALE—43 cores with voice coil, asst. sizes, $8; Triplett tube tester 1210A, $9; Vibrators, all kinds, 25% off list; Coyne Reference Set, $8; Rider's "The Oscillator at Work," $1; Coyne "Electrical and Radio Trouble Shooter," $5; J.F.D. sockets, 25% off list; also many new and used tubes. Write for list. Geo. Ariza, Box 695, Crystal City, Texas.

WANTED—Rotary converter to change 32v d-c to 110v a-c, any size. Have International cut-awl and Dick Blick masterscope for sale or swap. Sam Broach, Box 42, Appalachia, Va.

FOR SALE—BD Turner dynamic microphone, or CX crystal, new in original carton. David A. Bensman, North High, Sheboygan, Wisc.

WANTED—Recorder and play back with 2-speed motor; also late model analyzer and tube checker. Lew's Radio Service, 253 S. Conn. Ave., Atlantic City, N. J.

FOR SALE—New 5V4G tube, $1.60; 25A7gt/g, $1.60; 6SC7, $1.30; 35Z5/gt/g, 85c; used 43, 55c; 12SK7, 50c. Also have 100 to 200′ rubber & cotton covered bell wire, 1½c per ft. Edward Szymkowiak, 635 E. Oakland Ave., Toledo 8, Ohio.

WANTED—Thordarson transformers 90A04, 15A74, 15A67, and 15R05 or 87R85; also Lansing hi-fidelity speaker. John E. Loraine, 211 Summer Ave., Newark 4, N. J.

FOR SALE OR TRADE—National NC44 and speaker, used very little. FB7A and home-made power supply with 20 meter bandspread, 40 meter bandspread and general coverage C coils. One Triumph #110 all-wave sig. generator. Tapes 1, 2, 3, 4, and 5 American Morse for Instructograph; also a number of 6AC7, 25Z5, 305, 6N7, 6SN7, 2A3, 2A5, 12SV7, 12K7. Want good condenser tester, Supreme audolyzer, or similar eqpt. Ted Patrick, % Wheeler Electric Co., Toppenish, Wash.

NEW TUBES FOR SALE—One each: 1G6GT/G; 6C5; 6J5GT; 6SK7; 12J7GT; 12Q7GT; 14A7/12B7. R. Talley, 1305 Stratton Ave., Nashville 6, Tenn.

FOR SALE—Pair of 849's, fine condition, with approx. 2000 hours' service, $50 each or $100 pair. Carbon plate. De Forest 03A, slightly used, $5. La Vonne A. Dodane, 353 W. Woodland Ave., Fort Wayne 6, Ind.

FOR SALE Yaxley rotary switch 4-gang, 5-position, 1-pole per gang, shorting type, ¼" shaft, $2.25; Two 3-gang 450 mmf. var. condensers, ¼" shafts, $2.50 ea.; 12 trimmer condensers, 5-20 mmf. on 1¼" x 1⅞" bakelite base, ⅞" mtg. centers, 10c ea. or entire 12 for $1. I pay postage. Harry C. Aichner, Jr., 1116 W. 25th St., Erie 6, Pa.

WANTED 70L7GT for cash. John Kolody, 327 Second St., Troy, N. Y.

WANTED Precision 844 P in good condition, or any good voltohmmeter. W. E Alpiger, 917 Schiller Ave., Louisville 4, Kentucky.

FOR SALE—"Sound Pictures & Trouble Shooter's Manual," by Cameron & Rider, $6; "Auto Radio Manual & Index," Vol. II, by Rider, $3; Vol I through V Rider's Manuals, $35. Want Rider's Vols. XI, XII, and XIII. Warren Chase, Cambridge, Vt.

FOR SALE OR TRADE—Argoflex F4.5 camera, color adapter, etc. Want radio test eqpt. What have you? Harry Gursh, 1481 Shakespeare Ave., Bronx, New York 52, N. Y.

WANTED—Phono pickup with needle pressure not more than 2.7 oz. and phono motor with about 8" turntable. Cash. Hugh E. Turlington, Box 2, Coats, N. C.

WANTED J.F.D. auto radio cable machine; also #130 cable and an assortment of fittings. Edmondson Radio Co., 744 Poplar Grove St., Baltimore 16, Md.

YOUR OWN AD RUN FREE!

This is Sprague's special wartime advertising service to help radio men get needed parts and equipment, or dispose of radio materials they do not need. Send your ad today. Write PLAINLY—hold it to 10 words or less. Due to the large number received, ads may be delayed a month or two, but will be published as rapidly as possible. Sprague reserves the right to reject ads which do not fit in with the spirit of this service.

HARRY KALKER, Sales Manager.

SPRAGUE PRODUCTS CO., DEPT. RN-124, North Adams, Mass.

(Jobbing distributing organization of products manufactured by SPRAGUE ELECTRIC COMPANY)

SPRAGUE CONDENSERS *KOOLOHM RESISTORS

Obviously, Sprague cannot assume any responsibility, or guarantee goods, services, etc., which might be exchanged through the above advertisements

* TRADEMARK REG. U. S. PAT. OFF.

WHAT'S NEW IN RADIO

New products for military and civilian use.

PILOT LIGHTS

An improved pilot light assembly has been announced by the *Dial Light Company of America* on their lights having miniature screw, miniature bayonet, and candelabra type sockets.

This improvement is designed to eliminate every possibility of a short circuit. The sockets are anchor-tight and foolproof. The shell, bracket, and lugs are permanently secured by a tab and notch device.

Full details of the company's line may be secured by writing for the company's new catalogue. Address *Dial Light Company of America, Inc.*, 900 Broadway, New York 3, New York.

SOLDERING STAND

In order to increase the rate of soldering operations and provide added safety to the operator, the *Ess Specialty Corporation* has introduced a new soldering stand.

By means of this unit, the iron is held rigid and the work to be soldered is brought into contact with the iron. The fumes from the soldering operation are carried away by means of a fume stack. A shield with either plate or magnifying glass protects the worker from eye strain and helps to reduce the number of rejected parts.

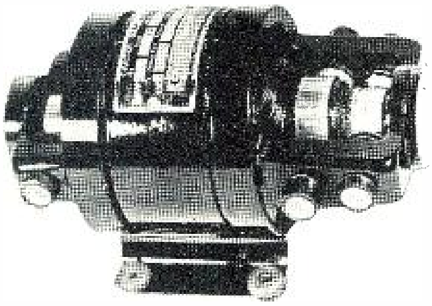
The exterior is finished in black crackle while the underside of the hood is finished in white to reflect all of the light possible.

Complete details are available upon request to Dept. SS, *Ess Specialty Corporation*, Bergenfield, New Jersey.

MICRO-MAGMOTORS

The *Carter Motor Company* has announced a new postwar line of very small dynamotors known as the Micro-Magmotors. The first of the series will be the Multi-Output unit with a permanent magnet field which saves the 10 watts usually necessary to excite the field coils. The outputs will furnish a total of 100 watts. This wattage may be divided over two or three different voltages. One of the outputs may be a.c. if desired.

One of the suggested applications of this unit is in mobile transmitter-receivers to provide an intermittent output of 350 volts, 150 milliamperes and a continuous duty output of 250 volts, 75 milliamperes.



The *Carter Motor Company*, 1608 Milwaukee Avenue, Chicago, Illinois, will furnish more complete data upon request.

NEW RESISTORS

Glazed steatite cores are being used in the new line of Regan Resistors distributed by *Techtmann Industries, Inc.*

These resistors have successfully passed the Navy shock and salt spray tests and show a moisture absorption after 15 hours of immersion of zero percent. The electrical properties of the steatite core are a dielectric strength of 198 v.p.m., a flexural strength of 14,600 p.s.i., and a dielectric constant of 5.65.

These resistors are available in a wide capacity range and resistance value. Delivery can be made promptly. Full details of these resistors are available upon request to *Techtmann Industries, Inc.*, 828 North Broadway, Milwaukee, Wisconsin.

SPEAKERS

The first civilian speakers to come off the production line at *Atlas Sound Corporation* are now available. The Atlas "Little Giant," the DR-12, is similar in many respects to the speaker which has been serving the Armed Forces since Pearl Harbor.

The DR-12 incorporates a new development in double re-entrant permanent magnet loud speaker design. All internal parts of the horn are die cast assuring close tolerances and fits resulting in resonance free operation.

The diaphragm is of noncorrosive, nonfatigable, moulded bakelite. The entire unit is absolutely waterproof in all climatic conditions. The waterproof housing accommodates the transformer or volume control. A universal mounting bracket is furnished and the whole unit requires a minimum of mounting space.

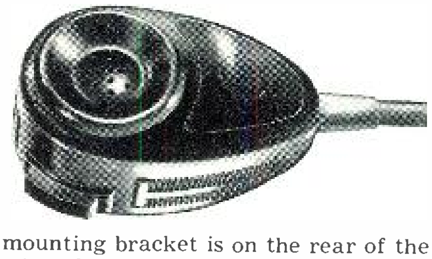
Inquiries regarding details and shipments should be addressed to *Atlas Sound Corporation*, 1443 39th Street, Brooklyn 18, New York.

MICROPHONE

A new model communications microphone has been placed on the market by *The Electro-Voice Corporation*, formerly known as the Electro-Voice Mfg. Company.

The Model 600-D is designed for police, airport, utility, mobile communications, and portable public address systems. Among the many features of this unit is the "press-to-talk" switch which opens the microphone and closes the relay simultaneously, if desired. The case is built of high impact molded phenolic to meet requirements for rugged use, yet weighs only 9 ounces. This unit is resistant to temperature changes over a range from —40 to + 185 degrees, F. The frequency response ranges from 50 to 8,000 cycles per second with an output of —57 db., 0 db. = 1 volt/dyne/cm².

The response curve is substantially flat for highest articulation. A panel mounting bracket is on the rear of the microphone and an 8-foot cable is furnished.



Complete data will be forwarded upon request to the *Electro-Voice Corporation*, South Bend, Indiana.

W.E. THERMISTOR

The thermistor, designed and developed by the Bell Telephone Laboratories, is being manufactured in quantity by *Western Electric Company* for the Armed Forces.

The thermistor is a small circuit element made of a mixture of metallic oxides which are pressed into discs, extruded into rods, or formed into tiny beads. These metallic oxides are mem-

Announcing

RCA-3B25

New Xenon-Filled Rectifier

Wide Temperature Range; Low Voltage Drop; Mounts in Any Position

THE RCA-3B25 is a xenon-filled, half-wave rectifier of the coated-filament type. It was designed for war applications and can withstand ambient temperatures as low as −75°C (−103°F) and as high as +90° C (+194° F). It can be mounted in any position, and its unusually rugged construction permits operation under conditions of severe vibration.

In single-phase, full-wave operation, a pair of 3B25's will provide 1 ampere d-c output to the filter at 1270 volts. The tube is rated at 4000 volts peak inverse anode voltage and an average anode current of 0.5 ampere.

For more complete data, send for "free data sheet on RCA-3B25." Address: RADIO CORPORATION OF AMERICA, Commercial Engineering Section, Dept. 62-19R, Harrison, New Jersey.

TECHNICAL DATA

GENERAL: Filament volts (a.c.), 2.5; filament current, 5.0 amperes; tube drop (approx.), 10 volts; overall length, 5 7-8″ ±7-16″; maximum diameter, 2 1-16″; cap, medium; base, medium 4-pin, bayonet; mounts in any position.

MAXIMUM RATINGS (Absolute values): Peak inverse anode volts (at 500 cycles or less), 4000; peak anode current, 2 amperes; average anode current, 0.5 ampere; surge anode current for max. of 0.1 second, 20 amperes; ambient temperature range, −75 to +90°C.

$^{\text{\$}}5^{25}$

The Magic Brain of all electronic equipment is a Tube . . . and the fountain-head of modern Tube development is RCA!

1919
1944

RCA

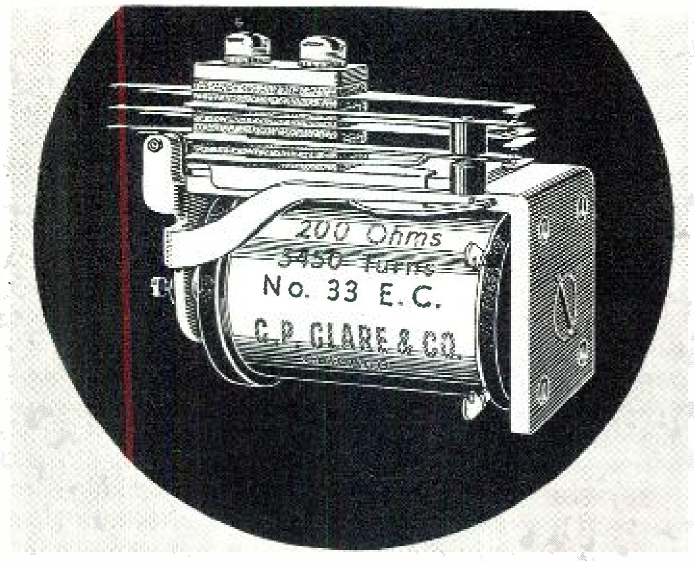
25 Years of
Progress in Radio
and Electronics

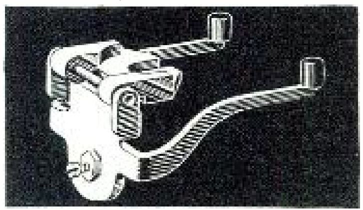
62-19R

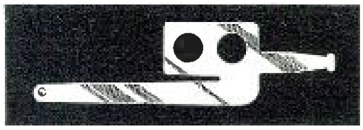
**RADIO CORPORATION
OF AMERICA**

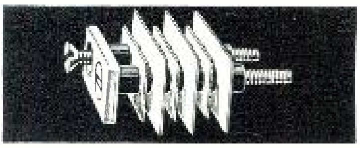
RCA VICTOR DIVISION • CAMDEN, N. J.

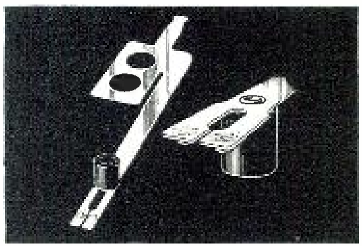
BUY MORE WAR BONDS











bers of a class of materials known as semi-conductors which are characterized by high negative temperature coefficients of resistance. Thermistors and their special characteristics may be utilized in electrical circuits wherever temperature changes can be produced. Thus, when the ambient temperature rises, the resistance falls accordingly. If a current is passed through a thermistor, heat is produced internally, the temperature rises, and the resistance lowers.

The thermal and electrical characteristics of externally, directly, and indirectly heated thermistors suggest a vast number of possible circuit applications. New thermistors are continually being developed for use in amplifiers, oscillators, voltage regulators, and volume limiters. In these circuits they serve a variety of functions such as stabilization, temperature compensation or time delay.

When placed in the proper bridge circuits, thermistors may be used as flow meters, as vacuum gauges, or, in general, to measure physical quantities dependent upon the flow of thermal energy from a hot body.

Many other important applications have been developed for using this component, and still further uses will be found. Inquiries regarding this unit will be answered, but no orders can be filled at this time by *Western Electric Company.*

MIDGET RELAY

A new, lightweight, midget relay, engineered for application where weight and space are at a premium is being introduced by the *Guardian Electric Mfg. Co.*

This unit, which is a single pole, single throw type, weighs only 1.2 ounces and measures $1\frac{9}{32}'' \times 1\frac{5}{32}'' \times \frac{29}{32}''$. The relay operates on d.c. only and has the switch capacity of a double pole, double throw unit with 1.5 ampere contacts. The power requirement is for 1.75 watts.

Further information may be obtained from the *Guardian Electric Mfg. Co.*, Dept. M-R, 1630 West Walnut Street, Chicago 12, Illinois. Specify bulletin 295.

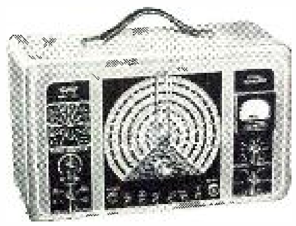
CHATTERLESS RELAY

A new feature of importance has been added to the *Kurman* "Old Timer" relay, 200 series. The chatter has been removed by a new improvement which consists of an energy-absorbing material, sealed within a contact carrying cage. The compound used is not affected by age, oil, or moisture.

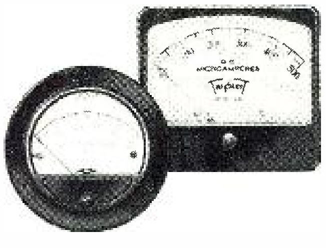
The relay has an input of 50 milliwatts, will key up to 150 words a minute or 60 impulses a second, and is

What will you need...

IN THE FIRST SIX POST-WAR MONTHS



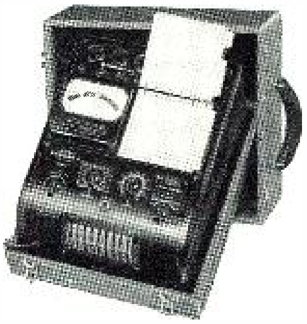
SIGNAL GENERATORS



PANEL INSTRUMENTS

VOLT-OHM-MILLIAMMETERS

POCKET TESTERS



TUBE TESTERS

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✓ CHECK THE TYPES AND QUANTITY

NOW—right now—is the time to protect your post-war business by estimating your future equipment needs. Check those needs, list them and place a *tentative post-war order* with your jobber now. This foresight will enable him to stock the Triplett instruments you will need, and will assure you quicker resumption of civilian business than you could expect if you wait till the last minute. Give best priority you can obtain to facilitate deliveries as production is available.

Newly perfected developments now being produced on important war contracts, and many other outstanding instruments, will be incorporated in Triplett offerings for the first time beginning with our initial civilian production. Be sure you get the complete list of Triplett instruments and radio test equipment.

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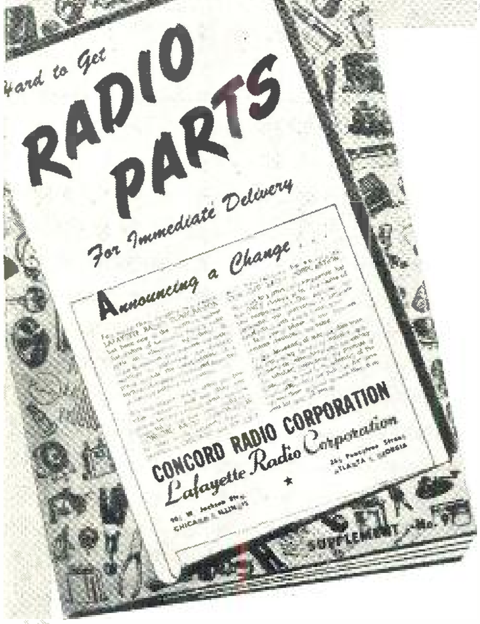
CONCORD RADIO CORPORATION'S

New 16-page supplement!



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Here's a real bonanza of radio parts. All items listed have been designated by Concord customers as "urgently needed." All are from well-known manufacturers. All are priced right. ***Remember, however, that they'll go fast—rush your request for this Special Supplement immediately!***

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mica insulated. The contacts will carry up to 2 amperes.

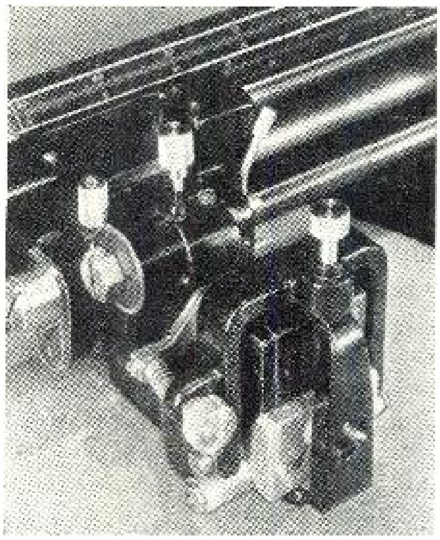
Full details on this relay may be obtained by writing to *Kurman Electric Company,* 35 37th Street, Long Island City, New York.

MAGNETIC CUTTERHEAD

With standards in lateral recording being raised constantly by improvements in radio broadcast quality, including FM, the *Fairchild Camera and Instrument Company* began a search for a better and more stable cutterhead. Their new Unit 541 is the result of this search.

This cutterhead, standard equipment on Fairchild's latest portable recorders, meets the exacting requirements of radio and professional recording. It is possible to record at unusually high volume level with little increase in distortion. At 98 lines per inch, the cutterhead is capable of fully modulating the groove.

In this unit, effective damping has been achieved through the use of exceptionally long cushion blocks and a positive means of adjusting the armature to correct balance without disassembling the cutterhead.



The frequency response shows an ideal curve for recording purposes up to 8,000 cycles. With only a moderate amount of equalization, the normal efficiency can be extended further.

The unit is mounted in an especially designed adapter which attaches to the mounting casting on the carriage assembly with one bolt, making the cutter head available as an addition to existing equipment.

Specifications of this unit include distortion of less than 1% at 400 cycles, over-all distortion including cutterhead, amplifiers, pick-up and acetate record is 1.7%. The frequency response is ±2 db. from 30 to 8,000 cycles. Impedance is 500 ohms and the audio power required is 0.6 watts.

Complete details and specifications are available upon request to the *Fairchild Camera and Instrument Corporation,* 475 Tenth Avenue, New York 18, N. Y.

—30—

www.americanradiohistory.com

Inside story of a fighting gadget

It's not much larger than a hand. You can see that. But this little machine has a big responsibility and packs a lot more than a fistful of wallop.

Its job is moving flaps and shutters on America's fighting planes. It has to be powerful. It has to be light. It has to be compact and super-dependable.

Making it was a big order. The way Lear did it was through sheer engineering ingenuity and almost unheard-of precision in production.

Today this Lear Actuator and the tiny, powerful electric motor that runs it are fighting gadgets. But in the days ahead there should be many important applications for such devices.

So we tell you about them now. Then you will know that such things are available as well as the kind of engineering thinking and production technique that made them possible.

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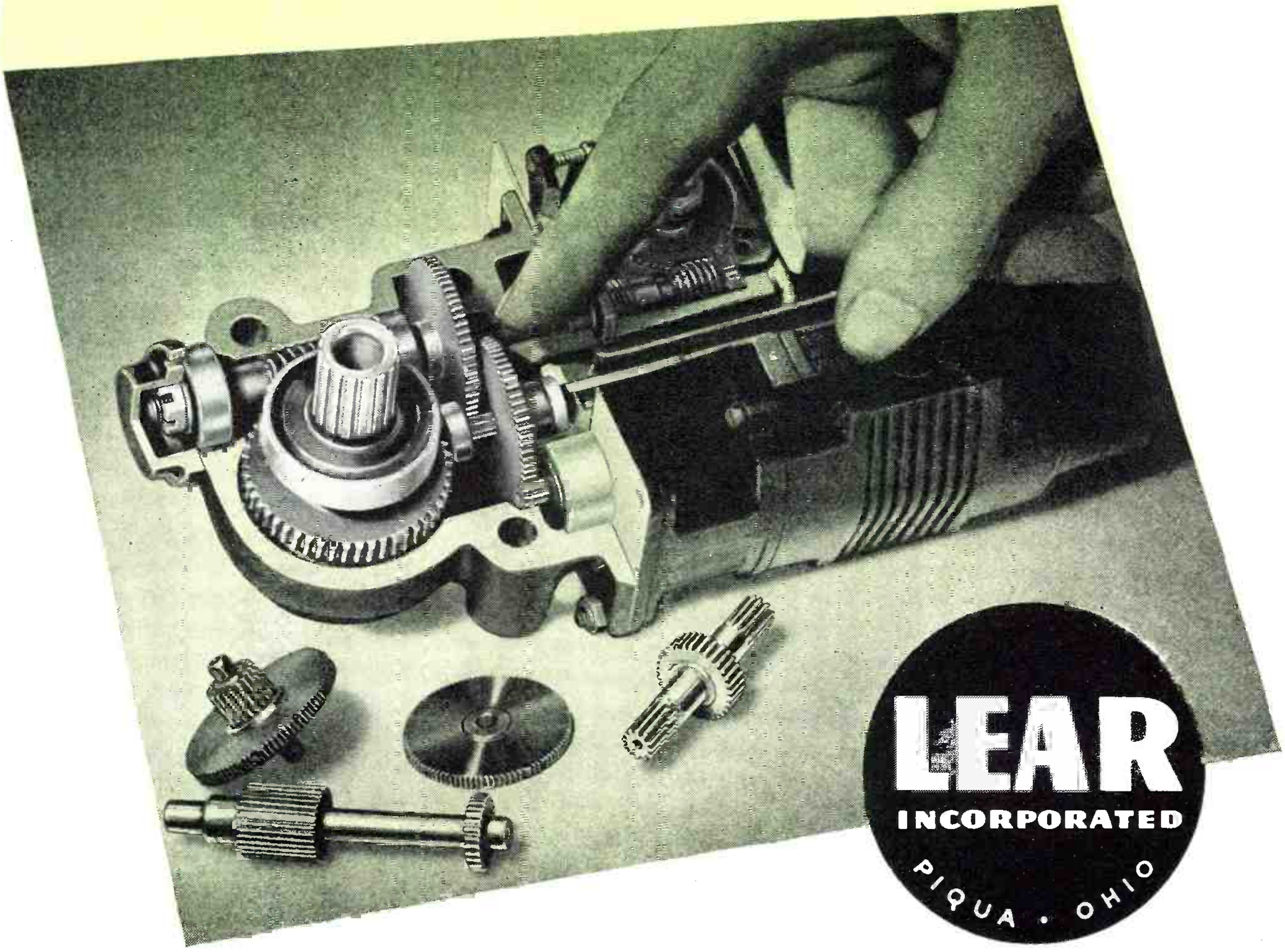

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Radio Laws and Regulations

By CARL E. WINTER

Prospective radio operators must be familiar with various laws and regulations governing transmitter operation to pass FCC exams.

SO YOU'VE worked on every kind of radio set from crystal receivers to radar. You can figure "percentages of modulation" in your sleep and you've looked over all the questions in the "Study Guide for the Federal Communications Commission Examination for Commercial Radio Operator License." You are certain that your technical knowledge of radio will enable you to pass with flying colors. But, wait a minute! What about Radio Law?

Don't underestimate Radio Law. It can, and may be the very thing which will pull your examination grade below the passing mark, for the FCC insists that, no matter how good a radioman you are, you must understand the "General Radio Regulations of the International Telecommunications Convention" which are covered in the FCC publication "Rules Governing Commercial Radio Operators." Additional wartime regulations are based upon these Rules and your chances of keeping your license, once you've earned it, will be slim if you don't understand what may, or may not, be done in the radio station in which you will work.

There are many types of radio stations but, basically, they all fall into two major classifications: those which require a Radiotelegraph operator's license and those which call for a Radiotelephone license. Broadly speaking, the same points of Radio Law are applicable to both classes. Consequently, it is not advisable to "cut corners" by attempting to ignore the Laws which may not apply directly to the type of operating which you plan to do.

The FCC issues a license to every station and this license must be conspicuously posted in the transmitter room. The station license specifies the class of station, type of emission, operating power and other data with which it will be up to you, as station operator, to conform.

This license is issued for the station's transmitter and certain technical changes cannot be made in the transmitter without the authority and approval of the Commission. As the responsibility for the correct operation of the equipment lies with the licensed operator in charge, it is necessary that the type of changes which must be authorized by the Commission be known to the operator and the procedure for notifying the Commission of these changes be understood and followed.

"Oh goody, John! You've answered the $64.00 Question!"

"Equipment tests" and "service tests" are made during the original construction of the radio station. The meanings of these terms and how and when these tests may be made should be learned, as undoubtedly a question or two regarding them will be asked during the examinations.

International regulations covering radio communications are designed to prevent loss of life at sea. A thorough knowledge of Radio Law pertaining to distress messages is therefore a primary requisite for all classes of operators' licenses. It is necessary to know what station is in control of distress traffic at all times. The procedure laid down by the Communications Act for handling distress traffic and the frequencies to be used for such traffic must be learned.

A radio operator must know both radiotelephone and radiotelegraph distress, urgent, and safety signals, the order of their priorities, and how to log them properly. Bear in mind that while there are rigid penalties for the transmission of false or fraudulent distress signals, secrecy regulations do not apply to such emergency traffic. In fact, any regulation which may prevent a station in distress from calling attention to itself may be thrown overboard but the operator must be careful not to resume ordinary traffic schedules except when permitted to do so by the station in control of distress traffic. There are specific rules governing these points, so be sure to learn them.

Distress messages and broadcast programs are the only types of communications which are not subject to the Secrecy Provisions of the Communications Act and, while in certain emergencies a station may be operated in a manner not specified in the station license, the Commission must be notified of such operations according to procedures outlined in the Rules and Regulations.

The licensed operator of a radio station must recognize and accept certain obligations. Foremost of these is the fact that intercommunication among mobile stations is guaranteed by the Communications Act and communications must be maintained accordingly. As an operator's license, depending upon its class, permits its holder to operate only specific types of stations, the operator of any station undertakes responsibility for the correct adjustment and operation of the station as a whole. Any failure to comply with

NEW COMPLETE RADIO TUBE DATA BOOK BY RAYTHEON

THE new complete data on tubes, including characteristics, outlined drawings and basing diagrams of all standard receiving tube types; simplified interchange information including over 1600 substitutions; hearing aid tube data and technical information regarding radio panel lamps. All this is included in the new Raytheon Tube Data and Substitution Chart prepared by the Technical Service Department of Raytheon Manufacturing Company.

The value of the technical information in this manual is inestimable and yet it may be obtained FREE from your Raytheon receiving tube distributor. Everyone concerned in the repair and maintenance of radios must have this ready reference book.

This manual is the first step in a tremendous merchandising plan which will bring you better business. This program teamed up with the superior, "Plus-Extra" quality Raytheon Tubes, will assure you of better customer goodwill, faster turnover and greater profits.

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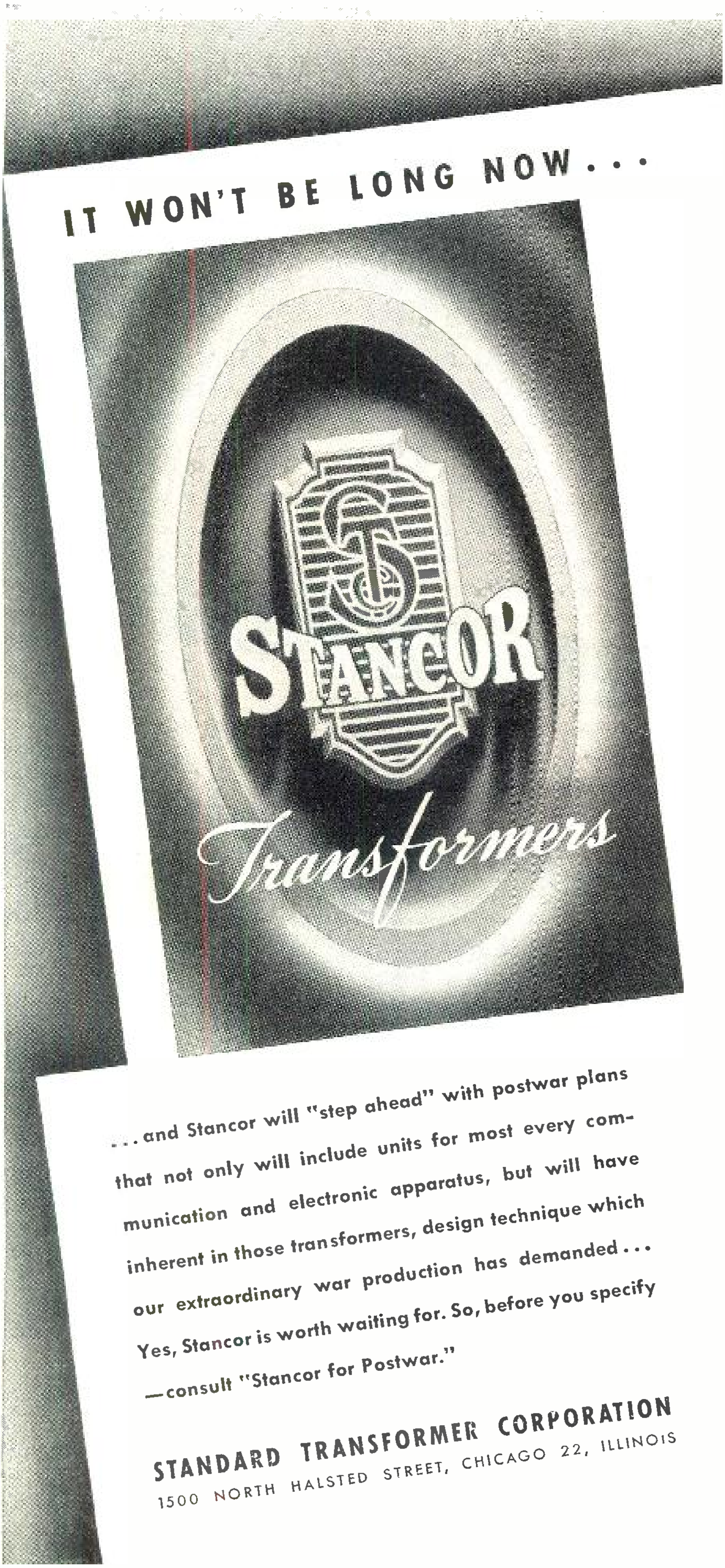


regulations set forth under the Communications Act or failure to comply with the specifications of the station license necessarily will fall upon the operator's shoulders and may result in suspension or even revocation of his license.

The operator is required to have his license posted at the station or have a verification card in his possession at all times when he is on duty and he must report immediately the loss or destruction of his license. Cases in which verification card or endorsed letter may be used as satisfactory evidence of an operator's authority in lieu of the license are set forth in the Rules and Regulations and should be studied. An operator is required to reply promptly to all notices from the Commission and the time limit set for reply to a Notice of Violation of the terms of the Communications Act is clearly stated and must be observed.

An internationally-acknowledged procedure for handling traffic is the backbone of international communications. Rules governing these procedures must be learned and such knowledge is useful inasmuch as all radio operators of all countries use the same procedures, frequencies, and signals. Modern radio operating is truly international in scope.

A log must be kept at all stations and a complete record of the station's operation must be set forth clearly in this log. The required entries, the manner in which they are to be made, and the length of time for which a log must be retained are stated in the Regulations and it is advisable that, in addition to knowing this subject well enough to pass an examiniation, the licensed operator maintain his log in strict accordance with these regulations as the FCC Inspectors examine station logs quite frequently.

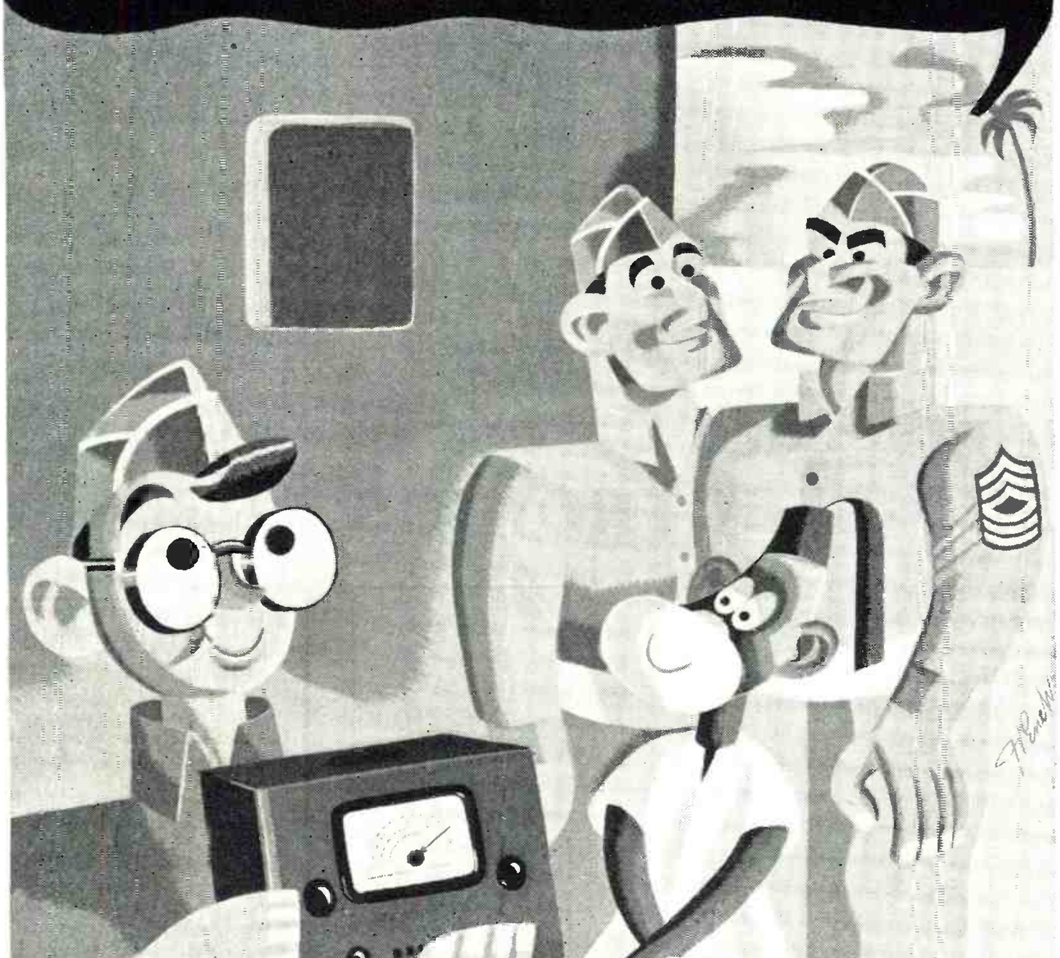
Radio stations are licensed to operate within certain power limitations. The prospective radio operator must know what these limitations are for a given class of station and the allowed tolerances for the station's assigned frequencies.

The operator must also learn which of the several methods of measuring antenna current are permitted by the FCC for official purposes and in addition, must know how to make these measurements. The percentages of modulation for the several types of broadcast stations are definitely stated in the Commission's Regulations and the station operator is required to know and observe them.

The prospective operator must understand not only how, but when, he may conduct tests of his station equipment. He should learn what is meant by the "experimental period" and how and when he is permitted to use the station's auxiliary transmitter.

Certain classes of operator licenses permit the licensee to operate aircraft stations. The operator should know what particular stations his license covers and regulations governing aircraft station operation, the frequen-

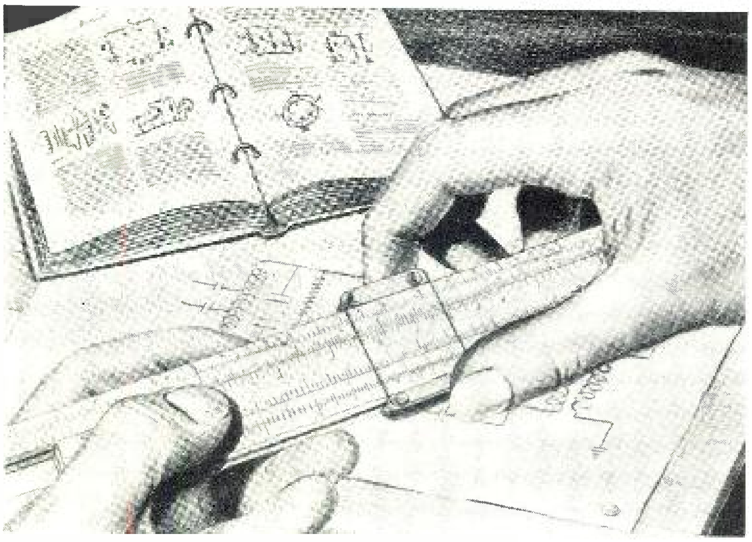
HE'S NO NATIVE. HE FOLLOWED HOGARTH FROM HARLEM BECAUSE OF HIS ECHOPHONE EC-1!

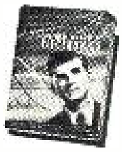


ECHOPHONE MODEL EC-1

(Illustrated) a compact communications receiver with every necessary feature for good reception. Covers from 550 kc. to 30 mc. on 3 bands. Electrical bandspread on all bands. Six tubes. Self-contained speaker. 115-125 volts AC or DC.

ECHOPHONE RADIO CO., 540 NORTH MICHIGAN AVE., CHICAGO 11, ILLINOIS





cies which may be used, method of keeping an aircraft station log, and inasmuch as the procedure for handling aircraft distress traffic differs from mobile distress traffic methods, Rules and Regulations should be thoroughly searched for points pertaining to aircraft distress procedure.

It is not too difficult to obtain an operator's license but it is quite a different matter to keep it when the responsibility for maintaining correct operation of a transmitting station is entirely up to you. Once you've got your license it's yours for five years. The Commission will not revoke it unless you pull a "boner." These "boners," ninety-nine times out of a hundred, consist of a violation of the Rules and Regulations of the Communications Act.

Much of the technical knowledge required for the FCC examinations for radio operator's licenses is not used in everyday operation. It doesn't hurt anyone very much if you have to open an Instruction Manual occasionally to keep your equipment on the air, but it will hurt one person . . . YOU . . . very much if you give the Commission an opportunity to crack down on you for a violation of Regulations. In short, a knowledge of radio law, unlike the technicalities of radio theory is something which you will apply every day. Therefore, it will pay you to learn the "Rules Governing Commercial Radio Operators" and learn them well.

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ROBOT WEATHER BUREAUS

SECRETLY-LOCATED "automatic weather stations" in remote points from the arctic to the tropics, are playing a major role in coordinating Allied land, sea and air attacks with favorable weather.

According to A. C. DeAngelis, General Manager of Friez Instrument Division of Bendix Aviation Corporation, for use at stations in frozen wastes, on isolated tropical islands and other undisclosed locations where the world's weather originates, automatic weather bureaus have been delivered.

The Navy wanted a device which would report automatically on weather conditions by radio from remote points back to official weather control locations, and while the necessary meterological instruments were available, engineers had to start more or less from scratch on equipment for power and timing of automatic radio devices, necessary to broadcast reports and data continuously gathered by recording instruments. Weather and termite-proof insulated houses had to be developed to shelter the recording and radio instruments. For instance, weather in the English Channel originates around Greenland so it was necessary to build automatic weather stations able to withstand the severe arctic climate of that region.

Other and equally-difficult problems were surmounted in designing housing for stations used in regions where extremely high temperatures prevailed, but after a year, the first automatic weather stations were produced.

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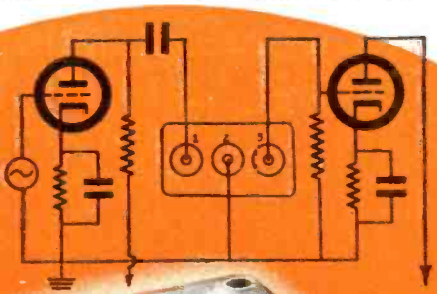
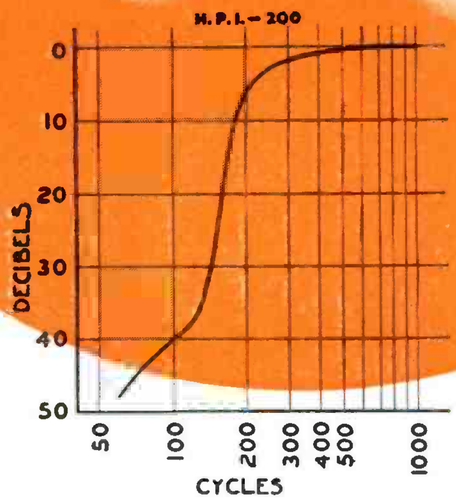
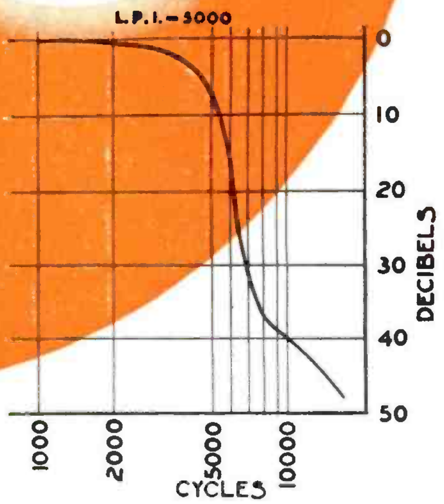
LOW PASS (TYPE L.P.I.)
HIGH PASS (TYPE H.P.I.) FILTERS







New additions to the UTC Interstage Filter family are now available in the type HPI and LPI units, respectively high pass interstage and low pass interstage filters.

The units are designed with a nominal impedance of 10,000 ohms to be used in a circuit as illustrated. Typical curves obtainable are shown above. Loss at cutoff frequency is less than 6 DB. At .75 times cutoff or 1.5 cutoff frequency respectively, the attenuation is 35 DB, and at one-half or twice cutoff frequency respectively, the attenuation is 40 DB.

These units employ a dual alloy magnetic shield which reduces inductive pickup to 150 Mv. per gauss. The dimensions in hermetically sealed cases are 1½" x 2½" x 2½". Filters of the HPI and LPI type can be supplied for any cutoff frequency from 200 to 10,000 cycles. Specify by type followed by frequency, as: LPI-2500.

May we cooperate with you on design savings for your application . . . war or postwar?

United Transformer Co.

150 VARICK STREET **NEW YORK 13, N. Y.**

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MILITARY COMMUNICATIONS

By SYDNEY A. CLARK

Office of Chief Signal Officer

A comparison of the communications methods employed by the major Allied and Axis powers.

EVERY army in the world vies with every other in the complex field of communications, and though the United States Army has pioneered for some 85 years, since the introduction of systematized visual signaling by Major Albert J. Myer, we always have learned from our friends and our enemies. *Royal Signals* in Great Britain, *Sluzha Sviazi* (Service of Communication) in Russia, *Nachrichtentruppen* in Germany and *Communication Engineers* in Japan are the counterparts of the Signal Corps in our own Army. Whatever the name, this branch of the service is the vital nerve that sets armies in motion and coordinates all campaigns within the structure of global strategy. Upon the efficiency of communications depends the success or failure of the smallest sorties and the most gigantic operations.

Students of comparative practice in various countries assert that in general the United States has been in the vanguard, though not invariably so. Britain pioneered in certain developments but lagged in the manufacture of good, practical radio equipment for its troops in the field—and likewise in the matter of radio security. These deficiencies showed up in certain early campaigns, but Britain took prompt steps to correct the faults. While British equipment is sometimes less neat and compartmentized than American, and therefore presents certain maintenance problems, it is very sturdily and soundly made, particularly with regard to large radios for tanks and heavy vehicles.

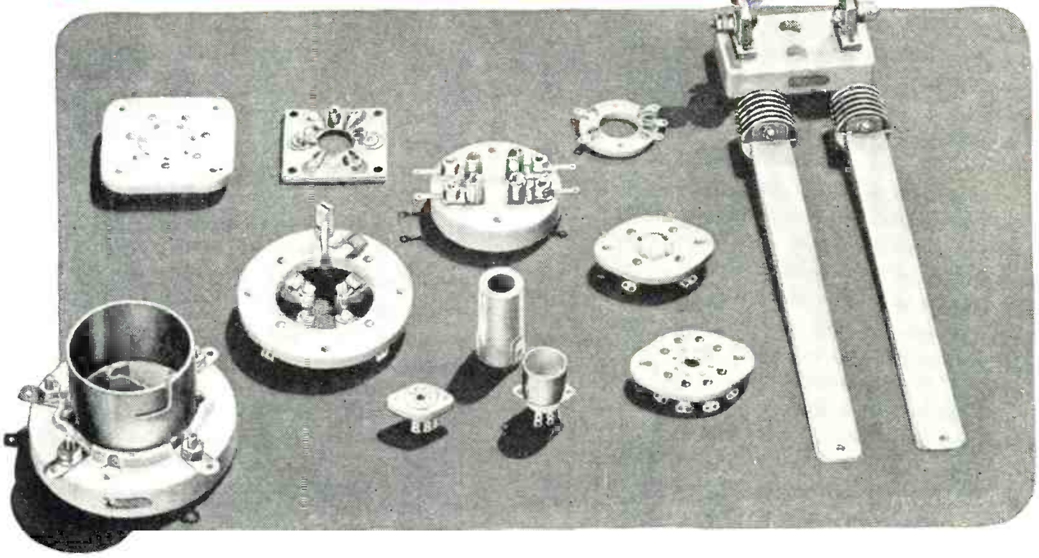
"They're too long. You're supposed to be on short-wave!"

The Russian *Sluzha Sviazi* was scarcely existent in Czarist days. Although there were 5,000,000 men in the regular army in 1914, and 3,000,000 reserves, there was virtually no Service of Communication. To each division headquarters a small signal detachment was allotted and equipment was exceedingly meager. When wire, for instance, was exhausted in the early stages of any campaign, replacement was virtually impossible. Writing of the Battle of Tannenburg, Major General Harry C. Ingles, Chief Signal Officer of the United States Army, states that "probably no campaign of the (first) World War furnishes such an example of faulty signal communication and the difficulties of command arising therefrom."

But Soviet Russia has succeeded brilliantly where Czarist Russia made military mistakes. During the long months of German advance after the attack of June, 1941, most of her industrial cities were captured and occupied by the Germans and consequently Russia sank to an alarmingly low level of production, but she captured some enemy radio sets, and promptly learned how to operate them. Her communications personnel were required to master a special manual dealing exhaustively with the use of captured equipment. When Russia finally was able to set up trans-Ural manufacturing plants on a great scale and when she began to recapture her lost cities, she assumed the task of supplying most of her own needs, and her performance in regard to signal equipment, as in regard to weapons and ammunition, has aroused the admiration of her friends and the incredulous anger of her enemies. Russian manufacture and methods are now conceded to be on a par with the best in the world.

Japan is decidedly the weakest of the great powers in communications achievement. Much of her radio equipment would be considered obsolete by the other armies. Describing one of the first airborne radios captured by our forces from a downed Zero fighter (in February, 1942), Major General Roger B. Colton, Chief, Engineering and Technical Service in the Office of the Chief Signal Officer, said, "The entire installation represents a command set of very crude construction. The coils are wound on bakelite forms, with poor insulation and no tropicalization. Many of the parts were either bought on American distress markets back about 1930-1932, or are very good replicas. All the tubes bear American nomenclature and are identical in construction with American glass tubes. The over-all electrical design and construction of this set is about ten years old from our viewpoint." General Colton discussed several other captured Japanese models and summed them up with this prudent caution: "It is recognized that the Japs usually are not original but are extremely quick to

Sockets
FOR ALL TRANSMITTING TUBES



ANTENNAS

CONDENSERS

TUBE SOCKETS

PLUGS & JACKS

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INDUCTORS

BROADCAST EQUIPMENT

CONCENTRIC LINE

Fom the miniatures (such as the IT series or 9000 series) to the big ones (such as 204A, 833 or 889R) Johnson can usually supply the sockets. Most Johnson tube sockets have been designed in cooperation with the tube manufacturers and many of them were actually in production and ready for delivery before the tube was announced. This explains why the Johnson line is the most complete and why Johnson is the only manufacturer producing many of the types.

This confidence, cooperation and assistance on the part of the tube manufacturers explains too, why Johnson's mechanical and electrical design is superior. Both the Army and the Navy have recognized this superiority in Johnson wafer sockets for example, by specifying both the ceramic and the contacts used by Johnson.

Quantity production and economical manufacturing procedures make Johnson the best buy on the socket market — in fact the price is usually less than that of poorly designed imitations.

On that new socket requirement, investigate Johnson.

Write for Catalog 968Z

JOHNSON

a famous name in Radio

E. F. JOHNSON CO.
Waseca, Minnesota

tool up and reproduce. Their construction often facilitates easy servicing by clearly marked parts and test panels for measuring voltage. Wiring is neatly carried throughout, and does much to dispel the idea that Japanese are capable only of copying. A number of points of design resembling American technique have been adapted rather than copied."

Organizational differences in the communication systems of the various warring powers vary substantially. Japan maintains no Signal Corps as such. Instead, the communications men operate as a portion of the Engineers. Germany maintains a large and well-organized Signal Corps and she stresses signal communications and thorough training for all army personnel intended for this service.

Both Germany and Japan have given careful consideration to the problem of making communications mobile in general warfare. The Japanese, however, give special attention to the proper use of visual signals in addition to the customary wire and radio communications. They make extensive use of small hand flags for predirected messages, such as indicating their battle lines to their air support and signaling the direction of the attack. This is in sharp contrast to United States practice, for our Signal Corps has now relegated to an exceedingly minor status the flag signals with which the service "began life" in 1860.

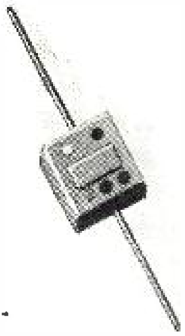
It is difficult to compare in size the Signal Corps of the respective countries. The United States Signal Corps personnel bears to combat personnel a smaller ratio than that of the German *Nachrichtentruppen* but this discrepancy is explained by the fact that German figures include what we refer to as communications personnel. These are members of the respective branches who furnish their own communications in units not larger than regiments. If we were to include communications personnel the ratio would be approximately the same.

Tactical employment of signal communications differs in some respects in all countries. Germany and Japan capitalized on blunders which they made in their earliest conquests and thus learned by the costly process of experience many of the tactics required to get a message through. They were able, because of their unscrupulous aggressions, to use this experience before the Allied forces could be built up to oppose them strongly. Early in this war both of these Axis powers placed a great deal of stress on radio. The effective use of this medium turned many difficult situations into victories.

Germany's Afrika Korps Nachrichtentruppen displayed special effectiveness in the early stages of the North African conflict in securing detailed information concerning British units, officers, positions, equipment, and strength. This success, however, brought quick reaction from the British, who thoroughly revised their sig-

PRODUCTION TESTING WITH PANORAMIC

Any variation in magnitude which can be converted to a variation in frequency—quantities such as length, permeance, volume, and height—can be more quickly and accurately measured by the PANORAMIC COMPARISON TECHNIQUE. Capacitors, inductors, resistors, and crystals are "naturals" for PANORAMIC production testing. A simple jig and a PANORAMIC COMPARATOR will provide your tester with an unbeatable combination for speed and accuracy on the production line.



In application, the component under test is placed into the jig containing the standard. The chosen tolerance may be established quickly by means of the panel control on the PANORAMIC COMPARATOR. From the deflections which appear on the PANORAMIC screen, deviations from the standard become immediately apparent both as to percentage and type. The instrument is usually adjusted so that a visible deflection indicates that the production unit is within the predetermined tolerance range, while the absence of deflection indicates an error in excess of the permissible tolerance. Coincident deflections indicate zero error; displaced deflections tell their own story regarding the percentage of error. PANORAMIC COMPARISON TECHNIQUE is economical in time and energy . . . but extremely accurate in results.

Our engineers will gladly suggest simple jigs for use in any type of production testing.

PANORAMIC RADIO CORPORATION
242-250 WEST 55TH ST. New York 19, N.Y.

nal communications practices and thereby were aided in turning the tide of battle. A lesson learned the hard way is never forgotten.

Japanese efforts in the field of radio showed a certain cleverness in early campaigns in securing information by breaking in on American frequencies with plausibly phrased orders and questions in good "American." There were, of course, many more Japanese who spoke our language adequately than Americans who spoke theirs. There were many examples of Japanese interference, for instance, at Guadalcanal, but it was successfully combatted by our troops after a few months.

One thing has been made abundantly clear in this war. Quick successes based on treachery and sneak attacks finally break down before the steady pressure of an aroused enemy of greater potential strength. This applies to the services of communication as much as to any arm of combat and perhaps even more, since communications direct and coordinate combat. He who would win must achieve *and maintain* the best communications, despite the far-flung theaters of action, the rapidly changing battle areas, the deadly work of enemy bombers and the mad pace of mobile warfare.

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QTC

(*Continued from page* 53)

International Morse code at the rate of 25 words per minute plain language and 20 w.p.m. in code groups. Wartime emergencies have suspended some of the provisions of this conference, but they have not affected the requirements for a First Class License. The "six months" law, which is temporarily suspended, provided that a person must have a minimum of six months service in a junior job before he was eligible to sail as the only radio operator aboard a ship. This regulation then provided that he must sail as third or second radio operator for six months before he would be permitted to take a "single-man" ship out by himself. This regulation is suspended for the time being, but applies only to the 2nd class radiotelegraph license and in no way affects the time requirements for the 1st Class license.

From the regulations stated above and existing conditions, it seems as though the chances are very slight for anyone under the 21 year age limit to be permitted to pass the 1st class exam. It would require the FCC to revise regulations and this would not have much chance of success, mainly due to the demand-supply problem, as more than likely there will be more men with a "first" looking for chief's jobs at the start of the next year than there will be jobs for them to take. That will happen, of course if the men now eligible to take the "1st" exam do so before the January 1st regulation goes into effect.

...................73

wherever a tube is used...

for example:

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Doors that operate automatically save man-hours where plant traffic is heavy, cut heating costs, reduce breakage in restaurants, are a convenience to package laden shoppers. The electronic principle involved has hundreds of commercial and industrial applications.

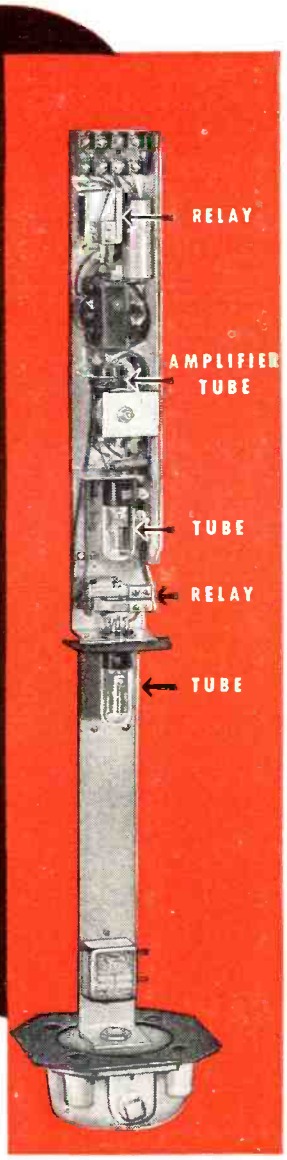


PHOTO-ELECTRIC DOOR CONTROL

Above unit manufactured by General Electric Co., is a part of STANLEY "MAGIC DOOR" CONTROLS.

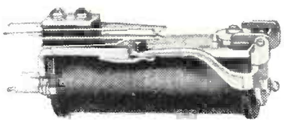
THERE'S A JOB FOR

Relays BY GUARDIAN

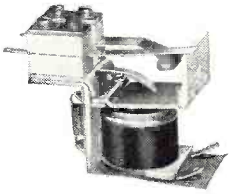
★ The "Magic Door" made by The Stanley Works of New Britain, Conn., uses a General Electric control unit which operates automatically at the approach of a pedestrian or vehicle. In this unit a beam of light focused on the cathode of a phototube causes a tiny current to flow. Enlarged through an amplifier tube this current operates a sensitive telephone type of relay such as the Guardian Series 405. Another phototube with an auxiliary relay, Guardian Series R-100, is employed to hold the doors open for anyone standing within the doorway.

The telephone type of relay is extremely sensitive and able to operate on the small current supplied through the electronic circuit. The auxiliary relay, Series R-100, is required to handle a greater current. It is a small, efficient relay having a contact capacity up to 1 KW at frequencies up to and including 28 megacycles. Contact combinations range up to double pole, double throw. Standard coils operate on 110 volts, 60 cycles, and draw approximately 7 V. A. Coils for other voltages are available. For further information write for Bulletin R-6.

Consult Guardian whenever a tube is used—*however*—Relays by Guardian are NOT limited to tube applications but are used wherever automatic control is desired for making, breaking, or changing the characteristics of electrical circuits.



Series 405 Telephone Type Relay



Series R-100 H. F. Relay

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A COMPLETE LINE OF RELAYS SERVING AMERICAN WAR INDUSTRY

Low-Frequency Transmitters

(*Continued from page* 31)

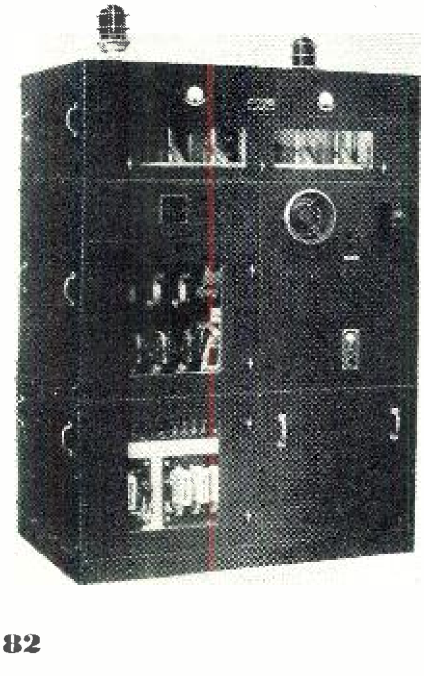
cies should be tried in the Arctic area. It was soon found, however, that all their advantages at the lower latitudes could not be realized in the neighborhood of the magnetic pole. In these regions, magnetic storms often blanketed the high-frequency waves so that communication over any great distance was impracticable even with the maximum of power. The magnetic storms were so frequent or so continuous that communication at these high frequencies was extremely uncertain. This blanketing effect had been noted in the lower latitudes but did not seriously interfere with communication except during infrequent short periods.

The low frequencies were not seriously affected by the magnetic storms and under certain conditions were found to transmit better under these conditions. The result was that low-frequency transmitters were soon considered necessary adjuncts of radio communication facilities in the region of the magnetic pole.

To meet the need for such service a low-frequency transmitter has been developed for the use of and in accordance with the specifications of the Civil Aeronautics Administration. Among other considerations influencing its design have been (a) convenience in transportation to isolated localities, (b) suitability for operation in cold climates, (c) accessibility of parts, (d) protection of operating personnel, (e) simplicity in operation, and (f) complete control from a remote point.

The various units comprising this transmitter are shown in the accompanying photographs and include an exciter unit, a power amplifier unit, a main rectifier unit, and a set of antenna tuning house equipment.

Fig. 3. Rectifier unit supplying all plate power to excite amplifier of 10-kilowatt low-frequency transmitter.



All main units have aluminum frames and panels and no unit is too large or too heavy to prevent its being carried in a large transport plane. Most of the localities where a transmitter of this type would be used are either adjacent to or within easy reach of an airfield where the equipment can be landed. This makes it unnecessary to limit transportation to the relatively short periods in the summer when land or water transportation is possible.

The entire transmitter will operate from a 230 volt, three phase, 60 cycle power supply. In case the supply does not give this voltage, adjustments are provided so that any voltage between 215 and 250 volts can be used. Power requirements can be economically met with a diesel engine driven generator of the type commonly used in isolated communities.

The exciter unit shown in Fig. 1 is a complete c.w. transmitter in itself and can be used independently of the power amplifier and main rectifier units. It will deliver at least 500 watts of power on any frequency between 80 and 200 kilocycles. Keying speeds up to 200 words per minute are obtained through the use of an electronic keyer.

The power amplifier unit is shown in Fig. 2. This unit is normally used at one operating frequency but it can be set up for use on any frequency in the range of the exciter unit. At any operating frequency within this range it will deliver 10 kw. of power. This output is obtained through the use of a single type 892R tube with conventional grid and plate tuning circuits. Since this tube is of the air-cooled type, the danger of freezing that would be present with a water-cooling system is eliminated.

The main rectifier unit (Fig. 3) employs 6 type 872A mercury vapor rectifier tubes in a conventional three-phase full-wave circuit capable of delivering 9,400 volts at 2 amperes direct current. It supplies all of the plate power required by the power amplifier unit. Included in the unit are the contactors required for starting the rectifier and for remote control. Filament voltages are continuously regulated for proper performance by an automatic voltage regulator, which also provides regulated power for the bias supply of the power amplifier.

Temperature of the main rectifier tubes is kept within the recommended range for satisfactory performance by thermostatic control of a blower and heating units.

Each of the three transmitter units is provided with convenient terminal boards and is arranged so that interconnecting leads can be placed in sheet metal ducts located on the floor. The radio frequency connection between the exciter unit and the power amplifier unit can be made with a two conductor shielded r.f. cable placed in these same ducts. Connections to the antenna tuning house can be made with a flexible coaxial cable. Both of these cables have a characteristic impedance of 70 ohms.

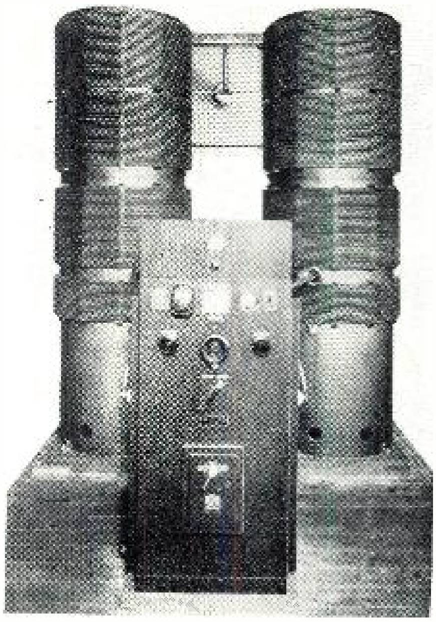


Fig. 4. Especially-designed antenna tuning house equipment for a 10-kilowatt low-frequency transmitter for Arctic use.

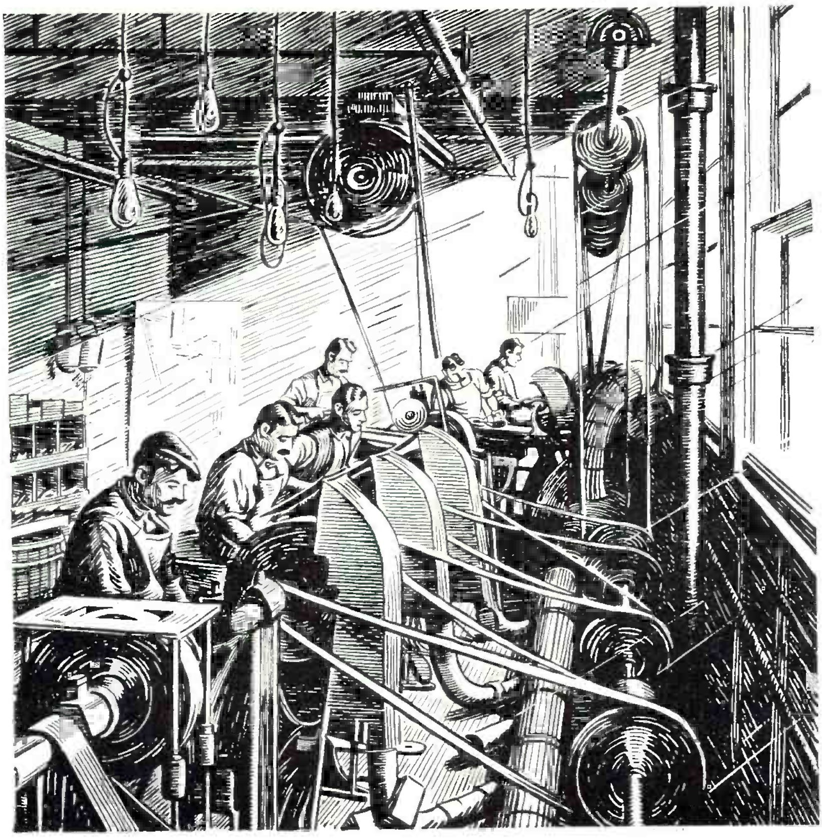
In Fig. 4 are shown the units used for coupling the coaxial transmission line to the antenna circuit and for tuning the antenna circuit. The control unit shown in the foreground contains a group of coupling capacitors and a control wheel for the variometer rotors of the two antenna loading inductors shown in the background.

The antennas commonly used with this transmitter are of the flat-top type and their effective lengths are considerably less than a quarter wave. Their effective capacity at the operating frequency may be between .00125 μfds and .00250 μfds, the recommended value being .00175 μfds. The effective resistances of the antennas vary with the frequency and may be as low as 2 ohms.

To properly tune these antennas, considerable loading is required and for efficient operation this loading should introduce little loss in the antenna circuit. The inductors shown in Fig. 4 have been designed with these considerations in mind and include a number of features which are normally disregarded at higher radio frequencies. Their Q (ratio of inductive reactance to resistance) at the operating frequencies is at least 1500. To avoid losses which would arise if the materials normally used to construct a building entered the field of the inductors, they are surrounded with a Faraday screen to keep such losses to a minimum.

The tuning house and its components are capable of operating over an outside temperature range of —49° F. to + 104° F. (— 45° C. to + 40° C.). The interior of the tuning house can be maintained at a minimum temperature of 32° F. with heating power of 3 kilowatts or less. —30—

BACKGROUND
FOR
KNOW-HOW



The telephone was still a novel device when *Connecticut Telephone & Electric* opened the doors of its first modest factory. Ever since, its people seem to have formed the habit of contributing to each revolutionary step ahead in communications.

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The Dispersion Transmitter

(*Continued from page* 30)

A2 will not read alike. Consider a condition where the phase displacement is zero or 180 degrees. The current, on the argument graph, would be zero in one ammeter while it would be twice the crest value in the other. There is no telling what the operation of the system would be under this mode.

Referring to the graph, Fig. 4, showing the rising of the horizontal-antenna currents as lagging the rise of the vertical-antenna current by a time interval corresponding to 90 degrees, it will be noted that at the instantaneous positions marked "Y" on the horizontal-antenna current curve, the vertical-antenna current is zero. This being the case, there is no interference due to the vertical-antenna current and the composite antenna operates as an independent horizontal radiator. At the points of instantaneous vertical-antenna currents marked "Z," the horizontal-antenna currents are zero and, therefore, there is no interference from the horizontal-antenna currents and the composite antenna operates as an independent, vertical antenna.

When this condition is obtained by tuning C1, due to the symmetrical swinging of the current waves either side of the zero axis, ammeters A1 and A2 will read equal values of effective currents. Therefore, it is obvious that the current falls in one antenna as it rises in the other. The radiated fields are lower in one while they rise in the other and vice versa. The combination of the emitted fields is such that a major lobe continuously changes its vector direction in a vertical quadrant allowing scanning of the ionosphere in a continuous manner between the extreme angles of the two antennas incorporated in the composite antennas.

Fig. 5, shows a wiring sketch of the system when coupled to the final power amplifier of the transmitter. It should be noted that the phasing and loading of the amplifier was obtained by two different methods of coupling. For the horizontal antenna, mutual-inductance coupling was employed while the vertical antenna was fed directly from the amplifier tank as an autotransformer. In this way a 90-degree phase shift was obtained and the amount of loading depended on the degree of coupling in each case.

It will be noted that this phase shifting method is quite similar to that employed in the discriminating circuits of FM receivers.

Amplifier Loading

The available carrier power, at the power amplifier, must be distributed equally into the two members of the composite antenna. The permissible degree of loading was obtained by plotting sine curves of the phase angles for two waves displaced by 90 degrees. By hypothetically extending the sine scale on the Y axis and calling this scale the current scale, the resultant instantaneous current curve was plotted as a function of the displaced curves. Fig. 3 shows how this was arrived at.

The result of this deduction indicated that two systems could be coupled to a common amplifier and, providing a phase displacement of 90 degrees was employed, each could load the amplifier to within 71 percent of full load while the combined loading of the amplifier would be but 100 percent.

At certain intervals during each cycle, the current would rise in one system while it fell in the other and vice versa. This was the operation desired to cause the radiated resultant field lobe to vary through a 90-degree angular sweep, in synchronism with the carrier frequency.

The d.c. plate power to the class "C" amplifier stage of the transmitter was 350 watts at full load. At full load, 250 watts at 7.15 megacycles was obtained in a dummy antenna. The plate efficiency was therefore 71.5 percent. As resonant conditions were maintained in regard to the antennas, the combined or actual loads were analagous to that of the dummy antenna.

From the foregoing it was found that when either antenna system being coupled to the amplifier stage alone caused a dissipation of 71 percent of the d.c. plate power (percentage from

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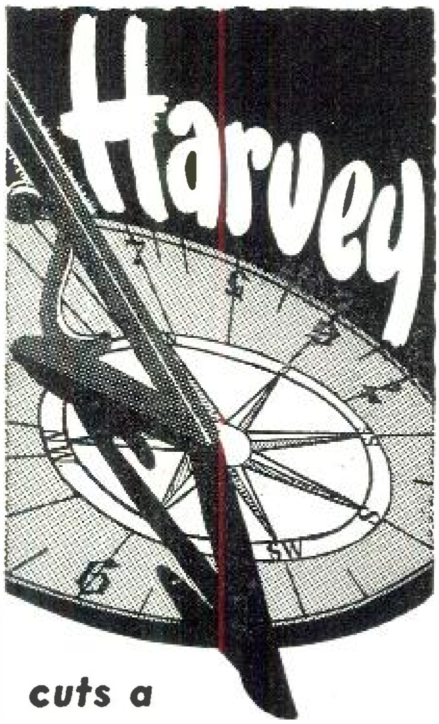

STATION	DATE	TIME	LOCATION	REPORTS AND COMMENTS
W8SLH	8-1-40	11:30 P.M.	Cincinnati, O.	Inauguration of carrier synchronized system. No fading of signals reported. Communicated until 12:00 M.
W9BWN	8-3-40	8:50 P.M.	Chicago, Ill.	No fading reported and unusually strong signals. Continuous communication until 10:05 P.M.
K4GTE	8-6-40	9:30 P.M.	Barinquen Field, Porto Rico	Reported "Your signal very stable." Signal strength reported as "loud." Continuous communication until 10:17 P.M.
HR1AT	2-6-41	9:57 P.M.	Tegucigalpa, Honduras	"Perfectly readable strong signals of purest note with no trace of fading." Continuous communication until 10:02 P.M.

Table 2. A representative report on the operation of the transmission system.

curve of Fig. 3), it was considered as having its share of the available output power from the amplifier.

In this manner each antenna, individually, was coupled to absorb 71 percent of the power from the power-amplifier stage. With both antennas coupled, the simultaneous load was found to be actually as anticipated or 100 percent on the amplifier (0.3 amperes at 1165 volts).

Tuning

The tuning of this transmitting system was found to be very simple and straightforward. The horizontal LC circuit was first tuned and then decoupled from the amplifier's tank. The vertical antenna clip was then run along the amplifier's tank until 71 percent of full load plate current was obtained. The amplifier tank was kept tuned during this process.

Following the above adjustment, the horizontal-antenna tuned circuit was then coupled to the amplifier tank until full load current was drawn at the amplifier plates. At this coupling point, by disconnecting the vertical antenna clip and after checking tank tuning, it was found that the degree of coupling of the horizontal antenna also placed a 71 percent load on the amplifier. With the two systems coupled, simultaneously, the amplifier reached full load plate current only.

The final phase adjustment was made with the tuning capacitor across the horizontal antenna coupling coil. By observing the r.f. line currents at A1 and A2, Fig. 5, at a little to one side of peak tuning, the r.f. current in the feeders increased at A1 while it decreased at A2. On the opposite side of peak tuning, the current decreased at A1 while it increased at A2. There was a tuning point near peak tuning where the currents in the feed lines were equal. At this point the system was locked, it being assumed that correct phasing was obtained.

At this operating point the horizontal-antenna system was found to operate independent of the vertical-antenna system. There seemed to be a great increase in radiation efficiency as local monitors gave indications of greatly increased field strengths. The heterodyned signal at receivers had a distinct, sharp note.

Together with the vertical scanning of the radiated lobe is a circular polarization shift of 90 degrees caused by combining a vertical with a horizontal antenna in this instance. Emission of a circularly polarized wavefront was not considered harmful as it has been found that all transmissions after reflection from the ionosphere, arrive at remote receiving points substantially horizontally polarized, regardless of polarization at the point of origin. The effect of raising and lowering of the resultant lobe, however, enables scanning the ionosphere so that regardless of the position of a receiver, at a distance from the transmitter it will intercept a pulse of signal per scan at the instant when the angles of incidence and reflection fit the base line between transmitter and receiver.

Summary of Operating Conditions

Table 1 summarizes operating conditions during a period in which initial long-distance tests were made.

Table 2 is representative of operation of this transmission system on the specified wave band. Due to the start of war, further tests could not be carried on.

The following detailed tests made with Tegucigalpa, Honduras are representative of the procedure employed to test the system.

On February 6, 1941, at 9:40 p.m., Eastern Standard Time, HR1AT, Tegucigalpa, Honduras transmitted a prolonged CQ. These signals were intercepted with some difficulty at W2DKE, Schenectady, N. Y., the station owned and operated by the writer.

The experimental Ionoscan antenna was first connected as a center-fed, half-wave dipole, one-quarter wavelength above earth. The frequency of operation was 7115 kilocycles. Extreme care was exercised to make sure that full power was applied to this antenna system. With this connection, the transmitted lobe was determined to be at very high angle or about 90 degrees. HR1AT was called at 9:43 p.m. for 3 minutes continuously. There was no response.

At 9:47 p.m., HR1AT was again heard sending a prolonged CQ which lasted about two and one-half minutes. The Ionoscan antenna was quickly switched over to the top-loaded, ver-

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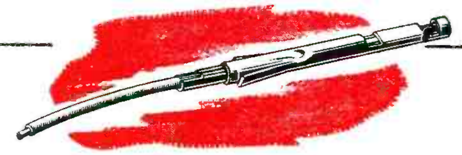
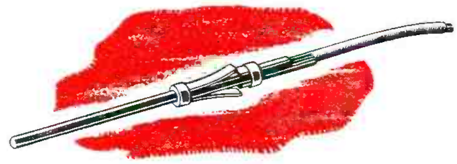
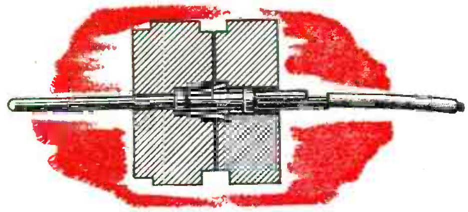


Socket construction features spring-loaded contact for positive electrical connection with pin.



Both pin and socket feature spring snap for ease of assembly in housing insulators after soldering.



Cross-section illustrating how contact pin is snapped into place after soldering on lead wires.

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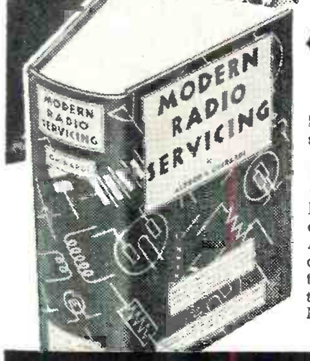

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tical radiator connection and tuned for full loading of the final amplifier stage. Under this condition, the emitted lobe was previously determined to be of very low angle or approximately 10 degrees. At 9:50 p.m., HR1AT was again called for three minutes continuously with this radiator. There was no reply.

At 9:55 p.m., HR1AT was again heard transmitting a CQ lasting about one and one-half minutes. The full Ionoscan antenna connections were then made and the loadings quickly checked (all adjustments having been predetermined) and HR1AT was again called for one minute.

HR1AT replied immediately, reporting signals received at RST 589, QSB nil. Decoding the signal report for the benefit of the uninitiated, the report would read as follows: "Perfectly readable, strong signals of purest note with no trace of fading."

Summary of Results

Long-distance communications with the system were limited in that the system was installed only at the Schenectady end. For this reason, communications could be established only with those stations which produced readable signals in Schenectady. The receiving of signals at Schenectady from long-distance stations depended on the skip-distance conditions favoring the received signal, atmospherical limitations, etc. Usually the signals from long-distance stations were characterized by low intensity and both rapid and periodic fading. Schenectady is situated in the bed of what was once a fair-sized glacial lake (Lake Albany). It is only 400 feet above sea level and is completely surrounded by mountainous regions. Signals coming "in" must jump these mountains, while those going out must do likewise. The Ionoscan antenna enables this to a fair degree.

In most every case, distant signals are located by laborious hunting of the weak signals in the band, with the further effort of straining to make sense out of their rapidly fluctuating signals amidst difficult atmospheric conditions. It was quite evident, when contacts were made, that signals from Schenectady were being received with far greater ease. It is of interest to note also that the power radiated by HR1-AT, Tegucigalpa, Honduras was 250 watts or substantially equivalent to that used at Schenectady.

In view of the foregoing, it seems reasonable to assume that at certain intervals during the combination of currents in the composite antenna system, the direction of the radiated field was caused to sweep through an angle that coordinated the reflected components from the layer with the optimum sensitivity angle of the receiving antenna of HR1AT in the Honduras. The effect was so pronounced that immediate reply was enabled due to the distinction of the signals transmitted from W2DKE at Schenectady.

—30—

Tropical Factors

(*Continued from page* 34)

downy, overspreading, surface growth with a gray appearance, are the forms of plant life with the strongest tendency to take root in various equipment products. To these plants are there offered as fertile fields such elements as insulating bodies, coatings, and impregnants, especially those made of soft, organic materials. On the noted class of materials, furthermore, the fungi germination and spread may be slow or surprisingly fast, the rates in question being determined by the materials in use, the treatment given them, and the local conditions.

Continued presence of fungi upon bodies, of course, leads directly to deterioration and eventual disintegration of the superficies. Indirectly, too, it may lead to other, equally adverse effects, notably circuit and low insulation resistance troubles.

Measures that have been devised to lessen damage from fungi consist for the most part in thorough, dip or spray treatment of susceptible parts with fungicide-containing varnishes and lacquers[9]. Used to render these vehicles thus are such chemical agents as pentachlorophenol and phenyl mercuric salicylate. In the case of parts such as device coils a further protective measure sometimes is taken, this involving special impregnation and baking of them before they are coated with a lacquer of the type mentioned.

Termites, ants and cockroaches comprise the more pernicious element of animal life against which provision must often be made in apparatus. Several species of these abound throughout the Central American tropics, and the collective foragings of the creatures included quite often result in appalling damage. Like fungi these insect pests attack many of the softer materials used in equipments, i.e., insulations; woods; imgregnated cloth coverings; and similar substances.

Damage due to the activities of termites and ants is also serious both in itself and in the consequences it may have. It usually takes the form of eroded spots and of multiple borings, these borings being a fraction of an inch across and indefinite in extent. Such results quite often are marked by removal of substantial amounts of material. Cockroach damage again is largely superficial, and confined mainly to coverings or cloths that contain certain impregnants. It appears as light, moderate-sized spots, the products of an impregnant dissolving and withdrawing process. Aside from such damage further trouble stems from settlement of cockroaches in various equipment requisites, as in wiring ducts and other secluded spaces.

Against the danger of insect infestation a twofold defensive procedure is customarily followed. It consists of: first, use wherever practicable materials that offer nothing in the way of food value nor other inducement for

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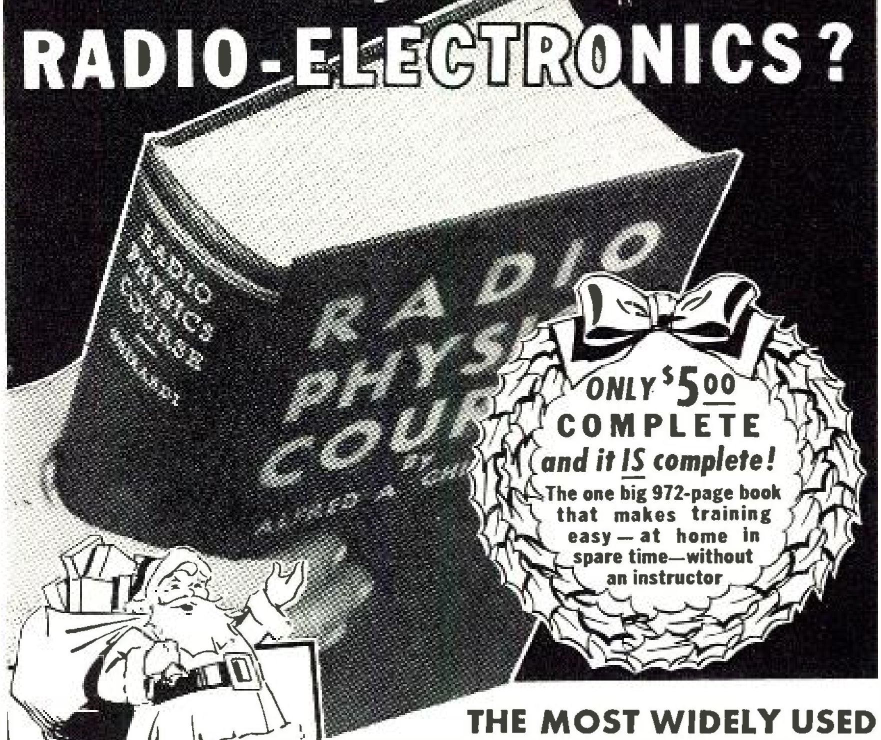

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the conduct of attacks upon them; and, second, the utilization of those forms of construction[10] which are inhospitable in themselves. Metals naturally compose the greater part of the list of materials immune to such attack though many compounds admit of being so rendered by impregnation or surface treatment. Construction forms, on the other hand, determine the degree to which small recesses, troughs, part interspaces, etc. may be sealed against intruders or the ease wherewith these places are exposable. Conclusively, a few minor changes in standard equipment along the lines indicated, rather than special equipment designs, a departure which it was not intended the foregoing comments should suggest, is normally about all that is required to attain practical exclusion of the small creature element.

Transport and Communications

Since practically all electronic products used in Central America are acquired from foreign sources and delivered by means of various transport and communication systems, there is need at times to consider the nature of these systems with a view to ascertaining possible influences they might have on products. Of those transport facilities outside the region in question, that over sea routes is likely to be the only one to exercise influence in this regard; inside the region, however, several may be thus influential. Established facilities there though including railroads; highways and roads; to a very limited extent airways; inland waterways; and coastwise shipping, yet lack sufficient detail and correlation to provide a generally close interconnection of communities. Then, too, some of the extant transport systems have reduced utilities during the rainy season. As a consequence a number of these may have to be resorted to in bringing a product to its destination.

Most of the influences exerted by the various transport facilities evidently would be upon product constructions. They, therefore, would have to reflect: a capacity to withstand the salt air and moisture conditions attending movement by sea; a compromise between ruggedness, small size, and lightness in weight in keeping with the types of transport and the multiplicity of product transfers; a unified form, that is, a completeness in assembly and readiness for installation to reduce the probability of loss of component parts or damage thereto; and the like.

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—30—

Amateur's Meter

(Continued from page 44)

just below the meter in the front-panel photograph. The output amplifier is a single-ended 25L6G stage with the vibrating-reed frequency meter wired directly in its plate circuit.

The power supply is a simple voltage-doubler circuit embracing the 25Z6G tube (V6), dual electrolytic capacitor (C_{17}-C_{18}), filter resistor R_{19}, and the .1-μfd. line by-pass capacitors (C_{19} and C_{20}). The tube heaters and pilot light are wired in series, in the order shown, and are powered through a 112-ohm line cord resistor, R_{18}.

Signal input to the instrument is through the single terminal marked ANT. The latter is a binding post or stand-off insulator terminal to which is connected a short length of insulated pickup wire, or a short, stiff metallic rod antenna (vertical and not more than 3 feet).

The quartz plate in the BC46T unit (xtal) is ground to a frequency 400 cycles lower than the carrier value. The vibrating-reed meter, M, reads in steps of 5 cycles from 380 to 420 cycles-per-second, with 400 cycles at the center of the scale. Final fine adjustment of the crystal oscillator frequency may be made, as will be described in the calibration notes, by means of the air-gap adjustment in the plate holder.

Mechanical Construction

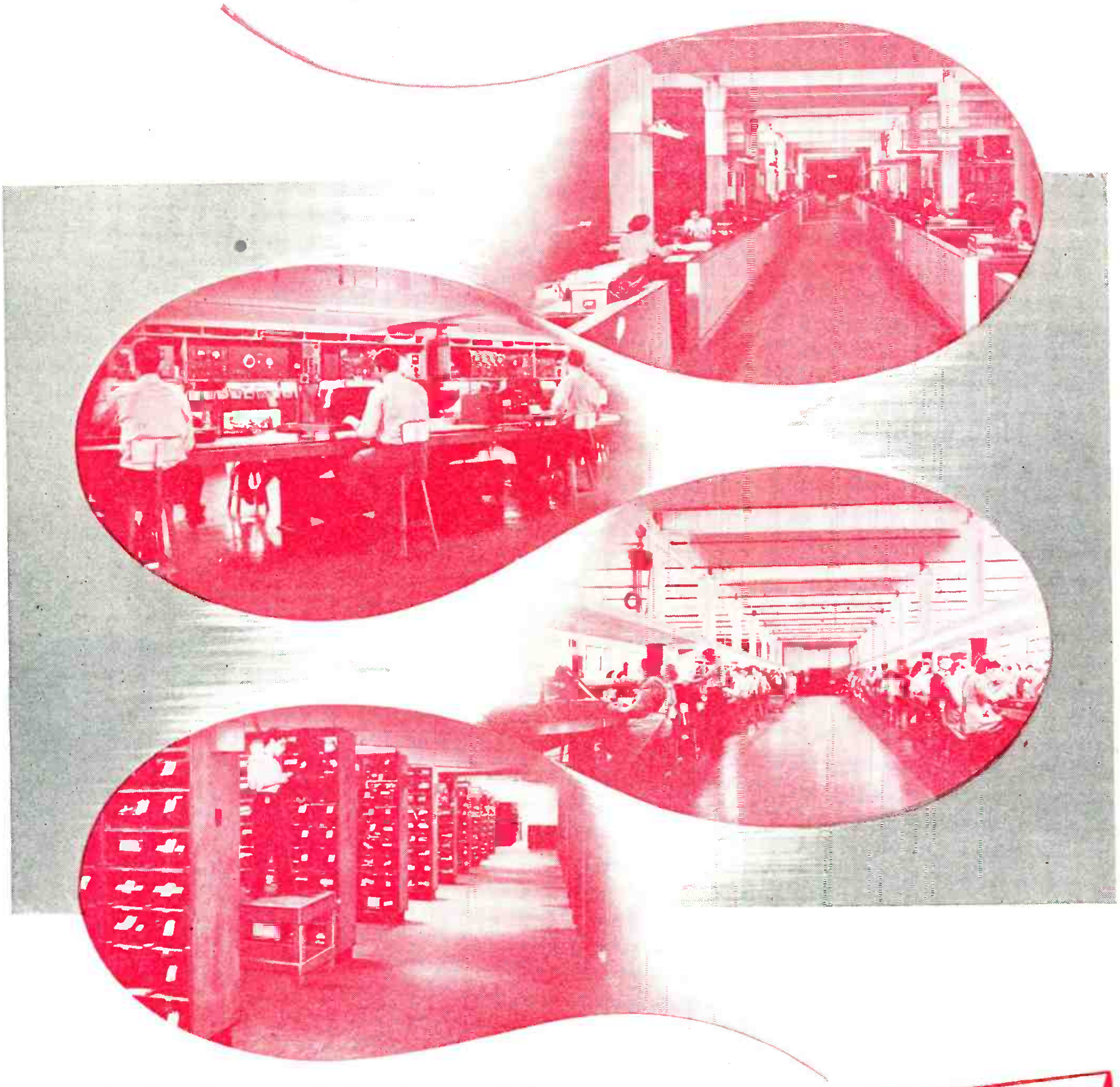
The entire deviation meter is assembled on a 7" x 13" x 2" chassis and 7" x 14" front panel. The instrument may be enclosed within a dust cover which need not be provided with ventilating holes or louvers, although the latter will be of some aid in stabilizing operation and prolonging the life of components.

Because of the comparatively foolproof nature of the deviation-meter circuit, the layout of parts on the chassis and panel is not critical. Chassis layout of the author's instrument is shown in Fig. 2. Front panel layout is revealed by the photograph of Fig. 1. It is not mandatory, however, that this layout be followed.

From Fig. 2, it is seen that the crystal unit is mounted on one end of the chassis, the rectifier and output amplifier tubes on the other. Shielded coils and active tubes are mounted in two rows along center and rear lines of the chassis top.

Leads from the meter, the 6L7 top cap, the on-off line switch (S), seen on the right-hand side of panel in Fig. 1, and from the pilot light (left-hand side of panel), pass through grommet-

DESIGN FOR ~~WAR~~ peace PRODUCTION



During the war, all departments of International Detrola's great radio-electronics plant have been brought to peak efficiency for volume manufacture of vital military equipment. Hundreds of thousands of square feet of production space have been re-allocated. Interiors and fixtures have been modernized, streamlined. These improvements have enabled skilled workers to chip precious minutes from production time while maintaining highest quality. All this will contribute to the excellence of manufacture *in quantity* of radio receivers, automatic record changers, television receivers and other peacetime electronic products. *Keep Buying War Bonds.*

DETROLA RADIO

DIVISION OF INTERNATIONAL DETROLA CORPORATION • BEARD AT CHATFIELD, DETROIT 9, MICH.

C. RUSSELL FELDMANN dr PRESIDENT

Makes *vhf* waves behave

THE KLYSTRON converts DC energy into radio frequency energy by modulating the velocity of an electron beam between spaced grids.

The ultra-high-frequency waves thus generated are so short that they approach heat and light waves in the electro-magnetic spectrum.

This makes it possible to project, by reflection, a shaped beam of *vhf* waves. Sperry engineers have put this principle to work in important wartime devices for our Armed Forces.

► **Klystrons are now in quantity production, and certain types are available. Write for information.**

The name "KLYSTRON" is a registered trade-mark of the Sperry Gyroscope Company, Inc.

• • •

Like other Sperry devices, Klystrons are also being made during the emergency by other companies.

Sperry Gyroscope Company INC.

GREAT NECK, N. Y. • DIVISION OF THE SPERRY CORPORATION

GYROSCOPICS • ELECTRONICS • AUTOMATIC COMPUTATION • SERVO-MECHANISMS lined holes in the chassis. All sockets are regular octal, except the one holding the BC46-T crystal unit, this being a standard 5-pin type.

It is advisable to mount all parts rigidly, making liberal use of lockwashers. Power-line wiring and the filament connectors should be isolated from the rest of the wiring by physical separation and by clamping close to the chassis, but the selective nature of the vibrating-reed meter will guard against hum interference.

Adjustment and Operation

After assembly and wiring, adjustment must be made in the following order:

(1) Switch on *S* and allow the instrument half an hour to come up to normal operating temperature.

(2) Insert a 0-10 d.c. milliammeter in that part of the crystal oscillator "B"-plus line marked "X" in Fig. 4, and adjust trimmer C_{15} for minimum dip of a milliammeter. At this point, the crystal oscillator is functioning. For best stability, however, C_{15} should be advanced slightly beyond this point to bring the plate up slightly out of the dip groove.

(3) If it is desired to check the crystal-oscillator frequency against an external standard and to make close adjustments upon the quartz plate, a coupling lead may be provided between the output end of C_{13} and the external monitor or standard. The crystal air gap is then adjusted for *exact* calibration.

(4) Provide a short length of wire or vertical rod as a signal antenna and connect to the terminal marked "ANT" (Fig. 4). Switch on the transmitter or oscillator to be monitored.

(5) If the carrier is exactly its assigned value, the 400-cycle reed of meter (M) should vibrate with maximum amplitude. If the carrier frequency has deviated in either direction up to — 20 or + 20 cycles, an appropriate reed will vibrate to indicate the amount. Deviation frequencies between adjacent reed values are detected by simultaneous vibration of two reeds. For example, deviation of + 12.5 cycles will cause both 410- and 415-cycle reeds to vibrate simultaneously—but each at only half maximum possible amplitude. In this manner, it becomes possible to read frequencies every 2½ c.p.s. from 380 to 420 c.p.s. For maximum ease of interpretation, the regular meter scale may be replaced with one reading "20-15-10-5-0-5-10-15-20"—zero being the 400-cycle point. Such a scale will indicate directly zero, positive, and negative deviation.

(6) As the distance between the transmitter or oscillator and the deviation meter is increased, or as the length of the pickup antenna is decreased, the audio component delivered to the 25L6G meter tube will diminish in strength. If the signal is insufficient to drive the reed meter, the audio gain control, R_9 (lower center of front panel in Fig. 1) must be advanced in setting.

Within the INDUSTRY

STANLEY A. DUVALL brings to his post of Chief Engineer for the Runzel Cord and Wire Company of Chicago over 50 years of experience in all phases of electrical communications. Mr. Duvall has done communications work in foreign countries as well as in the United States. His experience in the tropics will be of assistance in determining the procedures to follow in the manufacture of fungus-resisting materials for tropical climates.

* * *

PHILCO CORPORATION, through its president John Ballantyne, has announced the appointment of William B. Yoder as controller of the company.

Mr. Yoder was associated with Mathieson, Aitken and Company of Philadelphia, certified public accountants, from 1929 to 1942. He qualified as a CPA in 1934.

Mr. Yoder joined Philco in May, 1942, as assistant to the treasurer.

* * *

RADIO CORPORATION OF AMERICA has announced the return from foreign service of three of their engineers.

Pinckney Reed, a field engineer of the RCA Service Company, is back in the states and assigned to the Naval Research Laboratory in Washington, D. C., after a year in Brazil.

James L. Cost, who formerly handled a service circuit in Birmingham, Ala., for the RCA Service Company, has returned from the Canal Zone after two years in motion picture sound service there.

Another RCA field engineer, who recently returned from the Canal Zone after an assignment of about one year, is Robert Cobble. Cobble is now assigned to the U. S. Navy Yard at Charleston, S. C.

* * *

L. C. TRUESDELL, sales manager of the commercial division of the Crosley Corporation has been conducting a series of conferences with the company's distributors at Cincinnati in order to formulate plans for the resumption of postwar production of Crosley products. In addition to hearing of new merchandising plans, the distributors toured several of the Crosley plants in order to get acquainted with the type of wartime program which has been carried out by the company. At the same time, Mr. Truesdell announced the appointment of several new dealers and sales executives.

Mr. E. A. Bonneville of New York was appointed regional manager, Mr. John W. De Lind was named director of exports, and the Heating and Air Conditioning Supply, Inc. will act as the company's distributor for northeastern California. Woodward, Wight and Co., Ltd. was named distributor in the south, while Miami Valley Distributing Co. of Dayton will serve in southwestern Ohio.

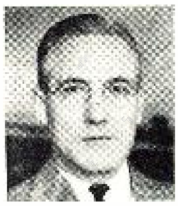
* * *

NATIONAL ELECTRICAL WHOLESALERS ASSOCIATION will hold their 37th Annual Convention during the week of April 22, 1945 at the Stevens Hotel in Chicago, according to the announcement made by Mr. Charles G. Pyle, Managing Director of the organization.

Mr. Pyle also advised that the convention will be held only if it appears to be advisable in light of transportation difficulties and other governing factors.

* * *

GEORGE RUSSELL has been appointed sales representative for the Belmont Radio Corporation in the Southern states, according to the announcement made recently by Mr. P. S. Billing, president of the company. Mr. Russell will make his headquarters in Birmingham, Alabama. He has been identified with the radio industry for over twenty years. He formerly was general sales manager for the Sentinel Radio Corporation.



* * *

WARD LEONARD ELECTRIC COMPANY has appointed Ken Hathaway as manager of their radio distributors division. Mr. Hathaway will be centrally located at 53 West Jackson Boulevard in Chicago.

He has long been associated with the radio industry and joins the Ward Leonard Company after two and one-half years with the government in radio and radar work. As a managing director of the Radio Parts National Trade show, Mr. Hathaway has had the opportunity to meet many members of the trade and is looking forward to renewing these friendships.

* * *

WESTERN ELECTRIC has announced the appointment of David B. Peckham to the post of comptroller of manufacture. He will fill the vacancy caused by the recent death of Mr. John M. Stahr. Mr. Clifford W. Smith will suc-

ceed Mr. Peckham as comptroller of sales.

Mr. Peckham joined Western Electric in 1912 upon graduating from Union College. He has held various posts with the company, including that of assistant comptroller of manufacture and superintendent of accounting. Mr. Smith has been connected with ERPI, a former Western Electric subsidiary, in Paris and London. He returned to the United States in 1936 to become assistant general foreign manager of ERPI s export division.

* * *

ANSLEY RADIO CORPORATION has appointed three representatives to handle the Ansley Dynaphone line of radio-phonograph combinations.

Reid H. Cox Company of Atlanta, Georgia will cover North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Tennessee and Louisiana. W. A. Leiser and Company of Philadelphia will act as distributors for Delaware, Maryland, Washington, D. C., Norfolk, Virginia, Pennsylvania, and New Jersey.

William G. Landes of San Francisco will be responsible for the area covering California, Oregon, Washington, Idaho, Utah, Nevada and Arizona.

* * *

SAMUEL J. NOVICK, president of the Lafayette Radio Corporation of Chicago, has announced a change in the company name to be effective immediately. Hereafter, the company will be known as the Concord Radio Corporation. Mr. Novick emphasized that only the name of the company has been changed, the personnel, location of the company offices and policies remain the same as those in effect for the past 22 years. The company is a distributor of radio and electronic equipment.

* * *

HALLICRAFTERS COMPANY has recently announced the appointment of Raymond B. Frank, formerly Naval inspector in charge of radio in Zone 3, Chicago area, to a post in the advertising department of the company.

He will serve as technical assistant to the advertising manager in charge of all publications including postwar catalogs.

Mr. Frank was technical editor of RADIO NEWS from 1941 to 1943 when he left to take the Navy post.

* * *

THE UNIVERSAL MICROPHONE COMPANY has announced that upon resumption of civilian production they will again enter the recording field in addition to continuing the manufacture of microphones.

The firm previously made its own complete professional recorders, but discontinued this production some five years ago.

The new Universal recording activity will not include complete sets. The

MAKE MORE MONEY IN Radio TELEVISION & ELECTRONICS Now!

GET THESE 3 BOOKS FREE!

You men already in radio know how great the demand is for **trained, experienced service men,** operators and technicians. You know how fast the field is growing and how important it is to keep up with developments—F M receivers, television, electronics.

Or even if you are merely INTERESTED in radio as an amateur, you must recognize the WONDERFUL OPPORTUNITY right within your grasp to **cash in on your natural talent.** Make it pay dividends. Get into the EXPERT RADIO SERVICE Line. Be a TELEVISION specialist—OWN A BUSINESS OF YOUR OWN. Fill out and mail the coupon below for all the details.

Get the Latest Inside Information—Trade Secrets by

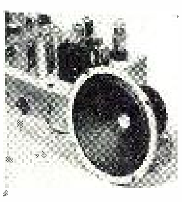
SHOP-METHOD HOME TRAINING

Learn by Doing

Use Actual Radio Equipment Furnished With Your Course

Experience is the best teacher. You learn by experience with the exclusive National Shop-Method of Home Training—actually build many circuits and do experiments with the big kits of standard radio parts included in your training equipment **at no extra cost to you.**

In the course of your study you actually build various types of receivers—a powerful superheterodyne, a signal generator, an audio oscillator and others . . . You make tests and conduct experiments that **show you the why and how of things.** You understand what makes the various elements of electronics operate because you actually see them work for you. Not only do you gain marvelous actual experience by this method of learning but you have valuable equipment you will use on the job in the practice of your profession as an electronics expert. Mail the coupon and learn what this means to you.



Now the famous National Schools brings its exclusive Shop-Method of training right in your own home. You can learn the most up-to-date, approved projects, systems and hookups step by step **in your spare time.** This is the sound, practical training you want and need—the development of experienced instructors working with thousands of students right in the shops and experimental laboratories of National Schools—**one of the most advanced trade educational centers of the world.**

This is the MODERN SYSTEM OF TRAINING. It matches the rapid progress constantly being made in radio, television and electronics. It is TIME TESTED too. National Schools has been training men for more than a third of a century. **In essence this is the very same training that has helped thousands to more pay and greater opportunity.**

You owe it to yourself—your future—to read the book "Radionics"—FREE to you when you send in the coupon.

National Trained Men Now Making the Best Money In History

The real value of National training shows up in the quick progress our men make on the job. Joe Grumich of Lake Hiawatha, N. J., turned down a job most men would welcome. He writes: "My latest offer was $5,800.00 as radio photo engineer, but I am doing well where I am now engaged. I am deeply indebted to National."

Ely Bergman, now on Station WOR, told us: "My salary has been boosted considerably and at the present time I am making over $3,000.00 per year, thanks to National Training." And from the far-off Hawaiian Islands, Wallace Choi sends this: "I am averaging $325.00 a month. I will say that I honestly owe all this to the excellent training I had at National."

National is proud of the progress graduates are making all over the world. Read about their records yourself in the books we send you FREE.

Make Extra Money Right From The Start

You get ahead fast with National Training. **Many beginners make good money** on the side fixing radios and doing service work. You can turn your knowledge into cash after the first few lessons. Progress is rapid. You can actually SEE YOURSELF GET AHEAD, because the National Shop Method is so sound and practical.

Now, right now, is the time to grasp the **opportunity of today—a successful career for tomorrow.** Get into the big money, rapid advancement, a position of importance. A BUSINESS OF YOUR OWN. **Radio, television** and the whole field of electronics invites you. The industry is crying for **trained men** everywhere. A rapidly expanding industry—probably the greatest in history—holds out the promise of a **rich future**—prosperous security.

Train While You Are In Service

Prepare, right now, while you are in uniform, for a glorious secure future in the field of radio and television when the war is over. **Make good use of your spare time** by taking your National Training now. Men **in** our armed service, or about to enter, get better ratings and more pay almost right from the start if they are trained in radio, television and electronics. The government needs experienced men in nearly all branches of the service. Prepare for present advancement and a sound future. Learn how easy it is the National way. We are so enthusiastic because we have seen the marvelous results of National Shop Method Home Training. **Send in your coupon today** and see for yourself.

1 A complete catalog describing the industry and the extensive training facilities of National Schools.

2. You receive a sample lesson illustrating the modern "Shop Method" instruction technique.

3. The vast opportunity field of Electronics. "The Dawn of a New World." is revealed in this fully illustrated book recently published.

FREE LESSON INCLUDED

Examine the exclusive National Shop Method of Home Training. See for yourself how sound and practical it is. Be convinced that you can learn radio — electronics, television — quickly and easily in your spare time. You can't tell until you try. This trial is ABSOLUTELY FREE. And you may keep all the valuable material we send you without any obligation of any sort. Fill out the coupon immediately while you are thinking about it and drop it in the mail at once.

Thousands of men in the Army Navy and Coast Guard have trained at National under U. S. Government sponsorship.

You are the man who must be satisfied.

Mail the coupon here for the three books that tell you the complete story of the marvelous new system of training in radio electronics and television. Learn the facts of this exclusive shop-method of home training. See for yourself! DECIDE FOR YOURSELF!

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(Mail in envelope or paste on penny post card)

Mail me FREE the three books mentioned in your ad including a sample lesson of your course. I understand no salesman will call on me.

NAME.. AGE........

ADDRESS ....

CITY.. STATE.....................
Include your zone number

Inglewood, California company will manufacture all recording components for firms making their own radio chasses for assembly in their own recorders and combinations. The line will include cutting heads, recording mechanisms, assemblies, and other parts and accessories.

* * *

JACK F. CROSSIN has received an appointment to the post of National Sales Director for the Hamilton Radio Corporation. Mr. Crossin has served as a radio executive for over twenty years, his most recent position being with the Crosley Corporation as head of the company's Washington office. This appointment completes a series of appointments designed to establish a national organization for the post-war marketing of "Olympic" radios.

* * *

TEMPLETONE RADIO has recently acquired a new plant with an area of 90,000 square feet which will be occupied by the radio and electronics divisions of the company.

The new plant is located in New London, Conn. The company plant at Mystic will be devoted to the manufacture of radio cabinets exclusively.

* * *

DAN J. FAIRBANKS, who was 36 years old, passed away last September. His first connection with the radio industry was with the International Resistance Company, where he served for 17 years. He resigned from the company early in 1944 and assumed the Salesmanagership in the Jobbers Division of Cornell Dubilier Corp., in which capacity he was active until his death. Mr. Fairbanks' genial personality and willingness to help the other man endeared him to untold hundreds of jobbers, distributors, dealers, and his associates. His passing is a great loss to the industry.

* * *

DAVID S. COOK has been named to the post of sales promotion manager for the Stromberg-Carlson Company of Rochester, New York. Mr. Cook will take charge of the sales training program and will direct the company's publication activities. During his two years with Stromberg-Carlson, Mr. Cook has been editor of the company's employee publication, the "Speaker." Prior to that time he held several public relations positions in Rochester, New York.

—30—

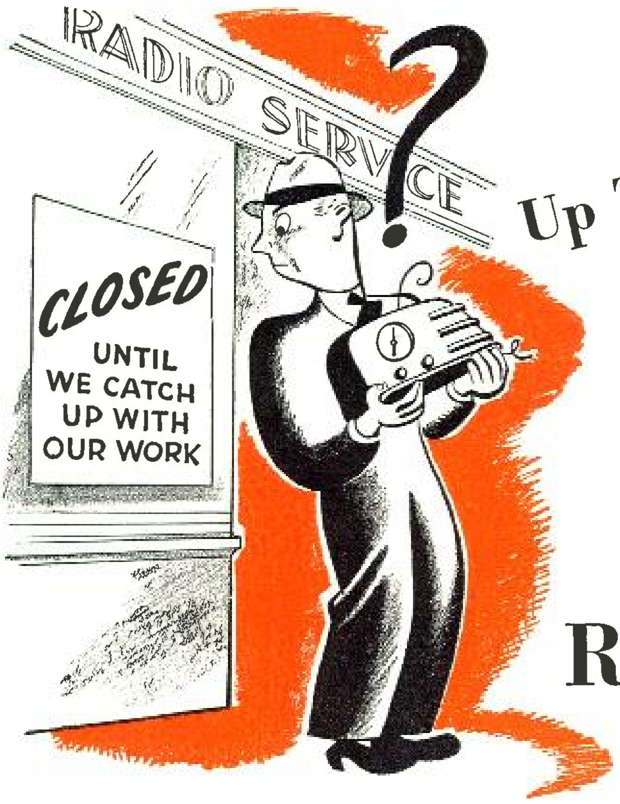
Spot News

(*Continued from page* 20)

functions during times of floods, hurricanes and other natural disasters. He said that the necessary frequencies should be made available to "hams" to continue their valuable work. According to Mr. Bailey some 67,000 men and women will be authorized to operate amateur stations when licensing is resumed. He also predicted that 250,000 amateurs would be on the air five years after the war. The use of frequencies above 56 megacycles also were recommended by Mr. Bailey. Testifying as director of the ARRL, Kenneth Warner said that amateurs should have wide bands above 60 mc. to permit experimentation with television and facsimile. Amateurs should have nine bands of frequencies above 144 mc. according to Mr. Warner. George Grammar, ARRL director of engineering, said that about 90% of the interference suffered by "ham" stations is caused by automobile ignition systems, particularly in urban areas. He therefore recommended legislation requiring the redesign of automobile ignition systems in the very-high frequencies.

Every effort is being made to complete these hearings within a thirty-day period so that an allocation plan can be submitted by the FCC to the State Department for study and inclusion in their proposal. At the present writing it appears as if the hearings will be completed within the specified time. Industry specialists are being congratulated for the thoroughness of their reports and analyses which should serve to provide a progressive program in years to come.

THE DEEP-ROOTED MYSTERY of the 50,000 portable phonographs that OWI requested and never shipped, prompted an interesting anecdote by Thomas Joyce, general manager of the radio-phonograph-television department of the RCA Victor Division, at the recent Boston conference on distribution. He said that some bright individual in one of the departments at Washington thought that we would get greater cooperation from the Arabs, if we had goods, instead of gold, to give them in exchange for their services. Accordingly the "goods" selected were phonographs, 50,000 phonographs, he declared. Apparently the executive ordering the phonographs felt that since we use many portable phonographs and find them quite handy, the Arabs, too, would like 'em, emphasized Mr. Joyce. And then came the dismal report from another executive in Washington, that since most of the Arabs never heard recorded music, the portable phonographs would be of little use. A series of conferences followed and the phonographs remained on our shores. And several months later they were offered for sale throughout the country. Americans were apparently delighted that the musical habits of the Arabs were an



Up To Your Ears in Service Orders?

Save Time with P. R. MALLORY & CO. Inc. MALLORY Replacement Parts

IF you're like most service men we know, you wouldn't mind closing shop for a while—just to *try* to catch up with orders! Of course *that* idea is out of the question. So here's a more practical suggestion:

Use Mallory volume controls, vibrators, capacitors, switches, resistors. They'll help you speed up your work. By concentrating on Mallory precision parts, you'll assure yourself, too, that the job will "stay put."

Mallory approved replacement parts save precious time in at least two ways: Every part is *standardized* so that it fits any of a dozen or more types of receivers. And every part has been *proved in service*—has an *earned* reputation for dependable performance.

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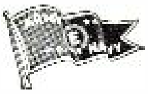

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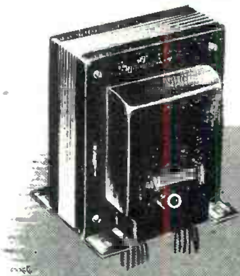


unknown factor, for within several weeks after department stores announced the sales, practically all of the units were sold. One department store in Columbus, Ohio, sold 2400 a few days after a single advertisement appeared, according to Mr. Joyce. Perhaps one of these days, we'll be able to conduct a test on the Arabs and learn which of the Washington executives was right!

RADIO APPEARED TO HAVE a host of friends at the railroad communications hearings, which were held in Washington ten days before the general allocation hearings began. Most of the representatives of railroads and manufacturing companies appearing before the FCC declared that space radio was exceptionally useful in yards and terminals and in congested areas.

Three types of communication systems were discussed: wired wireless or r.f. carrier, carrier radio, and space radio. Mountainous routes and tunnels also favored the use of space radio according to engineers of three Western roads: Burlington; Denver, Rio Grande and Western; and Santa Fe. Carrier radio was ruled out by these systems, since wire lines do not parallel railroad tracks on the mountain and tunnel routes. Engineers of the Baltimore and Ohio; New York, New Haven and Hartford; and Seaboard, also favored space radio. Carrier and space radio are being used by the Rock Island; Kansas City and Southern; Louisiana and Arkansas; and New York Central, according to the technicians representing these companies at the hearings.

The inductive system, involving pick-up from the rails, is being used by the Pennsylvania Railroad. This method, according to Dr. L. E. Grondahl, director of engineering and research of Union Switch and Signal Company, obviates the need for additional frequencies or frequency control, since the power used is very low, radiation negligible, and frequencies used on the low side. Thus it is a very practical system, he declared.

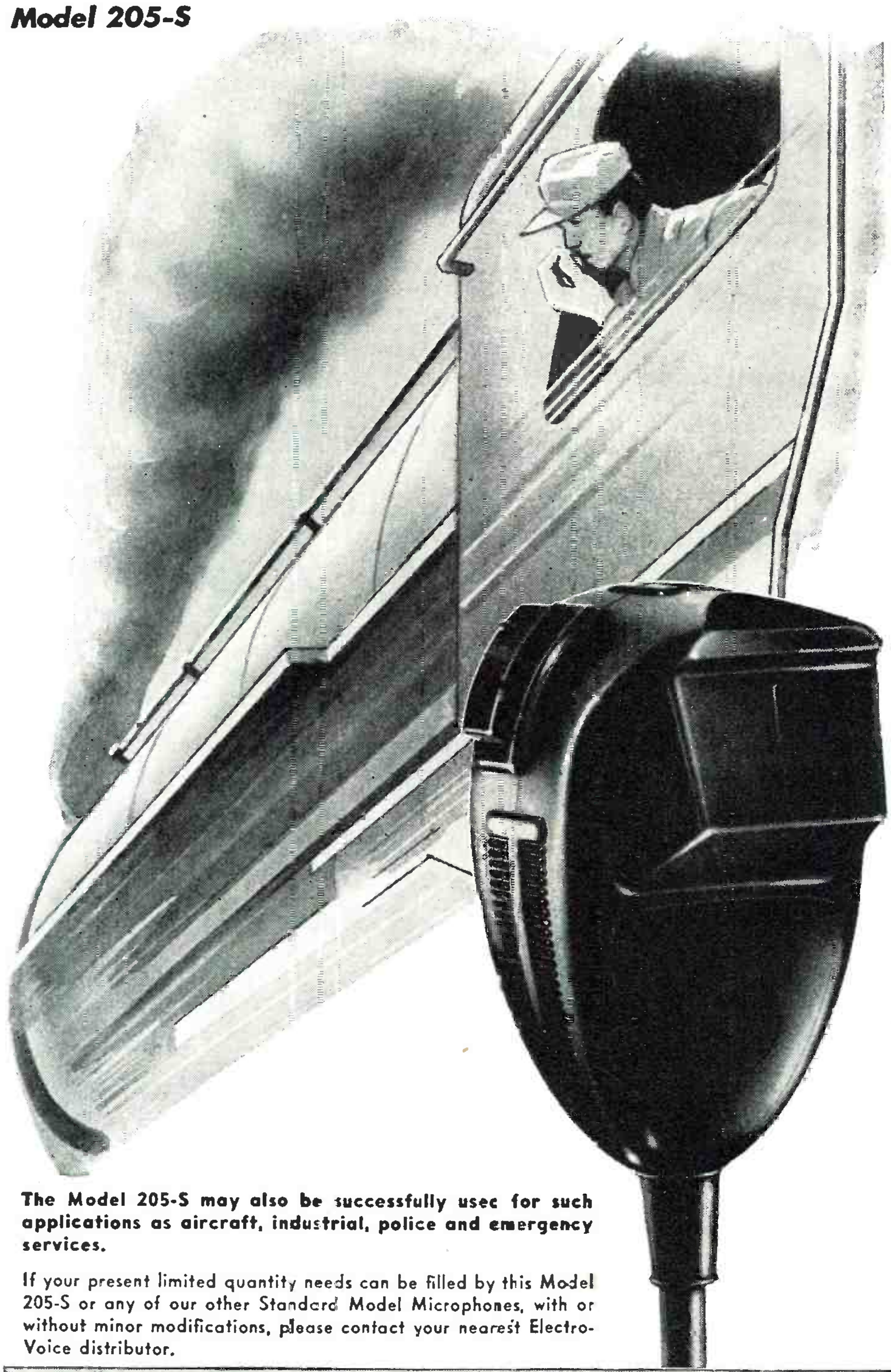
Commenting on the communications problem of the railroads, Commissioner Paul A. Walker said that the railroad companies would have to justify the safety advantages of space radio before sufficient channels might be set aside. Too much stress had been placed on the improvements in train control space radio would permit, Mr. Walker stressed. However it was generally conceded that safety and improvements in train control are allied factors in efficiency. Each are contributing elements and intelligently applied will afford the over-all effectiveness essential.

Representing the manufacturers of train radio equipment at the hearings were: William Halstead, president of the Halstead Traffic Communications Corporation; Dr. Charles N. Kimball, vice president of the Aircraft Accessories Corporation; Robert A. Clark, president of the Communications Equipment and Engineering Company;

FOR SAFETY'S SAKE!

Electro-Voice Hand-Held Differential Microphone

Model 205-S



The appalling number of railroad accidents in recent months has stimulated the demand for installation of radio communications on railway lines. Eventually, all lines will be thus equipped. Splendidly suited "for safety's sake" is the Electro-Voice Differential Microphone Model 205-S. A noise-cancelling microphone, it enables the transmission of voice clearly and distinctly, unaffected by shrieking whistles or grinding wheels. Ruggedly constructed, it can "take" the punishment of a hard-riding locomotive.

FREQUENCY RESPONSE: substantially flat from 100-4000 c.p.s.

LEVEL: —20 DB (0 DB = 1 volt/dyne/cm^2)

ARTICULATION PERCENTAGE: 97% under quiet. 88% under 115 DB ambient noise

TEMPERATURE RANGE: —40° to +185°F

WEIGHT: Less than eight ounces

INPUT REQUIREMENT: standard single button input

BUTTON CURRENT: 10-50 milliamperes

MECHANICAL DETAILS: molded, high impact phenolic housing. Minimum wall thickness, ⅛". Vinylite carbon retainer.

SWITCH: press-to-talk, with or without hold-down lock. Double pole double throw contacts provide an optional wide assortment of switch circuits. Standard circuit provides closing of button circuit and relay simultaneously.

THERMAL NOISE: Less than 1 millivolt with 50 milliamperes through button

IMPACT RESISTANCE: capable of withstanding more than 10,000 drops

POSITIONAL RESPONSE: plus or minus 5 DB of horizontal

CABLE: 5' three conductor, overall synthetic rubber jacketed

BACKGROUND NOISE REDUCTION: 20 DB and higher, depending on distance from noise source

The Model 205-S may also be successfully used for such applications as aircraft, industrial, police and emergency services.

If your present limited quantity needs can be filled by this Model 205-S or any of our other Standard Model Microphones, with or without minor modifications, please contact your nearest Electro-Voice distributor.

Electro-Voice MICROPHONES

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Wilbur L. Webb, chief engineer of Bendix Radio, and John W. Hammond, sales engineer at Bendix; L. W. Goostree, Jr., and E. W. Kenefake of General Electric; Ralph N. Harmon, manager of radio engineering, Westinghouse; F. B. Bramhall, transmission research engineer, and A. Boggs, assistant transmission engineer, at Western Union.

The use of walkie-talkies and ultra-high frequencies were discussed by several of the engineers. Thus far, walkie talkies have been used only in experimental fashion by several of the roads for emergencies. No conclusive evidence of its general essentiality was offered. It was felt that additional tests were required to provide final judgement of the apparatus. Few of the systems had experimented with frequencies above 250 megacycles, and thus had little to offer as to the merits of these higher frequencies. There was a general feeling that the higher frequencies might provide for increased signal directivity at lower power and a reduction in radiation.

In Canada, train radio has become popular, too. Two Canadian National locomotives, a diesel and an electric, have been equipped with FM transmitters, using the 38.6-mc. channel. The transmitter is housed in the locomotive, where there are also a receiver, speaker, and microphone. Two antennas are being used, a vertical and a horizontal. The signal control tower also houses a transmitter. A 20-foot coaxial antenna is used here. It is mounted on top of a lift bridge, about 175 feet above the ground. A three-eighths inch coaxial cable links the antenna to the transmitter-receiver. The system is being used for train orders in the Montreal area.

THE BLUE NETWORK will probably become the ABC network (American Broadcasting Company), before the year is out. The change was indicated during a reorganization which brought Chester J. LaRoche to the post of vice chairman of the network board. While Mark Woods remains as president, Mr. LaRoche will actually be executive officer of the network. Edgar Kobak was placed in charge of television, FM and international broadcasting. Plans before the FCC call for FM stations in New York, Chicago, and Los Angeles. Intensive plans for construction of studios in the cities where key stations will be located are also being made.

Personals . . .

Dr. Frank B. Jewett, vice president in charge of development and research of the American Telephone and Telegraph Company, has retired after 40 years of service. **Dr. Mervin J. Kelly** succeeds Dr. Jewett . . . **L. J. Chatten** is now director of the WPB radio and radar division, succeeding **Ray Ellis,** who has returned to his former post at General Motors in New York. **Howard M. Irwin** is now sales and advertising manager of Sound Equipment Corporation, California . . . **Dan Fairbanks,**, sales manager of the jobbing division of C-D, died recently. He was formerly with IRC . . . **Leslie Woods** has been named manager of industrial radio division of Philco, with headquarters in Detroit. Mr. Woods was with National Union as vice president and general manager . . . **Leon Adelman** will direct the metropolitan sales of Clarostat and serve as advisory sales manager, too . . . **Allen B. Du Mont** was recently honored by the American Television Society for the year's outstanding contribution to commercial television. The hero of the Italian fleet surrender, **Robert M. Pierce,** chief engineer of WGAR, Cleveland, has again become a hero. His tactfulness resulted in the surrender of the radio station at Luxembourg, before the Germans had a chance to destroy it. The station is one of the most powerful in Europe and has already been placed in the service of the United Nations. Colonel C. R. Powell, on behalf of the 12th Army group, commended Mr. Pierce for his "outstanding achievement" . . . **W. E. MacFarlane,** vice president of WGN and chairman of the Mutual Broadcasting System executive committee, died recently . . . **Theodore P. Wright,** has succeeded **Charles Stanton** as Civil Aeronautics Administrator . . . Mr. Stanton returns to his post as Deputy Administrator to devote his time to operational and technical problems . . . **Rhoades V. Newbell** is now advertising manager of the Magnavox Company . . . **Dr. A. M. Skellett.** formerly of Bell Labs, is now chief engineer in charge of research, for the National Union Radio Corporation.

-30-

Let's Talk Shop

(*Continued from page* 35)

ly, they did not provide adequate policing to carry out the various provisions of the law.

In many cases the licensing law operates only as a means of putting extra dollars in the treasury of the local government with no benefits whatsoever to the serviceman. The machinery of enforcement of a licensing law is almost prohibitive in cost. In order to bring offenders to justice, an attorney as well as adequate legal machinery must be available at all times. In many cases legislation would be necessary to change existing laws to allow the enforcement of a licensing ordinance. This writer does not believe that licensing is the answer to the serviceman's problems.

The answer to both organization and licensing rests on the serviceman himself. There is no reason why the Radio Service profession cannot prosper if the men in it will only realize that they, like all business men, operate under fixed economic laws which only have to be obeyed to be successful.

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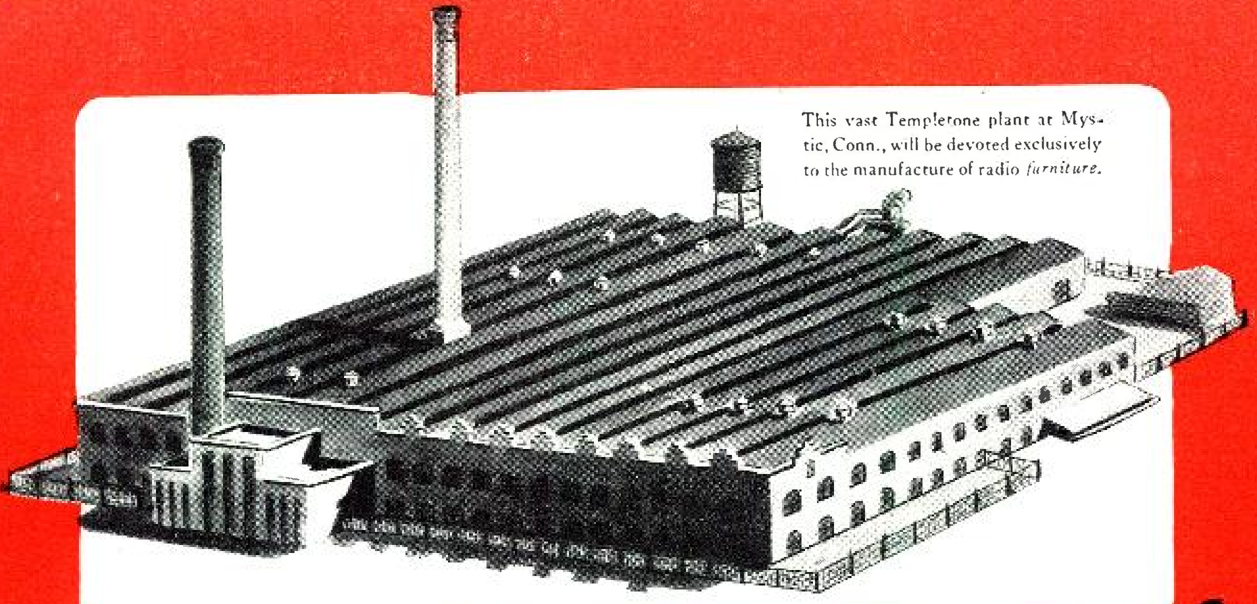
Will CABINETS be the BOTTLE-NECK ?



This vast Templetone plant at Mystic, Conn., will be devoted exclusively to the manufacture of radio *furniture.*

It can't happen here!

As time for reconversion draws nearer and nearer, the impending problem of radio *cabinetry* looms larger and larger. Radio manufacturers, large and small, have good cause to worry over this vital lack. For, scarcity of radio furniture may well prove the bottle-neck of postwar deliveries. But not so at Templetone. And not so with Temple dealers and distributors. For here, Temple Radios will be housed in Temple-built cabinets produced in the vast Templetone plant at Mystic, Conn.—assuring constant, ready deliveries as well as distinctive design and quality. *We urge you to write us without delay regarding representation in YOUR territory*

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WHERE FM WILL ALSO MEAN FINEST MADE!

Licensed under Armstrong and RCA Patents

Practical Radio Course

(*Continued from page 52*)

A further remedy lies in reducing the antenna efficiency by decreasing its length or adding a small capacitor (50-200 μμfd.) in series between it and the receiver input antenna terminal. If this is not effective, back-door points of signal entry, such as under-chassis wiring, grid leads and power circuits should be investigated. Shielding of the susceptible circuits, and the addition of standard power-line filter units at the power-line input of the receiver may be necessary. In rare cases, each possible point of entry may be contributing a bit of interfering signal and each must, therefore, be corrected separately before satisfactory performance can be obtained. (Methods of checking for this condition, and for remedying it, are similar to those discussed later under Reducing Interference Caused by Direct-Pickup of Interfering I.F. Signal by I.F. Amplifier.)

Often, realignment of the i.f. tuning circuits to a higher or lower i.f. will be beneficial. The frequency difference between the two particular interfering stations will then no longer be equal to the i.f. of the receiver, and the i.f. amplifier will not accept the interfering i.f. beat signal. There is sufficient range in the trimmers of most i.f. transformers to permit a change of alignment by as much as 10 kc. This usually can be accomplished without seriously affecting the receiver's performance otherwise. (Realignment to a new i.f. also will call for readjustment of the tuning gang capacitor trimmers and low-frequency padder.)

Cause of Direct Intermediate-Frequency Interference (Code, Beacons, etc.)

A complaint frequently encountered with superheterodynes is that of annoying code or beacon signal interference—especially in coastal areas near ship-to-shore code stations or near Coast Guard or airport radio beacons. Such interference frequently is of greater annoyance than image-response interference.

If a strong undesired signal is received of a carrier frequency *equal* (or almost equal) to that for which the circuits of the i.f. amplifier of the receiver are designed and tuned to, it may enter the receiver in either (or both) of two ways: (*a*) in most cases via the antenna and through an insufficiently selective preselector, to be passed on by the mixer or frequency converter to the i.f. amplifier, as illustrated in Fig. 2; and (*b*) by direct or indirect induction to the wiring or components of the i.f. amplifier system, as illustrated in Fig. 3. This undesired signal will be heard along with the desired signal to which the receiver is tuned—and will interfere with it. Such interference is usually heard at any position of the tuning dial, but if it arrives via route (*a*) it usually will be heard with increased intensity over a certain region of the dial on one or more tuning bands. If it arrives via route (*b*) it usually will be heard with equal intensity over the entire dial and on all tuning bands.

Fortunately, there are not many transmitters operating on carrier frequencies within the range commonly employed for receiver intermediate frequencies (105 kc. to 500 kc.). Those that are in operation are situated only in certain localities—mainly in coastal areas and along airline routes. Since they employ code transmission, this trouble is frequently referred to as "code interference." The interference usually appears as a "birdie," or in the form of a tone, depending upon whether the interfering signal is from a continuous wave (c.w.), or an interrupted continuous wave (i.c.w.) code transmitter.

The transmitters which are apt to cause such interference in receivers employing intermediate frequencies in the lower (200-400 kc.) range and located near air line routes are the aviation "A-N" beacons; those receivers located where the radiations of the powerful coastal ship or shore transmitters are sufficiently strong are apt to be troubled by code interference from them. Marine communications, beacon and direction-finding frequencies in common use are 285-315 kc., 370-380 kc., 390-400 kc., and some others. For receivers using intermediate frequencies in the higher range (450-470 kc.), signals from powerful coastal ship or shore trasmitters in the band between 390 and 400 kc. are the worst offenders.

Remedies for Direct I.F. (Code and Beacon) Interference

In those cases where the interfering signal reaches the receiver via the receiving antenna and the preselector, the degree of interference resulting is related to the amount of intermediate-frequency attenuation provided in the antenna, wave trap, and preselector circuits ahead of the i.f. system. By making this attenuation high at the interfering frequency, the interference is greatly reduced. Receivers having limited selectivity ahead of the mixer grid and relatively high i.f. gain and also those having a high-impedance, low-frequency antenna system will be particularly susceptible to this form of interference.

If the interfering signal is reaching the receiver mainly via the antenna system, it often may be reduced to a sufficiently low value by: (1) properly orientating the loop antenna for minimum interfering-signal pickup (possible receivers only); (2) shortening the antenna, or using one of a design which provides a fairly high attenuation in the i.f. range; (3) realignment of the i.f. tuning circuits to a higher or lower i.f. so they will attenuate the interfering signal and thereby reduce the interference. (Realignment to a new i.f. will also call for readjustment of the tuning gang capacitor trimmers

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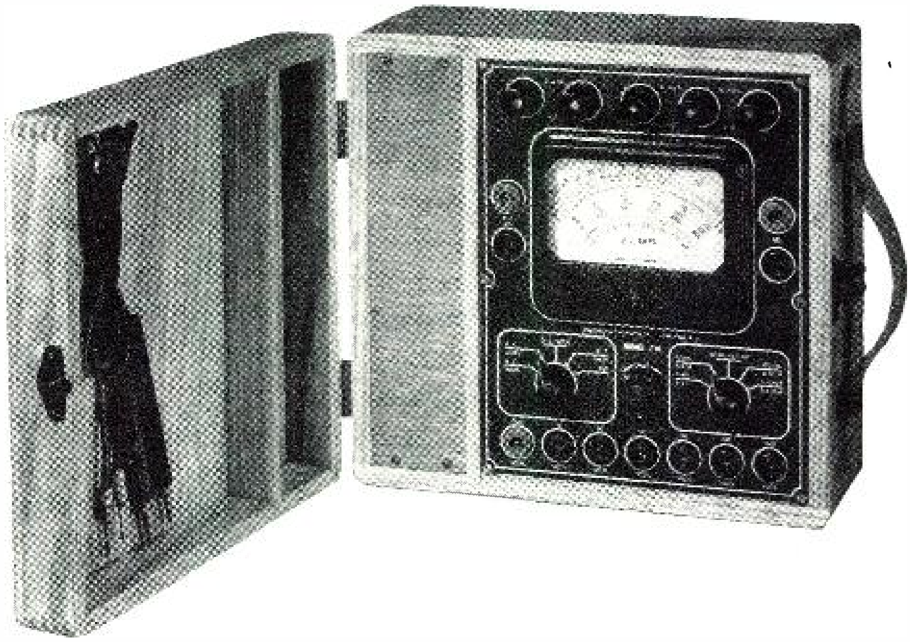
is now available for shipment within 10 days after receipt of order on priority of AA3 or better.



Sensitivity—

1,000 OHMS PER VOLT
ON BOTH A.C. AND D.C.!!

Measures:—

A.C. AND D.C. VOLTAGES UP TO—
1500 VOLTS

A.C. CURRENT UP TO—
3 AMPERES

D.C. CURRENT UP TO—
30 AMPERES

RESISTANCE UP TO—
10 MEGOHMS

Features:—

★ Uses New 4½" Square Rugged 0-400 Microampere Meter.
★ Direct Reading—All Calibrations Printed Directly on Meter Scale in Large Easy-to-Read Type.
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Designed and perfected in wartime to meet the exacting requirements of America's War Producers for a dependable volt-ohm-milliammeter, the Model 710 is being used by war plants engaged in the production of planes, ships, tanks, guns, etc.; also by various Army, Navy and other government agencies.

Specifications:—

6 D.C. VOLTAGE RANGES (1000 OHMS PER VOLT)
0 to 15/60/150/300/600/1500 Volts.

6 A.C. VOLTAGE RANGES (1000 OHMS PER VOLT)
0 to 15/60/150/300/600/1500 Volts.

7 D.C. CURRENT RANGES:
0 to 3/15/60/150 Milliamperes   0 to 3/15/30 Amperes.

A.C. CURRENT RANGE:
0 to 3 Amperes.

5 RESISTANCE RANGES:
0 to 1,000/10,000/100,000 Ohms.   0 to 1 Megohm   0 to 10 Megohms.

The MODEL 710 comes complete with cover, self-contained batteries, test leads and instructions. Size 6" x 10" x 10". Net weight 11 pounds. Price.................... $\$34^{50}$

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and low-frequency padder.) If these simple remedies do not sufficiently reduce the interference, a suitable wave trap tuned to the frequency of the interfering signal, should be properly inserted in the antenna circuit.

The use of a tuned wave trap in the antenna circuit offers a simple and inexpensive method of eliminating, or at least greatly attenuating, *antenna-borne* signals (within a narrow-frequency band) that are causing interference on the broadcast range—for example, the interference from transmitters operating at, or near, the intermediate-frequency value of the receiver, interference from a single distant, but strongly-received, broadcasting station, etc.

A form of simple wave trap that is extensively used for this purpose is the series-resonant *acceptor* or "shunting" type. One is shown connected in the antenna input system of the 2-band Wilcox-Gay Recordio A-89, 91 and 92 receivers, at (A) of Fig. 4. This is a *series-resonant* type, which theoretically offers a *very low* impedance to signals of the frequency to which it is tuned and a very much higher impedance to signals of all other frequencies lying above or below a narrow band around this resonance frequency. Therefore. by adjusting it so that it is tuned exactly to the frequency of the interfering signal, most of that signal will be by-passed through the wave-trap circuit to ground and so will be kept out of the input circuit of the receiver. To all other incoming signals of frequency other than its own resonant frequency, L_t-C_t offers a higher impedance; thus most of the available voltage of these signals appears across the primary of the antenna coil L_t. It is the duty of the tuned preselector circuits preceding the mixer or frequency-converter to attenuate all of these but the one *desired* signal. A pair of typical transmission characteristic curves for the series ("acceptor") type of wave trap are illustrated at (*B*) of Fig. 4. One shows how the impedance of the trap circuit varies with the frequency. The other shows how the current through it varies with the frequency. The limiting value of the impedance at resonance is the r.f. resistance of the coil and capacitor and connecting wires, which is purposely kept quite low in all such circuits. The sharpness of the tuning of this trap circuit also is affected, however, by the natural resistance of the antenna circuit (which is effectively in series with the trap circuit). Accordingly, such wave traps are most effective when not only their own internal r.f. resistance but also that of the aerial-ground circuit is kept low.

Another effective wave-trap circuit (or slight modifications of it) often used is illustrated at (*A*) in Fig. 5. This consists of a coil L_t, and tuning capacitor, C_t, connected in *parallel* with each other, and tuned to the frequency of the interfering signal it is desired to suppress. The combination is inserted in *series* with the antenna circuit. This type of trap is a *parallel-resonant* circuit because the signal voltage is applied across *both* the coil and condenser. The characteristics of the parallel resonant trap circuit. shown at (*B*), are such that at frequencies other than its resonant frequency the impedance it introduces into the antenna circuit is small. Therefore, it does not appreciably affect the flow of all received signals other than the interfering signal (to which it is tuned). It is the duty of the preselector following the wave trap to attenuate all of these but the one *desired signal.* Since, at its resonant fre-

Experience Counts

That machine above was built by Nicholas Cugnot in 1769. It is the great, great, great grandfather of the modern automobile. Cugnot's machine was the original Stanley Steamer. It had a boiler in front and when it ran it might go as fast as 2½ m.p.h. That machine was a far cry from our modern car, but it was a fine idea. The reason it was not more successful was that Cugnot simply did not have enough experience.

In the manufacture of all products, Experience Counts.

The **WARD PRODUCTS CORPORATION** has long been a leader in the design and manufacture of antennas for automobiles and home radios. Many important design changes, pioneered by **WARD**, have become accepted standards in industry. **WARD** products are quality products, reflecting the workmanship of craftsmen using modern equipment. . . . For the finest antennas for all automobile and home applications, look to **WARD!**

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quency, this type of wave trap introduces a much larger impedance into the antenna circuit and thus tends to reduce the strength of any undesired signal of that frequency, it is called a *rejector*-type wave trap. Keeping the r.f. resistance of the wave-trap coil and tuning-condenser circuit *low* will aid in making the trap circuit tuning fairly sharp. The natural resistance of the antenna circuit always is in series with this trap circuit. Therefore, if it is appreciable, the percent difference between the combined impedance of the trap and antenna circuits existing at the desired-signal frequency and that existing at the trap resonance (interfering-signal) frequency will not be as large as one might at first expect. Because the natural resistance of most ordinary receiving antenna circuits is comparatively high, this type of trap is not as effective for all-round use in suppressing narrow-band interference as is the "acceptor" type illustrated in Fig. 4, and consequently it is not as much used for the purpose, excepting in cases (Fig. 6) where it is built into the antenna-circuit of a receiver whose designer has control over the antenna-circuit characteristics.

To prevent pickup of unwanted signals and a.c. hum, the lead from the wave trap to the antenna primary coil L_1 should be kept short, and should be shielded. In fact, it is advisable to shield the entire wave trap. Combinations of several parallel-resonant rejector wave traps in series, each one tuned to the frequency of a different interfering signal may be used, but are rather complicated physically for more than two or three frequencies. In some cases, however, both an acceptor and a rejector type wave trap are incorporated in the antenna circuit of the receiver, both acting simultaneously to produce an effective working combination for effecting utmost attenuation of the undesired, interfering signal.

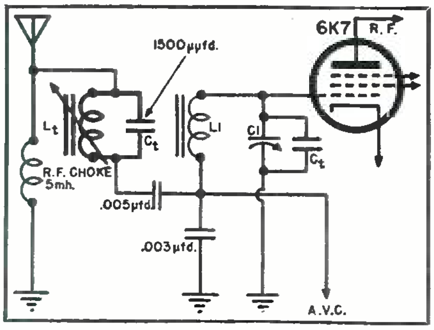

Fig. 6. Parallel-tuned wave trap and capacitively-coupled antenna circuit employed in Stromberg-Carlson 450 series receivers, for rejecting interfering signals.

Some wave traps (of both types) employ permeability tuning. They consist of a fixed capacitor, and a coil whose inductance is varied by varying the position of a powdered-iron magnetic core within it. An example of the use of permeability-tuned units in a parallel-tuned wave trap arranged in an antenna circuit of more elaborate design than the simple one already described is illustrated in Fig. 6. Permeability-tuned coil L_t and fixed capacitor C_t form the wave trap. The .005 μfd. fixed capacitor capacitively couples the antenna circuit to the receiver input circuit which also contains a powdered-iron-core type tuning coil L_1, tuned by C_1, a section on the gang tuning capacitor. This particular trap and antenna circuit arrangement, which is made very effective by proper choice of the constants of the various components, is used in the Stromberg-Carlson 450 series receivers.

While more complete rejection of *all* interfering frequencies is accomplished by well-designed band-pass tuning circuits tuned in conjunction with the regular receiver circuits, and built into the receiver at the time of its manufacture, good results may be obtained in eliminating interfering signals from a *single* station by means of either of these two types of wave traps. Wave traps also are the more common interference-correction devices applied by servicemen to existing receivers, because of their simplicity and low cost. Since band-pass preselector circuits necessitate additional separate sections on the gang tuning capacitor, installing them in existing receivers is impracticable.

Interfering image-frequency signals may be attenuated by tuning the traps to the frequency of the interfering station, while if the difficulty lies with signals near the intermediate frequency, the traps are, of course, tuned to give maximum rejection at this point. If the frequency of the interfering signal is definitely known, the traps may be adjusted with a signal generator set to oscillate at the unwanted frequency. Use a dummy antenna of 200-μμfds and adjust the trap for minimum receiver output while using a strong generator signal. In the majority of cases, it will be necessary to make adjustments of the wave trap when the interfering station is on the air and is being received, and it is usually best to do the job in the customer's home under the exact interference conditions that are being experienced.

It is best to use a shielded wave trap to prevent pick-up of a.c. hum. If the unshielded variety is used, it should be kept away from other parts on the chassis. Shielding the lead from the trap to the tube circuit will prevent the interfering station from being picked up again by this wiring.

Reducing Interference Caused by Direct-Pickup of Interfering I.F. Signal by I.F. Amplifier

When interference due to a station operating at the i.f. of the receiver is received with equal strength all over the tuning dial as a background to any and all stations, and it is not materially reduced by the use of an antenna-circuit wave trap, it indicates that it probably is being picked up either directly or indirectly by the wiring or components of the i.f. amplifier and therefore is amplified by it and reaches the second detector to cause interference with the desired signal (see Fig. 3). The interfering signal may be entering this amplifier *directly*, due to inadequate or faulty shielding of the i.f. coils or tubes; through the power line circuit, some of the wires of which are in close proximity to the i.f. amplifier wiring in the receiver; through the connecting lead between the antenna terminal and the antenna coil, the waveband switch, or the volume control, which runs adjacent or parallel to some of the i.f. amplifier wiring. Altering the position of such a lead, or, replacing it with shielded cable usually is sufficient to eliminate the interference. Sometimes, shielding of some of the i.f. amplifier wiring (especially

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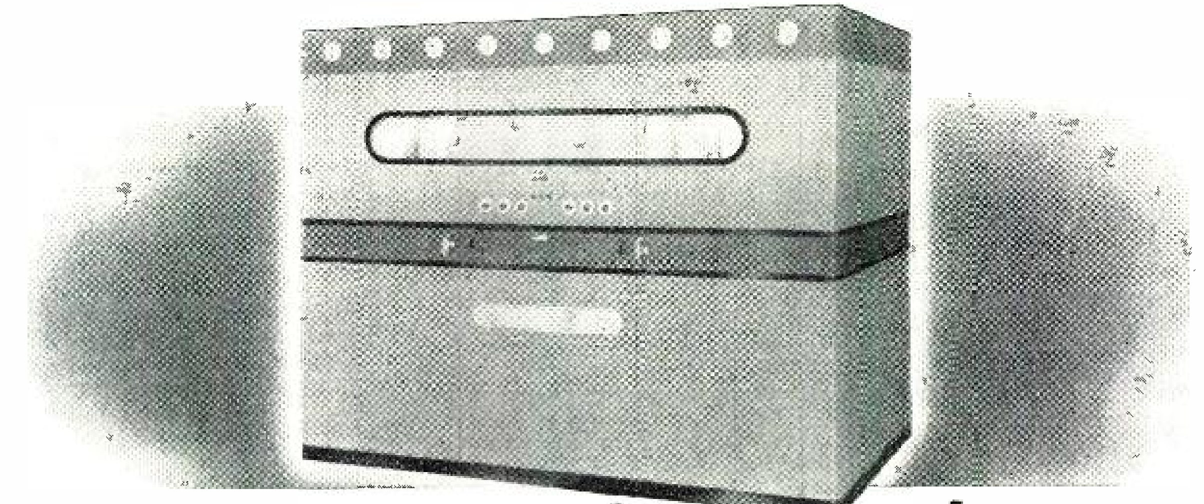
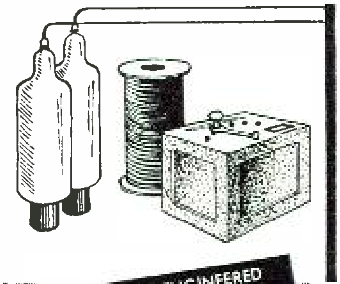
Gates "BC-10"

5-10 KW BROADCAST TRANSMITTER





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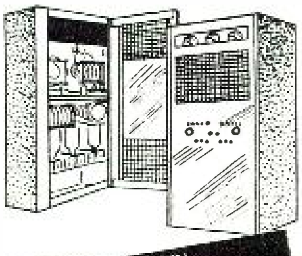

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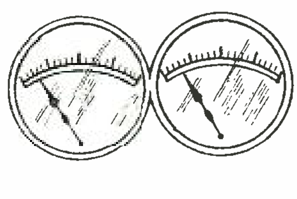
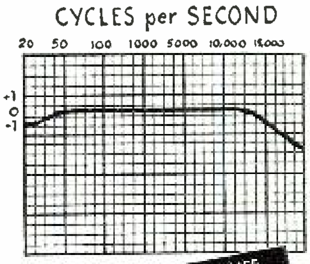


HIGH TRANSMITTER EFFICIENCY



HIGH FIDELITY RESPONSE CHARACTERISTICS

Here is one of the new things to come from Gates! Our engineers have already developed and approved engineering designs for this transmitter to be produced as quickly as the demands by the military on Gates' production no longer exist. The "BC-10" may be used for either 5,000 or 10,000 watt carrier. It is high level modulated and will be available complete with built-in phasing equipment.

May We Send You Details Regarding the Gates
Priority System for Prompt Post-War Delivery?

(Wartime restrictions do not allow the sale of new broadcasting equipment without priority; therefore, this equipment is presented merely to acquaint you with Gates' developments.)

Gates

RADIO and
Supply CO.

QUINCY, ILLINOIS, U.S.A.

Manufacturers of Radio Broadcast Transmitters, Speech Equipment, Recording Apparatus and Allied Equipment in the Electronics Field.

grid connections) is necessary. Or, shielding plates for the bottom and/or the top of the chassis may have to be installed to prevent direct pickup of the interfering signal by parts or wiring of the i.f. amplifier. Often, realignment of the i.f. tuning circuits to a higher or lower i.f. will be beneficial.

In order to localize the source of code interference, disconnect the antenna and ground from the receiver and "short" the antenna and ground terminals with a short jumper wire. If the code interference disappears, it indicates that it was entering the receiver mainly via the antenna circuit and, therefore, the installation of an antenna circuit wave trap is in order. If it still persists, all shielding in the i.f. amplifier circuits should be checked for good grounding contact, and shields over the entire i.f. amplifier section, and tubes should be tried. A power-supply line filter may also be effective.

(To be Continued)

Repairing Defective Transformers

(Continued from page 45)

container, connect the coil terminals to the leads in the tube-base, pour transformer oil into the can, leaving a small air space for expansion of the oil with heating, and solder the top to the body of the can. An added refinement is to replace the air in the container with a dry inert gas, such as oil-pumped nitrogen. This particular gas is used by telephone companies in pressurizing telephone cables. The procedure for filling the container with gas is as follows. Drill two small holes in the cover of the can as shown in Fig. 2. Apply the gas to one of these holes, allowing it to force the air out of the other one. After only a few seconds, practically all of the air will be replaced by the gas. The holes then can be sealed with solder.

A few constructional notes may be of interest. After the container is selected, mounting lugs may be soldered to its base or sides to permit the filled unit to be anchored firmly in position. Also a light framework made of metal sheeting or strips should be provided to hold the transformer or choke in place inside of the can, thus preventing short-circuiting of the leads due to the shifting of the unit inside the can.

Leads carrying a considerable amount of current, such as filament leads on a power transformer, should be connected to two or more of the tube terminals in parallel. If more leads are required than can be accommodated by a single tube base, additional tubes can be used.

Connections can be made to the socket base by the use of an octal-type tube socket, or by cable connectors which are designed to fit the standard octal tube base.

Transformer oil can be obtained from the local power company. For low-voltage units, oil which is no longer satisfactory for large power transformers can be used. However for high-voltage use, such as transformers for cathode-ray oscilloscope power supplies, it is recommended that only new dry oil be used. This is important as old oil causes trouble.

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Electronics at Work

(Continued from page 41)

that were heretofore considered impossible. To illustrate a few of the uses for which electronics can be applied satisfactorily, a few typical examples will be discussed.

In the manufacture of small capacitors for use in radio receivers and radio transmitters or in the manufacture of large capacitors for use in industrial plants, it always has been a problem for the manufacturer to wind the metal foil and paper (capacitors are usually composed of two sheets of thin metal foil separated by some insulating medium such as impregnated paper) with uniform tension to insure good insulation. Today an electronic motor-speed control, called the Mot-O-trol, is used for this purpose. The operator controls the speed of the winders simply by operating a foot-operated speed adjuster. By the installation of the electronic motor control greatly increased production was the direct result of the smoother speed control obtained by the operator.

Today electronic regulators are used to control the temperature of resistance heater-type furnaces within very close limits. Furnaces of this type are frequently used in the metal-working industry for heat treating and in certain manufacturing processes where it is necessary to insure that the insulating material (paint, varnish, etc.) is completely dry before shipment. So sensitive is this control, normal variations in line voltage have no effect on the temperature of the furnace. The application of the electronic furnace temperature regulator (or Furnatron regulator) is by no means restricted to the control of furnaces. Actually, ammonia manufacturers, synthetic rubber manufacturers and the chemical industry have many uses for this regulator.

From the very beginning of World War II we have heard that we needed more and more aluminum. Raw materials were no great problem since Bauxite ore, the principal source of aluminum, comes from mud found in many locations on the earth's surface. However, the production of the metal aluminum in a pure form depends upon many complicated conversion processes, and many of the conversion processes require the continuous application of large amounts of direct-current power.

The Ignitron rectifier, an electronic device, is one of the most efficient means for converting available alternating current to direct current, thus conserving power. This electronic de-

Announcing a new line of

I-C-E VACUUM CONDENSERS

This is the I. C. E. VC-100

A brand new line of fine vacuum condensers . . . precision engineered and produced by I. C. E. . . . available now. New, improved designs in sizes VC-12 . . . VC-25 . . . VC-50 . . . VC-100 (illustrated) are ready for delivery.

These condensers have been tested and proved . . . now, they're ready to work for you. Remember, I. C. E. *precision engineering* is your assurance of quality-plus. Order now!

I-C-E

ELECTRONIC TUBES

INDUSTRIAL & COMMERCIAL ELECTRONICS

BELMONT, CALIFORNIA

vice is easily installed and, having no major moving parts to require maintenance, can deliver direct current power continuously 24 hours a day automatically and unattended.

Today, Ignitron rectifiers are supplying dependable direct-current power for the vital conversion of Bauxite ore to aluminum and also in many of our steel mills, mines, factories, transportation systems and wherever large amounts of direct-current power are required.

For many years engineers have been hard at work developing processes for joining metals by fusing them together. Engineers have spent considerable time in trying to eliminate the use of rivets and bolts since this method required that holes be drilled in the pieces of metal. Also the use of rivets and bolts increased the weight of the finished product. Not only did this method of assembly hamper production, it also reduced the load-carrying ability of our airplanes and land vehicles to say nothing of the reduced speed due to lack of complete streamlining. The methods employed by the blacksmith were not applicable in many cases and at their best were quite slow and consequently expensive.

Today's modern shop practices and production requirements demanded a faster and more economical method of joining metals. Resistance welding (a welding process where two or more metals are joined together by passing a very large current—often this current is near 10,000 amperes—through the pieces of metal where the weld is to be made while the pieces are under pressure) was the answer. With this process, fabricated assemblies could be rapidly and securely joined and in addition the method was particularly adaptable to production processes where large quantities of duplicate assemblies are involved.

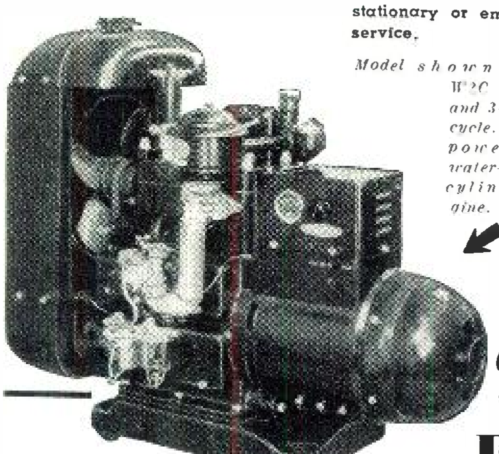
Formerly, bulky, short life, noisy mechanical contactors or switches were used to control the flow of current to the assembly being welded. Today, the Ignitron tube (yes, the same tube that is supplying direct-current power in the conversion of Bauxite ore to aluminum) is used to control the flow of welding current with extreme precision, efficiency and without the machine-gun noise inherent with all mechanical contactors.

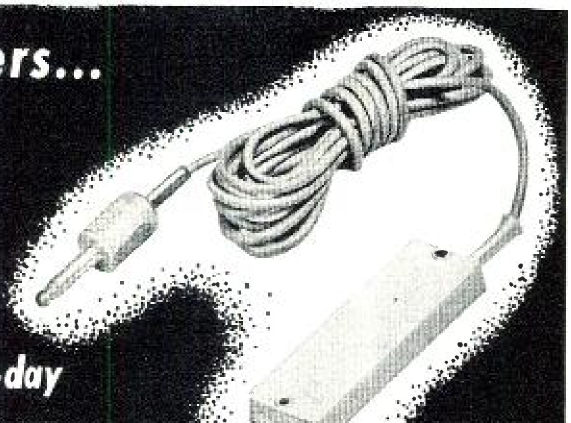
In fabricating plane parts and subassemblies made of aluminum, electronic resistance welding control can now send accurately-controlled current racing through the metal several hundred times a second and thereby literally "sew" plane parts together faster and stronger than ever before.

In the canning industry precautions must be taken to insure that no holes are present in metal containers. Large holes in the cans result in leakage of the contents while small pin holes, the diameter of which are approximately 1/64", permit air to enter the can and result in spoilage of the contents.

It was not many years ago that the inspection of sheet metal, used in the manufacture of metal cans, for pin holes was performed by workmen in the rolling mill. Brilliant lights were directed from the under side of the sheet. The workman would inspect the steel sheet for pin holes and if the holes were detected the defective sheet was removed from the conveyor by hand. Needless to say, this method of pin hole detection was tedious and boring for the workman and quite often it was found necessary to employ a number of inspectors working in short shifts to perform a satisfactory job. In addition to requiring a large number of inspectors, the speed of the mill was not over 50 feet per minute.

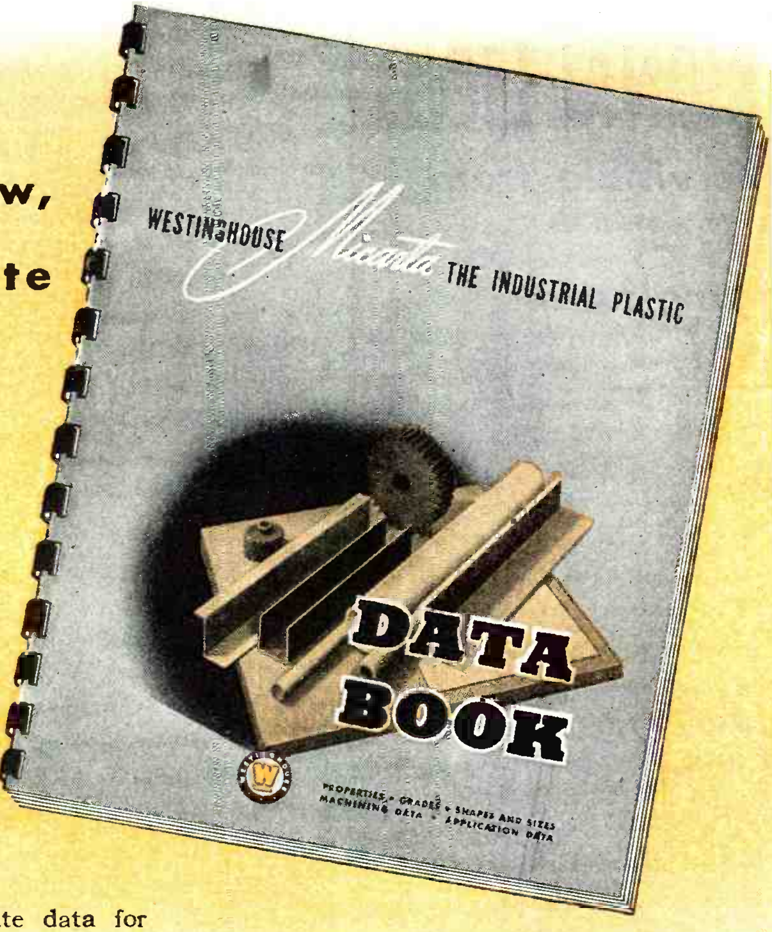
The electronic engineers took advantage of the fact that when light is focused on a light sensitive tube often called a phototube or photoelectric cell, a current will be generated, and so designed the photoelectric device known as a "pin hole detector" to inspect the sheets for pin holes as the sheet leaves the last stand of a rolling mill. Not only does the pin hole detector perform the job unerringly, it also allows the operator to increase production by operating the strip up to speeds as high as 1000 feet per minute! While the pin hole detector is designed for detecting holes on the order of one-sixty-fourth of an inch, it has been found in actual





Magnetic Pickup for String Instruments

40 pages of new, up-to-the-minute *facts* FOR COMMUNICATIONS ENGINEERS



Here's new and up-to-the-minute data for designers of communications and electronics equipment in concise, easy-to-use form.

Forty pages of property tables, performance curves and design suggestions provide working data for selecting the proper grade of Micarta for any communications application. Data covers both laminated, molded, and formed Micarta. Grades include those designed for severest wear and high dielectric strength. Micarta terminal blocks, commutators, bases, coil forms, switch spacers and tube sockets, are now standard in the industry. In these successful applications, you may find the basis for an improved design.

Reserve your copy of the new Micarta Data Book today. Write Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N. J-06354-1B

GET THIS HELPFUL DATA:

Grades of Micarta—their characteristics . . . corresponding Army and Navy types.

Properties of Micarta—electrical . . . mechanical . . . chemical . . . how they compare with other materials.

Designing Help—machining data . . . how to apply directional loads . . . molded and formed Micarta design suggestions.

Forms Available—standard shapes and sizes . . . plates, rods, tubes, angles, channels, zees.

Westinghouse
Micarta
THE INDUSTRIAL PLASTIC

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE practice that holes as small as one one-hundredth of an inch will operate the device even though the sheet speed is one thousand feet per minute.

In many industries, and the industry responsible for manufacturing the paper on which this article is written is a typical example, accurate control of the machine speed is inherent to uniformity of the finished product. Even a slight variation in speed, due either to overloads or reduced line voltage, may seriously affect the quality of the finished product.

Today electronic regulators function without moving parts or inertia and thus friction and wear are eliminated. Therefore, corrections to maintain constant machine speed are made with the greatest possible rapidity.

Perhaps many wonder how the manufacturer of candy bars manages to wrap the bar in such a manner that the attractive wrapper always has the trade mark in the same relative position on all bars. Many schemes have been used in the past, but today progressive manufacturers employ a simple electronic regulator, called a register regulator, to insure that the wrapper is always in the proper position.

The operation of this electronic regulator is very similar to the operation of the electronic unit that is used at the local bank to open the door when the beam of light is interrupted. Here a small contrasting spot, often not over ½" long and ⅛" wide, is printed on the wrapper web at the same time the trade mark is printed. A beam of light is focused on the paper in such a manner that the beam of light will strike the printed spot as the wrapping stock is fed through the wrapping machine. Since the spot is in direct contrast to the printed stock, the amount of light transmitted to the phototube on the opposite side of the printed stock will vary in much the same manner as if a person passed through a beam of light. The interruption of the light falling on the phototube is transmitted to the electronic regulator which in turn controls the exact location where the wrapping stock is cut by rotating cutters.

This application is by no means limited to the wrapping of candy bars since many chewing gum, tobacco firms and bakers are using register regulators to insure that their product reaches the consumer in an attractive, sanitary wrapper. Today electronics also is helping to make high-altitude flying safe for our flyers. It is possible, with the aid of instruments, for the individual pilot to determine during flight the actual oxygen content of his blood so that he can govern the oxygen flow to suit his actual needs instead of the former "on" or "off" method of supplying oxygen. This scheme is based on the change in color of the blood with a change in the oxygen content. A tiny light and phototube is clamped to the ear. The light is passed through the lobe of the ear to the phototube, the output of which is amplified by a Photo-Troller and passed to an indicating instrument.

To summarize the effects of electronics on our lives today, we might formulate four definitions of electronics:

1. To the average man on the street electronics means radio, television. the talking movie, the door-opening electric eye and the doctor's X-ray.
2. To the military man electronics is the guiding force of the greatest army and fleet ever assembled. It is the nerve center of the battleship, major means of locating enemy planes and submarines, communications between command posts, and coordinator of great air fleets.
3. To the medical man electronics is a means of delving into the unknown secrets of the human body, and of treating diseases that heretofore have baffled medical research since the dawn of modern medicine.
4. To the men of industry electronics is a new working tool. Electronics is a means for speeding production, improving the quality of the finished product and is a means for increasing efficiency.

While it is true that many electronic developments of great significance will spring from World War II it should also be borne in mind that *electronics is at work today* doing jobs that will hasten victory.

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Sound Reproducer

(*Continued from page* 37)

with enamel. Certain applications of the sound reproducer may warrant such construction and therefore it would not be out of place.

Both sides of the cabinet were made identical in appearance so that the cabinet may be placed in any position desired in a room. Grill cloth was used on the lower opening while on the top of the column directly over the speaker, a wire mesh with a cloth screening was used to prevent foreign objects and dust from accumulating within the cone of the speaker. The bottom of the cabinet is completely closed with ⅝-inch plywood.

A section of the bottom panel was made removable by simply removing a few screws. All electrical connections inside of the cabinet can then be made through this opening.

Conclusion

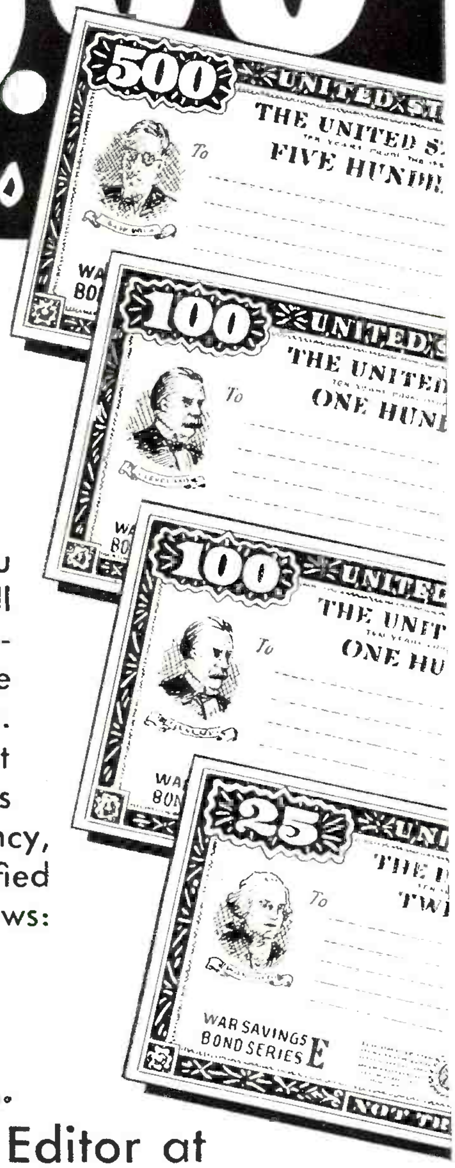
The sound reproducer was constructed completely before any tests were made as to its performance. By employing an audio oscillator it was found that the complete frequency range, as originally planned, had been attained. A not too predominant resonant peak at 80 cycles per second was achieved. Although no sound pressure meter was available, the output appeared to be flat across the entire range. The cabinet itself did not pro-

Win WAR BONDS

A GRAND TOTAL OF

$1,000.00

IN PRIZES *for Your Ideas*



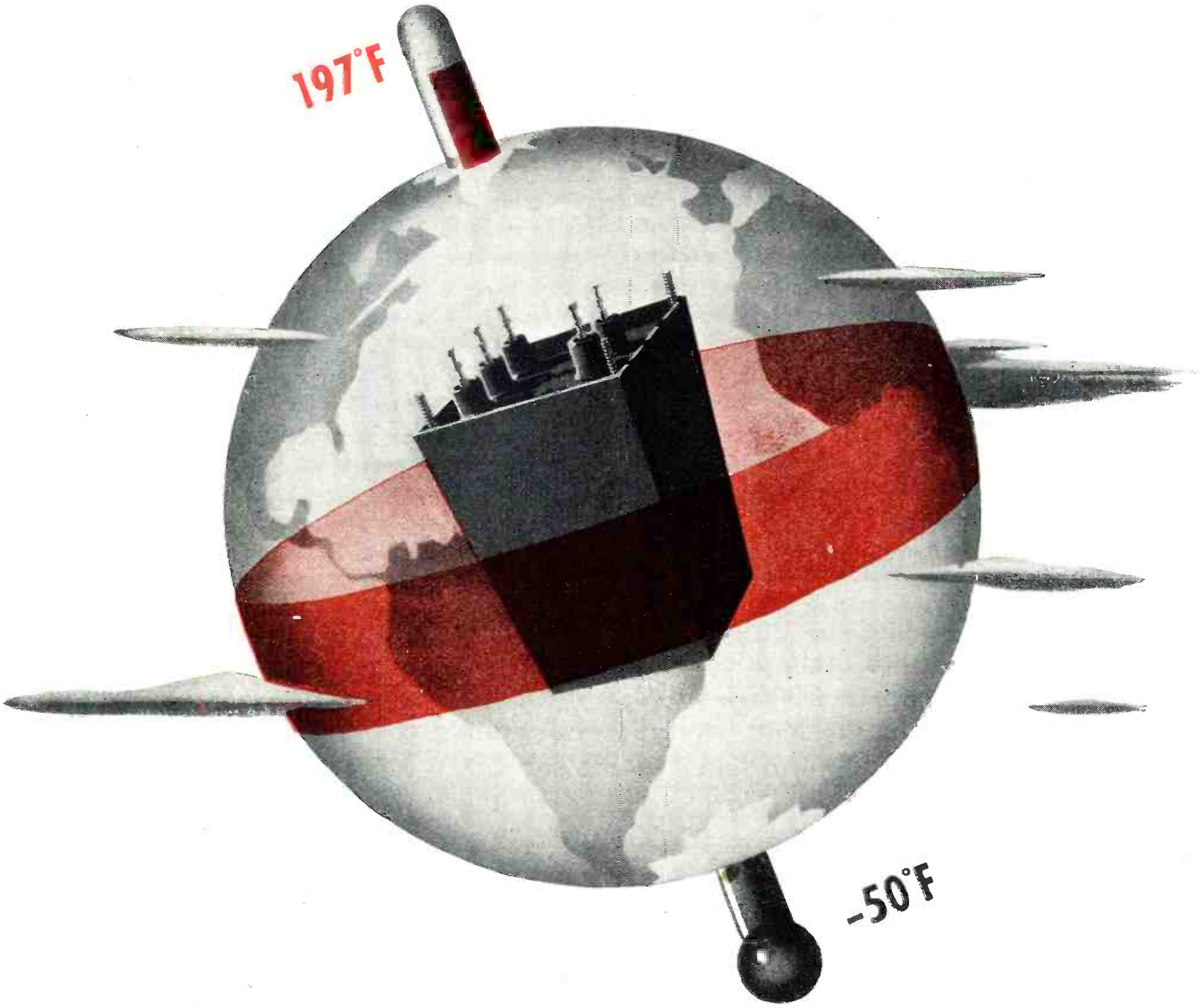
Midwest Radio Corporation—since 1920, famous for fine radios, and their factory-to-you selling plan with savings up to 50%—looks to the post-war future. To build the kind of radio *you* want, they ask *you* now to submit a letter on the subject: "What I Want In My Post-War Radio." For the 11 best letters, Midwest will give $1,000.00 in War Bonds. Letters must not exceed 200 words and you may send as many entries as you wish. Letters will be judged on the practical value of the ideas contained therein and the decision of the judges will be final. In case of ties, duplicate prizes will be awarded. All entries must be postmarked not later than midnight Dec. 31, 1944. Contest open to all except employees of Midwest Radio Corporation, their advertising agency, and members of their families. Winners will be notified on Jan. 31, 1945. Prizes will be awarded as follows:

First Prize . . . . $500 in War Bonds
Second Prize . . $200 in War Bonds
Third Prize . . . . $100 in War Bonds
and eight prizes of a $25 War Bond each.

Send your entry to Contest Editor at

MIDWEST RADIO CORP., Dept. 11-K, Cincinnati 2, O.

MIDWEST RADIO



Torture Test—DOUBLED!

The story of a transformer yanked back and forth from Pole to Equator

Men of the U. S. Army Signal Corps say that no matter where they run their lines, "It's either too hot or too cold." To make sure equipment can take it, the Corps runs the five-cycle humidity test.

They were giving this test to a Thermador transformer. They put it into a chamber, pressed a button to get the bleak 50° below. They pressed another button, the thermometer shot to the 197° of a blazing equatorial noon. Five times they raised and lowered the temperature. They watched, through the glass doors, water dripping onto the transformers—condensation.

After forty-eight hours they took an ice pick to get at the terminals.

They wiped them dry, connected the current, threw on the switch. If, after this torture, the transformer could take 2,000 volts it would pass the test. They gave it not 2,000 but 4,000 volts, doubling the test—and, of course, it took it!

BUY MORE WAR BONDS!

THERMADOR ELECTRICAL MANUFACTURING CO.
5119 South Riverside Drive • Los Angeles

THERMADOR TRANSFORMERS

DEFEAT HEAT COLD HUMIDITY

duce the hollow or boomy effect present in bass reflex cabinets. Its tonal quality was far superior to that usually obtained from home receivers.

The inside of the cabinet was lined with ⅜-inch sound-deadening material. This was used as it originally was thought to be quite necessary. However, after construction it was apparent that the use of this material could be reduced or possibly eliminated entirely. It may be well for the constructor to note the tonal quality of the reproducer before attempting to add the sound-deadening material. The final result might prove that better performance may be achieved if this material be eliminated. Many individuals may prefer a decided bass response for their particular choice; this effect would be gained if the sound-deadening material were eliminated.

The original idea for this type of reproducer was taken from a patent owned by William H. Hutter. The suggestion was made that the reproducer be used in a corner of a room with a 45-degree baffle directly above the speaker opening (top of the column) to reflect the sound waves horizontally across the room. This method is not suitable for use in a present-day home, as the baffle detracts from the appearance of the room.

By referring to the photograph, it will be noted that a novel method was used to reflect the sound waves. A conical-shaped 1/16-inch copper spinning was employed. This spinning, housing some type of plant, adds to the appearance of the unit. Sound waves emanating from the speaker are reflected horizontally across the room by this copper spinning. The cabinet then can be used in any location in the room. If no reflector of any sort was used, the sound would be projected towards the ceiling and an appreciable amount would thereby be absorbed. Inasmuch as this spinning would be difficult for any individual to construct, it might be well to draw up a sketch and have a local spinning company construct the unit for you. Any ornamental form may be used to house the spinning. It serves two purposes: mounting the spinning itself, and adding to the appearance of the unit.

In addition to the above, a 7½-watt, 110-volt blue bulb was mounted directly under the copper spinning. This blue light also adds appreciably to the final appearance of the unit. As another thought, to add to the attractiveness of the unit a color organ effect might be introduced, using three lights of various colors to blend with the particular tone being reproduced.

It is imperative that an amplifier of high quality be used. Most amplifiers are not designed to give the frequency range necessary and therefore your own construction of an amplifier with a definitely good output response between 70 and 14,000 cycles should be used. Present plans call for an article on such an amplifier to be published shortly in Radio News.

—30—

Manufacturers' Literature

Readers are asked to write directly to the manufacturer for the literature. By mentioning RADIO NEWS, the issue and page, and enclosing the proper amount, when indicated, delay will be prevented

TUBE STORY

The part that the electronic tube is playing in the war and some of the painstaking engineering that went into its development, is told in an attractively illustrated booklet, "It Was A Tube They Wanted" issued by *Amperex Electronic Products.*

Among the pictures and illustrations of some of the workings of electronic tubes, are many dealing with intricate and interesting plant operations. Precise small glass lathe operations, pre-evacuation processes, production testing, static and dynamic testing, and many other operations are described and illustrated.

The booklet is available to interested persons upon application to *Amperex Electronic Products,* 79 Washington Street, Brooklyn 1, New York.

"YOUR COMING RADIO"

A preview of the postwar radio is given to the public in a 28-page booklet made available by the *General Electric Company.*

Actual designs and information regarding the receiving sets which will come off of the production line are shown in some detail and the whole story of performance is told in non-technical language for the benefit of the prospective purchaser.

General Electric Company advises that a post card request addressed to the company at 1 River Road, Schenectady, New York, will bring your copy promptly.

DUMONT REPRINT AVAILABLE

A four-page article on the testing of photographic shutters, the measurement of flash bulb characteristics, and the calibration of diaphragms by means of the cathode-ray oscillagraph is available to the readers of Radio News upon request.

In this application, the oscillograph is used as a sensitive v.t.v.m. for measuring small d.c. or a.c. potentials on photocells. In combination with convenient photoelectric accessories, it is feasible to carry out a wide variety of light measurements.

The booklet, written by the engineering staff of the *Allen B. DuMont* Laboratories, is available upon request to the company at 2 Main Street, Passaic, New Jersey.

MICRO-SWITCHES

The general catalogue of the Micro-Switch Corporation contains information and engineering data on all types of micro-switches for industrial and electronic applications.

While the entire output of micro-switches is going to the armed services at the present time, the company will welcome inquiries from manufacturers whose postwar products will include one or more micro-switch applications.

The switches are manufactured in several types of construction for various applications and include bakelite, metal clad, explosion proof and splash proof types as well as those for aircraft and aircraft parts.

The catalogue will be forwarded to engineers and production men upon application to the *Micro-Switch Corporation,* Freeport, Illinois.

ALLIED'S BOOK GUIDE

As a guide to the newest and best literature on radio and electronics, the Allied Radio Corporation has published a small booklet listing the standard works in this field.

Listings cover the field from the simplest fundamentals to advanced practices for the beginner, student, radio amateur, instructor, and engineer. The catalogue is divided into various classifications so that a reader looking for a text or texts on u.h.f. can locate all the material available at Allied under the heading of u.h.f.

Copies of the booklet are available without charge from *Allied Radio Corporation,* 833 West Jackson Blvd., Chicago 7, Illinois.

INSTRUMENT FOLDER

A four-page folder giving information about several test instruments has been issued for general distribution by the *Superior Instruments Company.*

This folder describes the Model 710-volt-ohm-milliammeter, the Model 560 industrial analyzer, the Model 610-B megometer, and a new model voltage tester.

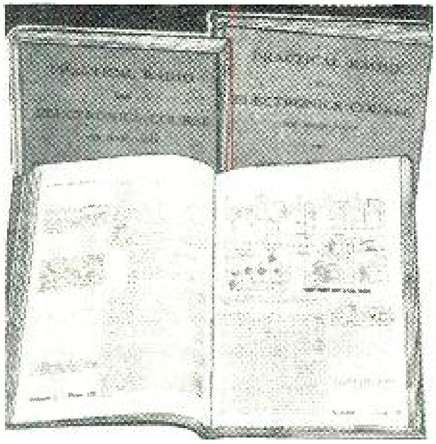
Engineering and performance data is furnished on each of the instruments described. All of the instruments covered are now currently available under a priority rating of AA-3 or better.

Persons interested in obtaining this folder should address their requests to *Superior Instruments Company,* Dept. N, 227 Fulton Street, New York 7, N. Y.

SCHOOL CATALOGUE

The postwar future of electronics has caused many persons to request information on how they can "get on the bandwagon."

In order to provide information on the educational facilities available, the *Midland Radio and Television Schools, Inc.,* have prepared an elaborate 48-page book printed in four colors telling



the part that the schools have played in training Army personnel as well as technically trained manpower for industry.

The school has outlined the various types of courses which are available in radio, electronics, and television. Copies of the catalogue will be forwarded to interested persons upon application to *Midland Radio and Television Schools, Inc.,* 17th and Wyandotte, Kansas City, Missouri.

RADIO COMPASS

The *Bendix Radio Division* has recently made available to the public a small booklet originally prepared for the company's employees, on the operation of the Radio compass.

The booklet is profusely illustrated with line drawings. The explanation of the operation of the compass is nontechnical and interesting. Various applications of this unit are explained, within certain limits, and the possibilities of its postwar uses briefly outlined.

Requests for this booklet should include the title of the publication, "The Radio Compass" Address requests to Technical Publications Section, *Bendix Radio Division of Bendix Aviation Corporation,* Baltimore 4, Maryland and a copy will be forwarded without charge.

SWITCH DATA

The selection of multicircuit switches for simultaneous control or independent or interconnected electrical circuits has been simplified by means of a new catalogue issued by *Metallic Arts Co.*

This catalogue, which has been designated the MACO-MP448, includes details of dimensions, circuits, and mechanical actions of the company's line of "Featherweight" switches.

Twenty standard spring and contact assemblies can be combined on the 3-ounce Maco high-impact frame to handle any desired number of circuits in a single switch.

The catalogue is free upon request to *Metallic Arts Company,* 243 Broadway, Cambridge, 39, Massachusetts.

RESISTOR GUIDE

A useful combination resistor guide and calendar is being offered by the *Madison Electrical Products Corporation* as long as the supply lasts.

The engineering data included on the calendar gives valuable information on wire-wound resistors.

There is no charge for the calendar and it may be secured by writing direct to *Madison Electrical Products Corporation,* Madison, New Jersey.

CANNON SOLENOIDS

A completely new bulletin covering d.c. solenoids has been issued by the *Cannon Electric Development Company.*

This 32-page bulletin contains photographs of the company's full line of d.c. solenoids, together with tabulated data, dimensional drawings, wiring diagrams, and response characteristic charts.

These units are especially applicable to aircraft installations as well as for film winding mechanisms and cameras.

A copy of this booklet will be forwarded upon request to *Cannon Electric Development Company,* 3209 Humboldt Street, Los Angeles, 31, California.

SOLAR CATALOGUE

An illustrated catalogue of the company's mica capacitor line has been issued by *Solar Manufacturing Corp.*

The capacitors illustrated and detailed in this bulletin meet the Army-Navy Specifications JAN-C-5 adopted April 20, 1944. The booklet is large sized with easy-to-read engineering data on several types of capacitors.

All tables given in the catalogue are simplified and the specifications cited are complete. On every page where receiving type micas are described, a detailed 6-dot color code is given.

A copy of this bound catalogue section is available to qualified persons upon request to *Solar Manufacturing Corporation,* 285 Madison Avenue, New York 17, N. Y.

FARNSWORTH RELEASE

The *Farnsworth Television and Radio Company* is at present distributing, upon request, their four-color booklet entitled "The Story of Electronic Television" to interested persons.

The subject of television has been reduced to everyday language in order that the layman may get a clear idea of what is involved in the successful transmission of pictures. The workings of the television camera is compared to the workings of the human eye, in order that the reader may grasp the principles involved. Similar familiar analogies are used throughout the booklet along with many colored photographs and diagrams.

A copy of this booklet will be sent to those requesting it from the *Farnsworth Television and Radio Company,* Fort Wayne 1, Indiana.

DATA SHEETS

The *Lampkin Laboratories* have recently issued a new booklet giving engineering data sheets for the company's micrometer frequency meter.

Specifications are given for the Type 103 and 105 meters, including a description of each unit, principles of operation, design and construction, and operating details.

Complete calibration charts and tables are included which provide an easy method for determining the meter's fundamental frequency for measuring any transmitter frequency from 100 kc. to 56 mc., and to interpolate between the dial readings entered in the standard calibration chart. The reverse calculations are easily obtained.

Copies of the booklet are available upon request to *Lampkin Laboratories, Bradenton, Florida.*

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SPOTS *before Your Eyes*

No, you are not suffering from astigmatism. The spots before your eyes on this page bring a clear view of things in store for CLARION RADIO dealers.

Features galore, soon to be announced to the public through national advertising, will be a sensation. They will answer one of the most critical merchandising problems that will face the radio dealer.

Get the complete CLARION story. Write for the name of the distributor in your territory. There is still time if you act TODAY.

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WORLDWIDE LOG OF SHORT-WAVE BROADCASTING STATIONS

(*Continued from page 55*)

11.948 **——** RADIO MOSCOW, MOSCOW, U.S.S.R. To North America, 6:48-7:25 p.m. (news at beginning of transmission). Also heard, 7:40-8:25 a.m. with an all-English program.

11.950 **——** RADIO MOSCOW, MOSCOW, U.S.S.R. Reported as heard beamed to North America, 8-11:30 p.m. daily. English news at 8, 9 p.m.; French news, 11:15 p.m.

11.955 **GVY** LONDON, ENGLAND (BBC). To Northern Germany and Poland, 4:30-7:15 a.m.; 11:15 p.m.-9:30 a.m. (Special Clandestine Press, 5:45-6 a.m.). To Southeastern Europe, 12 noon-12:15 p.m. To Middle East, 5:30-5:45 a.m. To Northern Germany and Poland, 7-7:15 a.m. (French).

11.970 **FZI** RADIO BRAZZAVILLE, BRAZZAVILLE, FRENCH EQUATORIAL AFRICA. Heard irregularly afternoons and evenings. Reported 12 noon to 8:45 p.m. and 1-2:15 a.m. Free French news bulletins in English, 7:25 p.m. Heard at 3 a.m. in French. Identification, "Ici Radio Brazzaville."

12.040 **GRV** LONDON, ENGLAND (BBC). To Australia, 1-5 a.m. To Japan and Northern China, 7-7:30 a.m. To Indonesia and Southern China, 8:45-11 a.m. To India, Burma, and Malaya, 11:15-11:45 a.m. (English). To Iran, 12 noon-12:30 p.m. (Persian). To Near East, 12:30-12:45 p.m. (Turkish). To Near East and Arabia, 12:45-2:15 p.m. To Cyprus, Malta, and Gibraltar, 2:30-3:15 p.m. To South America, 6-9:30 p.m. (Latin American Service).

12.095 **GRF** LONDON, ENGLAND (BBC). To Italy and Central Mediterranean, 6 a.m.-1:45 p.m. To Central America, 7-9:30 p.m. (Latin American Service).

12.115 **ZNR** ADEN ARABIA. Heard, 12:12-1:16 p.m.

12.120 **——** "RADIO FRANCE" ALGIERS. Heard occasionally about 4 p.m., transmitting in French. Also reported as signing on at 12 p.m.

12.130 **DZE** BERLIN, GERMANY. Heard with news in English at 3 p.m. Schedule, 8:30 a.m.-5 p.m. (Also reported as heard 4-7:30 p.m. with Latin American program.)

12.445 **HCJB** QUITO, ECUADOR. 6:30 a.m. 11 p.m., generally. Broadcasts in 13 languages, including English. Programs are of a religious character.

12.967 **WKRD** NEW YORK, N. Y. European beam, 3:30-3:45 p.m. and 4:45-5 p.m.

13.130 **——** KHABAROVSK, SIBERIA, U.S.S.R. Not heard regularly, but when on is heard between 2 and 4 a.m. All-native language. Signs off at 4 a.m. with music. Woman announces.

13.250 **ICD** "SOMEWHERE IN ITALY." Relays APHF ("Advance Press Headquarters Forward" in Rome) daily at approximately 7:50-9 a.m. and 6:30-7:30 p.m. to the networks in the U. S.

15.070 **GWC** LONDON, ENGLAND (BBC). To various countries in Europe, 4 a.m.-4:45 p.m.

15.110 **DJL** BERLIN, GERMANY. English news beamed on Africa is heard at 11:30-11:45 a.m. Gives prisoner-of-war messages. Signs off at 12 noon.

15.110 **——** RADIO MOSCOW, MOSCOW, U.S.S.R. To North America, 6:48-7:25 p.m. (news at beginning of broadcast).

15.120 **DXH2** BERLIN, GERMANY. 9-11 a.m.

15.130 **DXL6** BERLIN, GERMANY. Latin American program from Germany is being heard, 5-7:30 p.m.

15.130 **WRUS** BOSTON, MASSACHUSETTS. European beam, 10:45-11 a.m. and 3:30-3:45 p.m.

15.140 **GSF** LONDON, ENGLAND (BBC). To Near and Middle East and East Africa, 1 a.m.-3 p.m. To West Africa, 11:15 a.m.-4 p.m.

15.150 **WNBI** NEW YORK, N. Y. European beam, 7:45 a.m.-3:30 p.m.

15.150 **WRCA** NEW YORK, N. Y. Beamed to Brazil, 5-7:45 p.m. (Portuguese).

15.155 **SBT** STOCKHOLM, SWEDEN. North American beam in English, 11-11:55 a.m. Off at 12 noon. On again at 1 p.m. in German; closes down at 2:10 p.m. Signs off with ringing of many church bells.

15.160 **JZK** TOKYO, JAPAN. To North America, 11 a.m.-2:40 p.m. News on the hour. To North America, 6:15-8:15 p.m. News, 6:20 and 7:20 p.m. Also heard, 11 p.m.-4 a.m. Prisoner-of-war messages are given during all news periods.

15.160 **VLG7** MELBOURNE, AUSTRALIA. Reported heard, 5 p.m.-6 or 6:10 p.m

15.180 **GSO** LONDON, ENGLAND (BBC). To West Indies and Central America, 12-12:15 p.m. (African Service).

15.180 **GWO** LONDON, ENGLAND (BBC). To India, Ceylon, Burma, and Malaya, 1-4 a.m. and 6:30-11:45 a.m.

15.190 **CBFZ** MONTREAL, QUEBEC, CANADA. (CBC). (Not in operation at present.) (7,500 w.)

15.190 **WOOC** NEW YORK, N. Y. European beam, 10:45-11:15 a.m. and 2:45-3 p.m.

15.200 **DJB** BERLIN, GERMANY. A daily German transmission is heard over the German Home, Overseas, and Danish networks, beginning at 12 noon.

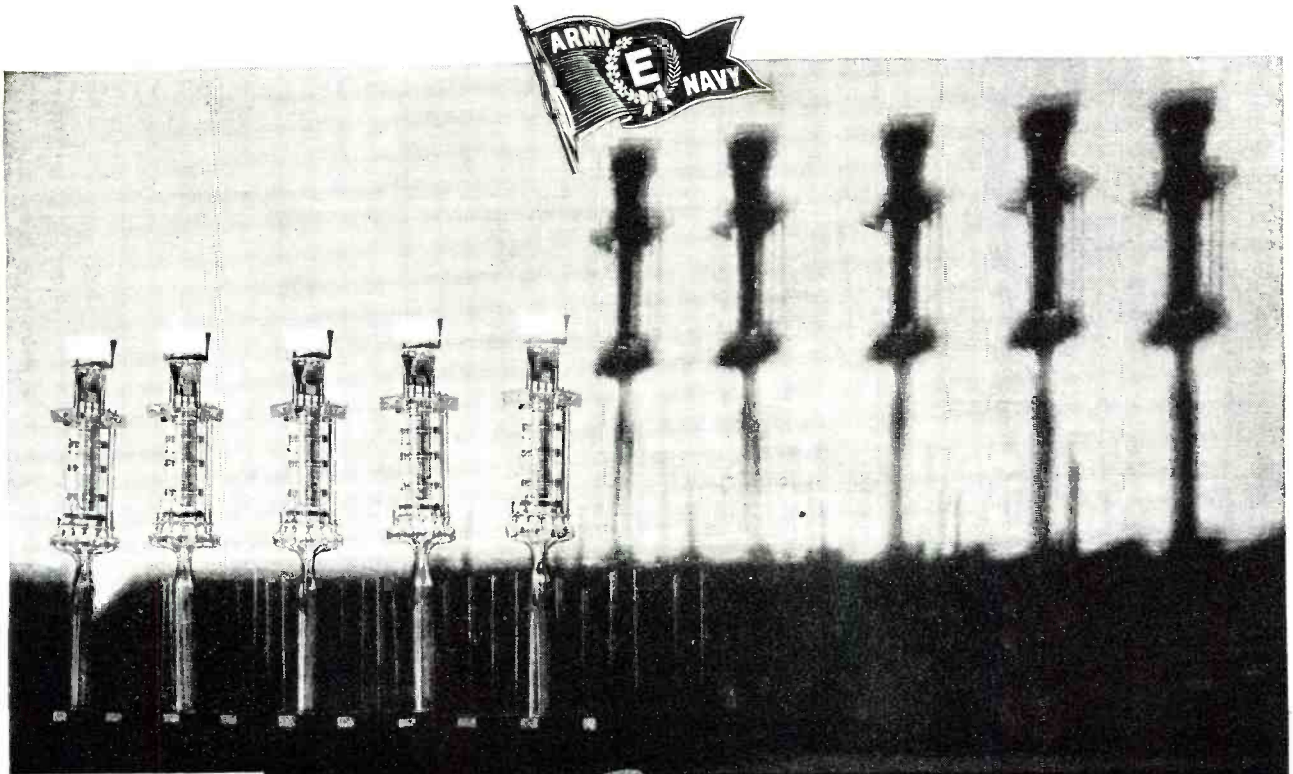
15.200 **——** "THE VOICE OF FREE INDIA." Reported heard, 11:30 a.m. Comes through with great volume at times, but is extremely erratic.

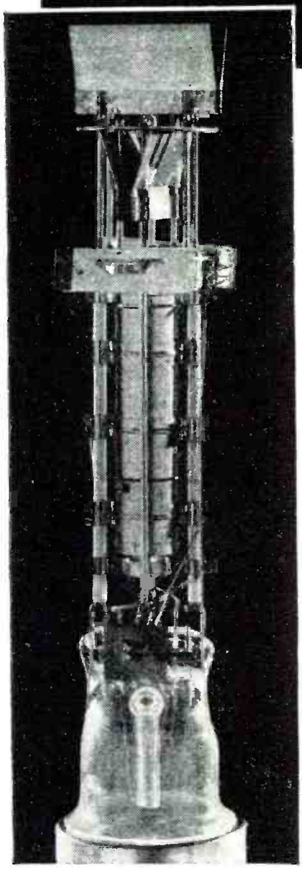
15.210 **WBOS** BOSTON, MASSACHUSETTS. Westinghouse Stations, Inc. Eastern South American beam, 5:30-8:15 p.m. (Spanish-Portuguese).

15.220 **——** NATIONAL CONGRESS RADIO (INDIA?). Reported heard from 12:15-12:50 p.m.

15.225 **JLT3** TOKYO, JAPAN. Heard 11 p.m.-4 a.m. To North America, 6:15-8:15 p.m. daily. News, 6:20 and 7:20 p.m. Prisoner-of-war messages are given during each news period.

(*Continued on page 120*)





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➧ Recently the Army-Navy "E" for production excellence was awarded to Allen B. DuMont Laboratories, Inc. In accepting this high honor, Allen B. DuMont said in part:

"Originally the Navy 'E' went to that ship scoring outstanding marksmanship. Today that 'E' again reverts to its original meaning. We of the DuMont organization make *electronic guns*. Each cathode-ray tube contains an electronic gun. We make those guns as accurately as our skill, ingenuity and conscientious inspection can make them. Thus I hope that our 'E' is the direct result of good electronic marksmanship, as reflected by the reports from various battlefronts."

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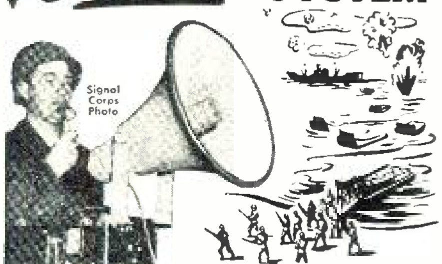


WORLDWIDE LOG OF SHORT-WAVE BROADCASTING STATIONS

(Continued from page 118)

15.225 "THE VOICE OF FREE INDIA."
—— Claims to be broadcasting from "right under the noses of the English in India." Heard, 11:30 a.m.-12:05 p.m. The entire transmission in English commentary of an anti-Allied flavor. Before the sign-off, the announcer reads a "code" message—this is a series cf numerals and letters. An anti-British poem follows, then music, and the sign-off.

15.230 MELBOURNE, AUSTRALIA.
VLG6 Australian Broadcasting Corporation. Beamed to Forces in Northern Australia, 10-10:30 p.m. (English).

15.250 CINCINNATI, OHIO. The Cros-
***WLWK** ley Corporation. Latin American beam, 5:30-8:15 p.m. European beam, 8:15 a.m.-5:15 p.m. English news, 9, 10, 11:45 a.m., 1, 2, 3, 4, and 5 p.m.

15.260 LONDON, ENGLAND (BBC). Tc
GSI Central and South Africa, 11:30-5 p.m. (African Service). To Iran, 6:30-6:45 a.m. (Persian). To Near East, 6:45-7 a.m. (Arabic and Turkish). To Near East, 8:15-8:30 (Arabic and Turkish). Tc Near and Middle East, 7-8 a.m. To Near East, 9:45-10 a.m.

15.270 NEW YORK, N. Y. European
WCBX beam, 7-7:30 a.m., 1-1:15 p.m., 3:15-3:45 p.m.

15.290 SAN FRANCISCO, CALIF. Gen-
KGEI eral Electric Co. Latin American beam, 5 p.m.-12:45 a.m. (English). News or commentary every hour on the hour. (The United Network, Fairmont Hotel.)

15.290 SAN FRANCISCO, CALIF. Gen-
KGEX eral Electric Co. Latin American beam, 11 a.m.-5 p.m. (English). News or commentary every hour on the hour. (The United Network, Fairmont Hotel.)

15.300 LONDON, ENGLAND (BBC). Tc
GWR South America, 12-12:15 p.m. (African Service); also, 7-7:30 a.m.

15.315 SHEPPARTON, AUSTRALIA
VLC4 Australian Broadcasting Corporation. Beamed to Western North America, 1:10-1:40 a.m. News, 1:10 a.m.

15.320 SYDNEY, AUSTRALIA. Aus-
VLI3 tralian Broadcasting Corporation. Beamed to Asia, 6:15-7:45 a.m. (Chinese, English, Malay, Dutch). Beamed tc Asia, 7:45-9 a.m. (Malay, English).

15.330 HSINKING, MANCHUKUO. 1-3
MTCY a.m., and 4-5 a.m. News, 1:30 and 2:30 a.m.

15.330 SCHENECTADY, NEW YORK
WGEO General Electric Co. European beam, 1:45-2 p.m. and 2:15-3 p.m. and 4:30-5:15 p.m.

15.420 LONDON, ENGLAND (BBC). Tc
GWD Australia, 1-5 a.m. Tc India, Indonesia, and Southern China, 7-7:45 a.m. (Eastern Languages). To India and Indonesia, 7:45-8:30 a.m. (English). Tc India, Burma, and Malaya, 8:45-11 a.m. (Eastern Languages). Tc India, Burma, and Malaya, 11-11:15 (English news). India, Burma, and Malaya, 11:15-11:45 (English). Tc North Africa, 1-2:15 p.m. (Arabic and Turkish). Tc France and Spain, 12:30-1 p.m.

15.435 LONDON, ENGLAND (BBC). To
GWE Iraq and Iran, 6-11 a.m. To Central America, 11:30 a.m.-12 noon (Latin American Service). To Central America and South America (North of Amazon), 12-12:30 p.m.

15.450 LONDON, ENGLAND (BBC). To
GRD Central and South Africa, 11:15 a.m.-1:45 p.m., and 1:45-3:15 a.m.

16.025 ALLIED FORCES HEADQUAR-
AFHQ TERS, ALGIERS. Heard irregularly in the morning, with pickups for the networks, usually between 7-9 a.m., sometimes to 12 noon.

17.700 LONDON, ENGLAND (BBC). To
GVP Mediterranean, 6:45-7 p.m. To Central and South Africa, Madagascar, and Belgian Congo, 5-6:45 a.m. and 7-9:30 a.m. To Central and South Africa and Madagascar, 10:30 a.m.-12:15 p.m. To Central and South Africa, 7-7:15 a.m. To Central and South Africa, and Belgian Congo, 7:15-8 a.m. To Madagascar, 11:30-11:45 a.m.

17.750 BOSTON, MASSACHUSETTS.
WRUW European beam, 10:45-11 a.m.

17.760 SAN FRANCISCO, CALIF. As-
KWID sociated Broadcasters. Latin American beam, 4 p.m.-7:45 p.m. (English). News or commentary every hour on the hour. (The United Network, Fairmont Hotel.)

17.760 SAN FRANCISCO, CALIF. As
KWIX sociated Broadcasters. Latin American beam, 11 a.m.-4 p.m. (English). News or commentary every hour on the hour. (The United Network, Fairmont Hotel).

17.780 NEW YORK, N. Y. European
WRCA beam, 10 a.m.-2:45 p.m.

17.790 LONDON, ENGLAND (BBC). To
GSG India, Burma, and Malaya, 7-7:45 a.m. (Eastern Languages). To India, Burma, and Malaya, 7:45-8:30 (English). Tc India, Burma, and Malaya, 8:45-10:45 a.m. (Eastern Languages).

17.800 SYDNEY, AUSTRALIA. Aus-
VLI8 tralian Broadcasting Corporation. Used irregularly.

17.800 CINCINNATI, OHIO. The Cros-
WLWO ley Corporation. Latin American beam, 5:30-6:45 p.m. (Spanish-Portuguese). European beam, 8 a.m.-2:30 p.m. English news, 9, 10, 11:45 a.m.; 1, 2 p.m.

17.810 LONDON, ENGLAND (BBC). To
GSV India, Ceylon, Burma, and Malaya, 3:30-10:30 a.m. To Central and South Africa, 6-11:15 a.m. To West Africa, 6-11:15 a.m.

17.870 LONDON, ENGLAND (BBC). To
GRP Central and South Africa, 11:30-1 p.m. To Africa (generally including Angola and Mozambique), 7:45-8:45 a.m.

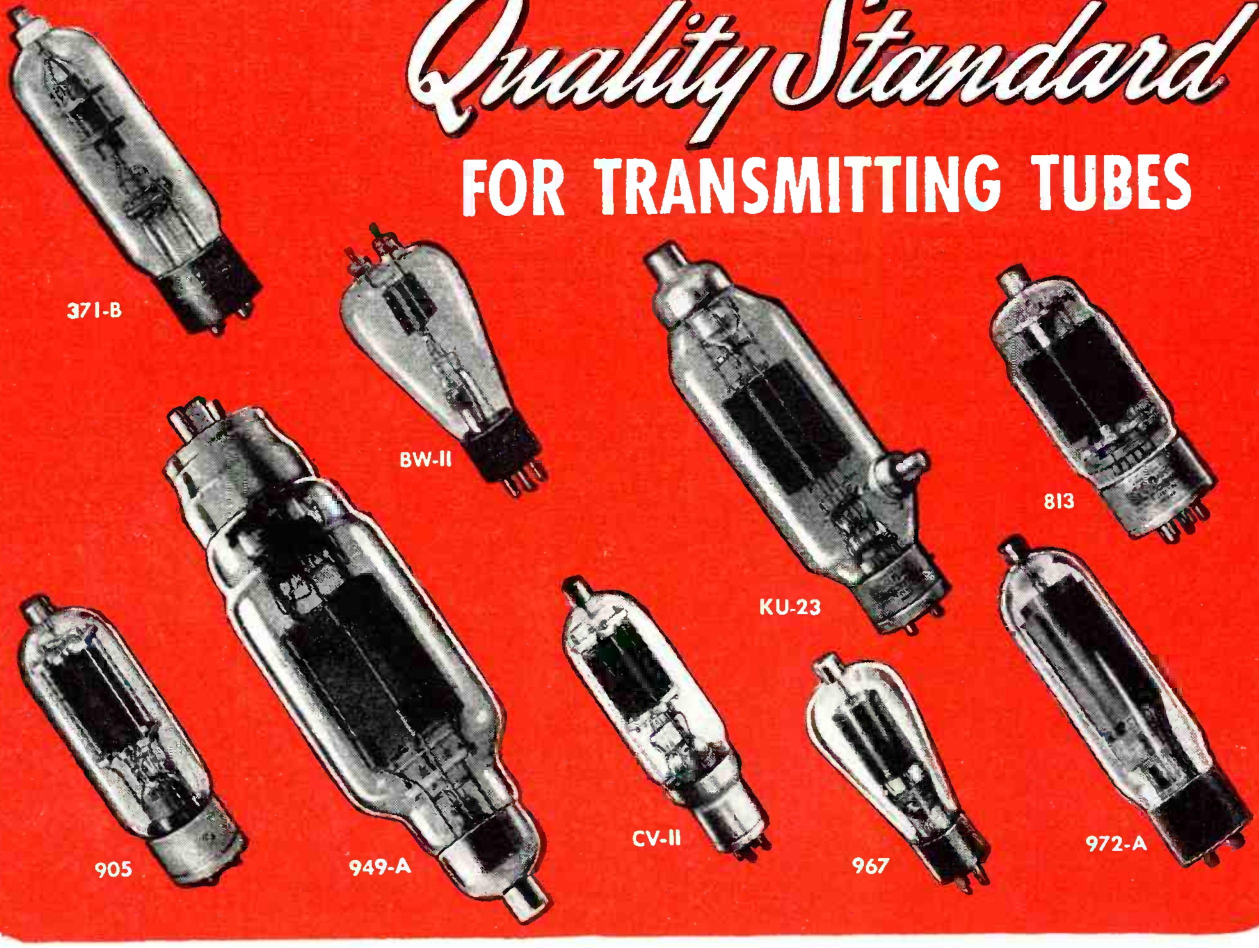
17.980 KAHUKU, HAWAII. On for the
KHE Army Hour, WEAF network feature, heard every Sunday from 3:30-4:30 p.m. EWT; relays all islands in the South Pacific but not the continent of Australia.

18.025 LONDON, ENGLAND (BBC). To
GRQ South America, 11:30 a.m.-12 noon (Latin American Service). To South America (South of Amazon), 12-12:30 p.m.

21.470 LONDON, ENGLAND (BBC). To
—— Central and South Africa, 6-11:15 a.m.

Casting the International Meter Rods in Paris 1874. The degree of accuracy attained 1/10,000,000 of a quadrant of a terrestrial meridian.

WHO SETS THE *Quality Standard* FOR TRANSMITTING TUBES



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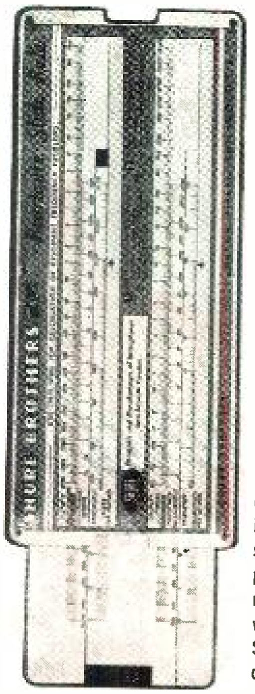


Training in the C.A.P.

(*Continued from page* 47)

beam. A fresh sheet of paper is set up for each student and the direction of the range courses altered each time.

This is a device for automatically transmitting over an amplifying system, the "A" and "N" range signals. These are actuated by a motor-driven pair of cams, the motor being a 33⅓-r.p.m., phono-motor with the governor and turntable removed. The speed of rotation of the cams should be about 60 r.p.m. so that one "A" or "N" character is transmitted each second, this being the actual transmission speed of airways range signals. A 78-r.p.m. motor can be fudged down to 60 r.p.m. if it has a speed regulator. If the motor has a constant speed of 78 r.p.m. it can be left at this speed since the "A" and "N" characters even at this speed are plenty slow. As seen from the photograph and from Fig. 3, there are two identical cams cut so as to each provide one dot, one dot-space, one dash and one dash-space. These cams are mounted back to back with a spacer between them and so aligned that the dot of one cam is lined up with the dot-space of the other. The cams, therefore, become so interlaced that one switch or the other is riding on a lobe. Each cam works against the lever of a "micro" or "mu" type switch.

RADIODDITIES

There is a class of electron tubes with liquid cathodes.

The terms *anode* and *cathode* do not literally signify "in" and "out," as most radio men are inclined to believe, but actually mean "up" and "down."

Only 25 percent of the numerous metal receiving tubes make use of all eight base pins.

There are some old-timers among electrical apparatus. For instance, the electric current was discovered 157 years ago; the electric battery is 144 years old; rubber-covered wire, 131 years; and the electromagnet, 118 years.

The harmonica is said to have been invented by Sir Charles Wheatstone of Wheatstone Bridge fame.

Insolation is the treatment of disease by means of sun baths.

A chap named *Watts* won a radio training course offered by superpowered WLW.

DB oil (name has no connection with radio terms) is used in manufacturing radio condensers.

As seen from the circuit diagram, Fig. 2, the "A" and "N" switching is done in the output circuit of the amplifier. Attempts to provide this switching in the input circuit proved difficult, due chiefly to loud contact "thumping" with each make and break of the circuit. This was most evident when the two signals were balanced for uniform output, simulating the continuous on-course tone. This was also partly the case even with the switching arranged in the output line. Because of slight overlap of the cam-switches, momentarily closing both contacts, there is a loud thump or click, which prevents a clean, continuous tone. This was remedied by the 100-ohm resistors shown across each switch contact. These resistors serve two purposes: first, they help to remove contact thump due to current surges on breaks; and secondly, they provide a faint signal on the open contact which corresponds to the opposite quadrant signal. Thus, this system will closely approximate the real range signals since, except when flying through the center of a quadrant, a very faint background can be heard if the receiver volume is turned up, and becomes slowly louder as the beam is approached. If some contact thump persists on the continuous tone, the resistors shunting the switch contacts may be reduced to about 50 ohms. This will effectively clean up the steady signal, but has the disadvantage that the background tone on the open contact, described above, becomes louder, and may be present when a strong "A" or "N" is required such as when flying down the quadrant bisector.

The "A-N" fader is self-evident. This is a 200-ohm wirewound potentiometer of 10 to 25 watts capacity. This type of control is linear wound and has the disadvantage that its adjustment is very broad over the center area which corresponds to the on-course steady signal. This is because the ear's perception of loudness follows a logarithmic scale. To be perfect, this control should have a logarithmic taper each side, away from center. (No such unit is commercially available). However, this is not a serious objection, in fact its wide adjustment through the on-course signal, makes it possible to quickly and easily find that fine-feathered edge to the right of the center of the beam, a traffic regulation which all good pilots observe.

The resistance of the "A-N" fader is not critical, but by making it large compared to the output impedance of the circuit, attenuation of the signal not wanted results from the large amount of series resistance it presents to the signal from the opposite quadrant. That is, suppose we wish to indicate a signal when the plane is in the "A" quardant, but not in the center of the quadrant, as in the case of plane 2 in Fig. 1. In this case, the "A" signal will be very distinct with the "N" signal only weakly audible. In this situation the fader arm is moved to the "A" end of the potentiometer but not to the extreme end. There should be about 10 ohms of resistance left between the "A" end and the arm, leaving 190 ohms between the arm and the "N" end. This is a voltage division of 1 to 19, or expressed

The motor and cam unit dismantled. Because in this case a 33⅓ r.p.m. phonograph motor happened to be available, it was utilized by removing the governor and altering the field current in order to bring the speed up to 60 r.p.m. A standard speed motor of 78 r.p.m. should preferably be used. The switches on the right are two mu switches with type V actuator lever. They are fastened to a mounting plate which is screwed to the motor casting.

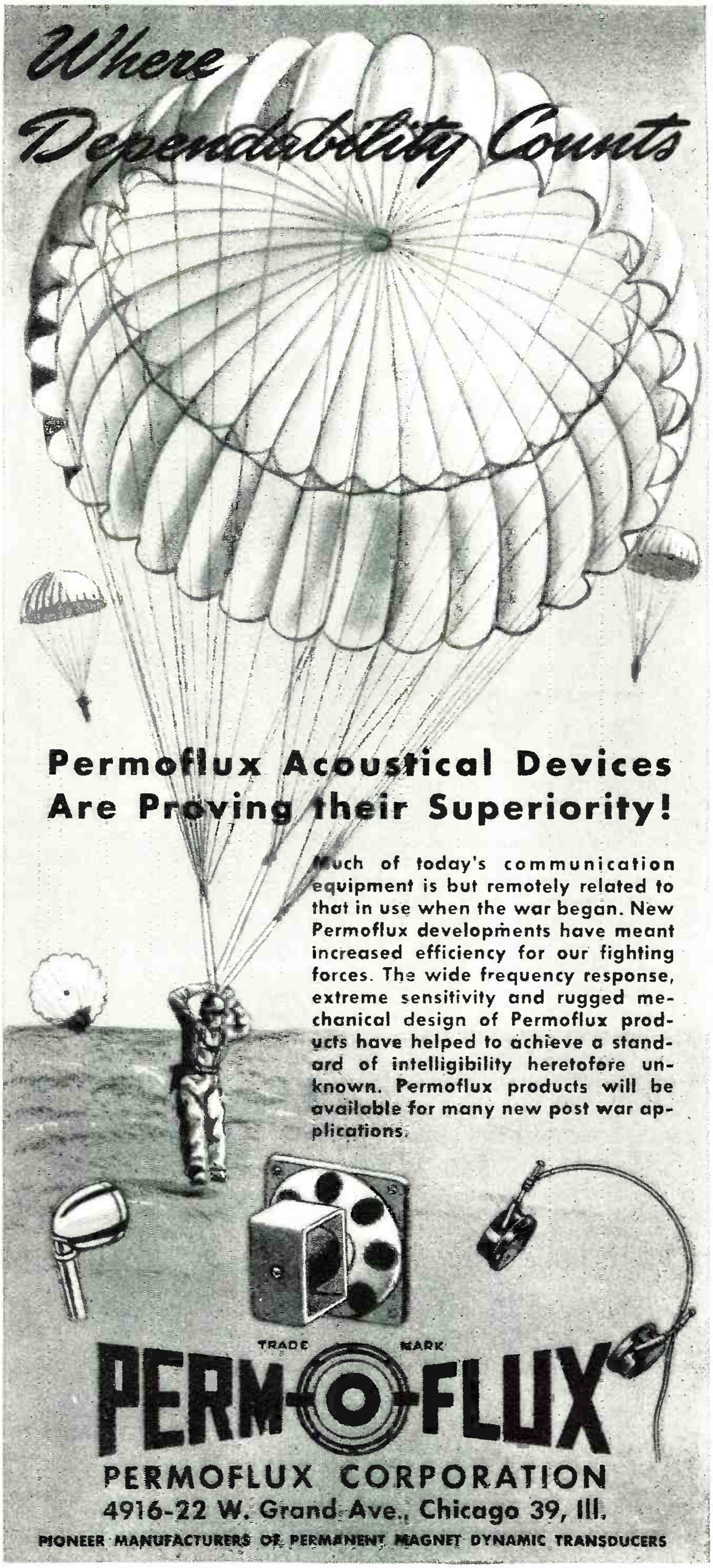
in terms of loudness, the "N" signal will be about 25 decibels weaker than the "A" signal; the "N" is faintly audible by straining the ears. This is about the correct level relationship for the position of the plane, number 2.

The volume control is a conventional "T" pad designed for a 15- or 8-ohm line, depending upon the voice-coil impedance of the loudspeaker. The only time it should be turned on full is when our hypothetical plane is close to the station on the edge of the cone of silence. As the station is actually crossed, the volume is quickly reduced to zero. The instructor operating the control box must clearly understand that the correct application of the volume control is as important as the "A-N" fader. The increase or decrease of the volume level indicates to the student whether he is approaching or receding from the station, and this is judged from the general volume intensity, independently from the "A-N" relationship.

The entire class watches the student's performance, and as he finally gets onto the beam and approaches the station, the increasing volume level raises the tension of the observers in the classroom.

The equipment constructed by the writer and shown in the accompanying photographs is very compact in design. The amplifier, oscillator, motor, cams and loudspeaker are all enclosed in a single case. The control box containing the volume control and fader are installed in a separate small box and connected to the main unit through 25 feet of flexible cable. The 1000-cycle tone is provided by rewiring the usual input stage of the amplifier to act as a regenerative feedback oscillator with values of capacity and resistance to oscillate at about 1000 cycles, which is close to the audio-frequency tone of the radio range signals (actually 1020 cycles). It is not necessary here to go into a discussion of oscillator or amplifier design as anyone attempting to construct this device should have such basic knowledge, and besides there is today a surfeit of published data on oscillators and amplifiers.

—30—



• • • • • LETTERS • • • • •

FROM OUR READERS

SUGGESTED ARTICLES

“I SHOULD like you to know of my hearty approval of your publishing articles that deal with electronics aside from radio. For example, the articles in the June issue entitled ‘Colorimetry’ and ‘Electronics in Medical Science’ are of the type.

“While I am interested in radio, I am also greatly interested in the application of electronics to other fields, including photography. I believe that a paper concerning the construction of a phototube and a photocell exposure meter would be of wide interest, especially if applied to general indoor, and photomicrography and projection printing.”

Sincerely,
Dr. G. H. Klinik, Jr.,
Samaritan Hospital,
Troy, New York.

May we suggest that Dr. Klinik read Mr. Albert A. Shurkus' article “Radiometric Elements” in the July, 1944 issue of Radio News *for a starter?*

* * *

POSTWAR DUMPING

“IN YOUR January edition of Radio News, an item in your column entitled ‘For the Record’ came to my attention. A reference was made to the radio equipment now in use by the Armed Forces. Quote, ‘We have found that one of the worst things that could happen after the war is won would be to have huge supplies of equipment returned and dumped on our shores where it would be sold to every Tom, Dick and Harry at ridiculously low prices. This happened at the end of the last war. It must not happen again.’

“I hope that this does not mean that these costly and much needed pieces of equipment should be destroyed. Such a move in a supposedly civilized country would be unheard of.

“Almost as bad, they might be bought by a few large concerns for a lump sum and resold at fabulous prices.

“I know of no country which would allow such stupidity, radio manufacturers or no radio manufacturers.

“It is my belief that if these radios and test instruments were made available to every ‘Tom, Dick and Harry’ at reasonable prices, instead of being detrimental to the radio industry, it would tend to warrant new equipment of the same nature and more of modern design, as the present types will soon be obsolete.

“Also, I feel that every effort should be made to increase the interest in the radio field. I can see no reason for concern on the part of the manufacturer, instead business should be better than before ‘Pearl Harbor.’

“I enjoy Radio News very much and look forward to every issue, keep up the good work.”

Pfc. Robert H. Anderson,
Burma Theatre.

If returning equipment is sold at decent prices—there will be no trouble—but will it? Time will tell.

* * *

MORE ON SCREWDRIVER MECHANICS

“. . . JUST because a man takes a test and passes his theory with high marks, doesn't mean that he will be a good repairman. That has been proven time and time again: good on theory—but a poor mechanic.

“If exams are to be required, the man should be given a test of theory of operation on radio receiving sets, phono operation, and he should have a fairly good maintenance background of television and FM. After all, experience is the best teacher.

“At the present there are a lot of bootleg repairs at so-called low prices. There is plenty of overcharging too. Much of the blame goes to the big chain stores who employ servicemen. They are the biggest offenders in radio servicing. They offer some ‘special’ in repair work and the final outcome is that the customer pays double. The so-called fifty-cent call giving a complete check and some minor repairs is an impossible situation.

“A fair plan to everyone when this mess is over might include:

1. Every town have standard of cooperation regarding standard prices for standard repairs.
2. Biweekly meetings should be held and complete checks made to check on shop participation in the standardization.
3. Monthly classes on new developments and a review of theory and other discussions.
4. The establishment of standard working hours for all shops to give the serviceman better working conditions.
5. Establish fixed penalties for shops violating the service rate code.
6. Provide help and assist servicemen who are losing out because of difficult service problems or lack of information.

“This plan is as good as can be expected—the trouble with radio servicemen is that they don't stick together.

“If a license plan is adopted, it should be an exam dealing solely with the field of radio servicing. I am not as fortunate as you, Mr. Berger. Yes, there are lots of us in the same position, too.”

S/Sgt. Leo A. Midi
Somewhere Overseas

“AFTER being shipped from France to England because of a wound I received at the front, I find myself sitting up in bed, which gives me time to catch up on my reading. To my surprise I found they have copies of Radio News which was my favorite magazine back in the states.

“Your technical information is what I like about it, but I wish to express my opinion on ‘Screwdriver Mechanics’ in answer to Mr. Berger in the ‘Letters from Our Readers.’

“He seems to think that the screwdriver mechanic is the jinx to radio repair work, and that something should be done to knock them out of their so-called business, by licensing all repairmen.

“Mr. Berger should bear in mind that all people won't care whether the repairman is licensed or not, they only want their radios fixed.

“Wholesale houses and manufacturers will sell parts to anyone—which is why they are in business. Thus, the screwdriver mechanic still can operate; he won't have to advertise—he will get customers without that advantage.

“Besides, a screwdriver mechanic is the guy who helps the poor people out, the people whose only recreation is a radio. When a poor man's radio goes on the blink, the S.M. fixes it for approximately 75% of the charge made by the “richman's radio repairman.” This is the reason we soldiers let our buddy S.M. fix our radios instead of taking them into town. There is room for all, why cut your buddy's throat.”

S/Sgt. Johnny Meyers
Somewhere in England

“I WAS fortunate enough to acquire a copy of Radio News for August, 1944, and the contents were to me like a letter from home.

“I would like to comment on a letter sent in to you by Samuel Berger of Eatontown, New Jersey.

“I am an administrative N.C.O. in the Air Forces in Italy and have been doing administrative work for the army for nearly four years. In my spare time (I have little), I have been studying radio and television with the N.R.I. I never repaired a radio, never worked on any but my own, and theory is my sole knowledge of radio at the present. I've studied hard for two years under trying conditions and I'm still studying. Mr. Berger is in favor of every radio technician having a test, and if possible obtaining a license. Although, I doubt if I could pass such a test on theory alone, I agree 100% with Mr. Berger.

“Thousands of men to be released by the army who attended radio school will pry into that field as so-called screwdriver mechanics. Most of these men are taught the army way and with what they were taught will try to enter into something larger than they were prepared to cope with.

“I hope to attend a recognized radio school after the war to acquire my practical experience, and when finished, I want to be able to have something in return for the hundreds of hours I studied and the many nights I remained in camp to get ahead a little faster.

“Screwdriver mechanics are similar

to many amateur photographers; they profit by fooling the public, not satisfying them.

"I may never get a license to be a radio technician, but I still say, give the guys that sweat blood to acquire the necessary know-how to be a good radio technician a chance to reap something for his efforts. This will benefit these men and you must agree with me, it will benefit the public.

"More power to you, Mr. Berger, I hope you win your point and it becomes a reality, giving the man that studies for years a chance to earn a living wage."

S/Sgt. Frank G. Brockerman
Somewhere in Italy

The pros and cons are still pouring in. All ideas on the subject are very welcome and we hope that someday some agreement will be reached.

* * *

CONSTRUCTION ARTICLES

"YOUR October issue is much better than some. What I refer to is the article on 'Noise Supression on Small Boats,' by H. B. Davis.

"Of several readers hereabouts, they say fine! What they also hope for is some construction articles and although many of us do not have the parts or equipment to construct at this time, some have and so we all like to read about the 'darned things.'

"What say? Well, I do not want to suggest the unfeasible, but here's hoping."

Henry A. Sherwood
Bridgeport, Conn.

"P.S. This letter is a compliment, not intended to be a criticism."

Thank you for the bouquet, Mr. Sherwood. We have scheduled many construction articles for forthcoming issues which should interest you and your fellow readers.

* * *

REQUEST

"WE have enjoyed RADIO NEWS a lot, especially the articles on utilities, such as the ones written by Mr. Turner.

"So far, we haven't come across anything regarding direct-reading electronic frequency or deviation meters. If you put some articles in the future issues pertaining to those subjects, we will certainly be appreciative."

Very truly yours,
Some of your Readers

A frequency-deviation meter for broadcast use appears in this issue. Your other request will be fulfilled shortly, as another article is being planned for a forthcoming issue.

* * *

"YOU had a splendid cover on the September issue, but the chap sitting in the chair unfortunately appears to be asleep."

A Reader
Hartford, Conn.

This will make the instructor very unhappy — unless the "chap" thinks better with his eyes closed.

—30—

Approach Control

(Continued from page 27)

cedures and method of operation, it was recommended by this conference that approach control be inaugurated on a trial basis for LaGuardia Field, New York. After the trial at New York and based on experience at that location, it was agreed that consideration then would be given to the matter of possible further expansion of these procedures to other locations.

During the summer and fall of 1940, approach control was operated at New York by Civil Aeronautics Administration airway traffic control personnel in the LaGuardia control tower. Various communication channels were used, including the low frequency transmitter of the control tower, the voice channel on the Civil Aeronautics Administration radio range serving LaGuardia Field and a 75 megacycle transmitter, transmissions from the latter being received by aircraft over the regular receiver installed for 75 megacycle marker reception.

None of these channels proved satisfactory, and further trial of approach control procedures at LaGuardia Field was temporarily discontinued during the winter of 1940-1941. However, by the spring of 1941, each air carrier company using LaGuardia Field had made arrangements to provide a transmitter on one of its assigned high frequency channels which could be used by the approach controllers in communicating with the various air carrier aircraft. This resulted in tying five high frequency transmitters together so that the approach controller could talk over all five at once, or over any one or a combination of transmitters, as desired. It was soon found, however, that this arrangement was not satisfactory due to considerable interference with other transmitters of the air carriers at different locations using the same frequency, and this plan of communication subsequently was abandoned.

The next plan for approach control at LaGuardia Field was placed in operation during the latter part of 1941 and remained in effect for the first part of 1942. This plan involved the use of a transmitter operating on 3117.5 kilocycles for transmission to all air carrier aircraft using LaGuardia Field. By that time, air carrier aircraft had been equipped to receive on this frequency as it had been assigned for their use as an air to ground channel.

The tests of approach control using this communication channel were highly satisfactory and resulted in cutting delays to aircraft arriving and departing at LaGuardia to ⅓ of what they formerly were. By the summer of 1942, everyone having experience with approach control at LaGuardia Field agreed that it was definitely worthwhile and an essential improvement in the air traffic control service.

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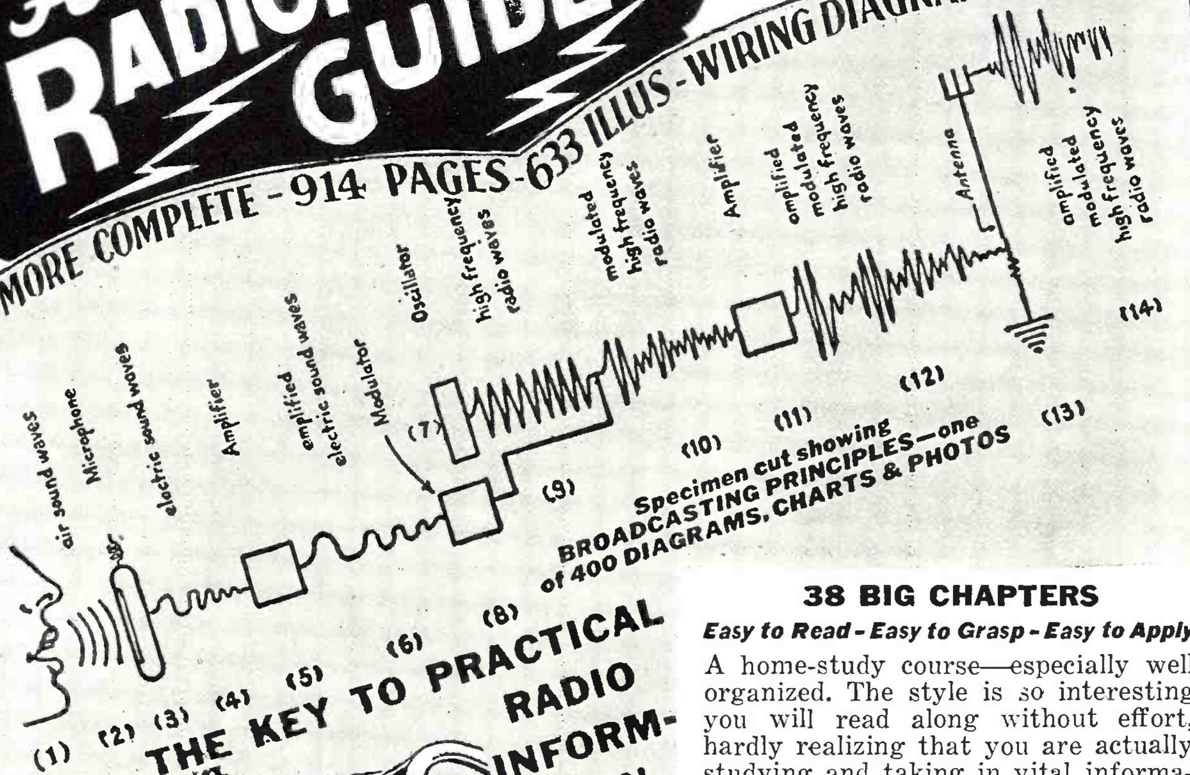

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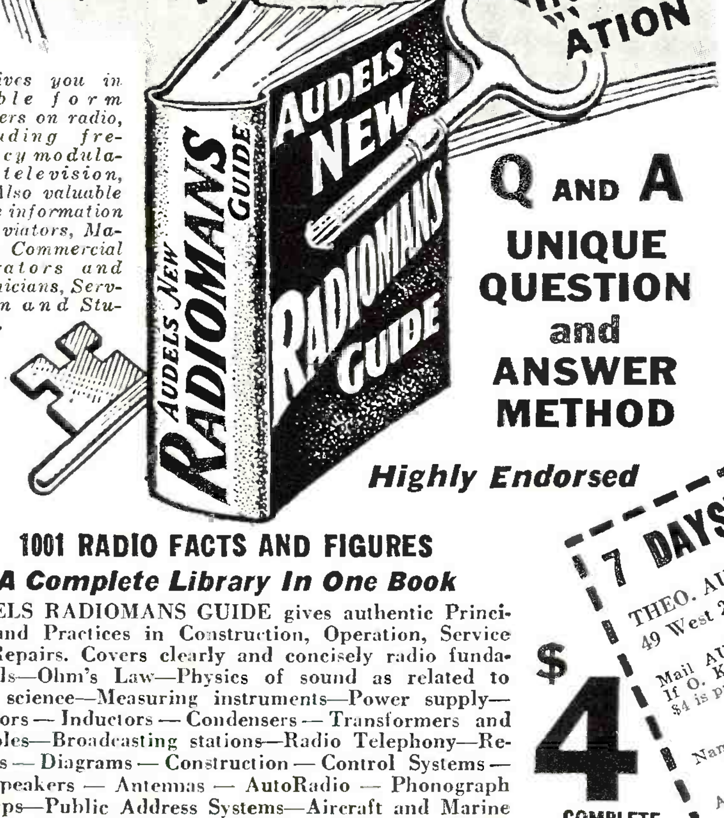

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However, it was necessary by that time to discontinue the use of the ground transmitter on 3117.5 kilocycles since use of that frequency originally had been authorized only as a temporary measure since it was not considered suitable by the frequency allocation authorities as a ground transmitting channel.

Establishment of Approach Control by CAA Control Towers

With the operation of airport traffic control towers by the Civil Aeronautics Administration, commencing in the latter part of 1941, one of the early problems in connection with approach control was overcome. This problem was the matter of the personnel operating the approach control service and issuing the approach control instructions. With Federal personnel operating the regular airport traffic control service, providing approach control became merely a logical extension of that service. In other words, Federal operation of airport traffic control towers meant that airport traffic control no longer was limited to protection of contact flight rule traffic, but could also include instrument flight rule protection while the aircraft were on and in the vicinity of the airport. Obviously, the control of instrument traffic by the control tower had to be closely coordinated with and under the general supervision of the Civil Aeronautics Administration airway traffic control centers.

Included in the operation of airport traffic control towers by the Federal Government was the establishment of an organized training program. This involved organizing an air traffic control training center at the headquarters location of each of the seven Civil Aeronautics Administration continental regional offices. These training centers, still in operation, make use of a simulated airway traffic control center, a simulated airport traffic control tower and one or more classrooms. A Link trainer is provided in which air traffic control and other CAA personnel are given instrument flight instruction. As a result of the use of these training facilities and of carefully planned on-the-job training, the performance of all personnel in CAA airport traffic control towers and airway traffic control centers today is at a uniformly high level. The personnel in the control towers have been trained not only in regular airport traffic control operation but also have been prepared especially for approach control service.

During the latter part of 1942 and all of 1943, the Civil Aeronautics Administration conducted further tests of approach control procedures, particularly in connection with providing suitable communication channels from the control tower to aircraft. After several conferences with Army, Navy, air carrier, airline pilot, and private pilot representatives, it was agreed that approach control should be established on a trial basis at certain selected locations by using the voice channel of the Civil Aeronautics Administration simultaneous radio range as the channel for approach control instructions. By April 15, 1943, control towers at 17 locations had been equipped with a microphone and other associated apparatus required to operate the voice channel of the local radio range when necessary in connection with approach control service.

Following further tests under this plan, the air carrier companies and the airline pilots decided that they did not consider it practical to receive approach control instructions over the voice channel of the Civil Aeronautics Administration low frequency radio ranges. Therefore, revised procedures were established whereby approach control instructions would be issued to Army, Navy and private aircraft over the voice channel of the radio range, and, as a temporary expedient, to air carrier aircraft over the control tower's low frequency transmitter or over airline radio facilities by interphone relay of instructions from the airport traffic control tower to the local air carrier company radio station.

Experience has confirmed the soundness of the basic idea of approach control. The control procedures and the flight procedures have been developed and the only problem remaining is the provision of a fully satisfactory communication channel.

Improvements Planned for Near Future

The most promising prospect for providing a suitable communication channel for approach control in the near future appears to be use of very high frequency (v.h.f.) transmitters in

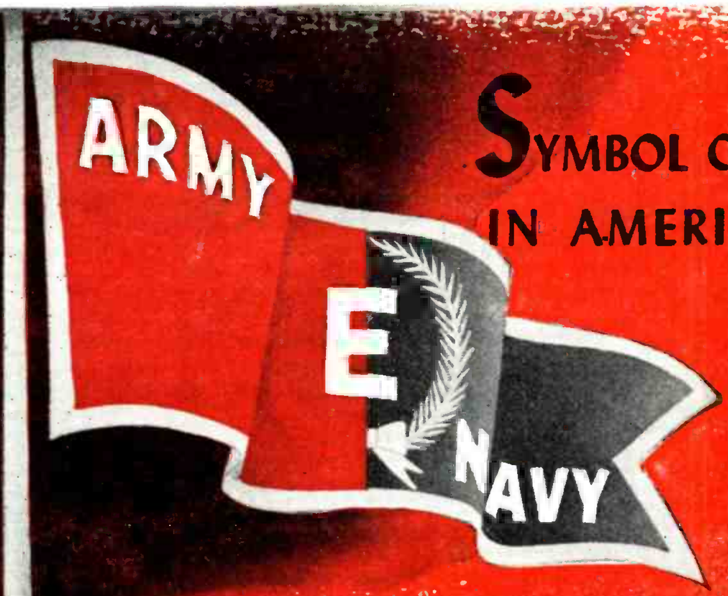
(*Continued on page* 142)

U.H.F. Course

(*Continued from page* 58)

be acted on by changing values of the a.c. voltage and its velocity may now be changed in the wrong direction. All this, of course, is in conjunction with the workings of the Klystron which probably should be reviewed to completely understand this explanation.

To make sure that the electron spends only a short time in the cavity-resonator space, the center section of the resonator is reduced by placing the sides closer together. On either side of this section, however, the distance between the walls is made greater. Thus, it is due entirely to the electron-transit time that this change occurs. There are other shapes that the cavity resonator can assume and some of these are shown in Fig. 8(A), (B) and (C). Note again that in each case that part of the resonator that allows the passage of electrons has been made quite narrow so that very little time will be spent in going from one side to the other. In the foregoing only



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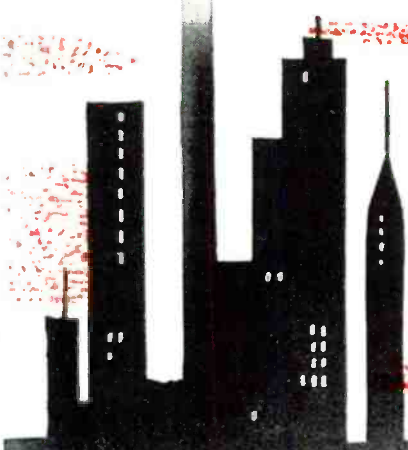

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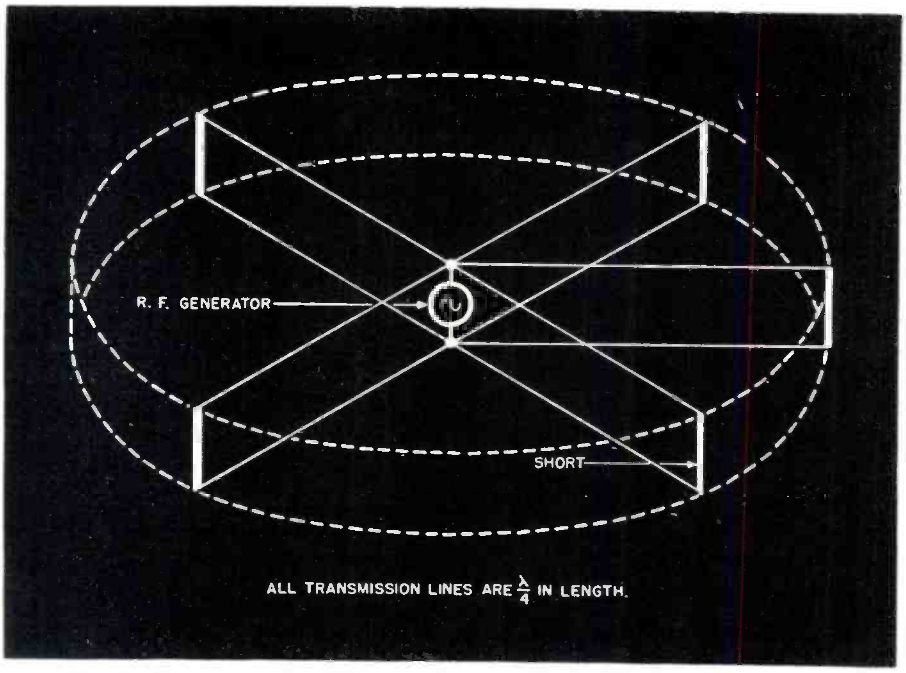


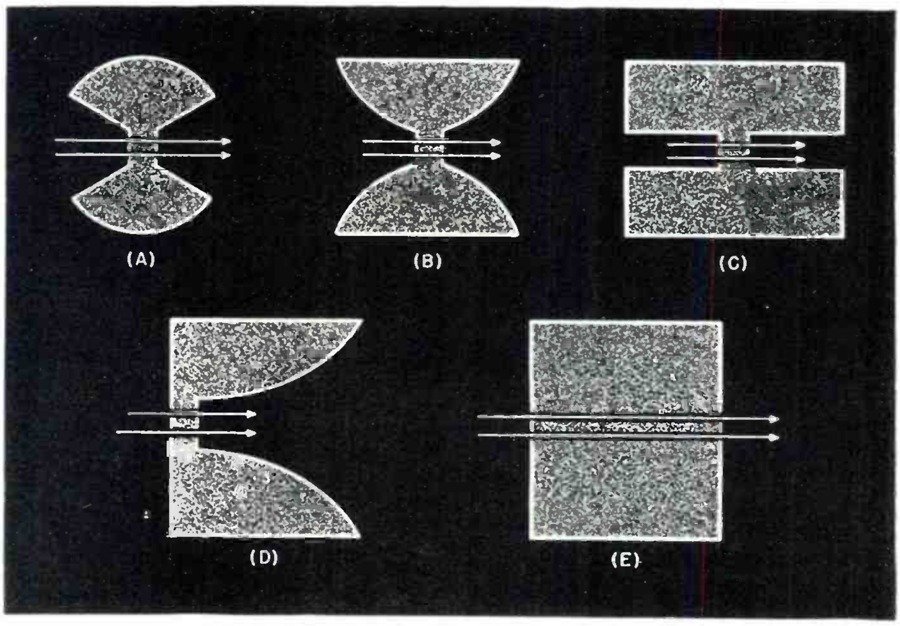
Fig. 7. The process of building a cavity resonator from a large number of ¼-wave transmission lines. The dotted circular line shows a cylinder that would be derived if there were an infinite number of these ¼-wave transmission lines.

electrons have been used to excite the resonator and this has been described in detail. Of course, it has probably occurred to the reader that if a hole or opening of some sort is made on the side of the chamber and an antenna is inserted, energy in this radiator may also start the oscillations going.

When these resonators are designed, the grid spacing is a very important consideration and often can prevent a Klystron from oscillating properly. It has been found that the electrons should traverse the intergrid space in one half cycle or less, preferably less. To achieve this, either one of two things can be done. First, a high accelerating voltage could be placed on the control grid or on the collector anode placed some distance beyond the second set of grids, the catcher resonator. The limitation on the amount of this voltage will be determined by the size of the power supply and the allowable heat dissipation of the Klystron tube. It must be remembered that electrons that travel faster, hit the intervening grids and collector plate with greater force and this gives rise to large amounts of heat. Water cooling and increased size of the collector anode would be solutions of the greater heat, but these have the disadvantage of making the apparatus bulkier.

The second way to cause the elec-

Fig. 8. (A, B, C) Three possible forms of cavity resonators. In each, the point through which the electrons must pass is made quite narrow. (D) Diagram of the Klystron cavity resonator, showing a comparison with that of the rectangular resonator at (E). Electron-transit time is responsible for the difference.



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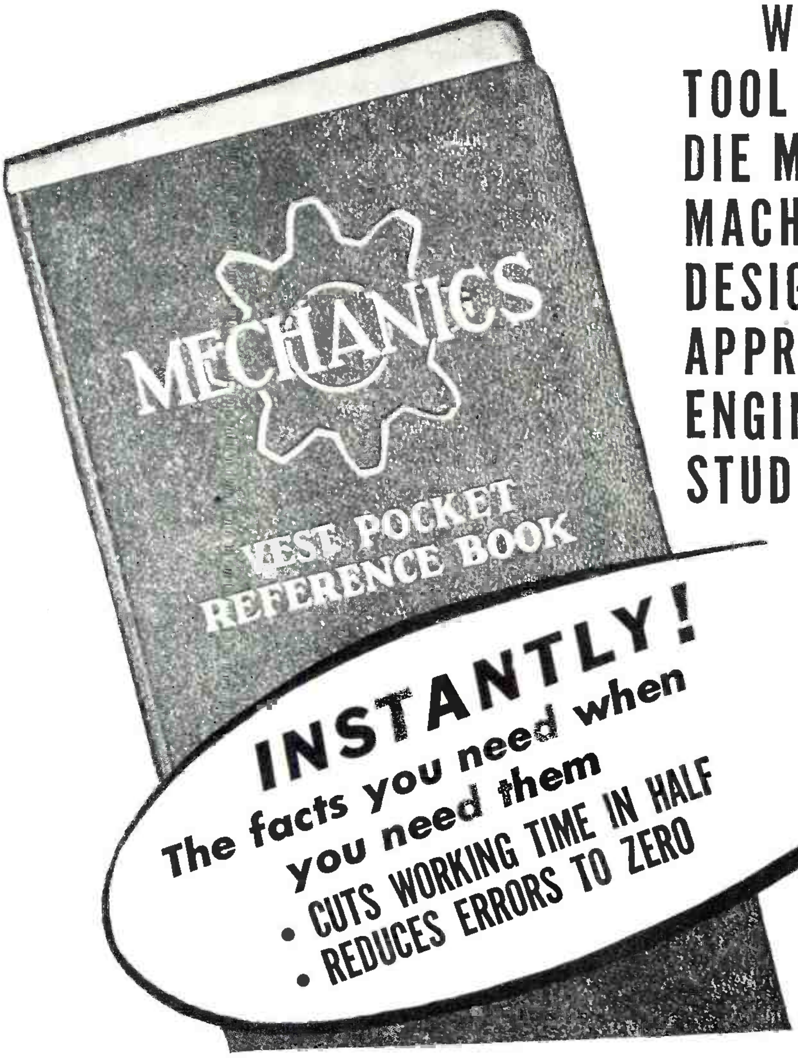

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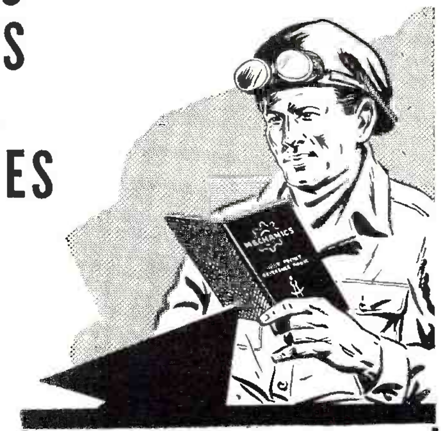

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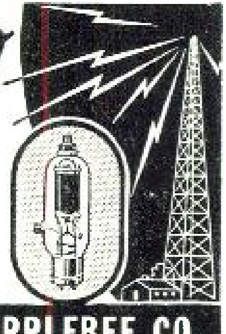
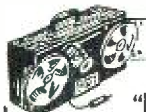




trons to spend less time between the grids is to place these closer together. The limitation on this method arises from the fact that too close a spacing will cause the tuning of the oscillator to be critical and may even prevent it from starting. Thus, it is between these two conflicting factors that cavity resonators and their center grid-like structures must be designed.

The resonant frequency of a cavity resonator may be changed within rather small limits by means of a screw arrangement that compresses the sides of the enclosure together. In an oscillator, there are two of these resonators and, hence, both must be tuned to the same frequency. This is a procedure that requires some time, so that generally the frequency is set once and left in this position. More information about cavity resonators will be given in the next article.

(To be continued in Feb. issue)

Modernize Your Oscilloscope

(*Continued from page* 50)

is attached, capacitively, to a degree ranging from negligible on power stages to a considerable amount on high-gain input stages. In order to prevent leakage of high voltage from the scope into input stages under observation, it is important that the ground terminals of the amplifier and the scope be tied firmly together and grounded.

Waves appearing on the screen of the scope from a stage under observation, which do not check with the input wave shape, can be identified and their source determined. For instance, if an amplifier is being checked with a 400-cycle audio tone and a 60-cycle wave appears modulating the 400 cycle, it will indicate that hum is entering the stage from some cause. If a 120-cycle wave appears it usually will indicate power supply ripple due to insufficient filter. 60- and 120-cycle waves are easily identified by turning the sweep to 60 cycle. A single loop of almost any shape (depending upon the phase relations of the vertical and horizontal voltages) will indicate 60-cycle hum. A double loop of a figure 8 shape, either elongated or squashed down, will indicate 120 cycle. It is possible to get straight lines in both of the above cases if the phasing is exactly such as to give such a pattern but usually there will be enough of a loop to identify the frequency.

Voltages can be measured with the oscilloscope if the vertical gain control is calibrated in terms of volts necessary to produce a certain deflection on the screen. For instance, if 1-volt peak input voltage will produce ½" deflection on the screen, a ¾" deflection will correspond to about 1.5-volts input. By employing the oscillograph in measuring the voltage at the input and output terminals of an audio stage, the stage gain can be determined with a fair degree of accuracy.

You will find that from a practical standpoint if an audio amplifier will pass a sine wave which looks good on the scope at the output terminals you can be fairly sure that the harmonic distortion in that amplifier hardly can be heard. The mere visual inspection of the output wave will reveal distortion more quickly than the ear.

—30—

Short-Wave

(*Continued from page* 54)

heard 10:00 a.m.-12 noon; English news, 10:50 a.m.; BBC news relayed at 11 a.m. (R-7).

JVU3, 11.89 mcs., Tokyo, is heard 4:40-6:15 a.m.; news, 4:40 a.m.; "Zero Hour," 5-6:15 a.m. in English (R-4).

JZI, 9.535 mcs., Tokyo, 11 a.m.-2:40 p.m. to West Coast, has replaced JZK, 15.16 mcs.; JZI is heard R-9.

CB..?, 11.855 mcs., Santiago, Chile, is heard 8-11 p.m. This is a new station and is heard R-6-8.

RNB, 11.645 mcs., Leopoldville, signs off now at 8:45 p.m.; then relays BBC's North American Service from 9 to 10:15 p.m. (R-9).

RNB, 9.785 mcs., Leopoldville, relays the BBC's North American Service from 10:30 p.m. to 12:45 a.m., since October 8. Heard R-9. (The BBC's information bulletin lists this broadcast from 9:30 p.m. to 12:45 a.m.)

RADIO CONGO BELGE, 9.385 mcs., Leopoldville, is heard 12 midnight-2:30 a.m. in French and Dutch.

RADIO SHONAN, 11.88 mcs., Shonan (Singapore), Malaya, is heard irregularly 8-9 a.m. in native language (R-4-5).

JVW2, Tokyo, is now on 9.675 mcs. instead of the previously reported frequency of 9.69 mcs. It is heard 4:40-7:15 a.m., with news in English at the beginning of the transmission.

The Pacific Service of the BBC from London now starts at 2:45 a.m. and runs to 5:45 a.m.; heard best on West Coast over GRM, 7:12 mcs., to 4 a.m., while GRX, 9.69 mcs., and GVZ, 9.64 mcs., are "weak" to "fair."

According to announcement heard, GSU, 7.26 mcs., and GSL, 6.11 mcs., start at 6 p.m. EWT in the North American Service of the BBC, regardless of what printed schedules declare.

Sweden or Switzerland are not heard during afternoons. HEK3, 7.38 mcs., is heard from 9:30 to 11 p.m.

Radio Atlantik, 7.42 mcs., is audible 8-10 p.m. irregularly.

None of the liberated countries has been heard as yet out here.

Radio Centre, Moscow, is heard only on 9.565 mcs., 7:40-8:20 a.m., and on 15.11 and 15.23 mcs., 6:47-7:15 p.m., both transmissions being in English. Other transmissions to North America are not being received on the West Coast well at present.

The Home Service of the U.S.S.R., on 9.565 mcs., is heard well daily from 10 p.m. to 1 a.m.

Reception of the *All India Radio* is getting better. Five of these transmitters are heard well from 8 a.m. till noon, not counting the 4- and 3-megacycle bands which we have not had much luck with here due to bad local station QRM. Evenings, VUD3, 7.295-7.30 mcs., is fair only.

VUD6, 9.63 mcs., at 10 a.m., overrides CBFX in Montreal completely; should have a still better signal later on, providing QRM will not spoil its quality.

Reception from Europe is improving evenings—that is in the 6- and 7-megacycle bands; the 9-megacycle band fades out by 10 p.m. EWT most evenings.

* * *

BEST BETS FOR BEGINNERS

Acting upon a suggestion made to your short-wave editor by Larry Gutter, Chicago, Hallicrafter's monitor, from time to time it is our intention to list in this department *"Best Bets for Beginners."* This month we have several such lists from different sections of the country as follows (EWT unless otherwise indicated):

WEST COAST—August Balbi, Los Angeles, has prepared these best bets for beginners in California (PWT):

15.26, GSI, London, 8:30 a.m.-2 p.m.; news in English, 9, 11 a.m., 1:45 p.m.

11.97, Radio Brazzaville, Brazzaville, French Equatorial Africa, 9 a.m.-5:45 p.m., 10-11:15 p.m.; news in English at 11:45 a.m., 1:45, 4:25 p.m.

11.897, JVU3, Tokyo, Japan, 6-7:40 a.m., 8-11:40 a.m.; news in English on the hour.

11.84, VLC7, Shepparton, Australia, 10:10-10:45 p.m., 6:45-7:45 p.m.; news in English at 10:10 p.m., also at 7:30 p.m.

11.645, RNB, Leopoldville, Belgian Congo, 9 a.m.-5:45 p.m., 10:45 p.m.-12 midnight. News in English at 5:30, 6:10 p.m.

9.785, RNB, Leopoldville, Belgian Congo, 7:30-9:45 p.m., relays BBC; news in English at 7:45, 9:30 p.m.

9.646, XGOY, Chungking, China, 4:35-9:30 a.m.; news in English at 7 a.m.

9.615, VLC6, Shepparton, Australia, 3-8:45 a.m. News in English at 3:30, 5, 7:15, 8 a.m.

9.535, JZI, Tokyo, Japan, 8-11:40 a.m.; news in English on the hour.

6.19, VUD2, Delhi, India, 7:15-9 a.m.

6.11, London, England, 4-9:45 p.m.; news at 6, 7:45, 9:30 p.m.

NEW JERSEY—Frank J. Barry, Perth Amboy, New Jersey, lists the following best bets for beginners in his area:

GSB, 9.51, London, 7 a.m. on (R-9).

GSP, 15.31, London, 12 noon on (R-9).

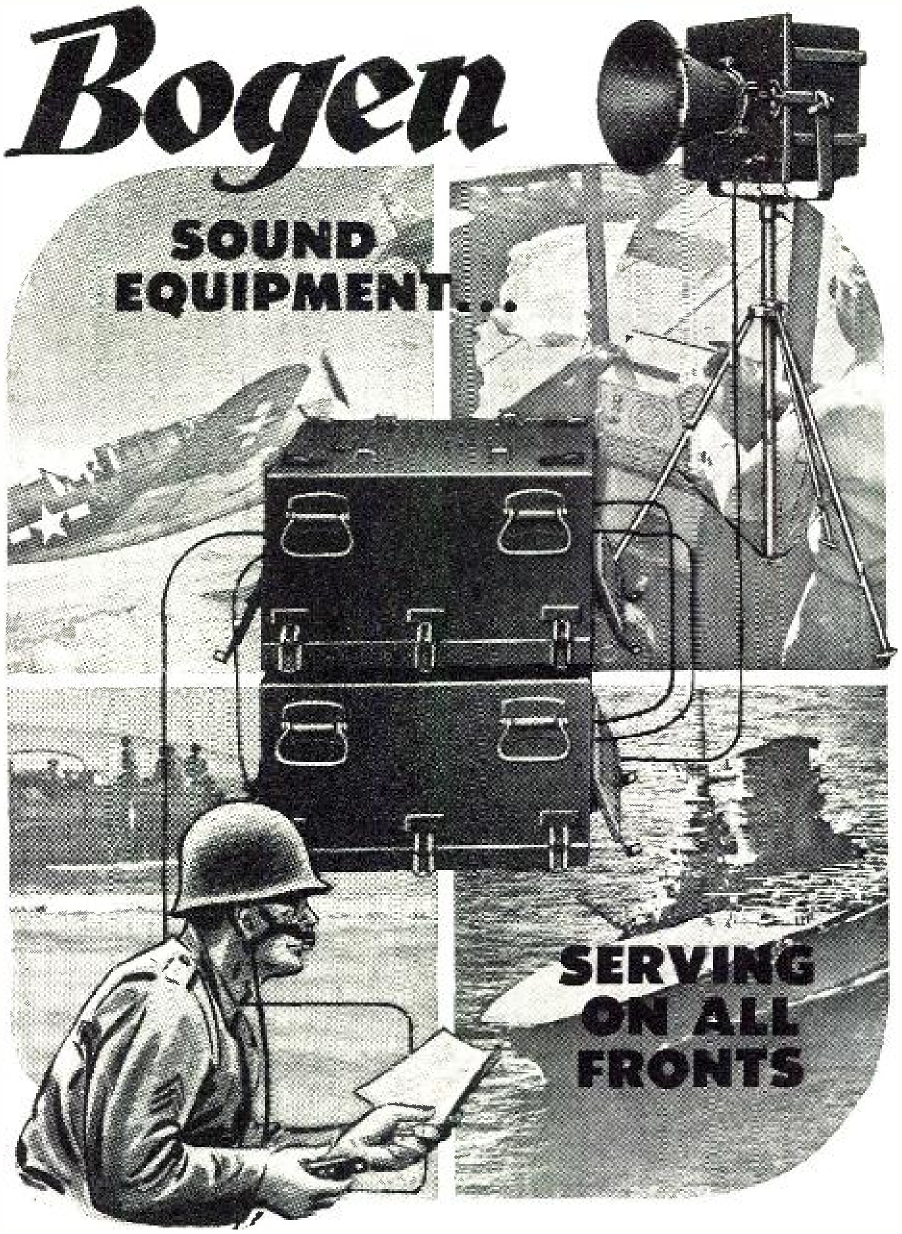
GSC, 9.58, London, 6:45 p.m. on (R-9).

OPL, 11.64, Leopoldville, Belgian Congo, 8:15-9:30 p.m.; signs on with steady beating of tom-toms. A frequency of 9.785 is used from 9:30 p.m. (R-9).

FZI, 11.97, Brazzaville, French Equatorial Africa, 7:45 p.m. (R-8).

VLG4, 11.84, Melbourne, Australia, 9:45-10:45 p.m. (R-7).

DJD, Berlin, Germany, 7 p.m., English news followed by messages from U.S.A. prisoners-of-war (R-9).



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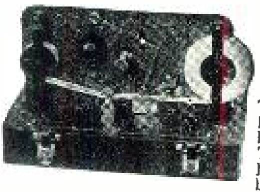

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7.38, 9.185, 9.539, Bern, Switzerland, 9:30-11 p.m. (R-9).

15.11, Radio Centre, Moscow, U.S.S.R., 6:45-9:30 p.m.; news in English at 8:15 p.m. (R18).

11.72, PRL8, Rio de Janeiro, Brazil, 10-11 p.m. (R-9).

MICHIGAN—Howard Landry, Detroit, comes through with the following best bets for beginners in that region:

Brazzaville, 11.97, 2:45, 4:45, 7:25 p.m. (English news).

Leopoldville, 9.783 and 11.645, 8:30 p.m. (English news).

Melbourne (Shepparton), Australia, VLC6, 9.615, 8, and 11 a.m.; also Melbourne at 1:15 a.m. on frequencies of 11.71 and 11.84 mcs.

Rio de Janeiro, Brazil, 11.72, 10 to 11 p.m.

HCJB, Quito, Ecuador, on 12.445, from 6 to 9 p.m.

HEO4, Bern, Switzerland, 10.338, 3:45 to 4:15 p.m.

Bern, Switzerland, 9.185 and 9.539 mcs., 9:30 to 11 p.m.

DJL, Berlin, 15.11, 7 to 8 a.m.

London is heard well in the 49-, 41-, and 31-meter bands from 5:45 p.m. to 12:45 a.m. (North American Service).

MASSACHUSETTS — Gilbert L. Harris, North Adams, Massachusetts, lists the following best bets for beginners in New England:

11.090, Ponta Delgada, Azores, heard 3-4 p.m.

9.785, Radio National Belge, 9:30 p.m. to 12:45 a.m. (relaying BBC).

15.750, Radio Centre, Moscow, U.S.S.R., 12 noon to 12:30 p.m.

15.959, Radio Brazzaville, 11:55 a.m.-12:55 p.m.

9.615, VLC6, Shepparton, Australia, 8-8:55 a.m.

9.440, Radio Brazzaville, Brazzaville, French Equatorial Africa, 2:45-6:15 p.m.

11.405, Radio Dakar, French West Africa, 2:45-5 p.m.

9.735, CSW7, Lisbon, Portugal, 8-9 p.m.

10.338, Bern, Switzerland, 3:45-4:15 p.m.

11.84, Prague, Bohemia, 6-7:30 p.m.

10.78, SDB2, Stockholm, Sweden, 12 noon to 6 p.m. (experimental).

9.80, DKS, Radio Atlantik, 12:30 p.m.

SOUTHWEST—From Tulsa, Oklahoma, Don Brewer sends along this list of best bets for beginners in the southwest:

GVX, London, 11.93, 5:15-7 p.m.

OPL, Leopoldville, 9.78, 9:30 p.m.-12:45 a.m. (relaying BBC).

Radio Brazzaville, Brazzaville, French Equatorial Africa, 11.97, with English news from 7:25-7:45 p.m.

VLC6, Shepparton, Australia, 9.615, 8-8:45 a.m.

Bern, Switzerland, 9.185, 9:30-4 p.m.

CXL25, Berlin, Germany, 7.28, 7-8 p.m.

HCJB, Quito, Ecuador, 12.445, English until 7 p.m.; English news relayed from San Francisco, 6 p.m.

MIDWEST—Maurice Siskel, Indianapolis, Indiana, offers readers in the midwest the following best bets for beginners:

9.783, Leopoldville, Belgian Congo, relaying BBC, 9:30 p.m.-12:45 a.m.; strong signal with a little fading; identifying words, "Radio National Belge."

9.615, VLC6, Shepparton, Australia, 8-8:45 a.m., beamed to eastern North America; very good signal. Closes down with playing of "Star-Spangled Banner" and "God Save the King."

9.185 and 7.380, Bern, Switzerland, 9:30-11 p.m., daily except Saturday; fair to strong signal, depending largely on weather conditions.

6.070, CFRX, Toronto, Canada, heard afternoons and evenings; newscast at 4 p.m. on weekdays; signal is good, but there is a bad whistle on the frequency.

2.880, GRC, London, comes in weak, evenings.

11.645, Leopoldville, Belgian Congo, news at 8:30 and 9:10 p.m.; weak.

7.28, DXL25, Berlin, heard after 9 p.m.; shuts down at 1:15 a.m., sometimes at 12 midnight; weak, some fading.

NEW YORK—Adrian Richards, Snyder, New York believes the following stations to be best bets for beginners in his area:

CHNX, 6.13, Halifax, Nova Scotia, 7 a.m. (S-8).

GSP, 15.31, London, 7:30 a.m. through 5 p.m. (S-8).

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GSU, 7.26, London, 5:15 p.m.-12:45 a.m. (S-8).

FZI, 11.97, Brazzaville, 7:25-7:45 p.m. (S-7).

OPL, 11.645, Leopoldville, Belgian Congo, after 7 p.m. (S-6).

DXP, 6.03, Berlin, 5:50 p.m.-1:15 a.m.; news in English on the hour (S-5).

9.185, Bern, Switzerland, 9:30-11 p.m., with news in English at 9:45 p.m. (S-5).

PRL8, 11.72, Rio de Janeiro, 10-11 p.m., with news in English at 10 p.m. (S-6).

* * *

REPORTS FROM READERS

(EWT unless otherwise indicated)

MASSACHUSETTS—This month we have the following fine report from Gilbert L. Harris, North Adams, Massachusetts:

15.110, DJL, Berlin, heard with news in English to Africa, 11:35 a.m.; also has been heard with English at 4:48 p.m.

15.155, SBT, Stockholm, Sweden, heard signing off at 11:50 a.m.; back on at 11:59 a.m. until sign-off at 12:32 p.m.

10.780, SDB2, Stockholm, Sweden, heard signing on at 12 noon on Sunday recently; sometimes goes later than 6 p.m. Experimental. (R-9 plus).

15.750, Radio Centre, Moscow, heard 12 noon-12:30 p.m. (R-9 plus.) More English is used on Sundays than on weekdays.

12.455, HCJB, Quito, Ecuador, heard at 10:45 a.m. with very good signal.

9.875, CR7BE, Lourenco Marques, Mozambique, heard signing off at 4:43 p.m. (R-9 plus).

9.440, Radio Brazzaville, news in English at 2:45 and 4:45 p.m. (R-9).

9.610, DXB, Berlin, heard at 12:25 p.m. coming on with identifying signal; program began at 12:30 p.m., evidently a program to the Far East.

10.005, Voice of Free Arabs, heard Sunday, 2:15-2:33 p.m.; also from 3:15 to 3:30 p.m.

7.42, DKS Radio Atlantik, heard weak at 2 p.m., but at 4 p.m. was R-9 plus.

10.338, Bern, Switzerland, signs on at 3:43 p.m. with music box chimes; English news at 3:48 p.m.; signs off at 4:15 p.m. (R-9 plus).

An unidentified station broadcasting in a "foreign" language was heard a recent afternoon from 4:15 to 4:30 and again at 5 p.m. on 7.50 megacycles.

AFHQ was heard at 10:10 a.m. on approximately 17.27 megacycles recently with press reports to New York and London. Signed off at 10:23 a.m. (R-9 plus).

A station believed to be Paris, France, was heard recently from 5 to 6 p.m. on 7.315 megacycles; a c.w. station QRM'd the transmission very much.

The new Cincinnati stations and the BBC's powerful transmitters override many weak stations in the 9-megacycle band nowadays.

Of interest may be the fact that The Netherlands (Huizen) was heard prior

to the war on 9.59, 11.73, 15.22, 17.77 and 18.07 megacycles. Will be watching out for these transmitters again soon.

CBFZ, Montreal, Quebec, Canada, will soon be on 15.190 megacycles, I am informed.

WASHINGTON — Dwight Hanson, Tacoma, Washington, who uses a Hallicrafters S-20R Sky Champion and an inverted "L" antenna, sends us this report (PWT):

GSI, 15.26, London, African Service, 8:30 a.m.-2 p.m., with news at 9, 11 a.m. and 1:45 p.m.; excellent.

GVX, 11.93, London, in North American Service, 2:15-4 p.m.; news, 2:45, 3:45 p.m.; excellent.

DJL, 15.11, Berlin, in African Service, 8:40 a.m.-2:30 p.m.; news every hour on the hour; fair.

DXJ, 7.24, Berlin, in North American Service, 2:50-10:15 p.m.; news every hour on the hour; signs off with the German National Anthem.

FZI, 11.97, Brazzaville, Middle Congo, to North America at 4:25 p.m.; news at 11:45 a.m., 1:45 p.m., 4:25 p.m.; excellent. On 9.440 megacycles, heard 3-6:30 p.m.; good.

OPL, 11.64, Leopoldville, Belgian Congo, to North America, 5:15-6:15 p.m., with news at 5:15 and 6:10 p.m.; excellent.

VLC6, 9.615, Melbourne (Shepparton), Australia, 8-8:45 a.m.; news at 8 a.m.; excellent.

XGOY, 9.645, Chungking, China, 7-10 a.m.; news at 7 a.m.; good.

Radio Saigon, Saigon, French Indo-China, 7-8:30 a.m.; news in English at 7 and 7:45 a.m.; excellent.

JZI, 9.535, Tokyo, Japan, 8-11:30 a.m., with news in English at 8, 9, 10 and 11 a.m.; excellent.

Radio Shonan, 9.555, Shonan (Singapore), Federated Malay States, 7:30-10:30 a.m.; English news at 7:30 and 10:15 a.m.; excellent.

VUD2, 6.19, New Delhi, India, 7:30-9 a.m.; English news at 7:50 a.m. and relays a BBC newscast at 8 a.m.; good.

11.76, Delhi, India, 5-7 a.m., to Far East; English news at 6:30 a.m.; good.

7.38, Bern, Switzerland, 6:30-8 p.m.; news in English, 6:45 p.m.; fair.

11.775, Bern, Switzerland, heard throughout afternoon; English newscast at 3:15 p.m.; rings bells at beginning of program and plays National Anthem at end; sounds a gong during each newscast; fair.

HCJB, 12.445, Quito, Ecuador, chimes begin program of "Friendship Hour," 4:30-5:30 p.m.; good.

MASSACHUSETTS — John J. Kernan, Boston, Massachusetts, reports the logging on September 21, of XPSA, Kweiyang, China, 8.465 megacycles (relaying Chungking); there was a little fading every three minutes, then the station came back strong; native music; news in English at 2 a.m. EWT.

Bern, Switzerland, on 9.539, with news in English about 9:45 p.m., is heard R-8-9 here. Berlin on 7.01 mcs., has news in English at 2:25 a.m. (R-2-4).

The Stockholm, Sweden, station on 10.78 mcs. has news in Swedish between 2 and 3 p.m. (R-7-8).

Mr. Kernan reports hearing a talk in Indian on 12.20 megacycles at 2:55 p.m. a recent Sunday. (Could this be one of the Japanese-controlled Java stations radiating to India?) He also reports hearing a French station recently on 10.17 megacycles, 9:45 p.m.

OHIO—Robert Hoiermann, Alliance, Ohio, writes us:

ABSIE was picked up recently on approximately 7.07 megacycles from 6:45 to 7:15 p.m., with news in German at 7 and in French at 7:15 p.m. The signal strength was fair, with a lot of QRM.

Deutscher Kurzwellen Sender Atlantik, sometimes announced as "Soldaten Sender West Angeschlossen der Deutschen Kurzwellen Sender Atlantik," is now being heard here every evening until nearly midnight on 6.22 and 7.420 megacycles with usually very good signal strength, sometimes R-9 plus, but with a lot of QRM from jamming stations and c.w. transmitters.

MICHIGAN — Howard Landry, Detroit, sends us a fine report this month, as follows:

Reception from Australia has improved very much in the last few weeks, with the 8 a.m. transmission coming in with perfect clarity. Signal strength is very good throughout this entire transmission on 9.615 mcs. At 11 a.m. the second transmission to North America from Australia comes in fairly clear on 9.615 mcs. Reception of the transmission to North America at 1:15 a.m. is about the same as the 8 a.m. radiation.

ZFY, Georgetown, British Guiana. 6 mcs., comes in occasionally around 6:30 p.m., with news in English from the BBC at 6:45. It usually leaves the air at 7:45 p.m. Reception is quite poor.

INDIANA — From Gary, Indiana, William Wozniak reports:

6.480, GB, Guatemala City, Guatemala, has a musical program at 10-11:45 p.m.

JLG2, 9.505, Tokyo, has news in Japanese at 5 p.m.

GRC, 2.880, London, with news in English at 10:30 p.m.; reception good but lots of static.

HCJB, Quito, Ecuador, 9.958 and 12.455, "Voice of the Andes," generally has fine organ music between 7 and 9 p.m.

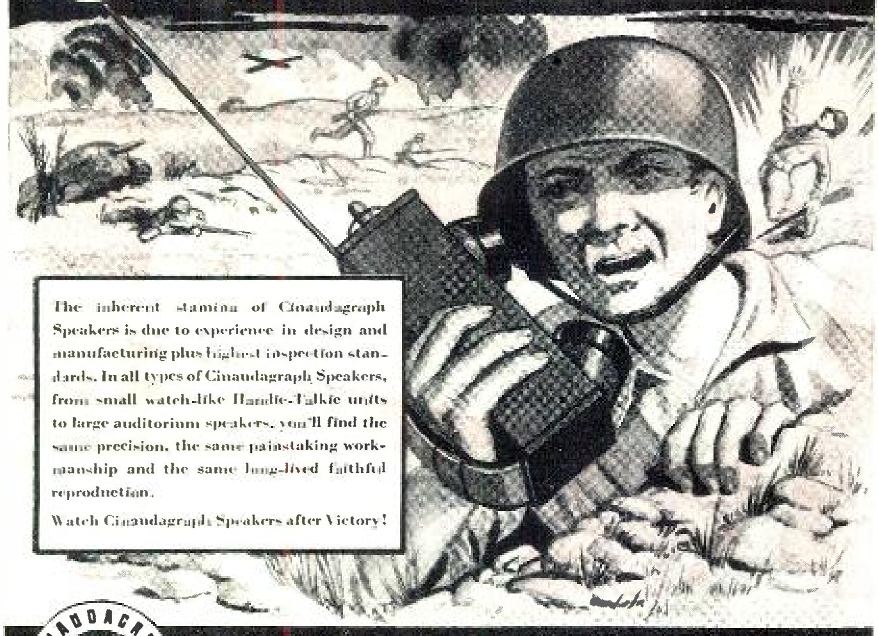
HIIG, 6.280. Ciudad Trujillo, Dominican Republica, heard 9:30-10 p.m.

VLG4, 11.84, Melbourne, Australia, has news in English at 11:15 p.m.

WEST VIRGINIA—Charles Gonder, Morgantown, West Virginia, sends us this report:

A German station has been heard recently on 6.22 relaying Berlin's service to North America. No location was given; sign-off was at 9:30 p.m. (This is the frequency now used by Radio Atlantik.)

KROJ, Armed Forces Radio Service, San Francisco, has been heard lately on an announced frequency of 17.76



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megacycles around 10:55 p.m.; reception was poor.

* * *

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* * *

LAST MINUTE TIPS

At my listening post in West Virginia, I have recently been hearing XGOY, Chungking, China, on 9.646 megacycles from 7:30 to around 11 a.m. with a fair signal. On occasions an English newscast has been heard well at 8 a.m. XGOY's schedule is 7:35 a.m.-12:30 p.m., with news at 8, 10, 11, and 12 a.m.

Although it has been reported to us that PIRN, Manila (Japanese-controlled, of course), on 9.64 now gives the news at 9 p.m. EWT, we heard a newscast by a woman announcer at 8:30 a.m. EWT from that station.

The best Moscow broadcasts recently heard here have been on 9.565, 15.23, and 15.75 from 7:40 to 8:25 a.m., and on 15.23 (occasionally on 15.75) from 6:47 to 7:30 p.m. Radio Centre has been heard several evenings lately at 7:20 p.m. on 15.23 with a good signal, relaying a news correspondent to the NBC in New York.

Radio Brazzaville, 11.97 and 9.44 has English news at 4:45 p.m.; fine signal on both frequencies. At 2:45 p.m. the news in English is given over the 11.97 frequency only; this is the strongest signal from any station abroad, although at those times the transmission is being directed to Africa, the East, Europe, and the British Isles. At 7:25 p.m. both frequencies are again used for transmission of the news in English to Canada and the United States; the 25-meter band wavelength is the stronger. Prior to the news in English, it is given in French for Canadian listeners.

HAT4, Budapest, 9.125, has become stronger on its newscast in English for the United States at 9:20 p.m.

I recently heard VPD2, Suva, Fiji Islands, on 6.135 between 4:30 and 6 a.m. on Sunday, with a fine signal. This station relays the BBC news at 2 a.m., Sundays only.

OIX3, Lahti, Finland, is being heard here well on its evening transmission to the United States which begins at 8:25 p.m. EWT, radiation is on 11.785 mcs. and starts off with the Finnish war communique, followed by other news.

Radio Shonan (Singapore), reported on 9.555 mcs., announces its frequency as 9.538 megacycles. We are hearing this frequency well from 6 to 7 a.m. EWT. Prisoner-of-war messages are sometimes given around 7:40 a.m. EWT.

After not having been heard here for some months, "Radio Eire," 9.595, believed to be located in Athlone, Ireland, is coming in with a good signal

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from 5:10 to 5:35 p.m. EWT, with news in English. Recently they have asked that reception reports and suggestions be sent to "Radio Eire," New York City.

It has been learned that a Dutch or Allied-controlled radio transmitter has already been set up in Holland by the Allies transmitting on 450 meters and relaying "Radio Orange" from London. By the time this reaches the news starts it is likely that the powerful voice of Huizen (possibly on 9.59 megacycles) will again be speaking from a free Holland. PCV, on 18.065 mcs., at Kootwijk, is another Netherlander to be on the lookout for. (We would appreciate early reports on Dutch-controlled short-wave broadcasts if picked up.)

ZFY, 6.00 mcs., Georgetown, British Guiana, puts in a fair signal here from 6:30 to 7:45 p.m.; carries the BBC news from London at 6:45 p.m. EWT.

VLC6. 9.615, Melbourne (Shepparton), Australia, on its 8-8:45 a.m. transmission to listeners in the eastern United States, provides one of the loudest short-wave signals today. There is good quality, and I can recommend it to anyone interested in listening to the continent "down under." There are several other transmissions from Australia in the 31-meter band which come in well during the hours of 7 to 11:45 a.m.

JBC, 18.135, Java, heard recently at 12:02 with music; signed off at 12:06 p.m. (Harris).

Voice of Free India on 15.220 mcs., was recently heard with news in English at 11:40 a.m. (Harris).

-30-

Class "C" Amplifiers

(*Continued from page* 39)

decrease on modulation. As has just been mentioned, too heavy modulating signals will cut off the power between cycles, the amount depending on the extent of overmodulation. Thus the average power is reduced, even though the d.c. plate current has increased; and downward modulation results. In this case, downward modulation is the result of overmodulation.

It is interesting to note from Fig. 4 that the audio modulator must supply peak power of four times its normal power—which would possibly lead one to conclude, offhand, that the audio system must be larger than previously thought. Further investigation will clear up the matter. The points X and X' are the half-power points of the curve—the points at which power has .707 of its maximum value. (This is a standard investigation point.) The time of power flow between these two points is 90°, or ¼ of a complete cycle. Thus, the audio system must supply its normal power for one cycle, or 4 times that power for ¼ cycle—identical conditions. However, this power is required only for sine wave conditions. The power requirements for speech are generally less, because of the narrow wave forms inherent in speech. The peak requirements remain the same, but the average audio power is reduced to some 30% of the carrier instead of 50%.

A method of approximating the percentage modulation is to observe the current rise in the antenna or feeder circuit, on modulation. If the total power at 100% modulation is 1.5 times the unmodulated carrier power, then

$$P = I^2R$$

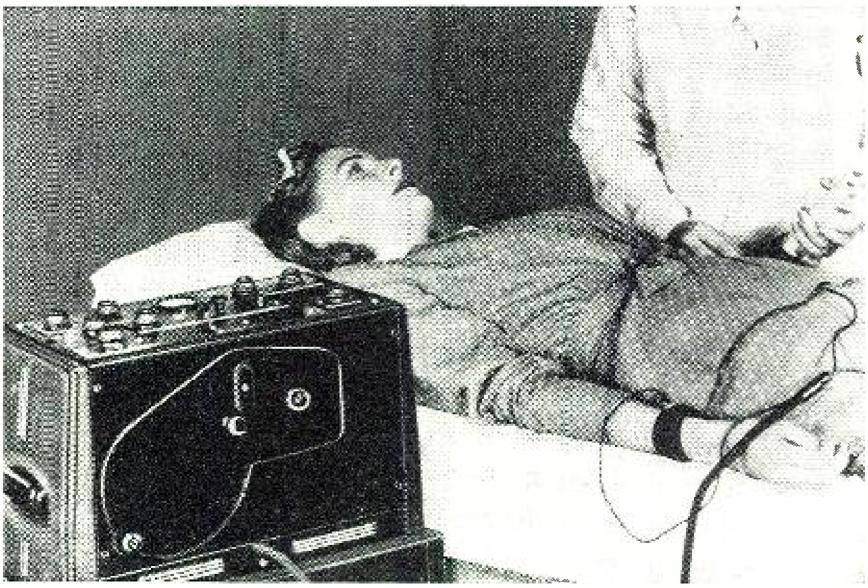
$$\text{and } 1.5 = I^2$$

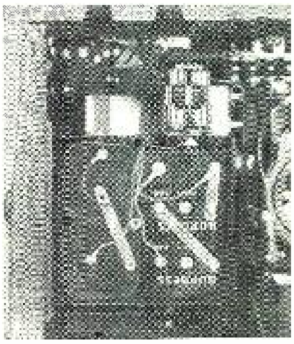
(since R remains constant it can be considered as 1)

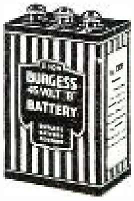
Therefore $I = 1.225$, or the current has increased 22.5% for 100% sine-wave modulation.

Linearity is important in modulation, and is dependent on the grid bias and load impedance. A high load impedance, as computed by $Z = E/I$, where E is the d.c. plate voltage on the r.f. tube and I is the d.c. plate current, gives more linearity but lower output, and vice versa. Care must be taken in the selection of r.f. tubes, and in the grid bias. If reasonable power output with low minimum plate voltage is required, a tube with a low amplification factor is necessary. The driving power required for good linearity increases rapidly as 100% modulation is approached, hence the driving source of r.f. power exciting the r.f. amplifier must have good regulation.

-30-







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BOX NO. 378 c/o **RADIO NEWS**

"This section is designed to help the radio industry obtain trained, experienced, technical men to facilitate vital war production. Before applying for any of these positions consult your local United States Employment Service office to determine War Manpower Commission regulations concerning the changing of jobs. If you are already employed in war work at your highest skill, stick to your present job."

IS *Your* OPPORTUNITY HERE?

Think this over carefully. Where do you go from the spot you're in now? Are your surroundings friendly and full of promise for the future? Consider now the place you might fill in the electronic industry leadership assured to the fine staff of engineers, scientists, technicians at NATIONAL UNION RADIO CORPORATION. We're all young in years and ideas though most of us are old in electronic experience. We enjoy working together. We know we're going places! We're inviting you to join us if you have the qualifications. If you're looking for a success pattern for your future, it may be here with us at National Union. Find out! Come in and talk it over or write us!

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Approach Control

(Continued from page 128)

airport traffic control towers. The Civil Aeronautics Administration already has installed these transmitters in most of its control towers and expects to have all its towers so equipped shortly. The final step then is for pilots to be able to receive these transmissions. The air carrier companies are planning to install v.h.f. receivers just as rapidly as possible. Some military aircraft already are equipped to receive in the v.h.f. band.

If no unforeseen difficulties are encountered, it appears that approach control procedures by CAA airport traffic control towers can be established at practically every major civil airport for use during the coming winter. Air carrier aircraft will be contacted, in most instances, through the v.h.f. transmitter in the airport traffic control tower. Aircraft not equipped to receive this frequency, which in general will be mostly Army, Navy, and private aircraft, will receive their approach control instructions, as at present, over the simultaneous voice channel of the local Civil Aeronautics Administration radio range.

Proper arrangement of navigation facilities is an important factor in realizing maximum benefits from approach control procedures. The most desirable arrangement of these facilities involves the establishment of a 75-megacycle fan marker as a holding fix on the approach leg of the radio range approximately 8 to 10 miles from the radio range station. Aircraft will be cleared to this fix by the airway traffic control center which will assign altitudes to the aircraft in accordance with their estimated time of arrival over the fix. As the aircraft arrive at the holding fix, the pilots report to the control tower using the appropriate communication channel, and thereafter are under the jurisdiction of the airport traffic controller.

The airport traffic control tower clears the aircraft past the holding fix for an approach to the airport, and progressively lowers the aircraft in the holding stack at 1000-foot intervals. The airport traffic controller attempts to regulate the flow of traffic in the holding stack so that as an aircraft completing an approach becomes visible to the control tower, the aircraft having the next turn to land will be ready to leave the holding marker. As experience at each location is obtained, it is expected that the airport traffic controller will not have to wait for each aircraft to become visible before he clears the next aircraft from the holding fix, but will clear aircraft from the fix at intervals of perhaps 5 minutes. These intervals can be shortened to 4 minutes and eventually to 3 minutes as further experience is gained. However, it is believed that at least for the first year of operation of approach control, the average in-

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Thus, co all factors, approach control edures which are expected to be reaay for establishment very shortly at a substantial number of locations should make possible the flow of aircraft at a given airport at the rate of approximately 24 movements per hour as compared to a maximum of approximately 10 or 12 movements per hour where conventional procedures are in effect.

Additional Improvements

The Civil Aeronautics Administration recently has begun a program involving the installation of instrument landing systems at major airports. Also under way is the installation of v.h.f. radio ranges which will have two simultaneous voice channels for communication with pilots,—one for traffic control instructions and one for weather information. These facilities are expected to make possible a material improvement in the efficiency of air traffic control in general and approach control in particular.

This improved efficiency will be the result of the greater reliability and higher quality of the v.h.f. voice channels, and the more precise navigation which is expected to be possible when using v.h.f. navigational facilities. When these aids are in regular use, a pilot will follow the v.h.f. airway facilities to the desired airport and then, if an instrument approach is necessary, he will proceed out the instrument landing system to the holding fix. Thereafter, he will descend in altitude as directed by the control tower and eventually proceed to the airport for a landing using the instrument landing system. With the improved navigational facilities and better communication channels, plus the additional experience by ground and aircraft personnel in approach control procedures which will have been obtained by the time these facilities are in use, it is believed that average separation between arriving aircraft will be in the neighborhood of 3 minutes. This means 20 landings per hour per airport which, with 20 departures, results in an airport capacity during instrument weather conditions of approximately 40 aircraft movements per hour. Still later it may be possible to decrease the separation to an average of perhaps 2 minutes between successive landings, but it is not believed that any further reduction in separa- n or increase in frequency beyond his point will be possible until new types of automatic air traffic control facilities are produced and made available.

These automatic devices, however, can be definitely anticipated at a future date. They will include such developments as collision warning devices for aircraft and scanning screens for airport traffic control towers. This will mean that ultimately it may be expected that landings and take-offs during instrument weather conditions will have no more restrictions, from a traffic control standpoint, than do landings and take-offs during contact weather conditions.

—30—

PHOTO CREDITS

Page	Credit
25	FLYING Magazine
31, 82	Federal Telephone & Radio Corp.
33 (bottom). 34	Belmont Radio Corp.
36	Frank Ross, Staff Photographer
40, 41	Westinghouse

ERRATUM

The cover photograph of the November issue was taken at Templetone Radio Mfg. Corp., and not at RCA Laboratories, as mentioned on Page 4 of that issue.

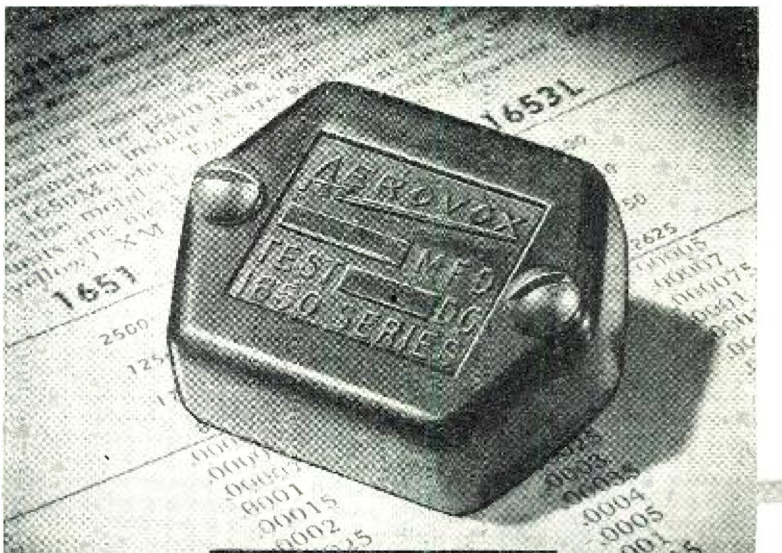
INDEX OF Advertisers

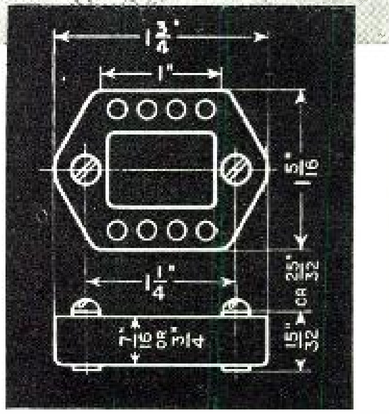
Dec. 1944

In ratings from 1000 volts to 10,000 volts test . . .

Molded-in-Bakelite

MICA CAPACITORS





● The 1650 Series is the most rugged of the heavy-duty molded-in-bakelite mica capacitors of the extensive Aerovox line. These high-voltage units are intended for the most critical service of low-powered transmitting circuits, buffer stages, power amplifiers, laboratory equipment, etc. Also recommended for use in ultra-high-frequency circuits, and accordingly their r.f. current ratings are given in the Aerovox Capacitor Catalog.

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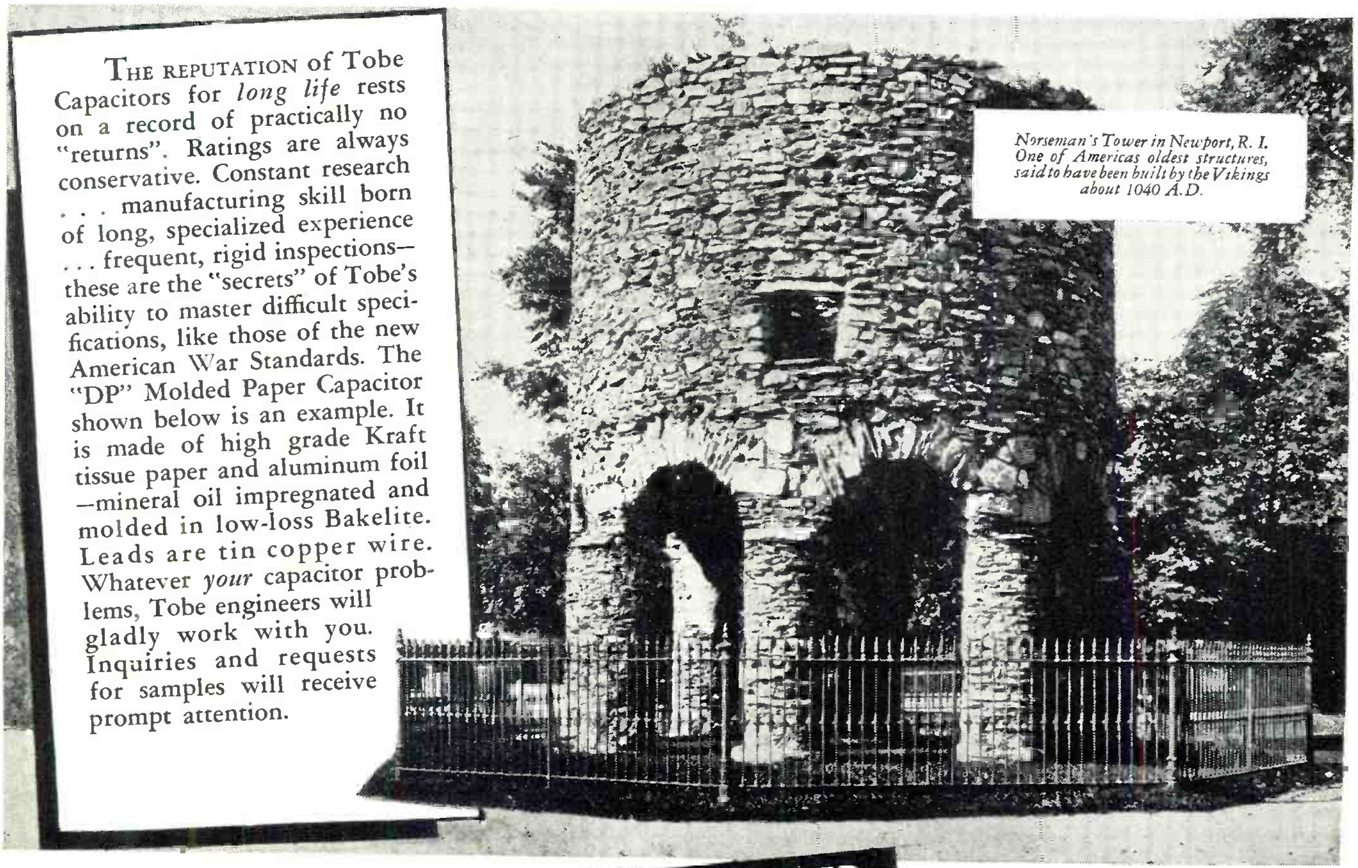

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2000	600	CN35A202	CN35B202
2500	600	CN35A252	CN35B252
3000	600	CN35A302	CN35B302
4000	600	CN35A402	CN35B402
5000	600	CN35A502	CN35B502
6000	600	CN35A602	CN35B602
7000	600	CN35A702	CN35B702
8000	600	CN35A802	CN35B802
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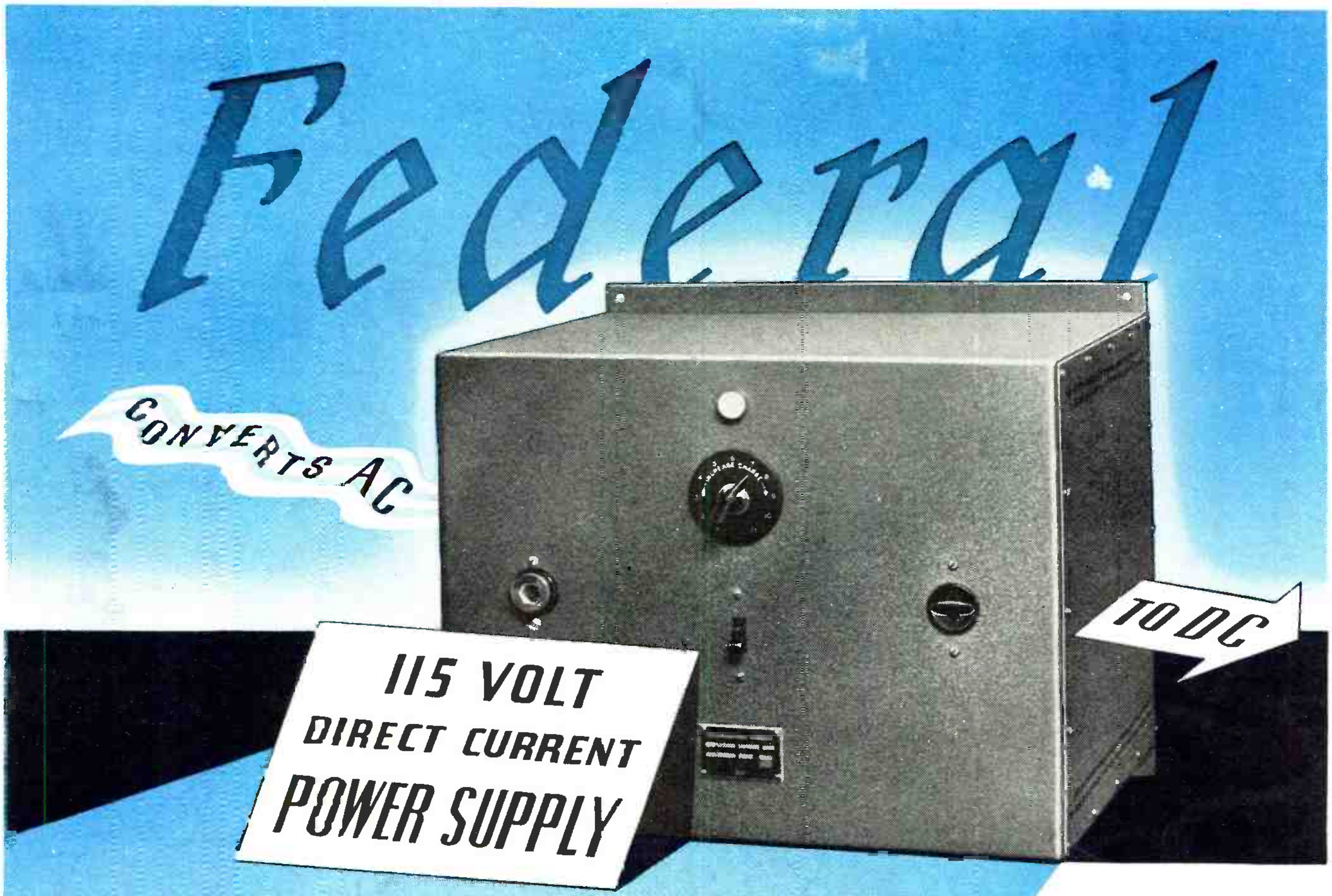

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