RADIO NEWS

MAY
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BIOLOGICAL OBSERVATION OF FUNGUS GROWTH ON RADIO-ELECTRONIC PARTS

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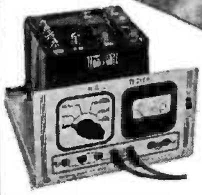
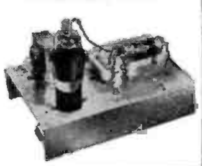


You build MEASURING INSTRUMENT above early in Course, useful for Radio work to pick up EXTRA spare time money. It is a vacuum tube multimeter, measures A.C., D.C., R.F. volts, D.C. currents, resistance, receiver output.

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!

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?

Let me send you facts about rich opportunities in the busy Radio field. See how knowing Radio can give you security, a prosperous future . . . lead to jobs coming in Television and Electronics. Send the coupon NOW for FREE 64-page illustrated book, "Win Rich Rewards in Radio." Read how N.R.I. trains you at home in spare time. Read how you practice building, testing, repairing Radios with SIX BIG KITS of Radio parts I send as part of your Course.

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I Trained These Men — SPARE TIME RADIO BUSINESS

"I have a spare time Radio and Electrical business of my own which has been very profitable, due to the efficient training I received from your Course. Last year I averaged over $50 a month." —FRED H. GRIFFIE, Route 3, Newville, Pa.

"I am doing radio work in my spare time, and find it a profitable hobby. My extra earnings run about $10 a week. I certainly am glad I took your N.R.I. Course." — FERDINAND ZIRBEL, Chaseley, North Dakota.

"About six months after I enrolled I started making extra money in radio. I am a farmer and just work on radios evenings and stormy days. That brought me a profit of $600 in the last year."—BENNIE L. ARENDS, RFD 2, Alexander, Iowa.

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"Not long ago I was working 16 hours a day in a filling station at $10 a week. Now I have my own radio business and average over $60 a week. The N.R.I. course is fine."—ALBERT C. CHRISTENSEN, 116—10th Avenue Sidney, Neb.

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

MAY • 1945

VOLUME 33, NUMBER 5

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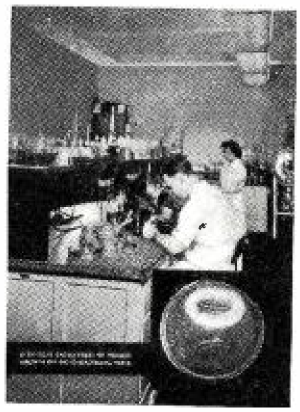

COVER PHOTO
Courtesy
Belmont Radio Corp.

Fungus-proofing of electronic equipment destined for our Armed Forces has been made possible by the diligent efforts of radio manufacturers in laboratories similar to the one depicted on the cover.

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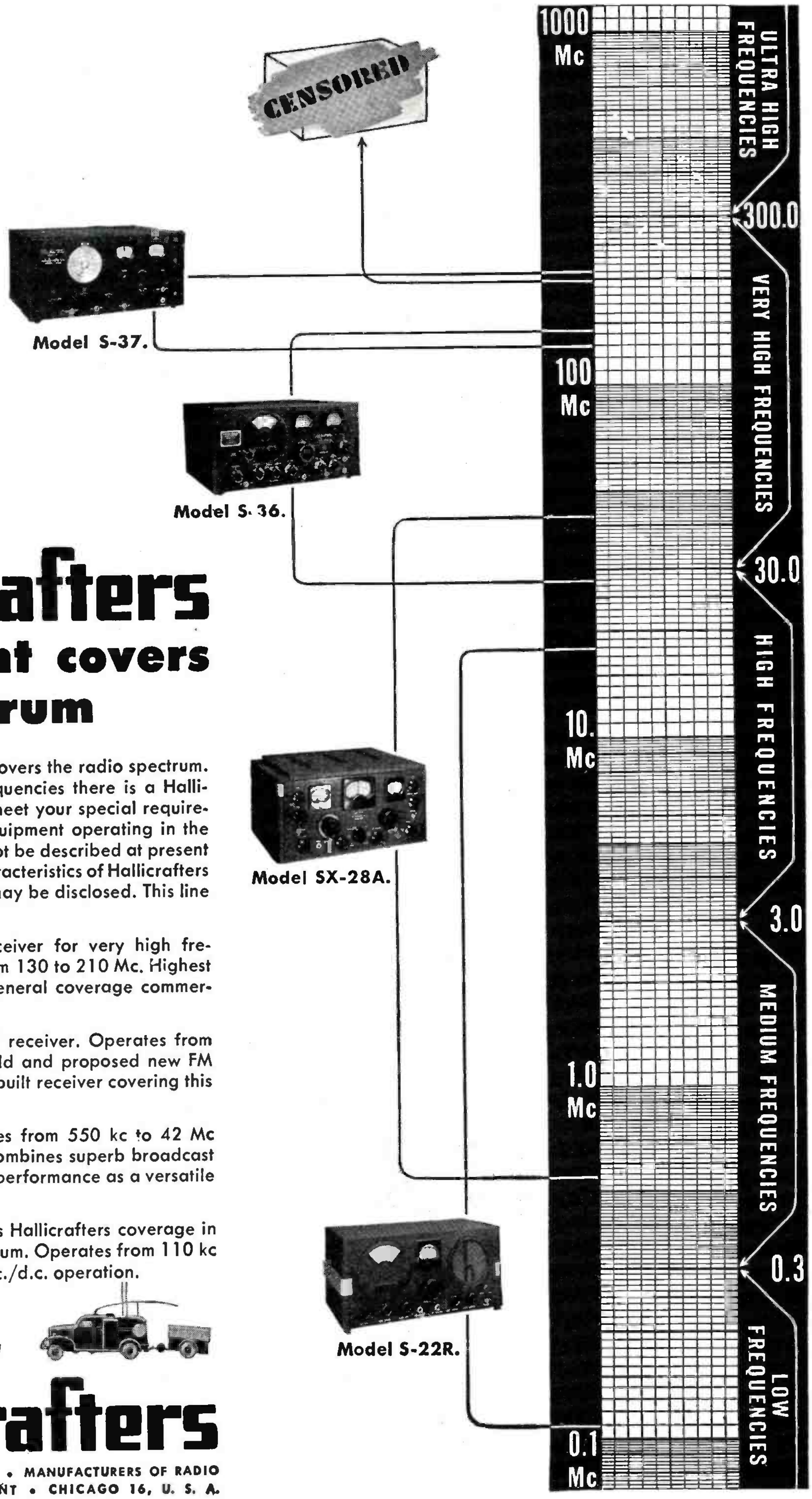

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FOR THE RECORD

by the editor

IN examining several nationwide surveys completed recently, we find a considerable difference in the estimated number of sets that will be produced during the period of five or six years following the conclusion of the war.

According to the survey of one leading set manufacturer, it appears that there will be an immediate demand for at least 25,000,000 new radio receivers.

Another large manufacturer, in fact one of the largest in the country, predicts that there will be a postwar market for 60,000,000 receivers. That's a lot of sets. In fact, enough to keep our industry going full blast for approximately six years.

Still another, this time a large tube manufacturer, predicts that American families will buy 100,000,000 radios within the first five or six years after total victory. And so the speculation goes. The ratio of 4 to 1 based on three surveys does not give us any confidence that any of the above figures could be considered as highly accurate. All of the surveys were conducted upon a similar basis. Therefore, it is rather hard to understand such a variation.

The biggest portion of the market appears to be coming from American families preferring combination radio-phonograph models. One survey states that many people have reported that they will pay $75.00 additional for television and will spend $10.00 additional to have FM. When the $10.00 figure is halved to $5.00, then almost unanimously they say they will want FM. This breakdown indicates that Mr. and Mrs. America have not as yet been sold properly on FM or that they have been entirely satisfied with the present standards of AM transmission and reception. Forgetting the technical aspects, does this not prove that as far as the *average* ear is concerned, present services are adequate to satisfy even critical listeners?

We would like to see a survey which would show how many people encounter interference on the present AM channels. It seems to us that this would give a better indication as to the true worth of the FM market. There are now over 30,000,000 radio homes in the United States with an average of 1.54 sets per home. When manufacturers get into full production, it is estimated that the average will rise to two sets per home and possibly more. Best guesses indicate that over 20,000,000 families will buy new receivers once they become available. Of these better than 45% indicate they will purchase radio-phono models. In addition, they have indicated their preference for console types. But the manufacturers of small sets will also find a tremendous market for table-model receivers suitable for use in the bedrooms, rumpus rooms, kitchens, etc.

HUNDREDS of overseas readers of RADIO NEWS have sent us letters and many of them have pleaded to standardize upon panel dimensions in postwar "ham" rigs. There has been a definite need for such standardization for many years. The familiar hodgepodge found in most "ham" shacks makes anything but a neat appearing assembly.

We strongly recommend that manufacturers take cognizance of the fact that their potential purchasers are thinking along these lines and that something be done about it.

We recommend that the front panel of all receivers, oscilloscopes, frequency monitors, etc., be standardized at a 19" width and that holes and slots be drilled to the amateur specifications set up many years ago. These standards would also apply to low-powered transmitting equipment. The only exception would be the large factory-made transmitters which consist of elaborate band switching arrangements and could not employ a short panel width for successful mechanical assembly of their units.

We have long had standard panel widths. We should like to see these retained in their present sizes. As long as blank panels are available, it is a simple matter to arrange a workable assembly and to have a far better balanced station.

Our staff is now engaged in the design of several postwar "ham" stations which carry out this standardization idea. First in the series will appear shortly.

The above does not apply only to amateur equipment but to such units as are used for semiprofessional recording, etc. These, too, will be presented.

LOOK for few or no major changes in the FCC's January recommendations on frequency allocations. The oral hearings late in February and early in March before the Commission in Washington turned out to be largely for the record and will not change it. Minor adjustments in the FM-tele-

(*Continued on page 88*)

CLEVELAND YELLOW CAB COMPANY
Uses RAYTHEON TUBES
in world's first taxicabs with two-way radio!

The eyes of the nation's transportation industry are on Cleveland these days, for it is there that the world's first taxicabs equipped with two-way radio are being demonstrated by the Cleveland Yellow Cab Company.

Officials say that dispatching has proved so much more efficient that future fleets similarly equipped will eliminate millions of miles of wasteful "dead" cruising. And they also report that Raytheon High-Fidelity Tubes, used in both transmitter and receivers, provide clear, dependable reception—even in the tunnels under Cleveland's Terminal Tower.

This application of Raytheon Tubes is just one of many being planned for the postwar period by progressive manufacturers in the electronics field.

If you are a radio service dealer, you, too, should realize that Raytheon's combined prewar and wartime tube experience will result in even *better* tubes for all uses. Keep an eye on Raytheon . . . and watch for a Raytheon merchandising program that will help you be more successful, in the peacetime years ahead, than you've ever been before!

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Increased turnover and profits . . . easier stock control . . . better tubes at lower inventory cost . . . these are benefits which you may enjoy as a result of the Raytheon standardized tube type program, which is part of our continued planning for the future.

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ELECTRONIC AND RADIO TUBES

DEVOTED TO RESEARCH AND THE MANUFACTURE OF TUBES FOR THE NEW ERA OF ELECTRONICS

Spot Radio News

By RADIO NEWS Washington Correspondent

Presenting latest information on the Radio Industry.

THE MONTH OF MAY appears destined for radio history. For that month should see definite decisions on all frequency allocations including those below 25 mc., which as yet are to be published. The most complex portion of the study covering the 10-30,000-mc. spectrum is now in the polishing stages.

Industry presented its arguments for modification of the proposals issued January 15, during a three-and a-half day session which began on February 28. FM problems occupied most of the debating time. As revealed last month, Panel 5 of the RTPB and the FM Broadcasters, Inc., were completely opposed to the 84-102-mc. move. Panel 5's report challenged Dr. Norton's calculations as inaccurate and offered the testimony of Dr. Beverage to disprove Dr. Norton's presentation. They indicated that their recommendations were in accord with the technical data supplied by Dr. Dellinger of the Bureau of Standards and Dr. Beverage of RCA Labs. The Panel said that Dr. Norton had based his conclusions on interpretations rather than factual material.

An unusually thorough analysis of the industry's FM challenge to Dr. Norton's data appeared in a special memorandum prepared by Major E. H. Armstrong, Dr. H. H. Beverage, and Charles R. Burrows, who is with Bell Labs. The report was made in collaboration with Dr. W. G. Pickard, a consulting engineer; Dr. H. T. Stetson of MIT; and Stuart Bailey, consulting engineer with offices in Washington, D. C. Discussing this challenge, Major Armstrong stressed the fact that the FM assignment problem was the most important that the Commission has ever had to solve. It was the Major's belief that the technical and economic aspects provided by a solution to the problem will be of material importance to the radio industry in which FM is scheduled to become a vital factor. Major Armstrong pointed out that the phenomena involved are understood by but a few engineers and even these experts declared the subject to be a complicated one.

The three problems that caused the FM followers and Dr. Norton to disagree were F2 layer, sporadic E sky-wave transmission, and tropospheric wave transmission. The F2 layer consists of reflections from the highest electrified strata of the upper atmosphere. Major Armstrong said that interference from this transmission was predicted for frequencies now being used in FM broadcasting during the peak years of the eleven-year sunspot cycle. Only during the daylight hours of the winter months can this type of transmission take place. He said that it can occur over long distances and generally appears a couple of thousand miles away from the transmitting station skipping over the intervening territory. At the present time he said this interference is occurring at much lower frequencies than are being used at present. As the sunspot cycle is approached, the wave frequency at which this interference occurs increases. It is this point that has prompted the controversy, which is, how high the frequency will go when the sunspot is at maximum.

Analyzing sporadic E, Major Armstrong said that this transmission consists of reflection from a lower or intermediate level due to ionized sections of the atmosphere. It is, however, more or less independent of the sunspot cycle. It has been known to occur during daylight or darkness but it is more prevalent during the summer. As the frequency increases this form of transmission decreases. Major Armstrong said that the rate at which it decreases is not too well known. Skipping is also a characteristic of this form of transmission. According to the Major, its effect is noticed at 500-1000 mile distances.

Bending of the waves at points within a few miles of the earth's surface, provides the tropospheric form of wave transmission. The Major said that this form of transmission is also independent of the sunspot cycle and occurs during daylight or darkness. The effects of these waves appear to increase with the frequency of the transmission, but according to the Major, there isn't much information available as to the rate of change. Oddly enough, this form of transmission has no skip distance, revealed the Major; instead it makes its presence felt over an area that may extend over hundreds of miles around the transmitting station.

Since the F2 layer transmission was considered to be more important as an interference factor than the sporadic E, according to testimony offered by Dr. Norton, Major Armstrong dwelt at length on F2 layer transmission. Major Armstrong pointed out that the Bureau of Standards in Washington has studied for many years the relation between the condition of the ionosphere and long distance transmission by way of the F2 layer. He said that they have devel-

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oped a technique for predicting the frequencies for which transmission may occur over specified distances. This information served as a basis of appraisal in the RTPB report, he indicated. Major Armstrong then disclosed that Dr. Beverage had testified that the highest transmission frequencies from Europe which he had ever observed by F2 layer transmission was 45 megacycles and the highest from South America was 43 megacycles.

Major Armstrong said that Dr. Norton had predicted transmission on the F2 layer running up to over 100 megacycles, which was about twice as high as has been heretofore accepted as the upper limit for this type of transmission.

Using the equator as a focal point of study, Major Armstrong said that since the equator is approximately 3,000 miles from the eastern centers of population and since the longest single hop which can take place is about 2200 miles, transmissions coming from South America must arrive in the eastern United States by two, three, or more hops. It is important, he said, that the condition of the ionisphere at each point of contact be considered. In Dr. Norton's predictions, according to Major Armstrong, only the point over the equator, or the strongest link in the chain, was considered.

The television observations from London made by Dr. G. W. Pickard at Seabrook Beach, New Hampshire, during two years of the sunspot cycle (which began in 1936) were also revealed by Major Armstrong in his testimony. He pointed out that Dr. Pickard had reported signal peaks of about 10 to 20 microvolts per meter at an antenna height of 50 feet on 41 megacycles, and a substantially weaker response on 45 megacycles (on sound channels). It will be recalled that Dr. Norton and Mr. Allen of the FCC had applied data on television reception from this London station as an interference factor basis in their discussion. Accordingly, Major Armstrong was quite keen in presenting testimony that challenged the FCC experts' data.

Major Armstrong also offered data from a paper on transatlantic reception of London television signals by D. R. Doddard, which appeared in the IRE Proceedings in 1939, to further support this television testimony. According to this paper, during only 10% of the days listened did the signal on a 45-megacycle channel rise over 10 microvolts per meter. Major Armstrong pointed out that the peak power of the London television transmitter, when modulating white, could have produced at the receiving point on Long Island, on the basis of an inverse distance field, a maximum value of field strength of 170 microvolts per meter.

Discussing sporadic E interference, Major Armstrong pointed out that there appears to be no problem between low-powered stations capable of covering 50 miles or less with antennas having heights of 1000 feet. He also pointed out that if the antenna heights were half as high, the interference problem also would be minimized.

To eliminate all possible suspicion that he had a selfish motive for keeping the FM band at its present assignment, Major Armstrong offered to surrender all royalties for a year. His concluding recommendations were that the 44-108-megacycle band be distributed so that amateurs would receive the lower end, FM would begin close to its present point and extend about 30 megacycles and television should have the remaining upper frequencies.

Dr. Norton presented a comparatively brief analysis of the reasons for the upward move of FM. Prior to the presentation of Dr. Norton's testimony, FCC Commissioner E. K. Jett praised Dr. Norton for his outstanding work throughout the world, during the past years, on wave propagation. FCC Chairman Paul Porter complimented Mr. Jett for offering this statement which was entered into the record. Dr. Norton said that his conclusions were based on extensive field tests. He pointed out that he had driven over hundreds of miles of roads in the eastern part of the country observing field intensities and listening to the signal noise ratio in level, hilly, and mountainous areas. He realized during these tests, he said, that FM would provide effective service if it could be free of interference problems. As a result of these trips and a study of the data on sporadic E presented by Dr. L. P. Wheeler, also of the FCC, he said he realized that this skywave interference would be sufficient to substantially reduce FM service areas.

His report showed that sporadic E on 44.3 mc. was received in the vicinity of Atlanta, Georgia, from a station in Paxton, Mass., during 12% of the time in July, 1944, with sufficient intensity to record the interference at a 50 microvolt contour. He said that his analysis of the Bureau of Standards' data on sporadic E indicated that this interference would be expected to exist for a much smaller percentage of the time above 80 megacycles. Clarifying the cochannel low-powered station operation problem, Dr. Norton said that the actual area free from sporadic E interference will be exactly the same regardless of power used so long as the power is the same for both stations. Therefore, when sporadic E interference exists, it will cause cochannel stations to interfere with each other throughout all areas beyond a certain distance from each station. He pointed out that the use of low power will not correct this situation, and accordingly, rural low-power station listeners

(*Continued on page* 18)

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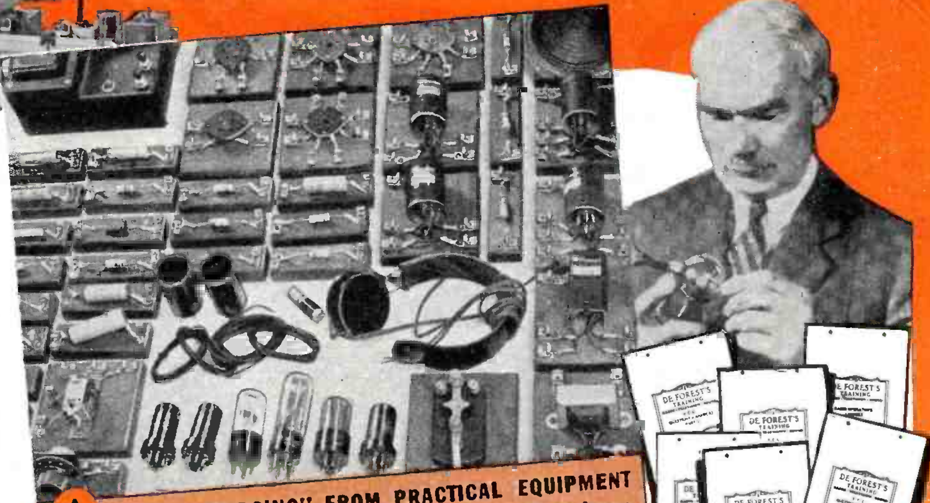

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"I cannot impress too strongly on anyone who may be considering taking your course the value of both the training and the employment service that goes with it. This service is not merely an empty promise, but a truly conscientious effort that continues until its job of preparing you is done." —*Philip Cummins, New Jersey.*

"I am amazed at the many subjects I have learned with DeForest's. I also want to praise your motion picture lessons. It is truly amazing, how well the action of electricity is brought out. I feel safe in saying that no book could ever establish effectively those principles and actions so well in my mind." —*Yale Schott, Texas.*

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SCGSA

(SIGNAL CORPS GROUND SIGNAL AGENCY)

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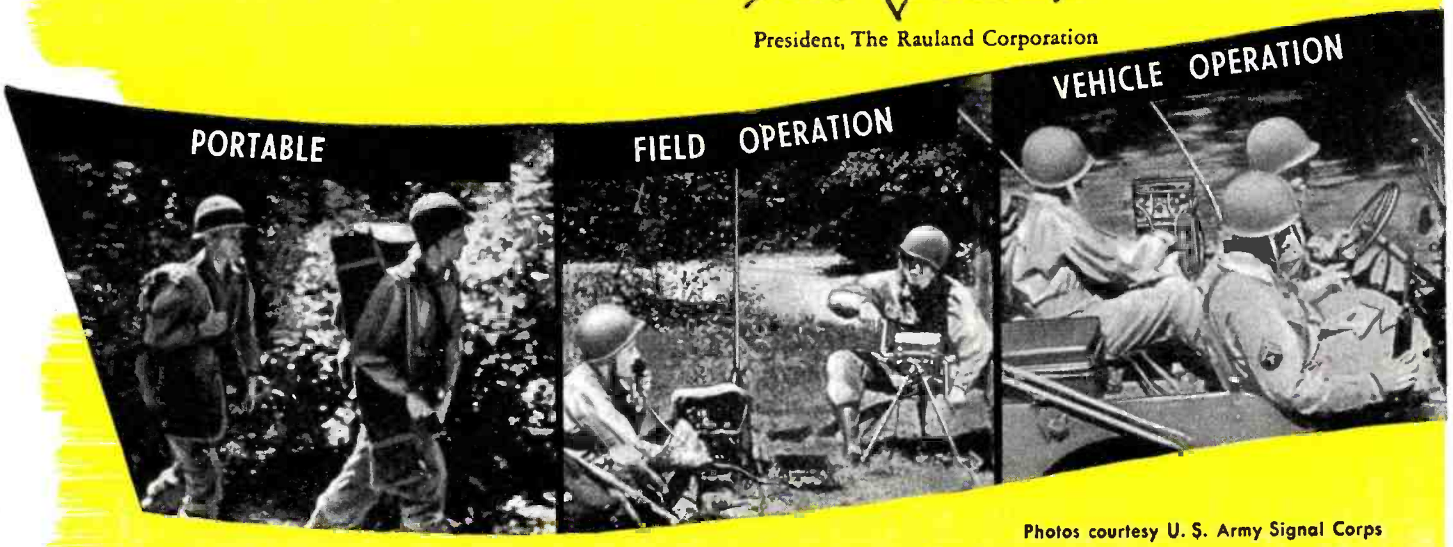
The Laboratory . . . here are born electronic weapons that are making history. Our American systems of army communications have proved mighty factors in our fighting successes, due primarily to the remarkable achievements of the Signal Corps Laboratories, known as SCGSA, comprising a chain of research units under one centralized supervision. At one of these Laboratory Units, Camp Coles (pictured above), was conceived the SCR-694, a compact, lightweight, highly versatile and efficient two-way radio telephone and telegraph outfit, for use in vehicles, as a portable ground station or front line command post.

It is a pleasure to give full recognition to the creative genius and organization of SCGSA and the really vital work it accomplishes, necessarily without public attention.

E. N. Rauland

President, The Rauland Corporation



Photos courtesy U. S. Army Signal Corps

RADIO • • RADAR • • COMMUNICATIONS • •

Rauland esteems it a high honor to have been

(*Continued from page* 14)

would suffer from this interference.

Dr. Norton pointed out that the tropospheric wave problem can be overcome by simply increasing the geographical separation between co-channel stations on the higher frequencies.

Because of security reasons Dr. Norton was unable to discuss in full detail the F layer interference data that provided his conclusions. He suggested a closed session under military supervision for a discussion of this problem. Major Armstrong agreed to attend such a session. Other experts including Dr. Jolliffe of RCA, and Dr. Burrows also agreed to appear. An associate of Dr. Beverage indicated that Dr. Beverage would be present too. The sessions covered a two-day period, and it is believed that several other experts, in addition to those just mentioned, from industry and government, attended. Since all the testimony was impounded by the military, no statements were available as to any decisions that were reached. However, it is believed that some report will be issued when the final allocations program is announced.

RECEIVER MANUFACTURERS WERE DIVIDED in their opinions on the FCC move of FM. John D. Reid of Crosley supported the FCC's proposal by offering five receiver-design features that would be provided by the move upstairs. The advantages offered were: 1) removes television from the high side-band image, thus allowing the best over-all stability to be obtained; 2) enables band-pass input circuits to be used; 3) reduces likelihood of long-distance interference; 4) reduces amplitude of ignition interference; and 5) enables a built-in antenna to be used.

He said that tuning of the input circuit of an FM receiver on the higher bands will not provide any appreciable attenuation of the adjacent local channel station. Comparing this to the standard AM band, he said that an average of 12-decibels attenuation of the adjacent local channel is obtained from a single-tuned input circuit. He also pointed out that the 84-102-megacycle band is small enough percentage-wise so that antenna gains of approximately two can be obtained from band-pass circuits. The use of a band-pass input circuit simplifies receiver design, improves image-frequency attenuation, and reduces receiver cost, emphasized Mr. Reid.

Mr. Reid also pointed out that an increase in width of the FM broadcast band would require a wider channel spacing than 200 kilocycles between stations. This comment was prompted by the suggested expansion of the FM band to 78-108 megacycles which, he said, would greatly increase receiver selectivity problems and cost.

M. L. Levy of Emerson Radio also supported the FCC proposal. He pointed out that his company realized the many problems involved in high-frequency receiver design, but they were also aware that the transfer to the higher frequencies would provide for improved results. Discussing the technical revisions necessary, he said that while a new intermediate frequency will be required for the higher channels, the problem is not a complicated one, for the industry is quite familiar with high-frequency i.f. design. There should be no difficulty in designing a suitable antenna system either, he said. The higher frequencies afford a tuning ratio that is less than at the lower frequencies, for the same number of channels, according to Mr. Levy. This, he said, is quite an advantage.

Several manufacturers opposed the FCC recommendations, stating that the changes in frequency would involve new designs that would delay FM progress from one to two years and also increase receiver costs. Among those in this opposing class were Stromberg-Carlson and General Electric.

Interesting testimony supporting the FCC move was presented by Cyrus T. Read of Hallicrafters. Mr. Read said that the phenomena of sporadic long-distance transmission was very well known. He cited the interference experiences of amateurs operating between 56-60 megacycles with low power. Reports issued by the ARRL indicated that little interference was encountered between 112-160 megacycles, disclosed Mr. Read. Commenting on the expense involved in converting receivers or developing new receivers, he said that it was entirely possible to build an inexpensive and simple converter that could raise the frequency range of present FM receivers with a minimum of trouble.

The simplicity of installation of a low-cost converter was described in a surprise post-hearing meeting by George Turner, chief of the FCC Field Division engineering department. He testified at a special session several weeks after the February hearings had been completed that his department had built and successfully operated a converter costing less than $9, using materials readily available at most retail stores. In a demonstration he connected the converter to a popular brand high quality FM receiver and tuned in the FCC low-powered transmitter operating on 97 megacycles without much trouble. During the demonstration Mr. Turner also used the converter described by Mr. Read of Hallicrafters quite effectively.

TESTIMONY ON THE ACTUAL QUANTITY OF FM RECEIVERS THAT HAVE BEEN MADE was replete with surprises. The figures were offered by Dallas Smythe, Chief of the Economic Division of the FCC accounting department. He reported that only 13,388 exclusive FM receivers have been manufactured to date.

The greatest bulk, 365,648, were combinations. Mr. Smythe also said that 16,719 FM adaptors have been manufactured. Discussing the relative costs of this equipment, Mr. Smythe said that exclusive FM receivers cost over $3,000,000; combinations were valued at over $71,000,000; and the FM adaptors' cost was slightly over $800,000.

A NOVEL RADIO SERVICE was proposed by Doctor Daniel E. Noble of Galvin in his testimony on limited private telephones. He pointed out that while the FCC provision of frequencies for a citizen's "walkie-talkie" service was admirable, it did not replace the limited private telephone proposal he had in mind in his original testimony. In the 460-470 megacycle band severe shadowing effects may be encountered, said Doctor Noble. This, plus the high battery drain and limited receiver sensitivity would make the "walkie-talkie" service impracticable for private telephone use. To overcome this problem, Doctor Noble proposed a provisional radio service which would provide for a new classification to be known as a class two provisional station.

Such a station would be portable or portable-mobile of 1-watt output, with a crystal-controlled transmitter. FCC approval would be required for station design. Manufacturers would also receive certificates of approval from FCC for their designs. Such equipment would be quite useful in communications service, at bridge constructions, road building, and other similar points.

A channel somewhere between 30-44 megacycles was suggested by Doctor Noble for this service. Commenting on the interference problems that might prevail, he pointed out that there are today several thousand portable 1-watt FM stations operating on the 42-48-mc. band without any interference problems.

Doctor Noble said that the simplified licensing procedure and liberalization of FCC rules for these stations would provide a very useful low-powered service that would benefit communities as an emergency and protective utility.

FIVE FM STATIONS WILL SOON GO ON THE AIR in an experimental program to study FM operation. The WPB has given permission to WAPI, Birmingham, Alabama; KLZ (W9XLA) Denver; WDH (W1XMR) Boston, Mass.; WITH (W3XMB) Baltimore; and WGST, Atlanta, Georgia to purchase 1-kilowatt transmitters. The transmitters were built prior to the war, but were frozen because of war restrictions. With these transmitters on the air the FCC hopes to be able to compile data that will assist them in appraising allocations and station locations.

The Birmingham station will operate on frequencies in the present and in the proposed bands. The transmitter in Denver will employ relay stations at the fringe of its service areas to study terrain reaction. A new type of horn radiator antenna will be used by the station in Boston, which will also operate on the present and the proposed FM bands. Cochannel interference problems will be studied by the station in Baltimore, which plans to broadcast simultaneously with W3XO in Washington. This station is owned by Jansky and Bailey. WGST is operated by the Georgia school of Technology who will study FM operation in its many phases.

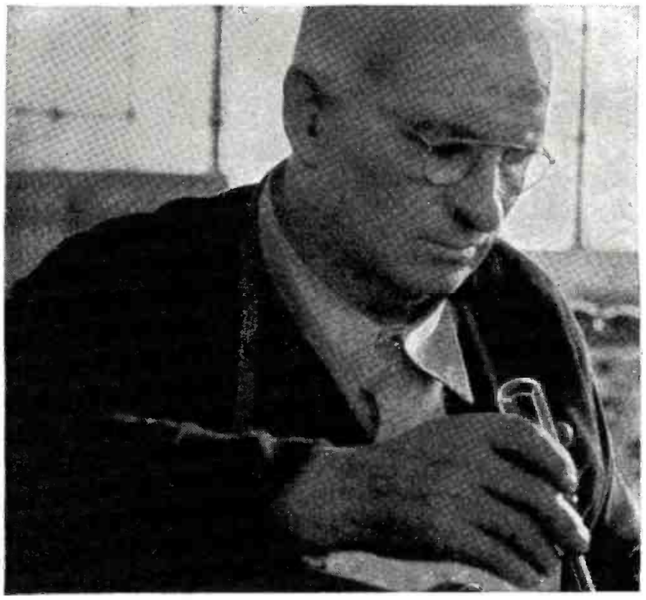
It is also possible that the WPB will assign transmitters to W9XEV Evanston, Ill., and the Cowles Broadcasting Co. for a station in New York. The Evanston, Ill., group plans to use the present frequency and the proposed frequency assignments and perhaps also apply pulse modulation, which was described in this column last month.

TELEVISION GROUPS WERE IN FULL SUPPORT OF THE FCC PROPOSALS. Speaking for Philco, David B. Smith said that the 12 channels proposed by the FCC for immediate commercial television, plus those which may later be added, will permit several hundred stations to go on the air after the war and provide a large part of the public with a regular television program service on at least one channel. Complete agreement with the Commission, that years will be required to fully develop television in the 480 to 920 megacycle experimental band was also cited by David Smith.

Former FCC Commissioner, Commander T. A. M. Craven, who is now with Cowles, supported the FCC proposals, but stressed the point that the high frequencies should not be set aside for future use. He pointed out that it was entirely possible that manufacturers may be able to supply high-frequency television equipment six months after commencement of manufacture instead of twelve, as previously believed. To support this evidence he read a letter from one prominent manufacturer. If such equipment is available, said Commander Craven, and we can demonstrate high-definition pictures and color, it would be wise to assign higher frequencies as quickly as possible after the war and thus avoid confusion. He said that if we can demonstrate this improved form of television shortly after the war, the public will certainly choose the better form of television available. When questioned about the u.h.f. receivers that will be necessary he said that one manufacturer had arranged to provide them within a short period of time.

SOME STRIKING DATA ON TELEVISION was offered by Dr. Thomas T. Goldsmith of the Du Mont Labora-

(*Continued on page* 92)



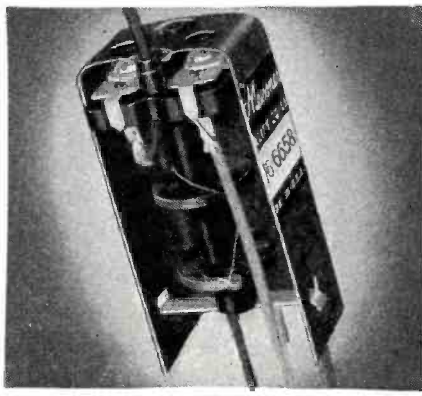
He has mastered his craft. Each movement of his sure, deft hands adds Meissner quality to the precision electronic equipment he builds. Dedicated to the armed forces today, tomorrow his skills will mean Meissner precision-built products for you.

MT. CARMEL HAS AN EYE TO THE FUTURE

"Personnel" is an outmoded word in the little city of Mt. Carmel, Ill. Why? Because it has been replaced by "precision-el," a word that more aptly describes the men and women whose skills and enthusiasm produce Meissner precision-built products for a world at war and who will soon help rebuild a world at peace.

A scene "Behind the Front." Skilled Meissner workers are turning out vital electronic war equipment. Their "know-how" means dependable weapons for our boys at the front now — it will mean better performance for you in tomorrow's products.

They live in the future! Through their hands pass the work of Meissner's "precision-el," embodied in Meissner precision-built electronic equipment now going to our armed forces. Many of the parts they now handle as part of their daily routine will mean new comforts in postwar living.



"Step Up" Old Receivers!

These Meissner Ferrocart I. F. input and output transformers are getting top results in stepping up performance of old worn receivers. Special powdered iron core permits higher "Q" with a resultant increase in selectivity and gain, now available for frequency range 127-206. Ask for numbers 16-5728 input, 16-5730 output. List $2.20 each.

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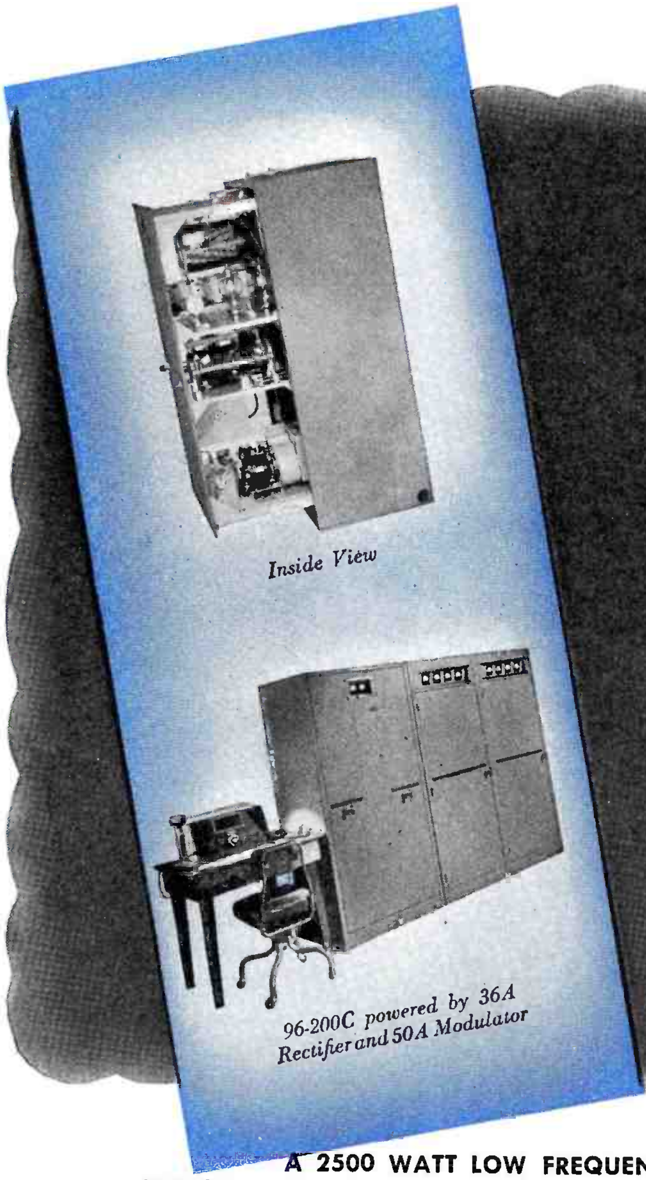
Is Your Promise for Future Performance

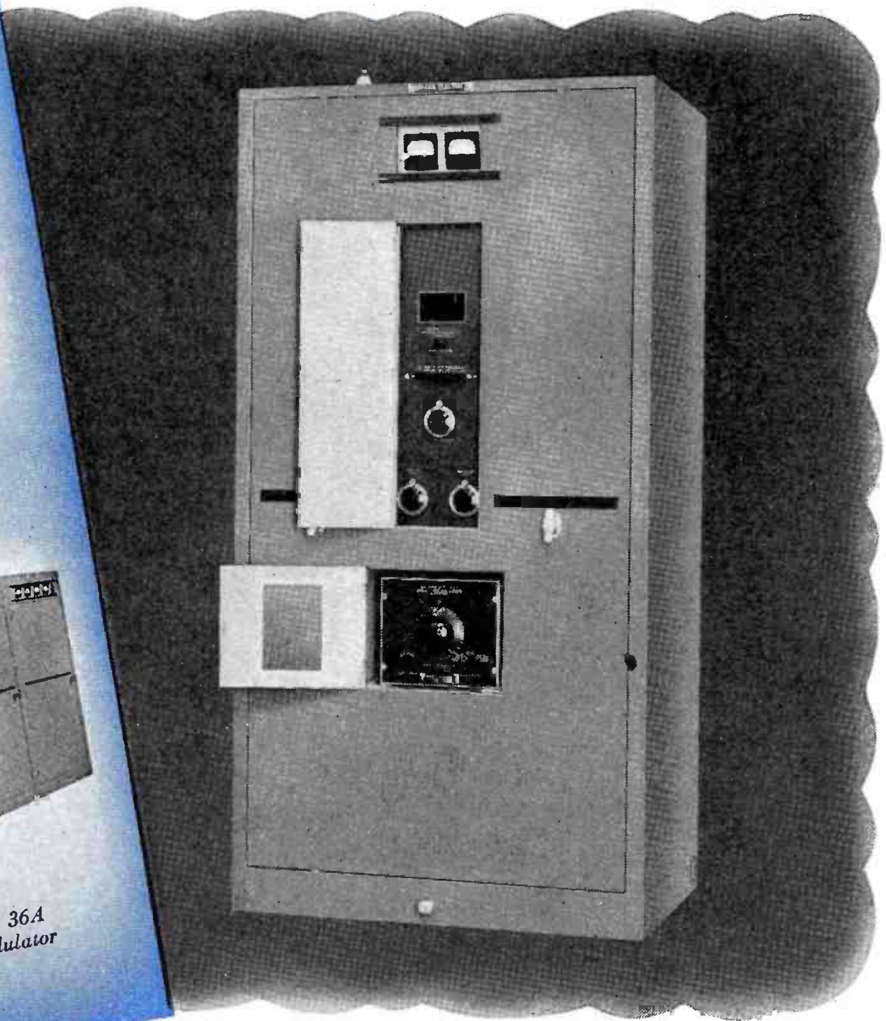
For many years, Wilcox installations have performed distinguished service in the flight control operations of the major air-lines of the nation and at broadcasting stations. During war years, new manufacturing techniques and new products have been developed to meet military needs.

Now, while Uncle Sam's orders have first priority . . . Wilcox Radio communications equipment is becoming available again. An expanded and improved line is being developed and completed to continue the leadership long associated with the Wilcox trademark in the field of radio equipment.



Inside View

96-200C powered by 36A Rectifier and 50A Modulator



A 2500 WATT LOW FREQUENCY TRANSMITTER

96-200C Transmitter designed for navigation aid, point to point, facsimile, radio teletype, or telephone-telegraph radio unit.

SPECIFICATIONS:

Power Output, 2500 watts.
Frequency Range, 125 KC to 525 KC.
Oscillator, crystal and/or master oscillator.
Modulator, 50A High-Level, Class B.
Power, 36A Rectifier.
Construction, Treated for tropic fungus or Arctic Cold.
May be used with 96C 2-20 MC transmitter.

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"HE WAN'STA KNOW WHY THEY CALL THIS THA' PACIFIC THEAYTER"
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Behind bombing missions and dog fights
at every one of our invasion points
you'll find Super-Pro receivers
on twenty-four hour duty with the AACS
under almost impossible
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INTER-AMERICAN RADIO

Like stations in the United States, modern building design is prevalent in South America (Radio Chilena, Santiago, Chile).

By JOHN W. G. OGILVIE
Dir. Radio Div., Office of Inter-American Affairs.

The author was born in New York; graduated Hamilton Col. and Oxford University. Joined staff IT&T, 1927; assigned to Cuban Tel. Co. Later transferred to Argentina, until 1935. Served as pres., Radio Corp. of Porto Rico. Assigned to Spanish Tel. Co., 1937, during Spanish Civil War. Returned to N. Y., 1938 as head of radio operations for IT&T. Joined CIAA, 1941; appointed Director of Radio Division. Arranged first broadcast from Puerto Rico to U. S. A.

The free exchange of information via international short-wave is one of the essentials for the maintenance of friendship and understanding between the United States and other peace-loving nations.

THE United States has reached a stage in the conduct of its foreign affairs where we must recognize that public opinion abroad is a major factor in influencing international relations. In order to promote friendships and to prevent misunderstandings, it is essential that the character, intentions, and actions of the United States be made known to the peoples of other nations.

Although all media can and should be utilized in the field of information, international short-wave radio broadcasting is the only medium not subject to foreign censorship and control. Further, no other medium can compare with short-wave for speed and magnitude of mass communications.

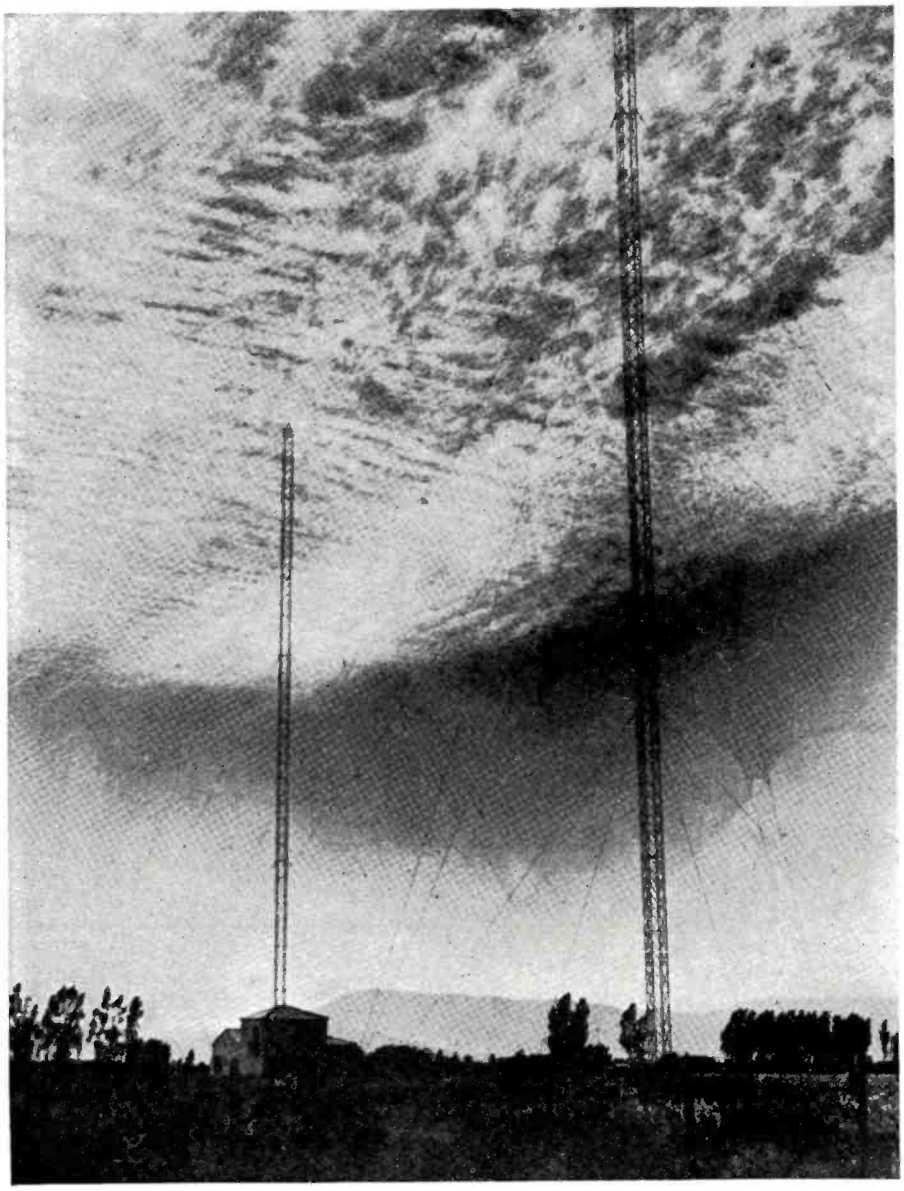
As the peace-loving nations of the world embark on the huge task of bringing about concrete realization of the Dumbarton Oaks proposals providing for a United Nations security organization and an economic and social council, it is of the utmost importance that the views of the United States, to which so many look for leadership, be freely disseminated to all parts of the world. Direct international short-wave broadcasting possesses unique virtues for such an informational operation.

The importance of future activities in inter-American as well as other international short-wave broadcasting has been emphasized by Secretary of State Edward R. Stettinius, Jr., who recently said: "Short-wave radio broadcasting is an indispensable instrument for creating an understanding of the United States."

The viewpoint of the Office of Inter-American Affairs, which has engaged in short-wave broadcasting to the other American Republics, was recently expressed by Assistant Secretary of State Nelson A. Rockefeller before the Federal Communications Commission. Testifying as Coordinator of Inter-American Affairs, the office he then held, Mr. Rockefeller said:

"It is inconceivable to us, as a result of our experience, that other nations would be willing to eliminate international broadcasting. It is our

Broadcasting from the Departmento de Imprensa e Propaganda studio in the DIP building, Rio de Janeiro, Brazil. DIP broadcasts one hour nightly on all stations in Brazil.



An elaborate array of transmitting antenna towers (Radio Sociedad Nacional de Mineria, CB126) at Santiago. The rural location is ideal for foreign transmission.

unqualified recomm
the United States '
direct international
casting facilities
those of any other
The Office of
fairs, established
the purpose of
defense and of
bonds between
Western Hemi
wave broadcasting op...
endeavor to promote the fullest p
sible exchange of information among the American Republics.

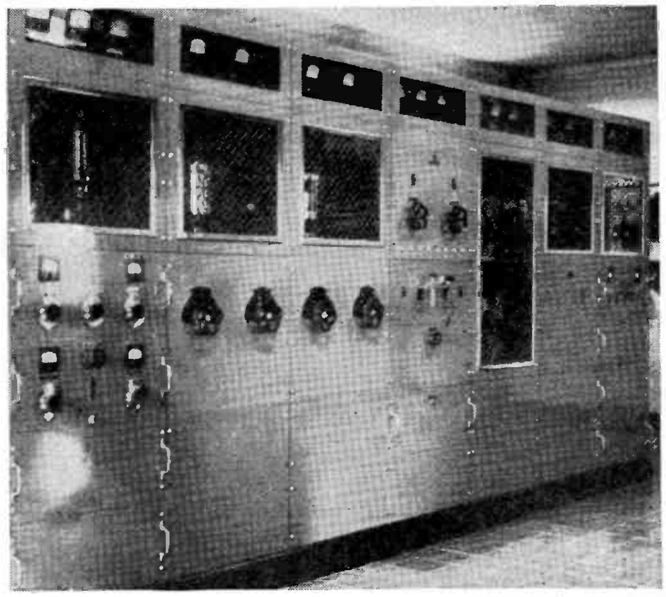
At the time the Office of Inter-American Affairs entered the international broadcast field, United States short-wave was far behind that of our enemies and our allies as well. Many powerful transmitters operated by Germany had for years been beamed to the other American Republics as well as to the rest of the world. German programs were planned and directed by personnel skilled in the Nazi technique of division and conquest. Japan, too, had long been making effective use of radio as a medium of mass communication to the other American peoples. Her purposes also were to mould public opinion against democratic faith and principles.

Our allies, long before the outbreak of hostilities in Europe, operated international short-wave transmitters, directing programs in several languages to the peoples of the Western Hemisphere.

Upon the entrance of the United States into the war in December, 1941, our short-wave service could not be compared favorably with the services of our ally Britain or our enemy Germany. We had available for use 14 transmitters, owned and operated by six licensees. Although 14 transmitters were obviously inadequate to meet the wartime problems before us, we would have been in a serious position without them. We are indeed

Control room of Radio Nacional, PRE8, Rio de Janeiro. Recorded programs are an important part of daily broadcasting.

Transmitting equipment which is employed at a South American station. The design and construction are typically modern.



grateful for the ingenuity and pioneering work of these licensees.

Before Pearl Harbor, short-wave transmitters were located in five cities in the United States. Stations were programmed with alternate language patterns such as English, Spanish, Portuguese, Dutch, French, Czech, etc. The Government could not request the licensees to alter their several language programming patterns and change their beam directions to cover all of the other American Republics, as this would have placed a large financial burden on the companies. Because of the concentration of population and receiving sets on the East coast of South America in the vicinity of the two major capitals of Rio de Janeiro, Brazil and Buenos Aires, Argentina, the companies had concentrated on developing radio audiences in those areas.

As the licensees could not be expected to assume financial obligations to construct additional transmitters and to obtain sufficient Spanish and Portuguese language talent so that their stations could be programmed in one language throughout the broadcast day, existing transmitters were leased for exclusive use by the Government.

Leasing of available transmitters was effected in November, 1942. One-third of the transmitter time was allocated to the Office of Inter-American Affairs for short-wave broadcasting to the other Americas and two-thirds to the Office of War Information for broadcasting to the rest of the world.

These transmitters were insufficient to provide multifrequency coverage to the world, and therefore orders were placed to construct an additional 22 transmitters.

Because the Spanish and Portuguese talent available was limited, and the majority of the talent was concentrated in the Eastern part of the United States, it was decided to assign the transmitters located in the East to Spanish and Portuguese broadcasts and the transmitters on the Pacific Coast to broadcasts in English.

During the first year of Government operation of transmitters—namely, 1942-1943—the Office of Inter-American Affairs, in cooperation with NBC and CBS, produced from the studios of NBC and CBS all Spanish and Portuguese language programs. The program plan assisted NBC and CBS in maintaining their commercial identity, as a complete Spanish and Portuguese language service was offered by each network. This was desirable, as both licensees had established local radio station affiliates in the other Americas.

In 1943, when it became evident that more frequencies were needed to improve reception and that additional transmitters could not be built quickly, it was decided to discontinue the individual programming by NBC and CBS. Therefore, in July, 1943, the two Spanish language services of NBC and CBS were combined into a single service and sent out on teamed transmitters, which provided multifrequency coverage to all areas in the other Americas. Each licensee provided the program to the combined Spanish language transmitters on alternate hours.

The Portuguese language service, likewise, was programmed equally by NBC and CBS.

In order to provide programs for the English language transmitters of the United Network located on the West Coast, commercial sponsors and domestic networks cooperated by making available their finest United States domestic programs. The Special Services Division of the Armed Forces also supplied programs especially designed for their military personnel in the Western Hemisphere. As a result, the English language short-wave service is today the finest in the world.

Simultaneous broadcasting of the same program in the same language by teams of short-wave transmitters had an important and beneficial result. The radio listener in the other Americas was able to select from several frequencies, and the affiliate stations in the other Americas picking up short-wave programs for rebroadcast to local audiences were also able to select the strongest and clearest signal for rebroadcast purposes.

To augment Spanish and Portuguese short-wave programs produced in the United States, radio commentators, writers, actors, and technical experts were brought to the United States from the other American Republics. Language experts were especially needed, as there is considerable variation of Spanish terminology in the various regions of the Hemisphere.

In the field of radio, the Office of Inter-American Affairs, has, since its inception, sought to encourage especially planned programs originating in the United States for broadcast in the other American Republics; and special programs from or about the other Americas for domestic broadcast in the United States. This work is being carried on in several ways.

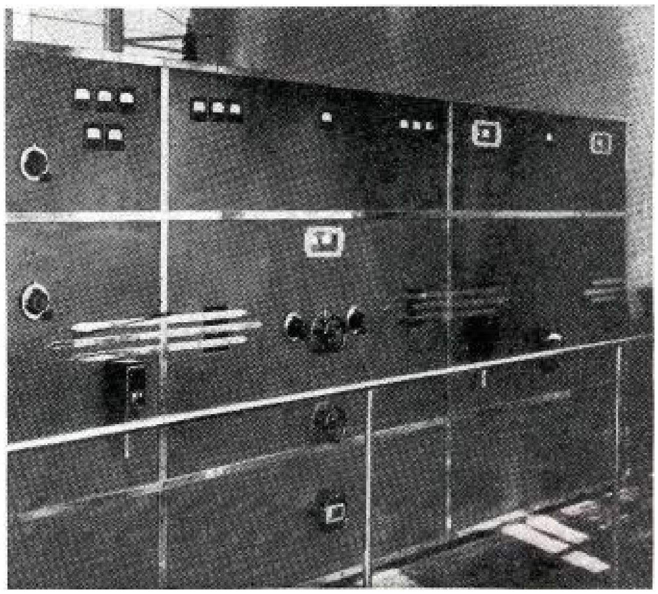
In addition to direct international short-wave broadcasting, it has been desirable, from time to time, to utilize commercial point-to-point services to the key areas of the Americas, for the purpose of having programs rebroadcast by local radio stations.

To reach all possible radio listeners, in the small towns as well as the large cities, transcription series, produced by Spanish and Portuguese talent in New York and Hollywood, are shipped to the other American Republics to supply stations in outlying areas.

Not only have transcriptions as-

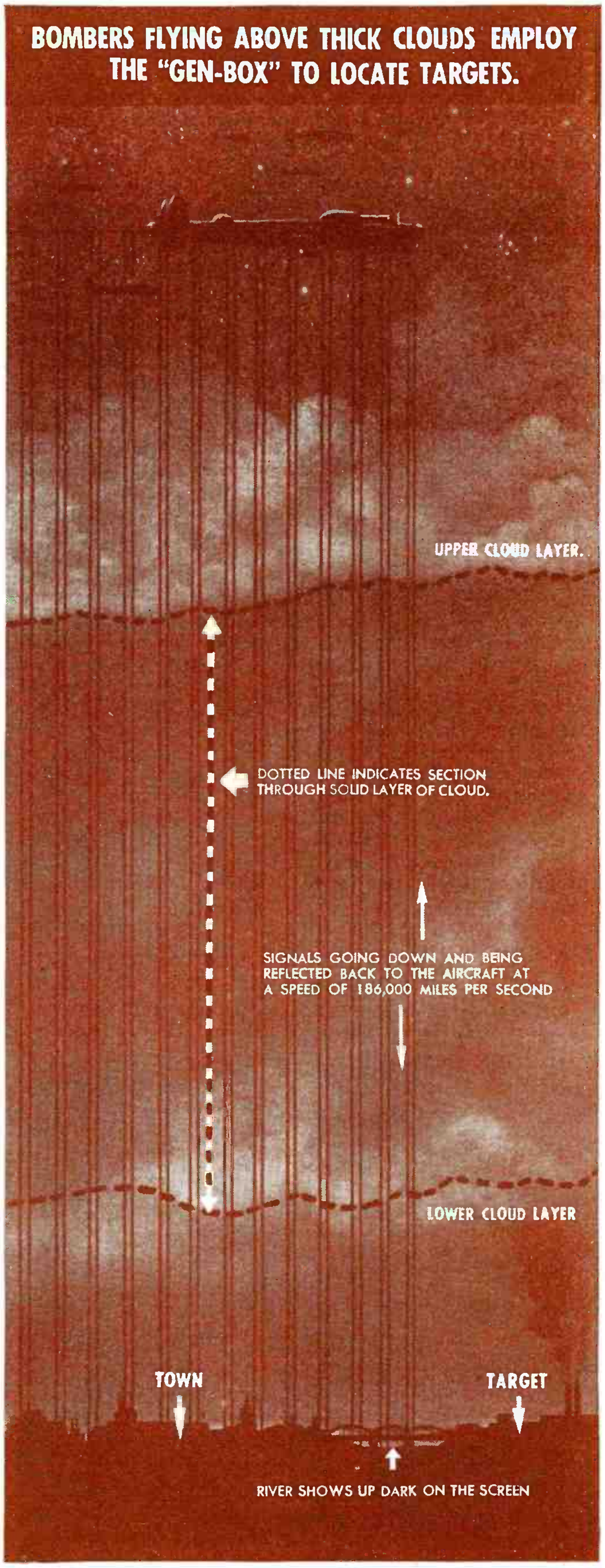
(*Continued on page* 101)

Director and assistant discuss with operator foreign transmitted program (Radio Sociedad Nacional de Mineria, CB126).



Modernistically designed transmitter of station Oliveria, Santiago. Many foreign broadcasts emanate from this station.

BRITISH ELECTRONIC



Diagrammatic drawing illustrating the "gen-box" principle, which "sees" targets invisible to the human eye, redrawn by RADIO NEWS staff artist, Julian Krupa, from an illustration appearing in The Illustrated London News.

By KENNETH R. PORTER

RADIO NEWS War Correspondent

ALLIED gunners and bombardiers are being helped on land, sea, and in the air by the aid of warlike electronic devices affording them almost occult powers of spotting enemy targets invisible to the human eye.

These devices are the outcome of years of wartime research conducted by teams of Allied experts bent on licking poor visibility existing under adverse conditions.

Undoubtedly, the provision of British anti-aircraft artillery with electronic aids earlier in the war was largely responsible for the wholesale destruction of German night bomber formations.

Whether or not the development of the electronic target indicator on the other hand, would have made as rapid strides as it did without the growing need for carrying out "nonabortive" bombing missions over enemy territory obscured by clouds and fogs or invisible in darkness, remains, of course, a matter of speculation.

Nevertheless, it is beyond dispute that electronically-aided gunfire and bomb aiming have become outstanding features of modern warfare and are destined to play an ever-increasing role in the future.

The Intersecting Radio-Beam Locator

At the beginning of this war, the RAF experimented with various aerial target locators based on the system of intersecting radio beams.

This system of locating targets by guiding night bombers to their respective objectives by the aid of two continuous radio beams intersecting with one another over the target was also used at the time by the Luftwaffe, and given a thorough test during the 1940-41 blitz.

Despite boastful German propaganda claims, however, it soon became evident from practical experience that this method of location was militarily a flop, as bombs released on the point of intersection under actual combat conditions invariably tended to fall off the mark. Failure, it was discovered, was due partly to the astonishing lack of imagination displayed by the Germans in countering Allied "jamming" interference and partly to the fact that directional calculations were worked out by ground-based personnel without leaving air crews sufficient latitude to correct marginal errors incurred in flight.

The British, alive to the limitations of this method of target spotting, decided without fail to break new ground and concentrating on electronically-controlled devices, shortly afterward gave birth to a range of radio-location equipment capable of defensive as well as offensive application.

The "Black-Box"

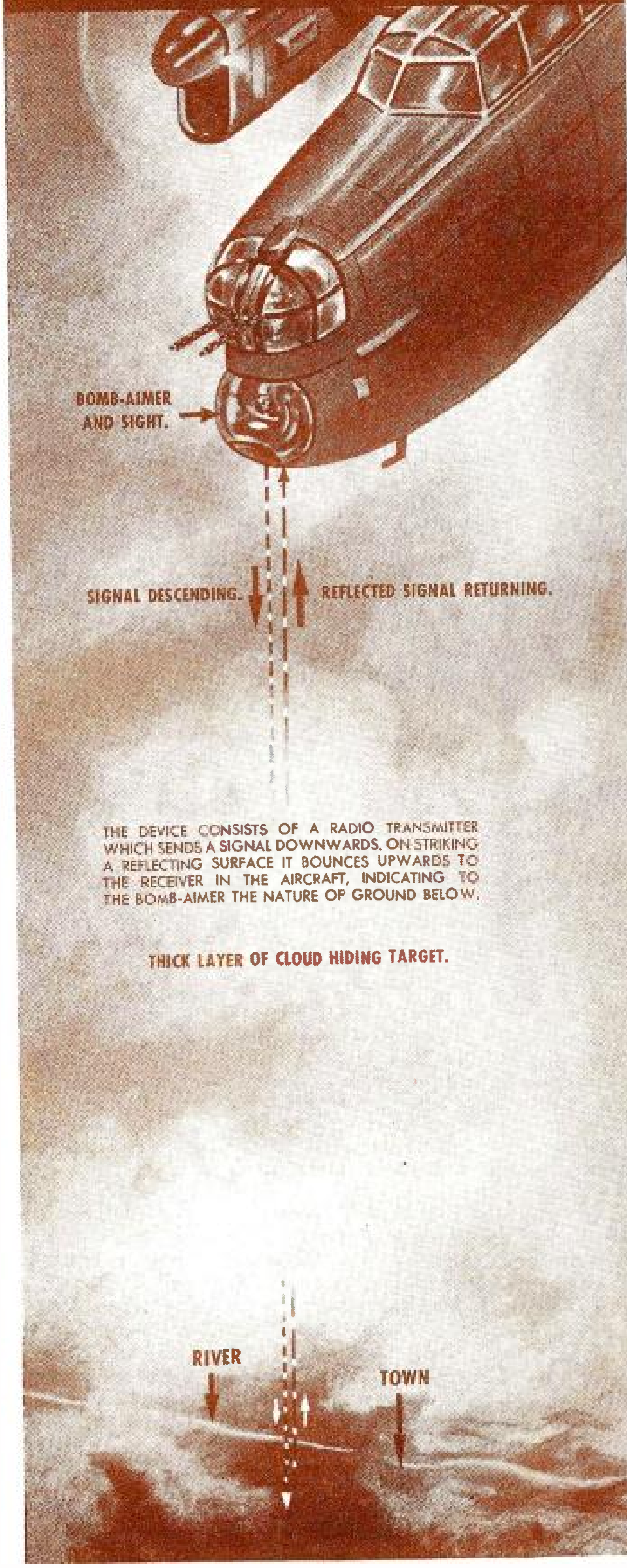
Perhaps the most spectacular in conception and fantastic in performance of these radio-location devices is the bombardiers' sight, known to the RAF as the "gen-box" or "black-box," the existence of which was recently disclosed by the military censorship.

This ingenious, British-invented apparatus is still

TARGET LOCATORS

Electronically-assisted gunfire and bombing have rapidly become outstanding features of modern warfare. Some of the devices employed are endowed solely with a life of destruction and destined to sink into oblivion as soon as the war is over. Others undoubtedly possess peacetime possibilities, enabling their future adaptation to a vast range of postwar applications.

"SEEING" A TARGET INVISIBLE TO THE HUMAN EYE.



partially cloaked in mystery but from information available from various sources, it is possible to piece together a fairly accurate picture of its basic principle of operation as well as of its effective value as a weapon of warfare.

Without divulging anything that might benefit the enemy, it can be stated that this instrument is based on the echo-sounder principle, consists of a radio transmitter and cathode-ray receiving screen, and in construction and operation resembles the American *Norden* bombsight.

An aircraft equipped with the "gen-box," flying over enemy territory emits downward a constant stream of electrical impulses travelling at light-speed (186,000 m.p.s.) which impinge upon reflecting surfaces of any objects within its field and bounce back, at the same speed, to the receiver in the plane.

On passage through the receiving unit, the echoed signals are transformed into a reproduction of the landscape in shadowtone outlines on the fluorescent screen of the cathode-ray tube by an electronic process employing television principles.

When flying over a target hidden by clouds, fog, or darkness, the bomb-aimer is thus able to recognize his objective by consulting his contour map and comparing the area over which the aircraft is passing with the outline depicted on the screen.

The enormous advantage this target-finder possesses over optical-mechanical devices of a similar type is apparent as it permits the bomb-aimer to select his objective at ease and subject to pin-point aerial bombardment even when visibility is zero.

RAF bombardiers, accordingly, look upon the human error-reducing sighting stand-by as black magic, calling the little box affectionately their "X-ray bombsight." At present used primarily for bombing, the "gen-box" undoubtedly has tremendous peacetime possibilities for future adaptation to a vast range of postwar applications.

The Sea-going Locator

It is understood that a sea-going locator, a naval version of electrically-assisted target spotters, is now in common use throughout the capital ships of the British Navy.

The chairman of the shipbuilding company which recently completed one of the four Lion Class battle-

(*Continued on page* 134)

RADIO for MORALE

By C. T. READ
Eng. Dept., The Hallicrafters Co.

The design features of a semiportable wartime receiver, supplied to our military forces for their entertainment.

Featuring a built-in antenna, metal housing, and a frequency coverage of 550-1600 kc. and 2.8-19 mc., this receiver supplies home-front reception in all corners of the world.

NEXT to mail from home as a means of keeping G.I. Joe in touch with the peacetime world he left behind him comes his favorite radio program. Many agencies, both military and civilian, are doing an excellent job of boosting morale and are providing entertainment for our fighting men on a scale never attempted in previous wars—but for day-in and day-out service, on every front and in places where live performers can seldom go, radio fills a vital need. From powerful short-wave transmitters on both coasts, America's best-loved programs are rebroadcast daily; beamed to the four corners of the earth—wherever Americans are fighting.

At first all sorts of radio receivers were used for morale purposes, anything from a camera-sized midget portable to a heavyweight communications receiver that happened to be available. Some of these performed yeoman duty but in many cases the hardships of front-line service proved too severe for receivers that were never intended for anything but peacetime use. With the growing realization of how much radio means to the soldier came the determination to provide equipment which would really do the job—a receiver that could withstand the extremes of temperature and humidity, that would resist fungus and corrosion, that could take the banging around it was sure to get—and above all, a receiver that would perform anywhere, from power line or batteries, and that would pick up the programs from home, loud and clear. With these requirements in mind the Army's Special Services Division asked *Hallicrafters* to design and build such a receiver—the new Sky Courier, Model RE-1, was the result.

Rear view shows position of coiled antenna wire and a.c.-d.c. line cord.

In creating a radio receiver to meet such stringent requirements three main points must be considered: performance—the maximum possible sensitivity, selectivity, and fidelity of reproduction that can be packed into ease of control and the fewest possible complications in setting up for use; and ruggedness—maximum protection against physical damage and the hazards of extremely unfavorable climates.

The requirements of high performance were not too difficult. Recent developments in high-Q, iron-core coils for use in the r.f. sections of receivers permit unusually high gain and selectivity to be built into comparatively small units. In the new RE-1, all r.f. and i.f. transformers are of the adjustable iron-core type and are arranged for easy servicing. The two i.f. coils are placed at the rear of the chassis where the openings for the tuning slugs may be reached without even removing the chassis from the cabinet. Three tuning ranges are provided. 550-1600 kc., 2.8-7.8 mc., and 7-19 mc. Dual final amplifier stages insure the greatest possible audio output with either battery of power-line operation. When operating from batteries, a 3Q5GT is used in order to conserve battery current but when the receiver is connected to the power line, a 50L6GT is automatically switched in to replace the battery tube. The 35Z5GT rectifier is used only for power-line operation. Aside from this dual output arrangement the circuit follows standard practice throughout.

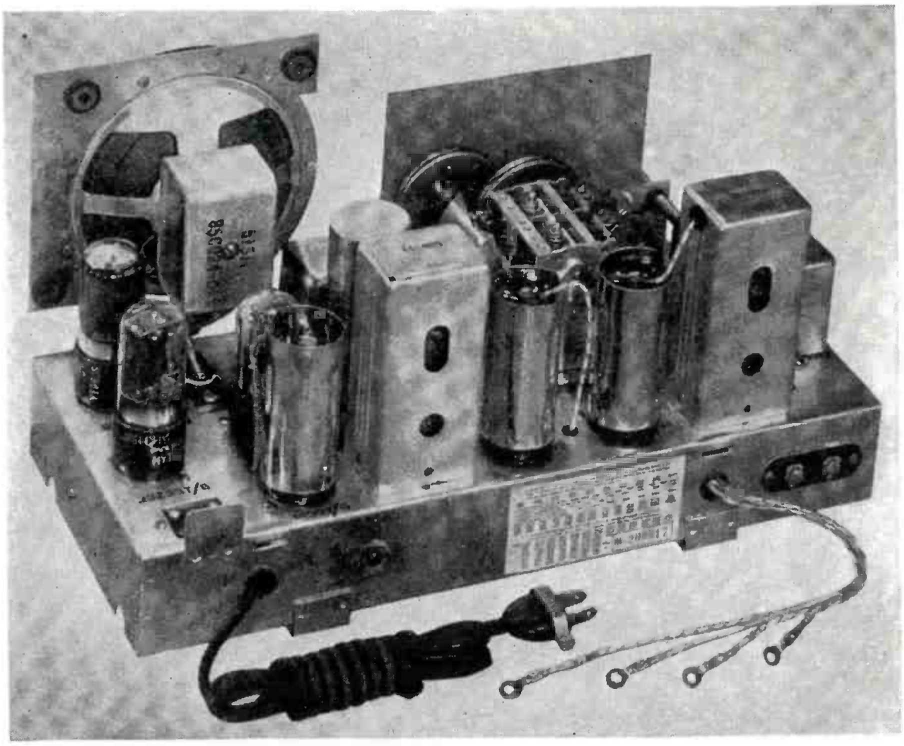
Convenience and maximum ease of operation in a receiver that would be taken everywhere and would be expected to receive from points half way around the world were another matter. Skilled military operators are accustomed to a multiplicity of controls and expect to perform several more or less laborious operations in setting up equipment, but no G.I. wants to spend fifteen minutes stringing up antennas before he can tune in on Charlie McCarthy nor does he want to fuss with any more knobs than are necessary.

Accordingly, every control not absolutely essential to efficient operation was removed, an entirely new cabinet design was developed which would afford complete protection against accidental damage without using hinged covers or cumbersome wrappings, and the antenna was placed on a reel recessed into the rear of the cabinet where it could be unwound and slung over the nearest tree without waste of time. In its final form the RE-1 has a recessed control panel set back far enough into the steel cabinet so that nothing protrudes and the set can be stacked with other equipment for ease of shipment. This design does away with all covers or doors which might be broken off or lost and the receiver is ready for instant use. When receiving reasonably strong signals it is not even necessary to unwind the antenna from its reel.

Ruggedness—ability to take the unavoidable abuse which goes with the service in the far corners of the world—cannot be taken for granted. Methods and materials that were satisfactory for years of peacetime service often failed completely when required to function in the heat and damp of the jungle, and so *Hallicrafters* went to unprecedented lengths in fitting the RE-1 for this kind of service. The entire receiver is fungus and corrosion resistant, transformers and chokes are potted for protection against humidity, the steel cabinet is light in weight yet strong enough to withstand the roughest handling, and every part, big or little, has been designed to do its job without failing.

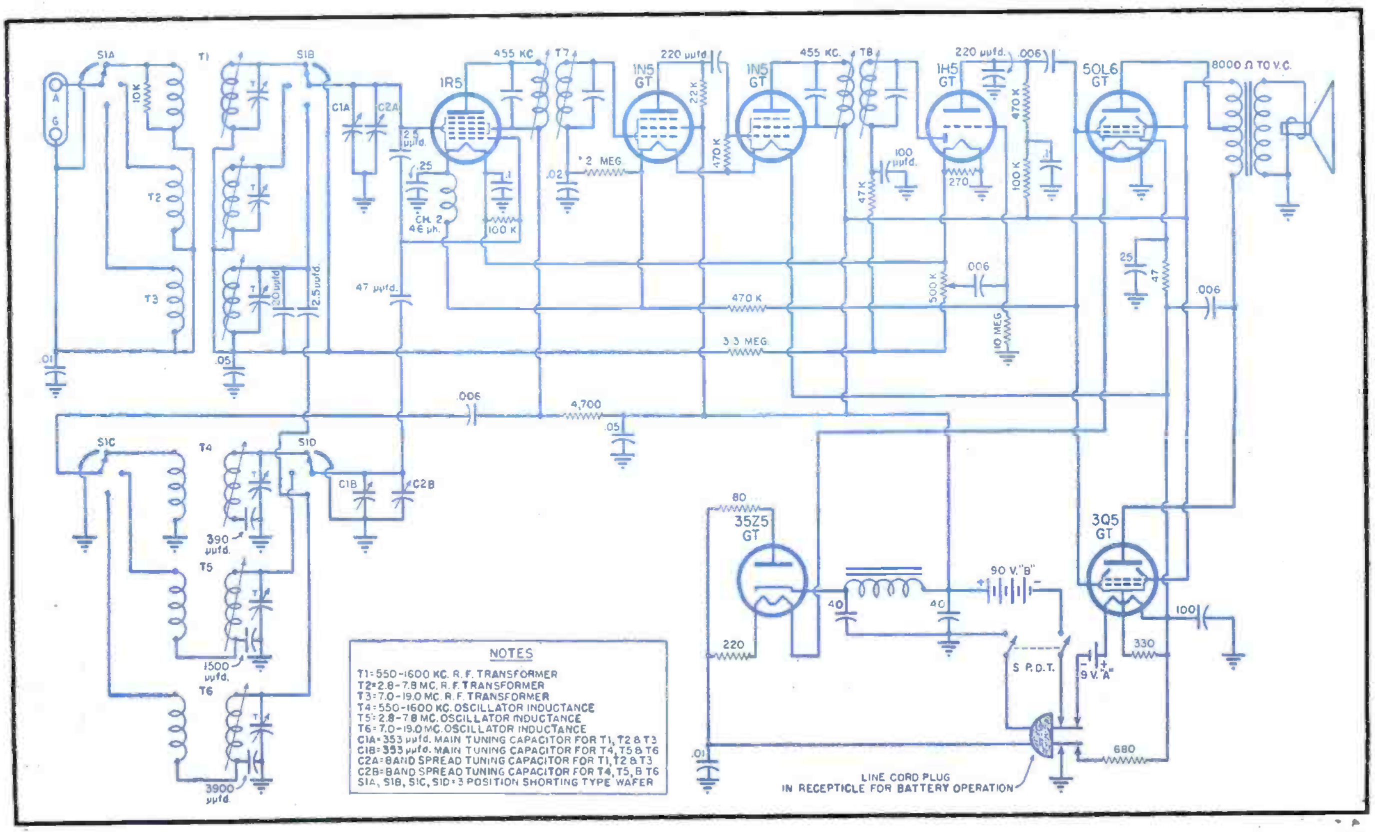
To anyone who has not been directly

(*Continued on page* 161)



Rear view of chassis. Automatic switching from a.c.-d.c. to battery operation is accomplished by plugging the line cord into the socket at left end of chassis.

Schematic diagram of the Sky Courier. For portable operation, the battery supplies both 90-volts "B" and 9-volts "A."



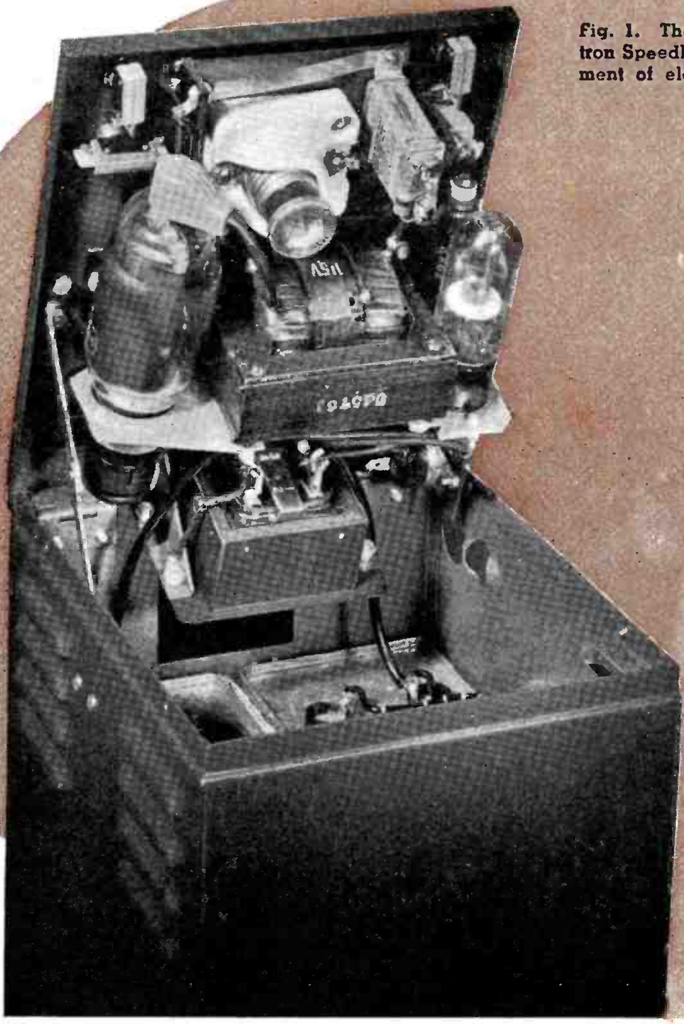


Fig. 1. The heart of the Kodatron Speedlamp, showing placement of electronic components.

The design and operation of electronic devices that have been of inestimable aid to the art of modern photography. Amateurs, as well as professionals, will find wide usage for such instruments.

ELECTRONIC

By RUFUS P. TURNER
Consulting Eng., RADIO NEWS

ELECTRONICS has a striking way of invading other scientific ground. It has joined hands with physics, chemistry, biology, and geology to provide new techniques and keener controls. Many thousands of words already have been written on the role of electronics in various scientific fields aside from electricity and communications.

The association of electronics and optics may be traced to the discovery by Becquerel in 1839 of the photoelectric effect. This was seven years before the first commercial use of the arc light. The present long line of electronic aids to photography was sired by the photocell when it first was employed to measure light intensity.

Electronic devices have been of considerable aid to modern photography. Close measurement of light intensity, accurate timing of exposures and processing baths, and production of intense, lightning-fast flashes of light for "frozen-action" shots are in the forefront, but are only a few of the contributions of electronic engineers to better photography.

By describing a few of the electronic devices, which long ago graduated from the photographic gadget stage, this article proposes to direct attention to electronic contributions to this very useful branch of optics.

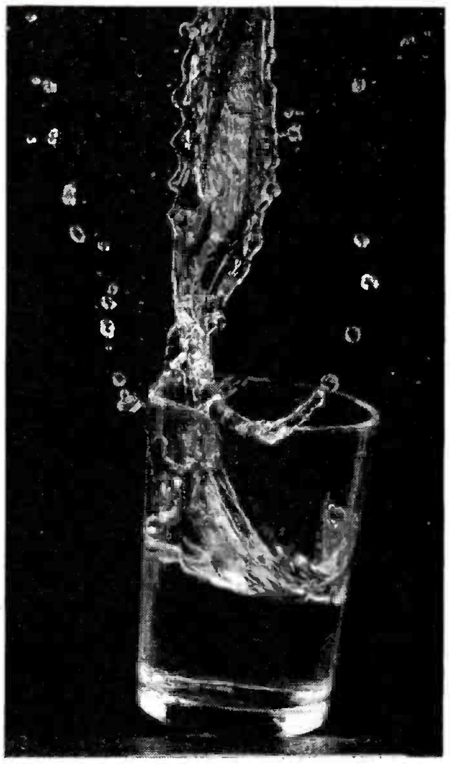
Exposure Meter

First of the useful electronic photographic devices was the exposure meter. This simple instrument has grown in popularity to such an extent that at present some type of electronic exposure meter is used by a large percentage of photographers. Several manufacturers now are engaged in the production of exposure meters.

This small, portable instrument was made possible by the invention of the self-generating photocell. This cell, unlike the gaseous and polarized high-vacuum types invented earlier, requires no polarizing battery, and so permits the simple light-meter circuit of Fig. 6.

Light rays impinging upon the active layer of the cell release electrons which flow in the circuit, deflecting the d.c. microammeter by an amount pro-

Fig. 2. Water splash, "frozen" by the Kodatron Speedlamp.



AIDS to PHOTOGRAPHY

portional to the light intensity. The meter accordingly may be graduated directly in light units and these units converted by means of a simple reference chart to data for setting the shutter of a camera and determining the length of exposure. The popular Weston exposure meter is shown in Fig. 4.

One familiar type of photovoltaic cell, used in photographic exposure meters, is made up of a selenium layer upon a heavy iron back plate. A collector ring is placed in contact with the exposed face of the selenium layer. This is the arrangement shown in Fig. 6. Electrons liberated by luminous energy pass from the selenium layer into the iron plate, and move from the latter into the meter circuit, constituting an electric current.

Speed Flash

Photographic chemistry has contributed fast modern films. Some of these are completely exposed in an almost infinitesimal amount of time. As a result, highest shutter speeds are usable. Fast snapshots made with film of this type permit the subject to be captured in a single phase of motion, without blurring or streaking.

Further refinement may be obtained by illuminating the subject with an intense light flash of extremely short duration. By this means, all motion of the subject apparently is arrested. Dramatic shots of living subjects and moving objects thus may be secured, and movements of machinery or other objects may be recorded photographically for scientific observation and analysis.

In modern speed-flash photography, not even the effects of respiration and pulse are discernible in the picture of a living subject. Photographic speed lamps make use of the brilliant flash produced by a momentary passage of electric current through a rare gas under reduced pressure in a glass tube. The gas tube is "fired" by a combination of electron tubes and capacitors in a special circuit by means of a high-voltage pulse.

The Kodatron Speedlamp, manufactured by the Eastman Kodak Co., is an electronic speed-flash device. Fig. 3 shows the external features of this modern lamp. The xenon-filled flash tube is seen mounted within the large reflector. The electronic control apparatus is assembled inside the metal box at the base of the lamp post. Fig. 1 shows the components inside this box. Note the rectifier tube to the left of the power transformer, Strobotron tube on the right, and large capacitors in the bottom of the box. The circuit schematic of the Kodatron Speedlamp is shown in Fig. 7.

Referring to Fig. 7, the Kodatron flash tube, V_3, is a composite lamp, consisting of a coiled glass tube filled with the rare gas xenon. Mounted within the spiral, in a position guaranteeing a faithful preview of the illumination which will result from the flash, is an incandescent lamp for use while focusing the subject. This latter is termed the "modeling lamp." Switch S_2 controls the modeling light. Both flash tube and modeling light are mounted within a slightly frosted glass bulb for best diffusion of the luminous energy. V_1 is a type 1616 rectifier, and V_2 a Sylvania type SN-4 Strobotron tube. The flash is set off by closing switch S_3, or by means of an external contactor, such as a camera shutter switch, timer, photocell, microphone, or similar device connected to the contactor outlet shunting switch S_3.

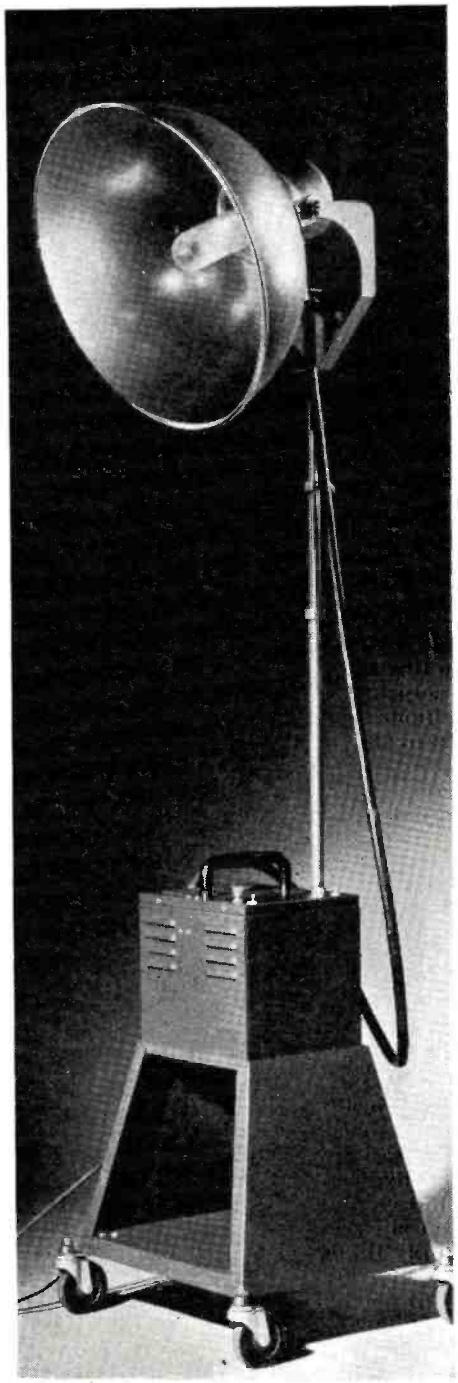


Fig. 3. The Kodatron Speedlamp.

Fig. 4. A Weston exposure meter.

Operation of the circuit is explained in the following manner: When switch S_1 is closed, capacitor C_1 is charged to a voltage equal to the peak value of the high-voltage secondary potential of transformer T_1 minus the drop in rectifier tube V_1. This charge amounts to about 2,000 volts. Although the full capacitor voltage is immediately across the flash tube, the latter does not fire because the potential still is not high enough to break down the gas. However, when switch S_3 (or an external contactor) is closed, a 300-volt potential is applied to the Strobotron tube, V_2. The latter accordingly is ionized and conducts momen-

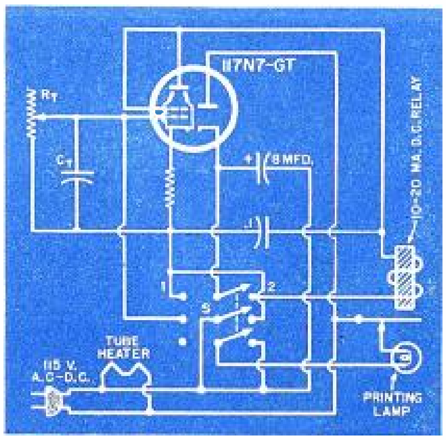


Fig. 5. Diagram of a phototimer.

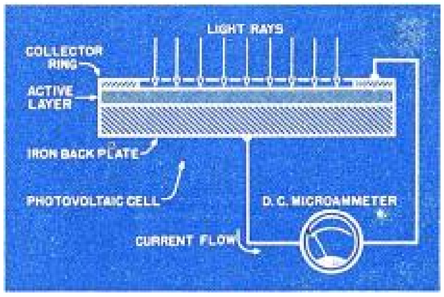


Fig. 6. Circuit of an exposure meter.

tarily. The result is that a current flows in the Strobotron anode circuit and through the primary winding of a small induction coil, T_2. The sudden secondary voltage from this coil is applied to an external grid wound about the flash tube spiral, and sets off the flash.

The flash of this lamp reaches peak intensity from start in less than 1/10,000 of a second. This flash is fast enough to stop any human or animal motion. Fig. 2 is a photograph of water splashing from a tumbler, taken with the Kodatron Speedlamp. More dramatic than an elaborate word description, this photograph demonstrates the possibilities latent in the "frozen-motion" photographic technique.

The manufacturers point out that negatives made with the Kodatron Speedlamp will have the following characteristics:

1. General over-all softness due to the tendency of the flash to depress contrast. This is mainly due to reciprocity effect, augmented by the high blue content of its spectrum (developing time must be increased to duplicate the contrast obtained with tungsten lighting).
2. Freedom from subject motion, due to the short flash. There is no evidence of body weave, respiration, pulse, or tremor.
3. Normal pupil size, because of the low-wattage modeling light.
4. Exceptional tonal rendering on panchromatic materials without the tendency to overcorrect in the red which is characteristic with tungsten illumination.
5. Greater depth of field, because of the quantity of illumination permitting the use of smaller stops.

Stroboscope

The Stroboscope produces a *series* of accurately-timed intense light flashes in a manner similar to that of the flash-lamp. When the speed of these flashes is made to coincide with the rate of movement of some object illuminated by them, the object appears to stand still. When the flashes occur at a slightly slower rate than the movement of the object, the latter appears to move slowly in its true direction. When, instead, the flash rate is slightly faster, the object appears to move slowly in the opposite direction.

The Stroboscope has two leading features. It becomes a universal tachometer which will measure the speed of moving machinery without being connected thereto, when its flashing rate is calibrated and controlled by a dial graduated directly in *revolutions per minute,* or some similar units. And it is useful in photographing moving devices. The wide industrial acceptance of the Stroboscope has resulted from its ability apparently to stop moving objects and materials for inspection under actual operating conditions.

The Stroboscope is important to photography, since it permits the making of pictures of machinery in motion at any phase of rapid repetitive actions. Its flash lamp utilizes a mixture of rare gases, and is fired electronically many times per second. The Stroboscope will permit photographing of repetitive phenomena occurring at rates up to 2000 per second. Flash rate is controlled by an internal oscillator or by an external contactor.

A small portable instrument known as a *Strobotac,* and the larger standard Stroboscope are shown side by side in Fig. 8. For large-area illumination beyond the capabilities of the Stroboscope, a *Strobolux,* which supplies approximately 100 times as much light as the Strobotac, may be controlled by the latter.

Photo Timers

Electronic timers are invaluable for the automatic control of lamps in enlargers and printing boxes. A typical a.c.-operated timer circuit is shown in Fig. 9. The printing lamp is switched off and on by this circuit, the operation of which is explained in the following paragraphs:

R_t and C_t are the timing circuit elements. The time constant of this resistance-capacitance section will determine the time of operation of the printing lamp. The d.c. relay (designed for operation at a few milliamperes) and the tube cathode resistor, R_k, are connected in series in the cathode circuit. C_f is an antichatter capacitor for smoothing the rectified cathode current and thus preventing chattering of the relay armature. A.c. plate and heater voltages are obtained from the windings of the transformer.

In operation, switch S is thrown to position 2. The relay picks up at that instant, turning on the printing lamp. At a later instant, determined by the values of C_t and R_t, the relay drops out, turning off the lamp. The position of rest of switch S is position 1. When the switch is in that position, any residual charge is removed from the capacitor by short circuit.

The grid bias, with switch S in position 1, is the voltage drop produced across the series circuit containing the relay and cathode resistor. This bias falls to a lower value as soon as S is thrown to position 2, being equal then to the cathode-circuit voltage drop minus the drop across resistor R_t. The resulting low bias voltage permits the plate current to rise to a value high enough to pick up the relay and switch-on the lamp. The voltage drop across R_t decreases as C_t continues to charge, the negative bias thereby increasing until the decaying plate current drops out the relay and turns the lamp off.

The dial of resistor R_t may be graduated directly in seconds or minutes and set to a predetermined time interval when using the timer.

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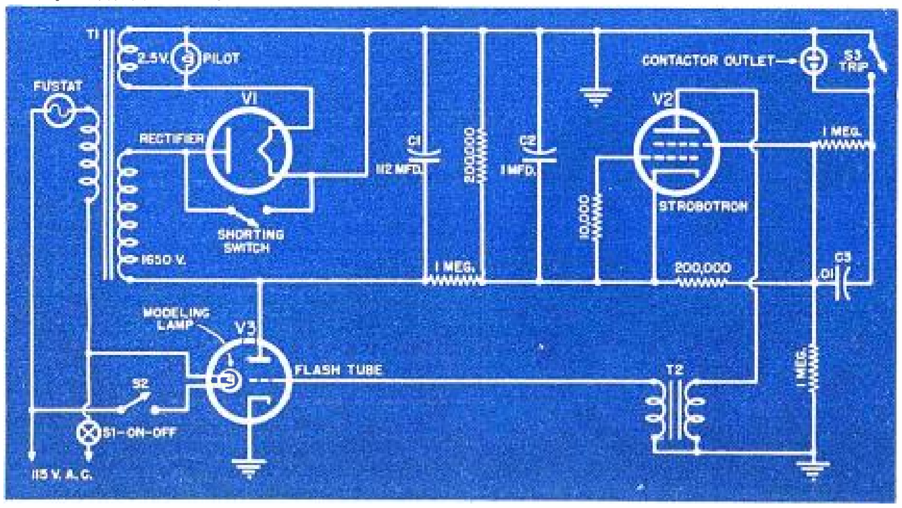
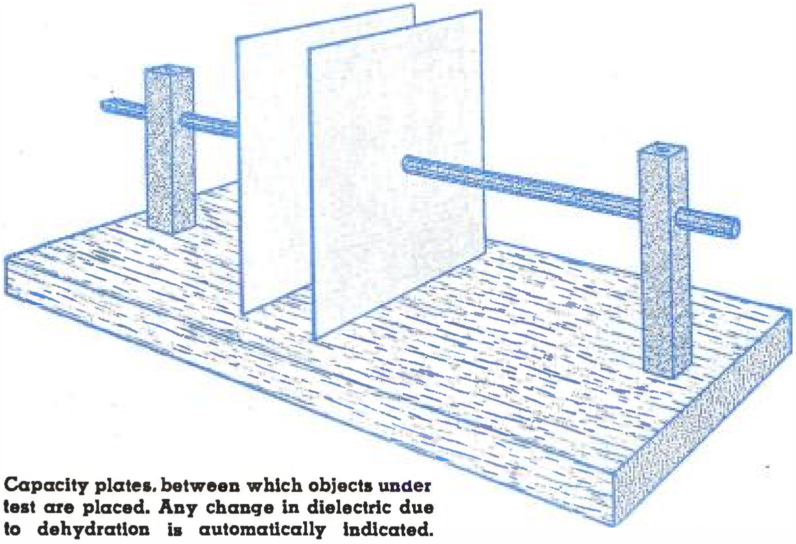
Fig. 7. Circuit diagram of the Kodatron Speedlamp shown on the preceding pages.
Courtesy of Eastman Kodak Co.





Capacity plates, between which objects under test are placed. Any change in dielectric due to dehydration is automatically indicated.

ELECTRONIC MOISTURE INDICATOR

By EARL SEIDLINGER

Although this instrument limits size of objects being tested, the design can easily be commercialized and adapted to industrial applications.

A GROUP of G. I. radio repairmen were detailed to build an oven and dry out a batch of radios that were to be sprayed with a waterproof lacquer. They were to design an oven and go to work on the sets. But they were stumped. They didn't know how long to leave the sets in the oven so that they would be dry enough for the lacquer to stick.

The first sets lay under the infrared lamps for three hours—long enough, they thought. The lacquer stuck and they were satisfied until one fellow had an idea. Why not make a gadget that will accurately tell how long it takes to dry the equipment? Maybe valuable time is being wasted. Perhaps an oscillator would work. It keeps appearing in most electronic devices.

It worked and worked well. They found the drying time could be cut in half and still the lacquer would stick.

The inventor of the gadget reasoned this way: if two frequencies are mixed together you get a third, or beat frequency. If the outputs of two separate oscillators, one fixed and one variable, are used, and their frequencies are adjusted close enough together, the resultant beat frequency will be audible.

From then on it was merely a matter of design—selecting parts from the material on hand and finding circuits that would do the job. The fellow built a two-plate condenser so that the distance between the plates could be adjusted from nothing to four inches. The plates, made of aluminum, each was four inches square to give greater capacitance. The condenser was placed in the drying oven where a damp object such as a coil or a piece of wood soaked in water could be put between the plates to dry. As the water evaporated the dielectric constant of the object began to change. As the constant changed, it changed the capacitance of the condenser. When the condenser was connected in parallel with the main tuning condenser of the variable oscillator, the change in capacitance changed the frequency of the variable oscillator.

The output of this oscillator and the output of a fixed frequency crystal oscillator were fed into a mixer stage. Because the frequency of the variable oscillator was adjusted to match the frequency of the crystal oscillator, the mixer output was within the audible range and made a detector stage unnecessary. Only a stage of audio had to be added to bring up the beat level so it could be heard.

In the plate circuit of each oscillator a 0-25 d.c. milliammeter was placed as shown in the diagram. The meters were not necessary; however, they were available and they did make an easy visual check on whether or not the oscillators were functioning. The 0-100 d.c. milliammeter placed in the output was a necessity. Minute changes in capacitance of the variable oscillators are not always enough to be noticeable to the ear or if the oscillator outputs are zero-beated.

When two unlike frequencies are caused to beat together, one of the resulting new frequencies is the difference between the two. A 243,000-cycle r.f. beating with a 243,003-cycle r.f. will produce a 3-cycle note. This note is below the range of audibility of the human ear. It can readily be seen that if a 3-cycle sine wave were impressed on the voice coil of a loud speaker, the speaker cone would move in and out smoothly three times a second, and no sound would be heard. However, a d.c. milliammeter in the plate circuit of the 6V6 would follow these variations,

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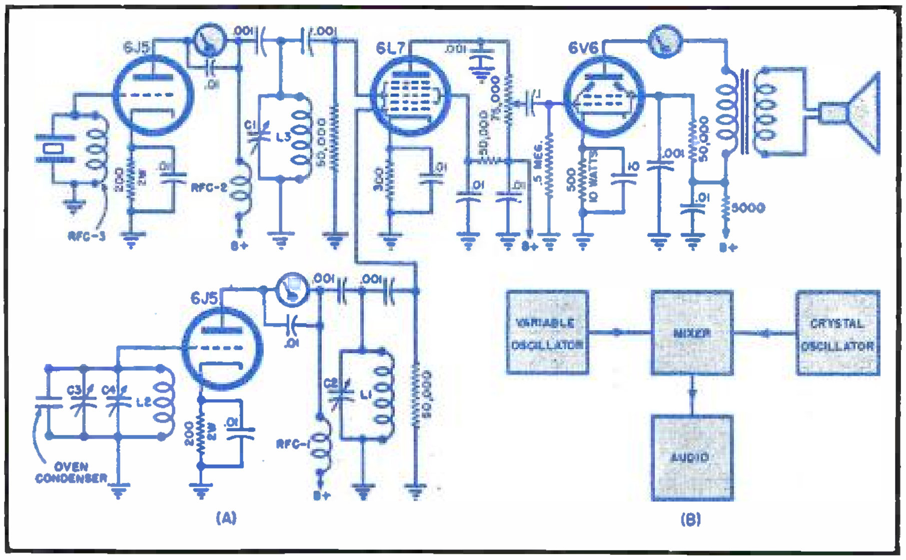
Circuit diagram of instrument. This unit is designed on the principle of a beat-frequency audio oscillator. Meter in output stage is used as a visual check.



A 200-yard driveway leads to the 50-year-old frame house which serves as the service shop.

The RURAL

by

S. R. WINTERS

THE mountaineer had plodded four miles across the hills from his home in a cove of the Great Smokies of the Blue Ridge Mountains. Slung across his shoulders was a poke (sack), formerly containing flour but now holding a battery-operated radio receiving set. Panting from the exhausting trek across the mountains, the man approached a stranger and exclaimed, "Mister, I hooked a car battery to my portable radio and burnt every gut out of it."

The above language was too inelegant for a pink tea but fully descriptive of the ill-fated experience of the man of the hills. However, he wasn't wandering aimlessly in search of help because, paralleling the antiquity of the mountains from which had come this man's strength, signs have always pointed the way out of difficulties. This time the signboard, (size 24 by 32 inches) located six miles north of Asheville, North Carolina, on U. S. Highway 70 from New York to Florida, read, "Radio Repairing, Work Guaranteed, Henry B. Baird, Drive In." A revised but truthful version could be substituted, reading "The Radio Man of the Mountains," inasmuch as Henry Baird has been servicing radio receivers in three mountain counties of west North Carolina since 1938.

The signpost, staked hard by this main north-to-south thoroughfare, flanks one side of a gravelly lane leading up to Henry's house, one room of which is a radio repair shop. This 200-yard roadway is lined with stately, giant pines, man-planted and grouped in threes, and whose fifty years of weathering the elements have produced no noticeable adverse effects, except erosion has exposed some of the big tree roots. At the trail's end is a 50-year-old rambling frame house, the nucleus of the 175-acre Baird estate, (now farmed by shareholders). It borders upon the acres of the immortal O. Henry, and Mrs. Sydney Porter (O. Henry's widow) is a neighbor of Henry Baird. The home of "the radio man of the mountains" is situated on a commanding hill and from this vantage the observer can scan enchanting beauty in the seemingly limitless horizons beyond—vistas that always merge in the blue haze of the Great Smokies, from which is derived the descriptive term "Blue Ridge Mountains."

The legend about the mountain going to Mohammed for convenience's sake may parallel the mountaineer's visit to Henry Baird, with his "gutless" radio receiver, but more often than not, Henry goes to the mountains with his radio repair kit. As evidence of this, parked alongside his home in the early forenoon may be seen one of two automobiles—he keeps a touring car and also a jalope—in readiness for any service call. For true missionary of the mountains that he is, Henry's trips into the coves and hills beyond are limited only by gasoline rationing. His telephone may ring day or night—a summons to bring along his simple testing equipment, consisting of a tube checker, weighing about five pounds, and a volt-ohm-milliammeter, weighing approximately two pounds.

Before the war severely restricted the use of gasoline, Henry covered three mountain counties — servicing thousands of radio sets. Now, with even necessary travel looked upon in askance by gasoline rationing boards, "the radio man of the mountains" encourages his patrons to bring apparatus in need of repair to the shop located in his home.

Twenty years in the radio business, starting as a salesman after graduat-

In view of gasoline rationing, patrons have been asked to bring receivers to the shop.

RADIOMAN

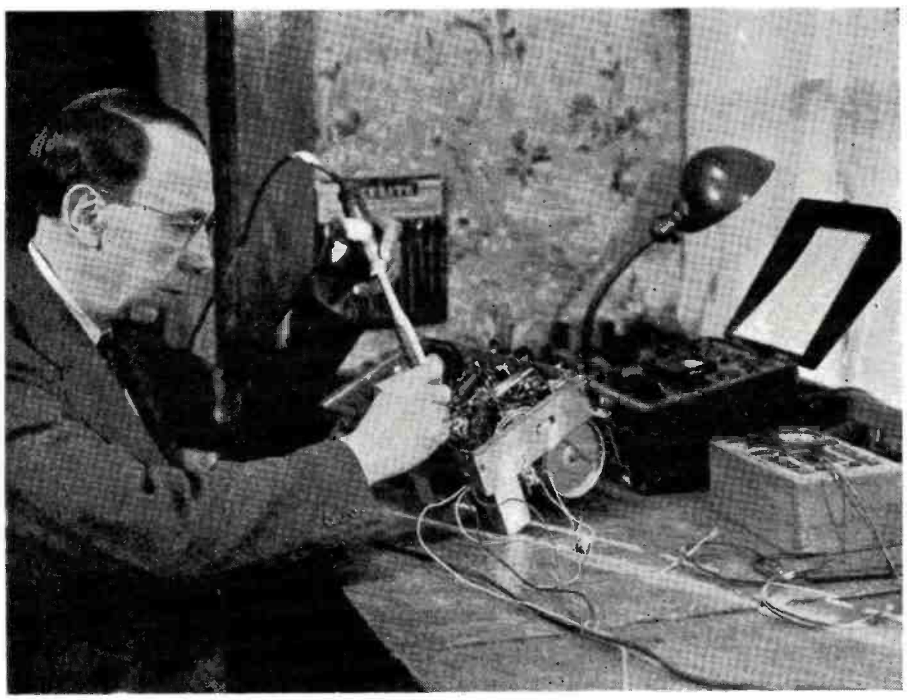
This signpost of a rural service shop tells the story of how radio receivers in remote communities are kept playing.

This twenty-four by thirty-two inch signboard is located six miles north of Asheville, N. C.

ing from the National Radio Institute of Washington, D. C., and continuing to sell sets until 1938, when he began servicing sets as an exclusive business—such pioneering over two decades has spread with favorable disposition the name of Henry Baird. This word-of-mouth advertising and low repair rates to meet the pocketbooks of a mountain folk "ill-fed, ill-clothed and ill-housed," makes Henry's 200-yard roadway lead, figuratively, far into the hills—and of late families as far away as the neighboring state of Tennessee have been pooling their temporarily unworkable radio receivers and having one neighbor's automobile transport a half a dozen or even more sets to this central repair shop. Having been repaired, they are returned to the remote neighborhood by designating some one neighbor's car as a pickup in accordance with the pooling arrangement.

To gather a faint idea of what a boon radio is to these mountain folk it is necessary to sketch a word picture of their homes, living conditions, and remoteness of their lives to cities and what we call civiliziation. Their lowly cabins—some of them situated deep in the recesses of a cove, others in the path of a wind-swept mountain top—may still be lighted by a vile-smelling oil lamp, a 50-year-old rifle stacked in the corner of the one room, with no rug on the floor except where the backwoodsman has pushed back the frontiers of civilization, as it were, and acquired a rag carpet for the floor. Not unlike her pioneer ancestors of a century ago, the wife of the mountaineer churns her butter in a homemade cedar churn, and without the spurt of development of the mountain handicrafts the housewife would not sit on a sheepskin cushion in a hickory-split chair as she maneuvers the dasher of the churn up and down. These churns of antiquity are bound with brass hoops.

Serviceman Henry Baird, shown servicing a radio receiver at his home repair shop.



The mountaineer's family does not sleep on a store-bought mattress, but instead seeks a night's repose on a bed tick stuffed with corn husks or wheat straw. The broom that sweeps the cabin—of dirt that may be considered clean by the mountain folk if it is native soil—may be fashioned from broomsedge which grows riotous in the nearby hills—or the broom may take the form of the end of a hickory pole split back into many thin thongs, and a handle inserted.

Alvin F. Harlow, in his treatise of "The Frontier People of the Appalachians," in *Travel,* describes the true mountaineer's home as a crude product of his own handicraft—or that of his neighbors. In the construction of a log house, beginning with the felling of the trees, only five tools are necessary—axe, saw, hammer, mallet, and an edged tool called a frow. With rough-hewn logs, unplaned poles, large shingles hand-split from blocks of oak, the mountaineer may build his own "castle" or construct it through the pooled efforts of neighbors in an old-fashioned house-raising bee. The chimney takes shape through the use of odd flakes and chunks of stone held together with clay.

The "Close-Up of a Hillbilly Family," as set down by T. Ham in *The American Mercury,* is pictured as follows: "The cabin is about 10 x 20 feet. Its two windows, little square port-

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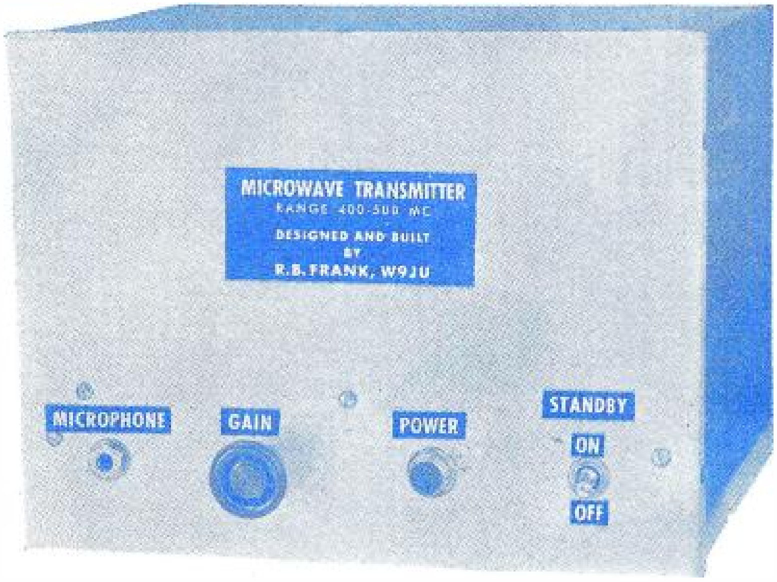


Fig. 1. Although operating at a fixed frequency, this unit may be adjusted to operate at any frequency between 400-500 mc.

450-mc. Microwave Transmitter

By

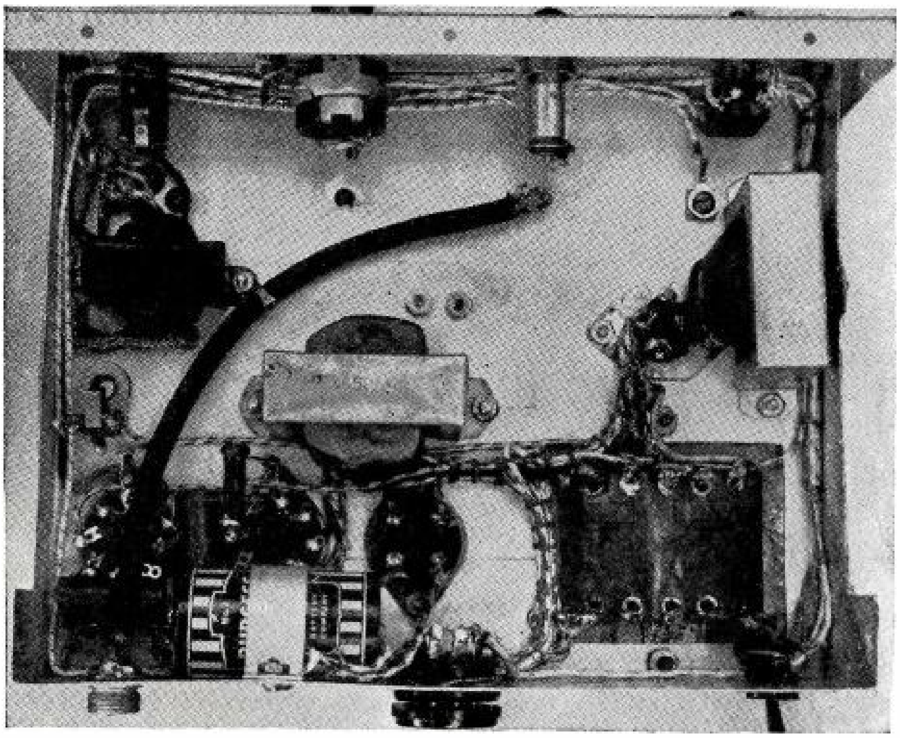
RAYMOND B. FRANK, W9JU

The design and construction of a five-tube microwave transmitter, operating in a frequency range that will become quite popular with amateurs postwar.

THE recent FCC announcement of frequency assignments above 25 mc. has renewed "ham" interest in microwaves. However, examination of published articles on microwaves reveals page after page of mathematical formulas, with little offered in the way of practical construction. An attempt to translate these articles into practical terms only results in further confusion.

The band from 420 mc. to 450 mc. does offer a possibility of construction, using known components and techniques. In addition, the adjacent "citizen's" radio band from 450 to 460 mc. intrigues the imagination with visions of personal "walkie-talkies" by means of which persons may contact their own homes. The home transmitter would probably be of low power and permanently installed. No announcement has yet been made of what type of equipment will be permitted in these bands, but it is very probable that because of simplicity, amplitude-modulated oscillators will be used for the transmitter, while simple superregenerative receivers will be used for the present.

Fig. 2. Underchassis view, showing proper placement of component parts.



Due to the difficulties of obtaining components for construction at this time, it was determined that any transmitter constructed would have to come mainly from the junk box. In experimental models, several of the common receiving-type tubes were tried but failed to perform satisfactorily at these frequencies. 7A4's did offer some promise and it is probable that they could be made to operate with proper precautions. The miniature series offered the greatest possibilities along with the "acorn" type. Of the miniatures, 6C4's gave by far the best performance with 9002's running second. However, it is possible to use more input to the 6C4's.

The power output, while only 1½ watts, is sufficient for satisfactory communication over "line of sight" distances. Of several oscillator circuits tried, the "tuned plate—tuned cathode" appeared to offer the greatest stability and power output. The modulator section uses a simple single-button carbon microphone into a 6SQ7 speech amplifier and 6V6GT modulator. In the absence of a suitable modulation transformer a center-tapped output transformer was used as the modulation choke. By using a choke connected in this manner instead of the common single-section choke, it is possible to use one of smaller physical size and rating, as the d.c. component through the choke is balanced and the saturating effect eliminated.

Construction

The material for the cabinet, chassis, and panel were salvaged from an aircraft receiver case. These cases are about 10 inches wide by 7½ inches high by 20 inches deep. The rear section of the cabinet was sawed off by means of a hacksaw, leaving a cabinet 10 inches wide, 7½ inches high and 8 inches deep. Material left over from the cabinet was used to form the front panel and chassis.

The chassis, a simple U frame, measures 9½ inches wide by 7½ inches deep and has a 2½ inch lip to form the rear edge. The placement of parts may be clearly seen from the photographs, and, in general, parts are placed where most convenient. The power transformer, salvaged from a defunct broadcast receiver, is mounted at the right rear corner. Alongside it, to the left, appear the 80 rectifier, 6V6GT modulator, and 6SQ7 speech amplifier, while between it and the oscillator the three-section filter condenser is mounted. The controls along the front panel are, microphone jack, gain, pilot light, and standby switch.

In the bottom view of the chassis, the microphone transformer may be seen mounted directly behind the microphone jack. The modulation choke is directly in front of the 80 rectifier socket, while the filter choke is mounted along the left-hand edge to remove it as far as possible from the field of the microphone transformer. A single #2 flashlight cell mounted along the rear edge furnishes the microphone current.

The socket mounted in the center of the rear chassis edge is an added refinement and permits the use of the transmitter from a Vibrapack or external power source. In addition, by means of a properly wired plug, the power supply built into the transmitter may be used to supply other equipment. This method of connection is standard with one of the leading amateur equipment manufacturers and is a great convenience.

Details of the oscillator construction are shown in Fig. 5. The oscillator unit had best be constructed separately and installed in the transmitter as a unit. A U bracket, formed from scrap aluminum, is used to support the sockets for the 6C4 tubes. One-quarter-inch outside diameter copper tubing is used for the plate and cathode lines with the "cold" ends of these lines supported by brass blocks drilled to receive the ends of the tubing. Small set screws hold the tubing in place. The "free" ends of the line are supported directly by the socket terminals. In an experimental model, Polysytrene supports were used for the "free" ends of the lines but it was found that the power output suffered because of this. The brass block supporting the plate rods is mounted on a small sheet of mica removed from a by-pass condenser. In this manner, this block, because of its capacity to the chassis, also serves as a plate by-pass condenser.

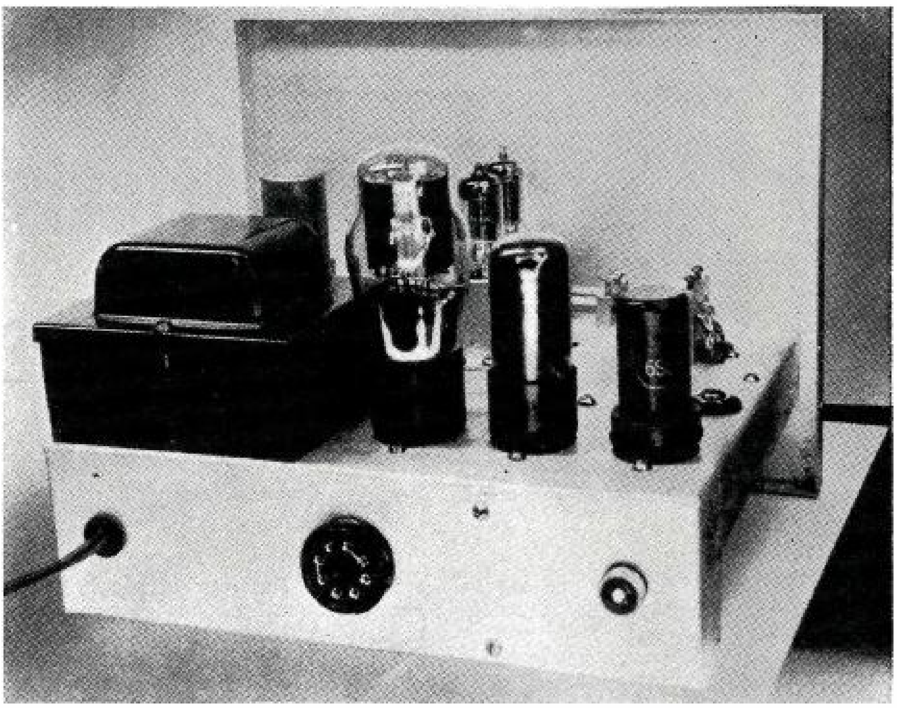
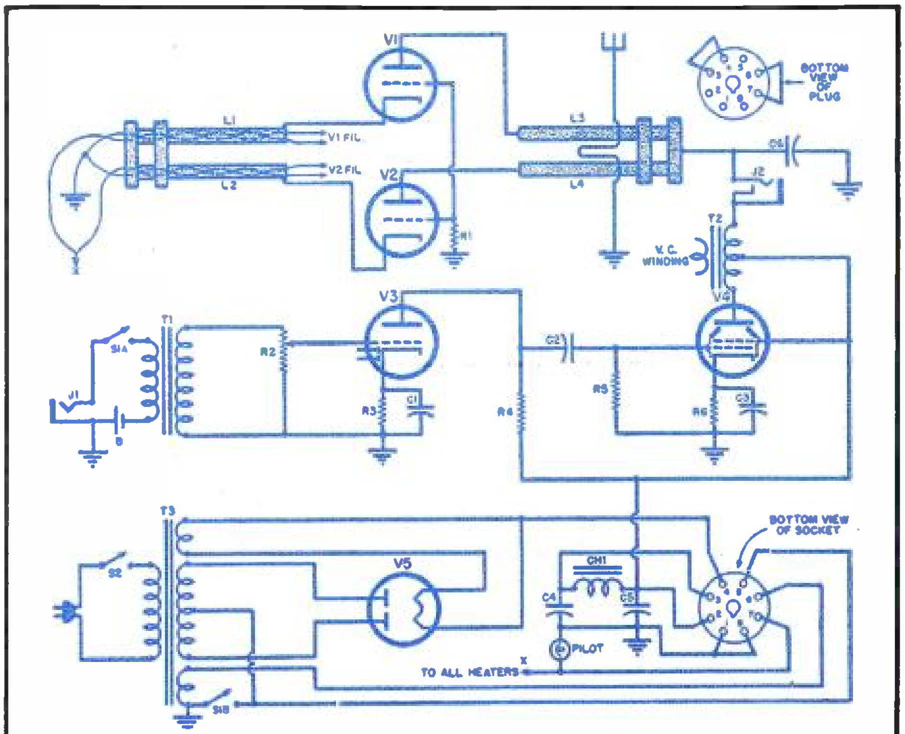


Fig. 3. Top-of-chassis view. Note the placement of the two 6C4 miniature tubes.

6C4's have two plate leads and it is important that both of these be used. The heater leads from the 6C4's are twisted together and passed through the cathode rods and down under the chassis through grommets. Shorting bars, made from ¼ by ½ inch brass

(*Continued on page* 152)

Fig. 4. Wiring diagram of transmitter. Oscillator construction is shown in Fig. 5.



C_1—20-µfd., 25-v. elec. cond.
C_2—.02-µfd., 400-v. paper cond.
C_3—20-µfd., 25-v. elec. cond. in can with C_4, C_5
C_4, C_5—20-µfd., 450-v. elec. cond.
C_6—See text.
R_1—4000-ohm, ½-w. res.
R_2—½-meg. gain control
R_3—2000-ohm, ½-w. res.
R_4—100,000-ohm, ½-w. res.
R_5—500,000-ohm, ½-w. res.
R_6—250-ohm, 2-w. res.
T_1—Single button micr. to grid—Stancor A-4205
T_2—Push-pull plates to voice coil—Thordarson T-13S40
T_3—340 a.c., 5-v. @ 2-amp., 6.3-v. @ 2-amp.,—Thordarson T-75R47
Ch_1—85-ma. choke—Thordarson T-13C29
J_1—Open-circuit jack
J_2—Closed-circuit jack
L_1, L_2, L_3, L_4—See text
S_1A, S_1B—D.p.s.t. toggle sw.
S_2—S.p.s.t. sw. on R_2
V_1, V_2—6C4 miniature tubes
V_3—6SQ7
V_4—6V6GT
V_5—80
B—No. 2 flashlight cell

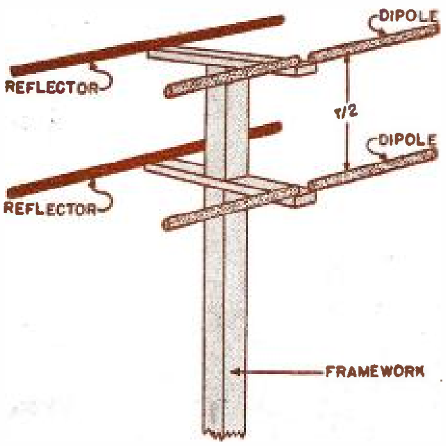


Fig. 1. Stacked array showing two dipole elements and their associated reflectors.

ANTENNAS For Television Receivers

By EDWARD M. NOLL

Part 5. The design and application of various antenna types that may be employed with television receivers.

A VARIETY of antennas can be used to pick up television signals. However, no matter what type is used, it must be carefully installed, and constructed of good low-loss material. For best performance, the antenna must have a broad, flat frequency characteristic—it must respond as readily to a side-band component which is three megacycles away from carrier frequency as it does to one which is only a few cycles away. To cover a number of television channels, its characteristics must, of course, be flatter over a still wider band of frequencies. Thus, an antenna which is to cover the first three television channels must have a linear response over 22 megacycles. This exceptional bandwidth can only be approximated in practical antenna construction for the average home receiver.

To obtain a reasonable signal at the high frequencies used in television transmission, it is necessary to use a tuned antenna (physical length of antenna a function of signal wavelength). Only in suburban or rural areas where there is ample room is it practical to install an aperiodic antenna such as a rhombic or long-wire antenna. The dipole antenna, shown in Fig. 10A, is the simplest antenna, and is very effective if it is in the clear and in the primary area of the transmitter. A number of precautions must be observed if the dipole is to function efficiently:

1. Mount it in the clear, at least six feet from any nearby object, to prevent loss, uneven response, and shift in the resonant frequency of the antenna.

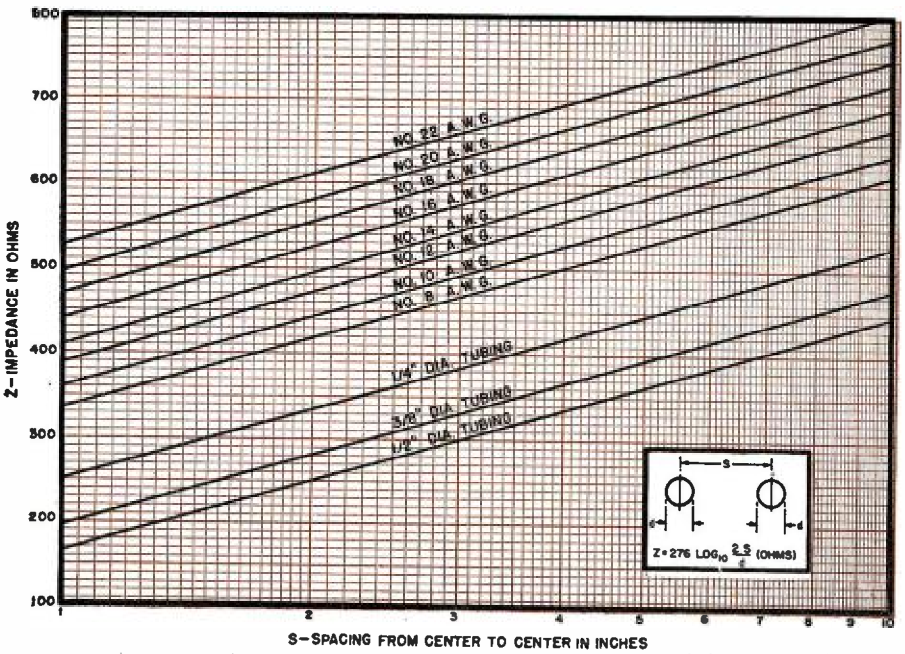
2. The dipole must be broadside to the transmitter (length of the antenna perpendicular to the direction of wave travel). See Fig. 7. Do not mount the antenna in such a position as to have an intervening tall building or structure of any great mass in the direct path between transmitter and receiver. This is particularly the case when the structure is only a short distance from the receiving antenna.

3. Likewise, a large structure directly in back of the antenna will cause trouble, for a reflected wave from this structure may strike the antenna just slightly after the arrival of the direct wave. This condition causes a blurred picture, and, if the structure is some distance away, a double image, or ghost, will result. Thus, you may see a man walk across the screen and directly behind him will be his shadow. One method of circumventing this difficulty is to use a reflector (a parasitic element which has no direct connection to the dipole or receiver, but is slightly longer than the dipole), as shown in Fig. 10B, mounted directly behind the dipole. This antenna has a considerably reduced sensitivity to a reflected wave from the rear, and an improved sensitivity compared to the dipole in the direction of the transmitter. Consequently, this antenna is a considerable improvement, for it improves signal strength, reduces reflection sensitivity, and reduces noise pickup from the rear. However, its bandpass characteristic is not as flat, and there may be some loss at the higher sideband frequencies, unless the dipole is properly constructed and proportioned.

4. In congested areas where it is difficult to obtain a direct path between transmitter and receiving antennas, it is necessary to experiment with the antenna positioning until a clean picture is obtained. Sometimes it can be obtained by taking a dipole and reflector system and tilting it at an angle (reflector mounted slightly below the dipole vertically, but still the same distance from it). In some isolated cases, the antenna is directed toward some reflecting surface and maneuvered until the optimum position is found. In this case, the antenna is picking up a reflected signal, and not the direct wave from the transmitter.

5. The dipole must be constructed to present a reasonably constant resistance to the transmission line over the entire bandwidth, and the reactance must increase very slowly as the

Fig. 2. Characteristic impedance of parallel-line conductors, both solid and tubular.



frequency departs from resonance (frequency at which the antenna is electrically, and almost physically, exactly one-half wavelength long). To prevent this serious change in impedance at the point at which the transmission line is attached to the antenna, it is necessary to use dipole elements which have a large periphery (larger radiating or pickup surface while still maintaining a resonant length). A dipole made of ¾-inch tubing, while resonant at only one frequency, has a much slower increase in reactance as the frequency departs from resonance, as compared to a dipole constructed say of #10 wire. Consequently, there is less change in impedance, and the antenna more exactly matches the transmission line over the bandwidth to be received. Other types of antennas also meet the reasonably constant impedance requirements; for example, the folded dipole shown in Fig. 4A has an improved bandwidth. In fact, the folded dipole can be used with both a reflector and a director (a parasitic element which has no direct connection to dipole or receiver, but is slightly *shorter* than the dipole), as shown in Fig. 4B, and is mounted directly in front of the dipole. This antenna system has a still further improvement in sensitivity; however, its sharpness would prohibit its use with an ordinary dipole, for its response would fall off seriously on the higher frequency sidebands.

The Transmission Line

The transmission line conveys the signal from antenna to receiver input. In effect, the transmission line is a transformer, and, as in the case of a theoretically perfect transformer, there should be no loss. However, in practice, this is not the case; in fact, the higher the frequency, the greater tendency there is to accumulate an excessive loss in the transmission line. Thus, careful consideration must be given to the choice of transmission line, physical dimensions, over-all length, and proper impedance match.

The television transmission line is untuned, for, as we know, in any tuned system there is a definite frequency discrimination which would limit the wide-band characteristics. Consequently, an untuned line which matches both transmission line to antenna and transmission line to receiver is used. This match is determined by the physical dimensions of the line, for every line, according to its composition, spacing, and size, has a characteristic or surge impedance.

If the line is interrupted at any point and terminated in a resistance equal to the surge impedance of the line, there is no loss through reflections or mismatch. However, this condition is only approached in practice, for the terminations are not pure resistances, but always contain some reactance which upsets the perfect match. We minimize this loss by designing the antenna to reflect a relatively small reactance variation over the band of frequencies used. The untuned line can be any convenient length so far as proper match is concerned, but still should be held to a minimum because the attenuation, particularly in a poor quality line, increases with length, causing a reduction in signal strength.

There are two common types of lines—the parallel open-wire line and the coaxial line. The parallel line consists of two identical parallel lines spaced a prescribed distance from each other; spacing is held constant by insulated spacers placed conveniently along the length of the line. The parallel line has very low loss, and matches relatively high impedances (200 to 700 ohms); however, it is susceptible to stray pickup, and for that reason is not too practical in noisy locations, or where it must pass in close proximity to other surfaces over a considerable portion of its length. The surge impedance of a parallel line can be conveniently calculated from the parallel-line chart shown in Fig. 2. This chart is based on the formula for parallel lines, or:

$$Z \text{ equals } 276 \log_{10} \frac{2s}{d} \text{ ohms}$$

where *s* is the wire spacing and *d* the diameter of the conductor. Any unit of dimension can be used so long as the same unit is used for both *s* and *d*.

The most common transmission line

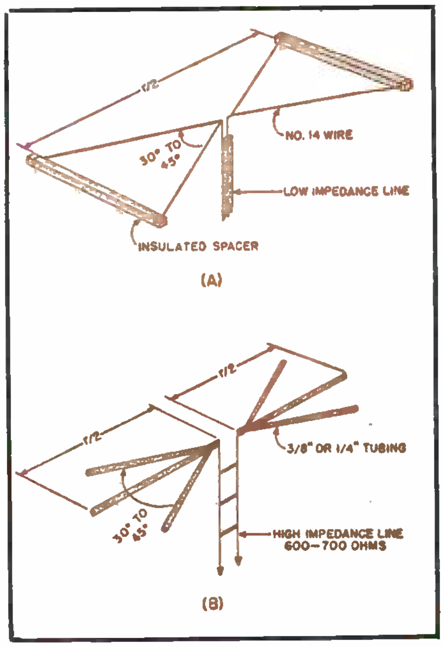
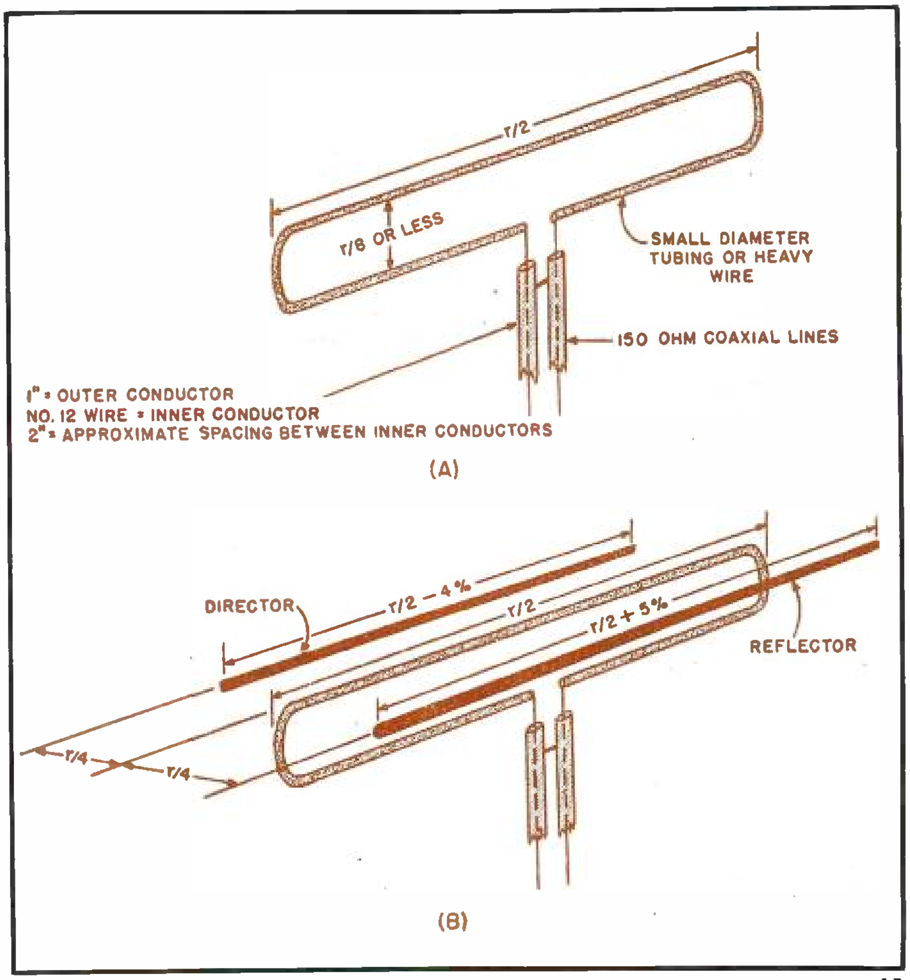


Fig 3. Two popular types of antennas: (A) V antenna; and (B) fanned antenna.

for the television receiver is the coaxial line. Its advantages are the effective shielding afforded by the outer conductor which prevents stray pickup, little affected by its proximity to other surfaces, and matches a low impedance (50 to 150 ohms) which is

Fig. 4. (A) Folded dipole. (B) Folded dipole with director and reflector.



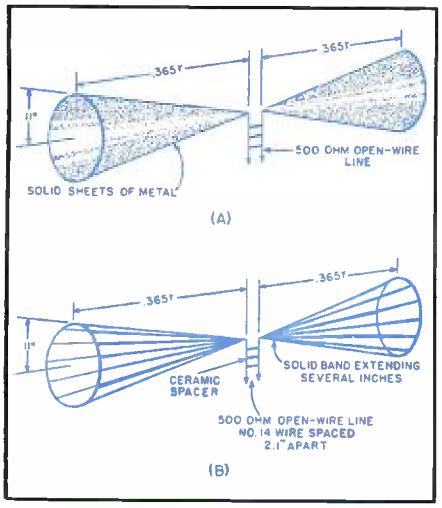


Fig. 5. Details of the conical antenna: (A) using solid sheet of metal and (B) employing twelve strands of equidistantly spaced No. 14 wire.

characteristic of a dipole antenna. The ideal coaxial line has maximum Q and minimum resistance; however, these two requirements are in opposition to each other and an optimum value must be chosen.

A coaxial line has four parameters: resistance, capacity, inductance, and Q. The larger the inner conductor the lower the resistance; the large conductor, however, means a low value inductance and a high capacity, reducing the Q. A condition of maximum Q and minimum attenuation occurs when the ratio between the diameter of the outer conductor to the diameter of the inner conductor is 3.6 to 1. With this 3.6 to 1 ratio the characteristic impedance is 77 ohms which, conveniently enough, matches the resonant impedance at the center of a dipole antenna. Consequently, the dipole antenna (half-wave antenna opened and fed at the center) and coaxial transmission line form a much used combination for television.

The above ratio may be varied from 2.5 to 7 without increasing attenuation more than 10%. Thus, at times, to secure a greater transfer of signal and a minimum noise pickup, the coaxial line is of some other impedance higher or lower than 77 ohms (varies between 50 and 150 ohms); the small increase in attenuation being counterbalanced by the increased signal amplitude delivered to the receiver.

The surge impedance of the coaxial line using air dielectric is given by the formula:

$$Z = 138 \log_{10} \frac{D}{d} \text{ ohms}$$

where D is the inner diameter of the outer conductor and d is the outer diameter of the inner conductor. For assistance in finding the actual dimensions of a coaxial line for a certain surge impedance, refer to the curve shown in Fig. 9. Since the surge impedance is also influenced by the dielectric material separating the outer and inner conductors, the surge impedance of lines using other than air for a dielectric should be obtained from the manufacturer.

The type of coaxial line to be used is the one with the minimum attenuation at the frequency to be received; this is particularly so if the line is to run in excess of 50 feet. If the span is less than 50 feet a poorer quality may be substituted. Various low-impedance transmission lines in order of their increasing attenuation at television frequencies are given:

1. Rigid coaxial line—copper conductor with ceramic bead spacers.
2. Flexible coaxial line—copalene dielectric.
3. Coaxial line—spun-glass dielectric.
4. Coaxial line—low-loss rubber dielectric.
5. Twisted pair—low-loss rubber dielectric and paraffin braid.
6. Ordinary twisted pair.

Fig. 6. Dimension chart, showing mechanical sizes of various types of antennas.

Television Band	Channel Center-Frequency Megacycles	Length of Full-wave in Feet L = 984/Megacycles	r/2	r/4	r/8	Length of r/2 Dipole Element r/2x.95	Reflector Length in Inches 5% longer	Director Length in Inches 4% shorter
No. 1	53	18′ 6″	9′ 3″	4′ 7″	2′ 3″	8′ 9″ Ea. section 4′ 4½″	9′ 2″	8′ 5″
No. 2	63	15′ 7″	7′ 10″	3′ 11″	1′ 11″	7′ 5″ Ea. section 3′ 8½″	7′ 9″	7′ 1″
No. 3	69	14′ 4″	7′ 2″	3′ 7″	1′ 10″	6′ 10″ Ea. section 3′ 5″	7′ 2″	6′ 6½″
Bands 1, 2 & 3	Center-Frequency 60	16′ 4″	8′ 2″	4′ 1″	2′	Length of conical element in inches L = .73r 12′ Ea. section 6′	Length of Rhombic leg in feet L = 4r 65′ 4″	Length of Long-wire in feet L = 12r 196′

Antenna Types

1. *Dipole.*

A typical dipole antenna is shown in Fig. 10A. Actual dimensions for its length can be determined from the formula:

$$\text{Length in feet equals } \frac{492}{\text{frequency in megacycles}}$$

The above formula will give you the actual physical dimension of a half-wave; however, the actual electrical half-wave is slightly less because of distributed capacity and, so-called, end effect. The electrical half-wave is, therefore, approximated closely by multiplying the physical half-wave by .95. Formulas for finding actual dimensions for reflectors, directors, etc., are found in the dimension chart, Fig. 6. The use of this chart along with the information given on the antenna illustrations will permit you to obtain all dimensions for any antenna discussed in the article plus any transmission line to be used with it. In the calculations for any particular band, the resonant frequency of the antenna is chosen at a point in the middle of the band.

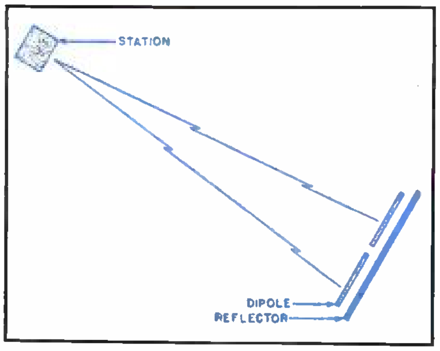


Fig. 7. Illustrating position of dipole and reflector in relation to transmission.

Thus, in the case of a dipole to be used on channel 3, the resonant frequency of the antenna should be 69 megacycles (band extends from 66 to 72 megacycles) and the length of the dipole is 6 feet, 10 inches. The diameter of the dipole should be at least ¾ inch, and it should be matched to a 77-ohm line. If a rigid line is to be used with a ¾-inch outer conductor, from the chart in Fig. 9, the inner conductor should be 3/16-inch tubing. However, an adequate match can be made using any value surge impedance between 50 and 150 ohms, for a 2 to 1 impedance deviation ratio can be tolerated without excessive loss.

If a reflector is to be used with the dipole, as shown in Fig. 10B, the reflector should be spaced approximately a quarter-wave behind the dipole. This spacing insures only a small decrease in antenna resistance and only a slight decrease in forward sensitivity. In practical construction for voice communications, the parasitic element is

(*Continued on page 130*)

An Inexpensive Remote ANTENNA METER

This antenna meter, designed particularly for broadcast station use, is inexpensive and easy to construct, using standard equipment.

By CHARLES SUMNER

WHILE Chief Engineer at station WISE in Asheville, N. C., the problem of constructing a remote antenna meter was confronted. The war had just started in earnest and very little equipment was available even to broadcast stations and when it could be had, the manufacturers would not set a definite delivery date. The station had two Model 347-A Triplett 0-3 ampere thermocouple r.f. meters with external thermocouples. One was being used in the antenna and the other was a spare.

In examining one of the thermocouples it was found that each unit had a small resistor of about one ohm in series with one of the meter lead connections. After shorting the resistor in one of the thermocouples and then connecting the thermocouples in series with the antenna circuit, the meter connected to the thermocouple with the shorted resistor read about .3 amperes higher than the other (Fig. 1).

If an r.f. filter circuit and line could be made with less than one-ohm resistance the line could be substituted for the calibrating resistance and a meter in the control room be made to read the same as the one in the doghouse by adjusting a small resistor in series with one side of the line. Once the adjustments were made the system would be practically foolproof.

R.f. chokes in the feeder line to the remote antenna meter were out because all of them contained too much resistance when added to the line resistance, however it was decided that a possible solution could be had by using two parallel circuits for filters, one on each side of the line. This was tried and proved successful.

The tuned circuits were easy to construct, using ordinary inductance formulas to get the physical dimensions of the coils in conjunction with the well known resonance formula. After the coils were constructed, the L_1C_1 circuits were tuned to resonance with the transmitter frequency by link coupling them *loosely* to one of the low-power stages of the transmitter and using a flashlight bulb connected to a one-turn link as a resonance indicator. The flashlight bulb and link are loosely coupled to the L_1C_1 circuit.

Exact resonance is not necessary and the circuits can be tuned by shorting out turns on the coils until resonance is passed and backing up one turn. The coils are wound with one or two extra turns so that they will have more inductance than needed. A good grade of mica condensers should be used for C_1 and if possible they should be checked for correct capacity before they are used. After the coils have been adjusted to the transmitter frequency they can be wired into the circuit. No further adjustment is necessary.

The relay used to short out the thermocouples when they are not being used is one used by amateurs to change their transmitting antennas from transmitter to receiver. It is not essential to the operation of the system but its use will prevent damage to the thermocouples by lightning discharges and prevent them from burning out. Thermocouples operate at a fairly high temperature and sometimes burn out when used within their range of operation. The loop X in the diagram was used to increase the resistance of the circuit between the two thermocouples. When the relay is closed, and the meters not in use, most of the antenna current flows through the relay contacts, thus causing low current through the thermocouples.

The remote antenna meter can be calibrated by comparing its readings with the antenna meter and adjusting the small resistance R. The resistor

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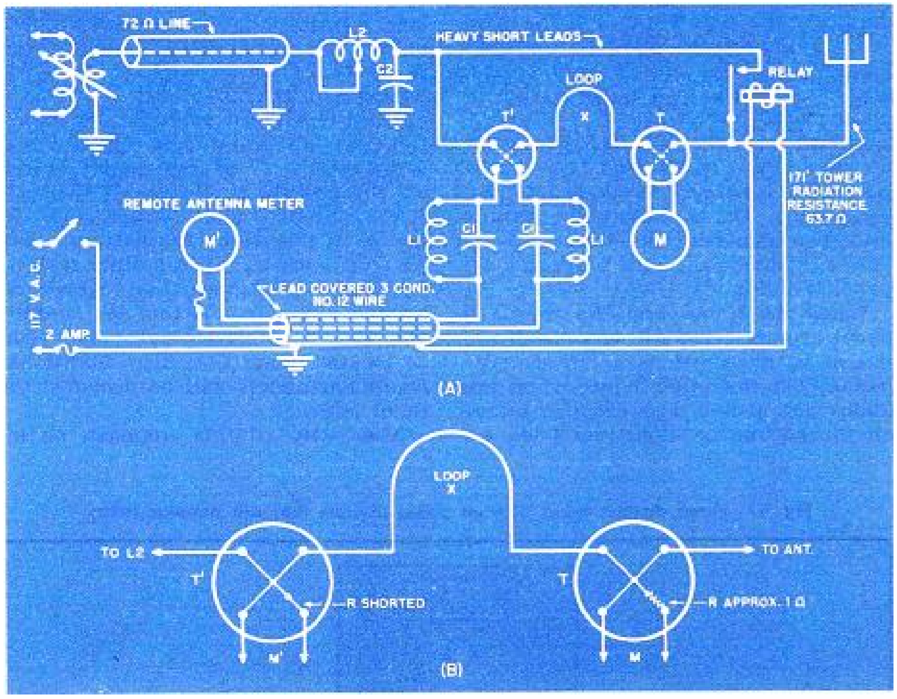


Fig. 1. Diagram showing method of wiring the remote antenna meter.

RELAY—Relays used by "hams" for changing over antenna to receiver with contacts wired in parallel. (a.c. 110-volt) operated.
L_2—Loading coil for antenna.
L_1—Coils wound on Hammarlund tube base form with prongs sawed off. Coil is 2½ inches long and 1½ inches in diameter, wound with #16 wire. Coil adjusted to 1230 kc. by link coupling it to one of the low-power stages of the transmitter and using flashlight bulb to show resonance.
T—External thermocouple for use with antenna meter.
T'—External thermocouple used with Triplett 0-3 ampere Model 347-A with internal calibrating resistor removed and jumper wire to replace resistance. Resistance about 1 ohm.
C_1—.00035 fixed mica condensers 1000 working volts.
M, M'—Triplett 0-3 amp., Model 347-A.
R—Small calibrating resistance. Short length of coiled copper wire cut and try to get both meters to read similarly.
Loop—Loop is a short length of wire shaped as shown in diagram to make the resistance of the direct connection between T' and T greater than the path through relay contacts when it is closed. Both meters will read almost zero when this is done. Loop is 3" in diameter and uses #16 wire.
S—S.p.s.t. 110-volt line switch.
C_2—Condenser to match antenna to line.

Designing a COMMERCIAL TYPE FRONT PANEL

By A. A. GOLDBERG, W2HKU

The proper procedure to follow to obtain professional-appearing front panels for your home-constructed electronic equipment.

DURING this war, many amateurs and radio experimenters have seen commercial or military radio equipment for the first time. The thing that caught their eye was the neatness and precision of the front panel which, of course, usually makes the greatest impression. Upon analyzing the design, it was noticed that the engraved or stamped panel behind the knobs created, to the greatest extent, the "snap" and neatness that commercial gear is noted for. Many a "ham" has wished he could duplicate this appearance but the price of the panel was far beyond his meager finances. These panels can be designed and produced quite easily by photographic means.

Before we begin the actual processes, let us analyze the various panel layouts of commercial receivers and test equipment. We can divide the layouts into two general classifications, the "total" panel and the "fractional" panel (See Fig. 1).

When the knobs and the engraved panel are scattered all over the front, it can be classified as a "total" type panel. On the other hand, when the knobs and panels are grouped either on the bottom or along the sides, we shall refer to them as "fractional" panels.

Fractional-type panels are very popular in commercial and military equipment for several reasons. First, the engraved or stamped panels are smaller, resulting in a considerable saving; second, the usable controls are lined along the bottom where they can be reached more easily; third, in the case of cathode-ray tube devices, where we desire a division of vertical and horizontal controls, the side fractional type panel layout is used to good advantage; and fourth, fractional panels usually present a neater appearance. For our purpose, fractional panels will be emphasized.

For the sake of example, let us assume we are building a superheterodyne receiver. In our panel design we shall strive to locate all the controls, except main tuning and db. meter, in line along the bottom. Any controls such as crystal filter or beat frequency oscillators, that cannot be located along the bottom for reasons of space or electrical efficiency, can be located along the side. Additional fractional panels will be provided for them later.

Now, why all this emphasis on in-line grouping of controls? Many designers are of the opinion that appearance or symmetry are not important, that electrical efficiency should be the only consideration in panel layouts. Efficiency is fine, but don't we all like to show off our gear to others? Isn't it nicer, while operating the equipment, to see an even, symmetrical pattern in front of us instead of a disorganized series of parts? Very little performance will be lost on ordinary frequencies if a lead is a few inches longer. Even at higher frequencies most inefficiencies can be overcome by the proper placement of parts behind the front-panel controls.

In choosing the chassis for our equipment, it is always best to obtain one at least four inches high. Not only is it better for the panel layout, but it will make for easier placement of the parts and neater wiring. If too shallow a chassis is used, the controls will be far too low on the front panel for appearance and ease of operation (see Fig. 3).

The front panel, either of steel, aluminum, or nowadays even "masonite," should be laid out and drilled with precision. Discrepancies in spacing, however slight, show up in the finished panel and distract from its appearance. The panel layout should be drawn full size with a few simple drafting instruments on a sheet of heavy paper. The paper is then fastened to the panel with gummed tape, and the various holes center-punched directly through the paper. The paper is removed and the holes are drilled. A few pains taken in drilling the panel will pay dividends.

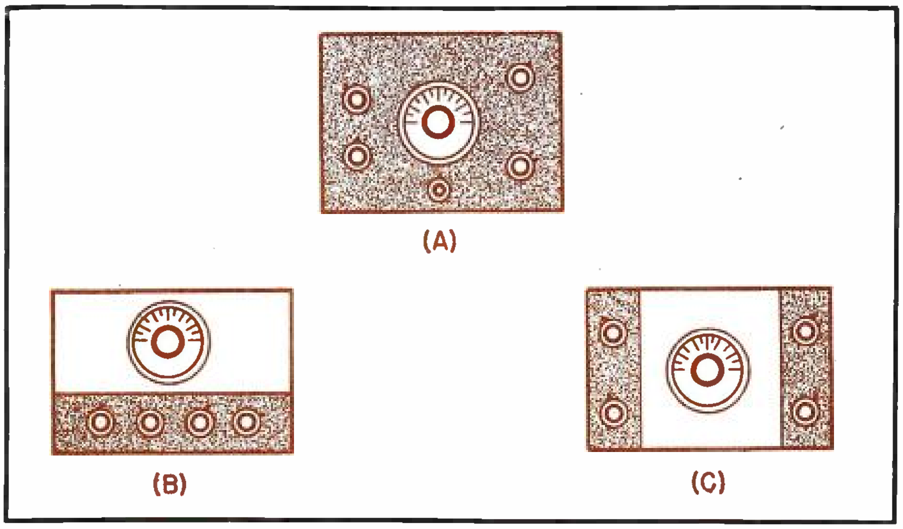
We shall now assume that the receiver is finished and is completely tested and aligned. With everything working to our satisfaction, we shall plan and produce the printed panels.

Some of the materials and tools needed will be as follows:

1. Small quantity of double weight, high contrast, glossy, contact printing paper.
2. One tube of MQ developer.
3. Small quantity of acid-hypo fixer.

The above can be obtained from any

Fig. 1. Three distinct types of front panel layouts that are popular today.



photographic supply house. Make sure the paper is large enough for the size of the panel to be printed.

4. Three large pans or bowls (do not use aluminum).
5. Small quantity of tracing paper.
6. Compass pencil or bow pencil.
7. Ball pen points and holder.
8. Ruler.
9. Protractor.
10. Hard pencil.
11. Bottle of black india ink.
12. Gum eraser.
13. Sheet of clear glass.
14. Rubber cement.

Make the panel approximately as high as the receiver chassis and as long as necessary, usually the full length of the receiver. Study the various receiver controls one by one and analyze their rotation. Most potentiometers turn a maximum of 270 degrees, while most variable condensers turn 180 degrees. All this should be taken into consideration.

Remove the control knobs and bushing nuts. Take a piece of stiff paper or cardboard, cut to the fractional panel size and make the necessary holes so as to allow it to slip over the control shafts. Replace the nuts and knobs and turn the receiver on. Now we can make the necessary markings with pencil on the cardboard.

The knobs should be tightened in such a manner as to make the center of the calibrations right side up. The band and other switches should be switched to their various positions and a mark made for each. Label the marks or controls, as it is easy to forget what they were made for.

When the rough cardboard panel is completely marked, remove it from the receiver. The tracing paper is placed over the cardboard and the various holes and calibration marks located. The tracing paper is then fastened to a drawing board or table and the calibration lines drawn in with precision. Make the various lines, numbers and lettering as needed with light pressure on the pencil. Fig. 3 shows various possibilities.

After the pencil layout is completed, ink in the lines that are to be reproduced. The ball pen is used for this purpose. Two different size pen points will come in handy, one for making the heavy calibration lines, and a smaller point for the numbers and lettering. If any ink spills on the paper or an undesired ink line is made, it can be eliminated by simply cutting it out with a razor blade. If the india ink tends to blot and a sharp line cannot be obtained, rub a small quantity of talcum powder onto the tracing paper, blowing away the surplus. When the inking is completed, remove the pencil lines with the soft gum eraser. The neatness of the finished panel will depend largely on the pains taken in preparing the tracing paper positive.

The developing should be done in a dark room. A small red 7½-watt lamp should be all the light present during developing. The three enameled or china containers are set out on a table. In the first bowl the contents of the MQ tube are mixed according to directions on the label. Fill the second with clear water. In the third, mix the acid-hypo according to directions on the package.

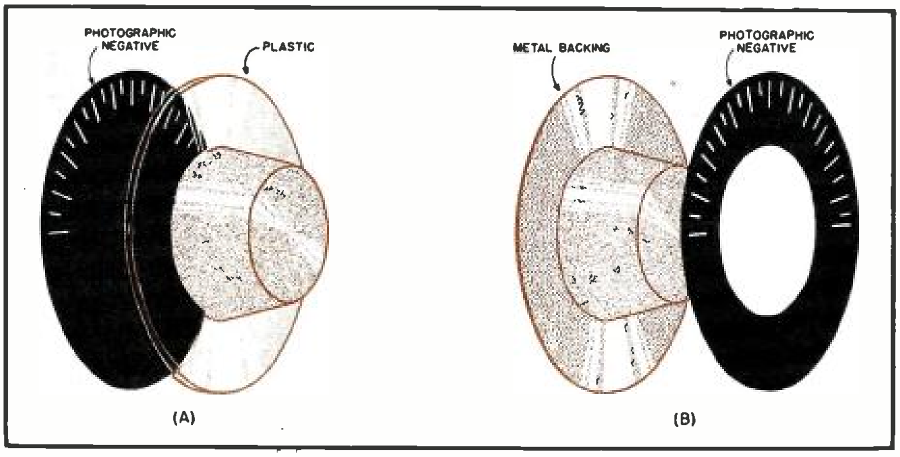


Fig. 2. Two methods of obtaining a professional-appearing calibration. (A) The photographic negative with the calibration marking appearing thereon is glued to the panel or to the back of the flange. A transparent plastic knob is used with this arrangement. (B) Photographic negative is glued directly to the knob flange.

Remove the contact printing paper in the darkened room and cut to slightly larger than the fractional panel size. Place the prepared tracing paper, inked side up, upon the printing paper; and then, in turn, place the clean sheet of glass over all. Be sure the emulsion or shiny side of the printing paper is up. Before exposure, make certain the unused balance of the printing paper is in its light-tight envelope. Now turn on the room lights and expose for about five minutes. Then darken the room, remove the exposed paper, and place into developer, making sure all the paper is covered by the solution. Watch the paper and in time the background will become black while the lettering will stand out in white. If a good black background and clean white lettering are not obtained, repeat the process with another piece of paper using more or less exposure as indicated by the results of the first trial.

When a perfect panel is developed, remove and place in the second container of clear water for about 15 seconds. Then place it in the third pan of acid-hypo. Keep the panel covered with acid-hypo for about 20 minutes, remove and wash in clear running water for about one-half hour.

The panel can be dried, face down, on a piece of lintless blotting paper. A weight on the top will cause the paper to dry flat. If a glossy surface is desired, the panel should be placed, face down, on the clean sheet of glass and the surplus water removed by squeezing down with the palm of the hand and blotting with a blotter. Peel the print off the glass when it is bone dry.

The panel can be mounted directly on the receiver with rubber cement. This is a very easy and practical method of fastening. For greater durability, a coat of clear lacquer can be brushed on. If extreme wear is to be encountered, a sheet of celluloid or plexiglass may be fastened over the top.

If certain calibration points are to stand out, they can be colored with permanent red or green drawing ink. The matted surface will take ink much better than the glossy finish.

This same process is useful for producing "custom-built" knobs and main dials. If a circular sheet of transparent plastic is fastened to the back of a knob, the photographic negative can be cemented to the rear of the plastic with the calibrations showing through to the front (Fig. 2).

A second method is to cement the photographic negative on a circular metal disc that is, in turn, fastened to the knob. The latter method has, necessarily, poorer wearing qualities.

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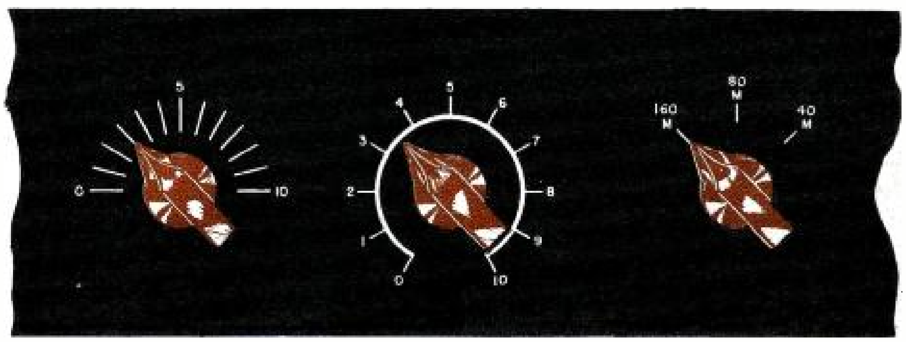
Fig. 3. Emphasizing neatness and clarity, this arrangement is obtained by gluing a photographic negative of the various calibrations directly to the front panel.



Determining the frequency at which a quartz crystal plate will oscillate by measuring its thickness with a micrometer.

Quartz Crystal Frequency Measurement

By KENNETH M. LAING
North American Philips Co., Inc.

A number of practical methods employed by manufacturers for accurately measuring the operating frequency of fabricated crystals.

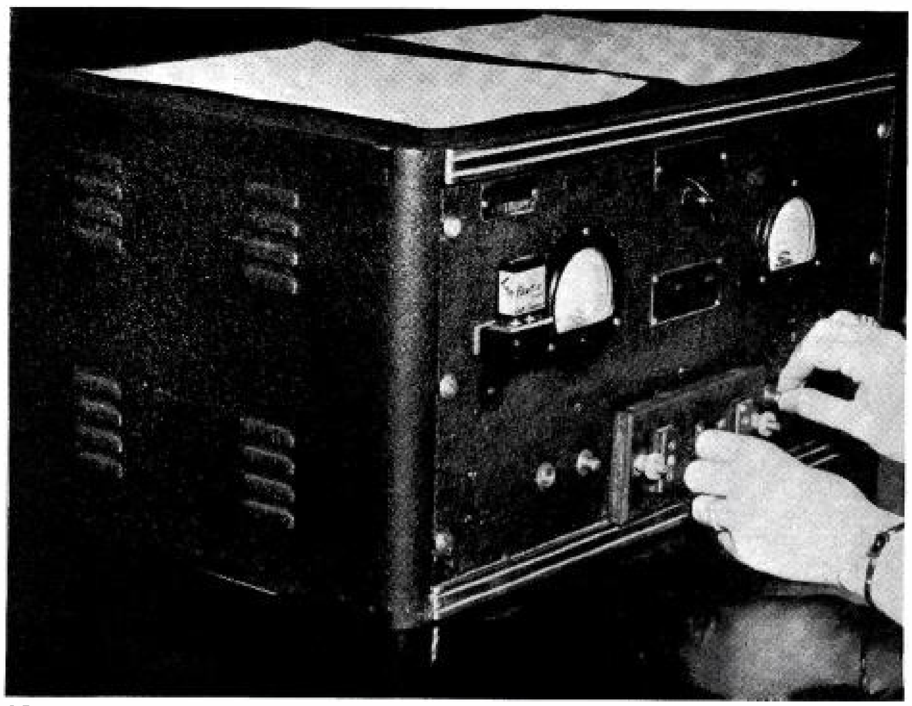
A QUARTZ crystal plate is enabled to respond to a very narrow frequency band because of the interrelationships of the electrical and mechanical constants of the material. The dimensions of the piece of quartz, insofar as they define the mechanical properties, thereby are enabled to control the electrical characteristics. One way, then, of determining the frequency to which a fabricated crystal will respond is to measure its size. In many quartz oscillator plates, it is the thickness of the wafer which determines the frequency. A measure of this thickness, usually with a micrometer, when divided by the appropriate constant, yields the frequency.

As with every physical measurement, there are errors and uncertainties which limit the accuracy of this method. The controlling factor is the difficulty of measuring thicknesses accurately enough in the range of 5 to 100 thousandths of an inch. The crystal might be measured more accurately if the surfaces were smooth planes. Actually, there are many small pits caused by the action of the etching solution used as a final treatment. In a larger sense, the surfaces depart from flatness in that some crystals are deliberately ground to be thicker in the middle than at the edges.

Another limit is the factor relating thickness and frequency, which is dependent on the angle between the faces of the plate and the optical and electrical axes of the natural crystal from which the plate has been cut. This is less important since the angles are fixed rather precisely, not to facilitate measurement by the thickness method, but to control the temperature coefficient of frequency of the crystal. In consideration of these factors, and because other methods are much easier, it is rarely that thickness measurement is employed.

All other methods of frequency determination are electrical in nature, and thus require that the crystal be electrically excited. However, in one application of this general method, the crystal is not in continuous electrically sustained oscillation. Toward the end of the process of manufacture of crystal wafers, they are swept between two metal plates and are supplied with a suspension of abrasive particles in oil. It was found that the continual shock of impact between quartz and abrasive, whereby particles of quartz are torn loose from the main mass, generates a small voltage between the plates, at a frequency controlled by the thickness of the quartz. This voltage, applied to the antenna terminals of a communications receiver and amplified, registers on the carrier strength meter or is made audible. The dial reading at which the signal is maximum is an indication of the composite frequencies of the crystals being lapped. The accuracy is not high, being about 5 parts in 1,000.

"Crystal duplicator," employing an accurately calibrated standard crystal, is used in comparing the final frequency of all processed crystals.



The other methods of measuring the frequency of crystals really measure the waves generated by an oscillator that is controlled by the crystal under test. Many measurements are made where extreme accuracy is not needed. It is possible to use an absorption wavemeter. With this the frequency of the crystal-controlled oscillator is compared to the resonance frequency of a calibrated coil and condenser, resonance being indicated by the occurrence of maximum voltage or current absorbed by the circuit. Another method compares the frequency being generated by the crystal oscillator with that from another oscillator. The frequency of the latter is variable and it is calibrated. The heterodyne frequency difference, rectified by a detector circuit, is amplified and made audible. When the audio frequency drops to zero, the variable oscillator is at crystal frequency. A unit embodying all of these circuits, and called a channel sorter, is used widely for rough measurements on semifabricated crystal plates. The range ordinarily is a 1- to 2-mc. section of the radio spectrum; the accuracy is about .5%.

When more exact measurements are desired, the same type of circuit is used, but with refinements, such as temperature control of the inductors and capacitors in the variable frequency oscillator. This instrument, with a frequency range up to 5,000 kc. has an accuracy of 1 part in 1,000. Harmonics of the oscillator frequency can be matched with higher frequency crystals up to 30 mc.

Much closer measurements are needed for the final steps in the manufacture of quartz plates, as they are used to fix the transmission frequencies of radio apparatus of very close limits. For measurements of greatest accuracy, a known standard frequency signal is needed that will not vary as much as 1 part in 1,000,000. This is, of course, a carefully regulated crystal frequency and associated oscillator circuit. Multivibrator circuits, locked to the crystal frequency, yield a series of harmonics at 10-kc. intervals throughout the usable spectrum. The exact location of these marker frequencies is determined by checking the crystal in this primary standard against the well-defined frequencies radiated by the government station WWV. Thus, a means of reaching an accuracy of 1 part in 10,000,000 is available, though not often used.

The crystal to be measured is oscillated in a suitable circuit and the signal is picked up with a communica-

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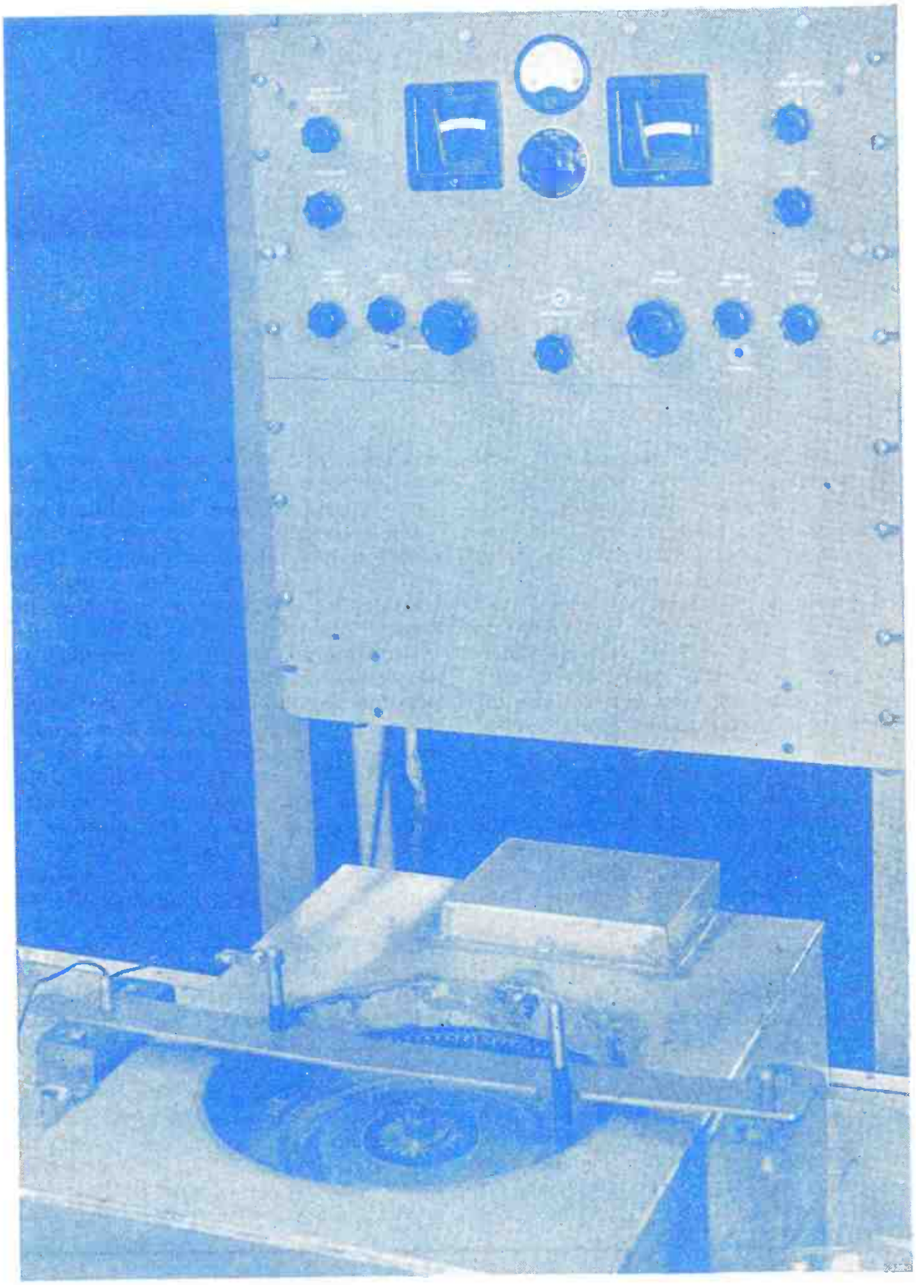
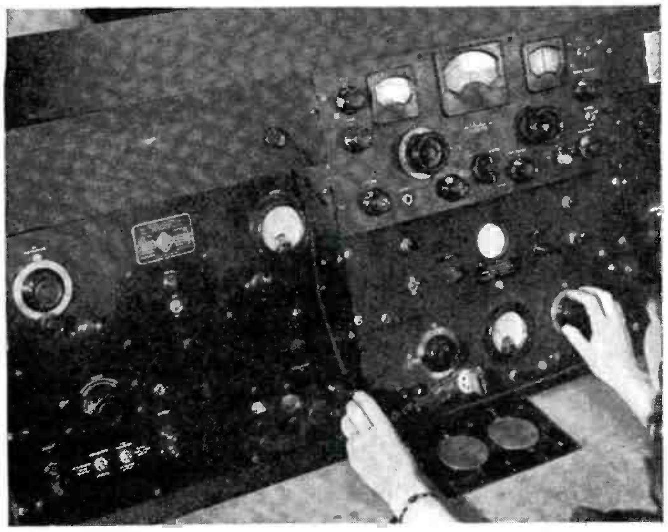
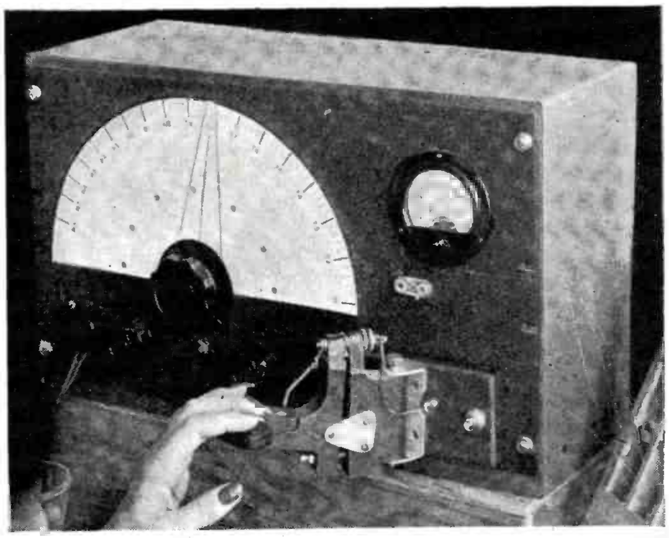


A quartz crystal lapping machine with a communications receiver for measuring the frequency of the signal produced by the crystals as they are lapped.

An array of electronic equipment which is used to determine with extreme accuracy the operating frequency of crystals.



A channel sorter is used for rough frequency checks. The crystals are placed between the electrodes of the vise-like jig.



LET'S TALK SHOP

With JOE MARTY

Eastern Editor, RADIO NEWS

INASMUCH as licensing of radio servicemen is receiving a great deal of attention throughout the industry, it might be well at this time to examine the situation as regards this very pertinent subject.

A number of states and cities have passed or have up for consideration licensing ordinances of various kinds. It seems to me that there are a number of things to consider before any commitment should be made for licensing.

1.) Will licensing do what the serviceman hopes it will do?
2.) Is it in the best interests of the industry?
3.) Is the serviceman dodging a responsibility at the expense of his future freedom?
4.) Can it be controlled once it is established?

Returning to point number one; obviously, the only reason for licensing of servicemen is to attempt to control the bad business practices and the gyp tactics of many men who are operating as radio repairmen today. A point to remember is that many businesses and professions are licensed and they still have trouble with the gyping and the charlatan. The thought occurs that by the passage of a licensing law, the only thing gained would be to drive the gyp underground where he will be harder than ever to control.

Point number two—"Is it in the best interests of the industry?"—brings up many thoughts. First, by virtue of the fact that there is a licensing ordinance operating will mean that fewer number of servicemen will be operating, and therefore fewer customers for parts jobbers will be available.

Secondly, there is no guarantee by any set manufacturer or other manufacturer who has need for the services of a serviceman, that they will use only licensed servicemen for installation and repair. Unless the ordinance is very carefully worded so that all possible loopholes are plugged, there will spring up the greatest crop of bootlegging servicemen that this industry has ever known. If the licensing ordinances reduce the number of servicemen, will we not be in the same position we find ourselves today where the customer is being kicked around due to the fact that there is a dearth of servicemen. I do not believe John Q. Public will submit to this kicking around, regardless of the number of servicemen, after the war. It is my feeling that the pressure of business will militate against licensing of servicemen.

Point number three is the one dealing with the responsibility of the serviceman to himself and to his customer and to the industry. It is a well-known fact that the average serviceman refuses to accept the responsibility for controlling and maintaining the ethics and the good business practices of his profession. It is always very easy to say "Let George do it," and this is in effect what is being said by the serviceman who intends to lean very heavily on the licensing ordinance. In other words, let the government do it. However, there is a great danger that in adopting this attitude the average serviceman is trading his future freedom of operation for a very negligible advantage over a competitor.

"Now put the condenser and tubes back in place, and if you've followed my instructions carefully, you should be able to hear me again!"

Perhaps I am too old-fashioned but it seems to me that any good serviceman has nothing to fear from competition, provided he has the courage to stand up for what he knows is right and to fight for those things which he knows will better his business and his standing in the community.

I believe that servicemen for too long have dodged their responsibilities. Certainly there is enough talent, enough good business judgment, and enough good common sense in the ranks of the now-operating servicemen to solve all problems which are plaguing them today.

Point number four. The matter of controlling and enforcing a licensing ordinance has always been one that I do not believe would operate properly. It is very easy to build up a Utopian idea that now that we have a licensing ordinance John Gyp will not be allowed to service sets unless he passes an examination, and so forth, but when it comes time to haul him into court to answer for his misdeeds we have an entirely different set of circumstances. First, the ordinance has to be written so carefully that there are no legal loopholes, since it is obvious that if a man is a gyp in the operation of his business he will take advantage of every opportunity to gain his ends.

Secondly, the matter of enforcement becomes a very critical one and must be kept directly under the control of the operating servicemen in any particular community, otherwise the gyp is able to creep back into the fold on a technicality and the whole job is wasted. The costs of enforcement are another item. Where gyping is particularly bad, you will find that the gyps are in a majority and where there are a large a number of these men operating at the expense of the legitimate servicemen it is obvious that it will take a great deal more policing, a great deal more time spent in court, and a great deal of other servicemen's time to watch out for violations. The law enforcement agencies act only on complaints and do not themselves, generally speaking, bring actions without complaints.

The above remarks on licensing are presented not necessarily either for or against the idea, but merely to point

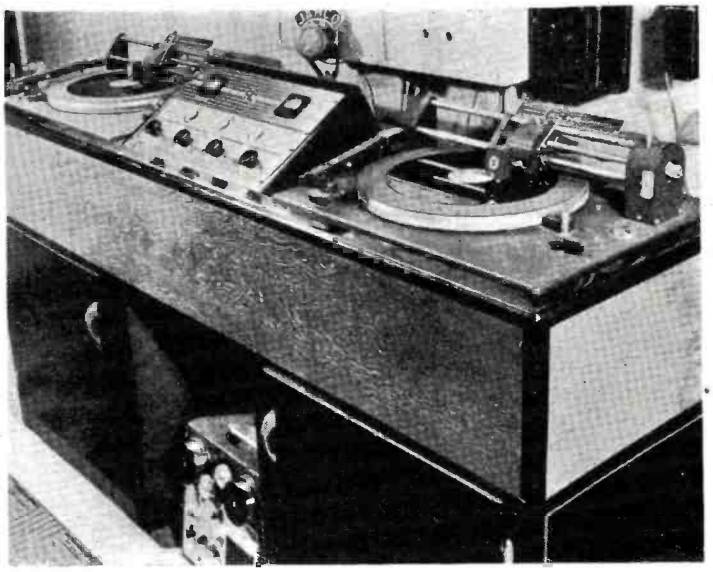
(*Continued on page 86*)

DUAL SPEED RECORDING UNIT

A NEW combination unit, which offers recording cutter and playback, radio reception, and a public-address system in one package has been introduced by *Robinson-Houchin Optical Company* of Columbus, Ohio.

This unit, one of which is currently installed in the Jack and Heintz Company of Cleveland, is a console model which incorporates all of the features of the RA-16 portable Radiotone plus an acoustical cabinet. The unit is housed in a combination pressed steel cabinet with black crackle panel and cream dupont cabinet which makes it suitable for studios, plants, and schools. It is also available in all-black dupont.

The machine may be used to record programs directly from the built-in radio, or from the public-address system. These records can be played back instantly over the playback machine.



Simplified operation is the keynote of this assembly, employing two dual Radiotone recording units.

The Radiotone records at 78 or 33⅓ r.p.m. and cuts from either the inside or outside of the disc. The high-fidelity cutting head has a uniform frequency response from 40 to 6000 cycles.

The playback arm is of heavy construction, counterbalanced to give 1½ ounces pressure on the magnetic needle. The frequency range of the pickup is from 30 to 7000 cycles.

The operator may vary the low-frequency response by means of two duo-chromatic equalizers. One of these equalizers operates at about 100 cycles from 1 to 15 db. above or below normal; the other equalizer gives constantly variable boost at the high frequency. At 7500 cycles, the boost is from 1 to 22 db. with an attenuation of from 1 to 15 db. below 5000 cycles.

The unit is provided with two dual high-impedance input channels. Either input channel is equipped with two separate jacks. One jack includes the preamplifier and provides an over-all gain of 115 db. which is sufficient to operate microphones with an output of as low as minus 70 db. The other jack by-passes the preamplifier tube and lowers the gain to 80 db. These characteristics are suitable for most crystal, magnetic, and dynamic pickups, as well as zero level line.

All of the functions of this unit are regulated instantly by depressing one or more of the seven different control buttons with which the Radiotone is equipped.

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Console model features RA-16 recording unit and acoustical cabinet.

PRACTICAL RADIO COURSE

By ALFRED A. GHIRARDI

Part 34. Covering the various basic vacuum-tube oscillator circuits, and the modifications of them, employed in radio receivers.

AS WAS explained last month, the amplifying properties of a tube having three or more electrodes and associated with suitable electrical components and a circuit that couples the plate circuit back to the grid circuit so that energy transfer back to the grid in the proper phase relation can take place, give it the ability to generate an alternating current of a frequency determined mainly by the electrical constants of these components. A vacuum tube operated in such a circuit is called an *oscillator,* and its function is essentially to convert a source of d.c. into radio-frequency alternating current of a predetermined frequency. In fact, the characteristics of radio tubes which make them good amplifiers are also responsible, in general, for making them good oscillators.

Many vacuum-tube oscillator circuit arrangements have been devised, but not all of them are suited for practical use as local oscillators in modern superheterodyne receivers. Those that have been most frequently used for this purpose are the Armstrong grid-tuned tickler feedback circuit, the Hartley, the Colpitts, and the tuned-grid tuned-plate arrangements. These will now be studied.

Grid-Tuned Tickler Feedback Oscillators

The simple grid-tuned tickler feedback oscillator circuit was described last month. It has been used in many superheterodyne receivers—especially in short-wave receivers, those in which a separate oscillator and mixer tube are employed, and in straight battery-operated type receivers.

A modification of this circuit, in which the tickler winding, L_t, is connected in the cathode circuit, is illustrated in Fig. 1. The feedback still is inductive in nature. For simplification in manufacture, the tank and tickler coils, L and L_t, are wound as a single tapped coil.

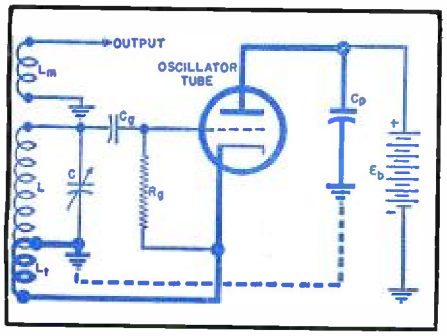


Fig. 1. A modification of the simple grid-tuned tickler-feedback circuit. Here the tickler winding is in the cathode circuit, and the tuning and feedback windings have been combined into a single-tapped coil. Feedback circuit shown by heavy lines.

Notice that in this circuit the rotor of the tuning capacitor, *C,* is at ground r.f. potential. This permits the use of the simple type of grounded-rotor gang tuning capacitor for tuning both the oscillator and preselector circuits simultaneously when this oscillator is used in a superheterodyne.

Automatic grid bias is provided by C_g and R_g (R_g will often be found connected across the grid capacitor C_g, instead of as shown). The r.f. by-pass capacitor C_p keeps the r.f. currents out of the plate supply source. Pickup coil L_m, inductively coupled to the oscillator tank coil *L,* usually is connected into the cathode lead of the mixer tube in order to feed the oscillator output to the mixer, as will be explained later.

The Hartley Circuit

The basic distinguishing feature of the famous Hartley and Colpitts oscillator circuits lies in the fact that in both of them an exciting voltage of the proper phase is obtained by connecting the grid and plate electrodes of the oscillator tube to *opposite ends of the tank circuit* with respect to the cathode connection, with the ratio of exciting voltage to alternating plate-cathode voltage determined by the relative reactances existing on the two sides of the cathode connection.

The basic Hartley and Colpitts circuits (with grid-capacitor and leak, by-pass capacitors, etc., omitted for clarity) are illustrated in Fig. 2. Notice their similarity, in that in each one the grid and plate are connected to the opposite ends of the tank circuit with respect to the cathode connection. They differ from each other mainly in one important respect: in the *Hartley* circuit the division of the plate and grid circuits is made by tapping the tank inductance, and *inductive* feedback takes place, whereas in the *Colpitts* circuit this is done by splitting the tank capacitance; hence *capacitive* feedback takes place. Various versions of these basic circuits have been devised to best suit the requirements of the many uses to which such vacuum-tube oscillators are put.

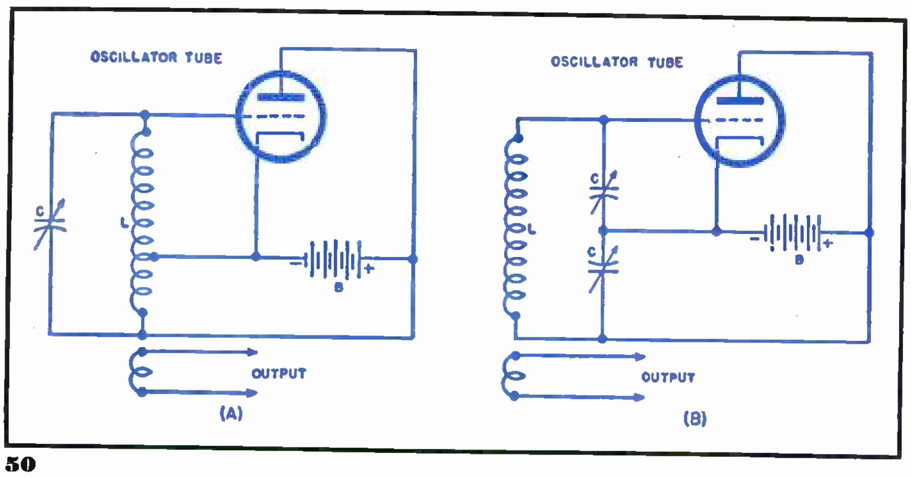
In both of these circuits the grid resistor, R_g (not shown), causes the grid to be biased considerably negative with respect to the cathode.

Modified Hartley Superheterodyne Oscillator

A modified form of *Hartley* oscillator circuit that has been quite popular in late-model receivers is illustrated in Fig. 3. Tuning capacitor *C* and the *entire* winding *L* form the tank circuit, and their resonant frequency determines the frequency of oscillation.

The cathode of the tube is returned to a tap about ¼ to ⅓ from the low end of this tuning coil. Since this causes the lower portion, L_t, of the tuning coil to act as a feedback winding, the position of this cathode tap on *L* is important in determining the amount of feedback that will result, and the strength of the oscillator current in the tank circuit. In both this and the tickler feedback circuit of Fig. 1, too great a coupling between the plate and grid coils causes harmonics to be generated—especially on the

Fig. 2. Basic Hartley (A) and Colpitts (B) oscillator circuits.



high-frequency end. Too loose a coupling may result in the oscillator ceasing to function on the low-frequency end of the band. Somewhere between these two conditions is found the best workable degree of coupling.

R.f. by-pass capacitor, C_p (Fig. 3), allows r.f. current to circulate freely between the lower end of the tuning coil and the plate, thus by-passing it around the internal impedance of the "B"-voltage supply. Thus, the d.c. plate voltage is introduced in the oscillator by a shunt path. This is termed "shunt feed," and this arrangement often is known as the Shunt-Fed Hartley Oscillator. Shunt feed usually is preferable in the Hartley oscillator, and it is required in the Colpitts circuit. Often, an r.f. choke is connected in series with the positive terminal of the "B" supply, in order to improve the action of C_p.

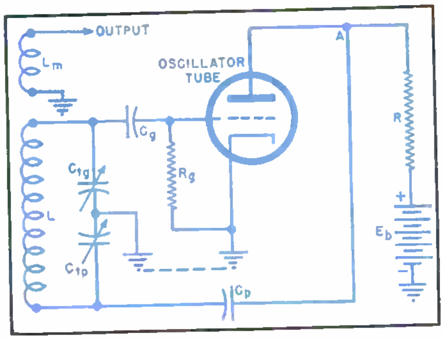


Fig. 4. Colpitts oscillator circuit in which the tank capacitance is tapped, dividing the grid and plate circuits. Capacitive feedback results.

An important advantage of this version of the Hartley circuit over the basic Hartley illustrated in Fig. 2, is that here the high "B" voltage is not applied to both sets of plates of the tuning capacitor *C*. Instead, the rotor of the tuning capacitor is at ground potential, so a simple grounded-rotor-type unit may be used.

It is obvious that this circuit can be used conveniently only with oscillator tubes having indirectly-heated cathodes which are insulated from the heater circuit. Since filamentary-type cathodes require r.f. chokes in the heater supply circuit, the cathode may be "off ground" at r.f. potentials.

The Colpitts Oscillator for Push-Button Tuned Superheterodynes

The *Colpitts* oscillator circuit has found considerable use in push-button tuned receivers. A simple form is illustrated in Fig. 4. Remember that the Colpitts circuit differs from the Hartley in one important respect—the division of the plate and grid circuits is made by tapping *capacitance* rather than by tapping the inductance. Notice that instead of using part of the inductance of the tuned circuit for the plate circuit and part for the grid circuit as is done in the Hartley circuit, the tuning *capacitance* here is broken up into two sections. One, C_{Tg}, is used for the grid and the other, C_{Tp}, for the plate r.f. circuit. The tank tuning capacitance is now composed of C_{Tg} and C_{Tp} in *series*, the combination being in *parallel* with tuning coil *L*.

The action of the Colpitts circuit, in general, is as follows: Any disturbance will change the direct plate current flowing through the plate circuit. Any such change in plate current will cause the voltage drop occurring in the plate circuit to change, thus changing the potential of point A with respect to ground. Now this change in voltage also is applied across the series-combination of by-pass capacitor C_p and tuning capacitor C_{Tp}, because the combination of the two in series are in parallel with the impedance of the plate load and the plate supply voltage. Any change in the voltage existing across C_{Tp} will cause capacitor C_{Tg} to charge or discharge in accordance with the charge or discharge occurring in C_{Tp}. In this manner, an oscillating current is set up in the L-C_{Tp}-C_{Tg} tank circuit.

The alternating voltage across C_{Tg} is that which actuates the grid of the tube; the one across C_{Tp} is that which serves to excite the oscillating tank circuit. In other words, the alternating voltage across C_{Tp} corresponds to that across L_1 in the Hartley circuit of Fig. 3, and that across C_{Tg} corresponds to the voltage across L_g in the Hartley circuit. The method of grid circuit excitation is *inductive* in the Hartley and *capacitive* in the Colpitts circuit.

An advantage of the use of the Colpitts-type oscillator in multiband receivers is that since the tank coil has no tap, one less coil circuit needs to be switched each time the receiver is to be switched to another waveband.

In a broadcast-band receiver employing a Colpitts oscillator, capacitor C_{Tp} may be in the form of an adjustable padding condenser that may be set once for satisfactory feedback over the entire band to be received. Capacitor C_{Tg} will then be employed as

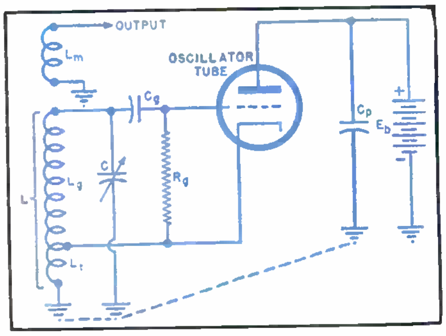


Fig. 3. Modified Hartley oscillator that enables the rotor of the tuning capacitor to be grounded.

the tuning capacitor for the oscillator.

In receivers employing push-button tuning, a series of inexpensive adjustable trimmer capacitors may be used for tuning the oscillator circuit over the entire waveband, and others used for tuning the antenna and preselector coils. These may be combined with push-button switches that switch them in or out of the tuning circuits. One such combination is provided for each station frequency to be received—the capacitors associated with each push-button having all been previously adjusted and set to the exact capacitance values required to tune their individual circuits to the correct frequencies. The simplified basic switching circuits for a push-button tuning arrangement of this type in a superheterodyne employing one tuned r.f. preselector stage is shown in Fig. 5.

Oscillator Employing Both Inductive and Capacitive Feedback

An oscillator circuit that employs both tickler and capacitive feedback is illustrated in Fig. 6. This has several important advantages over the straight Colpitts oscillator of Fig. 4. By proper selection of oscillator con-

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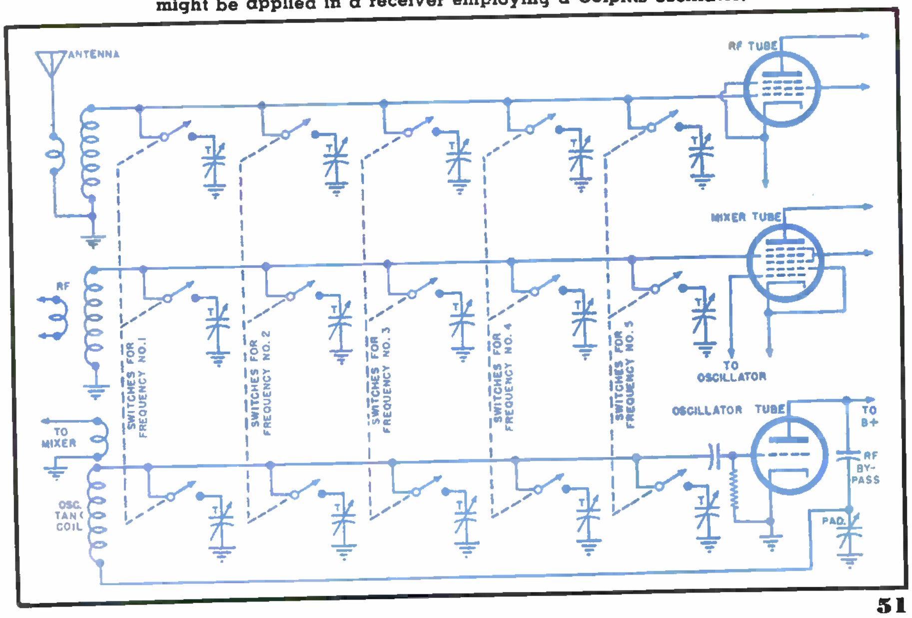
Fig. 5. Wiring diagram illustrating how push-button tuning might be applied in a receiver employing a Colpitts oscillator.



LINEAR SWEEP GENERATORS

By ABRAHAM TATZ

An analysis of the circuits of linear sweep generators, used in oscilloscopes and television camera and picture tubes.

THE oscillograph, used so widely for observing voltage variations with respect to time, is essentially a cathode-ray tube with associated amplifier and timing circuits. A narrow beam of high-velocity electrons has demonstrated so many advantages as a measuring device that its application has been extended to the observation of voltage variations in many industrial electronic devices.

If the voltage variation is periodic with respect to time, the cathode-ray tube literally yields a visual picture of this variation on a fluorescent screen. If the variation is a transient, the picture will not be continually evident, but may be photographed for careful analysis. In addition, the cathode-ray tube, as a sensitive and accurate indicator, is being used in television for the translation, at the transmitter, of light variations into voltage variations, and in the receiver for the translation of the voltage variations into variations of light intensity for image reproduction.

The characteristics of the electron beam which allow such critical and complex usage are its extreme flexibility under controllable motion over a wide frequency range and the narrowness of the beam for accuracy of detail.

The tube which develops the beam is a vacuum tube, consisting of an indirectly heated cathode and an accelerating device to produce a stream of high-velocity electrons. During the process of acceleration the stream is focused to a point on a remote target. In Fig. 1 the tube photograph shows the relative positions of the cathode, control grid, focus, and accelerating anodes, the entire mechanism being called an electron gun. The pencil of electrons is sharply pointed at the far end, forming a spot of light on the screen. The pencil, far from being rigid, is extremely pliable, because the electrons making it up are of negligible mass and inertia. Hence, the beam will react to external fields of force, static, or magnetic, practically instantaneously.

The fields, apart from the electron gun, are called the deflection mechanism, and may be within the tube or outside of it. Under the influence of static deflection the beam acts as a group of negative charges, attracted by positive voltage and repelled by negative voltage. Under magnetic deflection the beam acts as a current-carrying wire, electrons flowing with high velocity toward the screen. Hence, by magnetic deflection the beam will tend to move in a direction at right angles to the direction of the flux and also at right angles to its own direction of motion.

The target which the beam strikes after deflection depends on the particular application of the cathode-ray tube. In the oscillograph the target is a chemically-treated screen which glows at the spot struck by the beam. The narrowness of this spot is fixed by the focus mechanism, and its brilliance depends on the control-grid bias of the tube. With no deflection the spot is stationary, usually centered on the screen. Under the influence of an electrostatic field existing between the horizontal deflecting plates, the spot will be displaced to a side, at an angle from its original motion. The field affects the beam only for a small period in its forward motion; the angle of deflection depends on the strength of the field, the duration of influence on the speeding electron, and the distance from plates to screen. If the deflection is achieved by a periodically changing static field the displacement will be repetitious. If the frequency of change is high enough, over ten times a second, the screen will show a continuous horizontal trace because of the persistence of the screen glow and the reaction of the human eye. The same can be said of vertical deflection acting alone.

When both vertical and horizontal fields are applied simultaneously the beam will move along a path which at any instant is the resultant of the two displacements. In most oscillograph applications the horizontal deflection causes the beam to move with uniform speed from left to right, to fly back to the starting place very rapidly and re-

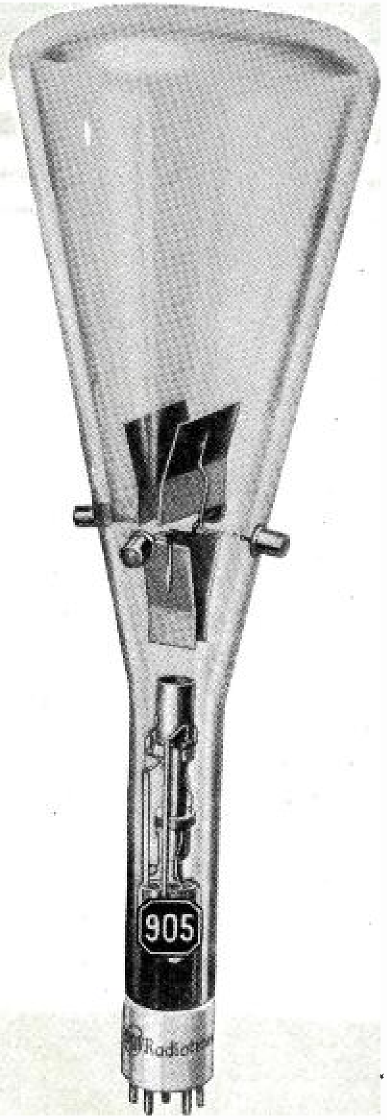


Fig. 1. An RCA five-inch high-vacuum cathode-ray tube.

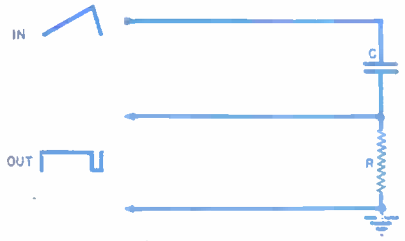


Fig. 2. Differentiating circuit to develop blanking pulse.

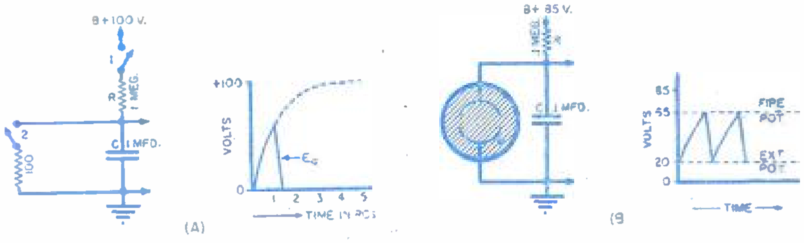


Fig. 3. (A) Mechanical switching circuit for sawtooth wave. (B) Electronic switching circuit using neon discharge tube.

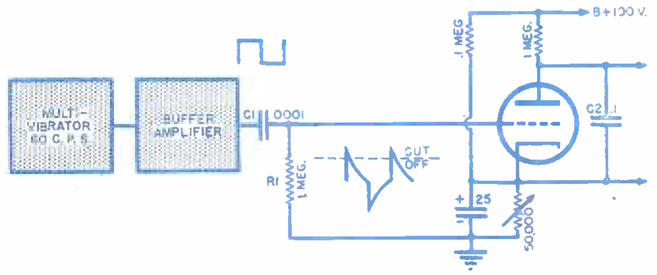


Fig. 4. Peaking circuit and biased triode for shortening fly-back time.

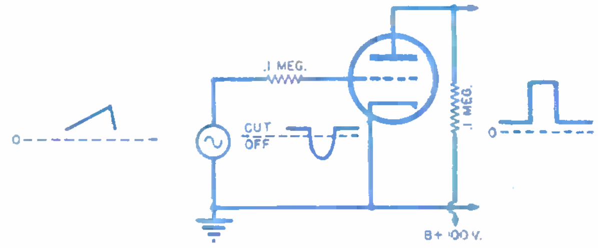


Fig. 5. Squarer circuit to substitute for first two stages of Fig. 4.

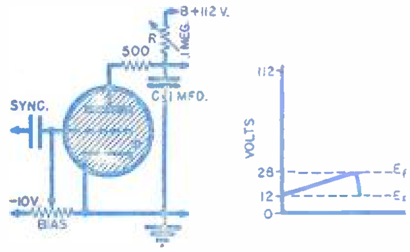


Fig. 6. Sweep circuit, using gas triode or discharge tube.

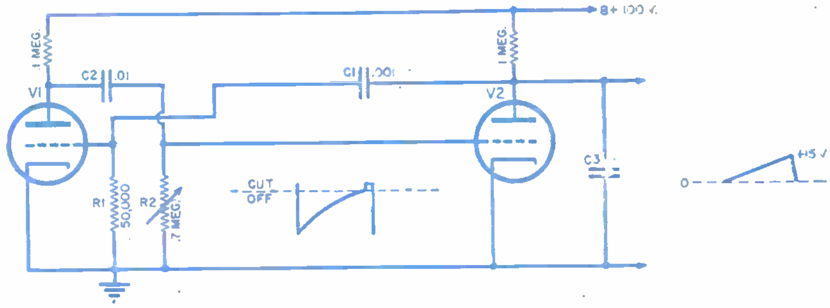


Fig. 7. Multivibrator sweep circuit, showing voltage wave applied to grid of V_2.

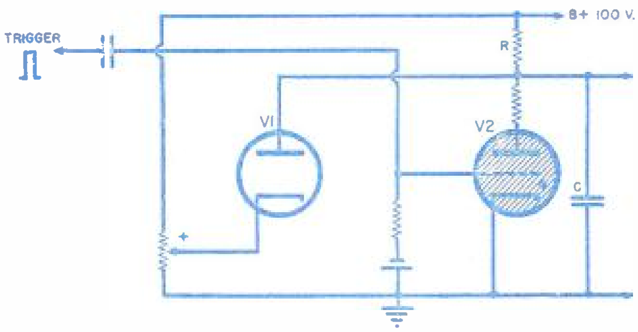


Fig. 8. Wiring diagram of gas triode single-sweep circuit.

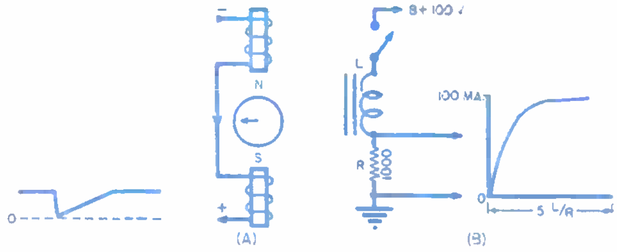


Fig. 9. (A) Position of horizontal deflection coils showing windings and current flow to deflect beam towards left. (B) Mechanical switching circuit and curve of current rise.

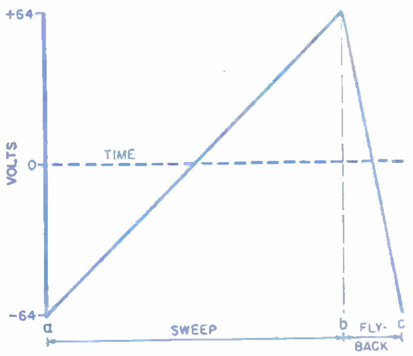


Fig. 10. Sweep voltage to horizontal plates.

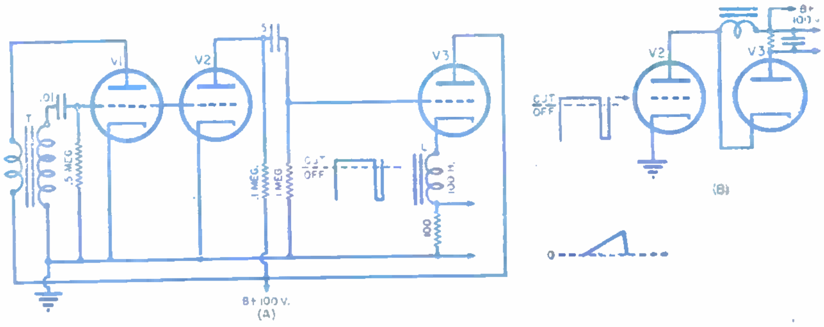


Fig. 11. (A) Blocking oscillator, amplifier, and sweep tube for linear sweep of coil current. (B) Sweep coil placed in plate circuit of V_3, with damping diode.

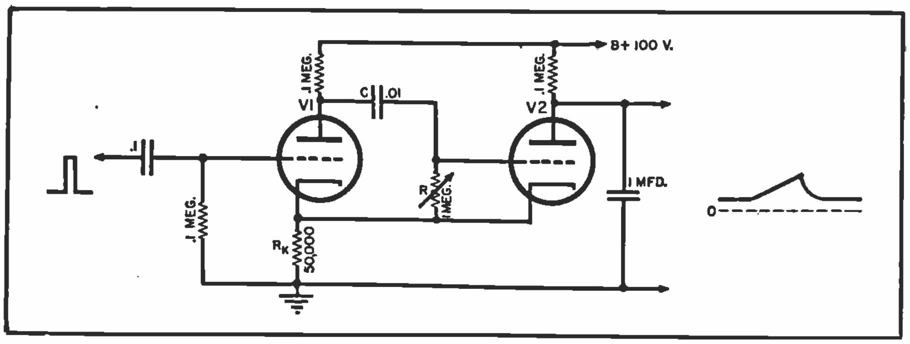


Fig. 12. Wiring diagram of a vacuum-tube single-sweep circuit.

peat the uniform motion at the frequency of the change in the horizontal deflecting field. The uniform speed, a quality called linearity, can be achieved only if the horizontal field of force changes equal amounts in equal time intervals.

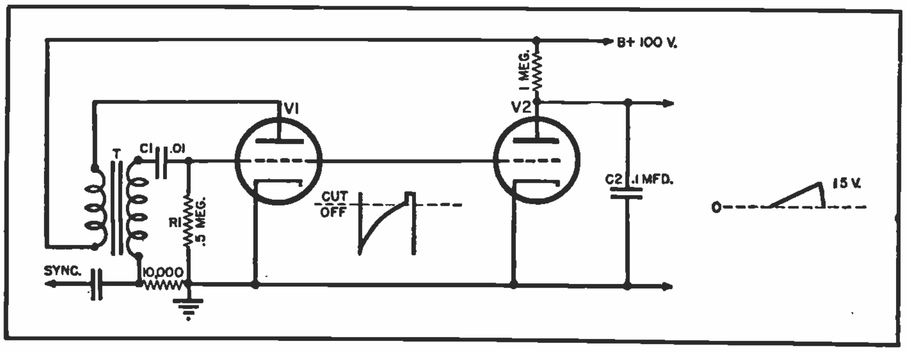
The voltage wave of Fig. 10, applied to the right-hand horizontal deflecting plate with respect to the other horizontal deflecting plate, will react on the beam in the following manner. If the sensitivity of the tube is assumed to be 32 volts per inch, the spot at time (a) will be repelled by negative 64 volts to a position two inches left of center when facing the front of the tube. At time (b) the spot will be attracted by the positive voltage to a position voltage two inches right of center. Since the field is a linear change in time, if time (a) to (b) is 16,000 microseconds and (b) to (c) 666 microseconds, the beam will move one inch to the right every 4,000 microseconds. Then it will fly back quickly to its starting position two inches left of center, since the potential at time (c) equals the potential at time (a), taking only 666 microseconds to flyback. The total time, sweep plus flyback, will take one sixtieth of a second, so this is a sixty cycle per second linear sweep, whose forward portion is used as an accurate time base, just as the horizontal axis of a graph in rectangular coordinates. Frequencies of sweep other than 60 cycles per second give different units along the time axis. Instantaneous values of a voltage varying in time, applied to the vertical plates, are plotted against this time reference as the beam moves its pointer rapidly and consecutively on the screen. Negligible power is needed for this measurement, and the high input impedance of the device avoids loading the circuit being tested.

If the vertical field, for example, is made to vary sinusoidally at the sweep frequency, the beam traces out on the screen one cycle of sine wave. If the vertical signal frequency is three times the sweep frequency the screen shows three full cycles of sine wave, for the vertical field changes three times as rapidly as the horizontal field. In general, if the horizontal field is a linear sweep, a voltage variation of any shape applied to the vertical plates will be shown with respect to time as a continuous screen picture as long as the deflecting frequencies are related by an integral number.

The target of the beam pencil in the case of a television receiver (Kinescope) is also a fluorescent screen. The beam is made to move horizontally left to right by a high-frequency horizontal sweep, and also vertically from top to bottom by a relatively slow vertical linear sweep. The beam therefore scans the picture screen in horizontal linear rows in vertical succession. The intensity of the beam is made to vary according to the demodulated picture (video) signal applied to the grid of the cathode-ray tube, reproducing the picture intelligence in terms of light intensity on the screen. The receiver beam tracing is made to lock with a similar tracing system at the transmitter, the process of synchronization, so that the transmitter and receiver beams are always in step with each other.

At the transmitter (Iconoscope) the beam is aimed, not at a screen, but at an image target, called a mosaic, which has a stored static charge distributed over it. The value of the charge at any one spot on the mosaic is directly related to the intensity of light from one element of the object

Fig. 13. Blocking oscillator and discharge tube for linear 60-cycle sweep.



scene under the influence of the television camera. The rapid horizontal sweep, pulled slowly downward, strikes this mosaic in a succession of rows. The discharges of the elements of stored charge on the mosaic yield voltage variations, the video signal to be amplified and made to act as the modulating intelligence upon the transmitted carrier frequency. The received signal is demodulated and applied to the receiver picture-tube grid. Since both beams are in step the received image is a reproduction of the transmitted scene, picture element for picture element.

In this article the circuits required to generate these linear sweeps will be analyzed in detail. It will be assumed that an electron beam is focused on the screen of a test oscillograph whose internal circuits already yield a linear horizontal sweep, at a frequency set by the controls at sixty cycles per second. The wave shapes to be analyzed will be applied to the vertical deflection mechanism in such fashion that a positive voltage will move the trace upwards as it sweeps across the screen from left to right. Furthermore, the wave shapes to be studied will all be generated at a frequency of sixty cycles per second, to show one full cycle of the generated voltage on the test screen. This frequency choice is justified firstly because the power frequency sine wave can be used to verify the internal sweep frequency of the oscillograph. Secondly, circuits to generate sixty cycle sweeps are standard for vertical deflection in television, whereas the value of the horizontal sweep frequency in television, set at 15,750 cycles per second (525 lines per frame) is subject to argument when greater resolution of the picture is desired.

The waveform of Fig. 10 is called a sawtooth wave. The sweep portion must be linear for accurate resolution of either a voltage waveform or a television picture. The fly-back may not be linear, for this portion, although rapid, should not be observed on the screen. It interferes with clear observation of the signal. Usually the cathode-ray tube is blanked out with an increase in bias, cutting off the beam for the duration of the flyback. The linear variation of deflecting field may be in the form of a changing static field of voltage as in Fig. 10, applied to a pair of flat metal plates within the envelope of the cathode-ray tube, or in the form of a linearly changing magnetic field derived from a sawtooth wave of current flowing in a pair of deflecting coils placed around the neck of the tube.

Linear Voltage Sweep Generators

A voltage sweep is usually derived from the slow charge of a condenser through a large resistance and the rapid discharge of the same condenser through a small resistance. Consider the mechanical switching circuit of Fig. 3A. Closing switch 1 will start

(*Continued on page* 106)

By CARL COLEMAN

FRED HOWE, General Secretary-Treasurer of The Radio Officers Union, recently announced the new agreement between American Export Airlines and the Flight Communications Officers of that company. This, we believe, is the first radio agreement covering flight radio officers by either an AF of L or CIO union.

Fred sent a nice letter along with much other information: "I have no knowledge as to what conditions will be after the war, but if you wish my opinion it is this: For two or three years, shipping will be very brisk and wages will be comparatively high. Hundreds of Radio Officers who are now manning the ships will obtain work ashore, if work is plentiful. This will mean that just that many new men will have to be hired to take their places. Because wages are high at this time, many Radio Officers have married. It is my opinion that when the war is over, their families will be a powerful inducement for these men to quit the sea.

"It is also a fact that hundreds of Radio Officers are now going to sea solely to help their country win the war, and when the war is over, they will finish their work at sea and return to their former jobs in civilian life. All of this will mean another great turnover of marine personnel. Both the Army and Navy have trained hundreds of thousands of Radio Operators and a certain percentage of these men will wish to apply the knowledge which they have gained by working as Radio Officers on merchant vessels.

"The Radio Officers Union will give every consideration to ex-servicemen if and when they apply. Most of these men who have learned radio operating in military schools, camps, on battleships, and planes, are good key men. They are good with the International code and a surprising number of them have had excellent training in the theory of radio communication and apparatus. With only a very little training, these men will readily adapt themselves to marine work. I do not anticipate any great influx of these men because they, too, have good homes to which they wish to return. . . ."

The above observations by Mr. Howe will be of much interest to those in the Armed Forces who have made inquiries in the past regarding getting into marine radio after the war, and Fred is one fellow who surely ought to have some good ideas along these lines.

ALVIN G. HERTZ has been assigned as Chief aboard a new Victory ship. J. L. Cooney has been assigned to a new C-2. A. W. Hingle, L. P. Pilcher, W. P. Lesslie and E. Waller have recently shipped as chiefs on Liberties.

A BIG jump in radio manufacturing employment after the war is foreseen by the Radio Manufacturers' Association on the basis of a recent survey. The industry will employ at least 145,266 in the postwar period, an increase of 68.6 percent over 1940, the association predicts. In making what is believed to be the first factual after-the-war survey of any industry, the RMA obtained figures from 202 firms, employing 80 percent of all the workers in the industry. Now engaged in all-out war production, these firms reported their midsummer 1944 employment at 241,286 and estimated postwar needs at 145,266. The increase over 1940 is attributed to a huge pent-up demand for new radios to replace worn out receivers, as well as the anticipated popularity of FM receivers and later of television sets.

U. S. Signal Corps was 82 years old in early March. Less than a hundred officers and men were in the original setup, compared with the hundreds of thousands today.

THE last three years have seen trained crews, sufficient to man 200 Liberties saved by safety methods of the WSA, Coast Guard, Maritime Unions, and Shipping companies, it was reported by Frederick Meyers of National Maritime Union. Mr. Meyers hailed the safety-at-sea conference in Washington, recently under the sponsorship of the Coast Guard, as evidence that this country was determined to keep its excellent wartime record intact.

FCC has made available to WMC the names of 1050 licensed radiotelephone and radiotelegraph operators who have indicated their availability for full or part-time employment in communications work.

This is the fifth of such lists by FCC which have been compiled in an effort to relieve current shortages of technically qualified persons in communications jobs.

FCC reports the filing of briefs by thirty-one broadcasting corporations and communication networks and that thirty or more briefs have been filed by persons and organizations which may be represented at the hearings to be held shortly.

Various radio outfits have shown an increasing interest in the FM field. The recommendation of the Radio Technical Planning Board that the FM position should remain unchanged was disregarded, it was declared, in the proposal to place FM at approximately double its present frequency.

This was reported as requiring an increase in the costs of producing receivers. "The problem of eliminating drift in tuning becomes still more serious if the frequency is moved upward to any considerable extent and particularly if moved as much as in this case (doubled)."

"Taxidermist nothing, I'm repairing the radio installed in it!"

(*Continued on page* 126)

CLASSROOM CHORES

By SGT. EDWIN KENT
Army Air Forces, Sioux Falls, S. D.

T/Sgt. Bastian Vogel, an instructor who saw combat duty over Europe, checks students as they operate high-powered liaison sets in plane during actual flight.

ONE of the paradoxes of the great AAF Training Command Radio School at Sioux Falls, S. D., used to be that most of its students, the majority destined for service in bombers, had never flown in a plane when they were graduated.

They learned to identify planes, worked in mock-ups of planes, operated and serviced equipment used in planes, saw planes flying overhead all the time—but never left the ground.

School officers realized there was no better teacher than practical experience, so, in July, 1943, a flight training program was launched with a fleet of light planes flown by noncommissioned liaison pilots. Each of these ships was equipped with a small commercial-type transmitter and receiver, and carried one student.

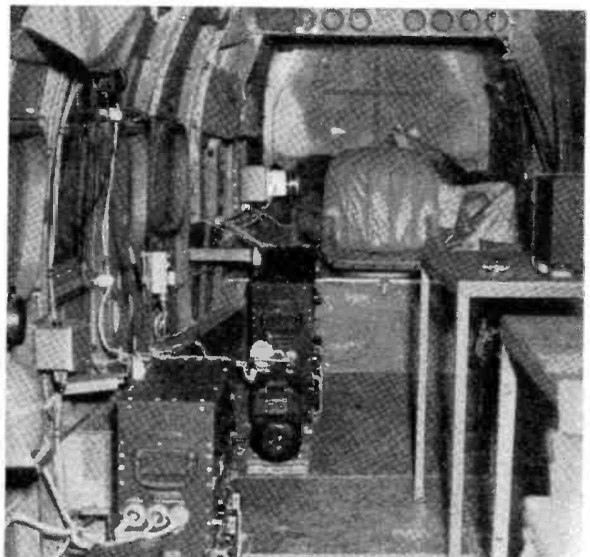
Disadvantages were that Air Forces radio equipment was not employed, and the students lacked supervision by an instructor while in the air.

Finally, one sunny afternoon in mid-May of last year a silvery bomber, carrying two seasoned pilots and four tense G. I.'s, zoomed aloft from a runway of the Sioux Falls Army Air Field, and made Air Forces history.

The flight, outwardly like any other, marked the inauguration of the first comprehensive effort ever made to give student radio operators training in "flying classrooms."

At the same time, it provided a graphic illustration of how the Sioux

Lt. Blaine King (left) and Maj. David Suter inspect radio-compass equipment of one of the "flying classrooms."



Transmitter units of liaison sets are shown mounted on the floor, where they are easily accessible for tuning.

10,000 FEET UP...

"Flying classrooms" for radio students fulfill the Army Air Forces' motto "Learn by doing."

Falls school performs the near-miracle of converting ordinary soldiers, 98 per cent of them without previous radio experience, into competent radio men within 20 weeks.

Heretofore, the principal use of "flying classrooms," which enable instructors to take groups of students aloft in regular school units, had been in the training of navigators and gunners. The gleaming plane at Sioux Falls was one of a large group formerly used in gunnery schools, and now completely rigged out with auxiliary Air Forces radio equipment.

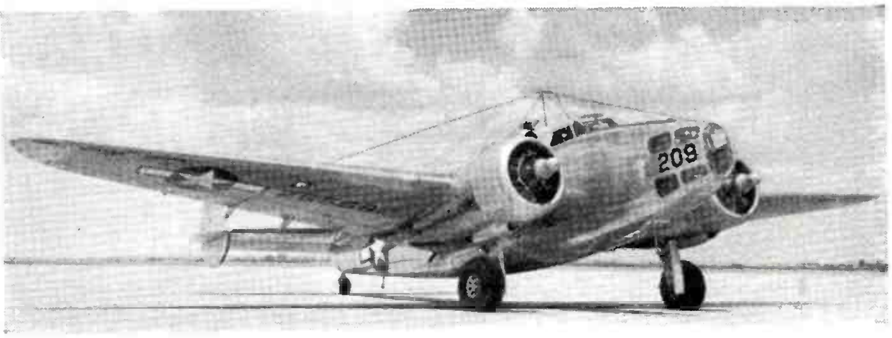
These ships are AT-18's, Lockheed-Hudson bombers, which were the first American-built type flown across the Atlantic to England by Ferry Command pilots, in 1939. They have been dubbed "Old Boomerangs" by the British, because "they always come back."

The interior of each radio training ship behind the pilot's compartment has been stripped of normal accessories, and now constitutes a large laboratory.

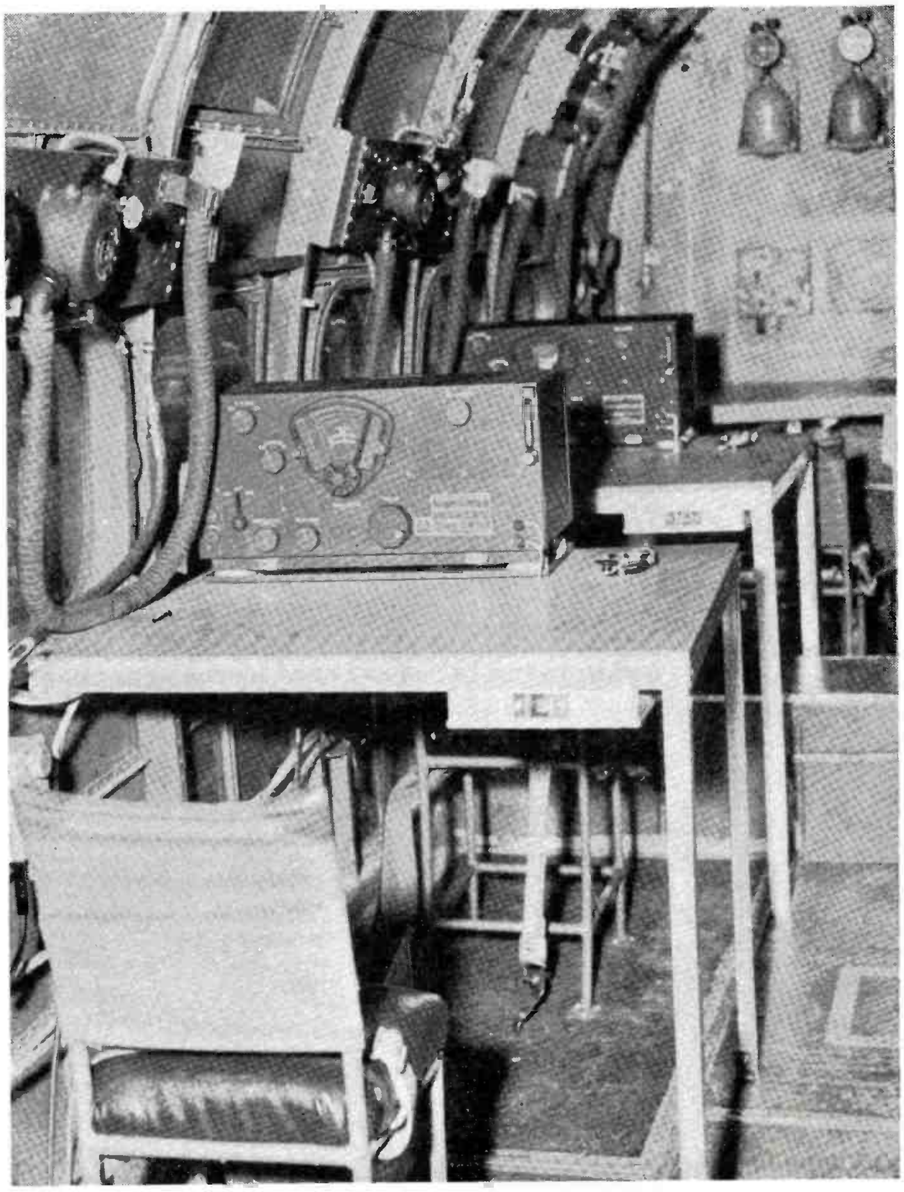
Just behind the partition cutting off the forward compartment, and on the port side, an SCR-269 radio compass set has been installed, with seats for two students.

Amidships, on the same side, the receiver unit of the SCR-287, high-powered liaison set, is mounted on an ample bench, together with a key.

The set's transmitter unit sits han-
(*Continued on page* 120)



One of the large fleet of Lockheed-Hudson bombers, type AT-18, which has been converted into "flying classrooms" for training radio students.


Interior view of the training ship, looking forward towards pilot's compartment. Receiver units of high-powered liaison sets are shown together with sending keys.


Fixed-wire antenna and directional antenna of radio compass shown mounted on plane.

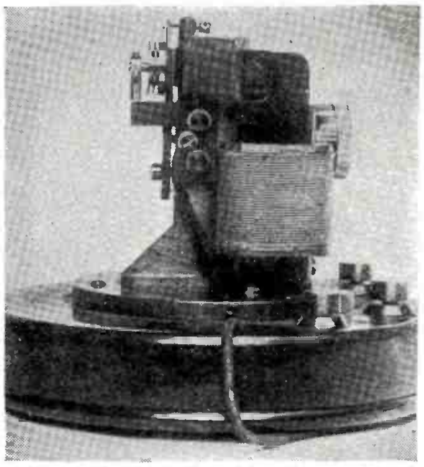


Fig. 185.

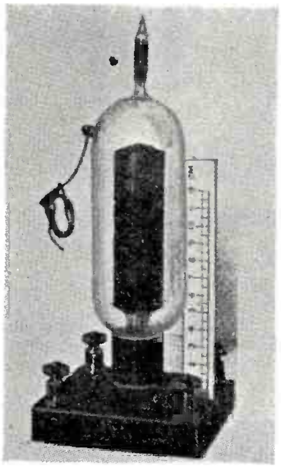


Fig. 186.

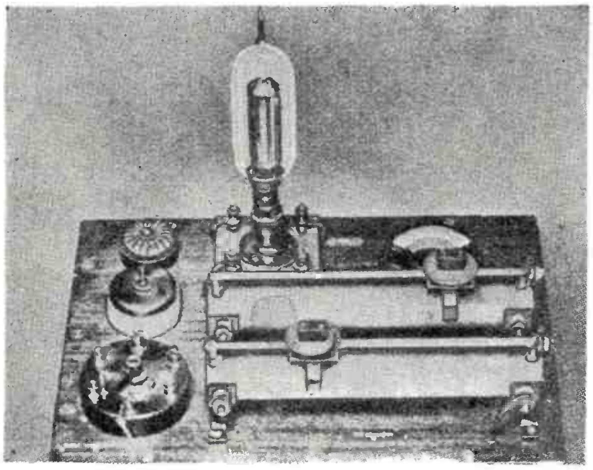


Fig. 187.

THE SAGA OF THE VACUUM TUBE

By GERALD F. J. TYNE

Research Engineer, N. Y.

Part 17. A study of repeater tube developments in local and long-distance telephonic transmissions.

THE problem of telephonic transmission over long distances was not as acute in Great Britain and on the European Continent as it was in the United States. This was due chiefly to the shorter distances involved. Such distances as lay within the borders of any one country, presumably all that would be required at that time to be covered by any one telephone system, could be spanned by the use of heavy gauge conductors and loading. Nevertheless, the advantages from the economic standpoint of a satisfactory repeater were realized and efforts were being made to develop such a device in Great Britain and in Germany.

A study of repeater and repeater-tube developments in Europe brings out the contrasts between the European and American telephone systems. In America the local and long-distance telephone systems are, for the most part, under a single central control, which is a public service corporation, subject to government regulation in the public interest. This corporation, the American Telephone and Telegraph Company, has numerous subsidiaries: operating, developmental, and manufacturing. Such an arrangement is a powerful impetus to systematic development and standardization. Such a connected development procedure is well exemplified in the earlier installments in this series in which the evolution of the American telephone repeater tube has been traced and studied.

In Great Britain and on the continent, on the other hand, the telephone and telegraph systems are, in general, controlled and operated directly by the governments of the respective countries. In these cases, while the earlier steps in new developments may come from either the government research organizations or in-

Fig. 188.

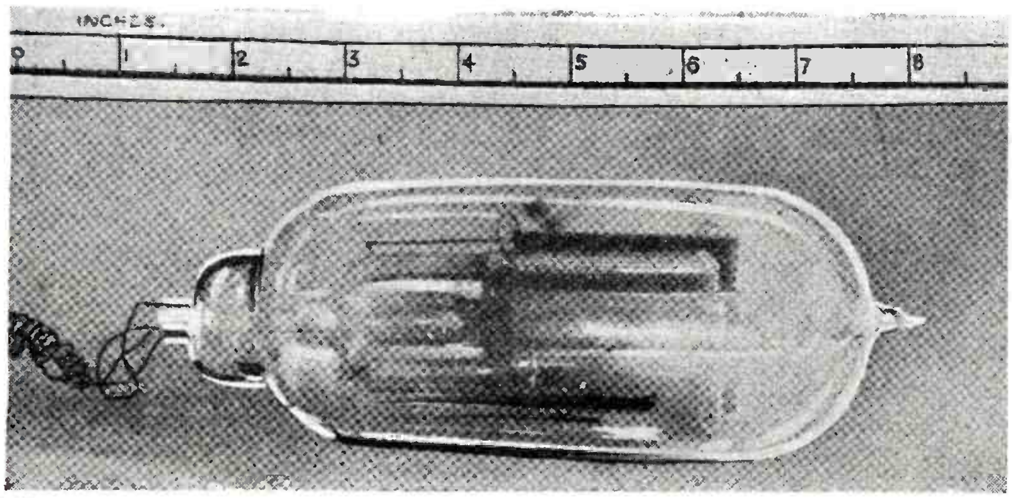
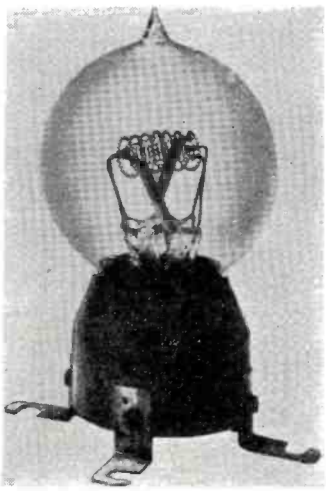


Fig. 189.



dustry, the providing of the actual equipment for use is by competitive manufacturing organizations. When a new installation, such as a long-distance cable, is to be made, the requirements which this installation is to meet are laid down by the authorities and bids for the installation are invited from various manufacturers. Hence, while a suitable system for the project may be installed by the successful bidder, it may differ considerably in equipment from previously installed systems, meeting similar requirements, but purchased from some other manufacturer. This delays standardization of equipment in the early stages of development and hence we find different repeaters and different repeater tubes in use simultaneously in various parts of a country.

The method of attack on the repeater problem in Great Britain was similar to that used in the United States in that efforts for a time were confined to attempts to develop a satisfactory receiver-microphone device. In America the so-called "Shreeve Repeater" came in for attention; in Great Britain a "telephone relay" along these same lines was devised by S. G. Brown. There were several varieties of this relay, one of which, known as "Type G" is shown in Fig. 185.

In this relay the received currents flowed through an electromagnet which actuated a steel reed. The vibration of this reed was applied to the carbon granules of a microphone unit and caused telephonic variations in the microphone current. Since in the carbon microphone the electrical output can be greater than the acoustical or mechanical input, such a device can be made to function as an amplifier or telephone repeater. It is claimed that the Brown "Type G" Relay gave a gain of about 20 times. Under favorable conditions as many as three of these devices could be used in tandem on a one-way circuit but at the expense of some distortion. The inherent disadvantages of the device were that the frequency range which could be repeated was limited by the mechanical characteristics of the moving element, and that there were difficulties in getting and maintaining the proper mechanical adjustments. Nevertheless, some installations were made, and the first of these was in Leeds in 1914, on a London-Glasgow circuit.[253] This was a one-way repeater, and was used in connection with a so-called "jumping switch." This "jumping switch" was a voice-operated relay which automatically made the necessary changes in connections to permit of two-way operation. Its use caused undesirable "clipping" of the conversation.

The engineers of the British Post Office were well aware of the limitations of the mechanical repeater, and in 1908 a small group of research workers, who were studying cathode-ray phenomena in the Post Office Research Laboratory, conceived the idea of developing a telephone relay of the

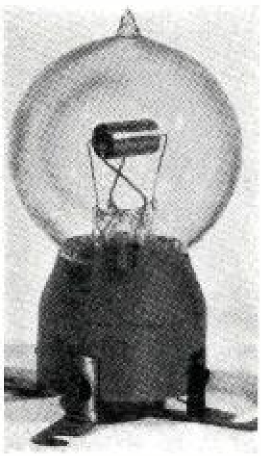


Fig. 190.

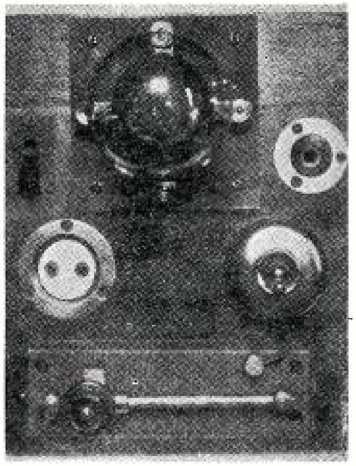


Fig. 191.

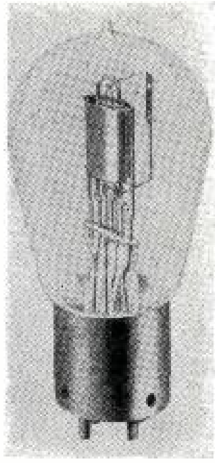


Fig. 192.

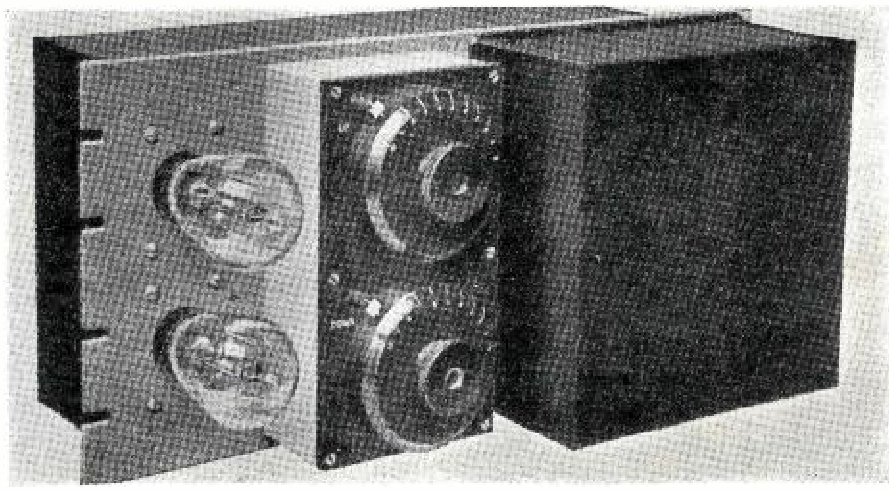
cathode-ray type.[254] Possibly their thinking had been stimulated by the issuance, in 1906, of the von Lieben patent on just such a device. The necessary machinery for making and evacuating such tubes was purchased and installed. Unfortunately the group was broken up by staff changes shortly thereafter, and the work was overshadowed by the possibilities of the mechanical amplifier which promised quicker results, even though of less satisfactory quality.

Interest in the thermionic repeater was reawakened in 1913, however, when the work of de Forest, Lieben and Reisz, Round, and others had brought the thermionic amplifier out of the research laboratory into the realm of commercial practicability. Fortunately, one of that small group dispersed in 1908 returned to the research laboratory about that time and resumed the suspended experiments. Samples of tubes were obtained fr-m de Forest, Lieben and Reisz, and Round, and examined to see if they could meet the requirements of telephone work. New experimental tubes were constructed, incorporating such special features as might adapt them to telephone requirements.

The Round type of "soft" tube at first seemed to be the best and a number of these were produced in the laboratory. They were somewhat larger than the original Round tubes, in order to handle the necessary power. Fig. 186 is a photograph of one of these tubes, the first type to be used in telephone service in England. Fig. 187 shows the repeater unit in which it was used. The essential features of this type of tube are (1) the cathode is of the Wehnelt, or oxide-coated, type; (2) the grid is a fine mesh completely surrounding the filament; (3) the anode is a cylinder surrounding the grid; and (4) there is a tubulation containing a wad of asbestos extending upward from the top of the bulb. This grid construction was adopted to prevent electrification of the inner surface of the glass bulb by electrons expelled from the filament, and the asbestos in the tubulation was used as a source of gas to restore the pressure when the tube became hard. The asbestos gave off small quantities of gas when heat was applied externally to the tubulation.

It is said that these tubes were rather stable in operation and gave a good quality of reproduction. When new they would start up from cold in about three seconds, but when older and as the internal pressure decreased they sometimes required some time to

Fig. 193.



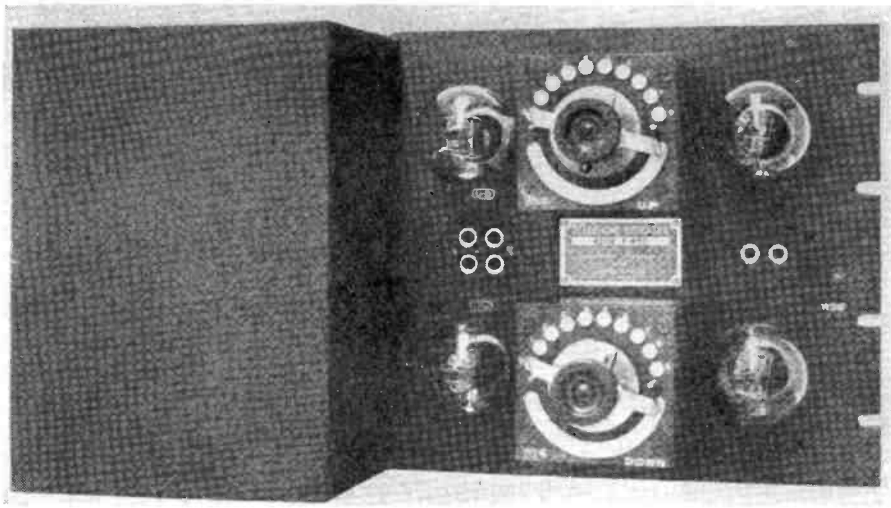


Fig. 194.

reach their full amplification. The pressure could be restored by heating the tubulation, in most cases. The life, when only moderate gains were required, was on the average about 600 hours.[255]

These soft tubes were difficult to manufacture with any degree of uniformity and were soon replaced by a "hard," or high-vacuum tube, the earliest form of which is shown in Fig. 188. In this tube the cathode was either tungsten or the oxide-coated type and was supported on a U-shaped glass frame. The grid was of nickel gauze, similar to that used in the soft tubes, and was fitted over the glass frame which carried the cathode. The anode consisted of two plates of nickel, supported by glass arbors, one on either side of the grid-cathode assembly. This tube was exhausted to such a vacuum that it showed no indication of ionization when worked at an anode voltage of 400 volts.

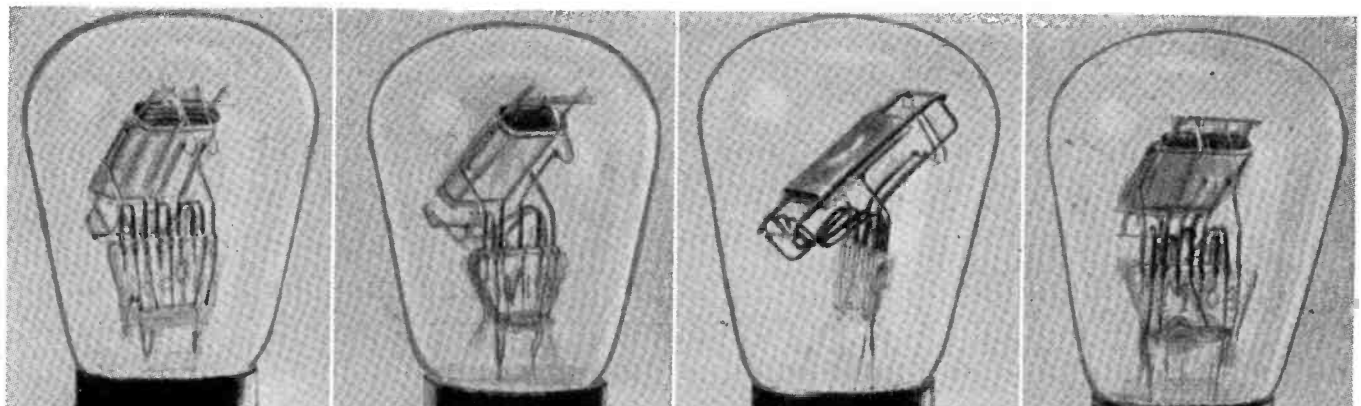
The glass work of this tube was rather troublesome to make[256] and subsequently the Post Office engineers inclined toward the use of a tube similar to that developed by the French Military Telegraphic Service under General Ferrie, and commonly known as the "French" tube. The version of this tube which was arrived at by the Post Office became the first "Standard Repeater Valve," and was officially known as "Valve, Amplifying, No. 1." It is shown in Fig. 189.

The filament of this tube was a fine spiral of tungsten wire. The grid was a somewhat more open spiral, at first of tungsten and later of alloy wire, mounted concentrically with the filament and about ¼ inch in diameter. The anode was a spiralled helix of tungsten wire mounted concentrically with the grid and filament, and with a radial spacing of $\frac{1}{16}$ to ⅛ inch. Later (1919) models of this tube had the anode made of sheet nickel, and one of these later tubes is shown in Fig. 190. The bulb, spherical in shape, was mounted on a red fibre base which carried the four terminal connections. These were flat strips of brass, arranged to be clamped under binding posts on the repeater unit. This method of mounting was used in preference to the four-pin base used on the "French" tube because of the necessity of keeping contact resistance to a minimum. The anode terminal strip was painted red "for reasons that will be appreciated by anyone who touches it while the valve is in operation."[257] The repeater in which this tube was used was known as "Repeater, Telephonic, No. 2," and is shown in Fig. 191.

The filament of this tube was designed to give a total space current of not less than 10 milliamperes when a potential of 150 volts was applied between filament and grid-anode connected together. The normal operating value of the anode current was 1 to 2 milliamperes. The working temperature of the filament was chosen to give a working life of about 2000 hours.[258] The tube had a mutual conductance of 450 micromhos and an internal impedance of about 20,000 ohms In order to insure obtaining a reasonably straight-line plate current-grid voltage curve, one of the requirements of this tube was that between grid voltages of −8 and zero, the mutual conductance must not vary more than 20% from the value at −4.5 volts, the grid bias existing in Repeater No. 2.

In order to insure meeting the other requirements, the proper filament current for each of these tubes was determined for the individual tube.[259] This was done by putting the tube into a test circuit and increasing the filament current until the mutual conductance reached a predetermined value. At this point the filament voltage was noted and thereafter the filament was operated at that voltage. The usual value of heating current was between the limits of .7 and .8 ampere, and the filament voltage was about 4.7 volts. Under these conditions the filament resistance was about 10 times its resistance when cold. The usual anode voltage was 200-220 volts.

Fig. 195.



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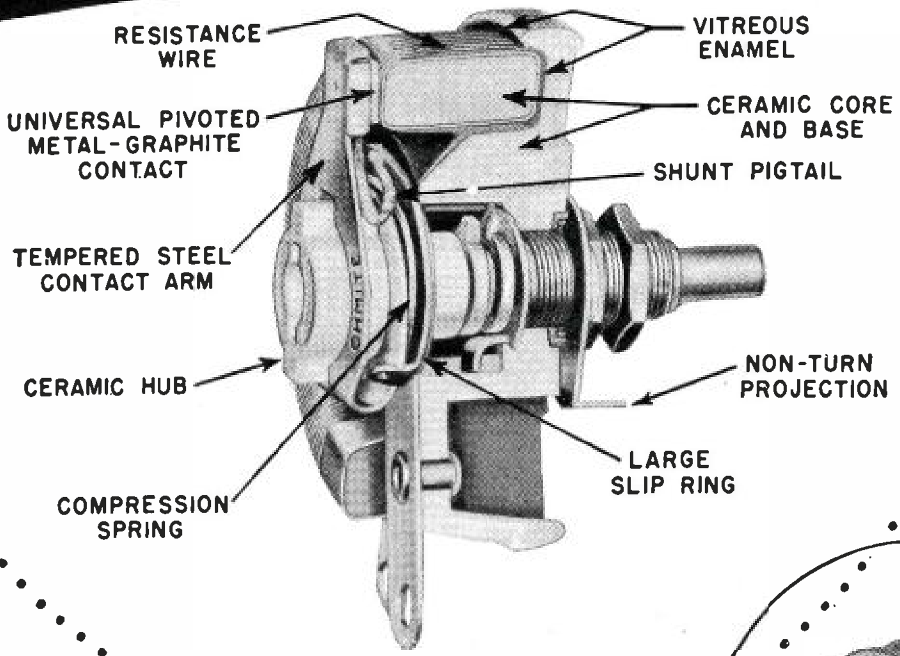

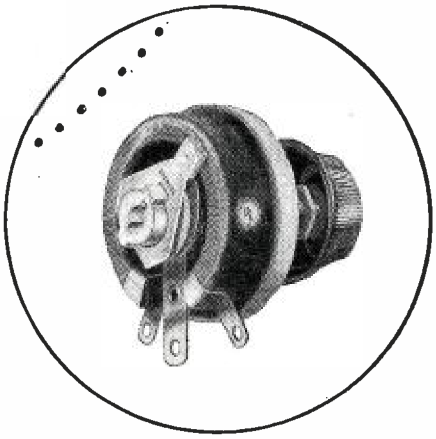

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By 1926 there were 26 repeater stations in Great Britain with a total of about 670 repeaters in service.[260] One of the "standard" amplifying tubes used in such repeaters was designated by the Post Office as "Valve, Thermionic, No. 25" and is shown in Fig. 192. It was made by the General Electric Co., Ltd. of London,[1] and was a further development of the "R" type tube used for radio applications. It was also used as an output tube in radio receivers under the designation "L.S. 5." It operated with a filament current of .82 ampere at a voltage of 4.5 volts in telephone equipment, and had a life of 1000-2000 hours. [261] This tube was used in both 2-wire and 4-wire repeaters, one of the 2-wire type being shown in Fig. 193.

Another type of repeater of about this same vintage is that installed on the London-Glasgow cable, which was placed in service about 1926. The repeater equipment of this cable was furnished and installed by Standard Telephones and Cables, Ltd., and one of the repeaters is shown in Fig. 194.[264] The tubes used were the Standard Telephones and Cables types 4101D and 4102D, designated by the Post Office as "V.T. No. 31" and "V.T. No. 32" respectively, which are essentially the same as the Western Electric (U.S.A.) 101D and 102D tubes previously described, using oxide-coated filaments. This similarity came about because the Standard Telephones and Cables, Ltd. had originally been the Western Electric Company, Ltd., an affiliate of the Western Electric Company of the United States, and the British product thus closely paralleled the American practice, and reflected the progress of American development.

Subsequently, other repeater tubes which operated at lower filament currents, permitting economies in repeater-station power plant and station wiring, were developed by Standard Telephones and Cables.[263] A group of these repeater tubes, which became available about 1932, is shown in Fig. 195.

The 4019A had plate characteristics in general similar to those of the 4101D, and could be used to replace it in existing equipment, with a slight increase in gain. The 4020A was intended to replace the 4102D. The 4021A replaced the 4104D with, again, some increase in gain. The 4022A was really a higher gain 4019A. The filament and plate voltages for the new tubes were about the same as for the replaced tubes. The 4019A, 4020A, and 4022A had a life exceeding 10,000 hours, while the life of the 4021A was in excess of 3000 hours.

The need for telephone repeaters did not arise as early in France as in other countries. This was partly at least due to the limited use of the telephone in that country. The attitude of the French might be typified as that of one Frenchman who, in 1915, when an at-

[1] The General Electric Co. Ltd. of London is not affiliated with the General Electric Co. of U.S.A.

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ARMY NAVY

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E. F. JOHNSON COMPANY • WASECA • MINNESOTA tempt was made to explain to him the American telephone system and its slogan "Universal Service," is reported to have replied that he couldn't see any sense in telephones anyhow, all the people he wanted to talk to in a hurry lived with him, the others didn't matter, and a letter was quick enough in any case.

There was little standardization of equipment. The subscriber supplied his own equipment, which resulted in a diversity of station sets, chosen according to the whims of the individual. Its electrical characteristics were the last thing he considered. No two central offices were alike in construction or operated in the same way.[264] Long-distance telephony was practically nonexistent until late in World War I. Even as late as 1921 distances of the order of 500 miles were spanned only with difficulty and under the most favorable conditions.[265]

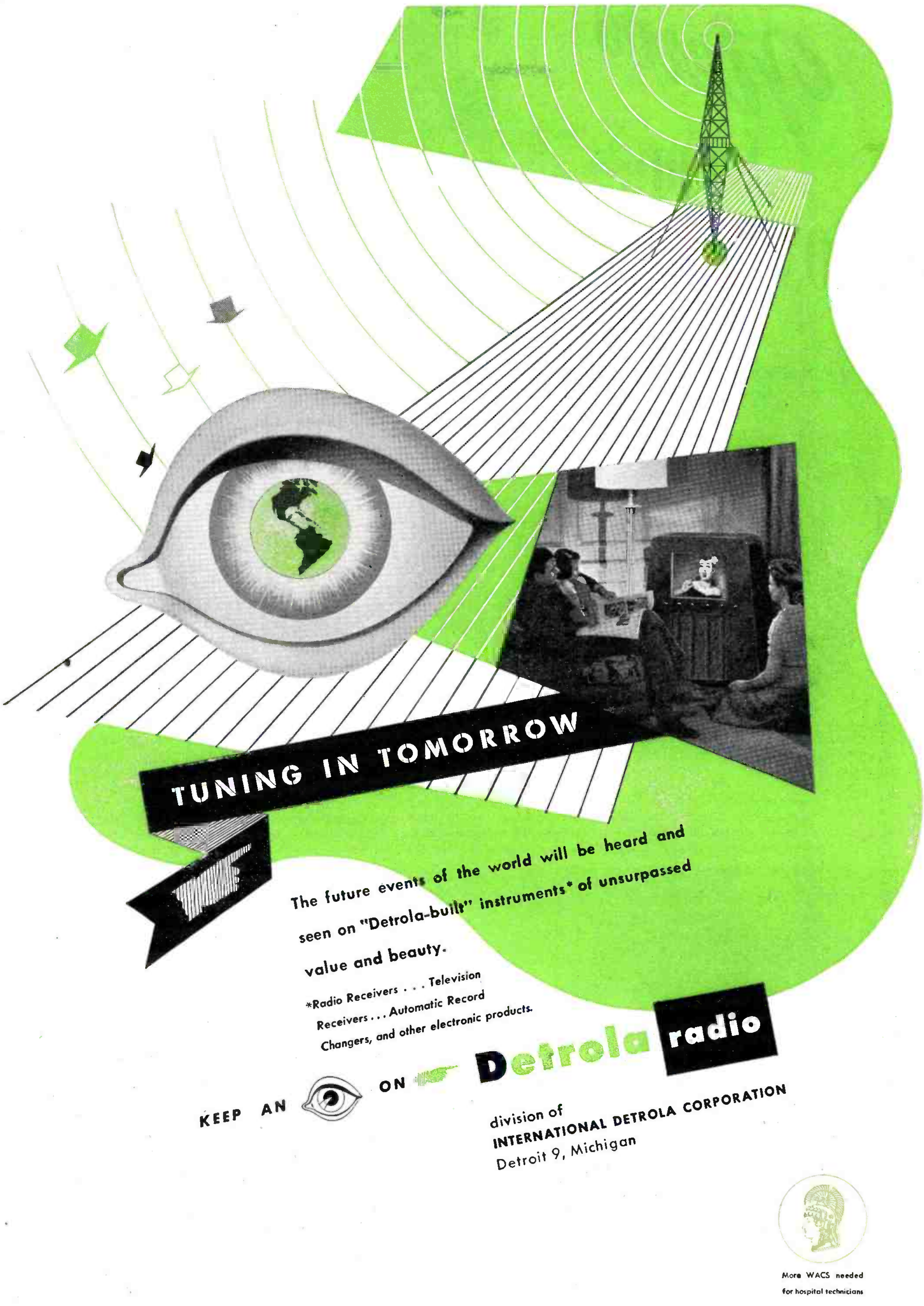
The first repeater used in France was installed and operated on an experimental basis at Lyons on a Paris-Marseille circuit in 1917. It was a two-stage affair, using tubes of the type previously denoted as "French" tubes, developed primarily for military use in radio work.[266] Following the success of this experimental installation an increase in the use of repeaters was proposed with the suggestion that the first step be taken by the installation of cord-circuit repeaters in Paris.[267]

By 1920, however, there were only 30 repeaters available. Of these, three were of the French type, using French tubes, eight were British repeaters installed at Abbeville and Lyon by the British Army during World War I, and the other 19 (of which 7 were of the cord-circuit type) were American repeaters of Western Electric manufacture. These last had been obtained from the stocks of the American Army in France.[268] The increase in the number of repeaters was slow, since early in 1923 there were but 38 in use. Of these 26 were cut in on specific circuits, while 12 were of the cord-circuit type.[269]

At the end of 1923, however, the French Administration contracted for a loaded and repeatered cable between Paris and Strasbourg. This cable was completely in service late in 1926. The repeaters used on this installation were supplied by Standard Telephones and Cables, Ltd. through their French subsidiary, the "Société Anonyme, Lignes Télégraphiques et Téléphoniques." These repeaters were of the type previously mentioned in connection with the London-Glasgow cable and were equipped with S. T. & C. tubes of the 4101D and 4102D types.[270]

Hence it may be said that, up to this time, no vacuum tubes designed especially to meet the requirements of telephone repeater service, and of French development and manufacture, had been used in France. This is not to say, however, that the French lagged behind other nations in the

(*Continued on page* 128)



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News from OVERSEAS

By KENNETH R. PORTER
RADIO NEWS War Correspondent

Communications outpost which played an important part in a recent British offensive through the marshlands of Holland.

IT IS alleged in England that whereas the United States, 3,000 miles away from the nearest battlefront, has been able to make tremendous progress towards the reconversion of her industrial machinery to peacetime requirements despite the necessity of keeping war production at full pitch, Great Britain's closeness to the field of battle as well as more limited industrial potentials have prevented her from taking any steps in effecting peacetime production programs.

Without in any way attempting to enter into a controversy on this thorny subject, it might be useful, nevertheless, to focus attention on certain features of the radio industry—undoubtedly one of the most important branches of postwar industry—which illustrates that Britain is neither as much lagging behind in postwar planning nor as limited in facilities for putting these into practice as might be assumed.

On examination of these features it would rather appear that quietly and without the blowing of trumpets, this country has done all the preliminary spadework necessary for the switchover of industry and has prepared, elaborate in detail and comprehensive in scope of application, plans which are being put into operation as the green light is given by the British Government.

British Radio Industry Looks Ahead

The British radio industry has been studying postwar needs at home and overseas for some considerable time and British radio manufacturers are convinced of their ability to hold their own against any competition from overseas in spite of the fact that U. S. engineers have had about two years longer of peacetime radio research than British engineers.

According to them, any illusions

British radio operator, working with the Albanian Partisans organization, sets up his wireless set. This suitcase-type transmitter-receiver is used on all reconnaissance. British military missions are sent into countries occupied by the Germans to equip, feed, and organize bands of Partisans to destroy enemy lines of communication.

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* * *

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American manufacturers of radio equipment may nurse of dumping their surplus stores after the war in this country can be dismissed as idle speculation, as this country's enormously expanded wartime radio-location industry is closely allied to radio and television, and methods and apparatus used for radar equipment production can be adapted without much difficulty, delay, or expenditure to the manufacture of peacetime radio or television receivers.

Moreover, the first tentative steps in radio set production were taken, in fact, some time ago and the British radio industry is just now exerting renewed pressure on their Government for the release of additional facilities for receiver production to meet the civilian demand; it is claimed by spokesmen of the industry that the ten thousand civilian sets now being made a month are scarcely a nibble at the problem as the demand—which before the war stood at 1,300,000 sets a year—has been increased beyond all comparison and at least 7,500,000 homes are in need of new radio sets.

British radio manufacturers are also encouraged by the knowledge of their Government's vital interest in their industry, playing a major part in the employment of ex-servicemen and war-workers released from other industries.

This knowledge is based on the setting up of Government-sponsored radio and television committees and the appointment of Mr. Attlee, deputy Prime Minister, as the Lord President of the Council to which these bodies are to report their findings and submit their recommendations.

Thus, for example, a television committee was set up fifteen months ago under the chairmanship of Lord Hankey, one of Britain's most eminent scientists.

This committee recently completed the compilation of material on Great Britain's future television services and handed their report to Mr. Attlee. From available information the members of the committee appear to favor the immediate establishment of television services on a nationwide basis, Government-provided facilities for research and development, and Governmental assistance to manufacturers of television receiving sets with particular reference to the export trade.

Television Transmission 24-Hours After V-Day

Without awaiting the final formulation of the television committee's recommendations, the British Government has already given the BBC permission to go ahead with preparations for the installation of television stations throughout the country, providing the necessary priorities for labor and materials.

Contrary to rumors, too, the Alexandra Palace transmitter has been maintained in working order throughout the six years of the war, and recently spare parts were ordered by the BBC which will enable the London service to resume transmission within 24 hours.

Finally, a panel of artists and scriptwriters is in the process of being built up to meet the special requirements of telecasting.

British broadcasting—which faced a completely blank page over twenty-two years ago at the end of an earlier great war—is today, therefore, virtually prepared to tackle postwar aural and visual broadcasting problems.

It is true that Mr. W. J. Haley, BBC chief, while recently outlining postwar plans, made no reference to sponsored radio which now looms more than ever in the background and menaces the continuation of the BBC's hitherto monopolistic service on account of the future extension of broadcasting to the ultra-high frequency spectrum.

But Mr. Haley's own attitude towards it was made perfectly clear when he pointed out that in other countries "money is driving more and more worthwhile programs off the air."

Nevertheless, anything the BBC's Director-General said, in his first public appearance since his appointment, can only be of temporary application as the present BBC charter ends next year and it is for the British Government to decide whether or not there shall be any change in this country's broadcasting structure.

Cinema Television Planning

The British film industry is as interested in television as the American film industry and according to Mr. A. G. D. West, a television scientist and President of the British Kinematograph Society, is planning to spend an enormous sum of money on cinema television research in the course of the next ten years.

In this connection Mr. West outlined the following technical development plan for the British film industry:—

Two years to re-equip film studios and cinemas, improving sound reproduction in theaters;

Two years for the full development of the color film;

Two years for the practical realization of commercial high-definition large-screen television;

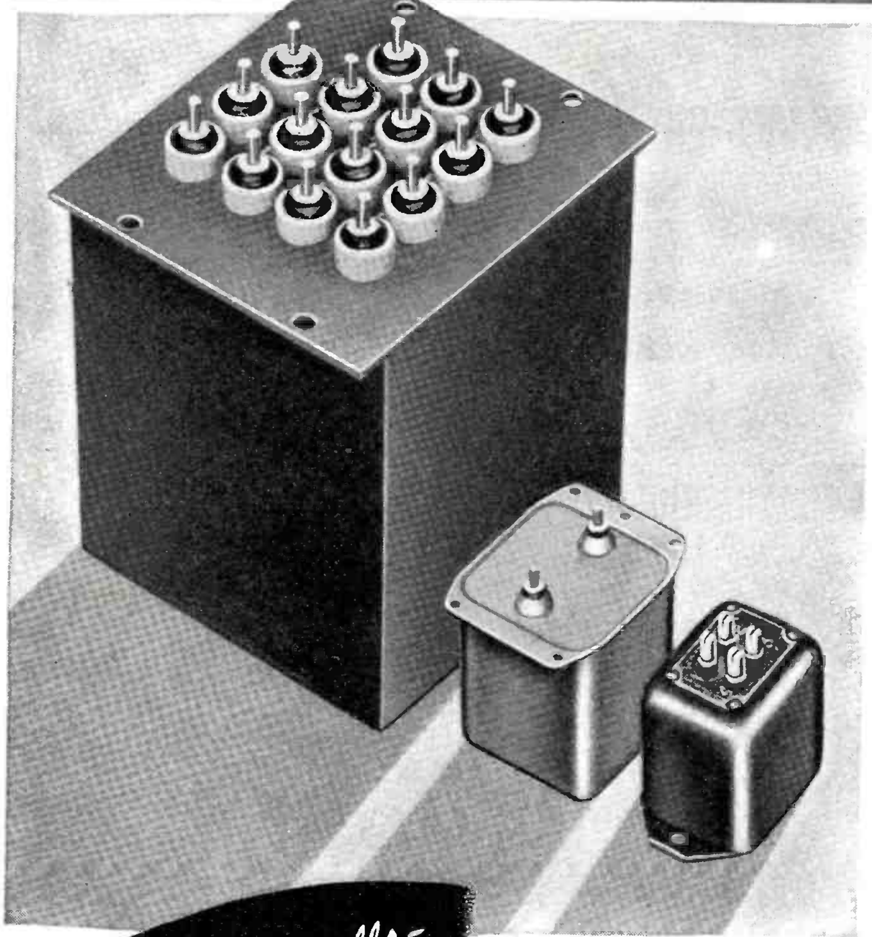
Two years to provide large screen television in color;

Two final years in the 10-year plan for a practical solution of stereoscopic projection so that films could be shown in three dimensions.

To achieve this program, Mr. West said, the film industry of Great Britain will have to attract the best technical brains, ensure stability of employment and encourage a co-ordinated effort of intensive research.

Civil Application of Radar

Practical proposals for the employment of radar in civil aviation and industry were recently made by Sir Robert Watson-Watt, British radar



pioneer, at the British Association Conference in London.

Sir Robert said that the transfer of modern radio technique from military to civil application will make a noteworthy contribution to the regularity, punctuality, and safety of civil air transport services, especially if followed up by the introduction throughout the British Empire and Commonwealth of uniform radio aids to air navigation, facilities for landings and take-offs, and for locating lost aircraft.

He also forecast the rapid increase in the scope of application to industry of such radar devices as the well-known "gen-box" used at present primarily for bombing.

British Railways to Be Radio-Controlled

As part of their five-year postwar plan for better railway services, the four British main line railways have completed preparations for the establishment of complete radio-control on trains.

A scheme which will enable the engine-driver to remain in constant contact with the signalman has been devised and experimentally tested by a team of radio experts employed by these railway companies and is to be put into operation as soon as conditions are favorable.

One of the main problems in railroad radio, the freezing of points in icy weather, has been solved by heating all points electrically and spraying them automatically with a de-icing fluid containing tapioca.

Legislation Against Misuse of Radio and Television

Mr. Herbert Morrison, British Home Secretary, addressing the first practical course of postwar planning for the police services, said he expects radio and electronic progress to add to the complications of a policeman's life.

In the course of his talk, he hinted that criminals in future may work by radio and use television to find out what was happening at distances and through heavy brick walls.

Mr. Morrison also foresaw the need for the introduction of legislation for the control of certain types of radio and television equipment in portable form to prevent their misuse.

School Television

The forecast that tomorrow's schools will all have their own airfields and television services and headmasters will issue their instructions to classrooms by radio and television was made by Mr. A. H. Baker, the chairman, at the London Conference of the Incorporated Association of Assistant Masters in Secondary Schools.

Mr. Baker added that he was grateful to a beneficent Providence for ensuring for him not to be called upon to act as one of the smallest cogs in her gargantuan machinery!

—30—

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Electronic Circuits Perform Mathematical Processes

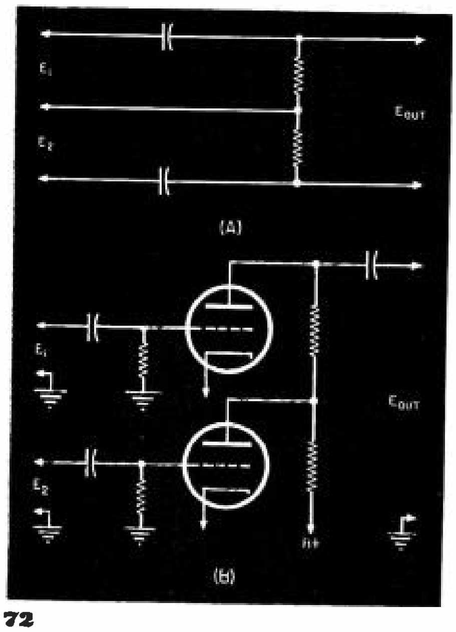
By M. N. BEITMAN
Supreme Publications, Chicago, Ill.

Analysis of various circuits that perform mathematical processes, from addition to differentiation.

ALTHOUGH every radio man has examined or worked with circuits which perform the equivalent of mathematical operations, very few radio technicians have realized this fact. Mathematics, from the point of view of a radio technician and serviceman, permits the calculation of either the unknown facts from available data or the correct size of a component to fit a given circuit. The use of Ohm's Law to calculate the voltage drop produced across a known resistor when the value of current in a d.c. circuit is available, is an example of the first case. The making of a coil of a given inductance with wire and a coil form obtainable, may be considered another problem where a practical technician associates mathematics and radio.

The radio engineer, having greater mathematical background, realizes that mathematical expressions are often used to describe physical phenomena. The physical event will take place and will continue whether the mathematical symbols have been written (or even understood) or not. But the correct mathematical expression for the physical situation will contain the full biographical history of the physical relationship and an accurate prediction for the actual behavior in the future. To the engineer, therefore, mathematics is useful to analyze, predict, and calculate physical facts. Only recently have radio men realized that electrical circuits can be made to perform the equivalent of solving mathematical problems and, in fact, are doing this in many familiar circuits.

Fig. 1. Means of employing electrical circuits to obtain algebraic addition. When E_1 and E_2 are in phase and G_1 and G_2 the respective gains of the two stages, then $G_1E_1+G_2E_2$ equals E_{out}.



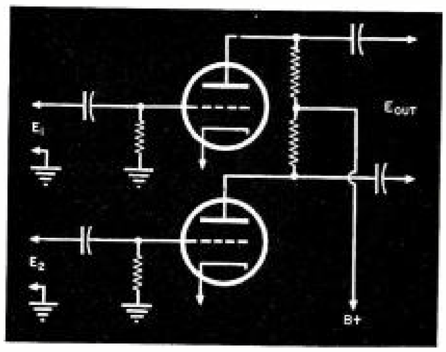


Fig. 2. Circuit for performing subtraction. A necessary requirement is that the two separate inputs be in phase. Circuits of Fig. 1 could similarly be used by employing a 180° phase shift between E_1 and E_2.

Let us consider a simple, but very useful mathematical operation—division of a quantity by a constant. Let us assume further that this quantity may be varying continuously and the constant is a number like 2 or 3. Electrical quantities may be changed to corresponding voltage values. With electronic equipment such diversified factors as hardness of metal, distance to an airplane, frequency difference, and audio noise, may be changed to equivalent voltage values. We see that our problem is simplified to the need for obtaining a fractional part of a given changing voltage. The familiar voltage-divider circuit will do the job for us. The resistor used as the voltage divider does consume power and if no power is available (only voltage), the input may be made to a vacuum-tube control grid, while the voltage divider is incorporated as the plate-load resistor. The amplification (gain) of the tube may be nullified by proportionately increasing the constant of division in the voltage-divider circuit.

Even from this single example you can see that electrical circuits do not take actual *number problems* and write the answer as a number. The quantities must exist or must be converted to electrical equivalent electromotive force (voltage), and the answer will be in the form of voltage or electrical power which, in turn, may be used to operate relays, alarms, counters, or indicating meters. But because many mathematical problems are carried out for the very purposes mentioned, electrical circuits are useful for solving mathematical problems. There are two additional advantages possessed by such machines (circuits) which cannot be claimed by greatest mathematicians. These circuits perform the operation without a possibility of error and they obtain the answer instantaneously.

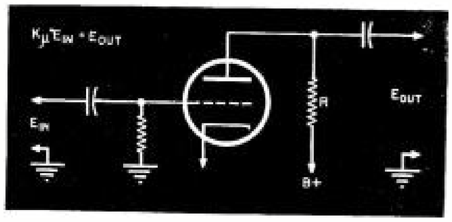


Fig. 3. Circuit for multiplication by a constant Kμ, where Kμ is the stage gain.

A few basic circuits which can be employed for performing the equivalent of various mathematical operations are shown. Please understand that these circuits are only suggestive. Practical circuits have many refinements and are designed with great care. The effects of frequency discrimination and phase shift are important in practice. These effects must be nullified electrically or corrected mathematically by operating on the indicated answer.

Two quantities, represented as voltages E_1 and E_2, may be added algebraically by means of the circuits shown in Fig. 1. Circuit A is used if

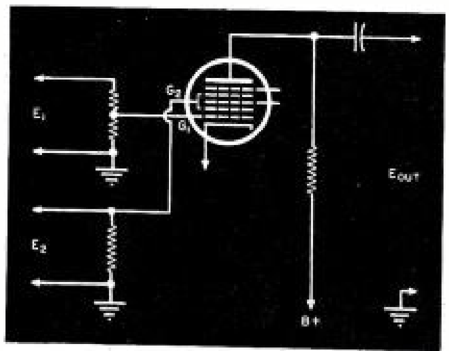
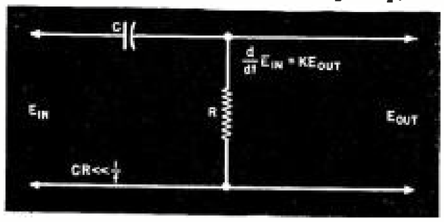


Fig. 4. Obtaining the product of two quantities. $E_1E_2 = E_{out}$, assuming that the gain of the tube for each input (G_1 and G_2) would be equal to one.

Fig. 5. Differentiating circuit. K in the formula below is a constant and depends on C, R, and frequency.



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WANTED FOR CASH—National NC-200 or Hallicrafter SX-29 comm. receiver, also Rider Chanalyst. State model & condition. Sgt. Dodge, 31034548, A.P.O. 339, % P. M., New York, N. Y.

FOR SALE—7B Space Explorer, 110v using 6 all-metal tubes. In good condition without cabinet, $18. Armin Vogt, Plymouth, Mass.

FOR SALE—Weston #280 DC volt-ammeter with 3v shunt 300v multiplier. Leads & case, $10. Earl Weckerly, Monroe, Wisc.

WILL TRADE—Metal cutting lathe 6" swing, 16" centers, 26" bed with compound slide rest, 4" face plate, no chuck, for any good signal generator or multimeter or what have you? Jos. E. Thompson, 1316 Wood St., Wheeling, W. Va.

FOR SALE—2 Albumatic record caddies, 50 record capacity, list $14, price $8 ea. or $15 for both. Several pr. new Klein comb. longnose cutter pliers, $2.25 ea. Heavy-duty power transformers 2½v fil. 400-400 hi. volt @ 150 mols., easily rewound for 6v, like new. Two Utah 15 watt P.M. 12" speakers, new, $14 ea. Want elec. motor, ¼ h.p. or more 60 cy. AC. M. A. Porter, 1713 Larrabee St., Chicago 14, Ill.

WANTED—A good location to be used as a radio repair shop, with or without eqpt. but with low expenses. Will consider partnership if suitable to both. I have some eqpt. Prefer location in East, Cleveland, or Chicago. Henry C. M. Bursun, 1984 E. 70th St., Cleveland, Ohio.

WANTED — Any number of following tubes: 25Z6, 35Z5, 25Z5, 12SN7, 12SA7, 5Z4, 1N5, 1H5, 12SQ7. Have for sale: 80, 6V6GT, 6X5GT, 1S5, 1S4 and 45. Mervyn Stagg, 484 Valley Place, Englewood, N. J.

WANTED—Late model (1940-41) table or cabinet radio, preferably FM, phono & radio combination, but not necessary. Will pay cash or trade. Have Stancor 10-P transmitter, Abbott MRT-3 transceiver, 2½ meter receiver, 25-watt amp., power supplies, mikes, etc. John Hochmeister, East Walnut St., Boonville, Ind.

FOR SALE — Stromberg-Carlson dual channel amplifier, new 14-tube, 4-6L6 in final. Record player in carrying case. 5 hi-power PM speakers, one a 15" RCA auditorium PM theatre type. 3 mikes & stand, one a 211 Turner, records, 150' extension cord, 300' or more speaker wire & other parts. Cost over $850. Sell for $550. Bowers Electric, Lebanon, Ind.

FOR SALE—Hallicrafters "S" meter and 1 vol. Ghirardi's Radio Physics Course. E. Lowe, % 3136 N. 48th St., Milwaukee, Wisc.

WANTED — Professional type recorder, Presto preferred, with mike & amplifier, 16" cutter, dual speed control. Also want 5- or 10-watt amplifier. Would like to hear from anyone having Class A recording eqpt. Jack Swanson, Morris Heights, Ithaca, N. Y.

FOR SALE OR TRADE — Hammarlund HQ-120 receiver. Parts for 300- and 50-watt unwired transmitter and many other transmitting parts. Need Rider's manuals, tube tester, RCA chanalyst, V-O-M, and sig. generator. Nevin Otis, San Andreas, Calif.

FOR SALE — Tubes, transformers, parts and eqpt., new and used. Write for list. Rosewood Radio Co., 1711 Woodland St., Nashville 6, Tenn.

WANTED FOR OVERSEAS USE—Small camera type radio, battery and a-c operated, must weigh less than 5 lbs. Must be in operating condition less batteries. Mrs. C. S. Church, 305 Prospect St., Wellington, Ohio.

FOR TRADE — Have both new or used tubes: 0Z4; 1A7; 1E7; 1N5; 7A6; 12SA7; 35A5; 6K8; 6SA7 to trade for new or used 1H4; 1F7; 12A8; 12J7; 12K7; 25B8; 35Z5. Don Y. Yen, Rockford, Mich.

FOR SALE OR TRADE—Several small 4- and 5-tube table radios, $10 ea. in new wood cabinets. Also used tubes. Send for list. Paul A. Price, 3636 Odell Ave., Chicago 34, Ill.

NEW TUBES FOR SALE—6-6K8; 6-6F7; 6-6C5; 6-50L6; 1-12A6; 3-3Q5; 3-25L6; 6-6L6; 1-47; 1-2051; 1-0Z4; 1-2X2-879; 1-12SA7; 1-12SQ7; 1-6SA7; 1-6SK7; 1-6E5; 3-6D6; 3-6C6; 3-80. Also one used and one new Weston 0.1 ma. Harry Ringel, 3343 Decatur Ave., Bronx, New York, N. Y.

FOR SALE—RME DB-20, just reconditioned with new tubes. Hal. Mayer, 42 Delaney Ave., Buffalo 17, N. Y.

WANTED — Used Radio Physics Course and Modern Radio Servicing by A. A. Ghirardi, also four 35/51, 1-N5GT, 1-P5GT tubes. S. Kish, Corning, Calif.

WANTED—Automatic record changer in good condition, cash or trade, also Rider's manuals. William's Radio Service, 648 Phillips Lane, Louisville 9, Ky.

FOR SALE — #308 Radio City Product tube tester, in excellent condition with full instructions, in portable case. $30. John M. Potts, 95 Radnor Road, Norfolk 3, Va.

WANTED—Triplett or other good 0-1 or 0-5 milliammeter in good condition. Chas. Brown, 502 N. High St., El Dorado, Kans.

FOR SALE—New tubes in boxes: 6-3Q5; 3-6C5; 3-50; 1-'10; 2-81; 5-80; 2-485; 5-01A; 5-55. Entire lot, $22. Horace Ursillo, 225 Sutton Ave., E. Providence, R. I.

WANTED—Test equipment. Will sell or trade good photo equipment and plans for power jig saw. Write for list. Model Lab., 8536—89th St., Woodhaven 21, N. Y.

FOR SALE — 6" meter 0-200 MA. d-c Pouzot movement—Hyne Berline—Paris; also 6" meter 0-130v AC-DC Chauvin Arnoux—Paris. Both A-1. F. Sherwood, Box 253, RD #4, Rector Rd., Scotia, N.Y.

FOR SALE OR TRADE — Stancor 20P transmitter wired and complete with Triplett meter, cabinet and tubes; one Stancor 10P transmitter—cabinet, coils for all bands, tubes, Triplett meter, but not wired. Sell or trade for photo equipment. Ernest Baucum, Box 22, Altus, Okla.

WILL TRADE Gernsback Manuals 1 to 7 and others. Want good camera. W. S. Crooks, Box 94, Kent, Ohio.

URGENTLY WANTED — Phono pickups of all types. Cash or trade. Davis A. Bensman, North High, 1210 North, Sheboygan, Wisc.

WILL EXCHANGE — Need tube & test eqpt. and will trade 1 Lifetime Schaefer pen and 17-jewel waterproof wrist watch, both in A-1 condition. W. H. Hollenshead, 6746—37th Ave. S., Seattle, Wash.

WANTED—Good communications receiver, SX-24 or SX-28 or similar. Cash, or will trade radio parts, tubes, meters, pistols, and musical instruments. S. Palasek, 62 Main St., Port Washington, N. Y.

FOR SALE—Two new 12A7's $1.95 ea. and two new 6Y6-G's at $1.60 ea. S/Sgt. John Mader, 2131 AAF, Basic Sq. B, Gunter Field, Ala.

FOR SALE—Supreme 502-S tube tester, completely factory modernized. A-1 condition. Frank Saitta, 250 Slocum Way, Fort Lee, N. J.

WANTED—Set plug-in coils for National AGS receiver, or forms with information for winding same. F. C. Kimball, 726 Caldwell Road, Oaklane 11, Calif.

WILL TRADE a 35Z5 tube for a 12SQ7. Alfred Zeller, 7535 Satsuma, Houston, Texas.

FOR SALE OR TRADE—Readrite #430 tube checker; Yankee tube checker; and Rejuvenator (modernized); Philco 050 tube checker; several pairs of headphones; Oliver typewriter; amplifiers up to 25 watt, etc. Wilfred H. Simpson, Armstrong, B. C., Canada.

WANTED—Any good communication receiver such as SX-24, SX-25, RME or national. R. Stofan, 332 Herrick Ave., Teaneck, N. J.

FOR SALE OR TRADE—Supreme #89 set & tube tester in A-1 condition. Want an automatic record changer or $35 cash. John C. Erkan, 240 Oriental Place, Lyndhurst, N. J.

TUBES FOR SALE—2-25Z5; 1-6A7; 1-6A8; 3-6SJ7; 1-6J5GT; 1-43. Will put money toward short wave receiver. What have you? Paul Stephens, 202 Broadway St., Meyersdale, Pa.

WILL EXCHANGE an all-wave signal generator for tube tester or radio books. J. Bazewick, 3000 No. Christiana, Chicago 18, Ill.

WANTED—Tube tester, sig. generator, or what have you? Raymond D. Smith, 50 Chestnut St., Lowell, Mass.

WANTED—50L6 and 12B8 tubes; also record player. Fred W. Garrett, 601 Valle Ave., Kokomo, Ind.

WANTED — Tube checker, sig. generator and set tester. Must be in A-1 shape. William Strickland, 210 W. Breckinridge, Louisville 3, Ky.

SEND US YOUR OWN AD TODAY!

For over two years now, the Sprague Trading Post has been helping radio men get the materials they need or dispose of radio materials they do not need. Literally thousands of transactions have been made through this service. Hundreds of servicemen have expressed their sincere appreciation of the help thus rendered.

Send your own ad to us today. Write PLAINLY—hold it to 40 words or less—confine it to radio materials. If acceptable, we'll gladly run it FREE OF CHARGE in the first available issue of one of the five radio magazines wherein the Trading Post appears every month.

HARRY KALKER, Sales Manager

Dept. RN-55, SPRAGUE PRODUCTS CO., North Adams, Mass.

Jobbing Sales Organization for Products of the Sprague Electric Company

SPRAGUE CONDENSERS
KOOLOHM RESISTORS

TM. REGISTERED U. S. PATENT OFFICE

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

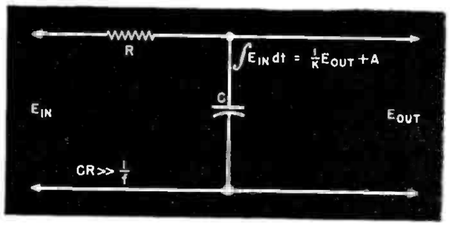

Fig. 6. Integrating circuit. In the above formula, K is a constant, depending on C, R, and frequency, while A is also a constant equal to the d.c. potential superimposed on E_{out}.

power may be taken from the source of each voltage. Circuit B requires no power since the input of each voltage is connected to the control grid of a tube and the grid resistor may be made high. For d.c. and for very-high-frequency a.c., special circuits will be needed.

In studying Fig. 2, which shows a circuit for performing subtraction, it is important to understand that a phase shift of 180° is equivalent to a change in sign.

In using the circuit of Fig. 3, for practical application, a tube with an amplification constant much greater than the multiplication needed is employed. K of the equation is less than unity; i.e., a fraction which primarily depends on the value of plate and load resistances. If the product of $K\mu$ is greater than the multiplication needed, a reduction can be achieved with the aid of a voltage-divider network in the plate circuit.

Great ingenuity can be exercised in designing circuits for multiplication of two voltages. The circuits shown in Fig. 4, are only suggestive. With very slight modification these circuits can be made to perform exponential operations on one of the quantities while the value of the exponent (power) will depend on the second voltage.

The circuits of the differentiator (Fig. 5) and integrator (Fig. 6) are used extensively for clipping and forming square, triangular, and other waveforms.

In Fig. 7, we have an illustration of an electrical circuit performing a complete mathematical operation. The occurrence of the sum and difference of two varying voltages is found in certain special applications of frequency modulation.

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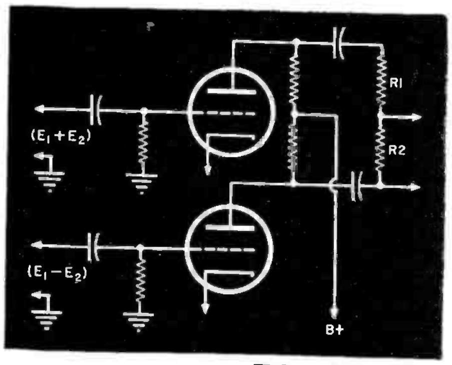
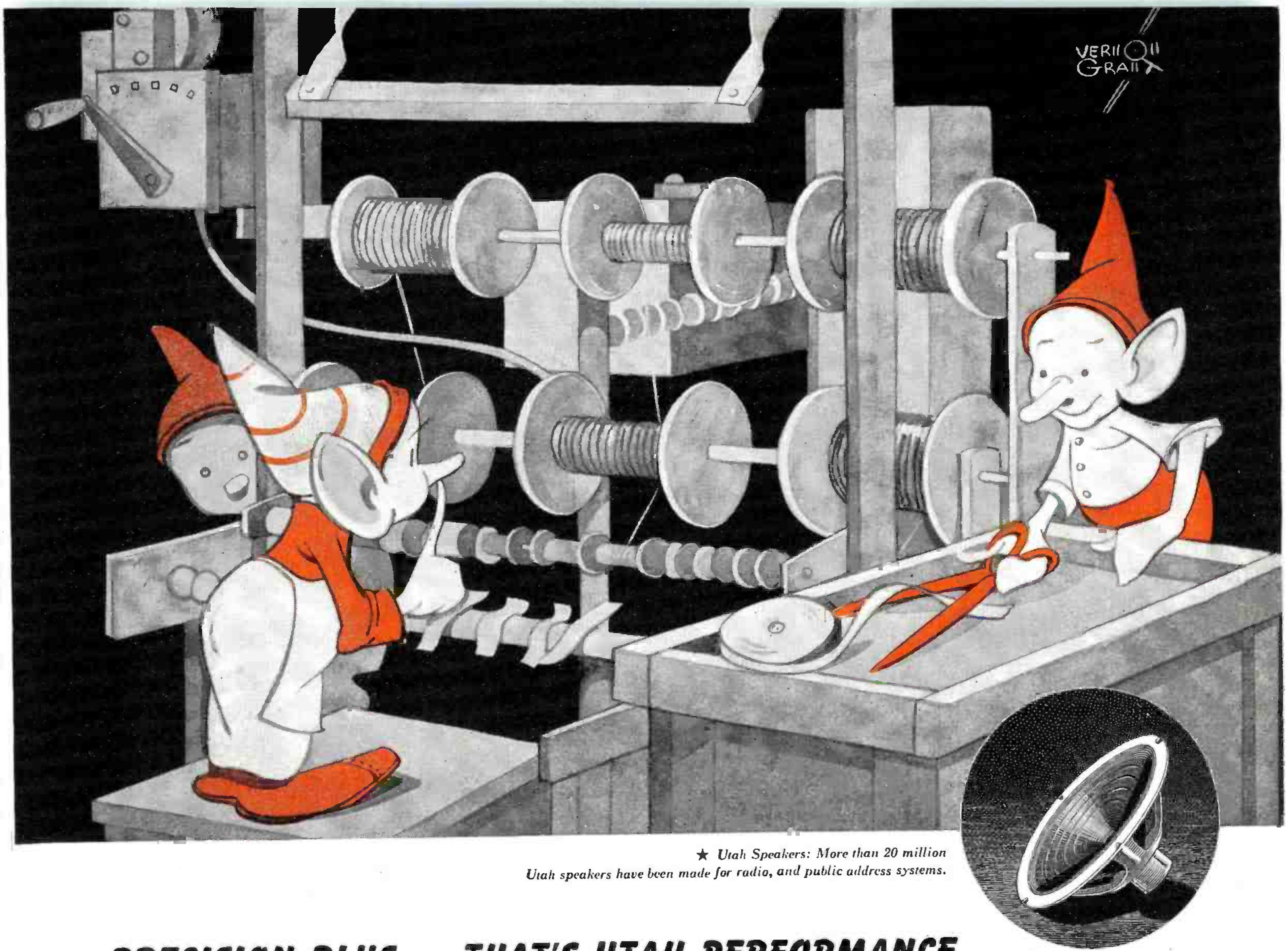
Fig. 7. Illustrating how an electrical circuit can solve two simple simultaneous linear equations.





★ *Utah Speakers: More than 20 million Utah speakers have been made for radio, and public address systems.*

PRECISION PLUS . . . THAT'S UTAH PERFORMANCE

When it comes to coil winding, Utalins* are past masters. They operate machines, built by Utah engineers, that produce finished products to a greater accuracy than ever possible by human hands alone.

This, and every manufacturing step, is part of a comprehensive process carried through in Utah's own factory . . . tooling, welding, plating, winding . . . to unexcelled standards of accuracy. Then comes checking, rechecking, supervising, testing . . . till every step of production has been thoroughly approved. In fact, there's not one moment from the original buying of raw materials to the final delivery, that Utalins* relax their efforts. This is the Utah perfection that guarantees performance.

*Utah's Helpers

utah

UTAH RADIO PRODUCTS COMPANY, 820 ORLEANS ST., CHICAGO 10, ILL.

Utah Electronics (Canada) Ltd., 300 Chambly Road, Longueuil, Montreal (23) P.Q. • Ucoa Radio, S.A., Misiones 48, Buenos Aires

WHAT'S NEW IN RADIO

New products for military and civilian use.

The products described herein are available, in most cases, only through high priority ratings. It is suggested that readers apply for further information on company letterheads, stating full details as to priorities available.

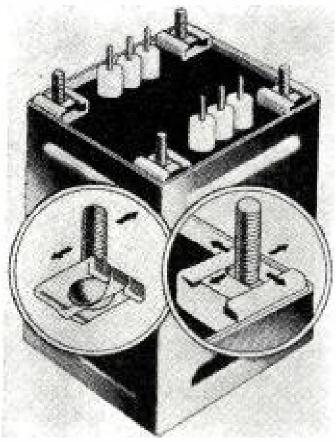
TRANSFORMER MOUNTING

The *Electronic Components Company* of Los Angeles has announced a new feature in their line of transformers.

This development consists of self-aligning, detachable mounting studs which allow an actual tolerance in mounting dimensions that can exceed one-quarter inch and thus eliminate rejects due to bad threads, leaks around studs, bent or broken studs or changes in length specifications.

A simple clip arrangement, stamped from heavy-gauge steel, cadmium plated, prevents the stud from turning while it permits centering in two directions. The stud can be moved, not bent, in four directions to align with irregularly spaced holes and is replaceable in the field with any round head machine screw available.

The company is currently manufacturing 15 standard case sizes with this feature. Details will be furnished



upon request to *Electronic Components Company,* 423 N. Western Avenue, Los Angeles, California.

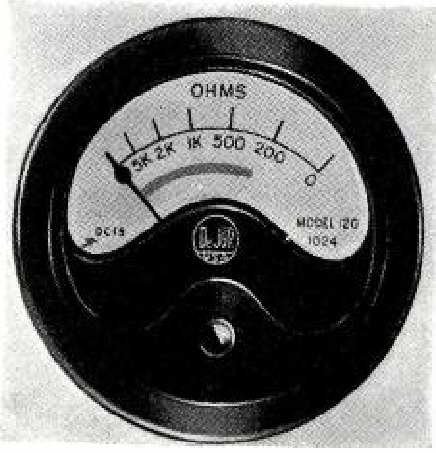
MINIATURE METER

The *DeJur-Amsco Corporation* has announced the development of a new hermetically-sealed, ring-mounted miniature 1½" meter, the Model 120.

This unit which is built to A.S.A. specifications is the smallest meter available and is capable of performing a variety of applications.

Because of the hermetic seal, the meter can be immersed in water at a depth of 30 feet for a period of seven days without damaging the mechanism.

The case, including the terminal studs, is completely waterproof, thus even if the glass breaks, the equip-



ment remains waterproof. The manufacturer recommends this unit for applications where equipment must sustain immersion. The unit is built of corrosion resistant materials with a black anodized finish.

The instrument flange may be mounted on any thickness of panel from 1/16" to ¼" steel or bakelite.

The meter is available in a wide variety of ranges including highly sensitive microammeter or microvoltmeter specifications.

Detail regarding this equipment will be furnished upon request to *De-Jur-Amsco Corporation,* Northern Boulevard & 45th Street, Long Island City 1, New York.

EQUIPMENT KNOB

A new type of knob for use on communications equipment and instruments is now being manufactured by *The General Cement Company* of Rockford, Illinois.

The knob is constructed of a smooth finished molded bakelite with a pointer arrow on the front. The unit comes complete with a ¼" brass insert and set screw which provides a finely balanced precision touch. Dimensions are 1¾" O.D. x ⅞" over-all height.

A sample knob and accessory information will be furnished to persons making the request direct to *The General Cement Company,* Rockford, Illinois.

TUBE CAPS

The *Alden Products Company* is making announcement of a new patented cap for metal tubes which were originally designed for the Air Corps.

The cap features an insulated lining which is held in place by a new and ingenious manner.

Details of this tube cap, the *Alden* 90-TCIMS, will be forwarded upon request to *Alden Products Company,* Brockton, Massachusetts.

30-WATT AMPLIFIER

Walker-Jimieson, Inc., of Chicago is announcing the production of a new portable 30-watt amplifier, which according to the manufacturer embodies several points of superiority. This unit is a humless, distortionless amplifier which operates on 110 volts a.c. and provides outstanding power and tone quality.

The amplifier features two mike inputs and one phono input which makes it adaptable for many amplifier applications. Output impedances of 4, 6, 8, and 500 ohms are available. Frequency response is from 50 to 10,000 cycles. The record gain is 69 db. and the microphone gain is 116 db. Seven tubes, three 6SJ7's, two 6L6's, a 6N7, and an 83, are used in this unit. The entire amplifier is housed in a gray wrinkle-finished steel cabinet which is equipped with carrying handles.

Amplifier equipment is available

only on priority at the present time. Further details of this unit will be furnished upon request to *Walker-Jimieson, Inc.,* 311 S. Western Avenue, Chicago. Illinois.

24-A LOUDSPEAKER

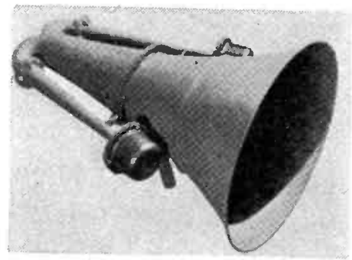
A new speaker, designed primarily for outdoor applications, is now being offered by *Langevin Company* as their model 24-A.

This unit is weatherproofed with a new type of vitreous finish which retains its noncorrosive qualities even in areas where high-corrosion conditions exist.

The horn is of exponential form so that the off-axis levels follows the usual curves. The horn has a bell diameter of 25", with an over-all length of 38" and an over-all width

of 26". The frequency response is from 110 to 6500 c.p.s.

Receiver attachments are available for coupling two or four driver units



and making the horn capable of maximum inputs of 50 and 100 watts.

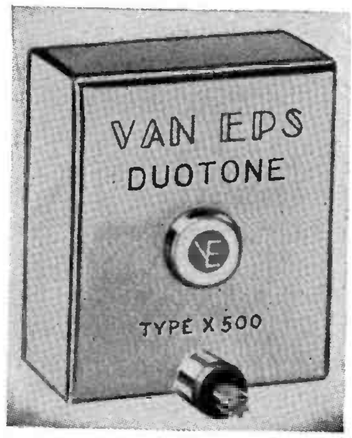
Details will be furnished by *Langevin Company, Inc.,* 37 West 65th Street, New York 23, N. Y.

CUTTING HEADS

Duotone Company has announced the availability of several hundred Van Eps Cutting Heads.

This unit gives a clean and undistorted cut on complex waves and has a single resonant point which is easy to equalize, according to the manufacturer.

The output of this instrument is stable under all temperature and humidity conditions. It has an exceptionally high output, thus requiring less power to drive and is available in 15- and 500-ohm impedances. It is designed for a 9/16" stylus. The head comes equipped with an extra mounting plate for instant mounting and can be easily interchanged where other heads are used. The head is hermeti-



cally sealed and completely guaranteed if the seal is not broken.

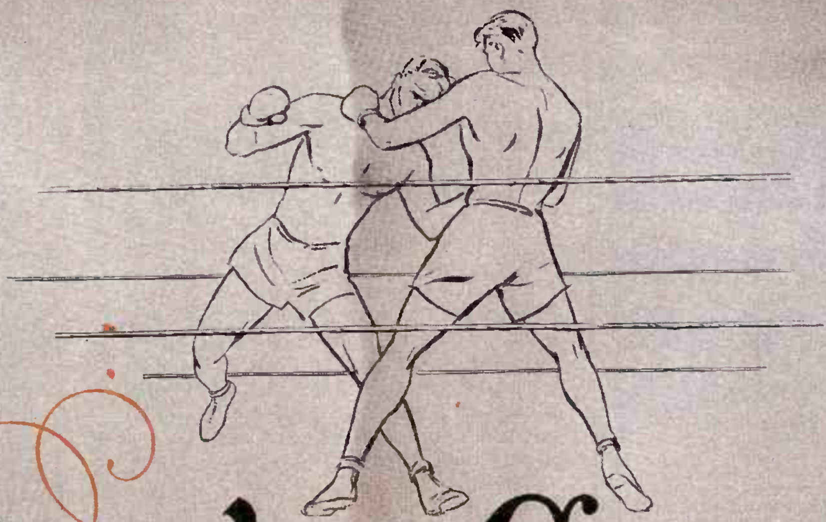
Latest literature on the Van Eps Duotone Cutting Head will be forwarded without charge upon request to *Duotone Company,* 799 Broadway, New York 3, N. Y.

TUBE ADAPTERS

The line of tube adapters, manufactured by *Adaptol Company,* is now being packaged in a full-colored carton container which, according to the manufacturer, gives added protection to the units in storage.

The company line of adapters includes approximately 200 different types, several with built-in resistors for easier and faster installation.

The stem of each adapter is marked



Quality Counts

IN 1892, James J. Corbett beat John L. Sullivan to win the heavyweight championship of the world. Corbett, who was considered a novice in the ring, weighed only 186 pounds to Sullivan's 220, and yet he knocked out Sullivan in the 21st round. Corbett had that touch of quality—of extra quality—that expressed itself in victory. For superior performance in any product—just as with Victory in the prize-ring —*Quality Counts!*

For years, the antennas manufactured by THE WARD PRODUCTS CORPORATION have been known as quality products, the workmanship of craftsmen using modern equipment under ideal conditions. Constant adherence to the principles of quality coupled with manufacturing experience has made WARD the leader in the production of sectional and one-piece antennas . . . For quality antennas for all applications, look to WARD.

WARD *Antennas*

BUY WAR BONDS

THE WARD PRODUCTS CORPORATION
1523 East 45th Street
Cleveland 3, Ohio

clearly with the tube type to be installed and the tube it is intended to replace.

Literature concerning the products of the company may be secured direct from *Adaptol Company,* 260 Utica Avenue, Brooklyn, New York.

INDICATING DEVICE

A three-way signal indicator, known as the "Teller," is now being produced by *Dietz Manufacturing Company.*

This unit is a continuously self-testing, shock-resistant indicator of simple construction. There is no filament to burn out, no springs or levers. The weight when installed is .64 ounce, with voltage ratings of 18 to 30 volts d.c. at a wattage of 1.2. Temperature range of this unit is from minus 75 degrees to plus 160 degrees. Altitudes up to 50,000 feet will not effect the operation of this unit.

The manufacturer suggests its use in applications on antenna reels, bomb releases, battery carts, landing gear position, oxygen warning systems, fuel pressure, signal-calls, fire warning,

beacon indicators, and in radio and radar.

Details will be forwarded upon request direct to *Dietz Mfg. Company,* 2310 South LaCienega Blvd., Los Angeles, California.

AUDIO OSCILLATOR

A low-frequency electronic tube oscillator, of unusual stability and offering performance comparable to that of an electromechanical oscillator of the tuning-fork type, is being manufactured by *The Allen Organ Company.*

This oscillator is available not only at the standard frequencies of 400 to 1000 cycles, but is being produced on a "cut to frequency" basis, thereby lending itself to a multitude of additional applications besides the usual functions of this type device.

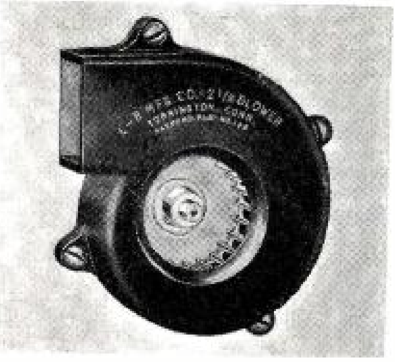
The instrument is mounted in a walnut case weighing approximately five pounds, and requires noncritical supply voltages of 6.3 volts and 45 volts for operation.

The Allen Organ Company, 817 Maple Street, Allentown, Pa., will forward further details upon request.

BLOWER

For applications requiring the dispersion of heat, the *L. R. Manufacturing Company* has developed and is manufacturing a new lightweight blower.

This unit, known as the Model No. 2½, has a one-piece housing with an aluminum motor plate 4½" from top to



bottom. Operating under all conditions of climate and temperature, the unit which weighs but 3½ ounces, delivers 50 cubic feet per minute at 8000 r.p.m. It is available with shaft bores of either .1895 or ¼".

The company now has available a line of blowers ranging in size from 3" to 6½" with weights from 2 ounces to 12 ounces and with capacities from 15 to 270 cubic feet per minute at 8000 r.p.m. Housings are lightweight, high-impact phenolic plastic. The wheels are turbo-type cadmium plated steel, available either in clockwise or counterclockwise rotation.

Details will be furnished upon request to *L. R. Manufacturing Company, Division of The Ripley Company,* Torrington, Conn.

PANEL INSTRUMENTS

A new line of 1½" electrical instruments are being manufactured by *Roller-Smith* of Bethlehem, Pa.

These instruments are designed to withstand the extreme conditions of temperature, humidity, vibration and shock in aircraft service. Service accuracy of 2% is maintained. Immersion tests have shown the instruments' ability to withstand hydrostatic pressures up to 14.7 p.s.i. without case leakage.

The line of 1½ instruments includes d.c. voltmeters in all practical ranges above 50 millivolts, and d.c. ammeters in all practical ranges above 500 mi-

croamperes. For certain applications lower ranges can be supplied.

Further information is available from the manufacturer, *Roller-Smith,* Bethlehem, Pa.

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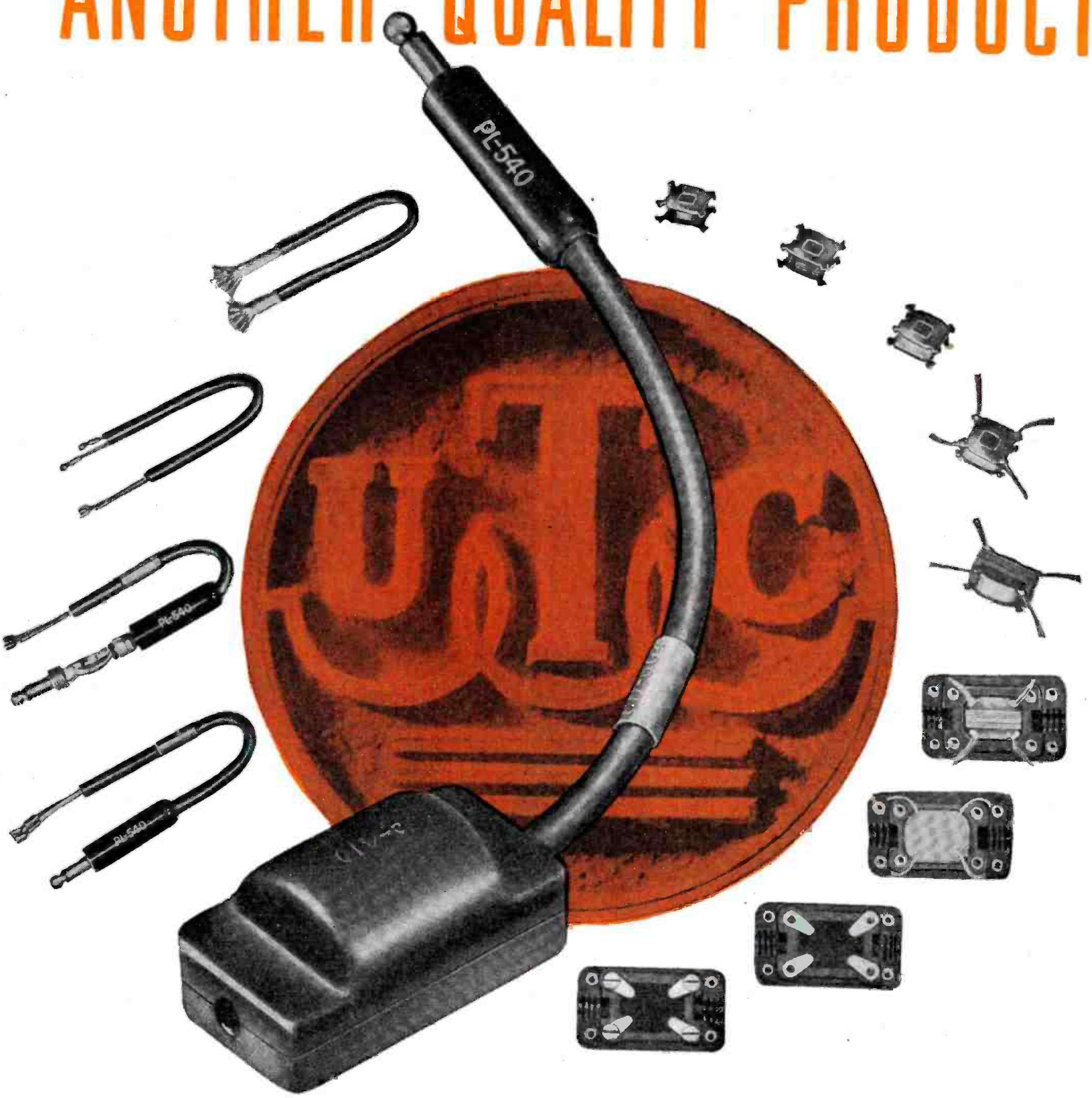
ECHOPHONE MODEL EC-1

(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
"The Ears of the World"

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

ANOTHER QUALITY PRODUCT



CD-604, CD-605 TRANSFORMER-CORD SETS

UTC production facilities for these Signal Corps headset adapters permit acceptance of additional quantity orders for quick delivery. Also available in hermetic construction.

ALL PLANTS

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

United Transformer Corp.

150 VARICK STREET NEW YORK 13, N. Y.

EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y., CABLES: "ARLAB"

Louis Webb Charts Present-day Service Procedure

By EUGENE A. CONKLIN

This serviceman closely follows a well-planned daily routine to help overcome the serious problem of material and labor shortages.

LOUIS WEBB, of Ogdensburg, is interested in postwar planning, but he also is of the opinion that the present war is good for many months more, and that the radio man must concentrate on present problems if he is to stay afloat. Here are a number of Webb's maneuvers which are keeping his service shop from folding up under wartime pressure.

To begin with, Webb has his share of personnel problems. He is attempting to handle not only home radio servicing, but the servicing of commercial p.a. outfits and of juke boxes. In order to accomplish this far from trivial feat he has had to establish a schedule and stick to it.

He has the following daily routine. From 8 a.m. until noon, customers may call at his shop to pick up or leave sets. A receptionist is on duty—a housewife who has children and who therefore cannot accept fulltime employment in a defense plant. During this morning period Webb is not in the shop but is busy with commercial work exclusively.

From noon until one o'clock is Webb's lunch period and the shop is closed until 5 p.m. to all customers. From 1 through 5, Webb is at work in the shop behind closed doors concentrating entirely on service-bench work. From 5 until 6 p.m. the shop is open again to the public with Webb pinch-hitting as receptionist.

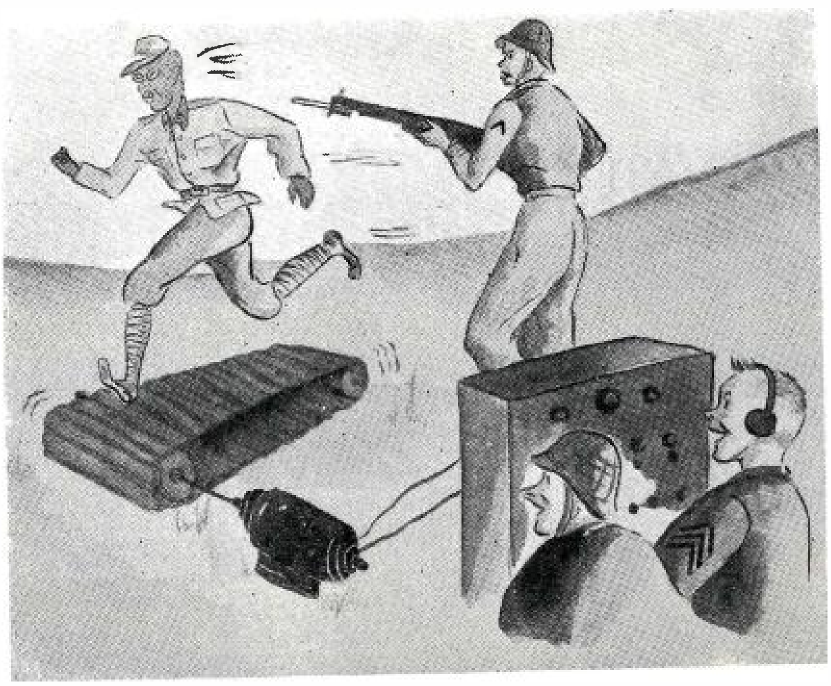
From 7 until 10 p.m., four nights weekly, Webb is available for house calls. All house calls are accepted with the understanding that Webb will get there as soon as he can and not before. Customers who insist on house service may have to wait from one to three nights before Webb pays them a visit.

Webb has a double-scaled tariff. For sets serviced in the shop he charges $1.00 per service hour plus costs of any and all components installed. For sets serviced at home, the charge is $1.50 per hour, exclusive of component costs. Webb feels that if a customer is willing to wait and wishes to pay the jacked-up service charge, he deserves home service. He also feels that giving up his leisure time at night requires additional compensation — hence the dual price range.

As to delivery—Webb has his own methods of dealing with this serviceman's Scrooge. He arranges for a group of high school boys who possess carts to report after school and go out to customers' homes and pick up ailing receivers. These first year high students receive 25c per call, paid for by the customer. The set is returned but this time the delivery cost is on Webb—both customer and serviceman paying half on delivery charges. In addition, there is an errand service operative in the community and Webb recommends this concern when a customer calls in requesting pickup or delivery service.

Webb also has an unusual method of training shop assistants. He contacts the local high school physics instructor who recommends two or three boys who are interested in after-school employment. These youngsters must have at least two years of school remaining to be acceptable for employment in Webb's service center. Under this setup, schoolboys report to Webb at 3:30 daily. Two test benches have been set up in the shop—each equipped with meters, and all forms of testing apparatus. The test equipment used on these benches is not of the best, being salvaged from Webb's stock on hand during past prewar years, but it does suffice for the highschoolers to use in their after-school sessions.

Under Webb's tutelage these small-fry shop assistants acquire a knowledge of radio fundamentals. By the time summer vacation arrives they will be competent to handle many service tasks. In particular, they will be used to install public-address units for summer gatherings. These youngsters will stay put in their job because they are acquiring a knowledge which will qualify them for Signal



"That's the best damn power-supply on the Island."

Corps activity when they are drafted. In this way, Webb does not have to worry about changes in his service staff. Youngsters who come through with flying colors receive excellent hourly compensation and, in addition, may look forward to full-time vacation employment.

Webb has several other interesting wartime operating methods. He places a poster in all the food markets of the city listing his shop schedule. He finds that these posters are read by housewives and by food-shoppers in general. He believes that such a series of posters placed in food markets everywhere is preferable to newspaper advertising. In addition, he uses signs in crosstown busses, said signs reminding riders of his shop schedule. Webb reports that almost everyone rides a bus these days and so his message receives community attention.

Webb does not neglect building up the goodwill of war veterans who will return after V-day. In his shop he has a bulletin board on which is placed weekly an assortment of pictures and letters from former customers now in the service. He takes it upon himself to write one letter a month to each and every shop customer now in some branch of the service.

Particularly is the tube problem a pressing and perplexing one. He does not make a charge for checking tubes but he does ask that customers cooperate by coming in during the 5 to 6 P.M. stretch nightly when one of his high school assistants acts as tube-checker.

He has a poster on his counter which he changes from week to week. It lists the tubes which he does not have in stock. If he does not have certain tubes available, but does have substitutes, this information is chronicled on the poster. Such a poster keeps incoming patrons from asking useless questions concerning tubes on hand. It goes without saying that customers must submit a "dead tube" for every new tube they purchase. In an effort to eliminate tube chiseling, every customer making a tube purchase has a card made out for him or her. On this card is listed every tube purchased from week to week. Cards are kept on file and no customer escapes having his or her own card—even the most casual transient.

Louis Webb uses time signals on the radio each morning at 8—just before the newscast—to remind listeners that they must call in during the morning if they wish to find the shop open—or during the last hour of the afternoon. Webb finds these spots very helpful in conjunction with his bus and food-market posters.

Summing it up, Webb believes that his maneuvers may be applicable to members of the radio-servicing profession everywhere. With minor modifications Webb's methods are certainly usable in many a service establishment.

-30-

Again it's HYTRON—Easy on the Battery!

HY1269 HY31Z HY65 HY69 HY1231Z

In mobile operation, the battery is the kingpin. Two-way police radio takes it out of the battery twenty-four hours a day. Conservation of battery power during stand-by periods is mandatory.

Instant-heating Hytron tubes with thoriated tungsten filaments came to the rescue of police radio. Only when on duty, does police radio equipment draw power when Hytron tubes are used. Filament and plate power go on together.

And that's not all. The Hytron HY31Z, HY65, HY69, HY1231Z, and HY1269 are rugged. HY65 performance in two-way motorcycle police radio has proved this. Including 12-volt filament tubes for marine applications, Hytron's instant-heating line is versatile. Concentration is on the R. F. beam tetrode — work horse of transmitting tubes — but also included is the HY31Z twin triode for Class B. One type can power a whole transmitter — R. F. and A. F. — thus simplifying the spares problem (e.g., Kaar Engineering transmitters built around the HY69).

Wartime uses are bringing additions to the Hytron instant-heating line. Watch for future announcements.

OLDEST EXCLUSIVE MANUFACTURER OF RADIO RECEIVING TUBES

HYTRON

RADIO AND ELECTRONICS CORP.

MAIN OFFICE: SALEM, MASSACHUSETTS
PLANTS: SALEM, NEWBURYPORT, BEVERLY & LAWRENCE

FORMERLY HYTRON CORPORATION

Let's Talk Shop

(*Continued from page* 48)

out some of the more important problems which should be considered before any group commits itself to writing and sponsoring and enforcing an ordinance on licensing. It is the opinion of the writer that licensing is definitely not the answer, and if adopted on a national scale, will do nothing more than add a host of problems to an already overburdened serviceman.

In this column we have spoken about the advisability of the average serviceman, who is now in business, doing some postwar planning. In an effort to help his thinking we are setting down several ideas which occurred to us and which may be helpful in determining his future course of action:

1). Determine if you want to continue in business.
2). What kind of business will it be?
3). Location.
4). Stock.
5). Servicing equipment.
6). Auto or delivery equipment.
7). Banking and credit connections.
8). Contacts with customers and prospective customers.

First, the time is ripe for you to determine whether or not you want to continue in the radio and electronic service business. If your decision is in the affirmative, then obviously the next thing to determine is what kind of radio and electronic business do you want. First, there is a wholesale service business. This is the type of business in which you do all of your work for other dealers or other servicemen.

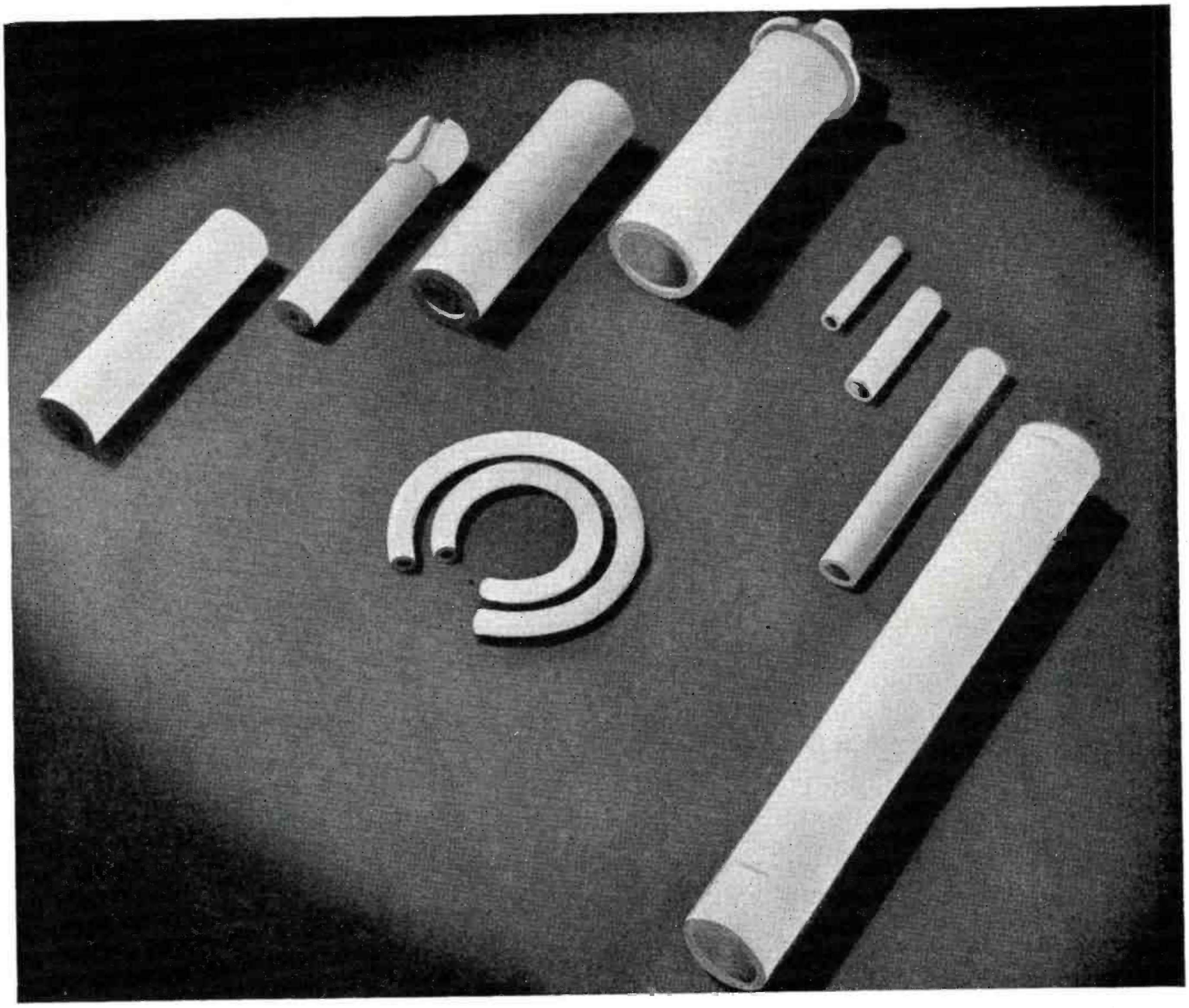
The second type is a strictly retail type of business where you are doing servicing work for manufacturers, industrial plants, or retail customers. The third type of business is a combination sales and repair business. In this type of business, the sale of electronic appliances and radios is carried on, together with the repair of all electronic items.

The next thing that should be considered is your location. This location will vary in each instance with the type of business that you are attempting to operate. If you have a strictly wholesale repair business, it is obvious that you do not need a main street location with a large store front and consequent added expense. If you are in the retail servicing business only, you definitely will need a location where the general public can see and find you. If you are operating the third type of business where a large share of your income comes from the sale of appliances and radio sets, you should have the finest location that provides the largest number of passers-by together with the best window display space that you are able to afford.

The next major consideration is your stock. You have to determine what kind of merchandise you want to sell, and make arrangements with your suppliers to furnish you with this merchandise. The repair parts and tubes which are necessary also should be very carefully checked and an adequate stock carried at all times to enable you to do your work with the least waste of time. It is perhaps good business to have two or three suppliers upon whom you can depend at all times. In the case of the radio and television sets which you carry in stock, it is perhaps most economical to do business with one set manufacturer.

In the strictly shop part of your business, your servicing equipment should be inventoried at once and all needs for equipment should be listed. Since there is going to be quite a scramble for test equipment immediately after the war, it is perhaps wise to talk to your supplier in advance of your actual requirements in order that he can make arrangements with the manufacturer to take care of you without delay.

Since the cost of servicing equipment runs into a considerable sum of money, it is perhaps wise to set aside certain definite sums each month looking towards the purchase of this equipment. Many new types of serv-



WE MAKE our own refractories, thereby obtaining the best possible control over the characteristics of VITROHM RESISTORS and RHEOSTATS.

WARD LEONARD ELECTRIC CO.

Radio and Electronic Distributor Division

ARMY E NAVY

53 WEST JACKSON BLVD., CHICAGO, ILL.

WL WARD LEONARD ACCEPTED MEASURE OF QUALITY

RESISTORS RHEOSTATS RELAYS

icing equipment will be available and remember it is the best equipped shop that is able to turn out the work fastest and with the greatest efficiency.

Your automobile or delivery equipment is probably in a pretty sad state by now due to conditions beyond your control. In most cases, this is the first thing needed by radio service shops; therefore, provisions should be made now to replace this equipment at the earliest possible time.

Most servicemen are in a fairly good financial position now due to the good business that has been enjoyed during the war. Undoubtedly, most of you have made your banking and credit connections and have built up your reputation which will be of the utmost value when it comes time to make large expenditures which will be called for in the modernization and the rehabilitation of your shops. A very good idea is to talk over your future needs and plans with your local banker in order that he may have a good grasp of your problems and can aid you in every way possible.

I have left to the last the most important postwar planning that needs to be done and that is the contacting and recontacting of customers and prospective customers. All signs point to the fact that there will be a big scramble for business after the war. In order to put yourself in the best possible position, you should at once begin to re-establish those customer contacts which have been lost, and to search out new customers, both industrial and retail, for your services. Too much emphasis cannot be placed upon this phase of postwar planning. Mailing lists should be gone over carefully, all sales help which does the institutional selling job on radio itself should be used now. This will give you an additional advantage over your competitors in the postwar period.

Servicemen must become salesminded and operate their business on sound business lines or else they will drop by the wayside. Competition will see to it that the man who does not sell and resell himself, his services, and his business to his customer, will not remain very long in the picture.

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For the Record

(*Continued from page 8*)

vision allocations *might* turn up, but they will not be as drastic as the partizans on both sides recommended. . . . When will the FCC hand down its final allocation decision? Best information here as we go to press can be summed up in one word: "Soon." About the first of May is a good date to figure on. . . . Two reasons are given for lack of changes from FCC's recommendations and the fact that before the Commission made its January roundup, everybody in radio had been consulted. On the agreement of most parties, even the Commission was surprised and pleased. As Paul A. Porter, new FCC chairman, put it after the hearings: "Even NBC and CBS both applauded the television allocation—the day of miracles is not past!"

IF THE FCC allocation changes for FM stations go through, Commission estimates are that 46 stations which are now licensed and seven for which construction licenses are outstanding will be immediately effected, although only five of the seven are actively under construction at this time. Four of the stations are in operation under wartime experimental or developmental licenses. Of the 44 others, 33 have installed full transmitter power and 20 have installed the antenna system authorized by construction permit. . . . Five of the 33 have a power of only one kilowatt or less, one has 20 kilowatts, five have 50, and one has 55.6. Ten FM stations have completed full construction and are testing, 32 are operating on wartime limitations, without regular transmitter power or with temporary antenna systems, or both.

THERE is still little hope that the critical paper shortage will see any improvement for many months to come. Rather than cut down on editorial material, we have elected to trim the page size of RADIO NEWS which will help to make possible a goodly supply of articles each month. .O.R.

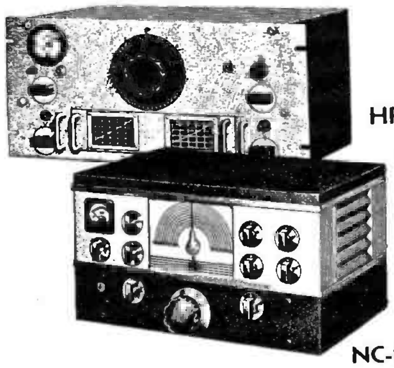
NATIONAL RECEIVERS ARE THE EARS OF THE FLEET

OFFICIAL U. S. NAVY PHOTOGRAPH

3 out of 4 of the Navy's ships— landing craft and larger—are equipped with receivers designed by National

This is a small part of mighty Task Force 58. It is more than a lot of ships and a lot of men, it is an integrated striking force of terrific power. Radio communications have played a vital role in the operations for which Task Force 58 has become famous.

We are proud that National radio receivers are a part of this Force.



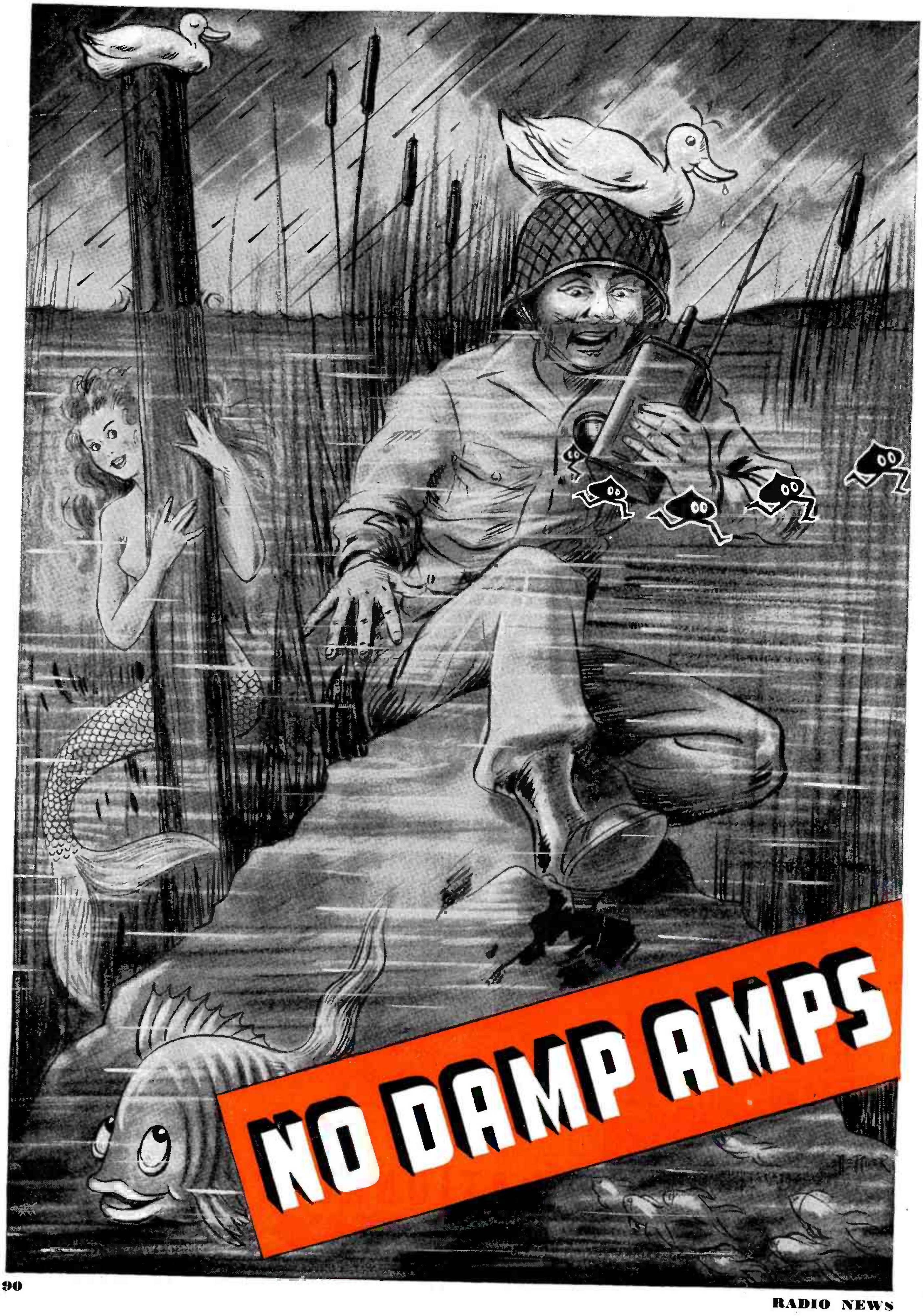
HRO

NC-200

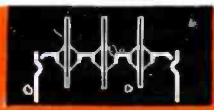
NATIONAL COMPANY

MALDEN MASS, U. S. A.

NATIONAL RECEIVERS ARE IN SERVICE THROUGHOUT THE WORLD

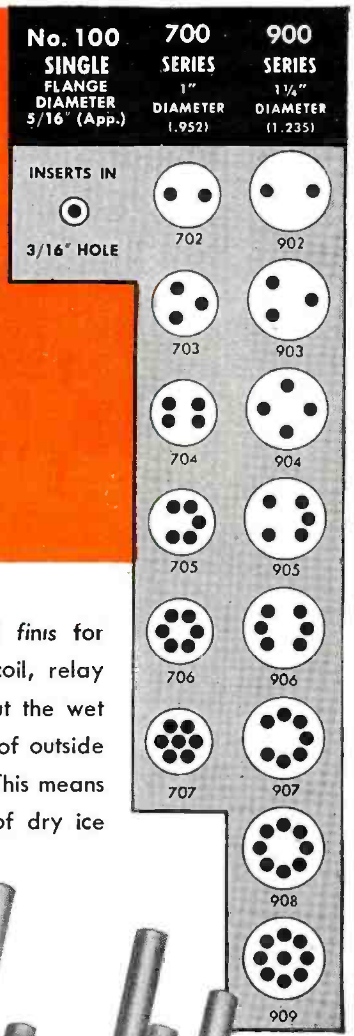

NO DAMP AMPS

No. 100

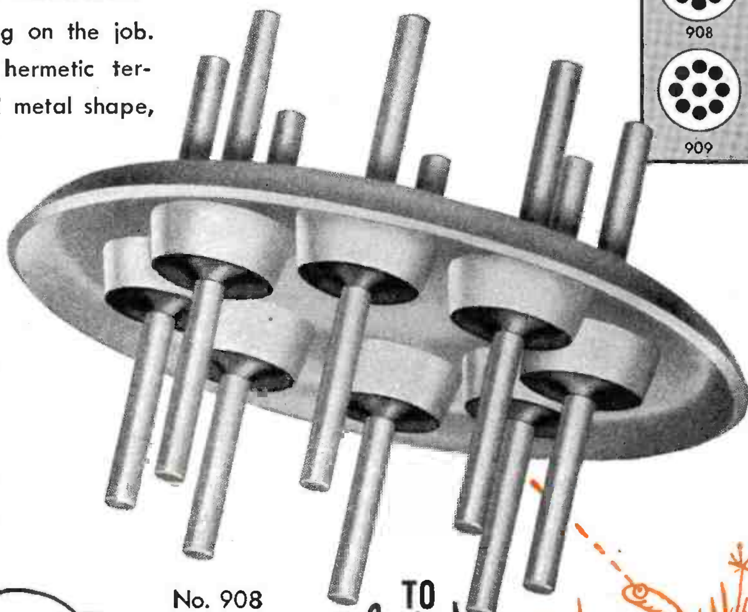


Fusite terminal panel used as cover for container. A single sealing operation.

Hole punched and adapter socket formed to receive Fusite terminal panel.



DUCKING . . . the issue is old stuff. A good ducking can spell *finis* for electronic equipment. When moisture wades in, the best transformer, coil, relay fold up. Protect them with **FUSITE** Hermetic Terminals. **FUSITE** keeps out the wet and seals in the dry. No damp amps are the positive result, regardless of outside atmospheric conditions. Time, place and temperature can be discounted. This means dependable performance. **FUSITES** pass the tough thermal shock test of dry ice to boiling water. They withstand production handling in your plant and manhandling on the job. **FUSITE** is an inorganic-insulated, hermetic terminal interfused within a reinforced metal shape, all in one piece. One and only one sealing operation is required to provide a perfect hermetic seal. **FUSITE** saves parts and labor, downs costs, ups production and helps to guarantee the performance of your electronic component parts. Look for this mark FUSITE stamped in every seal. It is your guarantee of "proved performance." Write for samples on your business letterhead.



No. 908

WITH FUSITE SEALS

GLASS TO METAL

FUSITE

HERMETIC TERMINALS

NO DAMP AMPS!

CINCINNATI ELECTRIC PRODUCTS COMPANY

CARTHAGE AT HANNAFORD, NORWOOD,
CINCINNATI 12, OHIO

Spot News

(*Continued from page* 20)

tories. He first proposed that the 102-108 megacycle channel be definitely assigned to television now. He said that the addition of a thirteenth channel will be of material assistance in extending commercial service and also standardizing receiver design. He then suggested that the 84-102-megacycle range be incorporated in television receiver design to provide both television and frequency-modulation reception.

Describing this combined service, he said: "As commercial television operation expands it can, if necessary, absorb these FM sound channels if that service no longer receives public demand in view of the superior television service providing both sight and sound."

Amplitude modulation was praised by Dr. Goldsmith in his testimony. He said that from their AM-FM experience on the 83.75-megacycle frequency, the narrow-band amplitude modulation can offer an excellent broadcast service. Dr. Goldsmith then covered the signal interference ratios. This point was also covered by Dr. Du Mont during the IRE winter meeting debate which was discussed last month. Dr. Goldsmith pointed out that although a higher ratio of 100:1 for received signal-to-interference signal is specified as protection for television than the ratio of 10:1 protection for FM, it is nevertheless true that television can tolerate occasional long-distance sporadic signals more readily than FM.

He pointed out that FM stations, which are relatively narrow-banded, can be designed to radiate effective powers of hundreds of kilowatts, while television stations with their broadband characteristics probably would be limited to powers of tens of kilowatts. In view of this condition there is a greater likelihood of FM stations providing long-distance high-level occasional interfering signals, he said.

He then pointed out that if any FM stations were assigned in the region near 50 megacycles, then all would probably be assigned in this region and all FM stations would be susceptible to sporadic interference. However television would have only a few of its channels in this region and these few would be susceptible to this interference. He said that the multipath problem had not been too serious between 44-84 megacycles. Neither did he anticipate any serious conditions because of multipath in the higher frequencies. He felt that where there is a choice between sound broadcasting and television for the use of frequencies between 44-84 megacycles, sound broadcasting should be assigned to the higher frequency because of the absence of extensive difficulties from multipath phenomena.

AN ALLOCATION PLAN THAT WILL PROVIDE FOR 398 television stations throughout the country was proposed by Colonel William A. Roberts, counsel for the TBA at the allocation hearing. These stations operating under a classification system could be established in 140 market areas of the country. Three classifications were recommended: class A, to serve primary markets; class B, located in areas adjacent to those of class A; and class C, located beyond the interference range of class A. The class A station would have a radius of 55 miles; class B, a radius of 20 miles; and class C, a radius of 40-55 miles, depending on the size and importance of the market.

In the study of major markets, Colonel Roberts said that New York City, Chicago, and Los Angeles might have seven stations; Philadelphia would have four; Rochester might have three; and Toledo one. With such an allocation system, television would be able to serve nearly 100,000,000 people.

In view of this plan, Colonel Roberts stated that the proposed allocations calling for twelve 6-megacycle channels should be made permanent and that the channel from 102-108 megacycles should be allocated at once for television. He also asked the allocation of a fourteenth channel immediately below the 102 megacycles for a temporary period of five years.

Discussing channel sharing, he said that this may be possible in some parts of the country but it must be closely controlled.

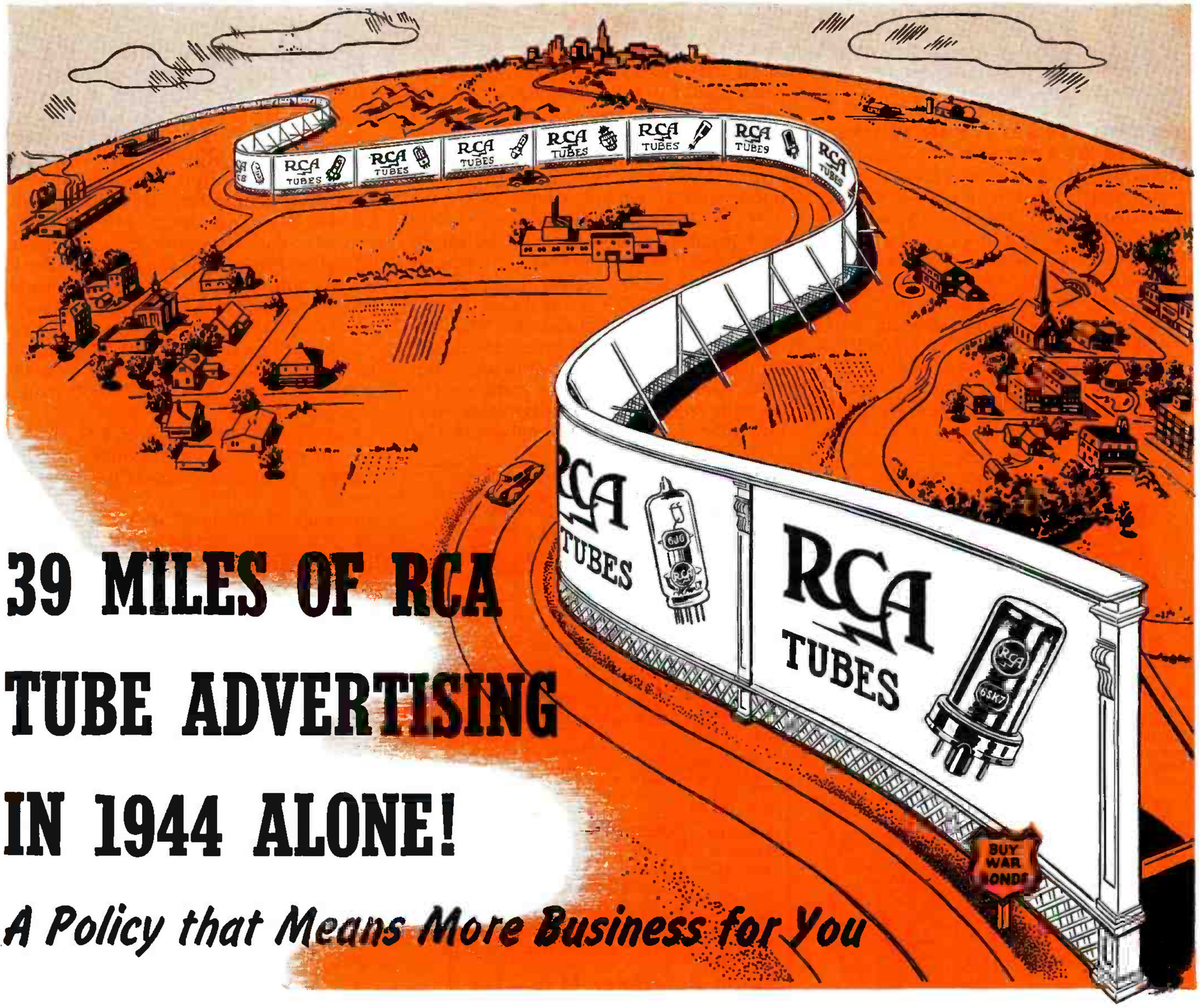
ABSENCE OF DAY AND NIGHT COVERAGE in from 30% to 50% of the areas throughout the country have prompted an intensive series of studies by the FCC and industry. The first step in the analysis was launched during the middle of March when FCC chief engineer George Adair called a meeting of industry engineers in Washington. At this session, the first of a series which will culminate in special clear-channel hearings in May, nearly fifty members of industry attended. Four committees were set up to report on: (1) what constitutes a satisfactory signal; (2) what constitutes objectionable interference; (3) distances at which, and areas over which various signal strengths are delivered; and (4) population intensity and postcard surveys.

The first committee consists of E. W. Allen, Jr., FCC, chairman; William B. Lodge, CBS; Ray Guy, NBC; and Philip Merryman, George C. Davis, John Barron, G. F. Leydorf, all of Panel 4, RTPB. In the second committee, C. H. Owen of the FCC will serve as chairman. Others serving include: Commander T. A. M. Craven, D. P. Spearman, and Dr. G. W. Pickard of Regional Broadcasters; Lynn Smeby (formerly with NAB and FCC and now with the War Department), George C. Davis and Grant Wrathall of Panel 4, RTPB. Dr. L. P. Wheeler of the FCC will serve as chairman of committee three, and E. F. Vandivere, Jr., also of the FCC, will be an alternate. Others on the committee include: J. W. Wright, CBS; W. S. Duttera, NBC; and Stuart Bailey, Frank McIntosh (formerly of the WPB Radio and Radar division and now a consulting engineer), and A. Earl Cullum Jr., all of Panel 4, RTPB. The fourth committee has as its chairman, D. W. Smythe of FCC. P. D. Spearman, Regional Broadcasters; Phillip Merryman, NBC; and Paul Peter and Howard Frazier of NAB constitute the other members of the committee. Mr. Frazier will represent the RTPB, Panel 4.

The progress that FM may make in the broadcasting system will receive considerable study during the clear-channel sessions and hearings. If the FCC finds that the FM system may supplant AM in many of the urban areas for primary coverage, more clear-channel AM stations may be licensed. Such stations would provide service in areas where there are no FM units because the areas are not too populated and it wouldn't be possible to support a special FM station in the area.

The clear-channel problem has attracted the attention of many legislators. Senator Burton K. Wheeler praised the new study, saying that it is imperative to provide coverage for the rural areas, coverage which does not exist today because of the grouped allocations of clear channels to stations in large cities in the East. Such channels should be shared by stations in the middle and far west, he declared. A recent address by FCC chairman Paul Porter also disclosed that there were 21,000,000 people who do not have primary service in the nighttime. This condition exists, he said, in nearly 57% of the country's area.

The clear channels set aside will not only involve stations in this country but our neighboring nations too. The schedule thus adopted will be submitted to the State Department for study at the inter-American conference in Rio de Janeiro in June. Incidentally the North American Regional Broadcasting agreement, also involv-



39 MILES OF RCA TUBE ADVERTISING IN 1944 ALONE!

A Policy that Means More Business for You

TAKE every ad about RCA tubes that reached industry, the trade, and the public during 1944.

The total area of all those ads would be equal to a billboard, 20 feet high, running for *39 miles!* Talk about advertising wallop! There's a program designed to do a real job...to set your stage for postwar profits.

Eight and a half million ads...each a powerful message to tube customers. Over four million square feet of *selling*, building your future RCA sales. And the "billboard" is still growing, mile after mile.

No wonder it will be easier for you to sell RCA tubes. No wonder it will be more profitable.

For with RCA's manufacturing skill and merchandising support behind you, you can't miss. You *know* your customers will want RCA. Sure, the RCA "billboard" is big...your postwar profits on RCA tubes will be big, too!

Listen to "THE MUSIC AMERICA LOVES BEST," Sundays, 4:30 P. M., EWT, NBC Network

RCA

62-6636-91

THE FOUNTAINHEAD OF MODERN TUBE DEVELOPMENT IS RCA

RADIO CORPORATION OF AMERICA

RCA VICTOR DIVISION • CAMDEN, N. J.

LEADS THE WAY . . . In Radio . . . Television . . . Tubes . . . Phonographs . . . Records . . . Electronics ing clear-channel allocations, expires in March, 1946. This agreement was made in 1937.

MICROWAVES HAVE RETURNED TO THE HEADLINES. Frequencies from 30 to 26.000 megacycles are now being scheduled for use in a variety of unusual relay systems by some of the country's leading corporations. Western Union has just received its authorization to begin experiments over a chain of stations that may eventually extend from Camden, N. J., across the Delaware River from Philadelphia through Bordentown and New Brunswick, N. J., to New York. Frequencies scheduled for use will range from 2,000 to 11,372 megacycles. According to the FCC, the relay network will use a system of modulation developed by RCA, providing thirty-two circuits for multiple operation.

A New York-Boston network, using 2.000, 4,000, and 12,000 megacycles, is also planned by the American Telephone and Telegraph Company. Nine elevated sites, including two mountain tops, four hills, and roofs of buildings are scheduled for use. Height ranges will be from 225 feet for the roof top in Boston to 1,395 feet of Asnabumskit Mountain in Massachusetts. The latter mountain is in Paxton township, famous for the FM transmitter. Bell system experts, who will work on the system, say that the microwave system offers innumerable opportunities for multiplex transmissions of sound and television, as well as telegraph.

Using mountain tops in the West, Raytheon is also planning a microwave relay system. In an application filed with the FCC, Raytheon has asked for permission to build stations on Mt. Adams, Washington; Mt. Shasta, Mt. Lassen, Mt. Tamalpais, Mt. Whitney, and Mt. San Gorgonio, in California; Wheeler Park, Nevada; Kings Peak, Utah; and Grays Peak, Colorado. Height ranges of these mountain peaks are from 3,000 to 15,000 feet. Frequencies to be used include 30.66, 39.55, 90. 200, 400, 900, 1,900, 4,000, 6,000, 10,000, 16,000, and 26,000 megacycles.

Raytheon plans to extend the relay system to New York following airline routes. Company officials predict that the services will be used for automatic warnings of airplane pilots, trains and ships, facsimile, land emergencies, public telephones, etc.

The microwave era is definitely here!

THE UNITED NATIONS CONFERENCE in San Francisco will be covered by not only the nations networks but dozens of independent stations throughout the nation. Progress of the conference will be aired directly and via transcriptions. Even television coverage is planned. WNBT, the NBC station, expects to fly films made during the day to the studios in the East for televising the same day, where possible.

The British Broadcasting Corporation will also have its representatives at the meetings. At this writing eight BBC correspondents have filed requests to attend.

THE SURPRISE NOMINATION OF CHARLES R. DENNY, JR., as FCC Commissioner by President Roosevelt has been applauded by everyone. Mr. Denny who is only 33 and at present counsel for the FCC, will succeed Commander T. A. M. Craven who resigned last summer. He has had considerable experience with the Commission, having handled the FCC defense activities during the House Select Committee investigation. Confirmation of Mr. Denny, which is expected in all quarters, will provide the FCC with a full staff for the first time since last June.

THE PAYMENT OF A LICENSE FEE BY RADIO STATIONS was asked for by Senator McKellar in a proposal presented during the hearings of the Independent Offices Appropriations Bill for 1946. The Senator said that payment of a license fee would contribute substantially to the financial needs of the nation. He declared that most of the radio time was being used for advertising from which huge revenues were extracted and that accordingly the Government should reimburse itself for permitting these earnings.

His proposal was soundly criticized by FCC Chairman Paul Porter and

Let there be Music

THE VALUE OF MUSIC...

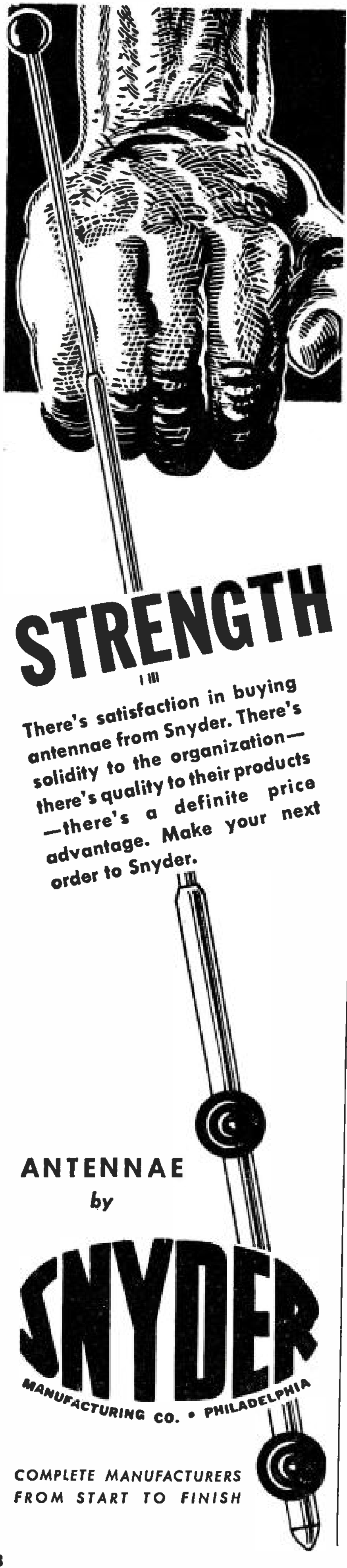
to America during this war can never be fully measured. At the U. S. O., in the jungle, in the factory and in the home, music has been a vital factor as a builder of morale and unity.

Brush is proud of its many contributions in the field of acoustics; notable among these is the Brush PL-20 pick-up. Its proven superiority in reproduction, its delicate but sturdy construction make it the leader in the field.

Write today for descriptive literature on the Brush PL-20 Crystal Phonograph Pickup.

THE BRUSH DEVELOPMENT COMPANY

3513 PERKINS AVENUE • CLEVELAND 14, OHIO



members of the Senate, including Senator W. H. White, one of Washington's leading authorities on radio. Mr. Porter said that the radio industry already pays very heavy taxes, and a license fee would not only burden the industry but destroy competition.

Television

THE INTRIGUING STORY behind the 1000-line French television system demonstration has been told in a special memorandum prepared for the FCC by R. Morris Pierce, formerly of the OWI and now with WGAR as chief engineer.

Mr. Pierce reports that last fall he visited Montrouge, a suburb of Paris at the invitation of Mr. Barthelmy, chief engineer of the Compagnie de Compteures to witness a demonstration of French television. This company is the largest French manufacturer of metering equipment and its subsidiary, the Compagnie Francaise de Television, is engaged in the research and manufacture of television equipment.

Mr. Pierce says that he attended two demonstrations, one covering the viewing of a 450-line picture projected on a 4 x 6 foot screen and another covering the viewing of a 1050-line picture shown on a cathode-ray tube with a 15-inch diameter.

Reporting on the 450-line demonstration, Mr. Pierce states: "The demonstration took place in a small theater, seating about seventy people. The program material was both live and film pickup. The quality of the projection was quite good considering the quality of the same picture as viewed on a 12-inch tube. The projection tube is approximately 6-inches in diameter and operated with a current of 1 milliampere at 35,000 volts, the tube being air cooled. The 450-line picture as viewed on a 12-inch pickup tube appeared to be not as good as the 441-line picture I saw at Camden, two years ago.

"A demonstration was then held of the 1050-line system. The picture was extremely good, the definition and contrast being excellent. At a distance of six or seven feet from the cathode-ray tube, the quality was quite comparable with that of home movies. In comparing the two systems I would say that the 450-line pictures were some better than newspaper pictures, but distorted by stroboscopic effects, while the 1050-line picture was not quite as good as a fine-line magazine print.

"Both the 450 and 1050-line systems were interlaced. The engineers stated that they had a system of interlacing by changing the phase of the synchronizing signals to avoid the necessity of using an odd number of lines. The synchronizing pulses on both systems were in black and fifty frames per second were employed.

"All transmissions were by wire. The engineers stated that the bandwidth required for the high-definition system was between 12 and 15 megacycles. They also stated that they had transmitted the high definition picture on a frequency of 200 megacycles, with a power output of approximately 70 watts. I stated that I felt that the ratio of bandwidth to carrier frequency was quite small, and it would be intelligent to operate at a higher frequency. They concurred.

"I also visited the studios of Radiodiffusion Francaise, which is the government agency responsible for all broadcasting in France. The studios are located in a large building about a half-mile from the Eiffel Tower where the prewar television transmitter is located.

"The transmitter in the Tower was used to provide a television service for German troop hospitals, and was operated until August 16, 1944. This transmitter was damaged by the Germans when they left, but is now being repaired and the government expects to initiate television service soon, using the 450-line system as used by the Germans. Several of the engineers stated that they expected to switch to the 1050-line system, but they did not appear to be in agreement on the date of the switch. Their estimates ranged from two to ten years.

"I was quite surprised to learn that so much money, time, and energy had been diverted to television research during the period France was occupied by the Germans. It would seem that the Germans could have used this engineering talent to better advantages."

Personals

NBC Washington commentator **Richard Harkness** has been elected president of the Radio Correspondents Association . . . **Emerson Markham** manager of television at General Electric has been elected a director of the TBA succeeding **Robert L. Gibson** . . . **Raymond R. Machlett,** president of Machlett Laboratories, has received the honor award medallion of Stevens Institute . . . **Dr. C. B. Jolliffe** is now a vice president at RCA and will be in charge of the RCA Laboratories. He succeeds **Otto S. Schairer,** who becomes a staff vice president . . . **Tom Joyce** has left RCA as manager of the radio, television and phonograph departments. . . . **G. L. Taylor** has assumed full ownership of the Midland radio schools . . . **E. L. Bragdon,** formerly radio editor of The Sun in New York, and recently with NBC as trade news editor, has joined the RCA information department . . . **Ben Miller** is now with UTC as sales manager. He was formerly with Meissner. **Samuel L. Baraff** becomes director of sales and merchandising of UTC . . . Army-Navy "E" awards have gone to **Barker and Williamson, Pacific Sound Equipment Company,** and **Harvey Wells Electronics, Inc.** A fourth white star has been won by **Henry L. Crowley and Company.**

-30-

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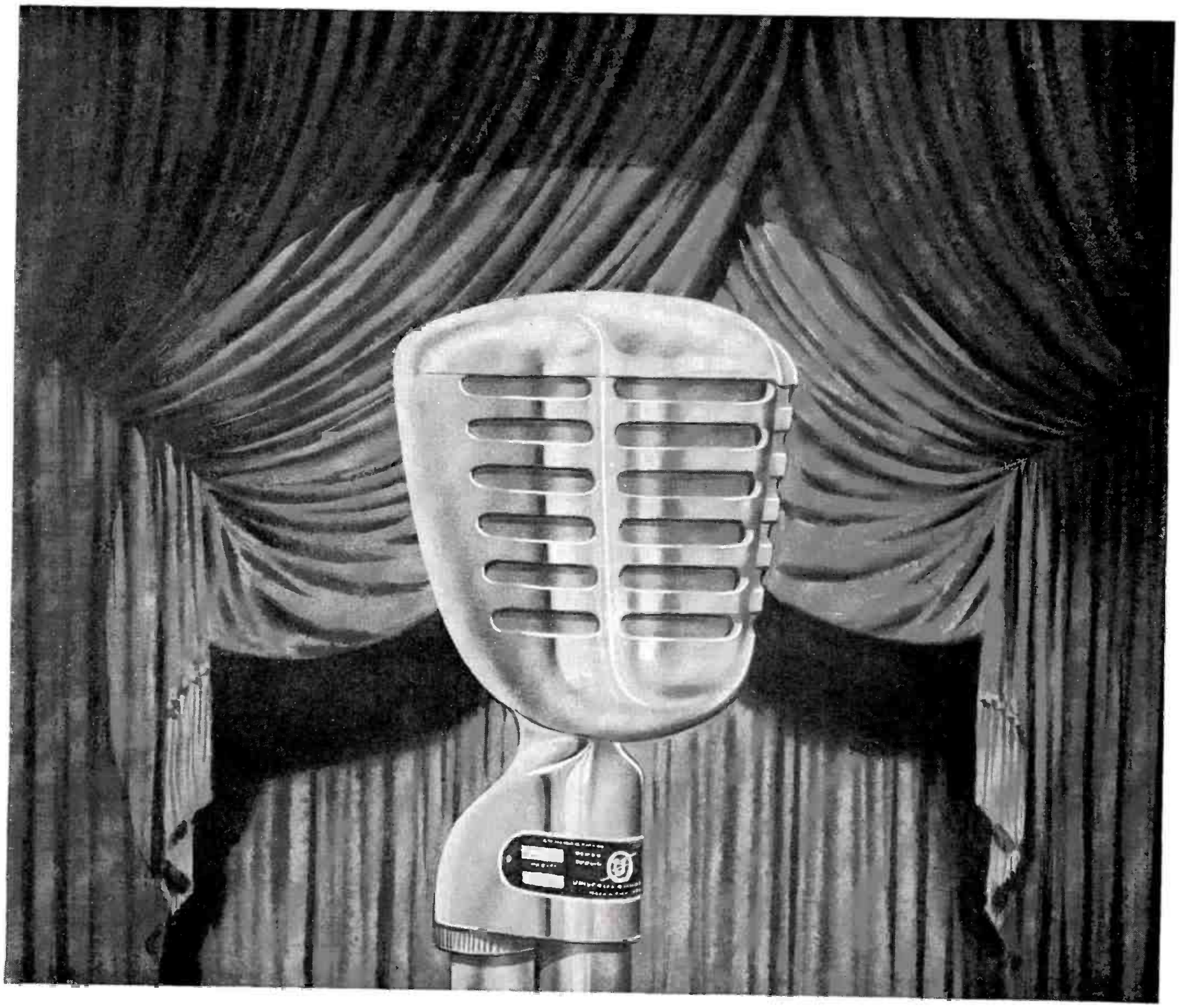

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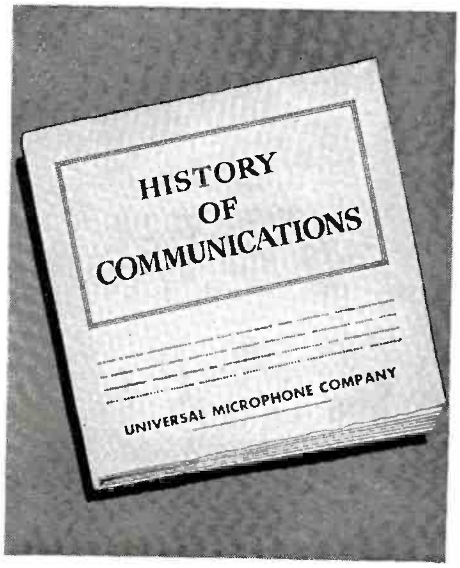

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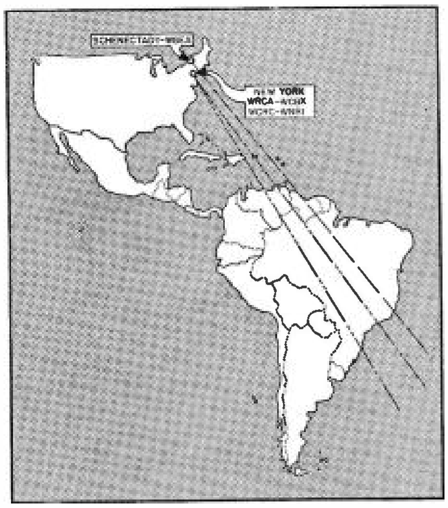
Inter-American Radio
(Continued from page 27)

sisted the United States in its war job of disseminating information, as other foreign countries are doing, but transcriptions also are a means of supplying fine radio programs indicative of the aims and culture of the United States to small local radio stations lacking trained talent.

Short-wave, commercial services and transcriptions could not effectively do the entire work necessary from a war standpoint, as certain programs could not be effectively produced in the United States. Therefore,



U.S.A. Short-wave stations programming in Portuguese to Brazil.

it was necessary to produce radio programs locally in some of the other American nations. As skilled radio talent, producers, and technicians were available in only the largest countries, the Office of Inter-American Affairs sent trained radio representatives to all of the major capitals to work with local radio stations and assist in the training of personnel, both talent and technical, and in producing pro-United States programs of a desirable nature. News and commentary programs were initiated by these representatives, as well as cultural, educational, health, and other types of programs favorable to the aims and work of the United States.

For example, teaching of the English language by radio was carried out in half of the American Republics, with outstanding success. In one country radio English lessons were produced in cooperation with the local government. A United States advertiser, aware of the effectiveness of this program, broadcast radio English lessons in 16 countries. Numerous local radio productions begun by the Office of Inter-American Affairs have become outstanding favorites with local radio audiences and more than 17 programs originated by the Office of Inter-American Affairs have been taken over by United States advertisers.

From a technical, engineering, and program-production standpoint, the Office of Inter-American Affairs has acquainted the peoples of the other Americas with United States radio methods and radio program production standards. A listening audience has been created among the other American peoples that looks with favor on the United States type of radio program.

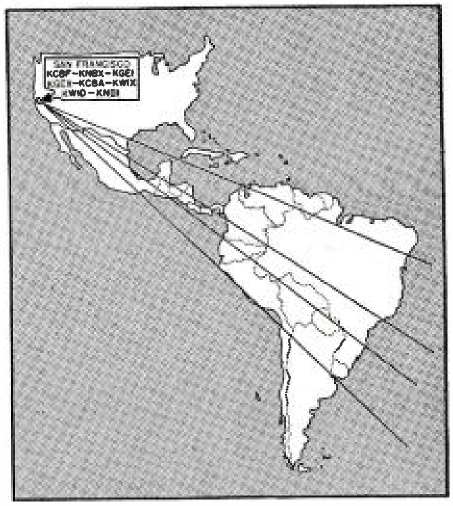
Radio producers, actors, and technicians brought to the United States from the other Americas for a period of work and study in connection with inter-American short-wave radio productions have returned home eager to apply the United States techniques and methods, in which they had been trained.

Care is taken to check thoroughly the results of broadcasts. Panels of radio listeners have been organized in the other American countries to provide periodic reports on the quality of our short-wave programs. In addition, these broadcasts are regularly monitored. New engineering techniques have greatly improved the control of short-wave broadcasting. Signal intensity monitoring stations which have been installed in various key areas in the other American republics have conclusively proved from their tape recordings that we are putting on a strong signal.

The result of all these coordinated operations of the Office of Inter-American Affairs is that a new and heightened economic opportunity is shaping up "south of the border" for manufacturers of radio receivers, transmitters, component parts, and other radio equipment. A brisk market is in prospect, when home receiving sets become available, that will be supplied either by our own industry or by radio manufacturers of other countries. It was by no means a small market before the war, but its possibilities have expanded broadly since then.

However, common business sense makes it necessary to concede that a merchandising problem exists for manufacturers of radio equipment in supplying the Latin American demand. On the one hand, there is a ready-made audience and an eager market. There is also a buying public that is already familiar to some extent with U. S. radio equipment, particularly radio tubes, of which the United States has been the only sizable foreign supplier since the war began. But, on the other hand, there is a sharp disparity between the economic levels of most of the other American countries and our own. There is a further divergence of economic levels as between any one of these republics and another. The obvious reason why Latin America has only one receiver to about every 33 persons while we have one to about every 2.5 persons is that fewer Latin Americans have been able to afford radio sets at prewar price levels.

Can our manufacturers meet these conditions? Can they supply that



U.S.A. short-wave stations programming in English to Central and South America.

thirsting market at price levels low enough to reach the largest number of potential buyers?

One answer is that, even before the war, we partially met the demand. We supplied this market by export and by radio equipment production in South America. In 1941 United States exports of radio equipment of all types to the other Americas totaled $12,789,000. By principal classifications these exports were as follows: radio receiving sets, $7,724,000; radio receiving tubes, $1,191,000; component parts, $2,390,000; loud speakers, $214,000; accessories, $243,000; and transmitting tubes and equipment, $1,027,000.

Considering the difference in economic conditions and therefore in the cost of materials and labor between the United States and other competing countries, can we design equipment at price levels that will compete favorably with equipment offered by competing manufacturers? That is a question to be answered by our own radio manufacturing industry only after surveying the possibilities of meeting

U.S.A. short-wave stations programming in Spanish to all Spanish-speaking countries of the other Americas.

Latin American requirements with equipment of sufficient simplicity to hold down production costs. The only alternative perhaps, is the establishment of large-scale and widely distributed radio equipment factories in Latin America.

A notion of the extent of the sales possibilities of household receiving sets can be gained by considering these facts: approximately 60.000,000 radio receivers serve 135,000,000 people in the United States as compared with only 4,200,000 sets serving 130,000,000 population of the other American Republics.

But that tells only part of the story. There are also differences in listening habits, transmission conditions and other factors that modify the picture.

Networks are not so highly developed in the other American republics as in the United States. There are only half a dozen networks that are of major development. The largest of them is the one headed by Station XEW in Mexico, which has a companion-competing network. Both networks are operated by Emilio Azcarraga. Brazil has the Byington and Chateaubriand networks, and Cuba the CMQ and Cadena Azul chains. In Argentina, the three major networks of consequence are those headed, respectively, by Radio Belgrano, Radio El Mundo and Radio Splendid in the capital, Buenos Aires. None of these networks has the number of either wholly-owned or affiliated stations that the leading United States networks comprise.

An important consideration is that a substantial proportion of Latin American transmitters broadcast their programs simultaneously on both long- and short-wave on two or more frequencies. In fact, probably about one-half of the Latin American transmitters are short-wave. This procedure is necessary because of local topographic conditions, which determine whether a broadcast from a given point can be received on long-wave or on short-wave. The use of high frequencies by these transmitters is not intended, as with our own, for international broadcast but is designed for reception within the country.

What we in the United States know as the "broadcast band" is actually only a part of the broadcast band for the home receivers in the other American Republics. In the United States a short-wave band on the receiver dial usually is just an added gadget; in Latin America it is used by fully half of the listeners. This factor has been of great value to the Office of Inter-American Affairs in its direct international short-wave broadcasting. It is of special significance to the plans of the United States radio manufacturing industry in supplying the Latin American market. In Peru, for example, approximately 85 percent of the home receiving sets have short-wave bands.

Another difference in Latin America is the existence of many low-power commercial broadcasting transmitters —some running less than 100 watts— which are what we would term makeshift installations, even if often ingeniously makeshift. In general, standardization is not highly developed as yet. This is true not only of equipment but also of broadcast time advertising rates.

One might question the purpose of licensing some of these installations at all. But the issue loses validity when we consider the natural and sensible desire of the governments of the other American republics to foster the growth of radio even if, at first, it is necessary in some cases to sacrifice quality to quantity to set up broadcasting stations. Already Brazil, Cuba, Mexico, and Argentina have developed extensive plans for international broadcasting. With growth will come improvement in equipment. Later will come gradual tightening of licensing standards.

Sending radio technicians to our neighbors may or may not be continued as a government function after the war. But, if it isn't, it would be shortsighted on the part of United States radio interests—both manufacturing and broadcasting—not to maintain such operation on their own account.

Much has happened during the war in the inter-American radio field. Describing the international short-wave broadcasting situation as it existed in the other American republics during their visit there in 1941, a United

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States Congressional subcommittee reported to Congress as follows:

"In the field of radio it would appear that we have been considerably remiss in keeping up with the pace set by other countries in acquainting citizens of Latin America with our national plans, procedures, purposes, culture, background, and related facts. In a large metropolitan city of one country visited by the committte, the Free French and the Japanese have more time on the air per week than we do. The Germans broadcast on the radio in the same city an average of 2½ hours per day. We broadcast one-half hour per week. . . . The radio is an extremely effective medium for reaching the people and we must avail of it on a much larger scale as an approach to better understanding!"

The tremendous advance in United States radio programming, since this statement was made, is indicated by our current consumption of more than 280 program-hours of inter-American radio time per week.

Looking to the future, it has been recognized by the United States Government that the free exchange of information internationally is one of the essentials to the maintenance of friendship and understanding between the United States and other peace-loving nations. One of the highest officials of the State Department has pointed out that modern communications have added a new and vitally important factor to international relations that formerly were largely confined to relations between governments through diplomatic representatives.

"Today," he stated, "it would not be too much to say that the foreign relations of a modern state are conducted quite as much through the instruments of public international communication as through diplomatic representatives and missions. . . . If the closer communications with each other of the peoples of the world are to result in mutual understanding, they must provide the full exchange of information and knowledge upon which understanding rests.

"The necessity of seeing that the full exchange is made—that the whole story of a people's character, its arts, its sciences, its national characteristics, is truly told—is a necessity which no modern government can, or would wish to, evade. This does not mean that the job is a job government should attempt to do itself. Clearly, no government can accomplish that tremendous labor, and no democratic government should try to undertake it. All the various instruments of communication—press, radio, motion picture, book publishing, works of art—must and will play their part. . . . Government's responsibility is not to do the job itself—not to supplant the existing instruments of international communication. Government's responsibility is to see to it that the job gets done and to help in every way it can to do it."

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TECHNICAL BOOK & BULLETIN REVIEW

"SOUL OF AMBER," by Alfred M. Still. Published by *Murray Hill Books, Inc.,* New York. 261 pages. Price $2.50.

This book is essentially a history of the electrical science as we know it today, but unlike most histories, the story is told in an interesting, human fashion. The work of such men as Faraday, Volta, Ohm, Oersted, and others becomes more intelligible when that work is evaluated against the background of their lives and times.

Of particular interest are the writings of the early Greek philosophers who attempted to explain the attraction of amber for other objects. As early as the times of Thales (c. 640-548 B.C.) speculation was rife as to the cause of this attraction. Since most unexplainable phenomena were attributed to the supernatural, amber was thought to possess a "soul" which attracted chaff and other material to it.

The book will provide many hours of interesting and informative reading for those who like to know something of the background of their chosen profession.

"WAR-TIME RADIO SERVICE," by Charles and H. A. Middleton. Fifth Edition. Published by *City Radio Company,* Phoenix, Arizona. 75 pages. Price $3.00.

In the fifth edition of this book for radio servicemen, the authors have stressed tube substitution, conversion of battery-operated sets to a.c., repair of burned-out tubes, and methods for making adapters.

The tube substitution chart is complete for all types of receiving tubes. This material is printed in tabulated form with the tube, substitute, and circuit changes given for each type. Where rewiring is necessary, complete information is given as to the proper procedure to follow. Over 55 pages of the book are devoted to this data.

The authors have pointed out that the conversion of farm radios to a.c. operation is a profitable addition to the serviceman's business and then proceed to give instructions and diagrams as to how this conversion may be accomplished.

The repairing of filaments of 150-mil tubes is explained and instructions for the construction of the necessary equipment to perform this operation are given.

The information included in this book has been verified by the authors in their own radio shop. Other practical servicing hints are given which should prove of value to the serviceman.

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Sweep Generators

(*Continued from page* 54)

the condenser charging and current will flow onto its plates until the voltage on the condenser becomes fully 100 volts, if switch 2 remains open. The change from zero to 100 volts takes the form of the dotted line. The product of R times C is the time constant of the circuit, in this case 100,000 ohms times 1 µfd. equals 100,000 microseconds. The full voltage rise to the applied voltage takes place in five time constants, or 500,000 microseconds; but of this rise only during the first three-tenths of the first time constant, or the first 30,000 microseconds, is the rise linear. If switch 2 is closed after only 100,000 microseconds, the condenser will discharge through the small resistance, falling to zero in five time constants (now only 5 times 100 microseconds). Repetition of this switching will repeat the charge and discharge for a condenser waveform of the nature required.

An electronic switch must obviously be provided in place of switch number 2. Linear voltage sweep circuits in general provide various methods of discharging the condenser in the circuit after it has been charged, and the tubes doing the job of switch 2 are called discharge tubes.

The circuit of Fig. 3B shows the simplest of these. A neon bulb, a diode filled with neon gas at low pressure in which neither electrode is heated, is an open switch as long as the potential between the two electrodes does not reach the critical firing voltage, in this case 65 volts. This critical potential depends on the gas pressure, proximity of electrodes, electrode material, and surface condition. When the condenser voltage reaches this potential the gas becomes ionized.

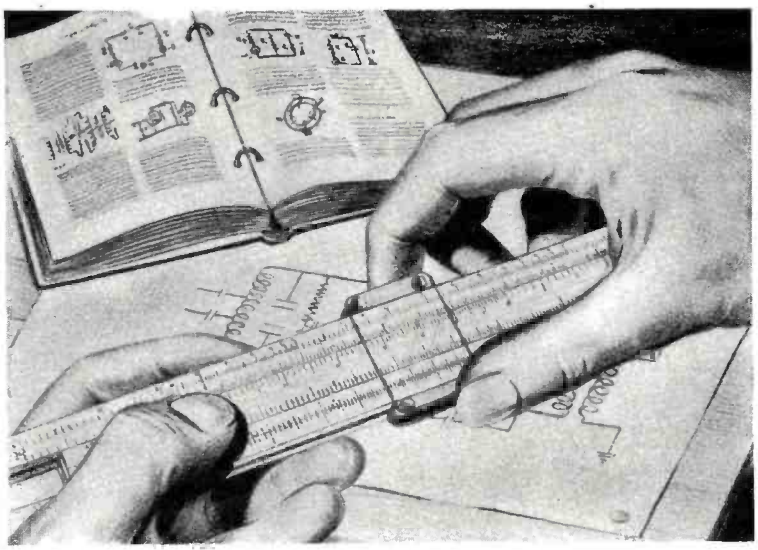
The ionization is sudden by cumulative electron dislodgment from the orbits of the molecules, and the tube becomes heavily conducting, acting as a low-resistance closed switch. The condenser discharges rapidly through the tube until the voltage across it reaches the deionization or extinction voltage, here 20 volts. Thereupon the tube again becomes an open switch for another charging cycle. These recur at a frequency of sixty cycles per second, for the values given, the sweep portion being almost 16,000 microseconds for the forty-five-volt rise.

Unfortunately, a time constant of 10,000 microseconds is used in charging to make the circuit operate. This allows the condenser to rise about seventy percent of the total possible change from 20 to 85 volts. The sweep is nonlinear and if it were used it would move the trace with nonuniform speed, slowing down at the end. It would therefore cause the observed voltage, on the oscillograph or in a television receiver, to be bunched up at the right of the screen. The defect could be remedied if the firing potential could be lowered, allowing the time constant to be increased to maintain the same frequency.

But there is no way to control the firing point of this tube. As a matter of fact, the firing point is extremely unstable, varying from tube to tube and changing with tube age and room temperature. The alternative is to use a gas discharge tube whose firing point may be fixed stably. Such are the triode gas tubes, types 884, 885, DuMont 6Q5GT and 2B4. Their advantages are larger instantaneous discharge current, faster recombination of ions and electrons during the fly-back, and a firing potential dependent on the bias controllable by the operator. The thyratron was the first of these used, in 1929, and contained a small amount of mercury to be vaporized when heated. Later types used inert gases such as neon or argon.

In the circuit of Fig. 6, the condenser C charges through the large resistance R, taking 16,000 microseconds to rise from 12 volts (extinction) to 28 volts (firing). This is a rise using only sixteen percent of the entire possible rise toward B plus, and consumes only sixteen percent of the first time constant. Here the desired linearity is achieved. The bias is set at 2 volts, sufficiently low to obtain the low firing potential. As the condenser charges, the plate voltage rises until

Here's how you can figure . . .



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the potential gradient within the tube is sufficient for violent ionization. When this point is reached the condenser discharges for the fly-back. During this fly-back time the grid is ineffective in controlling the current flow because the positive ions, formed by electron bombardment of gas molecules, are attracted to the negative grid and sheath it for the duration of conduction. Hence, adjustments of grid bias may be used to control the firing point, but it will not affect the extinction potential. The small triode plate resistor serves to limit the current flow during discharge to a safe value, for the tube may be damaged by current exceeding .5 amp.

The circuit is essentially a relaxation oscillator, and can operate over a range of frequencies from two cycles per second up to fifty kilocycles per second, which seems to be its frequency limit. The frequency is approximated by the formula:

$$F = \frac{E \text{ applied}}{RC(E_f - E_x)} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where E_f is the firing potential and E_x the extinction potential.

By virtue of its versatility of frequency and consistent linearity, this circuit is widely used in oscillograph equipment. The applied voltage is set high enough to be well above the firing potential used; the bias is fixed sufficiently low so that only about fifteen percent of the entire charging curve is utilized for sweep voltage, guaranteeing linearity. The sweep frequency is then changed by varying the RC combination of the charging path. Changing these will not affect the established linearity except on very low frequency when condenser leakage enters from the use of large capacitance. However, this can be compensated for. The same percentage of the charging curve will be used as sweep voltage as the RC components are changed once the firing point is fixed by the bias. A bank of condensers provides the coarse frequency control, the higher frequencies achieved by the smaller capacitances. A rheostat provides the fine frequency control, smaller resistance raising the frequency. In some oscillographs the bias is applied as positive on the cathode from the supply source, the cathode circuit filtered with a large condenser to maintain steady bias as the tube's conduction current flows into the cathode. Stability of frequency and linearity are obtained even though the supply voltage may vary, for a fall of B plus supply tends to lower the oscillation frequency and spoil the linearity, but a simultaneous fall of bias lowers the firing point, raising the frequency and increasing the linearity.

Since an integral ratio between sweep frequency and observed signal frequency is required for the observation of a whole pattern on the screen, a small portion of the signal voltage is applied to the gas triode's grid for synchronization. If the two frequencies are almost related by an integral number, the pattern's tendency to drift across the screen will be avoided by the locking process. A slight portion of positive signal swing applied to the gas triode's grid lowers the firing point of the tube as it is almost ready to fire, near the end of the sweep. The synchronizing signal initiates the conduction; the firing frequency is forced to assume the frequency that is perfect for a stationary pattern on the screen. All this is achieved by imposing a very slight loading on the signal source.

The output amplitude of this sweep voltage is insufficient to produce a sizeable sweep in a cathode-ray tube of the usual sensitivity, and must be amplified. To preserve the same sawtooth waveform without inversion, two amplifiers are needed. The amplifier circuits must be designed to pass the wave shape without harmonic distortion. For this purpose wide band-pass amplifiers are used, sacrificing gain to provide uniform gain and phase response for the harmonics involved in the waveform. Analysis of the sawtooth wave shape by Fourier analysis shows that the amplitudes of the harmonics decrease as the square of their order as long as the fly-back is not instantaneous. Usually frequency compensation circuits are designed to include the fifteenth harmonic for distortionless amplification. For a sixty-cycle sweep this means uniform gain and phase response up to 900 cycles per second.

The linearity of the sweep obtained from the circuit of Fig. 6 is good, but not perfect. Mathematically a rise during sixteen percent of the first time constant involves a voltage rise of fifteen percent, good enough for most applications. If perfect linearity, along with greater amplitude is desired, the component R can be replaced by a constant-current pentode operating above the knee of its E_p-I_p curve.

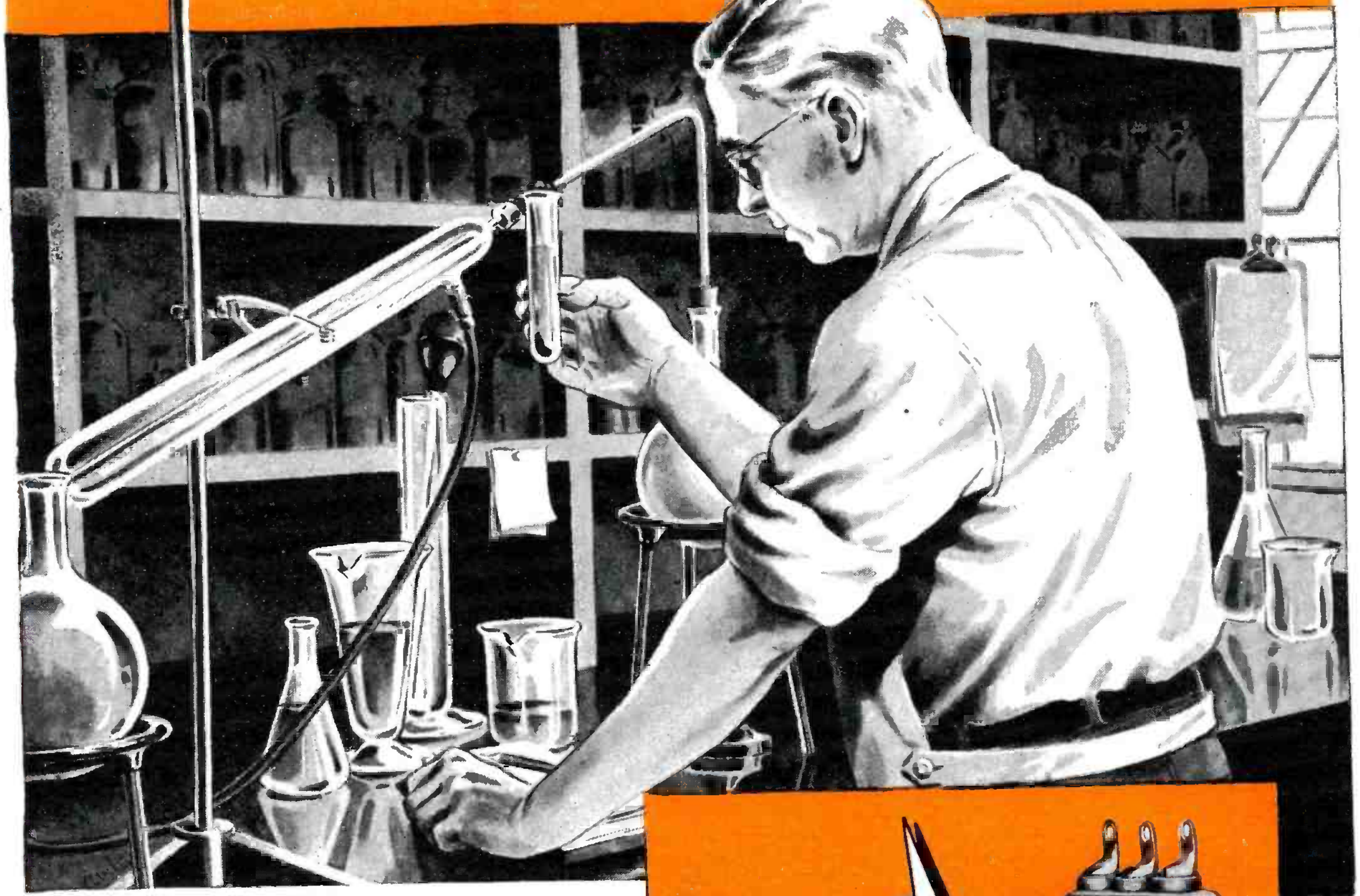
Bias and plate voltage are set on the pentode so that over the required range of plate voltage the current flowing into the condenser is constant. The constant accumulation of charge makes the condenser voltage rise linearly with mathematical accuracy, and the range of pentode linear characteristic is enough to obtain a linear sweep of greater amplitude, allowing greater efficiency. The gas triode bias may now be set at a higher value to allow the larger voltage rise on the condenser.

Vacuum-Tube Sweep Circuits

For television sweeps the gas triode discharge oscillator is not considered stable enough. Its firing point will change with temperature and tube age, and the time required for recombination of ions and electrons, also subject to variation, is too long to allow a short fly-back period. A vacuum-tube sweep circuit is therefore greatly favored in spite of the greater circuit complexity. Such a circuit typ-

chemical analysis

means better materials and manufacturing processes



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WET AND DRY ELECTROLYTICS MICA · DYKANOL · PAPER ·

ically consists of a tube, usually triode, which is cut off for a relatively long time, allowing a condenser connected between plate and cathode to rise toward the supply voltage. Before the rise can become nonlinear a positive impulse of short duration is applied to the grid to cause heavy conduction of the tube and discharge of the condenser. The forward sweep portion is obtained by charging the condenser through a large plate resistor, the fly-back obtained by discharging the condenser through the low-resistance tube.

Here the sweep frequency is controlled by an impulse generating oscillator, usually stable, and the fly-back time is controlled by the duration of the discharge impulse, usually short. The only disadvantage of such a circuit is that it does not have the versatility of frequency change that the gas triode circuit enjoys. The sweep, once adjusted for linearity at a high frequency, would become nonlinear if the impulse frequency were lowered to such extent that the condenser would have time between impulses to charge appreciably toward B plus while the tube is cut off.

If linearity is set for low frequencies, the high-frequency sweeps would suffer from loss of amplitude for the condenser voltage change would be negligible. Fortunately, television sweeps are not subject to frequency change, but instead are fixed at usually sixty cycles per second for the Vertical sweep and 15,750 cycles per second for the Horizontal sweep. Should an application other than television require sweep-frequency changes, a different output time constant would be needed for each frequency setting to preserve the same amplitude and linearity of condenser voltage sweep.

The following circuits use triode vacuum tubes as oscillators and discharge tubes. The types used in the circuits described are all 6J5's, or halves of the twin triode 6SN7. Other triodes possible are the 6C5, halves of the 6N7 or 6F8, or any ordinary triode amplifier tube.

The circuit of Fig. 7 is a sweep oscillator, components chosen for a sixty-cycle sweep. V_2 is the discharge tube, being cut off except for short conduction periods. The circuit is the conventional plate-coupled multivibrator, enjoying positive feedback from each plate to the other grid. Action of the circuit cuts each tube off in alternation, for the slightest tendency for conduction of one tube is cumulative by feedback.

Consider V_1 starting to conduct. Its plate voltage falls, C_2 discharges through R_2 to put a negative signal on V_2. V_2 conducts less, its plate voltage rises, C_1 charges through R_1, putting a positive signal on V_1. The now heavy conduction of V_1 makes its plate voltage fall to a low value, discharging the coupling condenser C_2, applying negative voltage to the other grid sufficient to hold V_2 cut off for the duration of the discharge of condenser

C_2. When the coupling discharge is completed the initial conduction of V_2 cuts V_1 off by similar cumulative feedback action.

The cutoff period for each tube is given by the formulas:

$$T_1 = C_1R_1 \log_e \frac{E_{L2}}{E_{CO1}} \quad \text{.......... (2)}$$

$$T_2 = C_2R_2 \log_e \frac{E_{L1}}{E_{CO2}} \quad \text{.......... (3)}$$

where the subscripts 1 and 2 refer to the tubes V_1 and V_2 respectively, where E_L is the voltage drop across the plate load resistor during heavy conduction, and E_{co} refers to the cutoff value of each tube. In the circuit of Fig. 7 the time constant C_2R_2 is much greater than the time constant C_1R_1; hence, V_2 is cut off for a greater length of time (T_2 in the formula). The conduction period of each tube is controlled by the cutoff time of the other tube. Since T_2 is greater than T_1, V_2 is cut off for a long time and conducts heavily for a short time only. The condenser C_3 can discharge to a very low value when V_2 conducts. When V_2 gets cut off the voltage across C_3 rises, aiming at 100 volts, which it would reach in five time constants (5 x 100,000 microseconds). Since the frequency is set at sixty cycles per second the cutoff time of V_2 is approximately 16,000 microseconds, sixteen percent of the first time constant. The condenser voltage rise of fifteen volts is therefore quite linear. The short conduction time of V_2 allows a rapid fly back. The grid wave of V_2 is shown in the figure to indicate short conduction time and long cutoff time.

The requirements of a long sweep and short fly-back time necessitate a circuit unbalance which causes a tendency toward instability. Specifically, the shorter time constant affects the gain of the tube V_2. To obtain an even shorter fly-back without affecting the oscillator, the circuit of Fig. 4 serves. The multivibrator output from either plate (C_3 removed in Fig. 7) is a square or a rectangular waveform applied to a buffer amplifier for isolation, then to a peaking or differentiating circuit. The time constant of this circuit (R_1C_1 in Fig. 4) is so short that the coupling condenser C_1 reaches the applied voltage of the square wave well within the time of each alternation.

The resistor voltage is peaked because of the cessation of current flow through it once the condenser has reached a stable potential. This peaked wave can be made as narrow as desired by shortening the time constant, preferably with a smaller coupling capacitance. It is then applied to a succeeding triode biased well beyond cutoff. Merely the upper tip of the input wave, the portion above cutoff, causes conduction of the tube. The output sawtooth is developed in the fashion described previously; long, slow charging, and sudden discharge.

The frequency of this sweep is still governed by the multivibrator frequency. Under the conditions of grounded cathodes, equal plate loads and similar tubes, this frequency will be given by the formula:

$$F = \frac{1}{(C_1R_1 + C_2R_2)\log_e \frac{E_L}{E_{CO}}} \quad \text{.......... (4)}$$

where E_L is the load voltage during conduction and E_{co} is the cutoff value of the tubes. Higher frequencies are obtained by using smaller values of coupling components. Often the circuit is provided with a degenerative cathode resistor to decrease the amount of feedback. This serves to raise the frequency because the smaller load voltage (E_L in the formula) holds the alternate tube cut off for a shorter time. At the higher sweep frequencies the output time constant should not be so large. For example, at a multivibrator frequency of 13,230 cycles per second, between discharge impulses there are seventy-five microseconds. A sweep time constant of five hundred microseconds is sufficient for a linear sweep.

The multivibrator circuit can easily be synchronized by applying a positive timing pulse to either grid. Effective when the grid is just below the cutoff point, when the tube is almost ready to start conducting, the timing pulse initiates the conduction. For most effective locking, the free frequency of the oscillator should be set just below the synchronizing frequency, or just below a subharmonic of that frequency. The ratio of the timing frequency to the oscillator frequency is not usually greater than ten to one. The difference between the free oscillator frequency and the locked frequency should be enough to guarantee that the free frequency is always lower, but not so much that the timing pulse is ineffective in initiating conduction.

The square wave applied to the peaking circuit of Fig. 4 may be derived from a source other than a multivibrator. If a sine wave generator is substituted for the multivibrator, and a clipping amplifier substituted for the buffer stage, a sweep will be generated at a frequency fixed by the sine wave generator. The latter can be the power line for sixty cycles, or a resistance-capacitance oscillator for other frequencies.

This type of oscillator is stable at audio frequencies, its output relatively free of harmonic content. Its amplitude must be stepped up sufficiently to overdrive the clipper tube. Usually the sine wave is changed by half-wave rectification to a large negative half-cycle swing driving the clipping tube's grid beyond cutoff, the plate wave then being squared.

The rectification can be accomplished (Fig. 5) simply by using zero bias on the clipper, lowering the input impedance of the tube to a very small value by drawing grid current for the entire positive half cycle. Another method is to rectify with a diode placed in series or in shunt as a half-wave limiter. One half of a 6H6 twin diode serves admirably for this purpose. The

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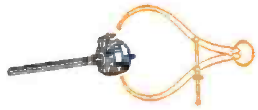

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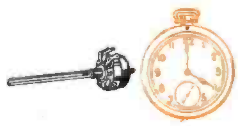

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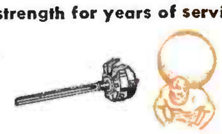

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disadvantage of this sweep generator circuit is the difficulty in synchronizing the sine-wave oscillator, restricting its use to master timing circuits.

A circuit that in recent years has found great favor in television reception is the blocking oscillator, section V_1 of Fig. 13. It has great frequency stability within the range of synchronization, relatively independent of tube age and supply variations. In design it is similar to the r. f. tickler-coil oscillator used in regenerative detectors, different in the values of L and C used for frequency determinants. Feedback of the plate signal is applied through the audio transformer in positive phase to the grid for regeneration, and a continuous sine wave is possible as output if the grid condenser and resistor are small. Every positive grid swing draws grid current for grid leak bias. If this RC time constant is made sufficiently large the bias becomes excessive, blocking the oscillator until the bias leaks off to ground. Especially, if the grid condenser is small enough to permit the grid current to charge it to a value beyond cutoff in one positive swing, and the resistor large enough to maintain this excessive bias for a long time, the grid wave is the same as the wave on the grid of V_2 in the multivibrator of Fig. 7.

This same waveform exists on the grid of the second triode, making it serve as the discharge tube for the sweep condenser C_2. Again in this circuit as V_2 is cut off, the forward sweep is developed by the charging of C_2 through the plate resistor, the flyback developed by rapid discharge through the tube. A low value of series resistance is inserted in the grid winding to be used for synchronizing signal, a positive timing pulse initiating conduction of the oscillator section near the termination of the cutoff time.

The frequency of the blocking oscillator may be raised by using smaller values of R_1 and C_1 in the oscillator grid circuit, providing always that R_1 is large enough to block oscillation after one swing. Typical values for the high-frequency horizontal television sweep are .001 µfd. and 50,000 ohms.

Electromagnetic Deflection

It has become more normal in television to use external coils for electromagnetic deflection of the electron beam. The principal advantage of the system is the different structure of the cathode-ray tube. The tube is simpler, more rugged, less expensive, and shorter in length. Especially if magnetic focus is used can the length be reduced. In addition, magnetic deflection allows a greater angle of deflection without defocusing. Hence, a television receiver tube can be placed horizontally for viewing a large screen without taking excessive space.

A magnetic yoke placed around the neck of the tube carries the focus coil and deflecting coils. Fig. 9A shows the position of the coils for horizontal deflection. The winding is such that a direct current flowing toward the lower part of the diagram sets up a magnetic flux, north to south, passing through the tube vertically downward. The electron beam coming toward the screen has a magnetic field circling it (clockwise facing the screen).

The action of the two fluxes, beam and coil, is to make the beam move to the left of the center, and keep it there for the start of a sweep. To move the beam to the right current must pass through the coils in the opposite direction, toward the upper terminal, and to keep it moving with uniform speed this current must increase linearly until at the end of the sweep the coil flux is vertically upward (north to south poles).

A rapid fall of sweep current will replace the beam at the left for another sweep. The sweep required therefore consists of a linear rise of current and a rapid fall. The current value needed for a given deflection depends directly on the accelerating voltage on the beam and inversely on the length of the deflection coil, the number of coil turns, and the distance from the screen. It is usually of the order of a hundred milliamperes or more.

At this point something must be said of the rise and fall of current in a circuit of inductance and resistance. The first and extremely important fact is that a change from one steady state (as zero current) to another steady state (as maximum current limited only by resistance) takes the form of an exponential curve, the same form as the condenser voltage rise in an RC circuit with constant potential applied. Similarly the fall of current is exponential. In Fig. 9B a small resistor in the circuit is inserted in series to view the current variations in the coil as the switch is closed and opened. Sudden closing of the switch will cause the current to rise from zero, rapidly and linearly at first, then nonlinearly to its final value limited by the ohmic resistance of the circuit. The time required to reach the final steady value is five time constants, where the time constant in seconds equals $\frac{\text{L in henries}}{\text{R in ohms}}$. The current rise is linear only for three tenths of the first time constant. Should the switch be opened suddenly the current would die out rapidly, the L/R time constant involving high resistance being very short.

A linear current sweep by electronic methods therefore includes a slow buildup of current in a low resistance; long L/R time constant circuit and a rapid fall of current in a high resistance; short L/R time constant circuit. In general, this means using a heavily conducting triode which is regularly cut off with a pulse of short duration.

The blocking oscillator circuit of Fig. 11A makes the tube V_3 serve as such a switching device. Again the small resistor in series in the cathode circuit is merely for experimental

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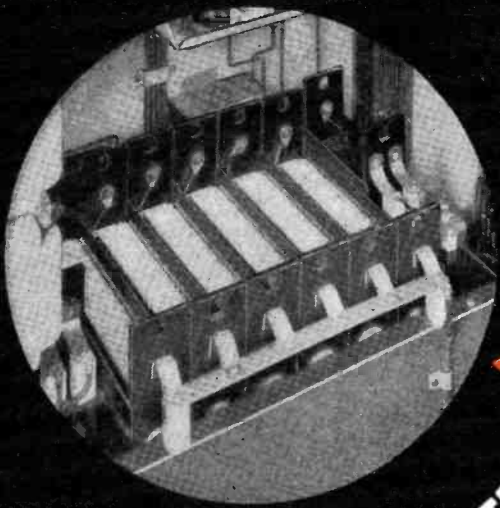

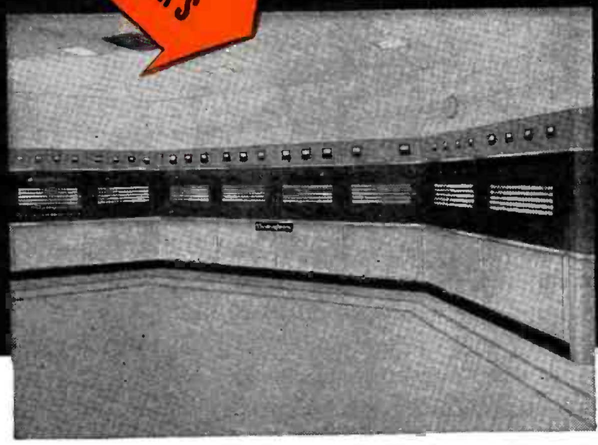

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viewing of the current changes. The grid signal of V_3 is the amplified inversion of the blocking oscillator grid wave, having passed through the amplifier V_2. The plate wave of V_2 is wide at the top while V_2 is cut off, and contains a narrow downward pulse while V_2 conducts.

This waveform, coupled to the grid of V_3, closes a low-resistance path for the linear rise of current for a duration of about 16,000 microseconds. Assuming the tube's resistance during heavy conduction to be 1,000 ohms, the time constant during the rise is (L/R) 100,000 microseconds, long enough to guarantee linearity of current rise. The negative pulse cutting the tube off creates a short time constant to allow a rapid decay of current.

The tube V_3 of Fig. 11A can be triggered by any downward going pulse with the same result. For example, the plate output of V_2 of Fig. 7 (C_3 removed), could be used. Also the plate output of the tube in Fig. 4 (C_2 removed), could be used. Another variation is the placement of the sweep coil in the plate circuit instead of the cathode circuit of V_3 in Fig. 11A, yielding the same current sweep. The circuit of Fig. 11B shows a plate circuit deflection coil with a damping circuit added. The damping is often needed because oscillations may occur during the initial portion of the sweep if the plate circuit has appreciable distributed capacitance.

The diode has a d.c. potential on its plate negative with respect to B plus, and will conduct only when the diode cathode (or triode plate) is very much lower in potential than B plus. This diode conduction therefore occurs only at the very beginning of the sweep rise, damping the oscillations that tend to form at that time. In practice the sweep tube is capable of delivering a heavy current (such as two 6V6's in parallel).

In some television equipment the current sweep of the plate coil is applied to a step-down transformer and then to the deflecting coil. The transformer proves an impedance match for greater transfer of power if a low-impedance deflecting coil is used. Another variation is the use of an air-gap iron-core choke in series with the sweep coil to improve linearity by decreasing the inductance and the time constant as the rising current tends to level off.

Blanking Circuits

In both voltage and current sweep generators the fly-back time must be short if a periodic sweep is used. Television horizontal fly-backs must not exceed one seventh to one tenth of the sweep time, and vertical fly-backs must not exceed one tenth to one fifteenth of the sweep time. Short as it is, the fly-back would cause distortion of picture reproduction, especially if the intensity of the beam is turned high enough to see the fly-back. The solution is to blank out the cathode beam during the entire fly-back time.

A negative pulse of fly-back duration applied to the grid, or a positive pulse of that duration applied to the cathode of the cathode-ray tube will cut the beam off.

The blanking pulse may be obtained in vacuum-tube sweep circuits by a parallel branch from the sweep impulse on the discharge tube. For example, the oscillator grid wave of Fig. 13 can be applied to still another triode grid, and the resulting plate pulse (downward) can be coupled by RC components to the grid of the beam tube for blanking.

Another method, especially used in voltage sweep circuits, is to apply a branch of the sweep voltage to an RC circuit of very short time constant. This is the differentiating circuit that will change a sawtooth wave to a rectangular wave (Fig. 2).

The negative pulse, of fly-back duration, can be amplified and inverted to be applied to the cathode of the beam tube for blanking. A third method, limited to the gas triode circuit of Fig. 6, is to use the grid voltage variation for blanking. During the sweep time the grid voltage is steadily negative. The firing of the tube during the fly-back brings the grid voltage up to zero potential as the positive ions cancel the bias. When the fly-back ends the bias is restored, ending the blanking pulse.

Incidentally, the blanking interval in the television transmitter is not wasted. During this short time, when no video signal is developed, a pulse of short duration is produced, repeated for every blanking interval. These pulses, together with the video signal, modulate the carrier wave. At the receiver the pulses are separated from the picture intelligence and used to synchronize the received time base oscillators to keep the beam in the picture tube in step with the beam in the camera tube.

Single-Sweep Circuits

For some specialized oscillograph applications voltage variations must be observed which are not periodic, but transient. For these applications the instant of transient occurrence must coincide with the beginning of the sweep, the sweep must last for the duration of the transient, and should not recur unless initiated by another transient. It is also possible for the same phenomenon that initiates the transient to trigger the single sweep. Since the picture on the screen is not continuous, a photographic recording must be made of the single sweep.

Fig. 8 is a gas triode circuit used for single sweep. The diode cathode is set at a potential just below the firing point of the gas triode, so that diode conduction prevents the triode plate from reaching the firing potential. A positive pulse on the grid lowers the firing point, the triode conduction discharges the condenser, which then charges as high as the diode will let it. The disadvantage of this circuit is that the trigger initiates the fly-back, rather than the sweep, possibly losing

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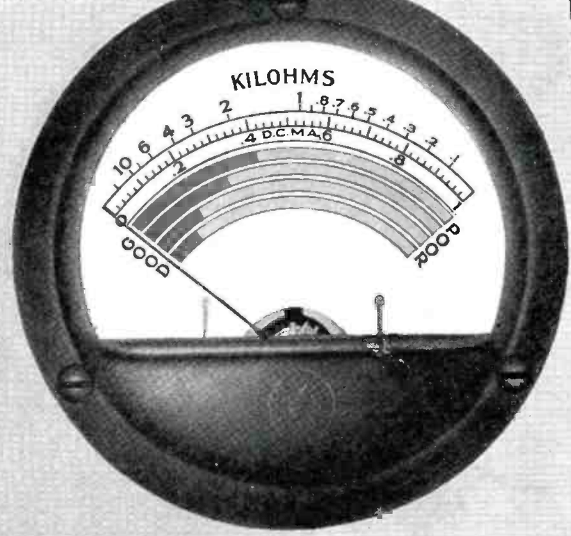

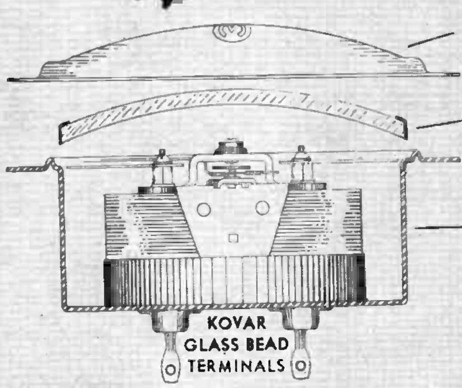

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vital information at the first instant.

An ideal single sweep circuit will start a condenser voltage rise at the instance of the transient and maintain linearity for the duration of the transient. For this purpose the multivibrator circuit of Fig. 7 can be adapted. Positive bleeder bias applied to the cathode of V_2 will withhold oscillation if V_2 is held cutoff while V_1 conducts.

A negative pulse applied to the grid of V_1, amplified by that tube, will start conduction in V_2. The falling plate voltage of V_2 will then cut V_1 off, holding it cut off by the time constant R_1C_1. A sweep condenser between plate and cathode of V_1 will then rise linearly in voltage until V_1 starts conducting again. Then the circuit settles back to the original stable condition. A circuit thus changing from stable to unstable to stable condition is termed a "flip-flop."

Another single sweep flip-flop circuit is shown in Fig. 12. Tube V_2 has zero bias, its conduction through R_k cuts V_1 off. This is the stable condition. Flipping is achieved with a positive pulse of short duration on the grid of V_1 sufficient to initiate its conduction. The drop in plate voltage of V_1 puts a negative signal on V_2, decreasing the bias developed across R_k and allowing heavy conduction in V_1. The plate voltage of V_1 now falls to a low level, cutting V_2 off and holding it cut off for a time directly related to the time constant RC. The 1-μfd. output condenser generates a linear sweep while V_2 is cut off; the flopping back to the stable condition when V_2 again conducts terminates the sweep rise. Another sweep does not occur unless the circuit is again triggered.

—30—

Antenna Meter
(*Continued from page* 43)

R is first shorted out with a heavy shunt and the meter readings compared. If the remote meter reads too high the shunt is removed and the resistance of R adjusted until the meters read the same. The adjustment is made by cut and try, clipping off a small length of the resistance wire at a time until the readings are the same. Very little resistance is needed if the resistance of the connections in the system is high. The connections in the filter and line circuits should be heavy and soldered.

The resistance of the antenna line and the tuned circuits was calculated and found to be approximately .476 ohms. The antenna line, which consisted of two No. 12 wires, each 100 feet in length, came to approximately .324 ohms. The coil L_1 consisted of 47¼ turns of No. 16 wire and had a resistance of .076 ohms. The extra resistance needed to make the remote meter read correctly was taken up in R, shown in Fig. 1.

It is not necessary to use two Triplett meters; one is all that is neces-

sary. The direct-reading meter can be of any make satisfactory to the FCC with or without the external thermocouple. This system has been in use at WISE for over two years and has required no adjustment. In fact, there are no adjustments to be made after the remote meter is installed and calibrated. Occasional cleaning of the relay contacts is all that is necessary to keep the system in good condition.

Other ranges of Triplett meters have not been examined but they are probably of similar construction. The calibrating resistor in other ranges could be measured to see if they could be used in this circuit. If the resistor is about one ohm the system will work.

—30—

Classroom Chores

(Continued from page 57)

dily nearby on the floor, on the starboard side of the ship, so the student operator may simply make a quarter turn in his seat and reach the dials for tuning.

This set works on a fixed wire antenna, but a second installation of liaison units, similarly mounted farther to the rear, functions through a motor-operated trailing wire antenna.

At the very back of the ship, in the center and facing directly forward, there is a seat occupied by the instructor during takeoff and landing.

The two students at the liaison sets, the two at the radio compass, the instructor, the pilot, and the co-pilot are linked by an interphone communications system, and have their own interphone controls and hand mikes.

To enable the instructor to listen in at all times, two mikes and control boxes are available to him. One pair is beside his rear seat, the other mounted overhead amidships for use as he moves from set to set.

The pilot, in full command of the ship, need not depend upon fledgling radio operators in an emergency, regardless of their ability, and he has his own radio equipment. This consists of an SCR-274-N, low-powered command set, supplemented by a remote control permitting use of the radio compass for "homing" whenever necessary.

Student training flights are not sightseeing picnics. The novice operators have far more to do than they will on actual combat missions, when radio silence is observed most of the time.

Activities on the flights, supervised by the Air Communications Branch of the school's Operational Training Division, comprise an intensive review, of the "produce or else" variety, of everything taught in the initial 19 weeks of the course.

Just as in the overseas theaters of war, the student operators are issued parachutes and then thoroughly briefed on what will be expected of them in the air.

Many of the instructors doing the briefing, like T/Sgt. Sebastian L. Vogel, of Fargo, N. D., who also served as mentor on the initial flight, have had considerable combat experience as aerial radio operators. It was Sgt. Vogel's doubtful privilege once to hang by one foot from the bomb bay door of a Flying Fortress, 27,000 feet above France.

The student operators work in nets on five assigned frequencies, handling procedure messages, coded "tactical" messages, communications about the weather in ALACO (Aircraft Landing Code), and the like. They carefully log all transmissions.

Three direction-finding stations in a big triangle on the field, coordinated through a control station in the school, permit the men aloft to obtain bearings and "fixes" from the ground.

Students operating the radio compasses in the planes have maps of the terrain covered during the flights, and steadily plot the course by tuning in various stations along the way.

Problems in triangulation are worked out with grease pencils on sheets of plexiglass covering the maps.

Students get practice on all three of the auxiliary sets on each flight, and, flying conditions permitting, go aloft a minimum of three times during their final week in the school prior to graduation.

Four flights a day are scheduled, each lasting two hours and covering approximately 360 miles, and five triangular courses have been established for the purpose.

For the first three months after the school opened in July, 1942, greater emphasis was placed on theory than on practice in the Sioux Falls institution. Then the emphasis was reversed.

Written examinations were abandoned, classrooms were converted into laboratories, and students were called upon continually to work with actual equipment.

Mock-ups of radio compartments were built in the school, to give students a taste of the real thing, and a network of model radio towers was constructed out-of-doors.

A model overseas air base was set up in a far corner of the field, where students live for a period, servicing and operating radio equipment in a number of grounded bombers and fighters. Conditions of warfare are simulated with the use of slit trenches, fox holes, mock air raids, and actual tear-gas attacks.

The flight training program in light planes was next, and proved a huge success. When the AT-18's replaced the smaller ships, the liaison pilots had compiled a record of 29,000 hours in the air, with more than 60,000 take-offs and landings, without a single serious mishap.

If any new ways develop to help radio students "learn by doing," the Sioux Falls school will be the first to adopt them. Col. Oscar L. Rogers, Commanding Officer, and Major David D. Suter, Director of Technical Training, will see to that.

—30—

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And that's typical of *all* Federal broadcast equipment. From lead-in cable to complete station, it has earned a reputation for *performance* because it's *built to stay on the air*.

Amplitude Modulation, Frequency Modulation, and Television . . . for quality, efficiency, dependability . . . look to Federal for the finest in broadcast equipment.

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Federal Telephone and Radio Corporation

AN IT&T ASSOCIATE, Newark 1, N. J.

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.

In view of the present paper shortage, a limited number of copies of the booklets described herein are printed. Manufacturers will endeavor to comply with all requests; however, if your copy is not received after proper request has been made, it most likely will indicate that the supply is exhausted.

CAMLOC SERVICE MANUAL

The manufacturers of *Camloc* Fasteners have published a unique service manual covering their line.

Various service operations are described and illustrated by means of a series of cartoons by Crawford Young. Exact procedures for replacing any type of fastener which has been damaged in service with *Camloc*, are described. Structure parts lists and tool lists are included for ready reference.

Copies of this manual, No. 44-C, can be obtained by writing *Camloc Fastener Corporation*, 420 Lexington Avenue, New York 17, New York, or 5410 Wilshire Boulevard, Los Angeles 36, California.

ROTARY CONVERTERS

Bulletin 13-25, covering the company's line of rotary converters, is available to purchasing agents and executives from the *Janette Manufacturing Company*.

Standard commercial-type converters and dynamotors are described in this 8-page bulletin, with applications and engineering data included. Electrical and mechanical features of this line of equipment are given for reference purposes.

This equipment is available only on highest priority ratings at the present time, but copies of Bulletin 13-25 will be forwarded upon request to *Janette Manufacturing Company*, 556 W. Monroe Street, Chicago 6, Illinois.

JENSEN MONOGRAPH

Jensen Radio Manufacturing Company has released the fourth monograph of their series of technical bulletins.

This fourth booklet is entitled "The Effective Reproduction of Speech" and covers the physical characteristics of speech as they effect the design of equipment and components for transmitting and reproducing that speech.

This monograph points out that there are two different types of performance required in the transmission of speech: fidelity or intelligibility with low fidelity. From these two basic types, the booklet proceeds to supply technical data on how each or both of the principles may be achieved.

This series of monographs which is prepared by the technical staff of *Jensen* is available at a cost of \$.25 for each monograph requested. The first three booklets in the series covered "Loud Speaker Frequency Response Measurements," "Impedance Matching and Power Distribution in Loud Speaker Systems," and "Frequency Range and Power Considerations in Music Reproduction." Any or all of the series published thus far may be obtained by addressing requests to the Technical Service Department of the company at 6601 S. Laramie Avenue, Chicago 38, Illinois.

HARVEY-WELLS STORY

In effect this booklet is an introduction to the personnel and products of *Harvey-Wells Electronics, Inc.*, communications manufacturers of Southbridge, Massachusetts.

In this elaborate booklet, a typical product of the company is traced through each step in its production from the engineering, drafting, production line, and packing, until it is shipped. The story is told almost entirely in pictures, with text material kept at a minimum. The final five pages of the book illustrate the company's line of mobile radio telephone equipment, ground station transmitter-receivers, marine equipment, and aircraft receivers and transmitters.

Copies of the booklet will be forwarded upon request as long as the supply lasts. Requests should be sent to *Harvey-Wells Electronics, Inc.*, Southbridge, Mass.

SHALLCROSS EQUIPMENT

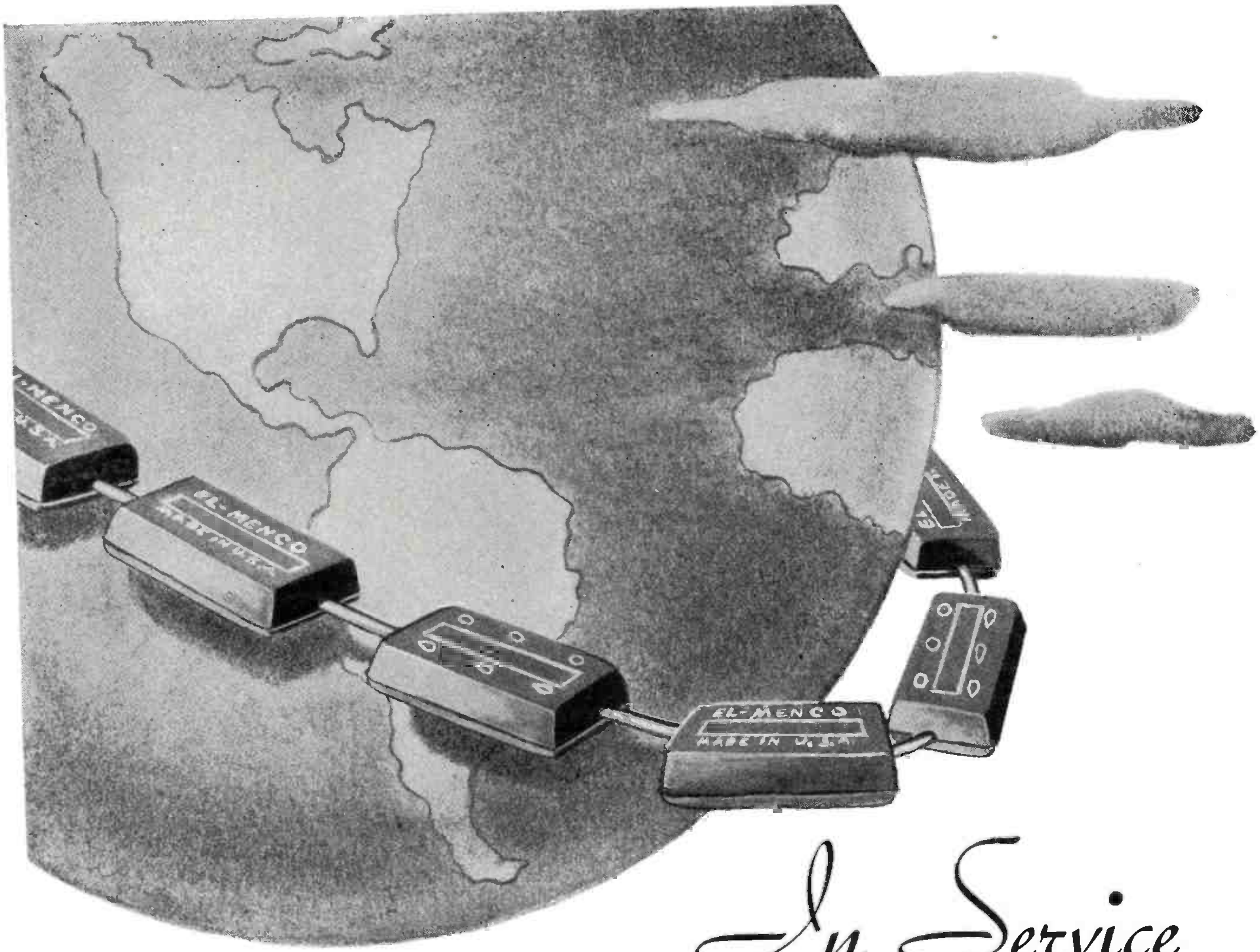
The *Shallcross Manufacturing Company* has issued a new bulletin F covering some of the company's high-voltage test equipment.

Described in this bulletin are the Portable Kilovoltmeter, suitable for use from 1 to 30 kilovolts; the Corona Protected Kilovoltmeter for measurements up to 200 kilovolts; and kilovolt multipliers for use with external meters.

A copy of Bulletin F will be forwarded upon request to *Shallcross Manufacturing Company*, Collingdale, Pennsylvania.

TUBE CATALOGUE

General Electronics, Inc., has announced the distribution of a new catalogue covering their line of transmitting triodes, mercury-vapor rectifiers, high-vacuum rectifiers, grid-



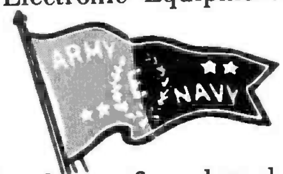
In Service

AROUND THE WORLD

El-Menco Capacitors are serving faithfully at countless vital spots in Army and Navy communications systems wherever they may be.

Because of their recognized high quality we know they will continue to girdle the globe after the war — in products whose manufacturers will demand perfection in *every* detail.

Manufacturers of Electronic Equipment:



Send, on firm letterhead for new Capacitor Catalog

THE ELECTRO MOTIVE MFG. CO.
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El-Menco

MOLDED MICA – MICA TRIMMER

Capacitors

controlled mercury-vapor rectifiers, power amplifiers and voltage regulators.

Tube characteristics and engineering data are included for 26 different tubes of the company's manufacture.

A copy of this catalogue will be forwarded to users of the above types of tubes, upon request. This line of tubes is presently not available for general distribution. Address requests for the catalogue to *General Electronics, Inc.*, 1819 Broadway, New York 23, N. Y.

TEST EQUIPMENT

A new bulletin, entitled "Electrical Test Instruments" is now available from *Industrial Instruments, Inc.*

In this booklet, the company has described their line of direct-indicating comparison bridges, capacity and resistance limit bridges, resistance and capacitance decades, Wheatstone bridges, voltage breakdown testers and test fixtures, Kelvin bridges, megohm bridges and megohm meters, and conductivity apparatus.

Copies of the booklet will be sent upon request to *Industrial Instruments, Inc.*, 17 Pollack Avenue, Jersey City, N. J.

MAGNESIUM CASTINGS

Superior Bearing Bronze Co., Inc., is distributing a four-page data sheet for design engineers covering magnesium castings, their uses, and engineering specifications.

A great deal of valuable design information has been included in this data sheet. All material is presented in a concise, yet fully understandable fashion, a feature which makes this data sheet of value for reference purposes. Physical properties of magnesium, finish metal allowances, section junctions and fillets, flanging, stress concentrations, and inserts of ferrous and nonferrous metals are covered in this data sheet.

Copies of this folder will be forwarded upon request to *Superior Bearing Bronze Co., Inc.*, Magnesium Division, 140 Banker Street, Brooklyn 22, N. Y.

UNIVERSAL LITERATURE

Universal Microphone Company of Inglewood, California, is offering two types of material of interest to radio servicemen.

The first item is their bulletin No. 1458 covering the new D-20 series of dynamic microphones which will be made with a frequency range of 50 to 8000 cycles and in 50, 200, 500, and 40,000 ohms. Priority regulations will govern the sequence of acceptance of orders, and such orders will be filled in order of acceptance.

The second item is of interest to radio countermen. Each month *Universal* will issue a calendar cutout, featuring art work, which will carry an item concerning free offers for various material the company has available.

Requests for either or both of the items may be made direct to the company at Inglewood, California.

PREMAX ANTENNAS

Premax Products has issued a new brochure covering their wartime antennas and outlining antennas and antenna equipment for the peacetime use of amateurs and commercial broadcasters.

This booklet shows the company's antennas installed on various types of military and naval equipment. Typical installations for police, marine, aircraft, and amateur use are given along with some engineering data on their application.

Copies of this booklet are available upon request to *Premax Products Division* of *Chisholm-Ryder Company, Inc.*, Niagara Falls, N. Y.

LEAR BROCHURE

Lear, Inc., has prepared a new 24-page booklet which explains and illustrates their engineering and production facilities by means of photographs and text.

The inside front cover is given over to a brief history of the company and its record of "know how" and then the balance of the book cites examples of "know how" in action. Various types of equipment engineered and built by *Lear* are illustrated, with the problem listed and then the company's answer to that problem told in pictures and engineering data.

Copies of this four-color brochure, entitled "Lear Know How" are available upon request to *Lear, Inc.*, Piqua, Ohio.

SYLVANIA MANUAL

A new 20-page manual has been issued by *Sylvania Electric Products, Inc.*, to assist the radio serviceman in making wartime tube substitutions in many different types of radio receivers.

The manual includes specific information for battery, 150 ma., 300 ma., transformer and auto tube types in addition to other commonly used receiving tubes. This information is tabulated for quick reference.

In addition, thirty-six adaptor circuit diagrams are included for use with the tabulations when changes in tube socket wiring are required.

This manual is distributed free to radio servicemen through *Sylvania* distributors, or may be obtained by writing direct to *Sylvania Electric Products, Inc.*, Emporium, Pa.

ANDREWS BULLETIN

A newly published bulletin covering rhombic antenna coupling transformers and coaxial plugs and jacks is being released by the *Andrew Co.*

Physical and electrical characteristics are included in this bulletin and specific applications are outlined.

Copies of Bulletin 31 will be forwarded upon request to the *Andrew Company*, 363 East 75th Street, Chicago 19, Illinois.

—30—

QTC

(*Continued from page* 55)

Pointing out that the issue involved was the determination of position in the radio spectrum of that best suited as regards the propagation characteristics of the transmission medium the brief stated, "Man, by his ingenuity and inventiveness can design and build new and improved equipment for the transmission and reception of radio waves, but he can do nothing to control the characteristics of the transmission medium which connects the transmitter and the receiver."

THE Army Signal Corps has recently completed the installation of a six-link long-wave radio communication system over the "northern route" to the British Isles.

It is reported that application has already been made with FCC for a "paid broadcast service" in which the service would operate three channels; classical music, lighter music, news announcements, etc., on the third. Last time FCC allocations assignments turned down paid broadcasting.

OWI now has available a half dozen new 50-kw. broadcast transmitters for pouring messages and programs into the Far East. These are in addition to a new 100-kw. outfit at Honolulu and a 50-kw. rig in operation on Saipan which is heard regularly in the broadcast band all over Japland.

T. G. SCOTT, Paul Brown, George Hicks, P. A. Montgomery, and W. E. Alexander were all recently on vacation down in the Gulf. Shipping out of the Gulf has been gradually increasing. Shipping out of New York has been brisk, since shortly after the first of the year. There have been men returning from vacations to take care of the ships, but it is reported that beach lists are rapidly getting well shortened up.

U. S. Maritime Commission has contracts with the various shipyards for a total of 226 new vessels to meet urgent military needs. The vessels will be of the Liberty, Victory, and regular tanker designs. WSA has also approved the transfer of two more Liberties to the Belgians and three to the Greek government.

RECENT information made public in New York indicates that before long the new type portable lifeboat transmitter-receivers may be made available. The new type gear, with hand generators in place of the old battery types, will operate on both 500-kc. and short-wave, together with a receiver. The apparatus will still incorporate the automatic SOS arrangement of the previous battery-operated portables . . . the new gear will be no larger than the old equipment and somewhat lighter in weight

.... 73.

meets special applications

saves time . . . saves tooling . . . speeds delivery!

If your application requires a specially designed relay Guardian engineers can be of great help to you. But, as a result of their wide experience in designing "specials" they have evolved a standard design so flexible that it is now specified in numerous applications that would ordinarily require a specially designed unit. Perhaps you can use it in your "special" application . . . with a saving in money and delivery time. This unusually flexible relay is the SERIES 345. Its chief features are the large coil winding area, numerous contact combinations, the non-binding pin type armature hinge pin, its resistance to shock and vibration, and an ability to operate in extremes of temperature. It is now being used in aircraft, radio, and other exacting applications to insure dependable performance.

STANDARD SERIES 345—The ample coil winding area of the SERIES 345 gives you a wide range of windings for various voltages and currents. Coil winding area is approximately .75 cubic inches. Average power required is 3.56 watts with three pole, double throw contacts of 12½ amp. capacity. Coils are available for either A.C. or D.C. operation.

The maximum switch capacity of the Standard Series 345 is three pole, double throw. Contacts are rated at 12½ amperes at 110 volts, 60 cycles, non-inductive A.C. Moving contacts are attached to but insulated from the armature by a bakelite plate. Terminals are solder lugs. Weight is 6½ ounces.

VARIATIONS OF THE SERIES 345 RELAY

TIME DELAY

WINDING—Multi-wound coils are available for operation on two or more circuits. Or coil may be wound to operate on the discharge of a 3 mfd. condenser.

CONTACTS—Normal switch capacity is three pole, double throw; maximum switch capacity may be up to six pole double throw with 12½ amp. contacts, or any variation of contact combinations within this range, including the operation of contacts in sequence. The flexibility of the contact springs may be increased through the use of coil spring rivets.

TIME DELAY—On D.C. coils a time delay of 0.25 seconds on release or 0.06 second on attract may be achieved through the use of copper slugs which require these time intervals for saturation or de-energizing depending on whether they are used on the heel or head of the coil.

DUST COVER—For applications where this relay may be subject to injury or in atmosphere where dust may be present in sufficient quantity to impede operation, the SERIES 345 may be equipped with a metal dustproof cover.

SCREW TERMINALS—Screw type terminals are optional for applications where terminals must be disconnected occasionally or where solder lug terminals are not otherwise practical.

DUST COVER

INTERLOCKING—Here the series 340 a-c relay is coupled with the d-c coil of a series 405 short telephone type relay in an overload application. Under normal conditions the series 340 contacts are mechanically held in a closed position. Normal current flows through the series 405 coil and then through the series 340 contacts to the circuit for which overload protection is desired. Excessive current, however, energizes the series 405 coil, releasing the locking arrangement and breaking the series 340 contacts. Push button control resets to normal but is ineffective if current is still excessive.

INTERLOCKING UNIT

SERIES 345 RELAY DATA

Normal Volts	Minimum Volts	Normal M.A.	Minimum M.A.	Coil Resist.	Normal Wattage
6	4.8	600	480	10	3.56
12	9.8	300	245	40	3.56
24	18	148	111	162	3.56
32	25.6	112	89	287	3 56
115	92	31	25	3720	3.56

Minimum operating wattage........................2.3

If you will write us about your relay problems our engineers will be glad to make recommendations which may save you time and money. Should you desire a quotation, please mention quantity.

GUARDIAN ELECTRIC
1630-E W. WALNUT STREET CHICAGO 12, ILLINOIS
A COMPLETE LINE OF RELAYS SERVING AMERICAN WAR INDUSTRY

Saga of the Vacuum Tube

(*Continued from page 64*)

development of vacuum tubes for other applications. In fact, development of the "French" tube by the French Military Telegraphic service early in World War I was one of the outstanding communications achievements of the War.

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CAPTIONS FOR ILLUSTRATIONS

Fig. 185. S. G. Brown's "Type G" Telephone Relay. Photograph courtesy Bell Telephone Laboratories.

Fig. 186. Original Post Office Amplifying Valve (Round's Type). Reproduced from Post Office Electrical Engineers Journal—1919.

Fig. 187. Post Office Repeater using Round's Valve. Reproduced from Paper No. 76 of the Institution of Post Office Electrical Engineers.

Fig. 188. Earliest type of high-vacuum telephone repeater tube used by

British Post Office. Reproduced from Paper No. 76 of the Institution of Post Office Electrical Engineers.

Fig. 189. Original form of "Valve, Amplifying, No. 1," Photograph courtesy R. McV. Weston.

Fig. 190. Later form of "Valve Amplifying, No. 1" Photograph courtesy Bell Telephone Laboratories.

Fig. 191. "Repeater, Telephonic, No. 2" Reproduced from Post Office Electrical Engineers Journal—1919.

Fig. 192. "Valve, Thermionic, No. 25" made by General Electric Co. Ltd. of London. Reproduced from J. A. Fleming's "The Thermionic Valve and its Developments in Radiotelegraphy and Telephony"—2nd edition.

Fig. 193. Two-wire repeater using "V.T. No. 25" Amplifying Valves. Reproduced from Paper No. 99 of the Institution of Post Office Electrical Engineers.

Fig. 194. Standard Telephones and Cables Type 4202F Repeater using 4101D and 4102D tubes. Reproduced from Post Office Electrical Engineers Journal—1926.

Fig. 195. Quarter Ampere Repeater Tubes made by Standard Telephones and Cables, Ltd. from 1932. Reproduced from Electrical Communication—1932.

(To be continued)

Television Antennas

(*Continued from page 42*)

only .1 to .15 wavelength behind the dipole. However, for television this would mean a sharp reduction in antenna resistance and consequent loss of wide-band response. The length of the reflector for various bands is shown in the dimension chart, and is approximately 5% longer than the dipole. Thus, in the above example, our quarter-wave spacing would be three feet seven inches, and the length of the reflector seven feet two inches.

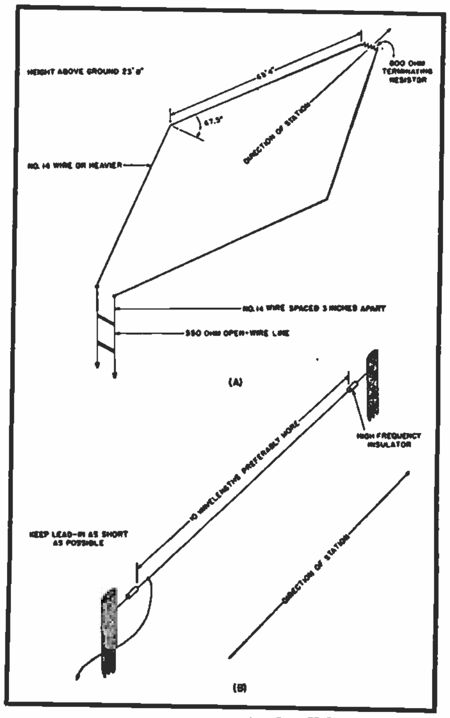
2. *Folded Dipole.*

The folded dipole, Fig. 4A, has a higher surge impedance and a lower rate of reactance increase as the frequency departs from resonance. Surge impedance of the folded dipole, four times larger than the impedance of a single dipole, is approximately 300 ohms and can be conveniently matched with a parallel coaxial line, each coaxial line having an impedance of approximately 150 ohms. In this case, if we use a one-inch outer conductor, from our coaxial line chart, our inner conductor should be made of #12 wire. Center-to-center spacing is not critical and is approximately two to three inches. Spacing between the legs of the dipole is approximately r/8 or less. The flat frequency characteristic of the folded dipole permits both use of a reflector and director with improved sensitivity, plus the use of smaller size tubing for the dipole itself. The parasitic elements must not be folded; actual construction is shown in Fig. 4B.

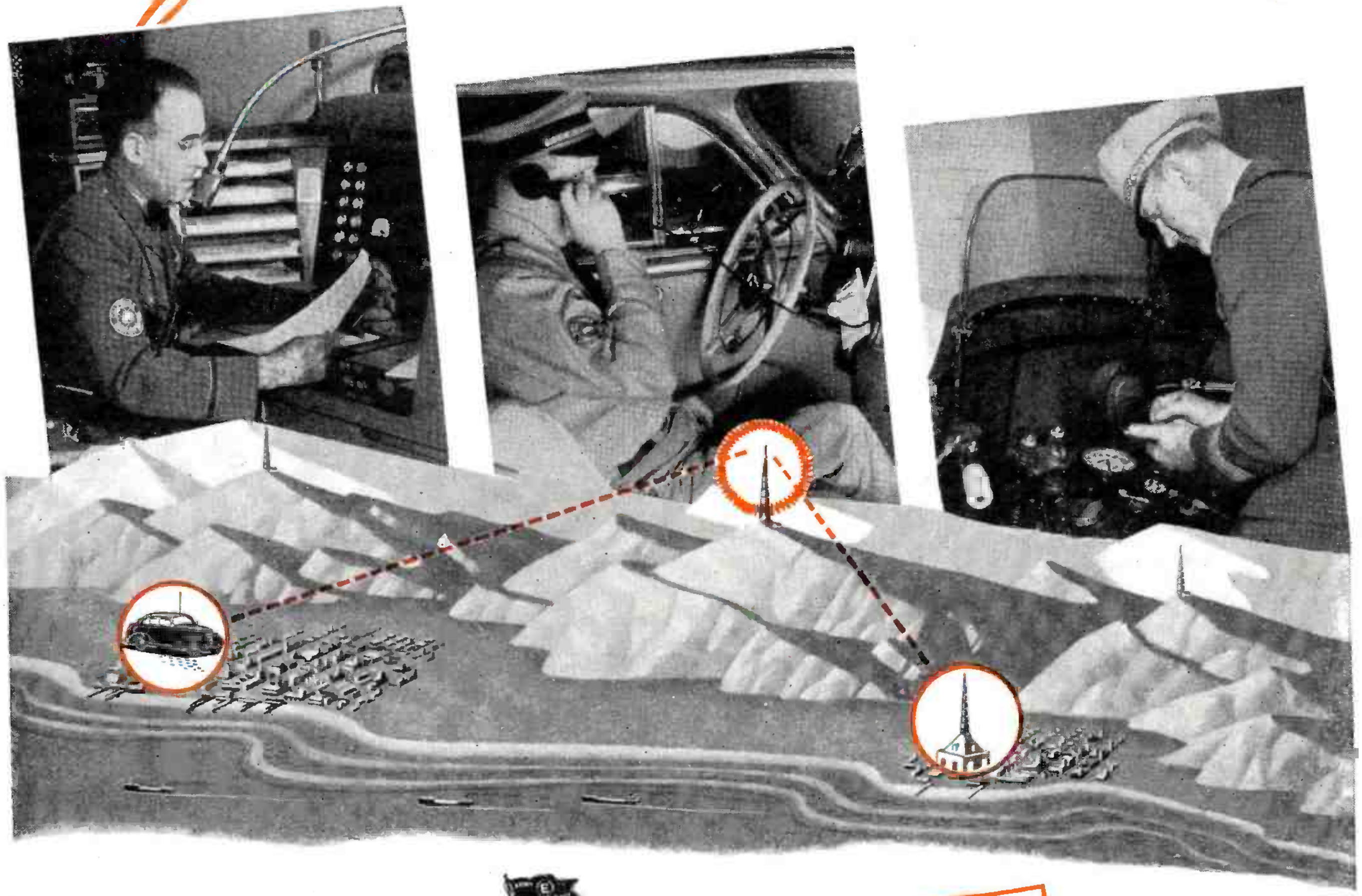
3. *Stacked Array.*

The stacked array, consisting of various elements stacked vertically, is a more efficient antenna, for it more ef-

Fig. 8. Mechanical requirements of 60-mc. rhombic antenna (A) and long-wire antenna (B).



California's mountains & valleys were TOUGH



. . . but not for *Motorola* F-M *Radio*

California's 158,693 square miles and 117,760 miles of roadways—with mountains like Mt. Whitney, 14,498 feet above sea level, and valleys like Death Valley, 300 feet below sea level—presented problems in state-wide coverage by radiotelephone that were super-tough.

Nevertheless, by the use of Motorola Radiotelephone F-M units and Motorola Radio automatic relay stations, the California State Highway Patrol has excellent radiotelephone communications with the 485 two-way patrol cars and the 377 one-way motorcycles patroling California's 58 counties.

Your State, County, City or Community should take advantage of the skill and experience that Motorola Radio engineers have displayed in installing F-M 2- and 3-way Radiotelephone systems in 33 States and over 1,000 communities throughout the United States, the Canal Zone and Hawaiian Islands.

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F-M & A-M HOME RADIO • AUTO RADIO • AUTOMATIC PHONOGRAPHS • TELEVISION • F-M POLICE RADIO • RADAR • MILITARY RADIO fectively utilizes the transmitted waveform. It has not only horizontal directivity, but also vertical directivity. Since, at television frequencies, the major portion of the useful radiation occurs over a line-of-sight path or low vertical angles (angle of vertical fire with respect to the plane of the ground), an antenna which is sensitive to these angles and only these angles improves receiver signal-to-noise ratio greatly.

At these frequencies the higher vertical angles fire into the ionized upper atmosphere and are lost, while the low angle (0 degrees to 10 degrees) represents the useful portion of the radiated energy. Consequently, if your receiver is sensitive also to higher vertical angles, as the ordinary single dipole is, it is to no avail, for no signals exist; in fact, it may readily be sensitive to noises close at hand which do arrive at a higher angle. Therefore, if we confine and concentrate our antenna directivity not only horizontally but vertically too, our reception is improved considerably.

The stacked array, of which Fig. 1 is a typical example, can be applied to all types of antennas discussed, with consequent improvement in sensitivity, wide-band characteristic, and low-angle reception. The antenna shown consists of two dipole elements and associated reflectors spaced approximately one-half wavelength vertically; transmission line separates into two sections at some point mid-way between the dipole elements, so that approximately the same length of line branches off to each dipole. Antenna resistance is halved by the parallel dipoles.

4. *Higher Impedance Antennas.*

To improve band-pass characteristics, raise antenna resistance, and more conveniently match a transmission line when using a stacked array, the ordinary dipole must be modified. This modification consists of fanning out the antenna dipole to present a greater surface to the wavefront, still maintaining a tuned characteristic. One example of a modified dipole is the folded dipole; others are the V antenna, Fig. 3A; fanned antenna, Fig. 3B; and conical antenna, Fig. 5. The V antenna can be constructed of small size wire on some type of framework, or suspended between two supports; its over-all length is r/2 and it matches a coaxial or parallel line of 100 to 200 ohms.

To still further increase antenna impedance and improve pickup, the fanned antenna of Fig. 3B can be constructed to match an open-wire line. In this type the length of each element in the fan is one-half wavelength and the antenna resistance is approximately 750 ohms. Two of these fans stacked a half-wave vertically would very conveniently match a 300-ohm line and would serve as a sensitive antenna on three or four bands.

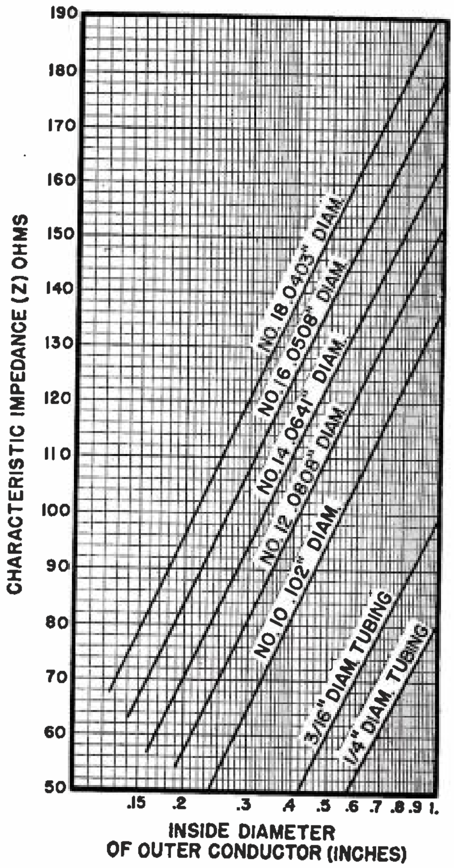
One of the most revolutionary antennas for television application is the conical antenna which has wide-band characteristics over an extremely wide band of frequencies, practically covering the entire television commercial band now in use. The conical antenna has a physical length of approximately .73 wavelength and with an angle of revolution of 11 degrees, matches a 500-ohm open-wire line. Various angles of revolution can be used to match other impedance lines. If solid sheet metal is not available or too expensive, the characteristics of the conical antenna can be duplicated as shown in Fig. 5B by using twelve #14 wires spaced equidistantly about the circumference.

5. *Long-Wire Antennas.*

In rural or suburban areas, considerably remote from the transmitter, and where sufficient space is available, the long-wire or rhombic is an excellent antenna. They are aperiodic (cover an exceptionally wide band of frequencies, at least 40 to 100 megacycles for one designed to operate on 60 megacycles) and are extremely sensitive. The rhombic antenna, Fig. 8A, with its legs in excess of three wavelengths, has exceptional horizontal directivity and excellent vertical directivity at low angles, plus a constant antenna impedance. With the rhombic terminated in a 800-ohm noninductive resistor (small wattage for receiving) it will match a 550-ohm line sufficiently well over the entire frequency range.

In locations where there is not sufficient room for the rhombic, a long wire can be used. The long wire has a pronounced directivity off its end

Fig. 9. Impedance chart of transmission lines for various sizes of conductors.



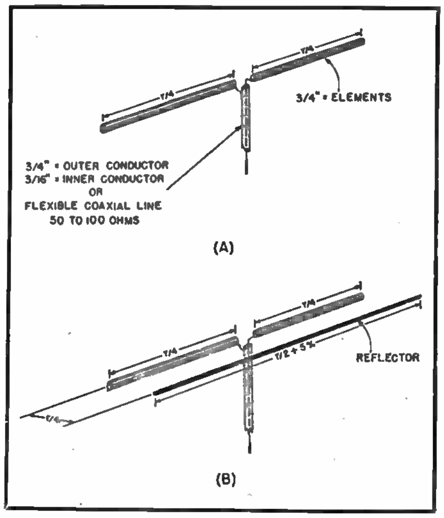


Fig. 10. Mechanical characteristics of a straight dipole antenna (A) and a dipole, including reflector (B).

(called an end-fire antenna) when its length exceeds 10 wavelengths. Since 10 wavelengths at 60 megacycles is approximately 165 feet, it is not too long an antenna for suburban sections. However, it must be directed toward the station, and its lead-in should be kept a reasonable distance from surrounding objects.

In the dimension chart, certain lengths were given for the various frequencies shown; however, calculations can be made for any frequency using the formulas listed in the columns.

(To be continued)

Target Locators

(Continued from page 29)

ships of over 40,000 tons, speaking at a luncheon which followed the launching, stated that among the many new devices incorporated was an electronic contraption "which could pierce the thickest of fogs, the blindest of mists, and the most impregnable darkness."

That these "electronic lynx-eyes" help to spell the doom of any surface vessel of enemy origin coming within their range of vision was proved, moreover, when British battleships blasted off the sea an entire Italian fleet off Mataban in pitch darkness by deadly-accurate gun-laying aided by electronic target locators.

Another naval version of the electrically-aided target finders is playing an important part in taking the sting out of Germany's new U-boat packs fitted with the Diesel-Luftmast or, as the Allies call it, the "Schnorkel" breathing tube which enables these under-water hyenas to charge their batteries while remaining submerged. Equipped with an improved type of the Asdic antisubmarine locator (which sends sound waves through the seas and records the presence of all submerged objects), British and U. S. naval vessels remain unperturbed by the German naval command's attempt to stage a "comeback" in the battle of the Atlantic.

A large variety of ground-warfare target-spotting systems are in use in this theater of operations.

The British Fifth Army makes use of a system of listening outposts connected with sound-ranging units located at artillery headquarters for spotting out-of-sight German guns.

It comprises a series of microphones, spaced out in frontal areas, for picking up sound waves emitted from firing enemy artillery. Converted by the resonators into electrical impulses, these waves pass along a telephone cable to a recording apparatus which throws an image onto a moving strip of sensitized paper.

Each microphone has a separate wire connection and every vibration is separately recorded as a sharp zig-zag which breaks a straight line.

The distance between the zig-zags on adjacent microphone recordings represents a time difference; an infinite number of places at increasing distances away from the microphones giving the same time difference for the sound wave reaching two microphones.

If a line is drawn from a point midway between the two microphones through all the possible positions from which the sound could have originated, a curve results, though, in practice, no curve is obtained but a straight line giving an average.

From the difference in time it takes the sound wave to strike two adjacent microphones, a bearing line is calculated. By using a number of microphones, a number of bearing lines are obtainable and at the point where all the lines intersect on the map the enemy gun is located.

Air temperature, wind speed, and direction all tend to distort accuracy of the results, however, and accordingly RAF meteorologists attached to the sound-ranging units are consulted before calculations are completed.

Provision is also made for the instantaneous switchover to radio by the simple expedient of pressing a button in the event of the telephone cable connecting the forward listening posts with the recording center being cut or damaged by enemy shell fire.

To avoid unnecessary wastage of sensitized paper, the recording machine is turned off as soon as a shell has landed.

Anti-Aircraft Target Locator

An entirely different system of target location is employed by U. S. anti-aircraft personnel for pin-pointing approaching enemy aircraft.

Usually, such target locators are installed in camouflaged, sturdy-looking iron boxes, dug into the ground, from which two telescopes protrude into the open and a cluster of wires trail towards well-concealed gun positions some little distance away.

The gunnery aids mounted on these boxes consist of a tracker head for the following planes in flight, an optical range finder, and a computer as well as other accessory equipment,

A RAT

ISN'T DEAD WHEN HE'S CORNERED...

That's when he begins to fight—*desperately.*

This war isn't won yet—even though we have the two-legged rats cornered.

It's going to take a lot of hard blows before they're knocked out for keeps.

Our boys aren't letting up over there—Don't let them down over here.

Buy *bonds* and more *bonds.*

Give *blood* and more *blood.*

Stay on your war job—

Until the last shot is fired.

Here at Kenyon, we're proud to play our small role on the stage of a BIG war. That's why EVERY Kenyon transformer used by our fighting forces throughout the world reflects only the highest precision craftsmanship. Kenyon workers are doing their share — bringing Victory closer by turning out top quality transformers uninterruptedly—and as fast as possible!

THE MARK OF EXCELLENCE

KENYON TRANSFORMER CO., Inc. 840 BARRY STREET NEW YORK, U. S. A.

details of which cannot be disclosed.

When an enemy aircraft is sighted by an outlying observation command post, action stations are manned by G.I.'s equipped with field telephones.

As soon as the appropriate position and course of the enemy plane has been communicated to the director crew, the big iron box comes to life and the two telescopes swing into the proper angle of the craft's approach.

Once sighted, the target is gradually centered by the aid of the controllers on the horizontal and vertical crosshairs of the telescopes and word passed on to the gunners below to follow the flight of the distant plane in unison.

The furiously swinging needles on the dials of the aiming device suddenly come to a rest as the indicator registers the target.

At the same time, the guns go into action spouting forth puffs of smoke and fire till one more Nazi plane and crew have reached journey's end.

—30—

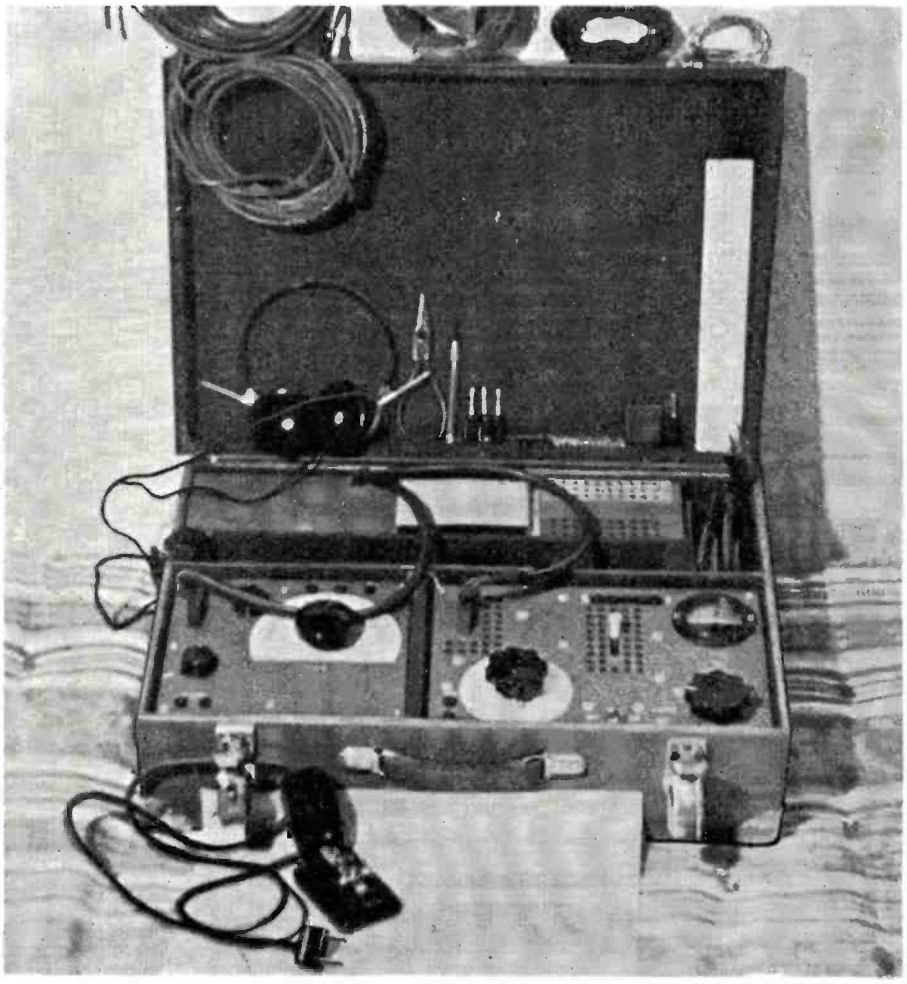
Aids to Photography

(*Continued from page* 34)

The circuit schematic of another small-sized timer is shown in Fig. 5. A 117N7GT tube provides both rectifier and tetrode sections in a single envelope and permits line-voltage operation of the tube filament. These features render the device extremely simple and compact, and reduce the number of parts required.

In operation, switch S normally is kept in the No. 1 position. This removes the d.c. voltage from the plate and screen of the tetrode section and applies it across the grid network, R_t-C_t, charging capacitor C_t. There being no current in the relay at this time, the latter drops out, but the lamp is not lighted because the arm of switch S now is open. S then is thrown to position 2. This operation applies d.c. voltage to the plate and screen and completes the lamp circuit. The

This innocent-looking traveler's suitcase is typical of those employed by German agents in carrying clandestine radio transmitter receivers into this country. The Radio Intelligence Division of the FCC has nabbed several agents carrying the units illustrated. Completely equipped, even with tools, vibrator supply, etc., these compact units are capable of sending and receiving messages to the Fatherland to give vital information on American troop movements and other data of special concern to the enemy. Several coils of wire are carried for the erection of antenna systems. The equipment is substantially built and quite up-to-date in circuit design. The important functions of the RID were given in detail in the October, 1944 issue of RADIO NEWS, which points out the necessity for our Government to be on constant guard against operation of clandestine radio stations.



control grid now receives the voltage drop developed across resistor R_t by discharge of capacitor C_t. Because of the negative polarity of this grid voltage, the tetrode plate current will remain cut off as long as the grid voltage is maintained at the normal value; and the plate-circuit relay will remain dropped out, keeping the lamp lighted. Capacitor C_t eventually will discharge completely through the resistor, however; and at that time the grid voltage will be lost, plate current will flow unrestrainedly, the relay will pick up, and the lamp will be extinguished.

The time delay of the circuit depends entirely upon the values of R_t and C_t. The larger the resistor value for a given capacitance, the longer will be the time required for the capacitor completely to discharge and the longer the lamp will remain lighted. The dial of rheostat R_t may be graduated directly in minutes or seconds and set to any required time interval when the device is used.

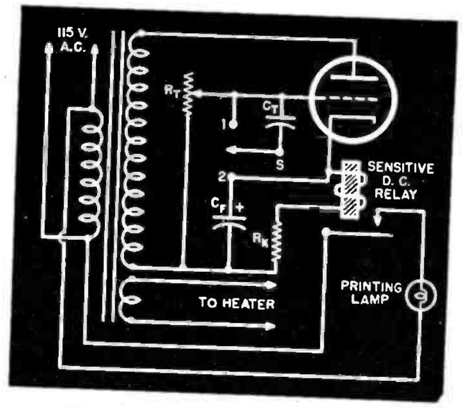


Fig. 9. Phototimer used for automatic control of lamps in enlargers and printing boxes.

Additional Devices

Further electronic aids to photography include densitometers for the examination of negatives, camera exposure timers, and automatic camera stop regulators.

The densitometer is essentially similar to the exposure meter, except that in the former the photocell is arranged so that a film negative may be inserted between itself and a special, standard incandescent lamp, and the indicating meter is graduated directly in emulsion density units.

Camera shutter timers are similar to the printer-enlarger timers just described except that they are arranged to close the shutter of the camera, rather than operate a lamp, at the close of a predetermined exposure interval. Some photographers prefer to connect the timer so as to control flood lights over a selected exposure interval.

At least one manufacturer has produced a camera in which a self-contained, self-generating photocell evaluates the illumination upon a subject and, by means of the currents generated, automatically sets the iris diaphragm to the proper size of opening.

Looking Ahead

There is no doubt that further contributions of electronics to photography will dot the progress of these two fields. Since many optical phenomena are akin to electronic phenomena, scientists in the two schools more nearly speak a common language and are more inclined to join hands and see eye-to-eye than, say, electronics engineers and chemists or electronics engineers and biologists. Both photography and electronics will benefit from future contributions.

Paramount among problems now recognized is the need of a device which, going further than the densitometer, will measure the degree of contrast in an entire negative and select the proper printing paper for best results. A simple exposure meter for the appraisal of color values as well as those of light, for color photo applications, seems useful. Improvements in, and simplification of infrared-ray photography likewise offers possibilities for experimentation and development.

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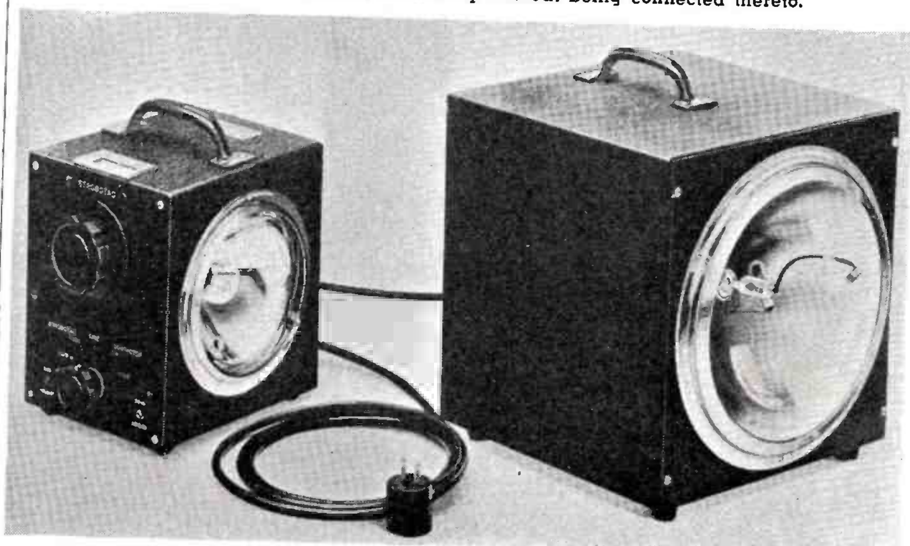
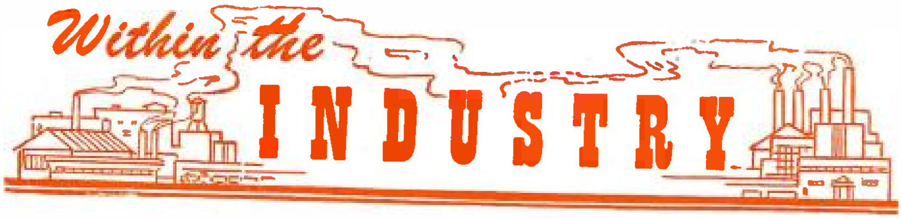
Fig. 8. The Strobotac (left) and a Stroboscope, which are used to measure the speed of rotating machinery without being connected thereto.





ROBERT BEATTY, formerly chief of Division C, War Production Board, has been appointed Sales Manager of the Tungsten and the Weld and Wire Products of the Warren and Towanda plants of *Sylvania Electric Products, Inc.*

Prior to his affiliation with the War Production Board, Mr. Beatty was sales engineer with the Driver-Harris Company and The Aluminum Company of America. He will make his headquarters at the Warren, Pa., plant.

At the same time the company announced Mr. Beatty's appointment, they also released information regarding the opening of their twenty-third plant. This factory is located in Jamestown, New York. This plant will house facilities for producing parts for electronic tubes and other electrical equipment. Its output will supplement that of several Sylvania plants.

* * *

WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY has made several new appointments which will be of interest to the industry.

Robert E. Burrows has been named manager of General Radio Sales with offices in New York City. Mr. Burrows will be in charge of the sales and promotion of the newly announced Westinghouse home radios to be released after the war. Until his recent affiliation with Westinghouse, Mr. Burrows was supervisor of advertising and sales promotion for the radio receiver division of the General Electric Company.

George S. Ryan has received the appointment of Assistant to the Vice-President of the company according to the announcement made by T. I. Phillips, vice-president. Mr. Ryan joined the staff of the Westinghouse in 1922 as a student engineer and since that time has held various positions in the power division of the company.

C. B. Dick has been appointed manager of the Feeder Division, a post vacated by Mr. Ryan upon his promotion.

Thomas I. Lane is the new assistant to the Central District manager of the company. Mr. Lane entered the employ of Westinghouse in 1913 and has served in various capacities in the automotive division since that date. His new headquarters will be in Pittsburgh.

Charles R. Matthews who has been prominent for the past 12 years in the electrical industry in Seattle, Washington, was named manager of the Northern California District of the Westinghouse Supply Company. He succeeds E. J. Duggan who has resigned.

* * *

TOM JOYCE, General Manager of the Radio, Phonograph and Television Department of the *RCA Victor Division* of *Radio Corporation of America*, has announced his resignation from the company after 23 years of service with the organization.

Mr. Joyce has been actively interested in television for several years and has done much to promote its popularity. Announcement of his future plans will be made at some later date.

* * *

GALVIN MANUFACTURING CORPORATION, makers of Motorola radios, has announced the appointment of the *Davis Radio Company* of Fresno, California, as their wholesale distributor for eight California counties.

The company is headed by W. F. Davis, amateur radio operator. *Davis Radio Company* has announced that it will carry a complete line of Motorola radios for the home, automobile, and farm.

* * *

AMERICAN TYPE FOUNDERS, INC. has announced the consolidation of two of its subsidiaries, namely, the *Philharmonic Radio Corporation* and the *Remote Control Division.* Zeus Soucek is the president of the new organization.

The consolidation was made in order to utilize the production facilities of the two companies to the maximum. The *Philharmonic Company* will continue its wartime production of electronic devices and the *Remote Control Division* will continue the production of precision remote controls for the Navy.

* * *

JOHN F. RIDER, currently serving in the U. S. Army Signal Corps, has been promoted to the rank of Lt. Col. in the Signal Corps.

Col. Rider entered active service in the Army on May 1, 1942, with the rank of Captain in the Signal Corps. From June, 1942, to November, 1943, he was stationed at the Southern Signal Corps School at Camp Murphy, Florida. Here he organized and became the director of the Training Literature Division. On November 6, 1942, he was promoted to the rank of Major.

He was subsequently transferred to Fort Monmouth where he organized

Centralab STANDARD, MIDGET AND ELF *Radiohms*

● For more than two decades the name CENTRALAB on a volume control has been a synonym for QUALITY.

The long wall-type resistance sector, the smooth performance and the satisfactory operation of these controls are in no small measure responsible for the fame of Centralab. Whether for original equipment or replacement always specify

CENTRALAB Radiohms

Centralab

CRL

Division of GLOBE-UNION INC., Milwaukee

Producers of VARIABLE RESISTORS — SELECTOR SWITCHES — CERAMIC CAPACITORS, FIXED AND VARIABLE — STEATITE INSULATORS — SILVER MICA CAPACITORS the Radar Literature Section of the Signal Corps Publication Agency. He is at present Deputy Director in charge of all operations of the Agency.

* * *

LT. COMDR. RALPH T. BRENGLE, USNR, is the recipient of the Navy commendation ribbon according to news released by the U. S. Navy recently.

Commander Brengle, who is well known in Chicago and national radio circles, was cited for his outstanding performance of duty while serving on the staff of the Commander of the Eighth Fleet during a period of almost continual offensive operations against the enemy in the central and western Mediterranean from October, 1943, through October, 1944.

* * *

HYTRON CORPORATION of Salem, Massachusetts, has announced a change in the corporate name to *Hytron Radio and Electronics Corporation.*

The Board of Directors also announced the election of new officers: Bruce A. Coffin was named President and General Manager; Lloyd H. Coffin was appointed Treasurer and Chairman of the Board of Directors; Edgar M. Batchelder was named Executive Vice-President; and Charles F. Stromeyer was appointed Vice-President and Director of Engineering.

* * *

STROMBERG-CARLSON COMPANY of Rochester, New York, has appointed two distributors to handle the company's line of postwar radios in the Tennessee area.

The Better Home Products, Inc., headed by William M. Fike, will represent the company in the Nashville trading area, while *The Tri-State Supply Company*, of Chattanooga will act as distributors for the Chattanooga area. C. C. Bower is the president of the latter company.

* * *

SENOR EMILIO AZCARRAGA, owner of the 100,000-watt Mexican station, XEW, is currently in this country to buy one million radio receivers for distribution in Mexico.

Since the purchasing power of the average Mexican in the agrarian sections of the country is very low, Senor Azcarraga hopes to be able to sell receivers to these people for $3.00 apiece. The set he is seeking is a two-tube broadcast receiver which would be encased in a rather large, cheaply built cabinet which is capable of withstanding high temperatures. The unit is to be simply wired and made with well-defined sections to facilitate rapid and inexpensive repair. Distribution would be made direct to the consumer through radio station, XEW.

Senor Azcarraga also revealed that he plans to increase the power output of his station to 1,000 kw. in the near future.

* * *

FRED R. ELLINGER, well-known manufacturers' representative, has just rounded out twenty years in the radio field.

Mr. Ellinger started in the radio business in 1925 as a member of the firm of R. F. Sparrow Company. In 1933 he started in business for himself as the *Ellinger Sales Company* with headquarters in Chicago.

The *Ellinger Sales Company* now handles the states of Indiana, Illinois, Wisconsin, Iowa, Nebraska, and Minnesota. His postwar plans call for the addition of several engineers to the company staff in order that real engineering service may be rendered his customers. Mr. Ellinger's home is in Park Ridge, Illinois.

* * *

L. G. BURWINKEL has been named assistant to the vice-president of *Westinghouse Electric and Manufacturing Company*, according to R. A. Neal, vice-president and sales manager of the company.

Mr. Burwinkel has been employed by *Westinghouse* for 21 years, serving in various capacities in the accounting and sales departments until 1938 when he became central auditor and district superintendent in the Pittsburgh office.

In 1940, he was appointed assistant to the Central District manager, from which position he was advanced to his new post.

* * *

McMURDO SILVER has announced the formation of a new company which will bear his name. The headquarters of the organization will be at 1240 Main Street, Hartford 3, Conn.

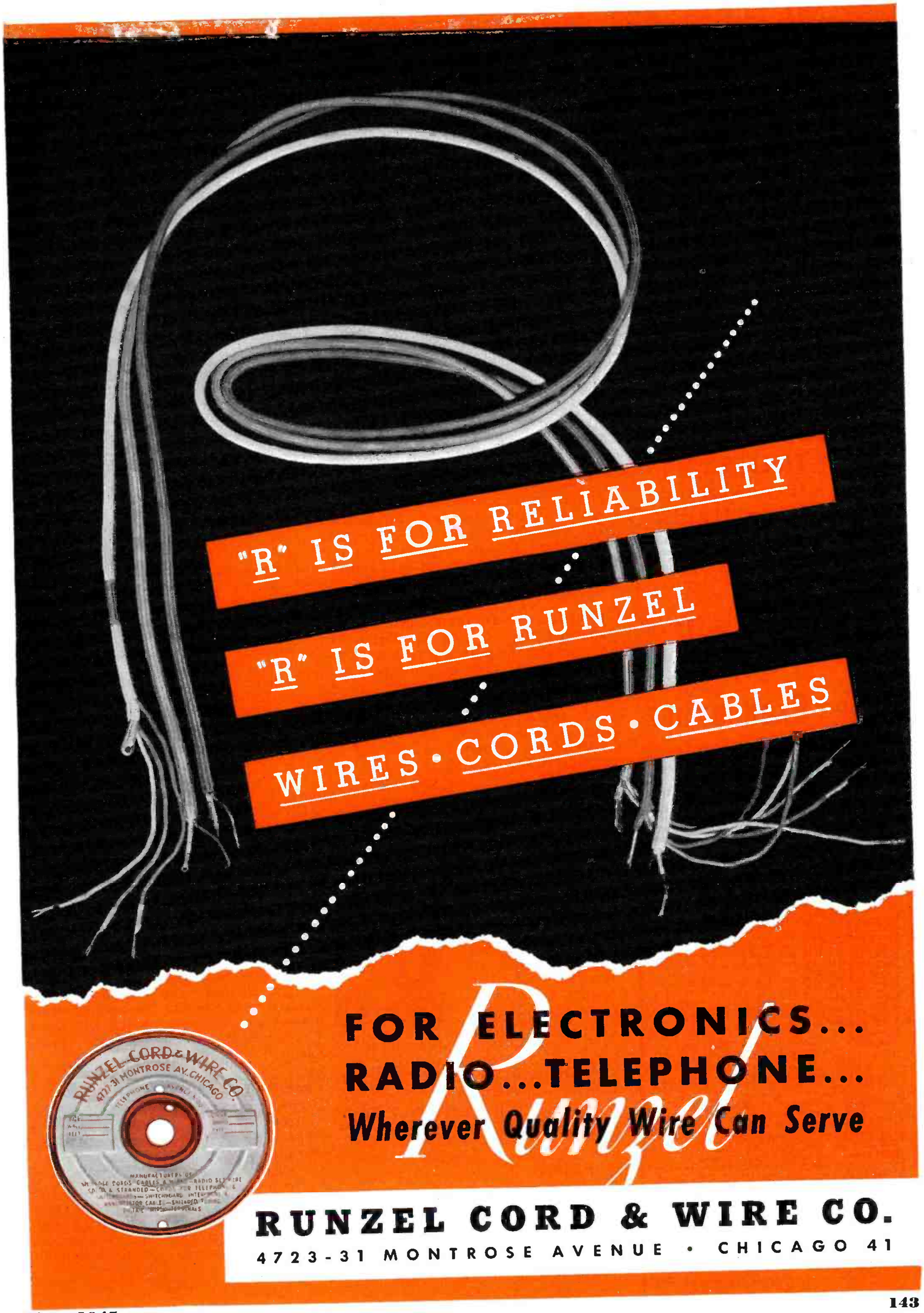
The company will specialize in amateur parts, kit and special equipment and in consulting engineering for a group of noncompeting clients in the radio and electronic field.

During the past six years, Mr. Silver has been connected with the Airplane and Marine Direction-Finder Corporation, Fada Radio and Electric Company, and Grenby Mfg. Company.

* * *

MIDLAND BROADCASTING COMPANY, owners of Station KMBC in Kansas City, Missouri, has announced the sale of *Midland Radio and Television Schools, Inc.* to G. L. Taylor, president and active head of the schools.

Under the new ownership, the school name will be changed to *Central Radio and Television Schools, Inc.*, the Midland name being retained by *Midland Broadcasting Company.*


"R" IS FOR RELIABILITY
"R" IS FOR RUNZEL
WIRES • CORDS • CABLES
RUNZEL CORD & WIRE CO.
4723-31 MONTROSE AV. CHICAGO
FOR ELECTRONICS...
RADIO...TELEPHONE...
Wherever Quality Wire Can Serve
Runzel
RUNZEL CORD & WIRE CO.
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As a result of this transaction, Arthur B. Church, president of KMBC and chairman of the board of the school, has resigned and Mr. Taylor, who has served as vice-president of KMBC has tendered his resignation.

Robin D. Compton will assume the technical duties formerly performed by Mr. Taylor, and in addition will devote much of his time to FM, television, facsimile, and other developmental and technical research projects.

* * *

R. F. BLASH, president of the *Webster-Chicago Corporation,* has announced the purchase of *Webster Products* of Chicago. The latter firm was, before the war, a manufacturer of automatic record changers. The former *Webster Products* organization and facilities will be retained and will operate as the *Electronics Division* of *Webster-Chicago Corporation.*

The Electronics Division is now manufacturing dynamotors and voltage regulators for war production. The company will resume the manufacture of record changers after the war and will add several new, but related, products to their line.

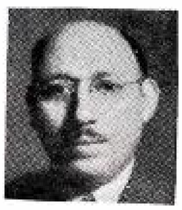
* * *

GENERAL DRY BATTERIES, INC. has announced the election of Walter A. Onorato to the post of president of the company. Mr. Onorato will also serve as president of the Canadian subsidiary of the company. He succeeds C. P. Diebel, founder of the company, who died in January.

Mr. Onorato has been serving as vice-president of the company and managing director of the Canadian company since 1934. He joined the firm in 1932.

* * *

YSIDRO GARZA Y GARZA, manager of *Importadora del Norte, S. A.* of Monterrey, Mexico, has been named distributor for the *Crosley Corporation's* products, for Monterrey and adjacent territory according to the announcement made in Cincinnati recently by John W. DeLine, Jr., director of exports.



Importadora del Norte, S.A. is setting up a modern merchandising organization in the Monterry territory and the company executives are now in the United States studying American methods of merchandising and distributing.

* * *

WESTINGHOUSE ELECTRIC SUPPLY COMPANY, the wholesale marketing outlet of the *Westinghouse Electric and Mfg. Company,* has announced the promotion of six of their representatives and the appointment of one new district manager.

L. G. Hardy, formerly branch manager at Jacksonville and Tampa, Florida, has been named Southeastern District Appliance manager with headquarters in Atlanta, Georgia.

C. W. Spengler of Miami, Florida, has been named acting manager of the Jacksonville branch of the company.

E. L. Houston has been appointed acting manager of the Tampa branch of the organization.

S. R. Clark, formerly acting manager of the Charlotte and Columbia, S. C., branches was promoted to branch manager of the company at Charlotte.

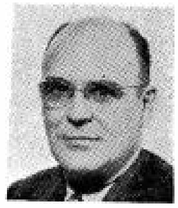
O. C. Rhodes of Tampa was named acting manager of Columbia, S. C., branch.

R. E. Hallman of Charlotte was moved to the post of acting manager of the Greenville, S. C., branch.

O. A. Bruneau has received the new appointment as branch manager of the Duluth, Minn., outlet of the company. Mr. Bruneau succeeds F. A. Johnson, who is retiring.

* * *

REX L. MUNGER, formerly Sales Manager of *Taylor Tubes, Inc.,* has been appointed Midwest representative for *Communication Measurements Laboratory* of New York. His work will consist of the disposal of surplus radio and electronic materials of all types for the *Defence Supplies Corporation,* a government agency.



Surplus stocks will be sold to manufacturers and distributors in accordance with the plans of the government, and in a manner calculated to prevent wholesale dumping of surplus equipment.

Mr. Munger will continue to act as advisory sales manager to *Taylor Tubes, Inc.* of Chicago.

* * *

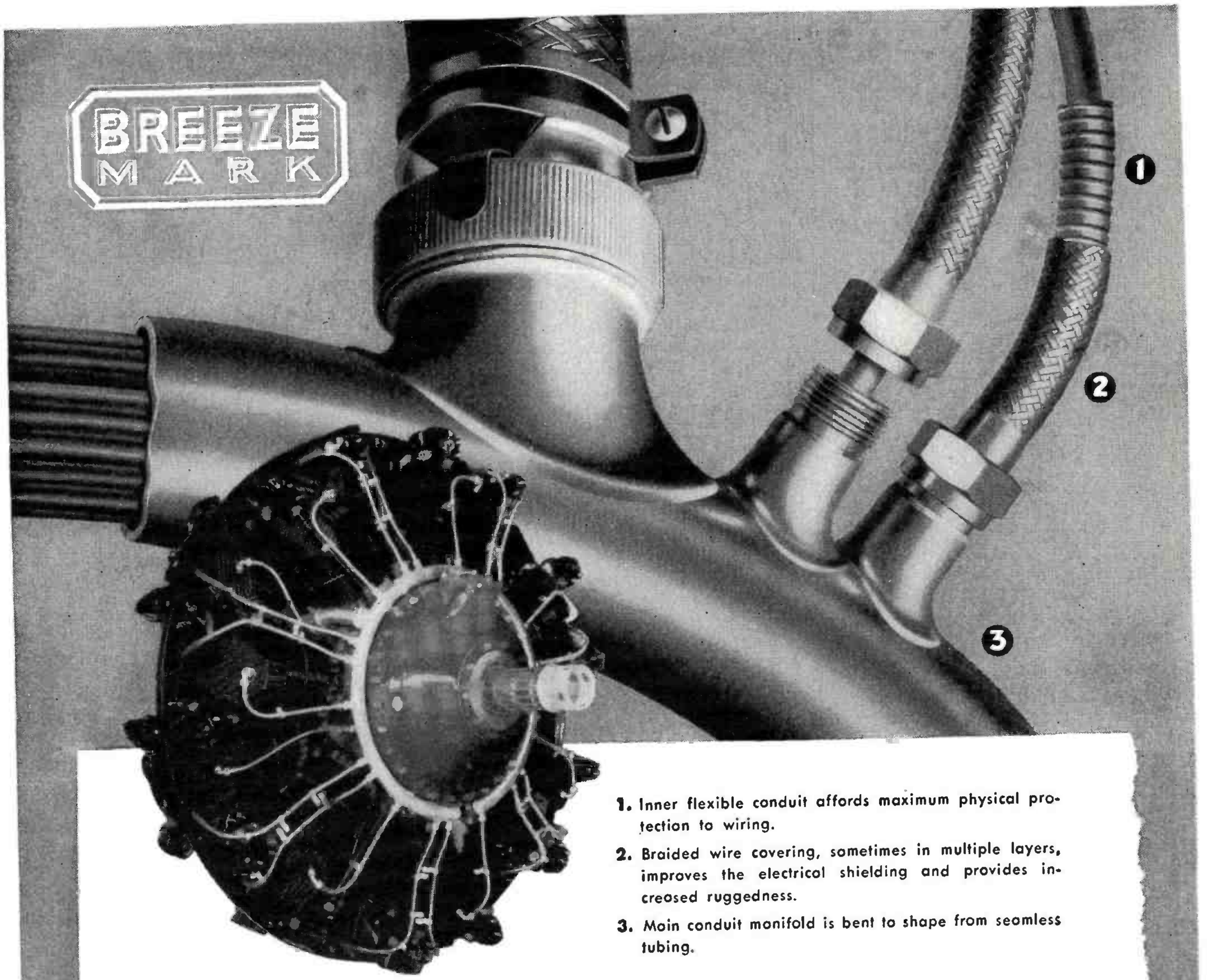
STANDARD TRANSFORMER COMPANY of Detroit has announced the appointment of Grant Shaffer as representative for the Jobber and Industrial Divisions of the company.

Mr. Shaffer who has been associated with *Stancor* for several years in an engineering capacity, will serve as a consultant on transformer problems.

* * *

BARNES AND REINECKE, Industrial Designers and Engineers of Chicago, have announced the formation of a new electronics division which will be headed by Merle C. Stillman.

Mr. Stillman will supervise the enlarged electrical engineering staff and offer additional services in the way of FM and television engineering, specialized electronics, a.f. equipment, and broadcasting station equipment design.



1. Inner flexible conduit affords maximum physical protection to wiring.
2. Braided wire covering, sometimes in multiple layers, improves the electrical shielding and provides increased ruggedness.
3. Main conduit manifold is bent to shape from seamless tubing.

Electrically Sealed Circuits

WITH BREEZE RADIO IGNITION SHIELDING

The Breeze Radio Ignition Shielding which equips the modern aircraft engine is the product of extensive laboratory test and research.

Effective shielding calls for a metal case of high conductivity around possible sources of radio interference, designed to lead off high frequency impulses to the ground and prevent their radiation. Each installation must be custom engineered to meet the needs of the problems involved.

Breeze Shielding is designed for ruggedness, resistance to vibration, and maximum isolation of high frequency interference. Each wire of the braided cover must be positively soldered at each connection, inner conduit must be tight to avoid electrical leakage, and fittings must be precision-machined for close fit and uniform pressure of contact faces.

New shielding problems presented by the rapid advance in the science of radio communication and television are constantly being solved by Breeze engineering. A background of many years experience in shielding automotive, aircraft, marine and commercial engines has made Breeze America's headquarters for Radio Ignition Shielding.

Breeze BREEZE MARK
CORPORATIONS, INC.
Newark, New Jersey

Moisture Indicator
(*Continued from page* 35)

and would serve as an indication of when the zero-beat point was reached. In the oscillators, 6J5's were used.

The apparatus does not call for high output and the tube's current and voltage ratings are low. The crystal frequency was 243 kc. That frequency was chosen because it was the only crystal available. In the variable oscillator there is a three-plate variable condenser in parallel with the main tuning and oven condenser. That is used because the variable condenser must be adjusted for *zero beat*—the point where there is a complete cancellation of output signal, where no sound is heard from the speaker, and there is no variation in the plate current of the 6V6, as shown by the steady reading on the 6V6 plate current meter. When tuning for it, it is the point of no sound directly between two sounds of rising pitch.

The two oscillators should be constructed as nearly alike as possible, with respect to size and location of components, and should be completely shielded so that there is no coupling between the two, ahead of the mixer stage. Although a crystal was used for one oscillator, this could be a self-excited oscillator, as long as care is taken to make it as stable as possible. Values for the components of the resonant circuits, C1L3, C2L1, and C3C4L2, are not given, since these values will depend on the frequency used. Values should be chosen so that the circuits will resonate at the desired frequency. Coils RFC-1, 2, 3, referred to in the diagram, are standard broadcast-type radio-frequency filter chokes and may be obtained from any parts dealer.

As the object dries, the variable oscillator shifts frequency and the beat frequency gradually builds up to an audio range. The output is zero-beated from time to time as the object dries. When it reaches a condition where there is no more change in the output-meter reading, the object can be considered dry, for all practical purposes.

The mixer stage is the same as that on any superhet and uses a 6L7, which is a common receiver mixer tube. The audio stage, too, is an ordinary stage employing a 6V6. The volume is controlled by a 75,000-ohm potentiometer in the grid circuit of this tube.

A shielded cable used to connect the oven condenser to the variable oscillator eliminates outside interference and gives the oscillator more stability. The power supply is conventional. It uses an 80 rectifier tube and a 300-volt, 75-ma. power transformer with 6.3- and 5-volt filament windings.

The apparatus was used with several objects. A small nut tied to a piece of thread was dangled between the oscillator plates when they were an inch apart. The resultant frequency shift was enough to kick the meter fifteen points, but not enough to make an audible note. A three-fourth inch block of wood soaked in water overnight dried out completely in an hour and a half in the oven. A hand brought within a foot of the oven condenser was enough to bring a squeal and people walking within two feet of it made a visual kick in the output meter.

-30-

Practical Radio Course
(*Continued from page* 51)

stants, the output can be made quite uniform with frequency. Because of the assistance rendered by the capacitive feedback, the number of turns required in the tickler winding, L_t, can be kept quite small, so that trouble from tickler resonance is avoided.

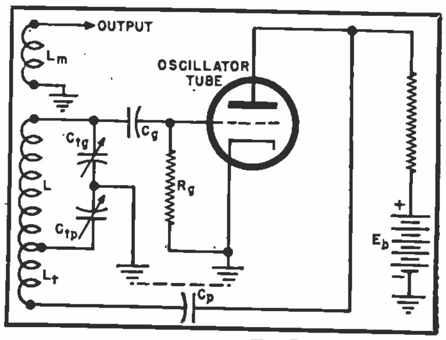
Tuned-Plate Oscillator

Mainly because of its excellent frequency stability characteristics, the tuned-plate type oscillator is favored for many applications such as in transmitters, communications-type receivers, etc.

The circuit diagram of a *tuned-plate* type oscillator is illustrated in Fig. 7. This circuit is so arranged, that a tuning capacitor, *C*, having a grounded rotor may be employed. The tank circuit *L-C* is shunt-fed from the plate circuit through the r.f. by-pass capacitor C_p. Coil *L* is inductively coupled to the grid tickler coil, L_t, and the output pickup coil L_m.

As long as the Q of the coils is greater than 10, the grid voltage will be substantially 180 degrees out of phase with the a.c. plate current regardless of the type of oscillator. However, in the case of the *tuned-grid* circuit the plate load is highly reactive. When the grid circuit takes power, as is the case in any normal oscillator, this reflected or transfer resistance becomes rather small due to loading the grid coil. An effective working Q of 20 or lower is not unusual in this circuit. Not only the resistance of the grid leak, but the a.c. resistance of the tube with the grid considered as a diode, must be considered as a load on the grid coil.

Fig. 6. Modified Colpitts oscillator circuit in which both capacitive and inductive feedback are employed. Tickler winding L_t provides the inductive feedback; capacitor C_{Tp} provides the capacitive feedback.



This extremely low load impedance in the case of the *tuned-grid* oscillator not only makes for low power efficiency but poor oscillator voltage amplitude as well. In order to have a large a.c. plate voltage component or voltage change across the load, when the load is small, a large current is required. The current which can be drawn through any vacuum tube is limited, so that, with the small currents available, a low plate-load impedance means a small plate voltage swing, and, in turn, a low grid excitation or oscillator voltage. A tuned-grid oscillator amounts to coupling a high-impedance generator into a low-impedance, variable, inductive load.

In the case of the *tuned-plate* oscillator the plate load is practically a pure resistance at the resonant frequency of the tuned circuit. With the low-inductance tickler required in the grid circuit, the reflected reactance into the plate load becomes negligible at all conditions of loading.

A *tuned-plate* oscillator is characterized by a high plate-load impedance, good efficiency, plate voltage in phase with the current and 180 degrees out of phase with the grid voltage. Thus, the plate-voltage variation is greater than in the case of the tuned-grid oscillator, and is in the proper phase relationship so that all of it is effective in causing feedback. As a result, greater oscillator grid voltage is realized. Since it is resistive in character, the load line is straight and the harmonic content is comparatively low. The harmonics that are present are by-passed directly to ground because of the low impedance of the tuned circuit to all frequencies, except the fundamental.

Experimental data shows that a tuned-plate oscillator will have a greater frequency stability under fluctuating line-voltage conditions than is commonly obtainable with the tuned-grid type. This feature becomes of major importance on the high-frequency bands of superheterodyne receivers. Frequency drift due to line-voltage fluctuation is caused, in part, by the shift in loading on the grid circuit when a.v.c. line voltage changes occur. Any change in the bias voltage will change the apparent load, the Q, and the frequency of the oscillator to a much greater degree if the tuned circuit is in the *grid* lead rather than in the *plate* circuit. In the latter case only a very small fraction of the disturbance is transferred from the grid to the tuned circuit.

Dynatron Oscillator

The *dynatron* oscillator, illustrated in basic form at (A) of Fig. 8, makes use of the peculiar secondary emission characteristics of a tetrode. This is illustrated at (B). Imagine the screen grid to be maintained at a constant positive voltage *greater* than the normal positive voltage of the plate, and the plate potential to be gradually increased from zero value. At first, the plate current increases (region *A-B*); then it *decreases* (region *B-O-C*) with increasing plate voltage; then it increases again (region C-D-E). The plate current decrease over region *B-O-C* is due to the secondary emission of electrons from the plate toward the screen grid. The screen grid attracts these secondary electrons because the fixed-screen potential is greater than the plate potential in this region. Therefore, the screen attracts all the secondary electrons until the plate has a potential equal to that represented by point *C*. Further increase in plate potential beyond this point causes the plate current to increase.

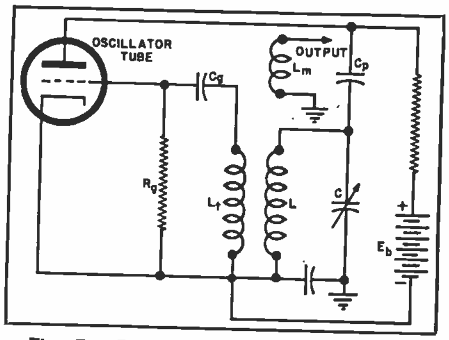


Fig. 7. A plate-tuned oscillator circuit that makes it possible to employ a tuning capacitor (C) having a grounded rotor.

It is the region *B-O-C* that is interesting from our standpoint. Here, an *increase* in plate voltage produces a *decrease* in plate current (hence the tube acts as a *negative resistance* over this region). If the tube, when operated in this region, has a tuned circuit connected in series with its plate circuit, as shown at (A), sinusoidal oscillations of the resonance frequency of this tuned circuit will be produced, by altering the plate voltage up and down over this critical range. The operation is as follows:

Any initial disturbance in the circuit at all (such as the application of plate or screen voltage) will cause a change in the current through the coil *L* and a change in charge in the capacitor *C*, the tank circuit. This means a change in voltage across *L* (and, of course, across *C*). If this small generated voltage is such as to *increase* the total applied plate voltage, the plate current will *decrease* because of the peculiar characteristic, and this decrease in plate current will generate a voltage across *L* which will be in such a direction as to tend to maintain this current constant. In other words, the plate voltage will increase again, causing a further reduction in plate current. This process continues until point *C* on the characteristic is reached, after which time, increasing voltage causes an increase in current. Hence, the direction of the generated voltage will be reversed—in such a direction as to reduce the plate voltage—and the current will rise to point *B* on the curve. In other words, if the normal plate voltage without oscillation is represented by point *O*, the reversed slope of the curve will maintain oscillations.

For some time now, the plates of

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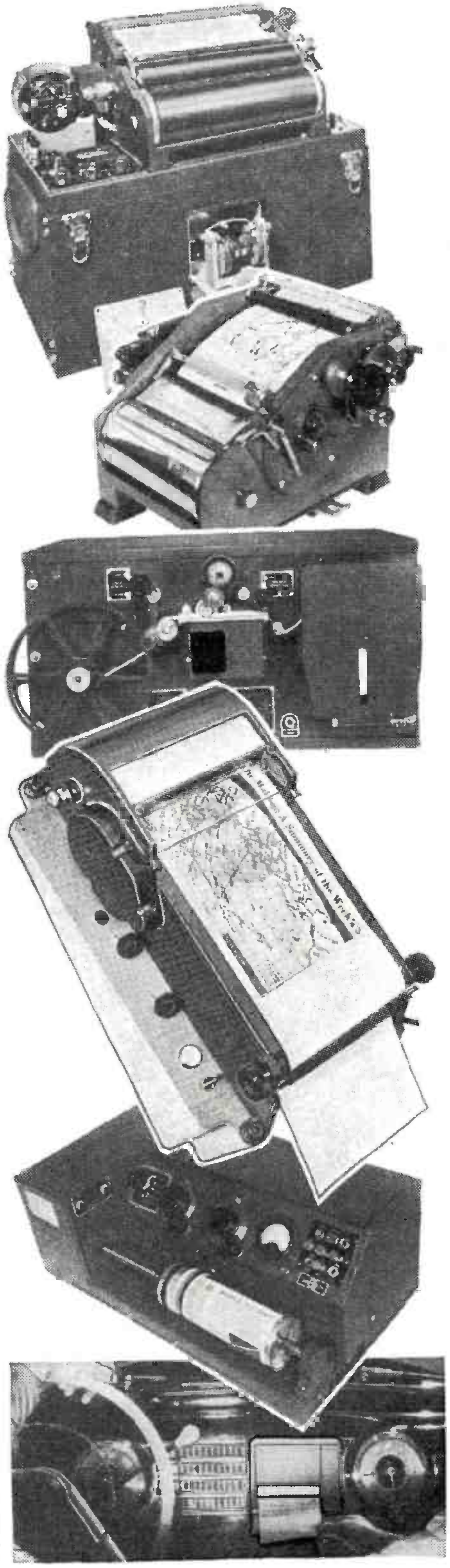

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screen-grid tubes have been carbonized during manufacture and the designs have been altered, in order to reduce secondary-emission effects so that tube operation would be improved for other uses. As a result of this, the use of dynatron oscillators in superheterodynes has fallen off because of the difficulty of securing screen-grid tubes that will oscillate satisfactorily in the dynatron circuit. Also, the characteristics of a group of tubes of the same type are not likely to be similar in the dynatron region, so tube replacement in such oscillators becomes difficult. However, the need for but a single coil and tuning capacitor, and the elimination of numerous adjustments have made this form of oscillator somewhat popular for some oscillator applications.

Crystal-Controlled Oscillators

In some superheterodyne receiver applications, for example in many phases of military communication, aircraft-navigation communication, police-car radio reception, time-signal reception, etc., the receiver is required to receive signals of only one frequency (or at most only a few definite frequencies), most of the time. Since the local oscillator employed in such receivers must operate at a fixed frequency (or at most only a few definite frequencies), the crystal-controlled type is frequently employed.

The basic circuit of a fixed-frequency crystal-controlled oscillator is illustrated in Fig. 9. Notice that the tuned-grid circuit has been replaced by a vibrating wafer of quartz crystal mounted between two contacting flat metal plates or electrodes. This circuit is in effect a tuned-plate, tuned-grid oscillator with the crystal, at its antiresonant frequency, taking the place of the parallel-tuned grid circuit. The voltage fed back to the grid circuit through the grid-to-plate capacitance is applied to the crystal and causes it to vibrate mechanically at a certain definite frequency, dependent upon its thickness and the direction in which it was sliced from the natural "mother" quartz crystal. This mechanical vibration of the crystal

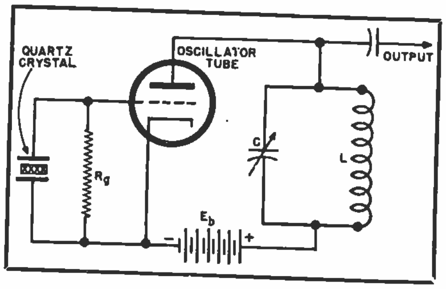


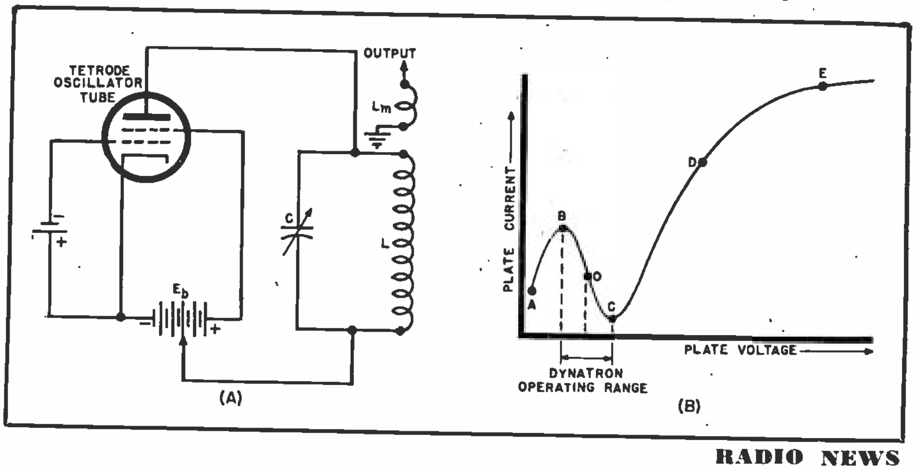
Fig. 9. A fixed-frequency quartz-crystal-controlled oscillator.

generates an electrostatic charge which is controlled by its vibrational characteristics. This piezoelectrically generated voltage excites the grid, which in turn controls the plate-circuit energy by the normal functioning of the tube's amplification powers.

Thus, the small piezoelectric charge of the crystal is amplified by the tube and again part of this amplified energy is returned to the grid circuit where it maintains the vibrations or oscillations of the crystal. The energy fed back to the grid circuit is at its highest potential at the frequency of maximum impedance of the crystal, its antiresonant frequency. At this frequency the crystal will exhibit maximum vibration and produce maximum piezoelectric charges to excite the grid. Thus, the frequency of the oscillator is determined by the antiresonant frequency of the crystal, and the plate circuit must be tuned to approximately this frequency. As in the tuned-grid, tuned-plate oscillator, the plate circuit must be tuned to a frequency slightly higher than the crystal antiresonant frequency, in order that it present an inductive reactance and maintain the proper 180-degree phase shift between the plate voltage and the exciting grid voltage. The amount of energy fed back from the plate circuit to the grid circuit is a function of the grid-to-plate capacitance of the tube. The grid leak resistor R_g serves to bias the tube as in the case of the self-excited oscillator circuits discussed previously.

The advantage of a quartz crystal over a coil-and-capacitor tuned circuit

Fig. 8. (A) Basic dynatron, or negative-resistance-type oscillator circuit, utilizing secondary emission characteristics. (B) Fundamental plate circuit characteristic of a screen grid tube, operated with high screen voltage. Portion B-O-C is the important negative-resistance (dynatron) region.



is that since the losses in the crystal are very low, its Q is many times that of any equivalent inductance and capacitance tuned circuit. Hence, the frequency stability and sharpness of tuning of such an oscillator is much greater than that possible with the usual inductance-capacitance circuit. Such quartz-controlled oscillators also are generally used as sources of the r.f. carrier current in radio transmitters. In applications where more than one frequency is to be produced by the oscillator, a separate crystal ground to the exact dimensions required for oscillation at that particular frequency is switched into the circuit for each different frequency required.

Oscillators for High-Frequency Circuits

As the ultra-high frequencies are approached, smaller and smaller inductances and capacitances must be employed in the oscillator tank circuits. Because their physical dimensions become so small it is difficult to build such components to have accurate values of inductance and capacitance. Finally, as we attempt to push up to higher frequencies, the stray capacitances between the leads to the tuning coil and capacitor and the interelectrode capacitances between the tube elements themselves become so great in proportion to the other constants of the tuning circuit that they determine the frequency of oscillation. That is why tubes especially designed for amplifier and oscillator operation at ultra-high frequencies are physically small, and have small clearances.

Tuning coil and capacitor combinations may be employed to tune oscillators at frequencies up to approximately 175 megacycles, but the Q of the combination will be low due to the high losses in both coil and capacitor. That is why the tank circuits in ultra-high-frequency oscillators are always comprised of either resonant coaxial or concentric transmission lines, or cavity resonators. These can be built to have high Q and high impedance at these frequencies, and because of their comparatively large physical dimensions in proportion to their resonant frequency, they can be built accurately to the desired dimensions and resonance frequency. Furthermore, by designing the tubes so their electrodes actually represent extensions of the resonant-line tank circuits, higher frequencies may be reached.

The Klystron and the new "disc" tubes, one of which from its shape is called the "lighthouse" tube, have made efficient microwave oscillators of considerable power possible. Electronically, the disc-seal tube is similar to the three-element tubes used in ordinary radio sets. It has the heated cathode, from which electrons are emitted; the grid, which controls their passage; and the anode, which receives them. However, it is built in a different way, from simple discs and cylinders. With the high-frequency waves for which these tubes are used, the shape has an importance which it lacks in tubes for the lower frequencies, such as those of ordinary broadcast stations.

In the microwave field it is not possible to look upon the oscillator tube as the evacuated part of the system and the wires and other associated parts and tuning circuits as units distinct and separate from it, as we do in the oscillators of lower frequencies. More and more it becomes necessary to think of a microwave oscillator, not as an electron tube with an attached circuit, but rather as a single electrical system having one section walled off and evacuated to house the electronic activity.

(*To be continued*)

450-mc. Transmitter
(*Continued from page 39*)

bar, drilled to slide on the plate and cathode rods, are used to adjust frequency and excitation. Antenna output is taken from a small loop grounded at one end and mounted in proximity to the plate rod shorting bar. Coupling is adjusted by bending this loop. The "free" end of this loop is connected to the center conductor of a small piece of coaxial cable which leads to a microphone connector mounted on the rear edge of the chassis. This cable should be firmly grounded at both the loop and connector ends. Alternately, output may be taken from the transmitter by means of a 2-wire line tapped on the plate rods.

Due to the shortage of meters, none was used in this transmitter, but in its stead, a meter jack, located in front of the 6SQ7, permits the measurement of plate current of the oscillator for preliminary adjustments. The standby switch, a double-pole, single-throw type, cuts both the "B" voltage and microphone battery when in standby position. The a.c. switch used to turn the power on and off, is mounted on the rear of the gain control R2. The pilot light is used to indicate when power is on.

After all holes had been drilled in the chassis and panel, they were immersed in a solution of 4 tablespoons of lye to a gallon of water and left in this solution about ½ hour until they assumed a beautiful satin finish. If silver-plating facilities are available, it is desirable to plate the brass blocks and rods of the oscillator to afford greater conductivity. However, this is an added refinement and not at all necessary.

Testing

When construction has been completed, tubes should be inserted in their sockets, the shorting plug in the power socket and the a.c. switch turned on. It is advisable to open the jack in the oscillator plate circuit by means of a piece of ¼-inch bakelite rod until the voltages have been checked. The

Sales manager Harry Kalker (center) of the Sprague Products Company, North Adams, Mass., gives careful attention to the daily batch of requests for free buy, exchange, or sell advertisements to be run in the Sprague Trading Post in this and other radio magazines. Assisting him on the job are office manager Mrs. G. I. Denoyan and research engineer Leon Podolsky, both of whom also take a personal interest in helping radio servicemen, dealers, and engineers obtain needed materials or dispose of materials they do not need through this unique wartime advertising service. During almost three years of operation, more than 7,000 individual advertisements have been handled in the columns of the Sprague Trading Post.

"B" voltage at the output of the filter should be approximately 250 volts and should not be allowed to exceed this value, or the oscillator tubes may be damaged. A 10-watt, 2000-ohm resistor should be connected in series with a 0-100-ma. milliammeter and plugged in the meter jack. The shorting bars should both be placed at the "cold" ends of the rod and a neon bulb touched to the plate rods near the socket terminal. Oscillation will be indicated by a change in the plate current and a glow in the neon bulb.

For frequency adjustment a pair of Lecher wires should be made up, using a pair of #16 bare wires spaced one inch and about five feet long. A piece of 1x2 lumber with standoff insulators will serve as a satisfactory support for these wires. This Lecher-wire arrangement should be coupled either to the antenna output connector, or directly to the "cold" ends of the plate lines by means of a small hairpin loop. With the meter and resistor combination plugged into the meter jack, a shorting bar consisting of a piece of brass rod mounted on the end of a bakelite or Polystyrene rod should be slowly slid along the bare wires, at the same time carefully watching the plate meter. At some point a small flicker in the plate current will occur. This point should be carefully marked and the movement of the shorting slider continued until another flicker occurs. The distance between these points should be carefully measured and the frequency calculated by the formula

$$F\text{ mc.} = \frac{5906}{\text{length (inches)}}.$$

It is probable that with the shorting bars at the extreme ends of the lines, that the frequency will be in the vicinity of 350 mc. The shorting bars should both be advanced in small steps toward the tube ends of the lines, carefully checking the frequency after each adjustment. In the transmitter described, 450 mc. was reached when the shorting bars were slightly less than half way along the rods. Some variation will occur in different transmitters, depending on the construction and lead lengths.

At some sacrifice in output, it is possible to make the frequency variable from the front panel, by means of a small condenser consisting of two ½-inch diameter brass discs, one soldered directly to the rear plate rod, while the other is mounted on a screw, adjustable through a hole in the front panel.

The antenna to be used depends on the builder's preference. A half wavelength at 450 mc. is only 12½ inches, so it is possible to put up an array of considerable gain in a very small space, using either coaxial line or open-wire line for coupling between the transmitter and antenna. If open-wire line is used, the spacing should preferably not be over 1½ inches between wires in order to eliminate radiation from the feed system. Many

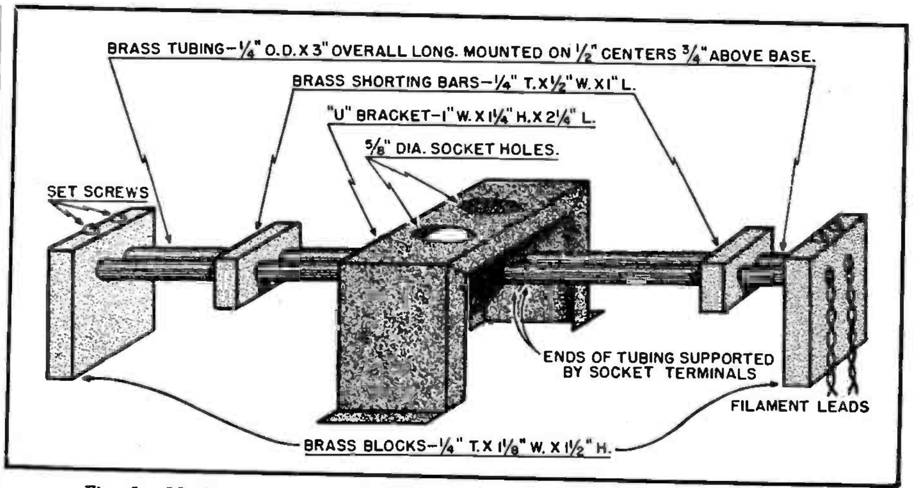


Fig. 5. Mechanical construction of the oscillator-tuning rods. The shorting bars may be varied to obtain any frequency between 400-500 megacycles.

types of antennas suitable for use at these frequencies are described in the various handbooks and if one of the directional type is used and made rotatable, true beam transmission is possible over "line of sight" distances.

For preliminary checking of the transmitter characteristics until such time as transmission is legal, a simple receiver consisting of a crystal detector connected to the center of two separate six-inch rods, with a pair of headphones connected across the crystal detector, with small r.f. chokes consisting of 50 turns of #30 enamelled wire wound on a ¼-inch bakelite rod in each headphone lead right at the detector, may be used. If a microammeter is substituted for the headphones, the effect of various changes in the transmitter and antenna may be observed and optimum adjustment made in this manner.

Optimum performance from 6C4's in this application is attained when the plate current for the two tubes is between 40 and 50 ma. Under no condition should the plate current be allowed to exceed 50 ma. or secondary emission from the tube grids will occur and greatly shorten the life of the tubes.

The only satisfactory simple receivers that have been developed for use at these frequencies are those of the superregenerative type. Superheterodynes are difficult to construct and the gain is little better than that of the superregenerative type although the selectivity is considerably better. A future article will describe the construction of a simple receiver of the superregenerative type.

While this transmitter does not represent the ultimate, it should serve to acquaint the builder with the characteristics of these frequencies, and serve as a basis for further experiments.

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The Veteran Wireless Operators Association banquet, which was held at the Hotel Astor in New York City on February 17, 1945.

Rural Radioman
(*Continued from page* 37)

holes, have never known glass. Both are boarded up in winter against the cold. The single room would be Stygian dark but for the blazing logs in the huge open hearth. Over the fireplace a long, rough scantling serves as a mantel, repository for several small bags of herbs, a seldom used kerosene lantern, and family pictures. Nailed to the walls, not too near the fire, are several bush hides of coon, fox, and groundhog. From pegs here and there hang overalls, a cap, a rifle, a coal-oil can. On one side of the hearth a stack of firewood, on the other a grotesque old talking machine, (perhaps playing "On The Wall," a melancholy dirge). At the far end of the cabin are the beds—four wide, wooden things of incalculable age, jammed headboard to footboard, two to a side. On these sleep all the family, together with such of their kin as may trek over the ridge for a visit. A reckless pullet from the flock of 30-odd outside, stalks solemnly across the floor in quest of a stray grain of corn."

"We allus lived hyar—my pappy an' his pappy afore him, I reckon"—is a stock phrase suggesting the status quo of the mountain folk before the advent of radio. Whole communities have remained unchanged for fifty years—and at least one community, Ox Creek, Buncombe County, is practically the same as it was 150 years ago. There are no mules or horses—not an automobile in nine square miles—and oxen are used exclusively as work stock and as a mode of transportation. The invisible radio waves, however, are the leavening process likely to transform these mountainous areas into modern counterparts of progress. News and entertainment by radio are infiltrating the coves and isolated outposts—where formerly there were no available newspapers. Sermons vie with hillbilly music for popularity, and many mountain music-makers have climbed the pinnacle of fame and riches via the ether route. An outstanding example is Roy Acuff, a mountain boy of Tennessee, whose singing of heart-songs on radio programs, in motion pictures, and by making personal appearances is grossing him a revenue in excess of $100,000 per year.

Henry Baird maintains that what radio means to these isolated folks can only be appraised properly by personal contact. He relates the instance of his most vivid experience of twenty years as a radioman. It was just before Christmas of 1944. He had received word of an elderly woman living alone in a remote spot of the hills—her only contact with the world beyond her own very restricted vista—sound or sight—was a radio receiver that had fallen into disrepair. An expensive repair bill, with which she was unable to cope, loomed whenever she consulted servicemen. Henry offered to fix the set without charge. It was put into working order, returned to her promptly, and when told it was o. k. she smiled that gracious smile of appreciation, with the remark, "I will have a happy Christmas after all." Money then seemed indeed but as "filthy lucre" when Henry told us that he refused any remuneration even for his time, adding that, "I was repaid tenfold when I saw how much this little radio meant to her."

The experiences of Henry Baird in fixing radios run the gamut from the simple procedure of adjusting a set in which the broadcast band had simply been switched to the short-wave band and the complex operation of checking and almost rebuilding a noisy receiver. About ready to despair, he disconnected the "magic eye" and the trouble vanished before his eyes. When trouble-shooting and finding something out-of-the-ordinary wrong, he jots down the nature of the difficulty and how he solved it—as a sort of reference guide should he encounter similar trouble. But here is one experience that Henry hopes will not be duplicated. He reports, "I went out on a job one day where I was met at the door by five dogs and four cats. I had to wade knee-deep through this menagerie to reach the radio. I have never been kissed by so many animals before. You may think this job was the cat's meow, but believe you me, when I had finished I was doggon' tired."

That reflects the lighter, the humorous side of this unique "radio man of the mountains." I like to think of Henry Baird as a many-sided personality—a practicing philosopher, a missionary to the mountain folk with the zeal of a spiritual missionary to a foreign field, and even as a philanthropist (for he is well-to-do in the rights of his own bank account and estate) in discounting rather than counting the dollars in repairing radio sets whose owners are not rich in worldly goods. Furthermore, he is a radio pioneer, having been inoculated with the "bug" in 1922 when he walked two miles to the home of a friend to listen to his first broadcast. The set was produced by that "grand old man" and "father of radio"—Dr. Lee de Forest. Making use of head telephones and plugged-in tuning coils, Henry recalls that this early receiver took on the appearance of a telephone switchboard, rather than than of a radio receiver.

The first station tuned in that eventful evening 22 years ago was that pioneering station KDKA; the musical number being played was "Sleepy Hollow," by Richard Koontz; and the announcer was Glenn Riggs. One night Henry was listening to a program when a sudden mountain thunderstorm developed, virtually stunning him, and causing him to throw the headphones to the floor, breaking them to smithereens. "Well, after that," muses the philosophical Henry, "I bought a radio of my own and really turned into a night owl. I would sit until the last station had signed off." Incidentally, and as a valuable pointer to other servicemen, he reserves his best radio set for use by customers when they would otherwise be deprived of radio during the period required for fixing their own sets.

Henry Baird, in stature at least, has the appearance of the mountain folk to whom he is a benefactor. Towering more than six feet, slightly stooped—a posture due to bending over an estimated 10,000 radio sets in twenty years, he reflects the kindliness and staunch friendliness of the hill country. He is a Beau Brummel, and goes to church on Sunday. Aside from one diversion, radio—both his vocation and avocation—his one hobby is that of approaching, in a serious mein, and asking a drug clerk for a particular drug in pharmaceutical terms—for instance, scorning the simple term aspirin and requesting the purchase of acetylsalicyclic.

Henry Baird, modest, unassuming man that he is, would not lay the slightest claim to being, even in disguise, an inventor or a radio manufacturer, but he, too, has a blueprint for tomorrow's radio receiver — at least how to simplify it. He captions his 9-point proposal as "Some Changes I Believe Every Serviceman Would Be Glad to See in the Postwar Radio," and this writer believes thousands of radio servicemen will rally to the cause of his agenda. It follows:

(1) Each radio should have the model number die-stamped on the chassis. It has been the practice of most manufacturers to print the number on a piece of paper and paste it on the inside of the cabinet or on the chassis. In many cases the glue dries out and the paper comes off and is lost.

(2) The capacity and working voltage should be plainly marked on each by-pass and filter condenser.

(3) The frequency of all i.f. transformers should be indicated on the can.

(4) The resistance of the field should be on every speaker.

(5) One standard color code should be used for all resistors.

(6) Portable radios should have an efficient loop built in the back cover instead of the mess of wires running all through the cabinet.

(7) Tube sockets should be marked with the type of tube used instead of printed on a diagram and pasted on the chassis.

(8) A simple dial mechanism should be worked out to replace some of the present complicated wheels and pulleys, which require a contortionist to string one of the blamed things.

(9) The types of tubes used should be reduced from the present six or seven hundred to not more than fifty. If this had been done several years ago the present tube shortage would not exist.

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Quartz Crystal
(Continued from page 41)

tions receiver. When the carrier signal strength meter is fully deflected the receiver dial reads the approximate frequency, but cannot be depended on to identify the nearest 10-kc. harmonic from the frequency standard. To make this identification with certainty, the heterodyne frequency meter mentioned before is used. What is heard from the receiver is the beating of the unknown crystal frequency with the variable oscillator frequency. When zero beat is found by adjustment of the frequency meter, the latter is turned off and the 10-kc. marker frequencies are turned on. It is possible then to hear the crystal frequency beating with the next upper and the next lower of the 10-kc. markers. Due to the nonlinear characteristics of the ear, the lower audio beat note seems louder. The frequency of this audio note is measured by beating it in turn with the output from a calibrated audio oscillator. The reading from the heterodyne frequency meter is combined with that from the audio oscillator to give the frequency of the crystal, usually to 1 part in 100,000, which is sufficiently accurate for the manufacturing tolerance required. The final comparison of the audio signals is sometimes done with a cathode-ray oscilloscope, as it is possible to confuse aurally the fundamental and a harmonic when comparing the beat note with the audio oscillator output, and thus to make a mistake of an octave or two. With the cathode-ray tube, the pattern for the correct relationship is an unmistakable circle or oval. This is easily distinguished from the looped figure formed when harmonics are compared.

This rather involved procedure, with its use of expensive equipment, would make it uneconomic to thus measure each of the thousands of crystals that the war effort requires. Since the production of crystals requires large quantities at each of a series of frequencies, a standard crystal is made for each of these frequencies and is calibrated by the exact and accurate technique described. Thus, the crystal being brought to the frequency of the standard is compared to it by the use of a device known as the

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WANTED: Part time technical writing assignments on a variety of subjects in the Electronic field. Letters indicating background, experience, etc., cheerfully submitted. Box #396, % Radio News.

SONG Poems wanted to be set to music. Send poem for immediate consideration. Five Star Music Masters, 420 Beacon Bldg., Boston 8, Mass.

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MISCELLANEOUS

MAGAZINES (back dated) — foreign, domestic, arts. Books, booklets, subscriptions, pin-ups, etc. Catalog 10c (refunded). Cicerone's, 863 First Ave., New York 17, N. Y.

crystal duplicator. This embodies two oscillator circuits, one for each crystal, and a detector for rectifying the beat note. A frequency meter circuit indicates the frequency difference. The ranges of the instrument are generally 50 kc., 5 kc., and 500 cycles per second for full-scale deflection of the meter. Thus, the crystal being worked may be brought to the frequency of the standard as closely as desired. This is usually within a few parts in 100,000.

—30—

Radio for Morale
(Continued from page 31)

in touch with current practice in radio manufacturing the specifications for some of the minor components might almost seem fantastic. For example, the hookup wire used in the RE-1 meets the following specifications and tests. Insulation is of cellulose acetate butyrate or vinyl polymer covered with a braid of cotton, rayon, or glass fiber. This covering must withstand both fire and water, it must not break down when subjected to a potential of 2000 volts for one minute after being immersed in water for 24 hours and when placed in the flame of a Bunsen burner shall not burn faster than one inch per minute and must not throw off any burning particles. Fantastic?—perhaps, but also vitally necessary if reliable service under the worst possible conditions is to be maintained.

One unusual feature of the new Sky Courier is the completely foolproof method by which the change from battery to a.c.-d.c. operation is accomplished. When operated on its self-contained batteries the line plug is inserted into a special socket at the rear of the chassis. This socket has two contact springs for each prong of the plug and the combination acts as a double-throw four-pole switch. With the plug in the socket, the 3Q5GT and "A" battery are connected in the circuit; when it is removed and plugged into an a.c. or d.c. outlet the "A" battery and 3Q5GT are disconnected and the 35Z5GT rectifier and 50L6GT final amplifier are placed in service.

Many pieces of radio equipment which have been designed for military use during the past few years will have no applications in the peacetime world as the purposes for which they were built have no peacetime counterparts. This is not the case with the new Sky Courier. The qualities of high performance, portability, and rugged reliability, so vitally necessary for military service, will be equally desirable in the years to come. Camper, woodsman, tourist, explorer, farmer—anyone who needs completely reliable radio reception in its most compact form will find a receiver such as this ideal for this purpose.

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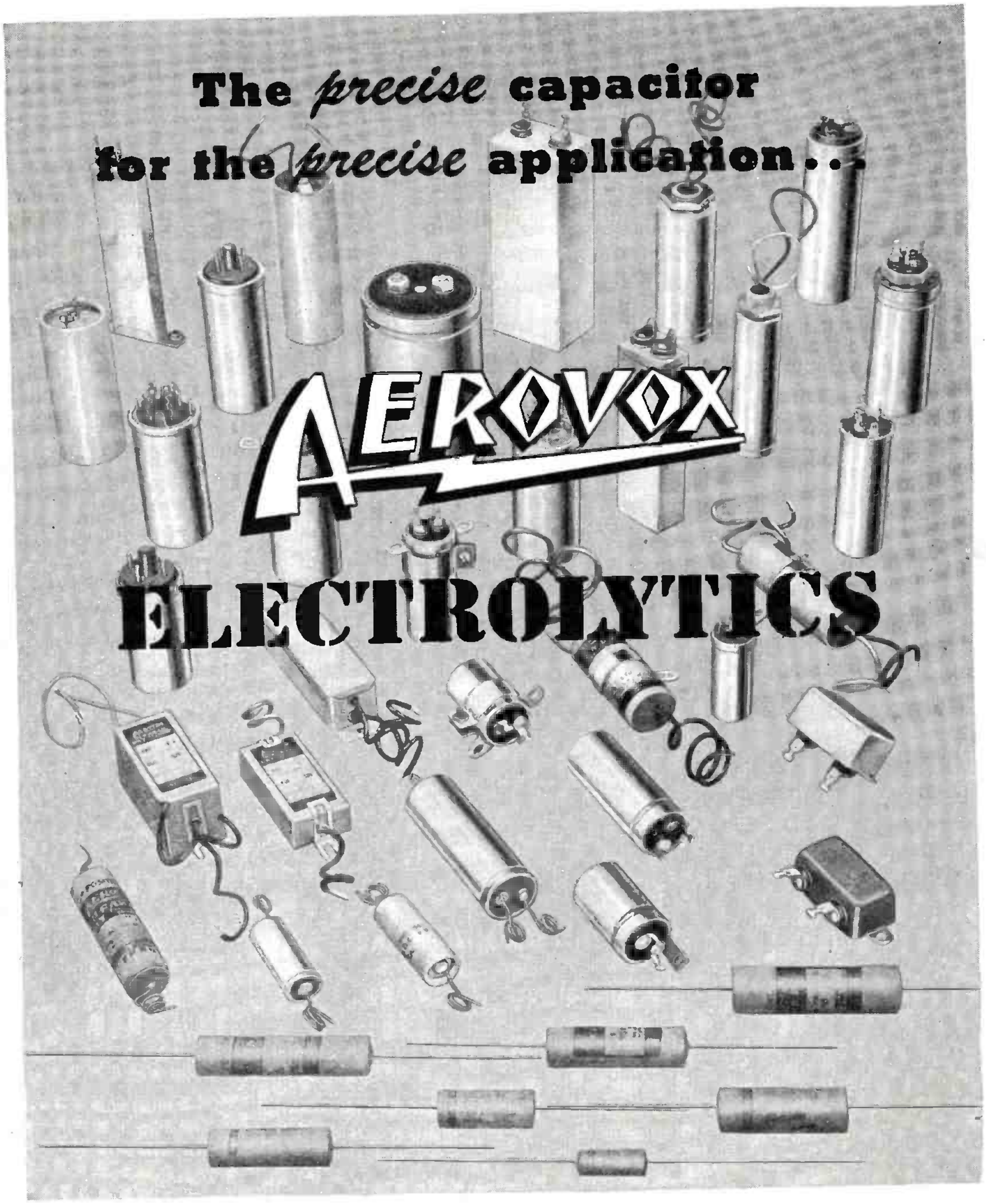
May 1945



● The electrolytic capacitor has its own special field of application in electronic, radio and electrical equipment. This type provides the equipment designer with *an unusually lightweight unit* of high capacitance in a compact container. Also, it effects considerable savings. **BUT...**

Electrolytic capacitors must be properly applied for long life and stable characteristics. There are essential differences between electrolytics and other types that restrict their use, such as over-voltage, allowable ripple current, capacitance, tolerance, temperature. **WHICH MEANS...**

The proper type and rating must be used for the given application, along with meeting mechanical considerations, if the basic advantages of electrolytics are to be gained. **THAT IS WHY...**

Aerovox, pioneer of the dry electrolytic, continues to offer the outstanding selection of electrolytic capacitors. There is the PRECISE capacitor for the PRECISE application, which guarantees satisfactory service and long life. Don't improvise!

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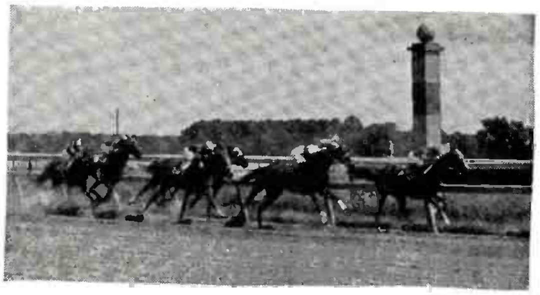
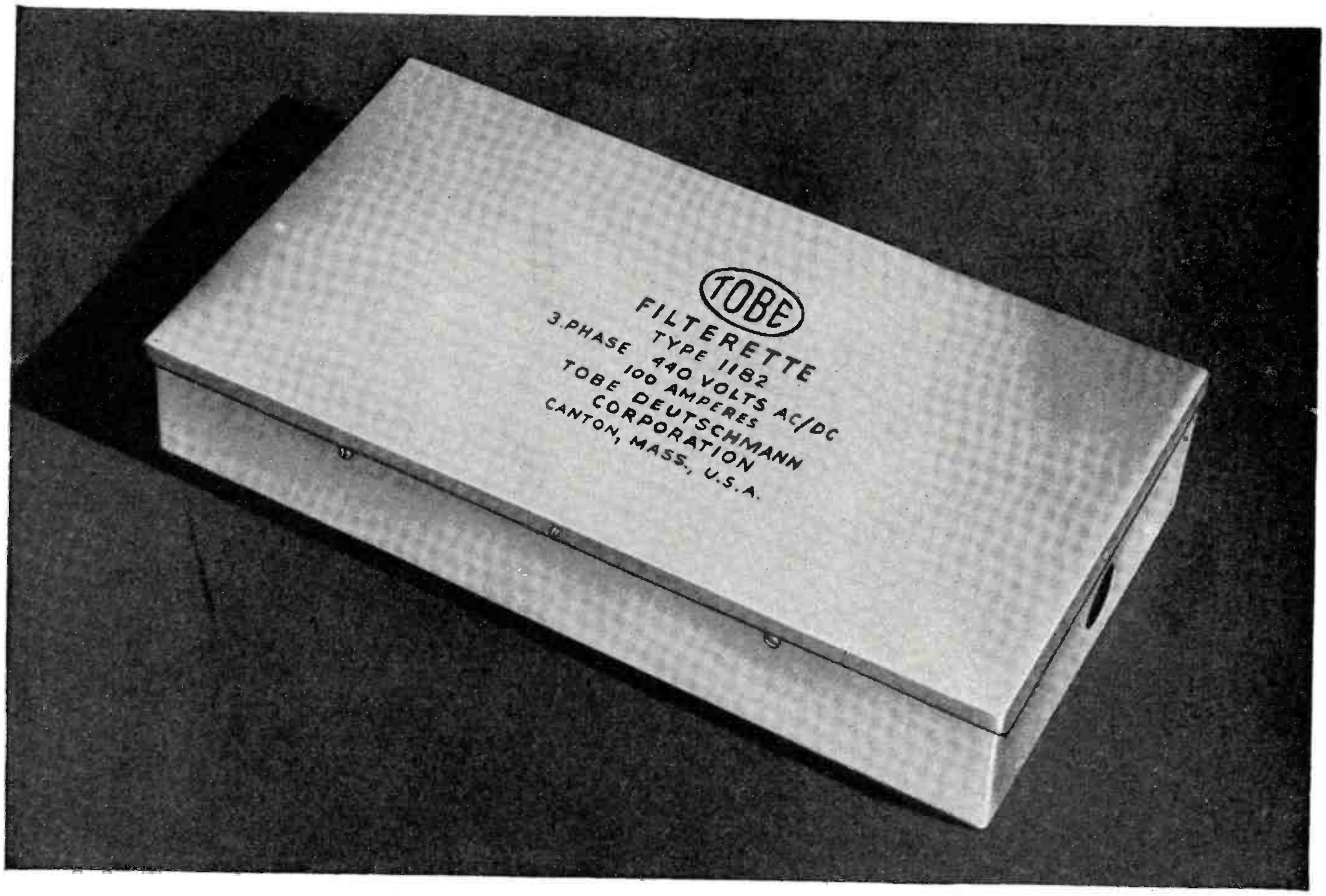


AWAY AHEAD!



Tobe Leads the Noise Elimination Field

Few problems are as vexing as the elimination of unwanted radio interference set up by the operation of nearby electric motors. And few sources of engineering advice on this subject are as experienced as the Tobe Engineering Staff. *Tobe is the acknowledged leader in this field;* our organization has devoted 17 years to the intricate problems of noise elimination.

The large #1182 Navy-Type Filter illustrated above is an example of our specialization. Examine the curve and container dimensions. This is only one of a large number of filters designed to meet special needs. Send for complete details. Let us help you solve any problem connected with blotting out unwanted "man-made" radio static. Your inquiries are welcome.

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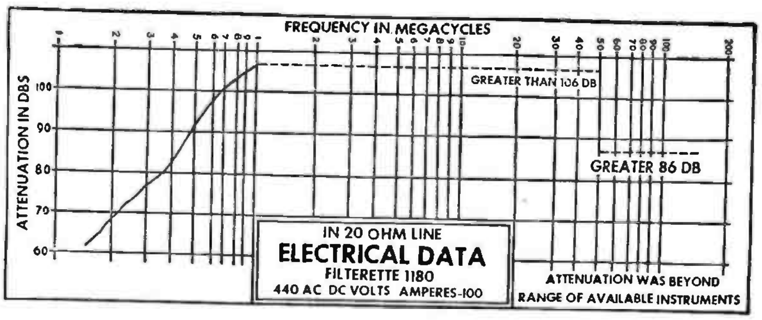


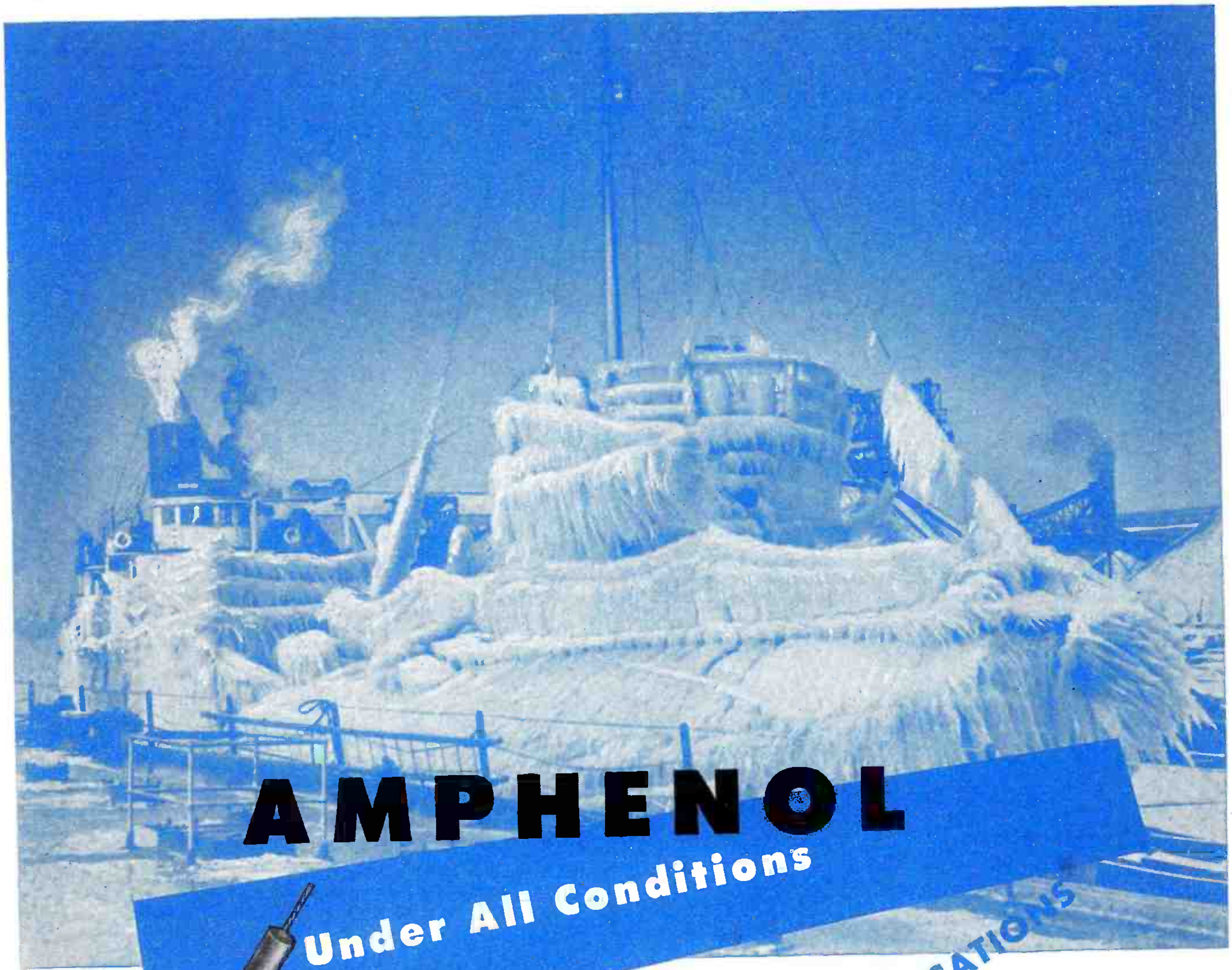
SUPPRESS MAN-MADE RADIO STATIC
TOBE
FILTERIZED

TYPE 1182—ATTENUATION RANGE
150 KC to 150 MC

CONTAINER DIMENSIONS

Length . . 22 1/8" Height . . 4 1/8"
Width . . 11 7/8"

This unit contains three #1180 Filterettes, each bearing Navy-Type No. CTD 53177.



AMPHENOL

Under All Conditions

CONTRIBUTES TO RELIABLE COMMUNICATIONS

Man's isolation under adverse conditions has ended with recent radio developments which overcome the trying conditions of air and sea transportation. This means rising above all conditions of interference. Among the things that have made this possible is Amphenol *current transmission equipment* that will carry the high frequencies without appreciable loss.

The name "Amphenol" on high frequency cables means the best of polyethylene insulated cable—cable that is sold under affidavit of exacting tests and inspections. "Amphenol" on low-loss connectors means the minimum of loss in tight fitting, secure holding connections. On both it means transmission equipment that will do its part toward providing the clearest possible transmission and reception of communications even under adverse conditions.

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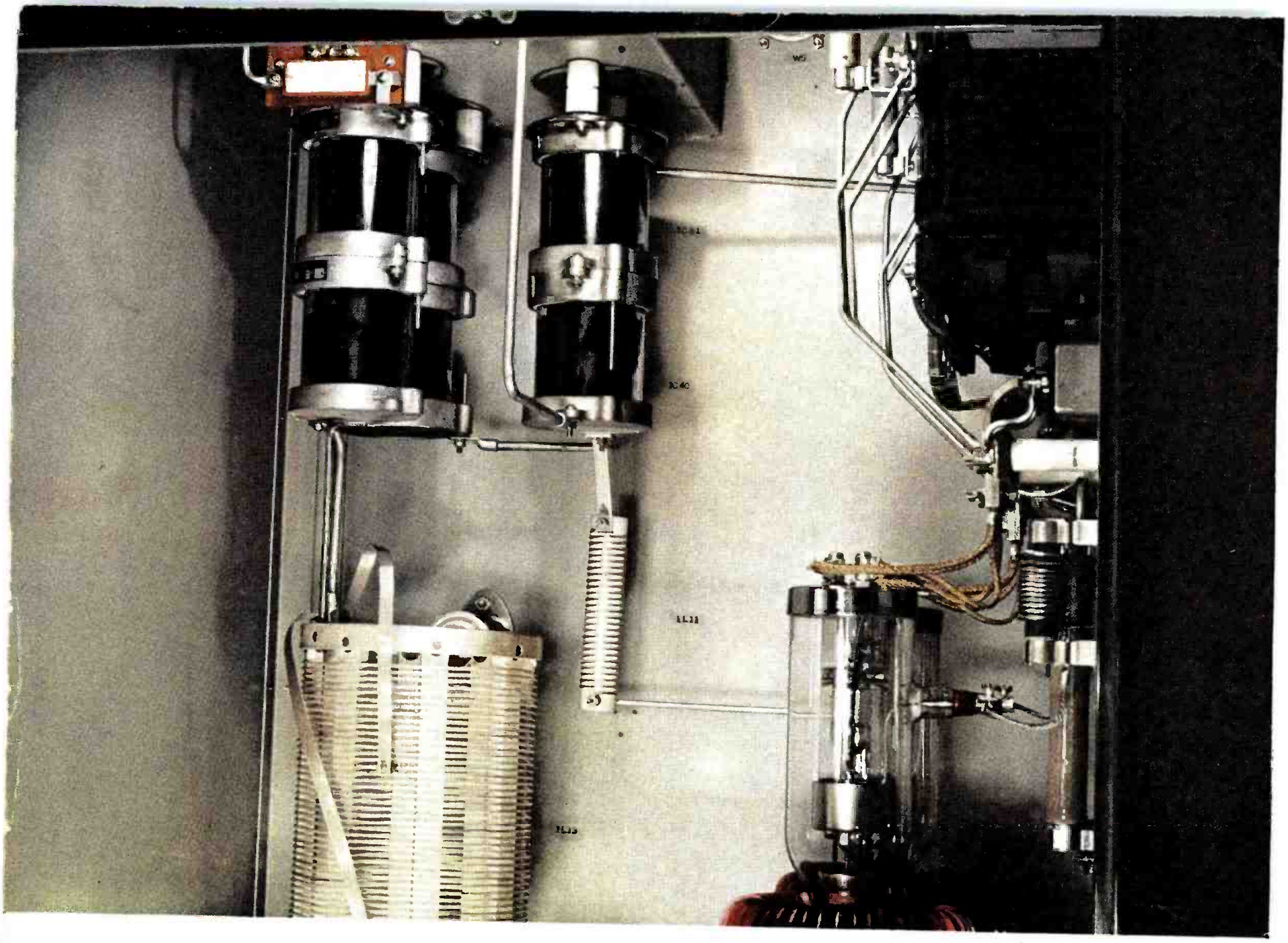

FARADON CONDENSERS FOR HIGH-POWER TRANSMITTERS

BROADCASTING, as an industry, is celebrating its 25th Anniversary this year. There were Faradon Condensers in many of the first broadcast transmitters. There have been Faradon Condensers in every RCA Broadcast Transmitter since—and in every RCA aviation, police, communications and military transmitter.

Today RCA engineers — and engineers of many other companies — specify Faradons exclusively for transmitting and electronic equipment. They know that these condensers are reliable, that they can be counted on to stand up under hard usage. And they have found that the wide range of sizes, ratings and mounting cases makes them easily adaptable to any equipment design.

For complete information on Faradon Capacitors for any purpose, write to the Engineering Products Department, RCA Victor Division, Camden, New Jersey.

Right and Above — *Power-amplifier cubicle of the new RCA 5/10 KW Broadcast Transmitter. In the design of this modern, streamlined transmitter particular stress is placed on absolute reliability. Faradon Condensers, manufactured by RCA, are used throughout.*

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