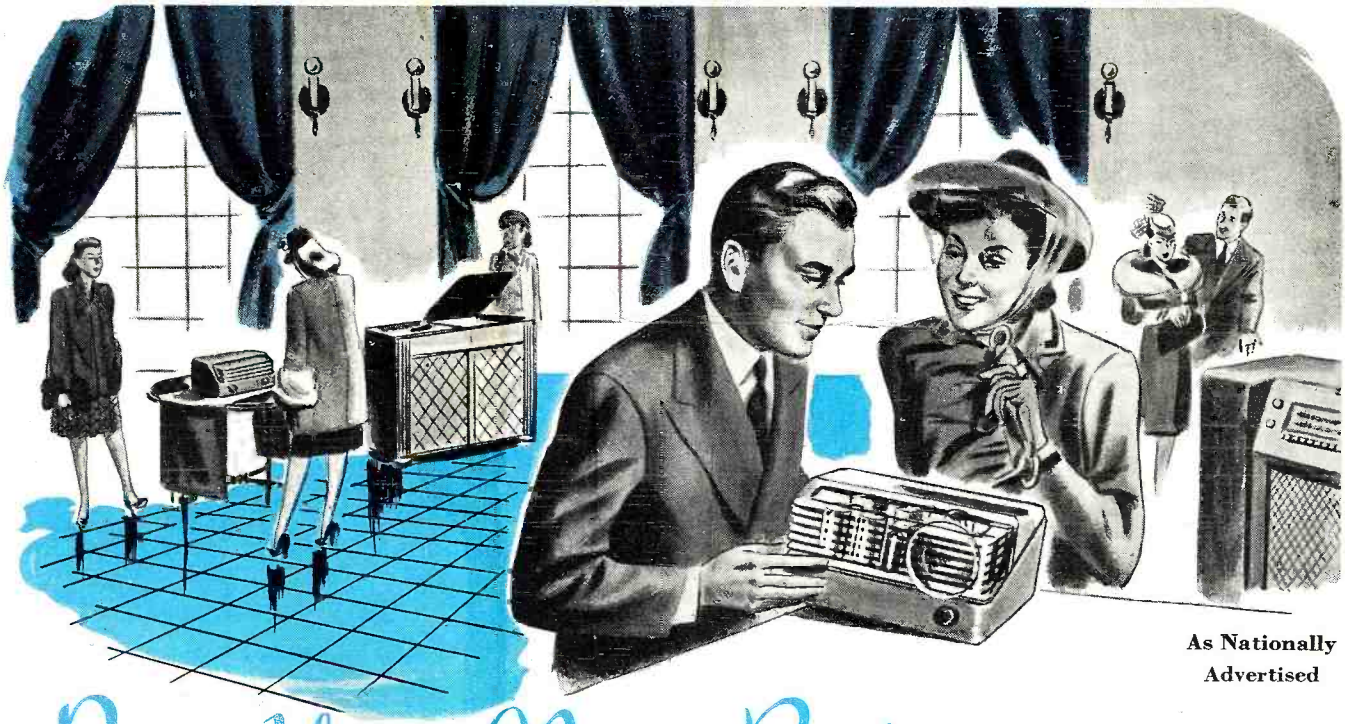
RADIO NEWS

JULY
1945
35c
In Canada 40c

COLOR TELEVISION CAMERA. INSET ... IM.



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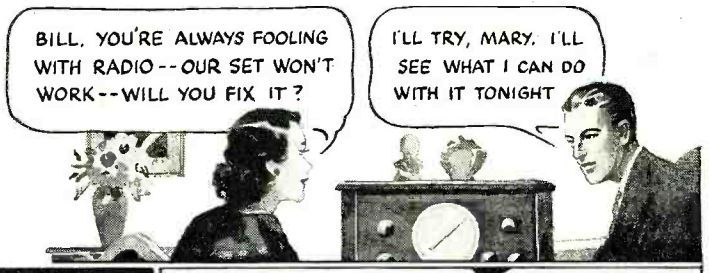

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Many Beginners Soon Make $5, $10 a Week EXTRA in Spare Time

The day you enroll I start sending EXTRA MONEY JOB SHEETS to help you make EXTRA money fixing Radios in spare time while learning. You LEARN Radio principles from my easy-to-grasp Lessons—PRACTICE what you learn by building real Radio Circuits with the six kits of Radio parts I send—USE your knowledge to make extra money while getting ready for a good full time Radio job.

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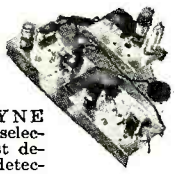
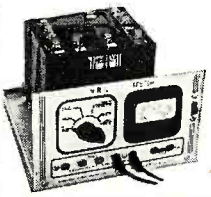
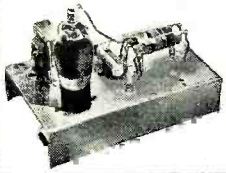




SUPERHETERODYNE CIRCUIT (right) Preselector, oscillator-mixer-first detector, i.f. stage, diode detector—a.v.c. stage, audio stage. Bring in local and distant stations on this circuit you build yourself!

MEASURING INSTRUMENT (above) you build early in Course. Use it in practical Radio work to make EXTRA money. Vacuum tube multimeter, measures A.C., D.C., and R.F. volts, D.C. currents, resistance, receiver output.



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RADIO NEWS

Reg. U. S. Pat. Off.

JULY • 1945

VOLUME 34, NUMBER 1

CONTENTS

FEATURES

DEPARTMENTS

COVER PHOTO

By Frank Ross

(Staff Photographer)

Color television camera used by the Columbia Broadcasting System. See page 32 for a discussion of several television systems.

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THE Model S-36 is probably the most versatile VHF receiver ever designed. Covering a frequency range of 27.8 to 143 megacycles it performs equally well on AM, FM, or as a communications receiver for CW telegraphy. Equipment of this type was introduced by Hallicrafters more than five years ago and clearly anticipated the present trend toward improved service on the higher frequencies.

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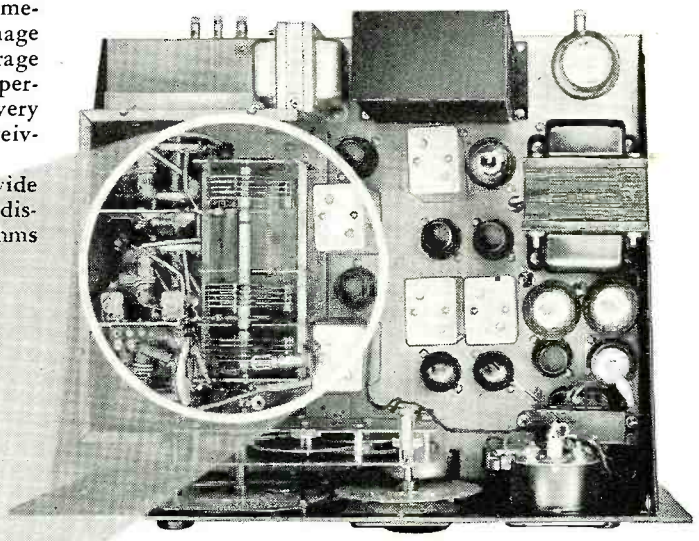
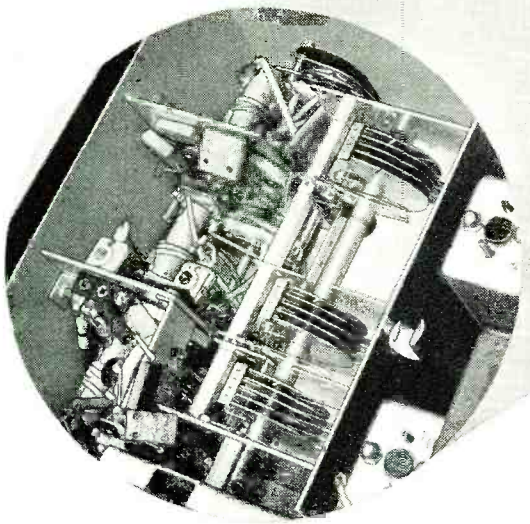
FM-AM-CW
27.8 to 143 Mc.
Covers old and new FM Bands





The RF section is built as a unit on a separate chassis which may easily be removed for servicing and incorporates a three position ceramic band switch. The positive action mechanical bandspread dial turns through more than 2200 divisions for each of the three ranges, 27.8 to 47, 46 to 82, and 82 to 143 megacycles.

For details on the entire Hallicrafters line of precision built receivers and transmitters write for Catalog 36-C.

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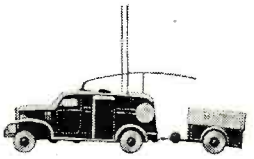

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FOR THE RECORD ..... by the editor

We share space this month in our column to bring you a special message from our Chief Signal Officer, Major General Harry C. Ingles. It speaks for itself.

UNEMPLOYMENT certainly will not be a factor for many months to come in the radio-electronics industry. Many manufacturers will continue to employ their skilled labor. Those who will be first to quit their jobs will, for the most part, be sweethearts and wives of returning G.I.'s. This will present no hardship to industry as most of the girls have been serving as a patriotic gesture and many of these have not depended entirely upon their factory income for support.

Perhaps more than most industries which have had a major role in the war, radio-electronics will see a minimum cut back. It still has a huge job ahead. The transition from the European to an all-out Pacific war will see little change in demands for military communications equipment. The only difference will be the technique employed to coordinate the movement of troops. Communications facilities in the European war depended largely upon wire services. While radio communications were widely used, wire services were preferred in most cases to prevent vital information from reaching the ears of the enemy.

The Pacific war, on the other hand, will be more of a true radio war. No longer will wire be as prominent. Contact between islands, etc., will depend upon radio for communications.

It is interesting to note that of approximately 160,000 items used by our Signal Corps only a few more than twenty have been dropped. The demand for equipment still goes on at a heavy pace.

The problem of supply becomes more critical as we extend our pipe line to Tokyo. For example, dry batteries must be shipped immediately after they leave the production

(*Continued on page* 128)

IT would not be difficult—and it would certainly be fitting—for me at this time to congratulate the radio and electronic industry on their immeasurable contribution to the victory in Europe. Your work here at home—whether it has been supervisory, technical, on the production line, or clerical—played an important part in this victory and will continue to play an important part in the prosecution of any campaign. In battle, our combat forces are able to advance and overcome the enemy because of the coordinated action of all units involved. This coordination is made possible through the use of Signal equipment—electronic, telephone, and telegraph—which civilians build.

With Germany defeated, we are able to cut back to some extent on our requirements for electronic equipment but we still require large quantities. We are still confronted with a powerful and implacable enemy in the Pacific and we still must supply an Army of over six million men. The race is only half-way through and it would be foolish indeed if we paused to celebrate the fact that we are now in the lead. The race must first be won—and the sooner the better.

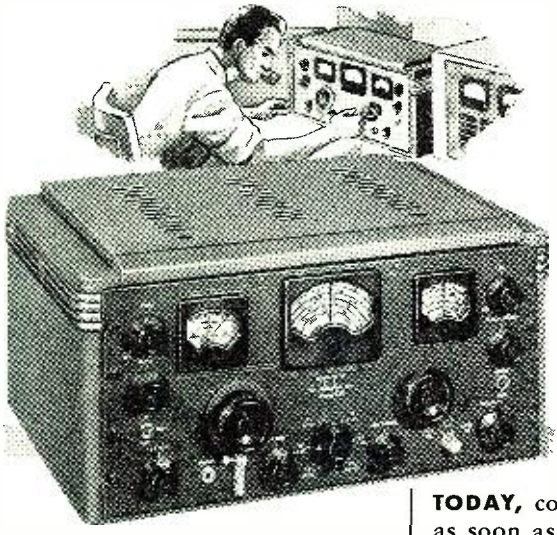
I should like therefore to use this occasion as an opportunity to put the industry's spotlight on the Pacific. There, even more than in Europe, our victory depends upon the job done by radio and electronics. Even though our requirements will now be somewhat less, we must give the Pacific job the full throttle attention that we gave the job in Europe. By doing so, we will speed the day of final victory.

Our fighting men will win this war for us if we give them the equipment. Front line soldiers depend on you to discharge this trust. You have done a magnificent job thus far, but we must continue our efforts. Victory can be hastened by your continued support. I am confident that you will do your best for the finest fighting force in the world—the United States Army.

H.C. Ingles

Chief Signal Officer, U. S. Army

RESERVE YOUR POS -WAR



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MODEL SX-28A—This is the latest model of Hallicrafters famous *Super Sky-Rider* . . . the finest communications receiver built today! Has a frequency range of 550 kc. to 42 Mc. continuous in 6 bands. With crystal, less speaker, net.....**$223.00**

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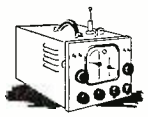

MODEL S-36—Covers both old and new FM bands. Operates on FM, AM, or CW. Outstanding for sensitivity, stability, high fidelity and versatility in the *very high frequencies*. Range from 27.8 Mc. to 143 Mc. continuous in 3 bands. Less speaker, net.....**$307.50**

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1. All you have to do is enter your order now with Allied.
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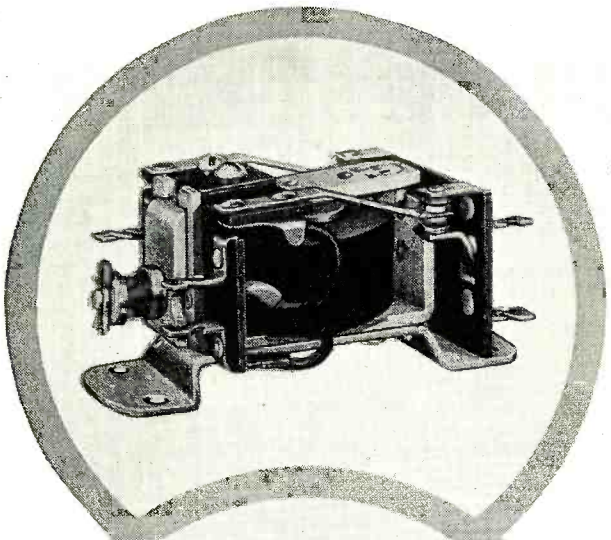

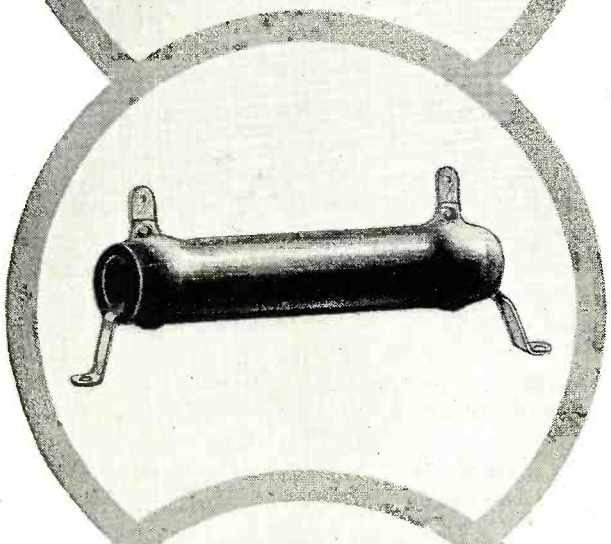

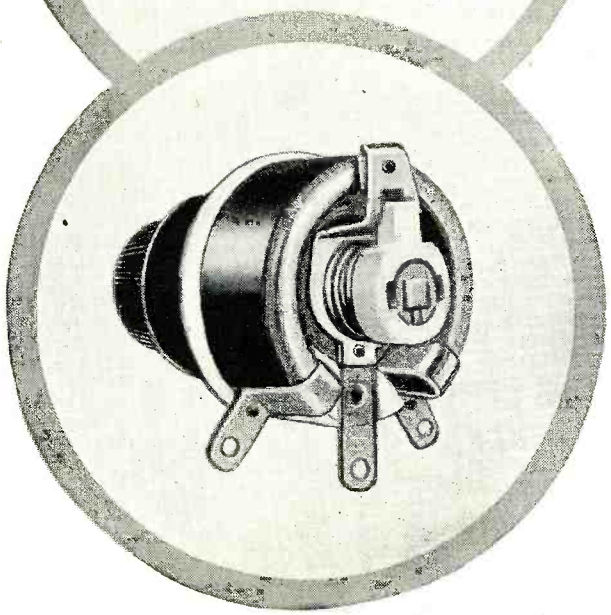

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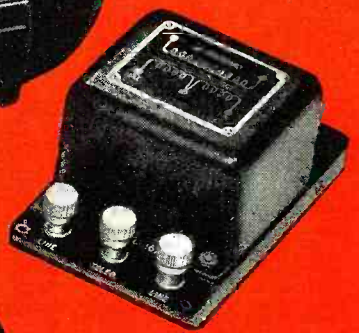

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Spot Radio News

Presenting latest information on the Radio Industry.

By FRED HAMLIN
Washington Editor, RADIO NEWS

THE ANNOUNCEMENT THAT NORTH AMERICAN PHILIPS COMPANY would cancel its restrictive patent agreement with RCA, effective July 1, has been called "a bombshell" by more than one close observer of the radio industry. Maybe a better term would be "time fuse"—a time fuse with a dozen different strands, any one of which may lead to a resounding explosion. . . . North American Philips, it will be recalled, is a war-born U. S. branch of the mother company, N. D. Philips Gloeilampenfabrieken—electric light bulb factory to you—which recently took back from the Nazis its world-famous plant in Eindhoven, Holland. Although the plant had not been spared by R.A.F. bombers, and although the Germans took everything that wasn't nailed down when they had to run, reports are that the factory is not in bad shape and that it will soon be the big influence it once was in the world radio appliance market.

North American Philips has three factories in the U. S.—at Dobbs Ferry and Mt. Vernon, N. Y., and Lewiston, Me. All Philips interests share the organization's excellent dosier of patents, including rights on the pentode tube, which is used in almost all home receiver sets. These rights are among the many that North American proposes to deny RCA. . . . Reasons for the Philips move are anybody's guess. Two of the better off-the-cuff deductions: That North American Philips officials really meant it when they announced early this year that they were "not going home" after the war and are now preparing to get into the U. S. domestic market in a big way; or that, after the RCA cancellation is nailed down, Philips will throw its rights on the open market, giving RCA a chance to buy them, but not exclusively. GE and Westinghouse have been mentioned as other potentially good customers. . . . This raises another serious question—what are other U. S. companies going to do about their present leases and agreements now that Philips has altered the set-up? Any way you figure it, the situation as it affects the radio industry proper is highly volatile, to say the least.

MAJOR REASON GIVEN officially for postponing the Rio de Janeiro Third Inter-American Radio Conference from May to September was that FCC had delayed handing down its final allocations report. This is a good reason, but not the only one. . . . Another is that State Department, after a series of meetings with representatives of the U. S. radio industry, is still puzzling over how to formulate a U. S. policy to which everyone will agree. State has one consolation—the Rio show will, at best, be only a trial run for the world conference, tentatively set up for "sometime next year." . . . You can take that date—if it can be called a date—with a grain of salt, since final world allocations can never be adequately nailed down 'til every nation clear around the world is represented at the world meeting, and there seems, now at least, little likelihood that Japan will be beaten and yet well enough organized to send a delegation by the end of 1946. . . . Meantime, State Department is officially optimistic about the ultimate outcome of world amity on the airways. "Never before," says Francis Colt de Wolf, chief of State's telecommunication division, "has there been closer integration between government and industry. I feel confident that we will ultimately reach solutions which will prove acceptable to all the users of the radio spectrum, although they may not obtain 100 percent of all their demands."

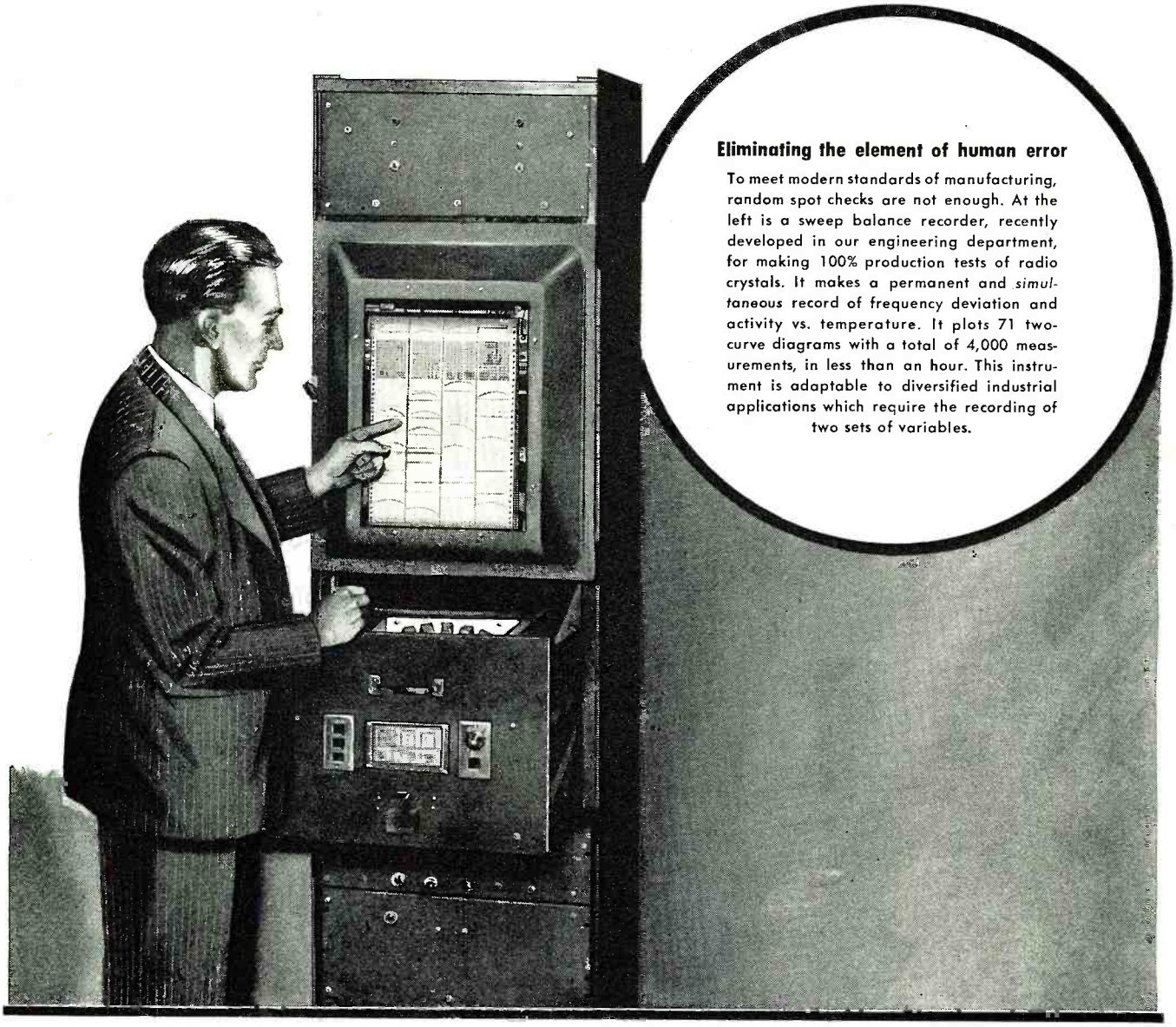
THE PHILIPS MOVE is not without its political implications, which reach back into the industry. Coincident with the Dutch company's announcement, Senator Capehart of Indiana, speaking for himself and for Senator Wheeler of Montana, introduced a resolution that the Committee on Interstate Commerce investigate "the relationship of foreign companies . . . to radio and other communication in the United States, with particular reference to patents." Senator Capehart is, of course, not unknown to the radio industry, nor is his company without interest in the Philips activities and patents. . . . Another Senator who is watching developments with more than passing interest is Kilgore of West Virginia, who last year, as chairman of the subcommittee on war mobilization of the committee on military affairs, published an official monograph on international cartels in which some of the leading characters were the Philips interests. Senator Kilgore's investigations were supported and closely watched by another Senator of the name of Truman, who is also said

"GREATNESS IS NOTHING BUT MANY SMALL TRIFLES"

Old Proverb

The precision required of Connecticut Telephone & Electric Division's production keeps us on our toes . . . developing new and better manufacturing methods . . . devising improved techniques of quality control. One example is the crystal tester developed by our engineers which gives us a quality check in quantity.

This is one of many special instruments in Connecticut Telephone & Electric Division's plants. Each is designed to assure our armed forces of better products. Each one contributes its trifle of greater dependability and higher accuracy to the electronic and communications equipment you will use after the war.



Eliminating the element of human error

To meet modern standards of manufacturing, random spot checks are not enough. At the left is a sweep balance recorder, recently developed in our engineering department, for making 100% production tests of radio crystals. It makes a permanent and *simultaneous* record of frequency deviation and activity vs. temperature. It plots 71 two-curve diagrams with a total of 4,000 measurements, in less than an hour. This instrument is adaptable to diversified industrial applications which require the recording of two sets of variables.

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to be interested in the proposed Capehart patent investigation. Incidentally, these mutual interests are not without amusing political side-lights —Capehart was a Willkie Republican and, since he came to the Senate, has been on the conservative side. Kilgore is a New Dealer from way back. . . . Coordinated with any forthcoming action on the Hill may be anti-trust activities, if indicated, by the Department of Justice, which already has an incandescent lamp suit involving Philips pending in Trenton, N. J. State Department might be involved in this, since it has for some time opposed cartels in the radio field, but its cartel section is small and its activities up to now have been only policy-forming. . . . Meantime, Philips recently announced plans for post-war production in U. S. in the field of industrial equipment rather than in the radio tube field which helped make the organization internationally famous. The Eindhoven, Holland, plant, which covers 78 acres and employs 20,000, is expected to go back into the Continental market manufacturing light bulbs, radio receivers and transmitters, radio tubes, television receivers, x-ray tubes and apparatus, and scores of other modern electrical appliances. Despite the fact that they were forced to work under the Nazis, the employees remained loyal to Queen Wilhelmina, once parading before German onlookers with a large portrait of her.

WHATEVER HAPPENS, international communications rates seem destined to go down considerably post-war. Today, cost of a full-rate cable message between New York and London is 20 cents a word, although the press rate under certain circumstances is only 3 cents a word. Elsewhere, the rates are considerably higher. To Russia, the full rate from New York is now 30 cents, to Montevideo 45 cents, to Australia 60 cents, to China 80 cents, to Borneo, $1.05 a word. . . . By contrast, the American Telephone and Telegraph Company recently proposed a New York-London radio telephone rate of $12 for 3 minutes, meaning that a business man could pick up his phone and talk to London for the present cost of a 30 word cable plus a 30 word reply. By the same measure, a three-minute conversation in which 300 or more words could be readily spoken would cost not more than $15 to any point on earth.

THE RECENTLY-POSTPONED FCC CLEAR CHANNEL HEARINGS have a much greater connotation than first meets the eye. As the FCC itself has pointed out, "certain determinations with respect to clear channels are closely allied with, if not inseparable from, regional and local channel studies," or, to put it more bluntly, a re-shuffling of clear channel allocations will backfire considerably into the regional and local fields. . . . There is no indication that radical changes will be proposed by the FCC engineers, but the industry has its community fingers crossed, and it is perhaps significant that no lawyers representing the big stations are submitting briefs until after the hearings get underway. . . . Expectation is that the opening sessions will be brief, FCC will outline its position, and then representatives of the industry will ask for adjournment until briefs can be prepared. Consensus is that FCC will demand some changes. Whether they will be drastic is moot question. . . . It is pointed out that the general Commission trend during the past five years has been to let some little stations in on the clear channels and that current proposed changes may affect such stations as WEAF, now on 660 kc. in New York, WMAQ on 670 in Chicago, WLW on 700 in Cincinnati, WGN on 720 in Chicago, WHO on 1040 at Des Moines, and several others.

A STRAW IN THE WIND was the recent informal engineering conference called by FCC to outline preliminary studies in preparation for the clear channel hearings. That clear channel stations are not the only thing FCC has in mind in tackling the problem was indicated in its invitation to the meetings. . . . "It is urged that all engineers who are expecting to participate in the clear channel hearing, or *who are interested in possible changes in the allocation standards for standard broadcasting stations,* be present," said the FCC public notice. The italics are ours. . . . Tentative subjects of the engineering agenda included what constituted a satisfactory signal, what constitutes interference, and distances at which, and areas over which, various signal strengths are delivered. Industrial cooperation is invited with Commission engineers to find the answers. . . .

MORE THAN A YEAR AGO the editor of RADIO NEWS, in his "For the Record" column, reviewed the tremendously important contributions of radio amateurs to the war effort and predicted the government would restore most all of their prewar channels and would allot additional frequencies after V-Day. At that writing many in the industry, particularly certain manufacturers, were worried about the possibility the government would "let the ham down" during the switch from war to peace. . . . But the FCC's report on proposed frequency allocations bears out the forecast made by the Editor. As the largest single class of station licensees (there were nearly 60,000 of them in 1941) the amateurs are to be allowed sufficient bands of frequencies to carry on their activities, including experimental, after the war. In an introductory statement accompanying the allocations report, FCC identified amateur radio as one of the oldest of the radio services and declared the frequencies earmarked for it are a valu-

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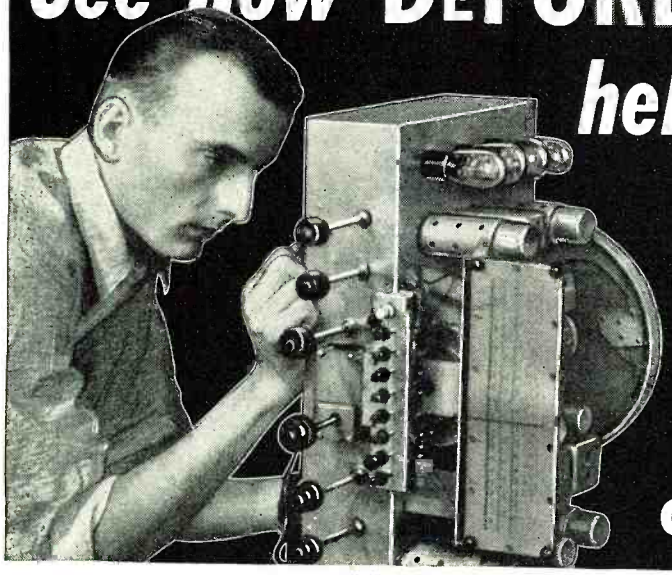

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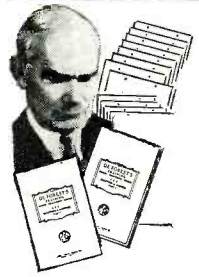

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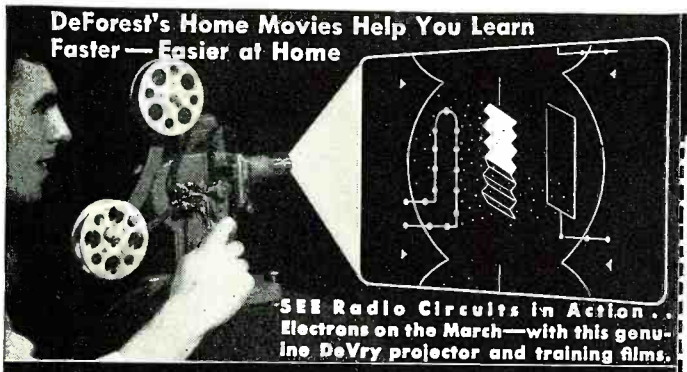

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able military reserve. . . . When amateur stations are suspended in wartime, blocks of frequencies become available for military use. If there were no amateur assignments, the bands would be filled with the signals of every nation and their recapture for military use would be almost impossible in blocks of any appreciable width. . . . The invaluable services performed by "hams" in times of national disaster also were cited by FCC. The American Radio Relay League estimates that more than 25,000 of the nation's licensed amateurs are serving in the armed forces and additional tens of thousands are serving in civilian capacities in laboratories, training schools, merchant marine and in wartime radio manufacturing industry. . . . Equipment and personnel contributed to the War Emergency Radio Service also constitute a major aid to prosecution of the war.

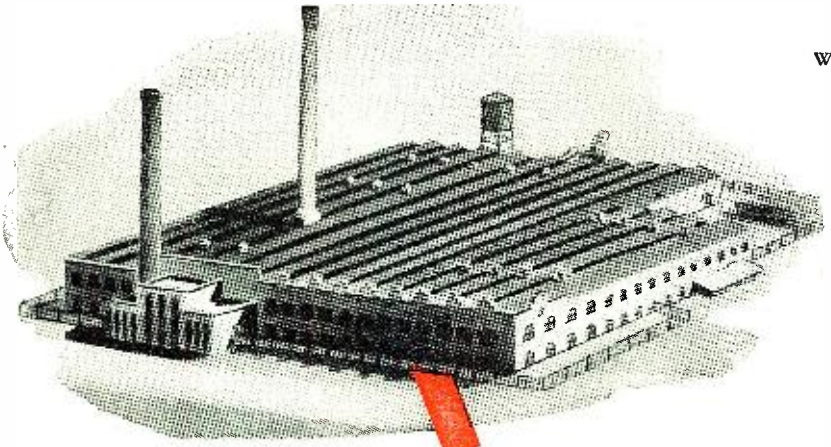
CONGRESS SLASHED $201,600 from the appropriation requested by FCC for its regular activities in the fiscal year beginning July 1, 1945, but gave the Commission exactly what it asked for—$2,430,000—to cover national defense functions in that period. The fund allocated for FCC's regular work is $2,554,400. Neither figure includes provision for overtime pay. . . . In the fiscal year ending June 30, 1945, FCC got $2,104,500 for regular activities and $4,191,143 for defense. Both amounts included overtime pay on a 48-hour week. . . . RID, Scotland Yard of the ether, was not forgotten. In the past nine months this FCC department gave emergency direction finding service to 573 aircraft in distress, investigated reports of interference with 629 authorized transmitters and tracked down 760 reports of illegal radio operations. . . . Earlier in this war, the long-range directions finders of RID (RADIO NEWS, Oct. 1944) were active in routing out spy transmitters here and abroad. RID "fixes" in South America helped to locate Axis transmitters, led to the round-up of about 300 Axis spies. . . . Under the new budget the Washington staff of the FCC's Foreign Broadcast Intelligence Service (FBIS) will discontinue monitoring short wave broadcasts from Europe on June 30, but it will continue to monitor Latin American broadcasts. (RADIO NEWS, Jan. 1945.) Its Monitoring stations at Portland, the Hawaiian Islands and at a "forward" island will continue to monitor Pacific area short wave programs. . . . FCC made no request to Congress for European short wave monitoring beyond June 30.

ONE OF THE MOST INTERESTING international problems that will figure in the councils of the State Department and of foreign countries, both at Rio and subsequently, will concern radio in aviation. South America is particularly interested in private aircraft and how its radio will fit into the trans-border picture. . . . One big step at the Rio conference will therefore be toward standardization of radio frequencies on a world-wide basis, and any such agreement reached will affect any American flier who decides to cross an international boundary line in his flivver plane after the war. . . . If frequencies are standardized, the pilot going from, say, Dallas to Mexico City will merely use his compact v.h.f. two-way radio to communicate with traffic control centers along the way. A frequency change will not be necessary. Our pilot won't have to worry about language difficulties, either, because Mexico's tower operators, according to the plans, will speak English as well as Spanish.

MANUFACTURERS WHO HOPE to supply v.h.f. sets for personal aircraft operations are trying to get an accurate line on the potentialities of the market in the immediate post-war period, but right now it is a case of too many figures rather than not enough. . . . Even the experts can't agree. The Crowell-Collier survey of the number of private aircraft sales five to ten years after the war ends places the figure at 100,000. William A. M. Burden, special aviation assistant to the Secretary of Commerce, has come up with an estimate of approximately half a million. Aeronautical Radio, Inc., takes a middle ground and uses a figure of 250,000, and FCC frequency allocations for personal plane radio are based on that figure. . . . The radios, according to Civil Aeronautics Administration plans, will, as soon as possible, be v.h.f., but the change-over on the airways from High to v.h.f. will take at least three years after the end of hostilities. The complete shift, on the ground and in the air, may take from six to ten years.

THE CAA VHF PLAN is international in scope. On long flights, the pilot will be on rigid radio traffic control only until he has reached his cruising altitude in "free" air, where he will switch to Direction Finder Navigation and determine his progressive positions by taking triangulated sights on two or more DF stations. These stations will be audible for about 700 miles under good conditions, no less than 300 miles under worst conditions. . . . Commercial planes will not require mass production of radio equipment, but in the private flying field there should be a large enough market to reduce prices considerably. One company—Rex Bassett, Inc.—has already catalogued a transmitter-receiver combination at $100. It is a one-and-a-half watt set supplied with tubes and crystals. . . . Accessories include dry battery power supply unit, aircraft type microphone, headphone set and plug and trailing wire antenna set. Cost of the accessories is $72.

(*Continued on page* 139)



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Where Temple cabinets will be made.

NO WASTE MOTION!

Temple will produce **BOTH** Chassis and Cabinets

Never in all radio history has a manufacturer been so completely equipped to both make and *deliver* quality radios as is Temple today. With its two great plants — one to be devoted exclusively to producing the fine Temple chassis, the other concentrating entirely on the cabinets that will house them — there will be no waste motion in making and delivering Temple Radios. Which means there should be no waste motion among Temple Dealers to cash in on the Temple line.

"Where **FM** *will also mean* **F***inest* **M***ade"*

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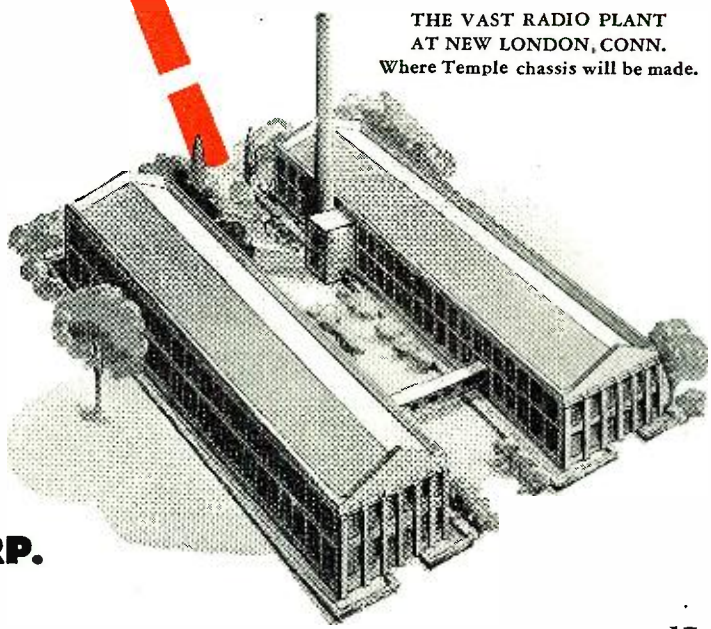

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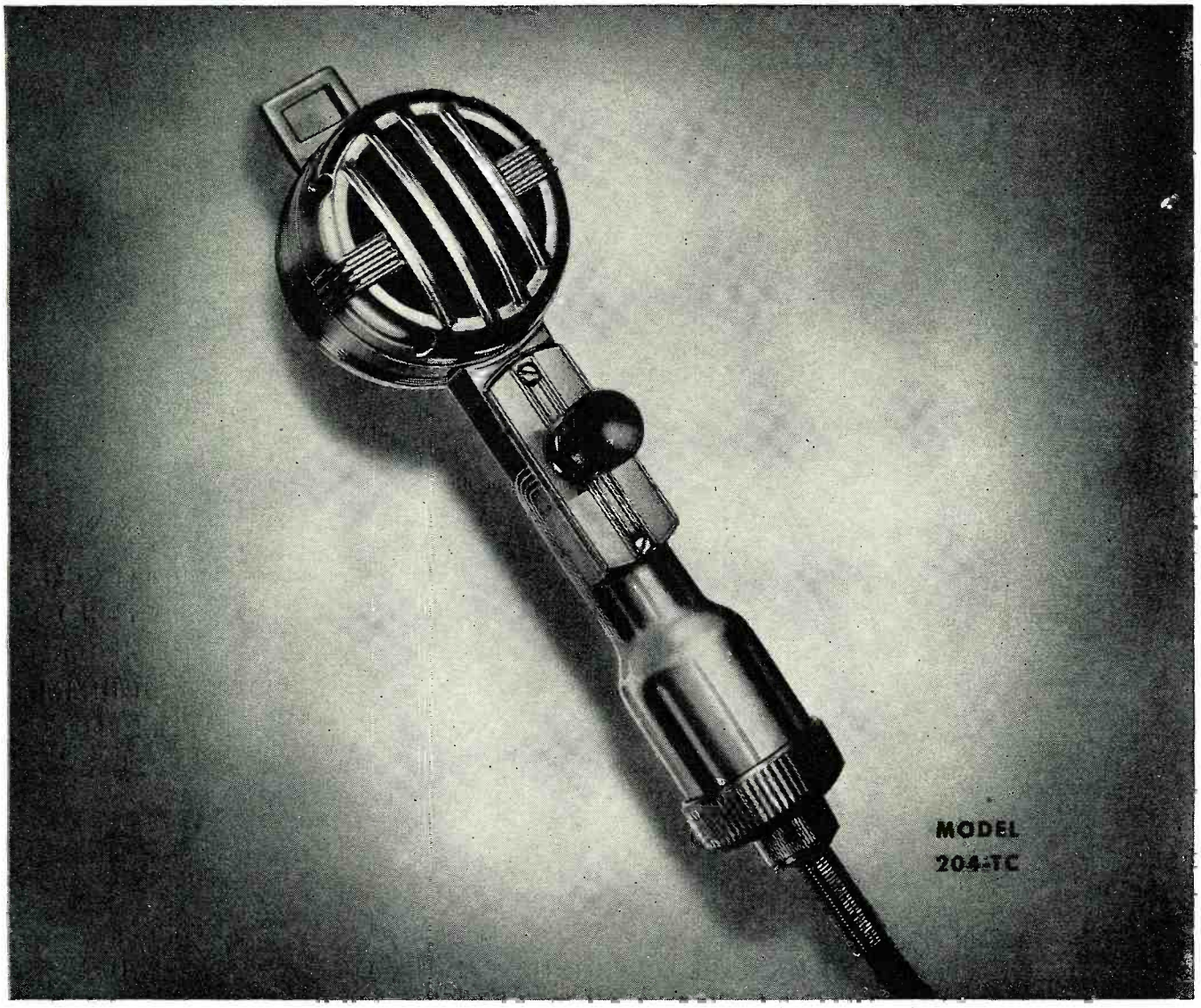

DYNAMIC HANDI-MIKE

TECHNICAL DATA
MODEL 204-TC

IMPEDANCE: 35-50 Ohms.

FREQUENCY RESPONSE: 200-7500 Cps.

OUTPUT LEVEL: Into 50 ohm input; 44 db below 6 milliwatts for 100 bar signal.

SWITCH: Type "T." Press-to-talk. Vertical toggle with snap action.

CORD: 6 feet long. Rubber jacketed. 2 Conductor and shield.

CIRCUIT: Two wires direct to microphone. Switch "makes" independent circuit. For use in connection with control circuit of transmitter or other relay operated device.

DIMENSIONS: Length overall 8 inches, head diameter 2 1/4 inches.

SHIPPING WEIGHT: 2 pounds.

There are seven other dynamic handi-mike models from which to make a selection.

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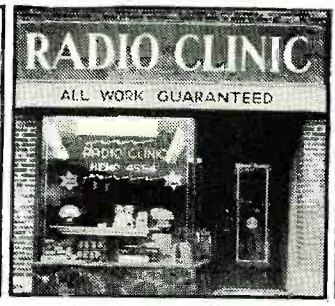

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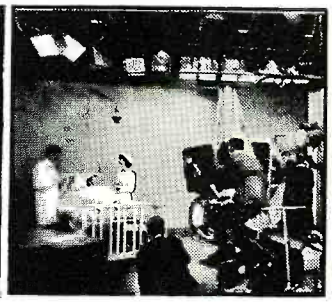

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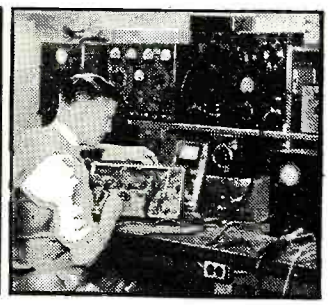

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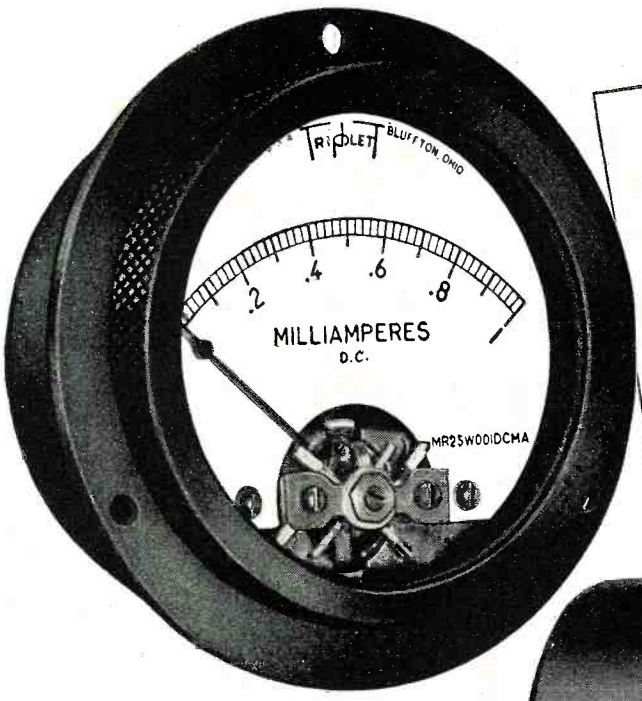

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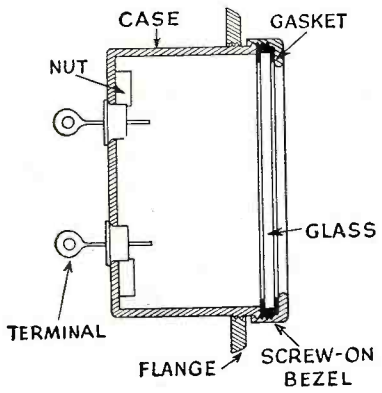

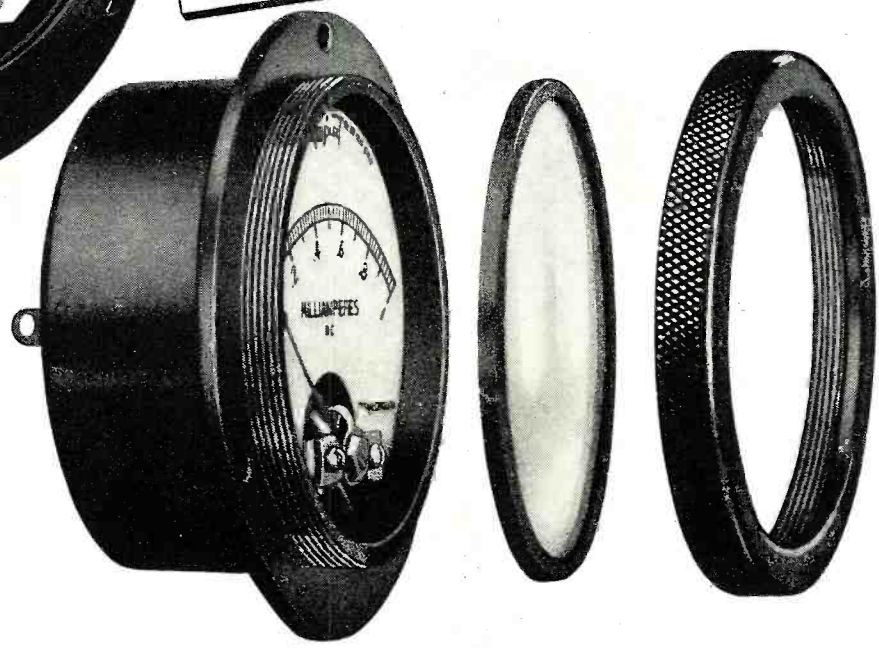

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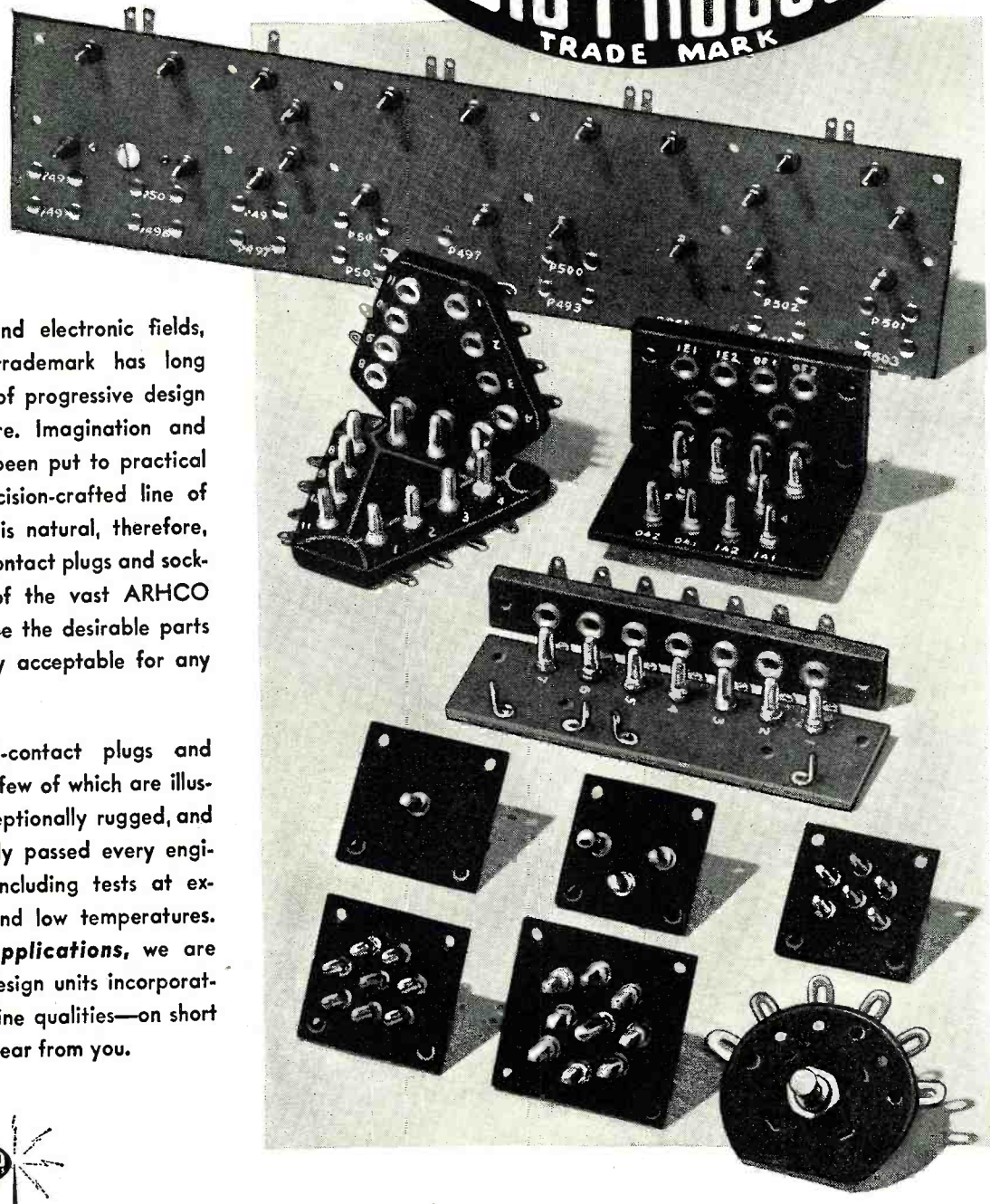

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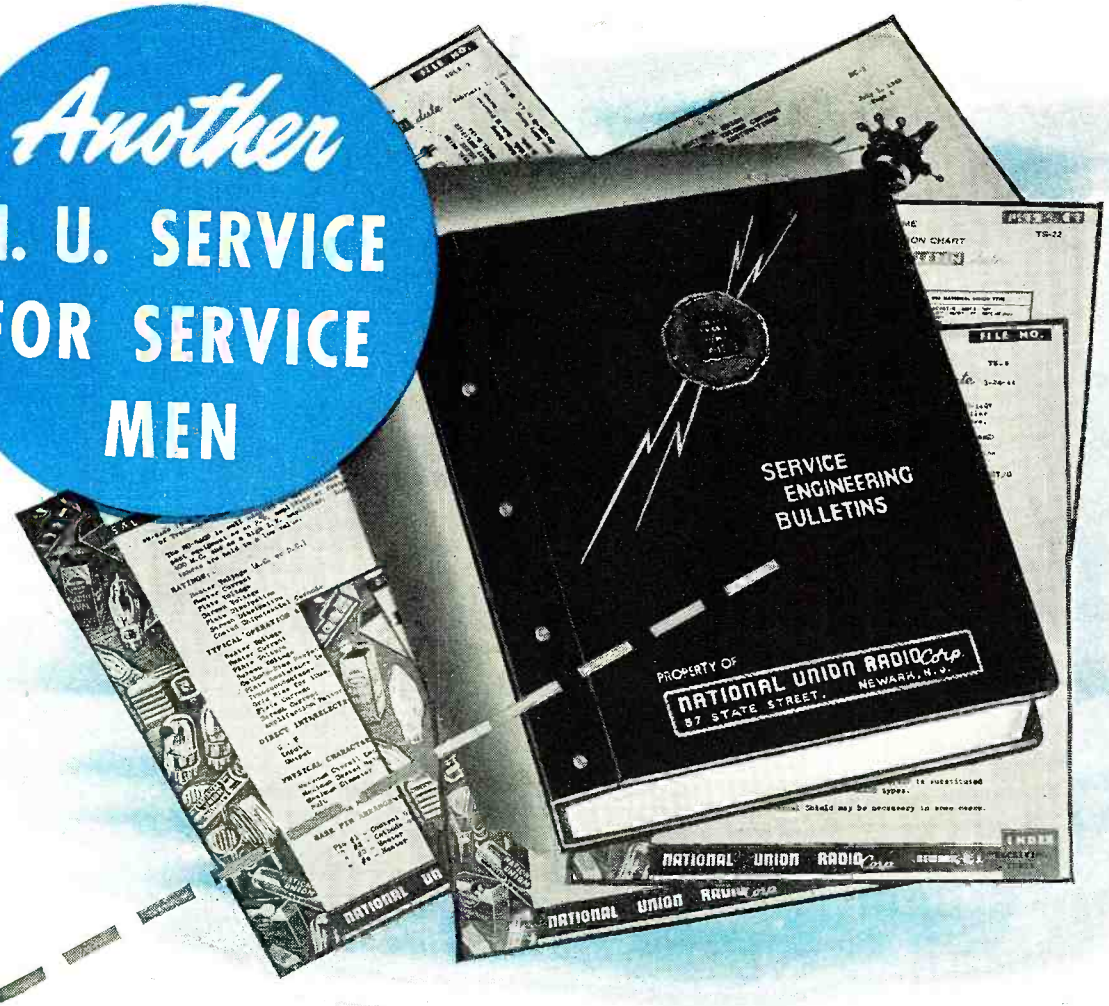

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- 35Z5 filament burnouts
- A simple Loktal to Octal adapter
- Tube substitution data for 25B5
- Replacements for special purpose tubes

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"CQ..." we'll hear it again-SOON

THE HAM IS COMING BACK... STRONGER THAN EVER

Who Said The "Ham" Is Finished?

THERE have been rumors to the effect that the radio Amateurs were going to be denied their old frequency bands, and given new bands of such high frequency as to be useless for medium and long distance communication.

Some rumors say "Remember the last War? We are going to get the same treatment this time!"

Now, we don't believe the "Hams" should be denied their rightful place on the air in bands suitable for communication beyond the horizon——and further, we do not believe that our Government would want to see those privileges denied.

Are not the "Hams" fighting on many battlefronts, working in war factories and laboratories for a New World wherein the individual will be able to live and enjoy his hobbies, his church and other personal freedoms which go to make up a healthy, happy world?

It is well-known among Government officials whose task it was to build our great war-time communications system that from the rank and file of amateurs came executives, instructors and thousands of engineers and operators. Without this nucleus of experienced men, it would no doubt have taken a much longer time to reach the present high degree of perfection in the communications branch of our fighting forces.

In every emergency Amateurs have proved their ability and willingness to come to the aid of their Country——who would be so unjust as to want to deny them their small place in the radio spectrum? We do not believe these rumors that the "Ham" will be denied his privileges. we believe rather that those who speak so much of justice coming out of this war will see to it that the Amateur receives his just reward.

The entire radio industry knows well, and appreciates the many contributions "Hams" have made for the advancement of high frequency radio communications, and surely they too can be counted on to assist the "Ham" in regaining his privileges *when the right time comes.*

HAMMARLUND MANUFACTURING CO., Inc.
460 West 34th Street, New York 1, N. Y.

THIS AD APPEARED IN MARCH, 1944

WE never lost faith in the friends of amateur radio. We believe progress up to this very moment indicates that Hams have many friends in high places. Of course, there is a lot of romance to Ham radio, but the place won by the Ham in the hearts and minds of important people is the result of a very practical demonstration of real worth—real American ability.

We wish to openly express our sincere appreciation for the wisdom of those whose job it was to guide amateur radio through these troubled times. And those who have given Hams a just portion of the spectrum are to be commended for their farsightedness.

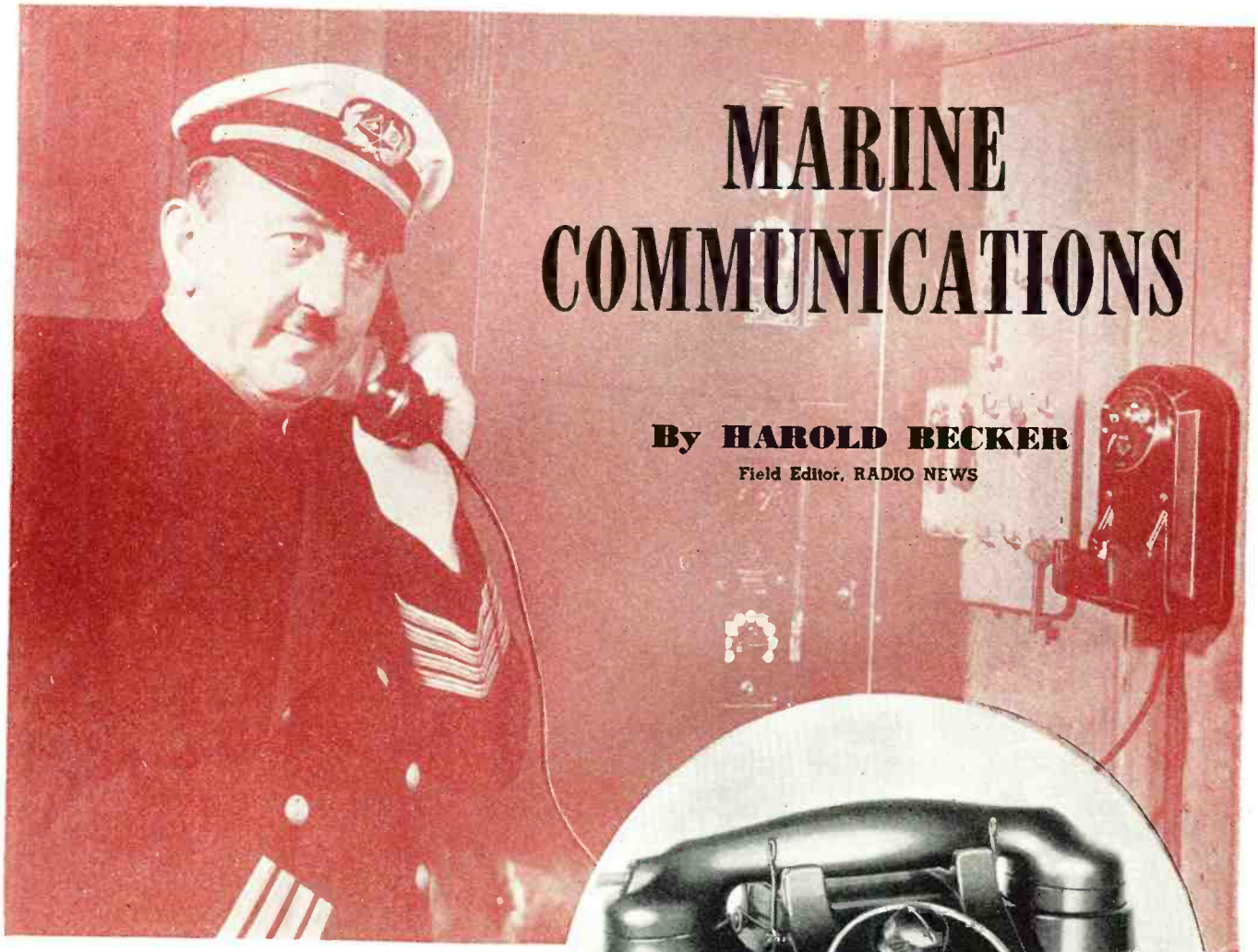
American amateurs can be thankful they live in a country where ability receives its just reward.

LLOYD A. HAMMARLUND, President

HAMMARLUND MFG. CO., INC., 460 W. 34th ST., NEW YORK 1, N. Y.

MARINE COMMUNICATIONS

By HAROLD BECKER
Field Editor, RADIO NEWS



Marine radiotelephone, which is operated like an ordinary telephone, is used to communicate with points within a radius of several hundred miles. Inset shows a Western Electric type 224 marine radiotelephone handset.

Marine enthusiasts will find greater pleasure and safety in the many new types of radio and electronic equipment for communication and navigation.

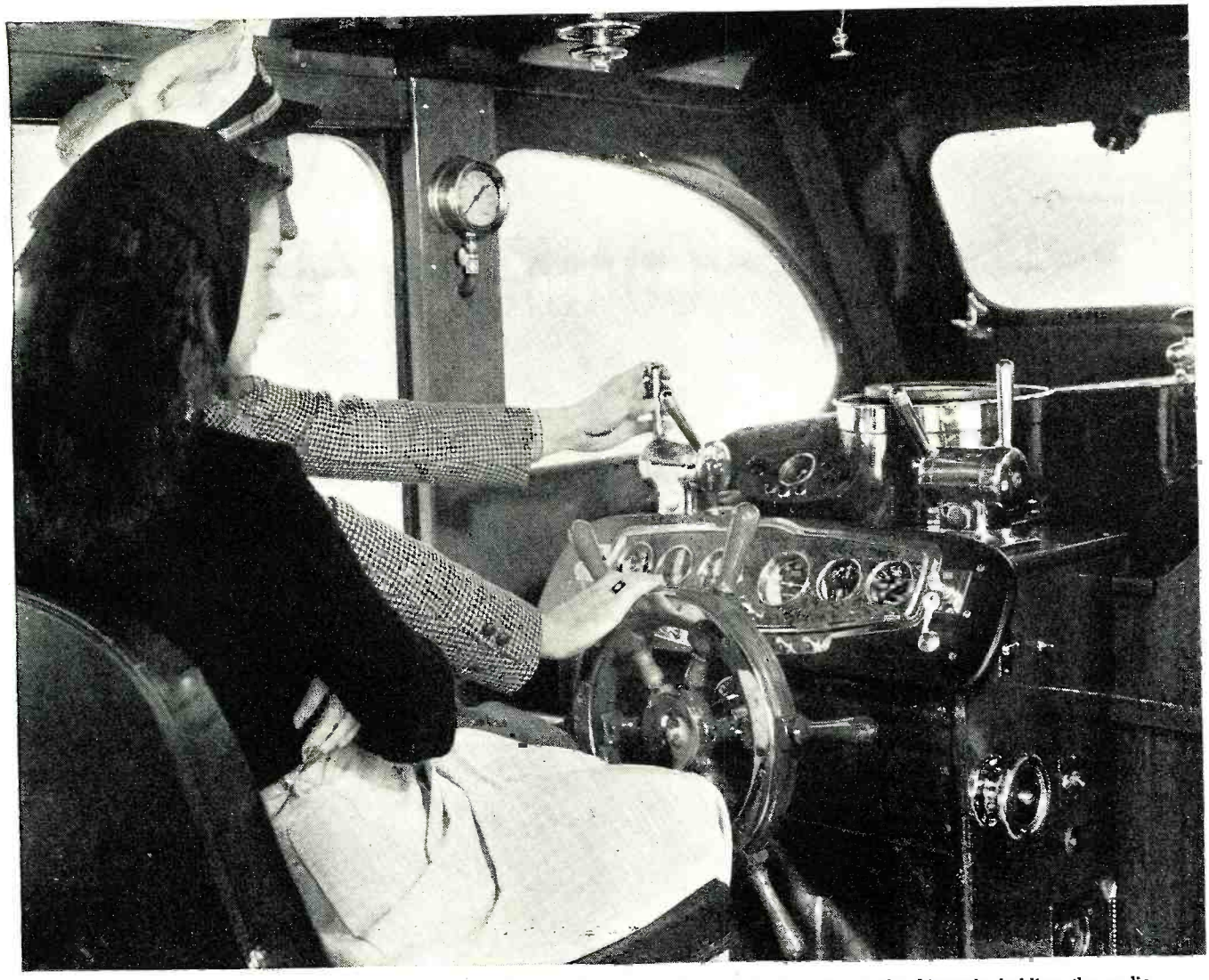
TO SATISFY the boating whims of an increasingly interested consumer, inventive genius has gone to work in furnishing postwar craft with a trimness and style heretofore unknown. Coupled with this imagination, radio and electronic designers have provided various facilities for radio communication, navigation, and safety at sea. The skepticism that previously existed in sea travel has been reduced by the ingenuity of present-day engineers. There is no longer the isolation from shore bases, no longer the floundering in strange waters, and no longer the fear of suddenly striking hidden shoals.

For many years marine radio communication was limited to the professional operator, with bulky, expensive equipment primarily in use. It wasn't until 1937 that the FCC paved the way for the technical development of the marine radiotelephone. Under this ruling, Third Class Commercial Licenses were issued to ship personnel who previously could not comprehend the difficulties of radio communication; but, with the development of less complicated sets they were able to assume the operating responsibility.

The latest improvements in radiotelephones have so simplified operations that it is necessary only to throw a switch and pick up the handset to engage in two-way conversation. Such equipment, which, by the nature of its service, must be used by nontechnical personnel, permits owners of all types of craft to take advantage of complete two-way communication with the land-line telephone systems.

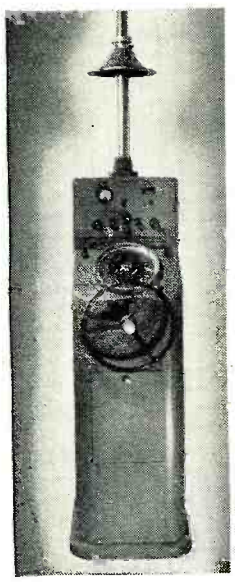
In most cases where radio telephony is installed in ships, three station hookups are maintained, ship-to-shore, ship-to-Coast Guard, and ship-to-ship. The most prevailing piece of equipment is a transmitter and receiver of the 224C type made by *Western Electric* before the war, which extends over a 2-11.5-mc. frequency range.

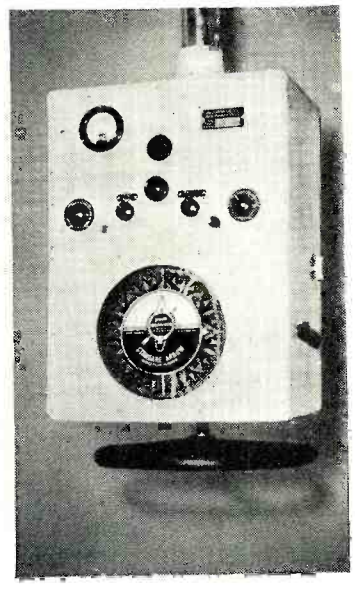
Prior to the beginning of hostilities,



Pilot at the controls of one of our many pleasure craft. Directly in front of him is shown the binnacle holding the radio compass. So indispensable has the radio compass become, that all large ships are required by law to employ one.

During the last few years, the marine industry has developed many types of radio-direction-finding equipment. Postwar will bring many new units, designed to be employed in all types of ships. The photos below show two distinct types; the one on the left is floor-mounted, while the other two photos show two views of an identical unit that is ceiling-mounted. Antennas in all cases are mounted above deck.





eight frequencies were at the disposal of the operator for ship-to-shore communication and in addition, 2670 kc. and 2738 kc. were used for contacting the Coast Guard and in ship-to-ship transmission. Dial controls are provided for in the radio receiver and transmitter to allow for quick shifts to any one of ten different frequencies. At the time of installation, the sets are permanently tuned and calibrated.

Under favorable conditions the range of the equipment exceeds a thousand miles. Coastwise ships receive signals from shore stations in the frequency band from 2500 to 2600 kilocycles and transmit to shore stations in the band between 2100 and 2200 kilocycles. This range serves well along the coast where stations are relatively close together and transmission is over salt water. On the Mississippi River and its tributaries, as well as on the Great Lakes, frequencies in the range of 2700 to 11,500 kilocycles are used.

The 224C is provided with both automatic voice-controlled relays and a press-to-talk button in the telephone

handset. The former is useful for those who are unaccustomed to pressing the button at the right time. The latter serves to eliminate excessive cabin noise or frequent whistles. The change from one method of operation to the other is made possible by including at the time of installation a simple strap connection in the equipment and by the selection of the appropriate handset.

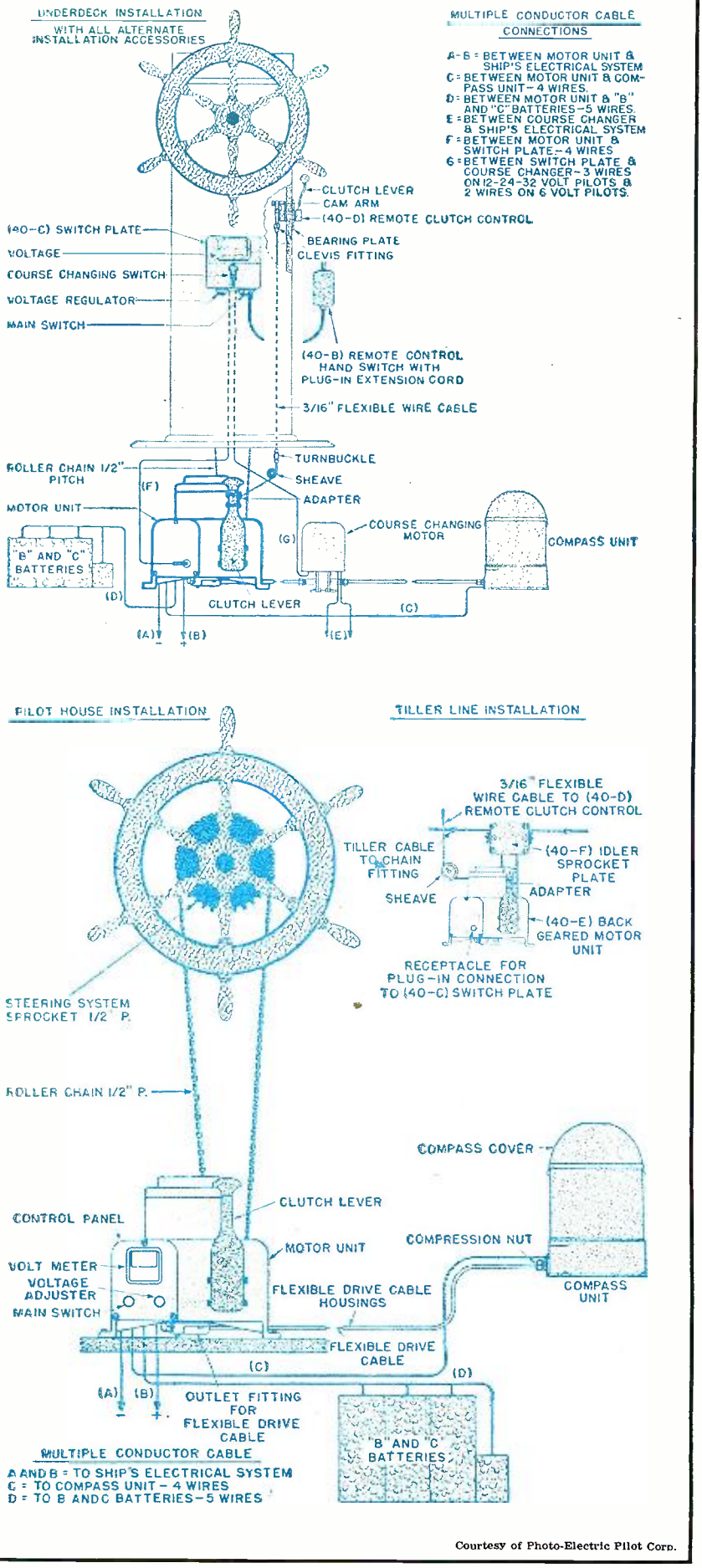
The transmitter is crystal-controlled and capable of its full 100 watts of power at any one of its ten predetermined frequencies. Thoroughly modern in all respects, it contains the latest refinements of an automatically controlled audio amplifier to fully accentuate the modulation of the carrier, and an automatic voice control of the carrier. A compact superheterodyne receiver, having quartz-crystal control, assures the high degree of frequency stability that is used in this setup. It also possesses the high degree of sensitivity necessary in this type of service.

The audio-frequency range is carefully limited to the band extending from 200 to 2,000 cycles, which tends to eliminate the noise found in the full audio range extending from 16 to 15,000 cycles. Cutting out the lower range and the higher overtones, the speech-to-noise ratio is greatly improved, thus offering greater intelligibility.

To call a shore station, the user merely lifts the handset and presses the call button. The shore station answers and connects him with the number he wishes. When the shore station calls, a bell rings, if the unit is not specially equipped for loudspeaker monitoring. Calls between ships may be made directly or cleared through the shore station.

A remote-control unit is also provided to allow communication on the ship-to-ship or Coast Guard frequencies from any portion of the vessel. Connections between the transmitter and the control unit are usually made by means of an 11-conductor flexible cable. In other models for merchant and pleasure craft, the radio receiver and radio transmitter are assembled as one compact unit. These sets have built-in loudspeakers and are fully equipped with telephone handsets. The carrier power usually has a minimum of 25 watts.

Hallicrafters has produced an outstanding medium power marine radiotelephone in the HT-14. A commercial adaptation of the famous SCR-543, the HT-14 has been literally "battle tested." Six crystal-controlled channels can be selected simultaneously in both transmitter and receiver, and to further enhance its effectiveness, it is capable of 100 percent amplitude modulation. A newly-developed diode noise limiter and audio-frequency fil-



Courtesy of Photo-Electric Pilot Corp.

Mechanical and electrical arrangement of an automatic steering unit. This equipment connects directly to the steering gear and will automatically pilot a boat on any preset course.

Illustrating a Soundview radio as used on a 40 foot express cruiser. This unit, although it is portable, has been designed particularly for marine use.

A ship-to-shore telephone installed on a 40-foot double-stateroom cruiser. This unit is quite complete and shows the very unique and satisfactory installation.

ter circuit in the receiver section add increased fidelity during exceptionally bad atmospherics.

Far beyond the imagination of Marconi, who intended radio wireless for ship communication, the style and capacity of telephony upon large liners stands as a milestone in marine inventive genius. It is difficult to superimpose forethought upon what the future may hold for this field. But, today, with government security preventing any insight on the latest innovations, the prewar craft must remain as the example of marine communication.

The equipment of *Radiomarine Corporation of America,* which is housed in a vessel such as the *S.S. America,* amply satisfies the radioman's dream of efficient design and comfortable compactness. To visualize any of the five high-powered transmitters is a high mark in an amateur's imagination. The radio room is furnished with four main transmitters for radiotelegraphy and one other for radiotelephony; three of the former group cover long, intermediate, and short-wave bands.

In the intermediate-frequency band of 350 to 500 kc., a 1000-watt specially designed transmitter provides 10 separate crystal-controlled frequencies. Long-distance short-wave communication is maintained over a 4- to 24-megacycle range with a 1000-watt crystal-controlled 20-frequency transmitter. Another equally powerful set is designed for 10 frequencies on 110 to 170 kilocycles; it is often used as a substitute when magnetic storms cause excessive fading.

A 600-watt, 5-channel transmitter with crystal control on all channels provides radiotelephone communication. The set's design lends itself to adjustment on thirty different frequencies, thus allowing for any future additions of transmitting channels. A "scrambler" device makes voice signals unintelligible to unauthorized listeners to protect the privacy of radiotelephone conversations.

A compact, specially designed console, 9½ feet long, houses the operating controls for the three radiotelegraph transmitters. Three receivers are included together with stop-start switches for the motor generators and the frequency selector switches. Signal lights indicate when the equipment is functioning.

Reception on the *S.S. America* is handled by any of nine receivers which may be switched to a loudspeaker on the bridge for time signals or distress calls. They provide a continual link between the *America* and other vessels, ports, and cities in any part of the world.

To continue with a full evaluation of the development of marine instruments, the problem of navigation has been efficiently alleviated by the introduction of new electronic devices.

In this field, the radio-direction finder has effectively overcome the troublesome difficulties of weather factors. So indispensable has this device become that all large ships are required by law to have them. It provides an accurate means of gaining bearings on shore beacon stations to determine the exact position of a vessel, when other means of obtaining this data are impractical.

Simplex-Bludworth Marine has developed a direction finder which can precisely fix a ship's position at sea, and enables the navigator to follow, without deviation, a predetermined course. The system employs radio-signal reception of a fixed frequency emitted from a radio beacon transmitting station, the position of which is already fixed and charted.

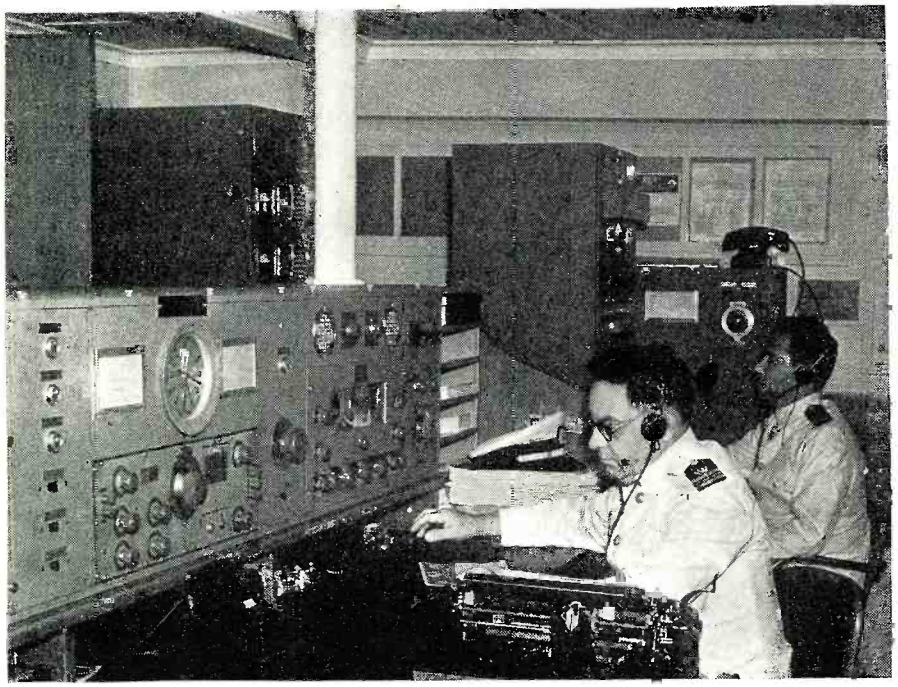
In the years before the direction finding concept was made operative, vision was the primary means for determining the ship's whereabouts. The mechanical, electrical means at the disposal of a seamen during present times not only provides greater accuracy, but it also is a less trying method of navigation, and yet simple.

A beacon signal is tuned in and the loop rotated until a signal null is obtained, at which point the angle between the vessel's keel and the position of the chartered radio beacon in use is measured. Several bearings may be taken from several radio beacon transmitting stations in the course of a few minutes and used to determine the vessel's position.

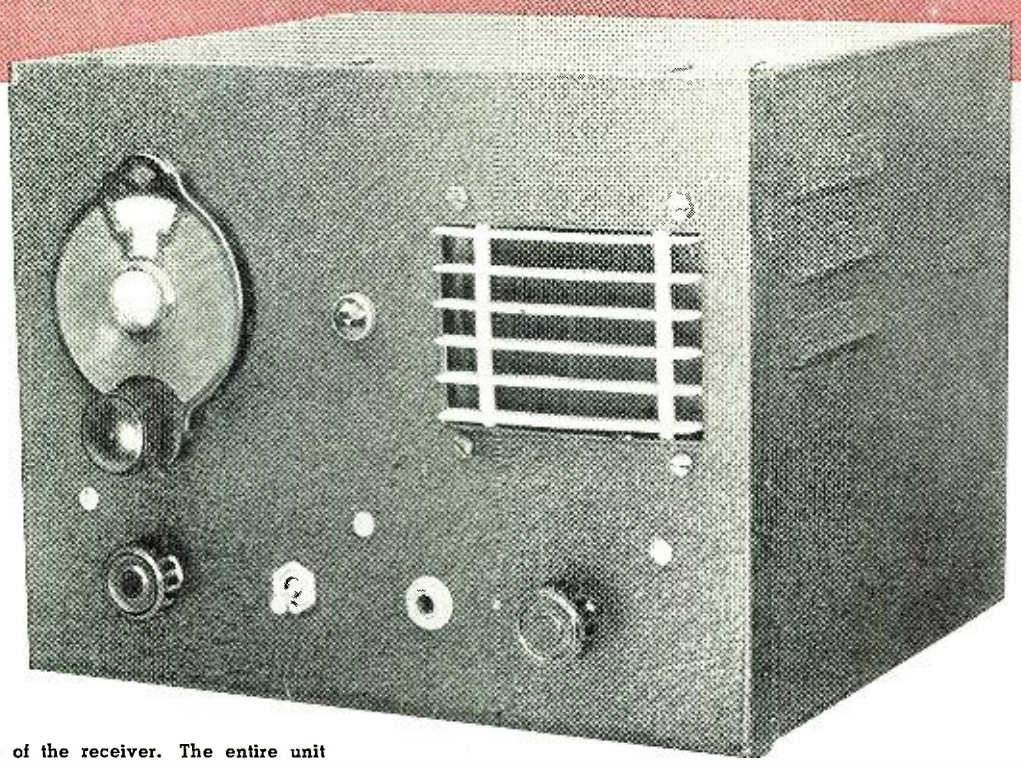
This instrument has a frequency range of from 280-520 kilocycles, with

(*Continued on page* 106)

Marine receivers employed in the radio-operations room aboard the S.S. America.



450 Mc. Super-Regenerative Receiver



Front panel view of the receiver. The entire unit was home-constructed and made of available parts.

By RAYMOND B. FRANK, W9JU

The design and construction of a u.h.f. receiver, to be used in conjunction with the transmitter described in the May, 1945 issue of RADIO NEWS.

THE builder who attempts construction of a receiver for the microwave frequencies encounters many difficulties not experienced at the lower frequencies. Inductances and capacitances become minute, and lead lengths are of the greatest importance. Resonant circuits are formed by leads resonating with circuit capacitances, while inductances of the conventional form have such a low Q that the efficiency and performance suffer materially.

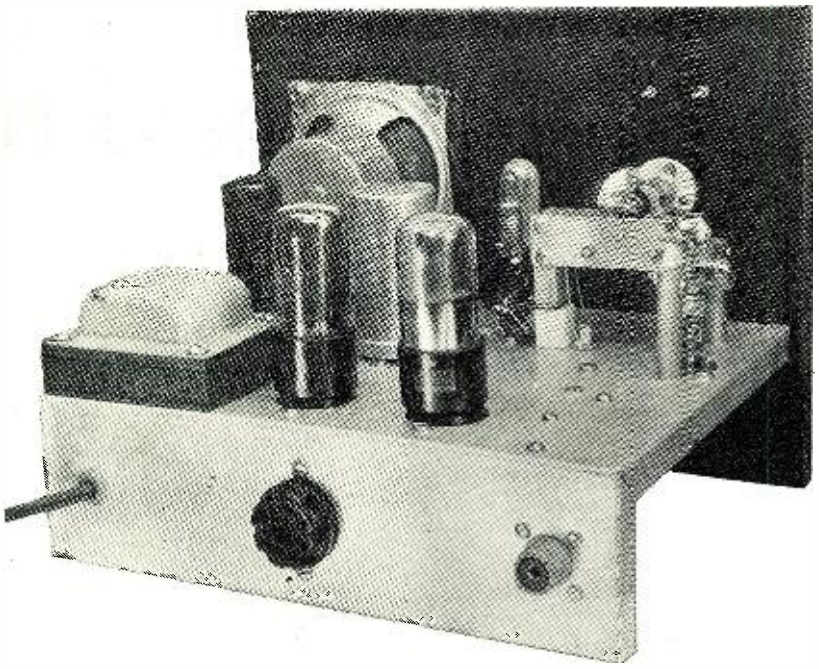
Common sense dictates a different approach to the problem of the tuned circuits, in order to attain a reasonable efficiency. Those of the lumped constants type seem to offer the greatest possibility. Construction of this type of resonant circuit presents no difficulty and offers the advantage of ease of adjustment.

While the use of superheterodyne receivers is entirely practical for the microwave frequencies, the difficulty of construction combined with the high cost and difficulty of obtaining parts, hardly justifies their use at the present time by the amateur interested only in getting acquainted with the vagaries of the ultra-highs. For the utmost simplicity it is difficult to exceed the performance of the simple self-quenching super-regenerative receiver. Sensitivity is high while the use of directive antennas, that will be common on the ultra-highs, will make the inherent lack of selectivity not serious at the present time due to the limited occupancy of the 450 mc. band. The problem of radiation from the receiver may be partially solved by using the loosest antenna coupling possible, consistent with sensitivity. Furthermore this problem should cause little concern if both stations use directive antennas, as the interference will then be confined to those causing it.

A trial of the various super-regenerative circuits revealed little to choose between them. All operated satisfactorily but the one shown, a conventional self-quenching type, seemed easier to get into proper operating condition. In addition, construction was very simple after the problem of the tuned circuit was solved. The circuit is entirely orthodox, and consists of a 955 self-quenching detector, followed by a 6J5 audio stage with a 6V6 output stage. Plate power is furnished by the 6X5 rectifier and a small power transformer. For added convenience a speaker was included in the design to permit a completely self-contained receiver that could, if necessary, be operated away from the home location with a minimum of accessories.

Construction

The receiver was constructed to match the transmitter described in the May, 1945 issue of RADIO NEWS, in size and general appearance. As in



Rear view of the completed unit, showing proper placement of component parts.

the transmitter, the cabinet was made from an aluminum cabinet formerly used to house aircraft radio equipment. The completed cabinet, after being cut down from its original size, measures 10" wide by 7½" high by 8" deep. Material from the original cabinet is used to form the front panel and chassis. The chassis, a simple folded piece of sheet aluminum, measures 9½" wide and 7½" deep with a height of 2½".

The controls along the front panel from left to right are, audio gain, located directly below the main tuning dial; standby switch; headphone jack; and regeneration control. The tuning dial, a *National* type BM furnishes a smooth tuning mechanism. Between the dial and the speaker grill, a pilot light is mounted to indicate when power is on. For an improvement in appearance over the conventional speaker hole in the panel, a grill was constructed using ½" strips of scrap aluminum separated by means of ⅜" long spacers from a junked band switch. A 3½" speaker of the PM type is mounted directly on the front panel by means of bolts and serves to hold the grille in place.

Placement of parts on the chassis may be clearly seen from the rear and under views of the chassis. The power transformer, a small replacement type, is mounted on a cutout at the right rear corner of the chassis. Directly in front of it the 6X5 rectifier tube is mounted just to the rear of the speaker. The 6V6GT output tube is mounted to the left of the power transformer, while the dual unit filter condenser occupies the space directly to the front of it. A 6J5GT audio stage is mounted to the left of the 6V6GT output stage.

The curious appearing assembly appearing behind the tuning dial is the detector tuned circuit, together with its associated components. Constructional details of this may be seen from the detailed drawings. The brass block which supports the entire assembly is a piece of bar stock ¾" wide by ⅜" thick and 1 7/16" long. A hole is drilled lengthwise through this block and tapped for a ¼-28 screw. In addition the block is slotted to within ⅜" of the bottom. The small ⅜" by ¾" plate bolted to the bottom of this block is to permit mounting on the ¾" long ceramic standoff.

The two long strips forming the main arms of the inductance are cut from 1/16" sheet copper and fastened to the brass block by means of 4-36 machine screws. An acorn tube socket is mounted close to the free ends of these copper strips by means of ⅜" diameter pillars of aluminum slotted at the top end to take cross arms, to which the socket is bolted. The tube socket is oriented so that the grid and plate terminals are at the top end. The plate terminal of the socket is soldered directly to the arm of the inductance which carries the rotor plate, while the grid terminal connects to the rear or stator arm through a 50 $\mu\mu$fd. ceramic condenser and the grid leak. In this manner a very rigid assembly is formed and the effects of vibration are minimized.

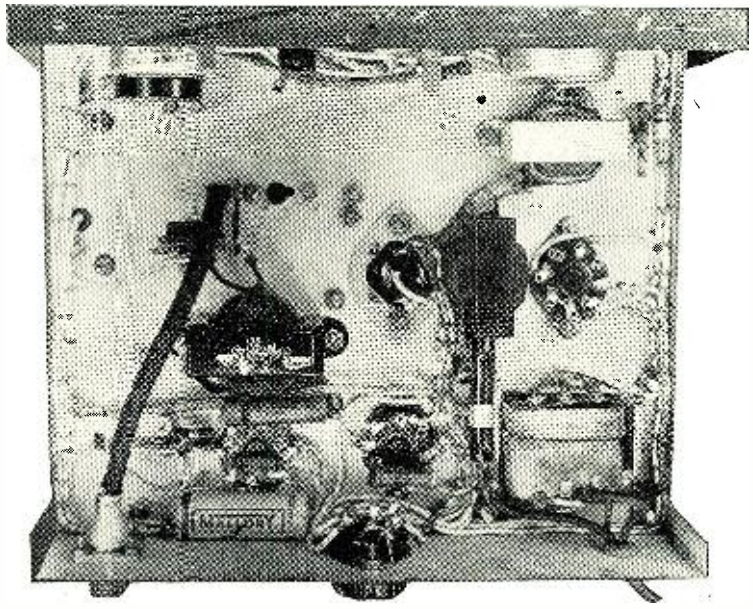
One of the heater leads of the 955 and the cathode are tied together and grounded directly to a tie lug which also supports one end of the heater choke. The other end of this choke is supported directly by the heater terminal of the tube socket. This choke consists of 22 turns of No. 30 enameled wire, wound on a piece of bakelite rod 9/32" in diameter.

The tuning condenser consists of the hardware from a *Cardwell Trim-Air* unit. The rotor, together with its bearing, is removed and mounted on the copper strip which goes to the plate terminal, while the stator plate is mounted on the strip which goes to the grid. The spacing between the plates should be adjusted to about 3/16".

A tie lug is placed between the lower end of the brass block and the standoff insulator and is used to support the plate choke (Ch_1) which consists of 35 turns of No. 30 enameled wire close wound on a 3/16" diameter bakelite rod. The plate by-pass C_3 runs directly from the lower end of the brass block to a solder lug bolted to the chassis.

Construction of the balance of the receiver is entirely conventional with the parts being placed where most convenient. Mainly for appearance sake the wiring is run around the edges of the chassis rather than using the point to point method. The plate voltage dropping resistor R_9, serves the dual purpose of dropping the plate voltage

Underchassis view, showing simplicity and neatness of wiring and construction.



to the required 180 volts, and for additional filtering. If a different plate transformer is used it may be necessary to change the value of this resistor in order to obtain approximately 180 volts at the output of the filter. With the small speaker used, it was not felt necessary to provide a great deal of power output and that obtained with the 180 volt supply was deemed sufficient.

As in the transmitter, provision was made for an external power supply simply by removing the power shorting plug P_1 and substituting a cable and plug with the proper connections and voltages. In addition, by using this arrangement, it is possible to use the power supply in the receiver to power other equipment if desired.

The grid lead from T_1 as well as the leads to the headphone jack and volume control should be run in shielded braid to reduce the possibility of hum pickup. While the audio gain control is not absolutely necessary, its inclusion was felt desirable for late at night listening when speaker operation was desired. Resistor R_7 furnishes a grid-to-ground path for the grid of the 6V6GT output stage when the headphone jack is used and prevents the loss of grid bias.

While provision for a co-axial antenna lead-in is made in this receiver any other type of antenna feed may be used. It is probable that capacity coupling would be desirable in most cases with other types of antenna feed, but this will have to be determined by experiment. The co-axial lead is led into the chassis through an *Amphenol* connector and up through the chassis through a *Millen* feedthrough bushing. A "hairpin loop" is formed by the inner conductor of the cable and the free end grounded to the chassis. This loop is bent to be in close proximity to the brass block near the top end.

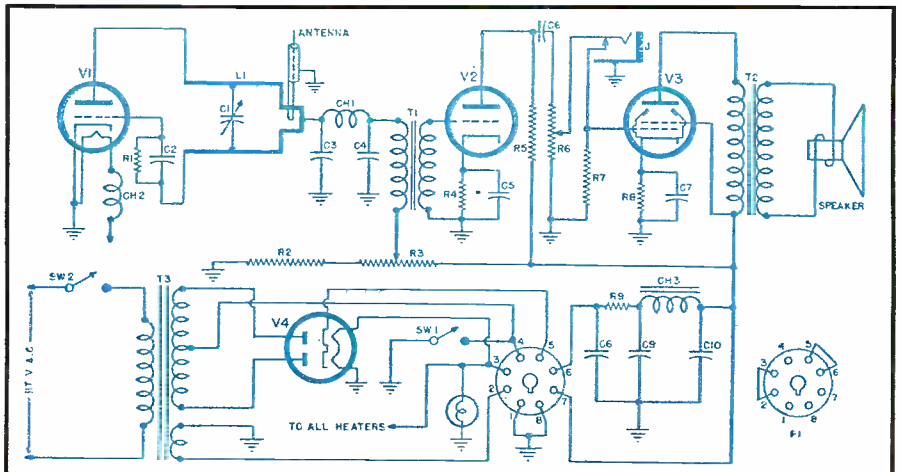
Adjustment

Upon completion of the assembly and wiring, the tubes should be inserted and the power applied. The first step is to check the "B" voltage, and if necessary increase or reduce the value of R_9 to give approximately 180 volts at the output of the filter.

When this operation has been completed, a ⅜ inch length of the thread from a ¼-28 brass bolt should be sawed off and screwed into the tapped hole in the brass block, using a light compression spring between the bottom of the hole and the brass screw in order to maintain tension on the screw so that it will stay in whatever position it is placed.

With the power turned on, the gain control should be advanced to maximum, and the regeneration control R_3 increased until the characteristic super-regenerative hiss is heard. If the receiver is operating properly this should occur when the regeneration control is advanced about one third way. Increasing the regeneration to

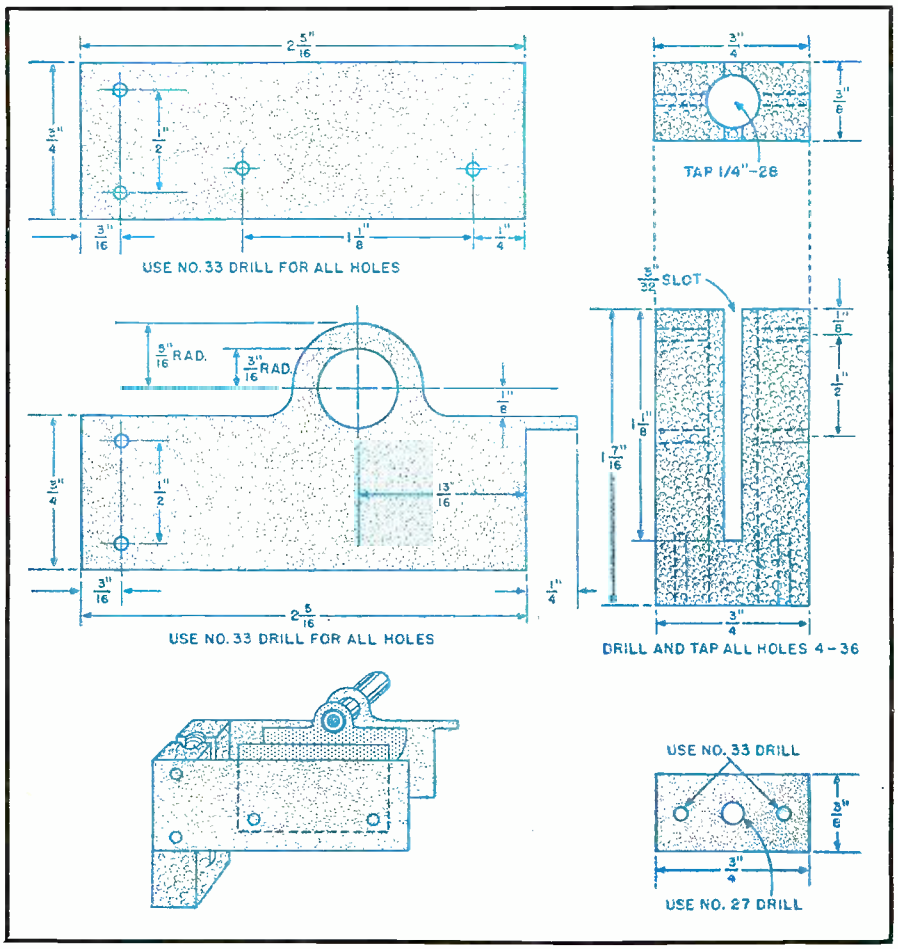
(*Continued on page* 92)



C_1—*See text*
C_2—*50-μμfd. ceramic cond.*
C_3—*50-μμfd. mica cond.*
C_4—*.004-μfd. mica cond.*
C_5—*20-μfd., 25-v. elec. cond.*
C_6—*.02-μfd., 400-v. paper cond.*
C_7, C_8, C_9, C_{10}—*20-μfd. @ 25-v.; 10-μfd., 30-μfd., 10-μfd. @ 350-v. elec. cond. (single unit)*
R_1—*10-meg., ½-w. res.*
R_2—*100,000-ohm, 1-w. res.*
R_3—*50,000-ohm pot.*
R_4—*2500-ohm, ½-w. res.*
R_5—*100,000-ohm, ½-w. res.*
R_6—*500,000-ohm pot., with switch sw_2*
R_7—*1-meg., ½-w. res.*
R_8—*250-ohm, 2-w. res.*
R_9—*1500-ohm, 10-w. res.*
T_1—*3 to 1 interstage trans.*
T_2—*5000-ohm to v.c. trans.*
T_3—*240-0-240 @ 40-ma.; 6.3-v. @ 2-a; 5-v. @ 2-a. trans.*
Ch_1, Ch_2—*See text*
Ch_3—*3-10 hy. @ 40 ma. filter choke*
J—Closed circuit jack
S—3½" p.m. speaker
Sw_1—*S.p.s.t. toggle switch*
Sw_2—*S.p.s.t. switch on rear of R6.*
P_1—*Power shorting plug*
V_1—*955*
V_2—*6J5GT*
V_3—*6V6GT*
V_4—*6X5GT*

Complete wiring diagram of the 4-tube a.c.-operated receiver. Particular care should be taken in the assembly and wiring of the detector-tuned circuit.

Mechanical layout, showing the assembly of the tuning condenser, C_1. Considerable care should be taken in its construction, as it is the heart of the receiver.



COLOR TELEVISION

By ROBERT W. EHRLICH

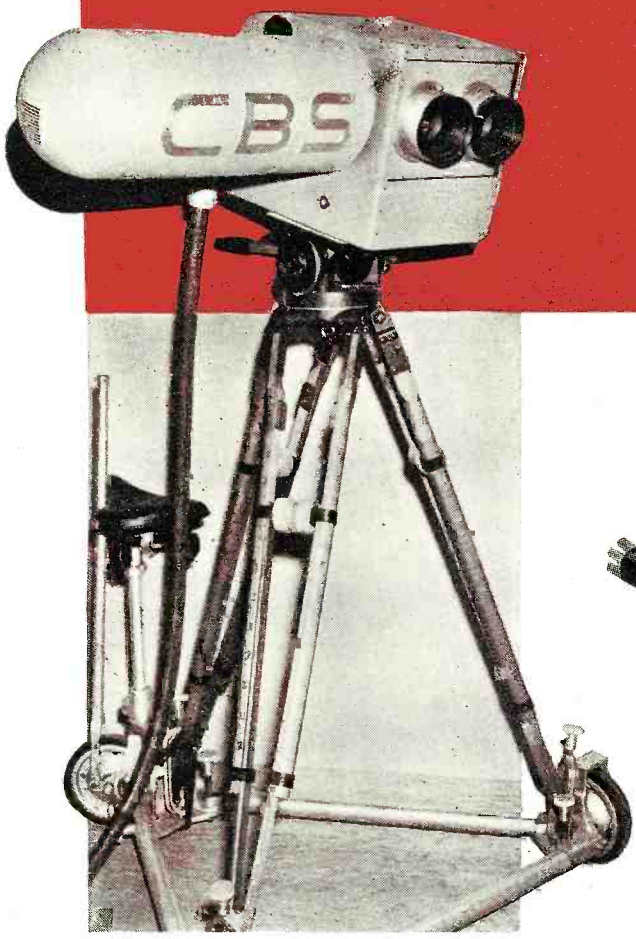


Fig. 1. Color camera developed by CBS with orthicon pick-up. One of the lenses is used for pick-up, the other for view finding.

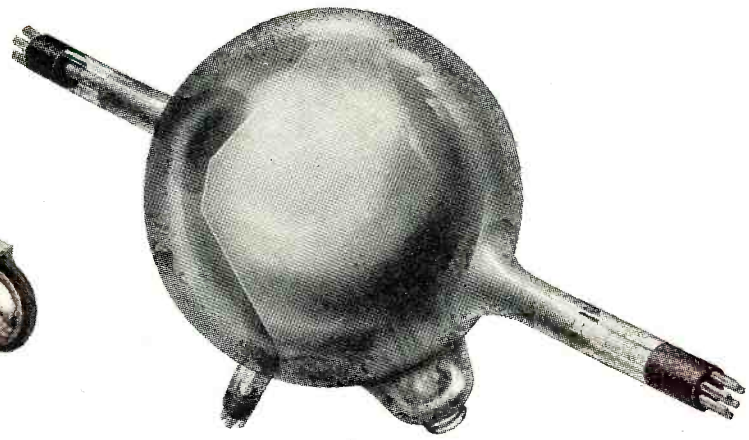


Fig. 2. Artist's conception of proposed John L. Baird multi-beam three color television tube. Beams from the three electron guns are focused on the screen which is coated with colored phosphors, producing three colors in the final image.

AS WORLD events move closer to the point where the radio industry can once again operate on a peacetime basis, the thoughts of designers, experimenters, producers, and advertisers turn toward television and its future. One feature that is expected eventually to be a part of television is the use of color. The purpose of the following article is to discuss the principles by which color television can be obtained, the problems involved in doing so, and finally what may be expected of color television in the future.

Color television is by no means new. As far back as 1928 it was demonstrated by Mr. J. L. Baird in England. Ten years later, an 8 by 12 foot color picture was shown before an audience of 3000 people at the Dominion Theatre, in London. In these early demonstrations, mechanical scanning was used, with its attendant limitations. With the advent of modern cathode ray tubes and circuits, it has been possible for experimenters in both England and the United States to develop practical color television systems. Before going into the details of some of these modern systems, a discussion of the principles of color reproduction is presented to give the reader a better idea of the problems in transmitting and reproducing a color picture.

All light which the eye can see consists of electromagnetic radiations, just like radio waves, whose wavelengths fall in the region between .00004 centimeters and .00007 centimeters. A more convenient unit of length for such small wavelengths is the angstrom unit, which is 10^{-8} cm. In terms of angstrom units, visible light ranges from about 4000 Å to about 7000 Å.

The wavelength of light determines its color. Long wavelengths, around 7000 Å produce the sensation of red; while successively shorter wavelengths of light appear orange, yellow, green, blue, and finally violet. These are the colors of the spectrum, and their relation is illustrated in Fig. 14. When all of these wavelengths are present with equal intensity, the result is white light; when there is no light, the sensation of black is produced.

When white light falls on a surface, some wavelengths are absorbed and others are reflected with varying intensities. The predominant wavelengths in the reflected light determine the basic color that the surface seems to have, while the relative intensities of various other wavelengths determine the exact shade. Figures 9A through 9F show the reflection characteristics for some typical colors. The job of any color reproducing system is to produce at each point on a viewing surface the same wavelengths of light that were present at the corresponding point on the original image.

The operation of a color system is based on the fact that it is possible to break up the entire color spectrum into a number of narrow band components. In the pick-up device, the color image is viewed in terms of each separate component, and a series of individual images is produced. The several images are then reproduced by conventional black and white processes. Finally, each image is colored to correspond with the band of wavelengths it represents, and all the

Resumé of what has been done in color television, emphasizing the problems involved and what the future holds.

images are recombined once again to produce the color picture.

In order to reproduce perfectly any possible color, it would be necessary to break the color spectrum into a great number of narrow bands. In practice, however, it is found that a system which utilizes only three relatively wide color bands can reproduce colors accurately enough for the average observer. Even a two-color system will work, but a picture based on just two primary colors is not as satisfactory as a three-color picture, whereas a four-color system would not give sufficient picture improvement to warrant the extra effort involved. For these reasons, present day color systems, including color photography and color television, are usually based on three colors.

The mechanism which breaks up a color image into three primary colors is a series of color filters. A color filter is simply a piece of colored glass or gelatin which transmits a definite band of wavelengths. Transmission characteristics of three color filters used in a typical television system are shown in Fig. 10. When viewed against white light, the filters appear blue, green and red, respectively. For convenience, they will be designated by those names in the succeeding discussion.

The action of a three-color system is represented schematically in Fig. 7. There, an idealized picture is to be reproduced consisting of a red spot, a green ring, a blue background, and a white border. The red filter passes only red light, so its image is a spot surrounded by a rectangular border. Similarly, the green image is a ring surrounded by a rectangular border, and the blue image is a rectangle with a hole in it. The rectangular border appears in all three images because it is white and contains all colors. The three images are reproduced in black and white at the receiving end, where each is viewed through its corresponding filter. They add together on the viewing screen to produce a color image.

The most important single problem in televising a color picture arises from the fact that three images must be transmitted for each image in an equivalent black and white system. The three images might be transmitted simultaneously on three different car-

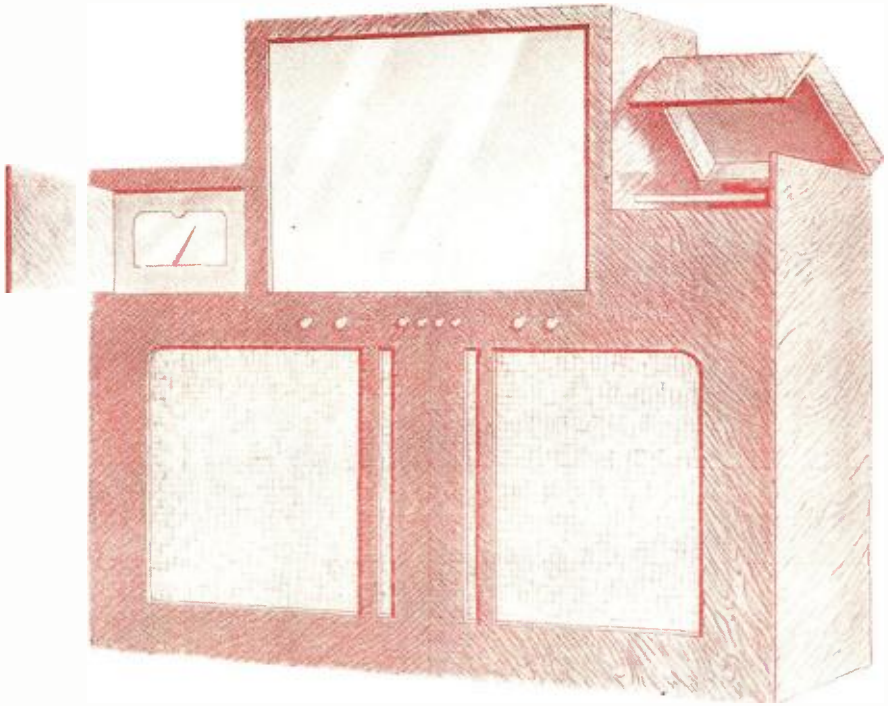


Fig. 3. Projection receiver, 24" x 30", demonstrated by Baird in 1940. Television controls, center; all-wave receiver, left; and phonograph pick-up shown on right.

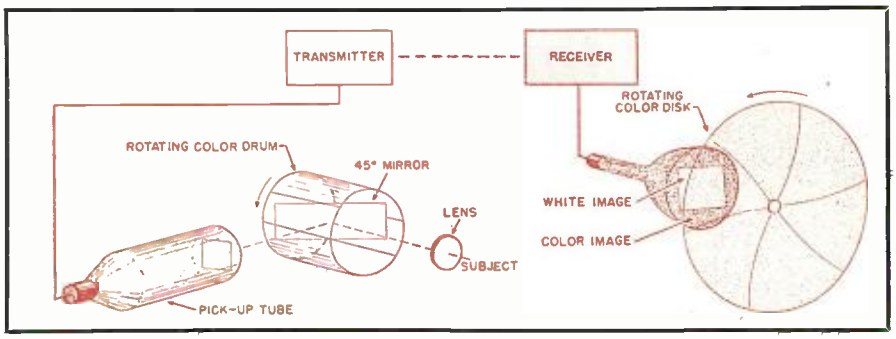
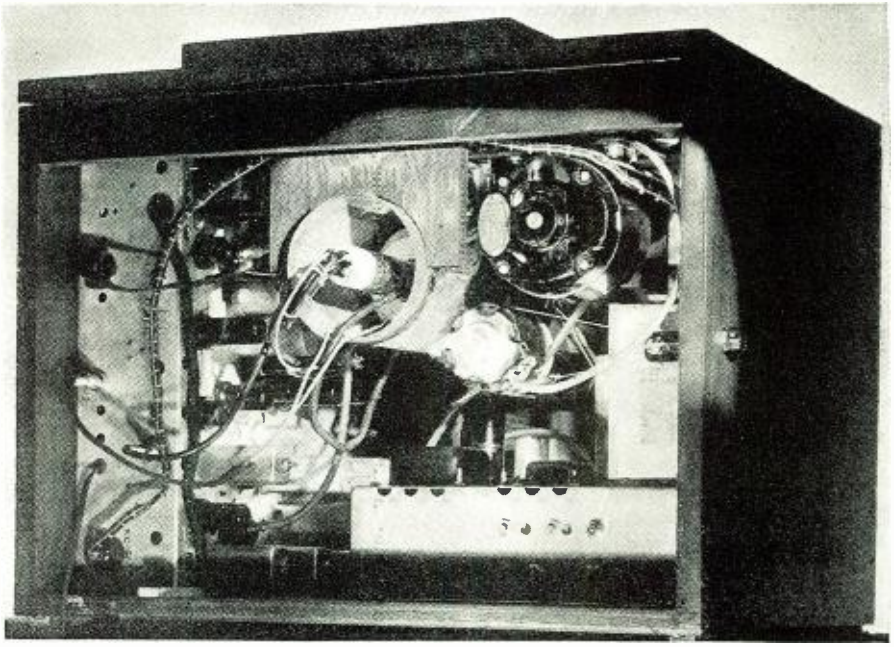


Fig. 4. Fundamental elements of the CBS color television system. The rotating color drum and synchronized color disc each contains two sets of three-color filters.

Fig. 5. Rear view of a CBS table model receiver using a 7" tube. The disc driving motor is connected by a belt to the electromagnetic brake assembly, below motor.



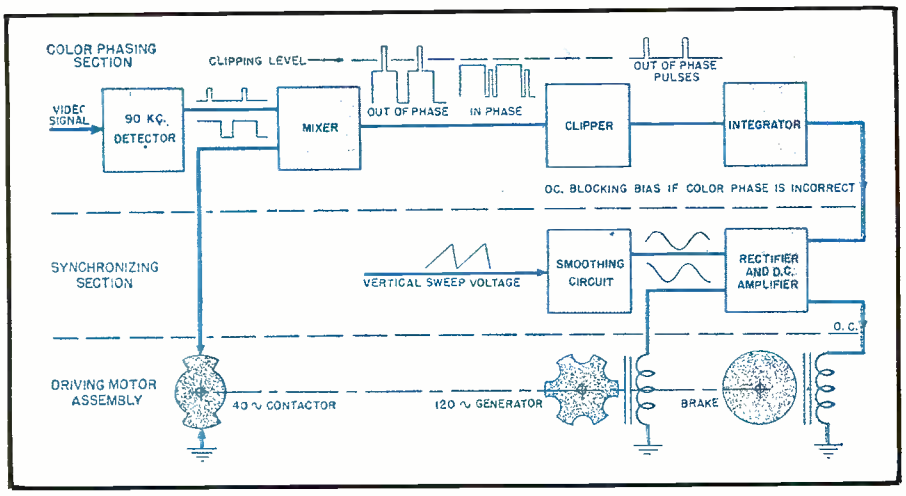


Fig. 6. Diagram of disc synchronizing circuit used by CBS. All functions shown are accomplished by three multi-element tubes and their associated circuits.

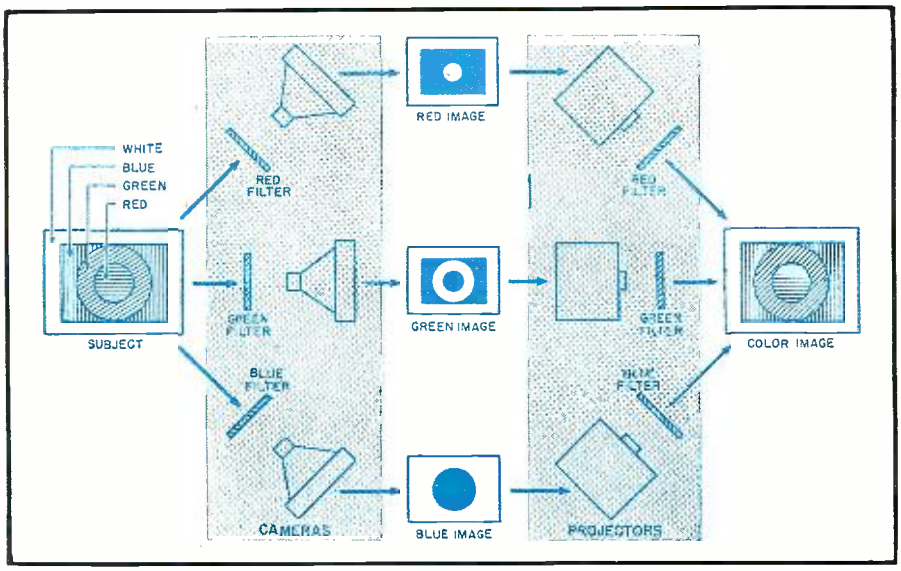
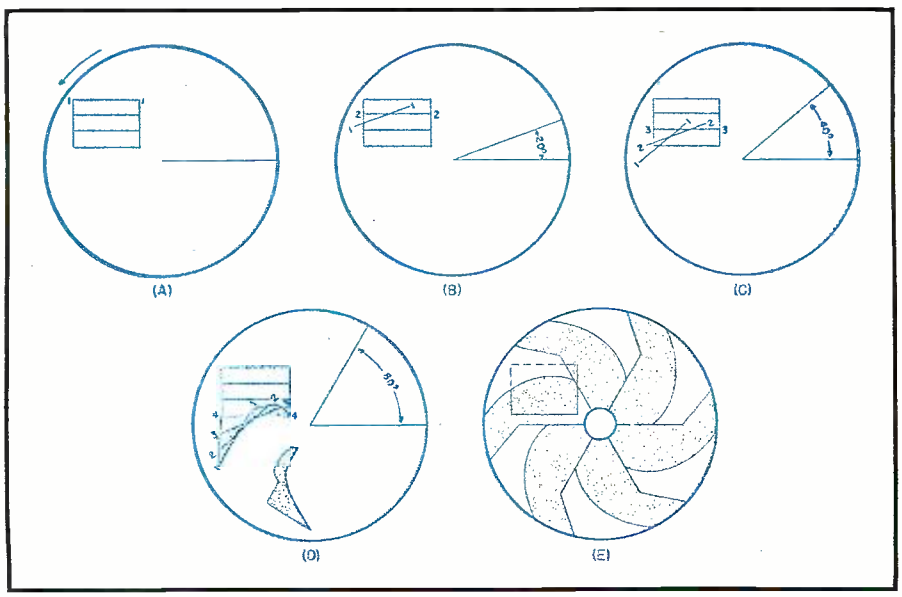


Fig. 7. Diagrammatic representation of the action of a three-color reproduction system.

Fig. 8. (A, B, C, D) Theoretical development of the shape of a filter segment for the color disc, based on the progression of the scanning spot down the picture. The speed of the disc is adjusted so that it rotates 60 degrees during one color field. (E) demonstrates pictorially the actual shape of the filter segments used.



riers, in which case the color station would occupy a band of radio frequencies just three times as wide as the conventional television channel; e.g., 18 megacycles. On the other hand, the three images might be transmitted in rapid succession on the same carrier, relying on persistence of vision to mix the colors at the receiver. With picture information coming through the video channel at three times the rate required for a black and white picture, the video channel band width must be three times as great. Assuming the same standards of scanning as are used now for black and white picture transmission, the video signal would contain frequencies up to three times 4.5 megacycles, or 13.5 megacycles, requiring a radio frequency channel about 15 to 17 megacycles wide. Whether the three images are transmitted successively or simultaneously, it is inevitable that the color picture signal will occupy a radio frequency channel width about 2½ or 3 times greater than that employed by an equivalent black and white picture signal.

Simultaneous transmission of the three images on three separate channels has some advantages in that it involves a minimum of technical transmission problems, since each image can be transmitted in exactly the same way as a black and white picture, and no additional flicker is introduced. However, the necessity of a threefold multiplication of r.f., i.f., and video circuits at the receiver constitutes a serious drawback. With the further development of wide-band amplifiers to handle a band width up to 10 or 15 megacycles, it will be possible to use the successive method of transmission to convey high definition color pictures over a single channel. Therefore, the greater amount of attention at the present time is being devoted to successive systems and methods.

The color system which has received the most attention in the United States is that developed by the *Columbia Broadcasting System,* under the supervision of Dr. P. C. Goldmark. Experimentation has proceeded to a point where complete receivers have been built, suitable for use in homes; and experimental broadcasts have been successfully carried out. It is accordingly of value to discuss some of the features of its operation.

Separation of the three colors in the camera is obtained by use of a rotating color drum, as diagrammed in Fig. 4. This drum contains red, blue, and green color filters, and its speed of rotation is so governed that each successive field is scanned in terms of a different color. At the receiver, the images are produced in rapid succession on a white-screen cathode ray tube; and a color wheel, rotating in synchronism with the camera's color drum, places the proper filter in front of each image. Persistence of vision combines the three images into a color picture.

(*Continued on page* 130)

Constructing a Heavy-Duty OUTPUT TRANSFORMER

By A. L. HURLBUT
Chief Eng., Wilson Mfg. Co., Canada

Constructional details of a heavy-duty output transformer, utilizing obsolete or discarded materials.

THE average person engaged in experimental work with high-quality audio amplifiers soon realizes the importance of using a good output transformer between the power output tubes and the loudspeaker. Such units are not only expensive but these days are sometimes difficult to obtain at any price.

Construction of the transformer here outlined will repay the builder with remarkable performance, considering the small outlay of time and material. The original was constructed by the writer to transfer the output of a pair of 6L6's with 350 volts on their plates to a speaker with some 25 watts field supply. It did, and is still serving after more than a year's operation. The unit should serve equally well for a more modest installation.

A trip to the radio "junk box" should unearth a power transformer that has perhaps seen better days. Remove the laminations from the coil windings and if the latter possess copper wire with the insulation still in good condition we may be able to use some of it later. A transformer originally designed to handle 100 watts or more should do nicely. Select a stack of the laminations about one inch thick as shown in Fig. 3.

Using gummed kraft paper tape of

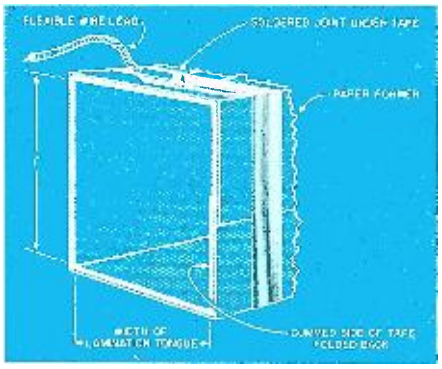


Fig. 2. A flexible lead is soldered to one end of the primary winding and taped securely.

the type used to seal parcels, or its equivalent, fold about ten inches of the gummed side back on itself and wrap it around a block winding-form of the same dimensions (1"x1") as at X in Fig. 3. Make two of these paper formers, as shown in Fig. 1, upon which to wind the two-section primary of the transformer. Use sufficient layers of paper to insure adequate insulation between the laminations and the wire. Each former should be of a length to satisfy the dimensional requirements shown in Fig. 3B. This

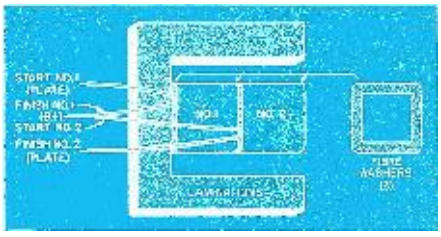


Fig. 1. The primary is wound in two separate coils with leads extending out of the same end. Laminations are to be removed when winding the secondary.

will be governed by the tongue-length of the "E" section of the laminations you have on hand. When completed, the formers should be thoroughly dried and then shellacked or varnished.

Connect and solder a length of flexible lead to the end of a spool of No. 32 enamelled wire and anchor the start of the winding as in Fig. 2, about 3/32" from the edge of the former. When you have completed the first layer of wire to within 3/32" of the other edge, insert a strip of ordinary waxed paper, the same width as the former and long enough to wrap around and completely cover the layer of wire. As you wind, check that no cross-overs occur in the windings for there would be a danger of short-circuited turns due to the enamel chipping at these points. When you reach the end of each succeeding layer, use another strip of waxed paper for insulation. The total number of turns for each primary is 3000. Both coils, while wound separately, should be as nearly identical as possible upon completion.

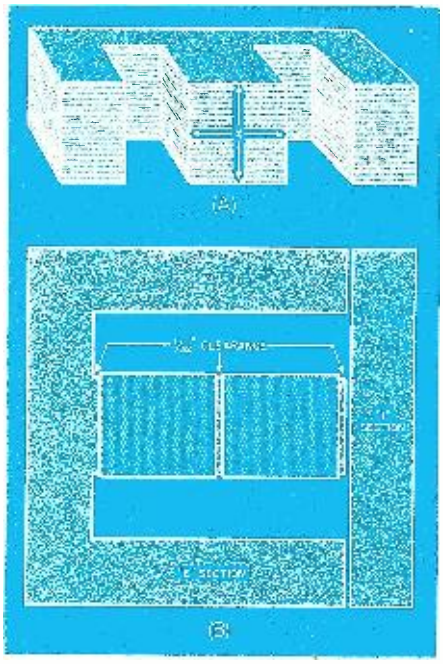
Each winding should be covered with one layer of gummed paper, trimmed to size and should look as in Fig. 1. If possible, allow the coils to soak in melted paraffin wax to which some resin has been added. Tie a string about the coil to prevent the outer wrapper from unwinding in the hot wax. Have sufficient wax to immerse the coil completely and leave it in the wax for a few minutes. Allow the coils to cool thoroughly before handling.

Placing the two halves of the primary in the arrangement shown in Fig. 1, wrap six layers of gummed paper about the two primaries to bind them together and at the same time provide a full width former upon which to wind the secondary. *Make sure that both primary windings are in the same direction before joining the wires designated in Fig. 1.*

The number of turns of wire required for the secondary will depend upon two considerations. First, a vacuum-tube manual must be consulted to ascertain the recommended plate impedance for the tube or tubes to be used in the final stage, at the particular voltage to be applied. Second, the approximate impedance of the voice- or moving-coil of the loudspeaker must be determined. For practical purposes this may be taken as 1.4 times its d.c. resistance.

(*Continued on page* 120)

Fig. 3. A one-inch lamination is used, stacked to a height of one inch. If the transformer is designed for push-pull operation, the core should be cross-laminated 1 x 1. If a single output tube is used, the core should be butt laminated.



Post this sign where it can be easily observed.

Sidelines for the Radio Serviceman

By RICHARD BYRON GRAF

The author presents useful information to servicemen who intend entering industrial electronics and household appliance servicing fields.

IT HAS been truly said that experience is the best teacher. Not only is it the prime requisite for most all professions, but it is one of the "musts" in the radio service profession. A man must have experience in many things other than radio repairing, to win out over stiff competition and make his shop a paying business.

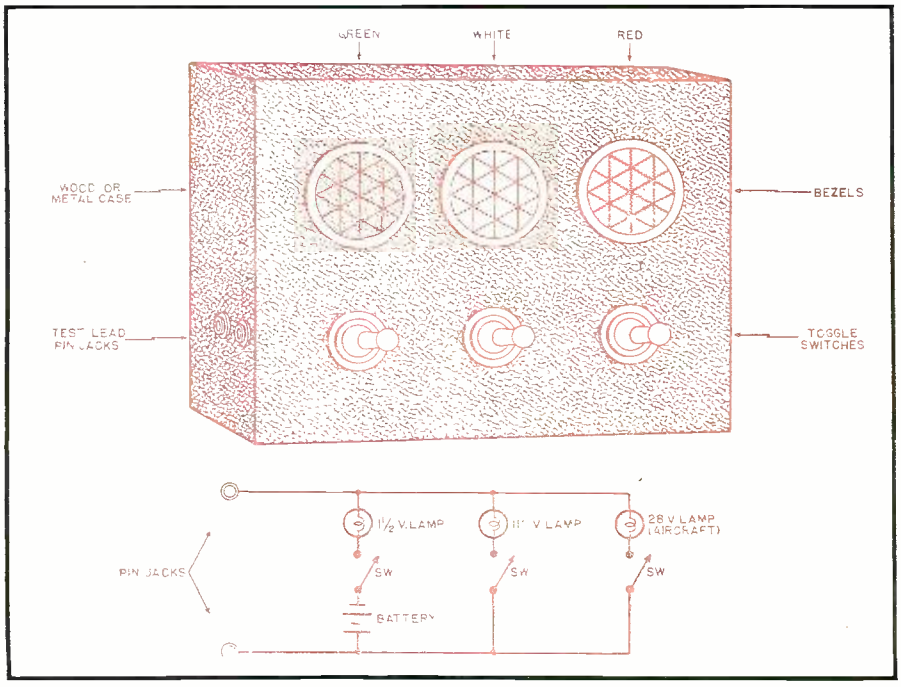
At this particular time, your business is probably booming, since the armed services have taken a lot of the radio repairmen who were your competitors. Few new radios are on the market and the old ones need major repairs, and people are staying at home and listening to their radios more and more as gasoline rationing tightens. *But,* those radiomen who are now in the armed services are coming back, having learned a great deal more about the game since they left. New sets will flood the market. Thousands of old sets will be junked instead of repaired. Summer is bound to come with its slack home radio business. When all this happens, the radioman with a sideline or lines will be on top. Begin right now to plan your campaign!

At this moment, hundreds, yes thousands of factories and mills are equipped with all sorts of electronic devices to speed production and cut down labor costs. After the war, thousands of homes, schools, and offices will be using these aids. They will not run indefinitely without constant repair and someone will have to repair them. Here is where you come in. The various devices contain many of the same parts with which we are familiar. There are some control and Thyratron hookups that may puzzle the average radio serviceman, but so do FM and television have many new hookups with which we must become acquainted.

You must keep abreast of the times, to succeed. Write to the manufacturers of these new instruments. They'll be glad to furnish you with detailed descriptions and other data. Do a little extra studying. Get out that old textbook and study up on what you've forgotten about electrical apparatus, a.c., motors, and so forth. Visit one of the mills or factories nearest you and check up on what electronic devices they have; this factory may need immediate service. Many factories would welcome this new equipment if they had a local man to install and look after it for them. The field is almost unlimited in its possibilities. During your visits to nearby factories, check the offices for intercommunication systems and speaker installations.

Let it be emphasized here, before we proceed to the actual repair of electronic equipment, that a good deal of preparation will be necessary. First of all, you must have a pretty thorough knowledge of electricity, especially in the commercial or industrial field. A great many of the new electronic devices include relay-control circuits for the operation and control of alternating- or direct-current motors. The electronic repairman must know his business to service industrial setups and do the work well. There are several good textbooks now

Fig. 1. A simple continuity and power tester. To test continuity of wires and plug connections, simply close continuity switch. To test for presence of 110 volts, close the 110-volt switch, leaving others in off position. To test circuits for low voltage, close 28-volt switch, leaving others off.



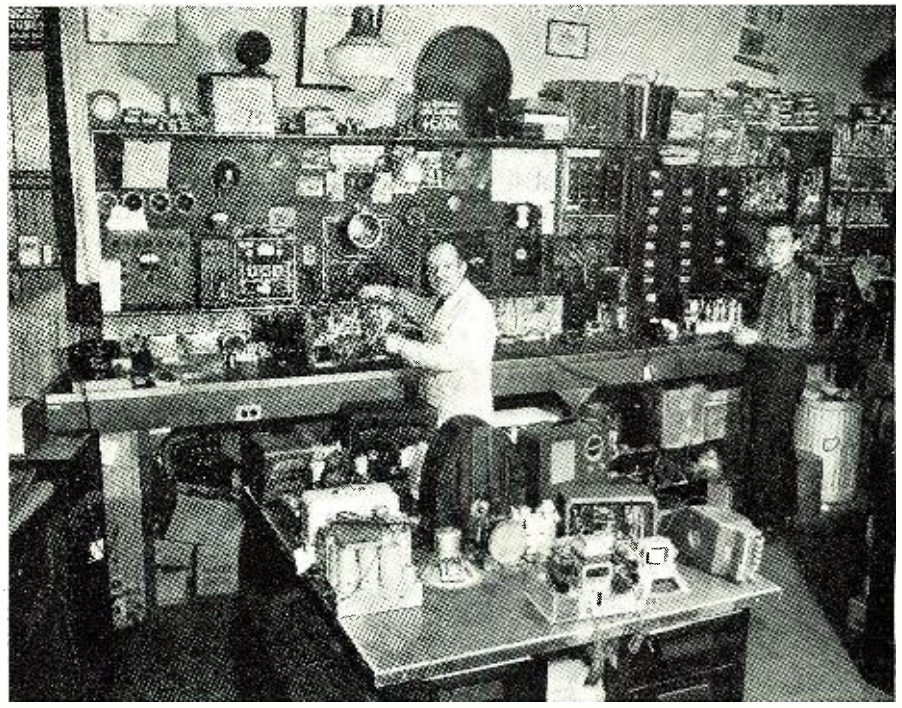
on the market dealing with this subject, and it will be well worth your time to study them *now*. Prepare yourself with the knowledge to do the work *right*. Next, be sure you have the necessary test equipment and tools to handle any job.

Let's begin with test equipment. The list in Table I will take care of most installations. This list includes most of the meters that you are now using for radio work. You will find that a simple continuity tester will also come in very handy. Fig. 1 illustrates such a tester, which can be made easily from junk parts in the shop. Your tool kit contains all the tools necessary, with the possible exception of a large 200-watt soldering iron, a wire stripper, and a set of adjustable S-type and Spintite wrenches.

When called upon to service equipment already installed, try to have at hand the circuit diagram for that installation. Sometimes when multiconductor cables are used for interconnection of apparatus, a wire is left off or a lug is connected to the wrong terminal. Just as you ask questions about a customer's radio set, to more quickly locate the defect, so must you ask whoever is in charge of the electronic equipment you are called on to service. Does it work at all? If the answer is "no", check the wiring carefully to see that it corresponds with the manufacturer's instructions. Take no one's word for it; find out yourself. Look for the obvious and simple first; check for power troubles, input voltages, and so on. If all seems okay, then proceed to eliminate the trouble through careful analysis.

When installing new equipment, follow manufacturer's instructions faithfully. Find out first if the equipment to be installed can be operated on the power supply available, whether a.c. or d.c., single or three phase, 25 or 60 cycle. Be sure you are right, then go ahead. Let the job be an advertisement for you and your methods. Make every job as perfect as you know how, regardless of how untidy or haywire the surrounding apparatus appears.

The repair of home electrical appliances, however small, has become a big and paying business for the alert radioman. Since the start of the war, it has become increasingly difficult for civilians to obtain electrical aids for the home. The Office of Price Administration has recently released a number of these items, but the average home must still do with what they have. Most home appliances owe their breakdown to misuse. The average housewife has little or no knowledge of electricity. Many of the appliances need very simple and minor repairs, just as many radios need only a new tube to put them back in operation. Here again, as in all electrical or radio work, good old common sense plays a big part. Appliance repair as a sideline has been the difference between success and failure of many radio shops. Get that sign out into your window. Have it read something like the one shown on page 36.



Service section of Supreme Radio Company, Boston, Mass., operated by Xavier Yort. Servicemen will find the addition of other sidelines exceptionally profitable.

This type of work calls for specialized training, you say? Not at all. You will have to impress on your customer the fact that the repairs are to be electrical only if you are not sure of your mechanical ability. Perhaps you can get the services of a good mechanic to help you solve some of the problems. The test equipment may consist of a good ohmmeter and a simple continuity tester like that shown in Fig. 1. Your tool kit contains all of the necessary tools.

Let us review the items listed on your new sign:

Waffle Irons

Rough handling often causes breaks in the wiring. Breaks occur most at or between the hinges of the two sections. Asbestos-covered wiring must be used for repair.

Electric Heaters

These include the small reflector type and the enclosed or stove type. Both use elements that are easily replaceable. Check for shorts and opens.

Electric Toasters

Most of these may have an open or burned out heating element. This can be replaced with one obtained from the manufacturers or a Universal substitute. On many toasters the nichrome resistor wire breaks at the terminals. Check for shorted terminals as they pass through the insulation (usually mica) on the toaster casing.

Hot Plates

Burned insulation on the line cord often causes shorts. Replace the entire cord. Elements can be easily replaced or substituted.

Beauty Machines

Permanent wave machines with timers, dryers, and violet-ray machines all use replaceable elements and parts. Troubles include worn cords, faulty insulation, shorts, and opens.

Electric Stoves

The installation of these items is a paying business in itself. All department stores and other electrical merchants who sell electric stoves require servicemen for installation and repair. Most stoves include a wiring diagram pasted on the back, making it easy for you to rewire a burned out system or replace an open element.

Electric Irons

Of all appliances, the electric iron is the one most often brought into the

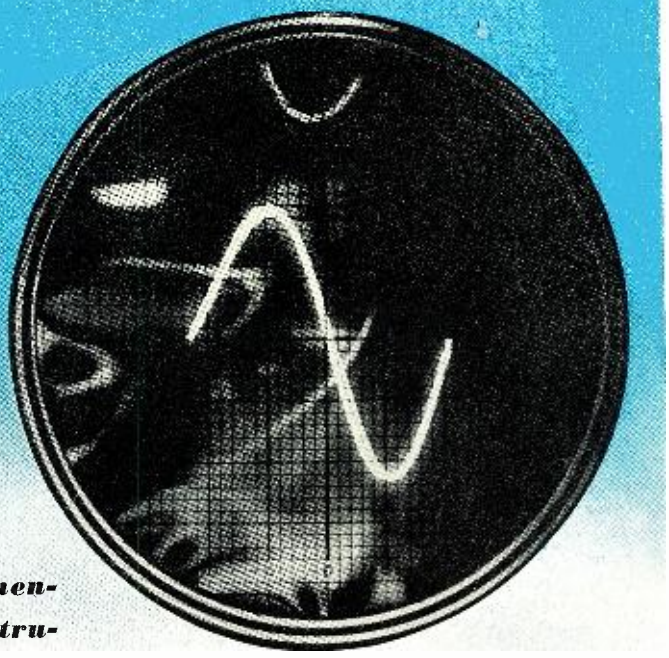
(*Continued on page* 112)

Table I. Test equipment that will be needed when repairing household appliances.

Portable a.c. voltmeter	Ranges 0-1, 10, 150, 300
Portable a.c. voltmeter	Rectifier type, Range 0-1000
Portable d.c. voltmeter	Ranges 0-10, 150, 300, 600
Portable d.c. milliameter	Ranges, 0-.1, 1, 10, 100, 150
Portable d.c. ammeter	Ranges 0-10, 20
Portable ohmmeter	Ranges 0-1, 1000, 1 meg., 10 meg.
Test lamp with standard socket for 110-volt line tests.	

Practical RADAR

By JORDAN McQUAY



The beginning of a radar pulse, a typical sine wave.

Part 2. Continuing our study of the elementary principles of the new technical instrument—radar, with details of the designs involved in generating and timing radar pulses.

LAST month we discussed the elementary principles of radar in the first of a series of articles on the *practical* aspects of the amazing new technical instrument, radar.

We learned that radar employs the principles of electronics, physics, optics, and high frequency radio. Radar can detect the presence of objects in the sky or on the sea—such as airplanes, ships, coastlines—and then determine their direction and range with uncanny precision.

The detection and location of objects is accomplished by means of radio-frequency *pulses* of energy, which are transmitted in a narrow beam in any given direction. The r.f. pulses travel at the speed of light until they strike an object or surface, and the energy is then reflected or re-radiated in various directions from the object. Some of this reflected energy returns to the radar set in the form of r.f. pulses known as *echoes*.

The determination of the actual range and direction of the object or target is based on two facts, that r.f. energy travels at the constant velocity of light (about 186,000 miles per second), and that the transmitting and receiving system of the radar set can be made highly directional.

Since the speed of the r.f. pulses through space is known, the distance or range between the radar set and the target can be found by multiplying the speed of light by one-half the time a single radar pulse requires to complete a round trip.

This time will be extremely short, usually only a few microseconds, and a cathode ray tube is used for accurate measurement of this important time fraction.

The radar oscilloscope records the time required for each radar pulse to leave the transmitter, travel out to any reflecting object within range of the set, and then return to the radar set. This measurement of *time* is displayed on a linear time basis and translated instantaneously into *distance,* in yards or miles, depending upon the calibration of the set.

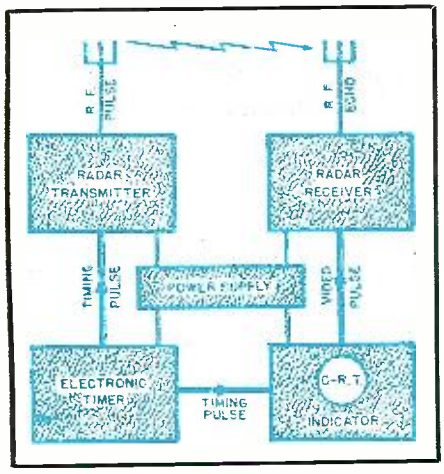
Having determined range or distance, the direction of the target in azimuth (relative to north) and in elevation (relative to the horizontal plane of the earth) can be determined by the physical position of the radar antennas.

This gives us sufficient information —range or distance, azimuth or bearing, and angle of elevation, all with respect to the radar set—so that we can locate the target accurately in space or on the water.

A basic radar set typical of all radar sets is shown in Fig. 1. The basic components of the set consist of a *transmitter* and *transmitting antenna,* a *receiver* and *receiving antenna,* an *electronic* timer which synchronizes all of the components, and a *cathode ray oscilloscope* for recording the information obtained by the rest of the radar set.

In practical operation, the transmitter and its antenna send out short bursts or *pulses* of r.f. energy at a fast but fixed rate of speed. When this energy strikes a reflecting object or target, part of the energy returns to the radar set. If the transmitter is turned off before the returning energy or "echo" arrives, the radar set can distinguish between the transmitted r.f. pulse and the reflected r.f. pulse. Then the transmitter can be turned on again and the complete cycle repeated—always allowing sufficient time for echoes to return from targets within maximum range of the set. Although slow to describe, the entire out-and-back process takes place thousands of times per second—due to the extremely high speed of radio waves in space—and the echoes are displayed on the oscilloscope only a few hundred microseconds after the original r.f. pulses have been transmitted.

Fig. 1. Basic block diagram of a radar set. Although many types of radar equipment are in use, they all operate on the same basic principles.



The Electronic Timer

The timing and synchronization of all of the many radar circuits and

components is accomplished by the *electronic timer* — the true pulse source, the heart of the radar set.

The electronic timer is responsible mainly for switching the transmitter on and off at precise and regular intervals. The timer also triggers the oscilloscope time base every time the transmitter pulses, and performs numerous other control functions which will be described later.

To accomplish all of these functions, the electronic timer generates an important voltage; a series of identical impulses, which have a certain length or duration and which occur at an exact and unvarying rate of repetition. This rate of repetition is known as the *pulse recurrence frequency* of the radar set, and is a critical requirement of the basic control voltage.

The important part played by this basic control voltage can be better understood by referring to the wave forms shown in Fig. 10. When these control pulses, A, are applied to the radar transmitter, ultra high frequency radiations, B, take place for the duration of the controlling pulse from the timer. At the same time, the same control pulses, C, are applied to the circuits of the oscilloscope, and a linear time base wave form, D, is triggered off at the start of each complete radar cycle. Later during each of these cycles, an echo pulse, E, may be received from some distant target. All of these wave forms are combined on the screen of the cathode ray oscilloscope, F, and are repeated or retraced on the screen during every complete radar cycle.

From a study of these wave forms (Fig. 10), it will be noted that the control pulses from the electronic timer are directly responsible for all the synchronizing action within the radar set, and the determining factor in the timing of each radar cycle.

The importance of timing in a radar set cannot be overemphasized. The measurement of time is the chief function of radar—since the measure of elapsed time is found to be a measure of distance.

It is therefore necessary that the basic control pulses from the electronic timer be sharply defined, precisely timed in length and duration, and recur at a given and steady rate of repetition. It's a big job for the electronic timer, one of the most important in the radar set.

But before we consider how the basic pulse form is generated, let's examine two outstanding characteristics of the control voltage: the *pulse recurrence frequency* and the *pulse duration*. We can better understand the importance of these two characteristics by studying the action of the radar transmitter which, it should be remembered, is controlled by the voltage pulses from the electronic timer.

Timing the Transmitter

We have already discussed how the range of a target is determined by measuring the elapsed time between

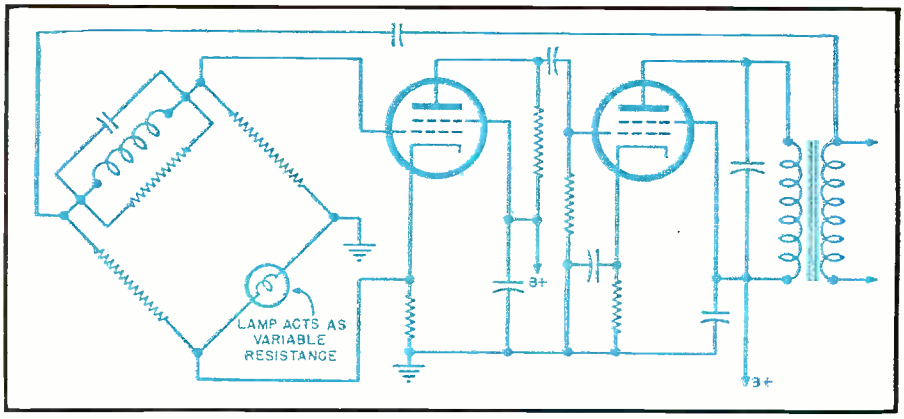


Fig. 2. Schematic diagram of a typical Wheatstone-bridge sine wave oscillator.

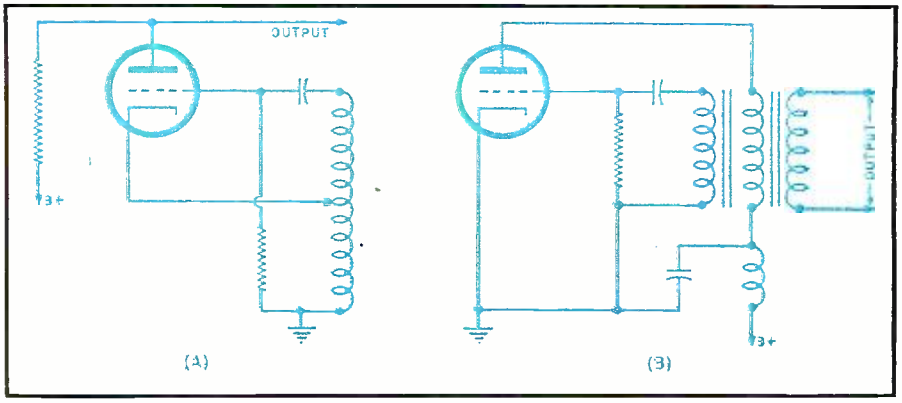


Fig. 3. Blocking oscillators that may be used as basic radar pulse generators.

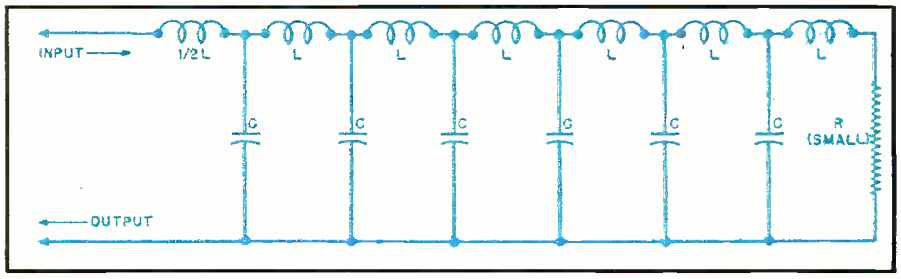
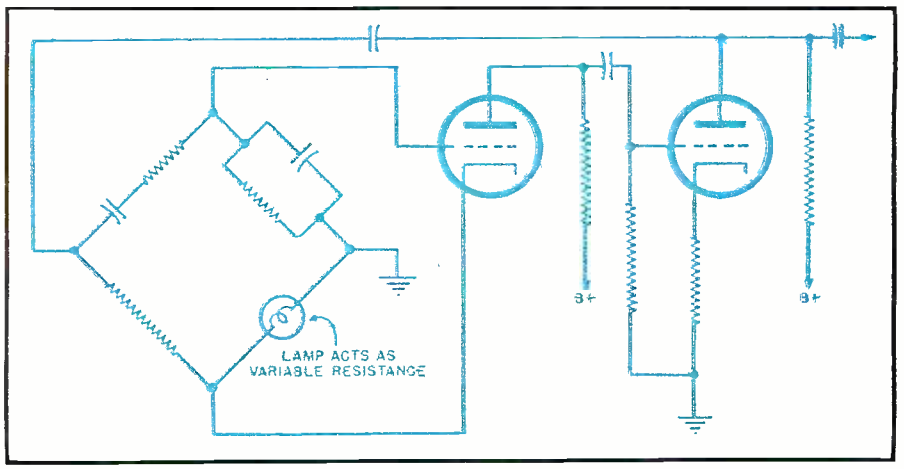


Fig. 4. Pulse-shaping line consisting of a number of series coils and shunt condensers arranged in a pi- or H-ladder network. The line is terminated in a short-circuit.

★ ★

Fig. 5. A typical Wien bridge which generates a pure sine wave in the initial stage of the electronic amplifier. The signal is then applied to a Class A distortionless amplifier to increase the voltage amplitude to a very high value.



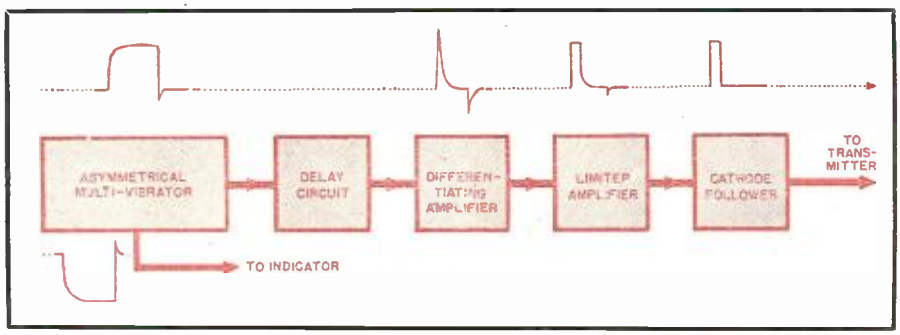


Fig. 6. An electronic timer employing a multivibrator as a master oscillator.

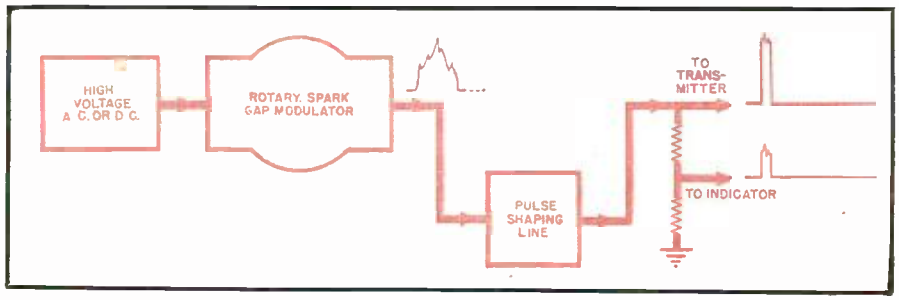


Fig. 7. Another form of electronic timer is known as a rotary-spark-gap timer.

the instant when an r.f. pulse is transmitted and the reflected echo is received.

The transmitted r.f. pulses cannot be very long in duration and they cannot recur at too short an interval, or the reception of the echo will be obscured by the next r.f. pulse from the transmitter. On the other hand, it is necessary for the duration of the pulse to be long enough so that the receiving echo has a definite pattern in order to differentiate the echo from static, noise, etc. on the oscilloscope screen. All of these factors influence both the pulse recurrence frequency and the duration of the pulse.

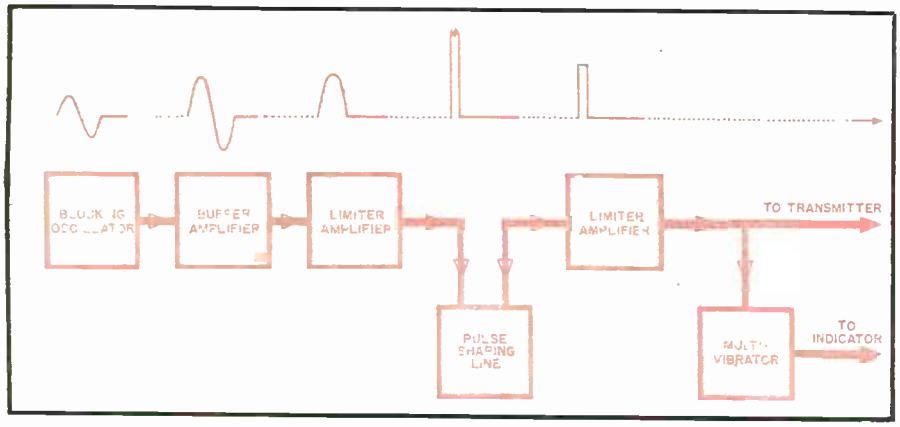
But the most important factor influencing the frequency of the radar pulses is a consideration of the *maximum range* up to which the radar set will operate. And the most important factor influencing the pulse duration is a consideration of the *minimum range* above which the radar set will operate.

There are many different types and kinds of radar sets, each for a particular tactical use: to locate aircraft from the ground, to locate surface vessels from a shoreline, to locate aircraft or ships from the air, or for other purposes. In every case the radar set is designed to function within a certain maximum and minimum range.

First, let's consider the maximum range limit of a radar set, as indicated on the calibrated scale on the face of the oscilloscope screen. This maximum range limit may be only several thousand yards on certain sets designed to detect and locate targets at a comparatively close distance. Other types of radar sets may be calibrated up to 50 miles, 100 miles, or even higher.

Since ultra high frequency radio waves travel in straight lines with very little refraction or curvature, the *extreme* limit of maximum range is not known. But at very great distances the returning echo is usually too weak to be detected by the radar set, and atmospheric disturbances create an additional difficulty of interfering static—which appears as "grass" on the time base of the oscilloscope. It is more convenient to have a large number of radar stations designed to operate over shorter ranges, than to attempt to have a single station functioning over extremely great distances.

Fig. 8. A blocking type oscillator used in the initial stage of the electronic timer.



We stated earlier that the maximum range of a radar set was an important factor in the determination of the p.r.f. or pulse recurrence frequency. To illustrate how the p.r.f. is determined, let's consider a typical example: We are designing a radar set which we want to detect and locate targets within a maximum range of 45 miles. Therefore,

$$1 \text{ radar cycle} = \frac{\text{Range of set in miles}}{(\frac{1}{2} \times \text{Velocity of radio waves})}$$

$$= \frac{45}{93{,}000 \text{ (approx.)}}$$

$$= 0.000484 \text{ second (approx.)}$$

This result—0.000484 second—is the time required for one complete cycle of operations of a radar set with a maximum range of 45 miles. Dividing this fraction of a second into unity, we can determine the frequency at which pulses must be transmitted by the set.

$$\text{p.r.f.} = \frac{1}{0.000484 \text{ sec.}}$$

$$= 2070 \text{ (approximately)}$$

Thus, for a given maximum range of 45 miles it is necessary to transmit about 2070 pulses per second. This p.r.f. must be known so that a returning echo will not interfere with the succeeding pulse being sent out by the transmitter. In other words, about 484 microseconds must elapse between the start of one cycle and the start of the next cycle of operations. This time interval fixes the highest frequency which can be used for the p.r.f.

In normal operation, the radar antenna system is moving almost continually and therefore the energy beam may strike a target for a relatively short time. During this period of time a sufficient number of r.f. pulses should be reflected from the target to produce a visible indication on the screen of the oscilloscope. Therefore, the normal speed of the moving antenna system together with the persistence of the cathode ray screen will ordinarily determine the lowest frequency which can be used for the p.r.f.

In practice, the pulse recurrence frequency is a value relatively low in the audio frequency range—generally between 250 and 5000 pulses per second.

The radar transmitter is actually radiating for only an extremely small portion of the time required for a complete cycle of operations. Referring to our example above, the set may be radiating during only a few microseconds of the total cycle of 484 microseconds.

The length or duration of the radar pulse is therefore a small fraction of

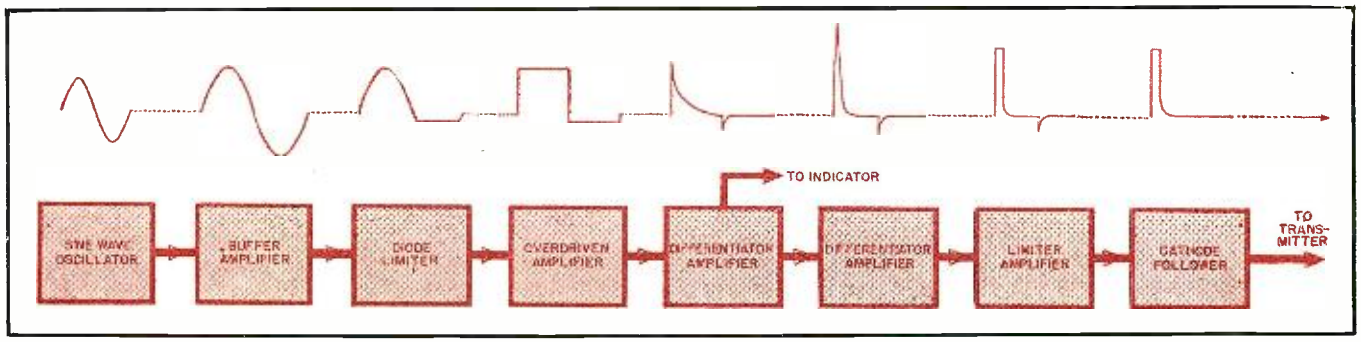


Fig. 9. A sine-wave oscillator timer. Sine-waves recur at a fixed frequency equal to the pulse recurrence frequency of the radar set.

the total time required for the pulse to complete a round trip from the radar set to a target at maximum range.

The actual duration of the pulse determines the minimum range of the set. For, if the pulse lasts too long an echo from a nearby target will return to the radar set before the last portion of the transmitted r.f. pulse leaves the antenna, and the echo from a nearby target will be concealed from view on the cathode ray oscilloscope by the presence of the transmitter pulse.

Radar sets which detect and locate targets within very close range thus may be expected to employ a pulse of extremely short duration—on the order of 1 or 2 microseconds. Long range radar sets may use a pulse of much longer duration—8 to 10 microseconds—since the set is not concerned with targets close to the radar station.

From this discussion it can be seen that a high degree of precision is expected of the control pulse from the electronic timer which switches the transmitter on and off—radiating pulses of r.f. energy.

Generating the Control Pulse

The electronic timer is so called because its function in the radar set is purely electronic; it is generally concerned with wave shapes of fairly low frequencies in the audio range. Although these wave forms may later affect the r.f. carrier of the transmitter and other components of the radar set, the principles of u.h.f. radio, physics, and optics are noticeably missing from this component of the set.

In the basic block diagram of a radar set (Fig. 1) we indicated the electronic timer as an essentially simple component. But the timing circuits are probably the most complicated stages of the entire set, and certainly the most difficult to adjust. Since wave forms emanating from the electronic timer control all other components of the radar set, the timing circuits must function with extreme microsecond-precision. A minute error in adjustment of any part of the timing circuits will be magnified a hundredfold by the time it reaches other parts of the radar set.

In the basic block diagram (Fig. 1) we also indicated the electronic timer as a complete and separate component. But in some radar sets the timing circuits may be integral parts of the transmitter, the indicator, or the receiver.

Regardless of the complexity or the physical location of the timing circuits in a radar set, however, their function is basically the same: *to generate a control voltage consisting of pulses of a precise duration and recurring at the p.r.f. of the radar set.*

There are two principal methods of generating these control pulses; (1) by means of circuits providing a recurrent wave shape which is converted into the desired output pulse shape by the use of distortion and pulse-forming stages, and (2) by means of circuits which generate the output pulses directly.

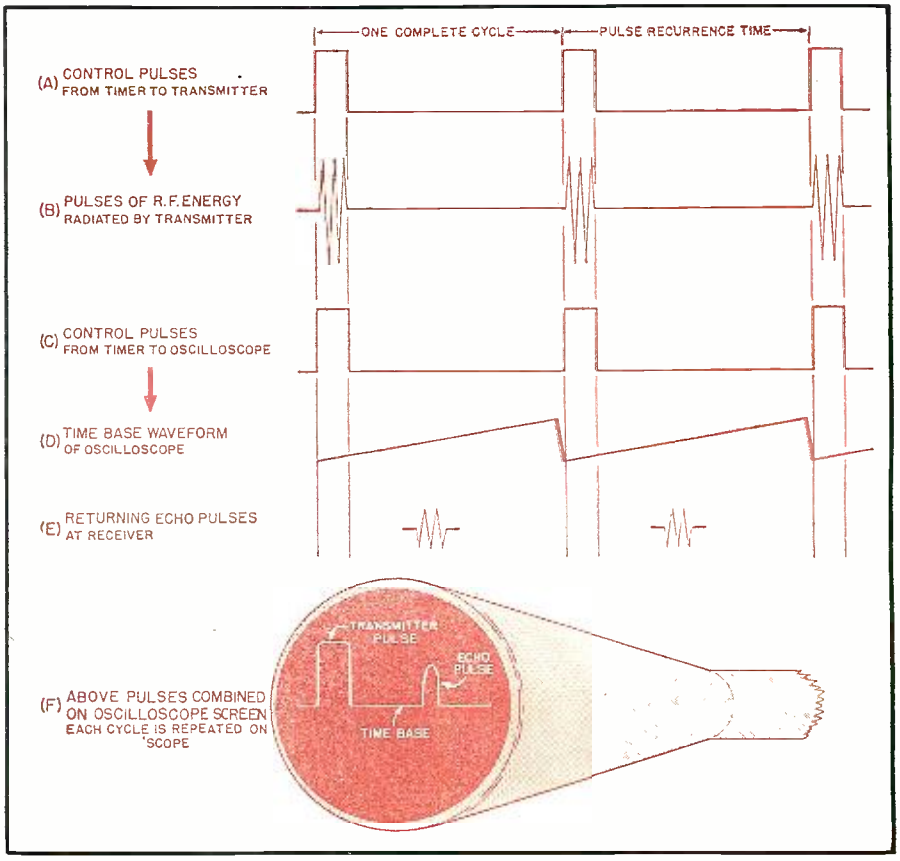
While method (1) requires the use of a large number of squaring, peaking, distortion, and amplifying stages, the output wave form will be sharper, more stable, and more precise than timing pulses generated by method (2).

It may be assumed, then, that most radar timing circuits consist of several electronic stages—the number contingent upon the desired degree of sharpness, the amount of power output required, and the desired stability of the pulse recurrence frequency.

The p.r.f. or pulse recurrence frequency is normally determined in the very first stage of the electronic timer. Any type of stable oscillator may be used, such as sine wave oscillator, a blocking oscillator, a ringing oscillator, or a multivibrator. The shape

(*Continued on page* 141)

Fig. 10. The heart of the entire radar set is the electronic timer. It generates a series of identical impulses which have a certain length or duration and which occur at an exact and unvarying rate of repetition known as the pulse recurrence frequency.



SIMPLE HIGH-FIDELITY TUNER

By W. W. KUNDE, Jr.
Design Eng., Thordarson Elec. Mfg. Co.

The design and performance characteristics of a wide-band amplitude-modulated tuner, whose output is within plus or minus two db. between 20 and 10,000 cycles.

THIS article describes a simple high-fidelity tuner capable of excellent program reproduction from local broadcasting stations. The quality of reproduction is limited only by the associated equipment.

A high-fidelity tuner must be capable of passing as wide a band of frequencies as possible, without interference from stations adjacent to the one being listened to. Since station frequencies are allocated at 10-kilocycle intervals in the broadcast band, a pass-band at or wider than 10 kilocycles would cause objectionable interference from adjacent channels. However, the larger stations in a given local area such as Chicago, Illinois, are separated by at least 50 kilocycles. Therefore, a tuner capable of passing a band of frequencies as wide as 10 kilocycles would give highly satisfactory results for local reception. In rural districts however, where local stations are often of relatively low power, the condition often prevails of a powerful distant station coming in with a signal strength approximately equal to that of the nearby local station. If these stations are 10 kilocycles apart there may be objectionable interstation interference, with a tuner which passes a 10-kilocycle band. This interference is the familiar "10-kilocycle whistle" caused by the heterodyning of two adjacent stations. The "10-kilocycle whistle" can be eliminated by using one of the many filters available for this purpose.

The tuner described herein has a frequency response of the audio output from 20 cycles per second to 10 kilocycles plus or minus two decibels, while the conventional tuner sacrifices the high-frequency response in order to eliminate interstation interference where 10 kilocycles station separation is encountered.

This tuner consists of an r.f. amplifier stage followed by an infinite-impedance detector. The infinite-impedance detector was chosen because it produces very little harmonic distortion, even at a high percentage of modulation. An examination of the circuit diagram (Fig. 4) will show that the circuit is conventional except for two details: the resistors shunting the tuned circuits and the use of condenser C_2, as shown in the circuit diagram. Condenser C_2, in conjunction with the other components in the detector's cathode circuit forms a frequency-discriminating network.

With respect to the audio output the cathode circuit of the detector may be shown as in Fig. 3A. This type of circuit has a characteristic frequency response as shown in Fig. 3B. However, the amount of high-frequency boost obtained from this circuit is limited. At the lower frequencies

$$E_o = E_i \left(\frac{R_2}{R_1 + R_2} \right)$$

As the frequency increases, the effect of R_1 decreases due to the shunt-

The completed unit, showing proper placement of component parts mounted directly on the chassis. Although a 3-gang variable condenser is shown, the actual design employs only two of these sections. The third is not connected and may be omitted. Note the shielded-type output terminal mounted on the side of the chassis. Shielded cable should be used to connect this tuner to its associated amplifier.

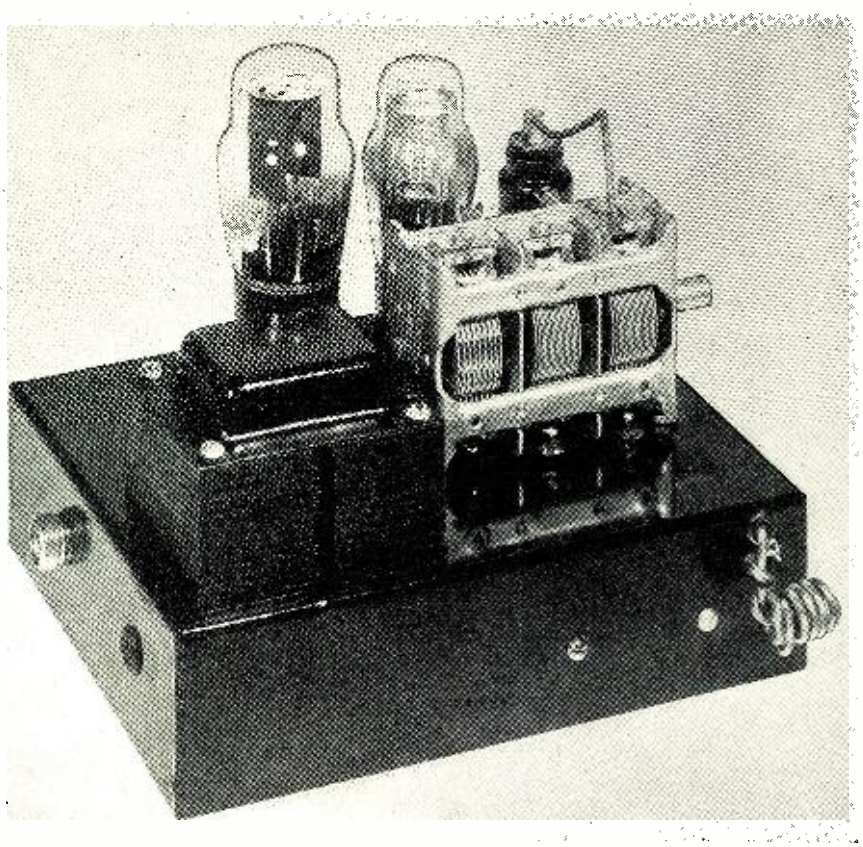
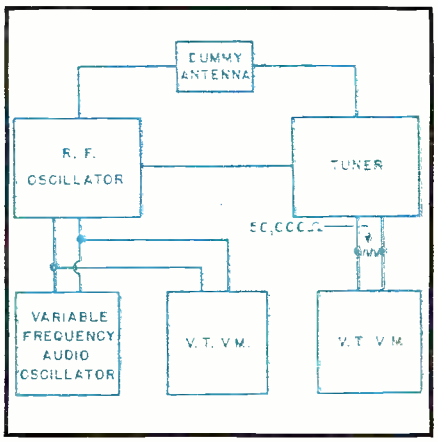


Fig. 1. Diagram showing equipment used in obtaining final performance characteristics of the completed unit.



ing effect of C. In the limiting case:

$$E_o = E_i \left(\frac{R}{0 + R_2} \right)$$

or $E_o = E_i$

This method of high-frequency compensation in itself does not give the desired result. Shunting the tuned circuits with resistors is used to give the additional high boost required.

The desired result of loading the r.f. coils is to obtain a tuned circuit which will pass a wide band of frequencies. The undesirable effect of loading the r.f. coils is that as tuning becomes progressively broader, with increased loading, adjacent channel interference increases. A compromise is achieved by loading the coils as much as possible without encountering objectionable interference from adjacent channels. Loading the coils reduces the sensitivity considerably. However, this is not objectionable because, as stated previously, local reception was a prime consideration.

This tuner combines the desirable features of the previous discussion: a frequency response of the audio output from 20 cycles per second to 10 kilocycles plus or minus two decibels and sufficient selectivity for good reception.

The curves shown in Fig. 2 indicate the results of various circuit changes on the response of the audio output. The circuit used in obtaining data for these curves is shown in Fig. 1. One curve (Fig. 2) shows the frequency response of the audio output without any coil loading, and without C_2 in the circuit. Another curve illustrates the response with one-megohm resistors shunted across the r.f. coil secondaries. A third curve shows the response with fifty-thousand-ohm resistors shunted across the r.f. coil secondaries. The final curve shows the results obtained after proper loading was determined.

Loading or shunting the r.f. coils has its limits. When the resistors shunting the r.f. coils were made smaller than fifty-thousand ohms, tuning became too broad and adjacent channel interference was objectionable. A frequency-discriminating circuit was used, as mentioned previously, to obtain the final curve.

Some experimentation with the antenna and ground connection is usually required for best results. This is necessary because the available audio output will vary somewhat for different types of coils, and the antenna should be no longer than necessary for best results. A long antenna tends to reduce selectivity and for this reason the length of the antenna should be a minimum, consistent with satisfactory reception. It was found that coils having high-impedance primaries required a good ground connection in addition to the antenna, while coils having low-impedance primaries gave satisfactory operation with a fairly short antenna and no ground connection.

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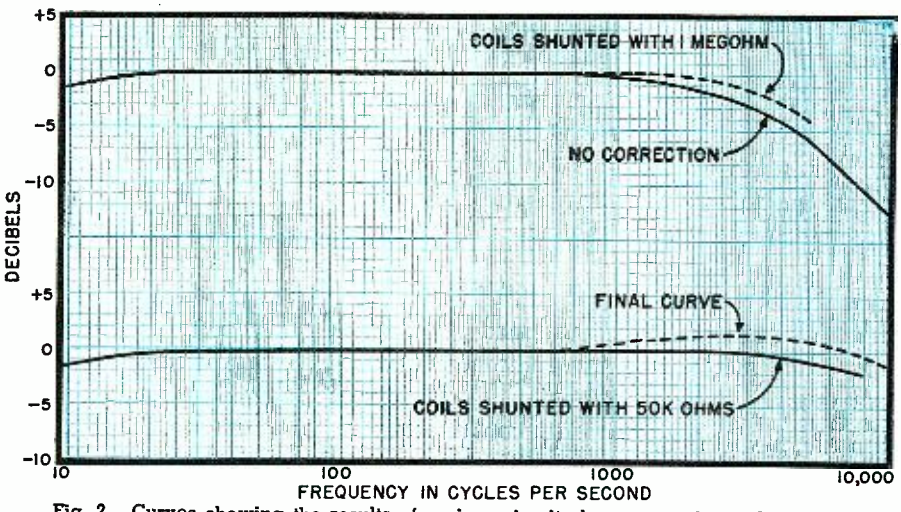


Fig. 2. Curves showing the results of various circuit changes on the audio output response. Excessive shunting of coils will cause adjacent channel interference.

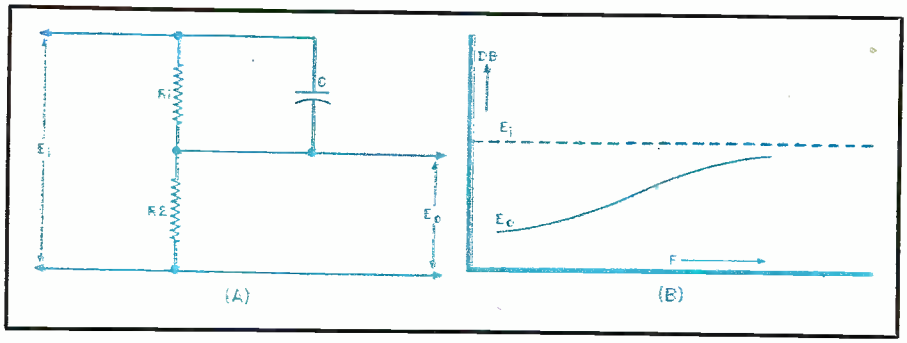
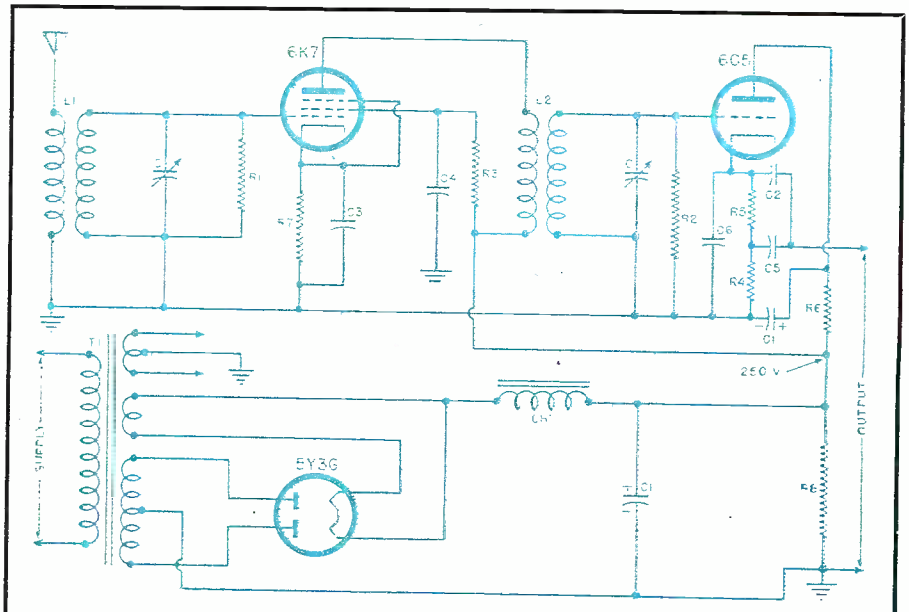


Fig. 3. (A) Simplified diagram of the cathode circuit of the 6C5 detector. (B) Characteristic frequency response of this circuit. By employing a by-pass condenser, C, across the resistor, R_1, the output at the higher frequencies is increased.

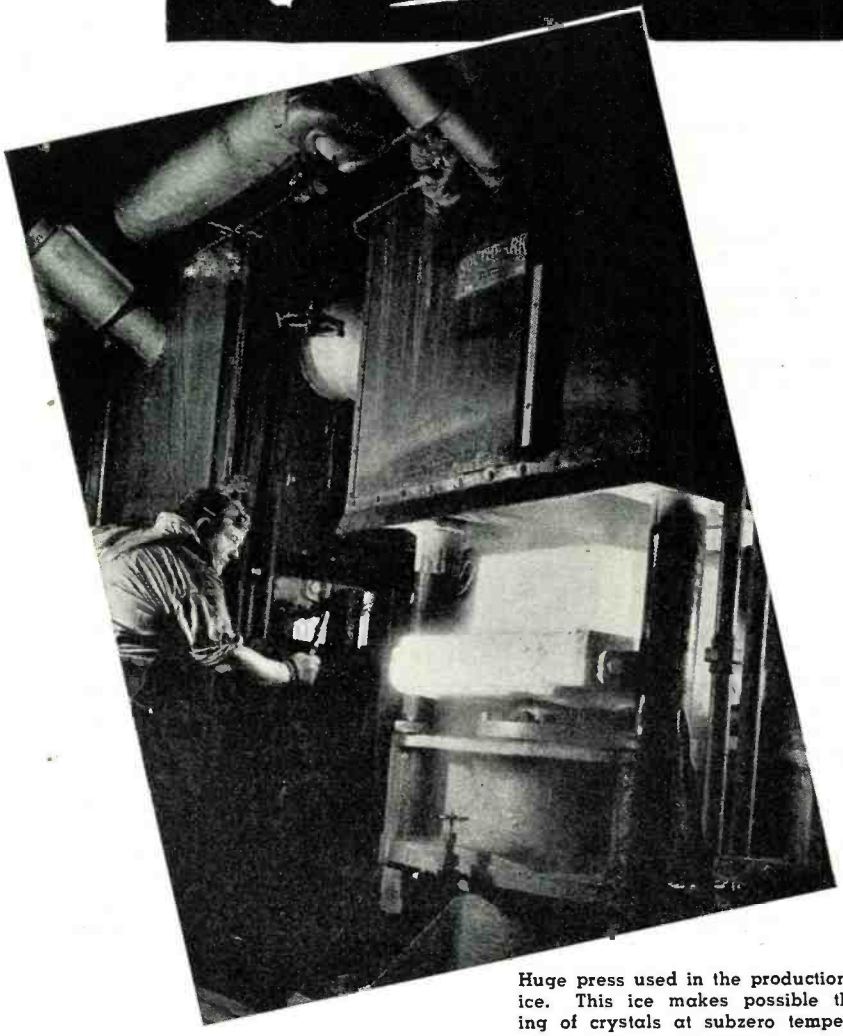
☆ ☆

Fig. 4. Circuit diagram of the 3-tube wide-band tuner. The circuit is conventional except for two details: Resistors are used, shunting the tuned circuits and a condenser, C_2, is employed in the cathode of the 6C5, cathode follower stage.



C—2-gang var. cond., 365-$\mu\mu$fd. per section
C_1—8-8-μfd., 450-v. elec. cond.
C_2, C_3—.01-μfd., 400-v. cond.
C_4—.05-μfd., 400-v. cond.
C_5—.5-μfd., 120-v. cond.
C_6—.0001-μfd. mica cond.
R_1, R_2—50,000-ohm, ½-w. res.
R_3, R_4—100,000-ohm, ½-w. res.
R_5, R_6—20,000-ohm, ½-w. res.
R_7—500-ohm, ½-w. res.
R_8—20,000-ohm, 10-w. w.w., res.
L_1—Antenna coil
L_2—R.f. coil
L_1, L_2 to be standard broadcast t.r.f. matched coils.
T_1—Power trans., 300-0-300 @ 50-ma., 5-v. @ 3-amps., 6.3-v. @ 2-amps. c.t.
Ch_1—Filter choke, 200-ohm @ 60-ma.
Tubes: 5Y3G, 6K7, 6C5G

Testing CRYSTALS



Huge press used in the production of dry ice. This ice makes possible the testing of crystals at subzero temperatures.

By ERIC S. JELTRUP
The Mathieson Alkali Works

Quartz crystals, used extensively in all military communication equipment, are pretested at temperatures ranging from —40° to 122° F.

IN THE present war, a pilot may breakfast in Cairo, find himself six miles above sea level crossing the Himalayas at noon, and land for dinner on the hot dusty plains of Chungking. His radio, therefore, must be an all-weather set that will respond equally well in the tropical heat of the Sahara or in the icy winds above the Himalayas.

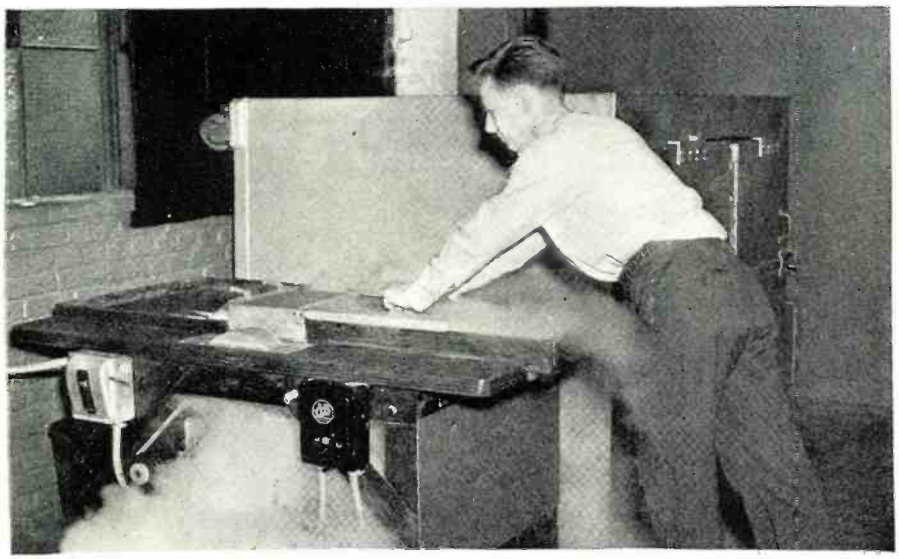
To assure the use of radio crystals in aviation radios that would react properly wherever our planes and those of the United Nations have to fly, new testing methods had to be developed by *Bendix Radio,* a division of *Bendix Aviation Corporation.*

Ambient temperature testing equipment, housed in a cabinet which conforms in size with the standard six-foot relay rack models, was devised to subject the crystals to temperatures ranging from —40° F. to 122° F. A testing chamber, about 8″ x 8″ x 8″, is built into each cabinet, and directly above the chamber there is a drawer about 2″ deep. These two sections form the testing compartment. They are located in the upper part of the cabinet within easy reach of an operator standing in front of it. Manually-operated electric switches, and visual temperature and current indicators are located on the front of the cabinet. An automatic recorder on each cabinet provides a permanent chart, penned on a paper record tape, of each test. The base of the cabinet affords storage space for dry ice cubes which are used during the tests.

From one to twenty crystals, cut from high quality Brazilian quartz, go into each *Bendix* aviation radio. Each finished crystal is plugged into the testing chamber, one at a time, and tested individually, a complete test re-

(*Continued on page* 86)

At Bendix Radio, the dry ice is cut into cubes approximately one-inch square for use in the drawer of the ambient temperature test equipment.



Two Way Radio for HIGHWAY FREIGHTERS

By HARRY F. CHADDICK
Chair., Radio Communications Comm., A.T.A.

Plans for the development of two-way radio for use by motor trucks hauling cross-country loads of highway freight.

Typical Galvin installation for two-way radio dispatching of motor fleets.

THE *American Trucking Associations, Inc.*, the only national organization representing all classes of motor trucks, for hire as well as private, has requested authority of the Federal Communications Commission to operate two-way radio equipment for the purpose of expediting freight and increasing road safety.

The members of the A.T.A., which represents truck operators throughout the nation, are in complete accord regarding the necessity of using two-way radio in future trucking operations. The members authorized the A.T.A. to form an organization, on a non-profit basis, to conduct the necessary experimental and pioneering work for highway radio communications networks to serve the trucking industry and other highway users, and to proceed, as soon as experimental work has been completed, to the development of proper methods and equipment for such a network.

In order to facilitate the necessary experimental work, the A.T.A. formed a Radio Communications Committee. The attorneys of the A.T.A. appeared before the FCC and requested the allocation of frequencies for the purpose of providing communications to and from mobile units. In support of their request for frequency allocations, the legal staff of the A.T.A. pointed out that there are, at the present time, approximately five million trucks operated in the United States. Of this number, 2,800,000 are operated by individuals or firms, 1,200,000 are operated by farmers, and 875,000 are operated "for hire."

It is these "for hire" carriers which provide a flexible system of transportation which is vital and essential to the nation's economy.

Truck operations are generally conducted at night in order to avoid daytime traffic congestion, however, accidents or road failures which occur on the highways at night, far from any means of communication, have long been a major problem of the truck operators in the conduct of their own operations. In order to make this night travel safer and to expedite the handling of freight, the A.T.A. proposes to use radio in its operations for the following reasons:

1. Help reduce the 40,000 deaths caused each year by highway accidents.
2. Permit drivers to call immediately for ambulances or medical aid in case of accidents.
3. Assist all highway users in need of assistance by calling for necessary aid.
4. Cooperate with the state police.

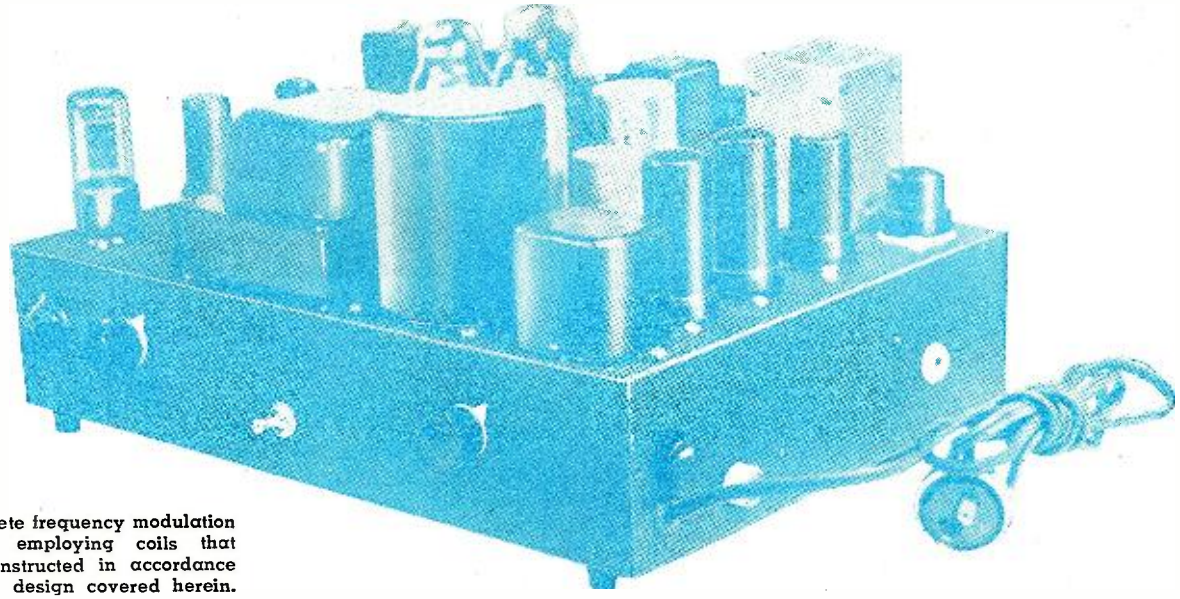
(*Continued on page* 110)

Two-way radio will eliminate this type of operation, as drivers will be in constant communication with dispatchers.

Easily Built FM Broad Band I.F. Transformers

By Ervin F. Lyke
Technician, Columbia Broadcasting System, Inc.

Important design characteristics of i.f. and discriminator coils for the radio amateur who prefers to construct his own units.



A complete frequency modulation receiver employing coils that were constructed in accordance with the design covered herein.

DUE to the lack of available FM receiver replacement i.f. transformers, some time has been spent in producing an easily built and adjusted i.f. unit capable of being incorporated in present frequency-modulated signal receivers and also to be used in the construction of such a receiver for home use.

It has been more or less standard to use 4.3-mc. i.f. transformers in commercial FM receivers. Therefore, any replacement transformer must, in most cases, use this frequency.

It is possible to construct a satisfactory 4.3-mc. i.f. transformer for FM use from the materials found in a discarded i.f. transformer from a communications receiver (one using a frequency of 1 to 3 mc.), or by using dual trimmer condensers and wave trap shield cans. If discarded high-frequency i.f.'s are available, the dual condensers used in them will be approximately the correct capacity and the shield cans will be the correct size. The coil form and windings should be discarded and a new form ½ inch in diameter and 3 inches long should be substituted. Many of these communication receiver i.f.'s used wood for the coil form and the impregnation used to enable them to be used at the lower frequencies would not be good enough for use at the new frequency.

The units to be described were built up using dual trimmer condensers of 100 to 250 $\mu\mu$fd. capacity purchased for 12¢ each at a large radio supply house. The coil forms were cut from ½ inch diameter polystyrene rod but bakelite can be used equally well. The original model used a shield can built up from 1/16 inch sheet aluminum but later shield cans from dismantled receivers were used with equal results. The only requirement is that the shield be of such a size as to allow at least the width of one coil diameter between the windings and the shield at the sides and ends of the coil. The coil form was secured to the trimmers by a 6/32 brass bolt which was screwed into the top of the coil form. This bolt should be of sufficient length to extend through the top of the shield so that the whole unit can be assembled, as in commercial transformers.

See Fig. 1A for the placement of the windings on the coil form. The primary consists of 38 turns of No. 22 plain enamel wire close-wound at the upper end of the form. The secondary is also 38 turns of No. 22 p.e. close-wound 3/16 inch below the end of the primary. Both coils are wound in the same direction and the uppermost ends of each winding are the plate and grid connections respectively. Each winding will occupy about 1 inch on the form. The ends of the windings are anchored by passing them through 1/32 inch holes drilled through the coil forms. In order to minimize the possibility of oscillation in the i.f. stage, the grid and plate leads passing up along the coils should be kept well separated and they should be rigid enough to hold their position.

With the windings spaced as shown, the bandwidth of these transformers is about 150 kilocycles when the primaries and secondaries are shunted by 10,000 ohms. These resistors need be no larger than 1/3 watt and can be wired directly to the trimmer condenser terminals.

In the construction of a discriminator transformer the same type of dual trimmer condensers can be used. With the capacity of the trimmers being variable from 100 to 250 $\mu\mu$fd., the same coil data applies. However, the primary is wound at the center of the coil form. Also, the secondary consists of two windings of 20 turns each. These windings are wound above and below the primary, making one continuous winding spaced at the center

for the primary. A connection is made to the center of the secondary and a lead is brought out to go to the discriminator voltage divider center tap. A small fixed mica condenser of 50 μμfd. capacity must also be connected from the secondary center tap to the plate end of the primary. This condenser goes inside of the shield can. The spacing between each end of the primary winding and the adjacent secondary winding is 3/16 inch. See Fig. 1B.

The curve shown in Fig. 2 gives the discriminator characteristic for the windings as specified. The linear portion of the curve is somewhat more steep than in manufactured units but this has the advantage of giving slightly higher audio output with a given signal input and modulation percentage.

Several of these transformers are in use and the alignment has been maintained exceptionally well. The use of air trimmers and the coating of the coil windings with liquid polystyrene coil dope makes the i.f. units slightly better but the additional expense is not justified by the increase in overall operation of the receiver.

(Ed.—Although it is quite apparent that the Federal Communications Commission will, in the near future, re-allocate frequency modulation broadcasting to a higher band, we feel that there will be sufficient interest for some time to come in the design of coils based upon an i.f. frequency of 4.3 megacycles—that is particularly so in the construction of replacement units for receivers already on the market. These receivers will no doubt continue to be used by simply employing some form of frequency converter adapter which will be marketed when the change becomes effective.

There is no doubt that when the new frequency allocation becomes effective, that the majority of the new receivers will employ a higher i.f. than that of the 4.3 megacycle frequency. In choosing a proper intermediate frequency, it will be necessary to bear in mind that the image frequency must fall outside of the FM band. As it is, at present, the band covered by frequency modulation is 42-50 mc., 8 megacycles wide, and receivers employ a 4.3 mc. i.f. producing an image frequency of 8.6 megacycles, which will fall outside of the band. If the frequencies assigned to FM will be as proposed, that is, 84-102 megacycles (18 megacycles wide), the i.f. frequency will need to be slightly more than 9 megacycles. Most likely a value of 9.3 megacycles will be decided upon.

Some manufacturers in manufacturing a higher priced line of receivers may allow a frequency band coverage of 84-108 mc. allowing for added expansion of FM broadcasting which is intended to be reserved for this purpose by the Federal Communications Commission. In these cases the i.f. frequency employed will be higher than that of 9.3 megacycles.)

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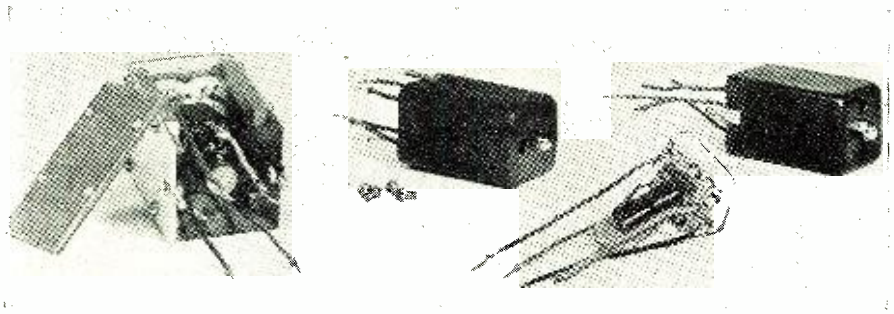


Detailed assembly views of the i.f. and discriminator transformers. (Left) discriminator coil showing proper position of phasing condenser. (Right) i.f. transformer showing shunt resistor mounted directly to trimmer lugs.

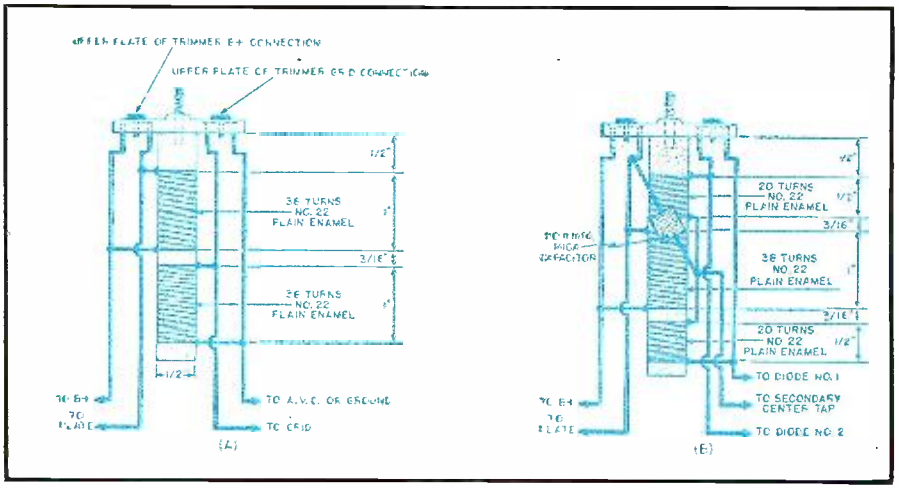
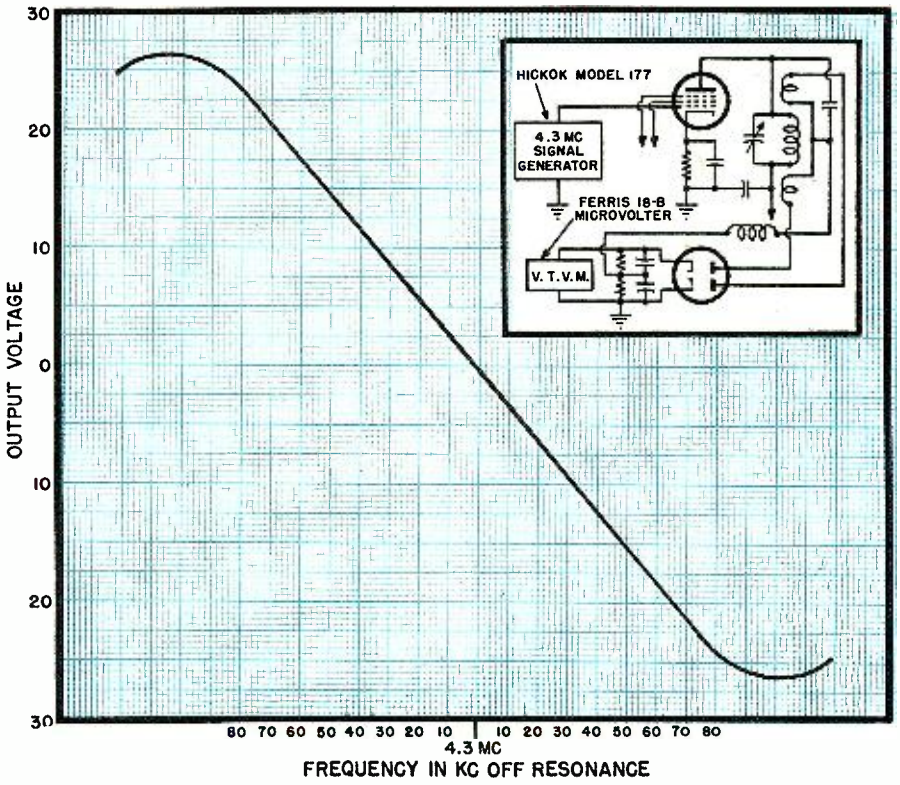


Fig. 1. (A) mechanical layout showing detailed construction of the i.f. transformer. (B) showing assembly details of the discriminator transformer.

Fig. 2. Curve showing characteristics of discriminator transformer as described herein. The linear portion of the curve is steeper than those of manufactured units, however it has the advantage of giving slightly higher audio output with a given signal input and modulation percentage.



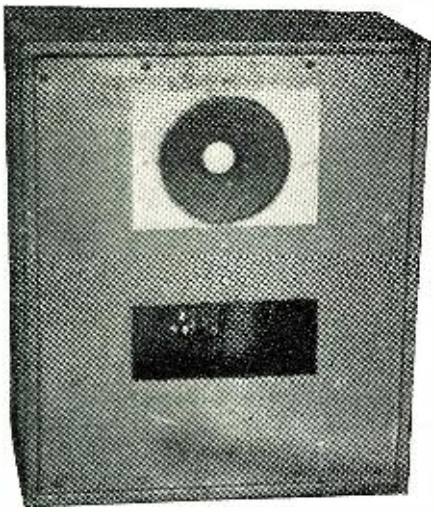


Fig. 1. Typical bass reflex type cabinet constructed by the author.

WARTIME SPEAKER ENCLOSURES

By J. CARLISLE HOADLEY

Constructional details of various types of speaker enclosures for high fidelity sound reproduction; easily built from old cabinets or available material.

NOW that speaker enclosures designed and offered for sale by the speaker manufacturers are on priority and so difficult to obtain, a few words on the construction of a suitable enclosure for your own speaker would, no doubt, be in order. Speakers of from 6″-12″ in diameter are now obtainable from many mail order houses and can be obtained in both field coil and permanent magnet designs. It is only the larger diameter models and the heavy duty types which are hard to get. Therefore, a method of constructing a high fidelity speaker enclosure is included, using easily obtainable speakers.

First, what do we desire in a speaker enclosure? We want primarily to provide a baffle to load up the speaker cone at the low frequencies, so that the speaker may push sufficient air to reproduce faithfully the frequencies below two hundred cycles per second. We wish to do this in some sort of enclosure which will look presentable in your living room. It must, therefore, do the job without assuming the proportions of a grand piano. One of the best ways to accomplish this is to use the bass reflex type baffle of the type similar to that evolved by *Jensen Mfg. Co.* This type of enclosure meets the desired requirements of small size and good low frequency reproduction. It operates on the principle of an over-coupled acoustic circuit. (The cabinet is so designed that when employed with a particular speaker a double resonant peak is obtained, one of which is lower than the speaker's original resonant frequency.) Effectively then, we have lowered the range over which the speaker will perform satisfactorily.

Also, since we have a vent in the front of the enclosure, the back wave at low frequencies is effectively added in phase to the wave from the front of the cone, which increases the efficiency of the speaker and enclosure at these low frequencies. This increase is quite noticeable over a similar enclosure without a vent. This type of enclosure has one bad feature. As the cone moves in, it compresses the air and gives increased damping with increased amplitude which tends to generate non-linear distortion on low frequency peaks.

It is a well-known fact that if we operate two speakers connected in phase to the same source, i.e. so that their cones move in and out together, the low frequency response will be somewhat similar to that of a single larger speaker. We can therefore simulate the sound of a large speaker by parallel operation of several smaller ones. Of course, we will not be able to handle any more power than the sum of the power capabilities of the smaller speakers, but at a reasonable volume level it is hard to tell the difference. The high frequency response will not be affected, only the power handling ability increased by the sum of the power ratings of the several speakers. There is a high frequency advantage, however, inasmuch as the smaller the diameter of the speaker, the wider the angle that it will radiate. The larger types tend to be much more directional. At 10,000

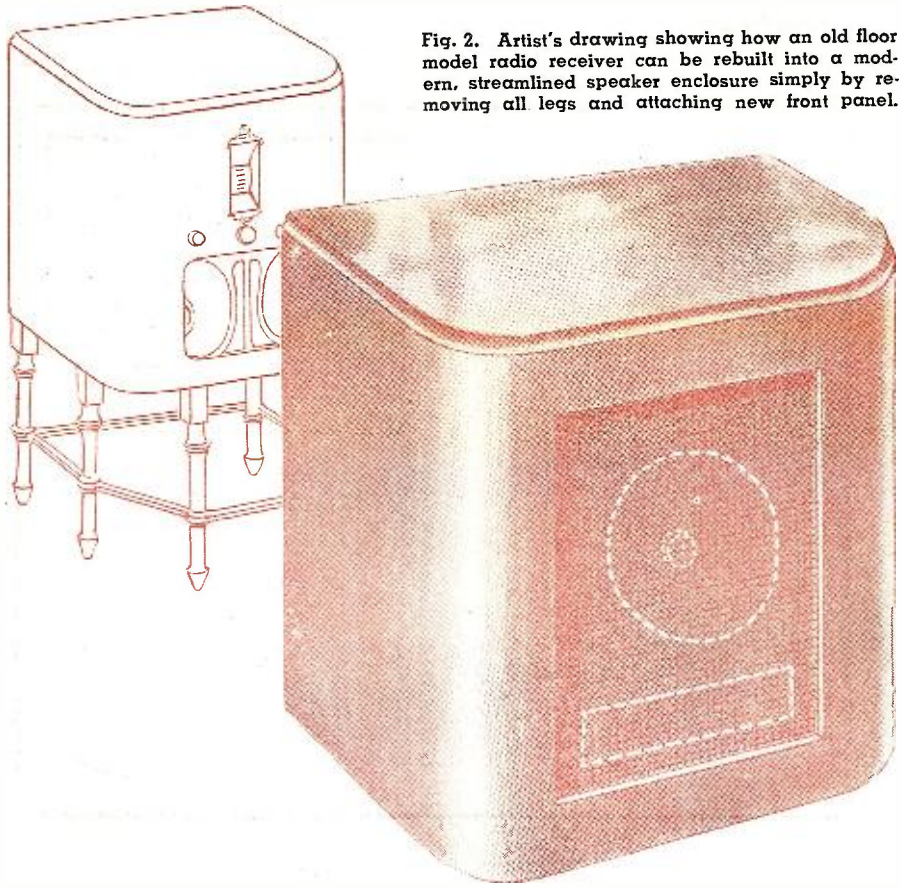


Fig. 2. Artist's drawing showing how an old floor model radio receiver can be rebuilt into a modern, streamlined speaker enclosure simply by removing all legs and attaching new front panel.

cycles for instance, at a distance of ten feet from the speaker, there is only a small area that the higher frequencies are heard. As we move off the axis of the speaker, the high frequencies attenuate rapidly. We therefore, in the absence of a multi-cellular tweeter, gain quite an advantage by using several smaller speakers. There are two ways of doing this. We may, for instance, use two or three eight-inch models arranged as in Fig. 4A and 4B so that they give the approximate low frequency response of a 12″ or 15″ unit but have much less directional characteristics and spread the high frequency sounds over a much wider angle. The effect is quite noticeable as we walk from one side of the speaker enclosure to the other as compared to a single speaker. Moreover, the baffle is somewhat smaller in size. Alternately, we may construct a deluxe model, as it were, by mounting our 8″ or 10″ speakers so as to utilize their low frequency response only and using as tweeters four two- or three-inch speakers so mounted as to cover an included angle of 180 degrees. This speaker system will give comparable results with an expensive wide range speaker system at a fraction of the cost, and the immediate advantage that the components are available.

In Fig. 3 is a sketch of an existing speaker system which cost in the neighborhood of twenty-five dollars to construct including the cabinet and the reproduction sounds like a hundred dollars or more! On actual test, the system operated from a good amplifier, reproduced satisfactorily from sixty cycles to nine thousand cycles and an audio oscillator indicated that it still operated above and below this range. It handled eight to ten watts of power, which is more than adequate for the home. Of course, if a similar system is added to the average table model radio, the improvement in fidelity will be amazing. In dual speaker systems it is important that the large speakers be isolated from the small higher frequency ones so that the large volume of air moved by the low frequencies won't affect their operation.

If permanent magnet models are used, no field power source is necessary but if field coil models are used then a source of power is needed. This can be built from a receiver power transformer of about 70-125 ma. capacity, a rectifier tube such as the 80, the 5Z3, 5U4G, 5W4, 6X5 or 5V4 and a filter condenser or two of say ten or twenty microfarads. The field model speakers should be purchased with the voltage in mind that the power supply will deliver or vice-versa. Remember the fields of all speakers must be so connected so that the speakers will operate in phase.

Inasmuch as it is usually difficult to furnish a cabinet with limited means, it is suggested that discarded console radio cabinets be pressed into use. Fig. 2 shows what was done with a 1936 console type cabinet which yielded a modern looking baffle comparable to the 1944 product. Or one may build the enclosure from plywood or 1″ stock and cover it with artificial leather. This is obtainable in most big cities and a beautiful job may be made by using it. The material is very durable and can be washed. It is neatly and easily applied by using linoleum cement, which is just the right consistency and neither dries too slowly nor too quickly.

The cabinets must be rigid. It is strongly suggested that home-constructed models be braced properly and glued with the addition of nails or screws to hold them tight while they are drying. The thinnest wood that should be used is ⅝″ plywood and ¾″ or even 1″ would be better. It must be rigid and if an old radio cabinet is used it is suggested that it be braced. Cleats can be screwed and glued to the inside of the back edge so that a back may be screwed on neatly.

The back of the baffle should be lined

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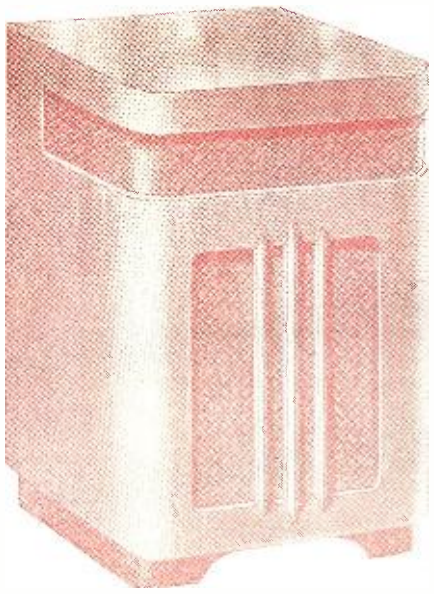
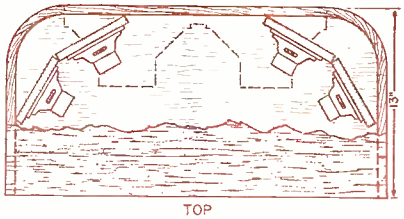




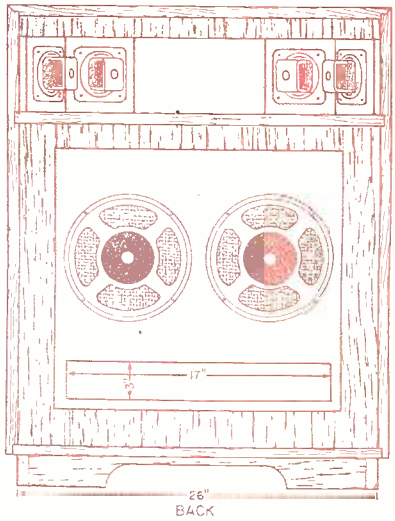
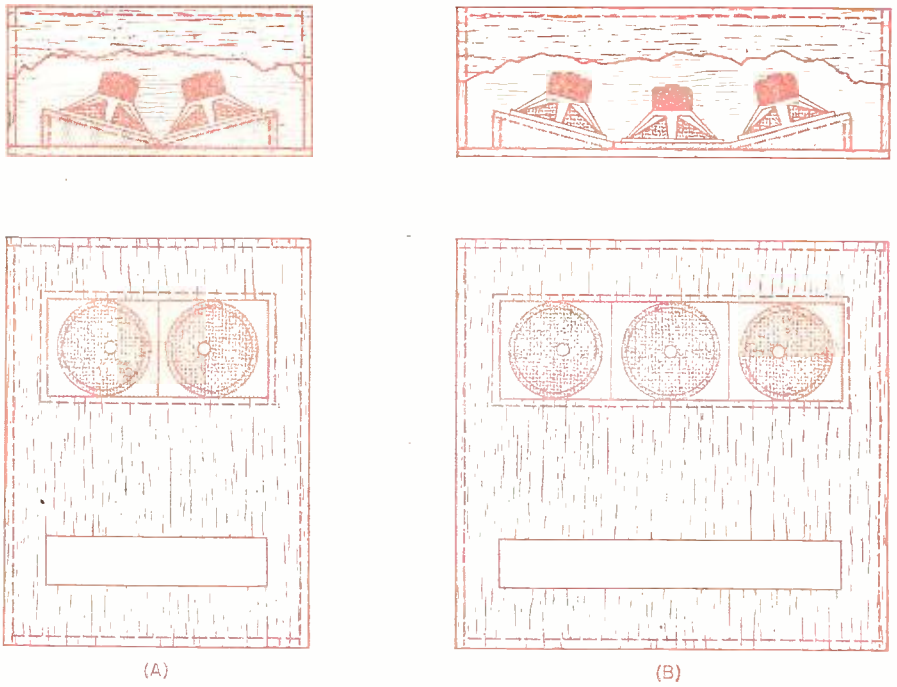


Fig. 3. Complete details for the construction of a bass reflex type, wide-range speaker enclosure. Four 3″ speakers are used, mounted in a semi-circle towards the top of the cabinet to obtain non-directional response. Two 8″ speakers are also used to extend the lower frequency range of the unit. Illustrated by J. Krupa.

Fig. 4. Illustrating the correct mounting position of the speakers to obtain non-directional response. (A) employing two speakers and (B) three speakers.



Unique Volume Expander and Compressor

The operation and design of two very clever volume expanders. By simply reversing the circuit design, volume compression can be obtained.

By Craig Stevens

AN EXPANDER, properly used in its place, can enhance the enjoyment of certain kinds of recorded music. It is well-nigh impossible to squeeze the enormous dynamic range of a full symphony orchestra into the closely-spaced record or transcription disc.

For the home recordist this problem is even more acute, as the usual home recorder, as well as the semiprofessional models, records an ever greater number of lines per inch, which places more severe limitations on the volume range.

Added to this are such items as inexpensive recording heads; inability to cope with high-volume levels without severe distortion; lack of sufficient power in the output stages, to drive the cutting head to reproduce high levels without serious distortion; and scarcity of sapphire stylii and first quality discs which increase the noise level, further reducing the available dynamic range. It might be stated at this point that it is not unusual in a commercial recording setup to see a 50-watt amplifier using two 50-watt tubes driving a 3-watt cutting head so that the attendant distortion will be negligible.

It may be seen, then, that the dynamic range impressed upon the record is not that which was possessed by the original rendition of the music. Certain kinds of music need more elbow room than others. Notable among these are most symphonic selections ranging from a muted violin solo to the full output of a 100-piece orchestra. A large amount of the beauty of these selections lies in the composer's manipulation of not only notes, chords, melodies, etc., but in his portrayal of feeling and mood with the volume as his tool.

An expander, then, is indicated. However, we do not have to re-endow our selection with all its original range, but we may materially increase its realism by extending it to a certain degree. We may do this in a way which also will tend to make the music even more pleasing.

Most commercial records, particularly of late, have a high hiss or scratch level which certainly does not improve with use. This scratch is particularly annoying on low-level passages where the scratch may well be as loud as the music. The mere attenuation of the high frequencies will eliminate the scratch, but it eliminates the highs also, wherein is contained a large part of the brilliance and tonal intelligence imparted by the composer.

However, we can strike a compromise. Suppose we use an expander that attenuates the highs on the low passages and accentuates them on the loud passages. We get an over-all sense that the scratch is missing from our records without being too cognizant of the slight loss of high frequencies at low levels. Furthermore, at low levels of sound we tend to concentrate on the music so that the loss is not as noticeable as one might think.

If we are of the "genus Recordist," we may invert our expander and use it as a compressor which will enable us almost to double the effective range that we can squeeze on our disc; also, we may record at a higher average level, improving our signal to noise level, further reducing our annoying hiss level *without* the attenuation of high frequencies.

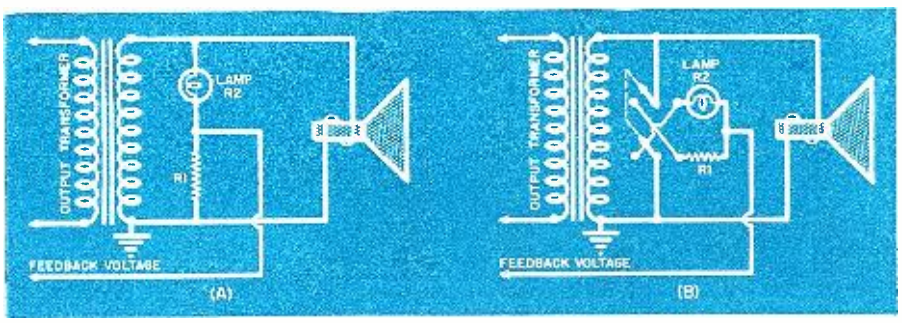
Expanders have consisted usually of a multitube circuit consisting of a variable-mu tube such as a 6L7, the gain of which is controlled by the signal level by rectifying it and applying this d.c. voltage which is equal to the average signal level to the mu controlling grid, or by using a medium-mu triode and controlling its bias voltage.

Both of these systems have inherent distortion because of the moving about of the tube's operating point on its plate characteristic. Furthermore, in some expanders built by the author, it was necessary to try a half-dozen tubes before a satisfactory one could be found. This procedure is fantastic now in light of the extreme difficulty in obtaining even a few tubes of the more common numbers.

Two expanders are therefore proposed, which offer several singular advantages. The first has as one of its important sales points the absurd total cost of not over fifty cents and a few hours work. It comprises two parts: number one, a resistor, and number two, a dial lamp. These two components are hooked up as in Fig. 1A across the output winding of the output transformer. The tap between them is returned to an appropriate point in one of the earlier stages of the amplifier and consists of a negative feedback arrangement. With a low volume signal, the resistance of the lamp R_2 is very low so that the amount of feedback is large and the gain of the amplifier is reduced by as much feedback as can be used without oscillation.

When a strong signal appears at the output transformer, the lamp will heat, and in doing so, its resistance increases rapidly. This reduces the feedback, increasing the gain of the

Fig. 1. (A) Diagram of the simplest form of expander, employing only two components: a resistor, R_1, and a pilot lamp. R_1 should be approximately one-half of the speaker's voice-coil impedance. The type of pilot lamp, R_2, depends on the output of the amplifier used (refer to article for explanation). (B) The same circuit, with the addition of a d.p.d.t. switch, which can be used to obtain either volume expansion or volume compression.



amplifier, because naturally, the ratio of the voltage at the tap to the voltage across the winding, is equal to the ratio of R_1 to $(R_1 + R_2)$. The amazing part is that when the device is operating at low levels, its distortion is less than the amplifier operating without the expander at all!

Now, if we introduce a network in the feedback lead; i.e., from the tap between the resistors, which will feed back predominantly high frequencies, then on low levels the gain at high frequencies will be reduced more than the low frequencies, reducing hiss and giving the illusion of cleaner reproduction. When a loud passage comes along, however, the gain at the higher frequencies is increased more rapidly than the gain at low frequencies and the loud passages come out in all their natural brilliance. This lamp circuit is *not* suitable for popular music as its time constant is too long, being in the order of .5 to 1 second, the lag being due to the time taken in heating the lamp filament.

This, however, is not a serious detriment to most classical selections and it tends to follow the average level of the music, smoothly and without any abrupt changes. Fig. 3 shows several possible ways to introduce feedback connections into several types of amplifiers. As a general rule the better the transformer in the amplifier, the more feedback can be used which means, of course, more expansion.

The simple inclusion of a double-pole double-throw switch (Fig. 1B) changes our expander into a compressor, as the action will now be reversed and an increase in volume will decrease the gain of the amplifier. Incidentally, this is, in fact, a real compressor whose action is not just to clip the peaks from loud passages and introduce serious distortion, but its compressive action is gauged smoothly by the level present at any instant.

Furthermore, it reduces distortion at high levels to some extent because of the increased degeneration. To the recordist this means that within reasonable limits, a close watch of level meters and eye tubes may be dispensed with and a higher average level may be recorded without the attendant danger of overcutting and distortion!

One so-called disadvantage of this system is that it does consume power, but it is a small fraction of that which is available at the output transformer and does not appreciably affect the power output of an amplifier of any but the smallest systems. It operates effectively at about .5 watt if a .15 ampere blue-bead dial lamp is used and slightly less than two watts if a brown-bead .25-ampere bulb is used. The lower current bulbs are desirable. Two bulbs may be hooked in series to give more expansion or to obtain a lower power loss.

This circuit does not have to be used on the low-impedance output winding of the output transformer.

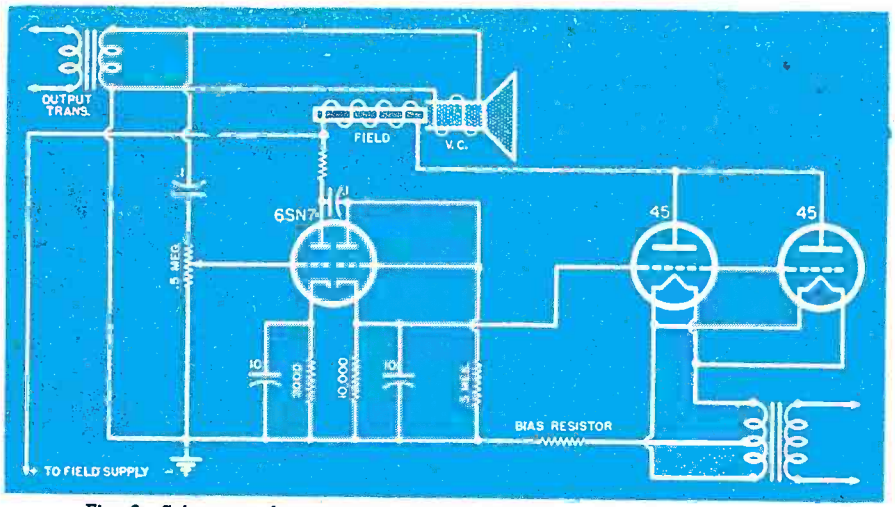


Fig. 2. Schematic diagram of a volume expander which depends upon a variation of the speaker's field coil excitation as its basis of operation.

The 250- or 500-ohm winding may be utilized on large amplifiers of the 12- to 30-watt breed. A 7-watt, 110-volt medium base bulb can be used here together with a higher series resistor. It may be noted here that if R_1 is made a rheostat or variable, it may be adjusted so that the lamp operates on its most sensitive point; i.e., the steepest part of its resistance temperature characteristic so that maximum expansion may be obtained. It must be kept in mind that when this network is shunted across the output winding, the combination load impedance as seen by the tubes, too, is lowered. If a lower tap on the output transformer is available, it should be used. If not, then the resistance R_1 should be kept as high as possible and still give the desired expansion. The feedback will tend to minimize this effect. All in all, however, it comprises a simple, effective, inexpensive expander-compressor, and best of all, it uses no priority items!

For the expander enthusiast who has a good sized field type speaker, there is another system which has merit. If we hook a diode to the output winding of our output transformer, we get a d.c. voltage proportional to the average level of the signal output. If we apply this voltage to the grid of a triode such as a 2A3, 45, etc., as bias, we will vary its resistance. If we place this triode in series with the field supply to our speaker, we will vary the field power supplied to the speaker. This would comprise an expander. It has the advantage that a speaker's sensitivity to high frequencies is determined by the number of

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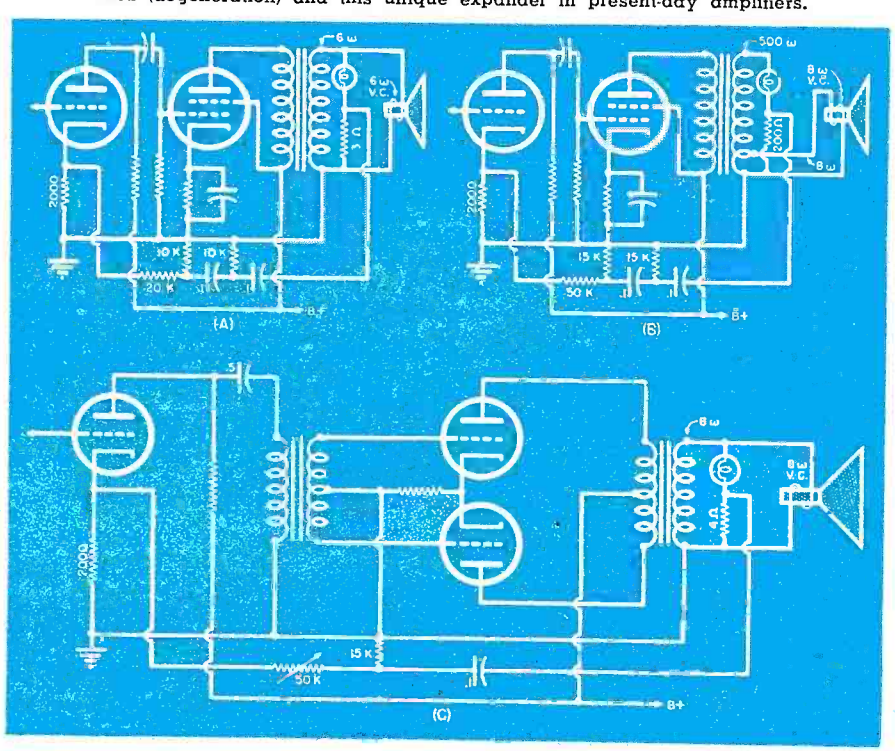
Fig. 3. Wiring diagram showing several possible ways to introduce feedback (degeneration) and this unique expander in present-day amplifiers.



Television I.F. Systems

By EDWARD M. NOLL

THE i.f. system of the television receiver can be explained and understood without difficulty; the design and construction of the system presents a multitude of difficulties. Revamping of i.f. systems by the serviceman is not advisable unless he understands the design problems thoroughly, is a capable mechanic, and has the necessary precision instruments to do the job. Under practically all circumstances, do not alter the manufacturer's design, or substitute poor quality or incorrect value parts. There is a tendency in the radio industry to reduce to an absolute minimum the number of i.f. adjustments, which, in the early television receiver, were complicated, misleading, and required adjustment by precision instruments.

The major tasks taken on by the picture i.f. system follow:

1. Pass the picture i.f. carrier (generally 12.75 mc.) and associated sidebands with reasonable gain and a linear response.

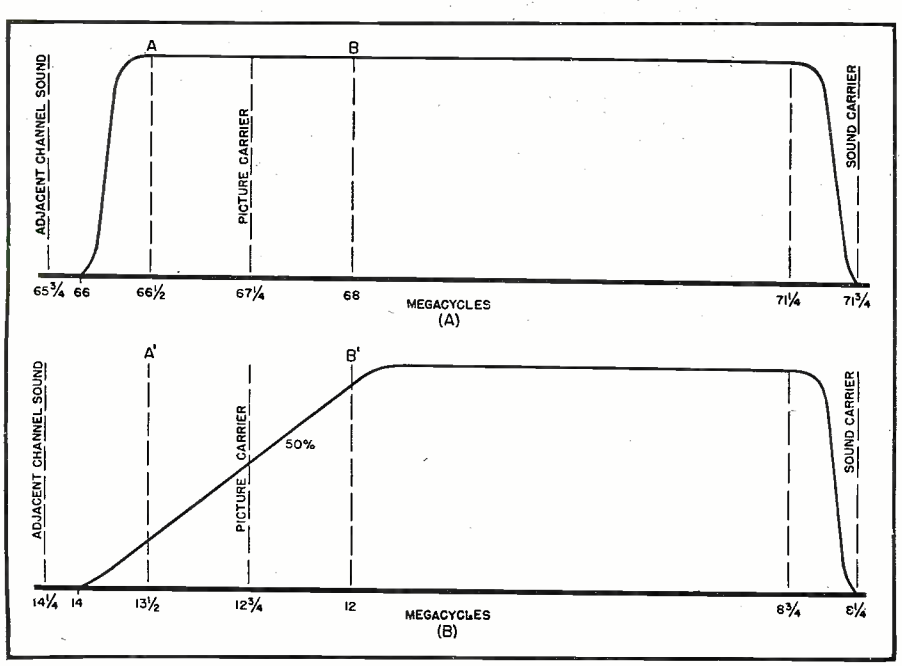
2. Have a reasonably sharp cut-off at the outer extremities of the sideband to reduce unwanted signal and noise pick-up.

3. Reject the sound i.f. carrier (generally 8.25 mc.) and sidebands.

How these tasks are performed is discussed in the following step-by-step analysis of the i.f. system of the *General Electric* Model 90 receiver, Fig. 2. The output of the converter tube contains two signals; the picture signal and, four and one-half megacycles lower in frequency, the sound signal. While, at first, it appears as though transformer T_1 were untuned, we recall from last month's discussion that many high-frequency i.f. systems do not use physical capacitors; instead, the total distributed capacity of the circuit is made to resonate with the transformer winding at the required i.f. frequency. In this *General Electric* i.f. system, the picture i.f. carrier is 12.75 mc. and the sound i.f. carrier is 8.25 mc. To tune precisely to this frequency range, each i.f. winding has a movable iron core which varies the tuned circuit inductance over a limited range. The tuned transformer T_1 is overcoupled to pass the necessary wide band of frequencies (flat, at least over a five-megacycle band), and is loaded by low value resistors R_1 and R_2. The i.f. feedback from the last i.f. stages to the low-level input stage through common power circuit impedance is prevented by the plate decoupling circuit R_3 and C_1 and the a.v.c. decoupling circuit R_4 and C_2.

In the output circuit of the first i.f. tube, sound and picture are separated. The sound is developed across the sharply tuned parallel resonant circuit in the suppressor grid circuit; the picture, across the parallel resonant circuit in the plate circuit. Since the sound must not reach the picture tube control grid (produces a series of patterns on the picture tube screen which vary with the audio modulation), the remainder of the picture i.f. system is designed to reject the sound carrier frequency. Likewise, the i.f. system must also reject the sound carrier of the adjacent television channel. Fig. 1B shows the idealized response characteristic of a picture i.f. system. This response is only approached in practice and, in order to prevent pick-up of the adjacent sound carrier (14¼ megacycles on the drawing, which is the difference between the local oscillator frequency, 80 mcs., and the sound carrier frequency of the adjacent television channel two, 65¾ megacycles) and the sound channel (8¼ megacycles on the drawing), special parallel traps are placed in series with the signal path. Consequently, capacitor C_3 and inductor L_1 form a parallel resonant circuit in series with the signal path and tuned to the adjacent channel sound i.f. carrier, 14.25 mcs., by a movable iron core. In the plate circuit of the next stage, capacitor C_4 and inductor L_2 are tuned to 8.25 mcs., the received channel sound carrier. Now if last month's installment is reviewed, the logic of these connections is revealed. The tuned circuit L_3 plus circuit capacity is a parallel resonant circuit in shunt with the signal path, and maximum voltage is developed across it at the resonant frequency, 8.25 mc., or the sound carrier frequency. Tuned circuit L_4 plus circuit capacity is a similar circuit tuned to the picture carrier frequency of 12.75 mcs. However, the parallel resonant circuit, C_3 and L_1, is in series with the signal path and prevents any signal of the frequency to which it is tuned from reaching the grid of the succeeding tube. Tuned circuit C_3 and L_1 rejects the adjacent channel sound; tuned circuit C_4 and L_2, the received channel sound. These circuits are not heavily loaded (high Q), and therefore, their rejection effi-

Fig. 1. (A) Signal distribution of a typical television transmitter on frequency channel three. (B) Response characteristic to which the video i.f. is adjusted.



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Part 7. Covering television i.f. systems—their design and how they perform their tasks of passing the video i.f. carrier.

★

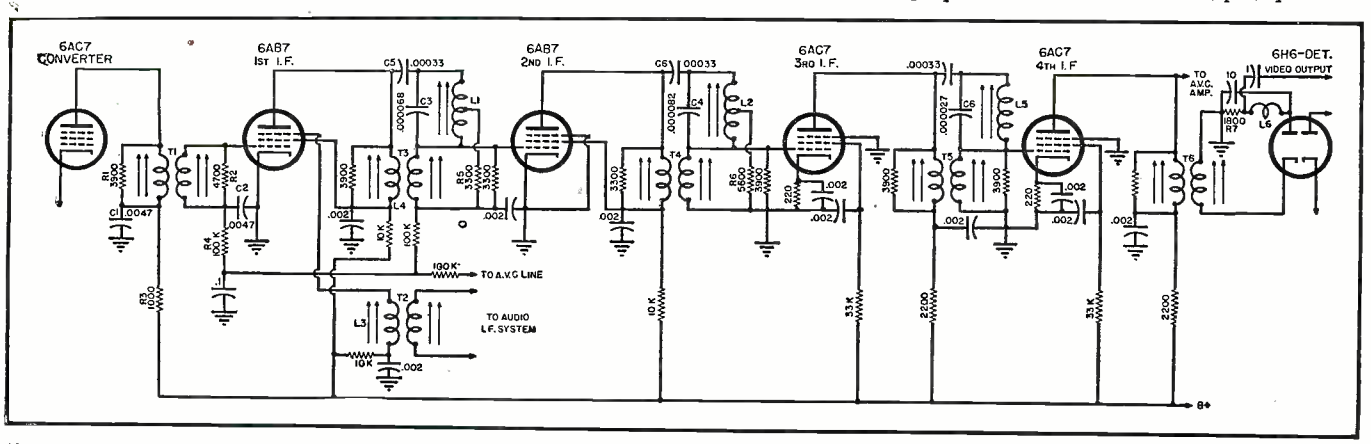
Major General Norman T. Kirk, surgeon general of the U. S. Army, addresses convalescent veterans via television at the Halloran General Hospital at Staten Island.

ciency is maximum. The regular picture i.f. parallel tuned circuits in shunt with the signal (acting as loads), are of necessity loaded and over-coupled to pass the sideband components of the picture i.f. linearly. Thus, the addition of the traps cuts off the response characteristics rather sharply and prevents amplification of undesired signals. Though each picture i.f. transformer is broadly tuned, a greater over-all gain can be obtained by designing transformers T_3 and T_4 for a greater peak at the low-frequency end of the band-pass, and transformers T_5 and T_6 a greater amplification at the higher-frequency end. The combined response of all stages will have the required linearity. Thus it becomes apparent that the television i.f. systems are not designed to have a linear response per stage, but are designed to have the proper over-all linear response. This makes it undesirable for the serviceman to indiscriminately adjust the i.f. stages unless he knows what each stage is to contribute and has the necessary instruments to show him if he is proceeding properly. Capacitors C_5 and C_6 are, of course, blocking capacitors which keep the d.c. plate voltage off the grids of the succeeding tubes. Resistors R_5 and R_6 carry the undesired signals off to ground and still do not seriously load the input circuit of the tubes.

The Response Characteristic

As explained in an earlier installment, to obtain a greater video response and better definition, a portion of one picture r.f. sideband is removed. Refer to Fig 1A, which shows the idealized signal distribution of a typical television transmitter on channel 3 frequencies. Since a portion of this sideband still remains (portion of low-frequency sideband up to approximately one megacycle) to excite the video detector, a signal component of a given amplitude at, say, ¾ megacycle has an upper and lower sideband component and will draw a larger average diode current than a signal component of 1½ megacycles having the same amplitude but only the single, high-frequency sideband component. To compensate for this effect, the video i.f. is adjusted to have a characteristic response similar to that shown in Fig. 1B. Now, if we take the same conditions stated above, the addition of the ¾ megacycle high and low sideband component equals the high-frequency sideband component of the 1½ megacycle signal. Consequently, the response of the i.f. system is made 50% down at the carrier frequency to make the output of the video detector linear for all modulation frequencies from some very low frequency (a few cycles in a well-designed receiver) up to the high-frequency extremity of the high-frequency sideband. This final change in the response pattern is made in the input circuit of the last i.f. amplifier. Up to this circuit, the carrier amplitude has been on the linear portion of the curve; in fact, the over-all response in front of this circuit is reasonably linear from a point 1 megacycle below carrier frequency to a point 4 megacycles above carrier frequency (figures given apply to a well-designed set, many sets fall below this objective). To reduce the response in the vicinity of the carrier frequency, a parallel resonant circuit, L_5 and C_6, is inserted in series with the signal path between the third and last i.f. stages. This tuned circuit, when alignment is performed, is gradually moved up toward the

Fig. 2. Diagram showing i.f. system of General Electric Model 90 television receiver. The output of the converter tube contains two signals: the video signal and the sound signal which is four and one-half megacycles lower than the video frequency.



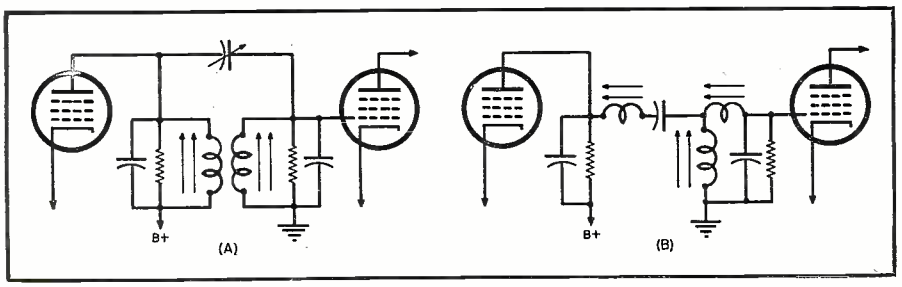


Fig. 3. Various methods of obtaining overcoupling. In these circuits the coupling can be regulated by changing the mutual inductive or capacitive reactance.

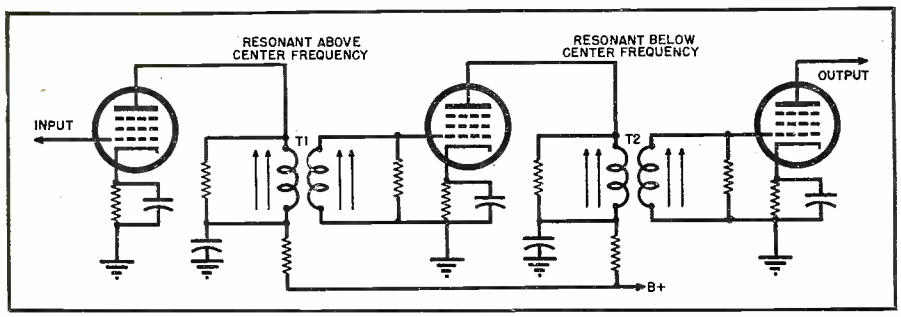


Fig. 4. Stagger-tuned stages in which transformer T_1 is tuned to a point on one side of the resonant frequency, while transformer T_2 is tuned to the opposite side of the center frequency. The response has a double-hump characteristic.

carrier frequency of 12¾ megacycles, until a point is reached where the amplitude has dropped to 50% of its former peak value. Thus, the i.f. response immediately ahead of the detector is the idealized curve of Fig 1B.

The output of the last i.f. stage is coupled through the final broadly tuned transformer T_6 to the diode detector which removes the modulation from the carrier. Possibly the most unusual feature of the detector is the very small value of the diode load resistor. This small resistor is necessary to obtain linear detection up to the highest-frequency modulation component—the theory behind the use of a small resistor will be discussed in detail in the article on video amplifiers to follow shortly. Suffice to say, at this point, that it minimizes the effects of circuit capacities which, because of their decreasing reactance, shunt the output seriously at high frequency. The addition of a small diode choke L_6 also

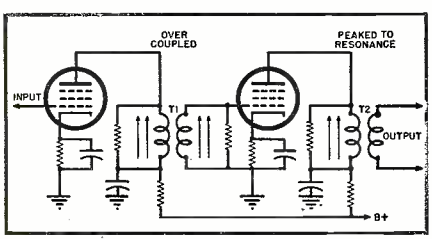


Fig. 5. Simple method used to broaden the response of r.f. and i.f. amplifiers.

assists in holding up the highs, for it has a rising reactance with frequency, improving diode efficiency. Output from the diode is fed through a large 1-μfd. coupling capacitor, which prevents low-frequency degeneration, to the video amplifier section.

A second output is taken off the last i.f. stage and coupled through a capacitor to an a.v.c. amplifier. The amplifier output feeds the a.v.c. rectifier and the sync separator. The d.c. component of the a.v.c. rectifier is applied as negative bias to the first and second picture i.f. amplifiers, compensating for variations in input signal strengths.

Wide-Band Methods

There are a number of other methods used in broadening the response of r.f and i.f. amplifiers. For example, the circuit of Fig. 5 shows a rather simple method of broadening the response and flattening the characteristic curve of a two-stage amplifier. Transformer T_1 of this circuit is overcoupled and has a double-hump characteristic, Fig. 7A, while transformer T_2 is peaked on resonance and has a single rise, Fig. 7B. The composite over-all response of the two-stages, Fig. 7C, has a reasonably linear characteristic. With resistance loading of the tuned circuits, linearity is further improved. Still another method uses stagger-tuned stages, Fig. 4, in which transformer T_1 is tuned to a point on one side of the resonant frequency (by resonant frequency is meant the center or carrier frequency of the incoming signal) and transformer T_2 to an equidistant point on the other side of the center frequency. The response is an over-all double-hump characteristic, Fig. 8, and must be further leveled by resistance loading.

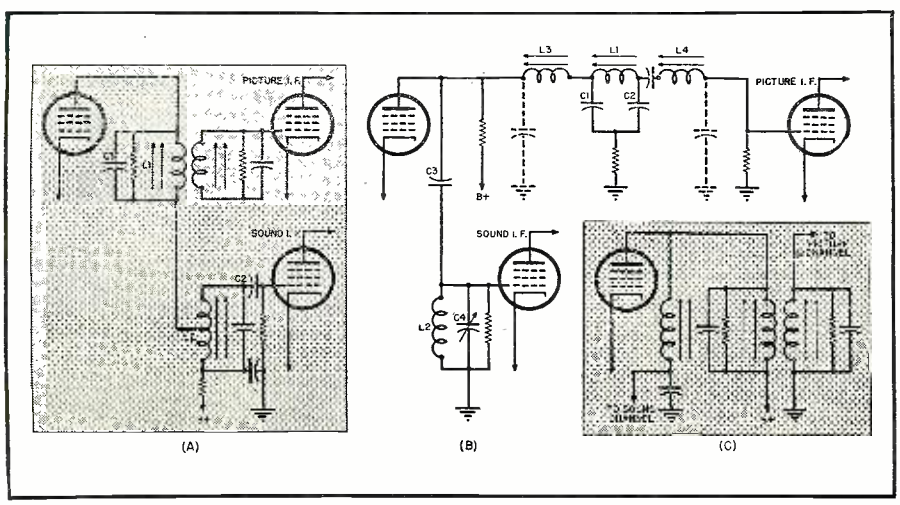
In addition to obtaining overcoupling by having the primary and secondary tuned circuits in close proximity, it can be attained by using one of the overcoupling methods shown in Fig. 3. In these examples, the extent of the overcoupling can be regulated by changing the value of the mutual inductive reactance or capacitive reactance.

Picture and Sound Separation

A number of other methods for separating sound and picture are shown in Fig. 6. In drawing (C), for example, a series and shunt tuned circuit form the plate load of the first i.f. amplifier. The shunt-tuned circuit serves as a load for the picture carrier while the series tuned circuit presents a low-impedance path to the sound carrier. Although the sound is lost so far as the picture channel is concerned, the large signal voltage it develops across the tuned circuit capacitor alone is ample to excite the sound channel. A somewhat similar type, with refinements, is shown in drawing (B). In this circuit, L_2 and C_4 form a parallel resonant circuit at the audio i.f. frequency; while L_3 and the distributed circuit capacity, a parallel resonant circuit at the picture i.f. frequency. A parallel tuned trap, L_1, C_1, and C_2, keeps the sound out of the

(*Continued on page* 72)

Fig. 6. Various circuits that may be used to separate the sound and video signals.



F. K. Barker sailed recently from the east coast aboard his tanker, which was in for extensive repairs necessitated by a fire. He reported the water was quite cold during his enforced swim. K. Ward was around the big town and sailed aboard a cargo vessel. L. Hvidsten decided to try his luck around the west coast regions and shipped out from there, rather than from the east coast. J. F. Driscoll sailed as chief aboard a cargo ship recently.

ACA Local 2 in New York came out in April with its new bulletin—"The Antenna" and lots of good information in same.

THE OWI recently revealed that merchant marine casualties, which include dead and missing and prisoners of war, as of September 15th, 1944, numbered 5,830. Up to early 1944, personnel losses in the merchant marine were higher proportionately than those of the armed forces, it was reported by WSA. In August, 1944 the total personnel of the merchant marine had increased from a prewar level of about 60,000 men to about 165,000 . . . New York State had the largest number, 23,240 and also the largest casualty list—1,493 lost.

It was also reported that U.S. shipyards constructed 125 vessels during February totalling 1,300,340 deadweight tons. Nineteen of these were military ships and ten were merchant vessels that were turned over to the Army or Navy. Of the ninety-six delivered to the merchant marine, 71 were dry cargo types and twenty were tankers, while five were minor types. The West Coast turned out 55 ships, consisting of 43.6 percent of total tonnage, the East Coast, 39 ships, 32.2 percent, Gulf Coast 27 ships, 22.7 percent; and the Great Lakes yards, 4 ships or 1.5 percent of the total.

West Coast yards have finished producing Liberty ships and are going full blast in building Victory ships . . . most of the yards along the East and Gulf Coasts have not yet finished their Liberty schedules but are converting to full Victory, "C," and "T" type construction. Bethlehem Fairfield launched its 38th Victory in early March it was reported.

A four and one quarter billion dollar cut in shipbuilding was approved in the House in early May and sent to the Senate. Further cuts in other fields are expected to be on the way, with some already having been announced, such as the dissolution of the office of Civilian Defense by June 30th with a resultant saving of $369,000 a year. The Navy slash was recommended by President Truman in a letter to Congress. More than two billion dollars are still available for completing the present ship construction program and approximately $600,000,000 for possible future ship construction, reconversion of vessels, and restoration of shipbuilding facilities, it was pointed out.

By CARL COLEMAN

This saving, in cutbacks of over four billions, can well be made despite the huge task facing the U. S. Merchant Marine. With nearly five thousand ships the merchant marine was the transportation highway to victory in Europe carrying vast numbers of men and ton upon ton of material to the warfront. During 1942 and 1943, the most dangerous time on the northern runs to Europe, losses ran to twelve percent and subs were taking a heavy toll in men and ships . . . now the U. S. Merchant Marine is the largest; about two thirds of the merchant ships of the world are at the present time flying the American Flag. . . . Men and materials now in Europe must be transferred to the Far East for the final phase of the war and this huge transportation problem will require many ships and many men to complete. It is estimated that about two to three times the tonnage will be required to bring the same pressure against Japan as was brought to bear against Germany.

E. B. HAWKINS sailed recently from the East Coast as chief on a cargo vessel. B. Carstensen took out a tanker, H. Andersen, a freighter, and F. MacDonald a cargo ship, also. W. Bacon sends along a letter from the Navy inquiring about marine radio and the V.W.O.A.—"WB" reports he has always had an ambition to be connected with V.W.O.A. If anyone else has the same ambition, write W. C. Simon at 149 President Street, Lynbrook, N. Y., and get all the dope. C. Upchurch dropped another line from Germany, which was sent about six weeks before V-E Day, telling of his yearning to become a marine radio op and of some of the details of his army life.

THE Navy's plan for a postwar fleet of 1,191 combat vessels, which will be a fleet of near three times the size of the prewar Navy, was made public in Washington recently. Vice Admiral F. J. Horne, vice chief of naval operations, reported that the U. S. Navy expects to end the war with 1,528 fighting ships, from submarines and destroyers on up to the heavy battlewagons. Of this total about 337 would be scrapped or used as target vessels, being obsolete by the end of the war. Of the fighting ships remaining in the postwar fleet, about 482 will be maintained on active status and 709 would be placed in an inactive state. Skeleton crews would be retained on the inactive ships to maintain them in immediate readiness for service. It was understood also that the navy would follow the rotation plan in its use of available vessels.

The Navy also in late April launched the new super carrier named for our late President, the "Franklin D. Roosevelt," and within a week at the same yard, the Kearsarge, 27,000 ton Essex class carrier was also launched.

"You must not have fixed it very well. This is the third time we've had to call you to repair it!"

SHIPMENTS of war material to Europe from the New York area was halted with the announcement of V-E day and preparations were being made to ship war materials to the Pacific; food, clothing, and post-exchange supplies only will be shipped to Europe from here on. ACA reports that sea-

(*Cont'd on page* 120)

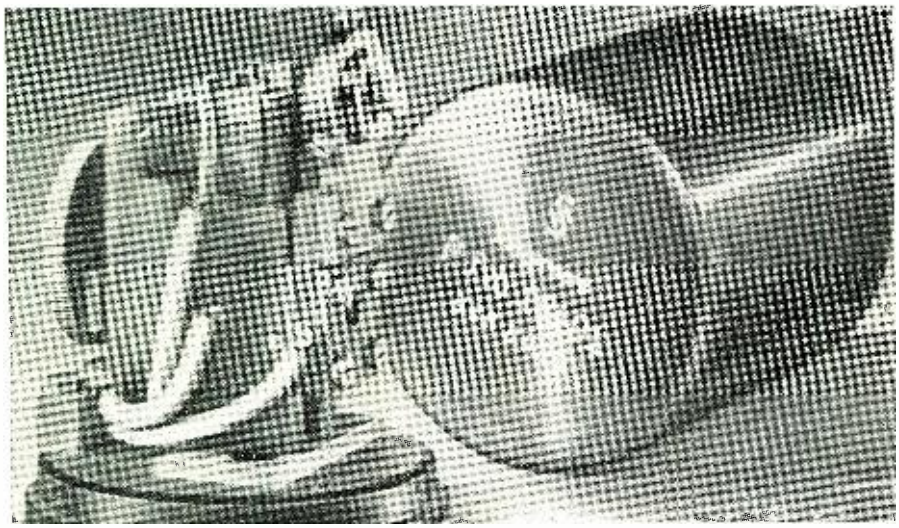


Fig. 196

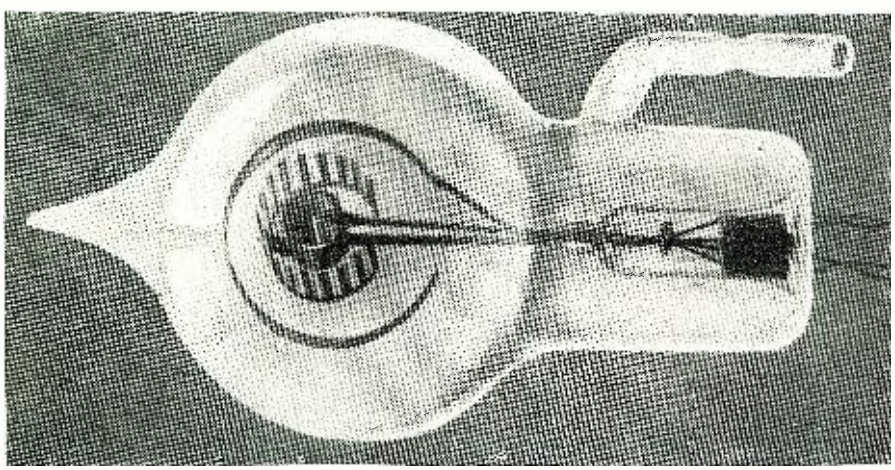
THE SAGA OF THE VACUUM TUBE

By GERALD F. J. TYNE

Research Engineer, N. Y.

Part 18. Continuing our study of telephone repeater-tube developments in this country and abroad and their application during the first World War.

Fig. 197



THE early development of the telephone repeater in Germany followed much the same path as in Great Britain and the United States. Early in 1910 the firm of Siemens & Halske attacked the problem along the line of producing a receiver-microphone type of amplifying device. They had secured the rights to the receiver-microphone repeater which had been developed by S. G. Brown in England. Using this as a basis, they succeeded in producing an improved mechanical repeater which could be adjusted to operate for some months without excessive maintenance.[271] This mechanical repeater is shown in Fig. 196. Its frequency response was not as good as was desired, however, and the search for a better amplifier continued.

In August, 1911, Robert von Lieben demonstrated the von Lieben-Reisz-Strauss tube (the LRS Relay described in a previous installment) to a group of representatives of the leading German electrical manufacturers. The demonstration, which was conducted in the auditorium of the "Institut fur physikalische Chemie der Universitat Berlin" was so impressive that four of these concerns—Allgemeine Elektricitäts Gesellschaft (A.E.G.), Siemens & Halske, Felten & Guilleaume Carlswerk A.G., and the Gesellschaft fur drahtlose Telegraphie (Telefunken)—jointly founded a laboratory, called the "Liebens Konsortium."[272] This laboratory proceeded with the LRS Relay development and studied its applications. In addition, three of the firms undertook development in their own laboratories.

In less than a year this development had proceeded to the point where the results were presented for consideration and test to the State Telegraph Administration by the A.E.G., acting for the Konsortium. These tests showed that while the tube was not perfect the defects did not present insurmountable difficulties. The chief difficulty was that of variation in performance with changes in temperature, and it was overcome to a certain extent by operating the tube in a constant-temperature enclosure. In comparison with the de Forest Audion which had also been under consideration, the LRS Relay had a lower output impedance and greater power-handling capabilities. It was used, before World War I broke out, on some long nonloaded open-wire circuits such as those connecting Koenigsberg (Prussia), Frankfort (Main), Cologne, Danzig, and elsewhere.[273]

After the outbreak of the war there was an urgent demand for reliable, good quality communications between battle areas and the headquarters of the Army and Navy. As early as 1914 circuits using the LRS Relay repeaters were in use to connect the Eastern Front with the Western Front and Berlin. Conversation was successfully transmitted over a distance of about 750 miles between the headquarters at Luxembourg and the Hindenburg Army in East Prussia. This was ac-

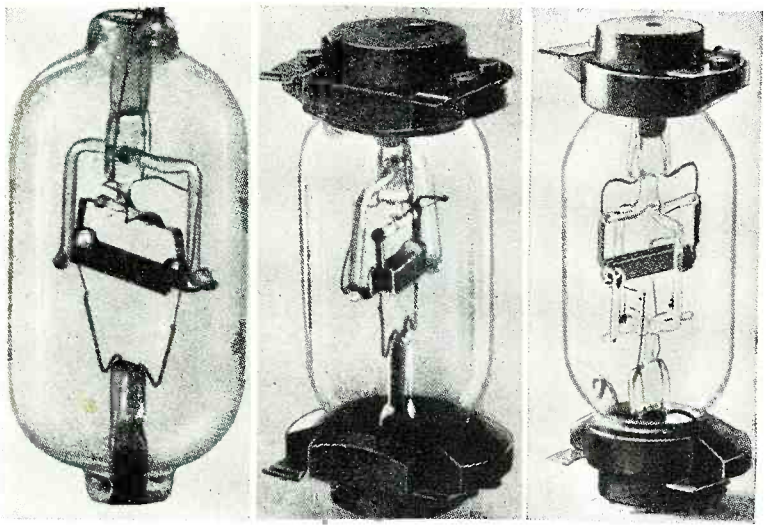


Fig. 198

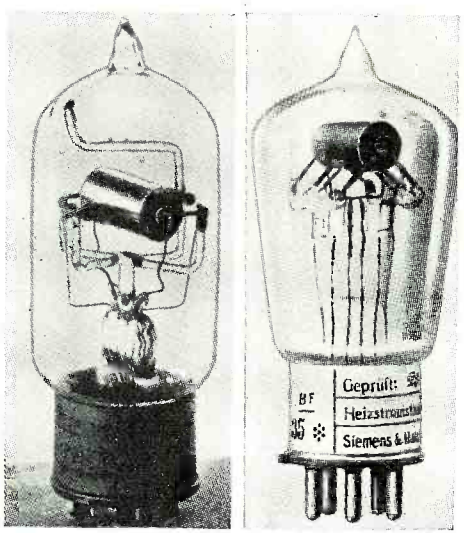


Fig. 199

complished by the use of a single repeater in Berlin. As the fighting fronts advanced this single repeater proved inadequate, and the rapidly increasing length of circuits required the use of several repeaters in tandem. This necessitated the use of the four-wire type of circuit (which was first proposed by the Dutch engineer, Van Kesteren) in which the tubes were used for unidirectional amplification only. By this arrangement good speech transmission was maintained between the Headquarters Staff and Constantinople, and with the armies in Macedonia, Rumania, and Russia. By the end of the war there were about 100 repeaters, of both 2-wire and 4-wire types, in use, which sufficed to take care of the urgent military demands.

In 1917, a program of research was instituted with a view to adapting repeaters to general civilian use, particularly on cable circuits. After making a study of the action of the Lieben tube, the elements were re-arranged and a concentric cylindrical element assembly, shown in Fig. 197, was adopted.[274] The mercury vapor filling was still retained, however. This means that the difficulties of operation caused by variations in atmospheric temperature were still to be overcome. These difficulties indicated

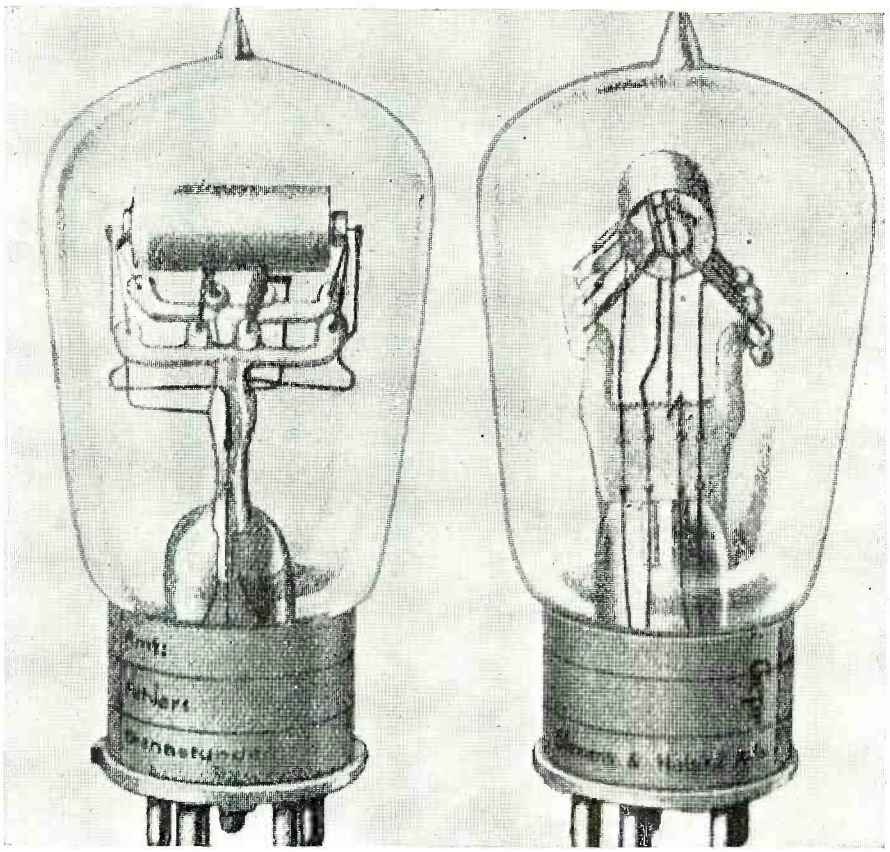
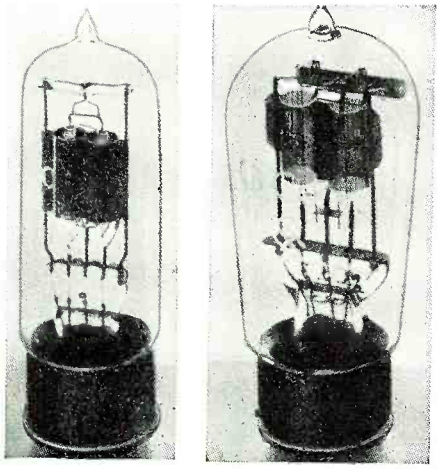


Fig. 200

Fig. 201



that a repeater tube which would be independent of gas ionization would be much to be preferred, and the change to a high-vacuum type of tube was decided upon. The first attempts were actually made by the Telefunken Company with the co-operation of Professor M. Pirani, in the incandescent lamp factory of Siemens & Halske.[275]

The Siemens & Halske Company evolved a high-vacuum tube with a tungsten filament, known as the type "Mc," and the A.E.G. produced the "K6" tube. Both these tubes were used during the latter part of the war for special telephone circuits for military use. The Mc tube, shown in Fig. 198, operated with a filament current of about 2.1 amperes at a voltage of about 4 volts, and the K6 with a filament current of 1.1 ampere at about 7 volts. Both operated at an anode voltage of about 220 volts, and had a space current of about 10 milliamperes. The Mc had an amplification factor of 6.7 and an internal impedance of about 10,000 ohms. The output was about 60 milliwatts.[276] The U-shaped electrode assembly of the Mc tube was adopted in order to obviate the necessity of centering the filament. At that time it was considered impossible to accomplish this centering by the application of tension to the

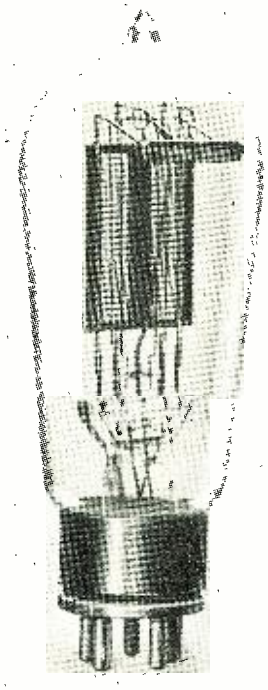


Fig. 202

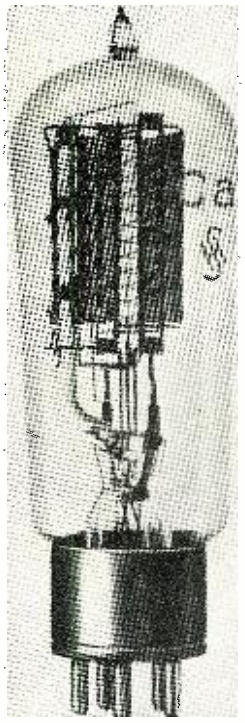
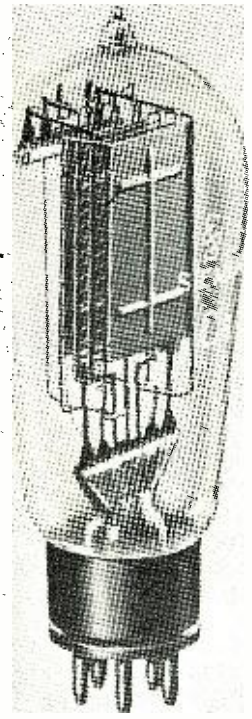


Fig. 203



ends of the straight filament wire. The K6 tube employed an assembly of plane parallel electrodes.[277]

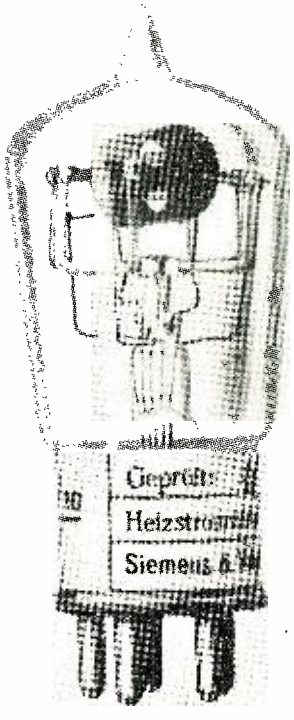
Since the power output required in ordinary repeater work is less than the output of these tubes, they were replaced, after the war, with smaller ones designed especially for telephone-repeater work. For this purpose equivalent tubes were made by several manufacturers, among them Siemens & Halske, A.E.G., Suddeutsche Telefon-, Kabel-, und Draht Werke (Nurnberg), C. Lorenz A.G., and Dr. Erich F. Huth Gesellschaft. With the exception of those made by Huth, which used plane parallel electrodes, all these tubes had a cylindrical electrode system.

The Siemens & Halske tube designated as type "BF" may be taken as an example of these tubes. It is shown in Fig. 199. This tube had a tungsten filament operating with a current of 1.1 amperes at 3.6 volts, thus consuming only half the filament power of the Mc. The anode voltage was 220 volts, and the saturation current about 8 milliamperes.[278] The amplification factor was about 12, internal impedance about 25.000 ohms, it had a mutual conductance of about 500 micromhos when operated at —6 volts on the grid, and it gave an output of about 30 milliwatts. The average life initially was about 600 hours, but was later raised to 1000 hours.

The BF tube was the first tube to be designed from the ground up with a view to meeting the rigid requirements of a telephone repeater tube, and it was the standard tube for use in all the Reichspost amplifiers from its introduction in 1920 until 1925. The cylindrical electrode system and glass supporting structure for the electrodes were carefully worked out to secure exact maintenance of the relative electrode spacings, and it was found to have a low sensitivity to microphonic disturbances.[279]

Meantime, the advantages offered for telephone repeater work by an oxide-coated cathode of the Wehnelt type, particularly as to constancy of filament operating characteristics during the useful life of the tubes, were appreciated. Siemens & Halske had begun work on this type of cathode (which was used in the LRS Relay) in 1912 and developed a tube with plate

Fig. 204



characteristics and power-handling capabilities similar to the BF, but using a Wehnelt cathode with a platinum-iridium core. This tube was designated as the type "BO" and was first introduced on a trial basis in the Post Office Amplifiers in 1923.[280] It is shown in Fig. 200.

The BO operated with a filament current of 1.1 amperes at 1.8 volts, thus requiring only about one-half the filament power of its predecessor, the BF. It operated at an anode voltage of 220 volts, and had a mutual conductance of 700 micromhos and an amplification factor of about 15. It was superior to the BF in that it was not nearly so sensitive to changes in the filament current. The BF required that the filament current be held to within plus or minus 5% of the nominal value, whereas the BO would function satisfactorily with variations as high as plus or minus 15%. The BO was also an improvement on the BF in the matter of useful life, which was at least 3,000 hours, an increase of 200%. Similar tubes were made by the other manufacturers noted above.

These tubes were satisfactory until the need arose for amplifiers of higher power output for use in connection with submarine cable work. For this application the Siemens & Halske type "OCK" tube, shown in Fig. 201, was developed in 1926. It had an output power of about four times that of the BO tube. In obtaining this output the amplification factor was reduced to about 6, the internal impedance to about 5,000 ohms, and the mutual conductance was increased. The filament was longer, and the filament power required (1.1 amperes at 2.4 volts) was greater than that of the BO. In this tube a new grid construction was adopted, which involved the use of

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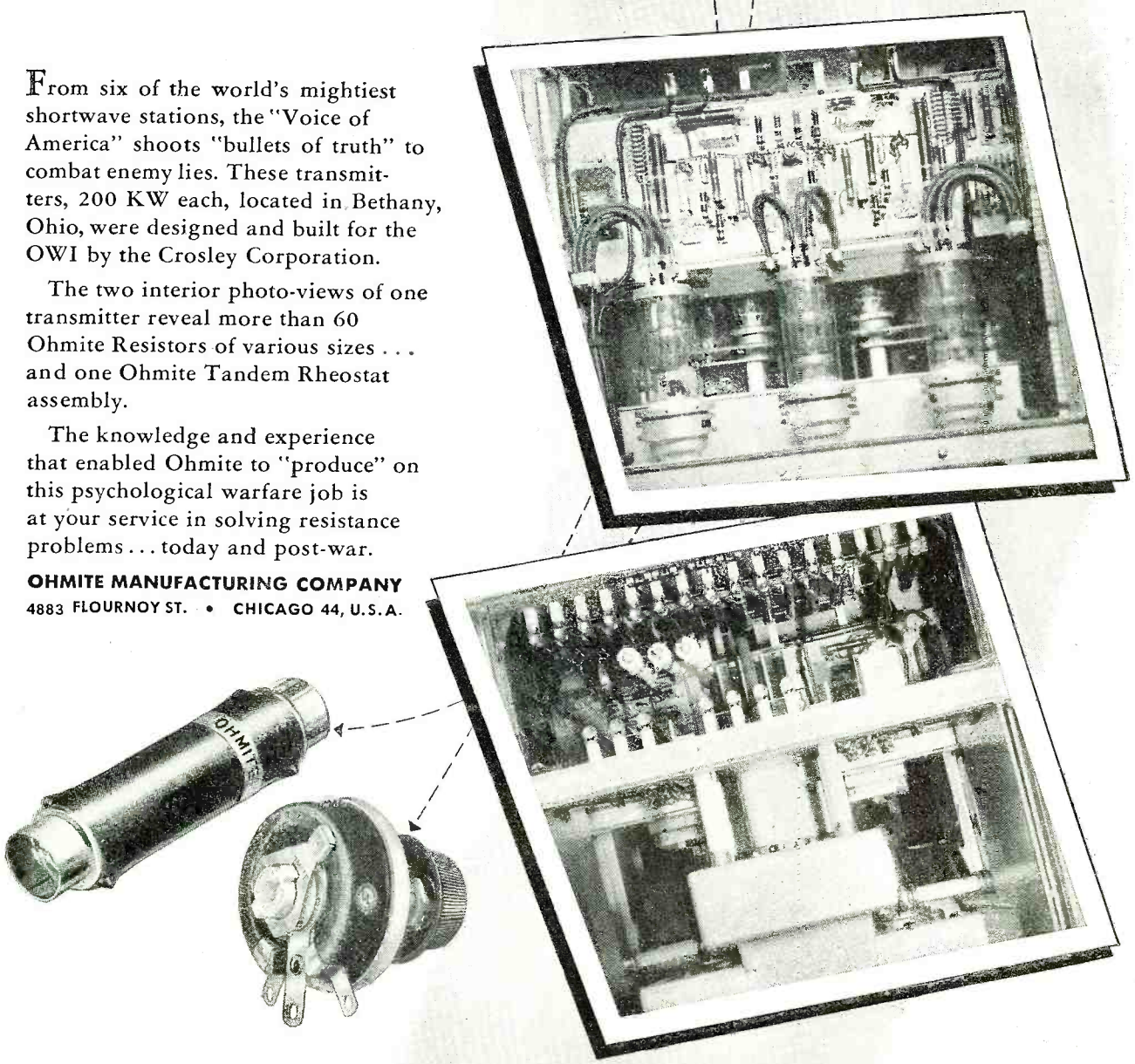

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grid wires of very small diameter. Difficulties were encountered in the process of welding these grid wires to the supporting rings. The difficulties were overcome by eliminating the welding operation and pressing the hard tungsten grid wires into the relatively soft nickel supporting rings. The cylindrical anode was of wire mesh, and was blackened to increase its radiating ability, and to lessen the chances of grid emission. This tube was later superseded by the type "Ca," shown in Fig. 203, which had greater reliability.

The next telephone tube to make its appearance was the type "CO" shown in Fig. 202. It had an amplification factor of 4 and an internal impedance of 1400 ohms. It gave an output of about 1 watt and was used chiefly as an oscillator output tube. It was similar in construction to the OCK tube, and was later replaced by the type "Da," shown in Fig. 203, which had a longer life.

The type "Ba," also shown in Fig. 203, began to replace the BO about 1933. It operated at a filament current of .5 ampere, and with 220 volts anode potential. It required the same heating energy as the BO, however. For some applications a similar tube, designated as the "Be," which operated at 130 volts anode potential was also used. The advantage of these tubes lay in the reduced filament current, even though the filament power was the same. The lower current resulted in economies in the power supply and wiring of the repeater stations. These tubes also had a longer life than the BO, their life being considerably above 5,000 hours.

In addition to the telephone repeater tubes discussed above, there was another type of tube used during World War I by the German Postal Administration for terminal amplifiers. This was a double grid type of tube developed by Schottky.[281] Two varieties were used, one made by Siemens & Halske and designated type "110" (shown in Fig. 204) and the other by A.E.G. and denoted "K26." The filament current was .55 ampere at 3.2 volts for the 110, and it operated at 12-24 volts on both the anode and auxiliary grid.[282] The amplification factor was about 6 and the internal impedance about 9,000 ohms. The output was small but the tube was particularly adapted to the producing of the desired gains at low anode potentials. This was essential for their use in military work, since the terminal amplifiers were self-contained portable devices operated from their own batteries. After the war these fell into disuse, since there was no further need for the gains which they produced. In fact, high gain would have been a distinct disadvantage, because of the difficulties involved in making full use of it. It still survived for applications where low anode voltages were necessary, as in some types of measuring apparatus.

All the tubes subsequent to the CO

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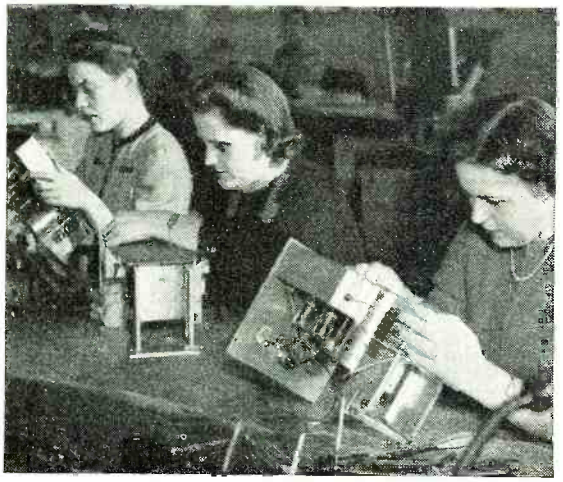

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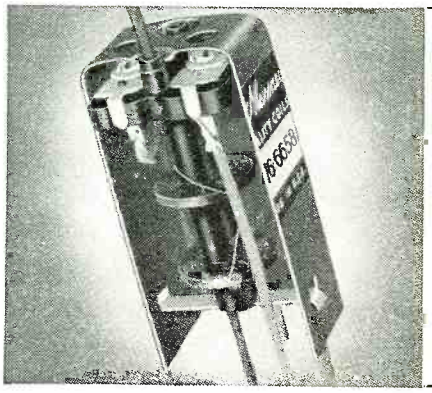

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having an oxide-coated cathode used a platinum-nickel alloy wire for the filament core, in place of the platinum-iridium alloy formerly used. The change was introduced about 1935 and the new alloy core had several advantages. The oxide coating of the old core presented a large and variable resistance to the flow of the space current, in the case of the BO tube the resistance being of the order of 1,000 ohms, depending on the temperature and the condition of the cathode surface. The use of platinum-nickel in the core facilitated the application of new coating processes and resulted in a thinner and more uniform coating with greatly reduced transverse resistance. It also tended toward stabilizing the resistance of the filament during its operating life.

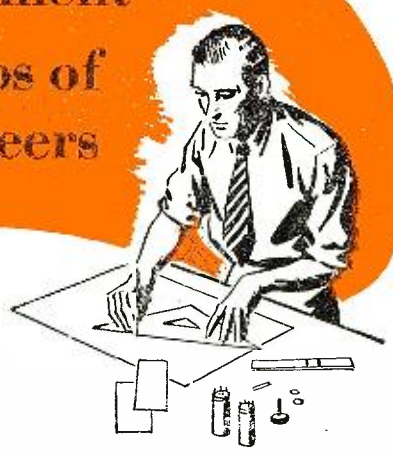
It will also be noted that the later tubes used a system of plane parallel electrodes. This permits the use of a W-shaped filament with consequent increase in the cathode emitting area. The cylindrical construction with axial filament previously used limited the filament to a single length. Increasing the length of the element structure was the only satisfactory way of increasing the emission. This involved mechanical difficulties particularly in tubes where the grid was placed close to the filament. An example of this is the OCK tube which had a filament length of about 1½ inches, which had to be kept accurately centered in a spiral grid only .118 inch in diameter. The plane parallel electrode system has the disadvantage that more power is required to maintain the cathode at the proper temperature since the radiation losses are greater. The open construction, however, facilitates the cooling of the grid and thus reduces the chance of grid emission.

With the introduction of the new cathode there was instituted a new method of nomenclature, suggested by the Postal Administration, and exemplified in the tubes shown in Fig. 203. It involved a designation composed of a capital or upper case letter, followed by a small or lower case letter. The capital letter indicates the output rating of the tube and the small letter indicates the place of the tube in the series of that output. Thus the "Aa" tube is the first of the "A" or lowest output series. The "Ba" is the first of the series with the next higher output rating. The "Ca," "Da," and "Ea" have respectively greater outputs, the last mentioned being a 5-watt tube.

It is interesting to compare German and American repeater-tube development. Both started at about the same time (1911) utilizing gaseous devices; the Arnold arc in America and the LRS Relay in Germany. In 1913 the American development of the high-vacuum tube with oxide-coated cathode got well under way, whereas the decision to use high-vacuum tubes was not made in Germany until 1917. The early German high-vacuum tubes used

(*Continued on page* 150)

FIRST in Research
FIRST in Development
FIRST in the Shops of Service Engineers



Pioneering by MALLORY Has Resulted in These History-Making Developments:

1. High voltage dry electrolytic capacitors.
2. Dry electrolytic capacitors in cardboard containers.
3. Etched plate A.C. capacitors.
4. Dry electrolytic capacitors for operation at temperatures as high as + 85 degrees centigrade.
5. Toroidal type A.C. capacitors.
6. High surge characteristics of dry electrolytic capacitors by employing cellophane separators.
7. F.P. (fabricated plate) capacitors.
8. Capacitors with self-mounting features.
9. Multiple dry electrolytic capacitors with controlled coupling characteristics.
10. Complete information for determining physical size of dry electrolytic capacitors of given rating.
11. Completely standard dry electrolytic filter capacitors.
12. Standard, close capacity tolerances on A.C. capacitors.
13. A standard line of A.C. capacitors in plastic containers.
14. Dry electrolytic capacitors with satisfactory performance at temperatures as low as —40 degrees centigrade.

These are a few of the many reasons why Mallory dry electrolytic capacitors have a deserved reputation for quality—why millions are in service today. Moreover, the Mallory line of capacitors is *complete*, and its distributors are ready to help solve your problems. Avail yourself of this service—begin today by asking for a copy of the Mallory Catalog of Approved Precision Products.

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

More than ever—
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MALLORY
APPROVED
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VIBRATORS • VIBRAPACKS* • CONDENSERS
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FILTERS • RECTIFIERS • POWER SUPPLIES

*Trademarks

"For the Service" SERVICE SHOP

By EUGENE A. CONKLIN

Service shop located near military camp proves profitable in serving men of the Armed Forces.

L. N. BEAUCAIRE, of Watertown, New York, has a radio service-shop geared to meet the specific needs of men in the Armed Forces. Within 8 miles of Watertown lies Pine Camp, a U. S. Army training headquarters with between 1000 and 40,000 inhabitants, varying with the season. At this writing it looks very much as though the war will be with us for quite some time and the Beaucaire methods may prove of more than passing interest to radio service operatives located near Army outposts, Navy or Marine bases, etc. Moreover, after the conflict ends, if compulsory training becomes a reality, many service camps will stay put to accommodate youthful servicees.

First of all, Beaucaire posts bus signs in buses plying between Pine Camp and Watertown. These signs advise Servicemen and women with portables in their possession that special "rush service exists exclusively for their benefit." These bus signs are read if for nothing more than want of other means of time-wasting on the trip into town.

Secondly, Beaucaire flashes a slide on the screen of a neighborhood theater, pointing out that soldiers and sailors home on leave or furlough should have their portables checked during their stay before making the long trek back to camp or training base. First-run show houses will not bother with screened ads but neighborhood houses are always happy to cooperate.

Secondly, Beaucaire places in all hotels and rooming houses where Servicemen with a weekend pass are apt to congregate—small cards which, when presented at the servicenter afford reduced radio service rates to the lads and lassies in uniform. Hotel managers and rooming house clerks are only too pleased to dispense these "courtesy cards" to their service guests.

Again, Beaucaire uses his shop window every other week to display photographs of radio as used by our Armed Forces. To make it hit home the windowizing shows photos of radio as used not only in the Signal Corps but in Navy, Air Corps, etc.—photos taken from current trade publications.

Beaucaire obtains from a close study of the local newspaper daily a list of Servicemen just arrived home for a visit. He sends each such "returned communityite" a postal card suggesting that if they possess a portable they call in and have it checked so that if tubes are weak or replacements needed they can be handled so that the radio will not go sour when they return to their branch of the service.

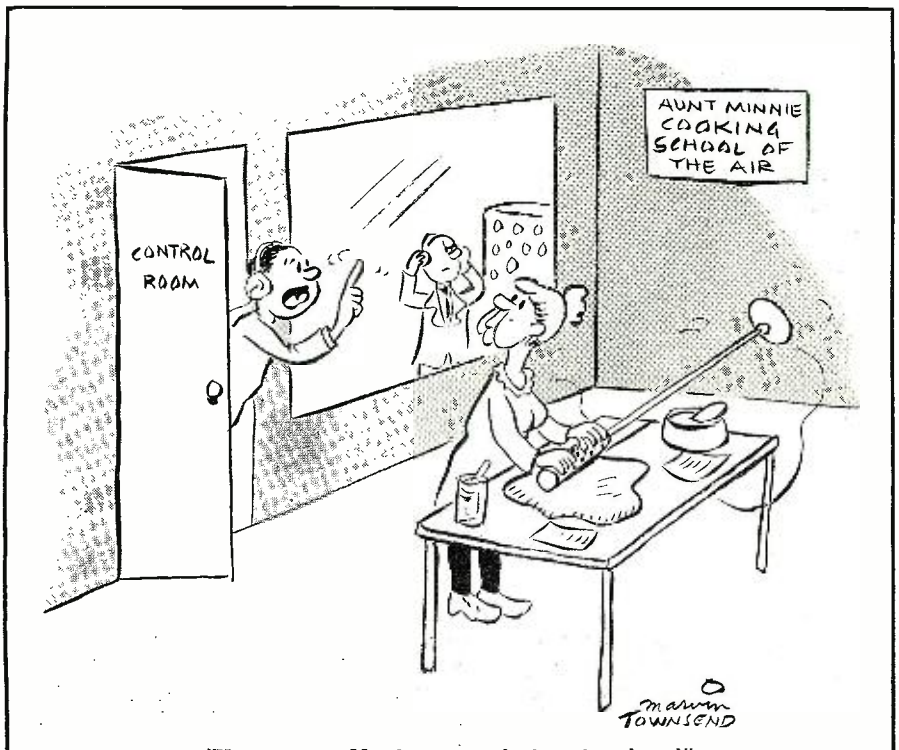
Beaucaire has three services for those in the Armed Forces of our country. First, an all-over checkup at $3.00. For this fee the set is checked over from cover to cover and tubes or other components found weak are replaced. To be eligible for this checkup the set must be in playing condition when brought into the shop. Such a checkup is a preventive rather than a cure-all measure.

Secondly, for servicees whose sets are already dead or defunct in operation, Beaucaire has a $5 00 fee for which he guarantees to put the set in playing order regardless of the number of faults prevalent and their severity.

Finally, this radioman offers a flat $1.00 an hour radio service rate to service folk (his regular charge to the civilian populace is $1.50 per hour). Many a Serviceman and woman prefers by-the-hour servicing because if the fault is a loose connection or minor ailment the service charge does not approximate "flat-rate inspection."

Beaucaire will give 8-hour service on weekends to those Servicemen holding weekend passes. Radios left before 1 p.m. Saturday or Sunday are ready for their owner by 9 p.m. Sets of those home on leave or furlough get 48-hour service unless in case of an emergency. Beaucaire extends *no* credit to service gentry: not that their word is faulty, but frequent sessions with galloping dominos ofttimes cause complications.

This serviceshop "for the service folks" is open weekends from 8 a.m. to 11 p.m. and Monday through Fridays from 10 a.m. until 5 p.m. Beaucaire handles civilian radio service but he earmarks 70% of his monthly tube stock for service personnel and 30% for civilian repairs. Radioman Beaucaire provides each Serviceman and woman clientele with an itemized bill listing repairs made so that if the set goes bad again after its owner



"No, no, aunt Minnie—not with the microphone!"

MAKE MORE MONEY IN Radio TELEVISION & ELECTRONICS

Now!

GET THESE 2 BIG BOOKS FREE!

You men already in Radio know how great the demand is for **trained, experienced service men**, operators and technicians. You know how fast the field is growing and how important it is to keep up with developments—F.M. Receivers, Electronics and Television. You know, too, a fellow cannot learn too much about any industry for REAL SUCCESS. Whether you have experience or are merely INTERESTED in radio as an amateur, you must recognize the WONDERFUL OPPORTUNITY right within your grasp to **cash in on your natural abilities.** Make them pay dividends. Get into the EXPERT RADIO SERVICE FIELD. Be an F.M. and TELEVISION specialist — OWN A BUSINESS OF YOUR OWN, if you prefer. Fill out and mail the coupon below for all the details of our plan.

Here's Just a Few of the Interesting Facts You Learn with the FREE MANUAL

1. Routine for diagnosing Radio Troubles.
2. Preliminary Inspection of Receivers.
3. How to Check Power Supply.
4. How to Identify Various Stages of Receiver.
5. How to Trace the Circuit and Prepare Skeleton Diagram.
6. How to Test and Measure Voltages.
7. How to Test Speaker in Audio Stages.
8. How to Test Detector, I.F., R.F., and Mixer Stages.
9. Complete Reference Table for Locating Receiver Troubles.

Get the Latest Inside Information —Short Cuts—Trade Secrets by

SHOP METHOD HOME TRAINING

FROM A REAL ESTABLISHED RESIDENT SCHOOL

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

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Incomes that seemed fantastic only a short time ago are now being reported by National graduates. And this is only a sample of **what the future holds** for the MAN WHO KNOWS RADIO, ELECTRONICS, F.M., TELEVISION and allied subjects. National is proud of the progress its graduates are making all over the world. Read the facts—the actual proof in the books we send you FREE.

Learn by Doing

Work with Real Experimental Equipment Furnished without Extra Cost as Part of Your National Training

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

Send the Coupon and prove to yourself what YOU can do in RADIO!

Be Sure of Your Success and Security After the War

Don't let your post-war ambitions lag. Don't let YOUR future depend on others. **Build a career for yourself.** Never in all history has the returning serviceman, or war worker been confronted with such a great future if he reaches out and grasps it NOW. Here is a new world opening before you. Get ready now while you are still in uniform—while you are on your war job. Then you can soon step into an essential, well paid position or, with little capital, GET INTO BUSINESS FOR YOURSELF. It isn't a bit too soon to start now. Radio men are vitally needed. Fill out and mail the coupon immediately and examine the NATIONAL SHOP METHOD HOME TRAINING COURSE carefully, without obligation.

FREE LESSON INCLUDED

Examine the exclusive National Shop Method of Home Training. See for yourself how sound and practical it is. Be convinced that **you can learn Radio, Electronics, Television**—quickly and easily in your spare time. You can't tell until you try. This trial is ABSOLUTELY FREE. Fill out the coupon immediately while you are thinking about it and drop it in the mail at once.

Mail the coupon here for the books that tell you the complete story of the marvelous new system of training in Radio, Electronics and Television. Learn the facts of this exclusive shop-method of home training. See for yourself! DECIDE FOR YOURSELF!

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

You owe it to yourself — your future—to read the book "Your Future in Radio, Electronics and Television"—FREE to you when you send in the coupon.

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National Schools, Dept. 7-RN,
4000 South Figueroa Street, Los Angeles 37, California.

(Mail in envelope or paste on penny post card)

Mail me FREE the books mentioned in your ad including a sample lesson of your course, without obligation. I understand no salesman will call on me.

NAME..... AGE.....

ADDRESS .....

CITY..... STATE.....

Include your zone number

arrives in camp this statement can be shown to the radioman who next works on it as a guide.

Beaucaire keeps a card in the file for one full year for every Serviceman or woman—said card listing the model of their set repaired, repairs, date of repairs, etc. According to this radioman, servicefolk come back for a second, and sometimes a third visit to the shop before they ship overseas to a destination too far to permit a furlough or leave to the home community.

Beaucaire has recruited service help from wives of the community whose husbands are in the Armed Forces. He has inserted an ad in the local newspaper urging such women to learn radio-servicing fundamentals and thus help service personnel radios, thereby doing their part on the home front. He has two fulltime feminine helpers with husbands in the service. Beaucaire finds that such help stays put and proves very efficient.

Putting it mildly, Beaucaire is at present at the service of the Serviceman and expects, after the war, to continue in similar channels. He handles an average clientele comparable to that of serviceshops geared to civilian trade.

-30-

ADAPTING ANY RECEIVER FOR CODE PRACTICE

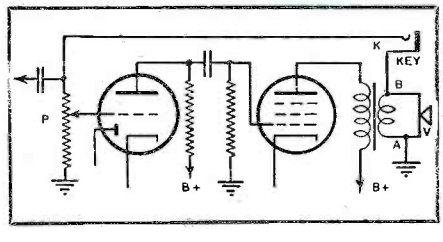
By Richard F. Baum

A RADIO receiver can be used as a code oscillator, without any coils or oscillator, and is suitable especially for home practice.

The diagram gives the audio circuit of a standard radio receiver. The voltage developed in the voice coil, V, of the dynamic speaker is fed back, over the key, K, to the volume-control potentiometer, P, causing the audio section to oscillate. P serves as pitch control; point A of the voice coil sometimes is (or has to be) grounded. Points A and B have to be reversed in case no oscillations take place.

The leads from the jack to the key should be shielded or removed when radio reception is desired. For power economy, an additional switch can be used to shunt off the plate voltage of all preceding tubes.

The oscillator works on the principle



of the multivibrator and no special oscillating circuit is needed. A volume control can be added, if desired.

The author used this oscillator for code practice and believes it is sufficient for anyone who wants to practice at home and who owns a radio receiver.

-30-

SIMPLE— ISN'T IT?

— yet, sealed for all time!

MARION

Glass-to-Metal Truly Hermetically Sealed 2½" and 3½" Electrical Indicating Instruments

A One-piece drawn steel cup-shaped case with high frequency induction soldered Kovar glass bead terminals. Black phosphate finished to meet 200 hour salt spray test.

B Marion Alnico magnet and moving system, with hardened beryllium copper instrument frame.

C Lithographed metal scale plate, individually printed.

D Double thickness glass window with Corning Glass Works metallized band on rim — high frequency induction soldered to steel case.

E Aluminum cover plate and flange, with anodic black satin finish.

"How is it done?" — this is the question on the tongues of hundreds of engineers from coast-to-coast. A simple basic design in conjunction with electronic production methods is the answer. And with it comes the final solution to the problem of completely tropicalizing electrical indicating instruments. There are no rubber gaskets and no cement seals. These instruments can be immersed in boiling brine or frozen in a cake of ice, for weeks, without deterioration of their seals or harm to their operating efficiency. And they are *positively* interchangeable: Type HM 2 with AWS Types MR 24 and 25 and Type HM 3 with AWS Types MR 34 and 35. Available in all DC ranges, for present or postwar applications. Write for additional information.

***SPECIAL NOTE:** Marion Glass-to-Metal Truly Hermetically Sealed Instruments cost no more than standard unsealed instruments.*

MARION ELECTRICAL INSTRUMENT CO.
MANCHESTER, NEW HAMPSHIRE

WHAT'S NEW IN RADIO

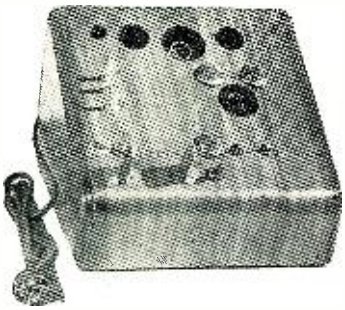
New products for military and civilian use.

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.

APPLIANCE TESTER

A complete electrical appliance tester is now being offered by *Radio Merchandise Sales* of New York.

This unit has provision for testing



all types of bulbs, with candelabra base, medium base and the mogul base; fuses; cords; pilot lamps; flashlight batteries; appliances; cartridge fuses and cord circuits.

This unit is housed in a sturdy and compact cabinet measuring 9" x 9" x 6". The "Electra-Test" may be placed on the dealer's counter and all testing performed in front of the customer.

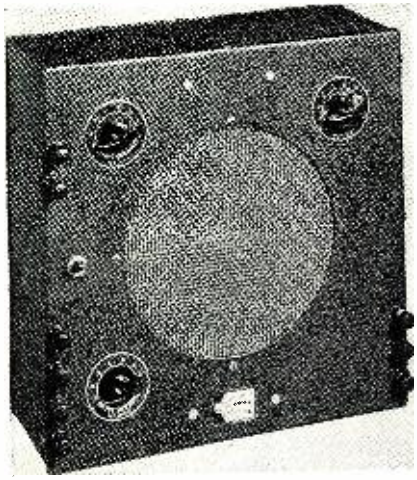
Radio Merchandise Sales, 550 Westchester Avenue, New York 55, New York, will forward complete details and a four-page brochure upon request.

UNIVERSAL SPEAKER

A new universal test speaker, manufactured by *Speaker Corporation of Chicago* is now available to the radio industry.

This new unit may be substituted for any permanent magnet, or electrodynamic loud speaker in the testing of radio sets, amplifiers, sound systems, etc.

Featuring a universal matching net-



work and a universal field resistance, it is possible to attain matching impedances of from 2 to 500 ohms and from 1500 to 25,000 ohms single or push-pull. Field resistance is from 450 to 7000 ohms with a 300 ohm tap.

No external field supply is required when testing sets where the original speaker was of the permanent magnet type. The test unit requires no tubes, transformers, accessories for operation. The unit comes ready to use.

Further details are available from *Speaker Corporation of Chicago*, 1725 W. North Avenue, Chicago 22, Illinois.

EXTENSION SPEAKER

The *Brush Development Company* of Cleveland, Ohio, has developed a miniature, molded plastic extension speaker for use by convalescents who may now enjoy their own radio program without disturbing others.

The "Hushatone" is designed for private listening. Lightweight, rugged and durable, its tone quality is comparable to large cone-type speakers,

and it produces sufficient volume with only .01 watt power consumption.

A light-weight "bimorph" crystal element insures uniform response and high sensitivity.

These features make "Hushatone" ideal for hospital installation as it is adaptable for use with any sound system or bedside radio.

Details of this unit will be furnished upon request to *Brush Development Company* of Cleveland, Ohio.

VOLTAMMETER

A multipurpose unit, for measuring current and voltage in a single test instrument, is being offered by *Associated Research* of Chicago.

Known as the Voltammeter, Model 601, this instrument is housed in a sturdy compact case which includes an a.c. voltmeter and an a.c. ammeter.

The ammeter measures from 0.2 to

500 amperes in eight current ranges; 0-1, 0-5, 0-10, 0-25, 0-50, 0-100, 0-250, 0-500.

The voltmeter measures from 30 to 600 volts in three ranges; 0-150, 0-300, and 0-600. The voltmeter can also be used on d.c. at these ranges.

Large instant reading scales have white backgrounds with figures in jet black, covered by glass and mounted at rear of panel. The metal case is provided with a stout carrying strap. The size of the case is 12½" x 9½" x 10". The weight packed for shipment is 25 pounds.

Details of this unit will be furnished upon request to *Associated Research*, 231 S. Green Street, Chicago 7, Illinois.

TUBE TESTER

Superior Instruments Company of New York is now manufacturing a new model 450 tube tester which incorporates several new features.

This instrument tests all tubes up to 117 volts, including 4, 5, 6, 7, 7L, octals, loktals, bantam junior, peanut, television, magic eye, hearing aid, Thyratron, single ended, floating filament, mercury vapor rectifiers, etc.

A specially designed rotary selector switch replaces the usual snap, toggle or lever action switches. The tester will check tube quality, shorts and leakages up to 3 megohms in all tubes, tests leakages and shorts of any one element against all elements in all tubes, tests both plates in rectifiers, tests individual sections such as diodes, triodes, pentodes, etc., and uses a 4½" square meter.

The Model 450 is housed in a portable leatherette covered cabinet 13" x 12" x 6". The net weight is 8 pounds.

This unit is available on a priority

How to Build Reputation For Your Service Business After the War

RCA TUBE ADVANCES THAT MADE RADIO HISTORY

A-C Tubes ... took radio out of the storage-battery stage...made home radio practical for millions more people.

Screen-Grid, Pentode, and Beam-Power Tubes ... each helped make radios smaller, more powerful, more satisfying ... thus increasing the market for radio sets.

Kinescope and Iconoscope Tubes ... made electronic television possible ... helped bring the vast postwar television market years nearer.

Miniature Tubes ... opened up tremendous new markets for portable radios and farm radios ... for civilian walkie-talkies after the war.

Metal Tubes ... improved performance, particularly in sets with high-gain circuits...eliminated need for tube shielding ... made servicing easier, faster.

Acorn Tubes ... helped bring FM and television nearer...helped immeasurably in uhf developments prior to the war.

Cathode-Ray Oscilloscope Tubes ... made radio servicing more exact, faster, and more profitable, reducing the number of complaints received by servicemen.

Electron-Ray Tubes ... the "Magic Eye" tuning indicators ... added sales appeal to larger radio receivers, and helped the service-dealer "sell up."

62.6636.93

Your reputation for servicing is built on two things...your ability to locate trouble and fix sets, and the prestige of the components you use.

Your ability comes first, of course...for your customer's first interest is in how well his set works. But don't forget how much the acceptance of the products you use ... particularly the *tubes*...helps build your reputation for fine servicing.

Of all the replacement parts you use, tubes are the most familiar to your customer. If he looks at the set you've serviced, new tubes may be his only *visual* indication of the work you've done.

That's why it's important that the name on those tubes should inspire his confidence... should be immediately acceptable to him.

RCA tubes *are* accepted. Your customers know them, and rate them tops. Why? Because, year after year, the RCA name has been associated with leadership in tubes.

Since the early '20's, RCA has led the field in introducing major tube developments. Look at these examples ... tube developments introduced and put across by hard-hitting RCA promotion and advertising... keys to major advances in the radio industry that have made your business become bigger and more profitable.

Developments like these brought prestige to RCA. And RCA, in turn, brings this prestige *to you* every time you display the RCA seal...every time you put an RCA tube in a customer's set. Give your servicing business every break you can after the war. Make the most of your chances with the *best-known name in tubes.*

The Fountainhead of Modern Tube Development is RCA

RCA

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

RADIO CORPORATION OF AMERICA

RCA VICTOR DIVISION • CAMDEN, NEW JERSEY

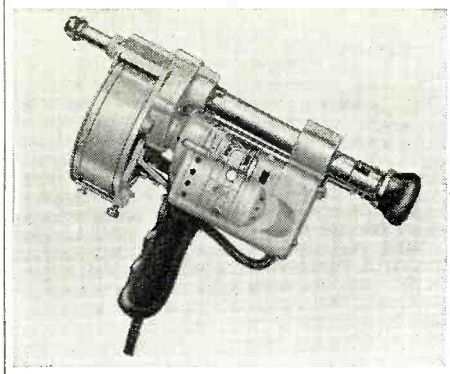
LEADS THE WAY . . In Radio . . Television . . Tubes
Phonographs . . Records . . Electronics

of AA3 or better. Further details will be furnished by *Superior Instruments Company,* 227 Fulton Street, New York 7, N. Y.

AUTOMATIC SCREW DRIVER

An automatic screw driver; the "Screwmatic," which is operated by air or electric power is being offered by *Reed-Prentice Corporation* of Worcester, Mass.

This unit is designed to drive screws in wood or metal. The easily detached,



self-filling magazine allows almost continuous operation with no hand feeding necessary. Each screw is driven to a pre-determined depth as a gauge on the spindle drive cuts off the torque; rotation of the blade is stopped, protecting screw heads and the work surface against marring.

Filling of the magazine is accomplished by a semi-automatic filler. Screws feed automatically into the chutes which lead to the nine fill channels. When the lever is pressed, the magazine indexes and only four stops are necessary. One refill machine services five "Screwmatics."

Details of this unit will be furnished upon request to *Reed-Prentice Corporation,* Worcester 4, Mass.

SYNTHETIC INSULATION

A new synthetic insulation for applications in radio and communication assemblies is being offered by *Walter L. Schott Company* of California.

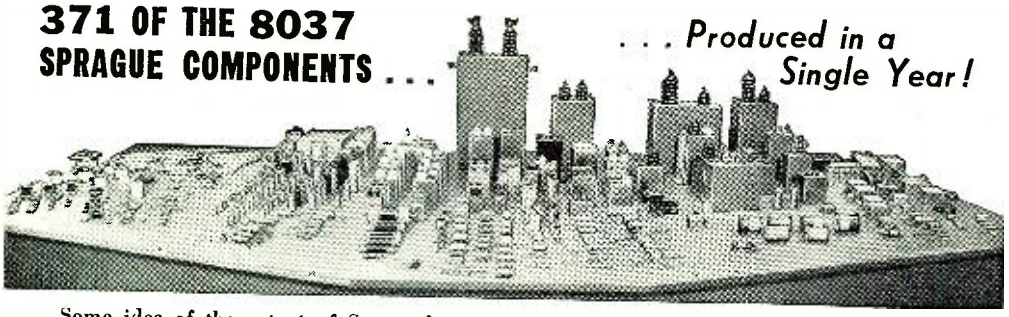
Known as "Flexitube," this product displays characteristics of high flexibility, resistance to abrasion and high dielectric strength. At room tempera-

ture, "Flexitube" averages 15,000 volts, with a guaranteed minimum of 12,000 volts for all sizes. Forty-eight hours immersion in tap water results in a

SPRAGUE TRADING POST

A FREE Buy-Exchange-Sell Service for Radio Men

371 OF THE 8037 SPRAGUE COMPONENTS . . . . . Produced in a Single Year!



Some idea of the extent of Sprague's war effort may be gained by the fact that it took only 365 days to produce 8037 types, sizes, and styles of Sprague Capacitors, Koolohm Resistors and other components such as those shown here. Many of the types illustrated represent important engineering achievements which will mean still better, even more reliable capacitors and resistors for post war use. You can always count on Sprague for engineering leadership!

WANTED—Good sig. gen. and multimeter, also radio books on receiver repair. Wade Marsh, 1315 Fifth Ave., S. Decatur, Ala.

FOR SALE—Home constructed volt ohmmeter, foundation meter Weston 0-1 ma., with test leads and battery, $20. F. Craven, 2216 S. 7th St., Philadelphia 48, Pa.

WANTED — Tubes, any amount. Send list. Fleming Radio Service, 523 S. 10th St., Cambridge, Ohio.

FOR SALE — Superior T-12 sig. gen. Needs correction and calibration, $12. Will trade for popular tubes, meters or parts. Lawrence A. Solberg, Mechanical Engineering, University of Minnesota, Minneapolis 14, Minn.

WANTED—Riders, including abridged 1-5, any or all; condenser checker, perfect; tubes 12 series, 35Z5, 50L6, etc. Philip P. Goldstein, 288 Ave. P, Brooklyn, N. Y.

WILL TRADE — 1½v. table radio with new tubes & push button tuning for test equipment. Fred V. McDowell, Box 23, Bolivar, Pa.

FOR SALE — Abbott T.R. 4 transceiver almost new, $65; also Mallory power supply in 6v. operation for same, $15. S. Tritsch, 96-09—66th Ave., Forest Hills, N. Y.

FOR TRADE—Radio equipment for 3¼x 2¼ cut film camera. Foy Styers, P.O. Box 1442, Asheville, N. C.

WANTED — Philco 070 sig. gen., 027 V.L.V., circuit tester and 030 dynamic tester. E. L. Washburn, 640—6th St., Richmond, Calif.

FOR SALE OR TRADE — 807 and 809 tubes for Stancor 10P; also phono motor 110v., 60 cycle, ac. Howard E. Allen, Augustana Theological Seminary, Rock Island, Ill.

WANTED — Late Triplett #1183-s tube tester and V-O-M; #1200-s V-O-M and #1213 tube tester. Faustino C. Ordas, 1220 Pensacola St., Honolulu 34, Hawaii, T. H.

FOR SALE—One lot, 30 tubes. Send for list. Goodwin Radio Shop, Rankin, Ill.

URGENTLY NEEDED — RCA Jr. volt-ohmyst 165 and late tube tester. Joe. Kishiyama, 3305A, Newell, Calif.

FOR SALE OR TRADE—Have RCA 171 station allocator with i.f.; V-O-M; 30-watt amplifier; all sizes and capacities of aluminum electrolytics; 2v. battery tubes 30% off list; 60 watt modulation transformer for 2-6L6; American Clipper Dynamic microphone. Want phonograph recorder and automatic record changer. Doering Radio Service, Akron, Rt. 2, Ind.

WANTED — Emerson ac-dc radios; Sprague Tel-ohmike condenser tester, Jackson test equipment, 35mm camera, John Lubinsky, Best Radio Shop, 3349 Fulton, Cleveland 9, Ohio.

WANTED—Late portable tube checker; condenser analyzer, sig. gen.; and portable set analyzer. S. Stargatt, 485 Pelham Rd., New Rochelle, N. Y.

WILL TRADE — #30, 34, 33, 32, 1C6, 1A6, 49, 31, 1A4, 1B4, 1G5G, 6L6 new tubes, RCA phono osc., and Eby electric eye; Kadette tunemaster. Want 6A8, IV, 6A7, 2A7, 6K8 and 6D8 tubes, 12v. tubes; and small power or filament transformers. Popma Radio Service, Orange City, Iowa.

FOR SALE OR TRADE—200 new & used tubes: 100 Sprague Koolohms 5 to 10 watt; GE ac voltmeter, 0-300v.; 0 to 10 ma. dc. meter; 0 to 1 ma. dc meter; Speedx automatic code sending machine with 10 tapes & 8 sending keys; 2 National condenser testers; 2 ac-dc 5 tube super het. table radios, etc. What have you? R. T. Vance, 1206 N. Seward St., Hollywood 38, Calif.

URGENTLY NEEDED — 35Z5, 12SQ7, 25Z5, 45Z3, 12A8 tubes and small ac-dc radios. W. Bertling, 413 E. North Ave., Baltimore 2, Md.

FOR SALE—Used Readrite 710-610 set tester and 550 Oscillator with output meter, less batteries; Superior #1260 dynarometer. Jahn Radio Service, 240 W. Maumee Ave., Napoleon, Ohio.

WILL TRADE—Few hard to get items or will pay cash for Jackson 640 sig. gen.; 624 multimeter, Supreme 542 pocket multimeters; Meisner 28-56 mc. converter, sig. booster, all-wave tuning unit 13-7614. Sgt. J. H. Weaver, 1735 Eye. St., N.W., Washington, D. C.

WANTED—Late communication receiver in good condition. Clair A. Rupert R.D. 1, Sandy Lake, Pa.

FOR SALE—New Taylor 866 Jr. isolantite base & 808 RCA isolantite sockets, $4. O. A. Weaver, 1121 Blair Ave., Hampton, Va.

FOR SALE OR TRADE — Hallicrafters Sky Challenger communications receiver with crystal, 6H6 noise limiter and tuning eye. Sell or part trade on 5" Dumont oscilloscope. Jeffrey J. Giesar, 1381 Lincoln St., Salt Lake City, Utah.

WANTED — 117L7, 117N7, 117M7 or 117P7 and 70L7 tubes. R. B. Andrews, Jr., Rt. 3, Box 176, Puyallup, Wash.

WARNING!

Federal laws cover the use of the mails to defraud—which means that most transactions resulting from Trading Post advertisements fall under their jurisdiction. Users of the Trading Post service are thus specifically cautioned to refrain from any dealings which might be cause for complaint to the Post Office authorities.

FOR SALE—Rela G-12 dynamic speakers, 18 watt with 500—250 ohm O.P. transformers with 2 Wright-DeCoster field exciters and extra cone. Want recording head and feed or complete recorder. F. E. Francisco, 227 W. Creighton Ave., Ft. Wayne 6, Ind.

WANTED — All std. radio tubes and Rider's manuals. W. C. Reynolds, P.O. Box 362, Bridgeport 1, Conn.

URGENTLY NEEDED — Tube checker able to check all tubes. Also Riders 6 to 13. Frank Draughan, 1804 E. 97th St., Los Angeles 2, Calif.

WILL TRADE—New Zealand radio books, magazines and radio parts for American radio parts, books, etc. What have you? Douglas Tims, 180 Stafford St., Timaru, South Island, New Zealand.

WANTED — Phono motor for 110v., 60 cycles ac., gear drive or rim 78 rpm. Henry Bergelt, 205-12 113th Ave., St. Albans 11, Long Island, N. Y.

FOR SALE — 4—852 tubes; 12 4mfd-1000v. condensers; KVA 110/220 to 2200/4400/8800 C. T. transformer; 2—24/1500v. dynamotors. Want back radio and electrical magazines, Weston type 301, 425, 476 meters. Grote Reber, 212 W. Seminary Ave., Wheaton, Ill.

URGENTLY NEEDED—Late model tube checker and V-O-M; also Riders 1 to 10. Louis J. Lantosh, 346 State St., Bridgeport, Conn.

FOR SALE — Hallicrafters SX-17 communication receiver. Forrest Burnham, Richvale, Calif.

WANTED — Battery charger in working order; also small portable radio. Lyle Sandin, 74 Wall St., Binghamton, N. Y.

FOR SALE OR TRADE—Astatic crystal and pickup arm; Ghirardi's Troubleshooters' Handbook; Radiotron Designers' Handbook, QST mags. 1943-44, etc. Want radio equipment. James Bezoff, 2732 Salina Ave., Dearborn, Mich.

WANTED—Riders 8 to 12 or complete set. H. W. Schendel, 518 W. Main St., Sparta, Wisc.

FOR SALE — Thordarson power transformer 5605, $4.50; and 6K7, 6J7, 6H6, 6Q7, 35Z5, 57, 58, 56, 80, 24A, 12SK7, 70A7, 26 tubes 10% off ceiling. Herbert Chaudiere, P. O. Box 92, Harrington Park, N. J.

WANTED—Portable tube tester and meters. John A. Wilkens, 1211 Glyndon Ave., Baltimore 23, Md.

WANTED — High voltage transformer, 1700v. secondary or higher, such as Neon transformer, 110v. primary. Stokes Radio, 6020 Locust St., Philadelphia 39, Pa.

FOR SALE OR TRADE—Philco 080 sig. gen.; hard-to-get tubes such as 35Z5, 25Z5, etc. Radio & electrical books, magazines and parts. Want 110v. ac. or dc. phono & magnet wire size 24 to 36 or what have you? Luther F. Asebes, P.O. Box 296, Omar, W. Va.

FOR SALE—Clough Brengle CRA oscillograph 3" tube; & sig. gen. with built-in sweep model O.M. Both for $75. Wimberley Radio & Electric Service, Hayti, Mo.

YOUR OWN AD RUN FREE!

This is Sprague's special wartime advertising service to help radio men get needed parts and equipment, or dispose of radio materials they do not need. Send your ad today. Write PLAINLY or PRINT — hold it to 40 words or less. Due to the large number received, ads may be delayed a month or two, but will be published as rapidly as possible.

Sprague reserves the right to reject ads which do not fit in with the spirit of this service.

HARRY KALKER, Sales Manager

Dept. RN-75, SPRAGUE PRODUCTS CO., North Adams, Mass.

Jobbing Sales Organization for Sprague Electric Company

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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

reduction of less than ten percent of its original dielectric strength.

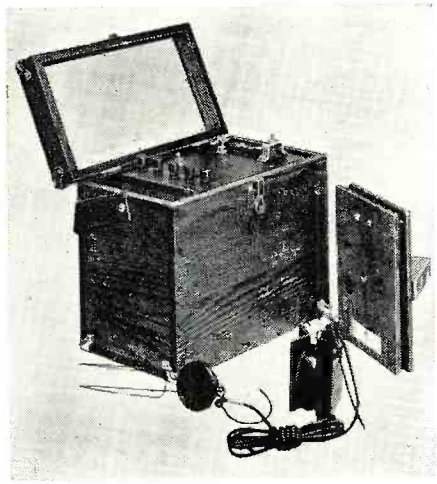
This insulation comes in stock colors of red, black, green and clear. Sizes range from 2 to 18 B. and S. Other sizes can be furnished upon request.

Further information and samples of "Flexitube" will be sent upon request to *Walter L. Schott Company,* Dept. R-1, 9306 Santa Monica Boulevard, Beverly Hills, California.

CABLE LOCATOR

A new model cable and pipe locator which incorporates many new features is being announced by *W. C. Dillon and Company, Inc.*

The unit which is used to locate the exact depth and position of buried



pipes or wires, is self-contained and fully portable. The set uses a lamp circuit for checking all connections after the equipment has been set up.

The locator is battery operated and includes a detector coil and a neutral exploring coil. The built-in spirit vial enables the operator to maintain level for absolute accuracy. The entire unit is housed in a sturdy hardwood cabinet measuring 12" x 7" x 11".

Further information and data sheets on the locator are available from *W. C. Dillon and Company, Inc.,* 5410 W. Harrison Street, Chicago 14, Illinois. Specify Model A Cable and Pipe Locators when making requests.

POWER BOOSTER

A power booster unit which transforms an ordinary inter-communication system into a paging system has been developed by the *Talk-A-Phone Mfg. Company.*

This unit, the HP-16, is capable of delivering a minimum of 15 watts "voice range" power. By pressing a button marked "Power" on the booster unit, it is possible to page individuals in the factory area at volume levels above the factory noises. When the call is answered at the outlying station the volume is stepped down permitting normal office volume to be received.

The HP-16 is compact, measuring 6" x 12" x 6¼". The unit is equipped with "On-Off" switch, pilot light indicator and a variable volume control. The unit is easily adapted to any existing intercommunicating system by means of four wires furnished with the booster.

An eight page catalogue covering this unit, and further information will be furnished by *Talk-A-Phone Mfg. Company,* 1512 S. Pulaski Road, Chicago 23, Illinois.

—30—

Television I.F. Systems

(*Continued from page* 54)

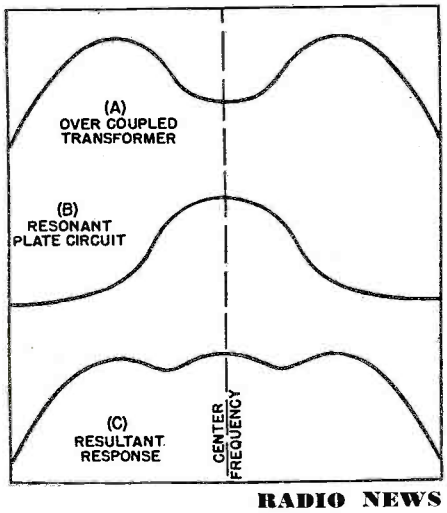
picture channel. Still another method, shown in drawing (A), has sound and picture tuned circuits in series as a plate load—the picture appears almost entirely across L_1 and C_1, for the low side of the tuned circuit reaches ground through a low-impedance path from the center-tap connection of the sound tuned circuit inductor L_2. Inductor L_2 and its capacitor, because of their resonant condition develop sound signal for the grid of the sound i.f. tube.

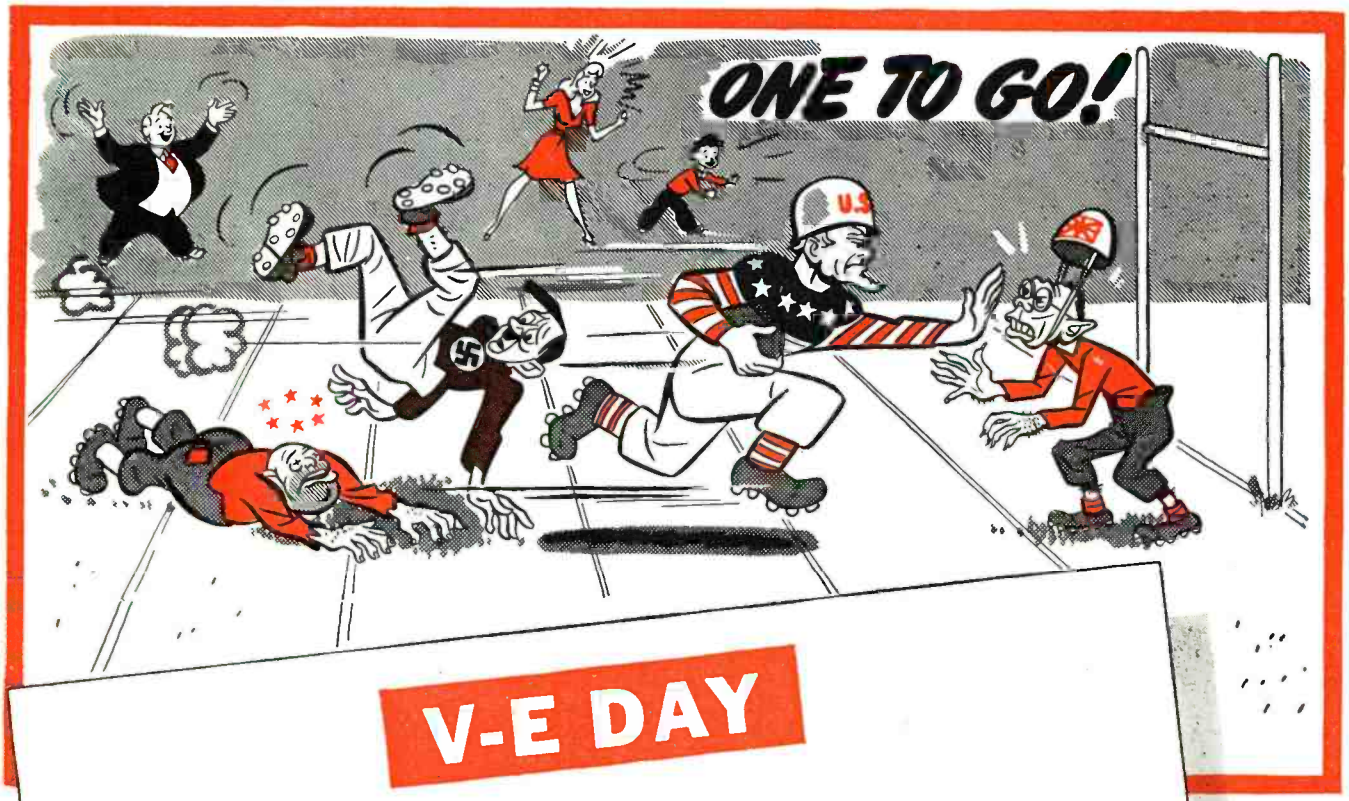
One of the simplest methods used to construct traps for keeping out undesired signals is to take a capacitor of reasonable size and wrap sufficient wire around it to resonate the combination to the undesired frequency. The wire ends are soldered directly to the capacitor leads, forming an effective trap. These small traps can be inserted, as shown in Fig. 9, to remove unwanted signals—the cathode trap is especially efficient, as it becomes highly degenerative.

Radio Amateur

The radio amateur, who is looking forward to the time when he can construct his own television receiver for amateur or home use, will find the i.f. system a challenge to his ingenuity—also a source of much useful knowledge of resonant circuits, traps, precision testing, wide-band amplification, etc. Some work has been done on the construction of mutually coupled circuits and traps on a small high-frequency coil form. These coils

Fig. 7. Response curve for overcoupled stage.





V-E DAY

To All Hytron Employees:

Put yourself in the shoes of that friend of yours who is now a combat infantryman fighting Japs. How is he going to feel on V-E Day?

Sure, he is going to be pleased and proud that the Nazis have got the thrashing they asked for -- but his joy in that Victory is going to be overshadowed by the grim realization that he has a long, hard fight ahead.

All of us at Hytron will have a tough job ahead, too, after Victory in Europe. The production demands of the Navy alone for the Jap war are staggering. The tubes we are producing will go far toward making possible the bombing raids, the bold fleet actions, the many invasion thrusts that will bring Japan to her knees.

GI Joe will have no time out for celebrations. He doesn't want that now. He wants to finish the job, so that he may come home and join with us all in a real celebration.

The management feels that we, too, have no time to spare -- will have none to spare until final Victory is won. Hytron plants will not close down on V-E Day.

Those boys overseas expect us to keep on backing them up; the management believes you want to do just that. On V-E Day -- and until V-J Day -- let us all give vent to our enthusiasm by redoubling our production efforts for final Victory.

Bruce A. Coffin
General Manager

Post: 3-31-45
Remove: After V-E Day

OLDEST EXCLUSIVE MANUFACTURER OF RADIO RECEIVING TUBES

HYTRON

RADIO AND ELECTRONICS CORP.

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

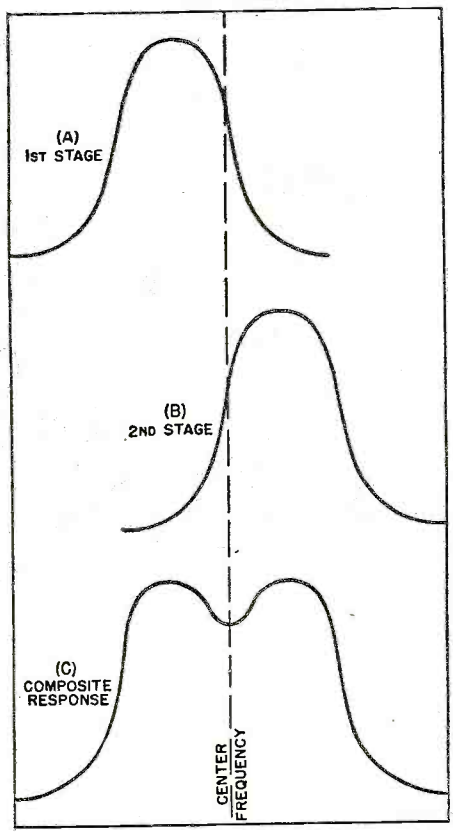


Fig. 8. Stagger-tuned response.

are not tuned, except for an occasional one which is resonated by a small trimmer capacitor. The remaining coils are wound turn-after-turn until the tuned circuit resonates at the proper frequency with the distributed capacity of the stage in which it is inserted. To permit the greatest gain, these coils are mechanically positioned so that one coil attaches directly to the plate pin of one tube and the other coil directly to the grid pin of the next tube, keeping circuit capacity at an absolute minimum. To prevent serious frequency drift, the coils are not shielded, and tubes are positioned to obtain sufficient ventilation, coils being carefully arranged in positions not conducive to feedback. The imagination and mechanical ingenuity of the amateur can overcome the difficulties involved, producing an effective and economical i.f. system.

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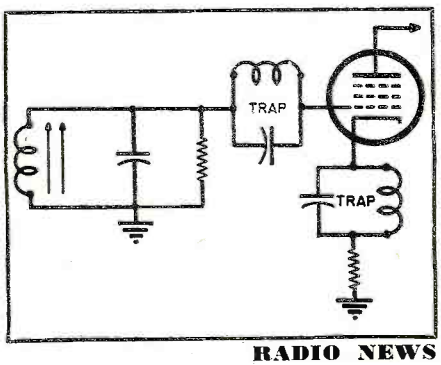
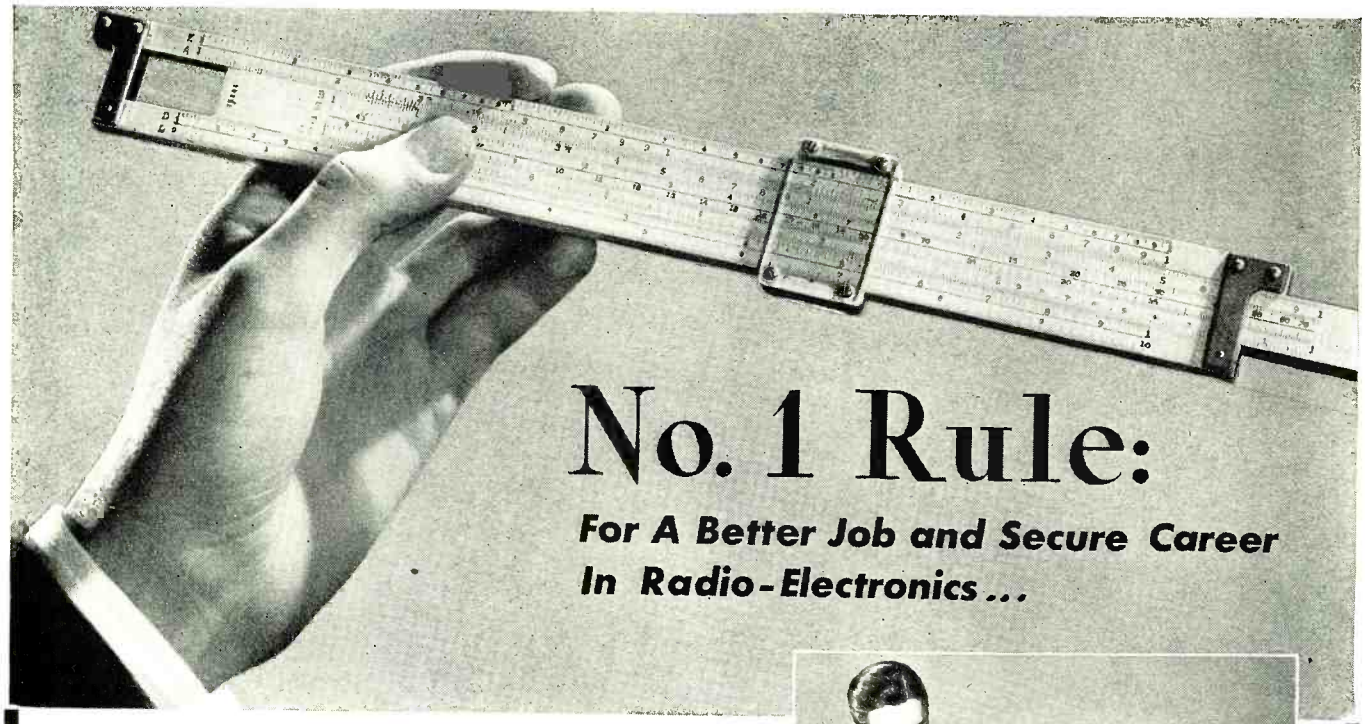
Fig. 9. Cathode and grid type traps used to remove unwanted signals.





No. 1 Rule:

For A Better Job and Secure Career In Radio-Electronics...

Add CREI Technical Training to Your Present Experience—Then Get That Better Radio Job You Want—Enjoy Security!

Thousands of new men have joined the ranks of the radio industry during the war. Now, and after final peace, even more thousands will return from the armed forces. Competition for the better technical jobs will return. Where will you fit into this picture?

If you are wise, you will look ahead and *prepare for the good-paying jobs* in radio-electronics. Every man in radio today has the opportunity to see the amazing developments that are taking place, as well as the unlimited opportunities available to men with modern technical training.

It is up to you to decide if you will be a "screwdriver" mechanic or a *real technician* in a *responsible engineering position.*

CREI home study courses are constantly being revised and kept up-to-date with the rapid developments in the industry. What do you know today about U.H.F. circuits, cavity resonators, wave guides, Klystrons, Magnetrons and other tubes? U.H.F. as well as all other basic principles of modern, practical radio-electronics engineering are covered in CREI home study courses.

CREI can help you prepare by providing you with a proved program of home study training that will *increase your technical ability* and equip you to *advance to the better-paying radio jobs* that offer security and opportunity. The facts about CREI and what it can do for you are printed in a 36-page booklet. It is well worth your reading. *Send for it today.*

Servicemen— Discharged Veterans

CREI RESIDENCE TRAINING NOW AVAILABLE UNDER PROVISIONS OF "G. I." BILL

CREI now offers Residence School courses in Radio-Electronics Engineering, Broadcast & Television Engineering and Broadcast & Television Servicing under the Serviceman's Readjustment Act of 1944 ("G.I." Bill.) Classes now in session. Enter at any time. Write for details.

Those interested in CREI residence school after the war should write for information about the CREI Priority plan.

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"Your Opportunity in the New World of Electronics"

TELL US ALL ABOUT YOURSELF, so that we can intelligently plan a course best suited to your needs. If you have had professional or amateur radio experience—let us prove to you that we have something you need to qualify for a better radio job. To help us intelligently answer your inquiry—PLEASE STATE BRIEFLY YOUR BACKGROUND OF EXPERIENCE, EDUCATION AND PRESENT POSITION

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HOME STUDY COURSES IN PRACTICAL RADIO-ELECTRONICS ENGINEERING FOR PROFESSIONAL SELF-IMPROVEMENT

Dept. RN-7, 3224—16th Street, N. W., Washington 10, D. C.

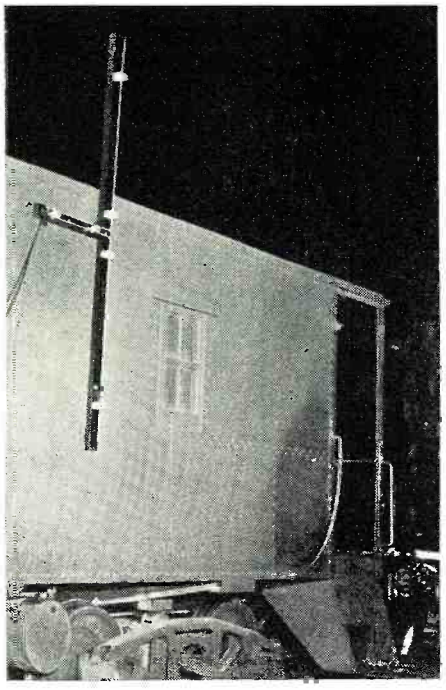
Contractors to U. S. Navy—U. S. Coast Guard—Canadian Broadcasting Corp.
Producers of Well-trained Technical Radiomen for Industry.

Fireman of the "Flying Ute" talks to the conductor via FM radio during test of locomotive-to-caboose communications.

Railroader tests the installation from the caboose. The speaker and remote-control panel may be seen at the left.

RADIO CUTS THREE HOURS OFF FREIGHT TRAIN TIME

Trial test of two-way FM radiotelephone equipment aboard a 65-car Diesel freight, proves successful under adverse conditions.



Two one-half-wave antennas were installed on the side of the caboose and used during trial test of FM equipment.

THE installation of two-way radio equipment aboard a fast manifest Diesel freight, the "Flying Ute," on the *Denver and Rio Grande Western Railroad,* has resulted in a saving of three hours running time for the 570-mile haul over the Continental Divide from Denver to Salt Lake City.

This 65-car freight train, loaded with explosives and vital war materials, was under orders to maintain a fast schedule over a route which included rugged mountainous territory and fifty tunnels, including the six and one-half mile long Moffett Tunnel. Because of the adverse radio conditions encountered in this area, *Galvin Manufacturing Company* selected this location for a testing ground for their two-way FM *Motorola* radio-telephone installation, using frequencies above 100 megacycles.

A mobile *Motorola* FM unit, consisting of a transmitter and a receiver, was installed in the cab of the Diesel locomotive and another unit in the caboose. The specially designed antennas were mounted on the Diesel and caboose, from which points they were connected by coaxial cables to the *Motorola* units.

Power for the unit mounted in the locomotive was obtained by means of an a.c. converter which was connected to the starting batteries of the Diesel. This unit provided voltages from 32 to 117 volts for the operation of the radio equipment. For the caboose, power was obtained from a gas-driven generator which furnished 117 volts a.c.

By means of this setup, the train crew in the locomotive was in constant contact with the train crew in the caboose. In operation, a green light at the transmitter in both the locomotive and caboose indicates that the sets are clear for transmission. When the transmitting switch is operated, a red light indicates that a message is coming through. Loudspeakers are provided in addition to handsets. When the handset is removed from the hook, the loudspeaker volume is cut down. In addition to the handsets, microphones were tested. The differential type microphone proved to be most advantageous as it tended to eliminate the transmission of most of the noises present in the cab or caboose while the train was under way.

Results of the test indicated that

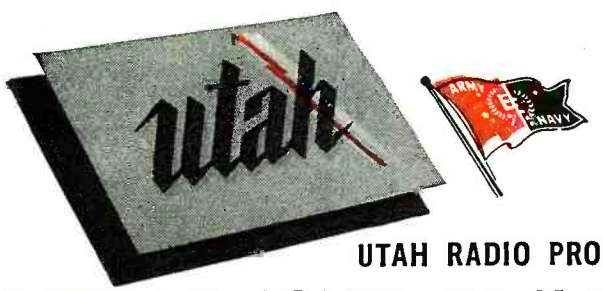
★ *This speaks for itself: Utah is its own transformer supplier for speakers, vibrators, wire recorders, etcetera.*

WHEN UTAH SAYS..."OK—SHIP"

It's like putting a big liner into water. Like a launching. Only here at Utah, we don't take time for celebration. Radio makers and electronics dealers appreciate the highly specialized product that has been manufactured ... the way a skipper appreciates a fine craft. Radio listeners, like ships' passengers, take all this precision for granted.

Here at Utah our workers (assisted by Utalins*) begin with nothing but the raw materials from which they make the tools that turn out Utah radio parts and electronic devices. At each step in manufacture . . . punch press, electroplating, welding, coil winding . . . from the beginning through to the finished product, Utah workers check, recheck, test and prove to Utah standards. When Utah says..."OK—SHIP" products of quality that stand up under every condition known to man leave to broadcast Utah performance around the world.

*Utah's Helpers



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

two-way communications between the cab and caboose was clear, intelligible, and constant despite the fact that many times, due to the circuitous nature of the route, the engine and caboose were out of line-of-sight touch with each other.

The *Rio Grande Railroad* reported that time was saved in the elimination of hand signalling, the clearing of switches, checking of hot boxes, and dragging brakes and that radio facilitated the teamwork of the crews by supplying them with constant information regarding right-of-way and cargo condition.

Increased safety due to the use of two-way radio was demonstrated dramatically when the conductor discovered a fire, fifteen cars back of the locomotive. Since any fire on a moving train is serious, its discovery and the proper handling of the situation is important. Since this train was loaded with explosives and vital war material the use of two-way radio undoubtedly averted what might have been a serious explosion. Upon discovering the fire, the conductor immediately broadcast his message and the fire was brought under control in a matter of minutes. In this instance, hand-signalling and the other conventional methods of controlling a train might have taken too great a time to prevent a catastrophe.

Special experiments were conducted whenever the locomotive entered one of the fifty tunnels on the route. In many cases, the talk-back came through clearly and distinctly, but in the Moffett Tunnel, the noise level was high.

This is another example of the part that two-way FM radiotelephone equipment will play in the postwar picture of all forms of traffic control by means of radio equipment.

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RID AND FBIS PERSONNEL ORGANIZE

THE prominent part that stories of the RID and FBIS have played in the news in recent months has stimulated an interest on the part of RID and FBIS men and women to organize.

Leading this movement, which has the warm endorsement of George E. Sterling, Chief of the Radio Intelligence Division, is Carl J. Kunz of Indianapolis, Indiana. It is the hope of Mr. Kunz that all present and former RID and FBIS men and women will register their names, present addresses, and industrial affiliation with him with the purpose that a directory of such personnel may be compiled for the information of other members.

Mr. Kunz has emphasized that such a listing will not be used as a mailing list for advertisers or used for soliciting funds. If sufficient persons show an interest in this directory, Mr. Kunz will have the list prepared.

All former RID and FBIS men and women are urged to write to Carl J. Kunz, 237 N. Warman Avenue, Indianapolis 8, Indiana.

—30—

Right across the "Board"

We've been "burning the midnight oil" . . . not only to deliver to Uncle Sam all the Eastern amplification equipment needed for Army Air Forces bombers and U. S. Navy planes and PT boats, but also to translate our extensive wartime experience into sound amplification equipment for peacetime use.

Our post-war production is *right* on the drawing board! We are ready to manufacture just as soon as Uncle Sam gives the "go-ahead."

To aid the war effort against Japan, our engineers are standing by to consult on any problem of sound amplification. Until the day of final Victory, our resources will be devoted to the design and production of vital war equipment.

Let us send you a series of useful articles prepared by our engineering staff on the newest developments in amplification related to sound systems. Ask for Series E-7.

Buy War Bonds

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EASTERN AMPLIFIER CORPORATION

U. S. Reg'n. Applied For

794 EAST 140th STREET • NEW YORK 54, N. Y.

News from OVERSEAS

By KENNETH R. PORTER
RADIO NEWS War Correspondent

THE time when a room full of massive coils and tubes was necessary for the reception of messages from a distance of a few miles is recalled by the death at the age of 95 at Sidmouth, England, of Sir Ambrose Fleming, the man who shares with Dr. Lee de Forest the distinction of having invented the thermionic tube.

This pioneer of radio became interested in wireless while investigating electromagnetic-wave propagation under the guidance of Clerk Maxwell and soon afterwards designed the wireless station at Poldhu, England, from which the historic trans-atlantic signals were received by Marconi on December the 12th, 1901, at St. John in Newfoundland.

The discovery of the two-electrode thermionic tube—which was made during an investigation of the causes of blackening electric lamp bulbs—did not make a rich man out of Sir Ambrose.

In fact, with the exception of the small retainer fee from the *Marconi Wireless Telegraph Company* for which he worked at the time, Sir Ambrose hardly benefited financially by his epoch-making invention.

Nor did Sir Ambrose make much money out of any of his other inventions, such as for instance the simple, spyproof, signalling equipment which in this war is enabling the Allies to send and receive secret messages without detection or interference by the enemy.

It may also be worth recalling that his brilliance as a research scientist did not prevent Sir Ambrose from believing firmly in miracles and becoming a leading opponent of the Darwinian theory of evolution which, at one time, he described as "a product of the imagination."

Are Electromagnetic Waves Guiding Pigeons?

Imaginary too, it might appear to the layman, are the tests carried out by British and American army scientists which prove that it is a "little tickle" emitted by electromagnetic waves, which, after making contact with the ear of a homing pigeon, guide it over long distances to its loft.

"We now are certain that a pigeon flies round in circles when released so that it can pick up the electromagnetic waves along which it will fly to its home loft" stated a senior officer of the Royal Signals at a recent press conference.

His opposite number in the U.S. Army took up the story and added: "Each bird's instinct responds to a different electromagnetic wavelength and once a pigeon has got a tickle strongly sounding in its ear it travels along surely."

The Last of the V-weapons

According to French press reports, repatriated deportees have given the following description of the V-type weapon which they were producing in a secret underground factory near Erfurt in Germany:

"Imagine a V-2 which instead of being blind surpasses the most perfect artillery in accuracy of trajectory. Then step up your imaginations still a bit further and visualize a projectile 15 to 20 yards long travelling at the speed of 3,750 miles an hour and controlled throughout its flight by radio and you have a pretty accurate picture of what was in store for London."

More effective than mere rumor, however, was the manually-controlled weapon used by Lt. Stevens of Texas, who while engaged in hard fighting on the Third Army Sector, found himself unable to release his pistol from its holster at a critical moment and thereupon threw in desperation his "handie-talkie" at blazing-away German machine-gunners.

Under the impression that the Lieutenant was equipped with a new type of secret weapon that would go off and blast them to smithereens, the firing stopped abruptly and the Nazi machine-gun crew came out with their hands up!

The Coronascope

Even the fertile imagination of a Jules Verne has been outdistanced, if not surpassed, by the invention of a radio device which is so delicate and supersensitive that it is capable of producing sun eclipses artificially.

This instrument is called the coronascope and enables the study of the strange and mysterious flame phenomena known as "breath pulses."

With its aid, French radio scientists and astronomers are at present prob-

making mountains out of molehills

Dependability is a lot of little things that add up—it's the end result of paying due homage to all the molehills of production so that the finished product will give a mountain of service. Like paying strict attention to seemingly unimportant details of workmanship. Like emphasizing the work of skilled technicians who are experts in their special field of building finer capacitors.

That's the way we've been making capacitors since 1910. Many of our men and women have been working on C-D capacitors for nearly 34 years. Others have been with us for five—ten—twenty years of loyal, devoted service.

Dependability is a C-D tradition. Every C-D capacitor has built into it the dependability . . . the skill, experience and research . . . that belong only to the leader, Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey.

TYPE YAT—*A compact, low capacity Dykanol "G" bypass capacitor—hermetically sealed in specially-treated drawn metal container. Range at 600V.—.05 mfd. to 1 mfd. at 100V.—.05 mfd. to .5 mfd.*

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ALSO AT NEW BEDFORD, BROOKLINE, WORCESTER, MASS.; PROVIDENCE, R. I.

ing the vast spherical regions around the sun in an effort to locate the causes of short-wave interferences and disturbances which, presumably, are brought about by eruptions of flaming gas leaping to heights of over 140,000 miles from the edge of the solar surface.

Does Foreign Broadcasting Pay?

The recent announcement by the French Government not to authorize in the future the use of private broadcasting stations coincides with the news that Radiodiffusion, the French official broadcasting service, has decided to reverse the regular BBC feature "Les Francais parlent aux Francais"—which for four years carried news to listeners in France denied all other access to untainted information —by a program from Paris called "The English speak to the English."

This interesting innovation in foreign language broadcasts opens up the question whether or not there is room on the ether for multidirectional foreign language broadcasts in peacetime and whether the size of the audience that can be reached in a foreign country will justify the expenditure involved.

Television Solves Difficult Sports Problem. But—

An invention which may well simplify one of the most difficult sports problems, that of refereeing, was recently demonstrated for the first time in England.

With its aid the actual play is reflected on a television table showing up every movement plainly and in detail, thus permitting a referee to apply the laws according to text-books and give his decisions by means of a siren or whistle.

The viewing table is enclosed in a little soundproof building and consists of a number of cathode-ray tubes arranged in a semicircle, which throw images onto a screen.

The invention can be used in football and other athletic games, and horse or dog racing, and allows for the finish of a race to be judged to a fraction of an inch, with possibility of error practically ruled out.

As it can, of course, also televise a game from beginning to end for transmission to the cinema or home, sports promoters are in fear of losing money in gate receipts and have formed an association which aims to introduce legislation for the protection of their interests against television reproduction.

Robot Voice Calls Out Station Names

Passengers riding on London subway trains are now being told "where to get off" by a robot voice calling out station names automatically as trains enter platforms.

This is accomplished with the aid of an electronic eye which starts a mechanism that broadcasts station names over a series of loudspeakers as soon as a train flashes past a certain spot along the track, breaking the connecting circuit.

S/Sgt. M. Charles Linko poses as a typical radio bug, in this unusual photographic shot.

Radio-phototelegraphy

As part of their plans for the development of telecommunications in the SEAC area, the British Cable & Wireless Company has inaugurated a direct phototelegraph circuit between London and Colombo, Ceylon, on an experimental basis.

Principally designed to enable servicemen to send photographs from India and the Pacific to their relatives and friends in Britain, the service is not yet open for general press or public traffic.

Radio Controls Making of Newsprint

The recently returned from Sweden War-Correspondent-Photographer Eliott Elisofon has disclosed that a special type of moisture-control apparatus operated by radio is used in Finnish paper mills for the making of newsprint.

Apparently, the moisture content of the pulp is governed in three different processing phases by this radio device, which was invented by a German named Paul Lippke.

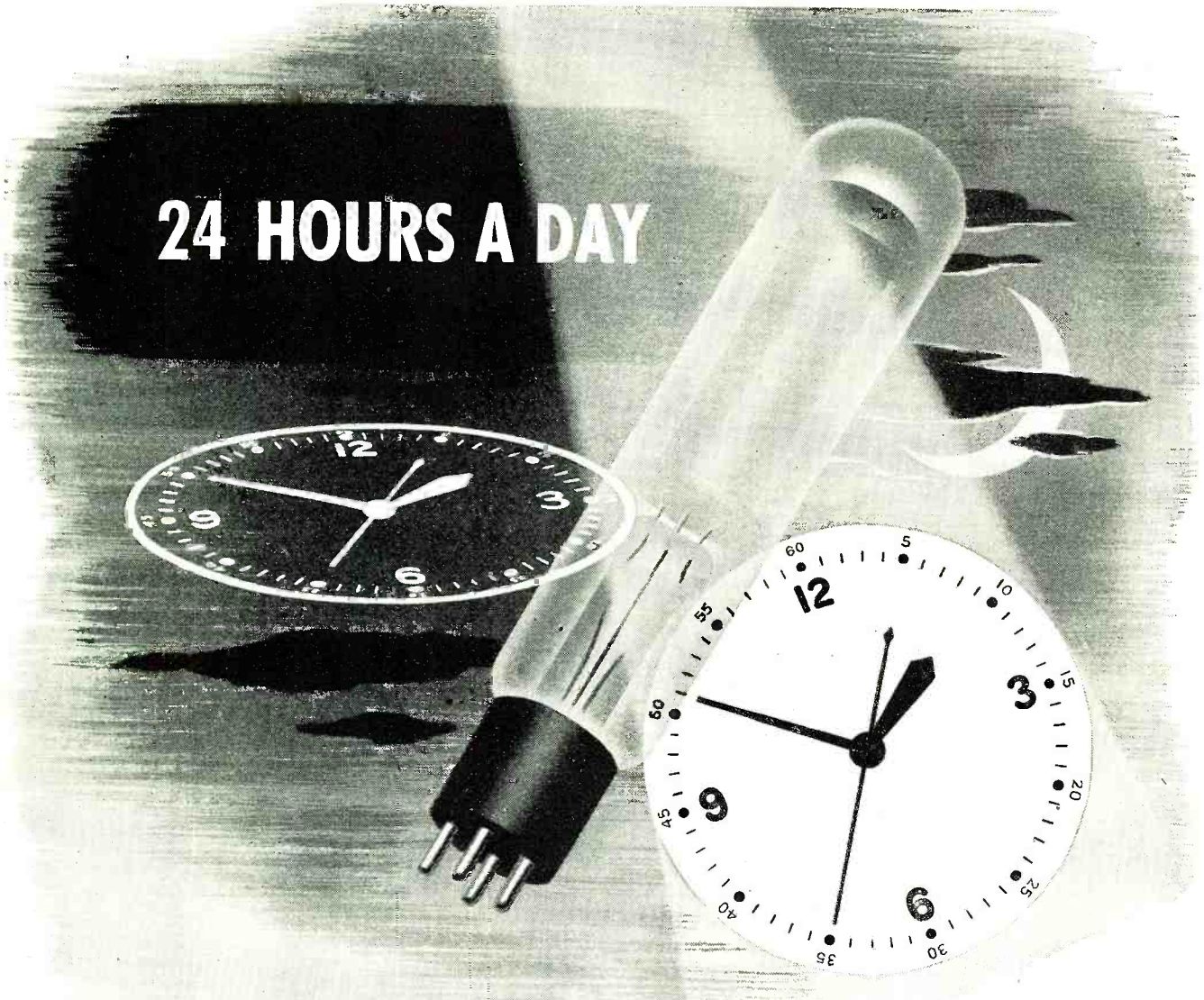
27,000 Sets of Airborne Equipment Carried on Single Raid

Some idea of the tremendous amount of airborne signal equipment used by Allied Air Forces can be gained from the fact that a single bomber carries a minimum of twelve separate units while a fighter carries at least four.

In fact, on a recent raid, 2000 heavy bombers, escorted by 900 fighters carried a grand total of 27,000 sets of signal equipment.

This equipment consisted of aerial navigation sets, intercommunication hookups, air-to-ground, plane-to-plane, radio-radar, and other devices specially adapted to the needs of the Army Air Forces.

—30—



On every fighting front . . . on land, at sea, in the air . . . Delco Radio products aid in the coordination of military operations. Their assignments include communication, detecting and ranging, directional-finding and all the other varied phases of radio and radar activity. It's a full-time job, continuing and continuous, to which Delco Radio products bring an effective combination of engineering vision — manufacturing precision. Delco Radio Division, General Motors Corporation, Kokomo, Indiana.

Delco Radio
DIVISION OF
GENERAL MOTORS

The Road to Tokyo is Tough —
Keep Buying War Bonds

TECHNICAL BOOK & BULLETIN REVIEW

"SIMPLIFIED RADIO SERVICING BY COMPARISON METHOD" by M. N. Beitman. Published by *Supreme Publications,* Chicago, Illinois. Price $1.50. 76 pages.

In this latest book by Mr. Beitman, the author has introduced a new and simplified method for servicing radio receivers without the use of instruments.

According to the author, this method may be utilized effectively by the beginner and expert alike as parts and circuit may be checked in a few minutes without the use of special testers or equipment. This book is a compilation of a series of lectures on radio repairing, presented by the author..

Radio theory is limited to a few essential facts, but the book may be used by those with limited radio knowledge. The comparison technique of radio servicing permits simple tests to be made to obtain electrical, visual, and other reactions from radio parts and circuits. Proper indications and the correct results are given in order that nonfunctioning of parts may be determined quickly.

The book includes comparison diagrams, tube data, and an index of receiver faults which assist in determining causes of receiver failures.

"INTRODUCTION TO PRACTICAL RADIO" by Durward J. Tucker. Published by *The Macmillan Company,* New York. 317 pages. Price $3.00.

This text provides an easily understood source book for the beginner and student. Mr. Tucker has developed the subject of radio in a logical and well-organized manner which makes this book especially suitable for home study and self instruction.

Early chapters of the book deal with the elements of electricity and electrical measurement and simple mathematical problems in Ohm's Law are included. Mr. Tucker has presented the necessary mathematics as needed and in no instance has extraneous material been introduced.

This book covers elementary d.c. and a.c. circuits, electrical instruments, inductance, capacitance and impedance. Problems are included at the end of each chapter, along with review questions.

The appendix includes logarithmic and trigonometric tables, a mathematical glossary, an electrical glossary, the Greek alphabet and the B and S. wire gauge.

As previously mentioned, this book is for the beginner who wants to learn radio theory in a practical and usable form. Since it was written with these students in mind, the book serves its purposes admirably.

—30—

More than 35 Years of Service to the RADIO INDUSTRY

Whether Amplitude Modulation . . . Frequency Modulation . . . or Television — dependability is a *must* for all broadcast equipment.

Federal broadcast equipment has earned a reputation for that dependability because *it stands up.*

For more than thirty-five achievement-studded years . . . from the Poulsen Arc to the new CBS Television Station . . . Federal has served the broadcast industry with superior equipment.

Federal's background includes such milestones of electronic progress as the 1000 Kw Bordeaux Transmitter; Micro-ray, the forerunner of modern television technique; and the first UHF multi-channel telephone and telegraph circuits, part of a world-wide communications system . . .

All this, plus the war-sharpened techniques that are the result of ability *and* experience, combine to give you craftsmanship . . . the kind of craftsmanship that builds dependability into all Federal equipment.

In AM . . . FM . . . TV . . .

. . . your prime need in broadcast equipment is dependability — *look to Federal for it.*

FEDERAL TELEPHONE & RADIO — FTR

Federal Telephone and Radio Corporation

AN IT&T ASSOCIATE

Newark 1, N. J.

Testing Crystals

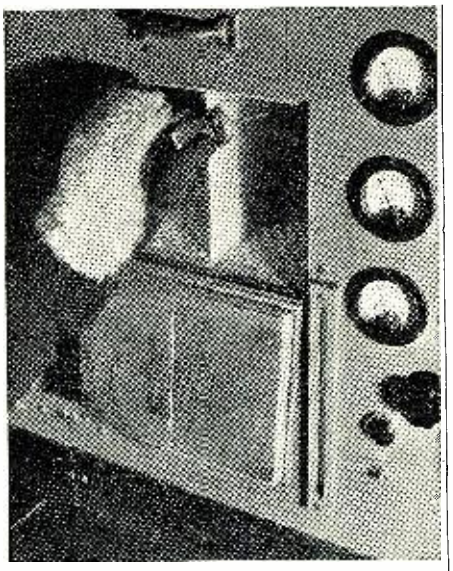
(*Continued from page 44*)

quiring about thirty to forty minutes.

Wearing a headset, the test operator tunes the precision equipment before the test begins, then turns on the "juice" to raise the temperature of the crystal to 122° F. When the desired temperature is reached, the operator switches off the heat and immediately puts a porous aluminum tray, about 2″ x 6″ x 6″, filled with small cubes of dry ice, into the drawer space above the testing chamber. A small blower fan operating at the back of the tray accelerates the rate of evaporation of the ice and dispersal of the cold throughout the chamber. Since the temperature of dry ice is —110° F., the atmosphere in the testing chamber could be dropped to —40° F. in ten to twelve minutes but, in actual testing, the rate is slowed down to simulate outside conditions more realistically. The gas released, as the dry ice is transformed from the solid to the gaseous state, is carried away from the operating area through an exhaust system connected with the testing cabinets.

Defects that cannot be visually detected, but that would render a crystal useless in certain climates, show up in about 20% of the crystals that are subjected to this ambient temperature test. The most common causes of rejects are unsatisfactory temperature coefficient, low activity, and frequency jumps.

Just before it is routed to the crystal testing department, the dry ice, which is delivered from *The Mathieson Alkali Works* to the plant in standard 55-pound blocks, is sawed into small pieces about the size of canned pineapple sticks to give it maximum cooling speed. From two to three pounds of ice are required per ice tray in the original testing compartments. A recent modification of the equipment uses only about a pound and a half per run.



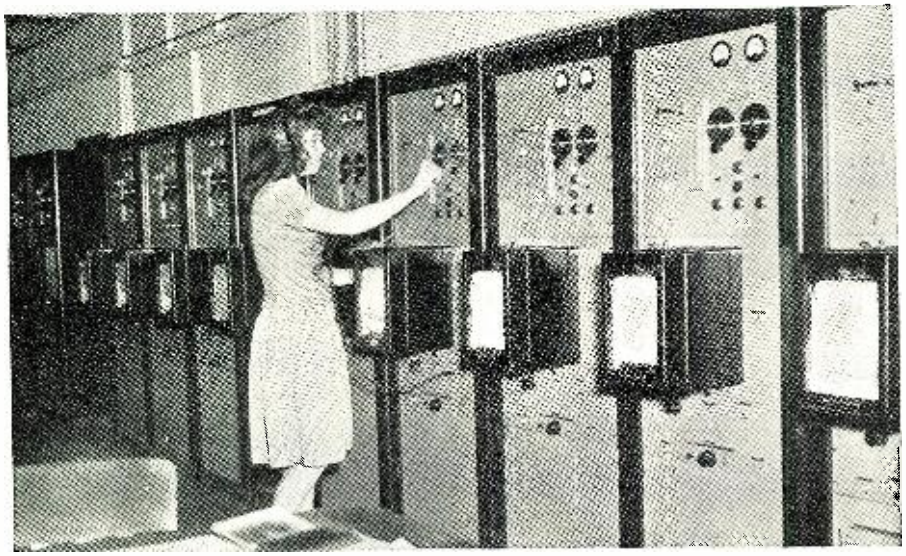
Test operator removing the quartz crystal from the test chamber. At the end of the test, the crystal is so cold that mittens must be worn by operator.

The cleanliness and extremely low temperature of dry ice make it a most suitable and practical refrigerant for testing crystals.

"Without dry ice," according to the production superintendent of *Bendix,* "there would be no such thing as mass production of crystals for airplane radios."

The mass production techniques which are being developed during the war for the manufacture of quartz crystals augur well for an improved product for the amateur and experimenter. Precision crystals will soon be available to the ham at a price that he can afford to pay, thus the accuracy and stability of the ham receiver will be improved and one of the most enjoyable of all pastimes will be enhanced. Although the war put a stop to ham activities, the improvements will be worth waiting for. —30—

Test operator tuning the precision test equipment just before the test on crystals is begun.



MAKE MONEY REPAIRING RADIOS
AND OTHER ELECTRONIC EQUIPMENT

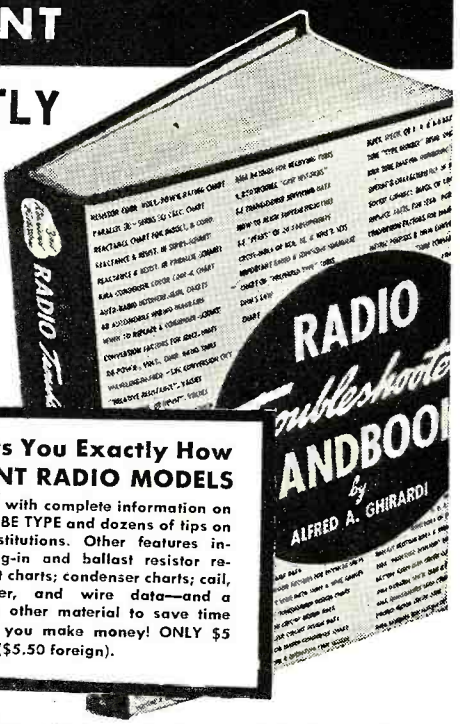
TELLS YOU EXACTLY *WHAT TO DO*...EXACTLY
HOW TO DO IT

If you like to repair radios at home in spare time, Ghirardi's RADIO TROUBLESHOOTER'S HANDBOOK offers you a new, fast way that makes the work easy—without a lot of previous experience or scarce, expensive test equipment. Or, if you are a professional radio man, it helps you repair two sets in less than the time you'd normally take for one. It is the ideal book for training new helpers, for substituting tubes and parts in these days of shortages, for repairing cheap sets quickly and profitably—in short, for repairing radios better, faster and more profitably than you may have thought possible.

4 LBS. OF FACTUAL, TIME-SAVING MONEY-MAKING SERVICE DATA

RADIO TROUBLESHOOTER'S HANDBOOK isn't a "study" book. It rolls up its sleeves and goes to work for you the minute you get it. It can easily pay for itself the first time you use it! Simply look up the make, model, and the trouble symptom of the Radio you want to repair . . . and go to work. No useless testing! No lost time or motion! The HANDBOOK'S clear instructions tell you exactly what the trouble is likely to be . . . and EXACTLY how to fix it. Actually, this big 4 pound, 744-page, manual size HANDBOOK brings you factual repair data for practically every radio in use today—over 4,800 individual makes and models!

In addition, there are hundreds o pages of helpful repair charts, tube charts, data on tuning alignment, transformer troubles, tube and parts substitutions, color codes, etc.—all for only $5 ($5.50 foreign) on an ABSOLUTE 5-DAY MONEY-BACK GUARANTEE.



This "Automatic Teacher" Shows You Exactly How to REPAIR OVER 4,800 DIFFERENT RADIO MODELS

Over 400 pages of the RADIO TROUBLESHOOTER'S HANDBOOK include specific common Trouble Symptoms, their Causes and Remedies for practically every Radio Receiver in use today. IN ADDITION, there are hundreds of pages including i-f alignment peaks for over 20,000 superhets; a big data section on i-f transformer troubles—and the most up-to-the-minute TUBE CHART you've ever seen with complete information on EVERY TUBE TYPE and dozens of tips on tube substitutions. Other features include plug-in and ballast resistor replacement charts; condenser charts; coil, transformer, and wire data—and a wealth of other material to save time and help you make money! ONLY $5 complete ($5.50 foreign).

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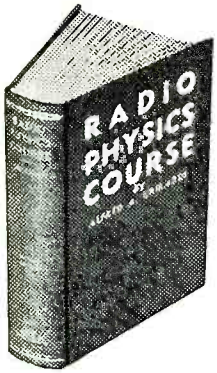
FOR BEGINNERS $5



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Train NOW for the most interesting of all postwar futures—RADIO-ELECTRONICS! Ghirardi's 972-page RADIO PHYSICS COURSE BOOK gives you all the basic training you need—at a price you can afford to pay! Actually, this big book has started more people in Radio-Electronics than any other book or course. It is more widely used for home study—and more widely used in U. S. Signal Corps and Navy Schools and in civilian schools and colleges than any other book of its kind!

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Explains circuit and operation of all types of essential service instruments: How and when to use them; How to build your own; Preliminary trouble checks; Trouble-shooting; Repairs; Obscure radio troubles; Aligning and neutralizing; Auto and Marine Radios; Interference reduction; AVC and QAVC circuits, etc., etc.

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Study now for a good job as a professional Radio-Electronic Service Expert. It's easy to learn from Ghirardi's big 1300-page profusely illustrated MODERN RADIO SERVICING book that costs you only $5 complete. This one big book covers all phases of the work! Explains all necessary test instruments . . . even how to build your own if you prefer; how to trouble-shoot all makes of radios, analyze electronic circuits, test components, make adjustments, repairs, etc., etc.—all step-by-step. Even explains how to start a successful Radio-Electronic Service Business of your own. Sold separately for $5 ($5.50 foreign), or see MONEY-SAVING COMBINATION OFFER in coupon.

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Enclosed find $.....for books checked; or □send C.O.D. (in U. S. A. only) for this amount plus postage. If not fully satisfactory, I may return the books at the end of 5 days and receive my money back.

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□ **Special MONEY-SAVING COMBINATION:**
Both Modern Radio Servicing and Troubleshooter's Handbook $9.50 for the two ($10.50 foreign).

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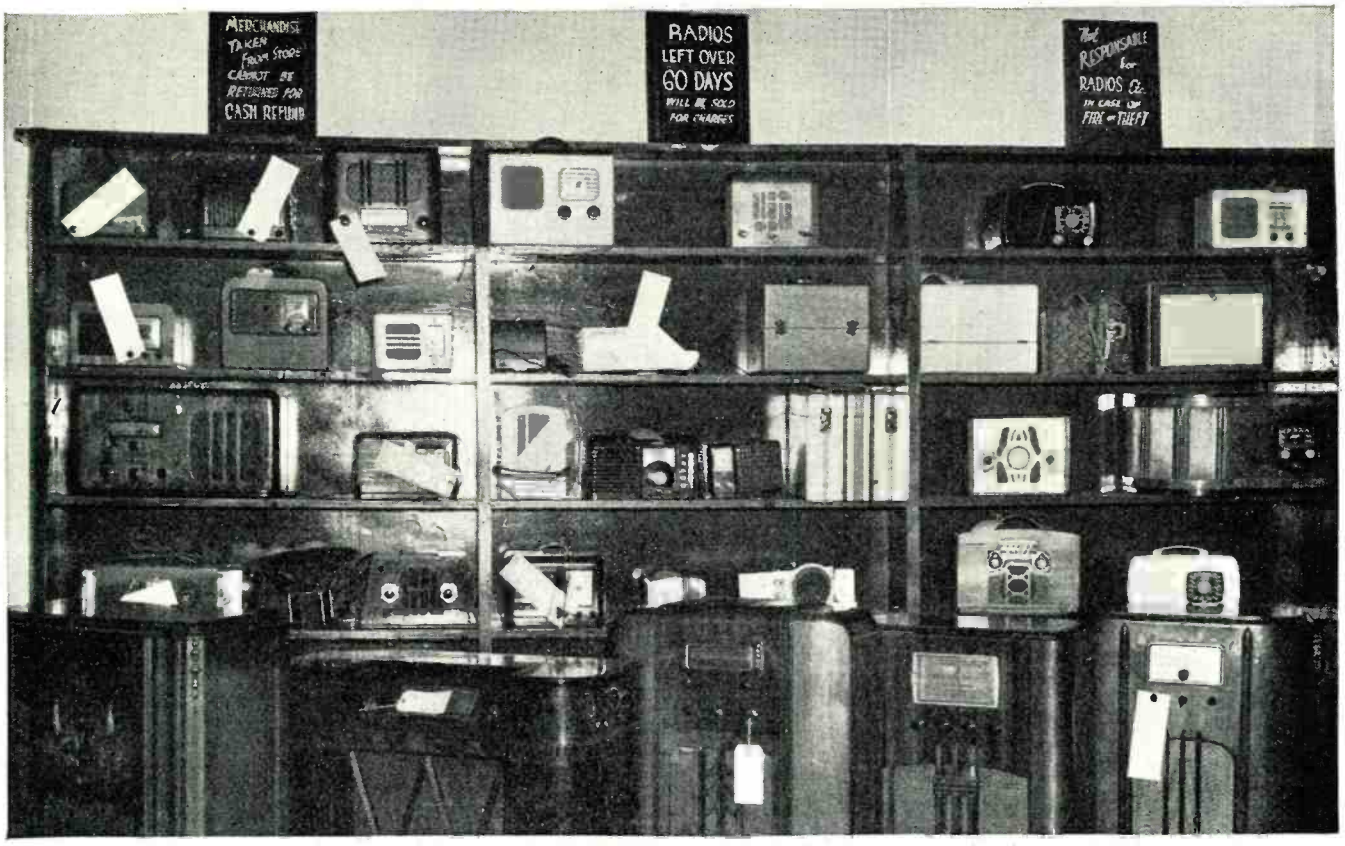
City & Dist. No.....State.....

(Please print or write plainly)



A conveniently-placed rack holds all receivers after repairs are completed. Tags on receivers contain complete records of repairs.

RADIO SERVICEMAN PLANS FOR POSTWAR OPERATION

By JOHN LATIMER

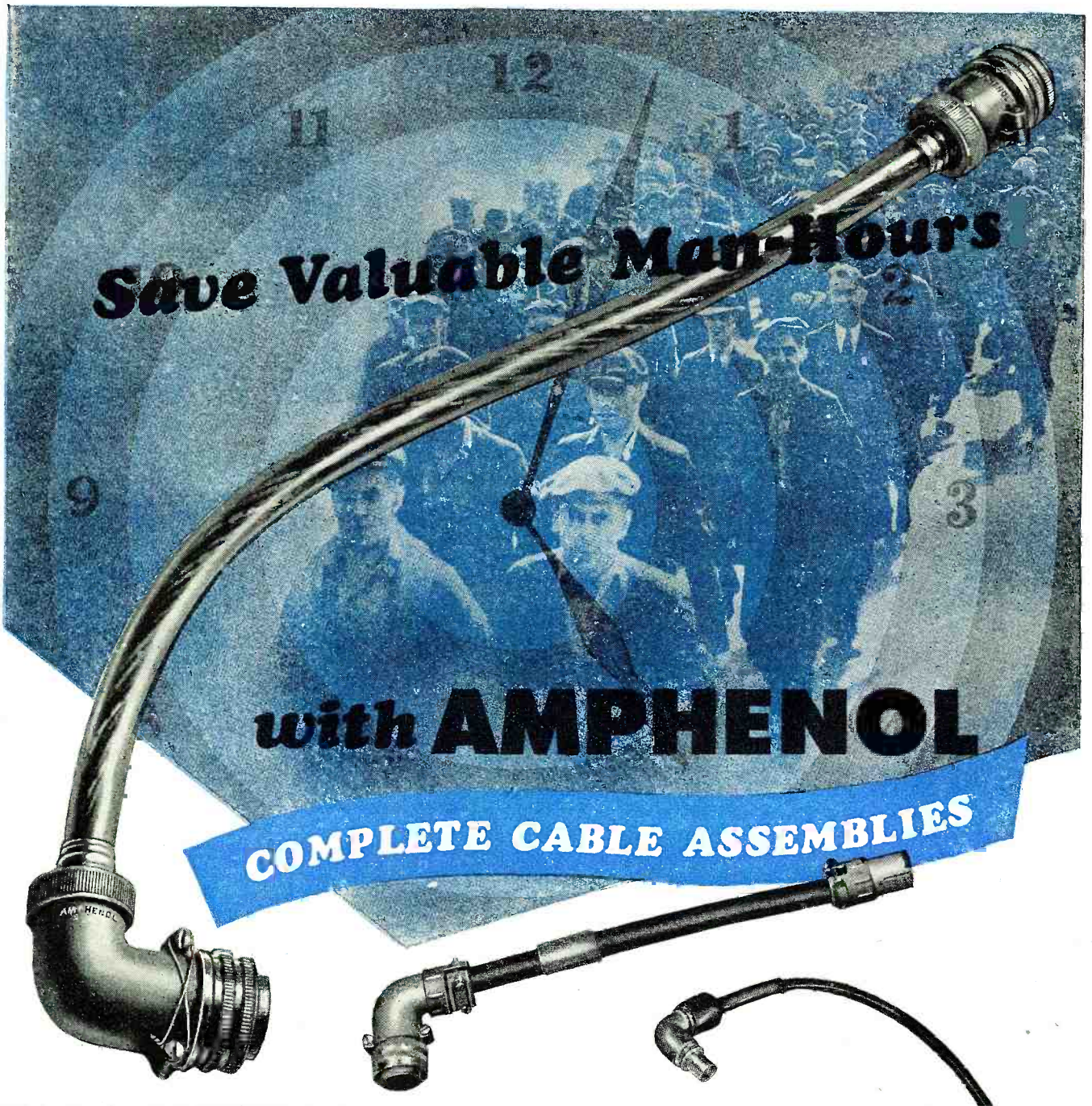
The unique features in design and operation that a former G.I. has adapted in re-establishing his own radio repair shop.

A well-displayed show window is an aid to efficient merchandising.

SHELDON POWELL, radioman of Watertown, N. Y., has designed a radio shop incorporating many postwar refinements. This radioman was formerly in the U. S. Signal Corps for six and a half years. He was discharged in August of 1944 and decided to enter the radio-servicing business. Because he is a typical serviceman, discharged from the Armed Forces, the service shop which he designed and the business methods which he is employing will be of very definite interest to fellow members of the Armed Forces who are even now planning their postwar establishments, to be had when the present conflict ends.

The Powell radio establishment has a number of unique features. First of all Powell uses his street windows to place customer radios which are already repaired. His two street windows can accommodate a number of house radios and portables. Besides serving to keep the radio shop from being cluttered up with repaired radios, these windows show the versatility of this radio-service operative. In addition to radios, Sheldon Powell places a microphone and repaired p.a. systems in the window on occasion to show that he is always ready and willing to tackle repair of such radio equipment.

As the potential customer enters the establishment, he looks about the customer reception room. On one side is a huge rack on which are placed sets awaiting service. This rack not only accommodates portables but also house radio chasses. In addition, a



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Tremendous volume production has necessitated the creation of countless jigs, fixtures and special equipment with resultant lower assembly cost, precision and quality workmanship, and dependability that characterizes all Amphenol products.

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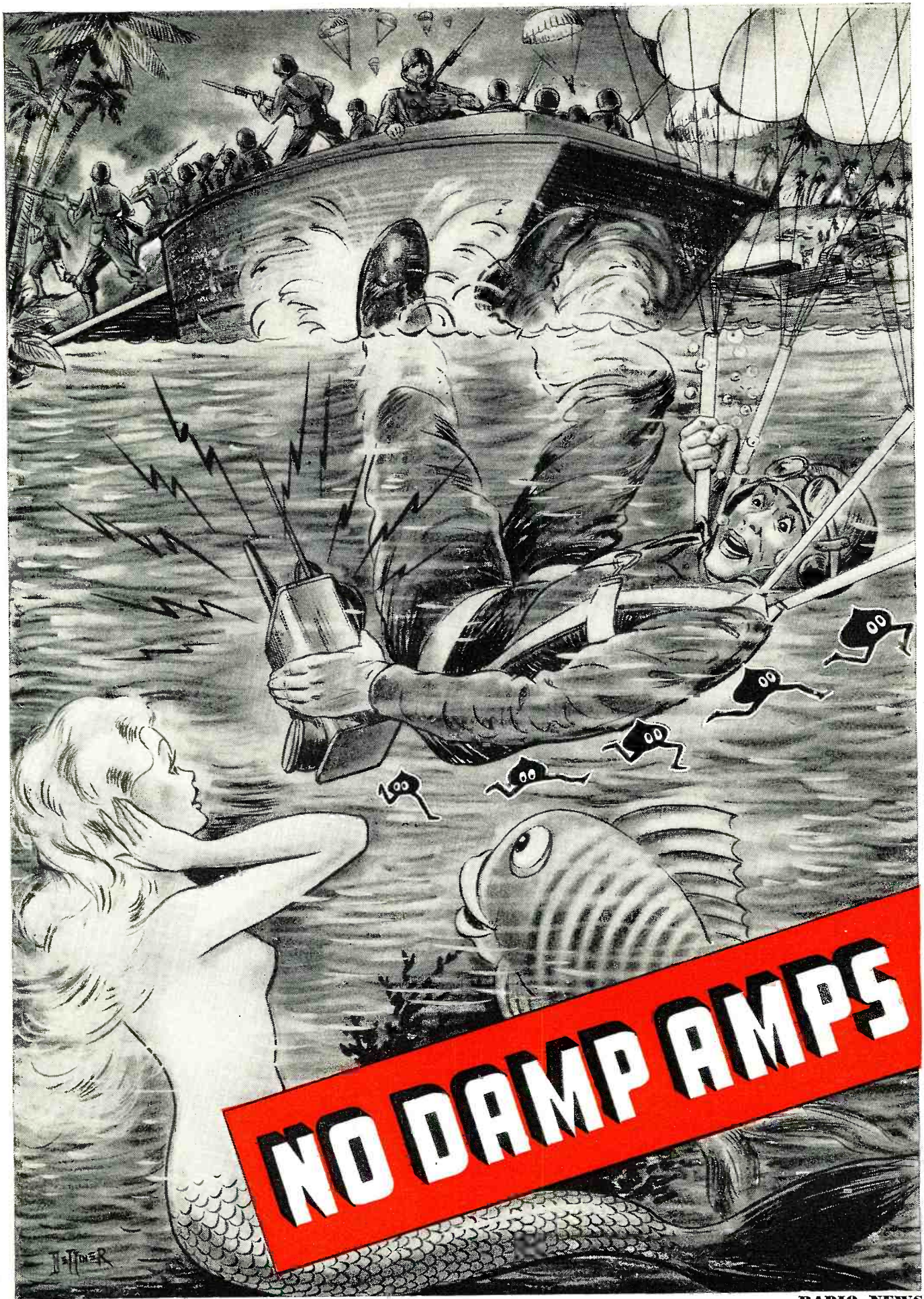

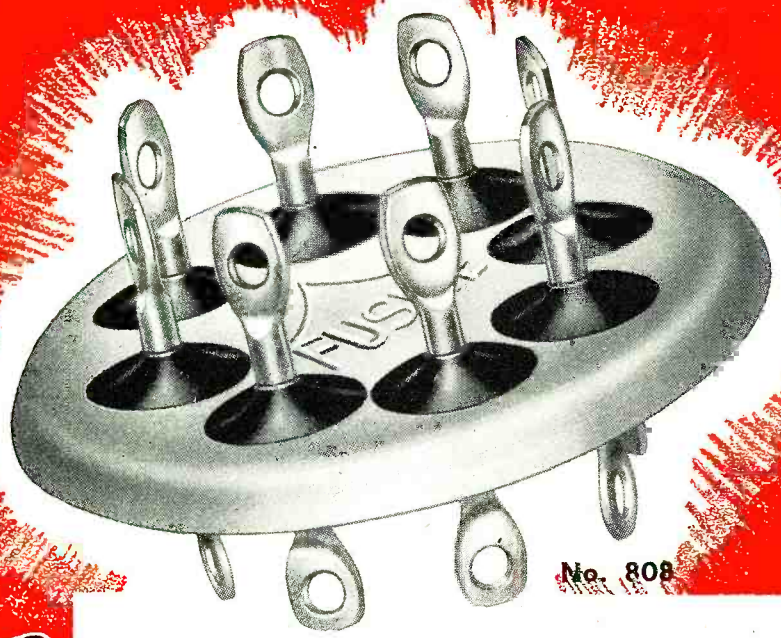

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No. 100 SINGLE FLANGE DIAMETER .5/16" (App.)	600 SERIES 1" DIAMETER (.952)	800 SERIES 1¼" DIAMETER (1.235)
INSERTS IN 3/16" HOLE	602	802
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LANDING . . . feet first is a first-class feat, in war or peace. To land business now and postwar, consider **FUSITE** hermetic terminals. They make it so much easier for you to hermetically seal your electronic component parts. **FUSITE's** pass the salt water and thermal immersion cycling tests. Another **FUSITE** feature is the flattened and pierced terminal ends. Maximum distance from disc to terminal end is only 5/16". This means **FUSITE** hermetic terminals are stronger, sturdier, more compact. When space inside the "can" is limited, **FUSITE** fits in nicely. See "Production Hint" how to do it. Discover for yourself how **FUSITE** hermetic terminals save parts and labor, down costs and up production. Write for samples. Today! This mark FUSITE is your assurance of the best in hermetic terminals . . . plus the additional satisfaction of improving the performance of your product.

PRODUCTION HINT

Solder on the lead wires; then bend the flattened terminol ends to get maximum inside clearance.

Hole punched and adapter socket formed to receive multi-terminal panel.

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

WITH FUSITE SEALS

A LANDING RAMP,
IS WHAT THEY TRAMP,
THE MOBILE STUFF GOES WHEELING!
BUT, ACTIVE AMPS,
CAN'T STAND THE DAMP
SO THEY GET *FUSITE SEALING!*

CINCINNATI ELECTRIC PRODUCTS COMPANY

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GLASS TO METAL

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HERMETIC TERMINALS

NO DAMP AMPS!

section of this rack is used to display used platters. Powell has built up a considerable business selling used records. Practically every one of his radio repair customers has a phonograph and a supply of recordings which they wish to sell.

On the other side of the room is a tube rack containing all tubes for sale. The rest of the room is bare, save for a small display case in which may be found components for the radio experimenter. Powell believes that a radio serviceman should become friendly with individuals who have been bitten by the radio bug. For that reason he invites school children and defense workers, whose hobby is radio, to drop in and talk over set design problems. He maintains a large stock of parts and is constantly buying or swapping more components from incoming radio enthusiasts. Aside from the small margin of profit on such transactions he benefits because after the war he intends to hold a weekly "radio club" session, teaching all those who desire the fundamentals of radio and selling short-wave kits and assorted paraphernalia.

Opening off the customer reception room is another small room where is housed a well-equipped service bench and a telephone. Powell can work at the bench but he will hear the service shop door open and if he is busy may call out a cheery "Be with you in a minute."

Because of the labor shortage this radio man is virtually operating a one-man shop. By placing the phone directly adjacent to the service bench he can minimize the time needed to answer shop calls.

Powell has a helper who calls and picks up, as well as returns, ailing radios. No actual service is offered in the customer's home—all service is performed at the shop. A small charge is made for pickup and return of any radio. By cutting out home servicing he saves many man-hours daily. Yet those customers who cannot bring in their own sets may still be accommodated.

This radio operative also is building up a steady traffic in used radio receivers. Very often a customer possesses an ancient radio which will cost a fortune to service. Such a customer is willing to part with this antique and purchase a more up-to-date console radio which will stand up for the duration. Powell finds that with the ever-increasing intensity of the draft, many individuals are interested in disposing of their receivers before leaving for the service.

Powell has his own system as regards charges for set servicing. He charges $2.00 to completely check over a set and ascertain the cause of its refusal to work. In addition, he charges the customer the full retail price for any components necessary to make the radio workable. What Powell is doing, in effect, is to charge a flat rate for labor. He finds that in the majority of cases the $2.00 charge is ample to cover the time spent in the set check-over. He guarantees 72-hour service if the customer calls for his or her own set. If delivery service is required an additional day is required before the receiver is returned to home port.

Sheldon Powell keeps a customer file and sends each patron a reminder every 90 days to the effect that a quarterly set checkup is cheapest in the long run. If this checkup reveals no component flaws the customer is only out the $2.00 service fee, which is cheap enough as a guarantee that the set is not apt to go sour unexpectedly.

Powell also has his own method of solving the tube situation. When a customer demands a tube which is not in stock Powell offers the patron one of two alternatives, either a wait until the tube comes in, or a rewiring of the set—or the addition of an adapter, making a substitute tube possible. If the customer desires such substitution all that he or she pays is $2.00 plus cost of the tube itself.

Summing it up, Sheldon Powell has designed his radio shop to meet the needs of the present and the postwar traffic. By offering used radios and records for sale, and by maintaining contacts with set experimenters, this radioman is building up an excellent community business.

—30—

450 Mc. Receiver

(*Continued from page* 31)

the maximum will result in howling or audio blocking. If no super-regenerative hiss is heard, it will probably be necessary to try different values of grid condenser and grid leak. Suggested values are 25 and 100 $\mu\mu$fd. for the grid condenser, and values between one and twenty megohms for the grid leak. When the proper values have been determined by experiment, the receiver should go into super-regeneration smoothly.

After the receiver is operating smoothly it will be necessary to adjust the frequency to cover the band from 420 to 450 mc. If no calibrated frequency source is available, this may be done approximately by means of Lecher wires. These may be easily constructed by stretching two No. 18 or 20 bare copper wires about three feet long, between two pairs of stand-off insulators, spacing the wires about one inch. One end of each wire should then be connected together by means of a small loop, which is then coupled very loosely to the tuned circuit at the brass block end. A shorting bar should then be slid along the wires at right angles to them. At certain positions of the shorting bar, the receiver will tend to go out of oscillation or the character of the hiss will change. The coupling between the Lecher wire loop and the tuned circuit should be loosened as much as possible, so that these

Available for Prompt Delivery on Priority of AA3 or Better!

The New Model 450

TUBE TESTER

SPEEDY OPERATION — assured by newly designed rotary selector switch which replaces the usual snap, toggle, or lever action switches.

EXTRA SERVICE—The Model 450 may be used as an extremely sensitive Condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute.

Specifications:

- ★ Tests all tubes up to 117 Volts including 4, 5, 6, 7, 7L, Octals, Loctals, Bantam Junior, Peanut, Television, Magic Eye, Hearing Aid, Thyratrons, Single Ended, Floating Filament, Mercury Vapor Rectifiers, etc. Also Pilot Lights.
- ★ Tests by the well-established emission method for tube quality, directly read on the scale of the meter.
- ★ Tests shorts and leakages up to 3 Megohms in all tubes.
- ★ Tests leakages and shorts of any one element AGAINST all elements in all tubes.
- ★ Tests BOTH plates in rectifiers.
- ★ Tests individual sections such as diodes, triodes, pentodes, etc., in multi-purpose tubes.
- ★ New type line voltage adjuster.
- ★ NOISE TEST: Tip jacks on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.
- ★ Features an attractive etched panel.
- ★ Uses a 4½" square rugged meter.
- ★ Works on 90 to 125 Volts 60 Cycles A. C.

The Model 450 comes housed in a portable leatherette covered cabinet complete with all operating instructions. Size 13" x 12" x 6". Net weight 8 pounds. Our Net Price

$39.50

SUPERIOR INSTRUMENTS CO. Dept. R. N. 227 FULTON STREET, NEW YORK 7, N. Y.

points are rather sharply defined.

Care should now be taken to measure accurately, the distance between two of these points. If this distance is in inches the frequency may be found from the formula:

$$F_{mc.} = \frac{5906}{\text{length in inches}}$$

If a meter stick is used for the measment the formula becomes:

$$F_{mc.} = \frac{150}{\text{length in meters}}$$

Upon determination of the operating frequency with the tuning condenser at minimum capacity, the brass screw in the brass block should be adjusted, screwing it deeper into the block to lower the frequency and raising it to increase the frequency. When the frequency is approximately 455 mc. with the tuning condenser at minimum capacity, adjustment of the inductance is completed. The tuning condenser should now be turned to maximum capacity and the frequency again checked. It should now be about 415 mc. If it differs from this it will be necessary to adjust the capacity, moving the stator plate closer to the rotor to reduce the frequency and away from the rotor in order to increase it. When this adjustment has been completed it is advisable to again check both ends of the tuning range and make any minor adjustments that may be necessary, either in the tuning capacity or the inductance trimmer screw.

It is possible that all this adjustment may have some effect on the smoothness of regeneration but this can be cleared up by selection of the proper value of grid leak.

The next step is to connect the antenna feeder to the antenna input connector. The antenna might well be a half wave doublet with a co-axial line feeder. The length of each half of the antenna in inches may be found by the formula:

$$L_{in.} = \frac{2770}{F_{mc.}}$$

With the antenna connected and a signal from some sort of transmitter or signal generator, the antenna coupling should be adjusted by bending the coupling loop on the end of the co-axial antenna lead. The coupling should be as loose as possible consistent with sensitivity, in order to minimize radiation and assure smooth regeneration control.

The lower the plate voltage that can be used on the oscillator, the better the sensitivity and selectivity. Polishing all metal parts of the tuned circuit and coating them with clear lacquer resulted in a considerable reduction in necessary plate voltage in the receiver described. An added refinement that should help even more would be to silver plate all parts of the tuned circuit. This practice is almost universally followed in military equipment for the high frequencies.

-30-

Volume Expanders

(*Continued from page 51*)

lines in the gap in which the voice coil operates, so that as the signal voltage is increased, the speaker's response to high frequencies would increase, within limits, considerably faster than its sensitivity to low frequencies.

So we again produce the desirable characteristic of expanding the high frequencies more than the low ones. Of course, if we exceed certain limits on the field voltage of our speaker, we will introduce distortion, but if we set the no-signal field voltage of the speaker so as to obtain about 30% recommended field power, by applying a required amount of bias on our triode, and we expand to about 125% of recommended field power, we will not introduce any serious distortion.

Incidentally, on very loud passages we actually increase our speaker's ability to handle power, reducing high-volume distortion in the speaker.

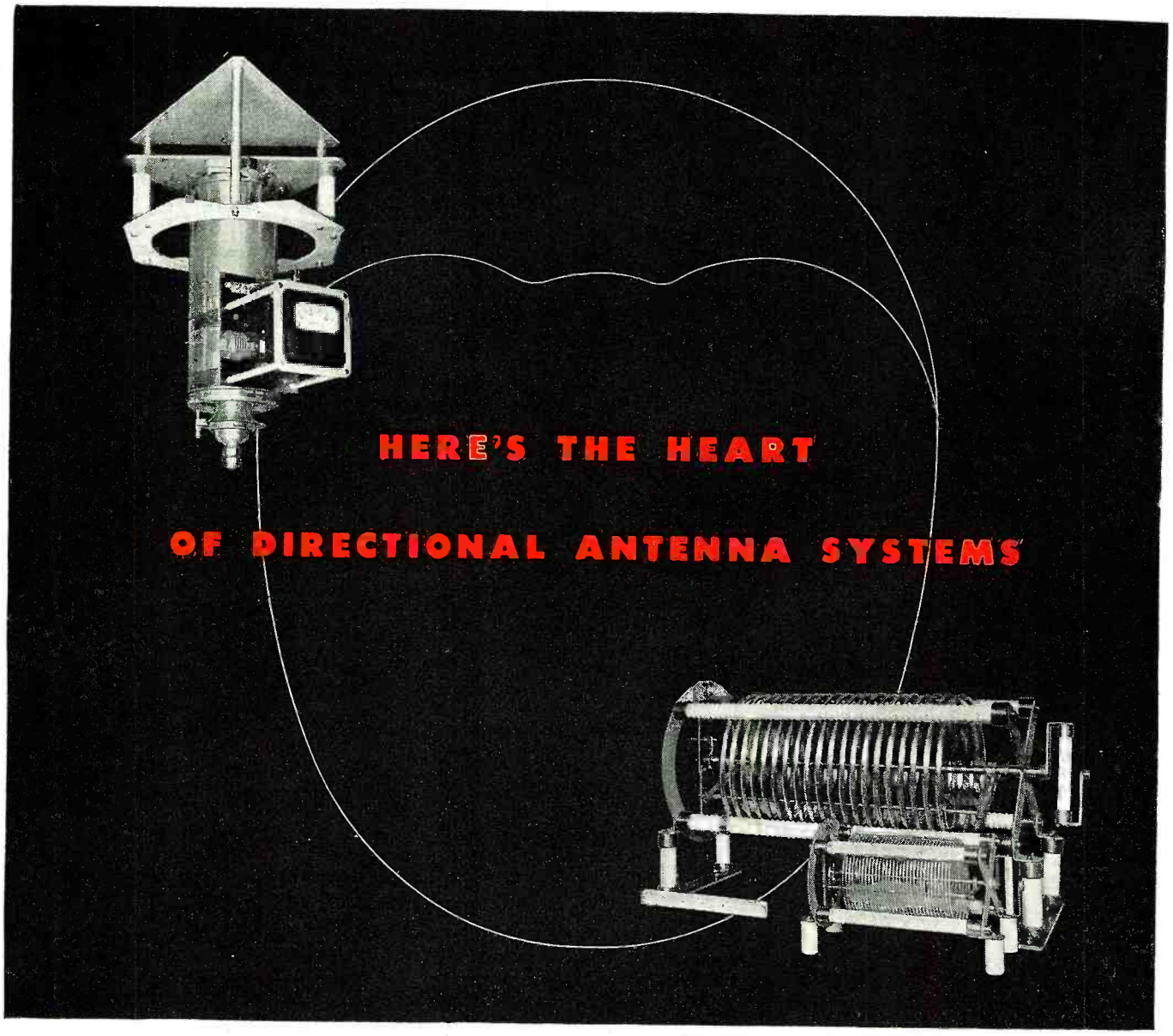
If our speaker is of the twelve or 15 inch, 15 or 20 watt variety, then we will have to put two or three triodes in parallel. There is quite a selection of tubes to choose from as we may triode connect such pentodes as 41, 42, 6F6, 6L6, 6V6, etc. The average triode or pentode can pass 30 ma. average and 50 ma. for a short time, so we can figure how many tubes we need for our system. It may be necessary to introduce an amplifier in front of our diode rectifier to obtain enough d.c. voltage to swing the grid of our triodes the required amount. This would allow an expansion control to vary the amount of expansion. If we can utilize a 500-ohm winding, however, this amplifier would be unnecessary.

Fig. 2 shows a tentative hookup for this system. The number of speakers which the experimenter may have, the large number of different amplifiers, and the variety of tubes available, makes it hard to specify exact values, but the circuit is simple and any tube manual plus the field resistance of your speaker, plus the field-supply voltage available, is all that is necessary to figure the values of the few components used.

Needless to say, this system could be used as a compressor by reversing the polarity of the diode output d.c. voltage and decreasing the bias on the triode, so that an increase in signal would decrease the field power. This would introduce distortion if carried too far and would, of course, be of no great use to the recordist unless he were to pick up the speaker's output with a microphone.

Either of these expanders will work well and they both have plenty of elbow room for the experimenter to exercise his originality in the exact connection of his equipment to meet his individual needs.

-30-



Westinghouse tower tuning and matching components shown above are a variable, gas-filled capacitor (top, left) and a continuously adjustable inductor (below, right).

In these dependable tower tuning and matching components lies the heart of directional broadcasting. They help give Westinghouse phasing and matching equipment the high efficiency, reliability and easy adjustment that meet today's needs.

These qualities stem from many features of Westinghouse phasing equipment. High Q inductors, low-loss capacitors and effective circuit design establish the high efficiency. Reliability is assured by using all components well within their ratings.

Operation has been simplified. Current division and phasing adjustment can be made while in operation. Phase adjustments can be made by a single control for each tower. The current fed to each tower can be adjusted by a single control without affecting its phase position.

Westinghouse—working with your consulting engineer—offers its wide facilities in installing complete directional equipment for every type of coverage from simple cardioid patterns (above) to more complex, intricate ones. Your nearest Westinghouse office will give you full information. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-08109

XXV RADIO'S 25TH ANNIVERSARY KDKA

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RADIO OPERATORS' LICENSE REGULATIONS

By TOM GREGG

Detailed information regarding rules and regulations issued by FCC governing commercial radio operators.

THE following information is intended to assist those who wish to obtain details on the various grades and classes of radio operator licenses issued by the Federal Communications Commission and some of the later rules and regulations issued by the Commission governing commercial radio operators, both radiotelegraph and radiotelephone.

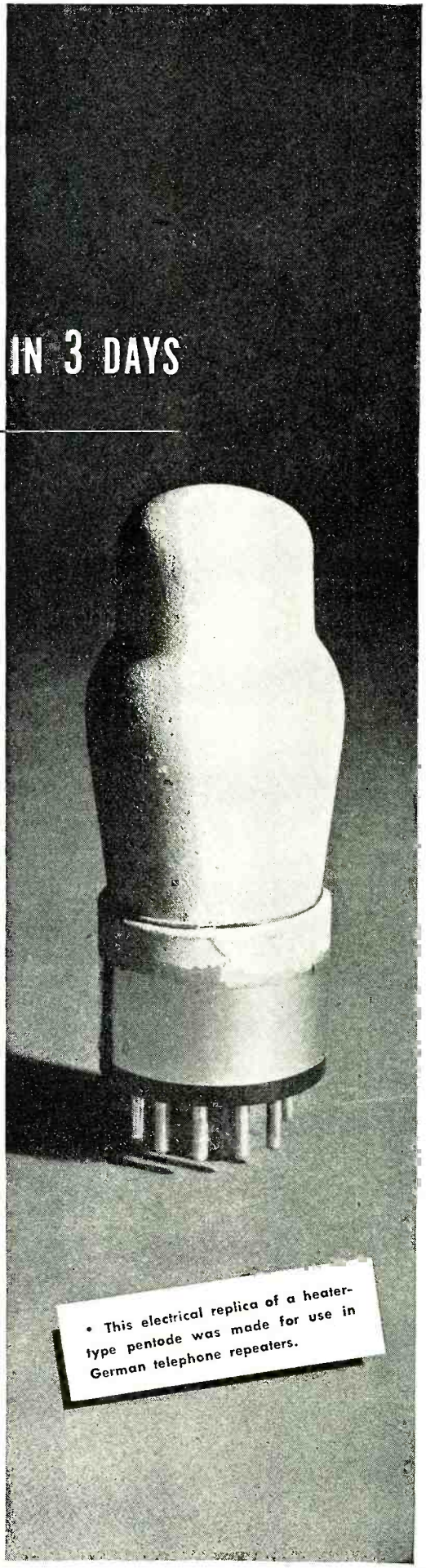
Local field offices of the FCC, where the examinations are held frequently, usually several days weekly for each class of license, will furnish details of the place and time for the various examinations. It is suggested that FCC bulletins "Study Guide and Reference Material for Commercial Radio Operator Examinations" (15¢) and "Part 13, Rules Governing Commercial Radio Operators" (5¢) be obtained from the Superintendent of Documents, Washington 25, D. C.

To those of you interested in license renewals, order 77-D, issued in December, 1944, notes: "It is ordered, that Sections 12.26 and 12.66 of the Rules Governing Amateur Radio Stations and Operators, and Section 13.28 of the Rules Governing Commercial Radio Operators, insofar as the required showing of service or use of license is concerned, *be, and they are hereby, suspended* until further order of the Commission, but in no event beyond Jan. 1, 1946."

Order 91-C states: "The Commission having under consideration its orders 91, 91-A, and 91-B and the request of the Board of War Communications that the Commission consider further relaxation of its rules and regulations governing the requirements for operators of broadcast stations; and, *it appearing* that the demand of the military services for radiotelegraph and radiotelephone operators has increased as a result of the war and that such demand has decreased the number of operators qualified for operation of broadcast stations resulting in a shortage of such operators; *it is ordered,* that until further order of the Commission, notwithstanding the provisions of Section 13.61 of the Commission's Rules and Regulations Governing Commercial Radio Operators, a broadcast station of any class, which by reason of actual inability to secure the services of an operator or operators of a higher class could not otherwise be operated, may be operated by holders of any class of commercial operator license; *provided, however,* that all classes of commercial operator licenses shall be valid for the operation of broadcast stations upon the condition that one or more first class radiotelephone operators are employed who shall be responsible at all times for the technical operation of the station and shall make all adjustments of the transmitter equipment other than minor adjustments which normally are needed in the daily operation of a station; *provided, however,* that a broadcast station may be operated by a holder of a restricted radiotelephone operator permit only in the event such permit has been endorsed by the Commission to show the operator's proficiency in radiotelephone theory as ascertained through examination, *provided, further,* that a broadcast station having a licensed power of 1000 watts or less may be operated by a holder of restricted radiotelephone operator permit which has been endorsed by the Commission to show the operator's proficiency in the operation of the particular station concerned, as ascertained by certification of the first class radiotelephone operator in charge of the station, on condition that in a technical emergency such operator shall not attempt to make any adjustment, but shall immediately shut down the station."

This order also points out that it shall not be construed to relieve a station licensee of responsibility for the operation of the station in exact accordance with the rules and regulations of the Commission. Order No. 97, issued in May, 1942: *"It it ordered,* that a class of operator license be established designated 'Temporary Limited Radiotelegraph Secondclass Operator License,' in addition to the classes of licenses specified in section 13.61 of the rules and regulations, which will authorize the holder thereof, notwithstanding the provision of Commission Order 91-A, dated April 21, 1942, to operate licensed radiotelegraph equipment installed aboard ships only, for the duration of the war in which the United States is now engaged, but in no event for a period longer than five years; and *it is fur-*

DUPLICATING A GERMAN VACUUM TUBE IN 3 DAYS



• This electrical replica of a heater-type pentode was made for use in German telephone repeaters.

Just behind the battlefront, a telephone system lay dead. The retreating enemy, hoping to return, had not blown it up, but had taken with them its vacuum tubes. To put it back to work, the General ordered 1000 new tubes — spot delivery.

A sample tube was flown back to the United States and brought to Bell Telephone Laboratories. It was of German design, different from any American tube in both dimensions and characteristics. Could it be duplicated soon? The job looked feasible. Within three days, try-out models were on their way to Europe. Three weeks later, Western Electric Company had made and delivered every tube. They were plugged in; vital communications sprang to life.

Vacuum tubes are an old story for Bell Laboratories scientists. Back in 1912 they made the first effective high vacuum tube. Three years later, they demonstrated the practical possibilities of tubes by making the first radio talk across the Atlantic, pointing the way to radio broadcasting. Since then, they have developed and utilized the vacuum tube wherever it promises better telephone communication — there are more than a million in your Bell Telephone System.

Today, Bell Telephone Laboratories is solving many of the toughest tube problems faced by the Armed Forces. When the war is over, it goes back to its regular job—keeping American telephone service the best in the world.

BELL TELEPHONE LABORATORIES

Exploring and inventing, devising and perfecting for our Armed Forces at war, and for continued improvements and economies in telephone service.

ther ordered, that a Temporary Limited Radiotelegraph 2nd Class Operator License may be issued to: (a) Any person found qualified to take an operator's examination, and who can pass the Commission's code test of at least 16 code groups per minute, and in addition obtain a rating of 50% or better on the Commission's written examination for a regular radiotelegraph 2nd class operator license. (b) Any person found qualified to take an operator's examination who has previously held, but does not now hold, a radiotelegraph first or 2nd class operator license, and who can now pass the Commission's code test of at least 16 code groups per minute. (c) An applicant enrolled in a Coast Guard Maritime Service Radio School, who has been certified to the Commission by that service that the applicant is qualified to take an operator's examination and possesses the qualifications prescribed by the Commission for this class of license, and that the said service school's course of instruction covers the requirements for this type of license."

No. 102, issued in June, 1942, states *"Whereas,* the conditions arising from the war emergency necessitate an increased number of radiotelegraph operators qualified to operate aeronautical and aeronautical fixed stations using Type A-1 or A-2 emission and the Commission having under consideration of a request of the Defense Communications Board that the Commission consider further relaxation of its rules governing radio operators; *it is ordered,* that for a period of five years from the date of this order, or until further order of the Commission, notwithstanding the provisions of Section 13.61 of the rules and regulations, the holder of a valid first or second class radiotelephone operator license or the holder of a valid restricted phone permit be authorized to act as a radiotelegraph operator in an aeronautical or aeronautical fixed station using type A-1 or A-2 emission; *provided,* that the face of the permit or license has been endorsed attesting to the holder's ability to transmit and receive at the 16 w.p.m. code group rate. *It is further ordered,* that the holder of an endorsed phone permit, herein authorized to operate station using A-1 or A-2 emission, shall not make any technical adjustments to the equipment which may result in improper operation thereof and that at least one person holding a radiotelegraph or phone first or second class license, or, in lieu thereof, in a station utilizing A-1 or A-2 emission only, a holder of a restricted radiotelegraph operator permit, shall be regularly attached to the staff of the station and readily available for the purpose of maintaining the station in proper operating condition."

Order 123, issued in October, 1944, orders that a class of operator license be established designated "Temporary Emergency Radiotelegraph Second Class Operator License" be valid for the operation of licensed radiotelegraph equipment installed aboard cargo vessels subject to the provisions of Part 2, Title 3 of the Communications Act of 1934 as amended, exclusively for the transmission of emergency communications directly related to the safety of life and property at sea; *provided,* (a) Such a license shall be issued to any person who passes the Commission's code test at 16 w.p.m. code groups in addition to a rating of 50% or better on elements 1 and 6 (Basic Law and Radiotelegraph Theory and Practice) of the commercial radio operator examination, and is found to be otherwise qualified to hold a radio operator license. (b) Such a license shall be valid only for the operation of a ship radiotelegraph station that carries at least one radio operator holding a Temporary Limited Radiotelegraph 2nd class license or higher grade radiotelegraph, who maintains at least 8 hours watch per day. (c) Such license shall expire one year from the date of issuance unless previously terminated by the Commission, and, unless otherwise provided by the Commission, shall not be renewable."

No. 124, issued in January, 1945, provides for the renewal under the following: *"It is ordered,* that applications for the renewal of commercial radio operator licenses other than Temporary Emergency radiotelegraph 2nd class licenses, filed with the Commission prior to December 31, 1945, and within a period of one year from the date of expiration provided in the license, may be acted upon by the Commission, notwithstanding the provisions of rule 13.11, until further order of the Commission."

The only special provisions regarding licenses are in connection with the Radiotelegraph First Class License. An applicant for this class of license must be at least 21 years of age at the time the license is issued and shall have had an aggregate of 1 year of satisfactory service as a radiotelegraph operator manipulating the key of a manually-operated radiotelegraph station on board a ship or in a manually-operated coastal telegraph station. The FCC "Rules Governing Commercial Radio Operators" covers the regular classes of licenses of 'tickets' issued in prewar times and will be the standard setup after the war. There were a total of six types of licenses issued in the following classes: In the Commercial radiotelephone group, 1st class and 2nd classes are issued; in the Commercial radiotelegraph group, 1st class and 2nd class operator licenses and there is also issued a restricted radiotelephone and a restricted radiotelegraph license. A person may not hold more than one radiotelegraph and radiotelephone license at the same time. Licenses are normally issued for a period of five years, renewal should be made during the last year of the license term.

Examinations consist of a written set of questions based on six examina-

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tion elements: 1—Basic Law, 2—Basic Theory and Practice, 3—Radiotelephone, 4—Advanced Radiotelephone, 5—Radiotelegraph, 6—Advanced Radiotelegraph. Applicants for original licenses will be required to pass examinations as follows: Radio 'phone 2nd class—Ability to transmit and receive spoken messages in English and written examination consisting of elements 1, 2, and 3. 1st class 'phone license is the same as the second class except that in addition element 4 is also included.

2nd class radiotelegraph—Ability to transmit and receive spoken messages in English, code test, transmitting and receiving at 16 words per minute in code groups, and written examination on elements 1, 2, 5, and 6. Radiotelegraph 1st is the same as 2nd, plus code speed increased to 20 w.p.m. in code groups and 25 w.p.m. in plain language. The restricted 'phone permit calls only for element 1 plus the ability to transmit and receive spoken messages in English. The restricted radiotelegraph permit calls for 16 w.p.m. in code group and elements 1, 2, and 5. Written examinations shall be in English and shall be written by the applicant in longhand in ink, except that diagrams may be in pencil. Written examinations require a passing mark of 75% of a possible 100%. The holder of a license, who applies for another class of license, will be required to pass only the added exam elements for the new class of license. If failing any part of exam or element, he will not be permitted re-examination for 2 months.

A license may be renewed without examination provided the service record on the license shows at least three years' satisfactory service in the aggregate during the license term and while actually employed as a radio operator under that license; or shows at least 2 years' service in the aggregate, under the same conditions, of which one year must have been continuous and immediately prior to the date of application for renewal. If the above requirements have not been fulfilled, but the service record shows at least 3 months' satisfactory service in the aggregate, while actually employed as a radio operator under the license during the last three years of the license term, a license may be renewed upon the successful completion of a renewal examination which may be taken at any time during the last year of the license term.

Renewal examinations will consist of the same elements as for original licenses. However, the written examination will be directed toward a determination of the applicant's qualifications to continue to hold the license for which he has previously qualified. If the renewal examination is not successfully completed prior to the expiration of the original license, the applicant will be examined in the same manner as if applying for an original license.

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Answers to RETA Membership Examination

THAT RADIO NEWS readers like to "test their skill" is amply evidenced by the number of requests received in our editorial offices for answers to the RETA licensing examination published in the March, 1945 RADIO NEWS article "Servicemen are Organizing."

The RETA (Radio and Electronic Technicians Association) is a voluntary and nonprofit organization operating in South Bend, Indiana. This group, which includes most of the prominent service dealers in the area, sets standards for servicing which benefit both the dealer and the public alike.

One of the membership requirements is the ability to pass a written examination covering the practical aspects of radio servicing. This examination is prepared by the directors of RETA and is given to each applicant for membership. Twenty questions are included in the examination and one diagram, containing nine errors, is presented which the prospective member is required to correct.

This group might well serve as a pattern for servicemen in other cities. Thus, through the pooling of common difficulties and problems, workable solutions have been found by the organization membership.

With permission of the directors of RETA, RADIO NEWS prints the questions and answers to the membership examination originally appearing in the March, 1945 issue of this magazine.

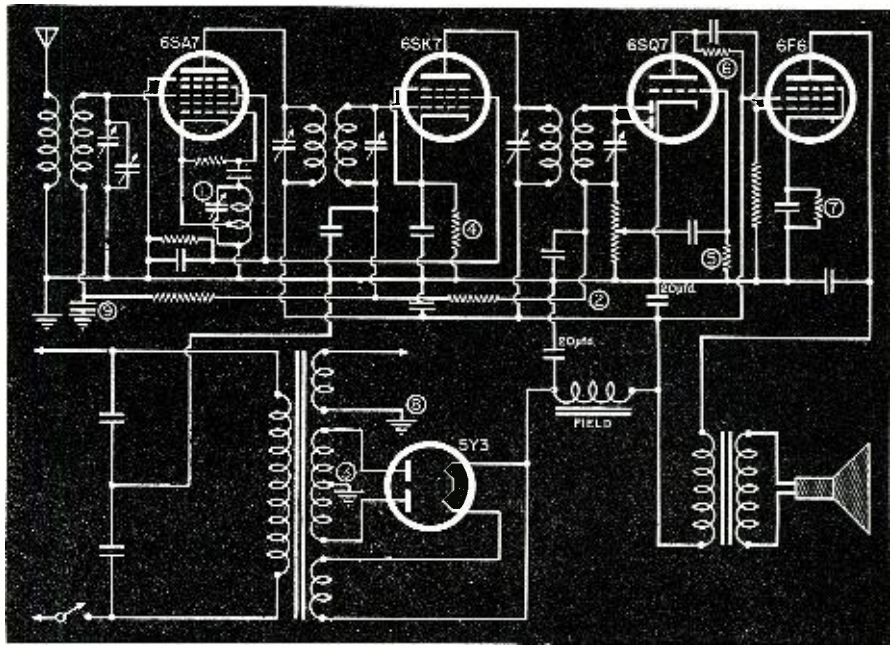
The editors of RADIO NEWS wish to acknowledge, with thanks, the help of John Lackman, president of RETA, in submitting this material.

Q. Locate nine errors in diagrams and complete the circuit—adding all missing components.

A. *See Fig. 1.*

Q. If a tube shows practically the same voltage on the cathode that it shows on the screen and plate, what trouble would be indicated?

Fig. 1. Schematic diagram showing corrections necessary to complete the diagram. The corrections are shown by circled numbers and are as follows: (1) The variable oscillator condenser has been added; (2) the AVC connection has been completed; (3) the center tap of the high voltage secondary of the power transformer was added and grounded; (4) the cathode resistor of the 6SK7 was omitted and need be added for proper operation of the stage; (5) grid leak resistor of the 6SQ7 has been added; (6) plate load resistor of the 6SQ7 is necessary in order that proper "B" voltage be obtained at the plate of the tube; (7) the addition of a cathode bias resistor for the 6F6 tube; (8) one side of the 6-volt filament string has been grounded; (9) a by-pass condenser on the lower end of the r.f. coil secondary need be added to complete the r.f. path.



A. *Open cathode resistor or shorted condenser between plate or screen and cathode when this condenser returns directly to the cathode.*

Q. Assume the tubes are all o.k. The output transformer overheats and set is dead, what is the trouble?

A. *A short from the plate terminal of the output tube or the output transformer to ground; most likely a shorted tone-compensating condenser.*

Q. A service job comes in with following tubes in the sockets: 6A8, 6K7, 6Q7, 25L6, and 25Z6. A new line cord is needed. What resistance line cord?

A. *6.3 v. + 6.3 v. + 6.3 v. + 25 v. + 25 v. = 68.9 v.*

$$115 - 68.9 = 46.1 \text{ v.}$$

$$\frac{46.1}{.300} = 154 \text{ ohms}$$

Q. If a dead set with the following tubes in the sockets came into your shop, what would be the first thing to do: 6A8, 12K7, 12Q7, 35L6, and 35Z5?

A. *It is apparent that the 6A8 is a 300-ma. filament tube, while all others operate at 150-ma. Remove the 6A8 and replace with a 12A8.*

Q. We have a battery a.c.-d.c. portable which is o.k. on battery position but goes dead after playing 15 or 20 minutes on a.c. What would be the most likely trouble:

A. *Check the filament dropping resistor and the fllament filter condenser. Heat would most likely cause an open in the filament circuit or, occasionally, a short in the filament filter condenser.*

Q. Why should the heater of the first audio tube in an a.c.-d.c. set be connected nearest the ground end of the heater series circuit?

A. *As the first audio tube is most susceptible to an a.c. potential, it is always advisable to keep its filament voltage as close to ground potential as possible, thereby keeping the voltage between heater and cathode to a minimum. This will prevent an a.c. hum from appearing in the output of the receiver.*

Q. What is the object of repeating high-frequency alignment at least once after making the 600-kc. rocking adjustment?

A. *The 600-kc. rocking adjustment will disturb the high-frequency adjustment to such an extent that the calibration will be incorrect at the high-frequency end of the dial.*

Q. Name 3 or more commonly defective components which can cause distortion in the final audio stage.

A. *Improper bias, defective coupling condenser, defective speaker, low-emission tube, etc.*

Q. In an a.c-d.c. super, what part or parts would be damaged if the 12SQ7 was accidentally placed in the 35Z5 socket.

A. *Nothing will happen unless the manufacturer has used the spare lugs as a tie point for other wires. This is done in many cases.*

Q. If a set suddenly becomes low in sensitivity on the low-frequency end of the band while retaining fair sensitivity on the high-frequency end of the band, what part would you check first?

A. *Open winding on antenna coil.*

Q. What trouble would be indicated if an i.f. signal can be passed through a set but no broadcast r.f. signal can be put through?

A. *Most likely an inoperative oscillator.*

Q. We have a super in which one i.f. trimmer refuses to reach a peak. What part would you suspect as being defective? Tubes assumed o.k.

A. *Open or shorted winding or padder in this i.f. coil.*

Q. What trouble would be indicated if the screen grid of an output tube runs red hot? Set is dead. Tubes are o.k.

A. *Plate circuit open.*

Q. In a battery a.c.-d.c. portable we have an open input filter. Will the set play on a.c. and if so how will its operation be affected? Why?

A. *No. With the input filter open, the d.c. voltage (B+) will drop to approximately half value. With low voltage the oscillator will not operate.*

Q. What part of a car radio might we term a necessary weakness?

A. *The power supply or antenna.*

Q. What part of a car radio installation is of major importance in the elimination of motor noise?

A. *Bonding and proper shielding of antenna lead-in.*

Q. What is a gassy tube and how do you go about checking a tube for gas while the tube is in the radio?

A. *A gassy tube is a tube which contains an excessive amount of gas, due to leakage or emitted internally by the various electrodes. A tube which may be considered gaseous can be checked by measuring the grid current. If grid current is obtained with proper bias on the tube, the tube is gaseous.*

Q. Name 15 tube types and identify them as to use.

A. *R.f. tubes: 78, 6D6, 7A7, 1N5, 1LN5. Oscillators: 6A7, 6A8, 6K8, 7A8, 1A7. Detectors: 75, 85, 6R7, 6Q7, 6SQ7. Output tubes: 42, 6F6, 6V6, 7A5, 50L6.*

Q. Why is it advisable to replace the pilot light as soon as possible in a midget using a 35Z5 rectifier?

A. *It forms part of the filament circuit. If the pilot light is burnt out, an additional load will appear across the filament of the rectifier tube and thereby cause the rectifier tube to become defective in time.*

—30—

G.H.Q. *for Shielding Problems*

In order to eliminate the radio interference caused by high-frequency impulses radiated from almost every type of electrical apparatus, Breeze pioneered the engineering and manufacture of shielding for aircraft, automotive, marine and industrial engines. Each application presented specialized problems which Breeze, with its wide background of experience in the field, has been well equipped to overcome. Today Breeze Shielding has stood the tests of 18 years of service, and is constantly being improved to meet new needs.

In the electronic age of tomorrow, the thorough shielding of electrical equipment of all types will be of even greater importance. To manufacturers or users of such equipment, Breeze engineering and production facilities make it America's Headquarters for Radio Ignition Shielding. For a complete analysis and recommendation, call in a Breeze shielding engineer.

BREEZE MARK

Breeze CORPORATIONS, INC. Newark, New Jersey

Marine Communications

(*Continued from page 28*)

a wide portion of the tuning dial assigned to 285-315 kc., the beacon band. A compass card, mounted on the face of the mechanism, provides the azimuth notation necessary for intersection.

A specially designed sensitive and selective superheterodyne receiver, with negligible radiation, serves as the input for the beacon signal. It is correctly matched to the loop element and has a maximum reception range of 500 to 1000 miles. A mechanical compensator automatically corrects any deviation normally resulting from local distortion.

Adding to the contribution of a direction finder to navigation, the *Photo-Electric Pilot Corp.* has designed a mechanism for automatic steering. The equipment offers a safe and efficient means of accurately guiding a vessel in all kinds of weather. Simply defined, automatic steering is the process of keeping a ship on any "desired heading" by mechanical means. "Desired heading" may be a course set by compass and chart readings; point to point steering; or, simply a straight course in any general direction.

The Photo-Electric Pilot unit is an ingenius device which operates from the ship's battery and connects to the steering gear. It will automatically pilot a boat on a split-degree course and has been designed especially to provide owners of boats up to 150 feet with the extremely important advantages of carefree steering.

In operation, a good, high-grade modern compass has a high directional force tending to keep its magnetic axis in a magnetic north and south direction provided there are no contacts, wires, or other appurtenances which might restrict the free movement of the compass card. The Photo-Electric Pilot has no such interferences with the compass card, but instead, only a small light beam, the intensity of which falling on the photoelectric cell, is controlled by the relative position of the compass card and compass bowl.

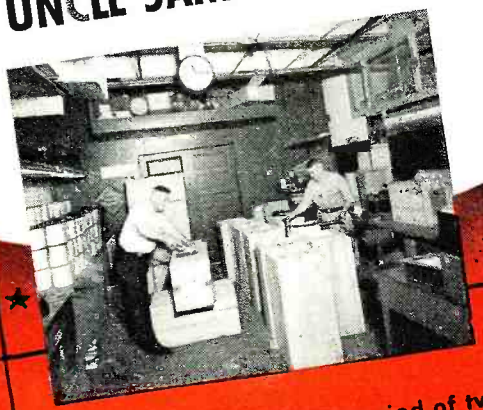
The motor drive unit is connected both electrically, through the elec-

New lifeboat radio equipment, manufactured by Radiomarine Corporation of America, has an operating range of 1,000 miles or more, automatically transmits SOS and direction-finding signals, and provides two-way radiotelegraph and radiotelephone facilities. Power is obtained from a self-contained hand-cranked generator. Each unit includes a collapsed balloon, a cannister of helium gas, and a kit of kite parts. Either balloon or kite, depending on weather conditions, may be used to hold aloft a 300-foot antenna wire.

Several thousand miles of wire produced on time for government use are shown in the above photograph.

MILES

OF GLASS BRAIDED WIRE FOR UNCLE SAM PRODUCED ON TIME



Packing the wire for government-designated supply depots.

Within the short period of two weeks, several thousand miles of special WL-Type glass braided wire were turned out to fill an urgent need of our air forces—the best illustration we know of how Runzel endeavors to meet production schedules ON TIME—all the time.

We invite your inquiries regarding the use of our products and services to fill civilian needs, as soon as conditions permit . . . for radio, for coin machines, and for all types of electronic usages.

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trical control, and mechanically, to the compass unit in such a manner that a movement of a fraction of a degree off the course originally set moves the rudder immediately to an amount proportional to the deviation from the course. The Photo-Electric Pilot motor then stops. If the ship swings further for some reason, more corrective rudder is given. If the ship returns to course, the corrective rudder is removed as fast as the ship swings back. When the ship is on its original course, the motor is inoperative.

When the mechanism is turned on, the clutch being disengaged, the steering motor will operate to bring the light beam in the proper position with respect to the compass card for the particular heading of the ship at that moment. The steering motor then stops, and if the clutch is then engaged, the ship will stay on that course until changed. Thus, it is to be noted that the Photo-Electric Pilot is entirely automatic in its operation. It is possible to gain the desired results from any position on the ship by the use of remote control.

Therefore, it is readily understandable that the fundamental requirements of accurate navigation have been accomplished. The developments have been achieved here with the same ingenuity as in radio telephony, and to move a step further, electronic innovations have also provided greater safety at sea than ever before.

A supersonic Echo Depth Recorder and Echo Depth Indicator manufactured by *Simplex-Bludworth Marine* solves the age-old perils to seamen, shoals and unchartered waters. The former instrument is designed to measure and record on dry facsimile paper a continuous profile of the sounded depth along a vessel's course. The system employs high frequency sound waves and precision timing. An impulse of sound is emitted by an oscillator in the hull of the vessel, and timed in units of depth throughout its path of travel to the seabed and return, where the "echo" is received by a second oscillator in the vessel's hull. This "echo" impulse is amplified electronically to operate the recording printer bar.

In the Echo Depth Indicator, the "echo" impulse is amplified electronically to operate a neon flash tube to produce, in the depth viewing port, an accurate numerical indication of the depth beneath the ship. These indicating numerals change with every variation in depth, making it easy to follow directly the irregular contour of the seabed along the vessel's course. An Echo Depth Recorder-Indicator combines both processes into one practical system.

To augment the usual safety devices within a lifeboat, a radio telegraph transmitter and receiver has been designed. The early sets produced for this purpose contained only one-way transmission on the international distress frequency of 500 kc. Recently, both *RCA* and *Federal Telephone and Radio Corp.* have devised additional improvements. The latest transmitter is capable of sending on short-wave as well as on the 500-kc. channel. Reception is also possible on these frequencies so constant contact can be kept by the lifeboat personnel.

The latest model of *Radiomarine Corp. of America* has an unusually different type of antenna. A three-hundred foot line is carried aloft by a kite or a balloon. Weather and wind conditions determine the use of either the balloon or kite. Distances of more than 1,000 miles can now be covered on the distress wavelength.

There have been many other advances made in Marine Electronics which cannot be talked about at the present time. To fully appreciate the extent of manufacturing ingenuity the imagination must go beyond logical thinking. It is an adventuresome story that radar and supersonics portend for the future.

Most boating firms which have been canvassed on the subject of radio and other electronic installations felt that the equipment should be independent of the vessel. *Chris-Craft Corporation* finds that radio equipment is rather difficult to use on a boat because of the difficulty in satisfactory ground-

Centralab

Selector Switches

are available to servicemen and experimenters in kit form . . . or standard, completely assembled and individually cartoned.

Insulation . . . either steatite or bakelite.

All switches have double-wipe contact terminals for long life and have a consistently low contact resistance of less than 2½ milliohms and are completely self-cleaning. Index is positive with 30° between each rotating position. Switches are also available for transmitter use.

Send for illustrated Catalog No. 24.

Centralab

Division of **GLOBE-UNION INC., Milwaukee**

Producers of **VARIABLE RESISTORS — SELECTOR SWITCHES — CERAMIC CAPACITORS, FIXED AND VARIABLE — STEATITE INSULATORS — AND BUTTON-TYPE SILVER MICA CAPACITORS.**

ing and shielding with engine noises. To do a thoroughly satisfactory job, it is rather expensive if the equipment must be used when the motors are in operation. If the motors are shut off, excellent results can be obtained without elaborate screening.

In most cases, this equipment was installed by radio engineers employed by the communications manufacturer. Electrical equipment, on the whole, has been considered extra by the majority of the boating concerns.

Credit for this article should be duly given to *Radiomarine Corporation of America, Western Electric, The Hallicrafters Company, Simplex-Bludworth Marine, Photo-Electric Pilot Corporation, Smith-Meeker Engineering Co., Chris-Craft Corporation,* and *The Mathews Company.* Without their cooperation, this paper could not have been written.

-30-

Two-Way Radio

(*Continued from page* 45)

5. Reroute trucks to avoid dangerous road conditions, storms, floods, washouts, traffic tieups, etc.

6. Improve the efficiency of operations by means of improved dispatching, rerouting, etc.

These advantages would be equally applicable to the local operations of the trucking companies.

The Federal Communications Commission Docket No. 6651, dated January 15, 1945, indicated that the grant of frequencies for the purpose of providing two-way radio communication with mobile units would be in the public interest. It was proposed that an allocation of frequencies be made as indicated in Table 1.

	NUMBER OF CHANNELS	CONTEMPLATED USE	FREQUENCY
Highways	12*	Mobile Stations	30-40 mc.
.....	12*	Fixed Stations	42-44 mc.
Urban	7**	Mobile and Fixed	156-162 mc.

*In the allocation of these channels, an average channel width of 40 kc. has been assumed and these channels will be integrated with marine service.

**In the allocation of these channels, an average channel width of 60 kc. has been assumed and these channels will be shared with forestry and conservation services and integrated with the marine service on a non-interfering basis.

Table 1. Proposed frequency allocation for the operation of two-way radio for highway trucking.

The Commission does not propose to allocate, at the present time, any permanent frequencies to any specific highway user as they feel that sufficient technical data is not available on which to base a decision on final allocations for general mobile two-way radio service. Necessary experimental work will have to be undertaken before permanent allocations are made.

Since this report was issued, conferences have been held between truck and bus operators with a view to working out the operational factors which are common to both types of carriers. After careful consideration, it was determined that each group would carry on independent experiments with all results to be pooled for the common good.

The present plans call for the installation of an experimental system in the Chicago area. A central station with a fixed transmitter of 250 watts is to be installed in Chicago and 100 mobile units will be put into operation. Twenty different truck companies will each be allocated five units for installation in their trucks. Trucks working in the four geographical directions will be selected so that the station load tests can be made under varying conditions.

Preliminary tests have proved that two-way communications can be maintained for a distance of approximately 50 miles and one-way communication, in-bound, from the mobile unit to the transmitter for a distance of approximately 80 miles.

Experimental work will be carried on for a period of from six months to one year. The actual operation from the motor carrier's Dispatching Department will be by direct line telephone to the transmitter, which will permit the dispatcher to call the transmitter, advise the operator of the unit being called and when contact is made, the operator will plug in a direct telephone line to the microphone and the dispatcher will speak directly to his driver. This operation is extremely simple. Records of all contacts will be kept, in compliance with the FCC requirements. The duration, time and nature of the call will be tabulated for reference purposes.

The initial installation point was selected for the reason that the terrain around Chicago is flat and few obstructions are encountered in this area. Several large cities within a radius of Chicago provide terminal points for additional experimental work and provide complete coverage of the entire distance by two-way radio.

Present plans, contingent on FCC allocations, call for a minimum of 100,000 mobile units and at least 1,000 fixed stations within a short time after the war. Experimental work is going on in both the 30-44 megacycle and the 102-108 megacycle bands.

From this beginning, a nation-wide network of two-way communications for the great fleet of highway freighters is nearing realization.

-30-

RAYTHEON TUBES RECOMMENDED FOR POSTWAR *Chris-Craft*

Chris-Craft, world's largest maker of speedboats, cruisers and motor yachts, has a line of new streamlined beauties on the drawing boards that are sure to be seen on every lake and river in the peacetime years to come. Their refinements, as compared with prewar models, are almost too numerous to count . . . and one of the most important available accessories is ship-to-shore radio, for which Chris-Craft will recommend famous Raytheon High-Fidelity Tubes.

Radio equipment for marine use must be able to take plenty of battering abuse, and Chris-Craft's recommendation of Raytheon Tubes is based on their splendid wartime performance under the most gruelling battle conditions on land, sea, and in the air.

The moral of this story for you, the radio service dealer, is that Raytheon Tubes, capable of absorbing the punishment of war, are the *best* bet for giving your customers the dependable, rich reception they rely on you to provide. Their consistent performance . . . plus a post-war Raytheon merchandising program that will revolutionize the radio service industry . . . are the two big reasons why you should feature Raytheon Tubes *now!*

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.

Raytheon Manufacturing Company
RADIO RECEIVING TUBE DIVISION
Newton, Mass. • Los Angeles • New York • Chicago • Atlanta

All Four Divisions
Have Been Awarded
Army-Navy "E" With Stars

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AMERICAN BROADCASTING CO.
Coast to Coast
181 Stations

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

Sidelines for Servicemen
(*Continued from page 37*)

shop for repairs. Usually the trouble is simple and corrected easily. Most complaints are caused by sparking at the plug connection, open or burned out elements, or a faulty line cord. Most irons are taken apart by removing the handle, plug shield, and two large hold-down screws. In the older irons, the large screws must be first fed a few drops of cutting oil before they can be turned, due to heat crystallizing corrosion on the screw threads and rust accumulation. Be sure the terminal studs for the cord plug are clean and rust free. If unable to clean them, or if they are worn beyond repair, replace with new terminals.

Check the continuity of the iron by means of a series lamp with the line or with your ohmmeter. If burned out, the element can usually be replaced by a Universal unit. Trouble in "automatic" irons often is due to poor contact, corrosion, or breakage of the thermostat. This is usually made up of bimetal strips with an adjusting knob. After cleaning thoroughly, test the thermostat by means of a standard "oven-type" thermometer placed against the sole or bottom plate of the iron while bending the bimetal strips and turning the adjusting knob. Always provide a new plug and cord set with the repaired iron, and polish the iron's plating.

Electric Mixers

There are many types of mixers in use. Trouble is almost always found in the motor. Look for broken, dirty, or worn brushes, loose brush springs, or a dirty commutator. Brushes must seat properly and conform to the curvature of the armature commutator. Test the armature itself for continuity with your ohmmeter, as follows: Place the tips of your test leads against each brush, and while slowly rotating the armature, observe the fluctuations of the meter. Be sure the armature rotates freely with no binding at the bearings.

Oiling is important. Use any household oil, such as "3 in 1" and use very little. Check the insulation of the line cord as it enters the motor casing. Too much oil often rots the rubber grommet around the cord and the cord itself. Clean the motor thoroughly. Remove old grease and carbon, first with a dry rag and then with a cloth dampened with carbon-tetrachloride. Clean the commutator segments with very fine sandpaper, if necessary.

Washing Machines

Washing machines are a much neglected source of income to the serviceman, mostly because they contain gear boxes and other mechanisms unfamiliar to the average radioman. All makes of washers contain a motor, gear box, and agitator. Here again, one of the chief causes of trouble is in the motor. Much of it is also due to clogged moving parts and drains. The motor can be checked and cleaned as for *Electric Mixer* motors, except this one is larger. Most washer motors are rated at one-quarter to one-third horsepower, and about 1750 r.p.m. It will pay you to keep one or two motors on hand in the shop for quick replacement in the event it becomes necessary to send off the customer's motor for rewinding.

Old machines sometimes have stripped or worn gears in the gear box. These can be replaced with little effort. If the machine is very old and the gears are worn badly, it often is best to remove the entire gear box and send it to the manufacturer for replacement. When replacing gears or cleaning washer pumps, always replace the gaskets with new ones and apply new cement. This prevents leakage and a recall. If necessary to renew the gear-box oil, use a good grade of number 20 motor oil, and fill only to the level indicated on the gear box.

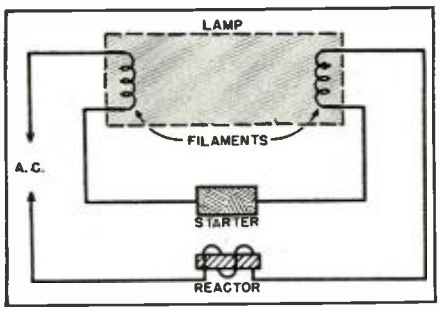

Fig. 2. Wiring diagram of a fluorescent lamp, using a single starter and lamp.

Vacuum Cleaners

The greatest fault with almost every cleaner turned in for repair is dirt. The housewife usually is careful to clean the dust bag, but pays little attention to dirt and strings being sucked up into the moving parts of the cleaner. Before you tackle the motor, check for clogged fan, fan-shaft, and brush holders. Clean all the inner fittings, paying particular attention to the brush-holders. If the cleaner does not contain a brush, check for clogged intake tubes or chambers. Go over the motor thoroughly. Use the same procedure as outlined for *Electric Mixers*.

Lamps

This includes all lamps: floor, desk, or fluorescent. Insulation of cords, proper wiring, open or broken switches, and poor contacts and plugs can be traced fairly easily in the ordinary lamp fixture. Fluorescent, or "daylight," lamps offer a different sort of problem. Of course, the foregoing troubles apply to these also. In addition, we have starters, reactors or chokes, and a method of mounting quite different from the regular lamp. One of the troubles encountered at times is poor or flickering light. This is due to a faulty starter or lamp tube. The "starter" is really a small tube enclosed in a metal envelope and containing bimetal contacts and a very small condenser. Starters are easily replaceable and are plugged into the base or fixture. The reactor, or choke, is usually mounted in the base or fixture. This coil is used to limit the arc current. An open choke causes failure of the lamp. Fig. 2 shows a simple circuit using a single lamp and starter. Check the entire lamp for dirty pin sockets, loose or broken wiring or faulty lamp tube.

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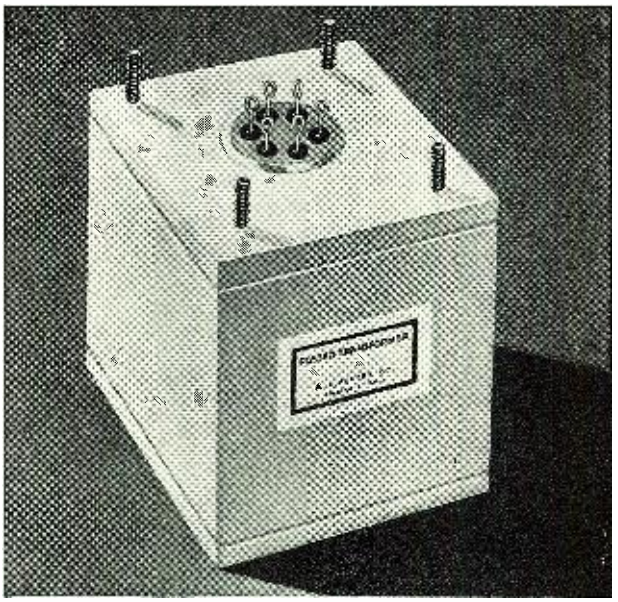
PERFORMANCE

in a tiny package



It had to be small, this new MULTIPLE CHANNEL BAND PASS FILTER, because it's destined to do a special military job. **FOSTER** designed and is building it, meeting the high performance standard required, kept it light in weight, and sealed it in a case that measures only **2¾ x 2¾ x 3¼"!**

Terminals are sealed in VITROSEAL, a basic advance in transformer manufacture, exclusive with Foster. VITROSEAL terminals are fused uniformly, simultaneously, into the metal, in multiple. The job is neat, fast, economical. The seal is sure and extremely resistant to vibration and thermal shock.

In the past 12 months Foster Engineers have solved more than 1000 individual transformer problems, designing and building entirely new units or "upping" the performance of units already in use.

If you manufacture electrical and electronic equipment, it may well be worth your while to address your special transformer inquiries to Foster.

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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.

ELECTRO-VOICE CATALOGUE

A simplified Reference Level Conversion Chart is one of the outstanding features of the *Electro-Voice* catalogue which has been issued recently by the company in an effort to aid in the standardization of microphone ratings.

The basic operating principles of microphones are explained which assists the buyer to select the proper microphone for the job. New types of special purpose microphones developed for voice and sound transmission, featured in the catalogue, makes this a valuable handbook for sound men.

Dynamic, velocity, carbon and polydirectional microphones in various *Electro-Voice* models are described from applications to specifications. Diagrams which include mechanical dimensions, and photographs are used to illustrate each model.

Copies are available by writing on business letterhead to the *Electro-Voice Corporation,* 1239 South Bend Avenue, South Bend 24, Indiana.

RADIOTELEPHONE BOOK

The *Galvin Manufacturing Corporation* is completing the distribution of their new directory, listing two- and three-way radiotelephone systems throughout the country.

The directory includes information as to FCC call letters, frequencies, transmitter power, number of transmitters and locations of radio systems for all Motorola radiotelephone systems in the United States and Hawaii.

Distribution of these directories is limited to persons using this equipment or directly connected with organizations employing two- or three-way communications. Copies will be forwarded at the company's discretion. Requests should be made to *Galvin Mfg. Corporation,* 4545 Augusta Boulevard, Chicago 51, Illinois.

W-J CATALOGUE

Walker-Jimieson, Inc. of Chicago has issued a new general catalogue covering radio and electronic equipment made by various manufacturers and handled by the company.

Included in this 30-page book are x-ray machines, tubes, cathode-ray units, test equipment of all types, tools, transformers, power supplies and various other types of electronic equipment needed by industry.

Copies of this catalogue will be forwarded to those requesting "Radio and Electronic Equipment" from *Walker-Jimieson, Inc.,* 311 S. Western Avenue, Chicago 12, Illinois.

LOCK NUT CATALOGUE

Applications of metal self-locking fasteners are covered in the new booklet being issued by *Adel Precision Products Corporation.*

The company's line which is marketed under the trade name "Stalock" includes fastenings for all types of applications; automotive, appliances and electronic.

Specifications are given for different types of "Stalock" fasteners. Copies of this booklet will be forwarded upon request to *Adel Precision Products Corporation,* Burbank, California, or Huntington, West Virginia.

BOOK FOR HAMS

A new book dealing with the techniques of Panoramic Reception has been published for free distribution by the *Panoramic Radio Corporation.*

Entitled "From One Ham to Another," this booklet is written for the ham in the terms he uses. This publication describes the problems that confront amateur radio operators and proposes solutions in reducing the number of missed signals, in determining quickly which frequencies are free and in stepping-up efficiency. Cartoons and diagrams are used throughout the book.

To obtain a free copy of this book, write direct to Mr. Harvey Pollack, *Panoramic Radio Corporation,* 242-250 W. 55th Street, New York 19, New York and request "From One Ham to Another."

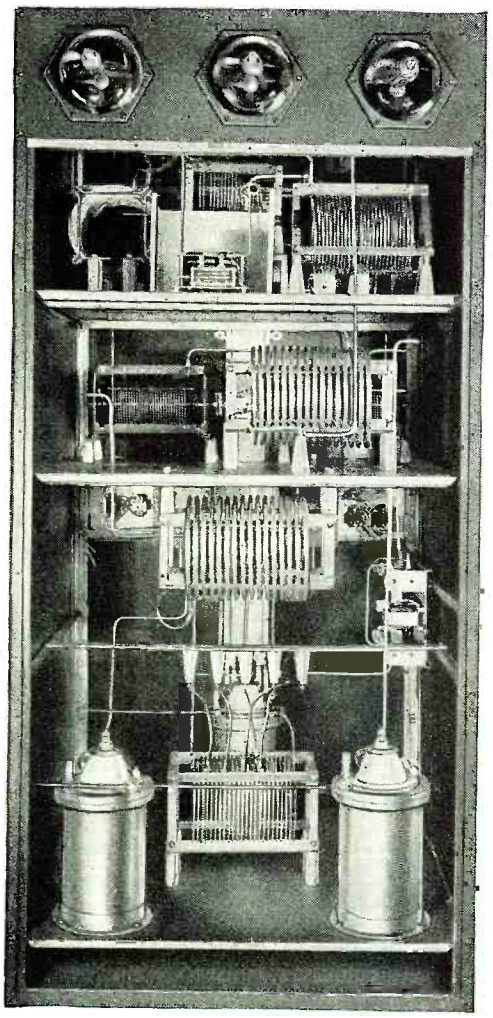
STEEL FASTENERS

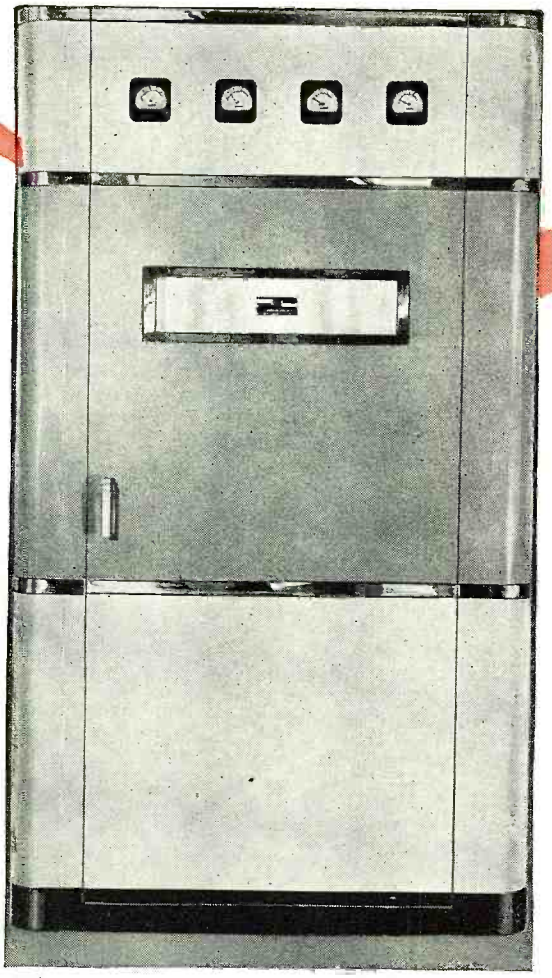
A comprehensive, 83-page engineering catalogue has been issued by *Allmetal Screw Products Company* of New York to assist designers, engineers and other plant executives to select the right size and type of noncorrosive fastening device for any particular job.

Included in this manual is a brief introduction to stainless steel, stock sizes and physical dimensions of various bolts, cap screw nuts, pipe fitting, etc. The book also has an extensive section devoted to engineering tables and data.

A copy will be forwarded to plant executives, designers and engineers

DIRECTIONAL ANTENNA EQUIPMENT





Johnson engineers have designed many highly successful installations of phasing and antenna coupling equipment to individual specifications. These units may be built to match any existing transmitter and thus become an integral part of your station. Let us help you and your consulting engineer plan your transmitting equipment for better market coverage. Orders received now will get first attention when priority restrictions are removed.

Here are two of the many installations of phasing equipment Johnson has furnished for Broadcast Stations, built to match existing equipment. Other items available from Johnson, made to individual specifications, are gas filled pressure condensers, coupling networks, tower lighting filters and special inductors.

JOHNSON

a famous name in Radio

E. F. JOHNSON COMPANY
WASECA, MINNESOTA

who make the request on company letterhead to *Allmetal Screw Products Company,* 35 Green Street, New York 13, N. Y.

TAYLOR TUBE BOOK

A complete catalogue covering all types of *Taylor Tubes* has just been issued by the company.

Full information on all tubes manufactured by the company in prewar days is included along with data concerning some of the newer types developed since the war. Twenty-two pages are devoted entirely to tube characteristics, and a large portion of the catalogue contains technical information on transmitters and tubes used in transmitter applications.

The catalogue is available without charge from local distributors of Taylor Tubes in each district, or it may be obtained directly from the company at a prepaid charge of 25 cents. Address mail requests to *Taylor Tubes, Inc.,* 2312 Wabansia Avenue, Chicago, Illinois.

ADAPTER MANUAL

A sixteen-page listing of JFD Sockette radio tube adapters has been issued by *JFD Manufacturing Company* of Brooklyn.

This manual represents a complete line of radio tube adapters and includes 380 types covering 1228 substitutions.

Among the types of radio tube adapters are listed the octal type, loktal type, loktal metal base type, the resistor types, etc. The manual also contains a special listing on how to convert tubes that are on hand into tubes which are unavailable, by means of the Sockette radio tube adapters.

This booklet will be forwarded free to servicemen, jobbers, etc., upon request. Copies of manual, Form No. 340, should be requested direct from *JFD Manufacturing Company,* 4111 Fort Hamilton Parkway, Brooklyn, New York.

KATO GENERATORS

The *Kato Engineering Company* of Mankato, Minnesota, has issued a new ten-page booklet covering their line of a.c. generators.

The booklet also includes information about the company's line of motor-generators, high frequency generators and d.c. motors. Complete engineering specifications are given for the various types of equipment.

Copies of this booklet may be obtained by writing *Kato Engineering Company,* 530 N. Front Street, Mankato, Minnesota.

WIRE RECORDER

Lear, Incorporated has prepared a new booklet on the *Lear* Wire Recorder which is now available for general distribution.

The many possible uses for this type of recording are treated in this booklet. A complete explanation of the recorder is given along with illustrations of the process. The booklet is prepared in "Question and Answer" form so that a person who does not know much about wire recording can secure pertinent information on the subject.

Copies of the booklet will be forwarded to those requesting them from *Lear, Incorporated,* Home Radio Sales Division, 230 E. Ohio Street, Chicago 11, Illinois.

ANDREW BULLETIN

A four-page engineering data sheet covering cable accessories has been issued by *Andrew Company* of Chicago.

Included in the data sheet are solderless connectors, glass-insulated terminals, junction boxes and "T" boxes for coaxial circuits.

Accessory material and data is also included which will be of interest to the engineer.

Copies of this four-page sheet will be forwarded upon request to *Andrew Company,* 363 East 75th Street, Chicago 19, Illinois.

TUBE REFERENCE LIST

A chart showing the recommended receiver type tubes and a reference list is now being distributed by *Sylvania Electric Products, Inc.*

Listings are arranged for convenient reference and include many types of tubes especially selected for better performance in new equipment being designed.

Copies of the chart are available on request to *Sylvania Electric Products, Inc.,* 500 Fifth Avenue, New York 18, N. Y.

INSULATING MATERIALS

A new engineering bulletin, ED 44, has been issued by *Continental-Diamond Fibre Company* covering their line of electrical insulating materials.

Testing data, properties, forms, fabrication, designs and uses are given for a great number of standard N.E.M.A. grades of phenolic laminates and other types of electrical insulating materials.

The bulletin is designed for engineers, and those who are responsible for production and design.

Request for the bulletin ED 44 should be made direct to *Continental-Diamond Fibre Company,* Newark 49, Delaware.

REFERENCE LISTS

In order to assist fabricators of aluminum and magnesium, the *Cerium Metals Corporation* of New York has issued two lists for reference purposes.

One of the lists contains a complete bibliography of important English, French and German Works on the use of Cerium in conjunction with magnesium and aluminum, while the second list covers patents which have been granted on processing operations.

Copies of both of these lists will be forwarded, without charge, upon request to *Cerium Metals Corporation,* 522 Fifth Avenue, New York 18, N. Y.

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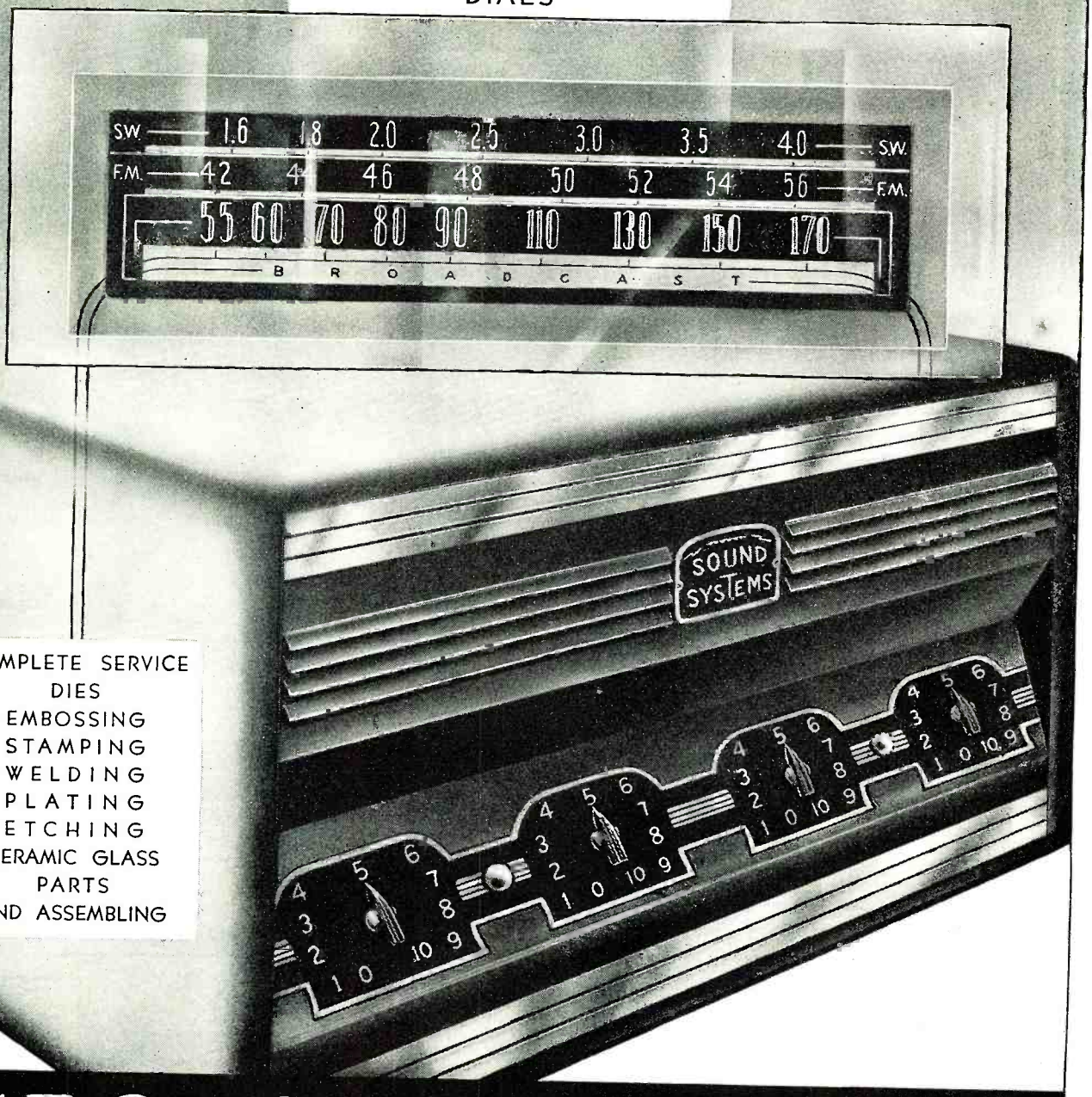

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What Makes the Plate Current Dip?

By GEORGE J. FALGIER
Radio Officer, U. S. Merchant Marine

THE purpose of the Air Force training school for Radio Operator-Mechanics at Scott Field is not at all to produce theoreticians or engineers; therefore it is proper that purely theoretical topics should receive a minimum of attention. The reasons why the d.c. plate current of a radio-frequency power amplifier drops to a minimum when it is tuned to resonance with the preceding stage may be considered as belonging to this category, yet occasionally a student in the transmitters phase will bring up the question. Some explanation must then be given of this phenomenon, commonly used as an indicator for tuning the power-amplifier stages of transmitters.

Many instructors explain the effect by stating that the power-amplifier plate tank is a parallel resonant circuit, offers maximum impedance at resonance, and thus causes the plate current to drop to a minimum.

This explanation does not correspond to the state of affairs actually existing in a Class C radio-frequency power amplifier, as may be shown by a simple experiment to be described. Those who use it assume that the r.f. plate current (the only current to which the plate tank could offer appreciable impedance) varies in the same manner as the d.c. component indicated on the plate milliammeter, reaching minimum when the latter does. This assumption is wrong. The r.f. plate current rises to maximum as the d.c. component falls towards minimum, and is actually at or near maximum at the very time it is said to be most impeded by the resonant tank.

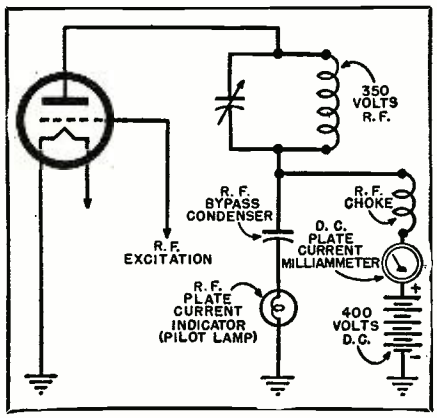
If the p.a. stage is series fed, one may check this statement experimentally by connecting a flashlight bulb or pilot lamp in series between the plate r.f. by-pass condenser and ground in place of the existing ground connection. It may be necessary to connect a few turns of insulated wire in parallel with the bulb to prevent burnout. If the stage is parallel fed, the ground connection for the plate tank must be opened and the bulb inserted across the gap. The glow of the bulb indicates the flow of r.f. plate current, and will be found to approach maximum as the d.c. plate current reaches minimum.

This experiment does not indicate that the textbook statements about the impedance of a parallel-tuned circuit are false. Not at all. It does show that those statements are not the proper explanation of plate current dip.

In the textbook circuits the excitation to the parallel tank is sine wave a.c. Under theoretically ideal conditions the reactance voltage generated by the tank would also be sine wave and at every instant equal and opposite to the exciting voltage. On the other hand, in the Class C power amplifier the excitation to the tank is in the form of pulses which individually are of short duration in comparison with the time of one cycle. Most of the time, then, the a.c. voltage generated by the tank finds no opposing voltage in the line and itself is able to cause a flow of current in the line—the r.f. plate current. If the tank is detuned so that it stops oscillating, the small light bulb between tank and ground will cease to glow, indicating that the r.f. current which had been present was indeed being generated by the oscillating tank.

Understanding that the p.a. plate tank becomes an effective r.f. generator when the stage is operating, we can readily explain why the d.c. plate current dips at resonance. The r.f. voltage developed by the oscillating tank is in series with the d.c. voltage being applied to the plate from the power supply. During one half-cycle this r.f. voltage will tend to aid the power supply voltage in causing plate current to flow, but just at that time the control grid (180 degrees out of phase with the plate) is most negative and prevents this aid from being effective. On the next half-cycle, when the control grid is not cutting off the flow of plate current, the r.f. voltage across the tank opposes the power supply voltage, reduces the instantaneous voltage on the plate, and thus causes the flow of current which takes place to be much smaller than it otherwise would be. Thus, the average plate current or d.c. component is made smaller, producing the well-known dip.

Simplified schematic diagram of r.f. power amplifier, using arbitrary voltage value. The instantaneous plate voltage varies from +750 volts, when the control grid is negative beyond cutoff, to +50 volts, when the control grid is positive.



relays
IN MARINE COMMUNICATIONS

From ship to ship and from ship to shore—whether on war craft or on peacetime boats of commerce and travel—marine radio communications equipment plays a major role. Leading manufacturers of such equipment use Relays by Guardian, two of which are shown installed in the DC power supply unit of the HT-11 Radiophone manufactured by the Hallicrafters Company, Chicago.

Hallicrafters HT-11 Radiophone Unit Showing DC Power Supply

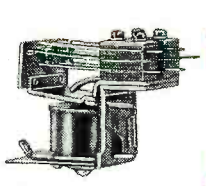
for Automatic Control of Electrical Circuits...

THERE'S A *Relay* BY GUARDIAN

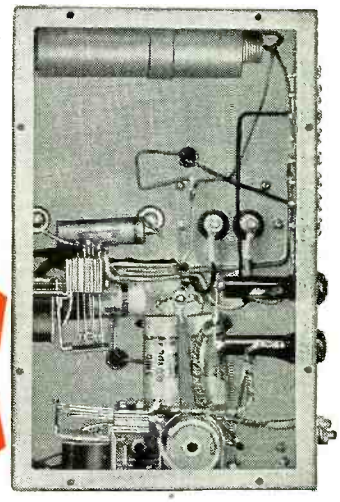
In this application one Guardian relay in its normal position feeds the input of the Vibrapack for receiving purposes. On the changeover from receiving to transmitting it disconnects the Vibrapack and simultaneously energizes the other relay. This in turn connects the Dynamotor input and output circuits.

Both relays are Guardian Series 115 with double wound coils for operation on 6 or 12 volts D.C. with the 6 volt winding in parallel and the 12 volt winding in series. It is a small, compact relay, ideal for use where space is limited.

Its use in Marine Radiotelephone is but one illustration of the many applications of relays in radio and electronic equipment. For complete description of numerous types of Relays by Guardian, write for Guardian's new Catalog No. 10.



Series 115 DC Relay



GUARDIAN ELECTRIC

1630-H W. WALNUT STREET CHICAGO 12, ILLINOIS

A COMPLETE LINE OF RELAYS SERVING AMERICAN WAR INDUSTRY

Stronger oscillations in the tank generate a higher r.f. voltage and cause the dip to be more pronounced. Conversely, any condition which weakens the oscillations in the tank will be accompanied by an increase in the d.c. plate current, as, for instance, removing r.f. energy from the tank and feeding it into the transmitting antenna.

The "tank-as-generator" explanation applies equally well to a parallel fed amplifier. With respect to r.f., the plate choke is in parallel with the tank, so that the r.f. voltage generated by the tank appears also across the choke and thus is placed in series with the power supply voltage.

-30-

QTC

(*Continued from page* 55)

men's insurance rates have been cut, which will be of interest to many. Premium rates on crew life war risk individual insurance policies have been lowered by the WSA to 50¢ per thousand dollars per month. Any seaman may buy life war risk insurance, over and about the $5,000 seamen's policy furnished gratis by the WSA, for amounts of $1000 to $15,000.

IN EARLY May, David Sarnoff, president of RCA gave little hope for the production of civilian radio receivers this year. Mr. Sarnoff, addressing the 28th annual stockholders meeting in New York, said, "We now have a backlog of government orders totaling $180,000,000 and this demand for war products will fully utilize our facilities during the remainder of this year."

At the same time the RCA president also reported that RCA Victor has made its plans for a speedy reconversion into the field of civilian radio, phonographs, television, and FM. "These preliminary steps have been taken without interfering with our primary job of producing radio-electronic equipment for the armed forces," he said.

THE OWI revealed that 22 of the 125 combination passenger-cargo vessels of the prewar U.S. Merchant Marine had been sunk. Of 11 ships of over 17,000 gross tons only one has been lost, and four in the 10,000 to 17,000 class.

DR. G. W. YOUNG, radio pioneer and owner of WDGY died in Minneapolis in late April. George Bailey, ARRL president has been elected to the new post of executive secretary of the IRE and it is believed will continue to hold both positions. B. J. Lande sailed aboard a tanker. E. Sittler, long-time marine serviceman in the Atlantic Coast area is toying with the idea of pounding brass at sea for a change. Trouble is, he's been doing so much work ashore he just could not find time to get started 73

Transformer Construction

(*Continued from page* 35)

The following formula will enable you to calculate the number of turns for the secondary:

$$\frac{6000}{X} = \sqrt{\frac{\text{Recommended Plate Load}}{\text{Voice Coil Impedance}}}$$

where "X" is the unknown number of secondary turns.

Here is a practical example. Suppose the recommended load is 5000 ohms (plate to plate) and the impedance of the voice coil is 8 ohms. The formula would then resolve into:

$$\frac{6000}{X} = \sqrt{\frac{5000}{8}}$$

$$\text{or } \frac{6000}{X} = \sqrt{625}$$

$$\frac{6000}{X} = 25 \text{ or } X = \frac{6000}{25}, \text{ or } 240$$

turns.

No. 21 or larger, enamelled copper wire will do nicely for the secondary, winding it in the same direction as the primaries. The start of the secondary may then be the ground, or low potential side, of the winding if so desired. It will do no harm to put several taps in the secondary, either in the vicinity of your calculated value or at other calculated points to make the transformer serve as a universal type. This will enable experimenting with various output circuits. In push-pull circuits the recommended plate-to-plate impedance is the value to use for the calculations. For a single output tube disregard the "B"-plus center tap and make the finish of the No. 2 winding the connection to the plate of the tube and the start of the No. 1 winding the B-plus connection.

When the secondary has been calculated, wind the turns of the first layer across the complete width of the side-by-side primaries, using a piece of wrapping paper between each succeeding layer. A couple of turns of gummed paper should then be used for a wrapper; the windings may then be removed from the winding device, and the laminations inserted. The "I" section of the laminations should then be added and the transformer reassembled in the same manner in which it was disassembled. Do not force the laminations into the coil in such a manner as to cut through the walls of the paper formers with consequent damage to the coils. If the transformer is designed for push-pull operation, the laminations should be interlaced 1x1. For single tube operation, butt joint (.003 gap) lamination is best. The final assembly is left up to the constructor; he can mount it in any manner that serves his purpose.

-30-

Facilities and Experience

For the Manufacture of All Types of

RADIO COMMUNICATIONS EQUIPMENT

BROADCAST PROGRAM AND RECORDING AMPLIFIER

Showing the wide range of the Wilcox line with this amplifier designed especially for the broadcasting industry.

Any type of radio communications equipment—from complete airline installations to specialized units required by various industries—make up the extensive line of Wilcox products. All Wilcox equipment is known for dependable performance and Wilcox assemblies are adaptable to the space available for installation. In postwar developments Wilcox will hold its place as pace-maker for advanced designing. Inquiries are invited.

WILCOX ELECTRIC COMPANY, INC.

Manufacturers of Radio Equipment

FOURTEENTH AND CHESTNUT — KANSAS CITY, MISSOURI

LETTERS
FROM OUR READERS

MR. BERGER SPEAKS AGAIN

"THE barrage of mail received in response to my letter on licensing the radio serviceman in the August, 1944 issue of RADIO NEWS is a clear indication that men both in and out of the Armed Forces have a keen interest in the welfare of the radio service game.

"To those who disagree with the proposal, may I point to Mr. Bert Dale's excellent article 'Servicemen Are Organizing' in the March issue of RADIO NEWS? The success and public acceptance of the licensing plan in his home town in Indiana speaks for itself. Further, as Mr. Dale's article quite plainly shows, the radio service profession can police itself effectively, particularly as regards the prevention of unscrupulous dealings on the part of individual members against the public.

"Some confusion has arisen as to the examinations required. By holding tests four times or more a year is meant that newcomers would not have to wait too long to take an examination. A license when issued would be valid for one or more years. The plan could be administered locally by radio-electronic servicemen and nationally by some commercially disinterested organization such as the IRE or RMA, as has been suggested.

"The idea behind any licensing and organizing plan must be to serve the public, for by so doing, it will inevitably benefit the radio-electronic service profession.

"Certainly many of the returning soldiers would like to enter into the field. Many, formerly engaged in the radio business, in one capacity or another, and others with radio or radar experience obtained with Uncle Sam's help would not be too happy if the maintenance-service field ran unchecked, as it has in the past, through the public's pocketbook and ill graces.

"There is no question that many radio technicians conduct an ethical business, but the public's interest would be better protected and the profession more dignified and lucrative, if radio-electronic servicemen, as a group, established their own system of licensing and organization for their common good and the public welfare."

Respectfully yours,
Samuel Berger

* * *

SCREWDRIVER MECHANICS

"AS A missionary, with radio as my hobby, I always get RADIO NEWS when on furlough, to pick up my 'radioeducation.'

"This time I am saving every copy to take back to the Bush of Nigeria with me, having been caught fixing Dutch Philips and other good superhets for Government men, missionaries, and one native chief with not one printed aid, and no meters, etc. It was a case of 'spit and touch' to find voltages.

"From the above you see I am in the 'screwdriver mechanic' class, but I heartily agree that whenever possible the radioman should be up tops and have his exams and licenses to make and service the great masses of fine electronic instruments for the public.

"The professional and the layman still have their places and always will whether it be arts, crafts, medicine or religion. But let's keep away from professional snobbery which causes the work we love to be smeared with wrangling and personal slams.

"I will be delighted when we have some real radio technicians to service the fast increasing number of sets in Africa, also when we have some more real M.D.'s to care for the dying hundreds in the Bush. But until that time, I and my kind, will keep on applying the best we know of 'screwdriver mechanics' to the sick radios and bodies while doing our main job of converting the heathen and training them to live for God."

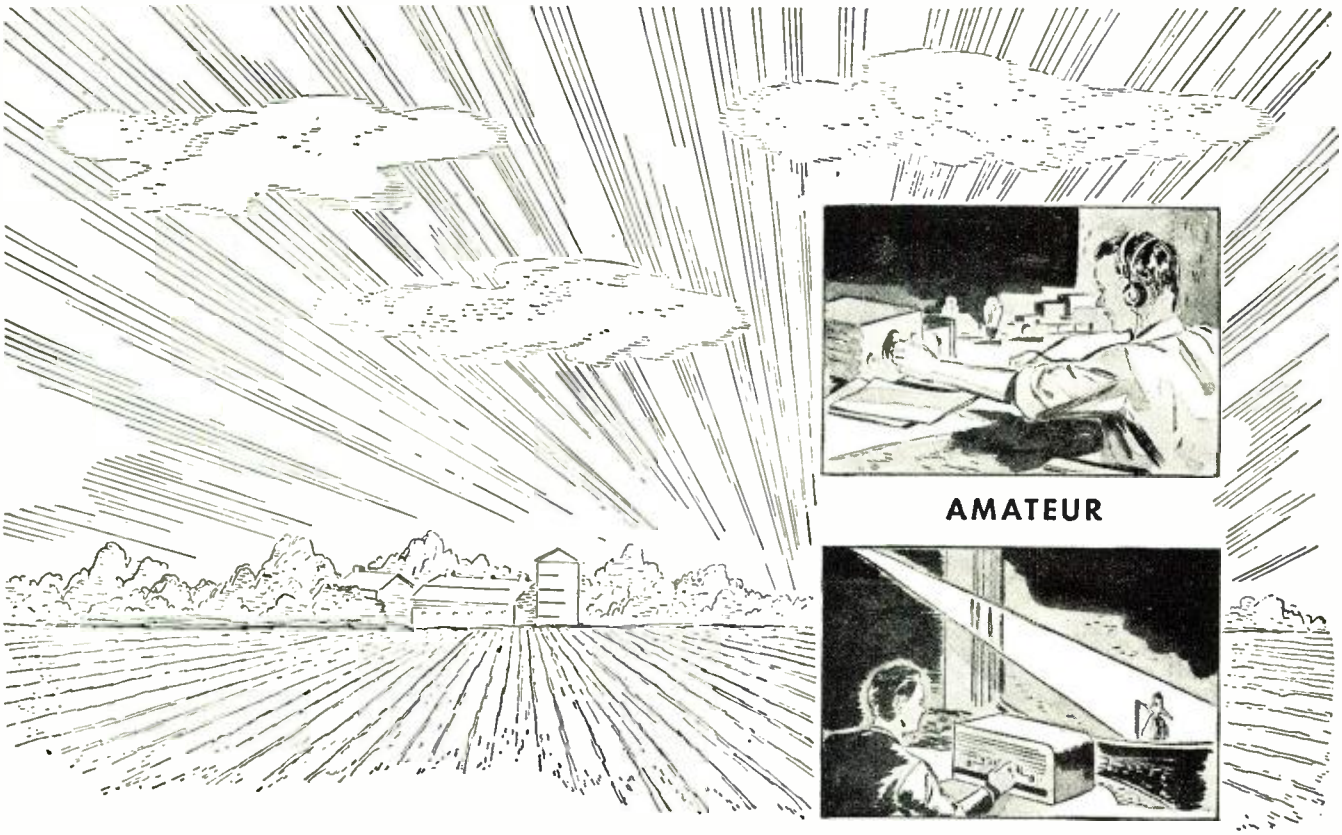
Yours sincerely,
Orville Thomer
Kitchener, Ontario.

* * *

"IN recent issues of your magazine, I have noted various letters discussing the idea of requiring radio servicemen to obtain FCC license by passing an examination before being allowed to repair receivers.

"I am contemplating being a radio serviceman myself after the war so I am very much interested in this subject. Also I like to work out radio examinations as evidenced by 1st. and 1st. tickets I have as well as Class A 'ham' license, but I still consider myself as being one of those 'screwdriver mechanics' which they are trying to eliminate from the business, because I don't own much test equipment and what I have is 'home' constructed; yet I could repair any receiver that an expert could, provided I had the time necessary, or so I believe.

"Assuming that the servicing license will be required eventually, I think this would be as good time as any to start the deal. But let's make the examination more sensible and realistic by having the radiomen examined in their own shops by working on actual repair jobs under the supervision of the FCC inspectors, or alternately, repairing radios in a special test shop set up in FCC headquarters. This would be much more logical than a written exam, which anyone could pass without knowing more than radio fundamentals. It would also require the FCC to hire more radiotechnicians which would provide jobs for more men after the war, although this



AMATEUR

SOUND AMPLIFIER

FIELDS OF TOMORROW

will be developed more efficiently because of Thordarson Transformers being designed TODAY!

Our 50 years of general experience, plus the many new results of war-time research are a guarantee that Thordarson will have the right transformer for every need, when civilian orders may again be accepted.

COMMUNICATIONS

EXPERIMENTAL

INDUSTRIAL

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500 WEST HURON STREET, CHICAGO, ILL.

Transformer Specialists Since 1895

. . ORIGINATORS OF TRU-FIDELITY AMPLIFIERS

would be a minor factor. The main thing is that such an exam would definitely determine the man's ability as a repairman. In the meantime, let's get the war over first."

Sincerely yours,
T/4 Roy A. McCarthy
Somewhere in the Pacific

* * *

RECEIVER DESIGN

"IN regards to suggestions on postwar receiver design, I must agree that receivers built after 1939 were, as a whole, inferior to earlier models. I believe this was partly due to both cheap parts and poor design, but probably more to the latter. The majority of receivers, even in the higher priced brackets, were limited to one i.f. stage, of doubtful gain, and a preselector on the broadcast band, leaving much to be desired in the way of short-wave performance, a.v.c. action, and signal-to-noise ratio. The audio amplifiers and loudspeakers in these receivers were also often sadly neglected. The slide rule dials were often anything but smooth in operation and could be greatly improved by having the station indicator attached to the dial scale plate by means of slides (on rollers or pulleys) on both the top and bottom of the dial scale plate rather than just on top, as is usually the case. The loudspeakers should be designed so that they can be easily recentered because the best of them work out of center occasionally (even those using the newer type wave spiders).

"In addition, no receiver should be advertised as having good all-wave reception unless it has at least one tuned r.f. stage. Personally, I prefer an r.f. stage to push-button tuning with no r.f. stage, but it would seem that the r.f. stage is a necessity (at least in some parts of the country), while push-button tuning is a luxury."

Sincerely,
Pvt. John R. Simpson
Camp Shelby, Mississippi

* * *

"HERE is hoping the receiver manufacturers are of the same mind as Reader Forgy (Letters from Our Readers, RADIO NEWS for April, 1945), and that the postwar set will not be just an assortment of fancy-named gadgets with no real worth.

"A few more points that he might have mentioned would include the following:

"The most commonly misused feature of the prewar receiver was, and is, the tone control. As ordinarily operated, treble tones are conspicuous by their absence and, on a high-fidelity set, the control eliminates the very range that entitles a receiver to be called 'high fidelity.' To eliminate static and interference under certain conditions, I suggest a two- or three-position switch for 'tone range control.' Position 1 would give full range reproduction from 70 to 8000 cycles, while position 2 would pass only 120 to 4000 cycles. If a continuously variable control is desired, it should be in addition to the 'T R control' and should operate only in the bass range, offering either boost or reduction.

"I agree with Mr. Forgy that manufacturers should provide better dial cords or eliminate them entirely. In addition, on the subject of dials, I can state from observation that most multiband dials are confusing and difficult to read. Means should be provided to center attention on only one dial-scale at a time, either mechanical, by shifting the scale, or by means of lights which illuminate only a single scale at a time. An even more important item: A means should be provided which will indicate absolutely when the receiver is 'in-tune.'

"Generally, I do not care for push-button tuning, but if provided, on the postwar set, a separate group should be provided for AM and FM stations. Too, they should tune the r.f. antenna stage, and not only the converter-oscillator. And that brings up another, more technical point: All except the very smallest midgets should have a stage of tuned r.f. on all bands, including the FM range. Also, since a special antenna will undoubtedly be necessary for FM, a suitable antenna system should be sold and installed with each set, a system which will effectively cover all bands, permitting a near-perfect antenna-to-receiver match throughout the all-wave tuning range.

"Now, what about the 'all-wave' receiver? Surveys have shown that the majority do not listen to the short-wave bands on their receivers, and only a small percentage of those who do, listen more than infrequently. (I have found that the real short-wave fans, such as myself, have a communications set for their serious high-frequency tuning.) Therefore, why not limit the short-wave coverage to a single band, 6 to 18 megacycles, and make use of the economies effected here to afford more and better features that will be used and appreciated by all? Such features might include: push-pull output, with 8 to 15 watts of low-distortion power; volume controls that do not become noisy or 'spotty,' and more rugged components generally.

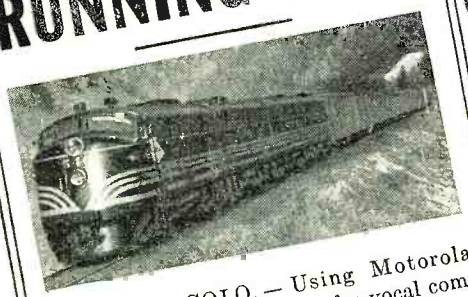
"I might go on and comment on such things as radio-phonographs, but they are a field for discussion in themselves. In passing, I'll say I have noted that the most common observation about radio-phonographs is: 'Why don't they make them stronger and simpler—and easier on my good records?' Oh, yes, and while you're at it, Mr. Manufacturer, we hope that you can give us all this and still make it easy on our pocketbooks, $80 to $150 for the average 'good' console receiver . . . up to $250 for the deluxe radio-phono combination. Not all of us can afford our 'dream receiver,' you know."

Sincerely,
Cpl. L. M. Jensen
Hill Field, Utah.

Can our readers suggest more postwar receiver improvements?

—30—

THE "FLYING UTE" CUTS 3 HOURS FROM AVERAGE RUNNING TIME



DENVER, COLO.— Using Motorola Radio 118 Mgc. equipment for vocal communications between locomotive and caboose, the "Flying Ute," crack freight of the Denver and Rio Grande Western, cut three hours off the average running time between Denver and Salt Lake City, it was announced today after a trial run.

with Motorola F-M 2-WAY RADIO-TELEPHONE SYSTEM

The efficiency, economy and safety provided by Motorola F-M two-way radiotelephone were demonstrated again—with spectacular results! On a test run over the rugged, mountainous route between Denver and Salt Lake City, "The Flying Ute," fast Diesel freight, carried 65 cars of explosives and other vital war materials.

The 570 mile run included 50 tunnels, but clear and intelligible communications between engine and caboose were maintained throughout most of the route.

FREE! Write for detailed Motorola Radiotelephone Directory covering more than 1000 Motorola two and three way F-M systems now operating in United States, Canal Zone and Hawaii.

GALVIN MFG. CORPORATION • CHICAGO 51

F-M & A-M HOME RADIO • AUTO RADIO • AUTOMATIC PHONOGRAPHS • TELEVISION • F-M POLICE RADIO • RADAR • MILITARY RADIO

Within the INDUSTRY

THE ASTATIC CORPORATION has announced the appointment of Frank B. Russell of Drexel Hill, Pa., to the post of sales representative to serve radio parts jobbers in the District of Columbia and Virginia.

Having just completed a visit at *Astatic's* new plant at Conneaut, Ohio, Mr. Russell is now contacting customers in his new sales territory.

* * *

GEORGE MYRICK, formerly administrative consultant to the Civil Aeronautics Authority has been named manager of the *Bendix Radio Division* personal aviation sales department according to the announcement made by William P. Hilliard, general manager of the division.

The company will manufacture and retail compact, lightweight and economical radio receivers, transmitters and direction finding equipment for personal airplanes after war.

Mr. Myrick, who graduated from Swarthmore College, has long been associated with private flying interests. Original design on the equipment will be in charge of Vernon Moore, and Charles F. Luscombe will act as Sales Engineer for personal plane radio.

* * *

L. G. CUSHING, factory representative for the *Universal Microphone Company* of Inglewood, California in the Wisconsin and Illinois area has moved his offices from 540 N. Michigan Avenue, Chicago to 210 E. Ohio Street, Chicago 1, Illinois.

The new location, in addition to general offices will house stockroom space which will be used for warehousing when the organization is far enough advanced in the production of civilian goods to again stock factory representatives with microphones, stands, accessories and recording components.

* * *

EDWARD M. BIEBER has recently been named to the post of sales manager for Laubscher products for the North American Division, comprising the United States and Canada.

The *International Merit Products Corporation* has been organized to act as sales representatives for the entire Western Hemisphere for phonograph needles, screws and other high precision turned parts manufactured by *Laubscher Brothers,* of Switzerland. The Latin America Division will be under the management of T. William Maas.

The Laubscher phonograph needles heretofore marketed in North America under a nationally known brand name will be trade marked Meritone. The new company's other products will be marketed under the trade make I.M.P.

Headquarters of *International Merit Products Corporation* is at 254 W. 54th Street, New York 19, N. Y.

* * *

J. N. A. HAWKINS has been named General Sales Manager of Industrial Electronic Products for the *Sylvania Electric Products, Inc.,* according to the announcement made by Don. G. Mitchell, vice-president in charge of sales.

Mr. Hawkins will have charge of products involving applications of electronics to commerce and industry and will be involved in the developmental work in connection with these products.

Since 1941, Mr. Hawkins has been engaged in research for the Navy and has served overseas. His new headquarters will be at *Sylvania's* 500 Fifth Avenue office in New York.

* * *

THE JACKSON ELECTRICAL INSTRUMENT COMPANY of Dayton, Ohio has announced the removal of their factory and offices to 16-18 South Patterson Boulevard, Dayton 1, Ohio.

Production facilities, offices and engineering laboratories have been substantially expanded at this new location.

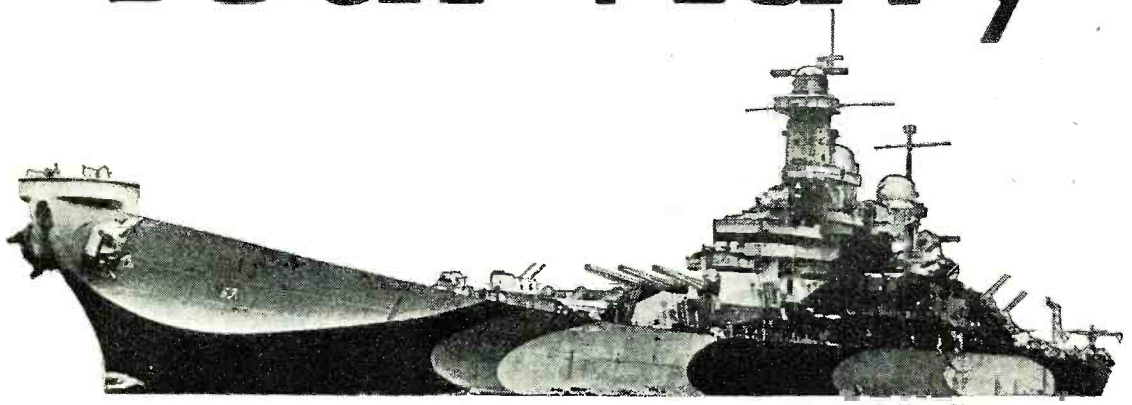
* * *

CHESTER H. THORDARSON, pioneer transformer manufacturer, passed away in Chicago recently at the age of 78.

Mr. Thordarson came to this country as a immigrant from Iceland at the age of 10 and at the age of 13 became the head of the family as a result of his father's death.

His first job was with a small manufacturer of electrical supplies at a salary of $4.00 a week. He next secured a job with *Chicago Edison Company* and as soon as he saved $75.00, he started in business for himself in an old building on Market Street. He soon had $18,000 and with this capital he started the *Thordarson Electric*

Your Navy



Official U S. Navy Photo

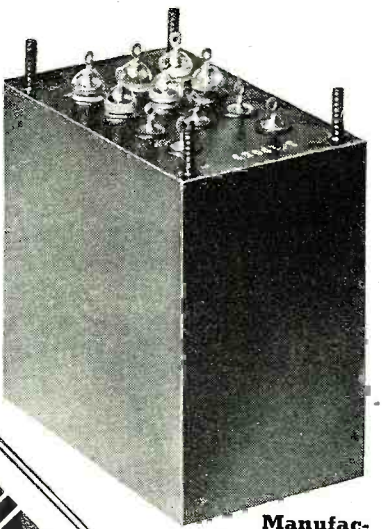
accepts nothing less than Perfection

That's why **KENYON HERMETICALLY SEALED TRANSFORMERS AND REACTORS** have been selected to play their part in the great forward march of the world's greatest Navy which demands and accepts nothing less than perfection of all its personnel and resources.

The construction employed in the unit illustrated will meet present government specifications from any branch of the armed services. **KENYON'S** high standard of quality has been diligently maintained to insure a product of perfection.

Designs available employ both glass-to-metal and steatite-to-metal sealed terminals.

Overall dimensions and mounting dimensions conform to the **KENYON** T-line case except that the mounting is single ended at top or bottom. It may be necessary to increase case height.



Manufactured for the Navy to their specifications RE 13A 553 B

THE MARK OF EXCELLENCE

Inquiries invited. Write for our new 1945 illustrated catalogue

KENYON TRANSFORMER CO., Inc. 840 BARRY STREET NEW YORK, U. S. A.

Mfg. Co., and is credited with having perfected the first electric transformer.

He remained active head of the organization until his retirement a few years ago.

* * *

FRANK B. RUSSELL of Drexel Hill, Pa., has been appointed direct factory sales representative for the *United Electronics Company* of Newark, New Jersey. The announcement was made by C. A. Rice, vice-president in charge of sales.

Mr. Russell will cover territory including Eastern Pennsylvania, Delaware, Maryland and Virginia.

United Electronics manufactures transmitting and industrial electronic power tubes.

* * *

LT. COL. JOHN F. RIDER has completed three years with the U.S. Army Signal Corps and is now returning to his civilian position as head of *John F. Rider Publisher, Inc.*

He has already begun plans for expanding the Rider Manual activities of the business to embrace television and when it becomes public, radar.

Much of Mr. Rider's efforts at the present time is being devoted to the postwar problems of the servicing industry.

* * *

CHARLES E. YOUNG, former supervisor of Economic Research, has been appointed manager of the newly-created Statistical Research Department of *Westinghouse Corporation* according to the announcement made by F. D. Newbury, vice-president of *Westinghouse Corporation.*

Mr. Young will direct investigations into business condition and study relations of such general trends to Company activities. The Statistical Research Department will also cooperate with headquarters accounting, market research and statistical departments in order to avoid duplication of effort.

Mr. Young holds his B.S. and M.B.A. from Northwestern University.

* * *

THE A. P. FOSTER COMPANY of Lockland, Ohio was recently incorporated and the following officers were named; A. P. Foster, president; R. K. Bolenbaugh, vice-president in charge of engineering; Don Foster, vice-president in charge of manufacturing; A. L. Jonas, secretary; S. J. Schultz, treasurer; and Ruth F. Rolman, assistant treasurer.

The corporation recently purchased a building to house their general administrative offices and laboratory. The new building will increase their present floor space 40 percent.

The company, which was founded in 1938, manufactures hermetically sealed transformers, coils and audio band-pass filters. Postwar plans call for the manufacture of the same items with the addition of fluorescent ballast components.

* * *

JEFFERSON-TRAVIS RADIO MFG. CORPORATION and the *Fonda Corporation* have effected a merger according to the information released by the stockholders of the two companies.

The merged corporation, known as the *Jefferson-Travis Corporation,* will combine the radio equipment field and continuous sound recording industries. Headquarters of the new company will be in New York and field engineering and sales offices will be maintained in Washington, D.C. and Boston, Mass.

Irving M. Felt is the president of the new corporation and other officers include: Edgar Ellinger, Jr., executive vice-president; John T. Filgate, vice-president in charge of engineering and production; Justin C. Harris, treasurer and Frank Baron, secretary.

* * *

A. W. FREESE has been named works manager of plant No. 2, the radio plant of *The Crosley Corporation of Cincinnati.*

Mr. Freese comes to Cincinnati from Chicago where he was vice-president and works manager of the *Majestic Radio and Television Company* of that city.

Prior to that time, he served as secretary and general works manager of the *Zenith Radio Corporation* for eleven years. He is nationally known throughout the radio manufacturing industry.

—30—

For the Record

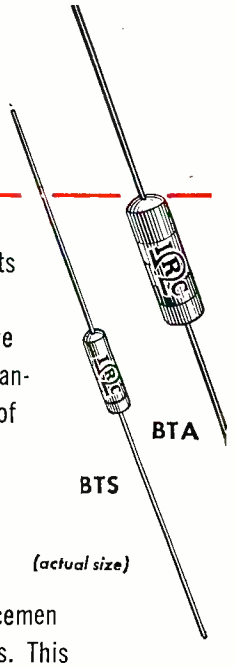
(*Continued from page* 8)

lines. Even with new types of cells, there will continue to be heavy turnover requirements for these vital units.

Civilians will receive, for the first time in months, quantities of dry cells that are in excess of immediate military demands. These will not be the so-called seconds or rejects sold in the past, but will be first-quality, fresh stock. The Army and Navy will come first. What's left will be found soon on the counters.

It will still be some time before we will see any major cut backs for most production schedules. There is considerable optimism at the present time that three companies at least will manufacture receivers before Christmas. This, of course, depends entirely upon military demands. . . . . O.R.

"Big Three" news about BT resistors



1 NEW MIDGET TYPES

To meet the growing demand for smaller, space-conserving components, IRC presents two new insulated METALLIZED resistors . . . Type BTS, ½ watt and Type BTA, 1 watt. Thoroughly dependable and engineered to embody the high-quality standards that have made BT's "preferred for performance", these tiny units can be counted on to do a man-size job. Like other BT's they operate at lower temperature than ordinary resistors of comparative size.

2 NEW LOW PRICES

New methods and new techniques in the stocking and packaging of resistors for Servicemen make possible the introduction of new lower prices on IRC Type BT and BW resistors. This means that you can now buy premium quality resistors at prices comparable to non-branded or "unknowns". For example, here are a few of the typical reductions based on list prices: BTS now 13c (BT-½ was 17c), BTA now 17c (BT-1 was 20c), BT-2 now 25c (was 30c), BW-½ now 15c (was 17c), BW-1 now 17c (was 20c), BW-2 now 25c (was 30c). Under IRC's new price set-up you can operate even more profitably than before.

3 RMA PREFERRED RANGES

IRC's standardization on RMA Ranges in both BT's and BW's as stock values for Servicemen, enables you to replace the same values you take out when making resistor repairs. Long used by set manufacturers, and now adopted by the Army-Navy in Specification JAN-R-11, the RMA Preferred Number System is a mathematical sequence of ranges which gives complete coverage with the least number of values. RMA Ranges listed for ±10% tolerance resistors are carefully spaced so that preceding or following values are never more than 20% apart, thus assuring complete coverage of every value with regularly stocked BT's and BW's.

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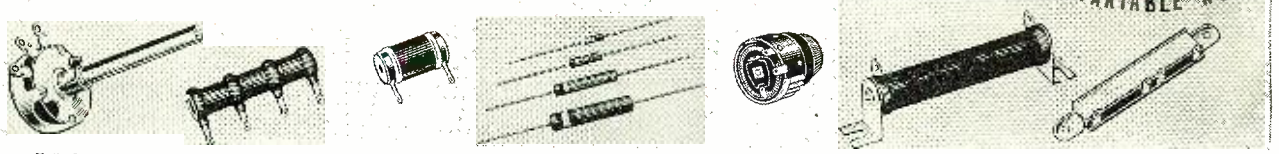
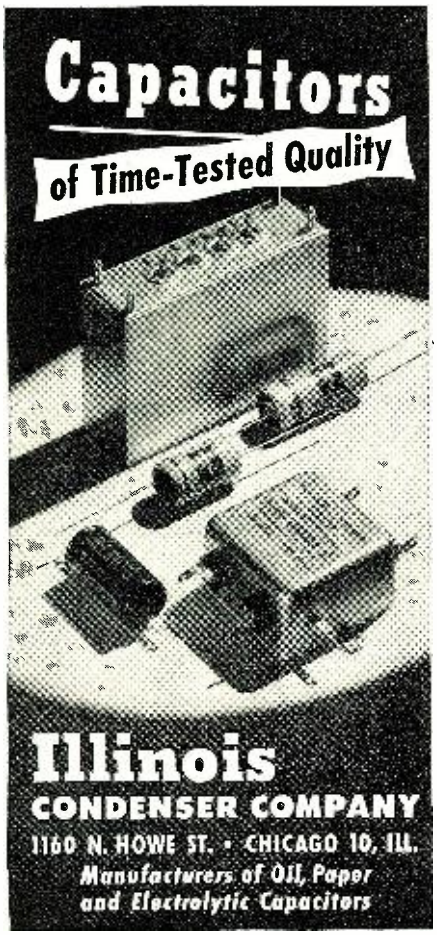




Color Television

(*Continued from page 34*)

The introduction of the three color cycle into a television system requires that some new scanning periods be defined. A "color field" is defined as the interval during which a single primary color is being scanned, normally one cycle of the vertical sweep oscillator. A "frame" retains its conventional definition as the period required to scan every line on the screen, regardless of color. A "color frame" includes the scanning of all three primary colors, and is normally three color fields. A "color picture" embraces the entire cycle of operations and may include several color frames, depending on the interlace ratio.

In order to develop the most practical system and still conform to the limitations of a six megacycle channel, a number of possible combinations of line, color field, frame, color frame, and color picture frequencies was tried, as shown in Table 1. These combinations were judged in terms of definition, flicker characteristics, and color breakup fringes that would appear around rapidly moving objects. System number three was selected as the best combination.

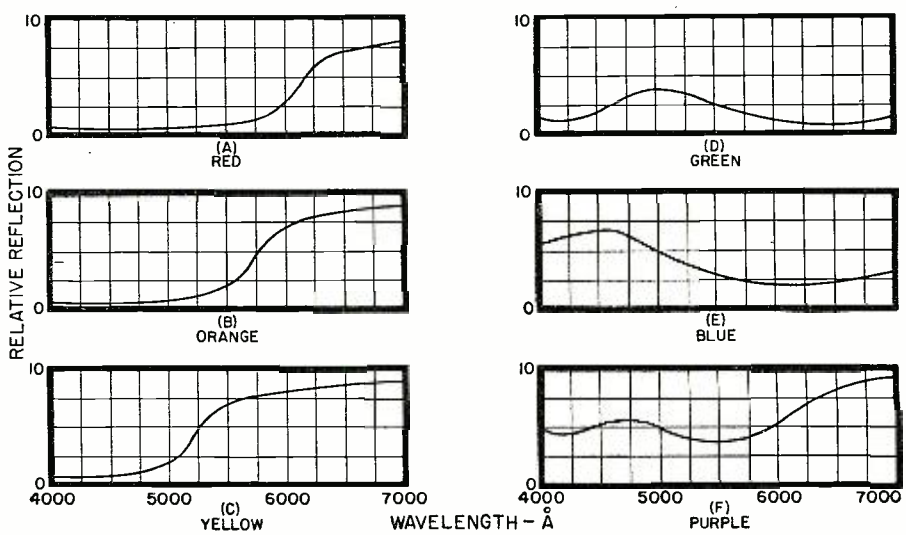
The difference between 525 lines in black and white pictures and 375 lines in system number three represents the sacrifice in definition that is made to add the color. A further sacrifice is made in flicker quality, since only 20 complete pictures are transmitted per second as against 30 in black and white system. Fortunately, the loss of definition is made up to some extent by the presence of color, which seems to add sharpness and brilliance to the picture. At best, however, color system number three represents a concession made to the limitations of available channels. In the future it is expected that wideband amplifiers will be developed further and that frequency allotments in the u.h.f. region will be made to enable a high definition color picture to be transmitted.

The color camera used by CBS is illustrated in Fig. 1. The bulge on the right of the camera houses a sensitive orthicon tube and preamplifiers, while the central part contains the view finder, optical system, synchronous motor, and rotating color drum. This drum has six segments and is driven at 1200 rpm.

The color camera is found to be several times less sensitive than a black and white camera using the same pick-up tube. A considerable loss of light takes place in the color filters, since each filter could theoretically transmit only one-third of the light from a white object, and, in practical cases, transmits even less. The results of this lost sensitivity are that high levels of studio illumination (around 200 foot-candles) must be used, making it difficult for actors to perform without discomfort; that outdoor subjects not in the sunlight are eliminated as program material; and that focusing problems are complicated by wide lens openings. Before the CBS color system can transmit the wide range of program material presently available to black and white television, a pick-up tube more sensitive than the orthicon will have to be developed.

Most of the CBS color studio equipment, such as synchronization signal generators and scanning generators, is similar to conventional television equipment, but at the control panel there is a unit called a color mixer which is special to color work. In this unit, the camera signal is fed into three identical amplifiers, designated as the red, green, and blue channels. A special keying circuit allows each amplifier to operate only during the time its corresponding color field is being transmitted. An independent gain control is thus available for each color. The outputs of the three amplifiers are mixed, and the result is a balanced video signal.

Fig. 9. Spectral reflection characteristics for some typical colored surfaces.



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The operator at the color mixer panel has before him a complete color picture, and he adjusts the balance of the three colors so that the white portions of the picture are as nearly as possible true white. During periods of experimentation, it was found that after a few hours the operator's judgment of what constitutes true white becomes faulty. His situation is similar to that of a person who works for long periods under artificial light and then is surprised to find how blue the daylight is. To correct errors of color judgment, a small panel, illuminated by a standard white light, is mounted next to the operator's color screen so that he has a continuous reference. Of course, at the will of the director it is possible to unbalance colors to produce any special dramatic effect desired.

Another new item of equipment found in the color studio is a signal generator to produce synchronizing signals for the receiver's color disc. This generator produces a square wave whose fundamental frequency is four times the horizontal scanning frequency, or 90 kilocycles. The 90 kc. signal is keyed into the composite video signal during the latter part of the vertical blanking period just before each red color field. In the receiver, a 90 kc. tuned circuit detects these pulses and uses them to establish the phase of the color disc.

A CBS color receiver is illustrated in Fig. 11. With the exception of the color disc, driving motor, and disc synchronizing circuits, it is no different from a conventional black and white receiver. The receiver illustrated produces a six by eight inch picture, and its over-all size is comparable to that of a similar prewar black and white receiver.

In the design of the color disc, advantage was taken of the fact that the image is just a moving spot of light. The center of the disc is located just off one corner of the picture, and its radius need only be a few inches greater than the diameter of the image tube, as shown in Fig. 8A. The direction of rotation is such that it follows the progression of the spot from top to bottom of the picture, so each filter segment can be somewhat smaller than screen size. The development of the shape of a theoretical

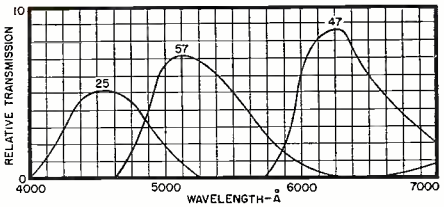


Fig. 10. Spectral transmission characteristics for a typical set of three-color separation filters. These are for Wratten filters, Nos. 47 (red); 57 (green), and 25 (blue) viewed against daylight screen.

filter segment for a 1200 rpm six-segment disc, as shown in Figs. 8A through 8D, is made by plotting the positions at which various lines of the picture image fall on the disc as it is rotated. The filter segments on the actual disc (Fig. 8E) are made much larger than theoretically required in order to allow for phase deviations in the disc and to take advantage of the persistence of the screen.

The driving motor for the color disc is a small 1/20 hp. induction motor whose free-running speed, with the disc connected, is somewhat over the desired 1200 rpm. Control of the disc speed and phase is accomplished by an electromagnetic brake, which is actuated by the receiver's disc synchronizing circuit.

A functional diagram of the disc synchronizing circuit is shown in Fig. 6. Operation of this circuit takes place in two steps, corresponding to the two sections of the diagram. The first section utilizes the color phasing pulses that are sent out as part of the video signal just before each red field, and its purpose is to hold out any further synchronization until the receiver disc drifts close to correct color phase with respect to the transmitter. When the second part of the circuit takes over, it compares the phase of the vertical sweep voltage with that of a 120 cycle voltage generated within the driving motor assembly. The phase relation between these two voltages determines the d.c. current through the electromagnetic brake, thereby locking the color disc into close synchronization with the sweep voltages and hence with the transmitter. The size of the disc segments is such that the disc can deviate up to 4 degrees in either direction without any effect, and the action just de-

Table 1. Chart showing combinations of scanning frequencies that were tried by CBS to obtain a color system for transmission in conventional television channels.

	1	2	3	4	5
Color Field Freq.	60	120	120	180	120
Color Frame Freq.	20	40	40	60	40
Frame Freq.	30	120	60	45	30
Color Picture Freq.	10	40	20	15	10
Interlace Ratio	2–1	1–1	2–1	4–1	4–1
Lines	525	260	375	450	525
Horizontal Oscillator Freq.	15,750	31,200	22,500	20,250	15,750
Color Breakup	U	S	S	S	S
Interline Flicker	U	S	S	D	U
Picture Flicker	U	S	S	S	S

S—Satisfactory U—Unsatisfactory D—Doubtful

scribed has been found capable of holding the disc within this value over a range of motor voltages from 96 volts to 124 volts.

The lower scanning frequencies used with the CBS system require that some attention be given to problems of flicker and brilliance. The Ferry-Porter law states that the critical flicker frequency, below which flicker is apparent to the eye, increases in proportion to the logarithm of the apparent luminosity, regardless of wavelength. To avoid flicker, then, it is necessary to limit the screen brilliance to a point where no flicker will be observed.

The worst possible flicker conditions exist when a pure green color is being transmitted, because a single color appears on the screen only 40 times per second, and green has the greatest apparent luminosity of the three colors. Calculations based on the Ferry-Porter law show that the limiting brightness for a frequency of 40 cycles is 1.8 foot-candles. That figure represents the greatest brilliance which the green component can be allowed to contribute to the picture. Further calculations based on the relative apparent luminosities of the color show that a white area in which the green component has a brightness of 1.8 foot-candles will have a total brightness of 2.7 foot-candles.

On a conventional white screen, a picture whose highlight brightness was limited to 2.7 foot-candles would not be satisfactory because room illumination washes out the blacks and reduces the tonal range and contrast. In the color receiver, however, the attenuation of light by the color disc helps to make practical the lower value of highlight brightness. Light that comes from the screen is attenuated by a factor of about 7 as it passes through the color disc, but outside light that would tend to wash out the dark areas is attenuated two times, once as it passes through the color disc to the screen, and again as it is reflected and passes outward to the observer. The total attenuation of incident light is then about 49 times. The result is that the color receiver's screen appears black (see Fig. 11) and that a highlight brightness of 2.7 foot-candles gives plenty of apparent brilliance.

Another problem that arises as soon as field frequencies are raised above 60 cycles is one of hum. With the 60 cycle field frequency used in black and white transmission, hum in deflection circuits appears as a static distortion of the image, whereas in the CBS color system number three, any hum pickup results in an objectionable 20 cycle color flicker, pairing of some vertical lines in the image, and loss of interlacing. Accordingly, CBS has undertaken research to determine the best methods to shield against hum pickup from the disc driving motor, power supplies, and other 60 cycle components. Effective shields have been developed, but such shielding will

naturally add another increment to the cost of any color receiver.

On the other side of the ocean, Mr. John L. Baird, England's foremost television pioneer, has been responsible for many unique contributions to the science of color television. Although he was the first to demonstrate the use of rotating color discs for color separation, most of his recent experiments have been made with a view toward producing a system in which no moving parts are needed at the receiver, the colors being combined by electronic or optical means. In addition, he has devoted some thought to the possibility of adding stereovision, or third dimension, to color images.

The characteristic of stereovision has been a supplementary feature in nearly all of Mr. Baird's more recent systems. In his "anaglyphic" method, used with a two color system, the images representing the two primary colors (orange-red and blue-green) are picked up from two different viewpoints, corresponding to the position of two eyes. At the receiver, both images are flashed in succession on a white screen, and the observer wears glasses that have one orange-red lens and one blue-green lens. One eye sees the orange-red image, and the other sees the blue-green image, and the two images fuse into a three-dimensional color picture. Another stereoscopic system, more adaptable to three-color work, does not require that the observer wear glasses, but it does require him to sit in a certain spot where two images taken from different angles can be focused by an optical system on his two eyes. In view of the inconvenience to the observer, stereovision is not expected to play an important part in the future of color television any more than it did in movies.

In his search for a means to avoid the use of moving parts at the receiver, Mr. Baird has produced several ingenious systems. In one of these (Fig. 12) the several images were produced side by side on a cathode ray tube, and an optical system accomplished the filtering and recombination; however, it was found that the required optical system was too elaborate. On August 16, 1944, Mr. Baird demonstrated a new system which has evoked considerable interest, both here and abroad, because it seems to afford a practical means of color synthesis without the use of moving parts at the receiver. The heart of the new system is a multi beam cathode-ray tube, shown in Fig. 2 and Fig. 13, for two and three color systems.

The viewing screen on the new tube consists of a thin sheet of transparent mica, the two sides of which are coated with colored fluorescent powders as indicated in the diagrams (Figs. 13A and B). The structure of the tube is such that the image might be viewed from both sides, provided a suitable filter were used on one side to compensate for light transmission through the mica. Alternatively, the screen

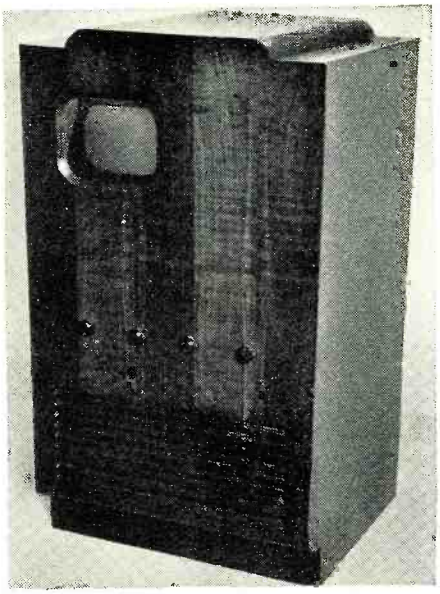


Fig. 11. CBS color receiver, using a 9" tube. Note that the viewing screen appears black due to the presence of the color filters in back of viewing screen.

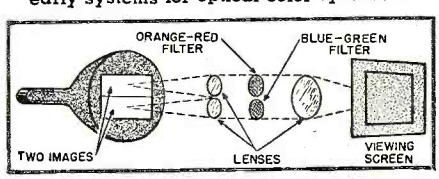
might be arranged for viewing from one side only, in which case a white fluorescent material would be used on the back side and the mica itself colored to filter the light coming through to the front.

The pick-up and transmission methods used in Mr. Baird's recent demonstration exhibit several differences from those used in the CBS system, but most of these differences are matters of experimental convenience rather than differences in principle. A rotating color disc is used for color separation at the transmitter, just as in the CBS system, for as yet Mr. Baird has demonstrated no method for electronic color separation at that point.

One obvious difference is the use of two primary colors rather than three. Most of Mr. Baird's experiments have been carried out with two color systems in order to simplify experimentation and to make use of the anaglyphic method of stereovision. It may be that two color systems will be adopted as standard in England in spite of the inherent color limitation, but it is clear that Mr. Baird has in mind the possible use of three colors since he has proposed a scheme whereby his multi-beam tube could be adopted for three beams (see Fig. 13B).

Another point of difference is the use of the flying spot method of scanning at the transmitter. A scanning raster generated on the face of a high intensity tube is focused by means of a lens on the subject. Photocells grouped nearby pick up the light vari-

Fig. 12. Diagram of one of Baird's early systems for optical color synthesis.



ations as they are reflected from the subject. This form of scanning simplifies experimentation by eliminating the difficulties involved in the use of a sensitive pick-up tube, but it rigidly limits movements of the subject. In a practical color system, a movable camera would be employed.

For his demonstrations, Mr. Baird has lately been using 600-line systems, with scanning frequencies based on 50 cycles. The actual frame and field frequencies varied, of course, with the particulars of the system being worked on at the time. The use of a 50 cycle basis for scanning frequencies is an outgrowth of the extensive use of 50 cycle power lines in England, while the use of 600 lines for color transmission reflects the fact that Mr. Baird's laboratory experiments are not limited to postwar bandwidths. A commercial application of the Baird system would be faced with the same channel limitation problems that have faced CBS engineers from the outset of their experiments.

It is clear that the Baird multi-beam tube could readily be adapted for use with American pick-up and transmission equipment. It, therefore, would be of interest to discuss the relative merits of the two methods of color synthesis, the rotating disc and the multi-beam tube, to determine which one will be eventually used in this country. The rotating color disc has some distinct drawbacks, principally noise, vibration, and loss of light through the color filters. These drawbacks can only be minimized by the use of good motor mountings, soundproof cabinets, and high intensity cathode ray tubes.

On the other hand, there are problems in the use of a multi-beam tube, chiefly those of register and keystoning. The three beams must be made to scan the screen in identical fashion, otherwise the color images will be displaced and fringes of color will appear around objects. Keystoning complicates these problems of register because two of the beams must be made to increase their sweep width near the bottom of the picture, while the third must sweep over its greatest angle near the top. This means that different deflection amplifiers are required for the beams, with the result that changes in circuit constants can affect the register. Certainly the necessity for making readjustments of size and position of three images as the set warms up would be undesirable from the standpoint of the operator.

In considering the possible application of any color system, it is necessary to investigate its suitability with projection, since it is expected that most of the larger postwar receivers will employ this mode of presentation. In a paper published by Dr. Goldmark and his associates in September, 1943, it was pointed out that although the color disc and motor could be smaller and quieter with a projection tube, the loss of light in the color filters

would seriously limit the available illumination. With a given projection tube, the screen diameter would have to be reduced by a factor of about 2.7 to give the same screen brightness. A Baird multi-beam tube adapted for projection would not suffer from filter loss; with careful attention to the fluorescent powders used, it would deliver about the same amount of light as a black and white tube.

Adaptability to black and white reproduction is another important consideration, since receivers for color should also be capable of receiving black and white pictures. A color disc receiver is particularly suitable for this type of service, for it is essentially a black and white receiver in the first place. To change over, it would be necessary only to change the scanning oscillator frequencies and move the color disc out of the way. While movement of the color disc assembly would be difficult in a table model direct viewing receiver, it would be easier in a roomy console model or in a projection receiver where the disc was small. On the other hand, it would be difficult to provide dual service with the multi-beam tube. To make a black and white picture, all three beams would be operated simultaneously. Problems of register would still be present, and these problems would be further complicated by the fact that color fringes caused by off-register operation would be more objectionable in a black and white picture.

The majority of engineers here in the United States feel that the simplicity and reliability of the color disc method, as demonstrated in the CBS color system, dictate its probable use in future color systems. This reliability was exemplified in Dr. Goldmark's lecture before the A.I.E.E.-I.R.E., in the spring of 1944. He pointed out that during the course of experimentation nearly every resistor and capacitor in the equipment had gone out at least once, while the disc motor and brake continued to operate with no trouble. Problems of filter loss in the color disc will introduce considerable difficulty in developing a projection receiver; however, Mr. Baird himself demonstrated such a receiver on December 20, 1940. Baird's receiver produced a 24 by 30 inch picture using a two-color disc and a 30,000 volt tube. It is to be expected that recent developments in cathode ray tubes, power supplies, and optical systems will make it possible to make a practical projection receiver for home use.

At present Mr. Baird is working on a new electronic color system in which successive lines are scanned in different colors. By making the total number of lines an odd multiple of the number of colors, each line would eventually be scanned by every color. The development of such a system would minimize problems of color flicker and color breakup that are inherent in all present color systems.

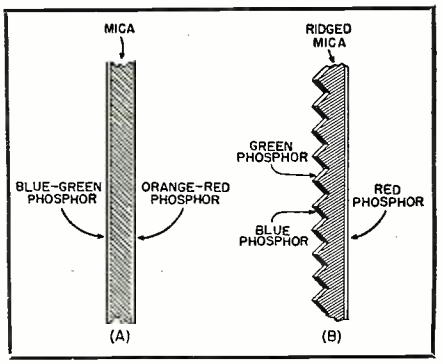


Fig. 13. Magnified cross-section of viewing screen for Baird's multi-beam tube. (A) For two primary colors and two electron beams. (B) For three primary colors and three beams.

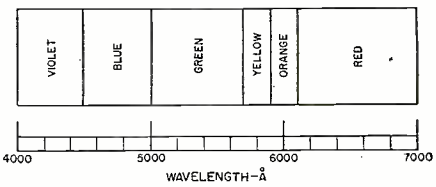
Naturally, a mechanical color disc could not be used because of the extremely rapid change from color to color; both the transmitter and the receiver would have to utilize some form of electronic color separation. If the new system could be developed to compare in simplicity with the color disc method, it would then offer serious competition to the latter. Until that time, American engineers are expected to concentrate on the development of mechanical color separation systems.

The future of color television will depend upon a number of economic as well as technical factors. Some of these economic factors are: The policies of *Columbia Broadcasting System* and other large radio organizations, those of the Federal Communications Commission, and the attitude of the public.

Columbia Broadcasting System's opinion, which is shared by a number of other television interests, has been clearly stated in a number of pamphlets, advertising releases, and statements by their engineers. They feel that the present 525 line black and white pictures and 375 line color pictures are not good enough to form a basis for television in the future. They propose an extension of the video channel to 9.5 megacycles and a corresponding increase in the radio frequency channel to about 16 megacycles, thereby enabling the transmission of 525 line color pictures and 725 line black and white pictures. In order to find room for such wide radio frequency channels, the proposal includes moving up from the present channel assignments below 200 megacycles into the region between 400 and 1000 megacycles.

A similar proposal was made in England, sponsored by Baird and others.

Fig. 14. Spectrum showing relationship of spectral colors to wavelengths of light.



Both here and abroad, these proposals have aroused active controversy. Manufacturers who sold sets before the war have, in many cases, contested them on the grounds that present pictures are good enough, and that set owners would be disgruntled by the sudden obsolescence of their equipment. While present standards might be "good enough" for black and white pictures, there is no question that they would not allow a satisfactory commercial application of color television.

In their recently announced frequency allocations, the Federal Communications Commission gave some encouragement to the new plan. While a series of 6 megacycle channels was assigned in the lower frequencies to enable the industry to continue substantially where it left off at the outset of the war, the region between 480 and 920 megacycles was set aside for television experimentation with no limitations as to band-width. Along with the new allocation came an encouragement to experiment with these new frequencies and the definite indication that a good part if not all of the television industry would eventually have to move to the upper frequencies in order to provide a good competitive basis for future expansion.

Accordingly, the television industry may be expected to undertake serious experimentation on high frequencies as soon as the cessation of war work makes it possible for them to do so. CBS claims that 80 to 90 percent of the experimentation necessary to render high definition color and black and white service on the high frequencies has been completed, and that they, in cooperation with *Federal Radio and Telephone Corporation* and *Zenith Radio Corporation,* could demonstrate the necessary equipment within a year or two after the war. While prewar developments would not indicate such progress, the CBS estimate takes into consideration the accelerated development of high frequency apparatus brought on by the war. Only the future can determine the accuracy of their estimate.

It is clear that, barring some radical changes in policy, the advent of color television will depend on the movement of a good part of the television industry into the upper frequency brackets. Such a transition will involve many enormous problems, such as duplicate transmission on two standards, obsolescence of old sets, and convincing the television listener that he should demand better standards and that his investment in new equipment will not be jeopardized in a few years by a new system. A detailed discussion of these problems is beyond the scope of this article, but the writer feels that it will take several years, even after technical details are perfected, for the various interests in the television industry to iron out their differences and accomplish a smooth and economically practical transfer to standards which will enable the transmission of high quality color pictures.

Based on data presently available, it is possible to form a fairly accurate picture of the television receiver that will be offered to the public once the foregoing problems have been solved. It will be a large console model employing the projection method to produce a picture approximately 18 by 24 inches. It will be capable of receiving 725 line black and white color pictures as well as 525 line color pictures. In addition, it will probably contain provision for receiving conventional radio programs, as well as a phonograph pick-up.

The r.f. frequencies for television will be between 400 and 1000 megacycles. Such frequencies will require highly directive antenna arrays, not only to make up for the loss in sensitivity occasioned by the small size of a single dipole at such frequencies, but also to help avoid troubles due to multipath transmission. So that it will be possible to receive stations from different directions, several arrays will be needed for each installation, or a single array may be used if it is rotatable. The great amount of research performed during this war on the subject of directional antennas and their mass production will make such arrays commercially practicable.

Converter and r.f. circuits will employ concentric line resonators and cavity resonators, and extensive use will be made of special u.h.f. tubes developed during the war, such as the *G.E.* Lighthouse tube. Wide-band i.f. amplification, color synchronization, and special power supplies will require that several more tubes be used compared to present television receiver practice.

Such receivers, with their associated antenna equipment, will certainly not be cheap. It will be necessary to impress upon the customer, as A. D. Sobel pointed out in his recent RADIO NEWS article, that he must not expect television sets to become more inexpensive, but rather that he can expect technical improvements to give him more for his money as time goes on. The owner of a receiver will regard it as an investment, just as he does his automobile. He will place it in a prominent position in his home; and he and his family will enjoy the superlative entertainment of world events and dramatic episodes, brought to their living room in full color.

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Spot News

(*Continued from page* 16)

. . . This brings total cost of the transmitter-receiver combination and accessories well below the pre-war level. The same model equipped with a storage plant unit, instead of a dry-battery unit, will retail at a higher figure. . . . Prospective purchasers of light planes, however, won't have two-way radio identified as an extra cost item. Lightplane manufacturers plan to offer the airplane as a complete package at one price, as is done in the automobile industry.

THE GOVERNMENT VIEW on VE day as concerning radio was made clear before the whistles celebrating Germany's defeat had stopped blowing. Perhaps more than most other industries which have had a major role in the war, radio will see a minimum cut-back. It still has a huge job ahead. . . . Summing up for Federal agencies, FCC Chairman Paul A. Porter said, "I do not anticipate any substantial changes in the policies of the FCC until the Stars and Stripes are firmly planted in Tokyo. We are in constant touch with the War Production Board and are aware of their plans for the gradual reconversion of plant and facilities for the production of communications equipment. It does not appear that there is any immediate prospect for relaxation of the Commission's freeze policies." . . . Mr. Porter pointed out that demands upon the communications industry for the Pacific War will continue heavy for some time, but held out at least a ray of hope for civilian interests. "We will coordinate licensing functions closely with the realities of production," he promised, "and when it becomes possible to make available manpower and materials for new construction or the improvement of existing facilities, all interested parties will have a full and equal opportunity to have their matters considered by the Commission. Ample notice will be given concerning any change of existing policies or procedures." The FCC Chairman went out of his way to congratulate the industry on the job done thus far: "Broadcasting has distinguished itself during the first phase of this war and other communication services have performed miracles in the face of great obstacles. But no relaxation can come till complete victory is achieved."

FINAL FREQUENCY ALLOCATIONS to the non-governmental radio services in the spectrum between 25 and 30,000 megacycles were announced by FCC, May 17. There was one exception, the 44 to 108 megacycle region is left unassigned pending outcome of measurements and tests of FM transmission during the coming summer. This space is to be allocated as follows: 36 megacycles to television, 18 megacycles to FM, 2 megacycles to

facsimile, 4 megacycles to the amateurs and 4 megacycles to non-government fixed and mobile services. Precise allocation within that region to the above services remains undecided, but FCC indicated three possible alternative allocations, which turn upon the exact location of FM. The three alternatives for FM are: (1) 50-68 mc., (2) 68-86 mc., and (3) 84-102 mc. The Commission also announced that with the cooperation of the radio industry it is immediately planning to proceed with tests designed to determine the best of the three alternatives. The Commission explained its decision not to make final allocation for FM at this time would not hamper future development of that service because FCC has received from the War Production Board advice that the radio industry will not resume production of new FM, AM and television transmitters and receivers "in 1945 or even in the first part of 1946 unless Japan capitulates." A small quantity of receivers and possibly a few transmitters may be made available before the end of the Pacific war, however . . . Allocations announced by FCC probably will be ordered into effect, service by service, with the Commission taking into account such factors as availability of manpower and materials, results of the Inter-American conference at Rio, and preparation of the Commission's rules and standards. . . . The allocation table released by FCC makes the unassigned space available as follows: 2 mc. are added contiguous to the FM band of 18 mc. width wherever that band is finally placed. Initially, these 2 mc. will be available for stations giving a facsimile service exclusively, but manufacturers of FM receivers should include these 2 mc. in new FM receivers since it is contemplated that facsimile may move above 400 mc., thus making these 2 mc. available for FM. In the proposed report, no separate assignment was made for facsimile below 400 mc., except insofar as it was stated that FM stations might be authorized to employ facsimile during hours when they are not rendering aural broadcast service. The remaining 4 megacycles, which were unassigned in the report, have been made available to the safety services. As a result of this and also as a result of making some changes in channel widths, a total of 139 additional channels have become usable to the fixed and mobile services in excess of those in the proposed report.

Personals

L. W. Adkins, of Cincinnati, has been appointed chairman of a special RMA contract terminations committee, having jurisdiction in that field with the Armed Services. He succeeds **E. E. Lewis** of Camden, N. J., resigned. **Ray F. Sparrow** of Indianapolis is vice-chairman. . . . **S. J. Novick,** president of the Electronic Corporation of America, was feted at a Labor-Management dinner held in Chicago. . . . **William J. Turnbull** has been

named assistant director of procurement by the Glenn L. Martin Company of Baltimore. . . . **John B. Harlow,** contract license manager of Western Electric's Electrical Research Products Division, passed away at the age of 61. He was associated with the Bell System for 35 years. . . . **Marshank Sales Company** of Los Angeles has moved to a new and larger location at 672 S. Lafayette Park Place. . . . **Frank W. Warner** has been appointed director of purchases in the manufacturing division of the Crosley Corporation. . . . **Will Whitmore** has been named advertising manager of Western Electric Company. . . . **Anthony Acquaviva** of Philadelphia was the first veteran of World War II to receive a Bendix Radio dealer franchise. . . . **J. E. N. Hume** and **J. W. Belanger** have been named assistant managers of sales of the Apparatus department of General Electric . . . **Charles Eisler,** head of Eisler Engineering, celebrated his and his company's 25th anniversary recently.

—30—

Practical Radar
(*Continued from page* 41)

of the wave from the master oscillator stage is not important, but the wave must be recurrent at a fixed frequency representing the p.r.f. of the radar set.

This initial wave form is then applied to a series of distortion pulse-shaping, and amplifying stages to achieve steep-sided voltage pulses of a given duration. Diode and triode limiting amplifiers, distortion or differentiator amplifiers, clamping circuits, and other forms of special stages are employed. Conventional buffer amplifiers are sometimes used to separate two adjacent and similar functions which might react on each other, and cathode followers are widely used as impedance-matching devices to prevent distortion of the sharply defined, final control voltage.

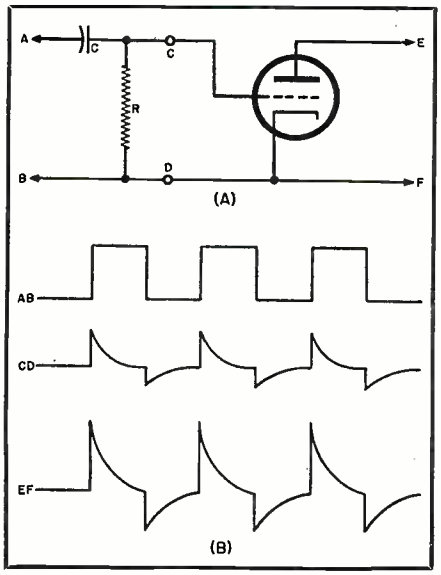
All of these special types of electronic circuits assist in the shaping of the output pulse form of the electronic timer *without affecting the pulse recurrence frequency of the wave form.*

The number of such stages used in an electronic timer will vary considerably with different types of radar sets. In some cases these pulse-forming stages may be reduced to a minimum, or even omitted entirely. But in all such cases—as we have already noted—the resultant output wave form will not be sharply defined, and will vary slightly in frequency or pulse duration or both because of lack of stability. This condition will result in slightly inaccurate range readings on the oscilloscope. But in some types of extremely portable radar sets, this is not too objectionable.

For purposes of our discussion, however, we will assume the more normal type of operation where a fairly high degree of accuracy is required. And the electronic timer, therefore, is called upon to generate an output control pulse that is stable in frequency and duration.

Four representative types of electronic timers have been selected to illustrate means of generating, timing, and shaping the radar control pulse.

Fig. 11. Short time constant (RC) circuit used to produce sharp pulses by differentiation.



Sine-wave-Oscillator Timer

One type of electronic timer (Fig. 9) is known as the *sine-wave-oscillator*

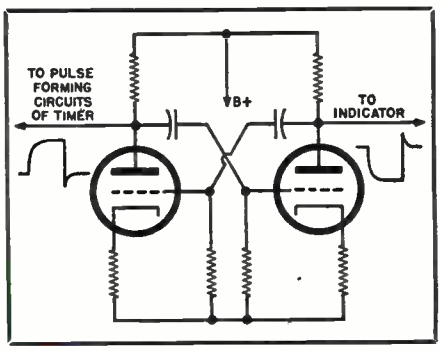


Fig. 12. Multivibrator circuit.

timer, since the initial stage of the circuit consists of a generator of sine waves. These sine waves would recur at a fixed frequency equal to the pulse recurrence frequency of the radar set.

Since the p.r.f. for most radar sets is relatively low in the audio spectrum —between 250 and 5000 per second— satisfactory frequency stabilization of the master sine wave oscillator can be achieved without the use of crystals.

Any of the several types of oscillators can be employed to generate sine waves.

The Hartley, Colpitts, Meissner, tuned-grid tuned-plate, or similar circuits may be used, providing some degree of resistance or impedance stabilization is introduced into the oscillator stage.

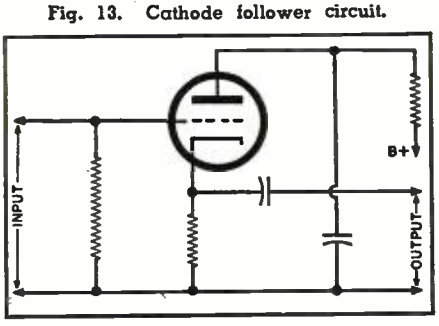
The triode phase-shaft (transitron) oscillator is occasionally used in electronic timers. The output of a triode is passed back through three successive resistance-capacitance stages which shift the phase of the original plate signal by 180°. This phase-delayed voltage is then applied to the grid of the triode, creating and sustaining oscillations.

But the most stable sine wave oscillators for radar use are those circuits employing bridge stabilization. There are two general types: the Wien-bridge oscillator (Fig. 5) and the Wheatstone-bridge oscillator (Fig. 2), both of which are constant-frequency devices of high selectivity.

Having generated a pure sine wave in the initial stage of the electronic timer (Fig. 9), the signal is then applied to a Class A (distortionless) amplifier to increase the voltage amplitude to a very high value. Sometimes more than one stage of amplification is necessary for this purpose.

The signal voltage is then applied to

Fig. 13. Cathode follower circuit.



a diode limiter, which is connected in such a way that it acts as a half-wave rectifier—diminishing one-half of the sine wave cycle. The other half-wave remains at a relatively high voltage amplitude, however, and is next applied to an over-driven amplifier.

One of the most common of the many distortion circuits applicable to radar is the overdriven amplifier, or squaring amplifier. The tube itself may be an ordinary triode or tetrode, operating with normal plate voltage, with the grid biased at about cut-off. Instead of using a normal input signal voltage on the grid of the tube, however, the full signal voltage from the diode limiter is applied directly to the grid. The resulting output wave form is shown in Fig. 9. The flat top of the wave is caused by a "damping" effect when excessive grid current is allowed to flow; the flat bottom is due to the plate-current cut-off characteristic of the tube. The *effective* grid potential differs from the actual input wave due to the heavy "loading" effect or "damping" effect caused by the flow of grid current. The plate voltage variations follow grid changes, and produce steep-front waves approaching the shape of square waves.

This voltage is then applied to a distortion circuit consisting of a short time constant (RC) stage followed by an amplifier, as shown in Fig. 11.

When the leading edge of a steep voltage wave is applied to a condenser of an RC circuit, the condenser charges according to an exponential curve. And the current in the RC circuit jumps to maximum and then decreases according to an exponential curve. The resultant voltage drop across the resistor of the circuit likewise jumps to maximum and then decreases according to an exponential curve.

By tapping off the voltage across the resistor of the short time constant (RC) circuit, we are able to obtain a peaked wave shape with a sharp, steep leading edge (Fig. 11). We ignore the diminished negative-going peak, since we are only concerned with the positive-going half cycle of the peaked wave.

The change which we have performed on the original square-wave voltage is known as differentiation or peaking. And the short time constant (RC) circuit is sometimes referred to as a *peaking circuit*.

The peaked wave form is then applied to an amplifier stage to increase the amplitude of the peaked wave.

At this point in the timing circuit, shown in Fig. 9, part of the timing signal is fed directly to the indicator circuits where the peaked wave is used to trigger the time base of the oscilloscope and to perform other control and synchronizing functions. But since we are concerned only with the detailed action of the electronic timer, let's continue with the control signal voltage as it passes through the timing circuits.

An examination of the peaked wave voltage at the first differentiator amplifier (Fig. 9) shows that we have created something of a triangular pulse, which we know will recur regularly at the p.r.f. established by the sine wave oscillator. At this point in the circuit, the triangular pulse could be applied to the radar transmitter and it might trigger the transmitter tubes at the proper p.r.f. However, we must not overlook a second important dimension of the radar pulse: the length or duration.

The triangular output wave of the first differentiator amplifier has no measurable width at any point along the slope; further, the pulse is much too wide to be of any practical use. We must, therefore, repeat the entire process of differentiation and amplification in order to produce a much narrower and more sharply defined pulse.

Any desired pulse width can be obtained in the process of differentiation, by choosing appropriate values for the resistance and condenser in the short time constant (RC) circuit—which will, in turn, determine the slope of the trailing edge of the signal pulse.

The output of the second differentiator amplifier can thus be of the required duration for operation. At this point, however, the amplitude of the pulse is too great to

apply to the transmitter—since it might overload the first amplifier or modulator units. Accordingly, the pulse is passed through a limiting amplifier—which may be either a diode or triode—to shear off all unnecessary voltage.

The pulse form is then passed through a cathode follower stage, which merely serves to match the output impedance of the electronic timer to the input impedance of the radar transmitter.

Thus, the sine-wave-oscillator timer has generated and formed a series of recurring pulses—of the proper duration and amplitude, and at the proper p.r.f.—which can now be used to control the action of the transmitter.

Blocking-Oscillator Timer

Another type of electronic timer (Fig. 8) uses a blocking oscillator in the initial stage of the timing circuit.

A single-swing blocking oscillator generates a complete audio-frequency cycle, then pauses briefly before permitting another oscillation to take place. This type of oscillator (Fig. 3) is somewhat similar in operation to the sine wave oscillator previously described, except that the oscillations are *not* continuous.

These interrupted oscillations are generated when the plate and grid circuits of the master oscillator tube are coupled tightly and the grid acquires a high voltage at the peak of each cycle. If the flow of grid current causes secondary emission within the tube, the grid will become more positive with respect to the cathode and there will be a heavy "damping" effect. This will cause the oscillation to cease after one complete cycle, and a further oscillation will not take place until the tube is restored to normalcy.

This form of oscillator is similar to but not the same as a squegging oscillator, which will be discussed next month.

To produce interrupted oscillations by either blocking or squegging, it is necessary to have a grid bias RC circuit with a long time constant and have very close coupling between the plate and grid circuits of the oscillator tube.

The recurrent wave form generated by the blocking oscillator may not always be a perfect sine wave, but in this case the presence of some distortion is not objectionable.

After leaving the master oscillator (Fig. 8) the wave form is applied to one or more stages of Class A or Class AB amplification to increase the voltage amplitude of the wave. An attempt is usually made to protect one half of the cycle from distortion—to the detriment of the other half-cycle of oscillation. Then, when the wave form is passed through a limiting amplifier—consisting of either a diode or triode—the unwanted (heavily distorted) half-cycle of oscillation is removed, as shown in Fig. 8.

This results in a positive-going high-voltage pulse of rather long duration, which is next applied to a pulse-shaping line—sometimes known as a charged line.

A pulse-shaping line consists of a number of series coils and shunt condensers arranged in a pi- or H-ladder network, as shown in Fig. 4. The line is terminated in a short circuit.

When a sudden burst of high voltage is applied to the input terminals of the pulse-shaping line, electrical energy travels down the line and is then reflected back to the input terminals. The time required for the energy to travel down the charged line and back to the input terminals is dependent upon the electrical length of the line. When the energy is reflected it is reversed in polarity, so that the resultant wave form at the terminals of the charged line will be a square wave *whose duration is twice*

(Continued on page 146)

the time taken for the energy to travel from the input terminals to the short-circuited end of the line. It should be noted that the duration of the output pulse is entirely independent of the duration of the original burst of voltage applied to the pulse-shaping line. The original burst of voltage merely serves to *actuate* the charged line, and the shape of the output pulse depends entirely upon the electrical characteristics of the line. The output wave form from a pulse-shaping line is generally of much greater amplitude than the original input burst of voltage.

For the pulse-shaping line to be of practical use, it will be necessary to provide some means of switching after the original input voltage has been applied to the line. Otherwise the reflected pulse would return to the plate circuit of the previous stage. An electronic switch solves this problem, causing the reflected pulse from the charged line to pass to the next stage of the timer.

It should be noted that the output wave form from the charged line is a sharply defined, steep-sided pulse having a precise duration. Since the actuating bursts of voltage occur at the established p.r.f., the output pulse of the charged line will likewise recur at that frequency.

After the control pulse has passed through a second limiter stage (Fig. 8) to diminish any excessive amplitude, the pulse is ready to trigger the radar transmitter—having the required duration, amplitude, and pulse recurrence frequency.

The indicator circuits of the radar set may sometimes be controlled and triggered by means of a multivibrator, as shown in Fig. 8. The multivibrator completes one cycle of oscillation each time an output control pulse travels from the timer to the transmitter, and the action of the multivibrator is controlled entirely by the electronic timer.

Multivibrator Timer

Another type of electronic timer (Fig. 6) uses a multivibrator as a master oscillator, and then shapes a pulse much in the manner of the sine-wave-oscillator timer previously described.

The multivibrator finds a wide use—both in timing circuits and in relay and control circuits. One reason for this is the simplicity with which required timing signals can be produced for a number of different components. Both positive-going and negative-going voltage impulses of equal but controllable width can be produced simultaneously on the two plates of the multivibrator tubes (Fig. 12), which makes the wave forms ideal for radar requirements.

In the multivibrator timer (Fig. 6), however, we are only considering the positive-going voltage wave output of the oscillator. The negative-going voltage wave—symmetrical to the positive-going wave, but 180° out of phase—normally would be passed to the indicator circuits as indicated.

A conventional, free-running, asymmetrical multivibrator furnishes a slightly distorted pulse of rectangular shape (Fig. 6) which would recur at a given pulse recurrence frequency of the radar set. A suitable choice of condenser and resistance values in the multivibrator circuit will result in any frequency of operation.

Following the master oscillator stage, a delay circuit is introduced in this particular timer, in order to make the leading edge of the positive-going control wave coincide with the leading edge of the negative-going wave which went to the indicator circuits. This delay circuit introduces no physical change in the shape of control wave, but merely retards the control wave with respect to time—by shifting the phase 180°.

This wave shape is then applied to a conventional resistance-capacitance short time constant (RC) circuit which, as we have previously mentioned, results in a peaked wave form across the resistance. This voltage is fed to the grid of an amplifier stage, and the output of the differentiator amplifier is applied to a limiting amplifier.

After the amplitude of the pulse form has been limited or reduced to its proper value, the control pulse—of proper duration and p.r.f.—has been established.

A cathode follower may be used to match the output impedance of the electronic timer to the input imped-

ance of the radar transmitter. But since a cathode follower is in reality a distortionless unity-amplifier (Fig. 13), the control pulse will not be affected by the addition of this isolating stage.

Rotary-Spark-Gap Timer

Timing circuits are not always separate or complete components within the radar set. They may be located physically with the transmitter, receiver, or indicator units; or they may be divided among several main components.

One important type of such a timing circuit (Fig. 7) could be contained entirely in the radar transmitter. It is known as a *rotary-spark-gap timer,* and directly controls the action of the transmitter—usually without benefit of amplifier or modulator stages, since this type of timer is a high-voltage modulating device.

A spark gap consists of two electrodes between which a very high difference of potential exists. If the spark gap can be made to discharge or conduct, an arc will take place between the two electrodes and this burst of energy may then be used to produce radar pulses.

A *rotary* spark gap consists of one fixed electrode and a number of secondary electrodes circularly arranged on a metal wheel. As the wheel is rotated, the secondary electrodes in turn approach the fixed electrode and a brief arc discharge takes place between the two elements.

The number of spark-gap discharges per second can be varied by changing the speed of the revolving wheel. The rotary spark gap could, therefore, be used to establish the basic pulse recurrence frequency of the radar set.

The sudden bursts of energy during the arc discharge are not sharply defined, however. They usually appear as very ragged and distorted pulses. But they are of such extremely high voltage, the bursts of energy can be used to shock a pulse-shaping or charged line—much in the manner of the blocking-oscillator timer, previously described.

Accordingly, the output impulses from the rotary spark gap are applied to a pulse-shaping line. This energy is reflected back from the short-circuited charged line as a very high-voltage pulse having sharply defined steep sides and a duration dependent only upon the electrical constants of the pulse-shaping line.

The voltage of this output pulse is of sufficient magnitude to trigger *or modulate* the radar transmitter *directly.*

By placing a fairly high resistance between the output and ground (Fig. 7), a smaller "edition" of the output control pulse can be obtained for triggering the indicator circuits.

In contrast to the timing systems which we discussed previously, the rotary-spark-gap timer is inherently unstable. This is generally true of all radar transmitters which are self-syn-

(*Continued from page* 144)

chronized, transmitters which do not have separate timing circuits.

Related Functions of Timer

The output control pulse from the electronic timer to the radar transmitter is usually a voltage pulse. The timer is seldom called upon to deliver substantial amounts of power, since the transmitter usually provides one or more stages of power amplification before the control pulse is applied to the r.f. transmitter tubes. However, if the control pulse from the timer were applied *directly* to the transmitter tubes, as in the case of the rotary-spark-gap timer just described, the control pulse from the timer would have to carry sufficient "kick" to modulate the high-frequency tranmitter tubes.

A radar set could be designed to operate over more than one range. In that case the timing circuits would be suitably changed to permit the instant use of more than one established pulse recurrence frequency — since every maximum range has a corresponding optimum value of p.r.f. This change in the timing circuits could be accomplished by means of switches which alter the value of critical resistors and condensers. Usually the only change necessary would be in the master oscillator stage which controls the pulse recurrence frequency of the control pulse.

The electronic timer may be called upon to produce, *in addition to the basic control pulse,* any number of special controlling wave forms affecting other components of the radar set. A square-wave voltage may be required to "block out" a portion of the oscilloscope time base during a particular portion of the out-and-back cycle of the radar pulse. If a radar set used only a single antenna for both transmitting and receiving, it might require a switching voltage wave form from the electronic timer—to separate the received echoes from the transmitted pulses. It might also be necessary for the electronic timer to supply the radar receiver with a "blocking" voltage, so that the first stage of the receiver would not be saturated and damaged during the brief period when the transmitter is pulsing high-frequency energy. The indicators of most radar sets usually require special control wave forms from the timer, in addition to the pulse that triggers the linear time base of the oscilloscope. These secondary functions of the electronic timer will be discussed in future articles of this series, and it is sufficient to note at this time that all of these secondary voltages and wave forms are directly related in phase (time) with the basic control pulse which modulates the radar transmitter.

Ed.—In a coming article, the practical operation of the radar transmitter will be considered, with new and important u.h.f. techniques put to a practical use in radiating the radar pulse into space. —30—

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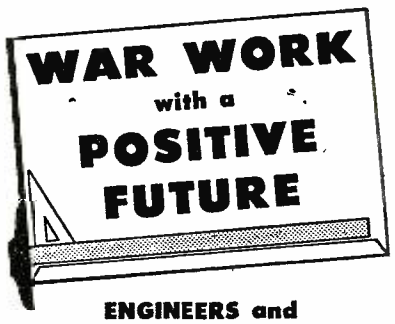

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Speaker Enclosures

(*Continued from page* 49)

with hair felt if possible. This can be obtained from auto supply houses as it is used under car floor mats, or may be the felt pad intended for ironing boards. In the absence of these, a blanket can be made with rock wool insulation and a piece of cloth or, as a last resort, a piece of celotex could be used. The idea is to absorb the high frequency radiations from the back of the speaker so they will not be able to reflect from the back of the baffle and, being out of phase with the speaker cone, cancel out some wanted frequencies therefrom.

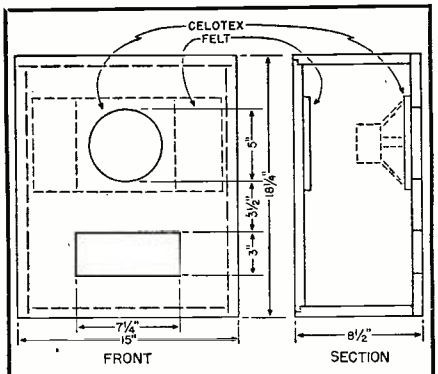
If a less elaborate enclosure is desired, the dimensions for a smaller, simpler model are given in Fig. 5. This houses a single heavy duty six-inch speaker. The author has been using this identical speaker system as a monitor speaker on a 15-watt, 2A3 amplifier, and the results are very good.

The approximate dimensions for bass reflex enclosures for different size speakers are given in Fig. 5, and you will see that even the largest enclosures are not too big for an average living room. Of course, an enclosure might be concealed in a bookcase or closet. The variations are practically limitless. You can arrange it to suit your own personal needs.

(Ed. Note: For further information on phasing of loud speakers, we refer you to an article appearing in the April, 1945 issue of Radio News, entitled "Phasing of Loud Speakers.")

—30—

Fig. 5. Mechanical dimensions for an enclosure employing a 6" speaker. Table shows cabinet size for other speaker sizes.



12" (or two 8") speakers.....
.....12" x 22" x 31"
15" (or two 10") speakers.....
.....13" x 25" x 33"
18" (or two 12") speakers.....
.....14" x 27" x 35"
All dimensions are o.d., assuming ¾" plywood.

Saga of the Vacuum Tube

(*Continued from page* 62)

a cylindrical element assembly with axial tungsten filament and having a life of 600-1,000 hours, whereas the American tubes were of plane parallel electrode construction, using oxide-coated cathodes with platinum-iridium cores, and with an operating life of 1,500 hours.

The first German oxide-coated cathode tubes using platinum-iridium cores appeared about 1923, with a life of 3,000 hours, and were not in full use until 1925. By 1922, however, the American tubes had been equipped with platinum-nickel cores, with a life of 20,000 hours. The use of platinum-nickel filament cores and plane parallel electrode systems was introduced into German practice about 1933, by which time the American practice had abandoned the open construction and was using a completely enclosed electrode system, of oval section to permit the utilization of a W-shaped filament. The filament current in the standard American repeater tubes was reduced to .5 ampere in 1927, with the same performance, whereas this did not take place in German practice until 1933.

The corresponding development in Germany of the vacuum tube as applied to radio, as distinct from wire practice, will be covered in a subsequent installment in this series.

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CAPTIONS FOR ILLUSTRATIONS

Fig. 196. Siemens & Halske Mechanical Repeater. Reproduced from Siemens Zeitschrift—1941.

Fig. 197. Modified von Lieben tube with concentric element assembly. Reproduced from Archiv fur Geschichte der Mathematik, der Naturwissenschaften und der Technik—1930-31.

Fig. 198. Siemens & Halske type "Mc" telephone repeater tube. Left—Experimental model. Center and Right—Production type tubes. Reproduced from S. & H. Veröffentlichungen, 1935.

Fig. 199. Siemens & Halske type "BF" tube. Left—Experimental model (1920) using glass star. Right—Production type tube. Reproduced from S. & H. Veröffentlichungen, 1935.

Fig. 200. Siemens & Halske type "BO" tube. Reproduced from Elektrische Nachtichtentechnik—1925.

Fig. 201. Siemens & Halske type "OCK" tube. Left—Early construction with glass bracket for cathode attachment. The grid is unsupported at the upper end. Right—Later construction with better reinforcement. Reproduced from Siemens & Halske Veröffentlichungen—1935.

Fig. 202. Siemens & Halske type "CO" tube. Reproduced from S. & H. Veröffentlichungen, 1935.

Fig. 203. Latest developments (1935) in telephone amplifier tubes made by Siemens & Halske. Left—Type "Ba," which replaced "BO." Center—Type "Ca," which replaced "OCK." Right—Type "Da," which replaced "CO." Reproduced from S. & H. Veröffentlichungen—1935.

Fig. 204. Siemens & Halske type "110" tube. Reproduced from "Taschenbuch der drahtlosen Telegraphie und Telephonie" edited by Banneitz, published by Springer, Berlin, 1927.

(To be continued)

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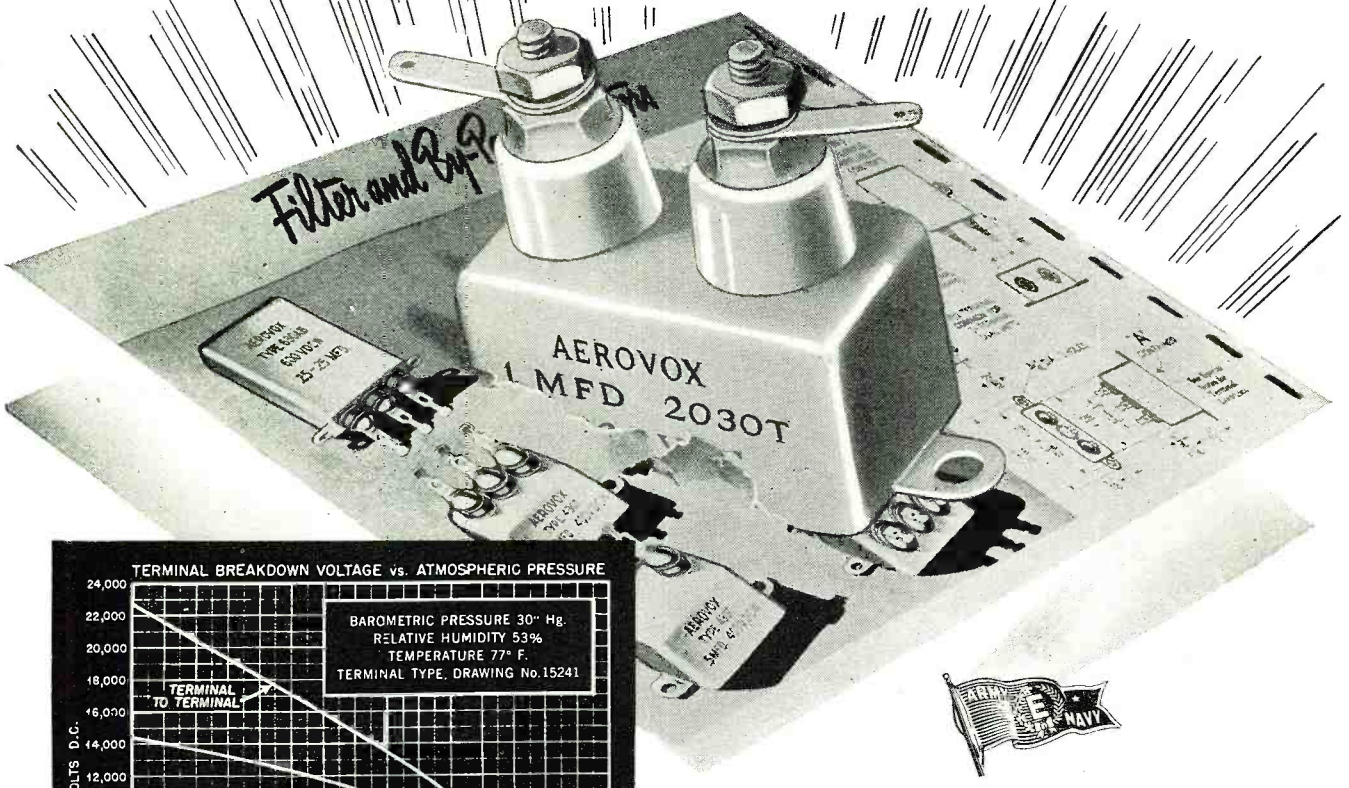

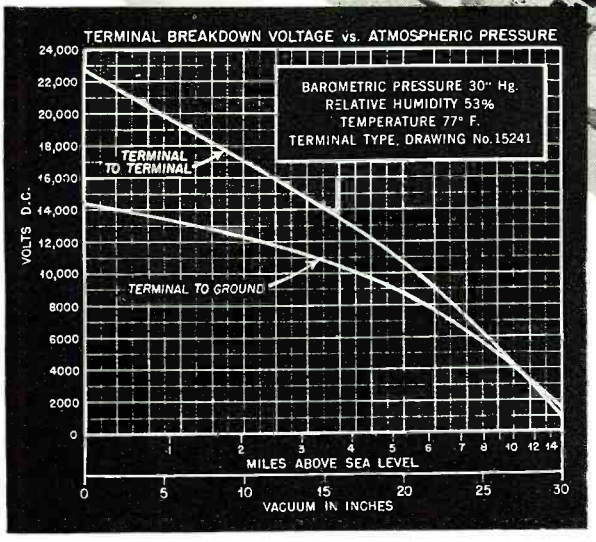

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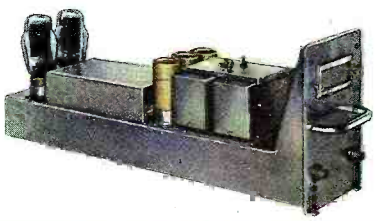

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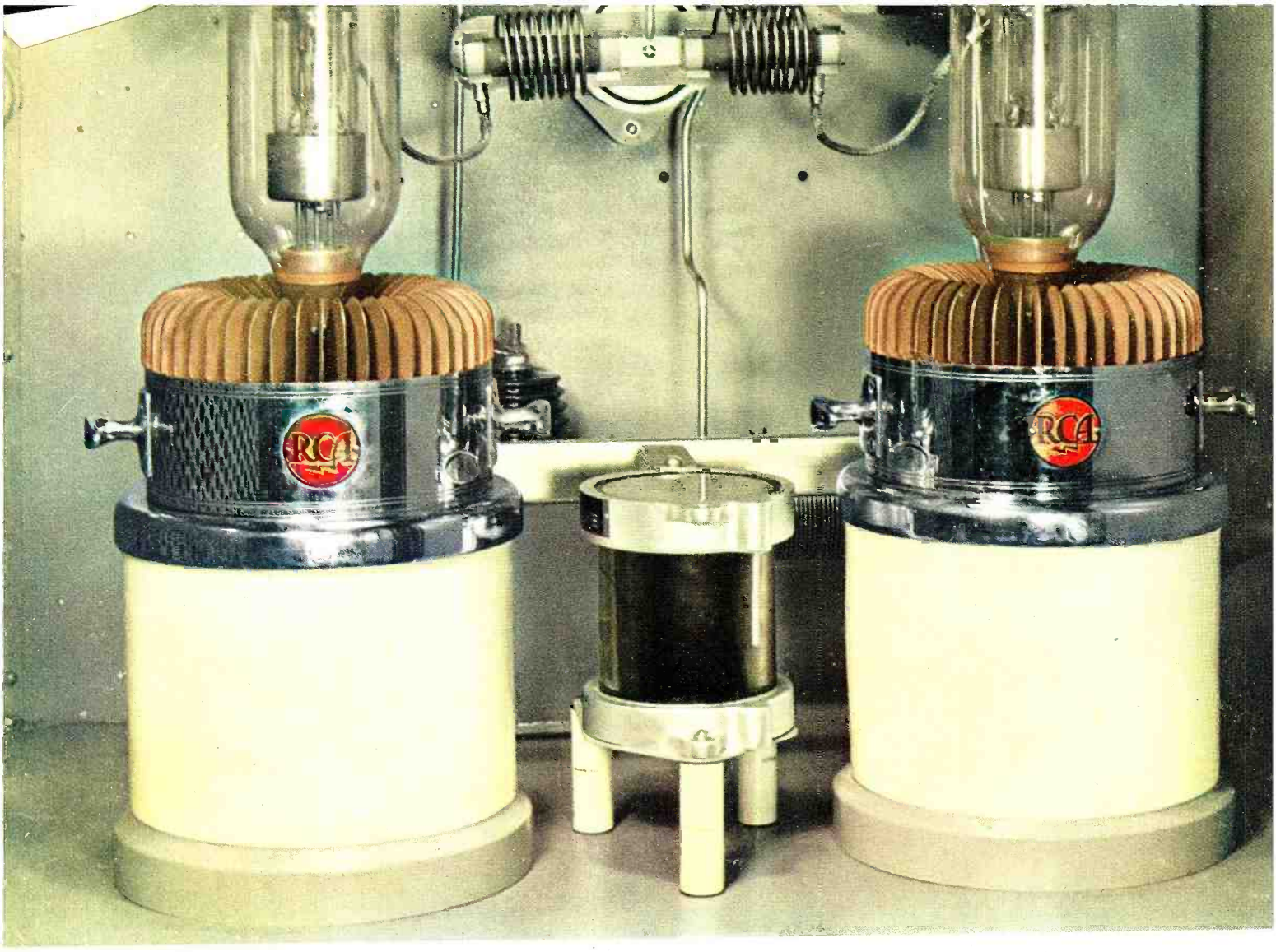

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