OVER 125 ILLUSTRATIONS

RADIO-CRAFT

HUGO GERNSBACK, *Editor*

"WIRELESS" PUBLIC ADDRESS

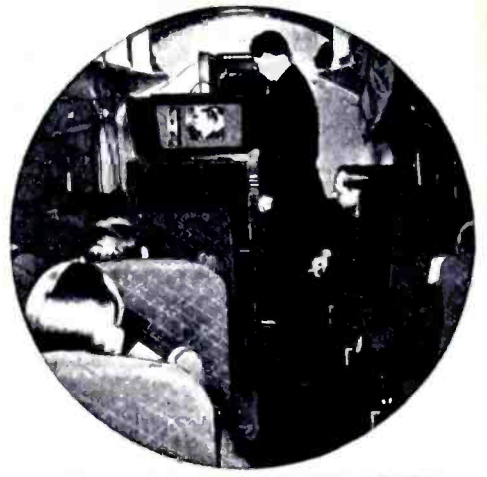
See Page 398

JAN. 40 RADIO'S GREATEST MAGAZINE

25c IN U. S. AND CANADA

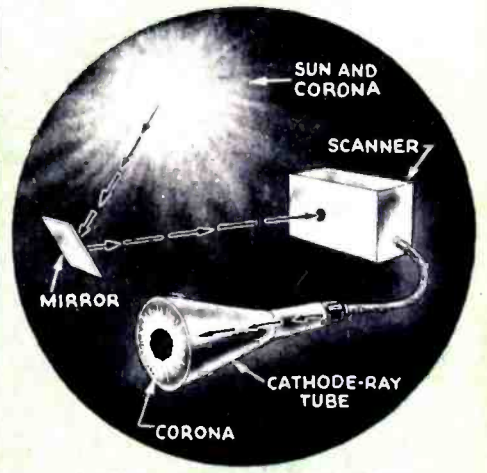
HOME-MADE DYNAMIC SET-TESTER MAKING AN F.M ADAPTER

MIDGET 3-IN 2 AMPLIFIER • RADIO AIDS FLYING DOCTOR

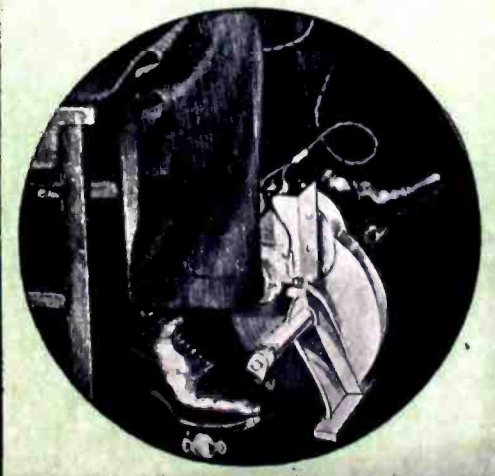


TELLY IN AIRPLANE!

EYE-CURRENT DETECTOR



THE CORONAVISER



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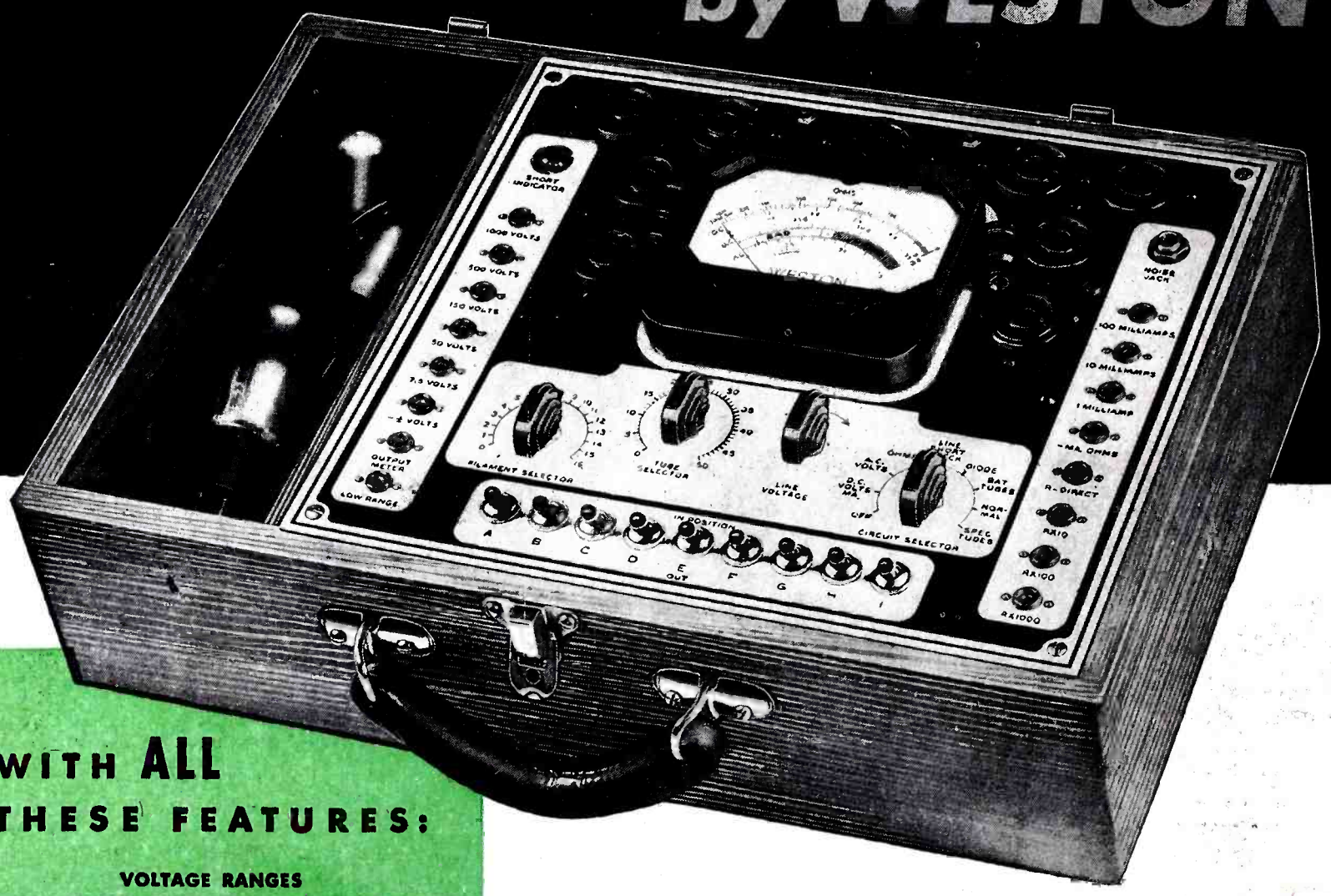

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All WESTON service units are *standardized* for rack or panel mounting.

With 23 circuit testing ranges... plus more than a dozen essential tube checking features... the new CHECKMASTER provides *everything* you need for years of dependable trouble shooting and estimating. And it's been made extremely compact, and light in weight... the panel measuring only 14" x 17". Thus it's ideal for field work, as well as for checking tubes and servicing in the shop. Best of all, the CHECKMASTER is WESTON *designed and* WESTON *built*. This means quicker, better servicing... for you'll have no doubts about your measurements. You'll *know* they're correct. It means you'll save money, too; for WESTON design forestalls obsolescence... gives many *extra* years of dependable service. Let us send you all the facts. Return the coupon, now!

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RADIO-CRAFT

Contents JANUARY, 1940 Issue

VOLUME XI -- NUMBER 7

In the NEXT ISSUE

Selling and Installing "Electric Eye"
Newest Blind-Landing System
Scratch Filter Design
Entirely New Miniature Tubes
Easily-Built 2-in-1 "Card File" Battery Set

★

Radio-Craft is making a poll of Service Organizations and Servicemen to determine their preferences for service instruments of various types. Therefore, we ask that readers please list in the order of preference the five major types of servicing instruments which they would like to see described in forthcoming construction articles. A postcard will do.

★

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Dunedin—James Johnston, Ltd., New Zealand.

★

BOOK REVIEWS

RADIO SERVICE TRADE KINKS, by Lewis S. Simon (1939). Published by McGraw-Hill Book Co., Inc. Size 9 x 11 ins., cloth cover, 27 illustrations, 269 pages. Price $3.00.

Here indeed is a useful manual for radio Servicemen, giving them quick reference to common radio ailments and practical methods of correcting them.

Under alphabetical listing of hundreds of specific makes and models of radio receivers, the author concisely indicates the symptoms of the operational faults to which each is most subject, then gives effective methods of making the necessary adjustments or repairs, based in nearly all cases on actual experience in his own extensive repair business.

The direct method of presenting the trouble and the remedy, without a prolonged technical analysis, makes this an especially valuable book for the man who wishes to repair household and auto-radio receivers on a practical, commercial basis.

TELEVISION AND SHORT-WAVE HANDBOOK, by F. J. Camm (1939). Published by Fortuny. Size 5½ x 8 ins., cloth cover, 130 illustrations, 272 pgs. Price $2.50.

A well-known English writer presents in 2 sections a "lavishly illustrated volume" which deals both theoretically and practically with every branch of television. The second section of the book discusses the elements in shortwave technique having particular bearing on television transmission and reception. Radio men may want to use this book as a reference for its 61-pg. dictionary of television terms. This dictionary also should make clear to the radio student any terms used in the text. We recommend Camm's new book.

WIRELESS DIRECTION FINDING, by R. Keen (1938, 3rd edition). Published by Iliffe & Sons, Ltd., London, England. Size 6 x 9 ins., cloth cover, 550 illustrations, 812 pgs. Price 25/ (American price, approx. $6.50).

Briefly, this book is a comprehensive manual on direction finding, dealing with wave propagation and D.F. theory in relation to modern ground, marine and aircraft installations, with extensive bibliography.

This reviewer always derives considerable satisfaction in recommending the later edition of any book because ordinarily subsequent editions not only contain later information but also correct errors that may have occurred in preceding editions. Insofar as this reviewer is aware there is no book that can approach Keen's work on the topic he has chosen; in this connection it may be worthwhile to note that the first edition was published in 1922. The treatment is exceptionally detailed and will be invaluable to anyone who is interested in the subject.

THE A.R.R.L. ANTENNA BOOK, by George Grammer and Byron Goodman (1939). Published by The American Radio Relay League, Inc. Size 6½ x 9½ ins., paper cover, profusely illustrated, 139 pgs. Price 50c.

To beginners in radio an aerial is a wire that connects to the antenna post of a radio set and extends most anywhere. To George Grammer and Byron Goodman, the antenna is a subject worthy of 18 chapters of detailed engineering analysis of what constitutes good antenna construction for transmitters and receivers operating on any wavelength. The book gives particular attention to the requirements of the ham or transmitting amateur.

DISCOVERY OF THE ELEMENTS, by Mary Elvira Weeks (1939, 4th edition, enlarged and revised). Published by Journal of Chemical Education. 6½ x 9½ ins., cloth cover, illustrated, 470 pgs. Price $3.50.

Briefly this book is the disclosure in unusually readable style of discoveries in the field of chemical elements. The book is of interest mainly to those who wish to have an exceptionally readable, albeit detailed, presentation of historical data on topics of interest to the student physicist and the electrochemist rather than to general radio practitioners.

HELLO AMERICA!, by Cesar Saerchinger (1938). Published by Houghton Mifflin Company. Size 6 x 9 ins., cloth cover, 20 photographs, 393 pgs. Price $3.50.

In popular, non-technical language, Saerchinger, first of the European broadcasting reporters, describes the inside workings of radio transmission and interpretation of news. This book is divided into 4 parts. Part I discusses People: President Roosevelt, King George, Shaw, Trotzky, Gandhi and many other broadcasters; Part II, Events: elections, war reporting, etc.; Part III, Atmospheres: mainly, word pictures of foreign countries; Part IV, Systems and Policies: The effect of changing conditions upon radio.

SERVICING BY SIGNAL TRACING, by John F. Rider (1939). Published by John F. Rider. Size 6 x 8½, cloth cover, profusely illustrated, 360 pgs. Price $2.00.

Faults in broadcast radio receivers, television sets, facsimile receivers, P.A. systems, intercommunicators and other devices all succumb to the searching analysis which may be made by the signal tracing method of servicing.

The actual whys and wherefores of applying this basic system of servicing is an extensive story which every radio man should learn from the ground up, and it is exactly this detailed story which Mr. Rider completely presents in his new book. A Serviceman who thoroughly acquaints himself with servicing by signal tracing will find that he has at his fingertips an unfailing servicing procedure which makes possible the location and correction of trouble in faulty radio equipment with minimum effort and time.

Chapters: What Is Meant by Signal Tracing?; Signal Amplification; Detection; Coupling Devices; Signal Tracing in Oscillator Circuits; Signal Tracing in Mixer Circuits; Signal Tracing in Control Circuits; Public Address Systems; Localizing Defects by Signal Tracing; Signal Tracing in Television Receivers; Signal Tracing in Receiver Design; Signal-Tracing Instruments.

THEORY AND DESIGN OF VALVE OSCILLATORS—For Radio and Other Frequencies, by H. A. Thomas (1939). Published by Chapman & Hall, Ltd., London, England. Size 6 x 9 ins., cloth cover, 103 illustrations, 287 pgs. Price 18s. (American price approx. $4.75).

This book is Vol. 7 of a series of monographs on electrical engineering, under the editorship of H. P. Young, M.I.E.E., M.A.I.E.E.

One of the most important functions of a vacuum tube is its use as an oscillator in receivers, transmitters, diathermy equipment, etc. An extensive treatment of this subject, from the standpoint of both theory and practice, is **very useful to every person concerned with vacuum tubes.** Such a presentation is "Theory and Design of Valve Oscillators," by H. A. Thomas.

Chapter headings: Fundamental Principles of Self-Oscillation in Valve-Maintained Systems; Types of Oscillators and Conditions for Maintaining Oscillation; Amplitude and Waveform of Oscillatory Current and Efficiency of Oscillators; Frequency of Oscillation and Its Dependence on the Maintaining System; The Frequency Drift of Oscillators; Frequency Changes Due to Effects of Temperature on Inductance Coils; Frequency Changes Due to Effects of Temperature on Condensers; Frequency Stabilization of Maintaining System; The Stabilization of Inductance; The Stabilization of Capacitance; Frequency Stabilization of Automatic Monitoring.

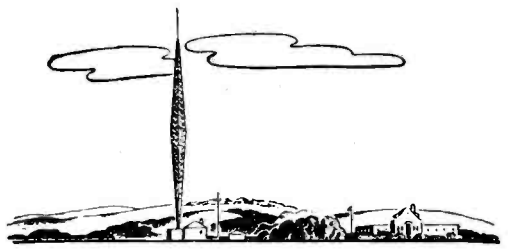
ELECTROLYTIC CONDENSERS, by Philip R. Coursey (1939, 2nd Revised Edition). Published by Chapman & Hall, Ltd., London, England. Size 5½ x 8½ ins., 124 illustrations, 199 pages. Price, 10s. 15d. (approx. $2.75).

In preparing a 2nd edition of "Electrolytic Condensers," the opportunity has been taken to remove a few errors that had crept into the first text. At the same time use has been made of a number of suggestions that have been put forward which the author hopes will clarify the treatment, remove any causes for incomplete understanding of the meaning, and thereby increase the general utility of the book.

A more logical treatment has been adopted for Chapter I to emphasize the distinction between electrolytic and other forms of condensers; while new matter has been added dealing particularly with the equivalent circuit of electrolytic condensers.

Especial treatment has been given to the "etched" forms of dry condensers; and to the so-called "surge-proof" dry condensers. The latest forms of "wet" condensers are described; forming part of the general trend toward smaller forms of condensers for all uses.

Further data on the electrical characteristics of the condensers has been given in Chapter VIII.



RADIO
could have rallied help for the Alamo

The tiny band of brave Americans besieged in the Alamo in March, 1836, by Santa Anna and his 4,000 troops fought a hopeless battle. Shut off from the rest of the world, they perished because they had no means of communicating their plight to their fellow countrymen.

Today Radio would carry the news instantly, as it brought the world news of Europe's new cataclysm.

R.C.A. Communications provides radio communication to and from 43 countries and among leading cities of the United States. This great communications system has already played a stellar part in keeping the world enlightened about the present critical events in Europe.

The National Broadcasting Company, another service of the Radio Corporation of America, has thrown the resources of its two nation-wide networks into the cause of making and keeping America the "best informed nation in the world."

Discoveries made in RCA Laboratories are incorporated in equipment manufactured by the RCA Manufacturing Company so that America can have at its command the most advanced means of radio transmission and reception.

By helping to make radio great...RCA helps to increase the opportunities which radio can offer to all associated with it. It is good business to make radio a better business.

RCA

Radio Corporation of America
Radio City, New York

RCA Manufacturing Company, Inc.
National Broadcasting Company

Radiomarine Corporation of America
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RCA Laboratories
RCA Institutes, Inc.

RADIO-CRAFT

''RADIO'S GREATEST MAGAZINE''

THE MULTIPLE RADIO RECEIVER

By the Editor — HUGO GERNSBACK

FOR many years there has been a crying need for a type of radio receiver which so far, for unaccountable reasons, has not been produced by the radio industry.

As everyone knows, the radio set in the home, particularly where there is a family with children, creates a situation which often becomes intolerable. The reason for this is that one member of the family wants to enjoy a certain program, while the other members wish to listen to another. Father wants to listen to a political talk, whereas the youngsters prefer "Heigh-Ho Silver" or what not. Mother wishes to listen to an opera, whereas her daughter wants dance music to entertain her friends. Usually, whatever compromise there is creates dissatisfaction and the utility of the radio set is thus diminished for all concerned.

Of course, a simple answer is: extra sets. Midget sets were supposed to be the answer to this situation, but it is not a complete answer because not every family can afford 2 or 3 or even 4 separate receivers.

The better answer is a *multiple radio receiver*. That is, a central radio set with 2, 3 or 4 separate tuning controls, with extra loudspeakers or headphones which are then to be placed in different parts of the house or apartment, so that all members of the family can enjoy their radio with as many as 4 different programs all being piped from a single receiver, at the same time. In this case radio harmony will return to the family and everyone can enjoy his particular radio program to his heart's content, and incidentally, greatly enhance the value of the radio set.

Why has all this not been done before? The reason probably is that the problem has not been given sufficient thought, and there were also certain commercial aspects. For one thing, the radio industry naturally is not particularly anxious to kill sales on midget sets if nothing better can be had. It is also true that if a multiple radio set such as I visualize, is perfected, it will obviously decrease the sale of many midget sets.

On the other hand, there are many disadvantages to midget sets which are not a definite benefit to the radio industry. To begin with, the tonal quality of the midget set is practically always mediocre. For this reason such sets do not help to sell the idea of radio as a whole as well as they should. Also, midget sets are particularly unprofitable to service and are the bane of Servicemen's lives.

An objection that may be cited is that a Multiple Radio Receiver is too expensive, too complicated and too difficult to make. This objection does not hold water because I can readily visualize a Multiple Radio Receiver that should not cost more than a present-day good console, and certainly not more than 10% more in cost than other good model sets.

The first multiple receiver, to the best of my knowledge, and one that worked eminently well, was a 2-channel short-wave receiver which could pick up 2 programs at once. It was first described in the July, 1935, issue of *Radio-Craft's* sister magazine, *Short Wave Craft* (now *Radio and Television*). This receiver was designed so one person could listen with headphones while another one could enjoy a different program with the loudspeaker, both in the same room.

This particular receiver had a multiplicity of parts. It is today possible to make a multiple receiver with only a few additional parts, making the existing parts do dual service, etc.

It is not necessary for me here to go into the technical aspects of the problem, suffice it to say that I can think of at least 3 different ways to solve the problem of a multiple receiver without making its cost prohibitive.

As far as the tuning is concerned, we will of course require 4 different tuning knobs or controls for the 4 different programs or channels that are to be selected. It is also possible to use pushbutton controls with simple 2-way switches to throw on a program in whatever part of the house it is required. Needless to say, such a 4-channel set does *not* require 4 times the number of tubes, nor does it require 4 different, large tuning condensers. *The present tuning equipment and the present tubes, as well as audio transformers, all can do double, triple or quadruple duty without affecting the quality of the output and without unduly complicating the Multiple Radio Receiver.* The whole idea boils itself down to a radio engineering problem and not a too difficult one at that.

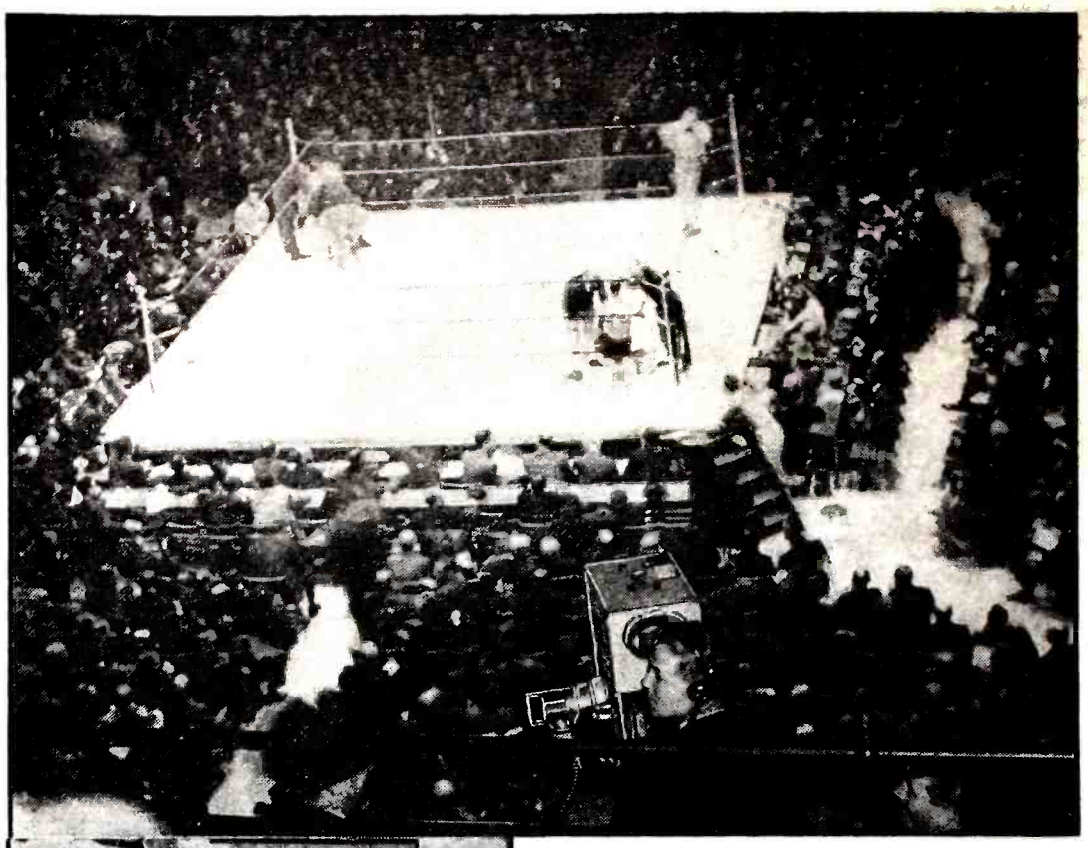
It is quite feasible to actually receive 2 different programs in the same room at the same time. This is easily done by having one of the listeners wear a pair of earphones, or head receivers, which can be plugged into the set with a long cord for that purpose. This is a special advantage for many situations which often arise in a household. We are particularly thinking of those hard-of-hearing who cannot enjoy a normal radio program unless the volume is turned up so high that it becomes unbearable for the rest of the listeners. Then we have the bed-ridden or ailing, who could individually enjoy a radio program by means of the head receiver which is something he cannot do at the present time.

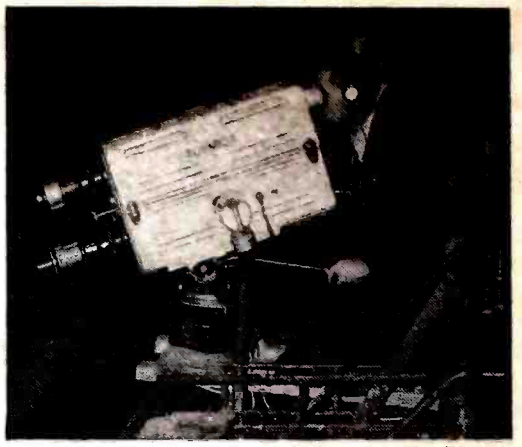
I visualize a Multiple Radio Receiver with 2, 3 or 4 outlets, into one of which are plugged the cords for the head receiver. The other outlets can be ordinary screw connections to which the wiring to other parts of the house is connected. The radio manufacturer would give a choice of either movable or fixed loudspeakers of which there are an abundance on the market today. We can have either wall loudspeakers or the type that can be put on a desk or table.

Here it is also necessary to have, for all practical purposes, volume controls which should be built right into the loudspeakers so that if the loudspeaker is used in another part of the house its volume can be controlled readily. The same idea should prevail for the head receivers where the volume should also be subject to control. A simple volume control can be built right into the cord so that the sounds can easily be regulated, from loud for the hard-of-hearing, to a whisper for the invalid or sick who do not wish to be jarred by too-loud sounds.

Objections will be cited that if Junior is up in the attic and wishes to change from one program to another, he must run downstairs and change the tuning of the Multiple Receiver in order to get another station which he desires. This is of course true, unless he calls down and asks sister or mother, or whoever is near the radio set to tune-in the program he wants, on his channel. These are, however, minor objections because it is never possible with anything to have 100% perfection and to control all eventualities.

As for the radio industry's aspect, the multiple Radio Receiver is an excellent one, and is certain to find wide acceptance once its uses and benefits become better known. A Multiple Radio Set, while it may cost a little more to make, also should be easier to sell to the home owner because it gives more service and does away with many of the present-day nuisances. There are many excellent talking points for a receiver of this type and it is my opinion that after the radio industry has studied the Multiple Receiver from all angles, we will see it soon in our homes.





(Photos—Graphic Photos)

TELEVISING THE FIGHTS!

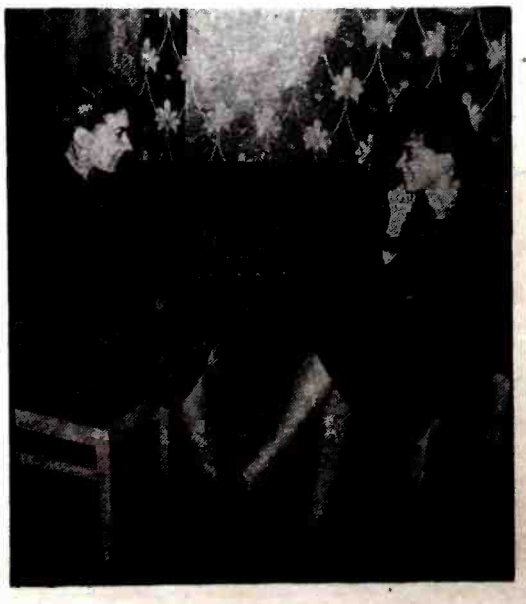
▲ In telecasting the Canzoneri-Davis fistic set-to last month, at Madison Sq. Garden in New York City, N.B.C. used 2 cameras, one occupying a regular camera cage swung from the 2nd balcony (see photo above, and left). This instrument was fitted with telephoto lenses and, from a distance of slightly more than 75 ft., gave an excellent view of tne 2 boxers.

◄ A second camera was located in a 1st-tier box, at about eye level with the floor of the ring. Bill Allen, television's first sports commentator, gave his interpretation from a ringside seat. The only concession made to television was the focusing of several of the Garden's spotlights on the ring (see photo, left).

HOTEL WIRED-RADIO

▲ Last month Wire Broadcasting Corp. demonstrated a static-free sound service, installed in the Essex House in New York City, which utilizes wired-radio facilities to bring recorded music tc hotel patrons who possess radio receivers. Above, Mr. Edward T. Collins, general operating manager of Wire Broadcasting Corp. of America, adjusts the transmitter which feeds disc music into a wire network servicing 625 tenants.

Below, the missus Felice (left) and Ruth R. Maier, sisters, listen to wire-broadcast music available at the hotel, without advertising interruption, from ▼ 11 A.M. to 3 A.M. Any radio set may be used.



THE RADIO MONTH

WAR NEWS

A soldier of the legion
Stood on the Maginot;
He knew there was a war on,
For he had a radio!

—ran an item in the *New York Sun*, last month. But, as we shall see, all was not as pacific elsewhere.

. . .

In Paris, Edouard Branly, probably the oldest living radio pioneer, both in point of years on earth and in activity in radio, celebrated his 95th birthday, Oct. 23. Although the invention which bears his name, the *Branly coherer*, was one of the very first radio detectors, the famous French savant has no radio set in his home.

Viewing the modern use of radio, "on the Maginot," and off of it, he is quoted in an *A.P.* report as having said:

"It bothers me to think that I had anything to do with inventing it."

. . .

The projected flight of Howard Hughes from Los Angeles to New York to Paris, and return, has been shelved, according to information to *Radio-Craft* from California, last month. For one thing the war has made unavailable, by radio, weather reports and other necessary data.

. . .

Radio was reported by *A.P.* last month as making possible the control from London of a chain of patrol boats on the continent-to-continent Atlantic shipping lane. British war vessels, posted in clusters, progressively advise merchantmen by radio of the positions of the unseen "ghost convoy."

"Radio Luxembourg," one of the world's most powerful broadcasters and located in that tiny principality, last month closed down. Pirating of its wavelength by foreign stations was the reason given.

. . .

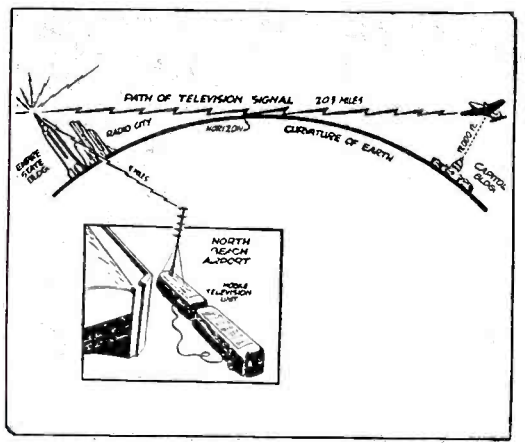
The British Broadcasting Corp. last month was reported setting-up a mobile unit in France for airing border battles to England. At first, though, recordings will be made, planed to London, and there broadcast.

TELEVISION

"'LIMITED Commercialism' may be OK'd to Encourage Television Experiments," was the 3-column heading of an item in *Variety's* Radio Section, last month. The F.C.C. is expected to OK plans to be presented to that body in a short time—"within 3 weeks, mebbe", if Walter Winchell, in a *New York Mirror* beat (we hope), rings the bell; he also stated that Philco, RCA, Du Mont and Zenith would use commercial telly programs.

. . .

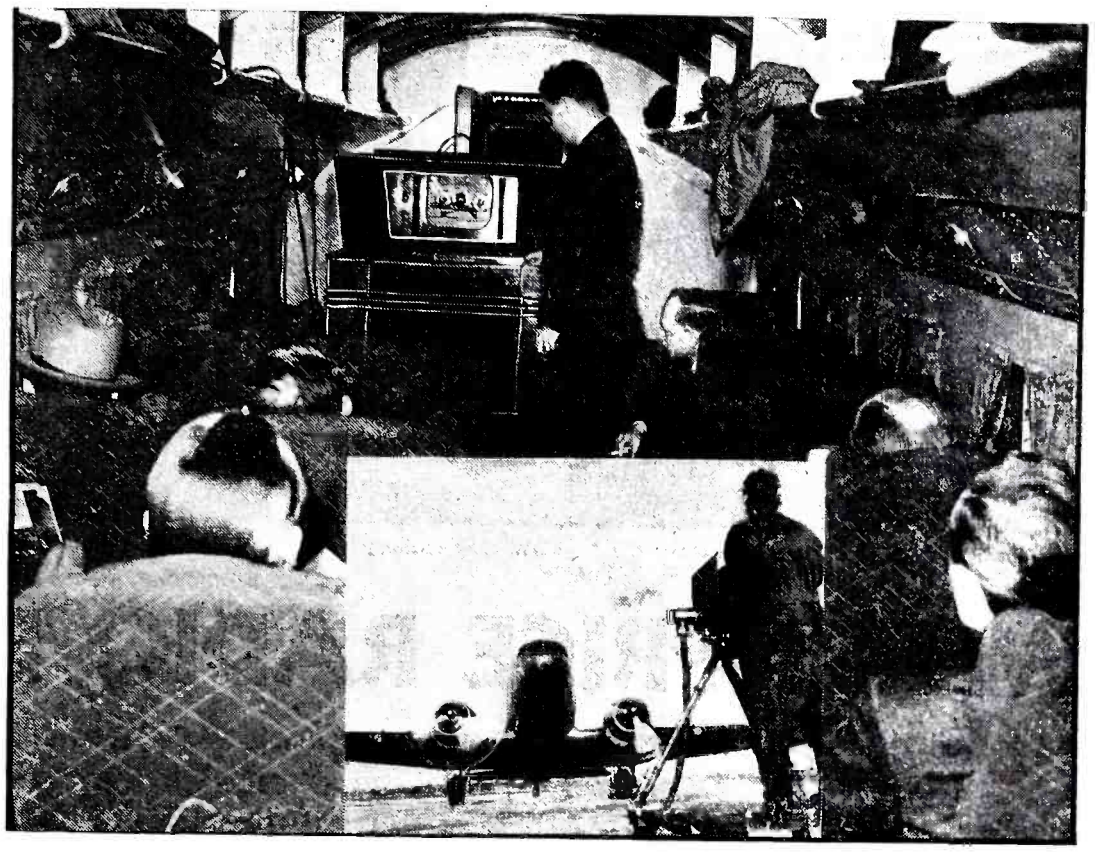
"The Milky Way" telecast over the N.B.C./RCA television system, last month, premiered their experimental use of combined "live" talent, and film. About 500 ft. of film was faded into and out of the program, alternating with the studio action. The Screen Actors Guild said, in effect, when they discovered the film in process of being made, "OK this time, buddy, but next time let us know before you start shooting telly-film interludes."



TELEVISION IN AN AIRPLANE!

A David Sarnoff, radio broadcasting's most foresighted pioneer, last month capped 20 years of guiding RCA through its progressive past by receiving television images from Radio City and North Beach Airport, New York, in an airplane flying over Washington, D.C., as depicted above (and on cover).

At the right we see the group of spectators in the United Air Lines plane which made this memorable flight, 200 miles from the Empire State Building. When the airplane returned to the North Beach Airport, the televiewers inside the plane were able to watch their own plane landing, as a telecamera, outside, picked up the scene of the landing! (See inset photo.) ➤



IN REVIEW

SOUND

NAZI efficiency slipped up last month, thanks to the *New York Times*, which checked recordings, of a shortwave broadcast in German by Dr. Paul Joseph Goebbels, against the official English text released later by Berlin. The "vitriolic radio attack," against Mr. Winston Churchill in the original (as translated from the German speech on the wax recordings), reportedly referred to an *Athenia*-disaster survivor as that "God-damned American citizen, Anderson."

• • •

WOR-Mutual listeners last month received a thrill when they heard the synthetic voice of European War correspondent Arthur Mann. The network's reporter had recorded his observations with sound effects—booming guns, etc. —at the French-German border as background; the disc was then flown to London, and there sent to U.S. listeners via special transoceanic facilities.

Telemusic, Inc., a Delaware-incorporated concern, last month opened offices in New York City, Prexy Walter W. Clark advised Albany.

RADIO MAYOR

LAST month F. H. LaGuardia found out by experience what it is like to become a "mobile Mayor," as he conducted New York City's business via 2-way radio while on an 85-mile tour of the new Delaware Aqueduct project. Five 2-way radio police cars spotted at 20-mile intervals kept the 14-car motorcade in touch with City Hall, and the Police and Fire Depts. In an emergency, N. Y. C. can now be remote-controlled by radio!

"F.M."

FREQUENCY Modulation will soon sew up a potential audience of 20,000,000 listeners for John Shepard, III, President of the Yankee Network, if plans announced last month are consummated.

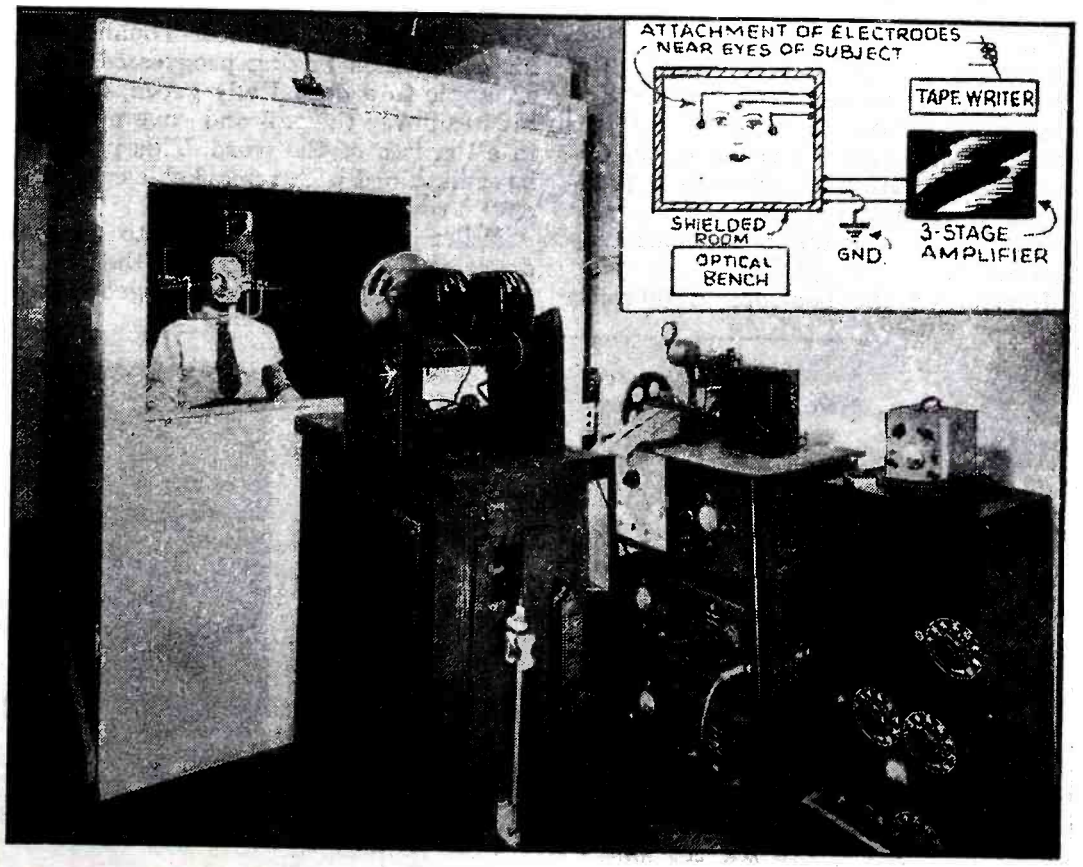
The F.C.C. has pending an application to permit Mr. Shepard to add to his Paxton, Mass., "F.M." transmitter set-up, now operating, a 2nd, 5-kw., frequency-modulated station atop Mt. Washington in New Hampshire, and a 3rd, 50 kw., at Alpine, N. J. The latter is expected to utilize part of the antenna mast now employed by Major Edwin H. Armstrong in operating his own station,

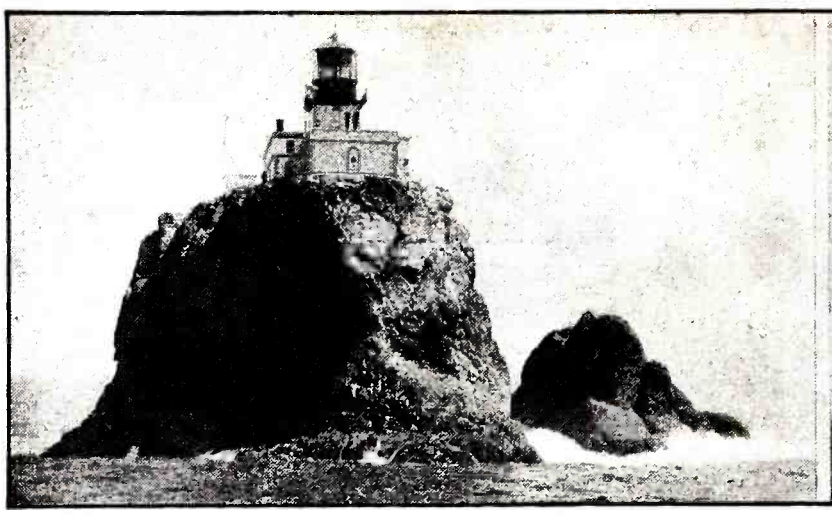
(*Continued on page* 442)

EYE-CURRENT DETECTOR

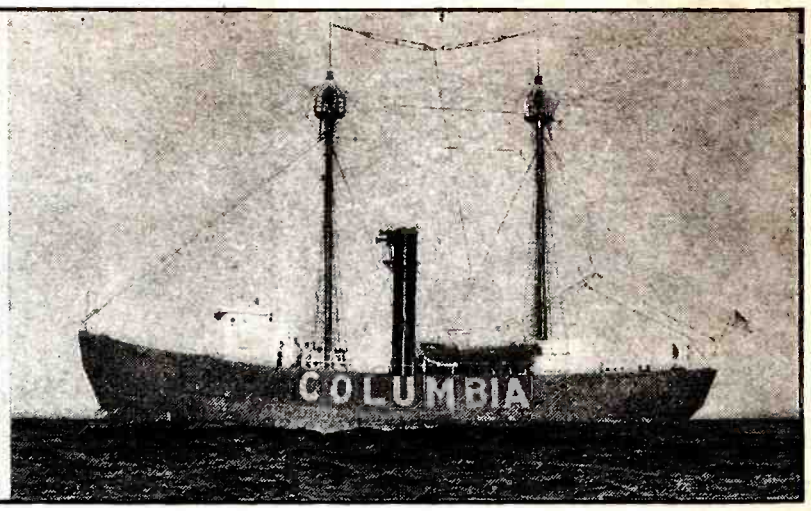
Do the eyes of a sleeper move?; do dreams cause eye movements? Radio instrumentalities may soon afford definite answers to these questions and to many others of far greater importance. Utilizing the fact that motion of the eye results in generating minute voltages, Ward C. Halstead, Ph. D., Ass't Prof. of Experimental Psychology, Div. of Psychiatry, Univ. of Chicago Clinics, has perfected the apparatus shown at right. The technique, developed to facilitate analyses of brain lesion cases, utilizes electrodes placed on each side of the eyes and a specially-constructed amplifier which manipulates a recording pen on waxed ticker-tape paper. ➤

At upper-right, inset, is a block diagram showing the relationship of the apparatus illustrated in the photo (which Dr. Halstead made available to *Radio-Craft* last month, and which shows the newest arrangement of the equipment). The Eye-Current Detector is also illustrated on the cover of this issue.





Tillamook Rock Lighthouse from seaward side. KGW crew couldn't board it because of rough seas.



Columbia River Lightship from which point broadcast originated.

WHAT PRICE RADIO PROGRAM!

"Neither snow, nor rain, nor heat, nor gloom of night, stays these couriers from . . ." getting a scheduled program onto the air.

GRAHAM McNAMEE, lolling in the luxurious, air-conditioned studios of Radio City, probably thought he was the hero of National Broadcasting Company's recent program commemorating the 150th Anniversary of the Lighthouse Service . . . . but the crew of KGW-KEX, Portland, who for 12½ hours weathered battering seas off the Oregon Coast are putting in their bid for a medal. *Any medal but a green one, that is.*

The network show dramatized heroic incidents in the history of the Lighthouse Service. At the end of each dramatization, a switch was made to the lighthouse or lightship figuring in the incident. The KEX crew was scheduled to board almost inaccessible Tillamook Rock Lighthouse for a 2½-minute interview with Henry Jenkins, hero of the Tillamook Lighthouse disaster of 1934.

Leaving Portland at 5 A.M., the broadcasters drove a hundred miles over Oregon's sharpest-curved road to Tongue Point, near the mouth of the Columbia River. Here they deposited Technician Carl Anderson who, from this point, was to pick up the broadcast by shortwave.

Instead of the spacious Lighthouse ship, Announcer Bob Thomlinson, Producer Barney Miller, and interviewee Jenkins, found themselves crossing the angry Columbia River bar in a 35-foot Coast Guard lifesaving boat.

For the uninitiated, a word of explanation: crossing the Columbia Bar in a small boat is like hanging to the tail of a bucking broncho in a cloudburst . . . . only you can let go the bronc! The boat swooped over 20-foot breakers, hurtled through the air . . . . and landed with bone-jarring crashes on the other side . . . . throwing enough water over the crew to float a Japanese wrestler.

Battered, soaked, and groggily profane, the lads emerged into what should have been smooth, open ocean . . . . except a heavy wind sprang up. It was a nice strong tail wind that completely enveloped them in the fumes from the exhaust in the rear.

At this point Announcer Thomlinson, his complexion having progressed from an apple to a deep Kelly green, draped his head over the rail and gave up . . . . in all senses of the word. This position he maintained with remarkable constancy the rest of the day.

Miller and Jenkins tried to escape drenching by squeezing into the small cabin . . . . but quickly emerged. Reason: drowning is painless; skull fracture ain't.

Boarding the Lighthouse, it developed, was an interesting procedure. At the psychological moment one leaps from the deck of the boat to a basket, is then hoisted 70 feet into the air, and swung onto the rock. Provided, the Coast Guardsmen comforted, that nothing goes wrong.

But there was a fly in the ointment . . . . two of them, in fact. One: 15-foot waves were swooping hungrily over the lowered basket. Two: the Coast Guardsmen decided they couldn't get the boat under the basket without being dashed against the rock.

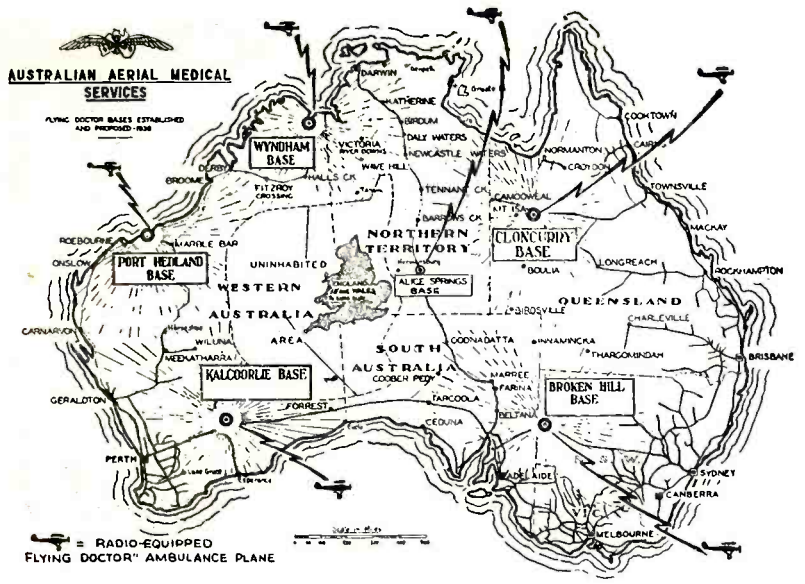
This, to coin a phrase, left the radio lads in a pickle.

By making the 25-mile return run to Tongue Point they would land just about in time to go on the air . . . . perhaps. The boat, being equipped with a receiving set only, could get incoming calls, but could not send out. They had no choice. They turned back toward the mouth of the Columbia, deciding to make a run for it. At the prospect of another several hours on the bucking brine without touching land, Thomlinson surrendered on all fronts. From Kelly, his

(Continued on page 432)

(Left to right) Jenkins, Announcer Bob Thomlinson, Producer Barney Miller.

U. S. Coast Guard boat which carried broadcasting crew to sea.



Inland Australia now has radio contact between 600 of its 25,000 outback settlers and civilization. A chain of plane and radio bases affords medical aid to the white population; Alice Springs Base, the final link, is rapidly nearing completion.

The type 37 pedal transceiver here shown in use is available to all dwellers in the Australian outback who feel that pioneering these solitudes will be made a little more bearable through the acquisition of a 2-way radio set. The "pedal generator" was the practical solution to the problem of high-voltage power for the transmitter.

RADIO AIDS "FLYING DOCTORS"

A doctor's radio service—long wanted by one group in New York City—has been in operation for several years in Australia! The success of an emergency radio network which serves more than 1½ million square miles of desolate bush country depends upon "pedal generators" to power transmitter-receiver units at settlers' homes.

ABOUT 25% of the 12,000 physicians and surgeons in greater New York can be reached in short order through a Doctors' Telephone Service, but with a view to still further facilitating medical treatment *and probably saving lives*, a Radio Paging Service has been suggested, and has been hanging fire since 1936, which would operate over a radius of about 50 mi. and which would make it possible to contact every doctor whose car was equipped with a receiving set.

PAGING BY RADIO!

The Radio Paging Service proposed for N.Y.C., and a number of other large cities throughout the U. S., would only be a method of signalling those who are wanted. No message or word of instruction would be communicated to a doctor en route. Upon receiving a pre-set signal, the doctor would go to the nearest telephone and call the Radio Paging Service for further information.

Laboratory and field tests have shown that it is possible to operate a receiving set through a series of pre-determined dots and dashes arranged to light a pilot lamp and operate a buzzer in the individual car of any doctor, on a frequency of about 30 to 50 megacycles, tone-modulated about 3 kc. and so coded that no other car receives a similar signal.

The F.C.C. has not as yet granted permission for this service to start operation. It certainly seems though that it would be a boon in every large city.

However, while American radio interests have been marking time on this idea, Australia has actually had in operation an extensive, related form of such doctors' radio paging service!

RADIO FOR PIONEERS!

Central Australia is known as the outback and constitutes about 1/3 the entire continent. With a white population of only about 25,000 settlers, the Federal government was perplexed with the problem of emergency aid to and communication between the settlers, widely-scattered on lonely cattle stations and remote mining fields, whose next-door neighbors in many cases may be distant 100 miles or more. It is often an arduous journey of 2 or 3 days to reach the nearest point of contact with the outside world. And during the "wet" season some areas are rendered impassable for any form of land transport, and the settlers may then be entirely isolated for weeks or even months.

A single line of railway and telegraph links the interior with the coast. And until recently the only means of communication was over meagre, rough "bush" tracks in this nearly empty region of almost 1½ million square miles.

6 RADIO BASES; 600 AUTO-POWER STATIONS

In 1928 there was inaugurated an aerial medical service operating out of radio-equipped bases. Today there are 6 of these bases, one each at Wyndham, Port Hedland and Kalgoorlie in Western Australia, Broken Hill in New South Wales, and Alice Springs in Central Australia. As we go to press, finishing touches are being applied to the final link in this chain—the Base Station at Alice Springs.

At each center complete hospital and nursing facilities are available. Australian Aerial Medical Services provides a qualified medical officer and an aeroplane with stretcher accommodations, a skilled pilot and mechanic, and a radio transmitting station in charge of a qualified radio operator.

Arrangements are made by the Association to provide communication between residents of the area served and the base transmitting station. Where telegraph and telephone facilities are unavailable, so-called radio "transceiver sets" powered partly by *pedal generators* (see photo on cover of *Radio-Craft*) are installed for the settlers, and licensed for a small fee, and these enable communication direct with the base station. The Doctor may give medical advice through the medium of these sets and if necessary leave immediately by hospital plane to administer medical attention. Medical aid is given by the Flying Doctors without fee inasmuch as the A.A.M.S. is a national organization.

Included in the radio set-up is a radio service car used for inspecting Flying Doctor transceiver sets, at radio outposts, of which there are more than 600.

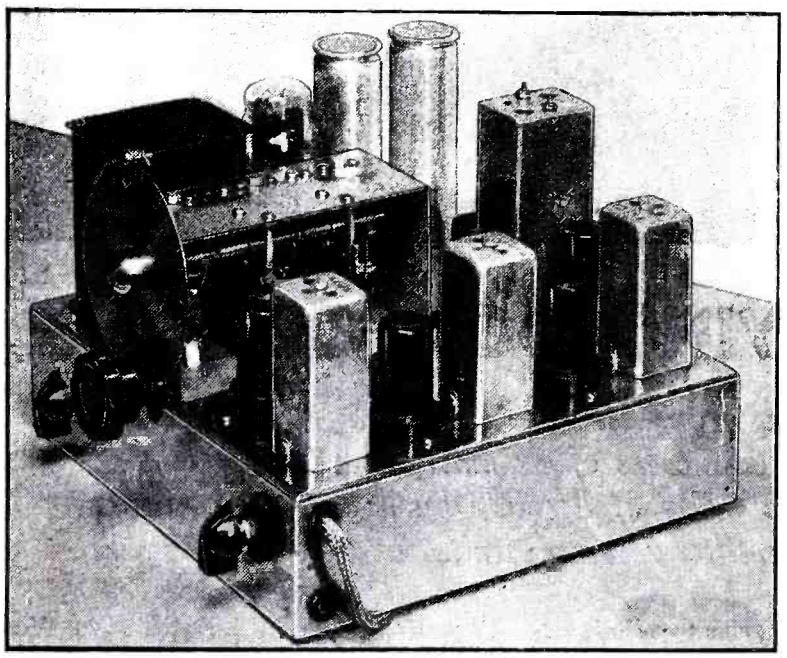
(Continued on page 447)

FREQUENCY-MODULATED PROGRAMS

With This Easily-Built F.M.-A.M.

Once again RADIO-CRAFT *offers its readers a "first": Originated by of Browning Laboratories, this new self-powered unit enables Servicemen to paratively) high-fidelity loudspeaker systems—with minimum cost and labor*

PART II—CONSTRUCTION AND CIRCUIT DETAILS



The first combined frequency-modulation and amplitude-modulation Adapter ever to be made! Its complete range is from approx. 40 megacycles to 54 megacycles which means that in addition to F.M. programs the sound portions of television programs, and those of certain special educational stations, may be received. The Adapter attaches to the audio system of any receiver or to the input of any A.F. amplifier.

THE article in the preceding, December issue of *Radio-Craft* by the writers, pointed out the advantages of *frequency* modulation as compared to *amplitude* modulation, as well as explained the operation of Major Armstrong's new "wide-band" system. (Included in this issue was a listing of "F.M." stations, as well as "A.M." stations in approx. the same frequency region; and also, the complete service diagram of the G.E. model HM-80 frequency-modulated table-type receiver. —*Editor*)

It is the purpose of this article to describe the construction and operation of as simple an *Adapter* as possible for quality reception of programs from a frequency modulation station. (Connected to headphones, it becomes a complete Receiver!—*Editor*) This Adapter was designed at the request of Mr. R. D. Washburne, Managing Editor of *Radio-Craft*, and the writers wish to acknowledge his helpful suggestions.

Our Adapter incorporates the R.F., I.F., limiter, and detection systems, and omits only the audio amplifier and speaker. This apparatus is probably the most economical method of receiving frequency-modulated signals as *it is not practical to alter present receivers' R.F. and I.F. systems.* This is true for the following reasons:

(1) An entirely different detection system is employed which requires, for correct operation, a certain minimum signal to be applied to it.

(2) A *limiter circuit* for smoothing out any voltages in the I.F. amplifier which may arise from amplitude changes in the carrier or spurious signals picked up and amplified such as static, ignition noise, and other types of man-made interference. This limiter circuit also smooths out noises generated in the receiver itself provided sufficient strength is obtained from the frequency-modulated station. Thus unusually quiet reception is obtained.

(3) Due to the requirement for a definite minimum signal at the grid of the limiter tube, the gain of the R.F. and I.F. amplifiers must be high. For successful discrimination against noise and static, the recovered audio voltage from the detector system must have a peak value of about 40 volts.

(4) The R.F. and I.F. systems must pass a broad band of frequencies approximately 100 kc. either side of the center frequency in order to obtain the quality of reproduction which is possible with this system.

With these points of difference clearly in mind, we can proceed to a discussion of principles of construction, alignment, and operation of an adapter for frequency-modulated signals, explaining as we go along the functions of the different components of the circuit.

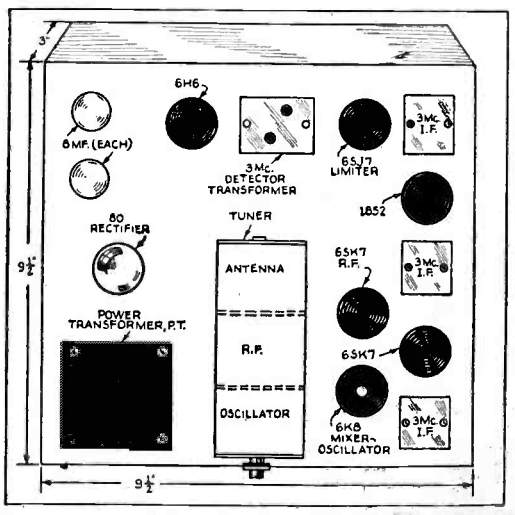


Fig. 2. Layout of the F.M.-A.M. Adapter, showing the locations of the main components on the chassis.

THE CIRCUIT

The circuit diagram of the complete Adapter—which is designed to feed into the audio stage of any audio amplifier (preferably a high-fidelity audio amplifier)—is shown in Fig. 1.

It will be noted that, with the exception of one or two points which we shall discuss presently, the circuit diagram up to the grid of the limiter tube is very similar to that of a conventional superheterodyne employing 2 stages of intermediate frequency amplification.

In order to procure sufficient bandwidth however, special 3-mc. I.F. transformers are employed which have a bandwidth of 200 kc. Resistors are placed across these transformers to damp out any transient oscillations which cause "fuzz" frequencies in the output. It will also be noted from the circuit diagram that the limiter tube acts also as another intermediate frequency amplifier stage, the plate circuit

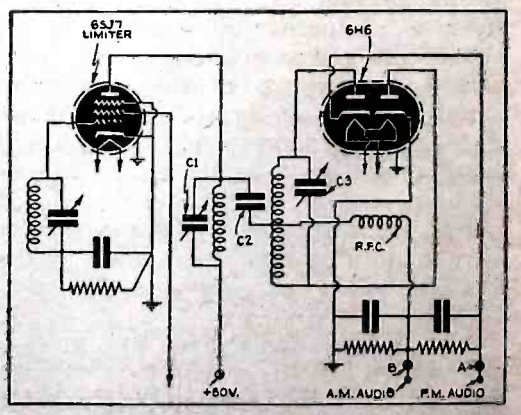


Fig. 3. Details of the special detector transformer and its relation to the limiter and detection circuits.

ON YOUR PRESENT RECEIVER!

Ultra-Shortwave Adapter

R. D. Washburne and perfectly executed by Messrs. Browning and Gaffney modernize "A.M." sets—which frequently have expensive cabinets and (com- (the latter being due to the use of a special wired and aligned 3-mc. assembly).

GLENN H. BROWNING and FRANCIS J. GAFFNEY

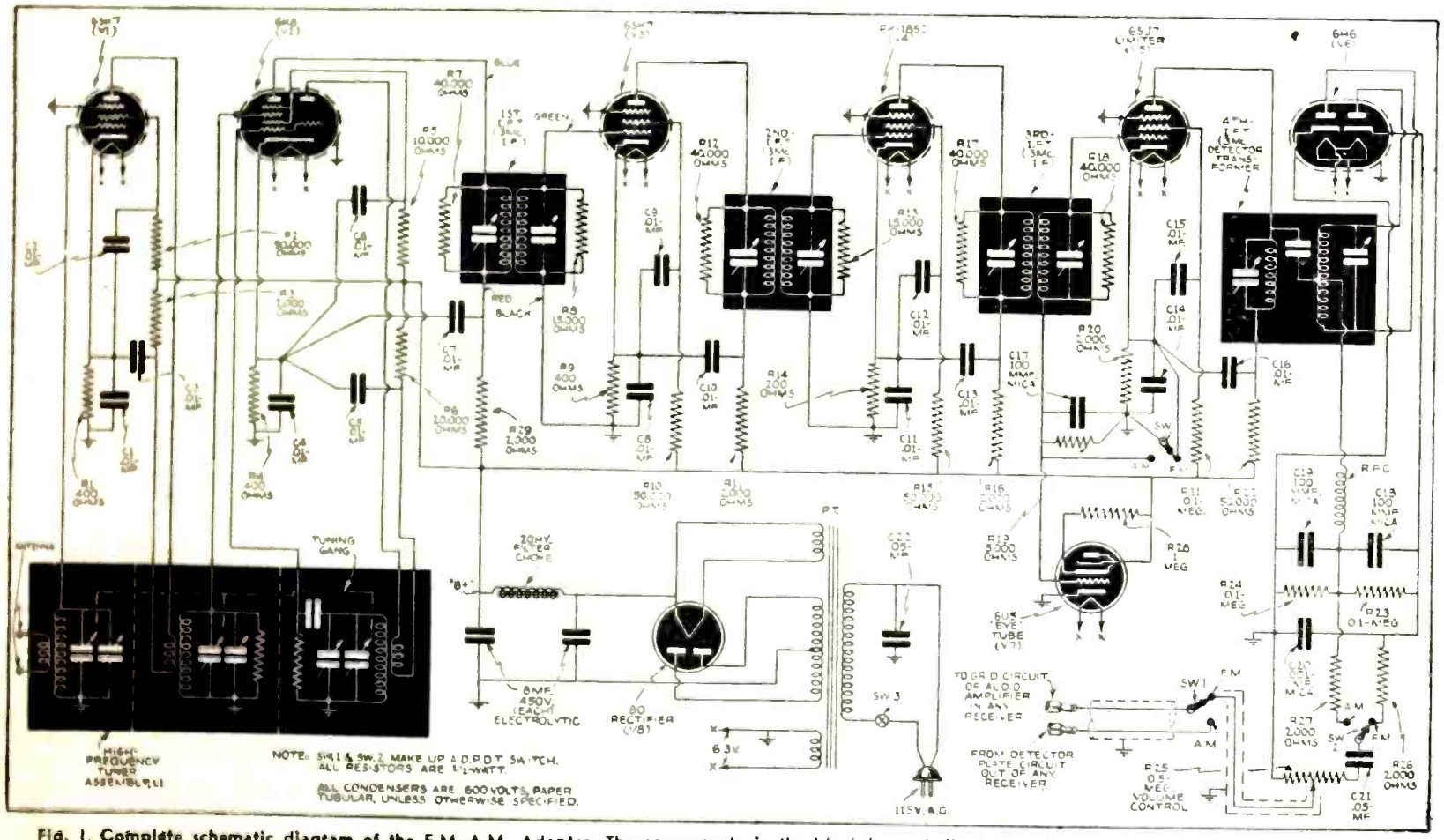


Fig. 1. Complete schematic diagram of the F.M.-A.M. Adapter. The components in the black boxes indicate that they comprise single units or assemblies.

of which feeds the detection transformer which is similar to the so-called "discriminator" employed for automatic frequency control in amplitude-modulated receivers.

THE HIGH-FREQUENCY TUNER

As the transmission of frequency modulation stations at the present time is between about 42 and 44 mc. (approximately 7 meters), a special high-frequency tuner was developed. Great care was taken in the layout of coils and tuning condensers to obtain maximum performance. In order to receive sound channels of television stations and educational station programs, the tuning range was made from approximately 40 mc. to about 54 mc.

This tuner comprises a tuned antenna circuit, a stage of R.F. amplification, and the oscillator circuit. Partition shields are used so that interaction and locking-in effects are eliminated. Chassis currents are eliminated by insulating each of the 3 ganged tuning condensers and grounding them to the shield at one point only. The entire tuning unit is 5¼ ins. long x 3 ins. high x 2⅛ ins. wide. The signal from the doublet antenna feeds to the antenna coil in the rear of the tuner, thence to the R.F. coil through the 6SK7 R.F. amplifier. The R.F. transformer in the plate circuit of this tube feeds the 6K8 mixer tube.

I.F. AMPLIFIER

The I.F. amplifier has been laid out so that the output is a considerable distance away from the input to minimize possibilities of regeneration. The intermediate frequency employed is 3 mc., this having been found highly satisfactory from the standpoint of obtainable bandwidth and image rejection together with the stability required in a 2-stage I.F. amplifier. The gain of the intermediate frequency amplifier, including the limiter tube, is approximately 14,000.

Several precautions must be observed in wiring if adequate stability is to be obtained. In this connection, bypassing of screen-grids and all decoupling points is made directly to the cathode of each tube as indicated in the diagram. This may be easily accomplished by connecting a rigid wire to the cathode and connecting the bypass condensers to the same point on this wire. Decoupling is employed on both screen-grid and plate circuits. Of course in wiring the Adapter, the usual precaution necessary in high-frequency circuits that all leads be made as short as possible, must be observed.

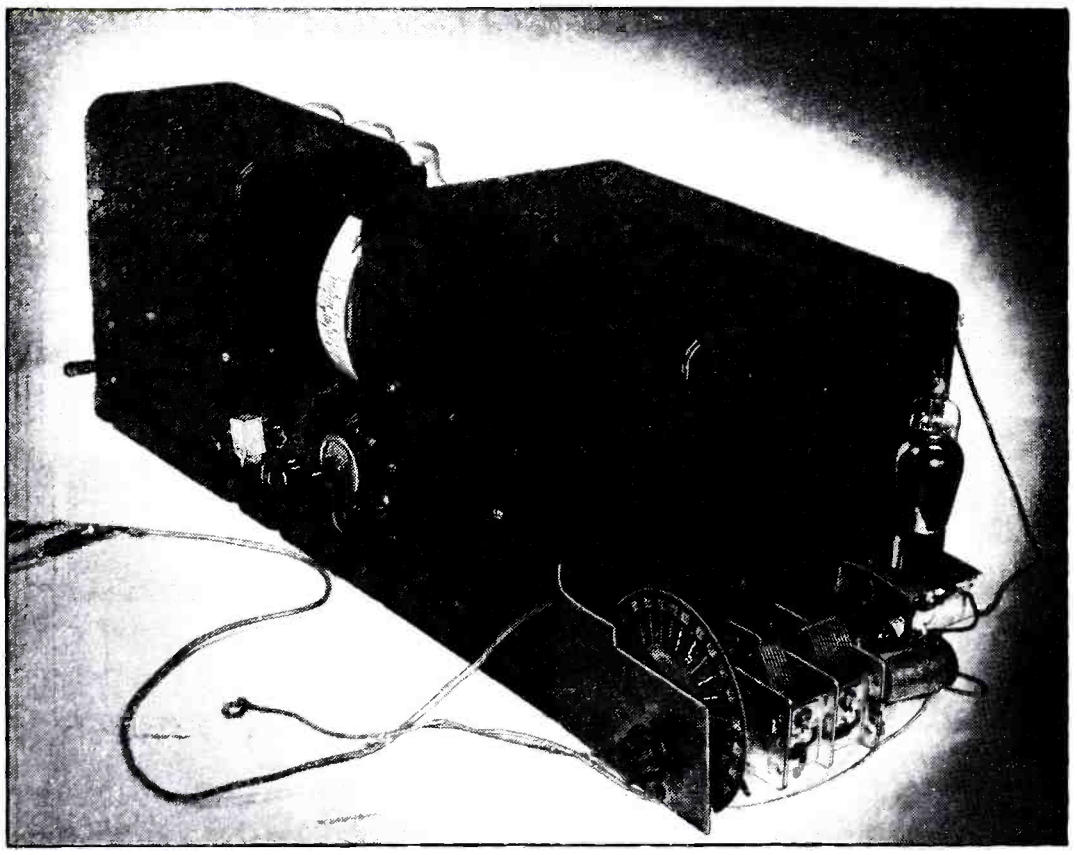
VERSATILITY

A switch has been incorporated allowing the Adapter to utilize the audio system of a receiver; or the receiver to be

(Continued on page 426)

HOME-MADE DYNAMIC TESTER

The importance of this article lies less in the construction of the dynamic tester, here readily apply Dr. Wallace's testing procedure by modifying any conveniently available



Shown above is an old Eveready T.R.F. receiver; attached to it, at right, is the add-on beat-frequency I.F. oscillator. Any conveniently available set may be used; the Eveready chassis was only one of several the Doctor has used.

EVER since the advent of the cathode-ray tube in radio receiver testing, I've been fighting a battle for the defense of *simplicity* in radio servicing instruments and procedures. My students are not overly endowed with money, and of course are not full-time radio repairmen as yet, so when I'm criticized for leaving the cathode-ray tube technique out of my elementary courses, I simply reply that if one of the boys will buy one, I'll show him how to use it.

Meanwhile the old-fashion techniques of voltage and resistance analysis are often too slow or cumbersome for practical use, so I offer this *Dynamic Tester to fill in the gap. It consists simply of a radio receiver with leads coupled to the outputs of various stages with which to feed the signal into the receiver being tested at the corresponding stage.

The final test of a receiver's performance is not the accuracy with which it can describe Lissajou's figures on the screen of a cathode-ray tube, but its ability to give satisfactory reproduction of the auditory programs from the broadcast studio. Hence this *sound* technique removes the complications of equipment and cost involved in the transfer to another sense mode, and gets the accuracy needed for the work, even though this accuracy is less than that of the *sight* technique.

*See "Complete Step-by-Step Dynamic Servicing," Parts I to V, **Radio-Craft**, Jan. to May, 1939, incl., for extensive treatment of the subject of dynamic servicing where more involved service apparatus is available.

THE DEVICE

The diagram of Fig. 1 gives the fundamental idea of the device used. A signal is picked up from a broadcast station with an aerial or from the output of a modulated oscillator, and is amplified through the R.F. tuner - amplifier section to sufficient power to drive the detector of any T.R.F. set.

This output is made available at J1 for use with a shielded test lead in applying it to the input of the detector of the set being tested. The output of the R.F. section is also applied to the detector, the output of which is applied in turn to the input of the A.F. amplifier section. The A.F. voltage is made available at J2 for grid drive of an A.F. tube and at J3 for the voice coil of a dynamic speaker.

The remaining portion of the device consists of a mixer—beat-frequency oscillator with separate tuning control for the production of any I.F. value needed for checking I.F. or 2nd-detector stages in superheterodynes. This is modulated by the original signal when a jumper is run from jacks J1 to J4 and is made available through jack J5. The remaining jack, J6, gives the output of the beat-frequency oscillator to be used in testing local-oscillator performance.

CONSTRUCTION

A T.R.F.-Set Tester. The device can be built for remarkably little outlay provided a T.R.F. receiver is available to build into the unit. Since most Servicemen have such a thing at hand the description will continue from this point.

First a switch must be installed in one of the voice-coil leads in order to cut off the output of the receiver being made over into the dynamic tester. Next a 100 mmf. condenser is connected to the plate of the last R.F. stage and the other side of the condenser connected to jack J1. All the jacks used can be pin-jacks with the ground for the shielding of the lead supplied by a nearby grounded jack, or they can be phone jacks and have the leads supplied with phone plugs.

Now a 0.1-mf. condenser between the plate of the last single audio stage (not counting push-pull) and jack J2 supplies the audio signal, and jack J3 to one of the voice coil leads with the other grounded gives signal suitable to apply to the voice coil of a loudspeaker. For testing T.R.F. receivers the dynamic tester is now complete.

A Superhet.-Set Tester. For testing superheterodynes, however, another tube and associated parts must be added. This is the mixer—beat-frequency oscillator for the production of modulated I.F.'s of any value. Unlike the usual signal generator used for service work, this device produces the I.F.'s the same way they are produced in a superheterodyne receiver, i.e., by beating with the incoming signal from the R.F. amplifier rather than producing them as fundamentals in the oscillator circuit.

This method was chosen for 2 reasons:

1st—because the oscillator frequency needed to produce the I.F. would be identical with that of the local oscillator of the set being tested and would enable a check to be made directly on oscillator frequency at one setting of the control; and,

2nd—because the parts needed to set up these frequencies could be taken from a discarded superheterodyne receiver.

As seen in the diagram of Fig. 2, the frequency of the oscillator is determined by the values of L1 and C1, both of which should come from a set with a high I.F. (below 500 kilocycles). The rest of the circuit is conventional and will be readily constructed from the diagram. The dynamic tester shown in the photograph was made from an Eveready receiver, chosen largely because

FOR SERVICING RECEIVERS

described, than in the principles of testing it employs. Any radio Serviceman may T.R.F. chassis, and then adding to it an I.F. oscillator, to secure a suitable service unit.

ROBERT F. WALLACE, PH. D.

it was available and had the added advantage of having the output transformer in the chassis rather than on the loudspeaker, which made the wiring of the switch in the voice coil lead and the voice coil output easier to do.

OPERATION

When a receiver is brought in for repair it is put on the bench, plugged into the power line, and turned on. If the set is inoperative when antenna and ground are applied, and the tuning condenser rotated over the band, a signal from the R.F. or I.F. pin-jack is applied to the detector of the set. If no signal is heard from the loudspeaker of the set being tested, the fault is in the power supply, detector or audio sections. If a signal is heard the fault is in the R.F., oscillator-mixer, or I.F.

In the former case the signal is applied from the voice coil pin-jack to the voice coil of the loudspeaker. If no signal is heard the fault is in the loudspeaker voice coil or the power supply and the conventional voltmeter-ohmmeter check follows. If the signal is heard, the signal is applied to the input of the output stage, and if necessary to the input of the preceding audio stage. The point at which the signal is blocked becomes the point for parts and voltage analysis, usually beginning with the tube associated with that stage. If the signal comes through from the detector stage the signal is applied at successively preceding stages until the signal is blocked and then conventional parts and voltage tests locate the trouble.

In case the complaint is intermittency much the same procedure is used to determine if the set cuts out when only a portion of the set is carrying the signal, and narrowing the stages involved down to 1 and then a thorough parts check-up.

Distortion comes in for the same type of analysis, by feeding the signal into successively earlier stages and determining at what stage the distortion is introduced. A check-up on this stage is then made and the faulty parts repaired or replaced.

The advantage of this device over standard oscillators lies in the following points:

(1) The signal is modulated by a broadcast signal which is better than a pure tone for locating distortion aurally.

(2) Adequate power is supplied for application to any stage of the set; ordinary oscillators do not supply sufficient signal to actuate voice coils of dynamic speakers.

(3) Instant check-up on the incoming signal is obtained by turning on the speaker of the testing device.

Finally, I don't make any claim of superiority for this device over the more elaborate devices used for dynamic testing of radio receivers. I merely say that many Servicemen can whip this device together who will not be ready to invest in cathode-ray or manufactured stage-analysis equipment for some time to come, and can meanwhile save time and do better work than with standard equipment alone.

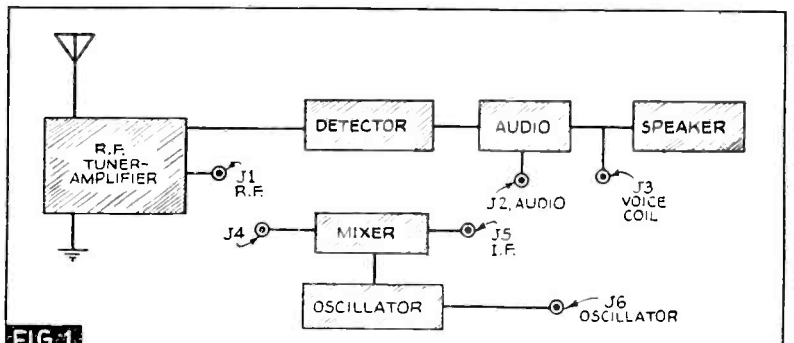


FIG. 1

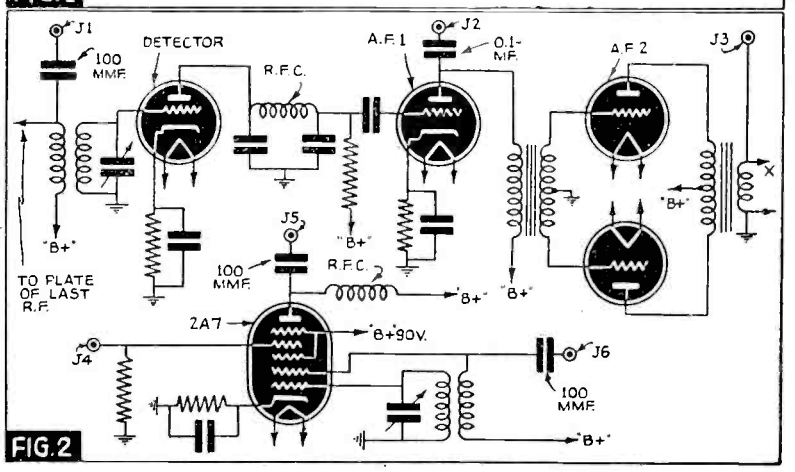


FIG. 2

SERVICING QUESTIONS and ANSWERS

INTERMITTENT RECEPTION

(141) Norris Chambers, Cross Cut, Tex.

(Q.) I have trouble with a Philco model 90, or 90A, using a single 47 tube as power output. I do not have a diagram for this set, and I assume the type 27 tube to be the oscillator, since the grid of that tube is coupled to what appears to be the oscillator section of the variable condenser. The set is semi-intermittent. That is, it cuts almost off, but whenever I try to test any part, or touch any grid or plate connection, it snaps back on, apparently in perfect order. But in a minute or so, it cuts practically off again. I believe that the oscillator tube is not working. I have tried other tubes of the same type from other parts of the set, and have also tried different tubes all together, all testing OK. I have shunted the resistor with other resistors, and tried a new 250 mmf. condenser, but it doesn't seem to help.

Previously I replaced the electrolytic condensers in this set. Could this affect the oscillator? They are apparently in good order now. The voltage for this set measures almost 300 V., with a 1,000 ohms/volt meter.

(A.) Intermittent reception by the Philco model 90 or 90A is caused by the following condensers opening during operation: (1) A.F. coupling condenser; (2) cathode bypass condenser; (3) screen-grid bypass condensers; (4) oscillation plate condenser.

Generally the condensers can be spotted by an exudation of wax from the container through the lug eyelet holes. Replace all such condensers, as the wax is forced out by the heat generated internally by a poor or intermittent contact between the pigtail and the foil.

SET LACKS VOLUME

(142) Chas. L. Culley, Melville, La.

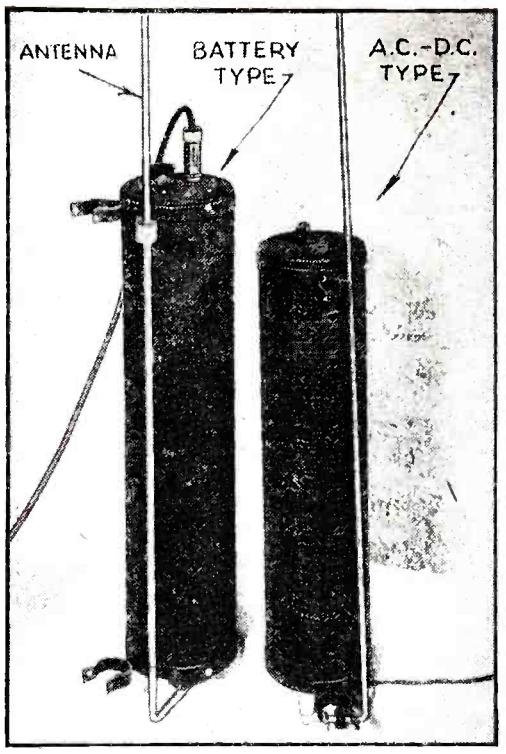
(Q.) Please explain cause and recommend cure for the following ailment. The "patient" is a Fairbanks-Morse 12A. The symptoms are lack of volume on high-frequency end of band, particularly; and, a lack of the volume to be expected from pair of 6L6's, over entire band.

By grounding the R.F. broadcast trimmers indicated (this may apply to other bands also, I failed to try) the volume assumes its normal strength. The grounding is obtained by inserting a screwdriver through hole in coil shield and grounding adjusting screw to coil shield. This applies to both antenna and R.F. trimmers. The receiver and its components check OK otherwise.

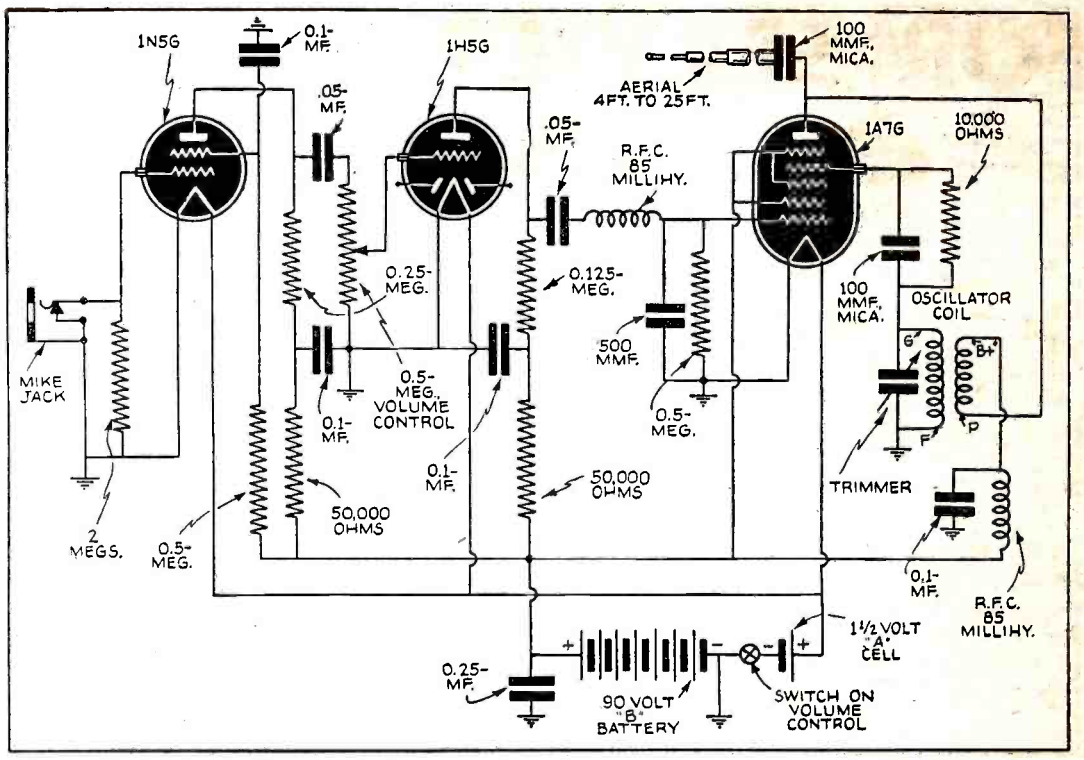
(A.) The fact that the trimmer condensers when shorted to ground increased gain to normal, indicates A.V.C. trouble, wherein the bias is excessive as supplied to R.F., mixer and I.F. However in view of the fact that the receiver incorporates A.F.C. we believe the receiver is out of balance or alignment.

Align the receiver in the conventional way with A.F.C. off. Then with the A.F.C. on, and a low-scale high-ohm/volt (not less than 1,000 ohms) meter connected across the cathodes of the 6H6, adjust the trimmer, shunting the variable condenser that tunes the secondary which feeds the anodes (plates) of the 6H6, for zero current. After alignment this meter should swing equally to positive and negative as one tunes through the signal.

Check resistance of A.V.C. circuit to ground; this should not be less than ½-megohm resistance.



As this view of the exterior appearance of the new wireless P.A. mikes shows, authors White and Rawitz have done a real professional job.



Schematic circuit of self-powered, fully portable, battery-type wireless microphone for P.A. men. Such a unit, completely devoid of trailing wires, has many advantages.

WIRELESS MICROPHONES

Years hence when self-powered microphones completely devoid of trailing wires lations, radio men will look back at this article by Messrs. White and Rawitz as

S. J. WHITE, E. E.

New public-address wireless mike in use. (Cover feature.)

WE often wondered how long it would be before some technician worked out a scheme to eliminate the stumbling block, or should we say stumbling cable, of portable microphones,—that is, the wire which frequently trails in and out of chairs and over and around people's feet before it finally reaches the associated amplifier. Even though a power outlet might be nearby to the microphone the sound cable to the amplifier, like the poor, was always with us. We'd like to have a nickel for every microphone ruined through being yanked to the ground by "entangling alliances", but the writers of this article found that, as usual, only necessity was the mother of invention.

As the senior writer told *Radio-Craft* readers in the October issue (*) the only apparent solution to a P.A. installation at a monster bingo game, attended by about 20,000 persons, was the use of the *wireless microphones* we devised along the lines of the now popular "wireless phonographs" (**), but which were developed especially to meet the needs of this professional sound installation.

As was pointed out in the article in October *Radio-Craft* the Federal Communications Commission authorizes the use of short-range "wireless" phonographs but it seems reasonable to believe that this range could be extended slightly if reasonable proof could be given that such operation would not in any way affect radio reception in other services or, more particularly, interfere with reception of signals from any other State.

However until the F.C.C. makes some definite decision in this connection, any type of oscillator operated as here described must be considered as a radio transmitter for which a license must be secured, unless the range definitely does not exceed approximately 150 ft. It is important to note in this connection that the wavelength upon which the "transmitter" is operated is an important factor in the range. We are able to control and limit the range of our wireless P.A. microphones to legal distances by adjusting the height of the antenna.

BATTERY-TYPE UNIT

THE circuit for the "wireless" type of microphone is similar to so-called "wireless" record players, except that 2 A.F. stages are added to permit operation from low-level microphones such as ribbons, crystals, dynamics, etc. The battery model of wireless mike will be described first.

The microphone is plugged into the input jack and its output is amplified by the 1N5 acting as a screen-grid voltage amplifier. A 1H5 further amplifies the A.F. signal. It is used here as a high-gain triode, the diode elements not being used. A volume control between the 1st and 2nd stage provides regulation of the A.F. signal on the modulator grid (No. 5) of the 1A7 output tube. The 1A7 is a pentagrid converter tube and combines the functions of oscillator and final A.F. modulator.

The oscillator coils are the same type that are used in wireless record players, and in a circuit oscillate somewheres in the broadcast band, generally between 1,200 kc. and 700 kc., depending upon the value of the postage-stamp trimmer across the grid coil.

The oscillator circuit is the common "plate feedback" type and is almost infallible in operation so long as the proper winding relationship is observed. The grid coil is lattice-wound on a wood peg ½-in. in dia. by 1½-ins. long. The plate coil is wound directly over the grid coil, provid-

*First Prize manuscript, 2nd Group of Prize Winners, in Radio-Craft's P.A. Contest.

**See "How to Make a Novel, Portable, A.C.-D.C.R.F. Phonograph Attachment" by R. D. Washburne and N. H. Lessem, Radio-Craft, April 1934.

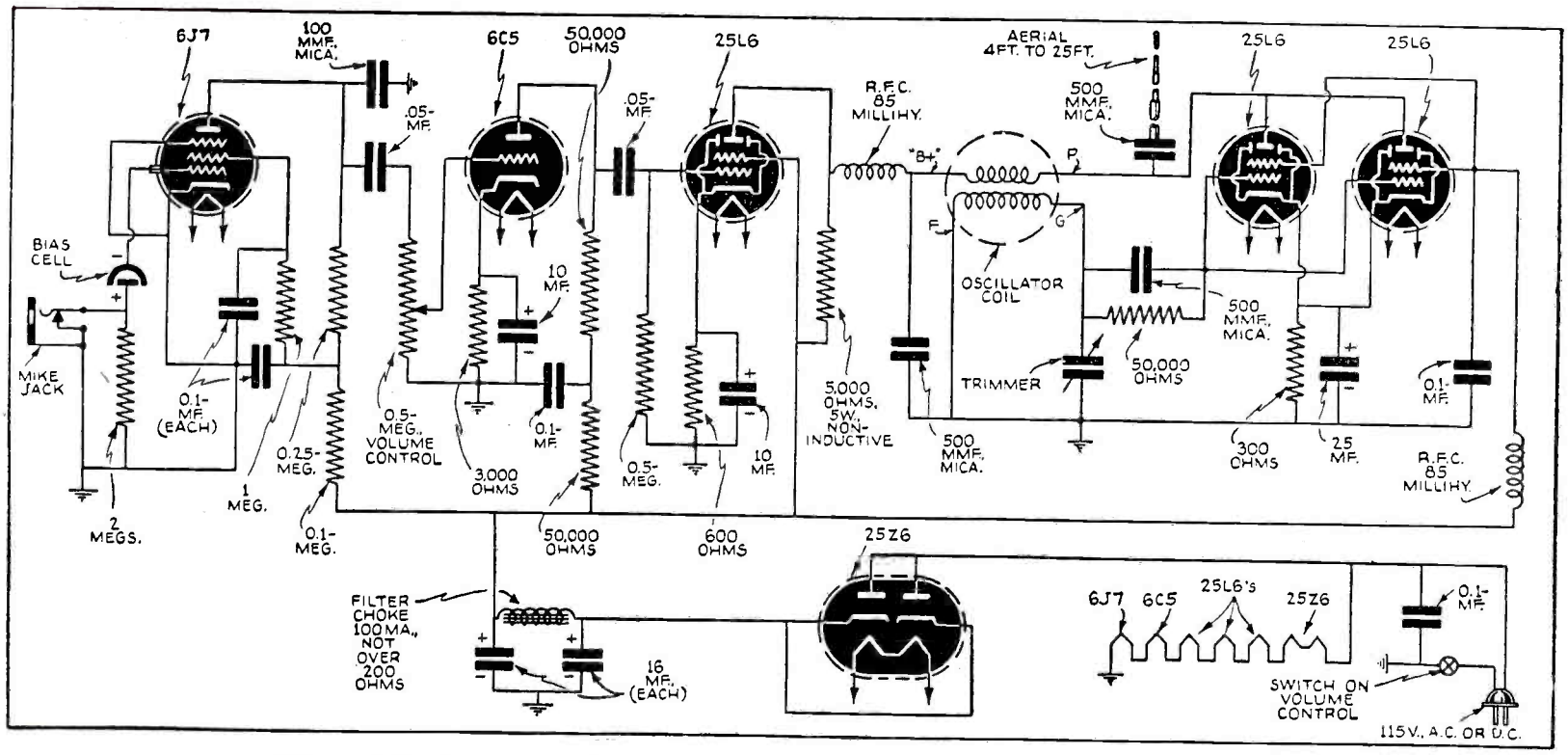


Diagram of the self-powered semi-portable A.C.-D.C. model P.A. mike. Antenna height controls range.

FOR PROFESSIONAL P.A.

have become the accepted type of sound pick-up apparatus for many P.A. instal- the first detailed published article on professional-type wireless mikes for sound men.

and ARTHUR RAWITZ

ing the closest possible inductive coupling. If the circuit does not oscillate when first tested, the leads of the plate coil marked "P" and "B+" should be reversed. The efficiency of this type of oscillator coil is very poor. However, this is of no consequence since the range of R.F. transmission would easily exceed the F.C.C. regulations if the optimum length of aerial were permitted to be used.

Resistors in the grid circuits may be ¼- or ½-watt size. Resistors in plate and screen-grid circuits should be ½-watt size.

ASSEMBLY

The unit has been assembled in such a fashion as to permit it being enclosed in a cylindrical housing 4 ins. in dia. x 18 ins. long. This also provides space for "A" and "B" batteries. The entire unit is then clamped to an ordinary mike stand as shown in the photograph.

The aerial is a 4-ft. length of aluminum rod ¼-in. diameter, and has about 3 ins. at the bottom end bent over at right-angles and fastened to the standoff insulator to which the aerial terminal of the oscillator is connected.

Referring to the circuit diagram, the 100 mmf. aerial coupling condenser is connected to the plate of the 1A7. It may also be connected to the grid end of the oscillator coil, but the plate connection affords greater stability and freedom from frequency shift when the body is brought close to the aerial rod. In fact there is no shift in frequency even when the coat sleeve is brushed against the aerial. The aerial rod is, of course, carefully insulated from the mike stand. For greater output use a piece of insulated wire about 25 feet long as an aerial.

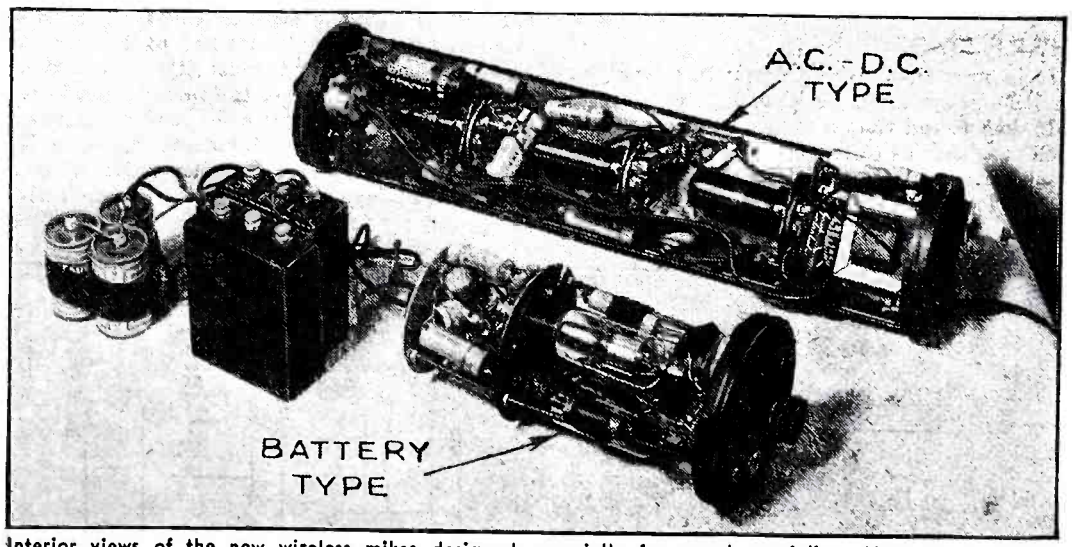
ADJUSTING XMITTER

To test and adjust the transmitter, locate the transmitter within a few feet of a broadcast receiver, preferably one that uses a tuning eye. Remove the regular aerial from the receiver and attach a short length of insulated wire. Twist this wire several times around the aerial rod of the transmitter. Tune the receiver slowly through the broadcast band until the R.F. output of the transmitter is picked up as indicated by a closing of the eye.

To make sure that the oscillator under test is being picked up and not a broadcast station, touch the aerial rod with the bare hand to ascertain that the eye opens again, indicating that the signal has been grounded.

If a microphone is plugged into the transmitter, and the volume control set about 2/3 towards maximum, audio feedback will occur.

(Continued on page 441)



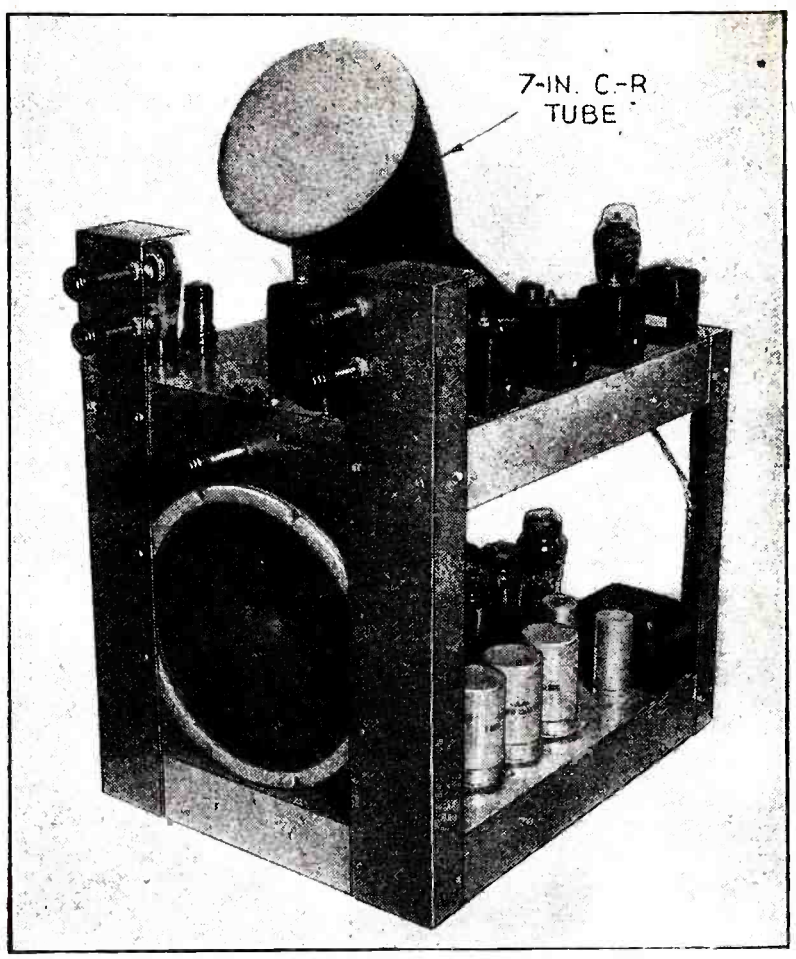
Interior views of the new wireless mikes designed especially for sound specialists. Note the compact assembly on a single strip of metal which slides down the center of the circular shield-housing. The reverse side of this metal strip presents a very similar appearance.

TELEVISION

. . . Based on the

The chief engineer of a television receiver involved during the development of a telly set, merchandised as an attractive kit proposition of how to get a good image size for regular

GORDON



Here is a photo of the completed Fulton "Observox" telly kit-receiver which was made available to *Radio-Craft* during a test period. Its circuit features are described in the accompanying article. The photo on pg. 402 illustrates a completely-wired model now available.

IN the design of a television receiver there are many things to consider. First we must choose between 2 types of circuit, namely the superheterodyne or "superhet.", and the tuned radio frequency or "T.R.F."

The T.R.F. has many points in its favor and is capable of giving excellent performance. However the United States has several television stations which will operate on different frequencies. This fact shows up the outstanding weakness of the T.R.F. set, that is, the difficulty of tuning to a number of different frequencies. The average T.R.F. set will require about 5 stages and the difficulty of tracking 6 or possibly 12 tuned circuits is readily appreciated. Even if an individual condenser or tuned circuit is provided for each station and a tuning switch or pushbuttons employed, the great number of parts required and probability of installing render the T.R.F. set almost impractical. Thus we conclude that the superheterodyne is the most suitable.

THE R.F. STAGE

It is now in order to determine whether an R.F. stage is to be incorporated or not.

It was found that a single tube converter such as the 6K8 introduced entirely too much noise under conditions of weak signal input. This noise was visible on the image as a constantly moving speckel or rain effect. A similar noise voltage in a sound receiver would be heard as a hiss. An 1852 was then investigated as an R.F. amplifier ahead of the converter; this considerably reduced the amount of noise because the level at which the converter operated was raised. Finally an 1852 was tried as the mixer with a separate oscillator with no R.F. stage. This combination proved the most desirable (see diagram in Fig. A1) since the gain was practically as great as that of the single tube converter with an R.F. stage and much greater than the single tube converter alone. With a weak signal the noise is negligible.

It has been found that in metropolitan areas the external noise due to auto ignition and diathermy makes it necessary for the television signal to introduce into the input of the television receiver at least 1 millivolt or preferably more in order to provide satisfactory reception. Since the average cathode-ray tube requires about 30 or at the most 50 volts, to completely modulate it, the overall gain of the receiver should be at least 50,000.

Taking the gain of the mixer to be 8, each I.F. stage about 12, assuming the detector to have an efficiency of 50% or a gain of ½, and allowing 10 for the gain of the vision amplifier; we find that 3 I.F. stages are necessary and the overall gain is nearly 70,000.

If the signal is so weak as to provide less than 1 millivolt, a more efficient antenna can be used or the gain of the receiver increased by the simple artifice of tuning so as to reduce the band width. Of course this reduces the definition of the image but where the signal-to-noise ratio is low an actual improvement in the entertainment value is effected inasmuch as a slightly fuzzy image is almost always preferable to one constantly spoiled by flashing specks.

THE OSCILLATOR

The oscillator employed is worthy of more than a passing glance. At first it may be difficult to see how feedback is effected since there are no taps or tickler coils. Actually the circuit is a modified Colpitts with the interelectrode capacities taking the place of the usual 2 capacities in series. This is shown in Fig. 1, where C1 is the plate-to-cathode capacity and C2 is the grid-to-cathode capacity. Condenser C3, the grid-to-plate capacity being only a small capacity in parallel with the main tuning condenser has no detrimental effect. This method has given stable oscillation with conventional tubes in excess of 100 mc.

THE I.F. CHANNEL

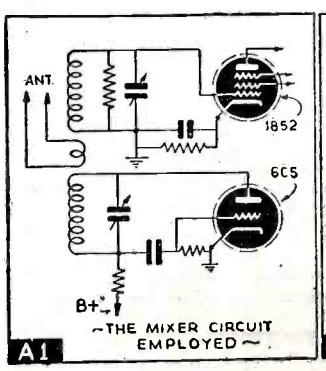
For our I.F. stages we have a number of possibilities. Since our vision modulation frequencies can be in excess of 4 mc. the intermediate frequency should preferably be greater than 8 mc. In the choice of the proper I.F. it should be borne in mind that the lower the I.F. the greater the gain and stability. It has been found through experience that it is desirable to choose an I.F. such that no harmonic of this I.F. can fall on the frequency of the incoming signal. If this should occur it makes itself known by a series of broad parallel lines across the image, often diagonally.

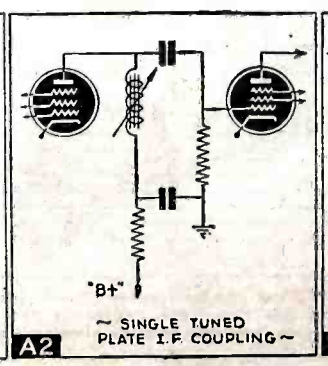
It is also wise not to choose a frequency such as 14 mc. because this is a well-occupied amateur band and a powerful amateur signal might be picked up directly by the I.F. stages. A frequency of 12.5 mc. was finally chosen as the I.F. since it satisfied these conditions.

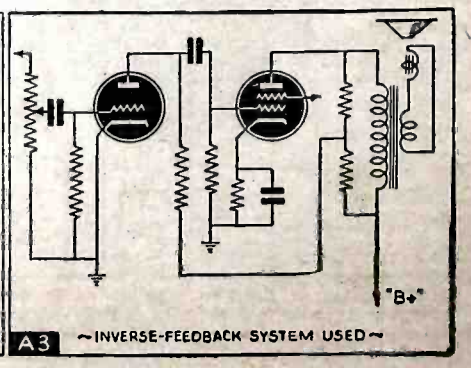
It can be shown that at the bandwidth and frequencies involved the gain of an I.F. or R.F. stage is practically inversely proportional to the circuit capacity. In other words, the lower the circuit capacity the higher the gain. Hence by utilizing only the tube and distributed wiring capacity to resonate the I.F. coils without the use of any trimming condensers (See diagram in Fig. A2.), the gain is the maximum realizable.

Since trimming of some sort is necessary to properly align the stages, an adjustable powdered-iron core is provided. A pair of overcoupled tuned circuits might be used, but in practice fail to give satisfaction because of difficulty of adjustment. Since the 2 coils are of necessity close together, adjustment of one of the iron cores affects the tuning of the other coupled circuit. The use of 2 separate permeability-tuned circuits coupled by means of a small variable condenser is capable of good performance but is also difficult to tune without elaborate equipment. The same also holds true of the various other more complex systems of interstage coupling.

By far the simplest telly I.F. circuit system is the use of a single tuned circuit in each plate circuit capacity-coupled to the grid of the following stage which uses a low-value grid resistor. Each of the previ-







DESIGN FACTORS—

Construction of a "7-Inch" Telly Kit-Receiver

manufacturer describes in detail the problems and original solutions sufficiently simple in design and effective in results to warrant it being for Servicemen. The selection of a 7-in. C.-R. tube solved the problem home viewing without recourse to the high voltages required by larger tubes.

BURROUGHS

ous systems mentioned also needs a relatively low-value resistor connected across the tuned circuits in order to flatten the response. The possible disadvantage of the single tuned plate system is that when a resistor of low enough value to give the desired response is used, the gain is very low. However, by staggering the tuning of the various stages the damping resistance can be increased to a value giving gain equal to the other systems and providing adequate bandwidth. This is the system finally employed and in practice is found very easy to line up since there is no interaction of tuning and only a single adjustment on each coupling.

It is of interest to note that in the last I.F. stage an R.F. choke is used in the plate circuit while the tuned coil is in the diode circuit. This is to provide a low-resistance input to the diode which increases its efficiency in spite of the low value of load resistor used. This load-resistor value must be low in order to provide the necessary high-frequency response. If it were higher in value the efficiency would increase but the impedance of the circuit capacities would be comparable to the load resistance and would bypass the high frequencies.

THE SOUND CHANNEL

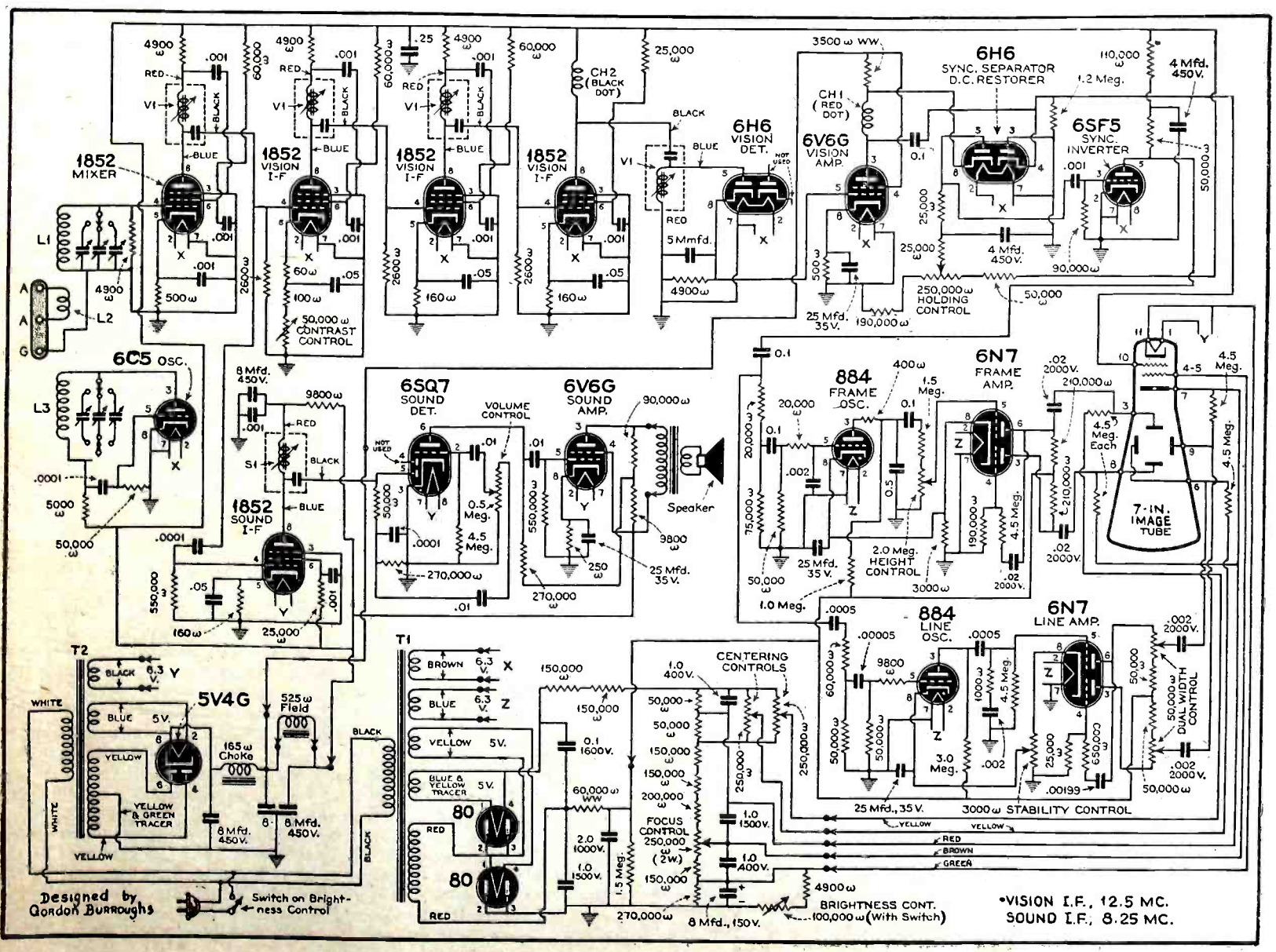
While a separate sound receiver could be used, economy dictates that the same oscillator and mixer tubes be used for this function. This works out well in practice and it is only necessary to add a single I.F. stage operating at the proper frequency for sound reception. The same single tuned coupling is used, but this time without the low-value damping resistor shunting it, since the bandwidth need not be so wide. This system of coupling shows adequate rejection of the vision I.F. and only the intended sound can be heard in the loudspeaker.

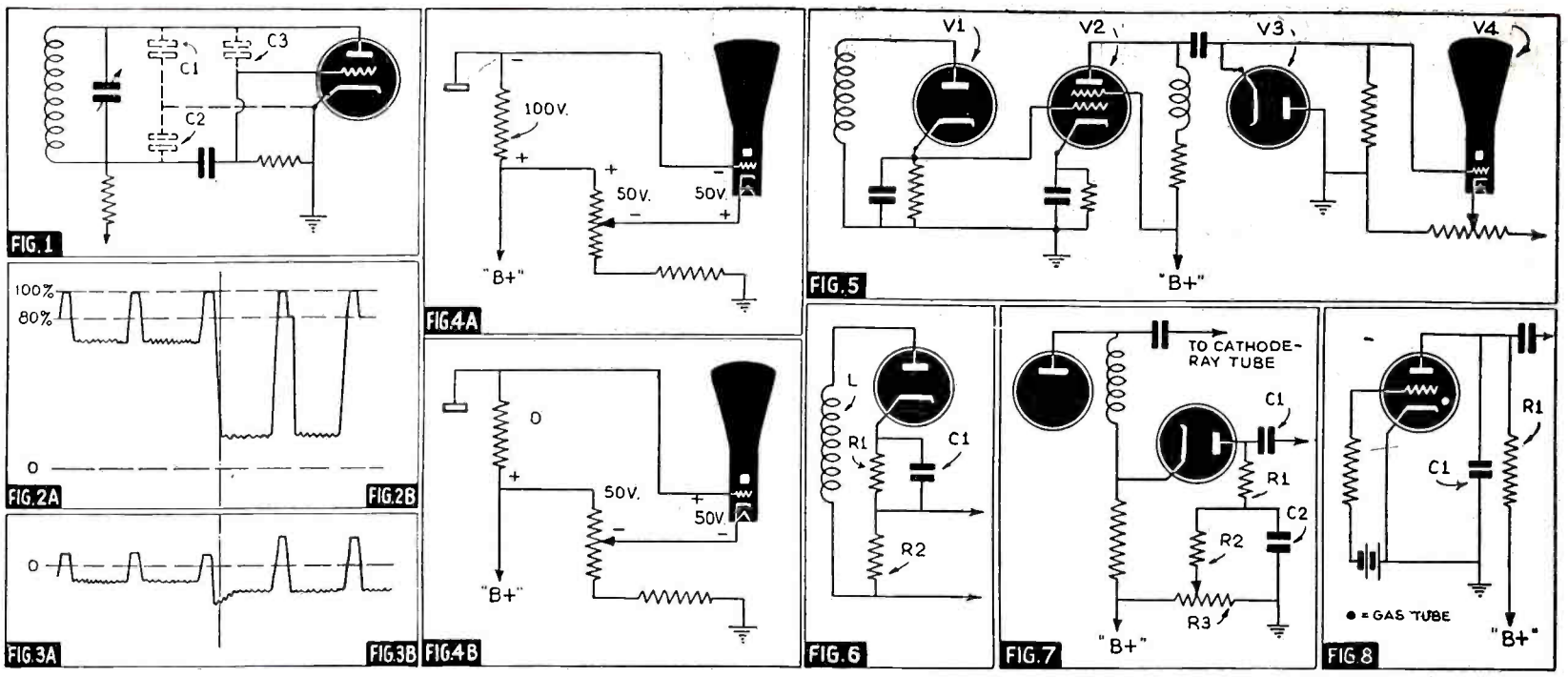
The sound detector is the conventional diode while the triode portion of the 6SQ7 is used as the 1st audio stage. The *contact potential* is relied upon for the grid bias of this stage. The plate load resistor goes to a voltage divider across the 6V6 power stage output transformer. This provides a degree of inverse feedback (See diagram in Fig. A3.) which does much to level the response and reduce the distortion. Since the television sound is transmitted with a higher degree of fidelity than a conventional broadcast station any steps to improve the sound receiver's fidelity are well worth while.

THE VIDEO AMPLIFIER

Returning now to our vision circuits we come to the vision amplifier, sometimes

(Continued on following page)





(Continued from preceding page)

called the *video* amplifier. In determining the type of coupling to be used between the detector and the vision amplifier it will be of interest to examine the type of signal we have to amplify.

The television signal developed across the load resistance of the diode detector consists of a series of extremely short, high-amplitude pulses. These are the synchronizing impulses and one is provided for each line of the image or "picture." Between these pulses is the image signal which consists of the rapid fluctuations of current corresponding to the fluctuations of the light values of the different portions of the line being scanned. This signal is transmitted so that zero amplitude corresponds to white while 80% of full amplitude provides a black signal and only the sync. pulses reach 100% amplitude.

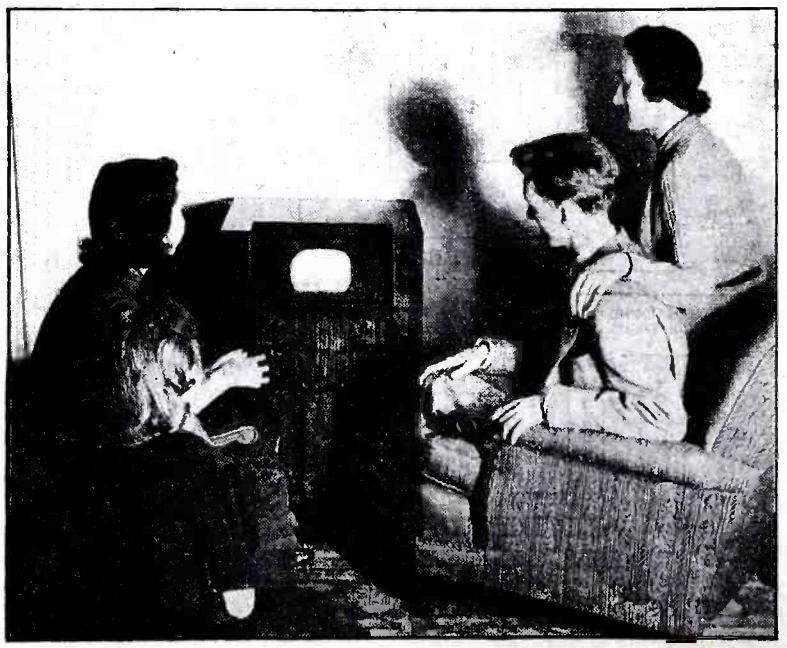
Since an increase of amplitude causes a darkening of the image; the sync. pulses, being of greater amplitude than black, drive the cathode-ray tube still more negative than the amount necessary to make the screen black. This, of course, produces no effect on the screen which is still black. Thus the sync. pulses are invisible; being superimposed on the black border of the image.

Figure 2A shows the waveform of a portion of a dark scene. It will be noted that the average amplitude of the picture signal is around 70% or in the dark region. Figure 2B represents a similar scene but now in bright daylight. The average amplitude is now around 10% although the shape of the waveform is the same as that of the previous instance. It will now be realized that the image signal fluctuations have a definite varying D.C. component. If the signal were passed through a coupling condenser in the conventional audio style it would emerge as shown in Figs. 3A and 3B.

It will be noted that only the variations are passed and the D.C. component is lost since with capacity coupling the wave arranges itself symmetrically about the zero point. The effect of this on the image will be a lightening of a dark scene and the darkening of a light scene which will necessitate a readjustment of the brightness control each time the scene is changed. Another possibly worse result of the loss of the D.C. component is the loss of synchronism each time the scene changes. This is brought about by the irregular height of the sync. pulses of Fig. 3A and 3B. These facts limit us to either direct coupling or some form of *D.C. restoration* if capacity coupling is used.

D.C. RESTORATION

The term D.C. restoration is given to the artifice of restoring the lost D.C. component. It may be accomplished by providing a diode across the grid leak and allowing the coupling condenser to be charged through it. Of course the diode must be polarized so as to conduct only on the tips of the sync. pulses and thus build up a charge to provide the D.C. component. It is possible in some instances to omit the bias on the vision amplifier and allow grid rectification to charge the coupling condenser making an additional diode superfluous. In the present receiver direct coupling was employed between the detector and vision amplifier. This, of course, perfectly transmitted the D.C. component.



The author puts a completed sight-and-sound Observox to the acid test of operation in normal home surroundings.

COUPLING-IN THE C.-R. TUBE

While direct coupling could be used between the vision amplifier and the image tube, this was deemed very inadvisable for the following reasons: when the image tube grid is directly connected to the vision amplifier plate, the image tube cathode is connected to a positive voltage so that the proper bias is applied to the image tube. This is shown in Fig. 4A. Assume a vision amplifier plate supply of 300 V. and a drop of 100 V. in the plate load; then, to apply the proper grid bias for the image tube it is necessary to adjust the cathode of the image tube to 50 volts negative in respect to the "B+" 300 V. plate supply. This places the image tube grid at its proper bias of approx. 50 V.

The hazard in this method lies in the possibility of damage to the image tube caused by the failure of the vision amplifier tube. If this tube should be removed from its socket or fail for any reason, it will cease to draw plate current and there will be no drop across the plate load and a positive bias will be applied to the image tube as shown in Fig. 4B. This same condition can occur during the interval of heating when the set is first turned on and the image tube heats quicker than the vision amplifier. Also when the set is turned off, the drop across the plate load vanishes; this time providing zero bias while the image tube continues to function for a moment on the power stored by the high voltage condensers.

Any of these occurrences cause the apance of a momentary, stationary bright spot on the screen of the image tube, which as is well known, is very detrimental to cathode-ray tube life. In a short time a dark, usually brown spot will appear in the center of the screen showing that it has been burned. This burned spot is not to be confused with the *ion* spot which is characteristic of most magnetic-deflection tubes.

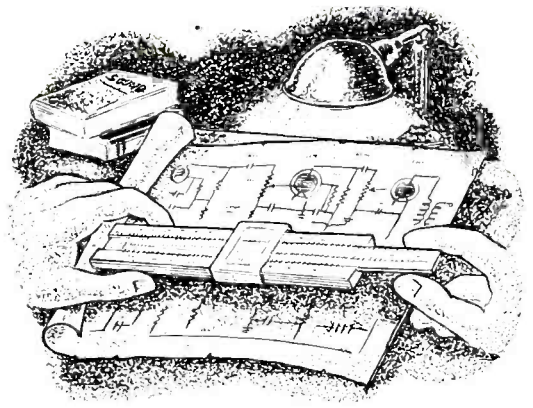
The ion spot is apparently caused by the failure of a magnetic field such as produced by magnetic deflecting coils to deflect the beam of ions which accompany the electron beam. These ions continue in a straight path and impinge on the screen and burn it. Since we chose a 7-inch electrostatic deflection tube, we will not be bothered with ion spots and any possibility of burning the screen can be completely eliminated by using capacity coupling from the vision amplifier to the image tube. Thus the grid bias of the image tube is isolated from the rest of the circuit and the possibility of a stationary spot is completely eliminated.

(Continued on page 428)

SOUND ENGINEERING

Free Design and Advisory Service For Radio-Craft Subscribers

Conducted by A. C. SHANEY



This department is being conducted for the benefit of RADIO-CRAFT *subscribers. All design, engineering, or theoretical questions relative to P.A. installations, sound equipment, audio amplifier design, etc., will be answered in this section. (Note: when questions refer to circuit diagrams published in past issues of technical literature, the original, or a copy of the circuit should be supplied in order to facilitate reply.)*

No. 1

REMOTE PREAMPLIFIER—HOW TO BRIDGE AMPLIFIERS

The Question . . .

We would like to secure a diagram for a 2- or 3-channel preamplifier using some of the new low-voltage tubes. Most preamplifiers are operated several hundred feet from main amplifiers and A.C. is seldom available. A preamplifier that would operate with several drycells and about 145 volts of "B" battery would be a great convenience. If you can furnish or advise where I can obtain such a good diagram the information would be appreciated.

We would also appreciate information on how to best connect 2 amplifiers with high-impedance inputs to one preamplifier with 500-ohm output.

R. A. BRAY,
Big Timber, Montana.

The Answer . . .

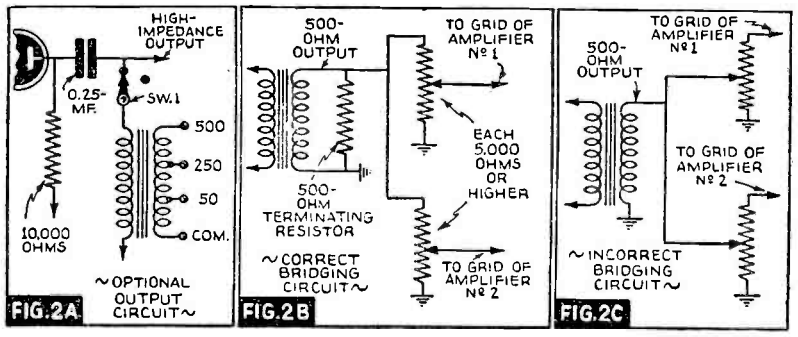
A circuit diagram for a 2-Channel Battery-Operated Remote Amplifier is given in Fig. 1. You will note that the latest-type 1.4-volt tubes were employed, as this can be operated directly from a 1½-volt drycell without the use of a ballast tube or resistor. A 90-volt "B" battery will furnish a suitable source of plate supply.

Although a 2-channel unit is diagrammed, an additional channel may be added by using 2 more 1N5G-type tubes.

Electronic mixing is employed to enable entirely independent control of each channel without affecting the volume of its adjacent channel. High-level mixing (in the second stage) is utilized in order to avoid the necessity of using expensive volume controls. A master control is inserted in the grid circuit of the output tube.

The output triode may be fed either into a universal output transformer, a universal line transformer, or it may be used directly as a high-impedance output, as illustrated in Fig. 1.

If the output transformer shows a loss of low frequencies because of the 1.5 ma. plate current, it might be advisable to use a shunt resistance feed, as illustrated in Fig. 2A. The switch, Sw.1, provides optional transformer output or high-impedance output. Naturally, the input circuit may be changed to a low impedance by including a suitable input transformer.



Although this entire preamplifier is entirely free from A.C., it is highly desirable to shield it completely, as it might pick up stray A.C. voltages when operated near power lines.

As to the second portion of the inquiry, any number of amplifiers having a high-impedance input (5,000 ohms or more), may be connected directly across a 500-ohm output of the preamplifier, as illustrated in Fig. 2B.

The important thing to remember in using bridge amplifiers, is that the input impedance of the "bridging" amplifier, should be at least 10 times higher than the output impedance of this circuit to which it is applied. Otherwise, either frequency discrimination or noticeable loss of gain may result.

The second important point to bear in mind, is that when these high-impedance bridging circuits are applied across the 500-ohm output of an amplifier, it is important to have a 500-ohm resistive load across the output. Otherwise, the frequency response characteristic of the output transformer may be greatly changed.

A third important point is to expect a loss of apparent gain in the bridging amplifier. For example if a power amplifier is rated at 50 db. gain based on a 500,000-ohm input, it will be found that when this input circuit is applied across the 500-ohm output, the affective loss of gain will be equal to 10 times the log of 500,000 over 500, or 30 db. Therefore, 50 db. rating of the output amplifier will only provide an affective gain of 20 db. (50–30=20). If this loss of gain can not be tolerated, it may be necessary to add an additional stage into the bridging amplifier.

A fourth precaution to keep in mind, when using high-impedance bridging amplifiers, is to be absolutely certain that the volume control (if any) does not shunt the input device. Such an incorrect arrangement is illustrated in Fig. 2C. It is quite apparent that the volume controls of the bridging amplifier, when operating under this circuit, will greatly affect each other, and shunt the output of the preamplifier. This circuit arrangement should never be used.

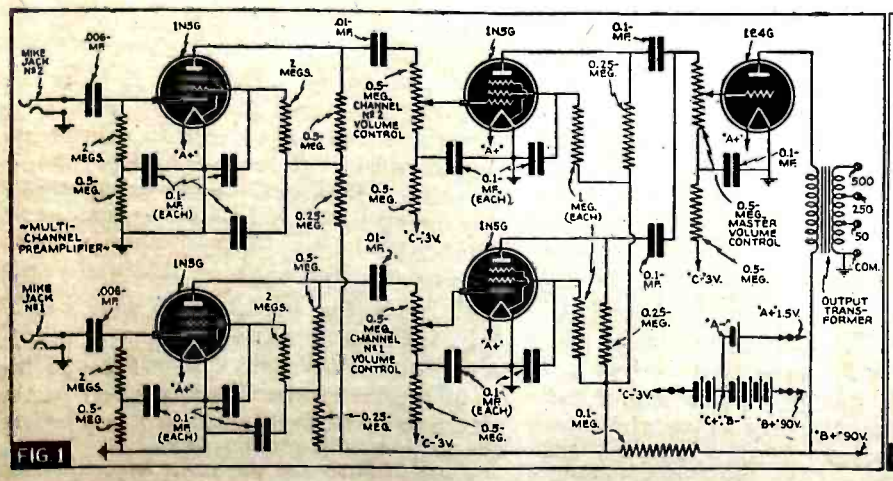
AMPLIFIER REWIRING

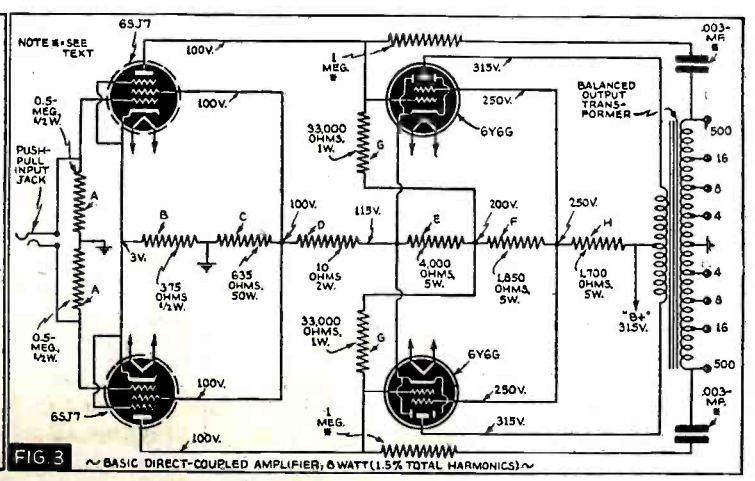
The Question . . .

Regarding the "All Push-Pull Direct-Coupled 10-watt Amplifier" in your July, 1939, issue of *Radio-Craft*, I would like to know whether it is possible to rewire a 9-watt amplifier in my radio set having a filtered "B" supply of only 350 volts to start with.

If 350 volts is practical, I would appreciate any data as to the ratings of resistors

(Continued on page 445)





EMERGENCY SERVICING

Any radio man knowing the fundamentals and provided with a little used in servicing, need not fear to tackle a fractious radio set, says Mr.

CHARLES R. LEUTZ

PART I (August, 1939) of this series of articles referred to radio receivers wholly out of commission due to one or more defective parts or tubes.

Part II (October, 1939) pertained to receivers in fair operating condition but not properly aligned. The discussion so far has excluded the use of any indicating or measuring meters or instruments.

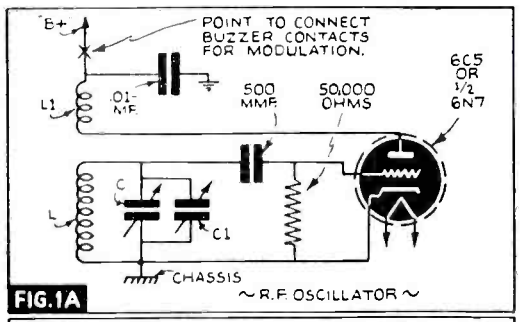


FIG. 1A

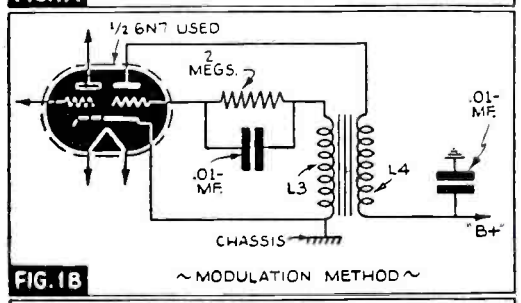


FIG. 1B

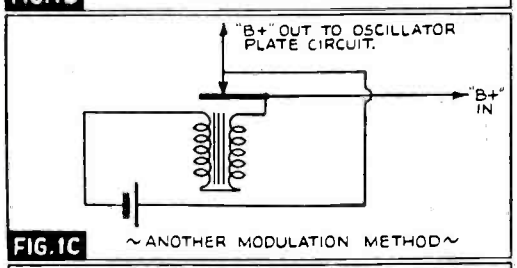


FIG. 1C

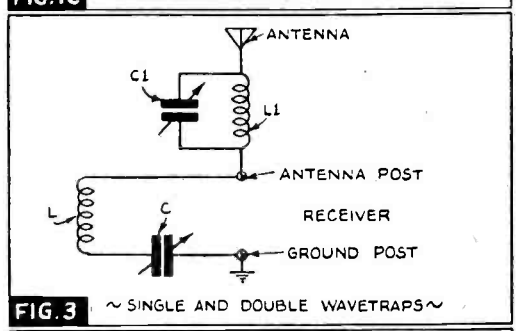


FIG. 3

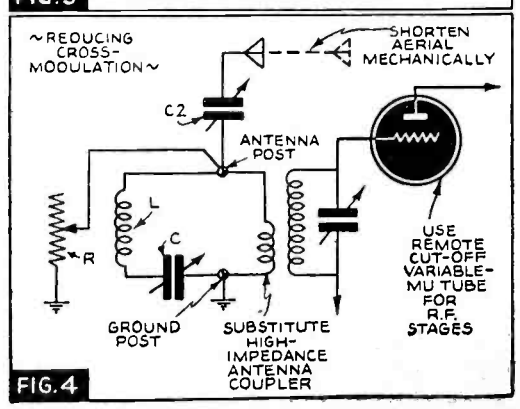


FIG. 4

It is conceded that in modern radio servicing practice the technician should have the best possible assortment of testing instruments and accessories. The possession of good test apparatus alone however does not guarantee a 1st-class repair job, no more than a set of expensive surgical instruments insures a successful operation. An experienced technician, knowing all fundamentals, can often locate trouble quicker by observation than the novice can by test! A good knowledge of radio fundamentals supplemented by adequate test instruments places the progressive technician in an enviable position and guarantees profitable operation.

It was previously mentioned that under some circumstances the necessary test equipment may not be immediately available, for one reason or another, and, it is the purpose of this 3rd article, in the series, to suggest possible alternatives to meet such situations.

SUBSTITUTE R.F.-I.F. OSCILLATOR

Most radio technicians are trained to use a signal generator, accordingly it may be in order to describe a makeshift substitute to use in an emergency. Plate and filament voltages for the oscillator tube can be taken from the receiver under test, if necessary.

Figure 1A shows one or many oscillator circuits suitable for a temporary signal generator. The coupler L-L1 can be a broadcast-band, tuned radio frequency transformer together with a variable condenser of about 365 mmf., both of which may be taken from an old receiver. Winding L is the secondary of the transformer and L1 the primary or plate winding. Any triode may be used such as a 6C5 or one-half of a 6N7 as shown, in Fig. 1A, schematically. This oscillator will cover a frequency range of about 530 to 1,600 kilocycles, and can be used as a signal generator for that range.

Harmonics of the oscillator can be used to obtain additional coverage. This same oscillator can be adjusted for any desired intermediate radio frequency. First it is necessary to make a rough calibration of the generator. With the receiver under test in operation, 3 or more broadcast signals of known frequency are tuned-in and in each case the local oscillator condenser C varied until the local oscillator beats with the incoming carrier; the final adjustment being "zero beat" (incoming carrier and local oscillator at same frequency).

A graph is drawn as per Fig. 2, allowing 10 equal vertical separations for each 100 kilocycles, from 1,600 to 600 kc. The 180° dial movement of condenser C (0-100 scale), is divided into 10 equal horizontal divisions. Following the above procedure assume that 1,300 kc. appears at 22 on the condenser C dial, 1,000 kc. at 40, 800 kc. at 57 and 600 kc. at 82. These points are located on the graph and a curve drawn through same giving a rough approximation of the remaining calibrations in kilocycles. The accuracy of the entire calibration is only limited by the number of different carriers checked and located on the graph.

CHECKING I.F.'S

Suppose it is desired to check intermediate frequency (I.F.) amplifiers and the frequency involved is 465 kc. Now, 930 kc. is double 465 kc. At 930 kc. on the above oscillator, the tuning condenser C (if 365 mmf., max.), will have a capacity of about 170 mmf. By adding a capacity of 4 times that value, or 680 mmf., the wavelength of the oscillator at that point is doubled and the frequency halved. A capacity of 700 mmf. is near enough and made up of available smaller condensers in parallel, viz, 2—250 mmf. and 2—100 mmf., or 1—500 mmf. and 2—100 mmf.

Now with the receiver tuned to the incoming carrier of 930 kc. and the oscillator set at approximately 465 kc., the condenser C is varied until the oscillator harmonic beats with the incoming carrier (adjusted for zero beat), and the exact dial setting for 465 kc. is readily obtained. In case a carrier of 930 kc. is not in range, carriers of 920 and 940 kc. can be used to locate 460 and 470 kc., respectively, on the oscillator dial; then 465 kc. will fall equally distant-between these 2 dial points. Other intermediate frequencies are readily located following the same procedure.

AUDIO OSCILLATOR

To use the signal generator some means of observing the output is necessary; if the receiver has a tuning eye (visual indicator) tube, that can be used as an indicator. Otherwise it is necessary for the signal generator to be modulated, so that an indication of relative output can be determined by headphones or the loud-speaker. Figure 1B shows one method of modulating the R.F. oscillator by adding an A.F. oscillator circuit to the 2nd-half of the 6N7 tube. Coil L3 is the primary of a low-ratio A.F. transformer and L4 the secondary; or L3 and L4 can be 2 iron-core chokes or filters laid parallel to each other. An alternative method is shown in Fig. 1C wherein the R.F. oscillator tube plate

WITHOUT TEST METERS

common sense, though unaided by most of the meters, etc., ordinarily
Leutz, co-originator of the famous old "Golden-Leutz Superhet.".

PART III

circuit is interrupted by vibrating buzzer contacts; the contact adjustment determining the frequency of modulation.

For rough audio frequency coverage tests, the audio oscillator (Fig. 1B) can be varied over a limited range by adding a small variable condenser in parallel to the grid winding L3. Test signal generators are usually modulated at a frequency of 400 cycles. The musical pitch A above middle C is 440 cycles per second.

Incidentally this 440-cycle standard musical pitch is broadcast practically 24 hours a day by the Bureau of Standards radio station WWV at Beltsville, Md., on a frequency of 5 megacycles.

EMERGENCY A.F. "OSCILLATOR"

The receiver's audio amplifier frequency range can also be tested by another simple method.

First the receiver is placed in an oscillating condition, if a tuned radio frequency set, the radio frequency amplifier is made to oscillate; if a superheterodyne, the intermediate radio frequency amplifier is adjusted to produce oscillations.

The amplifier tubes can be adjusted for oscillation by decreasing the bias resistors or adding an external feedback in the form of a small variable condenser connected from the 1st R.F. amplifier grid to the last R.F. amplifier plate. Assume a superheterodyne is involved and the I.F. amplifier is adjusted to an oscillating condition at 465 kc.

Now by coupling the signal generator, also set at 465 kc., to the I.F. amplifier, beat audio oscillations are obtained and automatically pass through the receiver's audio amplifier and loudspeaker. By varying condenser C of the local oscillator, the frequency of these beat oscillations can be varied from zero beat to 10,000 c.p.s. or more. It is a rough test of course, but useful to locate "dead spots" or "resonant points".

COUPLING DEVICES

The matter of coupling this temporary oscillator to a receiver under test does not lend itself to adjustments for definite or constant input values. With the oscillator operating at carrier frequencies, the receiver under test should be fitted with a *dummy antenna*, viz., a 200 mmf. condenser or 350-ohm resistor connected from the receiver antenna post to receiver ground post. In addition, a small wire, 1 foot long or so, should be connected to the antenna post of the receiver. By varying the distance between this wire and the local oscillator, a suitable input value can be obtained. Any further reduction in local oscillator signal strength required is obtained by reducing the oscillator tube plate voltage.

At intermediate frequencies (I.F.'s), the oscillator is coupled to the mixer plate circuit. Where the mixer plate lead is shielded, a small external wire can be connected to the mixer tube socket plate contact and the local oscillator brought into inductive relation with same. In the last mentioned procedure the mixer tube is removed from its socket.

For direct audio frequency tests, for example on an audio amplifier alone, the iron-core chokes L3, L4, can be moved into inductive relation to audio transformers, viz., at the input transformer to test the entire amplifier or at the output transformer to test the speaker.

There are many service problems pertaining to radio receivers wherein all component parts, circuits, tubes and alignments apparently test perfectly but unsatisfactory performance still prevails due to inherent design defects or other conditions internal or external to the instrument.

TESTING FOR NOISE

One of the most annoying service problems is the so-called "stewing" or "crackling" noises, either steady or intermittent, and which may be originating within the receiver or externally. Before wasting any time in locating such disturbances, an immediate test should be made to determine if the source is internal or external to the receiver. By connecting the receiver antenna and ground posts together, right at the terminals, if the noise stops it is definitely proven that the interference is being picked-up by the aerial. On the other hand, if the noise persists, there is no doubt about it originating within the receiver. An exception might be caused by a power line pick-up but with present-day transformer design such cases are most unusual.

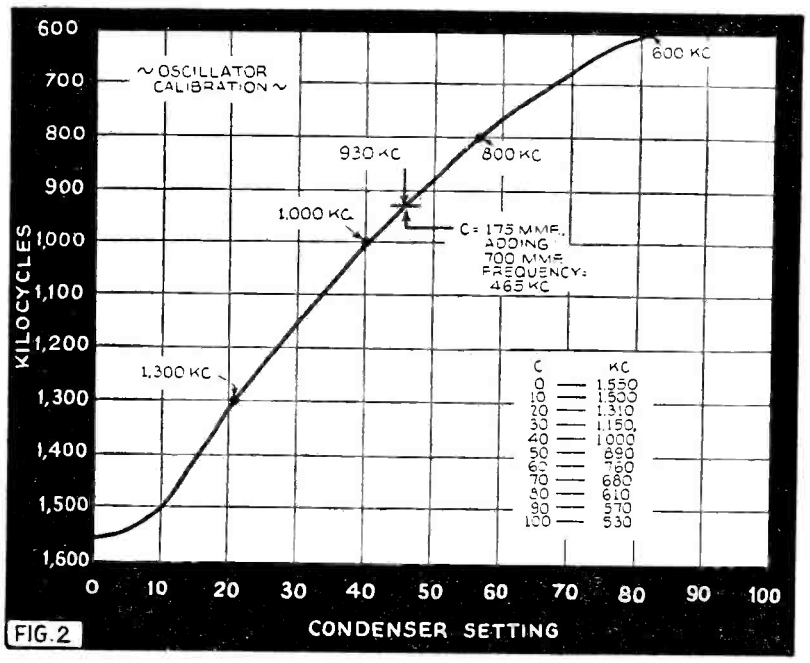


FIG. 2

Assuming the tests show the source of trouble to be within the receiver, by removing tubes one at a time, starting at the antenna end, the seat of the disturbance can be localized. Suppose all the tubes are removed down to the 1st audio stage and upon removing the 1st audio tube the noise ceases. We know that with the detector (T.R.F. set) or 2nd-detector (superhet. set) tube removed the noise continued, accordingly it cannot possibly be due to part of the detector grid or plate circuits.

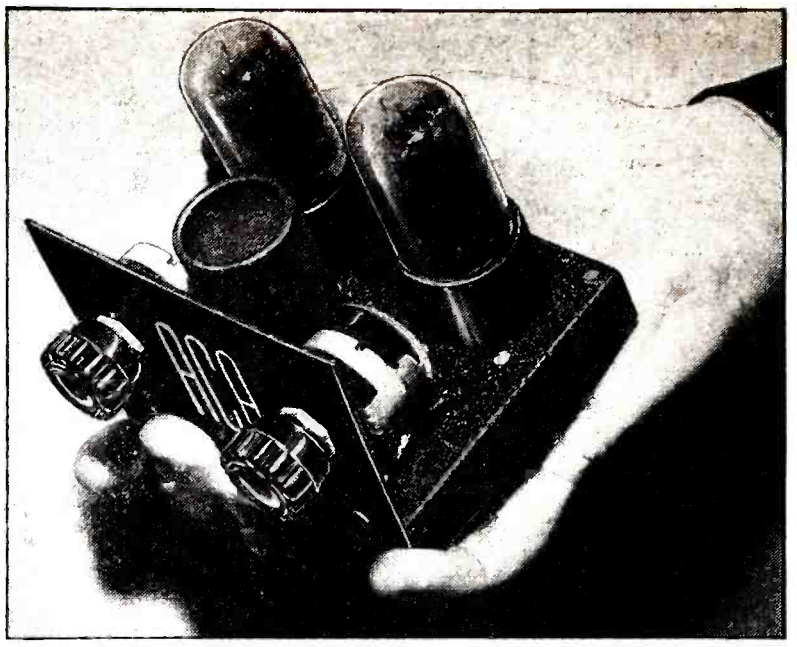
Upon reinserting the 1st audio tube the noise starts again and therefore the difficulty probably originates in the 1st audio grid circuit and is amplified by that tube; or it might possibly be located in the 1st audio plate circuit but only when plate current is flowing to that tube, for example a poor plate socket contact or partially defective plate coupling resistor or bypass condenser. Substitution of parts at this point will locate the defective part by elimination.

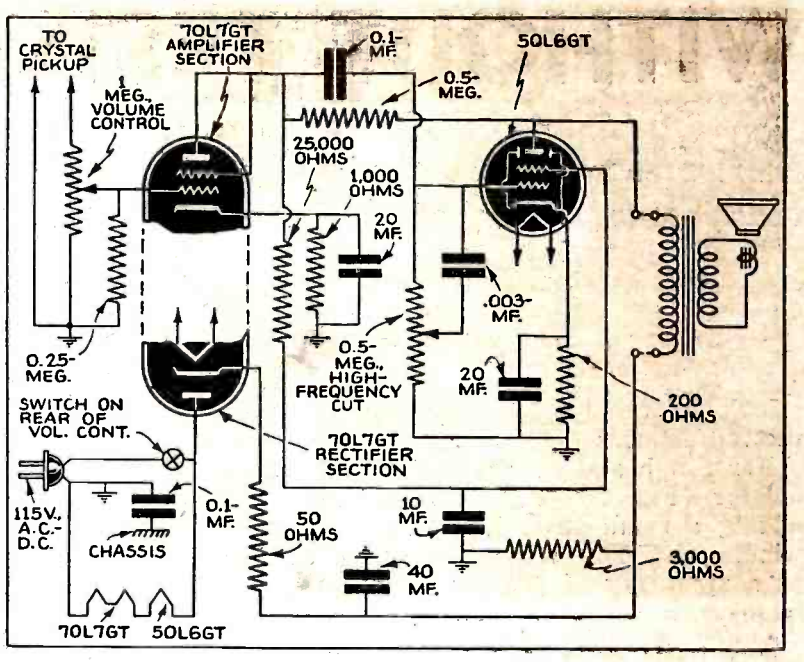
CODE INTERFERENCE

The complaint of radio-telegraph interference at intermediate frequencies (I.F.'s) is common, especially where the receiver is located close to a seaboard. This type of signal interference is best eliminated by installing either a single trap L, C, or a double trap adding L1, C1, as per Fig. 3, adjusting same to attenuate the interfering frequency involved.

Traps for this purpose can be readily made from an old I.F. transformer. The coil support can be cut in half and the 2 windings placed at right-angles to each other, or a copper

(Continued on page 441)





A "3-in-2" A.C.-D.C. MIDGET AMPLIFIER

Here is a 2-Tube, Low-Power, Multi-Use Amplifier admirably adapted for low-level, high-fidelity phonograph reproduction, and for radio (receiver output) amplification.

H. S. MANNEY

THE amplifier here described and illustrated fills a long-felt demand for a small, compact, economical unit, which can easily be constructed by any technician.

CIRCUIT

By utilizing 2 tubes whose filament voltages add up to 120 volts, ballast resistors are unnecessary. A single multiple condenser provides suitable bypassing in both the filter and cathode circuits. As the 70L7GT tube is a combined beam power amplifier and diode rectifier, it can be used as a combination voltage amplifier and power supply for the 50L6GT beam power amplifier. See the schematic diagram above.

The beam power section of the 70L7GT is used as a resistance-capacity coupled triode to drive the 50L6GT output tube, which is capable of delivering 1½ watts.

A constant-voltage, inverse-feedback circuit is employed through the use of one 500,000-ohm resistor, which is connected between the plate of the output tube and its triode driver.

A.B.C. VOLUME CONTROL

By connecting a ½-meg. resistor from center arm to the ground on the side of the crystal pickup control, an *automatic bass compensating* or A.B.C. network is made available. It will be noted, that as the volume is increased, a shunt resistor is placed directly across the pickup. The response characteristic of the crystal pickup is dependent upon the load into which it feeds. When it is fed into a 1-megohm load, a 12-db. boost is available at 70 cycles. When it is fed into a 0.25-megohm load, its response is substantially flat from 70 cycles on to 6,000 cycles. As the volume is decreased, the ¼-megohm shunt is gradually removed from across the pickup, so that bass boost takes place. At the higher levels, however, the ¼-megohm shunt is across the pickup, so that normal response is encountered.

OTHER FEATURES

A 0.003-mf. condenser provides maximum high-frequency attenuation when connected from grid to ground of the output tube. The degree of attenuation is made available by utilizing a control in place of the ½-meg. grid-return resistor normally employed.

Two 20-mf. bypass condensers across each cathode of the amplifier tubes insure good overall low-frequency response.

The 50-ohm resistor, placed in series with the 40-mf. filter condenser, limits the initial charging current to safe values.

For simplification, the on-off switch is combined with the volume control.

The chassis proper is connected through a 0.1-mf. condenser to one side of the line. This protection prevents the chassis from being connected to either side of the line under any condition of operation.

The ½-wave rectifier circuit provides equivalent operation from both A.C. and D.C. power lines. In D.C. work, however, it is important to watch the polarity of the line plug, as improper connection will make the amplifier inoperative.

No special precautions are required in assembling and wiring this ultra-compact unit. Reasonable care should be exercised in wiring the input circuit so as to avoid any hum pick-up from either the power line or power supply.

Any good speaker will adequately handle the output of this unit. It is important, however, to correctly match the output impedance of the 50L6GT tube. The speaker, therefore, should be equipped with a transformer having a primary impedance of 2,000 ohms and capable of passing 43 ma.

APPLICATIONS

Its low cost, compact size, and efficient operation, make this amplifier suitable for a wide variety of "home use" applications, including phono reproduction, radio amplifier, sound-on-film amplification, hearing-aid amplifier and inter-office communicator.

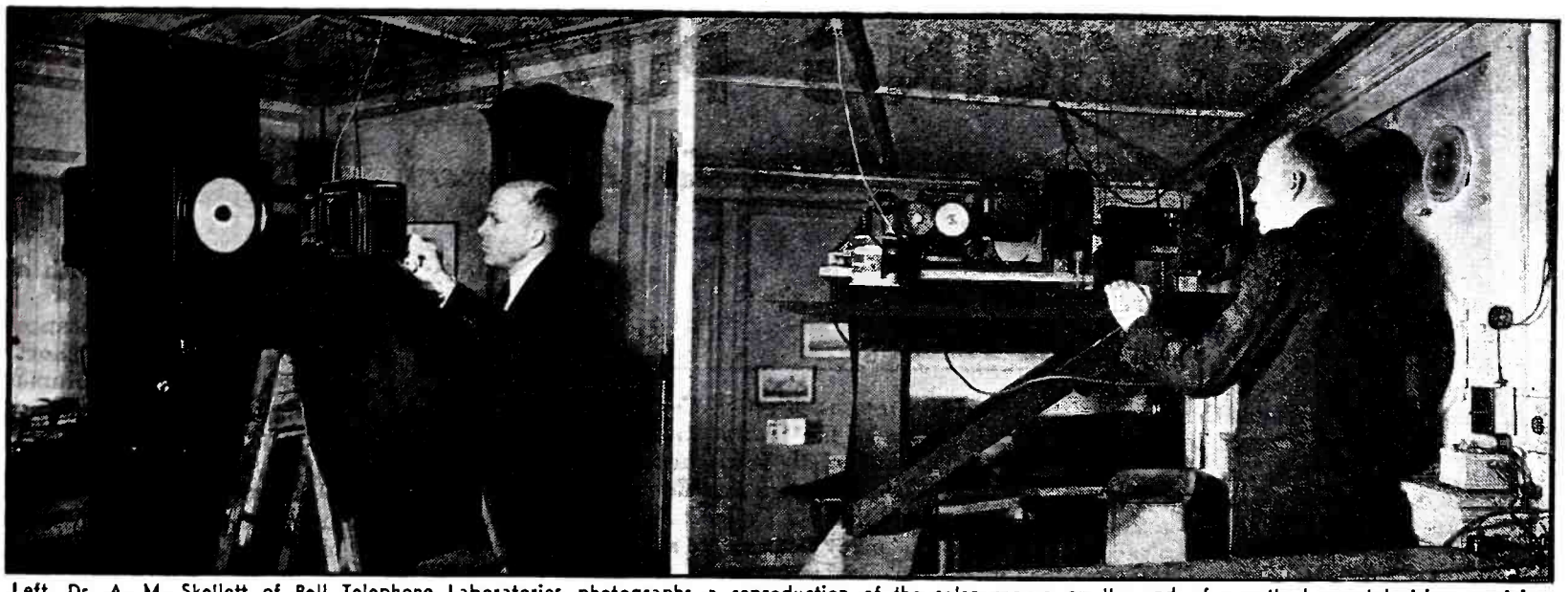
Of particular interest to experimenters will be the use of this amplifier in connection with photoelectrically-operated burglar alarms and checking devices of all types. Further, it is the ideal amplifier for use at home parties and similar gatherings. Imagine having a miniature public-address system using a small lapel-type microphone, this amplifier, and a small 3- or 4-in. P.M. dynamic speaker.

The amplifier is so small and compact and so convenient to use that it may readily be used as an A.F. booster for midget and other type receivers.

The author will be pleased to answer all questions relative to the construction of this device, upon receipt of a self-addressed stamped envelope.

The entire amplifier measures 3¾ ins. high, 4 ins. wide, and 4 ins. deep.

This article has been prepared from material supplied by courtesy of the Amplifier Company of America.



Left, Dr. A. M. Skellett of Bell Telephone Laboratories photographs a reproduction of the solar corona on the end of a cathode-ray television receiving tube. At right, Dr. Skellett is shown with the Coronaviser apparatus. Just above Dr. Skellett's hand is a casing over the rotating mirror which scans the image of the corona. At the left-hand end of the motor will be seen a small generator which makes the cathode-ray beam follow a continuous-spiral scanning path.

THE SOLAR CORONAVISER

New Application of Television Principles and Circuits

A special television system combining a wobbled-mirror mechanical scanner at one end and a cathode-ray tube at the other, for televising coronas not otherwise observable, was described last month before the National Academy of Sciences.

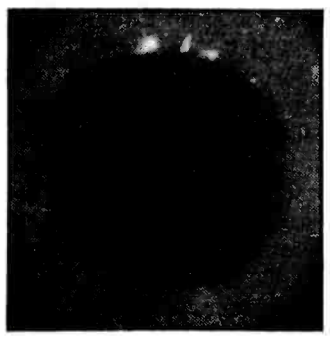


Photo of Sun's corona. Note flat-spiral ring of scanning lines.

THE solar corona—that flaming halo around the sun—is of great interest to astronomers because of what can be learned from it about the sun itself. Unfortunately it can be studied only during a few minutes on the rare occasion of an eclipse, because the main body of the sun is a million times brighter than the corona, and because of the glare set up by the scattering of light by the earth's atmosphere.

Astronomers have long wished for some system which would disregard the powerful beam of the sun and the steady glare of the sky, and concentrate on the corona. Radio research men also have been interested, because the major disturbances of long-distance radio transmission have their origin in the sun and studies to date have indicated that a day to day knowledge of the activity of the corona might prove useful in predicting the transmission conditions. Knowing of this need, it occurred to Dr. A. M. Skellett of Bell Telephone Laboratories that a television circuit had the necessary discrimination between steady light and variations. Apparatus embodying his idea was built in the Laboratories, and through the courtesy of Dr. G. W. Cook was given a practical trial in his private observatory at Wynnewood, Pennsylvania.

Briefly, Dr. Skellett's apparatus is a television system which scans a ring around the sun. Light from the heavens enters a telescope—in this case, a horizontal one—and a sharp image of the sun is focused on the mirror, R. Since this is of no use, it is reflected from a second mirror, M, into a trap where it is dissipated. Around the image of the sun is that of the corona, and that is scanned by a combined lens and mirror. As it rotates and rocks at the

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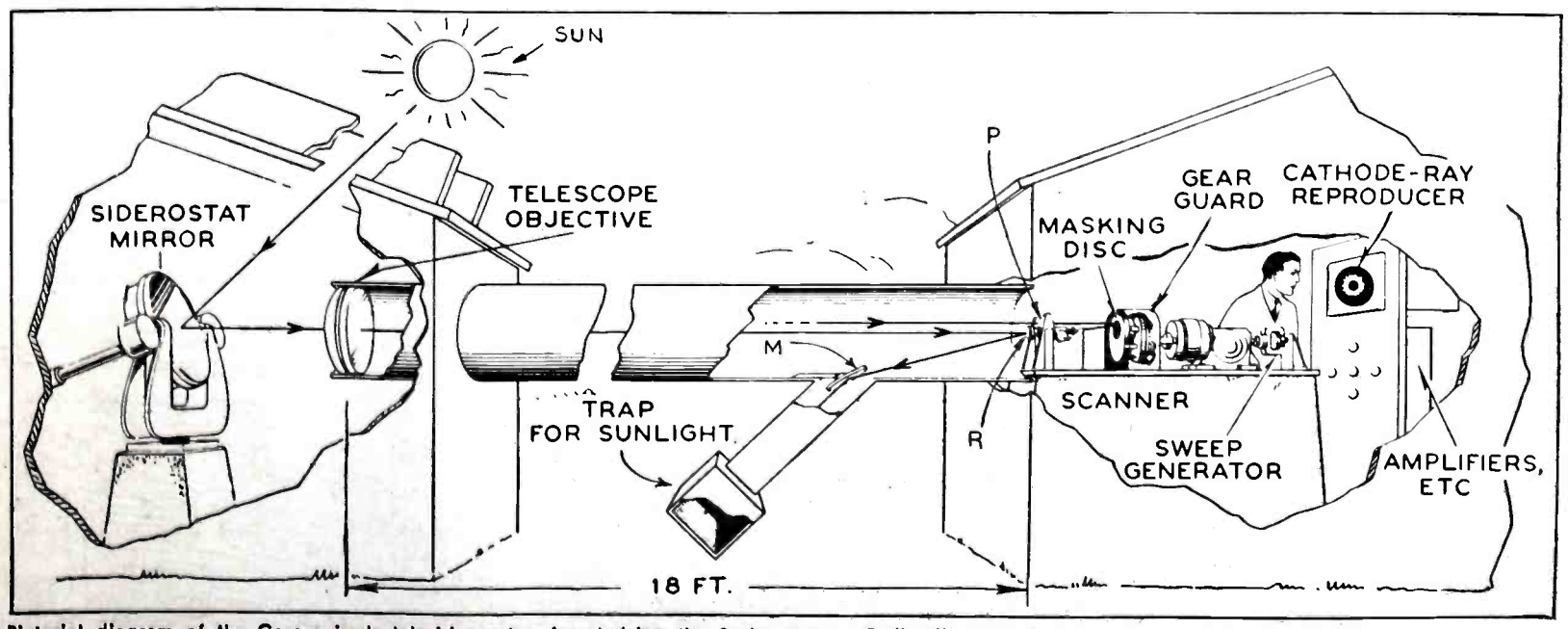

Pictorial diagram of the Coronaviser's television setup for studying the Sun's corona. Ordinarily such study can be carried out only during solar eclipses. (See simplified, block diagram on cover.)

SERVICING PUZZLERS

Solved by the Use of Test Equipment

No. 1

In the recent Weston Contest, in celebration of the 50th anniversary of Weston Electrical Instruments Co., Inc., on "How Modern Test Equipment Helped Me Solve a Difficult Servicing Problem," many letters were submitted which have general interest as typical of today's servicing requirements. These letters are presented here in the form of servicing notes which may prove of value in enabling the Serviceman to obtain the greatest possible usefulness from his test equipment.

Interference in New Installation. A new receiver, a Motorola 65, was installed for a rural mail carrier whose complete route was along a high line. The complaint was made however that even on stronger stations the interference level was high enough to spoil reception.

The set was realigned with an output meter and oscillator. The 1st and 2nd I.F. transformers were staggered so that the final result was a nearly flat-topped curve for 3 kc. on either side of the resonance. After carefully realigning the R.F. and padder trimmers, the result was somewhat less sensitivity and selectivity, but greater fidelity so that the local interference was completely blocked out.

Edward S. Courter.

Inoperation over Part of Dial. Many General Motors auto-radio sets, operating on a short pole-type aerial, are inoperative between 68 and 55 on the dial, although the rest of the dial works all right.

By feeding a signal from an oscillator, it was noted that no signal would go through the mixer tube, indicating that this tube was not oscillating at this part of the dial. The problem was solved by stepping the cathode resistor of the 6A7 tube to a value 1,000 ohms smaller. In some of these sets, the resistor has to be as much as 2,000 ohms smaller than the value originally used.

The set then brought in stations around 540 kc. perfectly when used on the short pole aerial. This trouble is apt to be misleading, since it might seem that the variable condenser plates are shorting, or that there is something wrong with some of the coils. Testing the resistance of the coils; testing for a short in the tuning condenser, and so on, however, will show these to be OK.

Monty Glass.

Distortion in Phono-Radio Set. Distortion, sounding as if the speaker was off-center, was the effect produced in a "combo." Routine check revealed that alignment was OK. Tubes were checked and found OK, so the set was brought into the shop.

By inducing an audio signal to the final stages and following it through to the speaker, trouble was established at the speaker. Examination showed that a phono needle had gotten on the outside of the voice coil and when the set was turned on the needle was pulled down against the speaker core, causing distortion.

R. S. Wheeler.

Hum in Intercall Systems. Severe hum trouble was experienced in small custom-built intercall systems, which were of the A.C.-D.C. type. Condensers were rated at the usual 16-16 mf. ratings as were specified, so no trouble was expected there. An oscilloscope check showed up only 60 cycles A.C.

Condensers were checked with a Weston 20,000 ohms/volt meter. On rechecking, it was found that electrolytic condensers (of the type which contains 4 separate capacities) were too tightly packed into the containers, and after a few hours of operation would leak through to cause hum.

Paul C. Mangan.

Low Volume in a Standard Receiver. Low volume in a late-model 7-tube radio set was encountered. Tubes were checked on a portable checker. The tubes testing OK, the set was brought to the shop.

Routine analysis revealed the following: All voltages checked good, I.F. and R.F. values were perfect, signal strength to 1st audio stage good, all coupling condensers and resistors checked OK; with an output meter across the voice coil of the speaker, the signal received from the oscillator read about half-scale. One lead from the voice coil was clipped to the output transformer. When the meter was placed across the secondary of output transformer, and without any adjustment to the oscillator, the signal drove the needle of output meter off-scale. The resistance of the bank-wound voice coil of the speaker was next measured, and found to be shorted between windings to about half of its original resistance. A new speaker cone restored the set to its original volume.

W. R. Newman.

Low Volume in Sets with A.V.C. and 2nd-Detector Combined. A number of late model sets, having the customary system of A.V.C. and 2nd-detector combined, and with the audio volume control as the A.V.C. divider, were serviced for lack of snap and volume. After routine checking of alignment, voltages and quality of circuit constants, all were found to be in good condition until continuity checking was attempted with a high-sensitivity ohmmeter.

Analysis revealed a high-resistance leakage path and sometimes a near short from the rotor contact of the volume control to ground, which would to some degree short out a portion of the audio signal to ground and also reduce the quantity of A.V.C. developed. In many cases, the causes of these symptoms could not be detected without the use of high-range, sensitive, continuity meters or microammeters such as the Weston 20,000 ohms/volt meter.

Stephen Furedy.

Loss of Volume. A defect in a Grunow model 11G receiver caused a loss of volume. The customer had taken a screwdriver and turned down tight, all the adjusting screws of both I.F. and R.F. stages, on all 3 bands of the receiver. No signal came through the I.F., but a signal generator put through an audio signal at normal volume from either plate of the 2nd-detector.

A voltmeter showed no screen-grid voltage on R.F. and I.F. amplifier tubes, showing up a shorted 0.1-mf. condenser to chassis. Being unable to get a signal through from the antenna post of the set, the signal generator was connected to the control-grid of the 2nd I.F. tube. A weak signal was indicated on the output meter connected across the primary of the output transformer. The trimmers of the 3rd I.F. transformer were adjusted; a signal generator connected to the control-grid of 1st I.F. tube, and the trimmers of the 2nd I.F. transformer adjusted; and, leads from the signal generator were connected to the control-grid of the det.-oscillator, and the 1st I.F. transformer trimmers adjusted. With a signal now being obtained through the antenna binding post (modulated R.F.), the broadcast trimmers and padders were adjusted. No signal was apparent on the foreign band, but voltages on the R.F. tube were OK. Resistance measurement between grid of R.F. and grid of 1st I.F. tube showed no continuity. Resoldering the contacts for this band on the wave-change switch terminals restored continuity and reestablished normal operation on this band. Equipment: high-resistance ohmmeter, a signal generator, and an output meter.

Dwight L. Cooley.

Fading in Car-Radio Set. In the car, a Stewart-Warner model R-1131 receiver faded out and gradually faded back to normal. Perfect performance was obtained on the test rack. Routine test in the car disclosed that fading was caused by oscillator failure, and that voltage at the set with the motor running was rather high, 7.5 volts.

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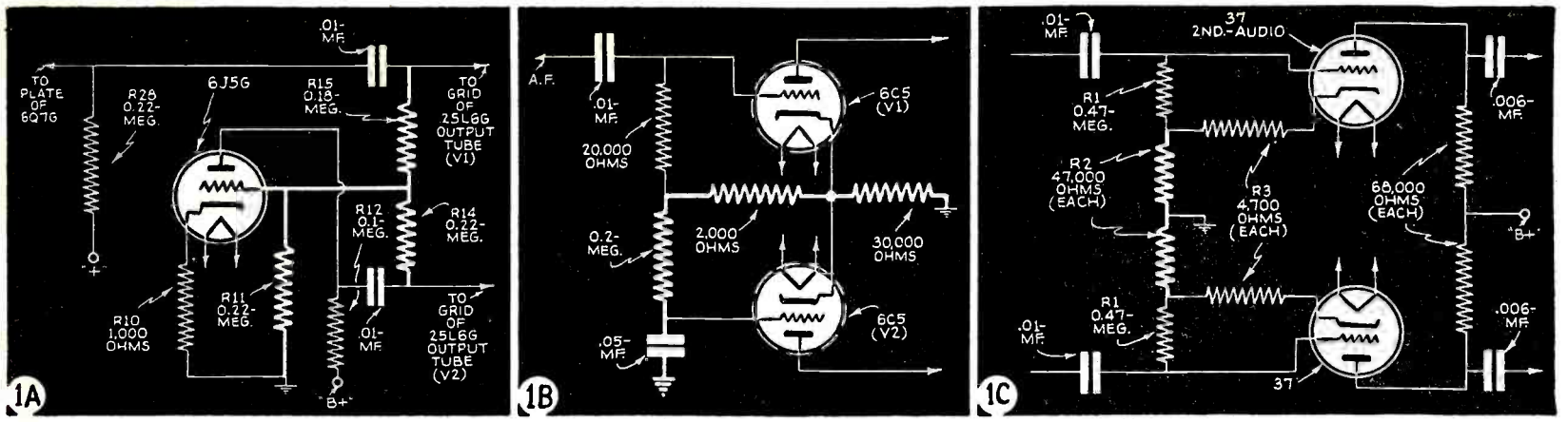


NEW CIRCUITS
IN MODERN RADIO RECEIVERS

The details of the modern radio receiver circuits that make them "different" from previous designs are illustrated and described each month by a well-known technician.

F. L. SPRAYBERRY NUMBER 28

(1) UNUSUAL DEGENERATIVE PHASE INVERTER WITH "FLOATING" GRID-RETURN

Silvertone (Sears, Roebuck & Co.) Models 6335-6435, 6490 and 6495. In this circuit degeneration is acquired through the application of a special phase inverter having a "floating" grid-return. It is seen in Fig. 1A that the grid-returns for the 2 output tubes are connected to the grid of the 6J5G. An initial positive voltage at the grid of V1 will tend to make the grid of the 6J5G about 42% as much positive in approximately the same phase. It will likewise tend to make the grid of V2 about 13% *positive*, as well, due to the nature of the simple resistance network. However the voltage at the 6J5G grid at the same time tends to make the grid of V2 some 5 times as negative as its grid is positive.

From application of this voltage impressed on the network in the opposite direction this voltage at V2 will tend to lower the positive voltage of the 6J5G grid and thus limit its own value.

The applied voltage of V1 thus cancels about 10% of that on V2 and V2 likewise cancels approximately the same amount at V1. This supplies the desired degeneration, and as the phase of the 6J5G plate is opposite to that of the 6Q7G plate, phase inversion is accomplished.

(2) CATHODE-TYPE PHASE INVERTER

Capehart Models 400-E and 500-E. A phase inverter in which the cathode voltage of a tube in one side of a balanced circuit brings about an equivalent change in the other side of the circuit the control-grid of which is not fed by any signal, is described.

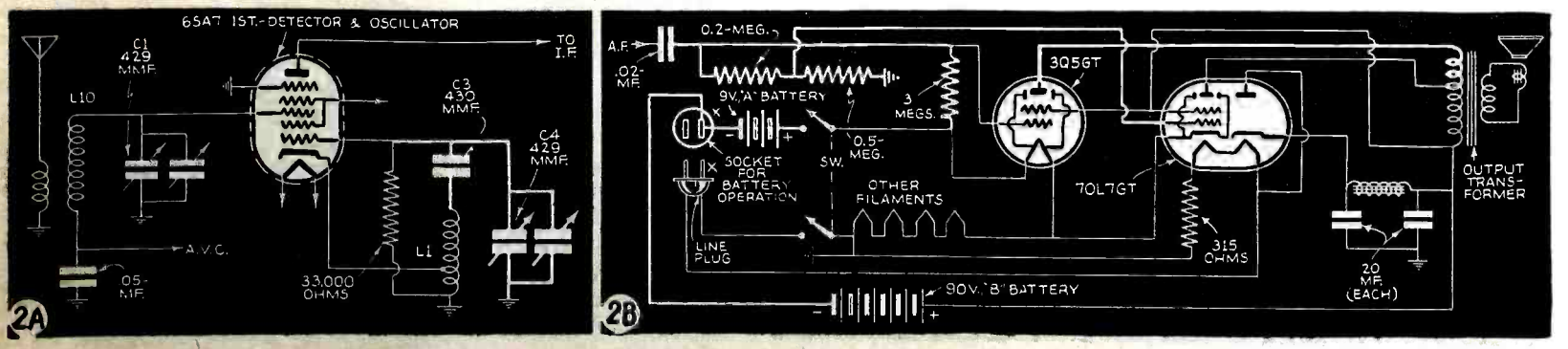
At this time there appears to be as much diversity of design of phase inverter circuits as in any other part of the broadcast receiver. In this one for example as in Fig. 2B the A.F. signal is fed to the grid of V1 directly from the volume control. A positive change on this grid for example will cause more plate current to flow in V1 and because of the rather high cathode to ground resistance (30,000 ohms) the cathode will become somewhat more positive. Being directly connected to the cathode of V2 it will make this cathode as much positive and since the grid of V2 is bypassed and cannot change in voltage the grid will be left more negative than before. The 0.2-meg. grid resistor acts to isolate the grid from the signal at the cathode rather than for the opposite or conventional use. The large difference in values between the 2 grid resistors serves to equalize as far as possible the signal output for both tubes.

(3) SPECIAL INPUT DEGENERATION CIRCUIT

Philco Models 40-195 and 40-200. A push-pull degenerative circuit which is not limited or affected by the necessary bias circuit, and providing an exact predetermined degree of degeneration, is given.

The circuit, which is shown in Fig. 1C, shows a simple resistance network for each grid of a push-pull circuit. Resistors R1 are the usual grid loading resistors. Resistors R2 are the principal degenerative resistors while resistors R3 are the cathode bias resistors. For these receivers considerably more degeneration was desired than would be acquired through omitting the cathode bypass condensers. The values of R3 must remain as shown for the purpose of correct bias, and without resistors R2 the

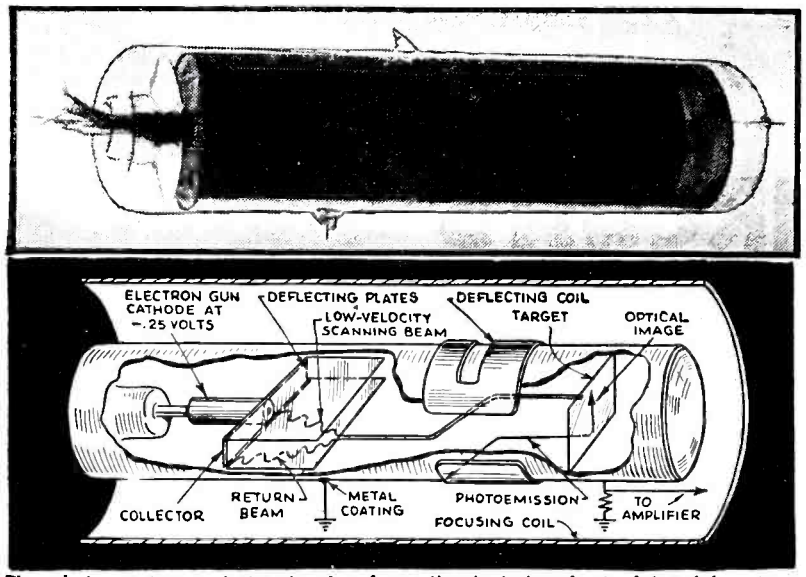
(Continued on page 433)



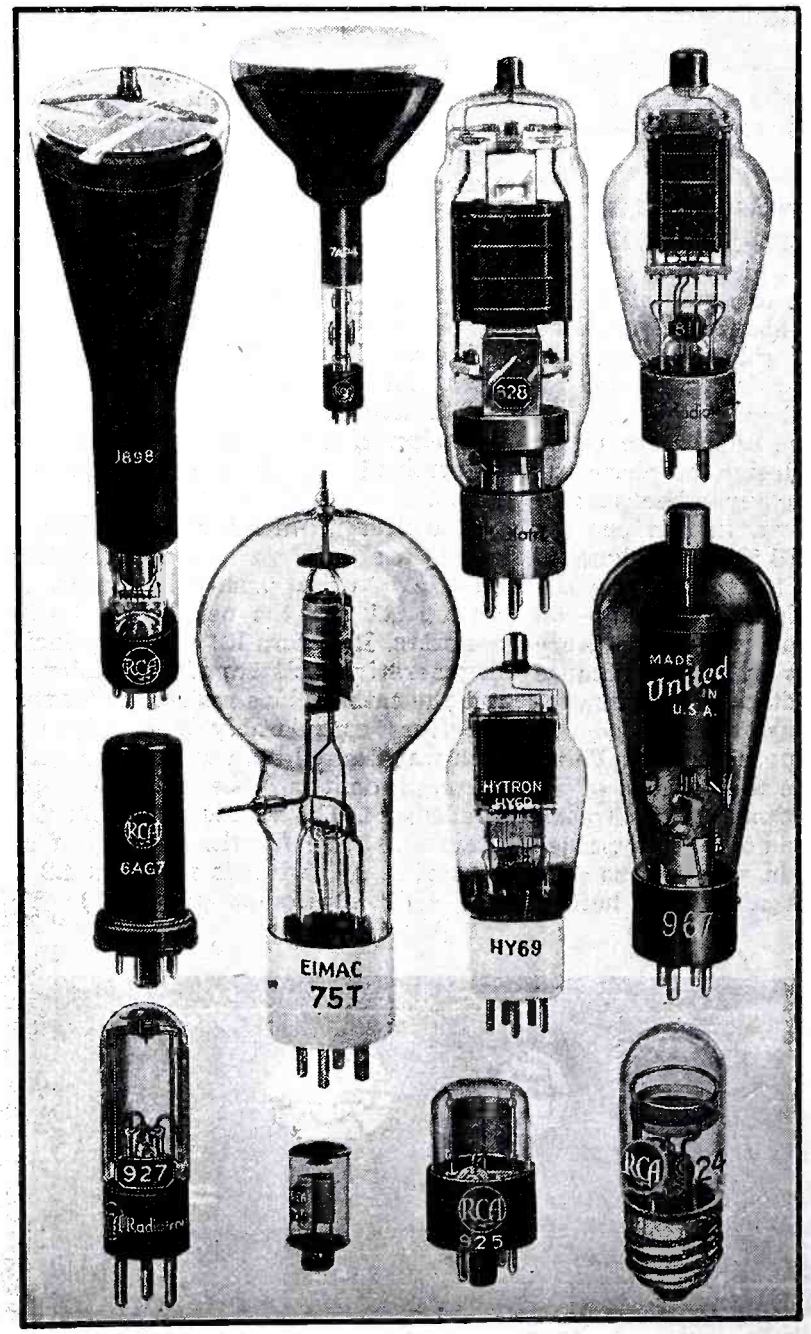
20 New Tubes

The tubes described this month extend from laboratory developments in television to new ideas in tubes for A.C.-D.C. receivers.

R. D. WASHBURNE



The photo at top and the drawing immediately below it depict a laboratory model of the new RCA Orthiconoscope.



IT is important that radio men have at least a nodding acquaintance with new vacuum tubes as they make their appearance. It is for this reason—and the fact that space in *Radio-Craft* is limited—that we only gloss over the description and characteristics of the following new tubes; for more detailed data covering the use of these various tubes under all possible types of operation, where additional data is available, readers are referred to the respective manufacturers for data sheets. In some instances characteristics data are given at the end of this article.

TELEVISION

*Orthiconoscope—Image Pick-up Tube

The Iconoscope, as it is known today, is capable of transmitting clear, sharp images, even under unfavorable conditions of illumination. Previous workers with the tube have shown that the good sensitivity is obtained in spite of an efficiency only 5% to 10% of that which is theoretically attainable. An analysis of the operation of the Iconoscope suggests that improved efficiency and freedom from spurious signals should result from operating the mosaic at the potential of the thermionic cathode, rather than near anode voltage. The beam electrons then approach the target with low velocity and the number of electrons which land is dependent upon the illumination.

Special designs were developed to make sure that the beam of low-velocity electrons was brought to the cathode-potential target in a well-focused state, that the scanning pattern was undistorted, and that the focus of the beam was not materially altered by the scanning process. A strong magnetic field perpendicular to the target was found useful in focusing and guiding the beam. In some of the earlier tubes which were tested, the scanning beam was released by a flying light spot moving over a photocathode. These experiments led to the present tube which uses a thermionic cathode to develop the electron beam.

One of the developmental forms of the tube is shown in the accompanying schematic diagram. The optical image is focused upon the mosaic (near the end of the tube) through a translucent signal plate. The strong electric field between the mosaic and a metal coating on the tube wall draws away the photoelectrons, leaving a pattern of charges on the mosaic representative of the scene to be transmitted. The scanning beam of electrons, focused and guided by a strong axial magnetic field, approaches the charged mosaic moving with almost zero velocity. Upon the parts charged positively (by emission of photoelectrons) the beam deposits electrons until the surface is returned to cathode potential. From the unlighted areas, the beam is reflected. Variations in the number of beam electrons which reach the mosaic produce the video signal.

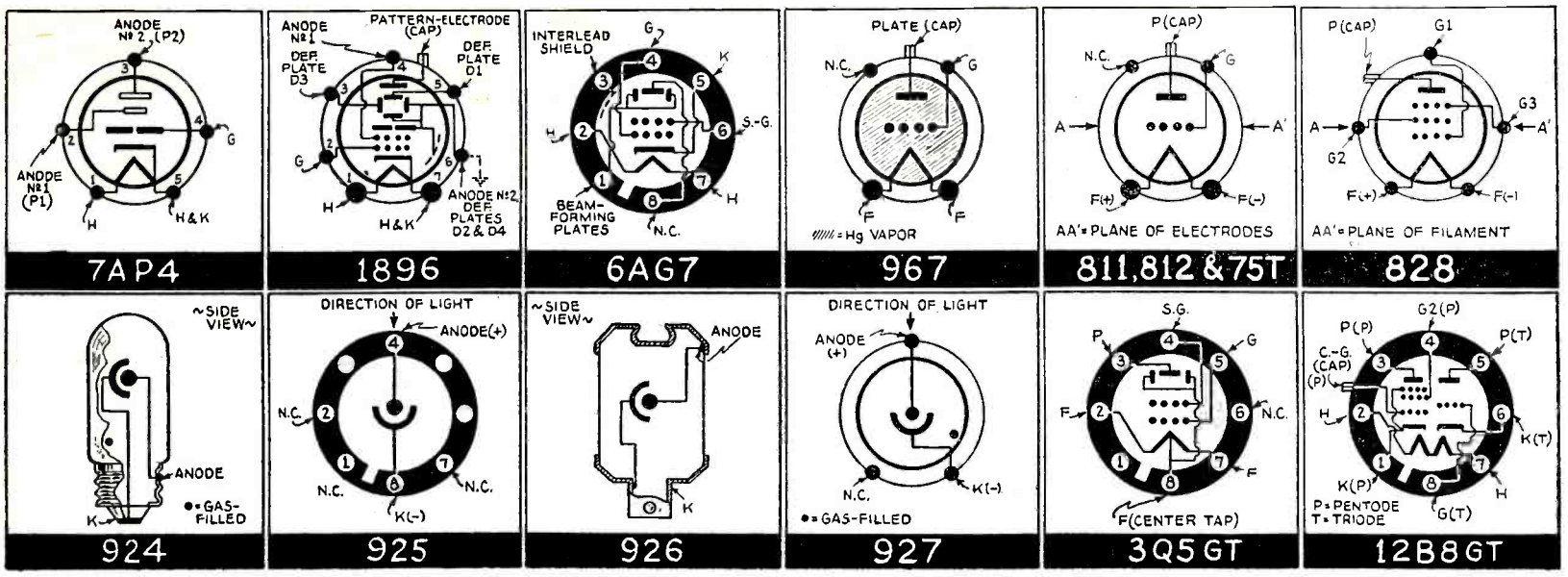
Since the entire tube, including gun and target, is immersed in an axial magnetic field, special deflection means were developed to cause the beam to be deflected in the field and to scan the target without being defocused. The high-speed horizontal deflection is accomplished by a pair of electrostatic plates which, in combination with the axial magnetic field, deflect the beam in a plane parallel to the plates. The vertical deflection is accomplished by a pair of deflection coils which distort the axial magnetic field so that the beam in following the magnetic lines is displaced from the axis.

The new pick-up tube, which has been called an Orthiconoscope, has a maximum output signal over 300 times the noise of a typical television amplifier. The signal is proportional to light intensity. Spurious signals are negligible. Within the accuracy of measurement, the efficiency of conversion of possible photoemission into signal is 100%. In its present developmental form, the Orthiconoscope gives promise of becoming a useful television pick-up tube.

1898—3-In. Monoscope Picture Tube
(Electrostatic Deflection)

The RCA 1898 is a small, low-priced cathode-ray tube of special form designed for use as a full electrostatic-deflection signal generator. It has a signal electrode with the picture of a girl's head, and is intended primarily for explaining television principles, but

*All information on the RCA Orthiconoscope is substantially verbatim copy supplied to *Radio-Craft* by Albert Rose and Harley Iams, *RCA Laboratories*, This tube is still under development and hence is not yet commercially available; for this reason, characteristics data are not supplied.



it may also be used to provide a picture signal of medium resolution for demonstrating television receivers.

7AP4—7-in. Kinescope (Magnetic Deflection; White Phosphor; Short Bulb)

The RCA 7AP4 is a high-vacuum, magnetic-deflection type of cathode-ray tube with 7-in. screen intended primarily for television reception. It is capable of producing a brilliant reproduction approximately 4.5 x 6 ins. in black and white of the televised object. The short overall length of the 7AP4 (only about 13½ ins.) facilitates the design of direct-viewing television receivers.

6AG7—Video Beam Power Amplifier

The RCA 6AG7 is a heater-cathode type of metal tube designed especially for use in the final video stage to modulate the Kinescope in a television recciver. This new tube features not only an exceedingly high value of transconductance but also high output-current capability. As a result, it is possible to obtain relatively high voltage gain with the low load resistance needed to give uniform output over the wide bandwidth required for high-definition television reception. Due to lack of space this tube was not described in preceding issues; it is presented now as a matter of completeness.

TRANSMITTING

Heat-controlled Crystal Tube (Telefunken)

Here is a tube, no larger than an ordinary radio receiving tube, which combines a quartz crystal contained in a vacuum envelope to eliminate the variable factor of ambient humidity, with a thermostatically-controlled heater in the base of the assembly to counteract variations in room temperature, in order to precisely maintain the rated frequency of the transmitter in which it is an essential element.

The temperature of the crystal in its vacuum enclosure is automatically maintained constant within 1/50 of 1 deg. C., regardless of surrounding humidity or temperature.

The above information on this new telefunken (Berlin) tube was translated from *Radio-Ror* (Copenhagen); photo, courtesy of Telefunken.

HY69—Beam Tetrode with Instant-Heating Filament

Hytronic Laboratories has just developed a filament-type beam-power tetrode for use in mobile and portable transmitters. This tube, known as the HY69, has characteristics that make it suitable for applications now calling for the type HY61 or the RCA 807. In many instances it may be used to replace the cathode-type tubes now in use.

A thoriated-tungsten filament permits operation directly from a 6-volt storage battery. The filament drain is 1.5 A. and the heating characteristics enable it to reach operating temperature before the motor-generator has reached its normal operating speed.

Therefore, the tube is ideally adapted for those transmitters in which the stand-by period is very much greater than the transmitting period. Also, the tube can be used to advantage in transmitters where the filaments are continuously lighted, for *such operation has a tendency to reactivate the filament.*. This is in direct contrast to the characteristics of a cathode, which has a tendency to dissipate itself during those periods when the filament is lighted and no voltage is applied to the tube.

The HY69 has a plate dissipation of 40 watts which makes it desirable for use in frequency multipliers or low-level modulated amplifiers where hithertofore the plate dissipation has been the limiting factor. The tube carries a maximum plate rating of 600 volts at 100 ma. for both C.W. and radio telephone operation.

As an audio amplifier, one type HY69 in class A will deliver approximately 7.5 watts with only 350 volts on the plate. At a plate voltage of 500, the power output for a single tube is increased to approximately 11 watts. Naturally, in push-pull 2 tubes will deliver more than twice this amount of power. In class AB-2, more than 3 times this power is obtainable from a pair of HY69's.

967—Grid-Control Rectifier

United Electronics Corp. has just announced the new type 967 grid-control rectifier. The tube corresponds to the 866A with the exception that it is of the Thyratron nature and may be used for voltage regulation, voltage control and keying circuits in amateur transmitters.

811—Transmitting Triode (Mu, 160)

The 811, a new RCA tube, has an unusually high power capability for its small size. This new tube features (1) a "zirconium-coated" plate which has remarkably high heat-dissipating qualities as well as excellent gettering characteristics, and (2) a new, low-loss "MICANOL" base which has both excellent insulating qualities at high radio frequencies and low hygroscopic characteristics. It has high perveance and can be operated at high plate efficiency.

The 811 is designed with a high mu and is intended primarily for operation as a class B modulator without bias up to 1,250 volts on the plate. In such service, two 811's are capable of modulating 100 per cent an R.F. amplifier input of 450 watts. The 811 is also useful in R.F. services with full input to 60 megacycles and reduced input to 100 megacycles. Two 811's in class C telegraph service (ICAS ratings) may be used with a plate input of 450 watts and a driving power of only 16 watts. Maximum plate dissipation of the 811 for this service is 5.5 watts.

812—Transmitting Triode (Mu, 29)

The RCA 812 is a companion to the type 811, and like the latter, has unusually high power capability for its small size. The other features credited to the 811, in the first paragraph in the preceding description, are also applicable to the 812.

The 812, however, is designed with a lower mu than the 811 and is intended primarily for operation as an R.F. power amplifier in the same frequency range as the 811. In class C telegraph service (ICAS ratings), two 812's may be operated at a plate input of 450 watts with the exceptionally low driving power of only 13 watts. Maximum plate dissipation of the 812 for this service is 55

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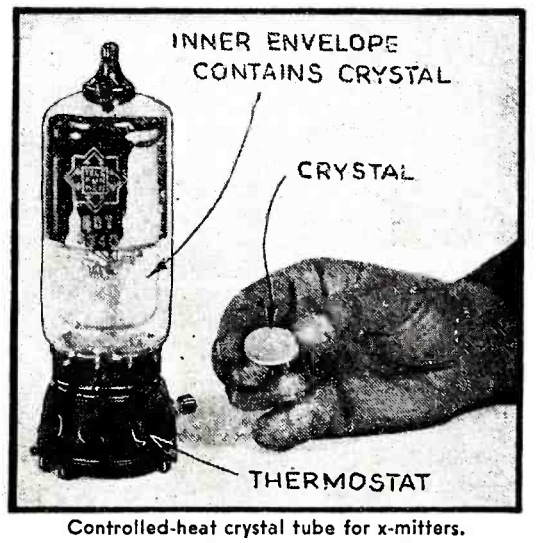
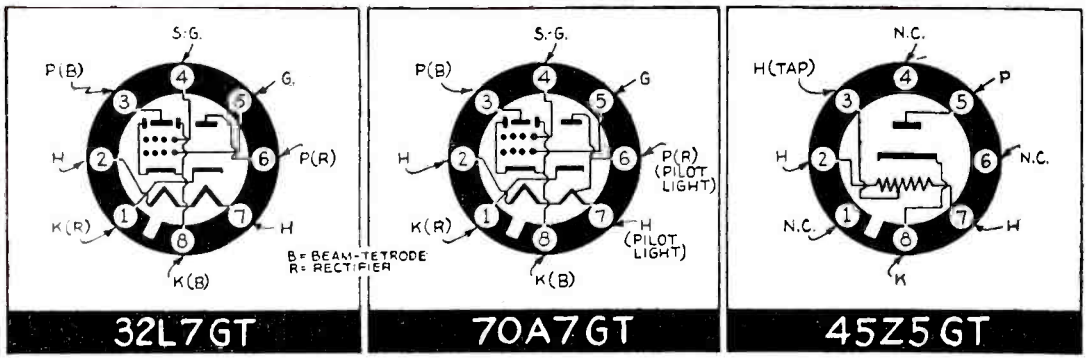


Controlled-heat crystal tube for x-mitters.



(Continued from preceding page)

watts. The 812 is also suitable for use as a biased class B modulator and as such is capable of modulating 100 per cent an R.F. amplifier input of 450 watts.

828—Transmitting Beam Power Amplifier

The RCA 828 is a beam power tube designed particularly for class AB_1 modulator and A.F. power amplifier service, but is also useful as an R.F. power amplifier, frequency multiplier, oscillator, and grid- or plate-modulated amplifier. Two 828's in class AB_1 service (ICAS ratings) are capable of delivering 300 watts of audio power with only 1 per cent distortion. Maximum plate dissipation of the 828 for this service is 80 watts. Because of its high power sensitivity, the 828 can be operated in R.F. services to give full power output with very little driving power, and consequently, with a minimum number of driver stages.

75T—Radiation-Cooled Power Triode (¼-kw.)

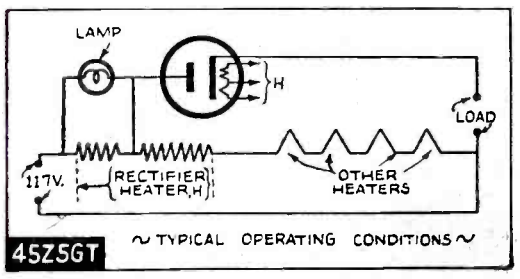
The Eitel-McCullough "Eimac" type 75T tube is of the radiation-cooled type especially designed to develop a high power output while requiring a low voltage on the plate.

The 75T has an entirely new feature in the form of a heat shield directly over the plate. This shield acts as a control to protect the plate-lead seal from excessive heat. Straight-line construction provides a great improvement over the conventional tube types in that interelectrode capacities are extremely low and electrical efficiencies are greatly increased. Short, straight leads go from grid and plate directly through the glass bulb—plate at the top and grid through the side—thus providing the maximum of interelectrode insulation. The use of a rugged 5-volt thoriated tungsten filament permits extra high power operation. Tantalum elements specially treated by the exclusive Eimac process, insure long life and trouble-free performance. Not as new as some of the other tubes described here, it is nevertheless, included here because of its outstanding design, and for completeness.

Plate is designed to operate at a cherry-red color on its normal dissipation rating of 75 watts. A perceptible red color is noted at 25 watts. These temperatures are perfectly permissible and no damage will result from such operation. The advantages of using the anode color as a tuning indicator will be readily appreciated as you become familiar with the 75T.

PHOTOTUBES

Perhaps not all 4 of the light-sensitive tubes described below will be new to *Radio-Craft* readers; but it was not possible to find room for the descriptions in preceding issues. However, the tubes differ so widely in their characteristics and therefore in their applications that many radio men may find the references to them useful in their work. Two of the tubes are gas-filled; the remaining 2 tubes are vacuum types.



924—Gas Phototube (End Type with Caesium-Surfaced Cathode)

The RCA 924 has a compact design with circular cathode facing the end of the bulb to facilitate its use in end-on applications.

925—Vacuum Phototube (Short Type with Caesium-Surfaced Cathode)

The RCA 925 features short overall length (only about 2½ inches). Like other vacuum phototubes, the 925 is suited to applications where the use of a high-resistance load is desirable to give maximum circuit sensitivity with stability. The large spectral response of the 925 in the red region makes this type useful where a tungsten-filament lamp is employed as the light source.

926—Vacuum Phototube (Cartridge Type with Rubidium-Surfaced Cathode)

The RCA 926, like the caesium-surfaced-cathode RCA types 921 and 922, has a short double-ended construction which eliminates the conventional base and provides a long insulating path between electrodes. The rubidium-surfaced cathode in the 926 has a spectral sensitivity characteristic which approximates closely that of the eye. As a result, the 926 is especially useful in colorimetry.

927—Gas Phototube (Small Type with Caesium-Surfaced Cathode)

The RCA 927 is only 11/16-in. in diameter and 2⅝ ins. in length. It is intended primarily for sound reproduction in connection with 16-mm. sound equipment.

RECEIVING TUBES

12B8GT—Midget Triode-Pentode

The Arcturus 12B8GT has been designed primarily for small A.C.-D.C. receivers wherein very limited space is available. The pentode section may be used as a conventional R.F. or I.F. amplifier and the triode section as a biased or grid-leak detector.

32L7GT—Midget Rectifier and Beam Power Amplifier

The Arcturus 32L7GT has been designed primarily for use in small A.C.-D.C. receivers wherein very limited space is available. It may be used in conventional half-wave high-vacuum rectifier and beam power amplifier circuits. The grid circuit resistance should not exceed 0.5-megohm.

The 32L7GT is similar in appearance to the type 12B8GT but minus the cap.

3Q5GT—Midget Beam Power Amplifier

The Arcturus type 3Q5GT is a filament-type beam output tube with a center-tapped filament. This makes possible either a series or a parallel arrangement of the 2 halves.

For series operation with other 0.05-ampere tubes pins Nos. 2 and 7 are used; and for 1.4 volt operation the filament voltage is applied to pin No. 8, and pins Nos. 2 and 7 connected together.

70A7GT—Midget Output and Half-Wave Rectifier

The Arcturus 70A7GT has been designed primarily for output—half-wave rectifier service in A.C.-D.C. receivers. In addition to this dual function the rectifier heater is tapped so that a 0.15-ampere pilot lamp may be connected between pins Nos. 6 and 7. As the D.C. output current of the rectifier flows through the pilot lamp section of the heater, this tube should never be used in circuits which do not require a pilot lamp.

The 70A7GT is similar in appearance to the type 3Q5GT but has a slightly longer envelope.

45Z5GT—Half-Wave High-Vacuum Rectifier

The Tung-Sol 45Z5GT is designed primarily as a power rectifier for A.C.-D.C. receivers. It features a 45 V. 150 ma. heater having a tap brought out so that, with proper external connections, the tapped section of the heater serves as a ballast resistor for a pilot light. It is recommended that the plate current of the rectifier be passed through the pilot lamp and tapped section of the heater which is accomplished by connecting the plate of the rectifier to the tap on the heater.

NEW NUMBERS—OLD TUBES, ETC.

A number of seemingly new tubes which have made their appearance on the market are, as a matter of fact, old friends whom we do not recognize because they are "disguised" either by different numbering, or by comparatively slight structural changes and corresponding identification by some change in the numbering (but which for purposes of *general* reference may be likened to earlier types).

Some of these cross-references are given below, together with wording which will help radio men who keep a file of tubes described in *Radio-Craft*, to identify certain tube types which, because of space limitations, have not run in "R-C." The companies which supplied the following data are credited. In most instances characteristics data on these tubes are available from the manufacturer.

5AP4/1805-P4. This tube is the "old" 1805 or 5-in. Kinescope with white phospher (P4). Electrostatic deflection. RCA.

1G4G. Detector Amplifier Triode. The filament current of this 1.4 V. tube is 0.05-A. RCA.

1G6G. Class B Twin Amplifier. A 1.4 V. tube drawing 0.1-A.

6AC7/1852. Single-Ended Television Amplifier Pentode; Sharp Cut-Off Type. Except for new numbering, same as 1852. Sylvania.

6AB7/1853. Single-Ended Television Amplifier. Pentode; Remote Cut-Off Type. New lettering for the 1853. Sylvania.

12SA7. Single-Ended Pentagrid Converter. In general class of 12A7. RCA.

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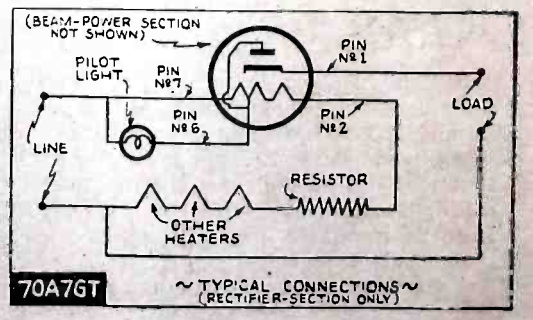


OPERATING NOTES

SERVICEMEN—What faults have you encountered in late-model radio sets? Note that RADIO-CRAFT *will consider your Operating Notes provided they relate to characteristic* (repeatedly encountered) *faults of a given set model. Payment is made after publication of the Operating Note.*

Trouble with . . .

. . . GLORITONE 26

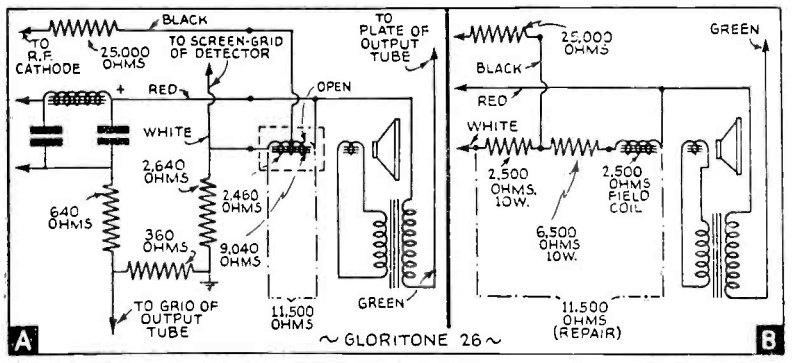
Several times, in my service work I have had to replace speakers in Gloritone models 26, a set which has a field resistance of 11,500 ohms. This is an unusually high resistance not often encountered in other radio receivers, and therefore replacements are hard to obtain. Of course one can order a replacement speaker field from the manufacturer, but this takes time, so to save time and to make quick repairs, I usually use the method outlined in Fig. B. I use a 2,500-ohm speaker with universal output transformer, and a suitable resistor, so as to not change the divider system. In most cases this is satisfactory to the customer, and I take his old speaker in as a trade-in and repair it in my leisure, but if he wants his original speaker back, I just put in the emergency speaker as a temporary repair and when I get the right field coil from the manufacturer, I make the permanent repair. This earns the good will of the customer, by giving quick service. It is always wise to check the field in this model should it have a bad hum or is completely dead.

Original circuit is shown in detail in Fig. A.

CLARENCE J. TABER,
Bluefield, Va.

. . . RCA 281

An RCA model 281 receiver faded at intervals. A stage by stage analysis finally disclosed the fault as shown in the diagram, Fig. A.



. . WESTINGHOUSE WR 336

The volume in a Westinghouse model WR 336 could not be reduced to zero. An R.F. signal was getting through from the diodes to the grid of the 6Q7 and being rectified in the plate circuit. The remedy is shown in the diagram, Fig. B.

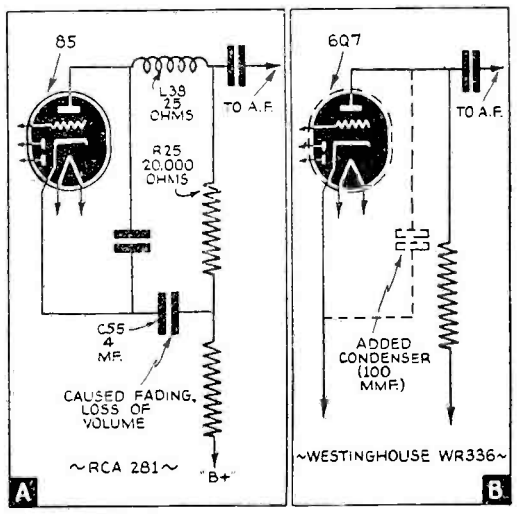
WILLARD MOODY,
New York, N. Y.

. . . MAJESTIC 15A

Strong stations could be tuned-in at moderate settings of the volume control on some of these sets, but on turning the control up there was a point at which severe motorboating occurred. Beyond this setting there was no reception at all. I found that the lug on the ½-mf. screen-grid bypass condenser for the 51-S I.F. tube was broken; repairing this restored normal operation. In another of these sets with the same symptoms, this condenser was found open.

. . . SILVERTONE 1923 BATTERY SET

I have found the following conditions in several of these sets. The switch, a D.P.S.T. affair, is apt to go "haywire." One pole is in the "A+" lead and the other in the "B+" lead; a small spring in the switch almost invariably shorts the two poles, and when this happens the high voltage takes the path shown by arrows in the diagram. As a result the three 1/3-watt bias resistors are charred, and usually several



tubes are burned out. Also, the 135 volts is impressed across the 25-mf., 25-V. condenser.

In the manufacturer's diagram the "B" leg of the switch is shown in the "B–" lead instead of in the "B+"; it is thus advisable to wire the replacement switch in this manner to prevent possible recurrence of this trouble. (See diagram, page 442.)

When this set fades off after a few minutes' operation, possibly with a rapid "chattering" effect, the "A" battery is very likely low; also, the 1C6 mixer-oscillator tube may be weak.

. . . DELCO 3208-3209—32-VOLT SET

Common complaint—noisy and intermittent. The primary of the audio transformer between the 76 and the 4-48 tubes (p.-p. parallel) is frequently found defective. See also that the fuse is clean and bright and its clips fit tightly.

KELLY W. BRYAN,
Huffman, Texas.

. . . MAJESTIC SETS

Frequently arcing occurs in the ballast unit in any Majestic receiver employing bal-

(Continued on page 442)

CASE HISTORIES OF P.A. SALES

No. 5

On March 16 and 17, 1939 the High School team was playing in the State Basketball Tournament in Minot, North Dakota. Radio reception being impossible due to local interference and interference from stronger stations at night around KLPM at 1,360 kc. brought fans to me for a solution.

To eliminate static, interference, and fading I suggested they rent a telephone line from Minot and my public address system be installed in the auditorium.

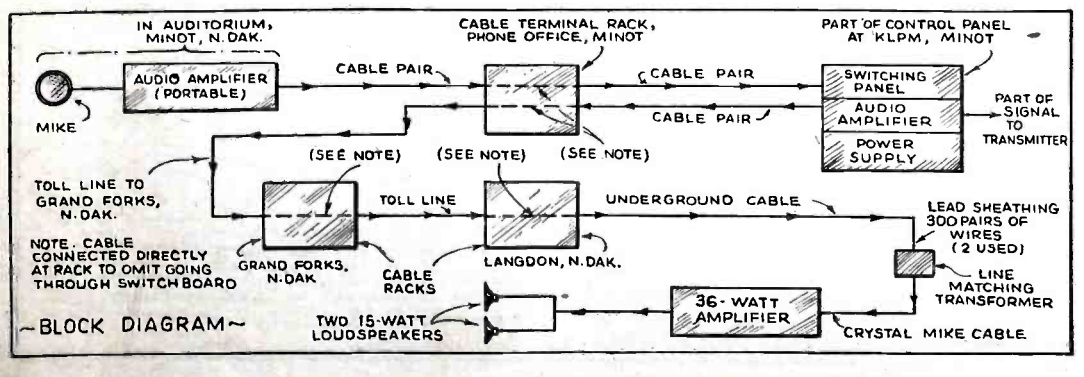
This plan was agreed upon and I proceeded as follows: The telephone line from Minot was around 300 miles but charge was for airline mileage at 10c per mile each hour or about $15 an hour. A 25c admittance fee was charged to meet this expense. Having only one day to advertise, my profit amounted to only a few dollars *but the publicity received in the local newspaper and the jobs I received afterward, more than paid for the effort.*

To bring a play by play description of the basketball games in the auditorium at Minot to the auditorium in Langdon, KLPM in Minot cut us into their audio circuit without charge. (See diagram at end of this article.)

Their announcer at the auditorium sent the program by portable amplifier through telephone cable to the telephone office in Minot where it was shunted on the racks back into cable pair leading to KLPM. Here, after further amplification, part of the signal went to modulate the KLPM carrier wave and part to a cable pair leading back to the telephone office. Here it was connected to a toll line running to Grand Forks, North Dakota. A 600-ohm output fed this line. Grand Forks shunted it to the toll line to the telephone office here. I shunted it from the racks to cable pair running to our auditorium. (See block diagram, on this page, below.)

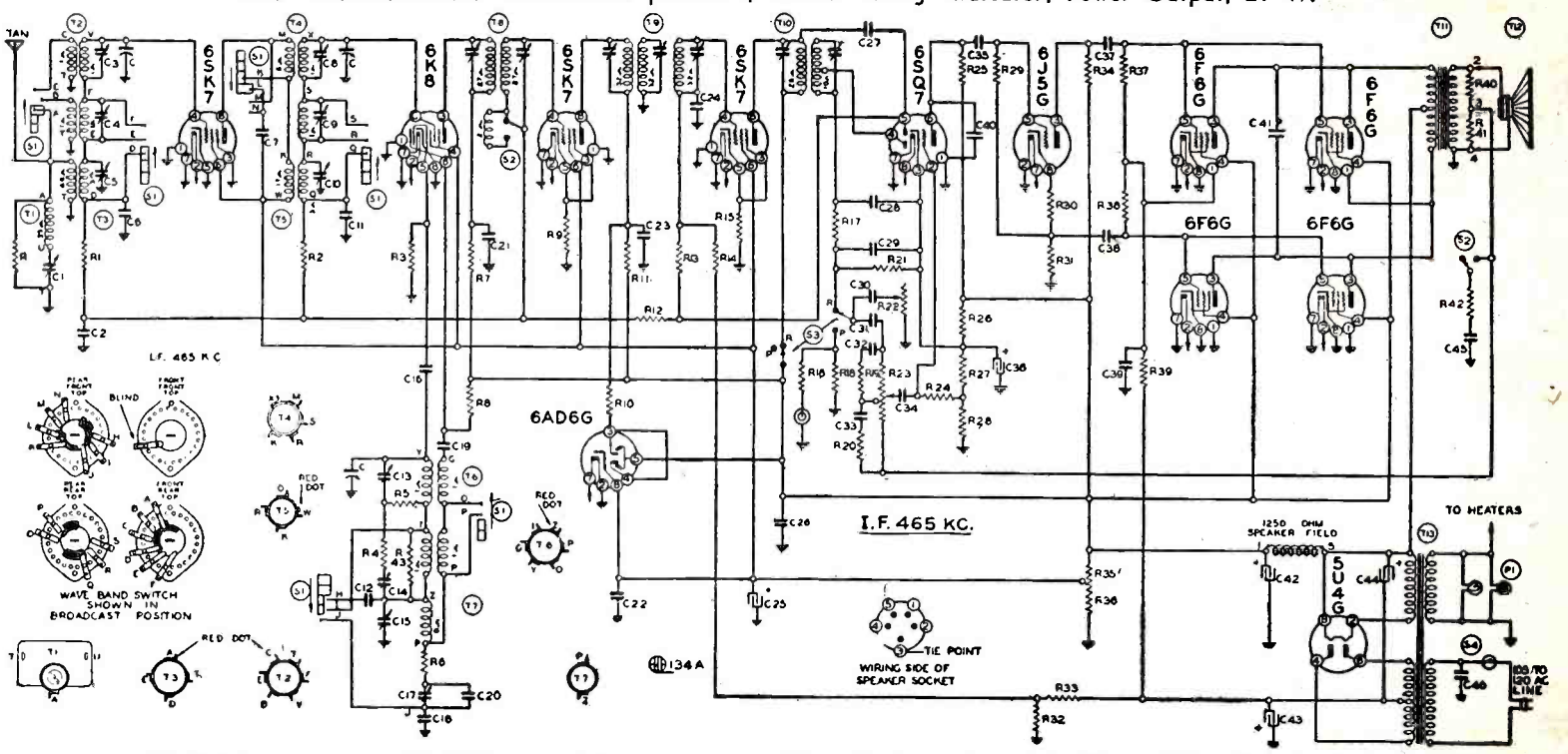
The telephone company would not remove repeater coils from these ordinary toll lines for 2 nights. Shunting around

(Continued on page 443)



MONTGOMERY WARD "AIRLINE" MODEL 93 BR-1201A CONSOLE

12-Tube A.C. Superhet.; 3 Bands (54 to 1,730 kc., 2.1 to 7 mc., 6.3 to 23 mc.); Pushbutton Tuning; Automatic Volume Control; Phono and Television-Sound connections provided; Visual Tuning Indicator; Power Output, 21 W.



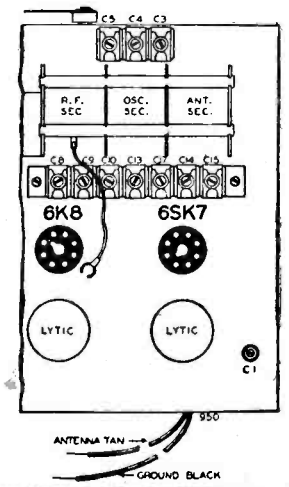
RESISTORS

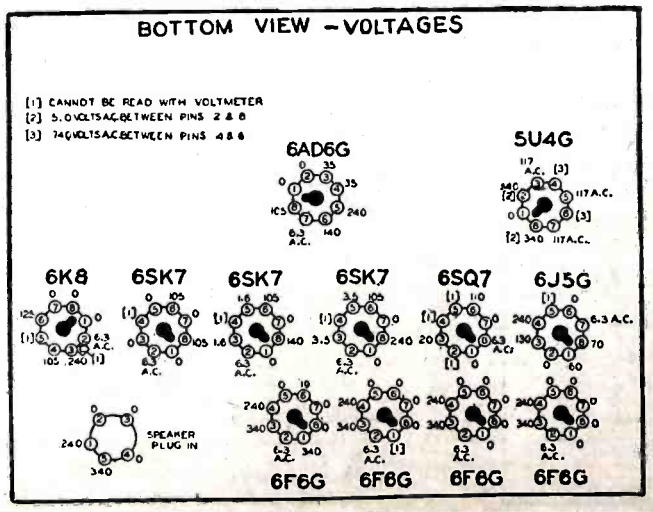
R, 10,000 ohms, 1/3-w.
R1, 0.1-meg., 1/3-w.
R2, 0.25-meg., 1/3-w.
R3, 50,000 ohms, 1/3-w.
R4, 30 ohms, 1/3-w.
R5, 50 ohms, 1/3-w.
R6, 20 ohms, 1/3-w.
R7, 2,500 ohms, 1/3-w.
R8, 30,000 ohms, 1 w.
R9, 200 ohms, 1/3-w.
R10, 1 meg., 1/3-w.
R11, 20,000 ohms, 1 w.
R12, 1. meg., 1/3 w.
R13, 0.5-meg. 1/3-w.
R14, 0.5-meg., 1/3-w.
R15, 1,200 ohms, 1/3-w.
R16, 0.25-meg., 1/3-w.
R17, 75,000 ohms, 1/3-w.
R18, 0.25-meg., 1/3-w.
R19, 0.1-meg., 1/3-w.
R20, 30,000 ohms, 1/3-w.
R21, 0.125-meg., 1/3-w.
R22, 50,000 ohms tone control
R23, 1 meg., volume control
R24, 1 meg., 1/3-w.
R25, 0.25-meg., 1/3-w.
R26, 50,000 ohms, 1 w.
R27 180 ohms, 1/3-w.
R28, 4,000 ohms, 1/3-w.
R29, 0.5-meg., 1/3-w.
R30, 5,000 ohms, 1/3-w.
R31, 0.1-meg., 1/3-w.
R32, 20 ohms resistor strip, 1/2 watt
R33, 125 ohms, resistor strip, 5 watt
R34, 0.1-meg., 1/3-w.
R35, 3,000 ohms resistor strip, 7½-w.
R36, 3,300 resistor strip, 3½-w.
R37, 0.1-meg., 1/3-w.
R38, 0.1-meg., 1/3-w.
R39, 0.3-meg., 1/3-w.
R40, 400 ohms., 1/3-w.
R41, 100 ohms, 1/3-w.
R42, 50 ohms, 1/3-w.
R43, 15,000 ohms, 1/3-w.
R32 and R33 in same unit
R35 and R36 in same unit

CONDENSERS

C, 3-gang variable condenser
C1, wavetrap—adj. condenser
C2, .05-mf. x 200 V.
C3, S.W. antenna trimmer
C4, M.W. antenna trimmer
C5, B.C. antenna trimmer
C6, .02-mf. x 200 V.
C7, 400 mmf., mica
C8, S.W.—R.F. trimmer
C9, M.W.—R.F. trimmer
C10, B.C.—R.F. trimmer
C11, 0.05-mf. x 200 V.
C12, 0.00395-mf. mica comp, type
C13, S.W. oscillator trimmer
C14, M.W. oscillator trimmer
C15, B.C. oscillator trimmer
C16, 50 mmf., mica
C17, B.C. Series Pad, adjustable
C18, 0.0025-mf., mica
C19, 0.002-mf., x 600 V.
C20, 450 mmf., mica
C21, 0.1-mf. x 400 V.
C22, 0.1-mf. x 400 V.
C23, 0.1-mf. x 400 V.
C24, 0.02-mf. x 400 V.
C25, 10 mf. electrolytic, 350 W.V.
C26, .1 x 400 V.
C27, 10 mmf., ceramicon
C28, 100 mmf., mica
C29, 100 mmf., mica
C30, 0.006-mf. x 600 V.
C31, 0.05-mf. x 200 V.
C32, 100 mmf., mica z
C33, .01-mf. x 400 V.
C34, .05-mf. x 200 V.
C35, .05-mf. x 400 V.
C36, 20 mf., 25 W.V., electrolytic
C37, 0.1-mf. x 400 V.
C38, 0.1-mf. x 400 V.
C39, 0.25-mf. x 200 V.
C40, 100 mmf., mica
C41, 0.008-mf. x 1200 V.
C42, 30 mf., 450 W.V. electrolytic
C43, 40 mf., 25 W.V. electrolytic
C44, 30 mf., 450 W.V. electrolytic
C45, 0.5-mf. x 100 V.
C46, 0.02-mf. x 600 V., bakelite
C25 and C36 in same unit

Above, Airline model 93BR-1201A; at right, trimmer locations.





ALIGNMENT DATA

The tone control should be in the treble position; volume control at maximum. Connect radio chassis to ground post of signal generator with short lead. Connect dummy antenna values in series with generator output lead. Connect output meter across primary of output transformer. Allow the chassis and signal generator to stabilize for several minutes.

I.F. ALIGNMENT

Using a 0.1-mf. dummy antenna feed 465 kc. to the grid of the 6SK7 (2nd I.F.) and adjust the 2 trimmers on top of the output I.F. transformer for maximum output. Follow the same procedure with the 3 trimmers on top of the interstage I.F. transformer, feeding the signal to the grid of the 6SK7 (1st I.F.); and ditto for the 2 trimmers on top of the input I.F. with the signal fed to the grid of the 6K7. In all I.F. alignments keep the tuning condenser in its minimum setting and the band switch to the broadcast band.

For oscilloscope alignment connect the 'scope between ground and the high side of a 125,000-ohm diode load resistor on the output I.F. Make same adjustments as above except readjust the input I.F. trimmers in broad position for uniform expansion.

SHORT-WAVE BAND

Feed a 21-megacycle signal from the oscillator to the antenna of the set through a 400-ohm resistor. Set the band change switch for short wave and the set dial at 21 megacycles. Adjust trimmer C13 for maximum output. Then adjust trimmers C3 and C8 for maximum output. **Note:** Make certain that the 21 mc. signal and not the image has been tuned-in by noting that the image falls near 20 mc. on the dial scale.

MIDDLE-WAVE BAND

Feed a 6-megacycle signal from generator to antenna of the set through 400-ohm resistor. Set band switch to middle-wave position and set dial at 6 megacycles. Then adjust trimmers C14, C4 and C9, in given order, for maximum output. Do the same for trimmer C12, using a 2.3-megacycle signal and with the set dial at 2.3 megacycles. The oscillator series padder condenser is mounted on the bottom of the chassis at the rear of the bandswitch. When adjusting this trimmer "rock" the tuning condenser and trim for maximum output.

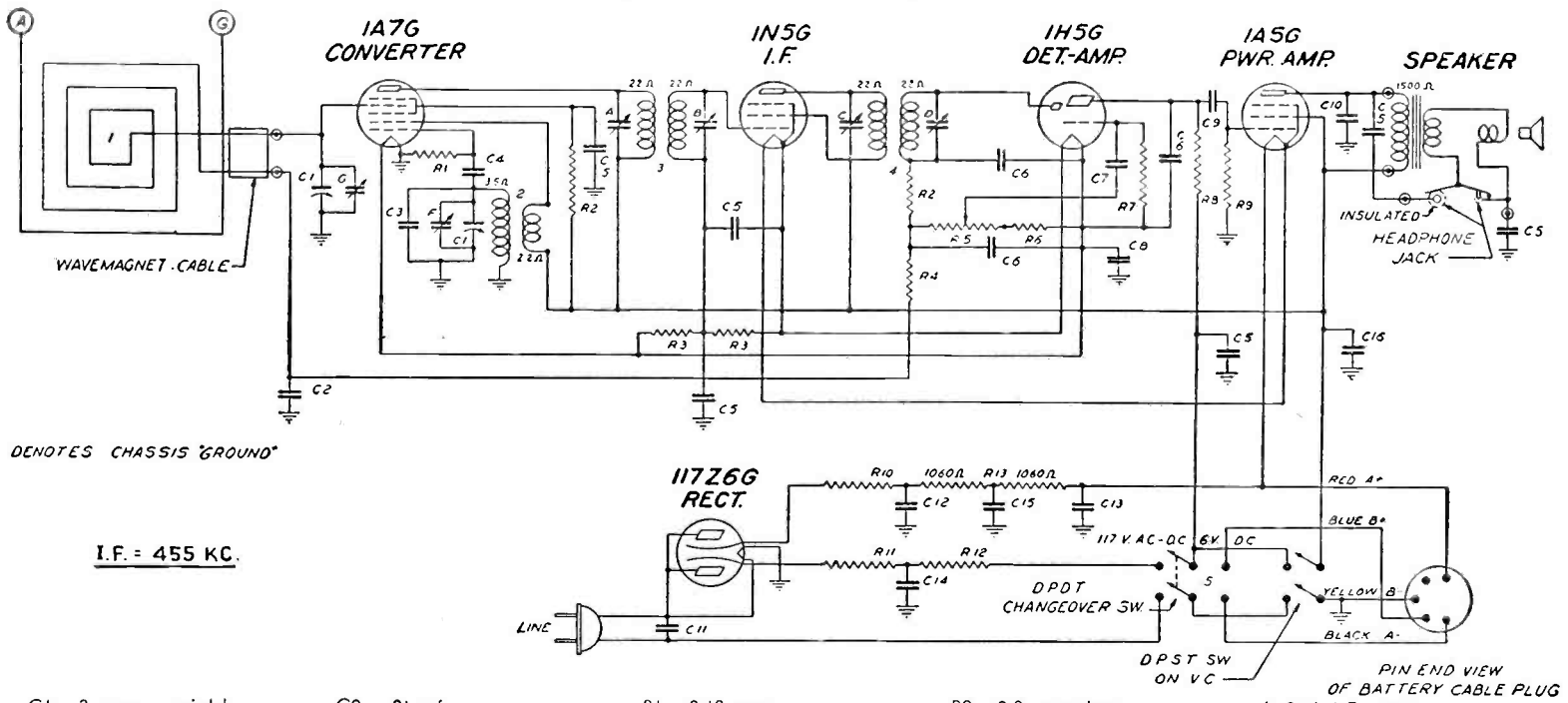
BROADCAST BAND

Return band switch to broadcast position and tuning condenser to its minimum capacity. Feed a 1,730-kc. signal through a 200-mmf. condenser to the antenna of the set and adjust trimmer C15 for maximum output. Then with the signal of 1,500 kc. to the antenna and the dial set at 1,500 kc., adjust trimmer C5 and C15 for maximum output. Do the same for trimmer C17 using the 600-kc. signal with the dial set at 600 kc. Finally with the dial still set at 600 kc. feed a 465-kc. signal to the antenna of the set and adjust trimmer C1 (I.F. wavetrap).

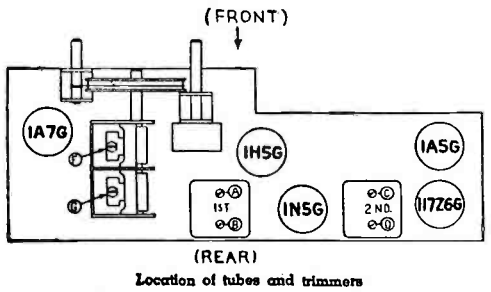
Radio Service Data Sheet

ZENITH PORTABLE MODELS 5G401M, 5G401D, 5G401Y and 5G401L (CHASSIS NO. 5537)

5-Tube Superhet.; A.C.-D.C. and Battery Operation; Detachable "Wavemagnet" Antenna (attachable to car windows, etc.); Automatic Volume Control; Headphone Terminal Jacks (permitting use of under-pillow phone in hospitals, etc.) Broadcast Band only.

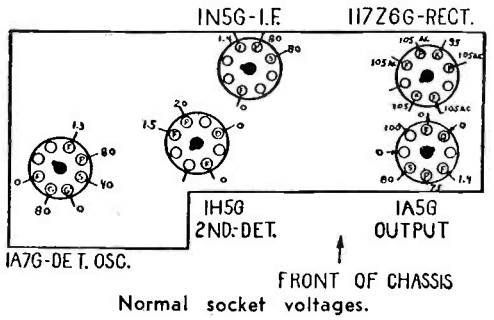


C1, 2-gang variable
C2, .2-mf.
C3, 30 mmf.
C4, .00025 mf.
C5, .05-mf.
C6, .0001-mf.
C7, .01-mf.
C8, 25 mf.
C9, .01-mf.
C10, 002 mf.
C11, .05-mf.
C12, 40 mf. electrolytic
C13, 20 mf. electrolytic
C14, 20 mf. electrolytic
C15, 20 mf. electrolytic
C16, 20 mf. electrolytic
R1, 0.12-meg.
R2, 47,000 ohms
R3, 0.22-meg.
R4, 3.9 megohms
R5, volume control
R6, 4,700 ohms
R7, 10 megohms
R8, 1 megohm
R9, 2.2 megohms
R10, 150 ohms, wirewound
R11, 1,000 ohms
R12, 2,200 ohms
R13, 2-section candohm
1, wavemagnet assembly
2, osc. coil assembly
3, 1st I.F. trans.
4, 2nd I.F. trans.
5, power switch
A, 1st I.F. trans. pri.
B, 1st I.F. trans. sec.
C, 2nd I.F. trans. pri.
D, 2nd I.F. trans. sec.
F, broadcast osc. (on gang)
G, antenna b'cast (on gang)



Location of tubes and trimmers

Locations of components and trimmers.



Normal socket voltages.

ALIGNMENT

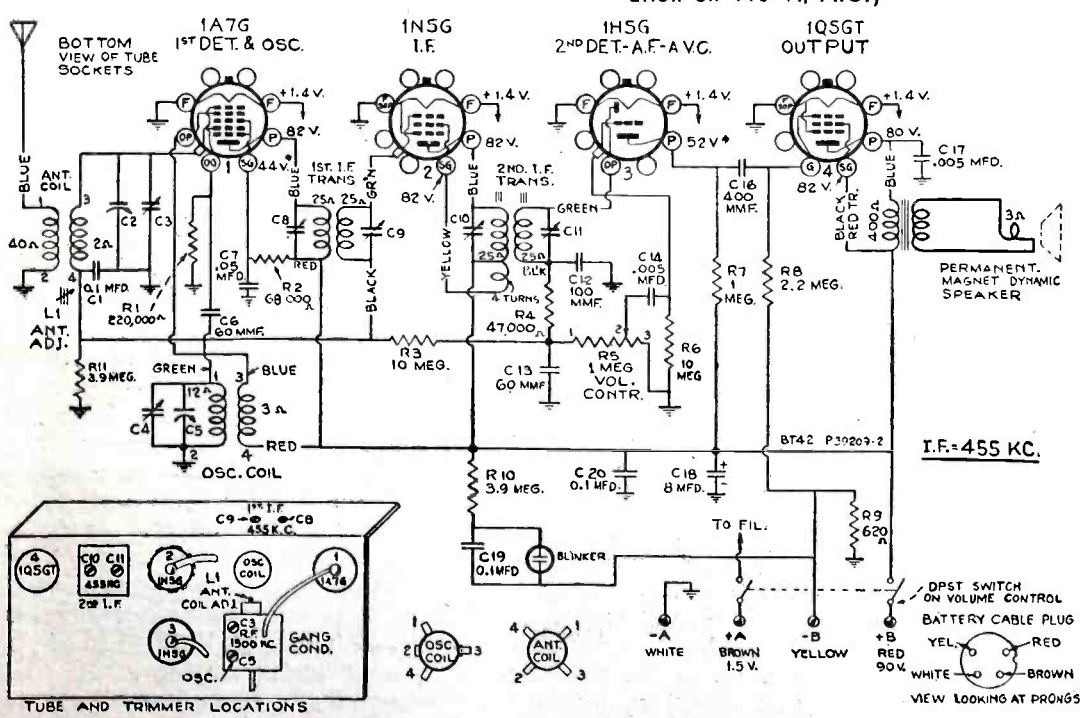
Using a 0.5-mmf. dummy antenna, apply a 455-kc. signal from signal generator to 1st-detector grid and adjust trimmers A, B, C and D for maximum response. Connect oscillator by means of single-turn loop, loosely-coupled to the wavemagnet (loop antenna). Set receiver dial at 1,400, apply a 1,400-kc. test signal and adjust trimmers F and G, respectively, for maximum response.

VOLTAGES:

All voltages measured from point indicated to chassis using a 1,000 ohms/volt meter. Ant. off; Vol. full on; C1 max.

RCA-VICTOR TABLE MODEL BT-42; AND CONSOLE MODEL BK-42 (CHASSIS RC-408A)

4-Tube Superhet.; Battery Operation; Low-Drain 1.4 V. Tubes; On and Off Neon "Economy" Blinker; Magnetite-core Transformers; Automatic Volume Control; Range 540 to 1,720 kc.; Output, 0.25-W. (max.). (An available converter unit, type CV4D, permits operation on 115 V., A.C.)



ALIGNMENT

Feed a 455 kc. test signal to grid cap of the 1A7G through a 0.01-mf. condenser and adjust the I.F. trimmers C8, C9, C10, C11 in this order. The tuning dial should be at 550 kc. Set the dial at 1,500 kc. and feed a 1,500 kc. test signal into the antenna through a 100 mmf. condenser. Adjust the oscillator trimmer, C5, for maximum response. Set dial to 600 kc. and, using a 600-kc. test signal through the same 100-mmf. condenser, adjust L (antenna coil), for maximum output. In this step trimmer C3 should be in its minimum capacity position. Finally, reset the dial to 1,500 kc., and adjust C3, from maximum output, using a 15 kc. test signal. Total "A" drain is 0.24-A.; "B", 10 ma.

PRECAUTIONARY LEAD DRESS

1. All filament (brown) and "B+" (red) leads must be dressed away from unshielded I.F. coil.
2. Green grid lead of 1A7G tube to be twisted around antenna (blue) lead for capacity coupling.
3. Red and brown battery cable leads to be dressed and held against front apron with tape.

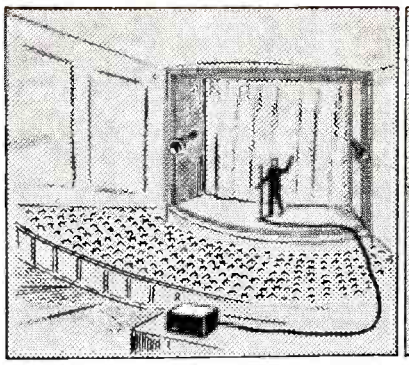
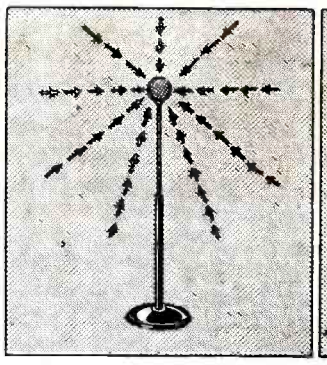


Fig. 2. Special microphones and uses.



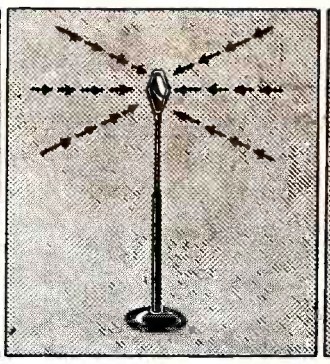


Fig. 1. Non-directional, bi-directional and directional mikes, l. to r., respectively.

How to Select and Place

SOUND EQUIPMENT

Much has been written about sound equipment but nearly always the discussions have been either highly technical or devoted mainly to one or two specific items. It is hoped therefore that the following, semi-technical article will have value as a coordinated presentation of elementary sound data.

PRACTICAL sound men, like practical men in any other line, seldom have either the patience or the necessity to read articles which discuss only the A-B-C's of their trade. Sometimes, though, such articles may recall to mind a few useful facts. The following article therefore may be of some interest to professionals in addition to the beginners in the sound field to whom it is addressed.

Since it is important to know what equipment can do, before putting it to work, let's see *why* the different *types* of apparatus are available for various services.

MICROPHONES

—**For Music.** For pick-up of music alone a *velocity* microphone is recommended.

It may also be used for voice if you talk or sing at least 8 or 10 inches from mike, which reduces the volume. Not recommended for outdoors where wind is likely to affect its performance.

—**For Music and Voice.** Where one mike is to handle both choir and organ, or orchestra and singer, the *dynamic* mikes have proved highly satisfactory.

These mikes may be used satisfactorily for either indoor or outdoor work. Wind noises will not prove troublesome under ordinary conditions.

—**For Voice.** For speaking or singing, *crystal* mikes give the best results. They may be used within 8 or 10 ins. of the speaker or singer.

These mikes may be used for music too, but where the speakers are in the same room, the results are not as satisfactory. Crystal mikes should not be used where temperatures exceed 120°. Such conditions frequently exist in a closed car on a hot day. Carbon mikes may be used when tone is not important. Use only with 12-watt amplifiers.

All the above mike recommendations are based on the supposition that the speakers are located in the same room with the mike. For this reason, some of the mikes suggested for voice, would otherwise be excellent for both music and voice.

If you prefer, you may use one mike for voice (singing or speech), and a second for music on the same amplifier. This is done by many successful orchestras which feature a vocal soloist, and want good pick-up on both at the same time. This is true for churches as well —one mike for the choir or pulpit, another for the organ. Two mikes will always do a better job than one. If you need as many as 3 mikes, use a mike mixer, which permits picking up sound from 1 additional point.

"How to Select and Place Sound Equipment" is a subject so extensive in scope that we cannot hope to review it in one article. Consequently it will be presented in a series of 4 articles of which this is the first. The titles of all installments are:

PART I—MICROPHONES
PART II—LOUDSPEAKERS
PART III—AMPLIFIERS
PART IV—PLACING SOUND EQUIPMENT

OTHER MIKE CONSIDERATIONS

Now, having found the best microphone for music, voice, or both music and voice, there are 3 other points to consider. They are the qualities of (1) fidelity, (2) sensitivity, and (3) directivity.

Fidelity.—You'll find, for instance, that some mikes give more faithful tone quality, while the outstanding characteristic of others is extreme sensitivity.

Fidelity is the accuracy with which a mike transmits all of the sounds it picks up. The usual range of music and voice falls between 32 and 10,000 cycles (vibrations) per second. The lowest tone of an organ may be 32 cycles, and the highest tone of a piccolo 10,000 cycles. In order to produce utmost naturalness of tone, a microphone should pick up all tones between these two extremes. The closer a microphone comes to covering this range of 32 to 10,000 cy., the better its fidelity. (Harmonics, for full music naturalness, may reach 18,000 cy.—*Ed.*)

Some mikes pick up sounds of all kinds with equal volume; others are better for low or high tones. Where the difference is somewhat noticeable, we suggest those mikes which cover the widest range and favor the lower tones to be best suited for music; those which take in only a narrow range, to be best suited for voice. For instance a microphone rated at 50 to 5,000 cycles is a good voice mike; one rated from 40 to 8,000 cycles is a good voice and music mike. Some microphones cover a wide range and favor the low tones. These are recommended for music where the deep tones are especially desirable.

A mike rated at 70 to 5,000 cycles within 5 decibels will pick up both lower or higher tones . . . but transmits such tones less perfectly than those within its fidelity rating. The term "within 5 db." or "within 8 db." merely tells you how closely the mike responds to all notes within its fidelity rating. For instance, one rated at 30 to 8,000 cycles within 2 db. is superior to one rated at 30 to 8,000 cycles within 5 db.

Sensitivity.—In a very noisy place a very sensitive mike would pick up too much of the noise in the room. By selecting a less sensitive mike and speaking directly into it, the voice will be loud and clear, without any background noises.

On the other hand, a more sensitive mike would be better in a quiet place; it would pick up the voice or music from greater distances, and permit more freedom of movement by speakers, etc. For general use, the writer suggests a mike which has medium to good sensitivity and fidelity ratings.

Sensitivity is shown in minus or *nega-*

(Continued on page 433)

All the worthwhile Radio Trade News of the past Month—Digested for busy radio men.

RADIO Trade Digest

IMPORTANT HAPPENINGS OF THE MONTH IN THE RADIO INDUSTRY

A PLEDGE: — To print the important news of the radio industry; to review major news events; to help point a path to radio profits.

No. 17 JANUARY, 1940 No. 17

OFF THE PRESS

To Keep You Informed

STANCOR HAMANUAL, published by Standard Transformer Corp., Chicago, Ill. 46 pp. Lists manufacturer's line, & gives diagrams & specifications for constructing amplifiers, power supplies, transmitters, etc. Price, 25c.

TWO BULLETINS, published by Aerovox Corp., New Bedford, Mass., each 4 pp. One covers new inductance, capacity checker, model 95; other, the capacity and resistance bridge.

CATALOG SHEET, Mueller Elec. Co., Cleveland, O. Pictures & describes booster battery cable assemblies.

FOLDER, Electrovox Co., N. Y. C. 4 pp. Describes 2 types of new Walco sapphire needle & solid walnut record rack.

CATALOG, Eagle Elec. Mfg. Co., Brooklyn, N. Y., 44 pp. Lists 1,200 electrical specialties & wiring devices, fuses, bed & desk lamps, etc.

WAR MAP AND SHORTWAVE LOG, Stromberg-Carlson Telephone Mfg. Co., Rochester, N. Y. One side of sheet shows 7-color map of war zone; other side gives log of foreign stations beamed at U. S., time conversion table, & other shortwave tuning aids.

INDUSTRIAL ELECTRONIC TUBE SHEETS, Westinghouse Elec. & Mfg. Co., Bloomfield, N. J. Tube prices given on sheet S860; two ratings given on sheet S860A.

1939–'40 CATALOG. Aerovox Corp., New Bedford, Mass., 28 pp. Lists more items of this manufacturer's line of condensers, resistors & test instruments.

1939–'40 CATALOG. Insuline Corp. of America, Long Island City, N. Y., 44 pp. Describes I.C.A. receiving & transmitting parts & accessories, service tools & attachments, racks, panels, chassis, antennas, auto-radio accessories, etc.

CATALOG 100, General Ceramics Co., N. Y. C., 24 pp. Steatite and ultra-steatite insulators, entrance bushings, coil forms, etc.

RADIO AND TELEVISION SERVICE NOTES, RCA Mfg. Co., Inc., Camden, N. J., 448 pp. New feature is tabulated replacement parts guide for RCA Victor sets from 1934 to date; has 650 illustrations & includes test equipment catalog. Price, $1.25.

FETE FAMOUS FIRSTS

Dr. Lee de Forest, Audion inventor, lunched with Vaughn de Leath, original radio girl, at the N. Y. World's Fair on Radio Pioneers' Day. Dr. de Forest's invention of the grid made radio what it is today; prior to that discovery tubes were little better than crystals as detectors, virtually valueless as amplifiers.

1939-'40 TEST EQUIPMENT—ACCESSORIES CATALOG, RCA Mfg. Co., Inc., Camden, N. J. Lists many new items, including lowest-price carbon mike in co.'s history; 16-pg. section shows principal replacement parts for mfr.'s sets made during past 5 yrs.

RADIO INTERFERENCE MANUAL, Sprague Products Co., North Adams, Mass. Gives filter circuits & data for suppressing noise from gas engines, mercury-vapor lamps, generators, switches, oil burners, etc., etc. Price, 25c.

FOLDER, Midwest Radio Corp., Cincinnati, Ohio. Data on new 14-tube receiver & offer of free midget.

SHEET, Hygrade Sylvania Corp., Emporium, Pa. Lists prices of tubes and gives data on interchangeability.

(Continued on page 418)

SEVEN UNITS IN RSA-NAB TIE-UP

Program Aired in Major Centers Marks Campaign's Inception —Other Chapter News

With the NAB-RSA Radio Promotional Campaign barely under way, 10 of the nearly 70 Chapters of Radio Servicemen of America are already participating.

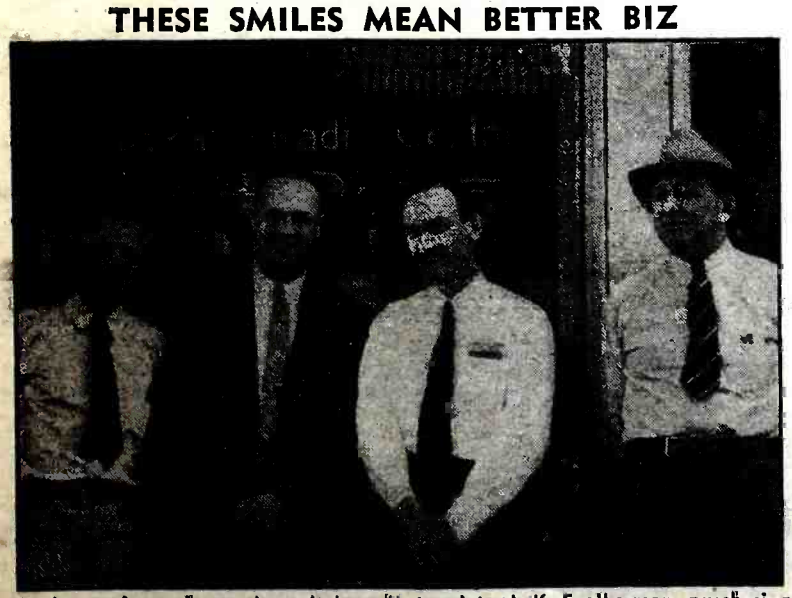
Chapters located in Boston, Cleveland, Chicago and Danville (Ill.) had made enough progress to take part in the "Curtain Raiser" program that launched the campaign. The Peoria, Davenport, St. Paul, Green Bay, Johnstown and Pittsburgh Chapters have completed the preliminary arrangements, making ready to cooperate with local stations in their respective communities in the carrying on of the program.

Chapter Notes

LANSING: Chapter set up a record of poor credit or undesirable customers. General advertising promotion was discussed at length and ads were ordered increased in local papers.

SOUTHERN NEW HAMPSHIRE: Ray Rogers Secretary has resigned from the Chapter as he has been transferred by his business firm to Portland, Maine. Walter W. Bennert has been elected to take Mr. Rogers' place.

THESE SMILES MEAN BETTER BIZ



The happy faces shown above belong (l. to r.) to J. K. Featherman, purchasing agent, and Morris H. Willis, mgr., both of Spokane (Wash.) Radio Co., W. S. Hartford, sales mgr. & Don Burcham, rep., both of Thordarson. Hartford is just back from a trip through West & Northwest. He reports biz better all through the territory.

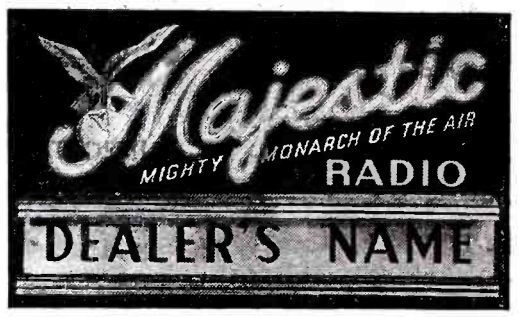
BOOKS BIGGEST PHONO-RADIO ORDER

G. W. Ward (2nd from l.) mgr. of Lyon & Healy, radio dept., hands largest order ever placed by co. for Capehart phono-radios to I. C. Hunter, sales mgr. of Farnsworth's Capehart div. Others pictured are: E. H. Vogel (l.), Farnsworth v.-p., & Howard Cushing, Capehart's Chi. district mgr.

MFRS. OFFER THESE SIGNS & SHEETS TO HELP YOUR BIZ GROW BIG & STRONG

Suggestions from field resulted in Hygrade Sylvania's new electric sign, offered dealers & Servicemen at $1.25. Comes with flat base for standing & chain for hanging; provision made for nameplate hanger (costing $1 extra). Sign measures 22½ x 8¾ x 3¾, & uses two 40-W. bulbs. Frame is green crackle; chrome-trim edges the green, black & white glass panel.

Mentioned last month, above is pic of DuMont 7x22 in. window sign. Attractive programs such as Nov.'s Canzoneri fight telecast make public conscious of telly programs' excellence; induce them to see demonstrations & buy sets. Sign marks dealer as progressive proponent of newest profitmaker!



Green fluorescent gas lettering above blue & gold shield, with space for dealer name lighted in red neon, marks Majestic R. & T. Corp.'s new dealer sign, which is of the stand-or-hang type. Transformer for 60-cycle operation is self-contained. Price (not quoted in release) said to represent nearly 60% saving & terms are 3 mo. Sign has 18-mo. guarantee.

Salesman Sam Says

LEEWARD ISLANDS—540 sets in use by 92,000 population. Sales total about 150 sets per yr. Market negligible.

WINDWARD ISLANDS—550 sets in use by 258,000 population. Demand very limited. Sales probably less than 100 per yr.

CAPE VERDE ISLANDS—600 sets in use by 186,000 population. About 200 sets sold last yr.; 90% of population definitely not prospects; 7 to 9 tube American sets in wood table model cabinets with meter & kc. dials bearing station names preferred; 85 to 90% of demand is for 220-V. D.C. sets.

TUNISIA—28,000 sets in use by 2,608,000 population. About 3,500 sold in '38, best customers being the 213,000 Europeans. Favorite models include 6 to 7 tube supers. in table models to receive short, medium and long waves. About 75% are 115-V., 50-cycle A.C.; 15% battery; 6% phono-radio; 4% auto-radio. Wood veneer cabinets in modern styling and with dials bearing station names are preferred.

SYRIA—18,000 sets in use by 3,050,000 population. Sales were about 4,770 in '38, a *decrease* of some 400 from preceding year; 6 to 8 tubes with 15-to-60 & 200-to-600 meter bands preferred. Modern cabinets of European design favored. Dials should be marked in kc., mc. & station names. No demand for auto sets.

CANADA—1,223,502 sets in use by 11,209,000 population. An excellent market (sales were about 251,260 sets during '38). This deserves your study. Bulletin No. 846, dated Oct. 3, gives full details & is obtainable from source given at end of this depart., for 10c.

Far more detailed information is available from the Bureau of Foreign & Domestic Commerce, Washington, D. C. Publications to request are: **World Radio Markets** *covering countries wanted &* **The Electrical & Radio World Trade News.**

Sales Helps and Deals

Aids To Profits, as Devised By Industry Leaders

National Union Radio Corp. has made available (at moderate price) football scoreboard signs, 20 x 28 ins. on steel, with space for listing 5 sets of teams, score by quarters & also final score. Also room for dealer's name, of course. Chalk can be used for scoring.

Same co. has new Radio Foto-Log with map showing locations of principal European broadcasters. Also included are data for shortwave listeners, listings of U. S. best. & telly stations & 300 photos of stars. Cost to dealer, about 3c each in quantities without imprint.

A Camay soap promotion over NBC & CBS nets & in magazines will give away 600 **Emerson** radios in 6 weeks. Dealers getting wide publicity.

Earl Webber Co. offering Servicemen's insulated screwdriver to dealers who show catalog to 5 friends—& enclose 20c in stamps "to cover cost of handling."

Hygrade Sylvania Corp. still using personalized blotters to publicize quality of line.

Thirteen talking movie shorts plugging **Philco** radios are available to dealers. First 40 ft. dramatize sets' appeal, remaining 20 ft. carry dealer info. & ad message.

Same co. is distributing "Chart-A-Game" for fireside football fans to use in score keeping. Complete diagrams of playing field & scoring space are provided.

If you are not cashing-in on the current War in Europe to push sets with short-wave bands as supplementary or replacement equipment you're missing an opportunity that may not come again for 20 yrs!

$'s & No.'s Dept.

BIZ UP 72% in jobbing div. of *Meissner Mfg. Co.* at end of fiscal yr. (Sept. 30). According to G. V. Rockey, v-p & gen. sales mgr., Sept. was the largest mo. in the history of the jobber div.

49% INCREASE came about in *Stromberg-Carlson* dealer line-up since introduction of 1940 line last May, as compared with 1938 figs.

BETTER BIZ was had by *G.E.* for first 9 mo. of '39. Total sales were $217,900,000, an increase of 13%. Dividends upped 43% to 87c a share. Orders received were up 32%.

PROFIT NOT LOSS was marked on the *Stewart-Warner* books for 3rd-quarter of '39. For 9 mo. ending Sept. 30 net profit was $256,000 as compared with net loss of $538,000 for same period in '38. (Frank Ross, co. v.-p., was elected a director.)

50% JUMP in remote-control models was marked by *Philco* in a single week.

CANADIAN FIGURES, according to *Radio Trade Builder*, include (a) 2,098,000 sets in use, (b) 275,000 sets sold per yr., (c) 12 mfrs. turning out sets, (d) 19 mfrs. turning out parts, (e) $11,000,000 invested in mfg. equip't., not including broadcast & other apparatus.

OFF THE PRESS

(Continued from page 417)

FOLDER, Wilcox-Gay Corp., Charlotte, Mich. Brief descriptions of Recordio combination phono-radio and recorder.

FOLDER, Nichols & Fletcher, N. Y. C. Describes standard-brand radio receivers, refrigerators & appliances.

CATALOG 1238, Cinaudagraph Corp., Stamford, Conn., 12 pp. Describes complete line of speakers & gives response curves.

1940 RADIO CATALOG NO. 101, Allied Radio Corp., Chicago, Ill., 204 pp. Introduces 60 new receivers, 3 new lines of P.A. systems, new ham apparatus—all in all more than 1,500 radio parts.

1939–'40 CATALOG NO. 175A. Cornell-Dubilier Electric Corp., South Plainfield, N. J., 16 pp. Pictures & specifications of mica, paper, Dykanol, wet & dry electrolytic capacitors. Also test instruments & interference filters.

OFFICIAL HANDBOOK, National Union Radio Corp., Newark, N. J., 40 pp. Gives characteristics, interchangeability, base connections, etc., of manufacturer's line.

AN EDITORIAL
By Artie Dee

Well, the World's Fairs are over, for this year at any rate. Some of the exhibitors gave a little space to radio—indeed, television was one of the hits on both coasts. And that's what happened to radio.

Gernsback Told Them

But, as was pointed out some time ago by Hugo Gernsback, the Oil industry had its exhibit building; the Railroads had their joint exhibit; and so forth. The Radio industry—one of the biggest industries in America—was represented only sporadically, not as a whole.

Each year the Radio Show draws thousands of persons who spend their good money to get in. They want to see and compare ALL the makes of sets AT ONCE. And the show always helps business—if it didn't the manufacturers wouldn't participate.

With at least one World's Fair almost certain to reopen in 1940, the industry is afforded an opportunity to run a radio show that will last not for just one week, but for *several months*. Instead of resulting in a brief business spurt, it might well produce a high and broad peak.

Does the industry want more business? You know the answer!

Showman Needed

Then let the industry get together with the Fair officials and arrange for a Hall of Radio at the new Fair. A monster exhibition that will show the history of radio's development, the manufacture of tubes, parts and accessories, the various sets and parts produced by leading manufacturers, the radio activities of Hams, broadcast stations, marine radio, government services, and public utilities, ship-to-ship and ship-to-shore and trans-oceanic radiotelephony, the work of the Serviceman, public address, electronics, facsimile, television, wired-radio telegraphy and telephony, wired sound, and all the "marvelous mysteries" with which the general public is unfamiliar.

Such a hall would certainly show an indirect profit to the industry as a whole, through augmented interest in radio. It might well show a direct profit to its sponsors through a small admission charge made to the public.

Anybody would spend a dime (and many would spend a quarter) to see a show like that!

If *Showmanship* is made the keynote, the second 128,000,000 Fair visitors—if the first record is equalled—may rate Radio Hall as the No. 1 attraction!

Personal

RTD extends sympathies to B. G. ERSKINE, pres. of Hygrade Sylvania Corp. *Mr. Erskine's son, HENRY J. ERSKINE, died after an appendicitis operation at the age of 21.*

VINTON K. ULRICH, sales mgr. of *Hytronic Labs.* div. of *Hytron Corp.*, is now also sales mgr. of the Renewal Tube Sales Div.

LIEUT. KARL W. MILES (8AQUA-CW & 8DEL-Spark some 20 years ago) has joined the engineering staff of *Howard Radio Co.*

DR. LEE de FOREST was honored at Radio Pioneers' Day at the N. Y. World's Fair. *(See Pic., Page 417.)*

W. H. BOHLKE of the *RCA Mfg. Co.* service div. has been made dir. of test-equip't & service merchandising. Bill is the editor of "Practical Television by RCA."

MAJOR R. L. DUNCAN, organizer & former pres. of *RCA Institutes,* has become pres. of the *Television Training School*—an independent educational enterprise.

C. W. BUNN, formerly of *Warner Bros.*, has been made gen. mgr. of *Wire Broadcasting Corp. of America.*

J. E. ROGERS has been appointed pres. of the *Rogers-Majestic Corp., Ltd.*, of Toronto, succeeding his brother, *E. S. ROGERS,* deceased. *B. A. TRESTRAIL,* sales adv. mgr., has been elected to the board.

ARTHUR ISBELL, mgr. of the commercial dept. of *RCA Communications, Inc.*, has retired after 37 years of radio work. *GEORGE SHECKLEN* of the Shanghai office replaces him.

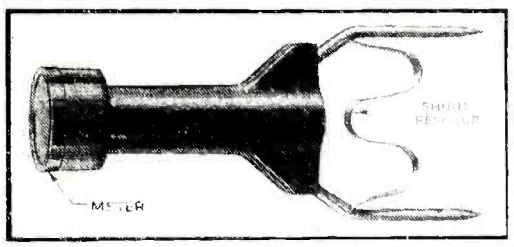
J. B. SECKIER has joined the sales staff of *Emerson-N. Y., Inc.*, distribs.

M. P. GRIFFITH has been appointed *Du Mont* television sales rep. throughout N. J. He works out of the main office.

MATT WILLIAMS of *Crosley Distributing Corp.* was elected pres. of the major appliance div. of the *Cincinnati Elec. Ass'n.*

WILLIAM B. CAMPBELL, former European mgr. of *Press Wireless, Inc.*, & business mgr. of *Hearst Radio,* has been elected a director & exec. v.-p. of *Nat'l Television Corp.*

ADJUSTS TO ALL BATTS



Adjustable but lower in price than previous model, G-E's new storage battery cell tester has permanently-attached resistor (shunt) which acts as load, & as spring for prod adjustment. Meter scale is 2½ ins. long & accurate to 2%.

Television Tips

FLASH! NBC rumored getting F.C.C. okay for telly commercials by Jan. 1!

ALLEN B. DU MONT LABS. have received their F.C.C. construction permit for a portable mobile television relay station (eyes a-truckin') to operate in the N.Y. area on an experimental basis. The telly truck is to use 156 to 162 mc. at 50 W. for sight & sound.

Officers reelected in the FARNSWORTH CORP. include J. B. McCargar of San Francisco, chairman of the board; E. A. Nicholas, president; E. H. Vogel, vice-pres.; J. P. Rogers, vice-pres. and treas.; B. Ray Cummings, vice-pres., and Edwin M. Martin, secy. (This co. reports production of radio receivers at 1,000 a day & up. Promises telly sets by Xmas; is readying telly station for Ft. Wayne.)

Harry R. Lubcke, telly director of DON LEE SYSTEM, discussed advertising possibilities of television before Los Angeles Jr. Adv. Club.

Mayor Fletcher Bowron of Los Angeles greeted visitors to that city's auto show via television over the DON LEE SYSTEM.

VISI-QUIZ program presented over NBC by Bob Eichberg, R.T.D. editor, & featuring such stars as R. D. Washburne, R.-C. managing editor, & Tommy Pentz, R.-C. art director, was successful & will become NBC program. Eichberg has also been asked to start series of crime shows for W2XBS. CBS is on the air with sight & sound tests.

700 HEAR RIDER ON RCA TEST EQUIP'T

One of Chicago's biggest radio get-togethers was held under sponsorship of RCA Mfg. Co. & local distribs. Approx. 700 dealers & Servicemen turned out to hear John F. Rider speak on & demonstrate uses of test equip't. Rider is touring 40 principal cities.

YOUR COMPETITORS—IN A YR. OR TWO

This group of students from Television Training Corp., N.Y.C., visited Arcturus Radio Tube Co. plant in Newark, N. J., as part of their course. Emerging, tired but happy (see above), they were thoroughly familiar with the manufacture & design of modern tubes.

What's this World's Fair battle to make away with those swell telly sets used in the various mfrs.' demonstrations? It's not a nice story . . . . And by the way, if you ask Stromberg-Carlson, Philco, Farnsworth, Emerson, *and* Pilot *about their telly plans you'll get some astounding answers . . . . Still speaking of telly, did you know of the muscle man who went into more than a score of Joisey jernts & told 'em to buy telly sets "—or else"? Anyway, it's a good story.*

Stewart-Warner's Sept. radio sales were biggest in the co.'s history . . . . Charles Golenpaul, jobber sales mgr. of *Aerovox*, predicts that the War will boost part sales way up to here . . . . A 450-lb. chandelier in the form of a musical note was installed at the *Hammond Organ Studios*, N.Y.C., as if you cared . . . . *Philco's* new phono needle has a long shaft said to reduce surface noises—each plays 20 records . . . . *Electronic Labs.* are putting out a new line of heavy-duty power supplies which will deliver up to 400 V. at 200 ma. from A.C. or D.C. They're called Portapower. (Doesn't that name sound familiar?)

Muzak, *pioneer wired-sound system, has opened a Detroit branch* . . . . Stromberg-Carlson's *new table model 425-H will pick up frequency-modulation broadcasts, too. If better fidelity is wanted output can be connected to phono jack of console set . . . . At a slightly higher price, low-loss yellow bakelite can be had instead of standard brown bakelite in* Aerovox *molded mica transmitting condensers.*

Philco Chicago distribs. are advertising 11 dry electrolytics valued at $22.25 all for 89c & the dealers are pretty sore about it . . . . After 8 yrs. of development, *Meissner Mfg. Co.* is out with brand-new vibrator which, tests indicate, has exceptional life . . . . Sideline seller: electric fire alarm with gong, wire & 2 detector heads to retail under $10 is *Technical Appliance Co.'s* latest baby . . . . *Stewart-Warner's* Air-Pal midget won hon. mention in the 4th Annual *Modern Plastics* competition. Another winner was *RCA's* molded record rack for phono fans.

R. D. Washburne, M.E. of Radio-Craft, *was the hit of Bob Eichberg's television* Visi-Quiz *with his clever impersonation of a discontented cow* . . . . RCA's *new Orthacoustic recording process gives higher fidelity & decreases surface noise, they do say* . . . . Nat'l Union Radio Corp. *has revised nets on its tube line; get your copy* . . . . Farnsworth's *phono radio combination called Panamuse comes from* pan, *meaning all, and* music—*not, as many thought, from* pan, *plus* amuse.

G.E., having revised its patent agreements, is readying television & frequency-modulation transmitters for sale with *G.E.* tubes included . . . . *Aerovox* says model 95 LC checker tests condensers & inductances under actual operating conditions . . . . Spanked by the *N.A.B.*, Elliott Roosevelt, *Emerson* news commentator, has agreed to be a good boy & cut the editorializing from his broadcasts—but he withdrew his 10 Texas stations from the Ass'n.

Westinghouse *1940 table and console models will have built-in loops* . . . . *3 new* Stromberg-Carlson *models include a low-price maple console, a 3-band table set with 3-gang tuning, and a convertible A.C.-battery job, making 42 units in the line* . . . . Solar Mfg. Corp. *has announced a new type of oil-filled filter condenser (type 0) for transmitting and a new dry electrolytic line (type DY) for original and replacement work.*

40% minimum dealer discount on *Emerson* line is partly credited for increase of up to 60% in orders over those of last year . . . . *Stewart-Warner* line now has 31 models as 6 new units are added . . . . *RCA's* installation of a sound system in St. Peter and Paul's Cathedral, San Francisco, uses gold-plated mike to blend with other altar fixtures—& 8-in. speakers of original design & ecclesiastical appearance . . . . Netcher's Boston store (in, of all places, Chicago) won prize with artistic window featuring new *Majestic* line . . . . Commonwealth Edison's Electric Living Exposition showed at *Majestic* exhibit how radios are made. Drew mobs!

Changes & New Addresses

Save stamps & time! Address your mail right the first time!

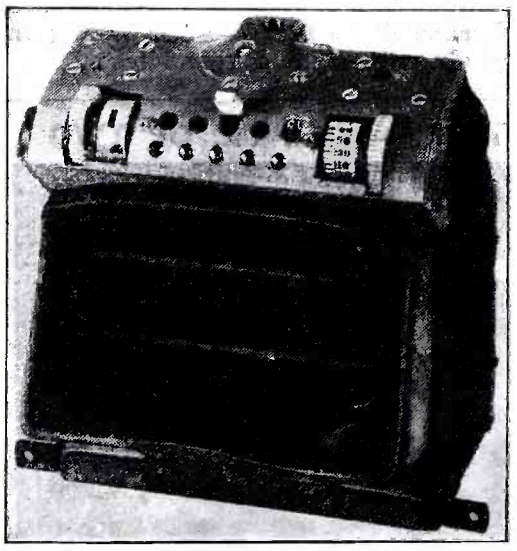
STEWART-WARNER distributors recently added are: *H. J. Sackett Electric Co.*, Buffalo, N. Y.; *C. T. Berner Distributors*, Dayton, Ohio; *Falkeim Lumber Co.*, Erie, Pa.; *The Hibbs Hardware Co.*, Portsmouth, Ohio. *Brown-Dorrance Electric Co.*, Pittsburgh, now also distributes this line in Wheeling, W. Va., and vicinity.

Fry & Roberts, 2412 W. 7th St., Los Angeles, Calif., have been appointed distributors of TRIUMPH MFG. CO., commercial test apparatus for Calif., Ariz., Nev. & Utah. These distribs are also opening an office in San Francisco.

WILCOX-GAY CORP. have appointed the following as distribs for their Recordio (a home & radio recording device): *York Supply Co.*, 517 W. 3rd St., Cincinnati, Ohio; *Appliances, Inc.*, 238 N. 3rd St., Columbus, Ohio; *Ohio Valley Sound Service Co.*, 2024 Pennsylvania St., Evansville, Ind.; *National Mill Supply Co.*, Ft. Wayne, Ind.; *George D. Barbey Co.*, 434 Walnut St., Reading, Pa.

Bruce O. Burlingame, 69 Murray Street, N.Y.C., has been appointed by INTERNATIONAL RESISTANCE CO. to handle IRC fixed & variable resistance products to jobber & industrial trade in parts of Eastern Pa., Md., Del., N. J. & D. C.

FORD ENTERS RADIO BIZ

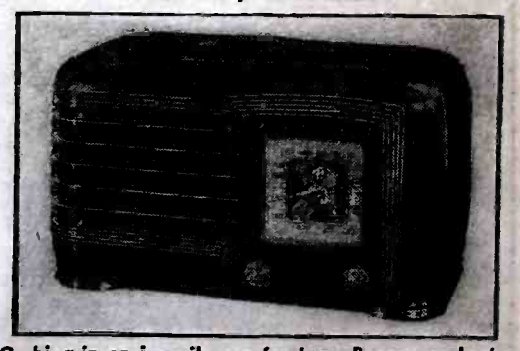


Antenna & speaker are included in the new auto-radio chassis developed by engineers of Ford Motor Co. Push-button control is had on 5 stations; set also includes A.V.C., tone control, & noise filter. Adjustable antenna plugs directly into radio chassis, designed for use in Fords & Mercurys.

DRAMATIZE BROADCAST SERIES

Jigsaw puzzle souvenirs of Mutual B'casting System's Gillette-sponsored World Series broadcasts were sent out to adv. agy. execs. To lend drama, messengers were dressed in baseball suits. Specially constructed "Baseball Mike" was rebuilt from World's Fair Trylon & Perisphere mike which was rebuilt from "8-Ball."

"HI-HO, SUPER!"



Cashing-in on juvenile yen for Lone Ranger gadgets, Pilot pictures this "romantic" character & his famous horse, Silver, on the illuminated dial. Set is 1-band, 5-tube, table-model super. with 5-in. speaker, A.V.C. and built-in antenna. Idea is to cash-in on Lone Ranger broadcast, movie & comic strip publicity.

LATEST RADIO APPARATUS

HIGH-CAPACITY, HIGH-VOLTAGE ELECTROLYTICS

Sprague Products Co.
North Adams, Mass.

KNOWN as types AP, AD and RC, these new units are high-capacity, high-voltage condensers (having sections series-connected internally) with voltage working ratings of 600 and 800. Specifically designed for public address and theatre applications.

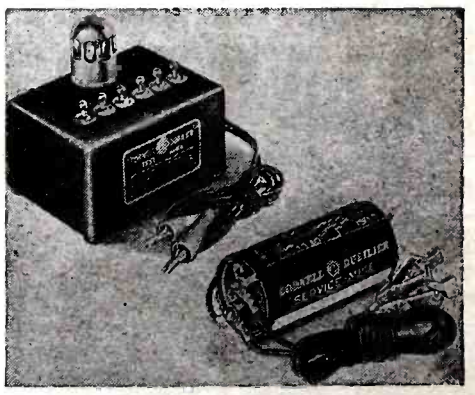
MULTIPLE SERVICE INSTRUMENT

Radio City Products Co.
88 Park Place, New York, N. Y.

THIS new model 801 instrument combines the functions of a tube tester, set tester and multi-meter; tests are at R.M.A. voltage standards, etc. The 4½-in. d'Arsonval meter has linear A.C. scales; 1,000 ohms/volt; 2% accuracy. Meter ranges: D.C. volts, 0-10/-50/500/1,000; A.C. volts, 0-10/50/500/1,000; D.C. milliamps., 0-1/10/100/1,000; Decibels, –8 to +15/15-29/29-49/32-55. Output ranges, same as for A.C. volts.

TESTERS FOR MOTOR-START CONDENSERS

Cornell-Dubilier Electric Corp.
South Plainfield, N. J.



THE motor-starting replacement condenser (capacitor) frequently has to be of a different capacity than the original one and hence these instruments save time in determining just the proper values of capacity required.

The "Tester-Mike" instrument is a multiple-condenser unit of the A.C. electrolytic type; toggle switches select different values. The "Service-Mike" is more compact; 4 terminals, instead of switches, are used for determining different values. Capacity range: 20 to 150 mf.

NEW VIBRATOR TESTER

Philco Radio & Television Corp.
Tioga & C Sts., Philadelphia, Pa.

YOU merely plug the "B"-power vibrator into the socket of this new instrument (model 013) and turn the power switch on. When the pilot lights in the instrument flicker with equal brilliancy, the vibrator is "OK". Tests synchronous and non-synchronous vibrators, all makes.

THE "HAM" DE LUXE SIGNAL SHIFTER

Meissner Mfg. Co.
Mt. Carmel, Ill.

A VOLTAGE-REGULATED, temperature-compensated, drift-free, variable-frequency exciter unit, its stability equals that of many X-cut crystals. Effective filter circuits completely eliminate keying "thumps", etc. The use of individual plug-in coils cover the 160-, 80-, 40-, 20- and 10 meter amateur bands.

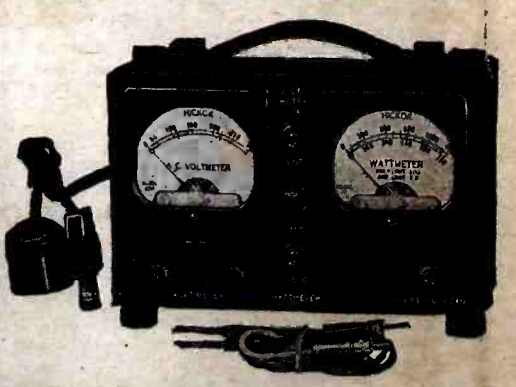
CODE PRACTICE OSCILLATOR

Bud Radio Inc.
5205 Cedar Ave., Cleveland, Ohio

THIS variable-note oscillator operates on 115 V. A.C. or D.C. and is suitable for either individual (or 2-way, by adding a speaker and key) or group code instruction.

VOLT-WATTMETER APPLIANCE TESTER

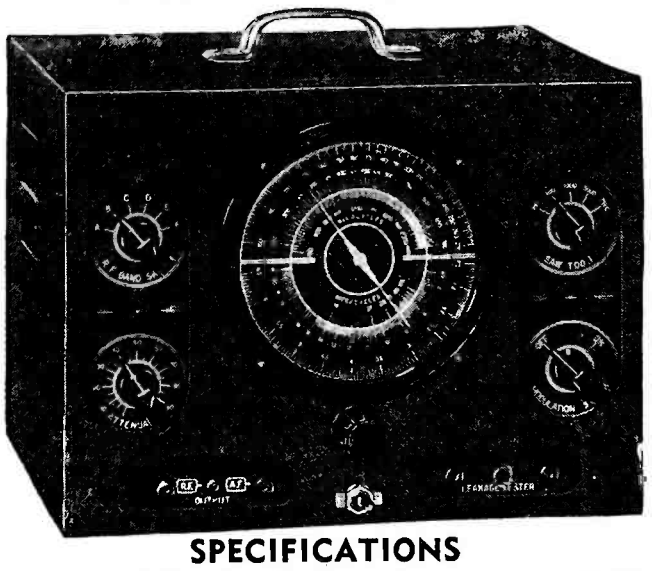
The Hickok Electrical Instrument Co.
10514 Dupont Ave., Cleveland, Ohio



A DUAL meter instrument which checks line voltage while measuring power consumption (watts) of refrigerators, washing machines, motors, flat irons, etc. Two power ranges are available, viz., 0/750/1,500 W. The A.C.-D.C. voltmeter scale is 0-300 V. Voltage circuits are fused.

(See page 424 for other latest items)

THE NEW 1130-S
SIGNAL GENERATOR
WITH AUDIO FREQUENCIES

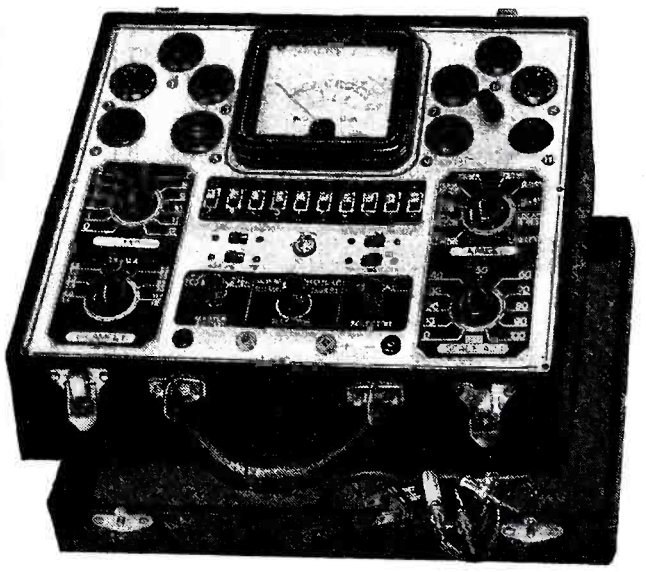


SPECIFICATIONS

Combination R.F. and Audio Signal Generator, R.F.—100 Kc. to 100 Mc., A.F.—100-7,500 cycles. All direct reading, all by front panel switching.
R.F. and A.F. output independently obtainable alone or with A.F. (any frequency) modulating R.F.
Accuracy is within 1% on I.F. and Broadcast bands; 2% on higher frequencies.
Audio frequencies in 5 bands; 100, 400, 1000, 5000, and 7500 cycles.
Giant airplane full vision, direct-reading dial.
Condenser and other leakages tested to 100 megohms.
All services on 90-130 volts A.C. or D.C. (any frequency).

Model 1130-S comes complete with tubes, test leads, carrying handle, instructions. Size 12"x9" x6½". Shipping weight 15 pounds. Our net price **$11.85**

THE NEW MODEL 1280
SET-TESTER
Combines Models 1240 and 1250



A complete testing laboratory in one unit, the Model 1280 combines the Models 1250 Multitester and 1240 Tube Tester. (See specifications of each below.)

- ★ Instantaneous Snap Switches Reduce Actual Testing Time to Absolute Minimum.
- ★ Spare Socket and Filament Voltages Up to 120 Volts, Make the Model 1280 Obsolescence Proof.
- ★ Latest Design 4½ D'Arsonval Type Meter.
- ★ Works on 90 to 125 Volts 60 Cycles A.C.

Even those servicemen who through past purchases know they can always get SUPER-VALUES from Superior, will be amazed and delighted when they read the specifications of this all-purpose instrument and then note the unbelievably low price. The Model 1280 features a 4½" D'Arsonval type meter for easy reading of the various scales, and in line with our new policy of stressing appearance as well as serviceability in our new 1200 line of test equipment, our Model 1280 utilizes an aluminum etched panel, designed for beauty as well as ruggedness. The primary function of an instrument is, of course, to make measurements accurately and when designing test equipment this is our first thought. However, we also appreciate the important part the appearance of an instrument plays in the impression a serviceman makes on his customers, especially on home calls. We have, therefore, paid special attention to the outward design of all of our new instruments. For instance, the panel of this Model 1280 is made of heavy-gauge aluminum and etched by a radically new process which results in a beautiful, confidence inspiring appearance.

Model 1280 comes complete with test leads, tabular data and instructions. Shipping weight 18 pounds. Size 13" x 11" x 6½". Our net price .. **$19.95**

Portable cover $1.00 additional

THE NEW MODEL 1250
MULTITESTER

SLOPING PANEL FOR PRECISE RAPID SERVICING

Etched aluminum panel

Specially designed electronic rectifier enables linear A.C. scale, high stability and little or no temperature drift.

Here is an opportunity to acquire a Multi-Service, Precision Engineered Instrument, for less than you would have to pay for an ordinary Volt-Ohm Milliammeter. Besides making the usual volt, resistance and current measurements (both A.C. and D.C.) this unit accurately measures the CAPACITIES of mica, paper and electrolytic condensers, INDUCTANCE of coils, chokes and transformers, DECIBEL gain or loss, of power amplifiers and public address systems, WATTS output of amplifiers, receivers, etc.

SPECIFICATIONS

Complete A.C. and D.C. Voltage and Current Ranges
D.C. Voltage:—0-15, 0-150, 0-750 volts
A.C. Voltage:—0-15, 0-150, 0-750 volts
D.C. Current:—0.1, 0-15, 0-150, 0-750 ma.
A.C. Current:—0-15, 0-150, 0-750 ma.
2 Resistance Ranges 0-500 ohms, 500-5 megohms
High and Low Capacity Scales .0005 to 1 mfd. and .05 to 50 mfd.
3 Decibel Ranges -10 to +19, -10 to +38, -10 to +53
Inductance: 1 to 700 Henries
Watts: Based on 6 mw. at O D.B. in 500 ohms .006000 to 600 Watts

Model 1250 works on 90-120 volts 60 cycles A.C. Comes complete with test leads, tabular charts and instructions. Shipping weight 9 lbs. Size 9½" x 11" x 6½". Our net price **$11.85**

Portable cover $1.00 additional

THE NEW MODEL 1240
TUBE TESTER

Instantaneous snap switches reduce actual testing time to absolute minimum.

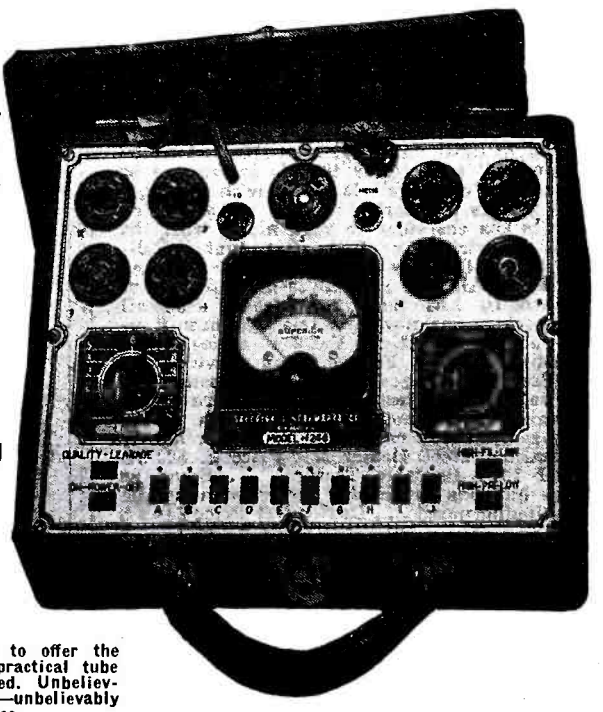
●

Tests all tubes 1.4 to 117 volts.

●

Sockets for all tubes— No adapters.

●



Superior is proud to offer the newest and most practical tube tester ever designed. Unbelievably low in price—unbelievably high in performance.

- ★ Tests all tubes, 1.4 to **117 volts**, including 4, 5, 6, 7, 7L, octals, loctals, Bantam Jr., Peanut, single ended, floating filament, Mercury Vapor Rectifiers, the new S series, in fact every tube designed to date.
- ★ Spare socket included on front panel for any future tubes.
- ★ Tests by the well-established emission method for tube quality, directly read on the GOOD ? BAD scale of the meter.
- ★ Jewel protected neon.
- ★ Tests shorts and leakages up to 2 megohms in all tubes.
- ★ Tests leakages and shorts in all elements **AGAINST** all elements in all tubes.
- ★ Tests **BOTH** plates in rectifiers.
- ★ Tests individual sections such as diodes, triodes, pentodes, etc., in multi-purpose tubes.
- ★ Latest type voltage regulator.
- ★ Features an attractive etched aluminum panel.
- ★ Works on 90 to 125 volts 60 cycles A.C.

Model 1240 comes complete with instructions and tabular data for every known type of receiving tube. Shipping weight 12 pounds. Size 6" x 7½" x 10¾". Our Net Price..... **$11.85**

Portable cover $1.00 additional

SUPERIOR INSTRUMENTS CO.

136 LIBERTY ST., DEPT. RC1 NEW YORK, N. Y.

LATEST RADIO APPARATUS

(Continued from page 422)

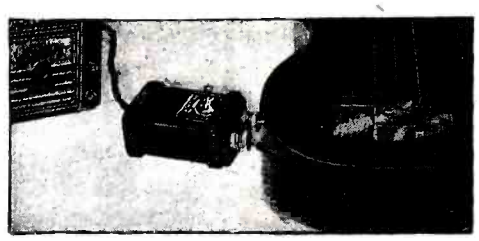
"HOLD-TITE" CONNECTORS

Atlas Sound Corp.
1447 39 St., Brooklyn, N. Y.

A NEW line of extremely versatile connectors, featuring the so-called "Duo-Plug" combination plug and screw-connector (see illustration). The female connector which bears a ⅝-in.-27 thread accommodates any of the parts shown. Shielded cable up to 5/16-in. dia. may be used; a spring extension eliminates sharp cable bends.

NEW UNIT MATCHES MUSIC PICK-UPS TO RADIO SETS

Amperite Co.
561 Broadway, New York, N. Y.



THIS new "boosting transformer," connected to phono input or across the volume control, enables Amperite Kontak microphones to be properly matched into any home radio set, for electronically reproducing any string instrument, such as the violin, guitar or piano. A switch on the unit permits either the radio set or the Kontak unit to be used.

NEW ADD-ON RADIO COMPASS

Western Electric Co.
195 Broadway, New York, N. Y.

THIS new add-on, model 50A radio compass gives yachtsmen and others operating coastwise vessels a precision navigating instrument at low cost. It is designed to operate in connection with Western Electric marine radio telephones. An indexed dial attached to the loop indicates the bearing of the station, with respect to the ship's heading, at minimum-signal position of the shielded loop antenna. All the marine radio beacons maintained by the U.S. Lighthouse Service at strategic points on the Atlantic, Pacific, and Gulf coasts as well as on the Great Lakes, are encompassed in its frequency range of 230 to 350 kc.

"SAFTEST" NEON CIRCUIT TESTER

M. M. Fleron & Son, Inc.
Trenton, N. J.

A SIMPLE device for testing motors, fuses and spark plugs, as well as electrical and radio circuits, at 80 to 550 volts. Neon indicator, in a bakelite and polystyrene "fountain pen" housing, safely tests high-voltage circuits.

ELECTRIC TIME SWITCHES

The Wadsworth Electric Mfg. Co., Inc.
Covington, Ky.

SERVICEMEN can use these time switches to advantage by automatically keeping their window displays lit up, a good portion of the night, to a pre-set "off" time. Its synchronous, self-starting motor, is lubricated for life; power consumption is low.

FIBRE-GLASS FLEXIBLE RESISTORS SOLD "BY THE INCH"

Clarostat Mfg. Co., Inc.
285 North Sixth St., Brooklyn, N. Y.

THE use of fibre-glass cores for resistors permits higher watts ratings for flexible resistors. Known as "Glasohms" these small flexible resistors are available in 2 power ratings and with either pigtails or terminals. The 1/16-in. dia. core is rated at 1 W. per inch and the ⅛-in. dia. at 2 W.; an overload of 300% (up to glowing-red heat) will not deteriorate the units.

Resistance values run as low as ¼-ohm or less, per body inch, and as high as 700 ohms (for the 1-in. resistor) per inch and 750 ohms (for the 2-in. resistor). Units are available up to 500 ft. long.

POWER PACK FOR BATTERY PORTABLES

General Transformer Corp.
1250 West Van Buren St., Chicago, Ill.

RECENTLY electrified farms and suburban areas will find a real use for this model L, "Porta-Power" power supply which makes it possible to operate *any* 2-volt, 4 to 8 tube battery radio set from the 115 V. A.C. power lines. Unit delivers "A", "B" and "C" voltages.

100-1,000 KC. FREQUENCY STANDARD

Browning Laboratories, Inc.
750 Main St., Winchester, Mass.

THIS type BL-MC instrument, for Servicemen and experimenters, incorporates stable 100-1,000 kc. oscillators which can be readily set to their respective frequencies, to within 1 part in 200,000, by zero beating against WWV's standard frequency. Either A.F. modulation or a pure R.F. signal may be obtained, and the amplitude of either varied by means of an attenuator. The apparatus is available in both kit form and ready to use; it uses 4 tubes, and operates on 115 V. A.C.-D.C.

"LUBRI-TACT" RHEOSTATS

James G. Biddle Co.
1211 Arch St., Philadelphia, Pa.

THESE precision, laboratory-type rheostats use special multi-leaf sliding contacts, made of a combination of graphite lubricator and phosphor bronze metal, for improved electrical contact and reduced wear.

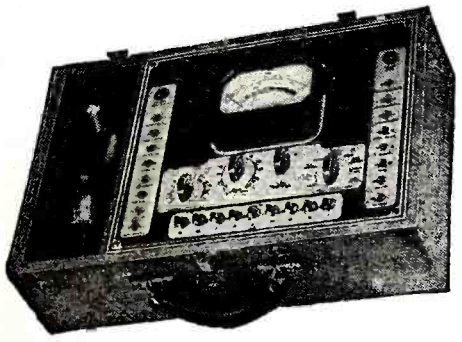
500 AND 1,000 W. RESISTORS

Ohmite Mfg. Co.
4835 Flournoy St., Chicago, Ill.

EXTREMELY heavy-duty units, a 500-W. resistor measures 12 ins. long by 2½ ins. in dia. The 1,000-W. resistor is 20 ins. by 2½ ins. in dia.—the largest vitreous-enameled porcelain resistor made. These are 2 of the more than 50 resistor-sizes which range from 1 to 1,000 W. in a single unit from 5/16-in. in dia. x 1 in. long, to 2½ ins. dia. x 20 ins. long.

THE "CHECKMASTER" TESTER

Weston Electrical Instrument Corp.
Newark, N. J.



THIS portable test instrument has 24 ranges, including fundamental facilities for receiver servicing, including practically obsolescence-proof tube checker.

Meter ranges follow: Voltage: 7.5/50/-150/500/1,000 V. A.C. and D.C.; output: 1.5/7.5/50/150/500/700/1,000 V. A.C.; current D.C.: 1/10/100 ma.; resistance: 0-10,000 ohms/0.1-/1/10 megs. Voltage, current and resistance measurements available at tip-jacks.

RECHARGEABLE FLASHLIGHT BATTERY

Quirk Battery Co.
Highland Park, Ill.

KNOWN as the Quirk Charge-O-Matic Battery, this tiny portable storage cell was designed especially for flashlights and similar use. It is a true storage cell, enclosed in a specially-designed spill-proof case. A simple charging unit is provided to recharge the storage cell from a 115-V., 60-cycle A.C. source. A charging unit operating from the automobile battery is also available. It is claimed that economy of 80 per cent or more, over drycells, is obtained by using the rechargeable flashlight batteries.

NEW "MIP" LINE OF COLORED, MOLDED-IN-PLATE SOCKETS

American Phenolic Corp.
1250 West Van Buren St., Chicago, Ill.

CALLED by the manufacturer the "strongest socket in the world" the steel mounting plate is molded right into the bakelite body and therefore cannot vibrate loose. Swell for repeated use in laboratory experimental equipment.

(See page 430 for other latest items)

SEE SOLAR ANNOUNCEMENT PAGE 448

FREQUENCY-MODULATED PROGRAMS ON YOUR PRESENT RECEIVER!

(Continued from page 395)

used in the normal manner, by the throw of the switch positioned on the front of the chassis.

To make the Adapter still more versatile, a second switch has been positioned in the rear of the chassis allowing a bias to be placed on the limiter tube and the detector system to be altered to receive amplitude-modulated high-frequency stations (sound channels of television stations and amplitude-modulated educational programs).

A tuning eye may be connected as shown and indicates, by the maximum tendency to close, the proper tuning on frequency-modulated signals.

THE LIMITER CIRCUIT

As before indicated, the function of the limiter is to tend to keep the amplitude of the signal in the I.F. amplifier constant. There are various methods of attacking this problem. Probably the simplest and most effective is to use a sharp cut-off tube, such as the 6SJ7, and incorporate a resistor and condenser in the grid-return circuit, as shown in Fig. 1. The function of this circuit is somewhat as follows:

When a signal of sufficient magnitude is impressed on the grid of this tube, the grid during one-half of the cycle will go positive. As there is no bias on the tube, electrons then flow in the grid circuit and through the resistor, effecting a limiting action due to the loading of the tuned circuit. This grid current builds up a voltage across the resistor and in turn builds up a charge on the condenser which makes the grid sufficiently negative so that, on the other half-cycle, there is limiting action due to the cut-off of the negative grid. In order to make the limiter operate satisfactorily, the time constant of the resistor-condenser combination must be made low.

CONSTRUCTION

The layout of parts is shown in Fig. 2. By correctly positioning the sockets and I.F. transformers, very short plate and grid leads are obtained. A cathode lead of No. 16 wire for bypass connections is wired to each tube socket and all bypassing in the circuits associated with this tube is returned to a common point on this lead, as shown in Fig. 1.

The rest of the wiring is not critical with the exception of the R.F. tuner which is connected with solid wire run as directly as possible to proper tube socket connections.

As will be noted, the "B" supply is standard. At least 250 volts should be used on the plates of the R.F. and I.F. amplifiers.

If the frequency-modulated stations which it is desired to receive have sufficient field strength at the receiver, one I.F. stage consisting of an 1852 tube will be ample.

ALIGNMENT

The first step in the alignment of the receiver is to properly adjust the detection transformer. The operation of this transformer can best be explained by reference to Fig. 3 which shows that portion of the circuit.

Here is shown a typical F.M. detection transformer, the primary of which is fed from the plate of the limiter tube, the secondary of which is both inductively and capacitatively coupled to the primary and which feeds a pair of diodes. The action of the device is such that if the incoming frequency f is adjusted to the so-called "center frequency" (in this case 3 mc.), the D.C. voltage appearing between point A and ground will be 0. Now if the incoming frequency f is either raised or lowered, the D.C. potential of point A with respect to ground, will become either positive or negative depending upon the direction of the departure of f from the center frequency. Obviously, if a signal is now impressed whose frequency is varying between certain limits at an audio rate, an audio voltage will be developed between point A and ground. This voltage may then be fed to a conventional audio frequency amplifier and thence to a speaker. In order to align the detection transformer, it is necessary to tune both primary and secondary carefully to the proper frequency.

A vacuum-tube voltmeter is connected between point A and ground and a 3 mc. signal fed to the grid-ground circuit of the limiter tube. The plate circuit of the detection transformer (C1) is then tuned to obtain maximum reading (if the V.-T.V.M. reading is small, adjust the condenser C3 so that a sufficiently large reading is obtained). The second step is to tune C3, the secondary of the detection transformer, so that *zero* voltage is obtained between point A and ground. After this is done, set the signal generator successively at 3.1 and 2.9 mc. whereupon positive and negative D.C. voltage of equal magnitude should be obtained between point A and ground. If these D.C. voltages are considerably different in magnitude, repeat the above process.

Having correctly aligned the discriminator circuit, the next step is to line up the intermediate frequency amplifier so that it covers a band of frequencies from 2.9 to 3.1 mc. To effect this alignment, connect the V.-T.V.M. between point B and ground and feed a 3 mc. signal into the control-grid of each I.F. stage in turn, working from the limiter tube back. With the grid-circuit trimmer set near its maximum capacity, the plate circuit is tuned to 3 mc. The grid circuit is then peaked at the same frequency.

Slight retouching of the plate trimmer may then be necessary to obtain maximum reception.

Having aligned all of the I.F. transformers in the manner indicated above, the oscillator, R.F. stages, and antenna tuned circuit may be aligned as in a conventional superheterodyne receiver. An ordinary amplitude-modulated signal generator may be used for this adjustment, and the V.-T.V.M. connected between point B and ground. The antenna and R.F. stages should not be critical in their adjustments as they are required to pass a band of frequencies 200 kc. wide; consequently no vernier dial is required for tuning.

In the transmission of frequency-modulated signals, it has been found that a transmission characteristic which accentuates the highs provides a somewhat better signal-to-noise ratio than the usual flat characteristic throughout the audio range of modulation. Means must be provided in the receiver for restoring the normal level at various frequencies if high-fidelity reception is desired. The arrangement provided in the Adapter takes the form of a resistance-capacity filter.

OPERATION

Perhaps the most outstanding characteristic of the reception of frequency-modulated signals is the tremendous dynamic range which is possible when the frequency of the transmitter varies over approximately a 70 kc. range. The first reaction of an observer to the audio signal produced from

such a receiver is that it is similar to that produced when volume expansion is employed. *The actual results obtained are, of course, much more satisfactory than with any volume expansion system.*

If sufficient signal strength is obtained from the station, and the limiter is operating correctly, the reception is devoid of noise. Auto ignition noise has no effect, static is unknown, and even tube noise is practically absent. The receiver seems "dead" in the interim between program and announcements. *The advantages of frequency modulation transmission can readily be appreciated by throwing the switch and listening to A.M. transmissions.*

It should be pointed out, however, that just because sufficient signal strength is obtained so that an audio amplifier of one stage before the power tubes can be operated satisfactorily, it is no sign that sufficient limiter action is obtained. Remember that about 40 volts must be developed between point A and ground in Fig. 3. This is sufficient to drive the power tubes.

"F.M." ANTENNA

A horizontal doublet is probably as satisfactory as any type of antenna for receiving the 7-meter transmission. Each section of the doublet should be approximately 68 inches long and a twisted pair should run from this to the binding post on the rear of the BL-40 tuner.

CONNECTING UP THE ADAPTER

The Adapter shown may be readily connected up to the audio amplifier of any receiver by means of a shielded lead, as indicated on Fig. 1. A single-pole, double-throw switch connects either the Adapter's audio output or the original receiver's audio output to the receiver's audio amplifier. The reason for shielding the leads to the audio amplifier is to eliminate 60-cycle hum which might be picked up on these leads. If the connections between the ordinary receiver and the Adapter are not too long, the shielding may not be necessary.

The Adapter may be conveniently located in the side of a console cabinet housing the ordinary radio receiver, and connections readily made to the audio system.

LIST OF PARTS

Three Browning I.F. transformers, type BL-3M, 3 mc., 1st, 2nd and 3rd I.F.T.'s;
One Browning detection transformer, type BL-3D, 3 mc., 4th I.F.T.;
One Browning high-frequency tuner, type BL-40 L1;
One Kenyon power transformer, No. 222;
One Kenyon choke, No. KC200, 20 hys.;
One Browning chassis;
Dial, knobs, etc.

CONDENSERS

Sixteen Tobe Deutschmann paper tubular, 0.01-mf., 600 V., C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16;
Three Micamold (mica), 100 mmf., C17, C18, C19;
One Micamold (mica), 0.001-mf., C20;
Two Tobe Deutschmann paper tubular, 0.05-mf., C21, C22;
Two electrolytic, 8 mf., 450 V.;
One D.P.D.T. switch, Sw.1, Sw.2.

RESISTORS

Three I.R.C. 400 ohms, ½-W., R1, R4, R9;
Four I.R.C. 50,000 ohms, ½-W., R2, R10, R15, R22;
Six I.R.C. 2,000 ohms, ½-W., R3, R11, R16, R20, R26, R27;
One I.R.C. 10,000 ohms, ½-W., R5;

(Continued on page 438)

TELEVISION DESIGN FACTORS

(Continued from page 402)

Of course, our D.C. component is now lost and must be restored by the use of a diode across the image tube grid leak functioning in the manner explained before. It is possible to use a copper-oxide or other dry-type rectifier to restore the D.C. component, but because of the unit's high internal capacity, it is necessary to use a resistance in series with it in order to prevent the capacity from shunting out the high vision frequencies. The use of this resistance results in imperfect restoration and the average illumination will not be maintained correct.

This proper utilization of the D.C. component is sometimes termed "Automatic Background Control", and is quite a necessity. The circuit of this portion of the receiver is shown in Fig. 5, where V1 is the detector, V2 is the vision amplifier, V3 is the D.C. restoring diode and V4 is the image tube.

It will be noted that there is a small inductance in series with the vision amplifier load resistor; this is used to help maintain the upper vision frequencies which would otherwise be attenuated by the output capacity of the vision amplifier. The inductance is chosen in value to resonate with the output capacity at a frequency slightly higher than the highest vision frequency to be passed.

THE SYNC. PULSE SEPARATOR

We come now to the most important part of the television receiver which is apparently the least understood, the *sync. pulse separator*. Upon the proper functioning of this portion of the circuit depends the stability of the image elements.

No matter how perfectly everything else operates, if the sync. separator is slightly off, or interference affects it the image will fluctuate up and down, or slip upwards a few frames or be unrecognizable entirely. In a properly-designed receiver the signal delivered to the sync. separator is of the form shown in Fig. 2A and 2B with all the sync. impulses of equal height and no image signal exceeding 80% of the height of the sync. pulses. In other words, all of the signal between 80 and 100% modulation consists of only the sync. pulses. The actual image signal is limited to below 80%. To separate these sync. pulses from the image signal is the function of the sync. separator.

There are many ways of doing this; one of the simplest uses a diode biased to an extent that requires a signal of at least 80% to overcome the bias and make the diode conduct. Consequently, only the sync. pulses have enough amplitude to do this. The bias may be obtained from the signal itself by the use of the circuit of Fig. 6. This diode is usually the other half of the 6H6 detector and L represents the last I.F. coupling.

The action is as follows: the signal is rectified by the diode and would appear across R1 and R2 in the form shown in Fig. 2A, 2B, but the values of R1 and C1 are high, being chosen to have a relatively long time constant, and R2 is given a low value. Consequently the voltage across R1 cannot follow rapid variations and C1 is charged to a value approximating 80% of the complete signal. This voltage, of course, is the bias that must be overcome before the diode conducts, and only the sync. pulses have sufficient amplitude to do this. In other words, the diode passes current only on the tips of the sync. pulses. Since the capacity across R2 is very low, the voltage here can follow rapid variations and only the sync. pulses are developed here.

There are two main disadvantages to this circuit; the first, due to curvature of the diode's characteristic, there is a certain minimum level below which it will not function properly. This means that a fairly strong signal is necessary to properly synchronize the sweeps. The second disadvantage is that it is very difficult in practice to insure that C1 stores up exactly 80% of the full amplitude. If it charges up to less than this the image signal gets into the sync. channel; while if it charges to more than 80%, the amplitude of the resultant sync. pulses is considerably reduced. The usual values chosen cause C1 to store a charge nearly equal to the full peak of 100% which, of course, gives a very small sync. pulse which must be amplified considerably by some high-gain tube such as an 1852 to afford proper synchronization. The low level of these sync. pulses causes the circuit to be exceptionally sensitive to interference which makes the image very unsteady.

CORRECTING SEPARATOR FAULTS

By providing the bias for the diode from a voltage divider network controlled from the front panel and connecting the diode to the plate of the vision amplifier we can eliminate these effects. The high level at the plate of the vision amplifier brings the operating point well up into the straight portion of the diode's characteristic and perfect synchronization can be had even with the signal so weak that the image can barely be seen. Interference has very little effect, since the bias is set at exactly the right point and the separation takes place at high level. The additional control made necessary is easy to operate, it being necessary only to turn it until the image is steady. This control can be left in the back of the receiver and once set, never touched if desired.

Figure 7 shows the circuit used. Tube V1 is the vision amplifier and the diode is the sync. separator. Units R2 and C2 are only for the purpose of filtering. It will be noted that the sync. separator is connected to the junction between the vision load resistor and the correcting inductance. This prevents the capacity of the diode from shunting the entire load and bypassing some of the high vision frequencies. The separated pulses are developed across R1 and fed out through C2.

There are too many other types of sync. separators to be dealt with here but they are all generally more complex than the one just described which works very well. The output of this sync. separator gives us negative impulses which will not do for synchronizing the sweep oscillators we shall choose. A positive pulse is needed so a 6SF5 stage is added to reverse the phase as well as to amplify the pulses a bit.

THE SWEEP OSCILLATORS

The *sweep* oscillators are necessary to generate *sawtooth-shaped oscillations* for the purpose of sweeping the cathode-ray beam across the screen in a series of uniform straight lines. There are many methods of generating these sawtooth waves but the simplest is the use of gas triodes such as the 884. Gas tubes formerly had a reputation for erratic operation but with present tubes and the circuit to be described they oscillate stably from the instant of turning on for hours on end without the slightest variation.

Figure 8 shows the fundamental circuit and the action is as follows: With a fixed grid bias it is characteristic of the 884 to pass no plate current until the plate voltage reaches a certain critical value. As soon as the plate voltage reaches this point a large

plate current flows, limited only by the circuit constants. The plate voltage is applied through R1 which is a resistor of high value. Since the plate circuit is shunted by a condenser the voltage does not rise to the full value instantly but rather takes an appreciable time while C1 is charging. As soon as the voltage across C1 on the plate reaches the critical value the tube passes current and very rapidly discharges the condenser. Immediately following this the voltage starts rising again and the cycle is repeated again and again. It is this slow rising and rapid falling of the voltage across C1 that constitutes the sawtooth sweep wave.

The 2 sweep frequencies necessary are 13,230 cycles for the horizontal or *line sweep* and 60 cycles for the vertical or *frame sweep*. The usual procedure for insuring synchronism is to have the oscillators operate very close to their proper frequencies so that a light sync. pulse is sufficient to pull them to the proper frequency. The disadvantage here is that if the oscillators should drift slightly, which they will do unless elaborate precautions are taken, the light sync. pulse will not hold the oscillators properly. If it is arranged to have the oscillators operate at about half the normal frequency or even lower, a stronger sync. pulse will be necessary to pull the oscillators into step, but then any drifting due to line voltage variations or other causes will have no effect. This is the system utilized in the receiver being described, since the sync. separator mentioned before delivers a very strong sync. pulse.

The output of the 884 oscillators is insufficient to cover completely the screen of the 7-inch cathode-ray tube used, therefore amplifiers must be added. They must be of the push-pull type to provide symmetrical deflection without defocusing at the edges of the image. Type 6N7's are used in the amplifiers in a circuit much the same as that used in the phase inverter stage of audio amplifiers with one important difference; that of frequency response. The frame amplifier must be flat from the very lowest frequencies to about 600 cycles, while the line amplifier must cover a range up to over 130,000 cycles. This is necessary in order to pass the sawtooth wave faithfully. This can be done by using relatively low-value plate resistors and large coupling condensers and grid leaks, no other correction being necessary.

The receiver described here has given excellent results in practice. In a downtown office building in New York City fine "pictures" are received consistently with a piece of wire only 6 inches long, for an antenna, mounted directly on the antenna terminal! The picture remains perfectly steady in locations of weak signal strength, in spite of auto interference strong enough to completely cover the screen with bright specks. The vertical resolution is good beyond 350 lines and the horizontal resolution is in excess of 300 lines. The interlace holds perfectly and flicker is unnoticeable.

Tentative operating voltages for the Observox models TK7-1 and TR7-1 teleceiver have been made available to *Radio-Craft*.

These test voltages measured to chassis are as follows (see diagram):

1852 mixer—terminals 5, 4 V.; 6, 135 V.; 8, 240 V.
1852 1st vision I.F.—5, 8 V. (approx.); 6, 160 V.; 8, 230 V.
1852 2nd vision I.F.—5, 2 V.; 6, 135 V.; 8, 225 V.
1852 3rd vision I.F.—5, 35 V.; 6, 200 V.; 8, 265 V.
6V6G 1st amp.—3, 200 V.; 4, 310 V.; 8, 22 V.
6SF5 sync. inverter—3, 0 V.; 5, 90 V.
6C5 osc.—3, 200 V.
1852 sound I.F.—5, 2.5 V.; 8, 160 V.
6SQ7 sound det.—6, 150 V.
6V6G sound amp.—3, 260 V.; 4, 265 V.; 8, 12 V.
884 frame osc.—3, 65 V.
6N7G frame amp.—3 & 6, 445 V. (each)
5V4G rect.—8, 350 V.
525-ohm field, rect. side—330 V.
T1, high side of high-voltage secondary—1,300 V.
Voltage at junction of the two 50,000-ohm fixed resistors connected to the Dual Width Control, 750 V.
Voltages top to bottom of voltage divider, extending from high side of centering controls to ground: high side, 2,350 V.; arms of Centering Controls, with arms at center position, and center-tap between the two 50,000 ohm resistors which shunt the centering controls, each 2,275 V.; center position of Focus Control, 500 V.
884 line osc.—3, 60 V.
6N7G line amp.—3 & 6, 520 V. (each).

This article has been prepared from data supplied by courtesy of Fulton Radio Corp.

WIRED-RADIO BEATS WAR PROPAGANDA BY AIR

Wired radio, with 10 programs carried simultaneously over telephone lines, has been announced in Leningrad, Russia. A phone call automatically cuts the program; permits conversation. A system similar in idea but different in detail is widely used in Switzerland. Foreign correspondents predict eventual wide use of such apparatus throughout Europe, so that nationals of each country will be unable to hear the words of the build-up boys in the lands across the borders.

LATEST RADIO APPARATUS

(Continued from page 425)

LIGHTWEIGHT GENEMOTOR

Carter Motor Co.
1608 Milwaukee Ave., Chicago, Ill.

DESIGNED especially for use on aircraft, marine and police radio, this "super hi-power" dynamotor is unusually small for its power output; weight of 150-W. size is only 13½ lbs. One-piece construction eliminates many parts and life-time oiling eliminates maintenance attention. Available in 2 sizes, 150 and 250 W., output up to 1,000 V. and input from 5.5 V. up.

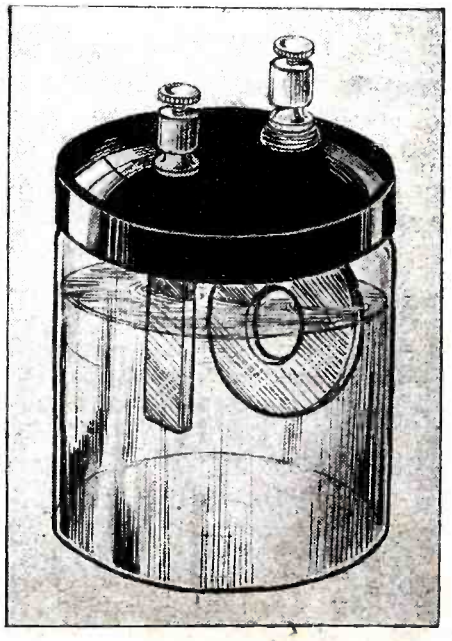
VERSATILE P.A. SYSTEM

The Ampro Corp.
2839 North Western Ave., Chicago, Ill.

IN addition to operating with microphones and phonographs this system can be used as a powerful auxiliary amplifier with low-priced class-room model talkie projectors for auditorium use, providing adequate volume for audiences up to 10,000 people. Undistorted output 55 W. with less than 5 per cent total harmonic distortion; max. output, 85 W. (for up to 8 speakers). Dual channels permit the use of 2 microphones, 2 projectors and 2 phonographs or a combination of these. Individual bass and treble compensators. Headphone jack permits monitoring.

ELECTRIC EYE PHOTOCELL KIT

Guaranty Cash Register Co.
95 Bowery, New York, N. Y.



DESIGNED evidently for juvenile science experimenters and radio fans, this kit of parts for building an elementary type of photoelectric cell is both educational and practical. The kit includes a lead anode, chemically-treated cathode, 2 binding posts, a glass jar and cap, and a gelatin capsule of chemicals to be dissolved in warm water. Complete instructions tell how to set up the light-sensitive cell and how to conduct several interesting experiments with it.

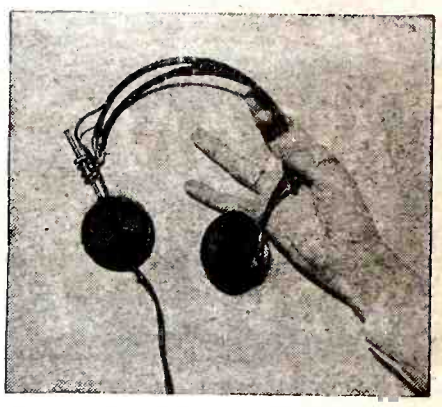
SELECTED DIRECTIONAL CRYSTAL MICROPHONE

The Turner Co.
Cedar Rapids, Iowa

THIS new model 44X microphone with an output level of –58 db. has a substantially "dead" back pick-up. Frequency response, 30 to 10,000 cycles. Has automatic barometric compensator.

NEW CRYSTAL HEADPHONES FEATURE "OVERHEAD" CORD

The Brush Development Co.
3311 Perkins Ave., Cleveland, Ohio



THE rugged and lightweight design of this high-impedance crystal headphone is appealing to ship radio operators, aircraft pilots, radio amateurs and all those who must wear phones for long periods of time. Crystal elements are hermetically sealed against all weather conditions. The phones are enclosed in black soft-rubber jackets for both improved bass response and added comfort. Further, a much needed reform, cord twisting, has been eliminated by bringing the cord to one phone and then over the head to the other phone (instead of under the chin).

This model BJ head-set has a range of 100 to 10,000 cycles per second; the impedance at 500 cycles is 40,000 ohms!

NEW-PROCESS FIXED CONDENSERS

Ariston Laboratory, Inc.
4045 Diversey Ave., Chicago, Ill.

A NEW line of Ariston condensers utilizes a new etching process which results in absolutely uniform etched-foil and greatly extended condenser life.

SMALL-SPACE "B" BATTERY

National Carbon Co., Inc.
30 East 42 St., New York, N. Y.

AN entirely new line of small-space "B" batteries for portables, utilizing the "voltaic pile" or layer-built principle of cell construction, has been developed. This Eveready "Mini-Max" line has *double* the normal life, size for size!

25-WATT, 1.7 TO 60 CYCLE XMITTER

The Hallicrafters
2611 S. Indiana, Chicago, Ill.

THE latest addition to the Hallicrafters line of amateur and commercial transmitters is the 8-tube model 1 HT-6 phone and telegraph transmitter which provides 25 W. output and operates at any desired frequencies, amateur or commercial, within the range of 1.7 to 60 megacycles. Size, 20 x 15 x 9 ins. high.

SOUND-RECORDING GALVANOMETER

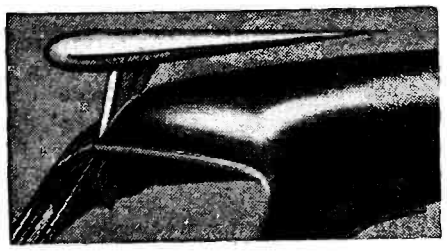
Phonotone Laboratories
Washington, Ind.

THE new model L Phonotone recording galvanometer (with optical assembly) is a versatile recorder for professional sound recording on 16 or 35 mm. film. It may be set for variable density, single-side variable

area, or bi-lateral variable area track. Power consumption, 1 W.; frequency response, up to 8,500 cycles; voice coil impedance, 1.8 ohms.

STREAMLINED CAR ANTENNA

Frank Rose Mfg. Co.
Hastings, Nebr.



AN elongated tear-drop of stainless steel is the newest in car antennas. This Zephyr antenna perches atop the car roof at front.

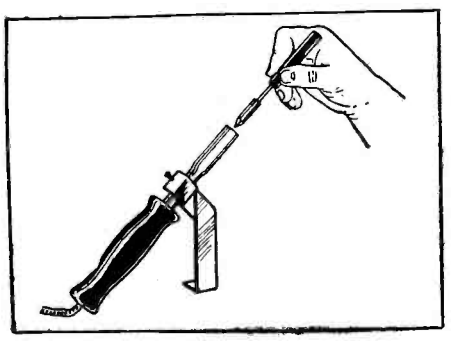
NEW VELOCITY MICROPHONE

Universal Microphone Co., Ltd.
Ingelwood, Calif.

THE M4 ribbon microphone has a frequency range of 40 to 10,000 c.p.s.; output level, –64 db. Employing permanent magnets, it requires no polarizing voltage.

UNIQUE PENCIL IRON

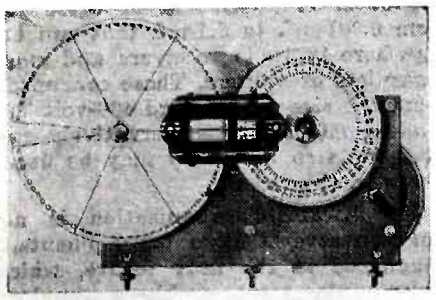
Electric Soldering Iron Co., Inc.
Deep River, Conn.



THE ESICO Pencil Soldering Iron fits into a heating holder. It has its own handle, and is designed for fine or close soldering.

SUPER-VERNIER DIAL

Crowe Name Plate & Mfg. Co.
3701 Ravenswood Ave., Chicago, Ill.



THE No. 530 precision tuning dial affords 600 graduations which may be exactly logged for future reference. Ideal for wide-range oscillators, etc.

(See page 438 for other latest items)

WHAT PRICE RADIO PROGRAM!

(Continued from page 392)

complexion deepened to olive green.

However, Technician Anderson, back at Tongue Point, having received a radio message from the Lighthouse crew that the broadcasters couldn't land on the rock, whipped into action. He contacted the Lightship *Columbia*, anchored 8 miles off the mouth of the Columbia, and made arrangements for the boys to broadcast from there. The Lightship being much closer to them than Tongue Point, he surmised that they stood a better chance of making it in time for the broadcast. He then relayed this message to the Coast Guard boat, which immediately set course for the Lightship.

Getting aboard a lightship from a launch in a heavy sea is a task requiring the combined qualities of an acrobat, a rodeo rider, and a Chinese fatalist, the lads discovered. A hatch was opened in the side of the ship . . . . a rope tossed out . . . . and, one by one, the crew poised themselves on the rail of the bucking, raring launch and swung themselves in . . . . landing inside on an already bruised and maltreated member of their anatomical family.

Painfully arising, they immediately resat. Lightships have a slower, more diabolic roll than launches, and practice is required to stay feet down on them. However, hanging onto all firm fixtures in sight, the sufferers managed to totter around in the manner of Irishmen returning from a vigorously conducted wake.

The Lightship crew, delighted at the prospect of company, had prepared a bountiful repast of corned beef, Bologna, stewed chicken, etc. Miller politely, but with strain, accepted a cup of coffee and a sandwich. Thomlinson staggered in, threw one horrified glance at the food, groaned, and stumbled blindly to the nearest bunk, where he stretched, white and moaning.

Miller, seeing Thomlinson laid out still and cold, grabbed a typewriter and began rewriting the script . . . . still writing as the show began in New York. Thomlinson, approximately 3 minutes before the local portion of the broadcast was to go on the air, crawled up the stairs with the help of two obliging sailors . . . . one fore and one aft, and was deposited in a chair before the mike. For convenience, a bucket was placed beside him.

Miller had re-written the script, reducing Thomlinson's part, so he would have plenty of time to lean over the side between speeches.

And Thomlinson affixed his glazed eyes to the script and proceeded to do one of the best jobs of his life.

When the interview was over, he deflated onto the table, and was gently carried below.

On the return trip across the Columbia River Bar, the churning sea heaved more than ever . . . . and so did practically all hands aboard, including the indefatigable Thomlinson, all members of the Coast Guard crew, and a Marine reporter. Miller and Jenkins, to their own surprise, but everyone else's profane disgust, remained in gastronomic status quo.

Arriving back at the Coast Guard station, the green-faced crew crawled bedraggledly ashore. They winced aside offers of hard-bottomed chairs. Smiling in the polite, pained manner of a dancer whose partner has just stepped on a corn, they refused food. Silently they crept into the car and began the journey home over Oregon's most curve-bedeviled road. The swaying, disturbing motion inspired Thomlinson to a last, grand performance. In many respects, critics agreed, it was his most remarkable of the day, inasmuch as no one thought he had it in him.

And they arrived home at 4 A.M., to quote the bard their tails dragging behind them.

And that's the story behind 2½ minutes on the air. So ya wanta be in radio . . . .

1940 "REDESIGN" PLAN IS IMPORTANT TO SERVICEMEN, ETC.

The forthcoming 1940 season will see further development of an entirely new "redesign" plan which well might be termed revolutionary. This plan is benefiting not only Servicemen-dealers but also independent Servicemen who stock a limited amount of merchandise for replacement purposes.

A few years ago, executives of the Micamold Radio Corp. came to the conclusion that there were too many thousands of different kinds of radio parts in use to enable the trade to stock and use exact replacements. A program was then started to design small groups of components which would serve to replace many thousands of special parts.

The first group developed was the *Tublytic* condenser series which was introduced more than 2 years ago. These were very compact tubular dry electrolytic condensers in singles, duals, triples, and quads of various ratings. Radio Servicemen with approximately a dozen of these items in stock could effect satisfactory replacements for most dry electrolytic condensers regardless of type.

The ballast tube problem was next tackled. There were about 2,000 different kinds of ballast tubes, or plug-in resistors, then in use and it was impossible for the trade to stock them. *Ballastrons* were developed and 3 of these units will satisfactorily replace over 2,000 possible types, by a simple alteration on the base. The Ballastrons are so universal in application that they have completely eliminated one perplexing problem for radio Servicemen.

Similar in principle is the *Unicord* which Micamold developed about a year ago. One of these universal resistor cords will replace practically all types now in service by employing various combinations of the colored terminating leads.

The latest development is a group of universal bypass condensers known as the *Kodacaps*. There are 11 of these ranging from 0.001-mf. to 0.5-mf. that can be used anywhere in radio receivers and amplifiers regardless of voltage. These condensers are about the size of standard 400-volt Tublytic condensers but are conservatively rated at 1,000 volts so that they may be used anywhere in the circuit.

The Micamold organization is now at work on several other developments, to be announced in the near future, which will make replacement problems simpler. The main idea is to so design a small group of units that they will eliminate larger groups of special units and thereby remove the great expense of stocking slow-moving parts.

NEW CIRCUITS IN MODERN RADIO RECEIVERS

(Continued from page 409)

degree of degeneration is insufficient. The value of R2 divided by the sum of R1 and R2 gives us a figure of .091 (approx.), which is the fractional part of the signal which is in reverse phase with respect to that fed to the grid. In this circuit, the gain being about 8, this amount of degeneration will reduce the gain to about 4.6 or to about 58%. It will reduce the distortion by the same factor.

(4) COMBINED GRID CONDENSER AND PADDING CONDENSER

RCA Model U-10. With a condenser gang of 2 similar units it is necessary to have an auxiliary capacity in the circuit for padding purposes. This however may be combined with the grid condenser for simplification of the circuit and the elimination of a condenser.

The circuit is shown in Fig. 2A. With similar tuning condensers, C1 and C4, and for an I.F. of 455 kc. starting at a tuning frequency of 540 kc., it is evident that inductances L10 and L1 would have to bear a ratio of 3.39 to 1, approx. for satisfactory alignment. However at the high-frequency end of the band (1,720 kc.), under the same condition, they would need a ratio to one another of only 1.7 to 1. with L10 the larger in both cases. Since the latter ratio is almost exactly half of the former we can reduce the capacity of the oscillator section to half its value by a series condenser. Note that C3 is almost identical to C1 or C4 in value. As for the usual padder its effect on the circuit is negligible at high frequencies but cuts the total capacity about 50% at low frequencies.

It is wired in such a way as to act as a grid condenser as well as a padder. Although much larger than necessary for a grid condenser alone no harm is done by this fact. Note further that since the oscillator grid is connected between the padder C3 and tuner C4, it receives only about ½ the excitation at low frequencies that it does at high frequencies, other factors being equal.

(5) SEPARATE OUTPUT TUBES FOR LINE-BATTERY CHANGEOVER

Emerson Models DF-302 to 306. For high circuit efficiency a 70-volt filament output tube is used in these receivers for A.C.-D.C. line operation while a 3-volt filament output tube is used for battery operation.

The circuit in Fig. 2B shows how the grids of both the 70L7GT and the 3Q5GT are supplied from a single A.F. source. The latter having a lower output is fed with about 40% more signal by means of the grid divider indicated. The output transformer complete winding is designed to match the A.C. plate resistance of the 3Q5GT tube, but since the A.C. plate resistance of the 70L7GT is somewhat lower in value a tap is provided on the transformer primary to match its value. While no bias is required for the 3Q5GT, the 70L7GT is biased at almost 5 volts by the drop across the 3-meg. and 0.2-meg resistors.

A novel means is used for changing from line to battery operation. The line plug is placed in a receptacle with one of its prongs to the X contact identified for this purpose. This not only insures that the line voltage is not turned on but it connects the negative terminals of the "A" and "B" batteries to ground through the switch. The on-off switches Sw. are ganged and operate with the volume control.

HOW TO SELECT AND PLACE SOUND EQUIPMENT

(Continued from page 416)

tive decibels (abbreviated "–db."). This is merely a term such as ounces or pounds, and is always used as a sensitivity measure and rating for microphones of all kinds. *The smaller the negative number, the more sensitive the microphone* . . . the larger the negative number, the less sensitive the microphone.

For instance, a mike rated at –47 db. is more sensitive than another rated at –60 db. This means that with both connected to the same amplifier, and with the same volume control setting, talking into the –47 db. mike would produce more volume in the loudspeaker than talking at the same distance into the –60 db. mike. The same holds true of all other mikes with different sensitivity ratings, the smaller the minus decibel rating, the more sensitive the microphone.

However, do not reject a less sensitive mike when its other features are desirable; most modern amplifiers develop their full power with any mike.

Directivity.—The directional qualities of a mike are, likewise, important. One person could sing or talk into a directional mike without difficulty . . . it would not pick up sounds from other directions as readily. In a round table discussion, however, each person would have to take his place in front of a directional mike when he spoke. A non-directional mike, which picks up sounds from all directions equally well, would be much better for this or similar work.

Non-Directional—When sound is picked up from all sides, a microphone is non-directional (Fig. 1, left.). This is desirable for dramatics, roundtable discussions and similar uses. Some mikes may be adjusted to make them either directional or non-directional.

Bi-Directional—Mikes which pick up sounds from 2 directions, front and back, fall into the bi-directional class (Fig. 1, center.). They pick up sound from both positions with equal intensity. This is desirable when more than one person wants to talk; or for interviewing people. It prevents crowding and allows freer movement.

Directional—Directional mikes pick up sound from 1 side only (Fig. 1, right). They are usually suitable for general use, especially where speakers are in the same room, because they are not so likely to pick up background noises.

Long-distance mikes have the same fine qualities as regular mikes but, in addition, can be used up to 1,000 feet from the amplifier without loss of volume or other disadvantages (Fig. 2, left.). Place the amplifier in back of the audience and control the volume of the loudspeakers there, where you can listen to the sound as the audience hears it.

The use of 2 mikes, long-distance or other styles, eliminates the necessity of having a mike in front of a speaker's face, and assures best results as he turns from side to side during his address (Fig. 2, right.). They should be the same or similar types for best results.

This article has been prepared from data supplied by courtesy of Montgomery Ward & Co., Inc.

Also see "Microphones Explained for Beginners," *Radio-Craft*, August 1938.—*Editor*

20 NEW TUBES

(Continued from page 412)

12SC7. Single-Ended Twin-Triode Amplifier. General class, 12C7. RCA.

12SJ7. Single-Ended Triple-Grid Detector-Amplifier. Class, 12J7. RCA.

12SK7. Single-Ended Triple-Grid Super-Control Amplifier. Class, 12K7. RCA.

12SQ7. Single-Ended Duplex-Diode High-Mu Triode. Class, 12Q7. RCA.

12C8. Duplex-Diode Pentode. RCA.

1620. Triple-Grid Detector-Amplifier. Heater, 6.3 V.; 0.3-A. For applications critical as to microphonics. RCA.

1621. Power Amplifier Pentode. Heater, 6.3 V.; 0.7-A. For applications requiring continuity of service. RCA.

1622. Beam Power Amplifier. Heater, 6.3 A.; 0.9-A. For applications requiring continuity of service. RCA.

1616. Half-Wave, High-Vacuum Rectifier. For transmitter use. RCA.

1623. Oscillator, R.F. Power Amplifier, Modulator. For transmitter use. RCA.

7AP4—TABLE I

Tentative Characteristics and Ratings

Heater voltage (A.C. or D.C.)	2.5	volts
Heater current	2.1	amperes
Fluorescent screen:		
Material	Phosphor No. 4	
Color of fluorescence	White	
Direct interelectrode capacity:		
Grid to all other electrodes	12 max.	mmf.
Overall length	13½″ ± ⅜″	
Max. dia.	7⅛″	
Bulb	J-56	
Base	medium 5-pin	

Maximum Ratings and Typical Operating Conditions

High-voltage electrode (anode No. 2) voltage	3,500 max.‡	volts
Focusing electrode (Anode No. 1) voltage	1,000 max.‡	volts
Control electrode (grid) voltage	Never positive	
Fluorescent-screen input power per sq. cm.†	2.5 max.‡	milliwatts
Typical Operation:		
Heater voltage	2.5	volts
Anode No. 2 voltage	3,500	volts
Anode No. 1 voltage (approx.)*	675	volts
Grid voltage # °	Adjusted to give suitable luminous spot	
Grid signal-swing voltage□	15	volts
Pattern electrode dissipation	1 max.‡	Mw/sq. cm.
Focusing electrode No. 1 (anode No. 2) voltage	1,200 max.‡	volts
Focusing electrode No. 1 (anode No. 1) voltage	500 max.‡	volts
Control electrode (grid) voltage	never positive	
D.C. Resistance between:		
Cathode and grid	1 max.	megohm
Cathode and deflecting plate D_1	5 max.	megohms
Cathode and deflecting plate D_2	5 max.	megohms
Typical Operation:		
Heater voltage	2.5 2.5 2.5	volts
Pattern electrode voltage	750 950 1,150	volts
Anode No. 2 voltage	800 1,000 1,200	volts
Anode No. 1 voltage (approx.)	240 300 360	volts
Grid voltage	adjusted to give suitable resolution and signal amplitude	
Grid voltage (approx.) for current cut-off	−50 −60 −70	volts
Vertical-deflection voltage,° on deflecting plates D_1—D_2	125 155 185	volts
Horizontal-deflection voltage,° on deflecting plates D_3—D_4	135 170 200	volts
Internal resistance between anode No. 2 and pattern electrode	greater than 1	megohm
Beam current (approx.)*	1 2 3	microamperes
Pattern electrode signal current, peak to peak value (approx.)	1 2 3	microamperes

* Adjustable to ± 20%.

\# Approximately 10% of Anode No. 1 voltage is required for current cut-off if the maximum permissible resistance is used in the grid circuit.

□ Peak-to-peak value for good brilliance with good resolution. For greater brilliance, up to twice this value should be available.

° Maximum resistance in the grid circuit should be limited to 2 megohms.

† This value applies to the brightest portion of a stationary pattern. Approximately double this value is permissible with a moving pattern.

‡ Design maximum for 117-volt line.

1898—TABLE II

Tentative Characteristics and Ratings

Heater voltage (A.C. or D.C.)	2.5	volts
Heater current	2.1	amperes
Direct interelectrode capacities:□		
Pattern electrode to anode No. 2	2.5	mmf.
Deflecting plate D_1 to all other electrodes	15	mmf.
Deflecting plate D_2 to all other electrodes	15.5	mmf.
Grid to all other electrodes	11.6	mmf.
Pattern type	girl's head	
Pattern diameter	2⅝″	
Overall length	11⅞″ ± ⅜″	
Maximum diameter	3 1/16″	
Bulb	J-24	
Cap	skirted miniature—style A	
Base	medium 7-pin	

Maximum Ratings and Typical Operating Conditions

All voltages are specified with respect to cathode

Pattern electrode voltage	1,300 max.‡	volts

6AG7—TABLE III

Tentative Characteristics and Ratings

Heater voltage (A.C. or D.C.)	6.3	volts
Heater current	0.65	ampere
Direct interelectrode capacities:°		
Grid to plate	0.060 max.	mmf.
Input	12	mmf.
Output	12	mmf.
Grid to screen	5 approx.	mmf.
Grid to cathode and heater	7 approx.	mmf.
Heater to cathode	11 approx.	mmf.
Maximum overall length	3¼″	
Maximum diameter	1 5/16″	
Base	small wafer octal 8-pin	

Characteristics

Plate voltage	300	volts
Screen voltage	300	volts
Grid voltage	−10.5	volts
Interlead shield	connected to ground	
Amplification factor	770	
Plate resistance	0.1	megohm
Transconductance	7,700	micromhos
Plate current	25	milliamperes
Screen current	6.5	milliamperes

Maximum Ratings and Typical Operating Conditions

Video Voltage Amplifier—Class A

Plate voltage	300 max.*	volts
Screen voltage	300 max.*	volts
Plate dissipation	8.7 max.*	watts
Screen input	2 max.*	watts

TYPICAL OPERATION

(In 4 Mc. Bandwidth Amplifier)

Heater voltage†	6.3	volts
Plate-supply voltage	250	volts
Screen voltage	140	volts
Grid voltage‡	−2	volts

□ Without external shielding.

‡ Design maximum for 117-volt line.

° Peak-to-peak values of deflection voltages required for scanning largest rectangle having 4:3 aspect ratio and contained in pattern electrode.

* Determined by measurement of current to pattern electrode when operated 25–50 volts positive with respect to Anode No. 2.

Grid signal—swing voltage (peak to peak)	4	volts
Plate current	33	milliamperes
Screen current	8.5	milliamperes
Load resistance	1,700	ohms
Voltage output (peak to peak)	70 approx.	volts

° With shell connected to cathode.
* Design maximum for 117-volt line.
† In circuits where the cathode is not directly connected to the heater, the potential difference between heater and cathode should be kept as low as possible.
‡ The D.C. resistance in the grid circuit should not exceed 0.25-megohm.

967—TABLE IV

General Ratings (Partial Data)

Filament	oxide-coated
Voltage	2.5 volts
Current	5.0 amps.
Heating time	approx. 5 sec.

Single-Phase—Half-Wave Circuit—1 Tube

Anode voltage:	
Max. peak inverse voltage	2,500 volts
Max. peak forward voltage	2,500 volts
Maximum anode current:	
Instantaneous	2.0 amps.
Average	.50 amp.
Surge (should not last longer than 1 sec.)	20 amps.
Maximum grid current:	
Instantaneous†	.25 amp.
Average	.05 amp.
Tube voltage drop	10–24 volts
Approx. Starting Characteristics:	
D.C. anode voltage	grid voltage
30 volts	0 volts
100 volts	−2.25 volts
1,000 volts	−5.0 volts
Deionization time (approx.)	1,000 microsec.
Ionization time	10 microsec.
Dimensions:	
Max. length	6⅝ inches
Dia.	2 7/16 inches
Bulb	S-19
Cap	medium metal
Base	medium 4-pin bayonet
Type of cooling	air

* The filament should be allowed to come up to operating temperature before the plate voltage is applied.
† When operating at a frequency of less than 25 cycles, the maximum instantaneous current is reduced to twice the average current rating.

Return leads from anode and grid circuits should be connected to the center tap of the filament transformer winding when A.C. is used on the filament. If D.C. is used the return should be made to the negative filament terminal.

The deionization time of this type of tube is too long to allow it to be used with satisfaction for inverter circuits.

All mercury vapor or gas-filled tubes require protective resistances in the grid and anode circuits to limit the current in these circuits to the rated values.

Because the mercury may be splashed on the tube elements due to shipment or handling, the filament of the 967 should be operated at rated voltage for approx. 3 minutes without plate voltage in order to distribute the mercury properly when the tube is first placed in service. The above procedure need not be repeated unless the tube is removed from the socket and during handling the mercury becomes splashed on the tube elements.

The condensed mercury temperature should be at least 25° C. before the plate voltage is applied. This may be ordinarily accomplished by introducing a time lag of at least 30 seconds between the application of the filament and the plate voltages. In event that arc back should occur when the plate voltage is applied, the preheating time of the filament should be increased.

When the 967 is subjected during operation to external high-voltage or high-frequency fields, shielding and R.F. filter circuits should be provided.

811—TABLE V

Tentative Characteristics and Ratings

Filament voltage (A.C. or D.C.)	6.3 volts
Filament current	4 amperes
Amplification factor	160
Direct interelectrode capacities:	
Grid—plate	5.5 mmf.
Grid—filament	5.5 mmf.
Plate—filament	0.6 mmf.
Bulb	ST-19
Cap	medium metal
Base	medium 4-pin "Micanol," bayonet
Plate	zirconium coated

Maximum CCS and ICAS Ratings with Typical Operating Conditions

CCS—Continuous Commercial Service
ICAS—Intermittent Commercial and Amateur Service

As A.F. Power Amplifier and Modulator—Class B

	(CCS)	(ICAS)	
D.C. plate voltage	1,250 max.	1,500 max.	volts
Max.-signal D.C. plate current*	125 max.	125 max.	milliamperes
Max.-signal plate input*	125 max.	150 max.	watts
Plate dissipation*	40 max.	50 max.	watts
Typical operation:			
Unless otherwise specified, values are for 2 tubes			
D.C. plate voltage	1,250	1,500	volts
D.C. grid voltage†	0	−9	volts
Peak A.F. grid-to-grid voltage	145	145	volts
Max.-sig. D.C. grid current	38	38	milliamperes
Zero-sig. D.C. plate current	48	20	milliamperes
Max.-sig. D.C. plate current	200	200	milliamperes
Load resistance (per tube)	3,500	4,500	ohms
Effective load resistance (plate-to-plate)	14,000	18,000	ohms
Max.-sig. driving power (approx.)	7.5	10.5	watts
Max.-sig. power output (approx.)	175	225	watts

As R.F. Power Amplifier—Class B Telephony

Carrier conditions per tube for use with a max. modulation factor of 1.0

	(CCS)	(ICAS)	
D.C. plate voltage	1,250 max.	1,500 max.	volts
D.C. plate current	60 max.	60 max.	milliamperes
Plate input	60 max.	75 max.	watts
Plate dissipation	40 max.	50 max.	watts
Typical operation:			
D.C. plate voltage	1,250	1,500	volts
D.C. grid voltage†	0	−6	volts
Peak R.F. grid voltage	26	35	volts
D.C. plate current	48	50	milliamperes
D.C. grid current (approx.)**	6	6	milliamperes
Driving power (approx.)**°	1	1.5	watts
Power output (approx.)	20	25	watts

* Averaged over any audio-frequency cycle of sine-wave form.
† Grid voltages are given for either A.C. or D.C. filament operation. When A.C. is used, the circuit returns are made to the mid-point of the filament circuit. When D.C. is used, the returns are made to the negative filament terminal.
° At crest of audio-frequency cycle with modulation factor of 1.0.
** Subject to wide variations depending on the impedance of the load circuit. High-impedance load circuits require more grid current and driving power to obtain the desired output. Low-impedance circuits need less grid current and driving power, but plate-circuit efficiency is sacrificed. The driving stage should be capable of delivering considerably more than the required driving power.
Data on operation in Class C available from manufacturer.

812—TABLE VI

Tentative Characteristics and Ratings

Filament voltage (A.C. or D.C.)	6.3 volts
Filament current	4 amperes
Amplification factor	29
Direct interelectrode capacities:	
Grid—plate	5.3 mmf.

(Continued from preceding page)

Grid—filament	5.3	mmf.
Plate—filament	0.8	mmf.
Bulb	ST-19	
Cap	medium metal	
Base	medium 4-pin "Micanol," bayonet	
Plate	zirconium coated	

Maximum Ratings and Typical Operating Conditions

CCS—Continuous Commercial Service
ICAS—Intermittent Commercial and Amateur Service

As A.F. Power Amplifier and Modulator—Class B

	(CCS)	(ICAS)	
D.C. plate voltage	1,250 max.	1,500 max.	volts
Max.-signal D.C. plate current*	125 max.	125 max.	milliamperes
Max.-signal plate input*	125 max.	150 max.	watts
Plate dissipation*	40 max.	50 max.	watts

Typical operation:
Unless otherwise specified, values are for 2 tubes

D.C. plate voltage	1,250	1,500	volts
D.C. grid voltage†	−36	−46	volts
Peak A.F. grid-to-grid voltage	175	195	volts
Max.-sig. D.C. grid current	18	25	milliamperes
Zero-sig. D.C. plate current	48	42	milliamperes
Max.-sig. D.C. plate current	200	200	milliamperes
Load resistance (per tube)	3,500	4,500	ohms
Effective load resistance (plate-to-plate)	14,000	18,000	ohms
Max.-sig. driving power (approx.)	6.1	9	watts
Max.-sig. power output (approx.)	175	225	watts

As R.F. Power Amplifier—Class B Telephony
Carrier conditions per tube for use with a max. modulation factor of 1.0

	(CCS)	(ICAS)	
D.C. plate voltage	1,250 max.	1,500 max.	volts
D.C. plate current	60 max.	60 max.	milliamperes
Plate input	60 max.	75 max.	watts
Plate dissipation	40 max.	50 max.	watts

Typical operation:

D.C. plate voltage	1,250	1,500	volts
D.C. grid voltage†	−35	−45	volts
Peak R.F. grid voltage	46	51	volts
D.C. plate current	48	50	milliamperes
D.C. grid current (approx.)**	1	1.1	milliamperes
Driving power (approx.)**°	1.2	1.5	watts
Power output (approx.)	20	25	watts

* Averaged over any audio-frequency cycle of sine-wave form.

† Grid voltages are given with respect to the mid-point of filament operated on A.C. If D.C. is used, each stated value of grid voltage should be decreased by 3.2 volts and the circuit returns made to the negative end of the filament.

° At crest of audio-frequency cycle with modulation factor of 1.0.

** Subject to wide variations depending on the impedance of the load circuit. High-impedance load circuits require more grid current and driving power to obtain the desired output. Low-impedance circuits need less grid current and driving power, but plate-circuit efficiency is sacrificed. The driving stage should be capable of delivering considerably more than the required driving power.

Data on operation in Class C available from manufacturer.

813—TABLE VII

Tentative Characteristics and Ratings

Filament voltage (A.C. or D.C.)	10.0	volts
Filament current	3.25	amperes
Transconductance, for plate cur. of 43 ma.	4,500	micromhos
Direct interelectrode capacities:		
Grid—plate (with external shield)	0.05 max.	mmf.
Input	13.5	mmf.
Output	14.5	mmf.
Bulb	T-16	
Cap	small metal	
Base	medium "Micanol" 5-pin	

Maximum CCS and ICAS Ratings with Typical Operating Conditions

CCS—Continuous Commercial Service
ICAS—Intermittent Commercial and Amateur Service

As Push-Pull Class AB_1 A.F. Power Amplifier and Modulator

	(CCS)	(ICAS)	
D.C. plate voltage	1,750 max.	2,000 max.	volts
D.C. suppressor voltage (grid No. 3)	100 max.	100 max.	volts
D.C. screen voltage (grid No. 2)	750 max.	750 max.	volts
Max.-sig. D.C. plate current*	150 max.	150 max.	milliamperes
Max.-sig. plate input*	225 max.	270 max.	watts
Screen input*	16 max.	23 max.	watts
Plate dissipation*	70 max.	80 max.	watts

Typical operation:
Unless otherwise specified, values are for 2 tubes

D.C. plate voltage	1,700	2,000	volts
D.C. suppressor voltage	60	60	volts
D.C. screen voltage†	750	750	volts
D.C. grid voltage (grid No. 1)°	−120	−120	volts
Peak A.F. grid-to-grid voltage	240	240	volts
Zero-signal D.C. plate current	50	50	milliamperes
Max.-signal D.C. plate current	248	270	milliamperes
D.C. suppressor current	9	9	milliamperes
Zero-signal screen current	4	2	milliamperes
Max.-signal D.C. screen current	43	60	milliamperes
Load resistance (per tube)	4,050	4,625	ohms
Effective load resistance (plate-to-plate)	16,200	18,500	ohms
Grid input power	0	0	watt
Max.-signal power output	300**	385	watts

As R.F. Power Amplifier—Class B Telephony
Carrier conditions per tube for use with a max. modulation factor of 1.0

	(CCS)	(ICAS)	
D.C. plate voltage	1,250 max.	1,500 max.	volts
D.C. suppressor voltage (grid No. 3)	100 max.	100 max.	volts
D.C. screen voltage (grid No. 2)	400 max.	400 max.	volts
D.C. plate current	100 max.	100 max.	milliamperes
Plate input	105 max.	120 max.	watts
Suppressor input	5 max.	5 max.	watts
Screen input	11 max.	11 max.	watts
Plate dissipation	70 max.	80 max.	watts

Typical operation:

D.C. plate voltage	1,250	1,500	volts
D.C. suppressor voltage	75	75	volts
D.C. screen voltage	400	400	volts

D.C. grid voltage (grid No. 1)°	−50	−50	volts
Peak R.F. grid voltage	52	50	volts
D.C. plate current	84	80	milliamperes
D.C. suppressor current	4	4	milliamperes
D.C. screen current	5	5	milliamperes
D.C. grid current (approx.)	0.3	0.2	milliamperes
Driving power (approx.)‡	0.5	0.4	watt
Power output (approx.)	36	41	watts

° Grid voltages are given with respect to the mid-point of filament operated on A.C. If D.C. is used, each stated value of grid voltage should be decreased by 5 volts and the circuit returns made to the negative end of the filament.
* Averaged over any A.F. cycle of sine-wave form.
† Zero-signal screen voltage must not exceed 775 volts.
** Distortion only 1% with 20 db. of feedback to grid to driver.
‡ At crest of audio-frequency cycle with modulation factor of 1.0.

75T—TABLE VIII

Characteristics

Filament voltage	5	volts
Filament current	6.5	amperes
Amplification factor	10.6	
Grid-to-plate capacity	2.3	mmfs.
Grid-to-filament capacity	2.2	mmfs.
Maximum plate current	175	milliamperes
Plate dissipation	75	watts

Tube must he operated vertically with ample ventilation provided. Seals should be cooled by *radiator connectors.*

Maximum Ratings

	Intermittent Service Telegraphy Class B Audio	Continuous Service Class C Telephony
Grid current (ma.)	30	30
Plate current (ma.)	175	175
Plate dissipation (watts)	75	75
Plate voltage	3,000	3,000

As frequency is increased circuit inefficiencies may necessitate a reduction of plate voltage or plate current so that maximum dissipation ratings are not exceeded.

Typical Operating Conditions For Class C Telephony and Telegraphy

Plate volts	750	1,000	1,500
Plate current (ma.)	135	175	175
Grid current (ma.)	30	30	30
Grid bias (volts)	−150	−200	−300
Power output (watts)	70	125	200

Excitation power roughly 1/10 the input power.

Class B Audio

Plate Voltage	Recommended Plate-to-Plate Impedance (ohms)	Power Output (watts)
2,000	12,500	400
1,500	10,000	300
1,250	9,000	250
1,000	6,800	200
750	6,000	100

3Q5GT—TABLE IX

Filament voltage	2.8 or 1.4	volts
Filament current	0.05 or 0.10	ampere

Series Filament Operation

Filament voltage	2.8	volts
Plate voltage	90	volts
Screen voltage	90	volts
Grid voltage	−4.5	volts
Plate current	7.5	milliamperes
Screen current	1.0	milliamperes
Transconductance	1,800	micromhos
Plate resistance	110,000	ohms (approx.)
Load resistance	8,000	ohms
Power output	250	milliwatts
Total distortion	7.5	%

Parallel Filament Operation

Filament voltage	1.4	volts
Plate voltage	90	volts
Screen voltage	90	volts
Grid voltage	−4.5	volts
Plate current	9.5	milliamperes
Screen current	1.6	milliamperes
Transconductance	2,100	micromhos
Plate resistance	100,000	ohms (approx.)
Load resistance	8,000	ohms
Power output	270	milliwatts
Total distortion	7.5	%

12B8GT—TABLE X

Heater voltage	12.6	volts
Heater current	0.3	ampere

Pentode Section

Plate voltage	90	volts
Screen grid voltage	90	volts
Control grid voltage	−3	volts
Plate current	7.0	milliamperes
Screen grid current	2.0	milliamperes
Plate resistance	200,000	ohms
Transconductance	1,800	micromhos
Amplification factor	360	
Control grid voltage for transconductance = 2 micromhos	−12.5	volts

Triode Section

Plate voltage	90	volts
Grid voltage	0	
Plate current	2.8	milliamperes
Plate resistance	37,000	ohms
Transconductance	2,400	micromhos
Amplification factor	90	
Approx. grid voltage for plate current cut-off	−2.5	volts

Direct Interelectrode Capacities

Pentode G_1 to plate	.015	mmf.
Pentode input	5.2	mmf.
Pentode output	9.6	mmf.
Triode grid to plate	2.3	mmf.
Triode grid to cathode	5.0	mmf.
Triode plate to cathode	6.3	mmf.
Pentode G_1 to triode-grid	.002	mmf.
Pentode plate to triode-grid	.078	mmf.
Pentode G_1 to triode-plate	.003	mmf.

32L7GT—TABLE XI

Heater voltage	32.5	volts
Heater current	0.3	ampere

Tentative Operating Characteristics
Power Amplifier Section

Plate voltage	90	90	volts
Screen grid voltage	90	90	volts
Control grid voltage	−5	−7	volts
Plate current	38	27	milliamperes
Screen grid current	3.0	2.0	milliamperes
Plate resistance	15,000	17,000	ohms
Transconductance	6,000	4,800	micromhos
Amplification factor	90	81	
Load resistance	2,600	2,600	ohms
Power output	0.8	1.0	watt
Total harmonic distortion	5.3	9.0	%
2nd-harmonic	2.2	6.5	%
3rd-harmonic	4.6	5.5	%

Rectifier Section

A.C. plate voltage	125	volts (max.)
D.C. output current	60	ma. (max.)

70A7GT—TABLE XII

Heater voltage	70.0	volts
Heater current	0.15	ampere

Operating Characteristics
Power Amplifier Section

Plate voltage	110	volts (max.)
Screen grid voltage	110	volts (max.)
Control grid voltage	−7.5	volts
Plate current	40	milliamperes
Screen grid current	3.0	milliamperes
Transconductance	5,800	micromhos
Amplification factor	80	(approx.)
Load resistance	2,500	ohms
Power output	1.5	watts
Total harmonic distortion	6.5	%

Rectifier Section

A.C. plate voltage	125	volts (max.)
D.C. output current	60	ma. (max.)
Voltage drop at 120 ma.	14	volts (avg.)

TABLE XIII

Heater (A.C. or D.C.) 45 volts 0.15 ampere
With 45 v. r.m.s. between pins No. 2 and No. 7, the open circuit voltage between pins No. 2 and No. 3 is 7.5 v. r.m.s.

Bulb	glass
Base	small 7-pin octal

Maximum Ratings and Characteristics

A.C. plate voltage r.m.s. (no series res.)	125 max.	volts
A.C. plate voltage r.m.s. (100 ohms series)	250 max.	volts
Peak plate current†	600 max.	milliamperes
D.C. output current†	100 max.	milliamperes
D.C. output current‡	60 max.	milliamperes
Average tube voltage drop at 200 ma. D.C.	16	volts

† With no external connection to pin No. 3.
‡ With plate current passing through pilot light and tapped heater section.

LATEST RADIO APPARATUS

(Continued from page 431)

MODERN SERVICEMAN'S BENCH LAMP

Eagle Electric Mfg. Co., Inc.
59 Hall St., Brooklyn, N. Y.

THIS No. 558 indirect-lighting lamp is highly convenient for use by the Serviceman; it can be clamped to the bench and yet still have the appearance of being a base-type lamp. A jointed arm permits moving the lamp into any position within a radius of 20 ins.

THE "DEN" RADIO

Radio Wire Television, Inc.
100 Sixth Ave., New York, N. Y.

ESPECIALLY suitable for the den or recreation room is this simple-appearing, model BB-27 A.C.-D.C. radio set of modern design, measuring 14½ x 6¾ x 8½ ins. in size. It is a 6-tube, 2-band job, broadcast (on built-in antenna) and from 4.6 to 12.2 megacycles (using external antenna), and has 6 station pushbuttons. Has tuning "eye", and phono pickup (or television sound) terminals.

NEW LABORATORY TYPE C.-R. 'SCOPE OR 'GRAPH

Allen B. Du Mont Labs., Inc.
2 Main Ave., Passaic, N. J.

THE extended frequency response of the amplifiers incorporated in this instrument makes it adaptable to television development requirements. It is available in 2 models, type 175 for study of high- and low-frequency current phenomena; and type 175A in which control circuits have been added to the oscillator, permitting one single sweep of the horizontal deflection. The low cost and extended range of this oscilloscope are made possible mainly by the use of the Du Mont intensifier-type cathode-ray tube; this tube, due to its bright image, enables operation of the units with a camera as an oscillograph.

FREQUENCY MODULATED PROGRAMS ON YOUR PRESENT RECEIVER

(Continued from page 427)

One I.R.C. 20,000 ohms, ½-W., R6;
Four I.R.C. 40,000 ohms, ½-W., R7, R12, R17, R18;
Two I.R.C. 15,000 ohms ½-W., R8, R13;
One I.R.C. 200 ohms, ½-W., R14;
One I.R.C. 5,000 ohms, ½-W., R19;
Three I.R.C. 0.1-meg., ½-W., R21, R23, R24;
One clarostat potentiometer, volume-control, ½-meg., ½-W., R25;
One I.R.C. 1 meg., ½-W., R28.

TUBES

Two Raytheon type 6SK7's, V1, V3;
One Raytheon type 6K8, V2;
One Raytheon type RK-1852, V4;
One Raytheon type 6SJ7, V5;
One Raytheon type 6H6, V6;
One Raytheon type 6U5, visual indicator, V7;
One Raytheon type 80, V8.

THE SOLAR CORONAVISER

(Continued from page 407)

same time, light from successive points on a spiral path is thrown into a photoelectric cell, where a direct current of varying magnitude is generated. Such a current may be considered as made up of two components—a steady current, due to light from the sky, and an alternating current due to the appearance of coronal features. In the amplifying circuits, the former is discarded and the latter is brought up to a level at which it will actuate the cathode-ray tube of a television receiver. Viewed directly, an image of the corona is seen, or by photography the image is recorded for later study.

Actual operation of the system was not as simple as might appear. The slightest smudge or grain of dust on the glass plate, P—which is the supposedly-invisible support for the scanning hole unit—showed up in the image. Any stray scattered light in the telescope was also harmful.

Although the development of an adequate instrument and the proving-in of the method have been achieved, the real capabilities of the device will only be realized when it is used under the crystal clear skies encountered on a mountain top in conjunction with a telescope which, by pointing directly at the sun, will eliminate most of the glare that was introduced by the horizontal mounting. Under these ideal conditions it is hoped that astronomers may observe the corona on many days of the year instead of having to wait for those rare occasions furnished by solar eclipses.

Gas explosions on the Sun which extend hundreds of thousands of miles into the sun's atmosphere are reflected on the Earth as magnetic storms, radio interference, etc. The Coronaviser now makes it possible to obtain considerable hitherto unavailable "first-hand" information regarding these explosions as indicated by variations in the sun's corona.

Just as it is impossible to see a firefly in sunlight because of the far greater strength of the sunlight, so too, it is not possible to see the sun's corona. However by interposing a mirrored disk in the telescope of the Coronaviser only about 1 part in a 1,000,000 of the sun's light, or that amount of light which is due to its corona, is available for tele-scanning; the remainder is reflected into a light trap where it is lost.

The amount of sunlight which manages to slip around the edge of blocking-out mirror is uniform in intensity, and hence, does not actuate the light-sensitive pick-up tube; the fluctuating corona however produces an A.C. voltage which actuates the amplifier, and in turn, the viewing C.-R. tube.

The scanning beam begins at the periphery of the blocking-out mirror and proceeds in a spiral around the mirror to the outside extremity of the corona. Unlike regular television scanning in which the beam makes an instantaneous retrace to a starting position the spiral scanning of the Coronaviser continues from the outside back to the inside at the same rate as the preceding inside to outside scan.

This system was first described last month before the Providence, R. I., meeting of the National Academy of Sciences.

WPIT Is Ex-W8XK

The new call of Westinghouse station W8XK, Pittsburgh, is WPIT. The call W8XK dated back through an evolutionary process to Dr. Frank Conrad's station 8XK, over which experimental shortwave broadcasts were made in 1921.

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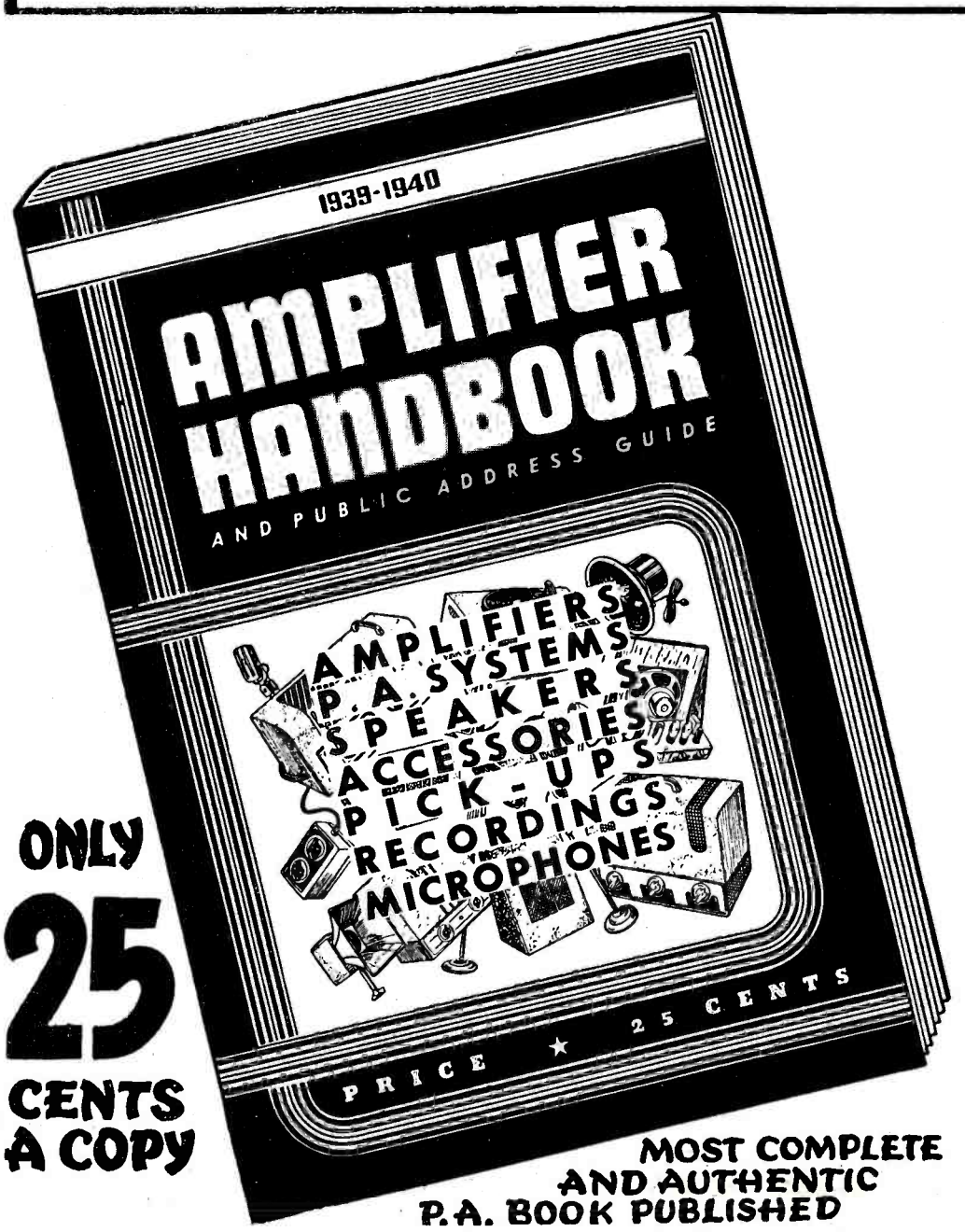

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THE CONTENTS

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A Resume of the Contents of the

AMPLIFIER HANDBOOK AND PUBLIC ADDRESS GUIDE

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CHAPTER XXIV—SERVICING

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(Continued from page 399)

To set the oscillator at some point between 2 local broadcast stations so that interference from them does not occur, adjust the trimmer condenser across the grid coil and follow with the receiver until the output of the transmitter is on an ordinarily quiet spot of the receiver dial.

If the volume control of the transmitter is set too high distortion of speech will occur. The output from the receiver should be controlled by the receiver volume control. When testing with microphone in the same room as the receiver, audio regeneration occurs before a desirable level of volume is reached. After the trimmer has been set and the desired frequency of transmission obtained, reconnect the regular aerial to the receiver, and take the transmitter into another room or into your next door neighbor's apartment, or better still leave transmitter in your room and ask your neighbor to tune you in on his radio set.

A.C.-D.C. MODEL

The battery-model wireless mike exhibits the greatest departure, from all other mike units on the market, in its design. However, for those who want to use the device on an electric power line, there is available the diagram shown on page 399.

EMERGENCY SERVICING WITHOUT METERS

(Continued from page 405)

shield baffle plate can be placed between the 2 windings. The trimmers are adjusted to eliminate the interfering signal. Standard, manufactured-type traps are usually more satisfactory due to having the proper L/C ratio for maximum cut-off. Additional traps may be used to eliminate severe interference from some particular nearby station, for example a broadcast station. In the latter case the trap inductance and trimmer will have to be proportionately smaller for the higher frequency involved. A better method of eliminating such interference is thru the use of a loop antenna or adjustable directional antenna.

CROSS-MODULATION

Tuned radio frequency receivers are commonly used in connection with public address systems. Earlier models are often subject to severe cross-modulation interference.

The first place to look is in the antenna circuit or 1st radio frequency stage, which is the point where cross-modulation starts. The successful elimination of cross-modulation involves securing increased signal strength of the desired frequency and decreased signal input from the undesired signals or frequencies. Here again a loop or directional antenna may provide a simple solution.

Otherwise a single wavetrap as per Fig. 4 may be of some value, L and C being tuned to the frequency involved. Decreasing the size of the antenna, mechanically or electrically may benefit, in the latter case a variable antenna series condenser is added (C^2). Another alternative is to insert an antenna potentiometer (R) of about 5,000 ohms. If the tuner is quite old the R.F. tubes may be of the abrupt cut-off type, in which case they should be changed to the remote cut-off variable-mu type of tube, such as the types 34, 35, 39/44, 6D6, 6K7, 7A7, etc. A tuner subject to severe cross-modulation invariably will be found to have a low-impedance antenna coupler. A change to a high-impedance antenna coupler, preferably "iron core", will often work wonders in eliminating this difficulty.

INTERMITTENTS

An incalculable amount of service time has been wasted tracking down defects which cause an abrupt change of loudspeaker volume or which cause periodical interruptions to reception. The logical procedure is to first make sure the receiver is at fault. By removing the regular antenna and ground and substituting a small indoor antenna a few feet long, elimination of the difficulty means the antenna is at fault, possibly a loose antenna connection or part of the aerial system grounding periodically. On the other hand if the difficulty persists, tests should be made to localize the source of the trouble. Where the receiver includes a record player, records can be played to determine if the trouble exists in the audio and speaker circuits. Connecting a pair of phones at the last audio stage will provide a check on the speaker. Provided the above tests are OK, it is then known that the trouble is confined to the detector or R.F. stages. By "jumping out" 1 R.F. stage at a time, as previously described, the defect can be tracked down to a definite R.F. stage or the detector circuit. After that the exact fault, such as a poor socket contact, partially defective condenser or resistor, loose internal tube element, loose connection, stray piece of loose wire or solder, etc., is more easily located.

SERVICING PUZZLERS

(Continued from page 408)

On test bench, high battery voltage produced fading. Further tests indicated that the oscillator coil was causing the trouble, in spite of the fact that the D.C. resistance of the coil was exactly as specified by the manufacturer. Checking the coil further by signal generator and V.-T.VM. disclosed an intermittent shorting of turns. Replacement of the coil cured the trouble. Later, a microscopic examination disclosed that the enamel wire insulation would break down at radio frequencies but not on the D.C. from the ohmmeter.

Raymond W. Tackett.

OPERATING NOTES

(Continued from page 415)

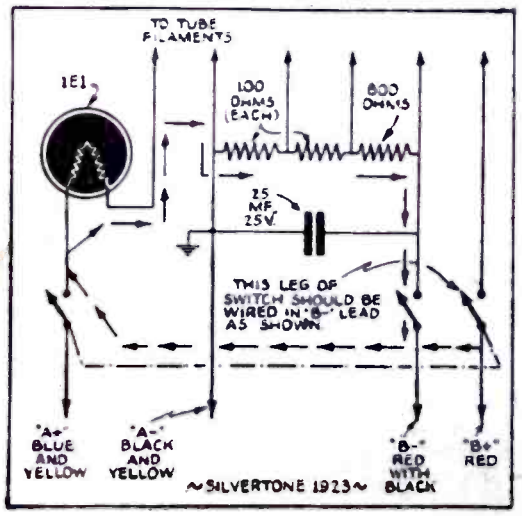
lasts (models 70, 90, etc.), at a point where a long thin bolt passes down through the unit to the bottom. This bolt carries live current and due to the heat generated becomes loose and oxidized. I found it to be a hard trouble to locate and only close observation will detect it. Remove ballast can and the long bolt and clean bolt head (under the head) and its seating.

RAYMOND CONOVER,
Stone Ridge, N. Y.

FADA 20B-460-S46 SERIES

To improve tone quality and reduce microphonics in this receiver add one 2-meg. resistor. Attach it to the plate of the 6Q7G and 25L6G. To reduce hum, the 2-meg. resistor in the grid circuit of the 6Q7G must be soldered directly to chassis at socket base.

L. GALANEK.



THE RADIO MONTH IN REVIEW

(Continued from page 391)

W2XMN (see cover of *Radio-Craft*, April, 1939). Possibly a 4th station will be erected in Mass. or Vt. The network will afford virtually static-free high-fidelity reception to listeners in all the major cities from Portland, Me., to New York City, the *Christian Science Monitor* reported last month.

ILLUSTRATED

Television covered its first major indoor boxing event on November 1 when the National Broadcasting Corp.'s television cameras transmitted over station W2XBS, the spectacular bout, between the veteran Tony Canzoneri and the youthful Al Davis at Madison Square Garden. (See photos on pg. 390.)

Telephone circuits were used, for the second time (in America), in relaying images and sound from Madison Square Garden to Radio City. The circuit extended from the mobile unit located in the basement of the Garden, to the Circle exchange of the New York Telephone Company, where equalizers and amplifiers maintained the components of the video signal in proper phase relationships, and strengthened the signal before passing it on to Radio City. The circuit for the video signal was first used last Spring in the relay of the 6-day bicycle race from Madison Square Garden. (See "Telly Piped over Phone Wires!", August, 1939, *Radio-Craft.*)

. . .

The wedding of wired sound and radio took place last month at the inauguration of a new sound service demonstrated in the Elizabethan Salon of the Essex House in New York City. (Photos, pg. 390.) High-fidelity transcription sound programs received at the Essex House over a wire service from a central point in New York City, which feeds a number of other customers with continuous music (from vertical-cut transcription-type phono records), were fed into a wired-radio transmitter unit, in the hotel, and there piped as wired-radio music to either standard radio receivers or "abbreviated" radio receivers in the various suites.

The outlet of the master modulator system at the present time receives 2 channels of wired-audio music and transmits these as radio signals on 1,100 kc. for concert music and 1,040 kc. for popular music. At the self-powered remote receivers either program may be tuned-in on an "abbreviated," dial-equipped radio set consisting of detector and audio stages, and a loudspeaker.

The device cannot cause interference with radio receivers in nearby buildings because it is a controlled carrier system, shielded and coupled electrically in such a way that radiation into free space is impossible. It should be self-evident that a system such as this necessarily affords completely static-free reception. Programs are received without announcement of any sort in 15-minute periods with a lull at the end of each period of about 2 to 3 minutes. Standard radio sets of any type also may be used to receive these programs.

. . .

"Oh, wad some pow'r the gift t' gie us to see oursel's as ithers see us . . . ," wrote Burns, but television last month fulfilled the bard's wish. With propellers still turn-

(Continued on page 446)

ANDREW HALBRAN DEAD

We are deeply moved by the untimely death of Andrew Halbran who died of a heart attack Tuesday morning, November 21, at the age of 41. Readers of *Radio-Craft* will remember Mr. Halbran not alone for the many interesting articles he contributed, but for his highly interesting photographs, too. Like no other photographer, he could make his photographs tell a story eloquently. The loss of Mr. Halbran will be felt not only by *Radio-Craft* and its readers but by the many other varied publications for which he has done consistently noteworthy work.

CASE HISTORIES OF P.A. SALES

(Continued from page 413)

switchboards prevented accidental breaking-in and pick-up from ringing circuits. Quality was not excellent but everything was perfectly understandable.

A HI-Fidelity transformer matched the line and fed the medium-impedance input of my 36-watt amplifier which drove two 15-watt speakers in bass reflex cabinets. A suitable condenser across the matching transformer secondary kills inductive sing from the line. (The amplifier must be isolated from the line by a transformer to prevent the hum and cross-talk.)

In addition we had a separate line to Minot for talking with the KLPM engineer. The program at 26 on a transmission level overloaded our amplifier so we had KLPM cut it in half twice.

We tested our local cable with mike and preamplifier at the phone office. Quality was beautiful at the auditorium! We will use this idea for remote pick-ups in the future.

This Minot-to-Langdon hook-up is the first of its kind in this state or many others. It is novel and new in many respects. The telephone company cooperated very well since this opened a new field for them.

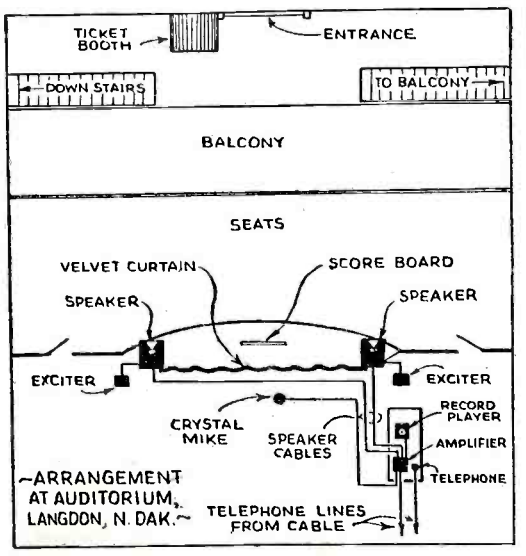
List of components used for receiving program from Minot:

One Thordarson HI-Fidelity line matching transformer;
One AX-36 Clough-Brengle 36-watt amplifier;
Two Wright-DeCoster model 5800 electro-dynamic speakers, 15 watts each;
Two exciters for speakers;
Two bass reflex speaker housings.

Equipment used for local pick-up (for testing):

One Electro-Voice ribbon microphone model V2;
One Webster preamplifier model DRS;
Telephone cable pair from telephone office to auditorium; amplifier equipment at auditorium as previously listed.

M. C. TURNER,
Langdon, N. Dak.



The Neilsen Audimeter Index is now in its experimental stage. About 200 Audimeters are reportedly attached to about 200 receivers in Illinois, Wisconsin and Ohio and automatically record the actual stations tuned-in, and the length of time spent in actual listening, as etched upon a special tape with graduations indicated by minutes. The data obtained from 2 Audimeters in continuous operation on a home receiver, is said to be equivalent to that obtained from about 1,000,000 coincidental telephone calls.

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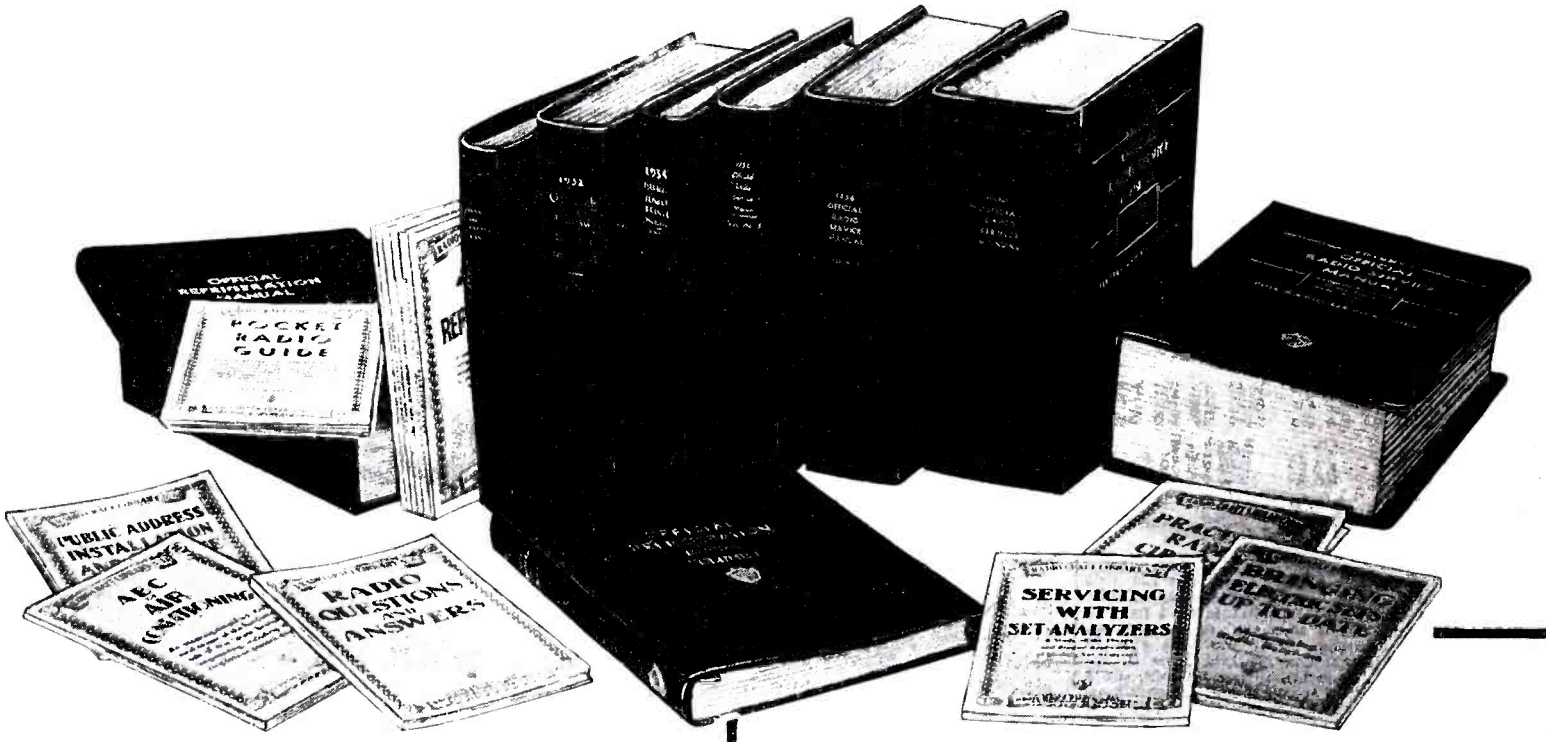

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SOUND ENGINEERING

(Continued from page 403)

and the approximate power output on such a unit which works on 350 V.

LOUIS WIECH,
New Castle, Pa.

The Answer . . .

In designing a direct-coupled amplifier, to effectively utilize a total of 350 volts, it becomes necessary to choose input and output tubes, and operating condition for them, so that the additive plate and bias voltages of both the input and output tubes approximately equal 350 volts, less the drop expected in the filter choke.

Using a pair of 6SJ7's operating with 100 volts on plates and screen-grids, and a pair of 6Y6G beam power output tubes operating with 200 volts on a plate and a bias of 15 volts, will fill our requirements, as a total voltage necessary for such a direct-coupled amplifier would be approximately 100+15+200, or a total of 315 volts. This would allow a 35-volt drop in the filter choke, which would normally be encountered when using a 200-ohm choke, capable of passing 165 milliamperes.

Figure 3 gives a complete circuit diagram for a direct-coupled amplifier, engineered to fit these requirements. All of the voltages indicated are measured from ground. It is to be noted that although 315 volts are applied at the plate of the 6Y6G tube, there are only 200 effective volts, as the cathode voltage subtracts from the plate voltage indicated.

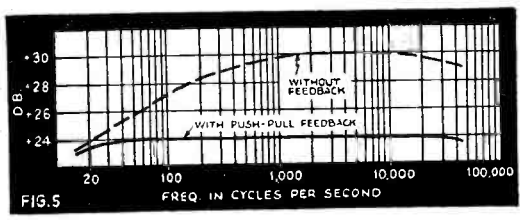

FIG.5

To simplify the construction and adjustment of this amplifier, the following tabulation of the tubes employed, and their currents and voltages are given:

	6SJ7	*6Y6G*
EP	100 V.	200 V.
EC1	3 V.	15 V.
EC2	100 V.	135 V.
IP	3 ma.	63.5 ma.
IC2	1 ma.	5.5 ma.

This amplifier, or any variation, may be engineered in accordance with the procedure outlined in the July, 1939, issue of *Radio-Craft*, page 16, and in the October, 1939, issue, page 202.

The values of the current flowing in each of the resistors are given below, so as to facilitate checking the amplifier upon its completion:

BLEEDER H (1,710 ohms, 5 watts) carries a total of 38 ma., which is equal to the plate and screen-grid currents of both 6SJ7's, plus an equal amount for bleeding, plus the screen-grid currents of the 6Y6G's, plus an equal amount for bleeding.

RESISTOR F passes 27 ma., as 11 ma. have left the circuit to pass through the screen-grids of the output tubes.

RESISTOR E passes 21 ma. as 6 ma. have left to pass through resistors G through the plate circuit, and on through the plate circuit of the 6SJ7's.

RESISTOR D passes 159 ma. which is equal to the total current passed by E (21) plus the total plate and screen-grid currents of both output tubes (138).

RESISTOR C passes 157 ma., which is the same amount of current as passed through D, minus 2 ma., which leaves the bleeder circuit to pass through the screen-grids of the input tubes.

RESISTOR B of course passes the total plate and screen-grid current of both input tubes, which, in this case, is equal to 3+1x2 or 8 milliamperes.

RESISTORS A are, of course, the grid-return circuit, and pass no current.

After the amplifier is constructed, its proper performance can easily be checked from the data given above, and the voltages indicated in the circuit.

As a total current drain of the amplifier is 165 ma., a choke having not more than 200 ohms resistance should be used. Under these conditions, 350 volts supplied by the rectifier, will provide just the right amount of voltage for the amplifier. (315V.)

A suitable filter circuit for the amplifier is illustrated in Fig. 4. It is to be noted that a balanced output transformer is provided in order to use push-pull inverse feedback. Only arbitrary voltages are given for the feedback compensating resistors and condensers (these happen to be the values used in our laboratory). Special values will be required to compensate for low-frequency losses of the output transformer. These can best be determined by experiment. For simplicity of design, the frequency response of the amplifier should be noted without the use of any compensating network.

Suitable resistor and condenser values should be employed so as to provide degenerative feedback for only those frequencies above which compensation is desired. The response current, with and without feedback of a typical output transformer is given in Fig. 5.

The power output of the amplifier is 8 watts with 1.5% total harmonic distortion.

The output transformer should have 4,000-ohm plate-to-plate primary impedance, and be capable of carrying 66 milliamperes.

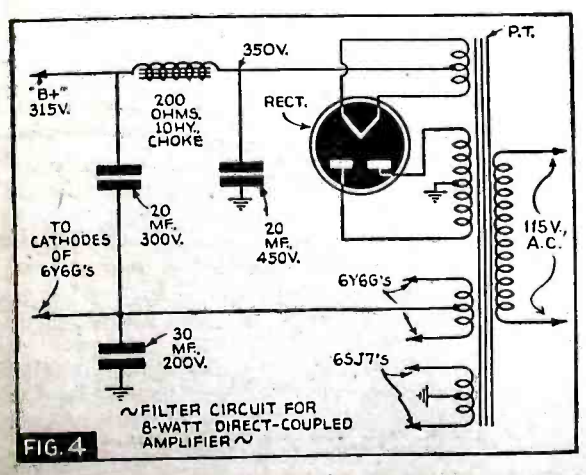

FIG. 4

Not a Single Negative Reaction!

OUR full-page announcement in the November issue of **Radio-Craft** on the new Sound Engineering Department solicited reader reactions. These reactions literally poured in and among them was **not a single "no!"**—indicating that this new department has established a much-wanted service.

Now we have published the first installment of this new department and are again calling for reactions; this time to determine whether the material selected is of the proper character.

Drop us a postcard or a letter and let us know what you think of it; also let's hear of your particular problems.

THE RADIO MONTH IN REVIEW

(Continued from page 442)

ing, televiewers inside a giant United Air Lines plane saw their own plane, via N.B.C./RCA telly, as it made a landing at North Beach Airport in New York after concluding an epochal flight into the stratosphere above Washington, D. C.!

On the 20th anniversary of the founding of RCA, an historic chapter in television was written when an invited group viewed, on a television screen more than 4 miles above Washington, D. C., goings-on at points in New York City 200 miles North, last month. Equipped with tubes through which they could breathe-in enough oxygen to offset the effects of the high altitude, the group, consisting mainly of New York newspapermen, was in constant 2-way contact with Radio City. (Photos, pg. 391.)

The plane's occupants had an "outside grounding view" of their landing by means of a mobile transmitter which picked up views of the landing upon return to the airport, transmitted this pick-up to the Empire State Building on one wavelength and re-transmitted it on another to the teleceiver inside the airplane 8 miles from the latter transmitter, but located only a few hundred feet from the mobile unit!

Interference (from electrical equipment in the plane including the radio transmitter and ignition apparatus for the ship's 2 motors), became a serious problem at the extreme distance of the test—which at lower altitudes is about 3 miles below horizon!

The receiver was a standard model now being sold in New York. The only change made in it was a slight adjustment in the automatic volume control to compensate for the whirling propellers. These, according to engineers, acted as reflectors, causing extremely rapid variations in the intensity of the received signal. The antenna was a wire dipole strung under the fuselage.

(The feat of hi-fi or 441-line image fidelity post-dates Don Lee's lower-fi pick-up in a plane a few years ago.)

* * *

In the "Journal of Psychology," Dr. Ward C. Halstead of the University of Chicago Clinics described how the eye acts as a miniature storage battery (with a strength 1/1,000,000 that of a battery used in an automobile); and that every time the eye moves there is a fluctuation of current which is detectable by the device illustrated on pg. 391 (which was developed to facilitate analysis of brain lesion cases). The Doctor reported that it is possible to secure reliable records of the direction and extent of eye movements while the subject is walking around a room. This flexibility is important in mental cases and is impossible with other methods of recording eye movements.

The latest technique is shown in the illustration made available to *Radio-Craft* last month. The subject is shown in position in an electrically-shielded room with head, shoulder and eye electrodes in place for recording the results of directed and spontaneous eye movements. Both the extent and direction of the eye movements may be determined from a continuous stylographic tape record made by the amplifier-driven polygraph, shown in the right foreground. A projection screen between the subject and the optical bench (foreground) has been removed here. The eye-movement recorder is also useful in recording the eye movements of patients with aphasia, that is, those suffering from loss of language—stuttering, stammering or amnesia; and in studies of pseudo-hallucination, fantasy and imagination.

RADIO AIDS "FLYING DOCTORS"

(Continued from page 393)

PIONEERS' RADIO STATIONS

The Traeger type 37 pedal transceiver outfit here illustrated comprises all the components necessary for a complete transmitting and receiving station, except for the aerial installation. The transmitter and receiver are contained in one cabinet as shown.

The receiver is a 4-tube superhet. using 2-V. Philips tubes. Tuning ranges are 15 to 60, 70 to 210, and 210 to 620 meters. The R.F. coils are cellulose-treated to exclude moisture; the I.F. coils are wax-treated for the same purpose. The "A" drain is about 0.4-ampere; the "B" drain at 120 V. is about 10 ma. Both headphone and loudspeaker operation are available.

The transmitter is a crystal-controlled affair using a single 2-V. Philips tube as the oscillator; the modulator also is a 2 V. Philips tube; and, a third 2 V. tube of the same make is used in the microphone amplifier. Telegraphy or telephony may be transmitted over this station, on any of 3 fixed wavelengths between 30 and 200 meters. On code the "A" drain is 0.26-A.; on phone, 0.6-A.

A pedal generator delivers the requisite plate power for only the transmitter; the transmitter and receiver filaments however have a common "A" source. An Eveready Air-Cell supplies the requisite "A" voltage for both units. The Air-Cell will operate the receiver for an average of about 1,500 hrs. or the transmitter for about 900 hrs. A standard "B" battery delivers 120 V. for the receiver.

PEDAL GENERATOR

The pedal generator on test at 180 r.p.m. of the pedals will deliver 600 V. for 1 minute. The maximum voltage for 18 W. input to the transmitter is 250.

The gear ratio from pedals to generator shaft is 20 to 1. The gearing is enclosed in an oil-tight casing with the gears running in oil. The output of the generator is 20 W. when the pedals are turned approximately 70 r.p.m.

The field casing of this pedal generator is built up of 2 permanent magnets joined by a soft-iron core on which is wound a coil connected in series with the armature. With this construction the voltage at the output terminals remains practically constant irrespective of the load.

A later, model 39, 2-way radio set has just been made available to the hardy folk of the outback. It incorporates a 5-tube transceiver and a 2-tube transmitter with a range up to 700 mi. on telephony under good conditions.

An area of more than a ¼-million sq. mi., 3 times the area of England and Wales, as the map shows, is covered by the aerial range of each of the 6 Flying Doctor bases.

The creation of medical services in isolated areas of Australia is due primarily to the inspiration and work of the Rev. John Flynn, O.B.E., superintendent of the Australian Inland Mission. The solution of the problem of communication came with the development by Mr. A. Traeger of the *pedal radio*.

Radio-Craft wishes to thank Mr. Alex J. Kenniwell, Australian Aerial Medical Services, Sydney, Australia, for his cooperation in making available the illustrations and much of the information contained in this article. We also wish to thank Mr. Sherman C. Amsden, Managing Director, Doctors Telephone Service, for the data on the projected Doctors' Radio Paging Service.

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(While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.)

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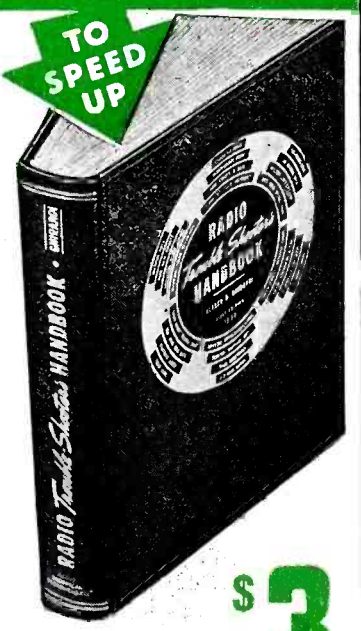

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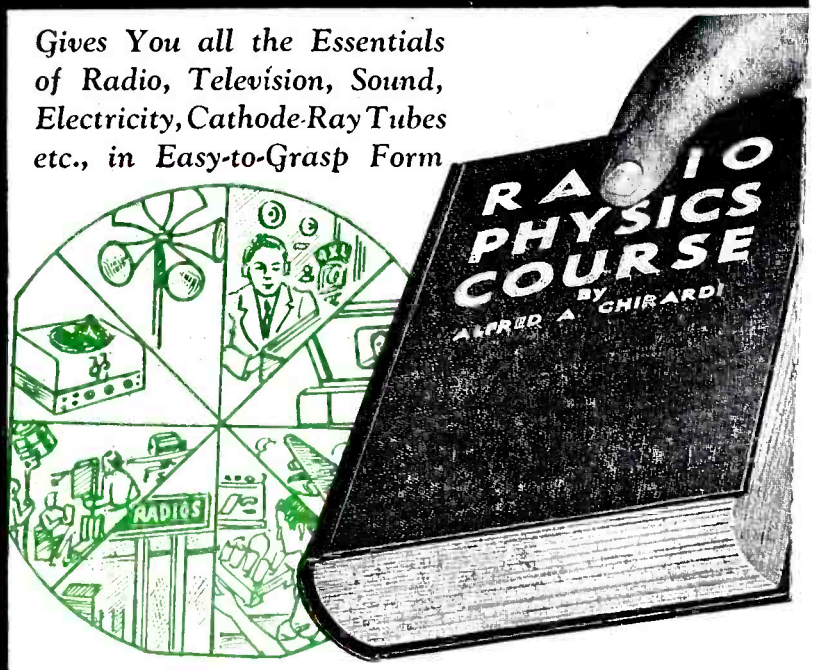

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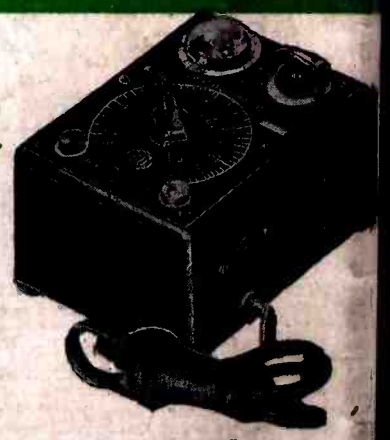

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