RADIO-CRAFT

HUGO GERNSBACK, Editor

OVER 125 ILLUSTRATIONS

TELLY IN AIRPLANE!

EYE-CURRENT DETECTOR

THE CORONAVISER

"WIRELESS" PUBLIC ADDRESS

See Page 398

"WIRELESS" PUBLIC ADDRESS

See Page 398

RADIO'S GREATEST MAGAZINE

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

MIDGET 3-IN-2 AMPLIFIER RADIO AIDS FLYING DOCTOR

RADIO "BIKE" GENERATOR

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Name ________________________________________
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I Jumped from $18 a Week to $50 -a Free Book started me toward this GOOD PAY JOB IN RADIO

Here's How it Happened
by S.E. NAME AND ADDRESS
SENT UPON REQUEST

"I had a job for a week at a shoe factory. I'd probably be at it today if I hadn't read about the opportunities in Radio and started training at home for them."

"N. E. I. Training took me out of a low pay shoe factory job and put me into Radio at good pay. Radio is growing fast."

"Eight months later N. E. I. Employment Department sent me to Station KVOB as a Radio operator. Now I am Radio Engineer at Station WOUI. I am also connected with Television Station WARK."

"The training National Radio Institute gave me was not enough to make it to $40 a day in spare time servicing Radio sets."

"When I finished training I accepted a job as service-man with a Radio store. In three weeks I was made service manager at more than twice what I earned in the shoe factory."

Radio is a young, growing field with a future. It offers you many good pay spare time and full time job opportunities. And you don't have to give up your present job, go away from home, or spend a lot of money to become a Radio Technician. I train you right at home in your spare time.

WHY MANY RADIO TECHNICIANS MAKE $30, $40, $50 A WEEK

Radio broadcasting stations employ engineers, operators, technicians and pay well for trained men. Radio manufacturers employ test-ers, inspectors, foremen, servicemen in good-pay jobs with opportunities for advancement. Radio jobbers and dealers employ installation and service men. Many Radio Technicians open their own Radio sales and repair businesses and make $30, $40, $50 a week. Others hold their regular jobs and make $5 to $10 a week fixing Radios in spare time. Automobile, police, aviation, commercial Radio; loud-speaker systems, electronic devices, are newer fields offering good opportunities to qualified men. And my Course includes Television which promises to open many good jobs soon.

MANY MAKE $5 TO $10 A WEEK EXTRA IN SPARE TIME WHILE LEARNING

The day you enroll, in addition to my regular course, I start sending you Extra Money Job Sheets which start showing you how to do actual Radio repair jobs. Throughout your training I send plans and directions which have helped many make from $200 to $500 a year in spare time while learning.

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Act today. Mail coupon now for sample Lesson "Radio Receiver Troubles-Their Cause and Remedy" and 64-page Book "Rich Rewards in Radio." They're FREE. They point out Radio's space time and full time opportunities and those coming in Television; tell about my course in Radio and Television; show many letters from men trained, telling what they are doing and earning. Read my money back guarantee. Find out what Radio offers you. Mail coupon in envelope or paste on penny postcard—NOW.

J. E. SMITH, President Dept. OAX, National Radio Institute Washington, D. C.

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Dear Mr. Smith: Mail me FREE, without obligation, your sample Lesson and 64-page book "Rich Rewards in Radio" which tells about Radio's space time and full time opportunities and makes you a good technician (Write Name and Address on back of this card).
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BOOK REVIEWS


Here is a useful manual for Radio Service men, giving them quick reference to common radio troubles and practical methods of repairing them.

Under alphabetical listing of hundreds of specific symptoms, radio models and methods, the author concisely indicates the symptoms of the operation, and notes which is to be first checked. Thus, each is subject, then gives effective methods of making the necessary adjustments or repairs, based in nearly all cases on personal experience in his own extensive repair business.

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

TELEVISION AND SHORT-WAVE HANDBOOK, by F. J. Conn (1939). Published by Putney. Size 5x 7 x 1 in., cloth cover, 130 illustrations, 272 pgs. Price $2.50.

An illustrated handbook written in 2 sections: "A vividly illustrated volume" which deals both technically and practically with everything about television. The second section of the book deals with short-wave technique having particular bearing on television transmission, and is written so as to use this book as a reference for its 61-p. dictionary of teletype. A comprehensive dictionary also should make clear to the radio student terms used in the text. We recommend Conn's new book.


This is a complete but inexpensive manual on direction finding, dealing with wave propagation and D.F. theory in relation to modern ground and ship installations, and 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 book on the topic he has chosen; in this connection it may be worthwhile to note that the first edition was published in 1927 and is practically completely detailed and will be invaluable to anyone interested in the subject.


This is the only complete book on the subject of antennas for the amateur radio station, covering all important wavelengths. The book gives particular attention to the requirements of the ham or transmitting amateur.


This is the fourth edition of "Discovery of the Elements," and it is interesting to note that the book has become too bulky to be made available in English. "Discovery of the Elements" is a concise, clear, and comprehensive account of the development of the elements, their properties, and their mutual relationships. It is an excellent reference book for anyone interested in the history of chemistry.

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SEND NOW FOR FULL DETAILS!
"Thermopylae Had Its Messengers of Death. But the Alamo Had None!"
(Congressional Record)

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.
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-aho 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 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 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 people can be convinced that a multiple radio set 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 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 the extra sets.

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. Then 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 small loudspeakers or the type that can be put on a desk or table.

Here it is also necessary to have, for all practical purposes, some 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. There 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.
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!

—in an item in the New York Sun.

In Paris, Edouard Branly, probably the oldest living radio pioneer, both in point of years on earth and in activity in radio, celebrated his 85th 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, planned 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, maybe," 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."

RADIO-CRAFT for JANUARY 1940

HOTEL WIRED-RADIO

A 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 to 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 65 tenants.

Below, the mssis Fallsie (left) and Ruth B. 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.
IN REVIEW

SOUND

NAZI efficiency slipped up last month, thanks to the New 
York Times, which checked recordings of a speech 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 Athens-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.—as he reached the French-German border as background; the disc was then flown to London, and there sent to U.S. listeners via special transoceanic facilities.

EYE-CURRENT DETECTOR

Do the eyes of a sleeper move? Do dreams cause eye movements? Radio Instrumentalists 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., Asst. Prof. of Experimental Psychology, Div. of Psychiatry, Univ. of Chicago Clinics, has perfected the apparatus shown at right. The technique, developed to facilitate analysis 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 photos (which Dr. Halsted 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.

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)
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, joking 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-REX, 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 figured in the incident. The KEX crew was scheduled to board almost inaccessible Tillamook Rock Lightship 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 bronco in a cloudburst . . . only you can let go the brone! 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 gorged with pro- fane, 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 482)
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.

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 aero-plane 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 article in the preceding, December issue of Radio-Craft by the
writers, pointed out the advantages of frequency modulation as com-
pared 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." sta-
tions in approx. the same frequency region; and also, the complete service
diagram of the G.E. model HM-80 fre-
quency-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. (Connect-
ed 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 in-
terference. This limiter circuit also
smoothes 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 ap-
proximately 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 fre-
cquency-modulated signals, explaining as
we go along the functions of the differ-
ent components of the circuit.

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 ampli-
fier)—is shown in Fig. 1.

It will be noted that, with the excep-
tion 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 super-
heterodyne employing 2 stages of inter-
mediate frequency amplification.

In order to procure sufficient band-
width however, special 3-mc. I.F.
transformers are employed which have a
bandwidth of 200 kc. Resistors are
placed across these transformers to
damp 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 fre-
cquency amplifier stage, the plate circuit

![Diagram of F.M.-A.M. Adapter](image-url)

![Diagram of FM-Modulation Circuit](image-url)

![Diagram of Rectifier Circuit](image-url)

![Diagram of Frequency Modulator Circuit](image-url)

![Diagram of Frequency Modulator Circuit](image-url)

![Diagram of Frequency Modulator Circuit](image-url)

![Diagram of Frequency Modulator Circuit](image-url)
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

![Diagram of F.M.-A.M. Adapter](image)

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 gauged tuning condensers and grounding them to the shield at one point only. The entire tuning unit is 5½ ins. long x 3 ins. high x 2½ 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)
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.

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 oscillator. 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 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.

ROBERT F. WALLACE, PH. D.

INTERMITTENT RECEPTION

(141) Norris Chambers, Cross Cut, Tex.

(Q.) I have trouble with a Philco model 90, or 99A, 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 200 mmf, condenser, but it doesn’t seem to work.

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. 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.V.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 A.F.C. on. 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 1/2-megohm resistance.

SERVICING QUESTIONS and ANSWERS

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 1IA. 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, and voltage and audio are the same as when the trimmers were not grounded), the volume is increased. I have replaced the electrolytic condensers in the set, but with no noticeable improvement. I need some suggestions.

(A.) Intermittent reception by the Philco model 90 or 99A is caused by the following condensers opening during operation: (1) A.F. coupling condenser; (2) cathode bypass condenser; (3) screen-grid bypass condenser; (4) oscillation plate condenser. Generally the condensers can be spotted by an oxidation of wax from the container through the lug eyelet holes. Replace all such condensers. The wax is forced out by the heat generated internally by a poor or intermittent contact between the pin and the foil.

RADIO-CRAFT for JANUARY, 1940
WIRELESS MICROPHONES

Years hence when self-powered microphones completely devoid of trailing wires, radio men will look back at this article by Messrs. White and Rawitz as 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 1HS 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 1AT output tube. The 1AT is a pentagrid converter tube and combines the functions of oscillator and final A.F. modulator.

The oscillator coils are the same that are used in wireless record players, and in a circuit oscillate somewhere in the broadcast band, generally between 1,500 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-

*S. J. WHITE, E. E.

W. White 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 rails 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,
have become the accepted type of sound pick-up apparatus for many P.A. installations, and 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 1/4- or 1/2-watt size. Resistors in plate and screen-grid circuits should be 1/2-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 1/4-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 mmd. 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)
TELEVISION

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

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 too small a capacity to parallel with the preceding 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 an 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 the bandwidth and frequencies involved in 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 variable iron core coil 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 inductances 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 single 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” Tally Kit-Receiver

The 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.

BROUGHS

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).
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 arrangement itself is symmetrical 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 by 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.

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 is necessary to adjust the cathode of the image tube to 50 volts negative in respect to the grid of the 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 appearance 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 70 degree deflecting 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)
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-ohm tubes. Most preamplifiers are operated several hundred feet from main amplifiers and A.C. is seldom available. A preamplifier that would operate with several dry cells and about 14 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 amplifiers with high-impedance inputs to one preamplifier with 600-ohm output.

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 IN8G-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, S2, 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.

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 the 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 at the output. Otherwise, the frequency response characteristic of the output transformer may 350 volts 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 effective 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 effective gain of 20 db. (59-30=29). 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 across 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 fractions radio set, says Mr.

CHARLES R. LEUTZ

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 envious 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 L2 is the secondary of the transformer and L1 the primary or plate winding. Any triode may be used such as a 6CS 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 (10-100 scale), is divided into 10 equal horizontal divisions. Following the above procedure assume that 1,900 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 1-600 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 380 kc. is not available, any carrier of 560 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-radio 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
the 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 mmfd. 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 ob-
tained by reducing the oscillator tube plate voltage.
At intermediate frequencies (i.f.'s), the oscillator is cou-
pied 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 align-
ments 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 "cracking" noises, either steady or intermit-
tent, 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 con-
necting the receiver antenna and ground posts together,
right at the terminals, if the noise stops it is definitely prov-
en 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 trans-
former design such cases are most unusual.
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 re-
sistor 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 interme-
diate frequencies (i.f.'s) is common, especially where the
receiver is located close to a seacoast. 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, ad-
justing same to attenuate the interfering frequency in-
volved.
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 1 ½ 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 pick-up. 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 ¼-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 ¼-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 ultracompact 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 48 ma.

Applications

Its low cost, compact size, and efficient operation, make this amplifier suitable for a wide variety of "home use" applications, including phonograph reproduction, radio amplifier, sound-on-film amplification, hearing-aid amplifier and interoffice 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 3 ¼ 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.
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.

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

(Continued on page 439)

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.

Low Volume in a Standard Receiver.

Low volume in a late-model T-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 controlled by 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 the 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 were adjusted; and, leads from the signal generator were connected to the control-grid of the detector-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 established 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 the fading was caused by oscillator failure, and that voltage at the set with the motor running was rather high, 7.5 volts.

(Continued on page 441)
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

Sielertone (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. This 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)

RADIO-CRAFT for JANUARY, 1940
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. WASHBURN

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

*Orthonoscope—Image Pick-Up Tube

The Orthonoscope, 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 Orthonoscope 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 Orthonoscope, has a maximum output signal over 500 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 Orthonoscope 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 Orthonoscope 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 commercially available; for this reason, characteristics data are not supplied.
7AP4—7-in. Kinescope (Magnetic Deflection; White Phosphor; Short Bulb)

The RCA 7AP4 is a high-vacuum, magnetic-deflection type of cath-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 picture. 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 receiver. 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 fact, 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 standby period is very much greater than the transmitting period. Also, the tube can be used to advantage in transmitters where the filament is continuously lighted, for such operation 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 hitherto 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 806A 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, 29)

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 perrseence 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 watts.

(Continued on following page)
828—Transmitting Beam Power Amplifier

The RCA 828 is a beam power tube designed particularly for class AB, 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 service (1CAS ratings) are capable of delivering 900 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. service to give full power output with very little driving power, and consequently, with a minimum number of driver stages.

75T—Radiation-Cooled Triode Plate (1/4-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 Eitel-McCullough 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 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 Cathode Plate-Cauded 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 Cathode Plate-Cauded Cathode)

The RCA 925 features short overall length (only about 3½ inches) and, 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-signal 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 Cathode Plate-Cauded 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 2½ ins. in length. It is intended primarily for use in connection with 16-mm. sound equipment.

RECEIVING TUBES

12B8GT—Target 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 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 5000 ohms.

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. It is intended primarily for use in a series or 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. 6, 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.

4525GT—Half-Wave High-Vacuum Rectifier

The Tung-Sol 4525GT is designed primarily as a power rectifier for A.C.-D.C. receivers. It features a 45 V. 150 ma. heater providing 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 in their 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 been brought out so that, with proper 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).
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 under. 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 not to 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 's-inv. screen-grid bypass condenser for the 51-8 I.F. tube was broken; repairing this restored normal operation. In another of these sets with the same symptoms, this condenser was found open.

SILVETONE 1923 BATTERY SET
I have found the following conditions in several of these sets. The switch, a D.P.S.T. (pair) 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 burnt 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-" lead; 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 100 micro-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.

KEVIN B. BRYAN,
Huffman, Texas.

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

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 and one can order for airline mileage at 10c per mile each hour or about $15 an hour. A 25c admission 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 was modulated 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. Shutting around (Continued on page 445)

RADIO-CRAFT for JANUARY, 1940 413
269 Radio Service Data Sheet

ZEITH PORTABLE MODELS 5G401M, 5G401D, 5G401Y and 5G401L (CHASSIS NO. 5537)
5-Tube Superhet; A.C.-D.C. and Battery Operation; Detachable "Wavemagnet" Antenna (detachable to car windows, etc.); Automatic Volume Control; Headphone Terminal Jacks (permitting use of under-pillow phone in hospitals, etc.); Broadcast Band only.

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 C3 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 C19 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 0.25-A. - "P". 10 ma.

PRECAUTIONARY LEAD DRESS

1. All filament (brown) and "B-P." (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.
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 the mike, which reduces the volume. Not recommended for outdoors where wind is likely to affect its performance.

—For Music and Voice. Where one microphone 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°F. 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 mikes are based on the supposition that the speaker is 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 allow of the present of both music and voice.

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."

..."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 nepa-

(Continued on page 453)
OFF THE PRESS

To Keep You Informed


TWO BULLETINS, published by Aerovox Corp., New Bedford, Mass., each 4 pp. One covers new inductance, capacity checker, model 59; other, the capacity and resistance bridge.

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


WARR MAP AND SHORTWAVE LOG, Stromberg-Carbon 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.


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


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.


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


(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

LANSDING: 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. Benpert has been elected to take Mr. Rogers' place.

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THESE SMILES MEAN BETTER BIZ

The happy faces shown above belong to (l. to r.) to J. K. Feethman, 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 bits 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 Capahart phonos for L. C. Huston, sales mgr. of Farnsworth's Capahart dir. Others, pictured are: E. H. Vogel (l.), Farnsworth v-p., & Howard Cushing, Capahart's Chi. dist. mgr.
Suggestions from field resulted in Hygrade Sylvania's new electric sign, offered dealers & Servicemen as (Continued from page 417) a first. Carriers for breakfast make public conscious of tellies' programs' excellence. Induce them to see demonstrations & buy! marks dealer as progressive proponent of newest proffitmaker!

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

COMPLETE RADIO SERVICE

Sylvania Tubes & Sylvania Radios

YOUR NAME HERE

Radio World Trade Digest

January

$S's & N°.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 Stieglitz-Carbonaro line 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%. Divi- ded 43% to stockholders. 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 $58,000 for same period in '38. (Frank Ross, co. v-p., was elect- ed a director.)

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

CANDIAN FIGURES, according to Radio Trade Builder, include (a) 2,098,000 sets in use, (b) 275,000 sets sold per yr., (c) 12 mfrs., (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)


FOOLDER, Nichols & Fletcher, N. Y. C. Describes standard-brands radio receivers, refrigerators & appliances.


1940 RADO CATALOG No. 191, Allied Radio Corp., Chicago, Ill., 264 pp. Includes 5 new recessed 5 new line of P.A. systems, new control, new name apparatus—all in all more than 1,600 radio parts.


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

GREEN fluorescence 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.

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 & 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 & tellies' stations & 200 photos of stars. Cost to dealer, about 6c in each 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 scripdriver to dealers who show catalog to 5 friends & enclose 20c in stamps "to cover cost of handling." Hygrade Sylvania Corp. still using personalized oblivters 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, you're missing an opportunity that may not come again for 20 yrs!
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.

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!

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

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 distributors. About 700 dealers & Servicemen turned out to hear John P. 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.

ADJUSTS TO ALL BATTERIES

Adjustable but lower in price than previous model, G-E 61 new storage battery cell tester has permanently-attached resistor (shunt) which acts as load, & as spring for pred adjustment. Meter scale is 2/10 ins. long & accurate to 1/2.

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 reduced in the Farnsworth Corp. include J. B. McCaughan of San Francisco, chairman of the board; E. A. Nicholas, president; E. H. Vogel, vice-pres.; J. P. Rogers, vice-pres. & treas.; B. Ray Cummings, vice-pres. & pres.; and Edwin M. Martin, sey. (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.)


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 Pents, 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.
What's this World's Fair battle to make away with those swell telly sets used in the various infra-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 Jotsey jerneys & 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 .... Phiico'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 tube model 225-H will pick up frequency-modulation broadcast bands, 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 micro transmitting condensers.

Phiico Chicago distrbts are advertisng 11 dry electrolytics valued at $22.25 all for 80¢ & the dealers are pretty sure 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 him mention in the 4th Annual Modern Plastics competition. Another winner was RCA's molded rec- ord rack for phono fans.

R. D. Washburne, M.E. of Radio-Craft, was hit by 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! Union Radio Corp. has revised nets on its tube line; get your copy .... Farnsworth's phono radio combination called Panarama comes from pan, meaning all, and music—not as many thought, from pan, plus anuise.

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 .... Sparked by the N.A.B., Elliott Roosevelt, Emerson news commentator, has agreed to 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 2-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

DRAMATIZE BROADCAST SERIES

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 & Mercury.

FORD ENTERS RADIO BIZ

Jigsaw puzzle souvenirs of Mutual 'casting System's Gillette-sponsored World Series broadcasts were sent out to adv. agencies. To land drama, mem- bers were dressed in baseball suits. Specially designed for the 1940-41 season, the "Quaker" was culled from World's Fair Trylon & Perisphere mikes which was rebuilt from "B.End".

Changes & New Addresses

Save stamps & time! Address your mail right at

STEWART-WARNER distributors recently added are: H. J. Sackett Elec-


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

WILCOX-GAY CORP. have appointed the following as distrbs for their Recordio (a home & radio recording device): York Supply Co., 517 W. 3rd St., Cincinnati, Ohio; Appliance, Inc., 238 N. 3rd St., Columbus, Ohio; Ohio Valley Sound Service Co., 2024 Pennsylvania Ave., St. Evansville, Ind.; National Mill Supply Co., Pt. Wayne, Ind.; George D. Barkey 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 re- sistance products to jobber & industrial trade in parts of Eastern Pa., Md., Del., N. J. & D. C.

(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 & Paul's Cathedral, San Francisco, uses gold-plated mike to blend with other altar fixtures, 5-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 Exhibition showed at Majestic exhibit how radios are made. Drew mobs!

"HI-HO, SUPER!"

Cash-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, 8-tube, table-model super, with 5-in. speaker, A.C. & built-in antenna. Idea is to cash-in on Lone Ranger broadcast, movie & comic strip publicity.

RADIO-CRAFT for JANUARY, 1940
THE NEW
CHANNEL-ANALYZER

FOLLOWS THE SIGNAL FROM ANTENNA TO SPEAKER OF ANY SET
The Well Established and Authentic

SIGNAL TRACING

method of locating the very circuit in which there is trouble, and the very component that causes the trouble, is now for the first time available at a price any radio serviceman can afford, and in an instrument that has been expertly designed and calibrated. The years of experience SUPERIOR has had in making fine test equipment are behind the CHANNEL-ANALYZER, the instrument that does what the usual test equipment cannot do, that raises servicing to a new high plane of speed and accuracy and marks the owner as one of the advanced operators in his field.

THE CHANNEL-ANALYZER WILL—

- Follow Signal from antenna to speaker through all stages of any receiver ever made.
- Enable you to LISTEN IN* to locate cause of distortion. The CHANNEL-ANALYZER is the only instrument of its kind that you can connect directly to any stage and, therefore, discover the stage in which the distortion takes place.
- Instantly track down exact cause of intermittent operation.
- Measure both Automatic Volume Control and Automatic Frequency-Control voltages, and circuits without appreciably loading the circuit, using built-in highly sensitive Vacuum Tube Voltmeter. The Vacuum Tube Voltmeter may also be used as an independent instrument.
- Check exact gain of every individual stage in receiver.
- Track down and locate cause of distortion in R.F., I.F., and A.F. Amplifiers.
- Track exact operating voltages of each tube.
- Locate leaky condensers and all high resistance shorts, also show open circuits.
- Measure exact R.F., Disc, and I.F. Frequencies, amount of drift and comparative output of oscillators in markets.
- Track down exact cause of noise.

Fundamentally, what the Superior Channel-Analyzer does is to permit the serviceman to follow the Signal from antenna to speaker through each and every stage of any set ever made, and inferentially, of any set that ever will be made, using the SIGNAL as the basis of measurements. Thus if there is trouble in one particular channel or stage of a receiver, the serviceman can isolate the faulty stage and then proceed to ascertain the very part or component that causes the trouble. Many of the troubles in modern receivers are due to the Automatic-Volume and Automatic-Frequency-Control circuits and ordinary instruments do not permit measurements directly upon these circuits. The Superior Channel-Analyzer includes a direct-current Vacuum Tube Voltmeter that DOES make these measurements directly and with a negligible loading of the measured circuits.

Other problems cause to be problems too, when the quick-solution method of the Channel-Analyzer is applied. For instance, suppose a local oscillator in a superheterodyne drifts. The Channel-Analyzer has the presence of drift may be discovered, but also the amount and direction of drift.

Distortion is another difficulty that often nettles a serviceman. The Channel-Analyzer has a jack for the insertion of earphones so that you can listen to the signal directly from any stage and, therefore, discover the stage in which the distortion takes place. Next, the VTVM is used to discover the very component in that circuit that is causing the trouble. How often have you cherished the hope that someday you would own an instrument that enables you to measure the actual signal voltage across the load of any stage in the set, and thus by comparison determine the gain per stage. The Channel-Analyzer enables those dynamic voltage measurements and does a whole assortment of other work besides, yet at a price much less than that usually asked for a dynamic voltmeter alone.

D.C. Voltages have important bearings on receiver performance. All these voltages can be measured on the Channel-Analyzer with the receiver in reproducing operation. In fact, in the usual con- sideration, MEASUREMENTS WITHOUT MOLESTATION OF THE RECEIVER, gets rid of the drawbacks of most conventional equipment which greatly reduces the voltage it attempts to measure, or kills the signal completely.

= Tubes that are used in the receiver under test are also given a thorough check by the Channel-Analyzer and as such a specialized tube tester, does a much better job of checking tubes than any other method.

Noise, another serious problem to servicemen, can be located with the aid of the Channel-Analyzer and can be done with incredible speed.

Here are the basic components of the Channel-Analyzer:
2. One-stage, high-gain flat responding and linear diode detector.
3. Tuned-circuit, high-gain amplifier and linear diode detector, 100 KC to 25 MC.
4. D.C. Vacuum-Tube Voltmeter, for measuring the rectified R.F., I.F. or A.F., and for independent use on external circuits, all by front panel switching.

By adroit engineering and skillful application of a wide knowledge of servicing requirements based on Superior’s years of experience, the four components listed above are made to do so many things and do them so well and fast that a large benefit is bestowed on servicemen, their work speeded and their experience greatly extended, all at record-breaking low price.

$19.75

THE X-RAYOMETER FEATURES

NEW
GIANT 9" METER — AND
A Built-in Power Supply Enables Resistance Measurements
UP TO 30 MEGOHMS

SPECIFICATIONS:

- RESISTANCE MEASUREMENTS IN 3 RANGES: 0-0.050 Megohms, 0.050-1 Megohms, 1-30 Megohms.
- D.C. VOLTAGE MEASUREMENTS IN 3 RANGES, 0-0.1 Volts, 0-1.0 Volt, 0-10 Volt.
- D.C. CURRENT MEASUREMENTS IN 3 RANGES, 0-0.1 Milliamps, 0-1.0 Milliamps, 0-10 Milliamps.
- AC VOLTAGE MEASUREMENTS IN 4 RANGES, 0-120 Volts, 0-250 Volts, 0-500 Volts, 0-1000 Volts.
- CAPACITANCE DIRECTLY READ ON METER SCALE IN 3 RANGES, 0-1 MFD, 2 MFD, 50 MFD.
- X-RAYOMETER comes housed in a new army type, crystal casting, heavy speaker cabinet. Complete with test leads, instructions and tabular data. Shipping weight 25 pounds. Only $17.95

SUPERIOR INSTRUMENTS COMPANY
136 Liberty Street Dept. RC-1
New York, N. Y.

Please Say That You Saw It in RADIO-CRAFT
LATEST RADIO APPARATUS

HIGH-CAPACITY, HIGH-VOLTAGE ELECTROLYTICS

Sparque Products Co.  

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; 2½% accuracy. Meter ranges: D.C. volts, 0-10/-50/500/1,000; A.C. volts, 0-10/50/500/1,000; D.C. milliamperes, 0-1/10/100/1,000; Decibels, -8 to +15/15/25/25/35/50. Output ranges, same as for A.C. volts.

TESTERS FOR MOTOR-START CONDENSERS

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

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

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 "HAM" DE LUXE SIGNAL SHIFTER

Meissner Mfg. Co.  
Mt. Carmel, Ill.

A Volta-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

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 Hz to 7500 Hz. 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 3/4% on R.F. and Broadcast bands: 2% on higher frequencies. Audio frequencies in 5 bands: 100, 400, 1000, 5000, and 7500 cycles.

**New Airplane Full Vision, Direct-Reading Dial**

Condenser and other leakage tests to 100 megohms. All services on 50-130 volts A.C. or D.C. (any frequency). Model 1130-S comes complete with tubes, test leads, carrying handle, instructions. Size 12 x 9 x 1 3/4. Weight 3 pounds. Our net price...

Price: $11.85

**Portable cover $1.00 additional**

---

**The New Model 1250 Multitester**

**Sloping Panel For Precise RAPID SERVING**

**Specifications**

Complete A.C. and D.C. Voltage High and Low Capacity Scales and Current Ranges. .0005 to 1 mfd. and .05 to 50 mfd.

- **D.C. Voltage**
  - 0.25
  - 0.5
  - 1
  - 2
  - 5

- **A.C. Voltage**
  - 0.125
  - 0.25
  - 0.5
  - 1
  - 2

- **A.C. Current**
  - 0.125
  - 0.25
  - 0.5
  - 1

- **Inductance**
  - 1 to 500 Henries

- **2 Resistance Ranges**
  - 2000 ohms, 500-5000 ohms

Model 1250 works on 50-130 volts 60 cycles A.C. Comes complete with test leads, carrying handle, instructions. Size 9 1/2 x 9 1/2 x 9. Weight 2 pounds. Our net price...

Price: $11.85

**Portable cover $1.00 additional**

---

**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.**

- 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 servemen who through past purchases know they can always get SUPER-VALUES from Superior can be amazed and delighted when they read the specifications of this all-purpose instrument and then note the unbelievable low price. The Model 1280 features a 4½-D'Arsonval type meter for easy reading of the tiniest volts, and in line with our new policy of cramming appearance as well as serviceability in our new 1250 line of test equipment, our Model 1280 utilizes an all-metal etched panel, designed for beauty as well as ruggedness. The primary function of an instrument of this type is, of course, to make measurements and, in the new equipment this is our first thought. However, we also appreciate the importance the appearance of an instrument plays in the selection of a tester, especially for home use. We have, therefore, paid special attention to the outward design of all our instruments. For instance, the panels of the 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 15 pounds. Size 9 3/4 x 9 1/2 x 5 3/4. Our net price...

Price: $19.85

**Portable cover $1.00 additional**

---

**Superior Instruments Co.**

136 Liberty St., Dept. RC1
New York, N. Y.

Please Say That You Saw It in Radio-Craft
LATEST RADIO APPARATUS
(Continued from page 422)

"HOLD-TITE" CONNECTORS
Atlas Sound Corp.
1447 39 St., Brooklyn, N. Y.

NEW UNIT MATCHES MUSIC PICK-UPS TO RADIO SETS
Amperite Co.
561 Broadway, New York, N. Y.

NEW ADD-ON RADIO COMPASS
Western Electric Co.
195 Broadway, New York, N. Y.

MODEL 666-H
This Volt-Ohm-Milli-ampmeter is a complete pocket-size tester with AC-DC voltage ranges: 0-10-50-250-1000-5000 at 1.000 ohms per volt; DC Milliamperes 0.10-0.5-2.0-5.0-10-50; High and Low Ohms Scale. With RED DOT® Lifetime Guaranteed Measuring Instrument. ...Dealer Net ...$14.50

RED DOT® LIFETIME GUARANTEED INSTRUMEN
...With the Trippett Model 1612 on your counter, your place of business immediately is brought up-to-date. For here is a "customer acceptance" tube tester that is impressive in the quick "readiness" it gives with its five business-like appearing 7-inch meter which permits the customer to read along with the clerk. A quick spin of the Illuminated Roll-Down Speed Chart will give you the settings in a flash. All tube sockets for entire chart scanned in less than 5 seconds. Has all tube sockets including Locals and new Bantam-Tube High Voltage series tubes including 117Z6G. Future tubes provided for by filament voltages in 20 steps from 1 to 110 volt. Note that jack and separate line voltage control meter. Suede finish Silver Grey and maroon case and panel over heavy, streamlined steel. Dealer Net Price: ...$29.84. Model 1613 Portable Tester ...Same as above but has detachable cover with handle ...Sloping panel. ...Dealer Net Price $34.84.

Please Say That You Saw It in RADIO-CRAFT
"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-enamed 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 1/2/50/-150/500/1,000 V. A.C. and D.C.; output: 1.5/7 1/2/50/-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.

Known as the MIP--manufacturer's "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)

Please Say That You Saw It in RADIO-CRAFT
FREQUENCY-MODULATED PROGRAMS ON YOUR PRESENT RECEIVER!
(Continued from page 395)

FREQUENCY-MODULATED PROGRAMS ON YOUR PRESENT RECEIVER!

FLEECY WARM 100% VIRGIN WOOL AMANA BLANKETS

Retail Value . . . $7.55

- These warm, long wear blankets are of the finest quality 100% virgin wool. Beautifully finished with satin trim. Available in a variety of modern colors. Size 76" x 84"—Dealer Deposit $4.00

FAMOUS MARLIN GUNS


STURDY STEEL BRIDGE TABLE AND CHAIRS

Retail Value . . . $23.50

- Steelet Style "up" sets offer folding bridge furniture that the most exacting housewife will be proud to use. Rigid steel table and comfortable steel folding chairs with unbreakable hinges and no sharp corners to snag garments. Immediate Delivery on Dealer Deposit of $8.00

YOU CAN CASH IN, TOO!

What National Union is doing for others, it can do for you. Equalization or premium obtained on small down deposit; you get your deposit back as merchandise credit. Try it and see why it pays to buy your tubes and condensers the National Union Way.

ASK YOUR JOBBER OR WRITE
NATIONAL UNION RADIO CORP.
57 State St., Newark, N. J.

GIFT MERCHANDISE for PERSONAL USE in addition to EQUIPMENT FOR YOUR SHOP . . .

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 I.F. 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 the sharp cut-off tube, such as the 6SJ7, and incorporating a resistor and condenser in the grid-return circuit, as shown in Fig. 1. The function of this circuit is somewhat similar to that of Fig. 2.

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. 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, the grid 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 ran 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 your location, 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 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 capacitively coupled to the primary and which feeds the detector circuit. The action of the device is such that if the incoming frequency 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 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 grid 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 be fed into 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 m.c. 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, with tone C3, the secondary of the detection transformer, is such that zero voltage is obtained between point A and ground. After this is done, set the signal generator to 2.9 to 3.0 mc. with zero positive and negative D.C. voltage of equal magnitude should be observed 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 A 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.

Significant retuning of the grid stage 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 characteristic which accentuates the higher frequencies 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 flatness at various frequencies if high-fidelity reception is desired. The arrangement provided in the receiver 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 is varied over 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 other expansion system.

If sufficient signal strength is obtained from the station, and the limiter is operating correctly, the reception is devoid of noise. Auto correction has no effect, static is unknown, and even tube noise is practically absent. The receiver seems "dead" in the interim between program and announce- ments. The advantages of frequency modula-
tion 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-53, 3 mc., 1st, 2nd and 3rd I.F.T.; One Browning detection transformer, type BL-54-3 mc., 4th I.F.T.; One Browning high-frequency tuner, type BL-40 Li; One Kenyon power transformer, No. 222; One Kenyon choke, No. KC200, 20 hys.; One Browning chassis; Dial, knobs, etc.

CONDENSERS

Sixteen Tuba Deutschmann paper tubular, 0.10 pf., 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 Tuba Deutschmann paper tubular, 0.05-mf., 250 V.; Two electrolytic, 8 mf., 450 V.; One D.P.D.T. switch, Sw1, Sw2.

RESISTORS

Three I.R.C. 400 ohms, 3/4-W., R1, R4, R9; Four I.R.C. 50,000 ohms, 3/4-W., R2, R10, R15, R20, R26; Six I.R.C. 2,000 ohms, 3/4-W., R3, R11, R16, R20, R26, R27; One I.R.C. 10,000 ohms, 3/4-W., R5.

(Continued on page 488)
Of course, our D.C. component is now lost and must be restored by the use of a diode across the image signal 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 input 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 if the sync. 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 6SN6 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 very low. Consequently the voltage across R1 cannot follow rapid variations and C1 is charged to a value approximating 80% of the complete signal. This voltage is not high enough to be detected by a voltage divider network controlled from the front panel and connecting the diode to the plate of the vision amplifier which will 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 curve. A 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 unimpeachable impulses which will not do for synchronizing the sweep oscillators we shall choose. A positive pulse is needed so a 6SN6 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 tube across the screen in a series of uniform straight lines. The waveforms of these sawtooth waves but the simplest is the use of gas triodes such as the 854. 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 854 to pass 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 degrading at the edges of the image. Type 6N7s 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 the proper frame 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 a pair of 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 300 lines and the horizontal resolution is in excess of 300 lines. The interface holds perfectly and flicker is unnoticeable.

Tentative operating voltages for the Osborne models TK-1 and TB-1 television 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, 280 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.
- 6S6F sync. inverter—3, 0 V; 5, 90 V.
- 6C5 osc.—3, 200 V.
- 1852 sound I.F.—5, 25 V; 8, 100 V.
- 6SQ7 sound det.—6, 150 V.
- 6V6G sound amp.—3, 260 V; 4, 265 V; 8, 12 V.
- 844 frame osc.—3, 65 V.
- 6N7G frame amp.—3 & 4, 445 V (each).
- 5V4G rect.—8, 350 V.
- 525-ohm field, rect. side—330 V.
- T1, high side of high-voltage secondary—1,200 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, 2,360 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 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.
New HICKOK Model 08

A.C.—D.C. APPLIANCE TESTING VOLT-WATTMETER

A SUPER VALUE! This Hickok-quality dual meter tester is a real value for an accurate, permanently calibrated tester for household appliances—refrigerators, washers, etc. Checks line voltage while measuring consumption in watts.

RANGES: WATTS: 0-750-1500. Note unit form scale—an exclusive Hickok feature. VOLTS: 0-300. Red Line at 410 and 226 volts. Meter has magnetic zone movement giving exact-increment practically uniform scale. Difficulties due to line checks and errors caused by using test leads in close proximity to live wiring are eliminated. Mains loading is reduced to one-tenth the normal operating current with full complement available. Bulletin No. 300 gives complete data.

DEALER'S NET PRICE............. $19.50

ADDRESS ALL INQUIRIES TO THE HICKOK ELECTRICAL INSTRUMENT CO. 7274 PUPERT AVE.—CLEVELAND, O. U.S.A.

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20 c, in order for 10
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3¢ each, Tesla-Odinin Coil 40¢ each
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2 Sp’k Tesla-Odinin Coil 48¢
1/2 K.W. Exc. Trf. Data, included FREE!
3 Sp’k Odinin: 110 Vt.
"Kick Coil" type...40¢
3 Sp’k Tesla Works on Ford Sp’k Coil...40¢
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100 Mech. Movements String Galvanometers
20 Motor Hook-ups 20 Simple Bell Circuits

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Single, 40¢ each. Get New Catalog 100 A.

The DATAPRINT Co.
Lock Box 322C, Ramsey, N. J.

Servicemen! Radio Technicians! Engineers! Get the bigger and better Sylvania Technical Manual...264 pages of vital tube information—complete data and diagrams for 344 types of tubes. Gives operating conditions, characteristics and circuit applications for standard glass tubes, "G", "GT", Loktal, Metal, Majestic and special types. Data on television amplifiers, cathode ray tubes, etc. Send 35¢ for your copy today.


LATEST RADIO APPARATUS

(Continued from page 425)

LIGHTWEIGHT GENERATOR

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

D ESIGNED especially for use on aircraft, marine and police radio, this "super hi-power" dynamo is unusually small for its power output; weight of 150-W. size is only 13 lbs. One-piece construction eliminates many parts and life-time oiling eliminates maintenance attention. Available in 2 sizes, 160 and 200 W., output up to 1,000 V, and input from 5.5 V. up.

VERSATILE PA SYSTEM

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

I N 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

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

D ESIGNED evidently forjuvenile science experimenters and radio fans, this kit of parts for building an elementary type of photocell electric cell is both educational and practical. The kit includes a lead anode, chemically-treated cathode, 3 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

T HIS new model 6X4 microphone with an output level of 55 db has a substantially "dead" back pick-up. Frequency response, 30 to 10,000 cycles. Has automatic barometric compensator.

Please Say That You Saw It in RADIO-CRAFT

NEW CRYSTAL HEADPHONES FEATURE "OVERHEAD" CORD

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

T HE 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 cycle is 40,000 ohms.

NEW-PROCESS FIXED CONDENSERS

Ariston Laboratory, Inc.
4045 Diversy 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.

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

25-WATT, 1.7 TO 60 CYCLE XMITTER

The Hallicrafters
2611 S. Indiana, Chicago, Ill.

T HE latest addition to the Hallicrafters line of amateur and commercial transmitters is the 6-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.

T HE 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
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. 830 precision tuning dial affords 600 graduations which may be exactly logged for future reference. Ideal for wide-range oscillators, etc.

(See page 488 for other latest items)

An improved highly efficient noise limiter; accurately calibrated main dial; band spread dial calibrated for 20, 40, 80 and 10 meter amateur bands; sensitive "S-Meter" and variable selectivity crystal filter are a few of the other features which have made the "HQ-120-X" one of amateur radio's most popular receivers.

Write for Booklet
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 Lighthouse and launched a small boat from the mouth of the Columbia, and made arrangements for the boys to broadcast from there. The Lightship being much closer to them than Tongue, believed 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 fire walker; 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, roaring launch and swung themselves in . . . landing inside on an already bruised and maltreated member of their anatomical family.

Painfully arising, they immediately re-\ nashtoff, when the opportunity presented itself, 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 inwardly, 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 obilging sailors . . . one fore and one aft, and was deposited in a chair by 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 transmissions.

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 on 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 profound disgust, remained in gastro-nomics status quo.

Arriving both at the Coast Guard station the green-faced crew crawled bedraggledly ashore. They winced aside offers of hard-bottomed chairs. Smiling in the polite, painted 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 curvy-be voluted 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. As much as no one thought he had it in him.

And they arrived home at 4 A.M., to quote the harp's tails drooping behind them.

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

The forthcoming 1940 season will see further development of an entirely new "re\ design" plan which well might be termed revolutionary. This plan is benefitting 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 Mica\ mold 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 Tubul\ tive condenser series which was introduced more than 2 years ago. These were very compact tubular dry electrolytic condensers in a variety of ranges, and proved to be very satisfactory.

The first group developed was the Tubul\ tive condenser series which was introduced more than 2 years ago. These were very compact tubular dry electrolytic condensers in a variety of ranges, and proved to be very satisfactory. The latest development is the use of a new, improved, dry electrolytic condenser regardless of type.

The ballast tube problem was next tackled. There were about 2,000 different types of biasing tubes, here and there in stock, then in use and it was impossible for the trade to stock them. Ballast tubes were de-
NEW CIRCUITS IN MODERN RADIO RECEIVERS

(Continued from page 408)

degree of deceleration is insufficient. The decoder alone no harm in 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 70L7G and the 3Q5GT are supplied from a single A.F. source. The latter having a lower output is fed with about 40½ more signal by means of the grid divider indicated. The output transformer completes winding is designed to match the A.C. plate resistance of the 3Q5GT tube, but since the A.C. plate resistance of the 70L7G 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 70L7G 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.

[Image and text regarding New CIRCUITS IN MODERN RADIO RECEIVERS, continued]

[Image of text continued]
20 NEW TUBES
(Continued from page 412)

<table>
<thead>
<tr>
<th>Pattern electrode dissipation</th>
<th>1 max. I/Mw sq. cm.</th>
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</thead>
<tbody>
<tr>
<td>Focusing electrode No. 1</td>
<td>(Anode No. 2) voltage</td>
</tr>
<tr>
<td>Focusiing electrode No. 1</td>
<td>1,500 max. I</td>
</tr>
<tr>
<td>Control electrode (grid)</td>
<td>never positive</td>
</tr>
<tr>
<td>D.C. Resistance between:</td>
<td>Cathode and grid</td>
</tr>
<tr>
<td>Cathode and deflection plate D₁</td>
<td>1 max. megohms</td>
</tr>
<tr>
<td>Cathode and deflection plate D₂</td>
<td>5 max. megohms</td>
</tr>
</tbody>
</table>

Typical Operation:

Heater voltage 2.5 2.5 2.5 volts
Pattern electrode voltage 200 950 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

<table>
<thead>
<tr>
<th>Voltage (approx.)</th>
<th>peak to peak value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>2 3 microamperes</td>
</tr>
<tr>
<td>12</td>
<td>2 3 microamperes</td>
</tr>
</tbody>
</table>

WELLWORTH TRADING CO.
1915 So. State St., Dept. RC-140, Chicago, Ill.

Wellsell TRADING CO.
1915 So. State St., Dept. RC-140, Chicago, Ill.

20 NEW TUBES
(Continued from page 412)

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</tr>
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Typical Operation:

Heater voltage 2.5 2.5 2.5 volts
Pattern electrode voltage 200 950 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

<table>
<thead>
<tr>
<th>Voltage (approx.)</th>
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<tr>
<td>0.1</td>
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WELLWORTH TRADING CO.
1915 So. State St., Dept. RC-140, Chicago, Ill.

Wellsell TRADING CO.
1915 So. State St., Dept. RC-140, Chicago, Ill.

20 NEW TUBES
(Continued from page 412)

<table>
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<tr>
<th>Pattern electrode dissipation</th>
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</tr>
<tr>
<td>12</td>
<td>2 3 microamperes</td>
</tr>
</tbody>
</table>
Grid signal—swinging voltage (peak to peak) 6 volts
Threshold current 4 ampere
Amplifier factor 100
Direct interelectrode capacities: Grid—plate 500,000 mfd.
Grid—filament 5,000 mfd.
Plate—filament 0.06 mfd.
Bulb ST-19

**TABLE IV**

<table>
<thead>
<tr>
<th>Tube</th>
<th>Filament voltage (A.C. or D.C.)</th>
<th>A.C. plate voltage</th>
<th>D.C. plate voltage</th>
<th>Operating conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.A.</td>
<td>6.3 volts</td>
<td>1,250 volts</td>
<td>1,250 volts</td>
<td>Transformer, 900 to 950 volts</td>
</tr>
<tr>
<td>B.B.</td>
<td>6.3 volts</td>
<td>1,250 volts</td>
<td>1,250 volts</td>
<td>Transformer, 900 to 950 volts</td>
</tr>
<tr>
<td>C.C.</td>
<td>6.3 volts</td>
<td>1,250 volts</td>
<td>1,250 volts</td>
<td>Transformer, 900 to 950 volts</td>
</tr>
</tbody>
</table>

**Typical operation:**
- Transformer, 900 to 950 volts
- Transformer, 900 to 950 volts
- Transformer, 900 to 950 volts

**Typical conditions:**
- Transformer, 900 to 950 volts
- Transformer, 900 to 950 volts
- Transformer, 900 to 950 volts

**Data on operation in class C available from manufacturer.**

**HANDBY POCKET "LAB"**


**MODEL 612**

A universal wide range AC-DC Volt - Ohm - Milliammeter, nomally priced. Ranges: AC-DC Volts 0-15-250-450 (60 ohms per volt); DC MA. 0-1-5-15-50. High and Low Ohms scales. Resistance, Low ohms, 0-400, backup circuit with 25 ohm at center scale. 0-5000 ohms. External battery may be used for higher resistance measurements. Size 3 1/4 x 6 1/2 x 2 1/4. Attractive modernistic silver and black panel. Dealer Net Price $7.95

**MODEL 511**

A Handy All Purpose Pocket Size D.C. Volt - Ohm - Milli-meter with square Read?t?le has four dial for reading 0-3-15-300 DC Volts and 0-1-5-2000 ohms. Furnished in black wood case, complete with self-contained battery. Dealer Net Price $2.85
(Continued from preceding page)

### Plate Measures, Useful

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate input*</td>
<td>75 max.</td>
</tr>
<tr>
<td>Plate current</td>
<td>42 milliamperes</td>
</tr>
<tr>
<td>D.C. plate current</td>
<td>200 milliamperes</td>
</tr>
<tr>
<td>Load resistance</td>
<td>500 ohms</td>
</tr>
<tr>
<td>Effective load resistance (plate-to-plate)</td>
<td>1,500 ohms</td>
</tr>
<tr>
<td>Max.-sig. grid voltage</td>
<td>105 volts</td>
</tr>
<tr>
<td>Max.-sig. max. plate voltage</td>
<td>1,000 volts</td>
</tr>
<tr>
<td>Max.-sig. max. grid voltage</td>
<td>1,000 volts</td>
</tr>
<tr>
<td>Plate voltage</td>
<td>1,250 volts</td>
</tr>
<tr>
<td>D.C. grid current</td>
<td>50 milliamperes</td>
</tr>
<tr>
<td>Power output (approx.)</td>
<td>0.2 watt</td>
</tr>
</tbody>
</table>

**Typical operation:**

- **As R.F. Power Amplifier—Class B Telephony**
- **Carrier conditions per tube for use with a modulator.***
- **Modulation factor of 1.0**

### Tentative Characteristics and Ratings

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filament voltage (A.C. or D.C.)</td>
<td>10.0 volts</td>
</tr>
<tr>
<td>Grid-filament</td>
<td>5.3 milliamps</td>
</tr>
<tr>
<td>Plate-filament</td>
<td>0.8 milliamp</td>
</tr>
<tr>
<td>Bulb</td>
<td>ST-19</td>
</tr>
<tr>
<td>Cap</td>
<td>medium metal line</td>
</tr>
<tr>
<td>Max. plate current</td>
<td>150 milliamperes</td>
</tr>
<tr>
<td>Minimum grid current</td>
<td>9 milliamperes</td>
</tr>
</tbody>
</table>

### Ratings and Typical Operating Conditions

- **Classification:**
  - Class B

- **Amplifier voltage:** 1,250 volts
- **D.C. plate current:** 1,000 milliamperes
- **D.C. screen voltage:** 900 volts
- **D.C. suppressor voltage:** 225 volts

- **Screen grid voltage:** 500 volts
- **Screen grid current:** 20 milliamperes
- **Screen time constant:** 100 microsec.
- **Miscellaneous:**
  - **Sensitivity:** 0.1 microvolt
  - **D.C. max. plate voltage:** 1,500 volts

---

### Tentative Characteristics and Ratings

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filament current</td>
<td>3.25 amperes</td>
</tr>
<tr>
<td>Transconductance, for zero grid cur. of 40 ma.</td>
<td>4,500 millimhos</td>
</tr>
</tbody>
</table>
| Direct interelectrode capacities:**
  - **Grid-plate:** 0.05 microfarad
  - **Grid-screen:** 0.05 microfarad
  - **Plate-suppressor:** 0.15 microfarad

<table>
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<td>Grid-filament</td>
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- **Screen time constant:** 100 microsec.
- **Miscellaneous:**
  - **Sensitivity:** 0.1 microvolt
  - **D.C. max. plate voltage:** 1,500 volts
RADIO-CRAFT for JANUARY, 1940

D.C. grid voltage (grid No. 11) -60 to -60 volts
Peak R.F. grid voltage 50 volts
D.C. plate current 80 milliamperes
D.C. suppressor current 4 milliamperes
D.C. screen current 5 milliamperes
D.C. grid current (approx.) 0.3 milliamperes
Driving power (approx.) 0.4 watts
Power output TABLE 36 41 watts

RADIO-CRAFT

Filament current to end each point
Ventilation Plate current
Plate current Grid voltage
Plate current Screen voltage
Screen voltage Power output
Load Power output

As Excitation at crest Averaged voltage

1,500 10,000
2,000 12,500
750 6,000
2,500 17,500
1,000 6,000
750 6,000

212-3G TABLE VIII

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

Tube must be operated vertically with ample ventilation provided. Sculls should be cooled by radiator connectors.

Maximum Ratings

Class B Audio Telephony
Plate volts 750 1000 1500
Plate current (max.) 175 175 175
Plate dissipation (watts) 75 75

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 2,000, 3,000, 4,000
Plate current (max.) 150, 200, 250
Power output (watts) 70 125 250
Excitation power roughly 1/10 the input power.

Class B Audio Telephony
Plate Voltage 250 250 250
Plate-to-Plate Power Output Impedance (watts) 12,500 2,500 500
3,000 2,500 500
1,500 1,000 250
1,000 600 200
750 600 100

212G TABLE IX

Filament voltage 2.8 or 1.4 volts
Screen voltage 0.05 or 0.10 amperes

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 1,000 millimhos
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 millimhos
Plate resistance 100,000 ohms (approx.)
Load resistance 8,000 ohms
Power output 270 milliwatts
Total distortion 7.5%

12BG2G TABLE XI

Heater voltage 12.6 volts
Heater current 0.3 amperes

Pentode Section
Plate voltage 90 volts
Screen grid voltage 90 volts
Control grid voltage -3 volts
Plate current 7.0 milliamperes
Screen grid current 2.8 milliamperes
Plate resistance 200,000 ohms
Transconductance 1,900 millimhos
Amplification factor 300
Control grid voltage for transconductance = 2 microhms = -12.5 volts

Triode Section
Plate voltage 90 volts
Plate current 2.3 milliamperes
Screen voltage 37,000 ohms
Transconductance 2,400 millimhos
Amplification factor 90
Approx. grid voltage for plate current cut-off = -2.5 volts

212GT TABLE XII

Heater voltage 32.5 volts
Heater current 0.4 amperes

Tentative Operating Characteristics

Power Amplifier Section
Plate voltage 90 volts
Screen grid voltage 90 volts
Control grid voltage -7 volts
Plate current 38.7 milliamperes
Screen grid current 3.0 milliamperes
Plate resistance 4,900 ohms
Transconductance 6,000 millimhos
Amplification factor 90
Load resistance 2,000 ohms
Power output 5.9 watts
Total harmonic distortion 5.3 0.0 0.0
2nd harmonic 2.2 6.5 6.5
3rd harmonic 4.6 5.5 5.5

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

79AG7 TABLE XIII

Heater (A.C. or D.C.) 45 volts 0.15 ampere
With 45 volts between pins 2 and 3.Tube return to cathode
Bulb Glass
Base Small T-1 pin octal

Maximum Ratings and Characteristics

A.C. plate voltage r.m.s.
(no series resistors) 25 max. volts
A.C. plate voltage r.m.s.
(100 ohms series) 250 max. volts
Peak plate current 60 max. milliamperes
D.C. output current 100 max. milliamperes
D.C. output current 60 max. milliamperes
Average plate current drop 9 at 200 ma. D.C. 16 volts

1 With no external connection to pin No. 2.

Please Say That You Saw It in RADIO-CRAFT
**A. C. ELECTRICAL POWER**

from a Windmill, from available Waterpower, from your Automobile, from your Motorcycles, from your Bicycle, from Pedals or Handcrank for portable Radio Transmitters, Navy Floodlights, Advertising Signs; do you want to operate AC, Radio sets, etc., in 22 V. 50Hz从事 light systems; operate two generators in series to get 220 V. AC, obtain two phase and three phase AC, etc.

**NEW LABORATORY TYPES C.R., SCOPES OR GRAPH**

Allen B. DuMont 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 full 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.

**FREE TRIAL OFFER**

New Remington Deluxe Noiseless Portable! AS LITTLE AS 10¢ A DAY

The New Famous Remington Deluxe Noiseless Portable that operates in a whisper, is yours for only 10¢ a day.

Send 25¢ deposit, balance C.O.D.

Shipping weight 18 lbs.

MONKEY-BACK GUARANTEED

WELLWORTH TRADING COMPANY

1915 S. State Street, Dept. RC-140, Chicago, Ill.

**LATEST RADIO APPARATUS**

(Continued from page 481)

**MODERN SERVICEMAN'S BENCH LAMP**

Eagle Electric Mfg. Co., Inc. 50 Hall St., Brooklyn, N. Y.

THIS No. 1558 indirect-lighting lamp is highly convenient for use by the Serviceman; it can be clamped to the bench and 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 in.

**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 8½ x 8½ ins. in size. It is a 6-tube, 2-band job, broadcast (on built-in antenna) and from 4.6 to 122 megacycles (using external antenna), and has 6 station pushbuttons. Has tuning "eye," and phono pickup (or television sound) terminals.

**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. 200,000 ohms, ½-W., R14;
One I.R.C. 5,000 ohms, ½-W., R19;
Three I.R.C. 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.

**TUNES**

Two Raytheon type 6SK7's, V1, V3;
One Raytheon type 6K8, V2;
One Raytheon type RK-1852, V4;
One Raytheon type 6S57, V5;
One Raytheon type 6H6, V6;
One Raytheon type 6U5, visual indicator, V7;
One Raytheon type 80, V8.

Please Say That You Saw It in RADIO-CRAFT
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 isomorphography 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 capability 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 Coronavisor 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 Coronavisor 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.B. 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 Coronavisor 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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P. A. HANDBOOK

RADIO-CRAFT
for JANUARY, 1940

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CHAPTER II—VACUUM TUBES
CHAPTER III—CIRCUIT ANALYSIS
CHAPTER IV—MICROPHONES
CHAPTER V—AMPLIFIERS AND PREAMPLIFIERS
CHAPTER VI—LOUDSPEAKERS
CHAPTER VII—Horns and Baffles
CHAPTER VIII—AMPLIFIER COMPONENTS
CHAPTER IX—POWER SUPPLIES
CHAPTER X—ACCESSORIES
CHAPTER XI—RECORDING AND PLAYBACK
CHAPTER XII—MATCHING AND MIXING
CHAPTER XIII—ACQUISITIONS
CHAPTER XIV—SELLING SOUND
CHAPTER XV—CALL SYSTEMS
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CHAPTER XVIII—HEARING AIDS
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WIRELESS MICROPHONES FOR PROFESSIONAL P.A.

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, a portion of speech will occur. The output from the receiver should be controlled by the receiver volume control. When testing with a telephone 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 in on your 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. How often do you want to use the device on an electric power line, there is available the diagram shown on page 359.

EMERGENCY SERVICING WITHOUT METERS

Shield baffle plate can be placed between the 2 tubes. 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. 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 cross-modulation interference. The first place to look is in the antenna circuit or lst 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 decreasing 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. Deenergize the antenna, mechanically or electrically may benefit, in the latter case a variable antenna series condenser is added (C). Another alternative is to insert an antenna potentialmeter (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 the coil should be changed to a choke variable-mu type of tube, such as the types 34, 35/44, 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 inicable 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. On the other hand, 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 oscillator 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.

SERVING PUZZLERS

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.V.M. disclosed an intermittent shorting of turns. Replacement of the coil cured the trouble. Later, a microwave examination disclosed that the enamel wire insulation would break down at radio frequencies but not on the D.C. from the ohmmeter of Raymond W. Tackett.

Features in January issue of
Radio & Television Incorporating FOTO-CRAFT

Facsimile Features "R & T"
The First "Visi-Quiz"
"Junk-Box" Facsimile Recorder
2.5 Meter Transceiver
—Harry D. Hooton, W8KPB
A Modulator for the Beginner's Ham Transmitter
—C. W. Palmer, E.E.
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RC-140

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 208-460-546 SERIES

To improve tone quality and reduce micro-
phonics in this receiver add one 2-meg. re-
sistor. Attach it to the plate of the 6Q7G and 25L6G. To reduce hum, the 2-meg. re-
sistor 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 45th 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 page 390.)

Telephone circuits were used, for the sec-
ond 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

The wedding of wired sound and radio

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JOE MARTY, JR., EXECUTIVE SECRETARY
304 S. DEARBORN STREET, CHICAGO, U.S.A.

*Oh, read some poor's the gift I give us to see ourselves as others see us . . . ." wrote Burns, but television last month fulfilled the bard's wish. With propellers still turn-

(Continued on page 446)
WONDERFUL NEWS FOR SALESMEN
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Book No. 14
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BREAKING INTO RADIO SERVICING

Book No. 15
ABC OF REFRIGERATION

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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 WHEE, 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 6877'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 18 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 to the plate of the 6Y6G tube, there are only 200 effective volts, as the cathode voltage subtracts from the plate voltage indicated.

To simplify the construction and adjustment of the amplifier, the following table of the tubes employed, and their currents and voltages are given:

<table>
<thead>
<tr>
<th>Tube</th>
<th>Plate Voltage</th>
<th>Screen Voltage</th>
<th>Grid Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>6877</td>
<td>100 V</td>
<td>75 V</td>
<td>15 V</td>
</tr>
<tr>
<td>6Y6G</td>
<td>110 V</td>
<td>85 V</td>
<td>15 V</td>
</tr>
</tbody>
</table>

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 200.

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 6877'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-grid 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 6Y6G.

Resistor D passes 150 ma. which is equal to the total current passed by E (21) plus the total plate and screen-grid currents of both output tubes.

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+12=15 ma. 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 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. (315 V.)

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 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 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 dynamic feedback for only those frequencies above which compensation is desired. The response current, 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 capable of carrying 66 milliamperes.

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.

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RADIO AIDS "FLYING DOCTORS"

(Continued from page 393)

PIONEERS' RADIO STATIONS

The Traeger type 37 pedal transceiver outperformed others in tests just described by utilizing 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 a similar make used in the microphone amplifier. Telegraphy or telephony may be transmitted over this station, on any one of 3 fixed wavelengths between 10 and 200 meters. Coded for the "A" tube drain is 0.26-A.; on phone, 0.6-A.

A pedal generator delivers the requisite plate power only to the transmitter; the transmitter and receiver filaments however, have a common "A" source. An Eversound Air-Cell supplies the requisite "A" voltage to 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 is tested 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 transistor under 2-1/2 transmitter with a range up to 700 mi. on telephony under good conditions.

An area of more than a quarter-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. Kennwell, 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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BIOGRAPHY

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