OCT. 3
1931

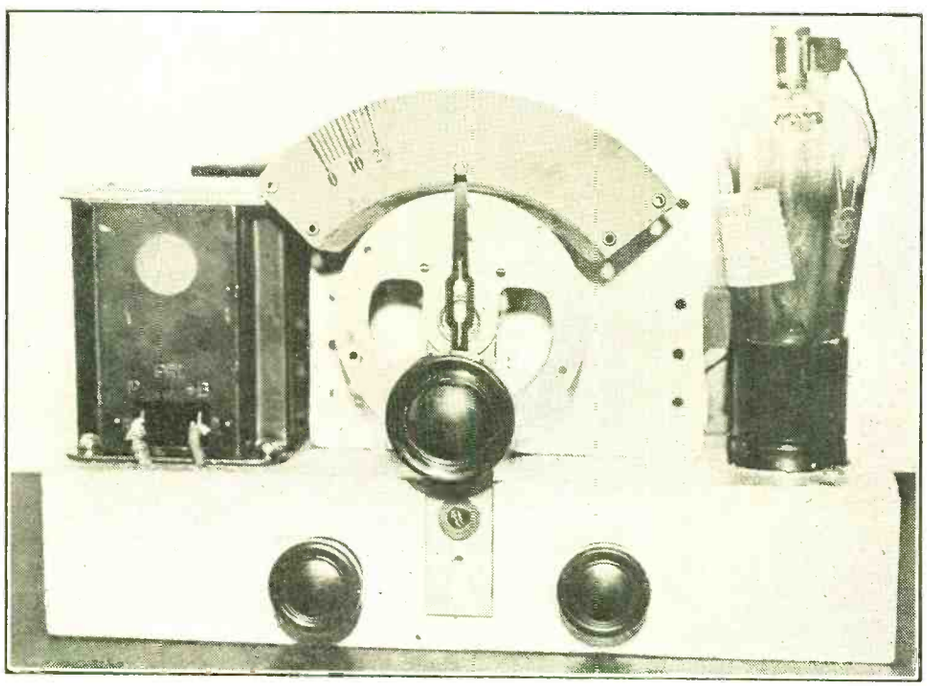
CAPITALIZING REGENERATION
IN AUDIO AMPLIFIERS

RADIO
REG. U.S. PAT. OFF.
WORLD

The First and Only National Radio Weekly

497th Consecutive Issue—TENTH YEAR

MIDGET SET FOR AUTO

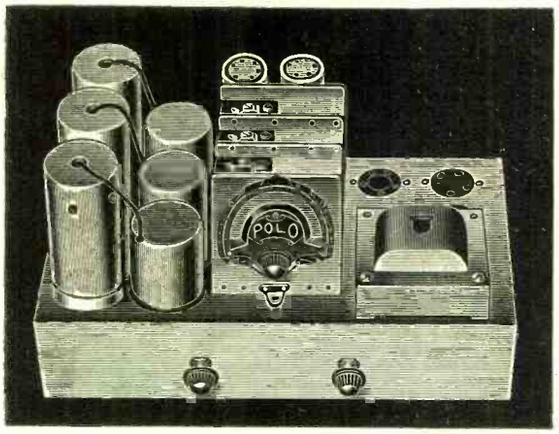


Photograph by Herbert E. Hayden

Front view of a simple set for installation in an automobile. See page 3.

Price
15¢
Per Copy

POLO 5-TUBE WIRED CHASSIS



$14.95

Our new wired chassis, 13" wide, 9½" front to back, flap 3" high, overall height 8", @ $14.95 net to trade, including Rola dynamic speaker, 1932 model, is Polo's newest big bargain. Coils, two radio frequency tubes and detector tube shielded. Tubes used: two 235, one 224 (detector), one 247 and one 280. Cat. MCH @ $14.95.

Kit of tubes, Cat. KTPM, $4.03 extra.

Three-gang, stator-shielded condenser with trimmers; full-vision, illuminated projection dial; volume control; tube shields for radio frequency and detector; 16 mfd. filter capacity; phonograph jack. For 105-120 v, 50-60 cycles.

Midget walnut cabinet (Cat. MWC) to house chassis and speaker, $4.05 extra, or install in a console.

Polo Midget approved by Radio World Laboratory

POLO ENGINEERING LABORATORIES

125 West 45th Street Telephone: BRyant 9-6516 New York, N. Y.

NEW . . .

SMALLER—LIGHTER

A CARDWELL QUALITY CONDENSER AT A

LOWER PRICE!

FOR RECEIVING, UP TO 365 MMF.
FOR TRANSMITTING, UP TO 150 MMF.

THE CARDWELL MID WAY FEATHERWEIGHT

SEE IT!

SOLD IN NEW YORK CITY BY

LEEDS RADIO	45 VESEY STREET
SUN RADIO	64 VESEY STREET
GROSS RADIO CO.	25 WARREN ST.

LITERATURE ON THESE AND OTHER CONDENSERS ON REQUEST.

THE ALLEN D. CARDWELL MFG. CORP.

95 Prospect Street, Brooklyn, N. Y.

NEW! for AUTO Radio

Types to Fit All Makes of Cars

LYNCH

Spark Plug and Distributor Suppressors

Metallized principle insures dependability and long life.

Write for illustrated catalog WS.

LYNCH MFG. CO., Inc., 1775 Broadway, N. Y. C.

NATIONAL DRUM DIAL

National Velvet Vernier drum dial, type H, for ¼" shaft. An automatic spring take-up assures positive drive at all times. Numbers are projected on a ground glass. Rainbow wheel changes colors in tuning. Modernistic escutcheon. Order Cat. ND-H @ $3.13.

GUARANTY RADIO GOODS CO.

143 West 45th Street, New York, N. Y.

---

853 PAGES, 1,800 DIAGRAMS IN RIDER'S NEW 6-LB. MANUAL

THE most complete service man's manual is "The Perpetual Trouble Shooter's Manual," by John F. Rider, published April, 1931, and full of real information. Wiring diagrams of ALL popular commercial receivers and kit sets from 1922 to 1931, inclusive. Also contains a course in trouble shooting. Loose leaf pages, 8½ x 11", bound. 853 pages; index and advertisements on additional pages. Order Cat. RM-31, and remit $4.50. We will then pay postage. (Shipping weight, 6 lbs.) Ten-day money-back guarantee

RADIO WORLD

145 West 45th Street, New York, N. Y

SYNCHRONOUS MOTOR, $4.25

For use on 60-cycle AC line. 12-inch turntable included. 80 revolutions per minute. The speed is self-regulated. This compact synchronous motor may be used with a phonograph pickup to play records. Cat. SYN-M @ $4.25.

DIRECT RADIO CO., 143 W. 45th St., New York, N.Y.

Fixed Condensers

Dubilier Micon fixed condensers, type 642, are available at following capacities and prices:

.0001 mfd.	10c	.006	20c
.00025 mfd.	10c	.00025 with slips.	20c
.0003 mfd.	10c	All are guaranteed	
.00035 mfd.	12c	electrically perfect and	
001	12c	money back if not	
0015	12c	satisfied within five	
.002	18c	days.	

GUARANTY RADIO GOODS CO.

143 West 45th St., New York, N. Y.

Two for the price of One

Get a FREE one-year subscription for any ONE of these magazines:

- ☐ RADIO CALL BOOK MAGAZINE AND TECHNICAL REVIEW (monthly, 12 issues)
- ☐ POPULAR MECHANICS AND SCIENCE AND INVENTION (combined) (monthly, 12 issues).
- ☐ POPULAR SCIENCE MONTHLY
- ☐ RADIO INDEX (monthly, 12 issues), stations, programs, etc.
- ☐ RADIO (monthly, 12 issues; exclusively trade magazine).
- ☐ RADIO LOG AND LORE. Monthly. Full station lists, cross indexed, etc.
- ☐ AMERICAN BOY—YOUTH'S COMPANION (monthly, 12 issues; popular magazine).
- ☐ BOYS' LIFE (monthly, 12 issues; popular magazine).

Select any one of these magazines and get it FREE for an entire year by sending in a year's subscription for RADIO WORLD at the regular price, $6.00. Cash in now on this opportunity to get RADIO WORLD WEEKLY, 52 weeks at the standard price for such subscription, plus a full year's subscription for any ONE of the other enumerated magazines FREE! Put a cross in the square next to the magazine of your choice, in the above list, fill out the coupon below, and mail $6 check, money order or stamps to RADIO WORLD, 145 West 45th Street, New York, N. Y. (Add $2.00, making $8.00 in all, for extra postage to Canada for both publications.

Your Name.....

Your Street Address .....

City.....State.....

DOUBLE VALUE!

- ☐ If renewing an existing or expiring subscription for RADIO WORLD, please put a cross in square at beginning of this sentence.
- ☐ If renewing an existing or expiring subscription for other magazine, please put a cross in square at the beginning of this sentence.

RADIO WORLD, 145 West 45th Street, New York. (Just East of Broadway)

NEW BOOKS

"EXPERIMENTAL RADIO ENGINEERING," by Prof. John H. Morecroft, of the Department of Electrical Engineering, Columbia University. A companion book to the author's "Principles of Radio Communication," but in itself a text on practical radio measurements. Cloth bound, 345 pages, 6 x 9, 250 figures.....$3.50

"THE RADIO HANDBOOK," by James A. Moyer and John F. Wostrel, both of the Massachusetts Department of Education. Meets the need for a complete digest of authoritative radio data, both theoretical and practical. Flexible binding, 886 pages, 650 illustrations.....$5.00

"RADIO FREQUENCY MEASUREMENTS," by E. B. Moullin, M.A., A.M., E.E., M. I. Rad. Eng. Reader of Engineering Science in the University of Oxford. Second Edition, entirely reset and greatly enlarged. For advanced students with mathematical foundations. Cloth, 487 pages and 289 illustrations $12.50

"FOUNDATIONS OF RADIO," by Rudolph L. Duncan. A treatise for the beginner, setting forth clearly and carefully the electrical phenomena associated with radio. Just the book to give you a firm grip on the subject.....$2.50

Remit with order. We pay transportation. Ten-day money-back guaranty on all books.

Radio World, 145 45th St., New York, N. Y.

UNINTERRUPTED READER INTEREST
EVERY WEEK — EVERY YEAR

RADIO WORLD

Vol. XX No. 3 Whole No. 497
October 3, 1931
[Entered as second-class matter, March, 1922, at the Post Office, at New York, N. Y., under act of March, 1879]
15c per Copy. $6 per Year.

TENTH YEAR
Technical Accuracy Second to None
Latest Circuits and News

A Weekly Paper Published by Hennessy Radio Publications Corporation, from Publication Office, 145 West 45th Street, New York, N. Y.
(Just East of Broadway)
Telephone, BRyant 9-0558 and 9-0559

RADIO WORLD, owned and published by Hennessy Radio Publications Corporation, 145 West 45th Street, New York, N. Y. Roland Burke Hennessy, president and treasurer, 145 West 45th Street, New York, N. Y.; M. B. Hennessy, vice-president, 145 West 45th Street, New York, N. Y.; Herman Bernard, secretary, 145 West 45th Street, New York, N. Y.; Roland Burke Hennessy, editor; Herman Bernard, managing editor; J. E. Anderson, technical editor; L. C. Tobin, Advertising Manager

A Midget for Autos

Two-Volt Tubes Used; Economy and Fine Performance

By Herbert E. Hayden

Photographs by the Author

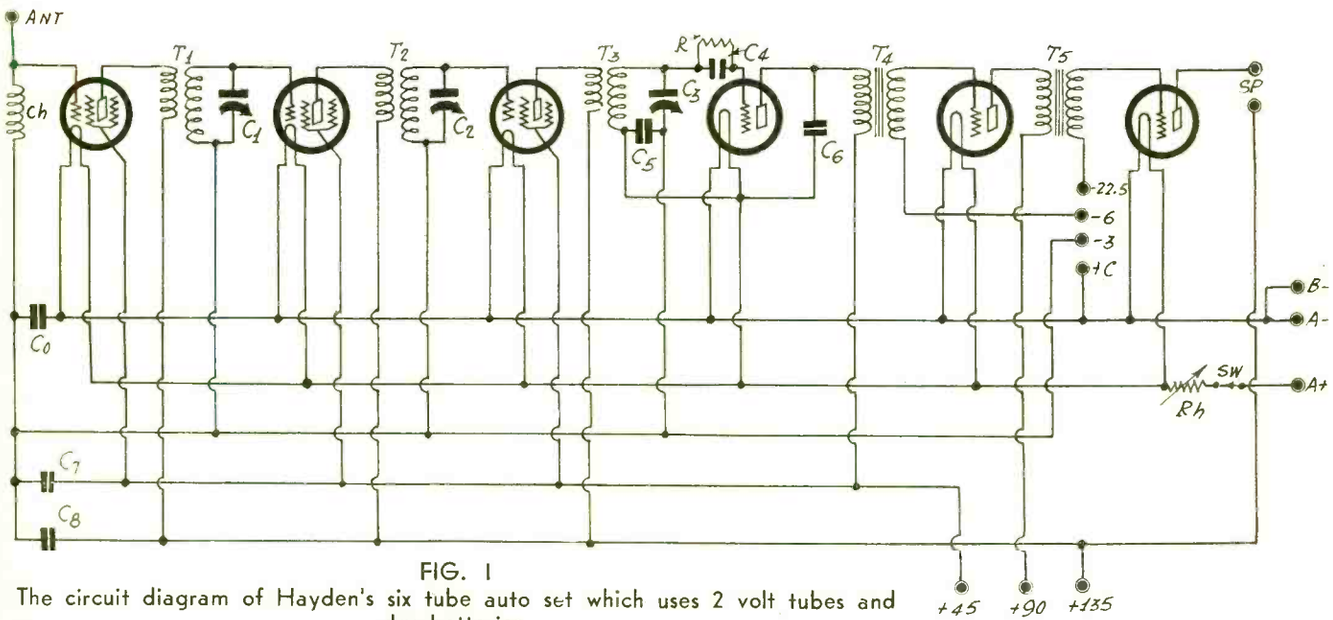


FIG. 1
The circuit diagram of Hayden's six tube auto set which uses 2 volt tubes and dry batteries.

NOW and then I have heard a radio receiver playing in a car as it was passing along on the road. I have often wondered what kind of sets were used, for I have tried many receivers supposed to have been designed for reception in a car but with uniformly unsatisfactory results. But now I have one that works, and it is a simple one. There is not a trick in the circuit at all, for it is a standard hook-up comprising three tuned circuits, all on one control, three screen grid tubes, two small three-element tubes, and a small power tube. The circuit of it is given in Fig. 1, which attests to its conventional nature. Perhaps it is because it is conventional that it works satisfactorily.

When I say that it works satisfactorily in a car I do not mean that it works as well in a car as it does at home. I am convinced that no set does because of the many adverse conditions met with in a car. It is my opinion that from an entertainment point of view no set will give satisfaction in a car while the car is in motion. The signal varies too much and there is too much interference from other cars.

Interference

One of the drawbacks in listening to a radio program on the road is interference from other cars. You can equip your own car with a device for killing the noise from the spark, but you cannot provide every car on the road with such a device, and very few cars have spark suppressors. Every car that passes in either direction, and every car that runs parallel with your own, causes interference. And think of the enormous possibili-

(Continued on next page)

List of Parts

Coils

Ch—One 800 turn duolateral choke, 10 millihenry inductance
T1, T2, T3—Three shielded radio frequency tuning coils for 350 mmfd. condensers
T4, T5—Two 1-to-3.5 audio frequency transformers

Condensers

Co—One 0.01 mfd. by-pass condenser
C1, C2, C3—Three 350 mmfd. tuning condensers in one gang
C4—One 250 mmfd. grid condenser with resistance clips
C5—One 0.1 mfd. by-pass condenser
C6—One 250 mmfd. by-pass condenser
C7—One 1 mfd. by-pass condenser
C8—One 2 mfd. by-pass condenser

Resistors

R—One 2 megohm grid leak Rh—One six-ohm rheostat
One 2 ohm ballast resistor in series with Rh (optional)

Additional Parts

Six UX sockets. Two cutput tip jacks
Eleven small binding posts
A filament switch with knob to match the knob of Rh
Three 7.5-volt grid batteries, making 22.5 volts
Four No. 6 dry cells connected in series parallel for A supply
Three 45-volt units of B batteries
A vernier dial for the gang condenser
A chassis made of ply wood or aluminum
Three 232 screen grid tubes. Two 230 tubes
One 231 power tube. Three grid clips

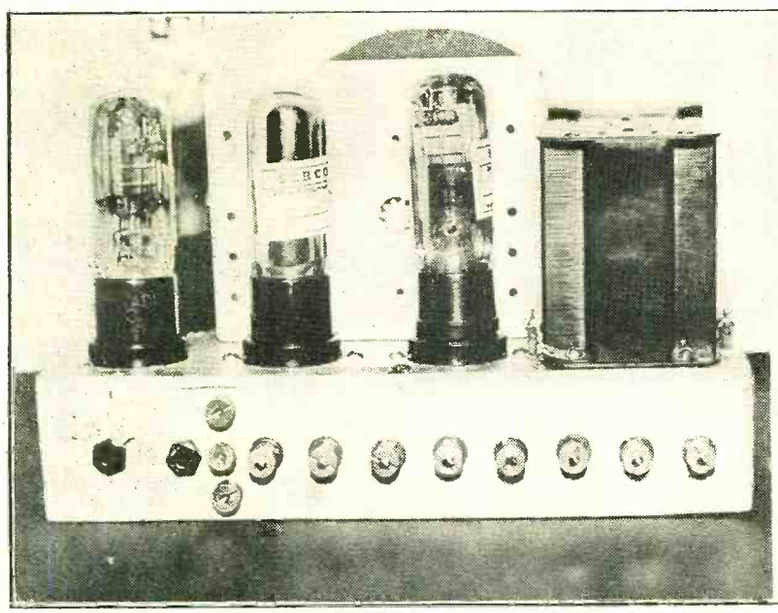


FIG. 3

Rear view six-tube battery set showing the arrangement of the tubes, variable condensers, the audio transformers and the binding posts.

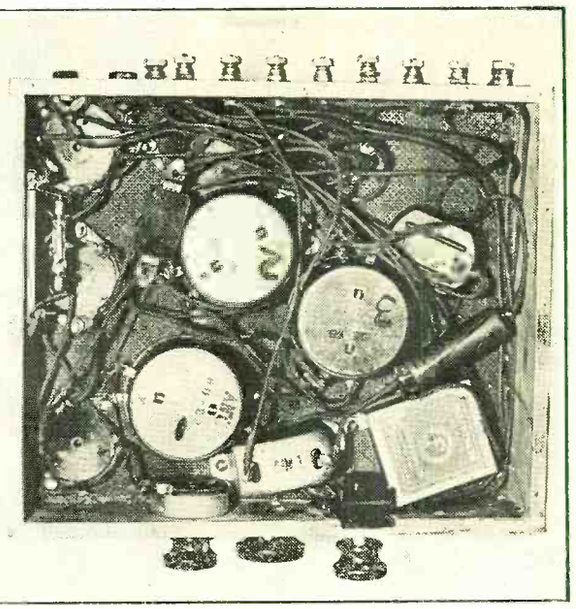


FIG. 2

Bottom view of the six-tube auto set showing the arrangement of the coils and the fixed condensers. Front view on front cover.

(Continued from preceding page)

ties of interference on a busy thoroughfare! Maybe there are six or more lanes of travel with every lane saturated.

But this source of interference is not as serious as it might at first appear. A busy thoroughfare is not the place to enjoy radio programs. It is too dangerous because it is distracting. And where there is little danger there is little interference. The thing to do when the program specially desired is due is to turn off the main road into a less traveled road or lane and listen in peace and safety. The particular feature desired does not take long and the delay does not amount to anything. Perhaps it can be made up by a little extra speed. The rest afforded the driver by the respite makes the increased speed safe.

The proper field for the radio in the car, which I have found by experience, is not on the road at all, but at the stopping places. Perhaps you take a trip to the beach. The radio receiver is then a source of entertainment not only to those who have the receiver but to others who are not so fortunate. You would be surprised how people gather around a radio set on the beach.

Parks and Camps

What applies to the beach also applies to camps and parks. Have you ever been encamped somewhere in a remote place, perfectly quiet except for soft music coming from a distance? There is charm in that. The music may come from a canoe on the lake or river near by, in which a young man is strumming a banjo, or it may come from a phonograph, or from a radio. While the music may not be first class as compared with that heard in concert halls, it lends enchantment to the quiet countryside or seaside in the summer evening. If you have your own radio set along you do not need to depend on chance for getting this music. You can supply it yourself for your own group and for others. While I have had this receiver only a short time, it has already given me several enjoyable evenings of this type.

Let me give a brief description of this receiver. Referring to Fig. 1, we note that there are three screen grid tubes in the radio frequency amplifier, each of which is a 232 of the two-volt series. Then follows a grid detector using a 230 tube and an audio frequency amplifier using the same type of tube, both being of the two-volt series. Finally there is a 231 power tube, which is the logical tube to use with the other tubes.

The input is untuned and the coupling coil is a 10 millihenry choke or an 800 turn duolateral coil of the type used in intermediate frequency transformers. This makes a good coupler and is superior to a resistance coupler.

There are three tuned r-f transformers, T1, T2 and T3, all shielded. The arrangement of these coils is shown in Fig. 2, which is a view of the under side of the completed receiver. The coils look like watch cases and are numbered from (1) to (3) in the order in which they are connected in the circuit.

It will be observed that the grid returns of the first three tubes are made to a lead which goes to the 3 volt tap on the grid battery. The tuning condenser rotors also go to this lead. Thus the rotors are not grounded as far as d-c potentials are concerned but for a-c they are grounded through condenser Co, which is connected across the 3 volt section of the bias battery. The rotors of the three sections of the condenser are connected together and therefore a special arrangement is needed in the detector input circuit. The coil here must be returned to the positive side of the filament and the condenser rotor is connected automatically to minus 3 volts. For this reason the third tuned circuit is completed by means of C5, a condenser of 0.1 mfd. capacity.

The audio amplifier is typical and contains two tubes and two audio transformers T4 and T5. These insure a high gain, which is needed in an automobile receiver, not only when it is operated in the car but also when it is operated outside of it at remote points from broadcast stations. Of course, most of the gain is obtained in the radio frequency amplifier with its three screen grid tubes and three sharply tuned circuits. The leaky condenser type detector is used for additional sensitivity.

The usual grid condenser C4 of 0.00025 mfd. is used and it is shunted with a resistance R of 2 megohms. The by-pass condenser C6 in the plate circuit of the detector has a capacity of 0.0005 mfd.

Bias on Grids

The grid bias on the three screen grid tubes is 3 volts, which is supplied by a section of the common bias battery, as has been stated. The bias on the detector, of course, is zero, and that on the first audio amplifier is 6 volts. The 231 power tube requires a bias of 22.5 volts. The bias battery used is made up of three 7.5 volt grid batteries tapped at every cell so that any desired bias may be given to the tubes within the limits of the 22.5 volts. Binding posts are provided for the battery, which is external to the circuit. The three negative posts are the three in a vertical column in Fig. 3, this figure showing a back view of the assembled circuit.

All the tubes in the circuit take only 0.43 ampere at 2 volts. Two dry cells in series give a voltage of 3 volts, the least number that can be used. But the voltage is one volt in excess of requirements. Hence a rheostat Rh is connected in the positive lead to the battery. The lowest value that this rheostat should have is 2.3 ohms. Since this rheostat is the only volume control in the circuit, the maximum value should be at least 6 ohms. Ten ohms would be satisfactory but a six-ohm rheostat was actually used and it proved satisfactory as a volume control. It is necessary to take precautions against permitting the ballast resistance to go less than 2.3 ohms because if it does the voltage across the tubes is more than 2 volts and the filaments are in danger. A stop on the rheostat would be advisable, or simply a mark beyond which it should not be turned. Sometimes there is a great temptation to turn the rheostat to zero, as the volume goes up, but this gain is obtained at a great risk of burning out the tubes.

In case a permanent safeguard is desired, a 2-ohm fixed resistance might be connected in series with the 6-ohm rheostat. The filament switch may be an integral part of the rheostat since the circuit opens when the rheostat is turned as far as it will go in the maximum direction. Such a rheostat should be used or else a separate filament switch should be installed. In this set a separate switch was used to make the panel symmetrical.

A No. 6 dry cell is rated at only 0.25 ampere. Since the circuit

(Continued on next page)

Lifting Voices, not Faces

Utility Ingeniously Served by Public Address System

By J. M. Kuhlik

General Manager, Miles Reproducer Co.

THE variety of uses to which microphones and public address systems are now being put is a tribute to the ingenuity and imagination of the dealers who sell or rent this equipment as well as to their customers who every day discover new departures from the conventional services that public address systems are commonly supposed to offer.

These new uses are all thoroughly practical.

A prominent department store conceived the idea several months ago of letting the managers of some of the high-priced departments listen in while the clerk was trying to sell merchandise to a customer. A man walks over to the jewelry counter and asks to look at diamond rings. The clerk shows him some.

"How much is this one?" asks the customer. "Fifteen hundred dollars," says the clerk. "Well, I only want to spend $800. What have you got for $800?"

"Why, we have quite a selection of diamond rings at $800."

Vendor Lifts His Voice

The manager in his own office listened in to the conversation over the loudspeaker for a while and then walked over to the counter and was introduced to the customer, and since the manager already knows just what was wanted, he was able to inspire confidence.

The method worked out so satisfactorily that it has now been installed in four other department stores operated by the same company.

People who are hard of hearing are likely to become gloomy and extremely sensitive if they see people inexplicably laughing and enjoying themselves. They are often also startled by suddenly seeing people in front of them whom they did not hear come into the room. One young man solved this problem for his mother, who was hard of hearing, by installing concealed microphones in the living room and lobby which were connected with a loudspeaker in the kitchen, with the result that she could always hear what was going on.

A fruit vendor in a street where the custom is for each vendor to invite buyers at the top of his voice found himself at a disadvantage because he had a small voice. He therefore installed an inexpensive microphone-amplifier-speaker unit and can now be heard any market day outshouting all his competitors.

A butcher on Amsterdam avenue, in New York City, installed a phonograph pick-up with loudspeaker leading to the street with a microphone hooked in at the counter. He broadcast music to the passersby. Interspersed between records are brief talks on the day's delicacies.

Mind Reading Assisted

Who among us has not at one time or another been mystified by the apparently amazing knowledge of the mind reader on the platform? A man circulates among the crowd. He stops and asks you some questions. You tell him your date of birth and your occupation. You whisper it to him so the medium on the stage can't possibly hear and you are astonished when the mind reader says:

"I feel the presence of a Mr. Smith here. He is thinking about going into the public address system business. He is wondering whether he would be successful in it. I have some important advice to give him on this subject. See me after the performance."

Perfectly astonishing, unless you know that when you "whispered" your name and questions to the man who questioned you, you were whispering into a microphone concealed under his lapel or shirt and that the transmissions of the microphone went directly to the earphones concealed by the woman "mind reader's" hair.

One of the Childs New York restaurants has installed a system which greatly improves service. Instead of a waitress running back and forth to the kitchen with every order, she has a microphone installed in the wall near her tables so that all she has to do is to go over to the microphone, which is connected to loud speaker in the kitchen, and give her order.

A dog breeder in Westchester County had a lot of trouble with his dogs at night. As 2 o'clock in the morning they got into a habit of setting up a concerted howling and barking. The only way he could quiet them was to get dressed and go down to talk to them. This was bad enough on Summer nights but in the Winter it was unbearable. He therefore hit on the bright idea of connecting a microphone at his bedside to a loudspeaker in the kennels. The results were very successful because as soon as the dogs heard his voice they immediately quieted down.

No Traveling Truck

In certain parts of Russia small villages located in the vast expanses of otherwise uninhabited country guard themselves against the attacks of hungry wolves by frightening them away with powerfully amplified shouts issuing from loudspeakers surrounding the village.

The sounds of music coming from the skies is familiar in populated sections of the United States. It is produced by a simple public address system and incidentally is quite profitable to the operator as there are many advertisers willing to go "on the air" in this novel way.

Traveling sound trucks are one of the fastest developments in the field. Many radio dealers are equipping small trucks with the necessary turntable, amplifier and microphone and are using the outfit for their own advertising while they travel through the streets as well as for renting time to other retail stores, political committees, etc. One operator, Bill Weinstein, has helped various auctioneers sell hundreds of thousands of dollars' worth of real estate by the use of sound trucks. The systems are so easy to operate that frequently Katherine, his 14-year-old daughter, operates them.

Of course, the more general uses of public address systems are those in auditoriums, churches, etc. There the microphone stand is placed on the speaker's platform and loudspeakers make the speaker's voice audible; in theatres for organist's announcements; in hotels and camps for paging systems; in schools for announcements from principal's office to teachers' rooms; in swimming pools and stadia for announcing events; in railway stations for train announcements and many other uses too numerous to mention.

With all the varied applications it might be supposed that public address work is very complicated but this is not the case at all. As a matter of fact the principles of all public address systems are basically the same. You need a microphone, an amplification system and loudspeakers—that's all. Of course, individual requirements differ. For example, we recently built a 50-watt amplifier for a tremendous auditorium which when tested out in our own laboratories shook the walls of the building with vibration and almost deafened our engineers for a few days. However, these special requirements are quickly learned. Public address work is therefore particularly inviting to individuals who are anxious to get into a field the possibilities of which are just beginning to be realized.

(Continued from preceding page)

draws more than this, two should be connected in parallel. Therefore the filament supply consists of four No. 6 dry cells connected in series parallel.

A magnetic speaker is the most suitable for this receiver, although a dynamic speaker with a 6-volt field winding could be used. However, if such a speaker is used it is necessary to run a line from the car storage battery to the speaker. This offers no special difficulty when the set is in the car but it would be rather inconvenient when it is taken outside. Hence a magnetic speaker is the more practical.

Mounting of the receiver in the car is always a problem. Of course, the conventional way is to mount it on the instrument panel on the right side of the car. Personally, I do not like to mar the car by making any attachments whatsoever, and most people with whom I have discussed the subject are of the same opinion. Even those who are most enthusiastic about a radio oppose a radio on the instrument panel just because it cannot be mounted without in some way marring the car.

I prefer to keep it in the rear compartment and let my wife operate the set while I am operating the car. The best place I have found for the batteries is under the rear seat. I have tried mounting them under the running board out of sight and out of the way, but this idea I abandoned after I had lost a few batteries in going over rough roads. Under the seat they are out of the way, they are accessible and safe. Room might also be found under the front seat by a rearrangement of the tools and the removal of useless baggage.

It is not necessary to provide for any special ground except that one point on the receiver should be connected to the chassis of the car, or the storage battery. The only logical point to connect to the chassis is the rotor of the gang condenser. This grounds the 3 minus point on the grid battery. No other connection must be made to the chassis of the car, for another connection would short-circuit something.

Capitalization of Feedback in

A Preliminary Report on Balancing of

By Herman

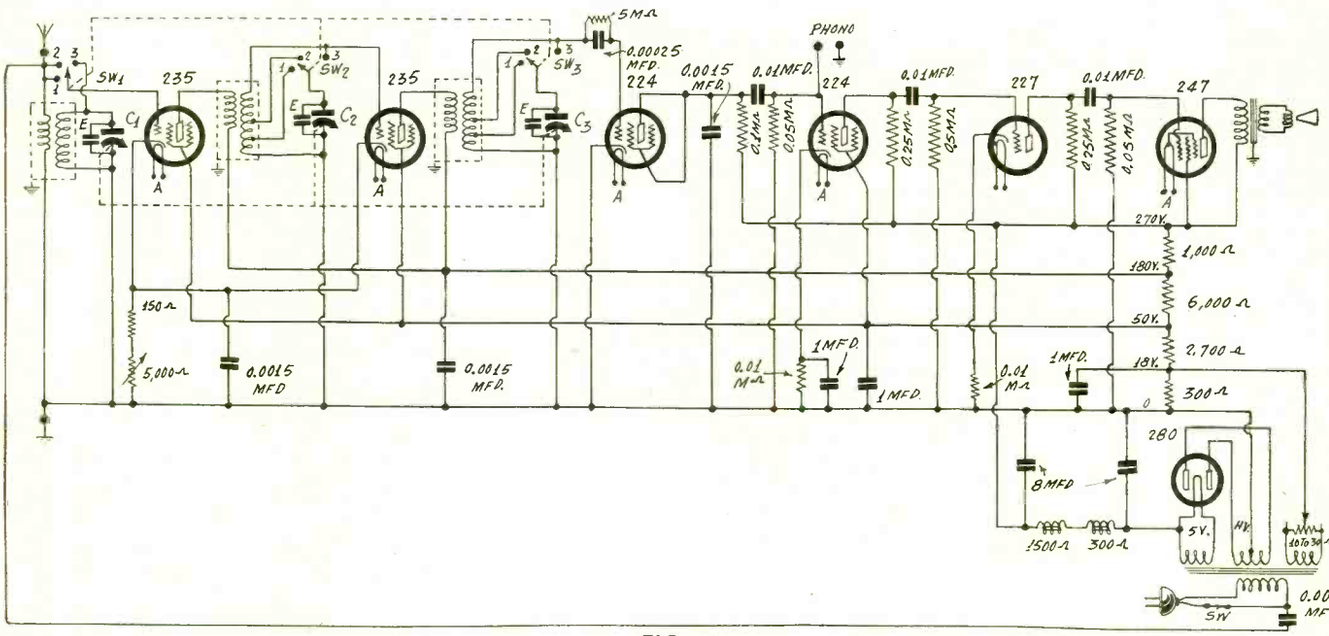


FIG. 1

LIST OF PARTS

Coils

One shielded antenna coupler, two shielded interstage couplers, as described
One power transformer, to handle five heater tubes, one 247 and one 280.
One B supply choke coil and one output transformer (both built into speaker)

Condensers

Two 8 mfd. dry electrolytic condensers with brackets
Four 0.0015 mfd. fixed condensers
Three 0.01 mfd. fixed condensers
Two 1 mfd. bypass condensers
One three-gang tuning condenser, C1, C2, C3
Three equalizers (E) for tuning condenser
One 0.00025 mfd. grid condenser with clips, on insulating disc

Resistors

One 150 ohm flexible biasing resistor
One 5,000-ohm potentiometer or rheostat, with a-c switch attached
One 5 meg. tubular grid leak
One 0.1 meg. pigtail resistor (100,000 ohms)
Two 0.25 meg. pigtail resistors (250,000 ohms)
Three 0.05 meg. pigtail resistors (50,000 ohms)
Two 0.01 meg. pigtail resistors (10,000 ohms)
One voltage divider, 5 watts rating or more, as diagrammed
One potentiometer, maximum 10 to 30 ohms

Remaining Parts

Antenna and ground connectors
One three-point, triple throw rotary selector switch, shaft insulated from everything.
One dynamic speaker, with pentode output transformer and field coil of 1,800 ohms d-c resistance built in
One chassis, 13½ inches wide, 9½ inches front to back, with front and rear elevating flaps 3 inches high; drilled for sockets, inductance switch, volume control, etc.
Two UY sockets, marked 235, two UX marked 224, one UY socket marked 227, one marked 247, and one UX socket marked 280
One a-c cable and plug
One full-vision illuminated vernier projection dial, travelling light type; scale; escutcheon; 2.5 volt pilot lamp
One roll of hook-up wire
One bakelite strip for holding audio resistors and audio isolating condensers and holding three 1 mfd. bypass condensers
One phonograph twin jack assembly
One cabinet (may be of midget Gothic arch type)
Tubes: Two 235, two 224, one 247 and one 280

CONSIDERING tuned radio frequency receivers on chasses small enough to fit in a midget cabinet, but good enough also to put into a less inexpensive console, we will run the gamut from the seven tube circuit, Fig. 1, to the four tube circuit, all four for alternating current operation.

Fig. 1 provides for broadcast coverage, also short wave tuning to about 40 meters, below which it would not be very effective, anyway. The wave band switching is accomplished not by shorting out unused turns but by having the entire secondary always in circuit, and moving the condenser from a position across the entire winding to positions across less than the entire winding. For coil switching a three point triple pole switch is required, with insulated shaft.

Secret of Stability

The secret of the stability thus gained is the use of feedback effects in the audio amplifier. It is easy to tell the direction of feedback from the results obtained. The feedback through the 227 second audio tube biasing resistor (0.01 meg., 10,000 ohms) is negative in respect to the current through the first audio biasing resistor and 300 ohm section of the voltage divider, which section biases the pentode. The negative bias is 18 volts when the other conditions specified in the diagram in respect to the voltage divider are fulfilled.

If a bypass condenser is placed across the 0.01 meg. biasing resistor of the 227, then, assuming suitably high capacity value, the negative feedback is virtually eliminated, and there is strong coupling between the two stages in addition to the intentional coupling provided by the plate and grid load resistors (0.25 meg. and 0.05 meg.) The circuit will motorboat then.

But if the bypass condenser is omitted, as it is in the diagram, then the negative feedback through the biasing resistor acts as a neutralizing agency in respect to the first audio and output tubes, and there is complete stability at the low frequencies. There may be a high-pitched squeal, but this is corrected by grounding the case or frame of the speaker. Even a small condenser across this resistor would make the squeal permanent. Since the output transformer is assumed to be built into the speaker, the diagram shows the core of the transformer grounded, which also constitutes grounding the speaker frame, so the handier frame may be used.

In last week's issue there was a discussion of a six tube circuit with an extra (seventh) tube added simply to stop the starting howl, but it was stated that this extra tube, peculiarly placed in the suppressor grid circuit of the pentode, could be put in the audio channel directly to shift the instability to an easily curable frequency. So Fig. 1 represents this method and also presents a solution of the long-standing problem of how to stabilize a three stage resistance coupled audio amplifier, although a superior solution will be published next week.

The solutions are not sacrificial for the tone quality is just as fine as is obtainable from resistance coupling, and that is ad-

Resistance Audio Amplifiers

Channel to Counteract Several Shortcomings

Bernard

mittedly superb Even the presence of the 0.05 meg. (50,000 ohm) grid loads does not spell attenuation of the low notes. The reason is that when an audio amplifier motorboats, regeneration at audio frequencies is causing over-amplification at the motorboating frequency.

This is distortion of as bad a sort as any. That is, it is no more forgivable to overemphasize the low notes than to overemphasize the middle ones, or the high ones, or any others. Besides, the motorboating sound modulates the signal, and it is beyond discussion as a tolerable shortcoming. Therefore a method should be used that prevents the feedback, or rather, reduces it to the point where all sign and trace of motorboating disappears. Only when such removal is effectuated is the amplifier any good, or indeed workable. Then if there remains, or is substituted, feedback at a middle or higher frequency, this should be corrected.

Result of Experimental Conclusions

As intimated, any high audio frequency trouble can be eradicated easily. In this case grounding the speaker frame does it, and in addition it is advisable to use a much higher detector bypass condenser, from plate to ground, than normally recommended. The keenness that has been transferred to the high audio frequency region permits the use of the relatively high capacity, 0.0015 mfd., specified on the diagram.

If one were to take tube circuits individually and independently, and analyze them, it soon would become mathematically apparent that the low note attenuation is palpably severe, due to extremely low leak values. If the isolating condenser were 0.01 mfd., the grid leak in the audio tube considered should be 10,000,000 ohms, to constitute the product of the two 0.1. This would be all right for an isolated circuit, but it does not apply to a practical amplifier, even of one stage, and it never applies to a multi-stage amplifier.

One reason is that feedback steps in to upset all calculations based on ignoring its presence. Nor is the 10 meg. figure even practical, since the grid to filament resistance of the tube circuit is less than that, and the two are in parallel. It all goes to show that the solution arises necessarily from experimental results, because feedback has to be considered, and it is virtually impossible to gauge it, but easy enough to capitalize it or overcome it.

Comparison With Push-Pull

The presence of audio regeneration is so important that it is strange the subject has not come in for widespread discussion from the practical angle.

Very large bypass condensers often are recommended, and nearly as often are needed, across biasing resistors, or other voltage reducing resistors, to establish the volume at the level it should have, and to safeguard the tone, particularly the low notes. But where there is such an abundance of regeneration it is well to consider the use of negative or positive feedback currents to serve in substance the same bucking purposes as found in an independent resistor biasing a push-pull stage.

In push-pull, it will be remembered, a single biasing resistor from filament center to B minus serves to bias the two tubes. No bypass condenser is put across it, as none is needed. The current in one tube is equal to that in the other tube, and the two currents are out of phase, therefore the biasing resistor is free from signal.

In single-sided circuits, such as those now under discussion, the phase difference exists, as between or among respective audio stages, and to that extent there is similarity with the push-pull case, although the voltages are not equal. However, there is no necessity here for equality of voltage. If positive feedback is excessive, that is, regenerative, all we want is enough negative feedback to stop the regeneration. And this we can obtain.

Bias Considerations

The method shown in Fig. 1 requires that the biasing resistor of a 227 be 0.01 meg. If 0.02 meg. is used the volume will be much less. If 0.005 meg. (5,000 ohms) is substituted, then the negative feedback is too low at high audio frequencies and there is squealing. In practical effect it is a case of biasing the tube to about the right amount, too high a bias curtailing volume, and too low introducing high audio frequency stability. The bias may be around 5 volts, which would be true if 0.5 ma flowed through the 0.01 meg. With 270 volts applied, this is in the correct bias region for the 227 tube.

The grid resistor in any audio circuit is shown as 0.05 meg., because that is an utterly safe value, but it may be increased to 0.1 meg. if the circuit will sustain that value. In fact, it is recommended that such a grid leak be tried for different values, including 0.05, 0.1, 0.25, 0.5 and 1 meg. It can be foretold that 1 meg. and up will cause motorboating, it is true that 0.5 probably won't cause such trouble, while the 0.25 value is reasonably safe, and 0.05 meg. utterly so. Use as high a value as compatible with the absence of motorboating.

Much depends on the inductance of the B supply choke coil, the method of obtaining detector bias (if negative bias is used), the inductance of the speaker transformer, and other things, but the coils affect only high audio frequency instability, for which speaker frame grounding and a relatively large detector plate bypass condenser are the remedies.

Why Large Capacities Are Not Vital There

The resultant stability, following Fig. 1, is shown by the fact that the bypass condenser across the biasing resistor of the first audio tube may be increased virtually without limit, and still the circuit is stable. The maximum value actually tried was 76 mfd.

Also it is true of the condenser across the lowest section of the voltage divider. This was tried at a value as high as 80 mfd., without any instability. However, the regenerative values are high enough to permit of small relatively capacities in these positions that in other circuits require very high capacities. Next week's article will solve the problem with all bypass condensers save a single 0.1 mfd. omitted.

The audio channel must be considered as a single unit, therefore by raising the leak in any audio stage to a value that produces motorboating, then using the lower value that cures the trouble, the positive feedback is checked to workable limits, and this feedback replaces large capacities.

A larger volume of sound was obtained with the detector hooked up as shown than by any other method tried, for the 235 or 244 (either one will do), with screen and plate tied together, constitutes a high mu tube. The 224 gives a greater sound output.

Regarding the circuit, as diagrammed, from left to right, we find that a fixed condenser of 0.0015 mfd. is connected with one end to the antenna post, the other side to the alternating current line. This constitutes a lamp socket antenna. While in days when sets of far less sensitivity were the vogue the lamp socket antenna was a highly dubious contrivance, in modern receivers, and particularly in the case of the circuit under discussion, good results may be expected from this device. However, any who have or desire an indoor or outdoor aerial, may use that, simply by connecting it to the antenna post, so that the input in cumulative, external plus internal antenna. This will increase volume and sensitivity.

Two Tuned Stages for Short Waves

The antenna coupler is a radio frequency transformer with a radio frequency choke coil as primary, loosely coupled to the secondary. The reason for the choke primary is that the sensitivity of the set becomes virtually uniform over the broadcast band.

No taps are on the antenna coil's secondary, since the method used for short waves is to constitute the antenna stage untuned, by cutting the primary choke into the grid-to-ground circuit, so that aerial goes direct to grid. It is too dangerous to monkey with three tuned stages for short wave reception, as the circuit becomes unstable at radio frequencies, and the number of short wave stations brought in becomes actually fewer, with less volume and little clarity. The method diagrammed is far superior and affords good short wave results.

Since two points of the switch are used for short waves, these points both go to aerial for one deck, or may be interconnected, with aerial joined to one of them.

The volume control is a high resistance rheostat that governs the bias of the two variable mu radio frequency amplifiers. Around 5,000 ohms is suggested, for then on the loudest local station the sound will not totally disappear until almost the maximum resistance is in circuit. However, any value up to 10,000 ohms may be used, with the result that the actually used part of the volume control will be less than the total angular displacement of the control knob. Another expedient, however, if you have a much higher value rheostat or potentiometer, is to put a 5,000 or 10,000 ohm fixed resistor across it.

A potentiometer may be used, although the hookup is that of a rheostat, and the potentiometer itself would be used as a rheostat. With a potentiometer you have the choice of direction

(*Continued on next page*)

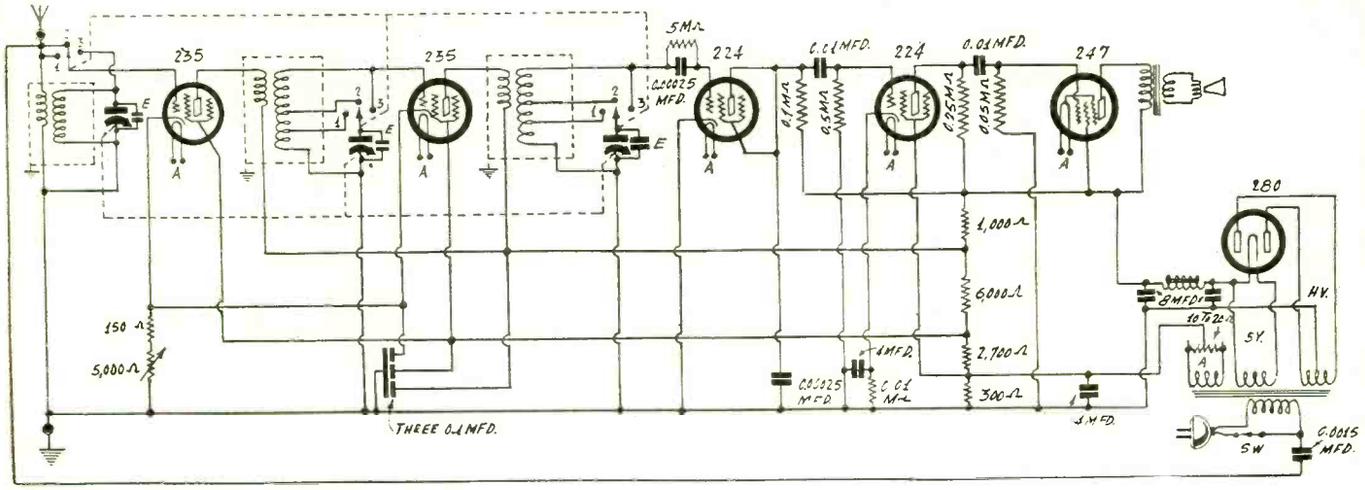


FIG. 2

A two stage resistance coupled audio amplifier used in conjunction with the tuner shown in Fig. 1. Such an audio channel has less stability but more usable gain than the one shown in Fig. 1, the problem being to retain the gain and still have complete stability. The troubles have been removed, except that of a startling howl that subsides after a minute.

(Continued from preceding page)

of turning the knob for increasing volume. If the knob turns in what you consider the wrong way, reverse the connections to the potentiometer. Only two connections are used, normally the center lug and one extreme, although some potentiometers have the index brought out to an extreme lug. You can easily tell, because if the index is not picked up there may be no signals heard, or if any are heard, turning the knob will not alter the volume.

LIST OF PARTS

Coils

One shielded antenna coupler, two shielded interstage couplers, as described
One power transformer, to handle five heater tubes, one 247 and one 280.
One B supply choke coil and one output transformer (both built into speaker)

Condensers

Two 8 mfd. dry electrolytic condensers with brackets
One 0.0015 mfd. fixed condenser
One block of three 0.1 mfd. condensers
Two 0.01 mfd. fixed condensers
Two 4 mfd. condensers
One three-gang tuning condenser, C1, C2, C3
Three equalizers (E) for tuning condenser
One 0.00025 mfd. grid condenser with clips, on insulating disc

Resistors

One 150 ohm flexible biasing resistor
One 5,000-ohm potentiometer or rheostat, with a-c switch attached
One 5 meg. tubular grid leak
One 0.1 meg. pigtail resistor (100,000 ohms)
One 0.25 meg. pigtail resistors (250,000 ohms)
One 0.05 meg. pigtail resistors (50,000 ohms)
One 0.01 meg. pigtail resistor (10,000 ohms)
One 0.5 meg. pigtail resistor
One voltage divider, 5 watts rating or more, as diagrammed
One center tapped resistor, maximum 10 to 30 ohms

Remaining Parts

Antenna and ground connectors
One three-point, triple throw rotary selector switch, shaft insulated from everything.
One dynamic speaker, with pentode output transformer and field coil of 1,800 ohms d-c resistance built in
One chassis, 13½ inches wide, 9½ inches front to back, with front and rear elevating flaps 3 inches high; drilled for sockets, inductance switch, volume control, etc.
Two UY sockets, marked 235, two UY sockets marked 224, one marked 247, and one UX socket marked 280
One a-c cable and plug
One full-vision illuminated vernier projection dial, travelling light type; scale; escutcheon; 2.5 volt pilot lamp
One roll of hook-up wire
One bakelite strip for holding audio resistors and audio isolating condensers and holding three 1 mfd. bypass condensers
One phonograph twin jack assembly
One cabinet (may pe of midget Gothic arch type)
Tubes: Two 235, two 224, one 247 and one 280

It is not necessary to insulate the volume control from a metal panel if the knob turns in the preferred direction to increase volume, but if you want to switch the connections of a potentiometer then you must insulate the control. This does not hold, however, for devices so built that the frame connecting to panel is electrically independent of all connections to the working part of the device.

The radio frequency in the biasing section is bypassed by a condenser large enough to serve the purpose. So 0.0015 mfd. is suggested, although any value from 0.001 mfd. up may be used.

For radio frequency bypass of that part of the voltage divider serving the plates of the r-f tubes a capacity of 0.0015 mfd. also is sufficient. No audio frequencies are concerned, as all the audio tubes, including the detector, take their B voltage from the maximum voltage point, which has 8 mfd. between it and grounded B minus.

Reasons for Modest Primaries

The interstage transformers have a relatively small primary for three reasons: first, the primary is wound over the secondary and there is capacity coupling large enough to be seriously considered in rating the coupling; second, the three coils are not over-shielded, therefore some small feedback, very handy in attaining selectivity and sensitivity, is present, but not enough to produce oscillation in the broadcast band; and, third, short waves are to be tuned in, and since one primary serves for all three bands, it must not be too large, as that would cut down the effectiveness on short waves, principally by producing instability.

Even though the volume control will virtually cut off the signal (reducing the plate current almost to zero and thus stopping amplification), the instability referred to consists of causing the control of the receiver on short waves to be confined to a very narrow span of the rheostat, with critical sensitivity adjustment that is very annoying, and never satisfactory even to the most accomplished tuning expert.

The secondary of the antenna coil is not tapped. When the switch is thrown to any one of the three positions the decks are controlled in one operation. At (3) the full secondary inductance is tuned by the condenser C2. When the selector switch is at (2), about one-third of the secondary turns is tuned by the condenser, the remaining two-thirds being used as a continuation to grid. At position (1) somewhat less than half of the number of turns tuned in the previous instance are across the condenser, all the rest being a continuation to grid.

Information on Coils

All the resistors are of low wattage type, excepting the voltage divider, so only that needs consideration. The value marked 300 ohms may be in fact 250 ohms, thus, lowering the pentode bias, and bringing up the volume a little, while reducing somewhat the maximum undistorted power output of the tube. The wattage rating of this resistor should be 5 watts or more. All may be 5 watts.

The coil data for 0.00035 mfd. are tuning. Figs. 1 and 2, are:

Antenna coil: Primary, 300 turn honeycomb choke, inductance 1.3 millihenries, nearest turn ½ inch from nearest turn of sec-

See the Final Solution of the Resistance Amplifier in Next Week's Issue

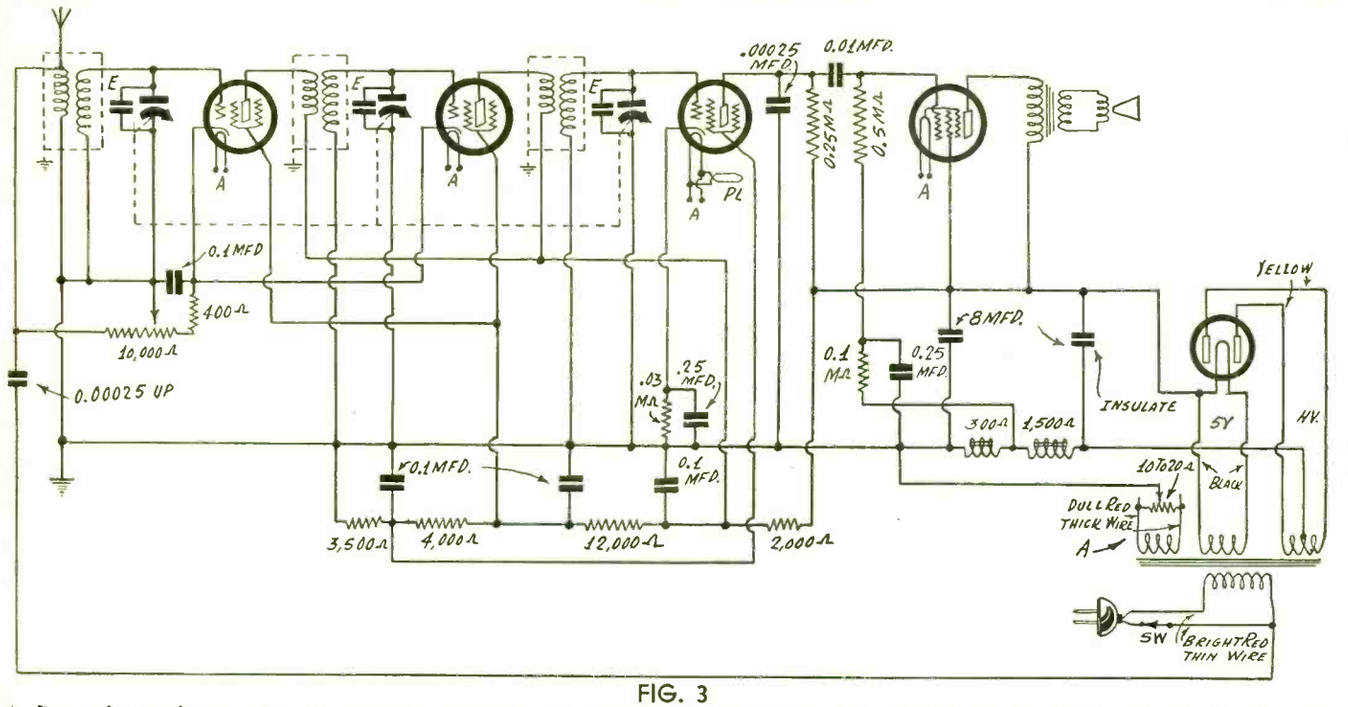


FIG. 3

A five tube midget, using the growing practice of putting the B supply choke (which is the field coil of the dynamic speaker) in the negative leg of the rectifier. This circuit, considering the cost of less than $20, works extremely well.

ondary and mounted inside the secondary form, parallel to the secondary. Secondary, 122 turns of No. 31 enamel wire on 1⅛ inch diameter 2¼ inches high. The grid return (ground) and of the secondary is at bottom, the primary at top.

Interstage couplers (two wound alike): Secondary, 117 turns of No. 31 enamel wire, on 1⅛ inch diameter form 2¼ inches high, tapped at the 76th turn from the grid end and at the 97th turn. Primary, wound over secondary, with layer of insulating fabric between, consists of 12 turns of any kind of insulated fine wire, which may be the same kind of wire used on the secondary, or finer.

The coil data for 0.00046 mfd. (the capacity used in the laboratory model): Antenna coil, same as above, except secondary has 105 turns, same wire. Interstage couplers: Primary, same as for interstage coils above. Secondary turns, 100, tapped at 68th and 84th turns from grid end.

The data for 0.0005 mfd.: Antenna secondary, 95 turns. Interstage couplers, primaries same; secondaries, 90 turns, tapped at the 62nd and 80th turns.

The reason for more turns on the antenna secondary is to offset the secondary inductance reduction effected by a large primary.

Fig. 3 is the diagram of a five tube circuit, including rectifier, concerning which there was some mention in last week's issue. This is a straight midget, possessing only such regenerative features in the audio channel as are incidentally present, as the boosting problem as affecting a single stage audio has not yet been worked out.

It is not certain that very much can be accomplished along the lines of audio regeneration with a single stage of audio, although some improvement is likely. So those desiring to build a five-tube model are encouraged to follow the diagram Fig. 3, as it is. Anything learned about extra regenerative effects in the audio channel will be published, and the changes can then be introduced, if desired.

This is the circuit that can be built of parts costing less than $20, including dynamic speaker, Gothic arch cabinet, etc., but not including tubes, which are two 235 for radio frequency, 224 for detector, 247 for output and 280 for rectifier.

The performance of this circuit is good, and it is attained with maximum simplicity and economy of construction.

The field coil of the dynamic speaker is used also as the B supply choke, and even a section of that combined field coil-choke is used as the biasing adjunct of the 247 tube.

It can be seen that the choke is in the negative leg of the rectifier, so the center tap (or center of a center-tapped resistor across) the 2.5 volt winding is connected to ground, which is unusual in kit construction, permitting the return of the grid circuit of the pentode to a more negative point, the tap on the field coil 300 ohms removed from ground. As all the B current passes through this 300 ohm section of the choke, the resultant bias may be around 20 volts, but a resistor of 1,200 to 1,000 ohms may be put across the 300 ohm section to reduce the bias. Fig. 4 shows this. The hum then will increase unless filtration is made stronger.

The usual bias recommendation for the 247 pentode is 16.5 volts, but this is not critical, and 20 volts may be used. A point to consider, however, is the advisability of using even less than 16.5 volts, for although the maximum undistorted power output will be reduced, the volume of sound is increased, and the low-note reproduction is made stronger. The resistor recommended as an optional connection in parallel with the 300 ohm section will do the trick. The bias will drop to 15 volts or a little less.

Another point worth considering is the use of a low-wattage voltage divider. In fact, pigtail resistors of 1 watt rating may be used. The values of these resistors are 2,000, 12,000, 4,000 and 3,500 ohms. The 0.1 meg. (100,000 ohm) resistor used in the resistor-capacity filter of the pentode grid circuit also is of this low-wattage type.

The volume control in the present instance (Fig. 3) is one that not only varies the bias on the radio frequency amplifiers but also governs the amount of radio frequency input to the

(*Continued on next page*)

LIST OF PARTS
(for Fig. 3)

Coils

One shielded antenna coupler and two shielded interstage transformers, as described
One output transformer and one B supply choke coil (built into the dynamic speaker)
One power transformer to handle three heater type tubes, one 247 pentode and one 280

Condensers

One three-gang condenser to match the coils
Three equalizing condensers or trimmers (E)
One block of three 0.1 mfd. condensers
One separate 0.1 mfd. condenser
Two 0.25 mfd. condensers
One 0.01 mfd. mica dielectric condenser
Two 8 mfd. electrolytic condensers; insulators for one of the condensers
Two 0.00025 mfd. fixed condensers

Resistors

One potentiometer, 10,000 ohms (lower value to 2,000 ohms permissible)
One center tapped resistor, 10 to 30 ohms
Seven pigtail resistors as follows: one 400 ohms (300 ohms also suitable); one 3,500 ohms, one 4,000 ohms; one 12,000 ohms; one 2,000 ohms; one 0.1 meg. (100,000 ohms); one 0.03 meg. (30,000 ohms); one 0.25 meg. (250,000 ohms; one 0.5 meg. (500,000 ohms)

Other Parts

One chassis, with socket holes drilled; size up to 13¾ inches wide, 9 inches front to back; elevating flap, 3 inches high
One Gothic cabinet
Two UY sockets marked 235, one UY socket marked 224, one UY socket marked 247 and one UX socket marked 280
One vernier dial with pilot lamp, escutcheon and scale
Ground binding post, antenna binding post with insulator
Dynamic speaker with 1,800 ohm field coil tapped at 300 ohms; output transformer built in. Field coil also used as B supply choke
One A-C cable and male plug
One roll of hookup wire
Two dozen 6/32 machine screws and two dozen nuts
One A-C shaft switch

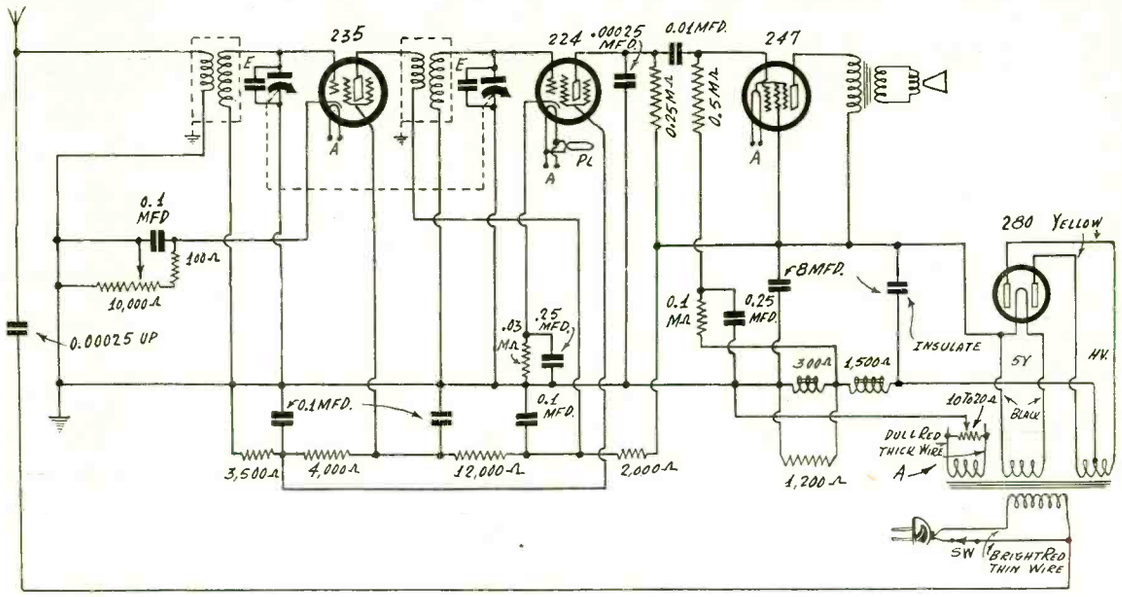


FIG. 4

The four tube circuit, substantially the same as the design shown in Fig. 3, save for the omission of a stage of tuned radio frequency amplification. The resistor to lower bias on the pentode is shown, but filtration must be good, otherwise hum will increase.

(*Continued from preceding page*)

first tube. This is a good method of controlling volume, making the control more rapidly effective, and thus permitting use of even smaller value of potentiometer than 10,000 ohms, if you happen to have a smaller one on hand, say, 3,000 or 5,000 ohms.

The speaker frame is not shown in the diagram as being grounded, as no trouble ever was experienced with this set in regard to audio regeneration at a high frequency that would require such expedient, but it is a simple matter to ground the speaker frame, and it is advisable to take this precaution, anyway.

The circuit uses the negative bias method of detection. It is of course true that this method is not as sensitive as the grid leak-condenser hookup for detection, but the practical difference is rendered immaterial, for the following reasons:

In designing the coils it is possible to build up the sensitivity so that it will be as great as would be true were grid leak detection used, provided that the coupling is made close enough between primaries and secondaries, or, to the same effect, the primaries have a larger number of turns than would be used for grid leak type of detection. Suppose with a given set of coils, intended for grid leak detection, you nevertheless use the negative bias detector, as diagrammed. The sensitivity may decline from 25 microvolts per meter to 35 or 40 microvolts per meter. However, if the primaries are made larger, then the sensitivity may be brought up to the point registered by the leak-condenser method.

LIST OF PARTS
(for Fig. 4)

Coils

One shielded antenna coupler and one shielded interstage transformer, as described
One output transformer and one B supply choke coil (built into the dynamic speaker)
One power transformer to handle two heater type tubes, one 247 pentode and a 280

Condensers

One two-game condenser the match the coils
Two equalizing condensers or trimmers (E)
One block of three 0.1 mfd. condensers
One separate 0.1 mfd. condenser
Two 0.25 mfd. condensers
One 0.01 mfd. mica dielectric condenser
Two 8 mfd. electrolytic condensers; insulators for one of the condensers
Two 0.00025 mfd. fixed condensers

Resistors

One potentiometer, 10,000 ohms (lower value to 2,000 ohms permissible)
One center tapped resistor, 10 to 30 ohms
Seven pigtail resistors as follows: one 100 ohms (150 ohms also suitable); one 3,500 ohms, one 4,000 ohms, one 12,000 ohms, one 2,000 ohms, one 0.1 meg. (100,000 ohms), one 0.03 meg. (30,000 ohms), one 0.25 meg. (250,000 ohms), one 0.5 meg. (500,000 ohms).
One chassis, with socket holes drilled; up to 13¾ inches wide, 9 inches front to back; elevating flap, 3 inches high.
One Gothic cabinet
One UY socket marked 235, one UY socket marked 224, one UY socket marked 247 and one UX socket marked 280
One vernier dial with pilot lamp, escutcheon and scale
Ground binding post, antenna binding post with insulator
Dynamic speaker with 1,800 ohm field coil tapped at 300 ohms; output transformer built in. Field coil also used as B supply choke
One A-C cable and male plug
One roll of hookup wire
Two dozen 6/32 machine screws and two dozen nuts
One A-C shaft switch

Avoid Large Stray Capacity

The limiting point, of course, is that of radio frequency squealing or oscillation. No more turns should be put on than the circumstances warrant, in respect to squealing. If you have coils hard to tamper with, the squealing may be corrected by increasing the value of the fixed portion of the biasing resistor of the r-f tubes (shown as 400 ohms), so that almost any value may be needed. There have been instances in the experimental work in connection with this circuit where the primaries were made so large that the fixed segment of the biasing resistor network was 1,800 ohms. However, with the directions as given such a high value will not be necessary. In fact, 400 ohms is about 100 ohms more than normally are needed, the reason for the excess being double assurance of stability.

An incidental point is that the primaries should not be so large nor yet be so close physically to the secondary—that is, there should be no excessive combination of both—as to introduce large resultant capacity coupling. There is capacity between turns of each coil and capacity across extremes, as well as capacity between one coil and another. So if the capacity is built up too high there will be a relative high minimum effective on the tuning condensers, and the capacity ratio of the condensers, maximum to minimum, will be lowered to the point where full coverage of the broadcast band of wavelengths may be defeated. The data given subsequently, however, provide for full coverage of the band.

Selectivity Stated

As for selectivity, this is an opposite companion to sensitivity. That is, as the one goes up the other goes down. Yet a certain amount of sensitivity is required, and this in effect limits the selectivity. The selectivity therefore is balanced against the sensitivity to produce a happy compromise, the same as must be done in all well-engineered circuits.

When distant stations are tuned in, 10 kc apart, one may be separated from the other without inter-channel interference, and this is as good a demonstration of selectivity as can be reasonably expected for a three-tuned-circuit tuner. There is 10 kc selectivity when there is not more than about 25 microvolts per meter field strength near the antenna.

The set incorporates the lamp socket antenna, with additional provision for an external aerial.

The Four Tube Circuit

The last of the four circuits promised for discussion is diagrammed in Fig. 4, which is a four tube a-c model, including rectifier, and which is patterned substantially after Fig. 3, with the exception there is only one stage of t-r-f. The other has two stages of t-r-f.

With this circuit there is no special point in using the volume control method employed in Fig. 3, therefore the simpler hookup

is shown, merely biasing of the r-f tube. The same value of volume control may be used, but the fixed element should be around 100 to 150 ohms. This is true because there will be much less necessity for correcting for oscillation, there being no danger of any until around 250 meters is reached, and the 100 ohm value will take care of that normally, and if not, then use 150 ohms.

Such a circuit as Fig. 4 is good for reception of local stations. Not too much should be expected of it. While it is true some persons have enjoyed some distant reception with a circuit like that, the cases are too few and far apart to justify expectation of ready repetition. That is, there are cases, but not enough of them.

A "Local" Set

It is to be regarded strictly as a local-reception hookup, and of course it will provide good quality, as there will be no side-band cutting, no over-selectivity, and no bad attenuation of audio frequencies. A little regeneration is present to render it all right to omit a bypass condenser from the biasing section (300 ohms) of the field choke, without too serious an effect on the low notes. Besides, the hum is kept down to a remarkably low level. In fact, some persons, on hearing the set, have asked whether it was battery-operated, the hum was so low.

Low hum characterizes all the circuits so far discussed, as it is regarded as of paramount importance to get rid of this trouble at all hazards, for hardly anything is more exasperating than to have a receiver thta is a hummer (in the evil sense). It is all right to have an automobile that is a hummer, as that would mean much pep and great speed, but we are building a radio set, not a car.

Certainly no a-c circuit could be expected to be much simpler, more elementary, more economical to build. Tube economy is another consideration, and of course the operating cost is very low, including the cost of tube life.

Parts Cost Less Than $16

The same considerations raised in respect to Fig. 3 apply to Fig. 4, as to construction, as the two circuits are substantially the same, except for the omitted tube and r-f stage. The set can be built of parts costing around $16, including speaker and cabinet, but not including tubes.

In regard to all such circuits, with choke coil in the negative leg of the rectifier, and especially with part of the choke used for biasing the pentode, it is well to stress the distinctions between this scheme and more common previous practice. Therefore the points will be discussed now, although constituting repetition.

B minus is the negative of all systems, commonly referred to as "the most negative." Always bear that in mind, as it is true regardless of what point is grounded. Now, in previously popular systems, with the choke in the positive leg leading out of the rectifier filament, B minus was grounded. The bias for a tube was obtained by a voltage drop between the positive connection of heater or filament and the grounded grid return.

Here we ground the center of the 2.5 volt winding. This winding always must be positive in respect to the grid return, for if the grid is to have a negative bias the return must be negative in respect to the cathode for filament type tubes.

Therefore the negative bias is obtained for the pentode by connecting the 300 ohm section of the choke coil, one side to ground, tap 300 ohms removed from ground to the grid return. Thus the grounded potential is positive in respect to the grid return, which can be better visualized by noting in the diagram that the center of the high voltage winding is negative (B minus) so all returns made to a point nearer to this center are negative, compared to ground.

The three other tubes, 235 and 224, are heater type tubes, and the cathode has to be considered. However, this problem is readily solved by regarding the circuit as the same as that for all heater type tubes. The bias is negative if the grid return is made to a point negative in respect to cathode, and this is always accomplished when a biasing resistor is interprosed between cathode and some point nearer B minus. Ground is nearer B minus than cathode, so the bias is negative.

Insulating a Particular Condenser

A point that must be watched carefully is that the electrolytic condenser of 8 mfd. that goes from rectifier filament to center of the high voltage winding (HV) is not at ground potential on either side. The anode (cap) is distinctly positive. However, the case (aluminum, tin or copper), is not grounded either, as it goes to B minus, which is not grounded. That requires the case be insulated from a metal chassis, if metal is used. If insulating material is used for subpanel or chassis, of course this special precaution need not be taken, as the insulation is automatic.

The other 8 mfd. condenser, however, has its case grounded, so no precaution is necessary here.

Both anodes (caps) of the condensers go to the rectifier filament, that is, a maximum B plus lead.

The filtration is the same with the choke in the negative leg as if the choke were in the positive leg, but the placement as shown simplifies the bias attainment. It seems to have become almost standard practice in midget sets, but the bias is obtained in some by putting two high resistances in series across the choke. This is possible, because then pentode plate current, in fact all plate current, will flow almost exclusively through the choke coil.

How Current Divides

Actually the current divides in proportion to the d-c resistance values of both. So if the total d-c resistance of the choke is 1,800 ohms, as here, and the sum of the resistances of the two high resistors were 1,800,000 ohms, the choke would carry almost 1,000 times as much current as the adjuncts.

All four of the circuits diagrammed have been carefully engineered, and when it is said that they do not represent utter finality it is only another way of saying that hope for further improvement still is entertained, for if nothing can be improved, nothing can be learned, and if nothing can be learned the excuse for living becomes sadly diminished.

Take the diagram, Fig. 1. This represents a thoroughly reliable circuit, and in support of that statement I will confide that I spent nearly 150 hours on it. Some 1,450 separate experiments were performed, including as an experiment each measurement of voltage or current, as this had to do with proportioning the regeneration, the major problem. The stability achieved gave me as big a thrill as I ever got out of taming any wild circuit. Then came still another improvement, the one to be related next week.

The total volume of sound is not so large as one might expect, considering the extra tube, compared to a two-stage audio channel. The extra tube served virtually exclusively as a stabilizing influence. No more volume of sound was obtained from a three stage amplifier, as Fig. 1, than from previously discussed two stage resistance amplifiers, but the stability was far better, indeed, it left nothing to worry about or apologize for.

Since that circuit was finally accepted as satisfactory, means were sought to regenerate strongly at low audio frequencies, to overcome the sluggishness of speakers in this region. Fig. 1 does not fully take into account the bashfulness of speakers when faced with 24 cycles, as compared, say, to 1,000 cycles.

Some very slight changes will make a very big improvement in this direction, and also reduce the hum to a still lower level. This is the care that will be ready for presentation in next week's issue (October 10th).

Since there is as much gain from two stages as from three, using the channels for the purposes outlined, it remains to solve the problem for two stages, to permit the low frequency regeneration for speaker assistance, as to avoid the only trouble left in the two stage system, that of a starting howl that subsides so soon as the heaters warm up. Solutions have been presented that require an extra tube, as discussed last week, and as considered this week, with the extra tube directly in the audio channel. It is hoped, however, that a few score more of hours of experimenting will yield the solution for the two stage channel, but that means that hardly much along this line need be expected in these columns for a couple of months.

A discouraging factor is the inductive load on the last tube.

The five tube and four tube models discussed this week possess some audio regenerative features, at least enough to make the low note reproduction passable, but, as said previously, if and when a method is devised for applying keener regeneration, the facts will be laid before the readers of this publication.

Meanwhile all the circuits are offered as being entirely suitable for present construction, and indeed there is actual factory production of five and seven tube models by one concern, the Polo Engineering Laboratories.

Figs. 3 and 4 are broadcast coverage only, while Figs. 1 and 2 give broadcast coverage excellently, short wave coverage well, to 60 meters, with less sensitivity where there is a lower band, below 60 meters, though fully good enough at the 50 meter band for police signals, relay broadcasting and the like.

Here are the coil data:

For Fig. 3

Antenna Coupler

For 0.00035 mfd. tuning condenser, wind 132 turns of No. 38 enamel wire for the secondary, and mount a honeycomb type radio frequency coil choke coil of 200 to 300 turns, inside the secondary, parallel to it, so that at nearest points the two coils are not more than 1 inch apart, but do not put closer than ½ inch apart. For 0.0005 mfd. make the secondary turns 127. The tubing diameter is 1 inch. The shield is 2¼ or greater diameter, not more than 2⅞ inches high.

If 1⅛ inch diameter tubing is used, because the shield is only 2¼ inches high, the secondary takes 122 turns of No. 31 enamel wire for 0.00035 mfd., or 95 turns for 0.0005 mfd.

Interstage Coupler

On either diameter stated above, the primary consists of 30 turns of any fine wire wound directly over the secondary, near the end at shield bottom, separated from the secondary with insulating material. Wrapping paper will do in a pinch. The secondary has five fewer turns than the antenna coil's secondary in either instance.

For Fig. 4

Antenna Coupler

Same as for Fig. 3. See directions above.

Interstage Coupler

Same as for Fig. 3. See directions above.

In all cases the size wire may be somewhat different without materially affecting the result.

Short Wave Super w

Optimum Values Obtained Experimer

By Brur

THIS short-wave superheterodyne was worked out experimentally and the various values are those which gave best performance. In only a few cases do the values used differ materially from those previously worked out theoretically.

One of the divergences is in the value of the grid bias resistance R5 in the detector. It is usually said that the best detecting efficiency is obtained at the bias where the bending of the grid voltage, plate current curve is greatest. This is not true for the detecting efficiency also depends on the amplification, that is, on the slope of the curve at the operating point. If the bias resistance is obtained from the plate current and the grid voltage where the bend is most rapid a value of about 75,000 ohms is obtained for R5. Experiment fixes the value of 30,000 ohms as the best. This is for a 224 screen grid tube as detector and a plate load resistance, R7, of 250,000 ohms, a screen voltage of 40 volts, and an applied plate voltage of 260 volts. These values are recommended.

High Frequency Filter

It is customary to use a choke of about 85 millihenries in the plate circuit of the detector to stop the transmission of the carrier frequency. It was found that this choke does not do enough good to justify its use. Hence it is omitted in this circuit. Also, if the choke is used it serves practically no purpose unless a small condenser is connected across the line on the output side of this choke. Hence this condenser also is left out. There remains only one condenser, C10, of 250 mmfd., to eliminate the high frequency carrier.

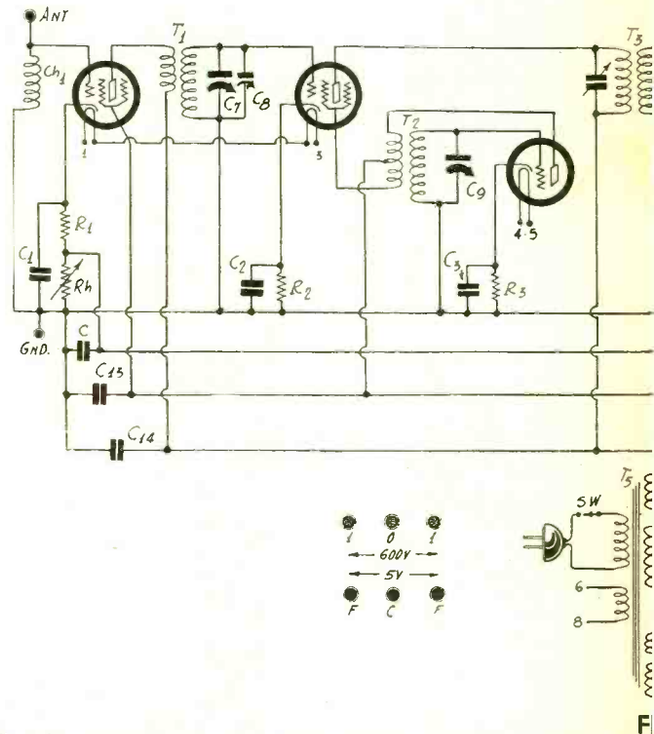
The by-pass condenser C5 across R5 was 2 mfd. It is advisable to use this size, or a larger one.

A single stage of audio amplification was sufficient, this being a 247 pentode operated with 250 volts on the plate and approximately 16.5 volts on the grid. This bias was obtained by the drop in the bias resistance R6, which was 400 ohms. The shunting condenser C6 was 4 mfd.

It will be noted that the output filter type of coupler is used between the loudspeaker and the tube. This was selected in preference to the use of a transformer because it was desired to return the speaker to the center (7) of the filament of the power tube rather than to ground or to B plus. This connection eliminates much of the reverse feedback on the low notes and so helps to bring out the bass notes better. This connection, of course, does not rule out the use of a transformer between the SP terminals and the voice coil of a dynamic speaker. Indeed, such a transformer is necessary if a dynamic speaker is to be used.

The condenser C12 in series with the speaker was 4 mfd. Theoretically this should be still larger for best operation on the low notes, but it makes practically no difference if it is increased beyond that value. Hence for economical reasons a four is used.

The value of the stopping condenser C11 was 0.1 mfd. and the grid leak R8 was one megohm. This combination insures good reproduction of the low notes as well as the high notes.



F

The diagram of a seven-tube short-wave superheterodyne wi experimentally determi

Intermediate Amplifier

The intermediate tuner contains two doubly tuned transformers, T3 and T4, each winding tuned to 450 kc. Each of these transformers is contained in an aluminum can 2 inches high and 2.5 inches in diameter. The two cans are placed with their centers approximately 5.5 inches apart. Even with this separation and careful shielding of the leads there is a tendency to oscillation in the intermediate amplifier when all the four tuned circuits are adjusted to exactly the same frequency, nominally 450 kc. However, the volume control stops the oscillation. By means of this control it is possible to operate the 235 intermediate amplifier close to the oscillating point of the circuit without at the same time materially reducing the amplification in the r-f 235 screen grid amplifier.

The grid bias resistance R4 is 150 ohms and the bias resistance in the first tube is the same. The condensers C4 and C1 shunting these are 0.1 mfd. units, which are high enough to by-pass either the signal frequency or the intermediate frequency. Besides these two resistances there is a common variable resistance Rh of 3,000 ohms. By means of this the bias on the two tubes can be varied over a considerable range. It is the only volume control in the circuit. A condenser C of 0.1 mfd. is connected across the variable resistance to prevent coupling.

Modulator Circuit

The modulator is a 224 screen grid tube operated with a high bias, which is obtained from the drop in R2. the value of which is 3,000 ohms. This is the best resistance when the plate voltage is 180 volts and the screen voltage is 75 volts. The shunting condenser C2 has a value of 0.1 mfd. The voltage from the oscillator is impressed in the screen circuit of modulator by means of a small pick-up winding on the oscillator coil form.

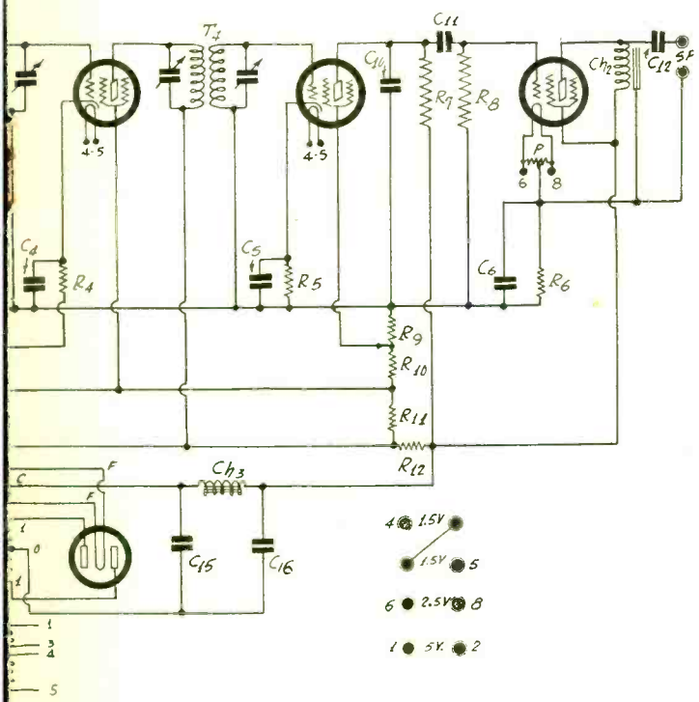
The oscillator is a 227 tube with tuned grid circuit and a tickler for feedback. The oscillator coil, T3, therefore, has three windings, one of which is tuned with a 350 mmfd. condenser C9. Bias resistance R3 for the oscillator is 2,000 ohms and the shunting condenser C3 is another 0.1 mfd. unit.

The input circuit to the modulator is an r-f transformer T1 the secondary of which is tuned with C7 and C8. C7 is

th 450 kc Intermediate

tally Wide Coverage with Three Coils

sten Brunn



G. 1

h an intermediate frequency of 450 kc. The design values were ed for best performance.

mounted on the same control as C9 and it has the same value. C8 is a trimmer across the r-f condenser and has a value of 200 mmfd.

An input choke Ch1 of about 10 millihenries is used in the antenna circuit.

The Power Supply

The power supply is a regular B battery eliminator with low voltage windings for the heaters. There are two 1.5-volt windings, one 2.5-volt winding, and one 5-volt winding, the terminals of which are arranged as in the figure at right. The two 1.5-volt windings are connected in series as indicated by the diagonal line and the two outside terminals are then connected to the heaters marked (4, 5). While the voltage is nominally 3 volts the voltage drop in the winding is about equal to the excess over the 2.5 volts required by the tubes. The proper series connection is made by connecting diagonally, and this diagonal line may be grounded if desired. Either (4) or (5) may be grounded.

The first two heaters are connected in series as shown and the terminals (1) and (2) are then connected to the corresponding terminals on the 5-volt winding. One point on this 5-volt circuit may be grounded, and a suitable point is the line joining the two heaters.

The 2.5-volt winding is reserved for the filament of the 247 power tube. Since this winding has no center tap and it is necessary to have one, a 30-ohm center-tapped resistance P is substituted.

The windings for the rectifier circuit are on the opposite side of the transformer and the terminals are arranged as in the figure at the left. Points (1) go to the plates of the 280 rectifier and point (0) goes to the ground. Points (F) on the lower winding go to the filament of the rectifier and point (C) goes to the filter.

The primary winding terminates in a plug. To insert the line switch Sw in the primary it is necessary to cut one of the leads to the plug and insert the switch. Or the switch may be connected in a line on the opposite side of the plug.

Filter and Voltage Divider

The filter consists of two 8 mfd. electrolytic condensers C15 and C17. A 30-henry choke Ch3 is connected in the positive side of the line between the two condensers.

The voltage divider resistances have the following values: R9, 2,000 ohms, to give a voltage drop of 40 volts for the screen of the detector; R10, 1,750 ohms; R11, 3,500 ohms; R12, 6,500 ohms. This makes a total of 13,750 ohms. It is quite permissible to make R10 1,500 ohms. The power ratings of these resistances should be: R9, one watt or more; R10, one watt or more; R11, 5 watts or more; R12, 15 watts or more.

C13 and C14 should not be smaller than 2 mfd. each and they may be much larger if desired.

The design of the transformers T1 and T2 given in the table below is based on the supposition that the intermediate frequency is exactly 450 kc, that the lowest signal frequency to be received is 1,500 kc, that C7 and C9 are 350 mmfd. condensers, and that C8 is a 200 mmfd. P is the number of turns on the primary of T1, S1 the number of turns on the secondary of T1, PU the number of turns on the pick-up winding on T2, T is the number of tickler turns on T2, and S2 is the number of secondary turns on T2. S1 and S2 are the two tuned windings. The size of form is 1,25 inches in diameter and the wire is No. 28 enameled, closely wound.

Coil Turns Data

	T1		T2		
Coil Number	P	S1	PU	T	S2
1	9	18	5	11	17
2	3	7	2	4	7
3	2	3	1	2	3

LIST OF PARTS

Coils

Ch1—One 800-turn duolateral r-f choke coil, about 10 millihenries
Ch2—One 100 henry audio frequency choke
Ch3—One 30 henry filter choke
T1—One set of radio frequency transformers as described
T2—One set of oscillator coils as described
T3, T4—Two 450 kc. doubly tuned intermediate frequency transformers
T5—One Kelford ABC transformer No. 330

Condensers

C, C1, C2, C3, C4—Five 0.1 mfd. by-pass condensers
C5, C13, C14—Three 2 mfd. or larger by-pass condensers
C6—One 4 mfd. or larger by-pass condenser
C7, C9—One double 350 mmfd. tuning condenser
C8—One 200 mmfd. trimmer condenser
C10—One 250 mmfd. by-pass condenser
C11—One 0.1 mfd. condenser
C12—One 4 mfd. by-pass condenser
C15, C16—Two 8 mfd. electrolytic condensers

Resistors

R1, R4—Two Lynch 150 ohm grid bias resistors
R2—One Lynch 3,000 ohm bias resistor
R3—One Lynch 2,000 ohm bias resistor
R5—One Lynch 30,000 ohm fixed resistor
R6—One Lynch 400 ohm bias resistor
R7—One Lynch 250,000 ohm plate resistor
R8—One Lynch one megohm grid leak
R9—One Lynch 2,000 ohm, one watt or more resistor
R10—One Lynch 1,500 ohm, one watt or more resistor
R11—One Lynch 3,500 ohm, 5 watt resistor
R12—One Lynch 6,500 ohm 15 watt resistor
P—One 30 ohm center tapped resistance
Rh—One 3,000 ohm variable resistance with knob

Other Parts

Sw—One a-c line switch
Seven UY sockets, six for tubes and one for oscillator coils
Two UX sockets, one for rectifier and one for r-f coils
One vernier dial for C7 and C9
One knob for C8 to match knob for Rh
Four binding posts
One metal chassis about 10x20x3 inches

The Use of An Ohmmeter

By Burton Williams

AN ohmmeter works on the principle of Ohm's law, that is, on the relation among voltage, current and resistance which states that the voltage drop in the resistance is equal to the amperage multiplied by the ohmage. If the battery is connected in series with the resistance and the current meter the voltage drop across the resistance is the same as the electromotive force of the battery, except for the negligible drop in the current meter. Hence we can say that the battery voltage is equal to the product of the ohmage and the amperage.

If the voltage of the battery is always the same the product of the ohmage and the amperage is also the same. Hence the ohmage and the amperage bear a reciprocal relationship to each other and we can measure either with the same meter, provided we put the proper scale on that meter. If we put a current scale on the instrument it measures current and if we put an ohmage scale on the same instrument it measures resistance.

Precaution to be Taken

If the resistance that is connected in series with the current meter should happen to be less than a certain value, the current will be greater than that for which the instrument was designed. The needle will fly off the scale. Indeed, the instrument may be irreparably damaged.

Hence when a current meter is used to measure resistance it is customary to put in a resistance in series with the circuit and to make this resistance such that when no other resistance is connected the current instrument reads just full scale. For example, if the current meter is a 0-1 milliammeter and the voltage of the battery is 1.5 volts, the resistance connected in the circuit is 1,500 ohms, because this will allow just one milliampere to flow in the circuit, which will result in full scale deflection.

The circuit is so arranged and so calibrated that this represents zero unknown resistance. That is, when the terminals for the unknown resistance are shorted, the deflection is just full scale. If a resistance of unknown value is connected in series with the battery and the meter in addition to the 1,500 ohm resistance the current will be less, and it will be less in proportion to the value of the unknown resistance. If we know the resistance of this "unknown" resistance we have a calibration point for the ohmmeter scale. The same way we can get any desired number of calibration points. But it is not necessary actually to use known resistance values. Every point on the ohmmeter scale can be computed for the current for any assumed resistance can be computed.

Ohmmeter Formula

The formula from which to work out a calibration scale is very simple. Let E be the voltage of the battery, I the current in amperes, R the unknown resistance, and r the fixed resistance required to give full scale deflection and no more. Then by Ohm's law we have $E=(R+r)I$. We are supposed to know E, the voltage of the battery we use, and we can easily determine the value of r just as soon as we know the value of I for the maximum permissible deflection of the current instrument. Knowing E and r we can assign any desired values to R and then compute the corresponding values of I. The relation thus obtained between I and R is the calibration.

Suppose our instrument is such that it gives full scale deflection on one milliampere, that is, on 0.001 ampere. Also let us use a single dry cell and assume that its voltage is exactly 1.5 volts. When the deflection is full the ohmmeter is supposed to measure zero resistance. Hence we set R=O in the formula. Then we have $1.5=r\times0.001$, or r equals 1,500 ohms. Thus our formula for this particular case becomes $1.5=(R+1,500)I$. From this we can easily work out a calibration without making a single experiment.

Higher Resistances

If it is necessary to measure higher high resistance values, it becomes necessary to increase the voltage of the battery used and also the value of r. In fact these two should be increased in the same proportion. If we use a battery of 4.5 volts the value of the fixed resistance should be 4,500 ohms and if the battery voltage is 45 volts the value of the resistance should be 45,000 ohms. If the voltage and the resistance are increased in the same proportion the same ohmage scale may be used regardless of the battery voltage, but of course, the scale divisions must also be multiplied by the same factor with which the voltage and the fixed resistance are multiplied.

Resistance values above about 100,000 ohms cannot be measued accurately unless the battery voltage is high. The reason for this is that it requires a very large resistance change to produce a readable current change when the deflection on the ohmmeter scale is near the end from which it starts to move as the circuit is closed.

Zero Adjustor

As time goes on the battery used becomes exhausted and the readings obtained will not be correct. They will always be higher than they should be. This is largely due to the increased resistance in the battery. The first evidence of this is that the indicator on the meter does not show zero resistance when the unknown resistance terminals are short-circuited. The easiest way to correct this error is to take two readings, one with test terminals short-circuit and the other with the unknown resistance across them. The value of the unknown resistance is then the difference between the two readings. This is exact provided that the battery voltage has not changed. As a rule the electromotive force of a battery remains practically 1.5 even though the cell is nearly dead as indicated by a current drawing voltmeter. The internal resistance of the cell has become extremely high. Hence it is all right to assume that the voltage has not changed and that it is only the internal resistance that causes the short-circuit deflection on the ohmmeter.

Sometimes the zero adjustment is made by means of a small variable resistance in series with r. In such cases the value of r is made less than it should be and the difference is made up with the variable resistance. When the meter is to be used the terminals for the unknown resistance are short-circuited and the variable resistance is adjusted until the indicator shows exactly zero resistance. Then the unknown resistance is put across the terminals and the resulting deflection is the correct resistance. This compensates for the rise of resistance in the battery. Clearly, when the resistance in the battery has risen to a value greater than that allowed for in the zero adjustor it is necessary to put in a fresh battery.

Short-Wave Club

Short-Wave Editor, Radio World, 145 West 45th Street, New York, N. Y.

Please enroll me as a member of Radio World's Short-Wave Club. This does not commit me to any obligation whatever.

Name .....

Address .....

City ..... State .....

☐ I am a subscriber for Radio World.

☐ I am not a subscriber, but buy copies at news-stands.

Each week names of new members of the Short-Wave Club are printed. There is no repetition. Here is this week's list:

Oliver Lindeman, 830 Lill Ave., Chicago, Ill.
Robert T. Beck, 413 W. 8th Ave., Lexington, No. Car.
R. W. Kelly, 440 Cherokee St., Bethlehem, Pa.
Arnold Reggans, 437 West 52nd St., New York, N. Y.
Nick Weimer, 1918 Cleveland Ave., Chicago, Ill.
William Brain, 306 North Windomere, Dallas, Tex.
Charles O'Grady, Sunnyside, Oaklandon, Ind.
Robert F. Shaw, W3AOC, 5818 N. 13th St., Philadelphia, Pa.
A. H. Peterson, 902 Fourth Ave., Devils Lake, N. D.
Sydney Steinberg, 1666 Pitkin Ave., Brooklyn, N. Y.
D. W. Picken, S.S. Oneida Pier, c-o Clyde Line, Pier 36, N. R. New York.
C. A. Broun, 1613 E. 75th St., Cleveland, Ohio.
Winton Webb, Perry, Ohio.
J. Clarence Lewis, Jr., 194 Jackson St., Matawan, N. J.
E. L. Tabor, Big Arm, Mont.
E. L. Boyle, 109 Gorham St., Canandaigua, N. Y.
Carlton Abernathy, 1840 Overbrook Rd., Clearwater, Fla.
J. V. Kushon, 218 Alwine Ave., Greensburg, Penna.
C. R. Trevino, Box 30, Sabinas, Coah, Mexico.
Harry Fanselow, 130 Suffolk St., New York, N. Y.
Wm. LeMaire, 221—21 106th Ave., Queens Village, N. Y. City.
Harold H. Hornbeck, 1953 Wabash Ave., Schenectady, N. Y.
Edward Raynes, 536 So. Euclid Ave., Oak Park, Ill.
Norman H. Funger, 397 Sherman North, Hamilton, Ont., Can
Robert Ittelson, 458—50th St., Brooklyn, N. Y.
William R. Conrad, 1351—12th St., Des Moines, Iowa.
Francis Convey, 1315—12th St., Des Moines, Iowa.
M. Schafer, 254 Lockwood St., Providence, R. I.
Ernest O. Bertrand, 2101 Linwood, Kansas City, Mo.
Donald E. Harper, 210 West Walnut, Herington, Kans.

Listen On Short Waves

Determination of Time Differences Illustrated

By Hood Masterson

MANY short-wave fans listen night after night and explore their dials carefully with the hope of getting signals from Europe and other remote places. And most of their work is time and patience wasted. Not that the receivers they have are not sensitive enough, perhaps; not that the signals from distant places don't come here! The trouble is that it takes the radio signals only about 1/60 second to come from Europe and the listeners don't get on the job until five or more hours later. By the time some short-wave fans twirl the dials in the hope of intercepting some signals from Europe, those signals have gone far beyond reach. In fact they are by that time a long way toward the Milky Way, or wherever radio waves go after they leave the earth.

It is the time difference between Europe and America that so many fans forget. Over in Europe as well as in other remote places people have about the same habits as they have here. They listen in during the evening hours, and when people listen radio stations broadcast. Now suppose we want to listen to a station in London, England. It is reasonable to assume that that station signs off at the latest at 1 a. m. in the morning, local time. The time difference between London and New York is 5 hours. Hence when the London station signs off it is only 8 p. m. in New York or in any place where Eastern Standard Time prevails. By 8 o'clock in the evening few dial twirlers have got ready to listen and most of their listening is done between 9 p. m. and 1 a. m.

Greater Time Difference

Listeners in the Middle states have still greater difficulty because when it is 1 a. m. in London it is only 7 p. m. in the Central Standard Time zone. Those in the Mountain and Pacific time zones have to get busy still earlier. Indeed, they have to forego their dinner if they want even a snatch of the London signals, or they have to take an afternoon off from work while they listen in.

That is the situation in regard to London stations and all other stations in the Greenwich time zone, from the north pole to the south. If the stations are farther east than London, the time difference will be still greater, and that difference should be taken into account when listening for DX stations. Obviously, it is useless to attempt to pick up any station that is not on the air at the time.

It should also be kept in mind that the time difference cannot be greater than 12 hours between any two points on the earth's surface. If the difference turns out to be greater than that going east it is always less than that going west. If a listener in the Eastern Standard Time zone sits up until after the London and other European stations sign off he may possibly be rewarded by signals from the west.

Of course, that is true even for those who live farther west.

North and South Communication

The best chance of getting remote stations is to operate in the north and south direction where the time difference between sender and receiver is zero to not more than an hour or two. Thus listeners in the United States and Canada have a good chance of receiving stations in South America. On the whole the South Americans are just a little ahead of the North Americans due to the fact that the South American continent runs off toward the east as compared with North America.

Signals traveling from South America to North America either travel in darkness all the time, or in daylight, except for comparatively brief intervals at sun set and sun rise. Thus for the most part transmission will not be erratic.

Commercial stations which must continue in communication with remote points regardless of the vagaries of radio transmission have two or more waves for use. They cannot depend on any one wave throughout the day. When transmission on one wave becomes poor, these stations switch to some other wave. Therefore if short-wave listeners want to receive at any time of the day, they must not only have a very sensitive receiver, but they must have a receiver which will cover the entire band of frequencies.

Beam Transmission

If a short wave listener has a complete list of short-wave stations he will find a very large number throughout the band. The ambition is to receive them all. There is very little chance of satisfying this ambition because many of the stations are not even transmitting. And many of the more prominent stations are transmitting on beams aimed to hit a particular point. If the short-wave listener is not in the beam there is little hope of picking up the station even with the most sensitive receiver. In the beam means along the shortest line between the transmitter and its intended target.

Although conditions are against the reception of distant short-wave stations, especially which you want and when you want them, there are so many stations operating all the time that even with a moderately sensitive receiver there is scarcely an hour of the day when a large number of them cannot be received. There are police, television, broadcast, amateur, and commercial code stations of all kinds, and if the short-wave receiver covers the band from 1,500 kc to about 30,000 kc literally thousands of stations are within listening reach.

Time Zones

Stations of the world give their time of operation in terms of Greenwich time counting from 0 to 24. Zero is midnight in London, 12:00 is noon and 24:00 is again midnight. This system is used regardless of the local time of the station. If the time of operation is known in terms of Greenwich time, and if the longitude of the receiver is known, it is easy to determine the local time of the receiver at which the station is operating. There are 24 hours during the day and 360 degrees of longitude. Hence every hour is equivalent to 360/24, or 15 degrees of longitude. The longitude of any place is always given with respect to Greenwich, and that is the reason it is easy to find the local time as well as the reason why Greenwich time is used. Counting from 0 to 24 is only a convenience to avoid using p. m. and a. m.

Each of the standard time zones in the United States and in Canada covers 15 degrees of longitude, approximately, and the longitude used in each zone is the middle. For example, the Eastern Standard Time zone is referred to the 75th meridian west of Greenwich. The zone nominally extends 7.5 degrees east and 7.5 degrees west of this meridian. The Central Standard Time zone centers on the 90th meridian, the Mountain zone around the 105th, and the Pacific around the 120th. There are local deviations from the true boundaries because it is inconvenient to have the boundary pass through populous districts. For example, it would be highly inconvenient to use Eastern Standard Time on one side of a city street and Central Standard Time on the other. The boundaries are more or less indefinite. On railroads the boundaries usually do come in cities or at division points, the trains arriving by one time and leaving by another.

Suppose a London station is beginning broadcasting at 20:00. At what time should a man in Chicago tune his set so as to get the program, if his set is sensitive enough? Chicago is in the 90th meridian zone. Hence the time difference between Chicago and London is 90/15 hours, or 6 hours. Since Chicago is west of London the Chicago time is six hours earlier. That is, when it is 20:00 o'clock in London it is only 14:00 in Chicago. But 14:00 is equivalent to 2 p. m. Hence the London transmission begins at 2 p. m. Chicago time, the same afternoon, of course.

Russian Stations

If the time of operation of a station is given in Greenwich time, it is not necessary to know more than the longitude of the receiver. But if the local time of the transmitter is given then it is also necessary to know the longitude of the transmitter. To find the time difference first obtain the longitude difference. If both longitudes are west of Greenwich, or both east of Greenwich, subtract the smaller from the larger to get the difference. If one longitude is east and the other is west, add the two longitudes to get the difference. Then divide the difference by 15 and the result is the time difference in hours. If a zone time is used, as in all places in the United States, the local longitude should not be used but rather the central longitude of the time zone in which the listener is located.

Suppose a station in Russia is operating at 02:00 Greenwich time. At what time should a man in Nevada, in the Pacific Standard Time zone be tuning for it? Pacific Standard Time zone centers around the 120th meridian west of Greenwich. Hence the time difference is 120/50, or 8 hours. We subtract 8 from 02:00, which amounts to subtracting 8 from 26:00, adding a day. Thus the local time in Nevada is 18:00, which is 6 p. m. Pacific Standard Time, the day before the time of the transmission. We do not need to know where the station in Russia is located if we know the Greenwich time of the transmission. REN, Moscow, Russia, is transmitting daily from 18:00 to 23:00. What time should a New Yorker listen for it? The time difference between London and New York is 5 hours. Hence the local standard time in New York is 13:00 to 18:00, or 1 p. m. to 6 p. m.

Station LSY, Buenos Ayres, Argentina, is transmitting from 16:00 to 20:00. At what time should a Chicago listener tune in? Chicago time is 6 hours different from Greenwich time. Hence the transmission in Buenos Ayres is from 10:00 to 14:00 Chicago time, or from 10 a. m. to 2 p. m. Central Standard Time.

A Question and Answer Department conducted by Radio World's Technical Staff. Only Questions sent in by University Club Members are answered. Answers printed herewith have been mailed to University Members.

Radio University

To obtain a membership in Radio World's University Club for one year, send $6 for one year's subscription (52 issues of Radio World) and you will get a University number. Put this number at top of letter (not envelope) containing questions. Address, Radio World, 145 West 45th Street, New York, N. Y.

Annual subscriptions are accepted at $6 for 52 numbers, with the privilege of obtaining answers to radio questions for the period of the subscription, but not if any other premium is obtained with the subscription.

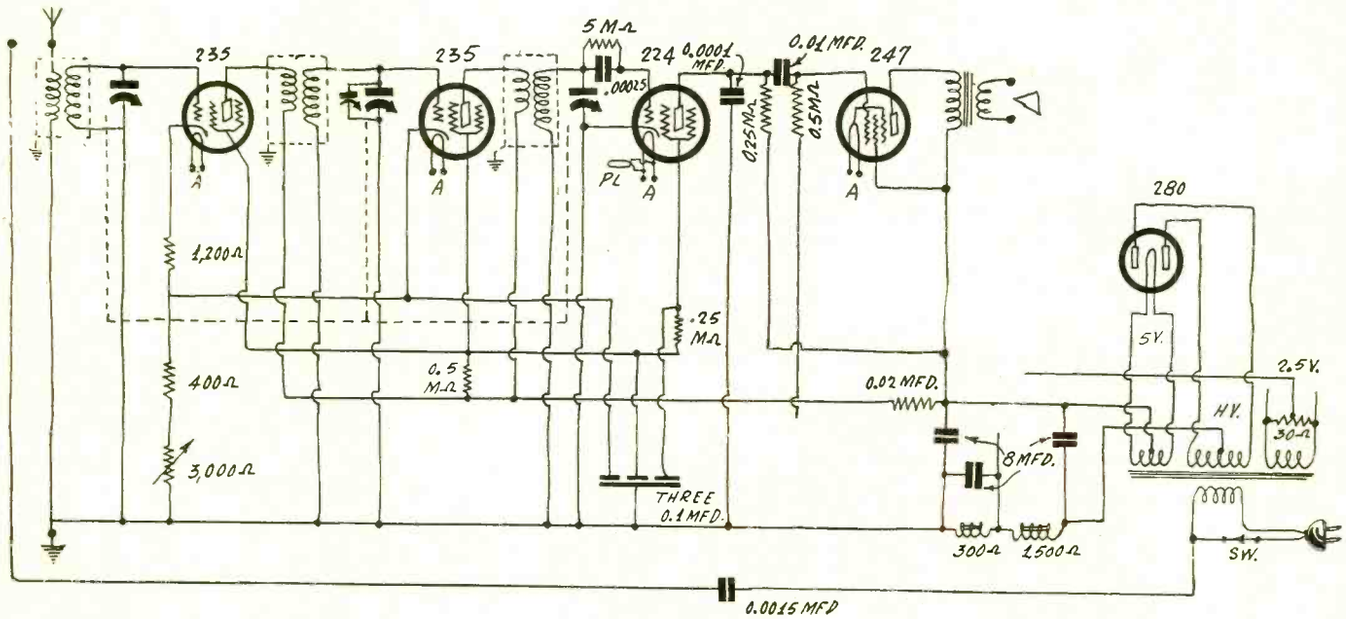


FIG. 954

The diagram of a five-tube midget containing three tuned circuits. This is a typical circuit used in up-to-date midget receivers. The grid return is to the 300 ohm tap on the B supply choke (dynamic field coil). The 2.5 volt center to ground.

Circuit of a Midget

WILL you kindly publish a diagram of a five-tube midget receiver with two 235 tubes for radio frequency amplification, a leaky condenser type detector and a 247 power tube, together with a rectifier using the 280 tube? Please show values of parts.—W.H.J.

In Fig. 954 is such a circuit. The various values are given on the diagram but some of them might be changed advantageously. For example, the bias resistance for the first 235 is 1,200 ohms in addition to the bias resistance common to the first two tubes. This 1,200 ohms resistance might be omitted. The 400 ohm resistance common to the two tubes might be reduced to 200 ohms, although 400 ohms will work all right. The 3,000 ohm variable resistance is quite necessary for controlling the gain.

* * *

Too Much Bias

THERE is too much bias on the 247 pentode tube in my midget set. The bias is obtained from a drop in a portion of the filter choke, the resistance of this portion being 300 ohms. Could the bias be reduced by connecting a resistance across the 300 ohm section of the choke? What effect would this have on the operation of the receiver otherwise?—E.S.

Yes, you can reduce the bias this way, but if you do there will be more hum in the output.

* * *

Oscillator With AC on Plate

IS it possible to make an oscillator using a-c on the plate? I am particularly interested in making a dynatron oscillator of this type. Would the output of such an oscillator be modulated?—F.W.J.

Such oscillators are used quite extensively. The oscillation occurs only during that part of the cycle when the plate is positive, and only a part of the positive cycle at that. The output will be modulated with a 60-cycle note and with most of the harmonics of this frequency.

* * *

Grounding the Speaker

THE single-sided amplifier by Brunsten Brunn in the Sept. 12 issue shows one side of the loudspeaker grounded. The primary is also virtually grounded. How can any power cross the transformer with both windings grounded and how can there be any power in the speaker when one side is grounded?—F. C. N.

If grounding one side of the speaker would prevent power from entering it the same thing could be said of a B battery, or any battery, which is grounded at one point. As long as only one point in a circuit is grounded it does not make any difference what that point is. In the case of the loudspeaker it is better to ground one point than not to do so. It would be best to ground the mid-point, if this were accessible. If it is not, then one side should be grounded. What applies to the secondary, or speaker circuit, also applies to the primary. One side, but only one, may be grounded. However, this must be taken with the proviso that the tube ahead must have plate voltage.

* * *

Meaning of Voltages on Tubes

FROM what point should the plate, screen, and grid voltages be measured? Should they be measured from B minus or from some other point?—B. W. Y.

All the voltages should be measured from the cathode of the tube. For example, the plate voltage should be measured from the cathode to the plate, the screen voltage should be measured from the cathode to the screen, and the grid voltage from the cathode to the grid. The cathode is always the electron emitting member. In the case of filament type tubes the filament is the cathode. If the filament is heated with direct current the negative end of the filament is the point from which to measure and if it is heated with alternating current the mid-point is the point. If the grid bias is obtained from a drop in a resistance all the voltages can be measured by connecting the negative terminal of the meter to B minus and the positive to the cathode, screen, and plate. The plate voltage thus obtained should be reduced by the cathode voltage to give the plate voltage and the cathode voltage should also be subtracted from the screen voltage to give the effective screen voltage. The cathode voltage is the same as the grid bials.

* * *

Preventing Reverse Feed Back

A SINGLE 247 tube gives plenty of volume for any home so that it is entirely unnecessary to use two in push-pull in the last stage. But when a single tube is used there is so much reverse feed back in the grid bias resistance that the output is not satisfactory. A by-pass condenser of reasonable size will not help much, except at the high audio frequencies. Can you suggest any way of preventing the reverse feed backs at low frequencies?—T. J.

A by-pass condenser of 100 microfarads does pretty well and that is not an unreasonable size if it is of the electrolytic type. Such condensers are available and they do not cost much. At 25 cycles per second and with a bias resistance of 400 ohms, a 100 microfarads cuts the reverse feed back by a factor of 6.36, and at 50 cycles per second it cuts the feed back by a factor of more than 12. Another way of reducing the feed back is to

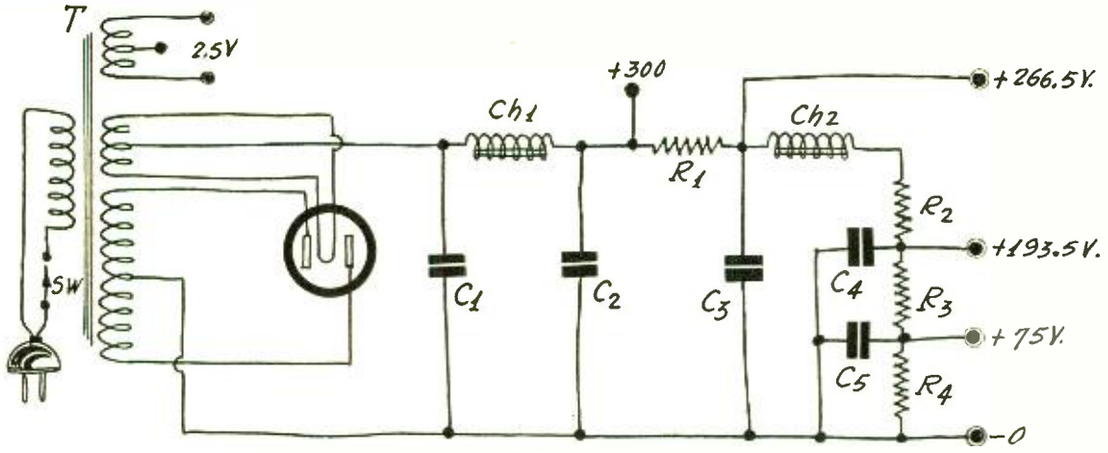


FIG. 955

The diagram of a B supply useful for supplying plate voltage in experimental as well as service receivers. For versatility the resistance in the voltage divider should be variable.

use a choke condenser output, making the inductance of the choke and the capacity of the condenser large. When this output circuit is used the speaker, or the primary of the speaker transformer, should be returned to the cathode of the power tube and not to B minus.

* * *

Coupling Between Short-Wave Coils

IN my short-wave receiver I use two tuned circuits, one in the oscillator, and the diameter is approximately three inches. They are placed about 6 inches apart with their axes on a line. Do you think that the coupling between the coils is too close and that shielding is necessary?—C. H. L.

The coupling is too close, especially for the coils for the shorter waves. If they were at right angles it would be all right perhaps. You can easily tell whether or not you need shielding since one of the circuits is supposed to oscillate. If while turning the oscillator condenser you hear clicks at two places and if the positions of these clicks depend on the setting of the r-f tuning condenser, the coupling is so close that the r-f tuner stops the oscillation. In the region between the two clicks there is no oscillation. If you have a converter rather than a short-wave set this coupling may not necessarily prevent you from getting signals, especially if the intermediate frequency is high, because then the two tuners are tuned to different frequencies when the signal comes in loudest. It does not matter if the oscillator does not function at one spot if it oscillates when the r-f circuit is tuned to the signal.

* * *

Circuit of a B Supply

PLEASE publish a circuit of a B supply suitable for a 247 power tube. I am going to build such a circuit which I intend to use for experimental purposes. One of the conditions is that the hum be as low as practicable. Please give the values of the condensers, chokes, and resistances?—J.W.A.

The diagram in Fig. 955 is suitable not only for circuits using the 247 power tube but also those using the 245, either singly or in push-pull. The a-c voltage across the entire high voltage winding should be 600 volts or slightly more. Ch1 should be a heavy duty choke, say one that will carry 100 milliamperes without saturation and at that current it should have an inductance of about 20 henries. Ch2 might be a regular 30 henry choke rated at 50 milliamperes or more. Condensers C1, C2 and C3 should have values of 4 mfd., 8 mfd. and 8 mfd., respectively. Of course, larger values may be used to suppress the hum still more. Condensers C4 and C5 might have 2 mfd. each or more. The values of the resistances in the voltage divider cannot be given, for they depend on the amount of current drawn from the various taps. For an experimental circuit they should be variable because then the voltages can be adjusted to any circuit within the limits of the B supply. Let us compute the values under the following conditions: The bleeder current through R4 is 15 milliamperes, the current into the 75 volt tap, 5 milliamperes, that into the 193.5 volt tap, 15 milliamperes, and that into the 266.5 volt tap, 79 milliamperes. Then R4 should be 5,000 ohms, R3 5,925 ohms, and R2 plus the resistance in Ch2, nearly 2,100 ohms. The resistance of the choke might be 400 ohms, making R2 1,700 ohms. If the voltage across the line at the 300 volt tap is really 300 volts, the value of R1 should be 294 ohms, or practically 300 ohms. This carries the most current and should be rated at least 10 watts.

* * *

Regenerative Audio Amplifier

WOULD it be possible to build a regenerative audio frequency amplifier that would not oscillate or overamplify at some frequency? If this is possible will you kindly show how?—H. B. N.

Such an amplifier is possible but it is preferably a non-reactive circuit. A B battery eliminator could be used with it but this would introduce reactance and the regeneration then would have to overcome a feebleness in some particular frequency region to avoid discrimination. That is, even in a reactive amplifier it would be possible to utilize regeneration to build up the amplification in certain frequency regions. For example, if the amplifier is deficient in the low notes, regeneration could be utilized to build up the signal at these values. The same could be done at the high notes.

* * *

Impedance of Choke

IN the September 26th issue you had an article showing how to compute the impedance of a resistance and a condenser in parallel. Will you kindly also show how to compute the impedance of a choke coil when the inductance is known?—B.W.C.

The impedance of a choke coil is the square root of the sum of the square of its resistance and the square of its reactance. The reactance is the product of the inductance in henries, the frequency in cycles per second, and the number 6.2832. As an example, let us take a choke coil having a resistance of 400 ohms and an inductance of 30 henries. What is the impedance at 60 cycles? The square of 400 is 1,600. The product of the inductance, frequency and 6.2832 is 30x60x6.2832, or 11,300. The square of this number should be added to 1,600 and then the square root should be taken to give the impedance. In this case we note that 1,600 is negligible in comparison with the square of 11,300. In such cases the impedance of the coil is equal to the reactance. Hence the impedance is equal to 11,300 ohms. If we had a high resistance of say 10,000 ohms in series with the choke the impedance is the square root of the sum of the squares of the resistance and the reactance. Now the total resistance is 10,400 ohms and the reactance is the same as before, namely, 11,300 ohms. Hence the impedance of the choke and the resistance is the square root of $(10,400)^2 + (11,300)^2$. The sum of these squares is 236 multiplied by a million. The square root is the square root of 236 multiplied by a thousand. The square root of 236 is 15.4. Hence the impedance is 15,400 ohms.

* * *

Regeneration in Superheterodyne

IS it practicable to regenerate in the second detector of a superheterodyne to make the circuit more sensitive? If it is, it seems to me that one tube could be dropped and still have a very sensitive circuit.—B. R.

It is quite practical, especially when the intermediate frequency is high. The feedback may be through a tickler coil, if the transformer is especially wound for it, or it may be through a separate transformer. The advantage of using regeneration in the intermediate frequency is that the adjustment may be made once for maximum sensitivity and it is not necessary to touch it later since the frequency remains fixed.

* * *

Midget Set Squeals

RECENTLY I built a midget receiver having three tuned circuits. All the tuning coils are in metal cans and should be well shielded. Yet the circuit oscillates violently. However, I can stop the oscillation with the volume control. Can you suggest any simple change in the circuit which will stop the oscillation and yet not reduce the sensitivity?—C.W.C.

If you do anything to stop the oscillation the circuit necessarily becomes less sensitive for the oscillation means that the circuit is regenerative. It is only a question of reducing enough of the regeneration to stabilize the circuit without making it degenerative. You have three tuned circuits. Hence you have two primaries after tubes. You can reverse any one of these primaries, or both of them. Try the combination which will give you the best results, considering stability. The best combination is probably the one obtained by leaving the first primary untouched and the second reversed.

A THOUGHT FOR THE WEEK

THE recent installation of a radio receiving system in New York's famous Bellevue Hospital means a great deal in the progress of radio and of humanitarianism. It seems quite likely that all the twenty-six municipal hospitals in Greater New York will be similarly equipped in the near future. It is the hope of the municipal authorities that the personal receiving pillows for sick rooms will also be added to the equipment, thus making our public hospitals a little more like heaven than the other place. Let other communities note these facts the next time they querulously discuss New York and its people.

RADIO WORLD

The First and Only National Radio Weekly
Tenth Year

Owned and published by Hennessy Radio Publications Corporation, 145 West 45th Street, New York, N. Y. Roland Burke Hennessy, president and treasurer, 145 West 45th Street, New York, N. Y.; M. B. Hennessy vice-president, 145 West 45th Street, New York, N. Y. Herman Bernard, secretary, 145 West 45th Street, New York, N. Y.

Roland Burke Hennessy, editor; Herman Bernard, managing editor and business manager; J. E. Anderson, technical editor; L. C. Tobin, advertising manager.

A Happy Start

THE new radio season is two weeks on its way, if one accepts the opening of the public show in New York as the commencement signal. This is simply an official event and does not necessarily carry with it any great immediate impetus to the thriving state of a season. The sharp upgrade in sales curves begins to take place about the middle of this month.

What the public show does reveal is what the season has in store for us. While the exhibits are manufactured receivers, the kit-sets will be along the same general lines, excepting that they will represent some advance thinking and designing, nearly always being a step or two ahead of the commercial product. As an example, the short wave field is well covered by the furnishers of kits, not nearly so well by the set manufacturers, who, however, can be counted to be along with their own models when it is felt the public at large is ready to buy such devices on a scale.

There is every reason to expect a thriving season, despite business conditions not being up to those of two years ago, for the prices are so low, almost inconsistent with the real workmanship they buy, that little money buys much. People have enough money to pay for what they need and want, but are demanding better value than ever, and the value is there this year as never before.

With television looming, short waves booming, and even broadcast sets retaining some interest to home constructors despite the fine manufactured broadcast sets, there will be plenty of both fun and work in store for this season.

Besides, inventors have been busy, and home constructors will have new improvements in radio and audio circuits at their command. One is the Bernard audio amplifier, to be described next week.

Standard Frequency Schedule, October November, December

Washington.

A new schedule of standard frequency transmissions by the Bureau of Standards has been announced for October, November and December. The full text follows:

The Bureau of Standards announces a new schedule of radio transmissions of standard frequencies. This service may be used by transmitting stations in adjusting their transmitters to exact frequency and by the public in calibrating frequency standards and transmitting and receiving apparatus. The signals are transmitted from the bureau's station, WWV, Washington, D. C., every Tuesday afternoon and evening. They can be heard and utilized by stations equipped for continuous-wave reception throughout the United States, although not with certainty in some places. The time schedules are different from those of previously announced transmissions. The only frequency utilized is 5,000 kilocycles. The accuracy of the frequency is at all times much better than a part in a million.

The transmissions are by continuous-wave telegraphy and at 5,000 kilocycles. They are given continuously from 2 to 4 p.m. and from 8 to 10 p.m., eastern standard time, every Tuesday throughout October, November, and December (except December 29). The dates are October 6, 13, 20, 27; November 3, 10, 17, 24; and December 1, 8, 15, 22.

The transmissions consist mainly of continuous, unkeyed carrier frequency, giving a continuous whistle in the receiving phones. The first 5 minutes of the transmission consist of the general call (CQ de WWV) and announcement of the frequency. The frequency and the call letters of the station (WWV) are given every 10 minutes thereafter.

Information on how to receive and utilize the signals is given in Bureau of Standards Letter Circular No. 280, which may be obtained by addressing a request to the Bureau of Standards, Washington, D. C. From the 5,000 kilocycles any apparatus may be given as complete a frequency calibration as desired by the method of harmonics.

Since the start of the 5,000-kilocycle transmissions at the beginning of this year the Bureau of Standards has been receiving reports regarding the reception of these transmissions and their use for frequency standardization from nearly all parts of the United States, including the Pacific coast and Alaska. The bureau is desirous of receiving more reports on these transmissions, especially because radio transmission phenomena change with the season of the year.

The data desired are approximate field intensity, fading and the suitability of the transmissions for frequency measurements. It is suggested that in reporting upon field intensities for these transmissions the following designations be used where field intensity measurement apparatus is not at hand: (1) Hardly perceptible, unreadable; (2) weak, readable now and then; (3) fairly good, readable with difficulty; (4) good, readable; and (5) very good, perfectly readable. A statement as to whether fading is present or not is desired, and if so, its characteristics, such as whether slow or rapid and time between peaks of signal intensity. Statements as to type of receiving set used in reporting on the transmissions and the type of antenna used are likewise desired. The bureau would also appreciate reports on the use of the transmissions for purposes of frequency measurement or control.

The bureau would also appreciate comment from all users of the service on the times of day when the transmissions are most useful. During July, August and September the evening transmissions were two hours later than in the schedule announced herein.

All reports and letters regarding the transmissions should be addressed Bureau of Standards, Washington, D. C.

$1,000,000 to De Forest Co.; Tube Dispute Settled

An agreement has been reached between the independent tube manufacturers, as the unlicensed ones were called, and the Radio Corporation of America, whereby all financial differences and suits are satisfactorily settled, and the independents become licensees. Also, all of the patents are pooled, so that the licensees obtain full protection, a situation not yet obtaining in the set licensing field.

The outstanding financial feature was the agreement by RCA to pay the DeForest Radio Company $1,000,000 forthwith, in consideration of its tube patents.

The agreement brings an end to the suit against RCA for $47,000,000 damages by independent tube manufacturers who, having obtained an injunction against a restrictive clause in RCA licenses to set manufacturers, claimed damages to their own tube sales. This restriction was clause 9 that provided all licensed set manufacturers must equip their sets initially with only RCA tubes. Before the injunction was granted RCA abandoned the clause as bad business policy.

Out of the tube clause suit grew the attempt to rule the stations of RCA and subsidiaries, both broadcasting and message-sending, off the air, because of violation of the Sherman act prohibiting monopoly and restrictions in restraint of trade. The Radio Law adds the penalty of license forfeiture for such violation as affecting communications. However, the Federal Radio Commission ruled, 3 to 2, that the tube clause did not affect monopoly of communications or restraint of trade thereunder.

The terms of the agreement newly reached include the acquisition of licenses under RCA patents by the active tube companies, including the De Forest company, the Gold Seal Electric Company, Arcturus, the Republic Radio Tube Company and the Diamond Radio Tube Company. In the same understanding, RCA and licensed concerns acquire tube-making rights under patents held by the De Forest Company.

IMPORTANT NOTICE TO CANADIAN SUBSCRIBERS — RADIO WORLD will accept new subscriptions at the present rates of $6 a year (52 issues); $3 for six months; $1.50 for three months; (net, without premium). Present Canadian subscribers may renew at these rates beyond expiration dates of their current subscriptions. Orders and remittance should be mailed not later than October 10, 1931. Subscription Dept., Radio World, 145 W. 45th St., New York, N. Y.

Sparkles

By Alice Remsen

PORTRAIT OF A SINGER

SINGING SAM

(WABC, 8:15 p.m., Monday, Wednesday and Friday)

TALL and broad-shouldered, kind and wise;
Ruddy-faced, with a friendly grin;
A voice reflecting the soul within,
Laughing wrinkles around the eyes.
A knowledge of what each creature needs,
The kind of knowledge experience brings;
A traveler's way of looking at things,
A tolerant viewpoint of life and creeds.
An open heart, sincere and true,
For righteous men, or men of sin;
A way of shaking hands with you
That sort of reaches under the skin.
With numberless songs, and fine ones, too;
Pleasing others his revenue.

—A. R.

* * *

HAIL! TO THE NEW RADIO Queen. Harriet Lee deserves the title, for not only is she a very beautiful woman, but also a radio artist of ability. Tall, statuesque and blonde; blue-eyed and Nordic. Gorgeous complexion, stunning figure, conservative dresser. Thinks well of everybody, is a good cook, plays a serious game of bridge, and drives a car well. What more could you ask?

* * *

WOR DOES NOT SEEM THE SAME without the cheery face and voice of Arthur Q. Bryan. But Arthur needed a rest before beginning what is going to prove a very hard season for him. He has several commercial contracts staring him in the face, both for writing and announcing. A surprise was sprung on little Artie, by Uncle Don Carney, the evening of September 19th, Arthur's last night at WOR. After his sign-off he was inveigled into a taxi and driven up to 90th St. and Central Park West, where Uncle Don has a gorgeous pent-house apartment. There he found assembled, with his genial host and hostess, Mr. and Mrs. Carney, well—almost everybody—including such well-known people as Mr. and Mrs. Leonard Cox, Mr. and Mrs. Roy Smeck, Mr. and Mrs. Laird, Lee Cronican, Arthur Hale, Phil Thorn, Mr. and Mrs. Roger Bower, Errol Crawford, Floyd Neale, and his niece, Olive Knowles Messenger; Mr. and Mrs. Bernard F. Stenz, the tennis champion; E. McKay, Arnold Morgan and Marjorie Horton, Alice Remsen, Mrs. Benson and many others. It was a wonderful party. Arthur received several parting gifts. Stories were told, songs sung and of course a lunch was served.

Uncle Don and his charming wife are splendid hosts. Their house is full of interesting things, pictures, marbles—and—I must not forget the aquarium of tropical fish, beautiful little things, all colors, hundreds of them. Uncle Don is very proud of his terrace. He took me out and showed me tomatoes, two of them, rather small and very green, but still tomatoes, grown on a New York roof; mint, parsley and radishes, too. One of these days I'll tell you more about them and the fountain, the vines and the view—but now, must say how much we miss Arthur Q. Bryan and wish him plenty of luck in his new field of endeavor. Arthur is a great lad, a swell announcer and a tenor of excellent quality and range.

* * *

ROSS GORMAN, PLAYING ON THE Blue Coal Revue, WABC, 5:30 on Sundays, is one of the most versatile musicians in radio, using no less than fifteen different wind instruments on a single program. Those include bagpipes, heclophone, English horn, and, of course, all manner of saxophones, clarinets and oboes. Ross was originally with Paul Whiteman and had his own band for several years.

* * *

BILL SCHUDT'S "GOING TO Press" period is the oldest C. B. S. program now on the air. During the time it has been broadcast Schudt has brought before the microphone leading writers in every field of journalism and the publishing business. A few had something to say and said it well; the majority had nothing to say but said it well just the same. It is a strange thing, but usually the best and most prolific of writers are dumb when it comes to public speaking. Mediocre writers can gab fast enough, being, like mediocre actors, cocksure of themselves. True artists are seldom sure of themselves and hesitate to inflict their own personal opinions upon the public except by medium of the written word. G. B. S. is, of course, an exception to the rule.

* * *

YOU MAY HEAR THE STREET Singer now every evening at 11:00 for he has taken the place of youthful Bing Crosby, who has been moved up to 7:00 p.m., where first Morton Downey and then Kate Smith held sway. A big step higher for both these singers.

* * *

SIDELIGHTS

JACQUES RENARD weighs two hundred and seventy pounds. . . . MARK WARNOW uses a pencil for a baton . . . RUSS COLOMBO wrote his own theme song . . . CATHERINE FIELD is of Scottish descent . . . UNCLE DON breeds 'em . . . JULIAN WOODWORTH is the smartest dresser in the orchestra world . . . JACK ARTHUR acts his songs . . . LEWIS REID wears a smile when reading continuity . . . BASIL RUYSDAEL is very serious . . . DAVID ROSS writes as well as reads poetry . . . AIMEE PUNCHON has a canary for a pet, and when she sings it joins in the chorus . . . PAUL SIMMONS is not only a fine baritone singer, but also a good golfer and an excellent singing teacher . . . BOB KELLER makes swell four-part harmony arrangements . . . So does CLAUDE MacARTHUR . . . EVELYN McGREGOR sings in a Jewish Tabernacle. She has a very fine contralto voice . . . MARION ENGLE plays organ in a Jewish Tabernacle . . . PETER DE ROSE has written another song, dedicated to May Singhi Breen—"When You Were Only Seventeen" . . . BETH CHALLIS is of English parentage, and her mother is just as sweet as Beth . . . GENE RODEMICH and JOHN FOSTER are both golf nuts. They play together at every opportunity.

* * *

BIOGRAPHICAL BREVITIES

ALL ABOUT TONY WONS

Anthony (Tony) Wons was born on Christmas Day. Supported his mother and five brothers when only thirteen. Got three dollars a week tending furnaces as his first remunerative occupation. Caught forty-eight butterfiies in one day when eight years old. Was one of the best butchers in a small Wisconsin town. Was a cowboy in Phoenix, Arizona. Clerked in a grocery store in Valparaiso, Ind. Is an expert violinist. Knows all about typewriters, (machines, I mean). Studied evenings for three years. Has done eight characters in the "Merchant of Venice," can actually do thirteen parts.

Is entirely familiar with the functions of a broadcasting station, having mastered production, announcing, acting and engineering. Attended a dramatic school. Broadcast for five years over WLS, Chicago and a year and four months over WLW, Cincinnati. Always stands when broadcasting. Was a baker for a month and won the plaudits of housewives for his lemon cookies and buns. Has more completed scrapbooks than his home town has streets. The World War started him on the road to success. He had months in a veteran's hospital to read, clip and paste up his now famous scrap books. Has read 100,000 poems; wrote only one. Drinks a pint and a half of orange juice a day to ward off colds. Prefers the serious side of life. Loves the woods. Hates the subways. Has memorized twelve Shakesperian plays. Reads everything he gets hold of. Has no fear of anything in this world. Keeps regular hours even when he doesn't have to. Barbers, photographers and dentists are his chief worries.

Lectures and theatres hold a great attraction for him. Sounds like and laughs like Will Rogers, but doesn't look like him. Addicted to fishing. Gets more than a thousand useful contributions from his listeners in an average week. Receives an average of fifteen thousand fan letters in each month. Likes dogs and cats but hasn't much time for them. Builds boats in his spare time. Likes to buy new clothes but prefers to wear old ones. Has had his published scrapbooks translated into Braille; derives the most pleasure from reading and answering letters from the blind.

Likes the idea of a non-denominational church and conducted one in Chicago with twenty nationalities and twenty-seven creeds. Each of his Scrapbook volumes is twelve inches thick. Is the father of a fine ten-year-old daughter. Is only thirty-nine years of age, yet his listeners think him a graybeard. You may hear him on the Camel Quarter Hour over Columbia. He is the master-of-ceremonies; you'll like him. WABC every day except Sunday, at 7:45 p.m. and every morning at 9:30 in his own program.

* * *

Answers to Correspondents

H. RHODES, N. Y. CITY Veronica Wiggins is the contralto on the Moonbeam Hour, WOR, every night, except Saturday, at 11:30. She is also the soloist on the A. & P. Gypsy program, WEAF, Monday night, at nine o'clock.

* * *

E. GORDON, L. I. CITY Jessica Dragonette is blonde and tiny. She was educated in a convent. Am sure she will send you a photograph if you write her. care NBC, 711 Fifth Ave., N. Y. C.

* * *

SUNDRY SUGGESTIONS FOR WEEK COMMENCING OCTOBER 4TH

SUN., Oct. 4th— Lew White, Organist	WEAF	8:00 a.m.
SUN., Oct. 4th— Footlight Echoes	WOR	10:30 p.m.
MON., Oct. 5th— True Story	WEAF	10:00 p.m.
TUES., Oct. 6th— Street Singer	WABC	11:00 p.m.
WED., Oct. 7th— Sherlock Holmes	WJZ	9:00 p.m.
THURS., Oct. 8th— Weaver of Dreams	WOR	10:00 p.m.
FRI., Oct. 9th— Old Dutch Girl	WABC	9:45 a.m.
SAT., Oct. 10th— Alice Remsen	WOR	9:15 .pm.

(If you would like to know something of your favorite radio artists or announcers, drop a card to the conductor of this page. Address her, Miss Alice Remsen, Radio World, 145 West 45th St., New York, N. Y.)

SIX STATIONS CLEARED OVER CLINIC TALKS

Washington.

The Federal Radio Commission made the following announcement:

Complaint was received concerning the methods and operation of the Hudson Clinic which broadcast over a number of stations in and around New York. The complainant is apparently a disgruntled patient of the clinic who resents both the manner in which he was treated and the amount demanded for treatment.

An investigation has been completed of the programs broadcast by this clinic, which is located in New Jersey and which treats varicose veins by injection methods. The stations over which these broadcasts were carried were: WAAT, Jersey City, N. J.; WBBC, Brooklyn; WAAM, Newark; WCDA, New York; DKBO, Jersey City; WOV, New York, and WRNY, New York. Sworn statements have been made on behalf of the Hudson clinic over these stations.

Hypothetical Questions Answered

Questions and answers by the Hudson Clinic were carried over some of the stations named. However, personal representatives of the clinic stated that these questions and answers were purely hypothetical and that no diagnoses were made or attempted at any time over the air.

Two representatives of the Commission were directed to proceed to New York on July 18 with the Commission's portable recording apparatus and to report programs of the Hudson Clinic. About 10 of these programs were recorded, all of which were similar in character to the transcripts submitted by the stations under oath.

While the Hudson Clinic is being severely criticized by the medical profession, the broadcasts seem to contain nothing upon which criticism might be based.

Case of Medical Ethics

All of the persons administering treatments are duly licensed physicians under the law of New Jersey, where the clinic is located. It appears that it is a case concerning ethics of the medical profession, and it is not a matter upon which the Commission may take action. It is therefore recommended that no action be taken regarding the programs by the Hudson Clinic over the stations named above and that the matter be closed.

7.7 Per Cent. of Families in South Carolina Have Sets

Washington.

The Bureau of Census announced:

The whole number of families in the State of South Carolina on April 1, 1930, was 366,265, as compared with 349,126 in 1920. The number of persons per family in 1930 was 4.8, which was the same as in 1920. The number of families reporting radio sets in 1930 was 28,007, or 7.7 per cent of the total.

NEW SOCKET

A rubber weatherproof socket is announced by the Eagle Electric Mfg. Co., Inc., 59-79 Hall St., Brooklyn, N. Y. It is constructed of non-blooming rubber and supplied with black and white 6" leads with waterproof re-enforcements, brass shell with spring contacts.

Pointed Opinions

GEORGE LEWIS, Radio Engineer and Vice-President of Arcturus Radio Tube Company: "The radio set of today always will be an integral part of television receiving. The two systems must be operated simultaneously for satisfactory results. One depends on the other in bringing a synchronized television program into the home. Commercial broadcasting is transmitted on frequencies between 550 and 1,500 kilocycles and a radio set is necessary to receive the signals in this wave band. Television is sent on frequencies between 2,000 and 2,200 kilocycles, and requires a special circuit or set designed for that wave band. True, we may have a compact cabinet combining the two sets, but a radio set to-day will be an efficient adjunct to the television receiver of the future."

* * *

J. CLARKE COIT, President, U. S. Radio & Television Corp: "There is a division of opinion on the matter of whether television will come in a separate unit or be incorporated in the radio set. A good many engineers believe television will be a separate unit, but time and engineering will give the answer. Meantime there is no reason for scrapping sets or withholding their purchase in anticipation of the time when television will be on a really practical plan."

MIDGET SET'S LEAD REDUCED

For the first time in several months there was a reduction during August in the proportion of sales of midget sets to total sales volume, according to George C. Furness of New York, Chairman of the Radio Manufacturers Association's statistics committee. Sales as well as shipments of receiving sets, tubes and other radio products showed a marked increase in August which has continued through September, with consequent increase in factory employment, he added. This condition is especially notable in the case of most parts manufacturers.

Through the concerted effort of the Association and the State Department at Washington, effectual action has been taken with several Latin American countries, especially Argentine and Uruguay, against recent tariff increases on radio products and also electric refrigerators. The United States Ambassador at Buenos Aires and the American Minister at Uruguay have united with local importers of radio to oppose the increased customs rates. Arthur Moss, of New York, chairman of the association's foreign trade committee, has been informed that the protest lodged with the Argentine and Uruguayan Governments are receiving careful consideration. An immediate result in Uruguay was a limitation of the tariff increase to a period of thirty days, with extension probable until a final decision is reached.

There has been no major failure among radio companies during the current year, and only a few minor bankruptcies, says the association, adding that it is considered a good showing under present general conditions. Radio sales are generally reported on the increase and collections not easy but good.

94 OUT OF 294 STATIONS NOT 50 CYCLES OFF

Washington.

During July 294 stations were measured by the monitoring systems of the Radio Division, Department of Commerce, and 94 at no time deviated more than 50 cycles above or below their assigned frequency, 70 deviated over 50 but under 100 cycles, 60 over 100 but under 200 cycles, and 70 over 200 cycles. The total number of stations is 613, but not all could be measured, due to low power of many.

The stations under 50 cycles (studio location if separate shown in parenthesis) follow:

KDKA—Saxonburg, Pa. (Pittsburgh).
KFDM—Beaumont, Tex.
KFEL—Denver, Colo.
KFEQ—St. Joseph, Mo.
KFJR—Portland, Oreg.
KFSD—San Diego, Calif.
KFSG—Los Angeles, Calif.
KFVD—Culver City, Calif.
KFWB—Hollywood, Calif.
KFXM—San Bernardino, Calif.
KGW—Portland, Oreg.
KHQ—Spokane, Wash.
KLZ—Denver, Colo.
KMBC—Independence, Mo. (Kansas City, Mo.)
KMO—Tacoma, Wash.
KMOX—St. Louis, Mo.
KMPC—Beverly Hills, Calif.
KOIL—Council Bluffs, Iowa.
KOMO—Harbor Island, Wash. (Seattle).
KPO—San Francisco, Calif.
KPPC—Pasadena, Calif.
KSAC—Manhattan, Kans.
KSD—St. Louis, Mo.
KSTP—Radio Center, Minn. (St. Paul).
KTAR—Phoenix, Ariz.
KTBR—Portland, Oreg.
KWJJ—Portland, Oreg.
KYA—San Francisco, Calif.
KYW-KFKX—Bloomingdale Township, Ill. (Chicago).
WAAB—Lexington, Mass. (Boston).
WABC—New York, N. Y.
WADC—Tallmadge, Ohio (Akron).
WBBR—Rossville, N. Y. (Brooklyn).
WBEN—Martinsville, N. Y. (Buffalo).
WBSO—Needham, Mass.
WBT—Charlotte, N. C.
WCAO—Baltimore, Md.
WCBA—Allentown, Pa.
WCDA—Cliffside Park, N. J. (N. Y. City))
WCFL—Chicago, Ill.
WCSH—Scarboro, Me. (Portland).
WDAF—Kansas City, Mo.
WDGY—Minneapolis, Minn.
WEAN—Providence, R. I.
WEBC—Superior, Wis.
WEEI—Weymouth, Mass. (Boston).
WFBL—Collamer, N. Y. (Syracuse).
WFI—Philadelphia, Pa.
WFIW—Hopkinsville, Ky.
WGAR—Akron, Ohio.
WGES—Chicago, Ill.
WGN—Elgin, Ill. (Chicago).
WGST—Atlanta, Ga.
WGY—Schenectady, N. Y.
WHAD—Milwaukee, Wis.
WHAM—Rochester, N. Y.
WHAS—Louisville, Ky.
WHO—Des Moines, Iowa.
WHP—Lemoyne, Pa. (Harrisburg).
WIP-WFAN—Philadelphia, Pa.
WISN—Milwaukee, Wis.
WJAZ—Mt. Prospect, Ill. (Chicago).
WJKS—Gary, Ind.
WJR—Sylvan Lake Village, Mich. Detroit).
WJSV—Mt. Vernon Hills, Va. (Alexandria).
WJZ—Bound Brook, N. J. (N. Y. City).
WKAV—Laconia, N. H.
WKBN—Youngstown, Ohio.
WKRC—Cincinnati, Ohio.
WLBZ—Bangor, Me.
WLIT—Philadelphia, Pa.
WMAL—Washington, D. C.
WMAQ—Addison, Ill. (Chicago).
WMBC—Detroit, Mich.
WMSG—New York, N. Y.
WMT—Waterloo, Iowa.
WNBH—Fair Haven, Mass. (New Bedford).
WOAI—Selma, Tex. (San Antonio).
WOC—Davenport, Iowa.
WOI—Ames, Iowa.
WOL—Washington, D. C.
WOR—Kearny, N. J. (Newark).
WOW—Omaha, Nebr.
WOWO—Ft. Wayne, Ind.
WPG—Atlantic City, N. J.
WPOR-WTAR—Norfolk, Va.
WPTF—Raleigh, N. C.
WRAX—Philadelphia, Pa.
WRVA—Mechanicsville, Va. (Richmond).
WSB—Atlanta, Ga.
WSBC—Chicago, Ill.
WSUI—Iowa City, Iowa.
WTMJ—Brookfield, Wis. (Milwaukee).
WXYZ—Detroit, Mich.

In calibrating oscillators for broadcast frequencies these stations may well be used. The frequencies are obtainable from independent lists.

LEIBOWITZ QUITS AMPERITE

Meyer N. Leibowitz has retired as president and general manager of the Amperite Corporation, New York.

TELEVISION AS REALITY HOLDS SHOW'S CENTER

The stride of radio was obvious in the contrast between the first Radio World's Fair, held in New York City in a relatively small space in 1924, and the eighth annual Radio-Electrical World's Fair, just ended at Madison Square Garden.

Seven years ago assortments of parts were exhibited and the glamor of being able to obtain loudspeaker reception on four tubes (with tubes at $5 each), was keenly stressed. In those days you had to build your own or go without, with the exception that some few sellers of kits also offered wired models of their "marvelous" circuits.

This year, more notably even than in the previous few years, the show is devoted to manufactured receivers, many of them midgets, some of them console types with phonograph facilities and the convenience of automatic record-changing, and in one instance remote control of radio and phonograph selection, volume and eight-station tuning.

"Television Now Ready for Home"

And instead of being highly enthusiastic about the marvel of actually obtaining understandable loudspeaker reception, the show sponsors and exhibitors are talking about television, and were exhibiting it. Moreover, executives circumspect about estimating when television will become commercially practical are talking about this new development being "now ready for its entrance into the home."

While radio in the early days virtually was the exclusive feature, this year more electrical appliances are exhibited than last year, particularly since some radio set manufacturers went into the electric refrigerator and similar lines of endeavor, and as radio dealers are encouraged to have electrical devices to handle as auxiliary lines. So washing machines, fans and other things electrical, many made by non-radio concerns, are among the devices to engage the eye.

Radio has grown into a developed science, its product clothed in glorious garments of furniture, with noted designers having been hired to turn out works of art, notably Everett Worthington and Norman Bel Geddes. But the Gothic arch, of orthodox economy and dubious art, still rules as the favorite for modest midget sets, though some manufacturers have departed from the commonplace to use an ornamental oblong table model cabinet, with speaker in the center, controls at left and right, to house their compact offerings. Also the tier cabinet has won its welcome, with the longer dimension of the oblong being the perpendicular.

Tribute to Faraday

The show week happened to include the one hundredth anniversary of the findings of Michael Faraday, who discovered electro-magnetic induction. Replicas of Faraday's magnets were exhibited at one of the two booths of the New York Museum of Science and Industry, and David Sarnoff, president of the Radio Corporation of America, in the address officially opening the show, paid tribute to Faraday's genius. His talk was broadcast by WJZ and a chain.

In his talk Mr. Sarnoff said of television:

"The synchronization of sight and sound on the screen, which revolutionized the motion picture industry, revitalizing it as an agency of public entertainment and education, has led to the production of a great many pictures of unusual merit and high dramatic appeal.

"This development is now ready for its entrance into the home, and I feel that next year, if one is privileged to indulge in a bit of prophecy, the theatre of the home will be established, and on the way to become an outstanding institution.

"Nor is the day distant when sight will be transmitted through the air to large numbers. We are on the threshold of television, and just as the shackels of silence were struck from the screen, so will the veil be lifted from our daily broadcast."

Television Demonstrated

The satisfactory emergence of television from the peep-hole stage was demonstrated by U. A. Sanabria, youthful Chicago experimenter, who brought on his elaborate apparatus, some of which was damaged in transit, so the demonstration did not take place on the opening night. The projection was on a ten-foot-square screen.

Projection demonstrated last year, the first one, was not very convincing, and the picture was small, this not being Sanabria's work, but this year the pictures were larger and clearer, and there was no waiting in line to peep at a picture, since full view was afforded to all visitors, a ground glass screen in a silver frame being in a reservation accommodating 300 persons. The screen weighed 362 pounds. A crimson mat was inside it.

The studio and transmission features were exhibited, also, as on a lower level was the pickup, or battery of photo-electric cells, before which the performers acted, as they sang and talked for the benefit of the television transmission actually then made. These transmissions are on short waves for all television work, except that the accompanying sound is modulated on broadcast waves in some instances. Therefore the equivalent of two receivers is necessary for reception of home talking movies received via radio, one for the image and the other for the sound.

Rear Type Projection

The transmission was made direct to a receiver and projection on the screen resulted. The projection was of the rear type, so that the viewers do not obstruct their own and others' views.

Four manufacturers exhibited factory-built television receivers. Each set was equipped with a viewing screen of small dimensions on the front panel. Thus persons in a living room could sit around the machine and go sight-seeing without budging.

That home construction of television sets is a keen attraction was proved by a contest under the auspices of the Boy Scouts of America for the building of the best television receivers.

Short waves came in for recognition even beyond the television outfits, for all-wave receivers were put on view, covering wavelengths from 15 to 550 meters, as well as strictly short wave sets. The fascination of short wave receivers is the possibility of obtaining great distance, including the reception of programs from foreign countries on the loudspeaker.

The general trend away from plug-in coils was obvious, as stress was laid on the convenience of band shifting by actuating a front-panel switch only. However, two precision manufacturers adhered to plug-in coils on the basis of better results.

In broadcast receivers the superheterodyne has come forward as never before. This circuit, introduced in 1922 by Maj. E. H. Armstrong, is the basis of most of the midgets that are beyond the "ridiculously low priced" class, and virtually all of the console models. The circuit has been fairly well standardized for manufacturers, and most of them are content not to depart severely from the standard.

The 1932 Circuits

There is a fundamental circuit for each tube group, and there are superheterodynes with so few as five tubes. Experimental work at licensing headquarters, from which recommended circuits are emitted, has resulted in this measure of standardization.

There was nothing radical in circuit design. The forward march of the superheterodyne began last year, with the expiration of the tuned radio frequency patent impending, and the licensing authority permitting other manufacturers to use the circuit it had previously held to itself.

The pentode output tube is virtually universal, and in alternating current sets radio frequency amplification is virtually exclusively done with variable mu tubes. Both of these types are screen grid tubes, and both have high gain. Therefore circuits using fewer tubes can be made to do the work of previous circuits that had half again as many tubes, or more. For this reason single stage audio is in popular use, and manual tuning is simplified by confinement to two circuits or at most three circuits, since the other tuned circuits in superheterodynes are not subject to variation tuning.

Auto Sets Shown

Automobile receivers also were exhibited, and there were signs that this business will catch on, although it is well known in the trade that the number of auto sets sold is not to be compared to the publicity given to car installations.

The financial situation was reflected also in prices of the sets, refrigerators, coffee pots, fans, sun-ray lamps, sewing machines, clocks, and other things electrical, these being almost without exception the lowest in the trade's history.

Largest Receiver Shown in Booth

Modern devices of international broadcasting were illustrated by picture and display in the National Broadcasting Company booth at the eighth annual Radio-Electrical World's Fair.

The world's largest radio receiver was one of the attractions. This receiver is a duplicate of one of the short wave diversity receivers used at the experimental station of RCA Communications, Inc., at Riverhead, Long Island, where trans-oceanic programs are picked up and conveyed to NBC studios for distribution to the networks. The enormous receiver is a development of the RCA-Victor company engineers.

Throughout the show engineers picked up foreign programs at Riverhead and transmitted them by land wires to the booth at the Garden. English, French, German, Italian and other programs were presented at the booth.

The idea of the exhibit was to give visitors an idea of the wide scope of international broadcasting.

BIG SWING TO SUPERHET NOW IS COMPLETED

OUTLAW SOVIET AND DRUG RING RADIOS FOUND

Washington.

Two outlaw radio stations, one in regular communication with the Soviet authorities in Moscow and the other directing, it is alleged, a gigantic narcotics ring thought to be under Japanese auspices, have been discovered in New York City, according to reliable information.

The Soviet station, which, it is alleged, is operated by the Amtorg Trading Corp., the Soviet agency in this country, has been under investigation for more than a year, operatives of the Department of Justice and the New York police cooperating. Due to the relations between Russia and the United States government, the State Department has also been consulted during the investigations.

The existence of the narcotics station was discovered only a few months ago. Apparently this station has been used to direct agents of the ring throughout the country and for communicating with ships at sea and through them with the sources of supply of drugs in foreign countries.

Station Directs Agents

The two stations have been operating in the amateur band where they did not interfere with commercial traffic and where they were comparatively safe from discovery. They have also been using the beam system making detection still more difficult. Once the Russian station was traced down to a point in Manhattan but when the police arrived to the place where it should have been, there was no trace of the station. The operators had become suspicious and had moved the station to a suburb.

Secrecy Maintained

The utmost secrecy has been maintained by the government in gathering evidence against the stations and their operators. The key men are known and it is expected that court action will soon be taken against the principals in the Federal District Court at New York.

At the Amtorg offices at 261 Fifth Ave., officials of the agency denied that they maintain any radio station, and branded the report as nonsense. They said that all their communication with Moscow is conducted through the Radio Corporation of America.

Harry P. Davis Dies; "Father of Broadcasting"

Dr. Harry Phillips Davis, vice president and director of the Westinghouse Electric and Manufacturing Company and chairman of the National Broadcasting Company, died at his home, 4917 Wallingford Street, Pittsburgh, Pa. He had been ill for several months following an operation.

He was active in the start of the first broadcasting station, KDKA. He envisioned a service radio might give over a wide area and to which every one might listen.

He was with Westinghouse forty years and was known as the "Father of Radio Broadcasting."

Literature Wanted

Readers desiring radio literature from manufacturers and jobbers concerning standard parts and accessories, new products and new circuits, should send a request for publication of their name and address. Send request to Literature Editor, RADIO WORLD, *145 West 45th Street, New York, N. Y.*

Joel B. Hoberman, 115 Salem St., Malden, Mass.
O. Klein, 5114 N. Kimball Ave., Chicago, Ill.
Fred Kelly, 522 Newton Ave., North, Minneapolis, Minn.
E. A. Royce, 4045 Eton St., Vancouver, B. C., Canada.
Oei Kimtoen, Boulevard Menteng 23, Batavia-Centum, Java, D.E.I.
E. H. Overbey, P. O. Box 12, San Antonio, Tex.
Clyde Pauley, Penn Ave., Owens, W. Va.
Bernard Birdwell, Prop., Birdwell Radio Service, Box 277, Hugoton, Kans.
J. A. Mixon, 321 New York Ave., McComb, Miss.
Inzolf Hansen, Post Box 1302, Trail, B. C., Canada.
Paul Potter, 1602 Lake Ave., Gothenburg, Nebr.
H. L. Bottoms, 2111—8th Ave. So., Birmingham, Ala.
Joseph Martin, 494 Howard Ave., New Haven, Conn.
Geo. Basly, Ocean Springs, Miss.
The Dixie Radio Shop., F. J. Thames, Sales Manager, P. O. Box 583, Beaufort, S. C.
O. J. Robinson, 153 Nevada Ave., E. Detroit, Mich.
Frank A. Dobbe, Radio Sales Service, 1355 So. Galena, Freeport, Ill.
John E. Moore, 2827 So. Smedley St., Philadelphia, Pa.
G. G. Vondermuhll, Jr., Box 26, Litchfield, Conn.
C. L. Weathermax, 852 Lakeside Place, Chicago, Ill.
R. W. Schleifer, 535 Armstrong Ave., Kansas City, Kans.
Herman Goldberg, 3613 Ave. "D," Brooklyn N. Y.
W. M. Donnelly, Watrous, Sask., Canada.
W. J. Courtney, P. O. Box 491, Lima, Ohio.
Geo F. Stupar, 7925 Coles Ave., Chicago, Ill.
C. A. Olson, Brainerd Radio & Television Service, 616½ Front St., Brainerd, Minn.
L. Allport, Box 95, Mohegan Lake, N. Y.
Frank Irvine, Box 122, Logan, Mont.
E. W. Young, R. F. D. No 5, Lincolnton, N. C.
P. Yuster, 561 Communipaw Ave., Jersey City, N. J.
R. N. Finkelbiner, 1428 Carlyle St., Toledo, Ohio.
L. C. Ash, 114 S. Wells St., Sisterville, W. Va.
Charles Prince, 1109 Oglethorpe St., Macon, Ga.
Myles T. MacMahon, 17 Belleclaire Place, Montclair, N. J.
Merl W. Wier, Glenns Ferry, Idaho.
Clarence R. Williams, Williams Radio Service, 745 Yuba St., Janesville, Wis.
Geo. B. Thompson, M.D., 2400 West Pico St., Los Angeles, Calif.
W. K. Patrick, 732 Kayton Ave., San Antonio, Tex.
Arthur G. Reichert, 1212 Tinton Ave., Bronx, New York City.
E. H. Goodman, 700 E. 19th St., Charlotte, N. C.
Joe Sofranko, 189 Easy St., Uniontown, Pa.
John Fredell, Jr., R. F. D. No. 1, Kane, Pa.
Ernest O. Bertrand, 2101 Linwood, Kansas City, Mo.
Thos. A. Sapp, Wireless Engineer and Importer, 13 Botley Road, Swanick, Hampshire, England.
Karl J. Albrecht, 6317 8th St., Washington, D. C.
R. O. Liston, 35 Jone Ave., Morgantown, W. Va.
R. Bradshaw, Hickory, N. C.
C. R. Bellinger, 331 Defiance Ave., Findlay, Ohio.
O. E. Norton, Box 1741, Lubbock, Texas.
L. B. Hackett, Brooklyn, Mich.
Geo. Hiser, 506 N. 11th St., Lafayette, Ind.
Chester R. Ogden, 1926 1st St., N.W., Washington, D. C.
J. W. Arnold, Good Pine, La.
John M. McNall, M.D., Veterans Administration Hospital, Aspinwall, Sharpsburg, Pa.
Harry Alden, 4734 N Spaulding, Chicago, Ill.

New Corporations

Specialty Appliance Corp., radio devices—Atty. D. L. Sprung, 295 Madison Ave., New York, N. Y.

Glen Radio Co.—Atty. I. Leavitt, 16 Court St., Brooklyn, N. Y.

Radio Development, Inc., New York, obtain patents and develop them—United States Corporation Co., Dover, Del.

Jersey Battery Co., Trenton, radio and electrical equipment—Attys. Homan, Buchanan & Smith, Trenton, N. J.

Atlas Broadcasting Corp., Jersey City, radio broadcasting—Atty. L. T. Fetzer, New York, N. Y.

Le Winter's Radio Stores—Exco Lawyers Albany Service, 116 Nassau St., New York, N. Y.

H & B Radio Corp.—Atty. J. J. Lewin, Long Island City, New York, N. Y.

Universal Radio Parts Co.—Atty. R. J. Dunkly, 1,418 Crotona Ave., Bronx, New York, N. Y.

International Sound Recording Corp., Dover, Del., recording devices of all kinds—United States Corp. Co.

The Educator Broadcasting Equipment Co., Newark, N. J., manufacture and installation of broadcasting equipment—Attys. Benny & Cruden, Bayonne, N. J.

MARCONI TALK FROM ENGLAND IS HEARD HERE

Coincident with the opening of the public show in New York City, Senator Guglielmo Marconi spoke before a microphone of the British Broadcasting Company, in London, and his talk was carried by the WABC and WJZ chains. The Senator, an Italian, spoke with an English accent, for he has lived much of his life in England. He said in part:

"I am supposed to confine myself to an account of point-to-point wireless telegraphy, but broadcasting has become such an important factor in the daily life of nations that the practice of it depends on principles which are common to wireless telegraphy.

"The thing from which it may be truly said that wireless has sprung was the discovery made by Michael Faraday 100 years ago, that it was not necessary for two electrical circuits to be in actual physical contact in order that electrical energy might pass through the small space between them.

"The great need of the present day is for a better understanding between men and nations," said Senator Marconi. "This understanding can be fostered and helped by improvements in our communications. A most direct and satisfactory means of communication between men is the spoken word. In this respect broadcast telephony occupies a unique position as being the most potent means for the dissemination of instruction and entertainment that the world has ever known. I am happy if by any effort of mine I have been able to make some contribution toward international sympathy and understanding."

Shakespeare Used Some Radio Lingo

Shakespeare, though he wrote three centuries before radio, said:

"Ah, stand by."—Anthony and Cleopatra.

"Take up some other station."—Coriolanus.

"His lecture will be done ere you have tuned."—Taming of the Shrew.

"And my dial goes not true."—All's Well That Ends Well.

"'Tis no matter how it be in tune, so it makes noise enough."—As You Like It.

"And those musicians that shall play to you hang in the air a thousand leagues from hence."—Henry IV.

Data Compiled on Sets, Tubes and Trademarks

Radio Set Manufacturers 1931-1932 Specifications, with name and address of every important set producer, model numbers, list prices, current, cabinet data on size, weight, wood, frequency, tubes required, etc., has just been compiled by National Radio Trade Directory, 303 Fourth Ave., New York City.

KESTER CANADIAN PLANT

Kester Solder Company announces the opening of a plant at Brantford, Canada. The plant will be operated under the name of Kester Solder Company of Canada, Limited.

A Record in the Radio Publication Field

RADIO WORLD

will, on October 24, issue its

500TH CONSECUTIVE NUMBER

This is, of course, more important to the publishers than to the rest of the world, but we believe that the radio field in general will be interested in the continued publishing of the paper for 500 consecutive times in a field that has seen very many changes.

You will make us happy if you will help us to celebrate this event by being represented in our

SPECIAL 500TH NUMBER

We don't care about the size of your copy—but we are honest in saying that we do care very much about having your firm represented in this issue, which will have an increased circulation because of our efforts to call the attention of the radio public to our special edition. Last form closes October 13, 1931.

Our advertising rates will remain the same, as follows:

	1 Inser.		1 Inser.
1 page	$150.00	1/6 page	$25.00
1/2 page	75.00	1/8 page	18.75
1/3 page	50.00	1 inch	5.00
1/4 page	37.50		

Classified advertisements, 7 cents a word; $1.00 minimum; remittance with order.

May we hear from you by an early mail, with order and copy for such space as may suit your purpose?

PUBLISHERS OF RADIO WORLD

RADIO WORLD, 145 WEST 45th STREET, NEW YORK, N. Y. — Telephone: BRyant 9-0558

RADIO WORLD'S BOOK SERVICE has been found of great value not only by radio fans, constructors, etc., but also by radio and other technical schools throughout the country. See the radio books advertisement in this issue.

HAMMARLUND SFL

Hammarlund's precision .0005 mfd. condenser, with removable shaft; single hole panel mount. Lowest loss construction; rigidity; Hammarlund's perfection throughout. Order Cat. HAM-SFL @ $3.00 net price. Guaranty Radio Goods Co., 143 W. 45th St., New York.

NEW DRAKE'S ENCYCLOPEDIA

1,680 Alphabetical Headings from A-battery to Zero Beat; 1,025 Illustrations, 920 Pages, 240 Combinations for Receiver Layouts. Price, $6.00. Radio World, 145 W. 45th St., N. Y. C.

Quick Action Classified Ads

Radio World's Speedy Medium for Enterprise and Sales

7 cents a word—$1.00 minimum—Cash with Order

ELECTROLYTIC CONDENSERS, Pasteboard case, 4 mfd., 48c, 8 mfd., 65c, prepaid for cash with order. Purchase Radio Service, 508 W. Davis Street, Ann Arbor, Michigan.

SCANNING DISCS 45-48 Flexible, $1.00. Aluminum, $6.50. 60 Flexible, $1.25. Aluminum, $7.50. Supply anything you need. Arthur M. Pohl, 3541 Michigan Ave., Detroit, Mich.

SOUND PICTURES TROUBLE SHOOTER'S MANUAL, by Cameron and Rider, an authority on this new science and art. Price $7.50. Book Dept., Radio World, 145 W. 45th St., N. Y. City.

25,000 OHM POTENTIOMETER, wire wound, in shield case; takes ¼" shaft. Will stand 20 ma. easily. Excellent as a volume control. Price, 90c. Direct Radio Co., 143 West 45th Street, New York, N. Y.

BALKITE A-5 RECEIVER, eight-tube, three stages of Neutrodyne RF and two stages audio with push-pull output. Good distance-getter and very sensitive. Has post for external B voltage for short wave converters. Brand new in factory case. Berkey-Gay walnut table model cabinet. Price $29 (less tubes). Direct Radio Co., 143 West 45th St., New York.

"RADIO FREQUENCY MEASUREMENTS", by E. B. Moullin, M.A., A.M.I.E., M.I.Rad. Eng. Second Edition entirely reset and greatly enlarged. Illustrated. 487 pages, plus 12-page index. Indispensable for radio experts and engineers. $12.50. Radio World, 145 W. 45th St., N. Y. City.

BE A DETECTIVE. Travel, earn, learn. No experience. Write United Detective System, 1333 Walton St., Chicago, Ill.

JEWEL LATEST 199 SET ANALYZER—For screen grids and Pentodes. Guaranteed like new. Bargain. Dale Slack, Wellington, Kansas.

RADIO WORLD AND RADIO NEWS. Both for one year, $7.00. Radio World, 145 W. 45th St., N. Y. City.

PHONOGRAPH PICK-UP — Made by Allen-Hough. $3.32. Guaranty Radio Goods Co., 143 W. 45th St., N. Y. C.

"HANDBOOK OF REFRIGERATING ENGINEERING," by Woolrich—Of great use to everybody dealing in refrigerators. $4. Book Dept., Radio World, 145 W. 45th St., N. Y. City.

SHORT-WAVE NUMBERS OF RADIO WORLD. Copies of Radio World from Nov. 8, 1930 to Jan. 3, 1931, covering the various short-wave angles sent on receipt of $1.00. Radio World, 145 W. 45th St., N. Y. City.

U. S. BROADCASTING STATIONS BY FREQUENCY.—The Sept. 19th issue contained a complete and carefully corrected list of all the broadcasting stations in the United States. This list was complete as to all details, including frequency, call, owner, location, power and time sharers. No such list was ever published more completely. It occupied nine full pages. 15c a copy. RADIO WORLD, 145 West 45th Street, New York, N. Y.

547 WESTON 3-METER RADIO SET TESTERS $35.00; Bargain Buy for servicemen and shops. A-1 electrically! Surplus test equipment. RUSH your order NOW! ARMSTRONG, Station E-4706, Philadelphia, Penn.

AGENTS WANTED—Sell my Foot Remedy. Draws pain from sore, burning feet, and corns. Used by millions. Make $15 a day. Sample 25c. Perrone, 174 Butler St., New Haven, Conn.

WANTED: TRANSMITTER, 40 to 75 watts, short or long wave. Phone operation, price and particulars to Molina Font, care Castellanos-Molina, 61 Whitehall, New York, (Phone: BO 9-4713).

"A B C OF TELEVISION" by Yates—A comprehensive book on the subject that is attracting attention of radioists and scientists all over the world. $3.00, postpaid. Radio World, 145 West 45th St., N. Y. City.

THE FORD MODEL—"A" Car and Model "AA" Truck—Construction, Operation and Repair. By the Ford Car authority, Victor W. Page. 703 pages, 318 illustrations. Price $2.50. Radio World, 145 W. 45th St., New York.

SITUATIONS WANTED

YOUTH, AGE 19, one year experience in servicing sets, would like to start from bottom and work up, with concern in or near Detroit. John A. Nagy, 1319 Merrill Ave., Lincoln Park, Mich.

Never Before At These Prices!

SPEAKERS

Farrand inductor dynamic for pentode tubes, chassis (no cabinet), for direct connection in plate circuit of single output tube, or for connection to secondary of an output transformer where push-pull pentodes are used. 9 inch outside diameter. Order Cat. 9-R.....@ $7.00
Farrand regular dynamic, chassis (no cabinet), with built-in rectifier, for AC operations. 9 inch outside diameter. Order Cat. F-DNS.....@ $7.00
Erla regular dynamic, chassis (no cabinet), for 6-volt storage battery operation, Westinghouse rectifier. Order Cat. ER-DYN.....@ $8.50
Ansonia magnetic speaker in Gothic cabinet of genuine walnut. Order Cat. AN-G.....@ $3.50
Ansonia magnetic speaker, in square cabinet, genuine walnut. Order Cat. AN-SQ.....@ $3.00
Temple dynamic speaker, in carved wood cabinet, with impedance matching device built in; AC operation; rectifier built in. Order Cat. TEM-DYN. @ $10.23

BOOKS

Official Radio Service Manual, by Gernsback & Fitch $2.10
Gernsback's Cyclopedia. Cat. GBC.....@ $1.00
Supplement No. 1 to Rider's Manual. (115 diagrams.) Cat. R-SUP. .....@ $ .00

COILS

Three-circut tuner coil for .0005 mfd., with silver-plated wire and space-wound winding on threaded bakelite form. Cat. SPW-T.....@ $1.10
Radio frequency coil to match above, same construction. Cat. SPW-RF. .....@ .65

RESISTORS

25,000 ohm potentiometer. Cat. POT-25....@ $ .88
Adjustable voltage divider, with sliders; six different voltages besides extremes; total is 10,000 ohms. Order Cat. VVD.....@ 1.00
Fixed voltage divider, total 17,100 ohms, affording twenty different voltages, including all bias voltages; for 245, 247 and similar circuits; 50 watts rating. Order Cat. MTVD.....@ 1.95
Carborundum grid leaks, 5 meg. Cat. CAR-5. @ .10
30 ohm filament resistor, 1 ampere capacity. Cat FR-30 .....@ .10
6.5 ohm filament resistor, 1 ampere capacity. Cat. FR-65. .....@ .10
2250 ohm 25 watt resistor (Ward Leonard). Cat. WL-2 .....@ 10
30 ohm variable center tap Humdinger. Cat. HMD. @ .39

CONDENSERS

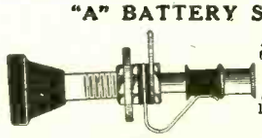
.00025 mfd. grid condenser with clips. Cat. GRC. @ .12
.00035 mfd. Scovill non-shielded condenser. Cat. SCO-3. .....@ .29
Heath short-wave condenser .00014 mfd. Cat. HE-14. .....@ .44
Erla short-wave condenser, .0001 mfd. Cat. ER-1. @ .41
Condenser block (dry) for 300-volt B supply; 8 mfd., 6 mfd., two 1 mfd. and one .5 mfd. in one case. Cat. FL-BL .....@ 3.00
Hammarlund double drum dial. Cat. H-DDD. @ 1.50
Marco vernier dial, disc type. Cat. MAR-D. @ .50
KK vernier dial. Cat. KKVDS.....@ .44
4-inch plain bakelite dial (not vernier). Cat PL-D .....@ .12

OTHER PARTS

Phonograph pickup, Allen Hough. Cat. PHPU. @ 2.75
Wave trap. Cat. WT.....@ $ .75
Westinghouse rectifier, for dynamic speaker. Cat. WESRC .....@ 1.50
Follow-through AC switch in moulded case. Cat. FTSW .....@ .20
Aluminum tube shield. Cat. ALTS.....@ .14
Binding posts. Cat. BNDP.....@ .05

RELIABLE RADIO COMPANY
143 West 45th Street
New York, N. Y.

"A" BATTERY SWITCH



A push-pull switch for battery-operated sets. Made by Benjamin Firm, sure contact, extremely long life. Price, 25c.

GUARANTY RADIO GOODS CO.
143 West 45th St., New York, N. Y

---

115 DIAGRAMS FREE!

115 Circuit Diagrams of Commercial Receivers and Power Supplies supplementing the diagrams in John F. Rider's "Trouble Shooter's Manual." These schematic diagrams of factory-made receivers, giving the manufacturer's name and model number on each diagram, include the MOST IMPORTANT SCREEN GRID RECEIVERS.

The 115 diagrams, each in black and white, on sheets 8½ x 11 inches, punched with three standard holes for loose-leaf binding, constitute a supplement that must be obtained by all possessors of "Trouble Shooter's Manual," to make the manual complete. We guarantee no duplication of the diagrams that appear in the "Manual." Circuits include Bosch 54 D. C. screen grid; Balkite Model F, Crosley 20, 21, 22 screen grid; Eveready series 50 screen grid; Erla 224 A. C. screen grid; Peerless Electrostatic series; Philco 76 screen grid.

Subscribe for Radio World for 3 months at the regular subscription rate of $1.50, and have these diagrams delivered to you FREE!

Present subscribers may take advantage of this offer. Please put a cross here ☐ to expedite extending your expiration date.

Radio World, 145 West 45th St., N. Y. C.

RADIO WORLD and "RADIO NEWS"

BOTH FOR ONE YEAR **$7.00**

You can obtain the two leading radio technical magazines that cater to experimenters, service men and students, the first and only national radio weekly and the leading monthly for one year each, at a saving of $1.50. The regular mail subscription rate for Radio World for one year, a new and fascinating copy each week for 52 weeks is $6.00. Send in $1.00 extra, get "Radio News" also for a year—a new issue each month for twelve months. Total, 64 issues for $7.00.

RADIO WORLD, 145 West 45th Street, New York, N. Y.

PENTODE, $1.00
VARI-MU, $1.00

List of Tubes and Prices

247 (pentode)	$1.00	120	1.00
235 (vari-mu)	1.00	200A	1.00
230	1.00	WD-12	1.00
231	1.00	224	1.00
232	1.00	227	1.00
222	2.10	245	1.00
171A	1.00	210	2.95
171 (for AC)	1.00	250	2.95
112A	1.00	226	1.00
112 (for AC)	1.00	280	1.00
201A	1.00	281	2.95
240	1.00	UV-199	1.00
UX-199	1.00		

RELIABLE RADIO CO.
143 West 45th Street. New York, N. Y.

RESISTORS
and Mountings

Plate Circuit

0.25 meg. (250,000 ohms) Brach resistor, for all screen grid tubes. Order Cat. BRA-25, at....12c
0.1 meg. (100,000 ohms) Brach resistor for all except screen grid tubes. Order Cat. BRA-10, at 12c

Grid Circuit

1.0 meg. Brach resistor for grid leak. Order Cat. BRA-100 at.....12c
2.0 meg. Brach resistor for grid leak. Order Cat. BRA-100, at.....12c
Carborundum grid leak for highest detector sensitivity. The leaks are marked "5 to 7 meg," because values in this range are present. Order Cat. CAR-57, at.....12c

Biasing Resistors

.005 meg. (5,000 ohms) Brach resistor. Order Cat. BRA-005, at.....13c
.015 meg. (15,000 ohms) Amsco resistor. Order Cat. AMS-15, at.....14c
.025 meg. (25,000 ohms) Amsco resistor. Order Cat. AMS-25, at.....14c
[The above resistors are of the tubular type and require a mounting. Lynch moulded bakelite mountings, Cat. LYM, at.....15c]

Filament Circuits

1-ohm Brach resistor, to afford 5 volts for four ¼ amp. tube when source is 6 volts. Supplied with mounting capacity 2 amps. Order Cat. BRA-1, at 22c
2-ohm Brach resistor, to afford 5 volts when two ¼ amp. tubes are supplied from a 6-volt source. Furnished with mounting; capacity 1 amp. Order Cat. BRA-2, at.....20c
4-ohm Brach resistor, to drop 6 volts to 5 for one ¼ amp. tube. Mounting supplied at this price. Order Cat. BRA-4, at.....18c
30-ohm Brach resistor. To drop 3 volts to 2 volts on 232 and 230 tubes; use two of these resistors in parallel. Order Cat. BRA-30 (mounting supplied); price is for TWO sets at.....22c

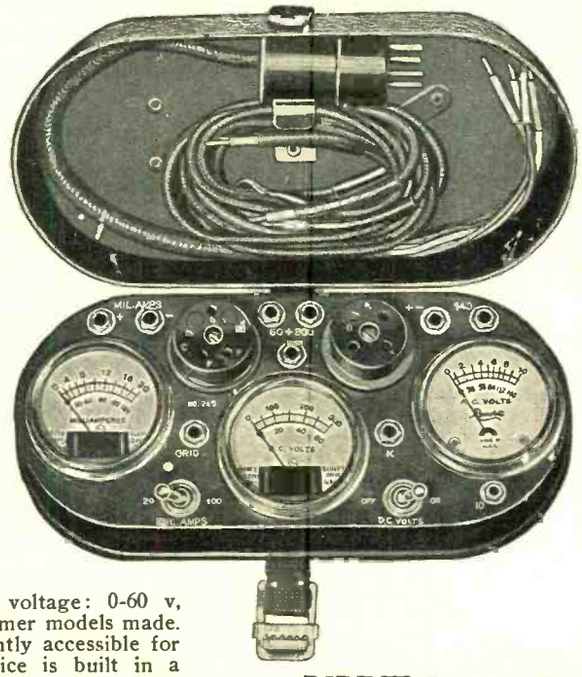
DIRECT RADIO CO.
143 West 45th Street,
New York, N. Y.

"RADIO FREQUENCY MEASUREMENTS"

By E. B. Moullin, M.A., A.M.I.E., M.I.Rad.Eng. Second Edition, entirely reset and greatly enlarged. 289 illustrations, 487 pages, plus 12-page index. Indispensable for radio experts and engineers, $12.50. RADIO WORLD, 145 W. 45th St., N. Y. City.

Send $8.26! Get This Tester!

HERE is your opportunity to get immediate delivery of the Jiffy Tester at $8.26 remittance with order, balance of $3.50 payable in one year. Your credit is good with us. This Tester will read plate current, plate voltage and filament voltage simultaneously, when plug is put into any set socket and tube in the Tester.



Jiffy Tester, Model JT-N, consists of three double-reading meters, with cable plug, 4-prong adapter test cords and screen grid cable. The ranges are filament, heater or other AC or DC 0-10 v, 0-140 v; plate current: 0-20, 0-100 ma; plate voltage: 0-60 v, 0-300 v. It makes all tests former models made. Each meter is also independently accessible for each range. The entire device is built in a chromium-plated case with chromium-plated slip-cover. Instruction sheet will be found inside. Order Cat. JT-N @ $11.76; $8.26 down.

DIRECT RADIO CO.
143 W. 45th St., N. Y. C.