N. S. EDITION

September

Radio Journal

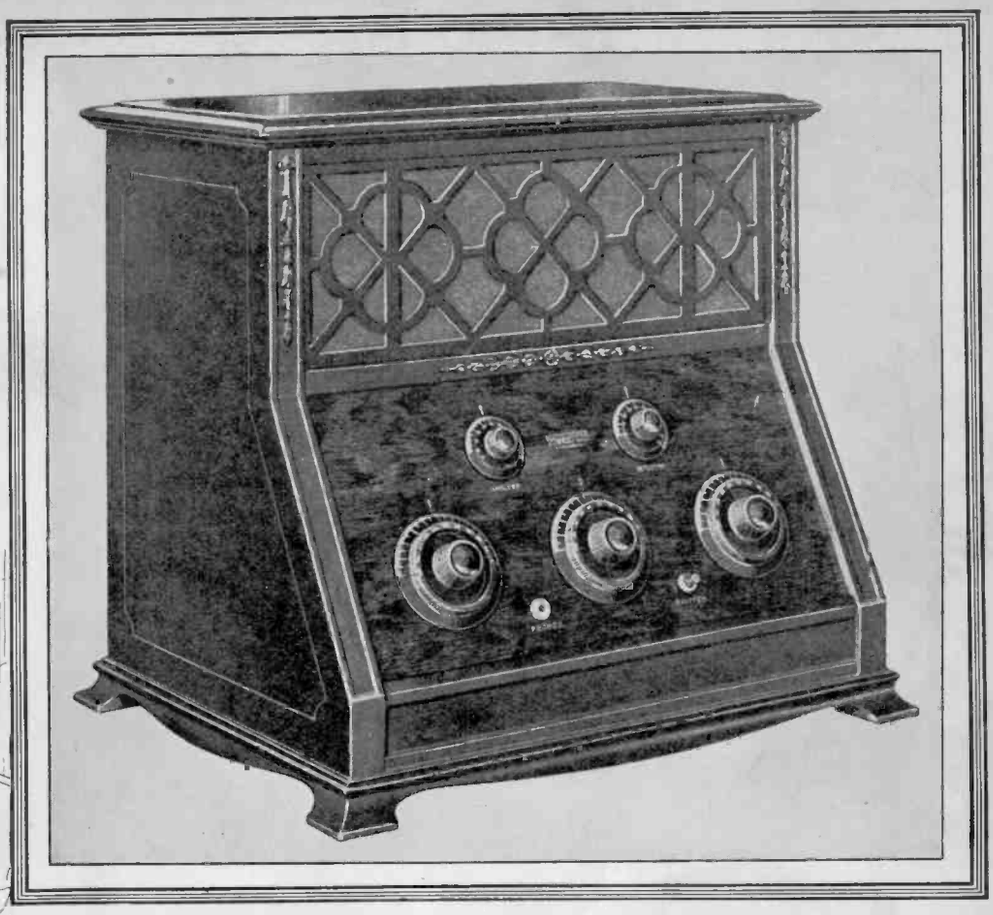
25c

Established in 1922

New Roffy Super---About C Batteries Sixth-Ham Fest
Portable Hetrodyne Without Batteries---Low Loss Ham Super

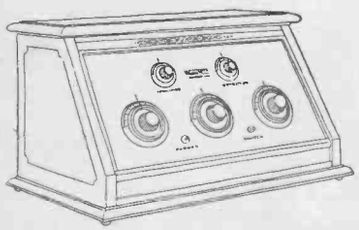
Proven Beyond a Peradventure

Stamm-Lawson Radio Mfg. Co.

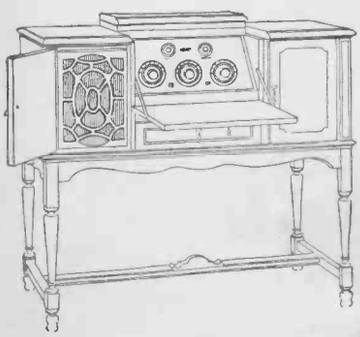


WorkRite Radio-King, a five tube (2 radio amplifier, 1 detector and 2 audio amplifier) super neutrodyne receiver. Beautiful mahogany cabinet, 22 in. x 20 in. x 14 in. This set operates with outdoor or indoor aerial and is highly selective. Long distance stations come in full and clear on the built-in loud speaker. Complete except tubes, batteries and aerial wire - - $220.

Now You May Choose Your Set With Certainty of Satisfaction



WorkRite Air-Master, same as Radio-King except without built-in loud speaker. Mahogany cabinet 21 in. x 14 in. x 14 in. Without batteries and loud speaker, tubes or aerial, $160.



WorkRite Aristocrat, a most beautiful mahogany console model 42 in. x 40 in. x 20 in. This set employs the same super-neutrodyne receiving apparatus. The cabinet contains a built-in loud speaker and space for A and B batteries. Not only a wonderful receiving set but also a charming piece of furniture. Complete except tubes, batteries and aerial - - $350.

THESE new WorkRite super neutrodyne receiving sets bring an assurance of lasting satisfaction in every phase of radio performance.

Combining ease of operation and remarkable selectivity these sets receive clear across the continent with full volume on the loud speaker under favorable conditions. Even over extremely long distances music is heard with striking clearness and freedom from distortion.

And, because these receivers are neither experimental sets or playthings, they have been built into beautiful cabinets of genuine mahogany. You will be as proud of the appearance of a WorkRite set as you are of its performance.

See these sets at your dealer, or write for the new illustrated literature

Licensed under Hazeltine Patent Nos. 1,450,080—1,489,228

The WorkRite Manufacturing Co., 1800 E. 30th St., Cleveland, O.

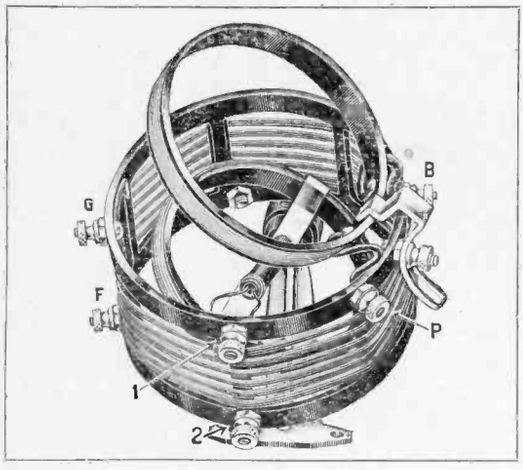
BRANCHES:

New York City, 1023 Knickerbocker Bldg. **Chicago,** 536 Lake Shore Dr. **Los Angeles,** 239 So. Los Angeles St.

WORKRITE

SUPER NEUTRODYNE RADIO SETS

Bremer-Tully
LEADS AGAIN
with a Real Low Loss Tuner



The Tuner which gives results heretofore impossible

THIS is the original B-T product, the first "tuner," improved with new B-T method of inductance winding and new adjustable untuned primary.

Low Dielectric Losses

Windings are supported with the least possible insulation (approved by Bureau of Standards.

Adjustable Untuned Primary

Meets the great problem of the past,—that of adapting a tuner to the various types of antennae circuit requirements and local receiving conditions.

Adjustments permit greater selectivity or increased signal strength as desired.

A new support, providing either base or panel mounting. Single hole mounting can be used if desired.

A new adjustable, lubricated cone bearing. Pigtail connection. Binding post connections with tinned soldering lugs.

Adaptable for any circuit requiring a tuner.

Two types for Broadcasting — 215-585 meters; for short wave work — 60-220 meters.

Price $5.00

Go to your dealer and examine this remarkable new tuner.

"Better Tuning" (now in its 6th edition) tells you why and shows you how—complete instructions and diagrams for progressive construction from Crystal to Reflex and Radio Frequency Circuits. Mailed on receipt of ten cents. Not a technical book but a book of Technique.

CARL A STONE CO.
1113 So. Wall St.
Los Angeles, Cal.

E. J. KOLPKE
644 New Call Bldg.
San Francisco, Cal.

CARL A. COOK
1116 Minor Ave.
Seattle, Wash.

BREMER-TULLY MFG. CO.

CANAL and HARRISON CHICAGO

Volume Five AUGUST-SEPTEMBER, 1924 Number One

CONTENTS

Radio Journal

is published monthly by Radio Journal Publishing Company, 113 Stimson Building, Los Angeles, California. Telephone 877-726.

EDITORIAL BOARD

Editor ..... K. P. FREDERICK
Scientific Editor ..... D N. CLARK
Advertising ..... A. W. MAJORS, THOMAS ELLIS

SUBSCRIPTION RATES

6 months	$1.50
1 year	2.50
2 years	4.00
Single Copy, Foreign,	35c
Canadian or Mexican—	
1 year	3.00
Foreign, 1 year	3.50
Single Copy	25c

Change of Address—Notify us of any change in your address. Be sure to give both your old and new address.

"Entered as second-class matter May 19, 1922, at the post office at Los Angeles, California, under the Act of March 3, 1879."

Chicago Representative, Franklin E. Wales
17 N. La Salle Street

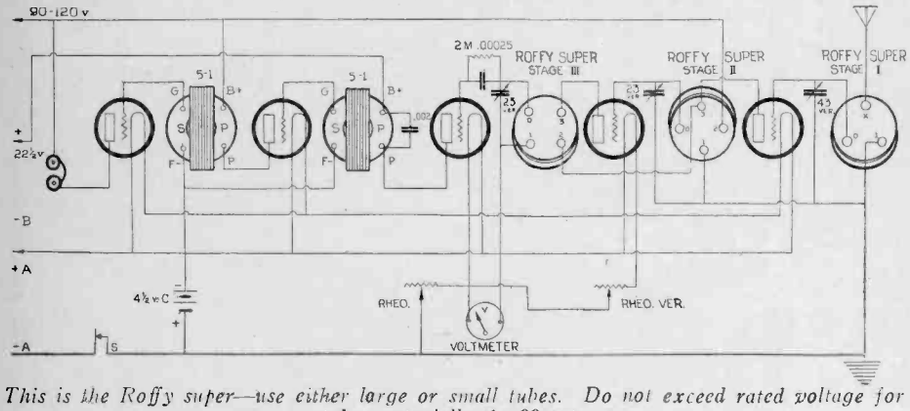
Printed in U. S. A.

Complete Story of Roffy Oscillator Circuits

By J. T. ROFFY

It is now a long while ago that Radio Journal offered the first article on the Roffy circuit, an article which created comment from coast to coast. The current article might almost be termed the swan song, in that it marks, apparently, the final development of this idea.

IT is not often that the designer of a certain definite line of development can write the word "finish" to his work. There always seem some small hidden problems that are apparent to the investigator and in striving for their solution, gradual progress is achieved. Progress like evolution however, is not an indefinite proposition. a particular line or trend of development can progress but so far to achieve its zenith and after that it is no longer a battle with its own kind. The above statements are fundamental truths that apply to all things in general and radio circuits are not an exception.

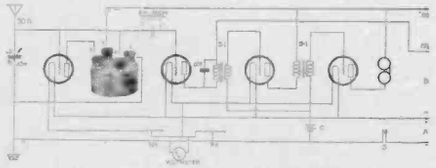


This is the Roffy super—use either large or small tubes. Do not exceed rated voltage for tubes, especially the 99 type.

In this short resume, we are not concerned with the development of the vacuum tube nor of audio amplification, but a wealth of information is condensed relating to the pick-up system of radio circuits. The technicalities involved are not unfathomable to the average reader and the careful perusal with its element of mental gymnastics will sharpen the readers' mind for the perception of other problems, may they be of play or the gentle diversion of earning a living. Therefore this thesis is presented as a study and a training. It is purposely written in such form that it becomes a mental test where the intellect of the reader is at once gauged and perception improved.

Whenever we speak of radio we are immediately reminded of the ambiguous term wave-length which we further complicate by quoting it in meters in a country that uses the foot-yard, etc., scale. The man who termed this form of energy transference as a wave used the word for want of a better term to describe a fluctuating state of strain. Measuring it in meters is expressing the rapidity of the fluctuations of a given time in a reciprocal. The popular analogy of radio waves likened to waves upon the surface of a pond after a stone has been pitched into it is incorrect and unworthy of further discussion.

In the electron theory of matter it is quite easy to prove that all matter is alike except in the number and position of the electrons of which all particles are composed. Since the electrons are not matter but a form of energy and that energy may be nothing but a state of mind, the world with all its tribulations may be but a



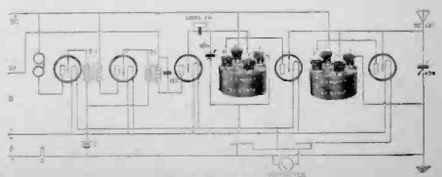
No. 1, the Roffy Hetro-trans.

long and restless dream (Huxly, Tunselman and others). The fact is that if a sending station is causing a fluctuating energy strain upon the surrounding space, the strain may be detected by other systems in resonance.

Two tuning forks of the same pitch are a true illustration of resonat energy transference because when one is struck the other will vibrate as if in sympathy. We are not dealing with human emotions and caprices, but a radio receiving system is of a complex nature where sympathetic resonance is our only means of choosing stations. An antenna in the field of numerous and differently fluctuating energy strains will by induction possess a converted form of energy strain. The magnitude of this antenna energy strain depends entirely upon the degree of sympathy to all or to a certain particular frequency. Like the more massive tuning fork emitting the deeper and slower notes, a long antenna is more in resonance with the less rapidly changing energy strains. To receive a band comprising all broadcast frequencies a short aerial with means of loading to the longest is required. This means of loading in all cases is some form of variable inductance. So far we have treated crystal and tube circuits alike but since we are not concerned with crystal rectification nor detector action we proceed to the first step in amplification by power resonance.

In the three element vacuum tube, the grid current is simply the energy that actuates the gate through which the electron stream of the filament flows to the plate. The grid and plate current energy ratios are not necessarily a function of the operation of the tube but are the factors of amplification. When this amplification is greater than unity the plate current can be coupled to the grid to assist, at the expense of the B battery current, the grid circuits' resonance. This is a form of radio frequency amplification and in the Roffy Hetro-Trans Circuit published in the 1923 September Radio Journal, this principle was first propounded. It will be noted from the drawing that the grids of the two tubes were joined to a common aerial inductance and tuned by a single condenser. The plate of the first tube energetically assisted the resonance due to high voltage and the second tube functioned as a detector due to negative bias and low plate voltage.

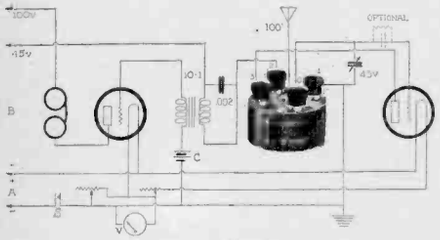
The second circuit, adding a stage of



Circuit No. 2

tuned radio frequency, immediately suggested itself. The third step became quite revolutionary as it consistantly outdemonstrated super-circuits of twice the number of tubes. Circuits No. 4 and No. 5 where an additional tube with resistance amplification and regeneration respectively employed, were not recomemended for the amateurs. Circuit No. 6 using an additional stage of tuned radio frequency did not exceed circuit No. 3 over five per cent in its all around performance. So the No. 3 hook-up became the champion circuit.

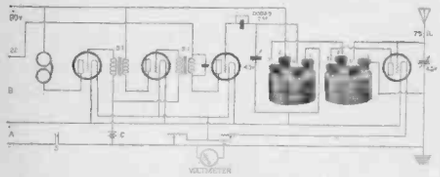
There have been thousands of these circuits built with general satisfaction. The few complaints that have cropped up were due to faulty construction,



The two-tube Roffy

improper handling of aerials, or tube troubles. Certain other minor defects, as extremely large condensers necessary to cover the full broadcast wave length band, etc., were also noted so the circuit was once more attacked, with a view to still further sharpen the set, eliminate the critical aerial (tailor-made as some one expressed it) and block the slight oscillation in the antenna.

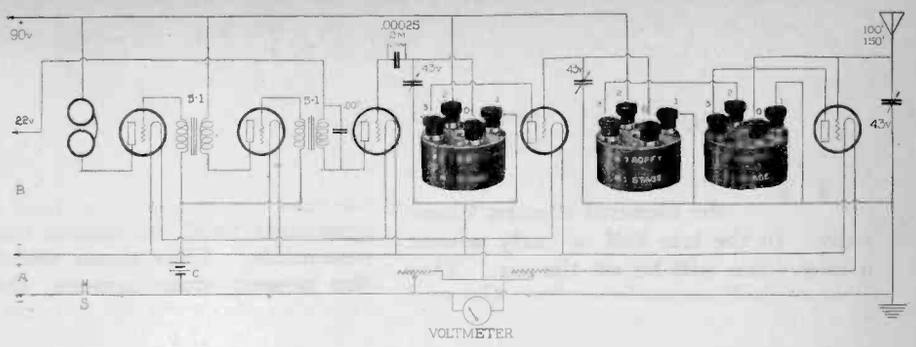
We now enter upon the final evolution of the line of development:—a regular R 3 set was taken and instead of hooking the antenna to the grid of the oscillator tube, about fifty turns of wire were wrapped around the oscillator transformer, then one end con-



Circuit No. 3

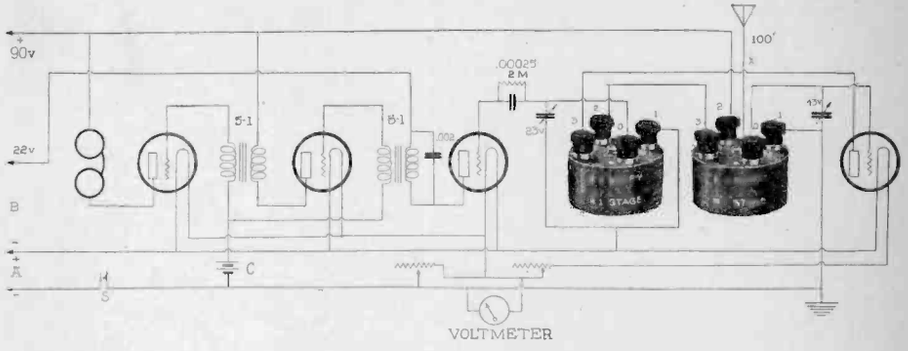
nected to the B battery + and the other to the plate of an additional tube, thence to an extra R 3 transformer and the aerial to the comparatively few turns of primary in the same. The diagram explains this hook-up in detail. Of course, this circuit behaved like an unbalanced sailor. It would hover on the ragged edge of nothing and if perchance a long distance station was accidentally within this setting the station would come in with a blast to flop out just as suddenly never to be found again.

Years of constant association with



Circuit No. 6

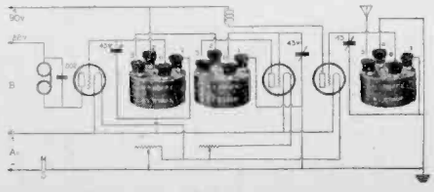
the technicalities of coil winding are bound to sharpen ones understanding of the mathematics involved but it is impossible to assume scores of unknown quantities to solve an equation. So the cut and try method had to be used for the development of the transformers. Actually several hundred transformers of different ratios were wound, tried, catalogued and then destroyed. Finally a split aerial inductance was evolved which gave the non-critical length aerial; second, a combination oscillator and energy transfer coil was evolved with a winding ratio of approximately eleven to one; third, an inverse action for radio



Circuit No. 7—Use 99 tubes only.

frequency amplification in an oscillator was solved; fourth, the inductance to capacity ratio was increased permitting the use of smaller condensers and embracing a greater wave length band; with a twenty-three plate condenser approximately from 225 to 750 meters.

This circuit shall be called the Roffy Super as the original Roffy idea of helping a plain detector with a high voltage oscillator has been carried to its final conclusion and no further improvement of this idea is to be looked



Circuit No. 3 with stage of blocking radio frequency. This was the first step in the development of circuit No. 7 and the Roffy super.

for as long as transmitting stations operate on their present principles or until a new means of electron modulation in tubes is discovered. The Super Roffy Circuit is more powerful in the amplification of distant signals than all other circuits which were submitted for comparison and regardless of the number of tubes, our tests comprised circuits up to and including nine tubes.

For those who wish to build less expensive sets, still retaining the principles of the newly developed Super Circuit, Circuit No. 7 or Circuit Two-tube Roffy are recommended. These two later circuits should be built preferably with dry cell tubes making the set inexpensive to build and operate, as well as being portable. Further a dry cell tube as an oscillator in the antenna is inoffensive to nearby sets. In the case of the Super Roffy Circuit the oscillator is not in the antenna and is preceded by a stage of blocking radio frequency and the tuning of this set in no wise affects other sets as was the case with the old regenerative sets. Constants of the circuits appear with the cuts and are deemed sufficient for the builder to construct this highly efficient set. I will be glad to answer any questions addressed to me care of Radio Journal.

Radio amateurs of all states will be welcomed in Cincinnait, Ohio, September 26-28 for the Ohio State A. R. R. L. convention, to be held under the auspices of the Union Central Radio Asosciation, leading amateur organization of this section. The Hotel Gibson has been selected as headquarters for the convention.

Denver Blossoming Out

WORK has been started on the Denver, Colorado, broadcasting station of the General Electric Company. In the late fall or early winter a new voice will be on the air. This station will complete the General Electric's nation-girdling system of three stations, the first of which, MGY, opened at Schenectady, N. Y., early in 1922 and the second, KGO, at Oakland, California, early in 1924.

The station, a two-story structure, will be located on 300x250 foot plot, four miles from the heart of Denver and on the main eastern motor highway. The studio building will be 58x47 feet and the first floor will be divided into reception room and offices for the executives, the correspondence and the program forces. On the second floor will be two studios, a waiting room and a control room for the station's amplifying equipment.

The first and main studio will be 45x22 feet in size, big enough to comfortably accommodate large musical organizations like bands and choruses. The deadening or reverberation period will be made variable through the use of movable hangings and floor coverings. As a program varies from speaker to band, or soloist to orchestra, different degrees of deadening are required to secure perfect tone quality and the Denver station will so be equipped that it may be readily changed to care for the different extremes of sound. The ceilings and parts of the side wall will be sound deadened by means of a one-inch felt covering over which decorative tapestry cloth will be hung.

Separated from the main studio by the control room will be a second and smaller studio. This arrangement has proved most successful at KGO in that one number may follow another with only the spacing of an announcement between them. This means that the listener is saved the annoyance of waits between numbers. The second studio also permits an artist to rehearse or tune his instrument before performing for "the air". The location of the control room between the two studios enables the operators who control the amplifying and microphone equipment to observe activities in either studio.

The power house will be a one-story building, 93 feet long and 42 feet wide and will be directly back of and connected to the studio building. The power house will be divided into two sections, a motor generator room and a power room. In the motor generator section will be eleven motor generator sets which are required to furnish current for filament lighting, plate current for the power amplifier tubes, generator field excitation and grid bias potentials. This room will also house the power transformers, the distribution panels and the starting compensators for the motors.

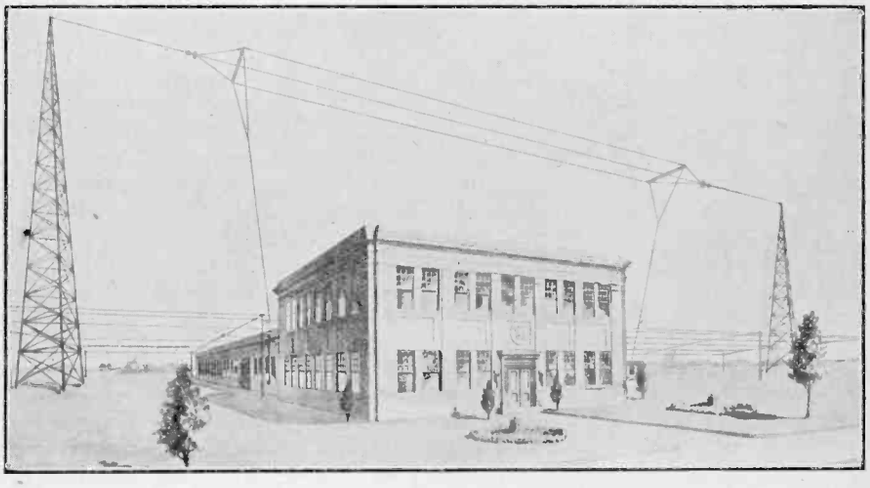
In the power section and located along opposite sides of the room will be two complete transmitting equipments, either of which may be placed in service at the will of the operator at the control panel. Should any difficulty arise with one set the other may be put into operation without interruption of program.

The amplified voice currents from the control room in the studio building will be brought to the power station operators' power control board from which point they may be connected to the transmitter in use.

The power tubes will be of the water-cooled type nominally rated at 20 KW. These higher powered tubes are used at a lower output than their rating in order that greater reliability and freedom from distortion may be obtained. A departure from the usual circuit arrangements will be made in the Denver station in that a master oscillator circuit will be utilized to assist in obtaining constant frequency for transmission and freedom from harmonics. The output of both transmitters may be connected to an artificial antenna unit which will be located directly under the lead-out insulators. The purpose of this feature is to test the equipment without radiation. Through this unit either set may be connected to the antenna and counterpoise.

The fifteen thousand volt plate supply for the water-cooled tubes will be furnished through a kenetron rectifier consisting of a six phase, 220 volt to 15,000 volt transformer, the output of which will be rectified through six UV 219 kenetron tubes. Any ripple will be eliminated by means of smoothing reactors and a bank of condensers.

Unlike WGY where the towers are located on top of a five-story building, a quarter of a mile from the control room or KGO where the towers are built on the ground also a quarter of a mile from control room and studio, the towers of the Denver station will be built on the ground, one on each side of the studio building.



Another new voice to whisper in thy ear, or drive thee mad trying to get it—the new broadcast station at Denver.

The antenna wires will be directly above the power house. The towers will be of steel, 150 feet high and triangular in shape. They will support a three-wire multiple-tuned antenna. Distance between towers will be 260 feet and the spreaders will be 120 feet apart, one down lead going directly into the power room over the artificial antenna unit and the second down-lead will terminate in the tuning equipment, located in a small building at one end of the antenna. The counterpoise consisting of a network of wires insulated from the ground and supported 15 feet above the ground by steel poles, will be used as a part of the antenna system replacing the usual ground connection.

A New Yorker who lives within ten minutes' walk of the Lewisohn Stadium had to travel to the Laurentian Mountains, in the Province of Quebec, to hear his first concert by the Philharmonic Orchestra. In a letter to WGY he reported that he heard WGY's broadcasting of the great orchestra from the Lewisohn Stadium while he was in camp in Canada.

Discussing the "C" Battery

By T. E. NIKIRK

Taking the bat out of C batteries might be an appropriate cognomen for this article, in which Mr. Nikirk carefully amputates the guesswork from the business of operating a C battery. The information should prove valuable to every radio fan, including horseshoe pitchers.

THE little C battery has caused many questions to be asked and answers, some from widely varying sources, do not always agree. This leaves the builders of their own sets in a state of doubt as to what this little battery does to the amplifiers. Many experiments would seem to point conclusively to the fact that the C battery is indispensible to the properly built amplifier. The greatest good obtained by its use is the improvement of the quality of music and voice received through either the loud speaker or head phones. The next benefit is the reduction of current consumption in the B battery, which is cut to half that used when no C battery is employed.

I have taken six A tubes, and likewise taken different values of C and B batteries, and secured an average which, I believe, will give very nearly the exact amount of C battery needed for various plate voltages.

Manufacturers of these tubes list a wide range of B battery voltage which may be used. According to several slips enclosed with the tubes, from 20 to 100 volts is recommended on the plate. The chart shows the amount of C battery that should be used with various voltages, as shown across the top of the chart.

The lowest figure given, 42.3 volts, is the closest to 43 volts which the writer could obtain for the test. The other voltages, up to 85.7 were picked to give, as nearly as possible, the results obtained when three or four 22½ block B units are used.

The normal voltage of the filament is given as 5 volts, but excellent results are obtained with much less. The last column to the right of the chart gives the plate current with only 3.9 volts on the filament. The only difference between 5 and 3.9 volts was the drop of .3 of a milliampere, and the difference in volume could not be noticed by the normal ear. This demonstrates that less than 5 volts can be used on A tube filaments when the A tubes are used as amplifiers, with good success in increasing the life of the tube and pulling a bit less current off the A battery.

B Battery Voltage

C Bat	42.3	65.2	85.7	96.0	120.0	144.0	144.0
	Values below are in milliamperes Plate current 5 volts on filament						3.9 on fil.
0	1.0	2.0	3.2	3.8	5.4	7.2	6.2
1.44	**.5**	1.4	2.5	3.1	4.6	6.3	5.5
2.88	.3	**1.0**	**1.8**	2.4	3.8	5.4	4.8
4.30	.1	.6	1.2	**1.7**	3.0	4.5	4.2
5.75	0	.3	.8	1.2	**2.3**	**3.8**	3.5
7.15	0	.2	.5	.8	1.7	3.2	**2.7**
8.60	0	.1	.3	.5	1.2	2.5	2.2

The 3.9 volts were taken from two cells of a lead plate type storage battery, giving two volts per cell. The C batteries used were the common or garden variety No. 6 dry cells. These cells were not new so the voltage obtained from them was less than the 1.5 per, all that is usually obtained, but was close enough for the purpose.

When zero C battery was used, or none at all, during these tests, the grid return was run to the negative side of the A battery. This is the standard way of hooking up the grid return when no C battery is used. The term grid return in applied to the side of secondary of the amplifying transformer, which runs to the negative side of the A battery or to the C battery.

This gives various negative voltages to the grid which, in turn, regulates the amount of plate current pulled from the B battery. The average plate current should be half of what is pulled when no C battery is used. For example, take 65.2 volts B battery. The current is 2.0 milliamperes which make 1.0 milliamps the proper plate current. Two dry cells, or approximately 3 volts, were used to get the 1.0 milliamps as the average plate current, and at that point the quality of the reception was the finest and volume the best. The full load plate current for an A tube is 4; and if the average current is less, or not more than that, the tube is not overloaded.

Figures No. 2, 3 and 4 show the characteristic curve as the heavy black line. Figure 2 shows the sine wave of a good amplifier with the proper amount of C battery which gives a uniform flow of current in the plate circuit. Figure No. 3 shows the condition when too much C battery is used, which indicates that the lower part of the sine wave is not complete, so quality must, of necessity, be very poor. Figure No. 4 shows the sine wave where no C battery is used. Here the same poor quality is noted as when too much C battery is used.

These tests were all made upon the first step of an audio frequency amplifier. The use of more than 100 volts on the plate of a second tube amplifier is not recommended if the ordinary type of A tube is used. The heavy plate current flowing as a result in the second amplifier will probably exceed 4 milliamperes, should more than 100 volts be used in the amplifier.

In several cases it was found possible to flow as high as 15 milliamperes through the plate circuit on second amplifier, which overloaded the tube nearly 400 per cent. The quality of the reception was then not nearly as good as it was when using only a one-step amplifier. When poor quality is obtained, oftimes the transformer or tubes, and sometimes something else, gets the blame for the trouble. This is often stopped by using a larger tube in the second step, such as a 5-watt transmitter tube, Cunningham, Radiotron or Western Electric.

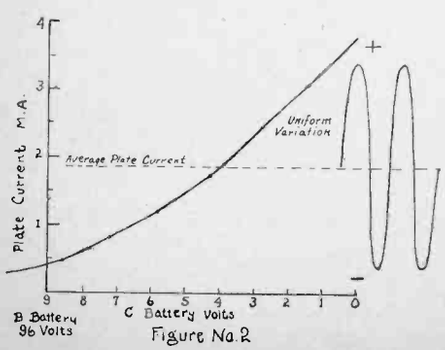


Figure No. 2

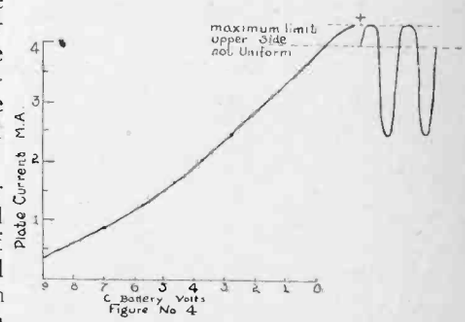


Figure No 4

Another method of improving the quality without changing tubes is to place a grid leak across the output of the second transformer of about 100,000 ohms resistance, or a one-tenth megohm grid leak.

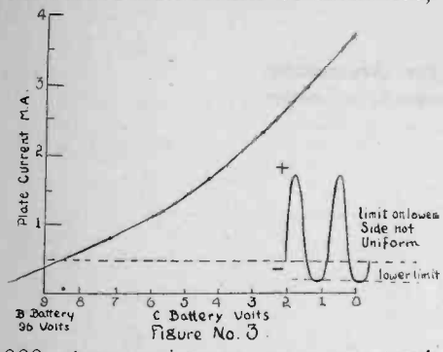


Figure No. 3

This will absorb a little of the energy from the first amplifier and the result is that there is a little less grid current on the second amplifier which, in turn, reduces the plate current. In keeping down plate current, as previously mentioned, heavily overloading tubes is prevented. The writer has found that a push-pull type for the second step gives excellent results as to quality and volume for local. In fact, it is too much, as a rule, for the loudspeaker to remain in the house.

The same C battery may be used for the first and second steps by hooking the grid return of each amplifying transformer to the negative side of the C battery.

Thos. H. Ince to Broadcast

By CHARLES F. FELSTEAD, 6CU.

THE Thos. H. Ince Corporation of Culver City, California, is contemplating the conversion of its limited commercial station, KZY, at the Ince Studio, into a broadcasting station. Thos. H. Ince, in a recent conversation, said that he hoped to have this station on the air for a half-hour in the evening about twice a week, just as soon as a broadcasting license can be obtained.

Mr. Ince firmly believes that motion pictures, radio broadcasting and educational work should go hand in hand, for motion pictures and radio broadcasting are the two greatest educational factors of the present day.

"Radio broadcasting," he says, "should do its bit, just as motion pictures have, to educate the great mass of the public who are uninformed. "This educational broadcasting," he further contends, "should be so interspersed with entertainment and music that it does not pall on the listener-in, but instead, seems part of a well arranged program."

Mr. Ince plans to have his station do educational work for the motion pictures, so the coming generation may grow up with some understanding of the problems of the motion picture business. Writers, directors and actors are made, not born, Mr. Ince says, and he hopes to help some of the aspiring ones along the road that leads to success in the picture business. He plans to have a series of lectures and talks by famous actors, directors and writers from his studio, so that the people who will make the motion pictures of tomorrow may have their feet placed on the right path.

Do not think that these programs will be dull lessons, though, for the entertainment and music that will accompany the lectures will be of the very finest. Actors and actresses whose names are known in every household and the very best of musicians will all furnish their quota for this most original of broadcasting stations.

Sixth District Ham Fest

THE Sixth District A. R. R. L. convention will be held in Modesto, California, November 7, 8 and 9. K. B. Warner, secretary, and A. A. Herbert, treasurer of the American Radio Relay League, will be present. Mr. Hiram Percy Maxim, president of the A. R. R. L. and of the International Amateur Radio Union, will also be present if possible.

Special railroads rates have been secured. Rates of a fare and one-half have been allowed. Buy your ticket one way and be sure to get a receipt for it, upon arrival at the convention you may present your receipt to the agent and get your return ticket for *one-half the fare*. In order to get this rate at least 1,000 people must purchase tickets to the convention amounting to at least $1 each. As many as possible who live over 50 miles distant are urged to go by train. These rates are good in any state in the Sixth District.

Upon arrival in Modesto the amateur will be met by guides who will take him to the official A. R. R. L. hotel and show him where to park himself, as well as get acquainted with the gang.

Special hotel rates have been allowed for conventioners. Those who go by auto should look for the red or green A. R. R. L. road guides. Arrows that point to the convention. Follow them.

The Southern California Radio Association has donated two beautiful silver cups, known as the S. C. R. A. cups, to the convention. These cups will be given away in a contest for the best operator in receiving and transmitting. Commercial operators will be the judges so "do your stuff," men.

The Modesto Radio Club will inaugurate its new perpetual trophy—the M. R. C. Wouff-Houng. If you haven't heard about it come and find out. It's remarkable.

Prizes in apparatus—Government examinations for license will probably be held—fun galore—and on the last day (if the weather permits) an auto trip to the greatest hydro-electric dam in the world—Don Pedro.

The program as so far outlined follows: Friday, the 7th—Registration until 2:00 p. m. at A. R. R. L. headquarters; 2:00 p. m., Traffic meeting; followed by registration of late comers. 8:00 p. m., Convention meeting called to order by Pacific Division Manager. Pacific Division business and other topics pertaining to the welfare of the Sixth District taken up. 11:00 p. m., play by M. R. C., followed by "stunts" by other organizations, winding up with the R. O. W. H. initiation.

Saturday, the 8th—9: a. m. Various contests held for cups and prizes. 1:30 p. m. Technical meeting wherein some of our puzzles will be solved. 3:30 to 7:00 p. m. Undecided. 8: p. m. Convention banquet, followed by a regular old-time hamfest. It is the special aim at this time to have every man present get acquainted with every other man.

Sunday, the 9th—10:00 a. m. Trip to the world's highest power dam in the mountains, if weather permits. Lunch may be had at the dam restaurant. Those who plan to attend can clip this:

Modesto Radio Club,
Box 833,
Modesto, California:
Reserve.....tickets for me at the A. R. R. L. convention. My call is.....
.....
.....

Joseph C. Smith and his Mount Royal Hotel Dance Orchestra, who have been regaling thousands from CKAC, LaPresse, Montreal, must get off the air, at least temporarily. Because the Prince of Wales heard him over radio from Long Island and issued a royal command that Smith and his band proceed at once to attend the king for a dance or two.

Portable Heterodyne for Travellers

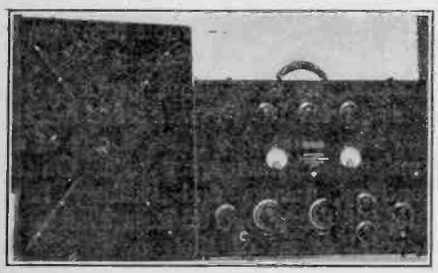
By L. R. ARMSTRONG

Mr. Armstrong astonished the natives last winter with his super-heterodyne. Now he has produced a portable which will operate with or without batteries—folks, of if you've any bouquets, pluck 'em now. It's your big chance.

A GREAT many of the traveling class, that is, those who are in the habit of taking annually extended journeys, either for pleasure or business, have become radio enthusisasts, and there is a growing demand for an efficient portable reciever that will not only keep one in touch with the home broadcast stations, but also have volume, tone and quality equal to that which we have been accustomed to enjoying nightly from the old reliable set in the living room.

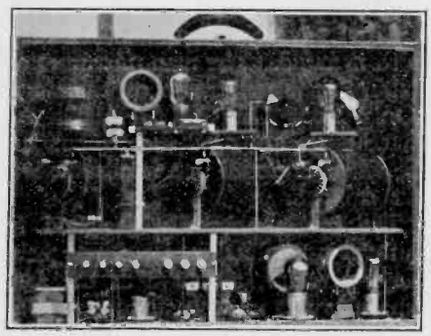
With this object in view, the herein described set was designed and built, and it has proven most satisfactory in all the above mentioned features. The parts used and wiring are the same as fully set forth in an article in the January, 1924, issue of the Radio Journal—(The Nation on a Loop and Loud Speaker). The layout is considerably condensed and modified, the push-pull power amplifier. Western Electric loud speaker and loop all being incorporated with the receiver in a case 25 inches long, 19 inches high and 10 inches deep. The loop, as shown in photo, consists of about 80 feet of litz wire mounted in cover of case, and has demonstrated its efficiency by bringing in to Los Angeles KDKA, Pittsburgh, several times during August. In fact, the receiver will pick up any broadcast signal that is stronger than the so-called atmospheric disturbances and static.

So far, the portable feature with quality reception was easy to obtain, but at home the six A tubes and three-



Showing panel detail and aerial on cover of portable case

power tubes in amplifier were fed by storage A and B batteries, entirely too cumbersome to carry around. Now, the particular receiver here illustrated is intended for use where electric lighting current is available, so a separate carrying case was constructed, containing transformers, rectifiers and filters for both A and B supply, making it only necessary to plug in on the nearest lamp socket to have a constant, strong and inexpensive source of current. There are now a number of "plate supply" units on the market and it is not difficult to assemble a



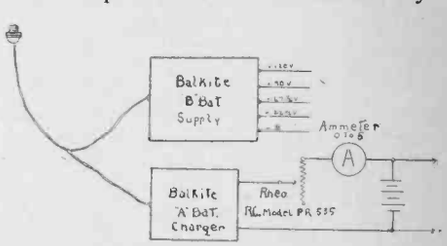
Take a look at this—the complete Armstrong outfit, tonsils, appendix and all. Make a fella want to go travelling.

home made outfit from standard parts available, but for finest results every bit of A. C. hum must be eliminated. The new Balkite "B" does this. The greatest difficulty encountered was in the 6-volt filament source. It took a lot of experimenting before an absolutely noiseless detector filament heating supply was furnished from the A. C. line, for there is no use carting around an ultra sensitive D. X. receiver, only to drown out weak distant signals with local tube or battery noises. Here the Balkite system of rectification proved most suitable. A regular stock Balkite A battery charger was used, its output being controlled by a six-ohm rheostat. (Radio Corporation Model P R-535 answered very well and did not overheat.) It is desirable to use an ammeter in regulating this adjustment, also a special capacity unit is necessary across the output or three small 2-volt battery units will answer, as shown on accompanying diagram. (The special capacity unit will be fuly described in a later issue).

At this point it is well to emphasize the importance of a strong, steady filament supply, if one desires to obtain the utmost possible out of the tubes. The above arrangement answers this purpose perfectly, and would say, in demonstration, that, as this is being written, at La Canada, California, September 15, both KFKX at Hastings, Nebraska, and WBAP, Fort Worth, Texas, have been coming in with a clearness and volume never equaled at any time last winter.

An eighty-ampere storage "A" battery, fully charged, was alternately tried with the rectifier on these stations and the latter was in every way equal, if not superior. The adjustment of the rheostat varied the signal from a point barely audible on the loud speaker to a volume far and above that possible using the storage "A" battery, and at all times the voice or music was exceptionally clear and free from distortion or local noises. The rectifier works particularly well with the new A. P. Tubes. Four were used during the above mentioned trials, three as radio frequency amplifiers and one as the frequency changer. Also, while operating at the loudest output it was possible to switch in a moment between the D. X. stations and back to Oakland and local without an oscillation squeal or howl.

The current supply case measures twenty-five and a half inches by fourteen inches by nine and a half inches deep. It takes but a few minutes to connect up and be on the air at any



Drawing illustrating how the set is hooked onto the light socketd, doing away with the battery

place where 110 volt A. C. electric lights are used.

Where such a supply is unavailable, the receiver will work very well on dry cell tubes. There is room provided in the case for dry "B" batteries. Should U V 199 or C 299 Tubes be used, it is necessary to select them with care and try every tube out in different sockets to ascertain where a particular one works best. While reception will not equal that obtained with "A" tubes, the transportation of the current supply case is dispensed with. But the author's advice is, "carry the complete outfit and surprise your listening

friends," for whether traveling or at home, the results produced through the use of this rectifying unit will prove most gratifying.

Further details concerning the construction of the receiver and current supply will be gladly furnished if inquiries are addressed to the author, care Radio Journal.

New Advance Model Four

RADIO sets are being developed, in these days, toward very definite ends. Simplicity of control, sensitivity, selectivity, clarity, volume, and distance, are all

set attributes which are not always developed concordantly. In other words some sets become masterpieces of clarity and truth of tone, but make no effort at what is termed distance these days. Others can pick out station after station from afar but are more or less indifferent performers when it comes to faithful reproduction.

The Advance Model 4 is a new set just announced by the Advance Electric Company which, for novelty in construction and design as well as for natural grace and beauty and performance, should be rated as one of the big "little" sets this winter. For the set is not large, the panel being only 7¼ by 11¼—a three tube reflex affair involving some principles of construction which prove extremely interesting.

The first tube is a step of radio frequency, the second is detector and audio frequency combined, and the third is audio. The manufacturers are staking their reputation on the slogan "Only Your Ear Can Decide". Advance parts are used throughout, and the whole enclosed in a handsome walnut cabinet.

The set is primarily designed for faithful reproduction, its clarity being the big factor, although at the same time it brings in such stations as Oakland on most any kind of an aerial or no aerial at all. One of its peculiarities is that it operates from any old aerial, or wire strung across the living room floor, or no aerial, or no ground. The makers tested it from Vancouver to San Diego before placing it on the market. Another incident of its construction is that all rubber has been eliminated, special cushioning features being substituted.

The manufacturers are establishing their marketing channels through the exclusive dealer plan and have already established extensive dealer outlets, while others will be established as the expanding factory output makes this possible.

Big Problems Before National Meet

SECRETARY HOOVER has called the Third National Radio Conference for the better voluntary regulation of radio. The conference will be held at Washington, beginning September 30.

Two such conferences have already been held, one in February, 1922, and one in March, 1923, both of which were generally attended by the persons and organizations interested. The result has been a lessening friction and misunderstanding through the voluntary cooperation of the industry, the public and the Department of Commerce, especially in the reduction of interference and the improvement of service.

The growth of radio and particularly the multiplication of broadcasting stations and the consequent congestion of the air has made necessary a consideration of many subjects and perhaps a revision of some present methods. Some of the matters which will be discussed and considered at the conference are:

Revision of the present frequency or wave length allocations, to reduce interference.

Use of high frequencies or short waves.

Classification of broadcasting stations; possible discontinuance of Class C stations.

Interconnection of broadcasting stations.

Limitation of power; division of time; zoning of broadcasting stations.

Means for distinguishing the identity of amateur calls from foreign countries.

Interference by electrical devices other than radio transmitting stations.

Relations between government and commercial services.

Such other topics as may be proposed by the Conference.

To facilitate the work of the conference the various groups in the radio field will be asked to name representatives who will constitute the formal advisory committee of the conference. As at present planned, the groups to be represented will be as follows:—listeners, marine service, broadcasting, (one from each inspection district), engineering, transoceanic communication, wire inter-connections, manufacturers, amateurs, point-to-point communication, government departments.

The committee so constituted will hold public hearings. All persons or organizations having any suggestions to make or views to express upon any features of radio activity are urged to attend and will have full opportunity to be heard.

Some of the matters suggested for consideration are not within the regulatory control of the secretary. As to such matters, any conclusions reached by the conference can become effective only by voluntary adoption by the interests affected. As to the features falling within the powers of the secretary the recommendations of the conference will be advisory to the department.

Defense of New York City from an invading army was undertaken by the Winter Plattsburg of the Quartermaster Reserve Corps of the Second Area. Last week a paper enemy was driven into the sea. A mobile public address system with Western Electric engineers was one of the means of defense. By its use a whole army could hear the voices of officers.

Based on the demonstration, the prospect for future wars and for military usage in peace times is one of no limitation on the human voice. On the contrary, tactics and strategy have adopted the public address system as a vocal organ of their own.

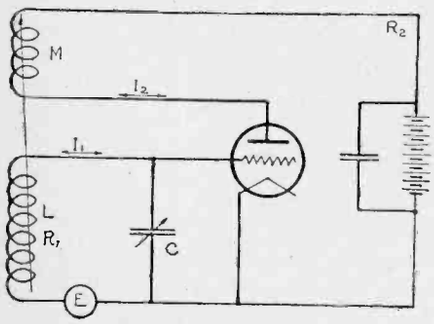
For those readers who have been puzzled by the dates on the past two issues of Radio Journal—The Journal has been advanced to catch up in its dating with the current publication of other issues, but all subscribers will receive their full number of issues regardless of the dating. All contracts either for subscription or advertising will be so advanced.

Quantitative Study of Regeneration

By C. B. JOLLIFFE and MISS J. A. RODMAN

The current in the tuned circuit with and without regeneration has been measured by using an electron tube voltmeter which registered the drop in potential across the capacity in the tuned circuit. This article is scientific paper No. 487 of the Bureau of Standards, the work being done by C. B. Jolliffe, associate physicist and Miss J. A. Rodman, assistant physicist.

THE electron-tube circuit network by which received radio signals may be strengthened materially by coupling the grid and plate circuits of the tube were first described by E. H. Armstrong. The principal methods used for obtaining this regeneration are (1) capacitive coupling using usually the capacity of



the tube itself, (2) inductive coupling where a coil in the plate circuit and a coil in the tuned grid circuit are inductively coupled. A short time after the discovery of this phenomenon the idea was advanced that regeneration in effect introduced a negative resistance in a tuned circuit. This idea has been variously interpreted and at times questioned.

Miller studied theoretically and experimentally the case of capacitive coupling, and showed that because of the capacities between the elements of an electron tube the input impedance of the tube depends on the nature of the load in the plate circuit. If this load in the plate circuit is inductive, it was shown that the input impedance can be characterized as a negative resistance, in which case the resistance of the tuned circuit is apparently reduced. The equations for calculating the amount of reduction of the resistance are given.

Very little quantitative data are available concerning regeneration which is obtained by inductive coupling between the output and input circuits of a tube, and this work is to show by experiment that the results of regeneration by inductive feed back may be calculated from simple alternating-current theory.

The circuit network as ordinarily used is shown in Figure 1. L is the total inductance in the tuned circuit, C the total effective capacity, and R_1 the total resistance. In order to isolate the effect that it is desired to study, it is assumed that the grid of the tube is maintained at such a voltage that it absorbs no power, and that μ is a constant in the relation

$$E_p = \mu E_g$$

E_p = alternating plate voltage,
E_g = alternating voltage applied to the grid,
μ = voltage amplification factor of the tube.

That is, the tube functions as an amplifier only or that the operating point remains on the straight portion of the grid voltage, plate current curve.

Considering the circuit LR_1C

$$E_g = \frac{I_1}{jwC_1} \qquad (1)$$

C_1 = the capacity of the tuned circuit included between the grid and filament of the tube,
$w = 2\pi \times$ frequency,

$$E_p = \mu E_g \qquad (2)$$

$$I_2 = \frac{E_p}{R_2} = \frac{\mu I_1}{jwC_1R_2} \qquad (3)$$

R_2 = total resistance of the plate circuit.

Then the voltage E_M fed back into the tuned circuit

$$E_M = jwMI_2 = \frac{\mu MI_1}{C_1R_2} \qquad (4)$$

This voltage is in phase with the current in the circuit LR_1C.

Then

$$I_1R_1 - \frac{\mu MI_1}{C_1R_2} + jI_1X = E \qquad (5)$$

where E is the voltage induced by the antenna or other means and X is reactance of circuit LR_1C.

Then

$$I_1 = \frac{E}{\sqrt{\left\{R_1 - \frac{\mu M}{C_1R_2}\right\}^2 + X^2}} \qquad (6)$$

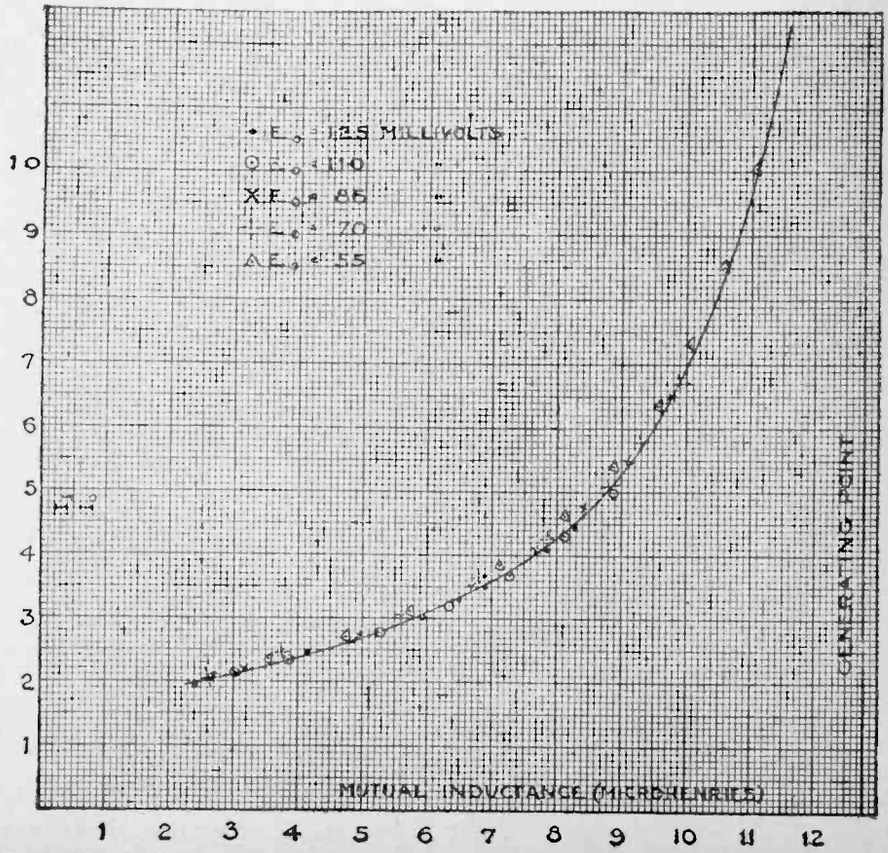


Figure No. 3—Current amplification in tuned circuit produced by regeneration for various applied voltages.

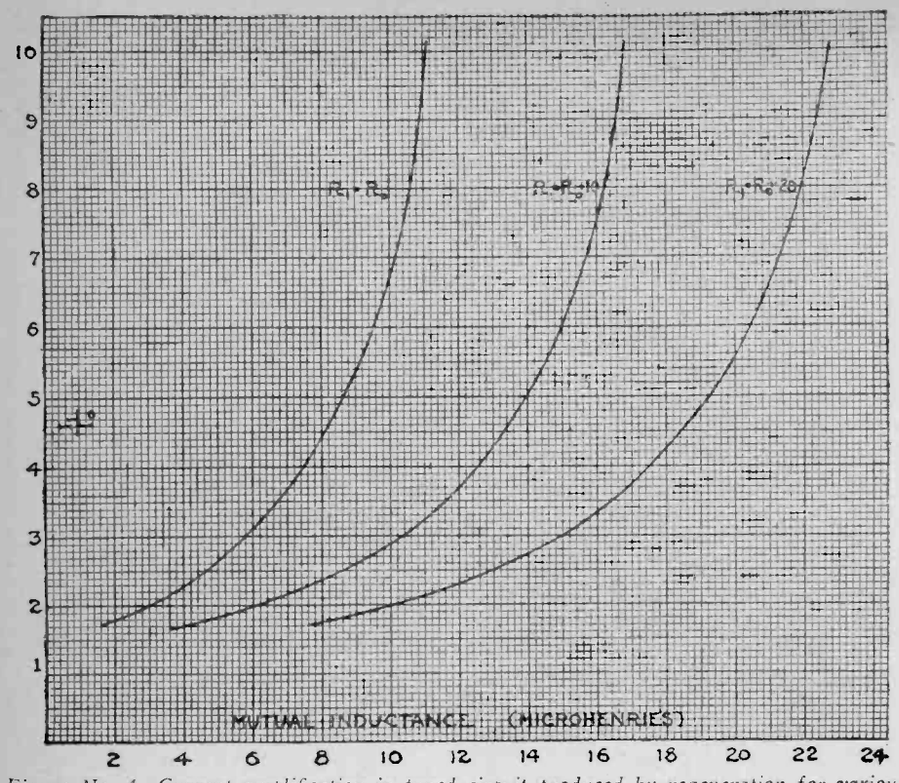


Figure No. 4—Current amplification in tuned circuit produced by regeneration for various values of resistance.

If circuit LR_1C is tuned to resonance with the impressed signal E, $X=O$

$$I_1 = \frac{E}{R_1 - \frac{\mu M}{R_2 C_1}} \qquad (7)$$

That is, the resistance is apparently reduced by an amount equal to $\frac{\mu M}{R_2 C_1}$. This same result may be obtained from the equations given by Hazeltine.

In order to test this equation experimentally a circuit similar to Figure 1 was constructed. The actual circuit network used is shown in Figure 2. The electron-tube voltmeter measures directly the voltage impressed on the grid of the tube, and this voltage is proportional to the current flowing in the tuned circuit. The voltmeter was calibrated by measuring the voltage drop produced by a measured radio-frequency current flowing through radio-frequency link resistors of various values. There was no perceptible loss produced in the tuned circuit by connecting the tube voltmeter across the condenser. This was shown experimentally by noting the point at which self-generation set in with and without the voltmeter connected. No measurable difference could be detected. The capacity of the first tube of the voltmeter added to the capacity of the tuned circuit, but since it was always connected no error was introduced. The capacity C_1 between the grid and filament of the tube was kept constant. The feed back was obtained by means of varying the distance between a coil in the tuned circuit and one in the plate circuit. These coils were coaxial and separated by a grounded screen. The adjacent edges of these coils were always separated 5cm or more. This mutual inductance was calibrated with all associated apparatus in place. The signal was introduced into the tuned circuit by coupling a small part of inductance L to a radio-frequency generating set which was inclosed in a grounded screen box and located at considerable distance from the other apparatus.

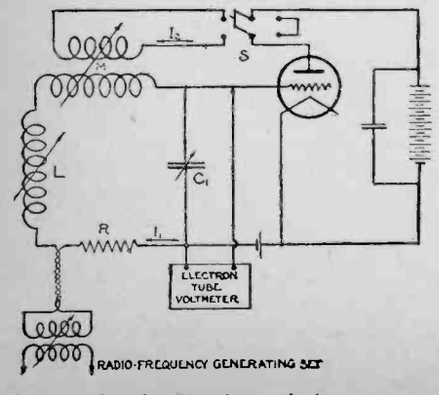


Figure No. 2—Circuit used for measurements.

A signal was introduced in the circuit LR_1C_1 and the circuit tuned to resonance with this signal. The inductor could be disconnected from the plate circuit by switch S. The voltage drop across the condenser C_1 was measured by means of the electron-tube voltmeter. The inductor was inserted in the plate circuit, and with no coupling (coils at right angles and separated) to the tuned circuit the drop across the condenser was again measured. Then the mutual inductance was varied and the drop across the condenser measured nearly to the point of self-generation.

The distributed resistance of the tuned circuit R was measured by means of the resistance-variation method.

From equation (7) it is evident that if I_0 is the current in the tuned circuit without regeneration and I_1 with regeneration then

$$\frac{I_1}{I_0} = \frac{R_1}{R_1 - \frac{\mu M}{C_1 R_2}} \qquad (8)$$

that is, the amplification of the signal should be independent of the impressed voltage. Figure 3 shows the relation between $\frac{I_1}{I_0}$ and M for various values of impressed voltages. This curve is continuous and the points show that $\frac{I_1}{I_0}$ is independent of E for any value of M used, the resistance remaining constant. Figure 4 shows the same relation with various values of resistance. The curves are similar and are displaced along the axis of M by an amount depending on the resistance in the tuned circuit. The curves shown were taken at a frequency of 320 kilocycles per second. Curves at other frequencies are similar.

In order to test quantitatively equation (8), $\frac{I_0}{I_1}$ was plotted against M for the various values of resistance. These curves should be straight lines, and from equation (8) their equation should be

$$\frac{I_0}{I_1} = 1 - \frac{\mu M}{R_1 C_1 R_2} \qquad (9)$$

The results are plotted in Figure 5. As seen, the $\frac{I_0}{I_1}$ intercept is not unity, but the curves for various values of R intersect at unity and a negative value of M. In plotting these curves the effect of the inductance in the plate cir-

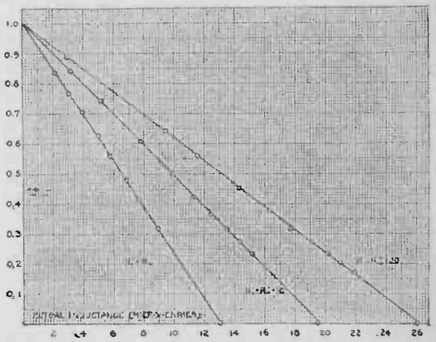


Figure No. 5—Graphical test of equation (9). Effect of capacitive feed back neglected.

cuit was neglected. This inductance should cause a reduction of the resistance in the tuned circuit, the magnitude of which may be calculated from the equations of Miller. It was simpler, however, in this case to determine this reduction experimentally by means of the resistance-variation method. The curves for this determination are shown in Figure 6. For this case these curves show a reduction in resistance of 10.9 ohms from this cause alone.

If a is this reduction of the resistance in the tuned circuit caused by the capacitive feed back through the tube the equation of the curves of Figure 5 should be

$$\frac{I_0}{I_1} = \frac{R_1 - a}{R_1} - \frac{\mu M}{R_1 C_1 R_2} \qquad (10)$$

The intercept on the $\frac{I_0}{I_1}$ axis should be $\frac{R_1 - a}{R_1}$ and the slope should be $-\frac{\mu}{R_1 C_1 R_2}$.

The numerical values for the slopes and intercepts measured from the curves of Figure 5 and the values calculated from the constants of the circuit are given in Table I.

TABLE 1
Actual and Calculated Slopes and Intercepts of Curves in Figure 5

Curve No.	R_1	Intercept.	$\frac{R_1 - a}{R_1}$	Slope	$-\frac{\mu M}{R_1 C_1 R_2}$
1	R_0	6.25	6.3	—0.0480	—0.0488
2	R_0+10	7.2	7.25	— .0368	— .0364
3	R_0+20	7.75	7.8	— .0297	— .0282

$C_1 = 480 \mu\mu f$ $R_2 = 10{,}400$ ohms $R_0 = 29.5$ ohms
$a = 10.9$ ohms

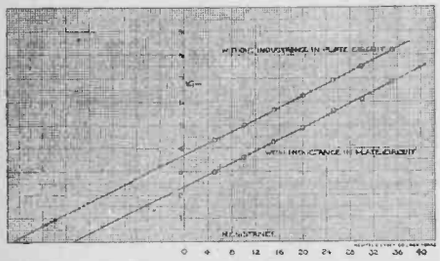


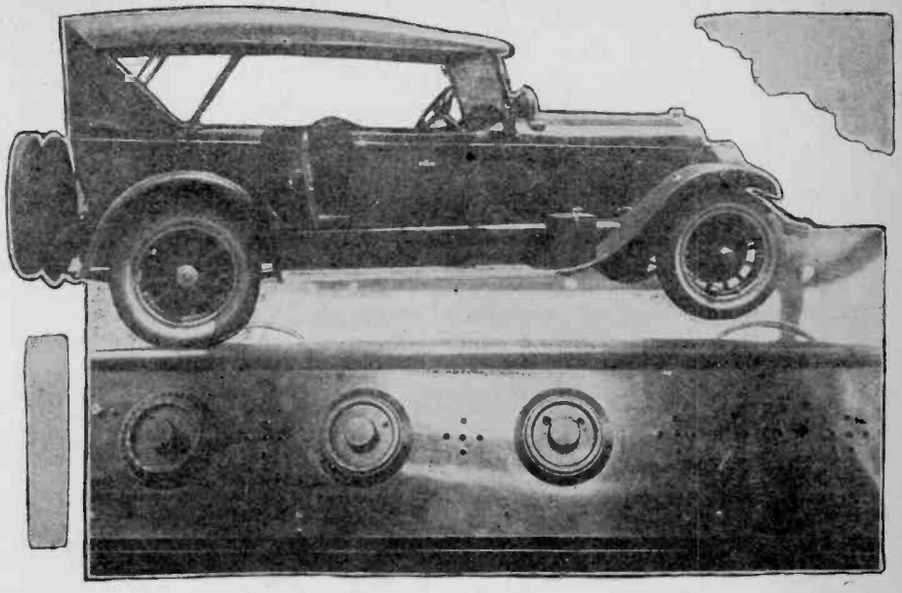
Figure No. 6—Determination of reduction of resistance caused by capacitive feed back.

If instead of I_0 the value of the current I'_0 in the tuned circuit with inductance in the plate circuit and $M = O$ is used and $\frac{I'_0}{I_1}$ plotted against M for the same data as used for Figure 5, the equation of the curves obtained should be

$$\frac{I'_0}{I_1} = I - \frac{\mu M}{(R_1 - a)\ C_1 R_2} \qquad (11)$$

Figure 7 shows $\frac{I'_0}{I_1}$ plotted against M. The intercept on the $\frac{I'_0}{I_1}$ axis is unity in each case. Table 2 gives the numerical values of the actual and calculated slopes.

Crime Crushing Cruiser Uses Radio



One reason why criminals in Detroit get the heebie-jeebies. This is the city of Detroit police car, showing arrangement of receiver in rear seat back. It is locked to the wave-length of the Detroit Police Department's broadcasting station and keeps the car in touch with headquarters at all times.

THE time will come, perhaps, when we will look back upon our present uses for radio and smile. But there are some folks, not the highest type perhaps, in Detroit, who do not smile at radio and probably never will. For in this hub of wheeldom radio is a vital adjunct to the police department. The picture herewith tells the story.

Writing about the set, and the manner in which the Detroit police department can keep in touch with this car at all times anywhere, John G. Knight, deputy police commissioner of Detroit, writes to Radio Journal as follows

"The antenna is four wires installed between the top and headline of top, and a loud speaking unit is installed in the same compartment as the set. The set is a five tube Neutrodyne, using No. 201-A tubes throughout. The loud speaker is a Western Electric.

"The set works very efficiently and is locked on the wave length of our transmitting station, which is two hundred and eighty-six meters.

"It cannot and does not vary over one-quarter of a meter, consequently not enough to notice any difference in the reception. We get very satisfactory results at any speed and in any position throughout the city."

TABLE 2
Actual and Calculated Slopes of Curves in Fig. 6

Curve No.	Slope	$-\frac{\mu M}{(R_1 - a) C_1 R_2}$
1	—0.0763	—0.0775
2	— .0508	— .0504
3	— .0382	— .0374

These results are in good agreement with the theory and show that in order to calculate the current amplification that may be produced in a tuned circuit by regeneration by inductive feed back the following equation should be used.

$$\frac{I_1}{I_0} = \frac{R_1}{(R_1 - a) - \frac{\mu M}{C_1 R_2}} \qquad (12)$$

where a may be calculated from the formulas given by Miller or obtained experimentally.

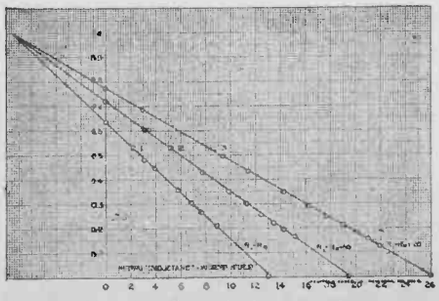


Figure No. 7—Graphical test of equation (11). Effect of capacitive feed back included.

For regeneration produced by inductive coupling between the grid circuit and the plate circuit of an electron-tube circuit network, it is shown that the amplification of a signal introduced into the grid circuit can be calculated from simple alternating-current theory.

The result of regeneration is an apparent decrease in the resistance of the tuned circuit. The equations derived are verified experimentally.

Farmers Make Hay by Radio

MOST radio fans find that their radio sets pay dividends in entertainment and instruction but the farmer who tunes in stations sending out produce market reports is in a preferred position. The farmer, on occasion, may turn radio information into cash and make such information pay him dividends on his set. One such farmer is reported by F. R. Cozzens, of Roxbury, Ohio, in the Southern Ruralist recently:

"John Weldon, a farmer of my vicinity, recently got a tip from the air which yielded him $19.60. The tip was an unexpected raise in the livestock market, coming at a time when Weldon was preparing to sell a shipment of hogs to a local buyer.

"As a result, he got in touch with the city market and $19.60 was his profit over the local buyer's quotations, after all shipping expenses were paid.

"This was not a streak of luck, however, for Weldon gets such tips frequently, and they are a part of his plans for making his radio pay its way.

" 'When I first installed my outfit in 1922, I determined to get something from the air besides music,' Weldon told me recently. 'I could receive reports from two large city markets, and a number of smaller ones; and to keep tab on these I bought a ledger.

" 'At the top of each blank page I wrote down the city where the market was located and names of the principal dealers therein, with their addresses. This book is kept on the table where the radio is located, and when I have something to market I get in touch with one of these cities, and write down quotations as I receive them. Then I 'tune-in' for another city, and get their prices. Afterward, I go over these reports and compare them.

" 'It is a simple matter, then, to estimate distance, shipping cost, and so forth, and from this I can select my market.

" 'Dealers in these cities are aware of my method, and I have made arrangements with them by letter to accommodate my shipments at any time. This not only applies to live stock, but to poultry, eggs and buttter. The latter articles are shipped by parcel post the morning after the quotations are received.

" 'I have a wide range of markets to select from (where formerly I was compelled to depend upon a local buyer's quotations) or those in the newspaper, which were always two days late.

" 'And the radio offers another advantage: By getting weather reports and crop conditions from different parts of the country, I can guess pretty accurately the trend of the market.' "

Somehow we would rather be here than where we are. Seriously, this is a graphic illustration of what radio can do everywhere

Portable Broadcaster

A very unusual occurrence took place when a metropolitan broadcasting station was recently disposed of by one of the pioneer radio corporations in broadcasting, because the station dominated the air to such an extent as to prevent radio listeners within its immediate scope from hearing any other stations. That was not only altruistic to a marked degree, but highly significant in a radio sense. It probably started a new era in broadcasting. It probably began the movement of broadcasting stations having their ultimate location away from the thickly populated areas of the country.

This unexpected stroke of policy was announced by the Zenith Radio Corporation, when it sold the well known station WJAZ, then located on the Edgewater Beach Hotel. Because of the uncontrollable interference caused by this station throughout the entire North Shore of Chicago, the company decided to erect a new station far enough away from the city and its environs so as to be no longer an interference to the three millions of people who make up the second largest city in the United States.

On the heels of this announcement, the Zenith Radio Corporation was deluged with letters from the chambers of commerce of many of the small communitnes in the outlying districts of Chicago. Some letters came from places two hundred miles away. So urgent were many of the invitations from these smaller towns that it was decided to conduct a series of tests to ascertain the best locality for broadcasting and to determine at the same time the place offering least opportunity for interference. The best working plan which sugested itself was to erect temporary broadcasting stations in all the towns selected for test. Then difficulties developed. For a time it looked as though the plan of making tests would have to be abandoned because the attendant obstacles seemed to be insurmountable. But, after considerable planning and experimenting in the company's laboratories, a way out was discovered.

The company now has in the process of construction a complete broadcasting unit mounted on a one-ton Federal truck. There have been portable transmitting stations for code but, from all available information, this is the first portable broadcasting station in history. It will be equipped with a one hundred-watt transmitter.

The educational value of radio broadcasting is recognized by Frank E. Seavey of the department of English, Tufts College. In a recent letter to WGY he wrote: "When I think of the thuosands of homes into which you are sending excellent music daily, homes in which, three years ago, no music above street songs was known, I feel that your work in education is vastly more important than ours."

Forest rangers in the Snoqualmie district of Washington find that by driving a copper nail into the base of a big tree and using the tree as an antenna they can send messages several miles.

Adding Radio and Audio to BT Circuit

By STANLEY WELDON

So much interest was occassioned by the publication of the first article on the so-called "nameless circuit" in the last issue of Radio Journal that Mr. Weldon has consented to go further in explaining the addition of radio frequency. And may we all profit thereby.

INTERFERENCE of almost every possible description must be met by the radio enthusiast who lives in the more congested areas of our cities. The interference from reradiating regenerative receivers is perhaps the worst form of interference to be met at the present time. This is caused by the improper operation of the regenerative type of receiver. By improper operation I mean using the receiver with the detector tube in an oscillating condition whereby whistles are heard when a station is tuned in.

The use of a regenerative set in this condition produces a very unsatisfactory signal in the headphones or loudspeaker. The whistle from your receiver combines with the whistle of the carrier wave of the station and the reradiated waves of other sets to make a series of whistles and shrieks that are almost unbearable.

The use of a stage of radio frequency ahead of the detector has the advantage of preventing your receiver from distributing other nearby sets. At the same time it will give you much clearer reception due to the fact that you are not causing a wave to be sent out from your antenna and heterodyne with the carrier waves of other receivers or stations, and thus cause a squeal in your receiver.

Radio Amplification

The method of radio frequency amplification as worked out by the Bremer-Tully engineers provides for balancing the capacity of the tubes in the circuit by means of small inductances and condensers. Energy is transferred through small condensers from the third winding on the transformers for the purpose of "bucking" the energy of the radio frequency transformers.

The transformers are mounted on the back of the tuning condensers so that it is an easy matter to adjust the exact position of the transformers for the least transference of energy between them. The third windings and the small condensers can then very easily balance out the reamining capacity between the wiring of the circuit and the capacity of the tubes themselves.

The diagram shows the stage of radio frequency assembled at the left of the detector unit, considering it a view from the front of the panel. A few changes in the wiring are necessary when adding the next stage to the detector unit. The aerial and ground connections are now placed on transformer number two and the connections on transformer one made to the radio frequency tube as shown in the diagram given this week.

The number one and two terminals of both transformers are conencted together, one side of the connection being made through the three plate condenser. This makes the reverse or negative feedback circuit for the purpose of preventing the raido frequency tube from oscillating.

Another change is made that should be noted. A .001 M. F. fixed condenser is connected across plus A and the terminal of the detector socket marked "P."

How to Operate Receiver

Adjust the transformers to a rough setting of about sixty degrees. Adjust condenser No. 4 at 20. (All dials should be adjusted to read zero with the plates all the way out.) Tune in a signal and adjust the reostats and C1 and C2 until a loud signal is obtained, preferably at readings of 15 to 20 on both dials.

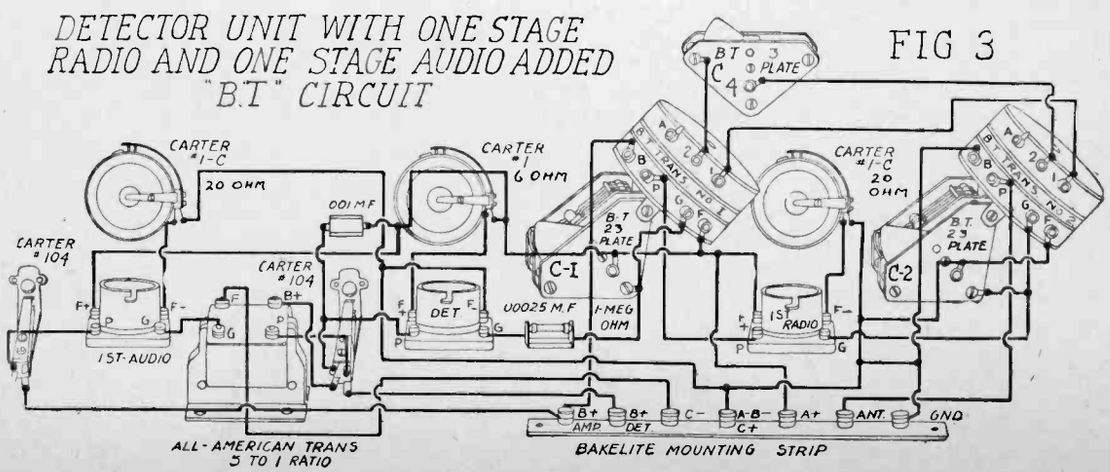
Vary the angle of the transfomers until the whistle of the carrier wave will disappear when C1 dial is rotated. When angle is properly adjusted and C4 placed at zero no oscillation should occur at any wave length.

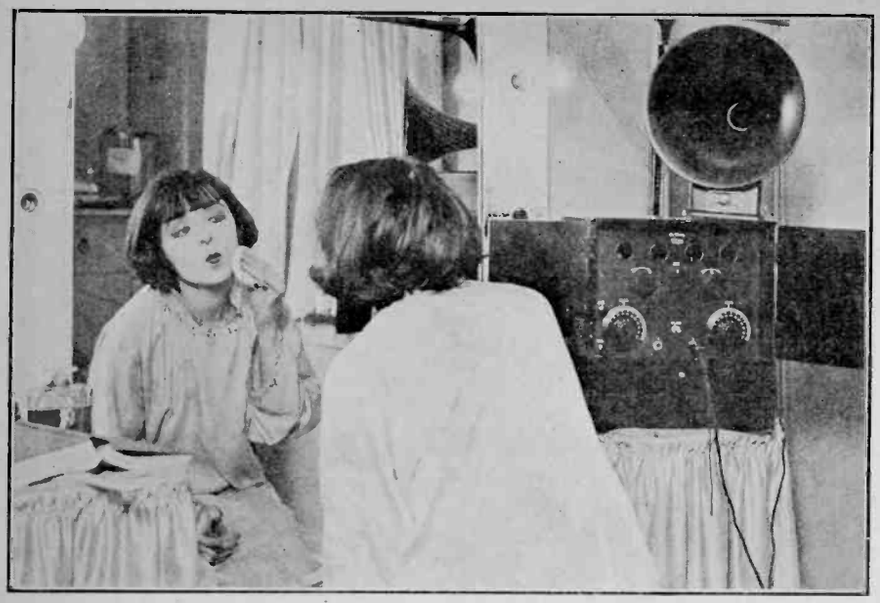
After you have constructed the detector and first stage of radio frequency it is a good plan to add one or two stages of audio frequency amplification. The diagram shows the circuit with one stage of radio, detector, and one stage of audio frequency amplification. Audio frequency is what gives power and volume to your receiver so that a loud speaker can be used in place of headphones. It also enables weak signals to be amplified so that distant reception is practical. Unless the audio amplification operates properly it will be impossible to secure best results with your circuit.

The audio stage is added to the right of the detector unit, as viewed from the front of the panel. Space is limited and room should be left for the addition of a second stage of amplification a little later on. Carefully chart out just where the two audio tubes and the transformer will fit in.

DETECTOR UNIT WITH ONE STAGE RADIO AND ONE STAGE AUDIO ADDED "B.T" CIRCUIT

FIG 3





This is better than we had hoped. Colleen Moore, First National's flapper star is putting on her best flaps. Furthermore she is making up to radio—would that we were viewing this thus.

Makes Good Three Tube Set

The circuit as shown in this article makes a very good three tube set and will well repay your efforts even if you do not wish to go further and make the complete five tube receiver. A stage of tuned radio will assure you of distant stations. A stage of audio will bring in the signals with sufficient volume for a loud speaker, and the circuit will not reradiate energy and cause interference with surrounding receivers.

For the benefit of those who missed the previous articles the complete lisf of material to construct the three tube circuit as shown in the diagram will be given.

1 Panel, 7x26x3/16, with baseboard 6x24x3/4. 2 B.-T. three circuit transformers. 2 B.-T. .0005 M.F. vernier condensers. 1 B.-T. three plate condenser. 1 B.-T. .00025 M.F. grid condenser and one megohm leak. 1 .001 M.F. fixed condenser. 3 vacuum tube sockets. 1 UV 200 detector tube. 2 UV 201-A amplifiers. 1 Carter 6 ohm rheostat. 2 Carter twenty ohm rheostats. (For amplifiers). 2 Carter No. 104 double circuit jacks. 1 All-American 5-1 audio frequency transformer. 6 Binding posts mounted on an insulating strip. One 22½ and one 45 volt B battery. Wire, screws, etc., for mounting and wiring up apparatus.

There will be little trouble experienced in building receiver and when it does occur it is most always due to poor material being used. If the above list of parts are used you should have no trouble in assembling the receiver and being assured that it will operate properly. If inferior apparatus is used, do not blame the author of this article or the originator of the circuit.

Try reversing the G and F terminals of the transformer and use the connection which gives the best results. Determine the best filament temperature for the tubes and adjust the rheostats accordingly.

All wiring should be done in as neat a manner as possible with all leads short and direct, all connections well soldered, etc. The best circuit will function but poorly if it is assembled in a slipshod manner.

In order that the dials C1 and C2 may read the same it may be necessary to move one of the dials on the condenser shaft. Tune in a weak signal carefully at dial reading near 50, with vernier half in. Note reading of C2. Loosen dial C1 on condenser shaft and reset so that it tunes at same reading as C2.

In tuning, use both hands. Rotate dial C1 back and forth across the signal, at the same time adjusting C2 for greatest volume, then adjust C1 for strongest signal. Complete adjustment with verniers in same manner. Control C4 may now be rotated toward 100 for increased signal strength, but should always be adjusted *below the point where distortion occurs.* Adjustment of dial C4 may require some slight adjustment of dial C2.

Measures Wave with Rule

Although the average radio fan has been given to understand that radio waves are intangible things that cannot be detected except by employing a very delicate receiving instrument, S. Kruse, technical editor of QST, using methods first employed by the famous German experimenter, Heinrich Hertz, in 1888. has succeeded in measuring radio waves with a common yard-stick. His investigation was prompted by the Department of Commerce ruling by which amateurs are permitted the use of short wave bands below 80 meters. The standard type of wave-meter commonly employed for such measurements has been found inaccurate for measuring the very short waves, in the vicinity of five meters, consequently he used an improvised method.

This can best be illustrated by comparing the wave motions set up by an oscillator with the curves in a line of rope when one end is fixed and the other moved up and down with a steady motion of the hand. When two parallel wires are connected to the oscillator, or transmitter, and just the right tuning is obtained, the oscillations passing to and fro will superimpose one upon the other just as the curves in the pieces of rope would if a regular motion were maintained, forming what is known as "standing waves." The right point in the tuning can be detected by means of a neon-filled tube connected across the ends of the wires opposite the oscillator. The tube lights when the wire system and the oscillator are in resonance.

Now if a sliding "jumper," or piece of copper wire, is connected across the wires, in some places the tube will go out; in others, it will light. When the places where the tube continues to light have all been located, they indicate the points of no voltage. The distance between them is equal to half a wavelength. It is a simple matter then to estimate the length of the wave with a yard-stick or other unit of measurement.

Ready for Bowdoin

With the exception of the necessity for using a power line across the Maine Central Railroad, work on which is being delayed by one of the worst storms of the season, the special American Radio Relay League station at Wiscasset, Me., is in readiness for the exchange of messages with Captain Donald B. MacMillan, now reported as having reached the Labrador coast. The only other happening to hold up the work of the installation was the carrying away of the counterpoise by a small steamboat, but this damage has been repaired, and with the abatement of the storm, it is expected regular two-way communication will be established.

The radio station has been set up in the offices of the Booth Bay-Wiscasset Steamboat Company, opposite the dock where MacMillan's expedition will land.

A Low-loss Super-heterodyne

By FRANK C. JONES, 6AJF

The super is going to be as popular as a young widow at a bachelor's ball this winter. Here's one built by a real ham. He heard KDKA broadcasting convention returns on the evening of July 4, with no aerial a-tall! Again we remark, it's different.

Many good receivers for broadcast reception have been made and described in various magazines, but little has been said about a super-heterodyne for amateur wave-lengths, especially a receiver which is capable of receiving European amateurs on wavelengths of from 50 to 150 meters. The super-heterodyne is the ideal receiver for amateur work because of its extreme sensitivity and its two controls for tuning. By using a loop aerial or only ground connection it is possible to cut through the worst kind of local interference and pick up DX amateurs, and when there is little or no intereference during the "quiet" period the addition of an outside aerial picks up European amateurs. This last applies to those living outside the San Francisco Bay district where they are not blessed with a dozen types of power buzzes.

The receiver here described will tune from about 30 meters up to 220 meters. It is a simple matter to increase the wavelength to cover broadcasts by winding an extra coil with the necessary number of turns.

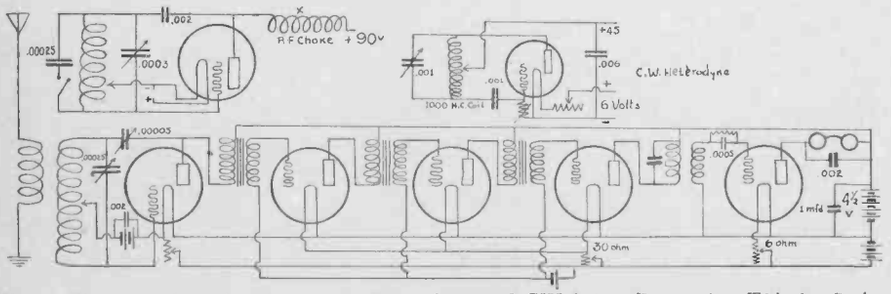
Remler intermediate frequency transformers and 199 tubes are used in the radio frequency amplifier and 201-A tubes in the first detector and the two oscillators. The second detector should be a soft tube such as a C300. However 199 tubes can be used throughout if desired.

The Oscillator System

Use is made of the hartley circuit in the oscillator system, which tunes from 60 up to 220 meters. Below 60 meters the second harmonic of the oscillator is used and, since low loss coils and condenser are used in the first detector circuit, it turnes sharp enough so that very little trouble is experienced from the main frequency or first harmonic.

For example, in tuning to 40 meters, the oscillator is adjusted to 80 meters, 22500 cycles which gives a harmonic on 40 meters, 4500 cycles.

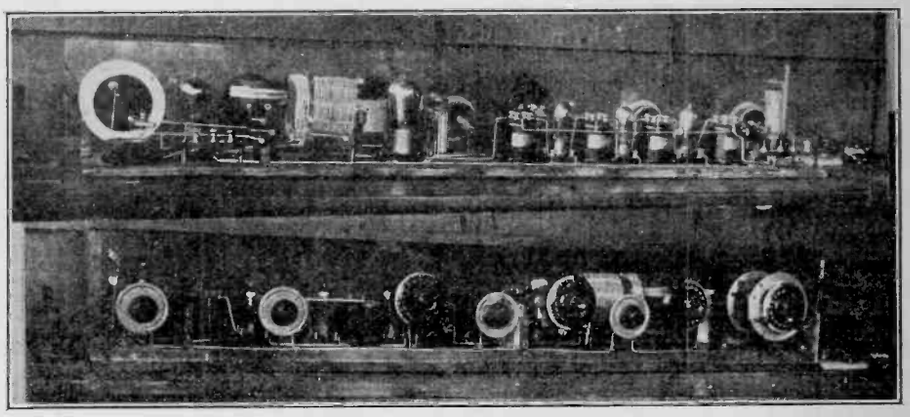
The oscillator coil consists of 14 turns of No. 18 DCCC wire double bank wound on a 3-inch fibre tube with the filament tap taken at the center of the 7th turn. The coil, with flexible leads, is mounted on a 3/16 inch shaft near the secondary coil of the first detector. This does away with a pick-up coil and its attendant losses from moving contacts etc. A .0003 vernier condenser is shunted across the coil and a fixed condenser of .00025 mfd is arranged to shunt across it for wavelengths above 150 meters. The radio frequency choke X is a 200 turn honeycomb coil.



Wiring diagram of the low loss super-heterodyne and CW heterodyne unit. This hooks 'em from 50 meters up.

The First Detector

The first detector circuit contains a low loss tuner arranged to use an aerial which would be small, such as an indoor aerial. The primary coil has been changed since the picture was taken and now consists of 5 turns No. 12 DCC wired placed several inches away from the secondary on the other side of the oscillator coil. It might very well be hinged so as to obtain variable coupling. The secondary coils are wound with No. 14 DCC wire, basket wound, and are held together with stout cord so as to eliminate losses as far as possible. The winding form consists of 17 pegs placed equally distant on a 3½-inch circle on a block of wood. The ends and center tap are brought out to the one edge and soldered into ordinary phone tips, the wires near the phone tips being tied down securely with cord. The coils are plugged into phone tip jacks which are mounted with a spacing of ¾-inch in a hard rubber strip. The grid, filament and plate leads are soldered to these jacks. Two secondary coils are necessary, one of 30 turns tapped at the 15th turn and another of 15 turns also tapped at the center. The larger coil will tune from below 100 meters up to about 220 meters, with a 11-plate Cardwell low loss condenser in shunt. The small feedback condenser in the plate lead should be a Chelten midget. The 4½ volt C battery in the filament lead ins shunted by an .002 mfd micadon.



The low-loss super wearing one of them diaphonous frocks. Front and rear view of the thing, the panel being of glass. And it's a bear for action.

Intermediate Frequency Amplifier

The intermediate frequency amplifier Remler type 600 and 610 transformers were used with 199 tubes. Better results and signal audibility will result if the Remler output transformer (type 610) is made over as follows: first remove the windings, which can be done by drilling out the

(Continued on Page 24)

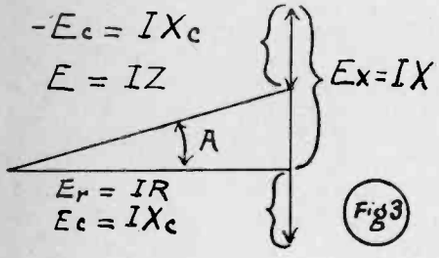
Electrical Units and Fundamentals

By PROF. H. LaV. TWINING

Continuing his mathematical calculation of the radio set, Professor Twining gives Radio Journal students some exact formulas. This series should make a valuable addition to the radio scientists library.

THE effect of inductance lagging the current behind the voltage and capacity causing the current to lead the voltage and their combined effect can now be computed.

If inductance and resistance are in the circuit then the total opposition to the flow of the current is called the impedance. It is designated by Z and E=IZ is Ohm's law as applied to this case. A part of this voltage E is used to drive the current I against the resistance R. This is known as the power component or the IR drop. It is designated by Er. The other component is represented by Ex, and it is that part of E which overcomes the induced counter electromotive force -Ex which is produced by the inductance. Since all induction takes place at a 90° phase displacement from Er, Ex and Er are 90° out of phase, I being in phase with Er and out of phase with E by the phase angle A. The amount that I lags E is determined by the inductance, the lag being small when the inductance L is small and large when L is large. The lag is limited to the values between zero and ninety degrees. Figure 1 shows the relationship in this figure.



$$E^2=Er^2+Ex^2$$

hence

$$E^2=I^2R^2+I^2X^2$$

where X is known as the reactance.

Then $E^2=I^2(R^2+X^2)$

Or $E=I\sqrt{R^2+X^2}$

But $X=WL$

Hence $E=I\sqrt{R^2+W^2L^2}$

This is Ohm's law for inductive circuits containing resistance. Hence

$$Z=\sqrt{R^2+W^2L^2}$$

where $W=2\pi f$

When the circuit contains capacity and resistance only the relation is shown in Figure 2. Where Xc stands for the capacity resistance, as before

$$E^2=E^2r+IX^2c$$

or

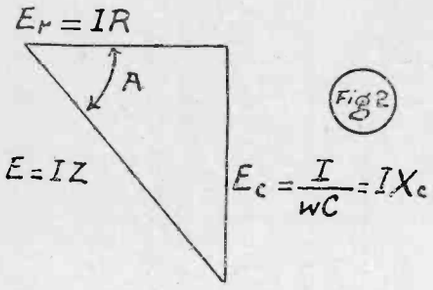
$$E^2=I^2R^2+I^2X^2c$$

and $E^2=I^2(R^2+X^2c)$

then $E=I\sqrt{R^2+X^2c}$

and $E=I\sqrt{R^2+\left\{\frac{1}{wc}\right\}^2}$

This is Ohm's law for a circuit containing capacity and resistance only.



The current in this case leads the voltage E by a phase angle A which depends for its value upon the relative values of the resistance R and the capacity C, in the same manner that the current I was made to lag the voltage E by a phase angle which depends upon the relative values of L and R.

In case inductance, capacity and resistance are all present in the current, then Ex and Ec are 180° out of phase at all instants, since one lags and the other leads Er by 90°. This relation is shown in Figure No. 3.

In this case the reactive leg of the triangle is the difference between Ex and Ec. If Ex is greater, then the current lags E by A degrees. If Ec is larger then the result is as shown in Figure No. 4.

In this case Ex is subtracted from Ec and the resultant triangle is as shown, and

$$E^2=Ex^2+(Ex-Ec)^2$$

or $E^2=Er^2+(Ec-Ex)^2$

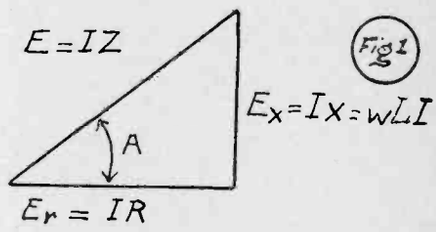
hence $E^2=I^2R^2+(Ix-Ixc)^2$

or $E^2=I^2R^2+(Ixc-Ix)^2$

and $E^2=I^2(R^2+(x-xc)^2)$

and $E^2=I^2(R^2+(xc-x)^2)$

so that $E=I\sqrt{R^2+\left\{wL-\frac{1}{wc}\right\}^2}$



or $E=I\sqrt{R^2+\left\{\frac{1}{wc}-wL\right\}^2}$

This is Ohm's law for a circuit containing resistance, inductance and capacity. If the capacity reactance and the inductive reactance be varied until they exactly offset the effects of one another, then a condition known as resonance is set up. In this case Ec=Ex and they are exactly equal and opposite, hence,

$$WL=\frac{1}{wc}$$

and $w^2=\frac{1}{LC}$

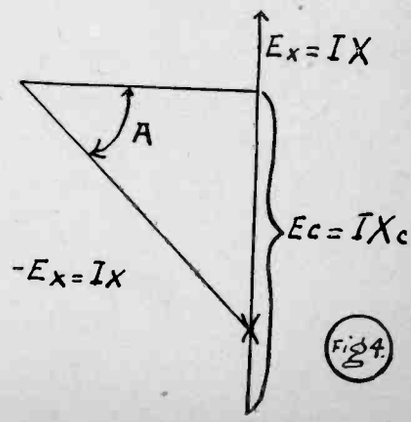
but $w=2\pi f$

hence $(2\pi)^2f^2=\frac{1}{LC}$

or $f^2=\frac{1}{(2\pi)^2LC}$

or $f=\frac{1}{2\pi\sqrt{LC}}$

(Continued on Page 26)



With The Western Amateurs

Conducted By A. L. MUNZIG

9ZT on New Waves

D. C. Wallace, 9ZT, 9XAX, and 9TT, holder of the Hoover cup and one of the best known amateurs in the country, sends us his interpretation of the new wave bands for amateurs:

The American Radio Relay League recently announced to its members the fact that the bureau of navigation has authorized amateurs to use the following wave lengths: Four to 5 meters; 20 to 22 meters; 40 to 43 meters; 75 to 80 meters; 150 to 200 meters.

All general amateur stations may have any or all of the above bands, provided they will make application to the supervisor of radio. Those who already have a license call may retain the old call and use any or all of the above bands.

In securing this new allotment of wave length bands, the "Z" licenses give up the band of 200 to 320 meters, leaving this band unused by anyone at the present time. "Z" licenses may use the band of 105 to 110 meters by applying for this band.

When applying for the new allotment of bands, it is necessary to write the supervisor, stating that you are able to tune your transmitter to some point within the band or bands desired.

Any form of plate supply may be used. This includes AC, rectified AC, or DC. This applies, as you will note, to the wave length band of 150-200 meters, so the old artificial fence of 176 meters, which puzzled so many of us for a long time, has been removed. The amateurs may transmit on wave lengths below 80 meters on their respective bands. They must, however, use coupled circuit in order to minimize key clicks. In other words, the old Hartley circuit has now gone by the board—likewise, reversed feed back. Most of the amateurs are having best results with a regular three-coil Meissner circuit, and some are using coupled Hartley.

It is interesting to note that, although these bands have been open to the general amateur for but a period of about one month, there are already more amateurs in the band between 75 and 80 meters than between 150-200 meters. By listening in any night on a transmitter which will tune down to 75 meters this can readily be ascertained.

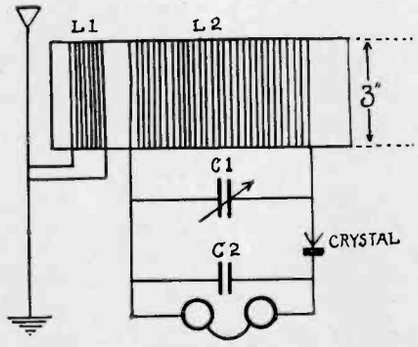
Contrary to the general opinion, the band of 75 to 80 meters has ample room for all of us. There are more stations able to transmit simultaneously in the band of 75 to 80 meters than there were in the old days when we had 176 to 200 meters. In short, there is less interference with the number of stations operating on 75 to 80 meters than there was with the same number operating from 76 to 200 meters. You can readily see the great possibilities we have in these low wave lengths.

If you have not already secured the low bands for your station be sure to write to the supervisor immediately for your license.

It is interesting to note that when using the new wave length of 75 to 80 meters, it is impossible for broadcast listeners to tune in any broadcasting station and at the same time tune in any amateur station. Several Twin City amateurs have found that broadcast listeners fifty yards away from the transmitter are entirely unaware of them when the station is operating, provided they are using the new band.

9ZA of Chicago, so Supervisor Beane tells me, has his broadcasting antenna on the same building with his transmitting antenna, and neither of these two broadcast listeners can hear 9ZA when he is on his usual working wave of 78 meters.

A new era has developed for amateur radio, and for radio as a whole, inasmuch as many more services may now use radio



G. Hammel, of 2822 Darwin Avenue, Los Angeles, submits this one as a crystal set worth testing out. For those who believe the crystal the best rectifier in the world, we pass it along.

without the slightest interference with each other. The day of the "silent transmitter" is now here and all general amateurs should immediately write the radio supervisor and secure permission to use any waves.

Great interest is being shown in the Dakota Division convention, which is to be held on November 28 and 29. These are the two days following Thanksgiving, so we shall expect a large turn out at this time.

Mr. F. H. Schnell has already written that he expects to come, and also Mr. A. H. Heber, treasurer of the ARRL, expects to be here with us. Mr. Jansky, who is chairman of the program committee, indicates that he has already secured promises from several well-known outside speakers who will make the trip here to give us a talk on various phases of CW transmission and reception.

Another Conversation Set

Radio 6EA of Los Angeles, on the air since May 30 with a five-way phone station, is using a forty-eight jar chemical rectifier with an RF choke coil and seven 1-mf condensers for filter, which produces pure DC current, supplied by a home-made plate supply transformer. Loop absorption modulation with an old Western Electric wall telephone microphone is used. Phoning is on 195 meters but the set can go down to 176 when QRM is bad. William Eitel, a BCL of Los Gatos, Calif., some 300 miles from Los Angeles, first reported the set. Others have been received by 6EA from San Gabriel, Eagle Rock, Bairdstown, and elsewhere as well as within Los Angeles. The best two way conversation so far, was with 6BGC in Glendale, about eight miles.

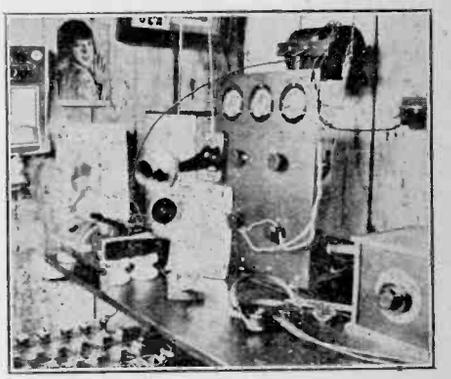
The five watter at 6EA, using well filtered chemical rectifier on 150 meters, has communicated direct with 1ABF, 1ARE, 1AWE, 1CMP, 2BCM, 2CLA, 2CWO, 3BVA, 3XAQ, 410, 4XC, 8ZK, 8ABS, 8BDA, and 8BXX. The operator has also heard 1FD, 1FS, 1BDA, 1BSD, and 4BZ on 150 meters. The station was heard by WNP at Greenland, also by Canadians, 3PZ and 3TB.

2CV Is Reassigned

Radio 2CV has been re-assigned to Irving Korenman of 1465 Sixtieth Street, Brooklyn, N. Y. Two transmitters are used, one 50-watt pure D.C.C.W., and a 10-watt S-tube rectified CW, phone and ICW. The aerial is a 4-wire inverted L flat top, on twelve foot spreaders 65 feet off the earth and 50 feet long. The counterpoise is a 7-wire fan. Reports will be gladly acknowledged.

From 9DHJ

Calls heard at 9DHJ, 702 Grant Street, Crown Point, Ind., operated by Fred Hall, on one-tube three-circuit tuner; 1MO, 1YB, 1FD, 1CKP, 1HW, 2EA, 2BE, 2BJ, 20M, 2BUV, 3CBM, 3CCD, 3CCN, 3CW, 3BVA, 3CCX, 3ADB, 3BDD, 3HK, 3VV, 4AIV, 4BL, 4KW, 410, 4JR, 4IU, 4QF, 5AIU, 5AMA, 5AMH, 5ADO, 5ACN, 5AMC, 5AJP, 5EB, 5PS, 5MO, 5AM, 5MB, 5QL, 5EK, 5RG, 5NN, 5XD, 5ZA, 6AHO, 6ARB, 6AWT, 6ABC, 6AMP, 6BRO, 6BVZ, 6CBB, 6AXD, 6XAH, 6EA, 7AGE, 7ACX, 7OB, too many 8s and 9s to list. Will be glad to QSL cards.



This is the phone set at 6EA. No, we don't mean the pretty girl either.

9ZT on 100 Meters

Stations worked using 9XAX on 109 meters during 1924: D. C. Wallace, 54 Penn Ave., N., Minneapolis, Minn, 9Z2-9XAX; 1xw, 1xj, 1bes, 1emp, 1xak, 1xah, 1xam, 1xaq, 2gk, 2awa, 2bsc, 3ii, 3mb, 3pz, 3vw, 3bdi, 3bwj, 3xao, 4bz, 4fj, 4hs, 4kn, 4xc, 4xe, 5ov, 5gw, 5ow, 5aic, 5ahj, 5xv, 5xab, 6arb, 6cfz, 6xe, 6xbc, 7fq, 7gb, 7ij, 8hn, 8pl, 8ve, 8adk, 8alf, 8awj, 8bbf, 8bnh, 8bwy, 8dcy, 8xbe, 8xbp, 8xbc; KDEF, KDEH, NKF, NKF-1 (one). Canadian, 1bq, 1af, 2bg, 2hn, 2og, 3bp, 3bq, 3ko, 3ly, 3aec, 4ct, 4ow, 9al.

Aside from the fact that no amateur spark stations are permitted in Cuba, regulations regarding amateur transmitting stations are very liberal and somewhat similar to those in the United States, according to F. W. Borton of Havana. In a letter he says that amateurs are allowed use of wavelengths from 75 to 200 meters.

Trade Talk from Radio Dealers & Manufacturers

Balkite "B"—No Battery

The exhibit of Balkite "B," which replaces the "B" radio battery, at the recent Pacific Radio Exposition, San Francisco, attracted considerable attention from the visiting members of the trade. The device is manufactured by the Fansteel Products Co., Inc., North Chicago, and furnishes direct current to the plate or "B" circuit of the radio set from the house lighting circuit.

In using Balkite "B" no changes or additions to the set are necessary. The binding posts provided are simply connected by means of leads to the corresponding connections on the set. Balkite "B' may be used either with the storage battery or dry cell type of tube and is simple, efficient, and unfailing in operation. The device has nothing to break, replace, wear out or get out of order and cannot deteriorate through use or disuse, lasting indefinitely, it is claimed. No attention other than the addition of a few drops of distilled water to the rectifier cells at infrequent intervals, usually not oftener than once a year, is necessary for the operation of the Balkite "B" on any receiving set.

The current consumption is very low, being considerably less than that of a 10 watt lamp, the smallest lamp obtainable. The average cost of current for operation is under one-tenth of one cent per hour. The Balkite "B" is represented in Los Angeles by Lombard J. Smith, 451 East Third Street.

Phones are Popular

Mr. Frank S. Tower, head of the Tower Manufacturing Corporation, 98 Brookline Avenue, Boston, Mass., was originally associated with one of the largest and most widely known musical organizations in the country, playing the 'cello. Several years ago he became a radio enthusiast and, realizing how crude and imperfect the ear phones of that time were and how distorted the sounds came to the listeners-in, he set to work devising an ear phone that would correct these faults and yet reproduce the true full tones in their natural volume. Mr. Tower sought to secure in his phones the exact, soft yet full volume of the sound as it came from the 'cello, which is considered the purest-toned musical instrument in the world. After many experiments and disappointments Mr. Tower finally accomplished his purpose. The Tower's Scientific Phone immediately jumped into popularity and today is one of the fastest-selling phones in the world, and the Tower Manufacturing Corporation has become the largest exclusive manufacturers of ear phones. The phones are backed by an extensive national advertising campaign.

New Lightning Arrester

A lightning arrester is somewhat like a life-preserver in that it is only called upon to work in an emergency.

No one knows, as a certainty, whether or not it will function properly until the emergency has passed. So the D. X. Instrument Co. Inc., of Harrisburg, Pa., makers of Fil-Ko-Parts for Radio, have issued for the Fil-Ko lightning arrester, a special guarantee which provides that should lightning strike an aerial to which a Fil-Ko Lightning Arrester is attached and damage the radio receiver, they will repair the set or pay the purchaser of the arrester $100.00.

Cut Bat. Prices

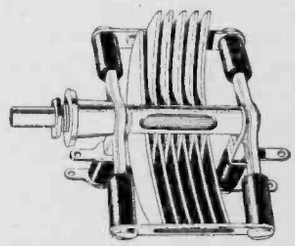
The first real move in the radio industry toward reducing the cost of radio set operation has been taken by the National Carbon Company, which was announced through a statement by James R. Crawford, general sales manager, a substantial reduction in the prices of Eveready "B" batteries. With the popular demand today insisting on multi-tube radio sets, the cost of operating a set has increased. Additional tubes require increased "B" battery current. The only way in which operation of sets involving several tubes can be made more general through decreased expense is by reducing the cost of the necessary "B" batteries, it is claimed.

Advertising Data

The Radio Department of Arthur Rosenburg Co., Inc., advertising agents, 110 West 34th Street, New York, is now distributing to radio manufacturers the first issue of the Radio Advertisers' Data Book, which it has compiled and published. This fifty-four page book contains the advertising rates, circulation, mechanical requirements and other data regarding all the radio consumer and trade publications, as well as those general magazines which feature radio—the Allied Trade Papers—covering such fields as the electrical, hardware, talking machine, music trades, and sporting goods in the United States and Canada. Data is also given regarding more than 300 newspapers which print radio news, programs, or features. This matter is arranged by states, towns and cities. It includes data on circulation, radio advertising rates, and the paper's method of featuring radio.

Crofoot Condensers

There is a real difference in condensers, both from an electrostatic and mechanical viewpoint, according to Francis M. Coker, 1612 Maple Avenue, Los Angeles, western representative of the Premier Crofoot condenser. The claims made for Crofoot, aside from general design, are:



Full capacity as rated, low minimum capacity, low skin resistance, low insulation leakage, low phase angle loss, semi or full straight line tuning curve, low hand capacity effect, sturdy construction, smooth, free acting rotor, evenly spaced and true aligned rotor and stator plates, all possible connectors soldered, bearings designed to prevent rotor end play and side shake, compact design and light weight, and graceful appearance. The had tuning range of any variable condenser is de-

(Continued on Page 33)