NATIONAL RADIO NEWS

·FROM RADIO HEADQUARTERS·

WASHINGTON, D. C., FEBRUARY, 1928

Marconi, the father of Radio looks into the future

Developments have been fast but greater ones are on the way

THERE is a bright future for Radio according to Guglielmo Marconi, the inventor of Radio. Short waves and directive transmission are closest to his heart and mind at the present time, according to a recent interview he granted. He believes that many secrets of photo-Radio, facsimile transmission, high speed communication and television are wrapped up in wavelengths below 80 meters and in the narrow beams of energy that the short waves are made to carry.

GUGLIELMO MARCONI

The renowned inventor was very much impressed by the enthusiasm of the people in the United States for Radio and by the number of practical uses to which Radio has been put.

"Study short waves and directive systems and experiment in these fields because they hold vast possibilities. Long distance Radio communication of the future will be over short waves. Only recently have we discovered that these waves are capable of results unobtainable with long waves," he said.

"Fading remains the most serious obstacle to be overcome although it is worse on long wavelengths than on short waves."

It has only been about 25 years since the first message was sent across the Atlantic by Marconi. In a recent article in Popular Science Monthly he is quoted as follows:

"What has been achieved in Radio has been the work not of any one man but of thousands. Many of the most valuable advances have been the work of enthusiastic amateurs. There are thousands of experimenters but there is room for thousands more. Nowhere are there so many young men interested in Radio as in America and I am hopeful that as a result of that interest we may find out some of the things we don't yet know.

"What causes fading and how to overcome it? That will be a good place for any young man to start and win enduring fame and incidentally make a great deal of money. Fading has been partially overcome by use of reflectors in the short wave beam system now in operation between England and Australia, India, South Africa, Canada and the United States. By these reflectors, the waves are all sent in a single direction, and are received with the strength of more than one hundred times that which would be possible without the reflectors. But this method is not applicable to broadcasting. Even with the beam system, fading often gives a great deal of trouble, although it is at its worst on wavelengths between 200 and 1000 meters.

"The very short waves and the very long ones do not seem to be so much affected as those in the middle ranges. We use waves of from sixteen to thirty-two meters for the beam system connecting the British Dominions with England, and often when the longer of these waves do not get through we get perfect com-

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World can use 350,000,000 radio sets

The Department of Commerce estimates that a world market exists for ten times as many Radio sets as have been sold and that there is a potential world market for twenty times as many Radio sets once broadcasting facilities are extended to bring all civilized portions of the world within the zone of constant reception.

It is estimated that 18,000,000 Radio sets are now in use. They serve about 90,000,000 people but this number is only 9 per cent of the population of existing zones of constant reception. If the zones were extended to include the whole world, 350,000,000 sets would be required. Consequently that old "bogey" the "saturation point" or the time when every home will have a set is believed to be many decades in the future.

Broadcasting has not made the progress in foreign countries that it has made here in the United States. Some countries prohibit broadcasting entirely. Nearly 60 foreign countries depend upon one or several of the 420 stations outside of the United States. Nineteen have only one station and 11 of these do not reach beyond national borders. In many countries Radio broadcasting is strictly a commercial proposition. Corporations are given concessions by the government and owners of receiving sets pay for service either direct to the station or to the government. The rates vary from one franc in France to $50 in Salvador for the first year. Invariably the government collects a share of the profits. Uncle Sam is playing his part in supplying the world with Radio sets and equipment although he faces strong competition from Germany, England and France. The United States exported $8,000,000 worth of Radio equipment last year and indications are that the volume will be greatly increased next year.

Teacher: "If your father bought a sixty-dollar Radio set on the installment plan and paid off two dollars a week, how long will it take him to pay it off?"

Jimmy: "Ten years."

Teacher: "Sit down, you don't know the lesson."

Jimmy: "You don't know my father."

"Pardon me a moment, please," said the dentist to the victim, "But before beginning this work I must have my drill."

"Good gracious, man!" exclaimed the patient, "can't you pull a tooth without a rehearsal?"

C. Francis Jenkins, Washington inventor of one of the present systems of Radio Television, predicts that low price receiving sets by which Radio visions may be received in the home as speech and music are now received, will be available within the next year.

The actual transmission of the human face almost instantaneously by Radio is practically an accomplished fact. Mr. Jenkins says that the only thing standing in the way of universal enjoyment of this new victory of science is the development of a receiving set within the reach of the average income.

Two new Radio developments of 1927 which are going to add materially to sales volume as well as service work for spare time or full time are the A C tubes and the new 4-element tubes. Adapting battery-operated sets to use the new A C tubes should be a mighty fine means of bringing in more business. In most instances it is a practical undertaking. The plan offers new fields of profit through the sale of necessary parts and accessories for making the change as well as the service charge for doing the job. The 4-element tube is not yet on the market but as soon as it does come on it will undoubtedly create new opportunities for profit as the desire for distance in receiving range is undoubtedly just as great as ever.

The December issue of Radio Retailing, a publication for Radio dealers, has an article entitled "Cheap Service Men Do Not Pay." They go on to say: "The day is over when any 'ham' can build as good a set as a factory-made product, and with this comes the realization that no longer can any young high school boy with a smattering of amateur radio be hired as an efficient service man. The money that is gained by paying a small salary to this type of service man is more than lost in his inability to make a favorable impression upon the customer.

Get a service man with a congenial personality, pay a reasonable salary with a bonus or commission for sales made while on service calls, and then, above all, make sure that he is familiar with the sets to be serviced through studying and understanding the service instructions issued by the manufacturer."

Arthur Goebel, winner of the Dole Prize as a result of his flight from California to Hawaii, says that Radio is an important factor in ocean aviation. In an interview he is quoted as having said, "We would have drifted off our course very badly had it not been for the Radio beacons. During a large part of the flight cloudy weather made observations impossible and we depended entirely upon the signals coming from the beacon stations.

The American Lighthouse Service is now operating 45 Radio beacons and 12 more are being completed. Anxiety for the safety of sailors has been minimized by the use of Radio beacons. During the last year Radio beacons were installed for the first time in Alaska and the Hawaiian Islands. Fifteen Radio beacons are located along the Atlantic coast, 10 along the Pacific and 18 on the Great Lakes. Eight more are under construction on the Atlantic coast, 1 on the Pacific, 2 off Alaska and 1 on the Great Lakes. The Radio beacon located at strategic points automatically transmits signals which are recorded by the Radio compass, enabling the navigator to determine his bearings. It is estimated that Radio compasses are now in use on more than one thousand commercial vessels besides on a large number of naval craft. The first of the Radio beacons was established near New York in 1921.

Never before in the history of broadcasting were there so many stations hooked up together as were used during the Dodge Brothers Victory Hour early in January. Forty-two broadcasting stations were broadcasting this program. This network of stations, it is estimated, carried the program to 30 million people. An interesting feature was the location of the different artists.

Usually when several stations hook up together to present a program, all the artists are in one studio. In this particular case, however, Will Rogers broadcasted from California, Al Jolson from New Orleans, Paul Whitman from New York, Fred and Dorothy Stone from Chicago, and the President of the Dodge Brothers from Detroit. It was a wonderful engineering accomplishment. We wonder if this is a forerunner of what we can expect when the heat of the political campaign for the next presidential election gets under way. As will be recalled, during the past presidential election, both President Coolidge and the Democratic candidate, John W. Davis, used a large hook-up of stations a day or two before election. However, the number of stations used then could not come anywhere near comparing with the Dodge Brothers' network.

Commander Richard E. Byrd, intrepid aviator and explorer, tried a very novel experiment a short time ago. Through broadcast station KDKA, a Radio message was broadcast inviting Noo-Ka-Ping-Wa to join him in his contemplated trip to the Antarctic. Noo-Ka-Ping-Wa lives on Bache Peninsula, Ellesmereland, 900 miles north of the Arctic Circle and only 600 miles from the North Pole. We hope he received the message. It will be a long time before Commander Byrd knows whether it arrived as Noo-Ka-Ping-Wa, replying by the first mail, cannot get his answer under way until next August.

Reviewing the Radio progress made during 1927, the Associated Press Radio Editor points out that the two new developments of note were the A C tube and 4-element tube. In previous years new inventions, new ideas of hook-ups in receiving sets were coming out so rapidly that it was hard to keep track of all of them. Receiving sets however underwent very little change in the past year. Perhaps the new tubes, particularly the 4-element tube, will be the forerunner of new types of receiving sets.

Harvey Firestone, rubber manufacturer, has been given a license by the Federal Radio Commission to operate a short wave Radio station between Akron, Ohio, and his rubber plantation in Liberia. The new station was designated as 8XAS and will operate experimentally for three months. This experiment marks the first time in industrial history that a large operation is conducted at long range by Radio. It may be the forerunner of wide-spread use of Radio by firms that have foreign interests and also by large firms that have branches in different parts of the country. This looks like a real opportunity in the making.

Despite the mild weather to date, Radio industry enjoyed a splendid season during the fall and winter. Dealers, distributors, and manufacturers alike are unanimous in their declaration that business so far this season has exceeded every prediction. There is nothing on the horizon now to stop the forward march of Radio. In fact, sales volume will probably increase more rapidly from this point than ever before. Better programs are being broadcast, football games, baseball games, prize fights, are on the air, in fact, hardly a week goes by but what enough good programs, lectures, announcements, news items, are being broadcast to satisfy even the most finnicky of Radio fans. Then the new tubes and other developments under way should open new avenues of future business.

Two N. R. I. Students get newspaper publicity

Ted Muralt, Lamoure, North Dakota, in a recent letter to us said: "I know that I owe you a line and here it is. I haven't sent in a lesson for so long perhaps you think I have given up Radio. But, no, never! It is the most interesting work I know of. I have been building and repairing Radio sets ever since I started your course and have been getting along fine. Repair work has been coming to me for miles around. I have fixed sets other men failed on. All due to your course."

And with his letter he encloses a clipping from a local newspaper. Here it is:

Ted Muralt Broadcasts With Simple Apparatus

Ted Muralt, local Radio expert of the LaMoure Electric Shop, this week, as an experiment, threw together a few old receiving set parts and a telephone transmitter, and presto! he had a broadcasting station.

Using only two ordinary receiving set tubes for power and two for modulation, he broadcast music which was picked up by receiving sets throughout the whole city of LaMoure, and indeed at points considerably more distant. The result was that he was flooded with requests for more or particular numbers.

The simple Radio transmitter which he devised consumed less power than an ordinary receiver.

Ted says that he will have to go below 200 meters (on the amateur wave band) to transmit, as a commercial license is required on the broadcast lengths. But he says that soon we may have a good station. Who knows?

This would mean a chance for local talent, who might break into the public eye—or ear, rather.

Here's an article that appeared in the December 18 issue of the Winslow, Arizona Daily Mail:

Of particular interest to the Radio bug, fiend or owner is the announcement by W. S. Young, 417 East Fourth Street (rear), of his appointment as radiotrician in charge of the local authorized Hammarlund-Roberts service station.

That his description of himself as an expert radio-trician, endorsed by the National Radio Institute of Washington, D. C., is no idle boast was ably demonstrated at an audition last night which a Daily Mail reporter attended, and in which an eight-tube "World's Record" superheterodyne was used.

This instrument, which is self-contained, including aerial and batteries, all enclosed in a most beautiful cabinet, was built by Mr. Young himself, and was only completed within the past few days. At the time the Mail reporter dropped in, the Los Angeles broadcasting station was coming in with "Silent Night" and other Christmas carols, and it seemed hardly possible that such clarity of tone and pronunciation could be picked up within the four walls of a house from over seven hundred miles away.

Yet, according to Mr. Young, Chicago stations could be heard just as plainly,

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Recent Vacuum Tube Developments

By Geo. O. Sutton
N. R. I. Staff

During the past few years there have not been any radical developments affecting the fundamental operation of ordinary Radio receiving sets. Previous to the year 1927, perhaps the last really new development which affected the fundamental operation of receiving sets was the introduction of the Neutrodyne receiver by Professor Hazeltine.

For several years the average listener has been expecting some radical improvements to be made but prior to the year 1927 such radical improvements have failed to materialize. However, the year 1927 witnessed the introduction of two different types of vacuum tubes than we had heretofore known. The first of these—the alternating current vacuum tube, was not such a radical change as was announced in the introduction of the four-element screen grid tube.

For sometime, the average broadcast listener has been demanding a type of tube which used alternating current directly on its filament so that all forms of batteries could be entirely eliminated in the operation of the average receiving set. The use of this type of tube, of course, called for the use of auxiliary apparatus also and was to a certain extent a departure from the methods previously used. The greatest advantage of the alternating current tube, however, is the elimination of all batteries, chargers and other auxiliary apparatus so that it is possible to have a self-contained Radio set which derives all current directly from the alternating current mains.

Following the announcement of the alternating current tube came the announcement that the screen grid tubes, UX-222, CX-322, would soon be placed on the market. And the long expected radical changes in the design of receiving sets has finally materialized in this announcement.

It has long been the dream of Radio enthusiasts that the time would come when it would be possible to twist the dial and receive any broadcast station in the world. Of course, this is only a dream and the screen grid tube will not complete this dream. Before such wonderful results can materialize, it is necessary that someone conceive such ideas and devote his efforts developing apparatus for the accomplishment of this dream. The screen grid tube is the latest development in vacuum tubes and it, no doubt, will materially improve the receiving range if properly installed and used with the correctly designed associated apparatus.

Experimenters, amateurs, broadcast listeners, and all Radio enthusiasts are, of course, interested in just what can be expected of this latest development. The average question is: "Will it better my receiving set? Will it increase the range? Can I use it in my present receiving set? If not, what changes will be necessary in order to include it?"

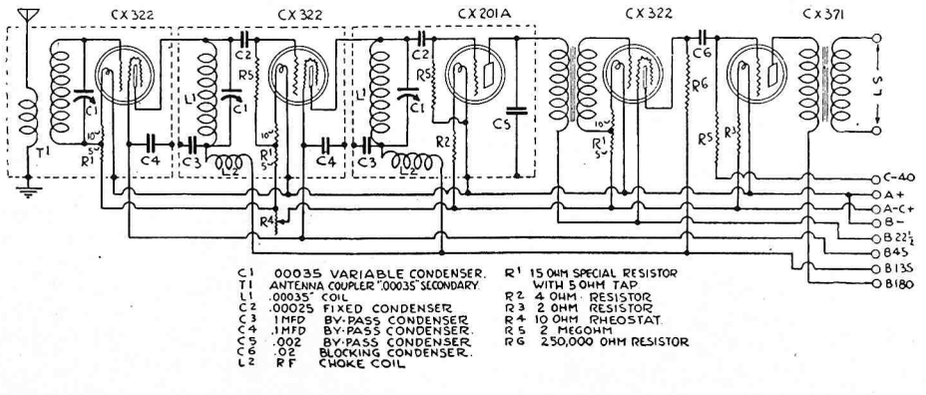
In the first place, the screen grid tube cannot be used in the average type of receiving set now in use. Certain changes in the basic design of present receiving sets will have to be made. In some cases, of course, it may be possible to make only minor changes. Where properly designed shielding is already a part of the receiving set, it is possible to make certain changes in the wiring together with a few additions.

The A. C. type of tube did not change the basic design of the receiving set but merely required the use of proper filament wiring together with the addition of a transformer for supplying the filament current. The A. C. tube has not caused any revolutionary effects on the Radio trade because D. C. receivers are still being sold and will continue to be sold, and I think the same applies to the screen grid tube, because the manufacturers cannot change their product over night and the introduction of any accessory such as this, calls for such an economic change by the manufacturers that it cannot be accomplished on short notice. Perhaps by next season we will have commercially manufactured receiving sets using the screen grid tube, but I do not believe that this tube will render obsolete all of the equipment now in use.

This latest tube development, I believe, will greatly enhance the value of receiving sets, because the sensitivity of the ordinary receiving set which uses the screen grid tube together with properly designed apparatus will be such that the receiving range will be increased vastly and coast to coast reception will once more become a common feat instead of something to be wished for.

The outside physical appearance of the UX-222 is very similar to the present tubes except for the cap on top of the tube. This tube has approximately the

(Continued on page 4)



C1 .00035 VARIABLE CONDENSER.
T1 ANTENNA COUPLER "00035" SECONDARY
L1 .00035" COIL
C2 .00025 FIXED CONDENSER
C3 1 MFD BY-PASS CONDENSER
C4 .1 MFD BY-PASS CONDENSER
C5 .002 BY-PASS CONDENSER
C6 .02 BLOCKING CONDENSER.
L2 RF CHOKE COIL
R1 15 OHM SPECIAL RESISTOR WITH 5 OHM TAP
R2 4 OHM RESISTOR
R3 2 OHM RESISTOR
R4 10 OHM RHEOSTAT
R5 2 MEGOHM
R6 250,000 OHM RESISTOR

Craze for Distance Turning to Quality of Reproduction

By George O. Sutton
N. R. I. Staff

(Continued from last issue)

The Audio Frequency Amplifier

Distortion in the radio frequency amplifier and detector is mainly due to the partial elimination or cutting off of the higher audio frequency currents whereas in the audio frequency amplifier we have just the opposite form of distortion with which to contend.

In the simple transformer coupled type of audio frequency amplifier, high quality amplification and reproduction can be obtained if certain fundamental laws are closely adhered to.

One of these is that the inductance of the primary of the audio frequency transformers must be very high. Theoretically, for perfect reproduction, the primary impedance must be at least twice the output impedance of the tube at the lowest frequency at which it is desired to amplify. If the lowest frequency to be amplified by the transformer is 50 cycles and considering that the output impedance of the tube is 25,000 ohms, the inductance of the primary should be approximately 160 henries. In practice, it is possible to obtain satisfactory quality with a lower value of inductance.

Matched Impedance Hokum

There has been a great deal said about matching the impedance of the primary to that of the tube and it can be positively stated that a great deal of the discussion along this line is mostly "hokum" because the primary impedance is changing for every frequency impressed upon it. A great improvement in the design of audio frequency transformers has, however, resulted from these discussions because the core material of the transformers has been improved, the size of the core has been increased and the inductance of the primary has been materially increased over the values formerly used.

The value of the fixed condenser which is usually shunted across the primary of the first audio frequency transformer to by pass radio frequency currents must be chosen with care. If this condenser is too large, the high audio frequency currents will be by passed and resonant effects are likely to be encountered. For the average type of transformer now in use, the value of this shunt condenser should not greatly exceed .001 mfd. and in most cases, a .0005 mfd. condenser will suffice.

The main requirement of the secondary of the audio frequency transformer is that the effective capacity in shunt to the secondary shall be very small. In nearly all cases where a fixed condenser is shunted across the secondary of audio frequency transformers, the voltage of the high frequency currents is materially reduced which results in a loss of the high frequency currents. Often a volume control is used at this point in the form of a resistance connected across the secondary and al-

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National Radio News

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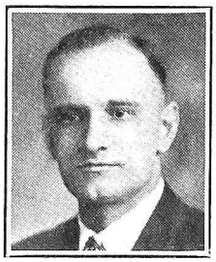
Washington, D. C. February, 1928

Making $55 to $70 a Week

377 East 160th Street, New York City.
December 12, 1927.



Dear Mr. Smith:

I am now making between $55 and $70 a week, thanks to your thorough course in Radio. Only last Sunday, December 11, I picked up $12 clear profit in a little over four hours on three service jobs. I could have made $3 or $4 more on another service job only it was raining. What a difference from the old chauffeur job, paying $30 per week and slaving 54 hours to make it.

Sincerely yours, Edward Zenner.

Made $894 in Spare Time

2320 Maple St., Little Rock, Ark.,
January 2, 1928.

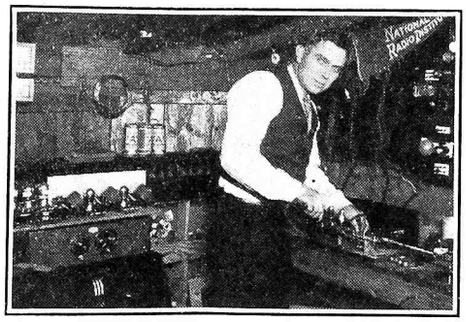
Dear Mr. Smith:

I am sending you a picture of my shop. I regret I do not have a more pretentious building. But maybe by next season I can have one.

I do not know exactly to a penny how much I have made directly from my course, but I should say that of about $894 profit to date practically all of it was gotten by results of the training I have received from N. R. I. I believe I can safely say that $800 of my Radio income is directly traceable to my N. R. I. training—and I am not through with the course yet.

You may tell your students for me, if you wish, that my experience has been to get the fundamentals of Radio down pretty well and then apply a good measure of "guts" and they will have a combination that can get away with anything. I have had "things" come into my shop I have never seen before but they went out working because I know the fundamentals and I have nerve enough to try.

Cordially yours, K. W. GRIFFITH.



Recent Vacuum Tube Developments

(Continued from page 3)

same geometric dimensions and uses a UX base which makes it interchangeable in the present type of sockets. The filament current consumption is .132 amperes (slightly more than the UX-120) at a voltage of 3.3 volts. The plate requires approximately 135 volts, the screen grid 45 volts (for R. F. amplification) and the control grid 1½ volts negative bias. The control grid corresponds to the ordinary grid in the three-element tube.

Within the glass tube, the appearance is entirely different. There are four elements instead of the usual three. The control grid is cylindrical in form, surrounds the straight filament, and is arranged in a manner similar to that of the usual 199, however, the connection to this element is brought out to the cap on top of the tube. The screen grid is also cylindrical in form and is placed between the control grid and the cylindrical plate, however, it also extends on the outside of the plate so that it completely surrounds the plate. The fact that the control grid, the screen grid and plate are cylindrical in form makes the tube resemble the 199 type, but the elements are more rugged and are somewhat larger than the elements of the 199 tube.

Primarily, this tube is designed to function as a radio frequency amplifier, although it can be operated as an audio voltage amplifier as well. The building up of extremely weak radio frequency currents to the point where they can be easily detected is, of course, the function of the ordinary radio frequency amplifier and since the UX-222 does not have a relatively fixed amplification constant, its greatest use will undoubtedly be as a radio frequency amplifier. Another particular advantage of this type of tube is that the internal capacities existing between the elements within the tube are so small that they can be regarded as practically negligible. Thus, internal feed-back and resulting oscillation will be eliminated in this type of tube, although it will be necessary to use extreme care in order to prevent feed-back of energy between the associated circuits of the apparatus.

The greatest advantage of this tube is the fact that the voltage amplification is not a constant but can be changed in accordance with the associated apparatus. The voltage amplification depends upon two factors: First, the mutual conductance of the tube. The mutual conductance necessarily determines the amplitude of the plate current variations which result from the reversal in polarity of the signal voltage that is impressed upon the control grid. The second factor upon which the voltage amplification depends is the load impedance in the plate circuit. Since the voltage across the output load is directly proportional to the load impedance in the plate circuit, the amplification available can be changed by changing the impedance of the load in the plate circuit. This means that for various uses, we can cause the tube to have very high amplification or low amplification depending entirely upon the impedance in the plate circuit.

From this, then, the resultant amplification is the product of the mutual conductance of the tube and the impedance in the plate circuit. The average mutual conductance of this tube is about 300 micro-mhos under proper operating conditions.

In the ordinary receiving set using three element vacuum tubes, the impedance load in the plate circuit is not manually changed with the change in signal frequency in order to tune to the various stations, but when using the screen grid tube, it is necessary to change the impedance in the plate circuit when it is desired to cause the receiving set to respond to signals of a different frequency. This means, then, that instead of tuning the input or grid circuit of this type of tube, it is necessary to have the tuning arrangement in the plate circuit instead.

Various methods of having a variable impedance load in the plate circuit suggest themselves, but perhaps the most practical way and especially so for the average constructor is to incorporate a parallel resonant circuit in the plate circuit. The characteristics of a parallel resonant circuit are just the opposite of a series resonant circuit which is used in the ordinary three-element vacuum tube circuit. In series resonance, the total impedance offered to the flow of current at resonant frequency is only the direct current resistance of the circuit. In a parallel resonant circuit, the total impedance offered to the flow of current becomes high at the resonant frequency, therefore, this form of variable high impedance readily lends itself for use with this type of tube.

By referring to the accompanying diagram, it can be seen that the parallel resonant plate circuits consist of the variable condensers C1, and the inductances L1. This condenser coil combination can be designed to cover the wave band just as the condenser coil combination is designed to tune the grid circuit of a three element tube in the ordinary receiving set. It will be noticed that the 222 tube derives its plate current through this parallel resonant circuit and this circuit becomes the tuning circuit instead of the grid circuit in the usual set.

The more efficient the tuned circuit the greater the impedance and consequently the greater the amplification. Previously, it was stated that the voltage amplification gain per stage was equal to the product of the mutual conductance of the tube and the impedance of the load in the plate circuit. As an example, let us suppose the impedance of the resonant circuit is 100,000 ohms (at some broadcast frequency) then by multiplying the mutual conductance, .0003 mhos by 100,000, we find that the amplification gain is 30 per stage. It is possible to have a much higher impedance at low frequencies than it is at the broadcast frequencies. Therefore, this tube readily lends itself for adaption in the Superheterodyne on account of the greater amplification per stage that can be obtained at low frequencies. For instance,

(Continued on page 5)

Dear Mr. Smith:
I wish to state that my study has been self-supporting from the beginning and I am looking forward to a wonderful business this season.

ROY A. MANSFIELD,
5332 Hamlin Ave., Baltimore, Md.

Dear Mr. Smith:
I am getting along fine with my course and I want to let you know how much I have learned. I have not distributed all my cards yet, but I have earned about $45 in the last two weeks. I am now building a 3-tube regenerative set for a friend of mine for which I am expecting about $20.

CARL TOTH,
10005 Kennedy Ave., Cleveland, Ohio.

Dear Mr. Smith:
I do not go out looking for work as I spend most of my spare time studying but so far just doing small jobs for friends I've made almost $60. I could do a lot more but have not got the time.

EDMUND SAXE, JR.,
38 W. 10th Place, Chicago, Ill.

Dear Mr. Smith:
I fixed a Superheterodyne set for the man I am working for after at least 6 or 8 of the best radio men of this city worked on it without results. I went to work according to your lessons. Now it works fine.

WILLIAM ADAMS,
R. F. D. 8, Norwich, Conn.

Dear Mr. Smith:
The other day I was called to repair a set that two Radio Experts before me tried very hard to make work properly, but could not accomplish anything. It took me only 20 minutes. All I had to do was to follow the instructions given in the Service Sheets. I have made $30 already.

MAX. POTTER,
327 Howard Ave., Brooklyn, N. Y.

Dear Mr. Smith:
I got $3.75 for my first job which was a success from the start. Today Capt. Mackenzie of the Colton Air Port conferred with me in regards to using a transmitting set in his plane. He appointed me to make arrangements about it.

A. KEARNEY BROWN,
746 N. 6th St., Colton, Calif.

Dear Mr. Smith:
Those "Go Getters" meant $25.00 profit to me, and a lot more in the future. It gives you prestige and recognition when you are not only a Radio-trician but a student from America's foremost Radio Institute. I am enjoying each lesson like some people love novels.

GRANT W. SIMON,
511 Capital Blvd., St. Paul, Minn.

Dear Mr. Smith:
I have been doing some servicing and have been making $2.50 an hour on what I have done. I have had two sets which have been to the factory and one of them twice and were not satisfactory until I repaired them. I have my first set yet to fail on.

R. A. BOGGS,
Lovington, Ill.

Dear Mr. Smith:
I have so much Radio work to do that I have very little time for studying. I wouldn't take two thousand dollars for the course.

ERIC ROBERTS,
R. No. 3, Box 27, Blue Springs, Miss.

Dear Mr. Smith:
My cards came last week. I gave some out to my friends and have done several jobs for which I give the cards the credit. I have been doing real good at Radio work.

W. L. GIBBS,
1520 Oakmont Ave., Richmond, Va.

Dear Mr. Smith:
I am coming along fine with my course and Radio work. At present I have 2 five-tube sets, 7 three-tube set to build, 1 four-tube set to repair, and a set of "B" and "C" batteries to deliver. I have a fine repair room now.

G. N. CONWAY,
Johnsonville, N. Y.

Dear Mr. Smith:
About the business cards, I have made $45.00 since I received them.

LLOYD R. McGINNIS,
R. F. D. No. 2, Carlisle, Iowa.

Dear Mr. Smith:
My first job was installing a set, and I had no trouble. My charge was $5. My next job was an old 4-tube set. It would only pick up 3 stations. I fixed it so that they got 6 new stations besides the 3 they got before. I invested $8.40 so I charged $14.00 and everything was O. K.

WALTER REDMAN,
115 Henry Street, Brooklyn, N. Y.

Dear Mr. Smith:
I have made enough money fixing Radios in spare time to pay for my course. I am sure I could have made a lot more, but I haven't the time to do much repairing.

MR. ANTHONY YENINAS,
269 Vine St., Plymouth, Pa.

Dear Mr. Smith:
You may be pleased to know I made a 5-tube Kit up and I never saw a set so selective, as clear as a bell and volume to burn. A friend of mine heard it. He said it was the best he had ever heard and asked me if I would sell it. Of course, I wanted to realize some money from my work so I said 'If you want it for $75.00 you may have it.' He jumped at the chance. I could have gotten $100.00 as easy.

MR. A. JOHNSTON,
145 Bancroft Ave., San Leandro, Calif.

Dear Mr. Smith:
I rigged up three aerials the afternoon before the Dempsey & Sharkey affair in New York which netted me $15.00 for about four hours work.

JAMES E. HARTIGAN,
183 Pine St., New Haven, Conn.

Dear Mr. Smith:
I owe you an apology for not writing sooner. I have been so busy the last month doing Radio work that I have scarcely had time to finish the remaining lessons of the course. During the past two months I have cleared about $150 in addition to money spent for numerous tools. Recently I secured a territory with the Canadian Westinghouse Company and have already sold and installed a $225 set.

D. C. DAVIS,
Woodlawn, Ont., Canada.

Dear Mr. Smith:
I have made $50 in the last three months installing and repairing sets. I expect to make as good if not more within the next thirty days as I am doing service and installation work for a furniture house in the neighborhood during my spare time.

JACK MUELLER, JR.,
954 N. Hamlin Ave., Chicago, Ill.

Dear Mr. Smith:
Just a line to say that any of the N. R. I. boys who write "there is no money in Radio"—and want to be shown, should try this. I spend 48 hours a week in a shop. In the evening I do spare-time work. I have picked up quite a bit of money already and this month I expect to net $100 for repair work, sets and parts sold.

ALBERT D. NORTON,
110 Cottage St., Easthampton, Mass.

Recent Vacuum Tube Developments

(Continued from page 4)

with a plate impedance of 500,000 ohms and a mutual conductance of .0003 mhos, the amplification is 150. When using this type of tube in a Superheterodyne, it may be possible to obtain greater amplification with one stage of this type than when using two or three stages of intermediate frequency employing the usual three-element tube.

Extreme care must be employed in designing and constructing the receiving set if these figures are to be attained. The above calculations are made when it is taken for granted that there is no tendency towards oscillation in the amplifier. Although it is true that the effective inter-electrode capacity of the tube is reduced to approximately .02 micro-microfarads which is an extremely negligible value, there will still be some capacitive and inductive coupling between wires leading to the tubes, coils, etc., between adjacent stages. The more the coupling between the various stages, the less will be the amplification gain and it can readily be seen that it is necessary to completely isolate in a metal container each amplification stage and the grid and plate wiring must be such that the effective inductive and capacitive coupling is negligible. The manufacturer suggests that it may be necessary to place a shield around the tube as well.

In the audio stages, it is possible to have a voltage amplification of 35 and to secure uniform amplification at all frequencies. When using the ordinary 201-A tube, the highest gain that is possible to obtain when using ordinary transformer coupling is in the neighborhood of 22.

The UX-222 can also be used as a detector, however, resistance coupling is required in order to obtain the required high plate or load impedance. For the ordinary constructor, it would be much better to use one of the three-element tubes as a detector until he becomes more familiar with the operation of this tube.

The possibilities for experimenting with this new tube are unlimited and many sleepless nights seem to be ahead of the experimenter who desires to obtain greatest results with this type of tube. On account of the greater amplification gained by the use of these tubes, the lure of distance once more comes into existence and this time with a knowledge that we have more efficient means of accomplishing the optimum results. The distance getting possibility of a receiving set using these tubes seems to be limited only by the factor of the noise level. That is, if the field strength of the signal is such that it is possible to listen to the signal without having the roaring and crashing of stray noises to destroy it, then this tube will detect signals which heretofore were thought impossible of reception and reproduction. The future, then, holds considerable in store for those who like to stay up until the wee small hours of

(Continued on page 10)

Radio Service Means Extra Profits

By Gordon Birrell

No Radio man can afford to overlook the growing importance of Radio service. The time has come when purchasers of Radio sets buy more than the set itself—they purchase Radio satisfaction, and it is service that makes satisfaction possible. The best Radio set ever sold needs its regular service inspection, adjustments and repairs just as any automobile does.

Radio has gotten out of the experimental stage long ago. But some dealers have not wakened up to the fact that it is service which keeps sets sold. The manufacturer of automobiles or the dealer who did not provide for service work and repairs would very soon find that his cars would not sell. There would be a great deal of "knocking"—and it would not be all in the motor. It would be among the purchasers of his cars.

Isn't it reasonable to expect that a high-grade receiver must be kept up to par before the purchaser will feel he is getting his money's worth? And unless the set owner is getting real satisfaction out of the use of his set, he certainly is not going to boost it to his friends who drop in for an evening's entertainment. The man who sold the set in the first place will make a big mistake if he thinks the purchaser will take it all out in "knocking" the manufacturer. He'll "pan" the dealer every time. Any man who has ever bought a Radio set will say he is quite right in doing it too.

Good Service Men Profitable

Yet service work costs money. If a dealer is doing this work, he has got to get a man who understands Radio and who will put every set absolutely right that he services. Since the dealer is in business to make money, the more high priced service men he has to employ, the more it is going to cost him to run his business.

Right here is where a mistaken idea is going to come in—does so in the case of many dealers. They think service represents simply an expense. Yet no one thinks for a minute the thousands of garages in this country are operating on a charity basis. No more should a Radio service station operate without showing a good profit.

On the surface of things, it is evident that a dealer can't afford to over-charge his customers for service and repair work. The more moderate his charges are here, the more favorably inclined the customers are likely to be at the time of purchase and the stronger boosters after the set has been installed. A dealer is very often apt to feel that he is between the devil and the deep blue sea until he grasps the idea that every service call is a double opportunity—an opportunity for sales of accessories and also an opportunity to get the names of prospective customers, both for sets and for service work.

Even the fellow who is doing Radio work on a small scale, perhaps in his spare time, has an opportunity to get in on the money making side of service work. Instead of paying out most of what he takes in to another man, he puts the money in his own pocket for his service calls. The actual amount of charges must vary with the part of the country, the type of customers, and to some extent, the practice of Radio dealers and electricians in the same community. Some men charge as little as $1.00 an hour, others charge $1.50 an hour and still others as much as $2.00. Then while some men charge from the time they leave home until the time they return, others charge by the actual amount of time spent on a set. But an N. R. I. man works out a scale for his own local situation that enables him to clear up some four to seven or eight dollars for an evening's service and repair work, altogether aside from any profits he can get on the sales of new tubes, new batteries, battery chargers, loud speakers and new sets.

Service Men Can Uncover New Business

Then its an easy proposition for him while he is talking with the set owner to get hold of the names and addresses of a number of the set owners of friends who own Radios—or who should own them.

When some large Radio dealers trace as much as 35% of their business to "leads" secured from customers in this manner, it stands to reason that any wide-awake man who can repair Radio sets has the nucleus of a fine business right here.

In fact, it would probably pay him to offer free inspection service just to get a chance to examine a man's Radio set, make recommendations as to any adjustments, repairs and replacements that must be made, the chance to sell accessories and to dig up likely prospects for new sets and for service and repair work for which a fair charge can be made.

The idea of free set inspections has been discussed in the pages of the National Radio News before this. But the idea is a big one, and well worth any man's working out in his own community. It does not take much ingenuity, either, to make the idea catch on among the Radio public. The biggest thing is to be able to handle the business that a man can pick up in this way, and training will take care of that, of course.

Just before an event like the Dempsey-Tunney battle or about the time that National Radio Day was celebrated, is an ideal time. But any time in the fall or winter, just when sets are being put into use for special broadcast programs, or after they have been in use a while and begin to show the effects of use, is a good time.

Business Getting Ideas

There are many ways to put the idea across on a big scale. In a small town, a series of advertisements in the local paper will explain the merits of the idea. Then perhaps a mailing to the entire subscription list of the paper, a government post card with a convenient return card is inexpensive and makes it very easy indeed for any set owner to request a free call.

NOTICE.—Owing to the length of this article it was impossible to get it all in this issue. It will be continued in the next one.—Editor.

Aircraft Radio

By J. A. DOWIE
Chief Instructor

Great strides have been made in the application of Radio to aviation. Safety in flying has been advanced not only by Radio beacons for guidance but by direct communication to and from planes in flight. Radio seems destined to be of even greater service to ships of the air than it has been to ships of the sea.

The success of the army Radio beacons in guiding planes from San Francisco to Honolulu, the communication established by Commander R. E. Byrd in his trans-Atlantic flight, and the Radio established certainty of the location where the ill-fated "Dallas Spirit" and "Old Glory" took to the water are positive proofs of its value. If planes of some of the other unfortunate flyers had been equipped with modern transmitters they, no doubt, would have been rescued.

The all-important thing in any form of navigation is to know at all times the exact position of the craft. What does it profit a man to know that he is steering the correct course if his point of departure is clouded in uncertainty? And how shall he know that the instrument upon which he relies for his direction is functioning accurately? At sea a liner's navigating officer does not depend entirely upon the compass (even though it be a gyro) and his knowledge of drift and leeway, caused by wind and tide, but are continually verifying the estimated position by reference to heavenly bodies and the Radio compass. In the case of a steamer in trans-oceanic service the margin of safety is not a narrow one and even a week's delay will find her with fuel and provisions aplenty. This is in strong contrast to a plane, where a few hours' delay may spell her doom.

One of the most promising aids to safety in flying is the Radio beacon. This system was given its first practical application during the successful flight of the Army plane from San

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A FRIENDLY TALK
with
E. R. HAAS, Director

To Succeed Run Your Affairs on Success Principles

IT IS amazing what can be crowded into 365 days in actual accomplishment—progress and financial success. The success of some men that you read about, and others that you hear about, was acquired so quickly as to make you doubt them even though you know they are facts.

It is not at all unusual for a fellow to suddenly "get the big idea" and forge ahead—double or treble his income in one year. "How is it done?" you will ask. "What is the secret of getting ahead and winning big pay anyway?"

I don't believe there are many secrets about becoming successful. Sometimes there is a certain amount of luck but most of the lucky fellows sooner or later slip back again because there is no assurance that Lady Luck will stay with them.

I believe the best way to be sure of success is to manage your personal affairs along successful business principles—I believe you will really be surprised at the results.

Now let's see just what the average fellow—the fellow working for a salary—has that needs managing. No matter how small his income he has some very valuable assets. There are the 24 hours in every day. It has often been said that "time" is man's most valuable asset—more valuable than money. By managing his time properly he can make himself a success.

The $10,000 or $25,000 a year man doesn't have one minute more in a day in which to earn his money. He has no advantages whatever from the standpoint of the amount of time at his disposal—over the $20 or $30 a week bookkeeper or clerk.

Let us see how a successful business man handles the "time" asset. For example, a Radio factory may have 300 employees (Radio Engineers, Inspectors, Assemblers, et cetera). If the manager puts all of these employees to work taking care of the business at hand without looking ahead to what he shall need next year and the year after, to keeping up with the trend, increase his business—if he uses the full time of all of his men taking care of just this work he would probably do well this year but how about the future? The successful manager does not do that. He will have a certain number of his men giving their time to developing new sets, new circuits, new speakers—finding new markets for his product, carefully watching and satisfying the ever-changing wants of the Radio fan in the way of Radio equipment.

Let me illustrate. There was a time in Radio when a great craze swept the country for long distance receiving. The fellow who pulled in the station from the greatest distance very proudly threw out his chest. This quickly changed, however, to a desire for tone quality. The factories that saw this change coming had men working producing loud speakers and sets capable of giving good tone quality, had the jump on those who used their full time producing sets that would receive over a great distance.

The wise manager will, therefore, invest the time of some of his men in the future of his business. The degree of skill and knowledge applied in producing the products of the company will determine the volume of business and amount of profit for the next year and the years to come.

And so it is with you. The amount of time you give every week, every month to acquiring money-making knowledge; the intensity with which you apply yourself and the extent to which you perfect your knowledge is going to govern the size of your pay envelope next year and for the years to come. In other words, one of the first principles of success is to be continually investing part of your time in what you expect and want to get in the future. Be ready!

Another asset you have is money. Some people say it takes money to make money and it is true that the more money you have, if wisely used, the more you will make, but even the fellow with an average or less than average income can use sound principles in making use of what he gets.

The successful factory manager will be continually investing money in new ideas for getting business, new machinery that will save time and money or produce a better article, salaries of men spent in developing new machinery and new products.

You can use up all your cash establishing a home, for entertainment, or for a dozen and one other things everybody would like to have. There are not very many people whose income is so large that they find trouble spending it all. That isn't the problem—the problem is how much of your income are you going to invest in your future and how are you going to invest it. The wise fellow uses part of his income to buy good books, good courses of training, and in other ways that will perfect him in the line of work that he has chosen for himself.

Now there is an element of speculation in all of this. The right thing to do as pointed out here is to invest part of your time and part of your money in your future success. The extent of the success you enjoy will depend upon "how" you invest it.

The more you know of the line of work you have chosen, what is going on now, what has taken place in the past, the better able you are to forecast the future. In any business, therefore, as in your business of becoming a personal success, you must keep your eye on the future—to see new opportunities for making money. It is not possible to stand still. We are in an age where practically every product manufactured is continually being improved—an age where men are continually perfecting themselves in their chosen line of work. The big thing for you, as for the big men in business, is to be ready to grasp new opportunities as well as be able to recognize them from your knowledge of your line of work.

E. R. Haas

Aircraft Radio

(Continued from page 6)

Francisco to Honolulu. The U. S. Signal Corp engineers installed two Radio beacons, one at San Francisco and the other on the island of Maui, which is south and east of the island of Oahu, where Honolulu is located. The sketch shown in Figure 1 illustrates the method used in guiding the plane.

By means of a 2 K. W. transmitter and two triangular loops supported on a 90 ft. tower each station transmitted the letter N (—.) from the north and the letter A (.—) from the south loop. Consequently, "N" is heard north of the course and "A" south of the course. When the plane is directly on the true course, the two signals merge so that only T (—) is heard. Consequently, when all is working well the pilot or navigator has merely to keep the plane on such a course that they hear only the T (—). If they hear N (—.) they steer to the south until only the T is heard. If they hear the A (.—) they likewise move to the north.

Development of a Radio guiding channel somewhat different to the army system which will enable aviators to keep on a definite course, irrespective of weather or topographical conditions, has been announced by C. F. Jenkins, of Washington, D. C.

The Radio guiding channel is brought about through the installation of a series of Radio transmitting stations at intervals of 25 miles over any given course. These make use of short wavelengths. By the use of vertical antennae the waves are radiated in one direction.

The airplane traversing this route is equipped with a simple receiving device which uses the power from this Radio-energized channel to light a small indicator lamp on the instrument board of the plane. The aviator, by noting the intensity of this lamp, can tell at once when he is not keeping in the channel, for as he gets off the course, the light from the little bulb becomes dimmer. As he returns to the course, the light becomes brighter.

(Continued on page 8)

Aircraft Radio, by J. A. Dowie, Continued

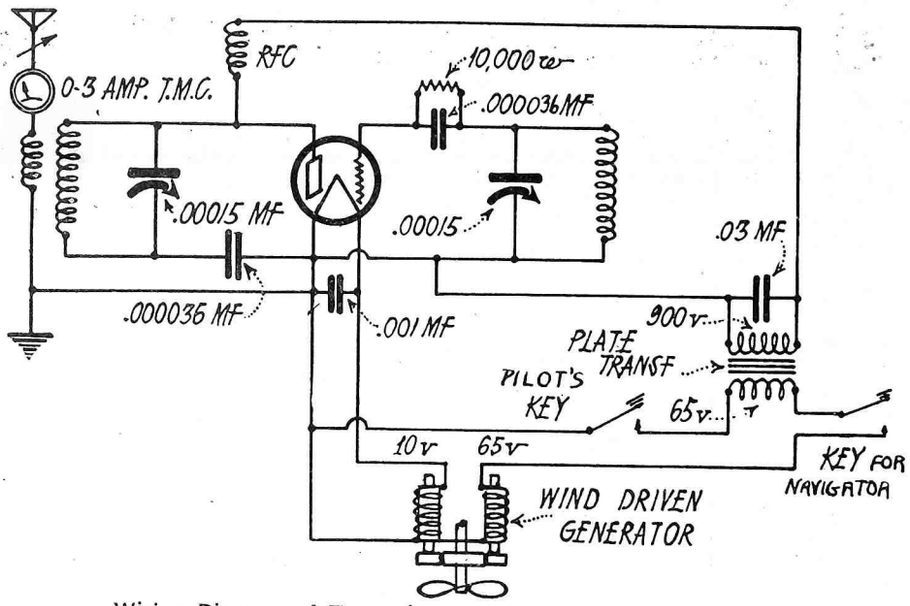
The constant transmission of Radio waves from these stations along the Radio channel makes it unnecessary for the airman to even know the course which he is flying.

"The Radio guiding channel," Mr. Jenkins explained, "is especially suited to commercial or government uses, such as the air mail, where flying must go on through rain, fog, snow and sleet. The present system of beacon lights along the air mail courses serve their purpose well for night flying in clear weather, but when storms come or fog lowers, and from a plane in flight that cannot be reached by other means.

Aircraft Transmitting Apparatus

The early objection to installing Radio apparatus on planes was due to its weight but this has been overcome by the development of short wave equipment which affords many more miles range per pound dead weight.

Short waves have amply demonstrated their ability to span land and sea so that a plane in flight can always be



Wiring Diagram of Transmitter used on "Dallas Spirit" Plane

these are blotted out to a large degree. Then is when the Radio channel guide will be most helpful."

"The advantages of this Radio guiding channel," Mr. Jenkins said, "include the ability to change the direction of the course, so as to take the airplane through mountain passes or other rough ground."

Radio power in the future will replace the gas engine for airplane propulsion, but at the present time it is indispensable for maintaining communication to guided or communicate with its base provided it has the proper Radio equipment installed.

Figure 2 shows the Radio Transmitter and the generator before being installed on the "Dallas Spirit." The transmitter was of the fixed tuning type, adjusted to 33.1 meters, the tuning condenser being adjusted permanently. The antenna system consisted of the frame of the plane as a counterpoise, and a 28 ft. wire reeled out with a lead weight

(Continued on page 9)

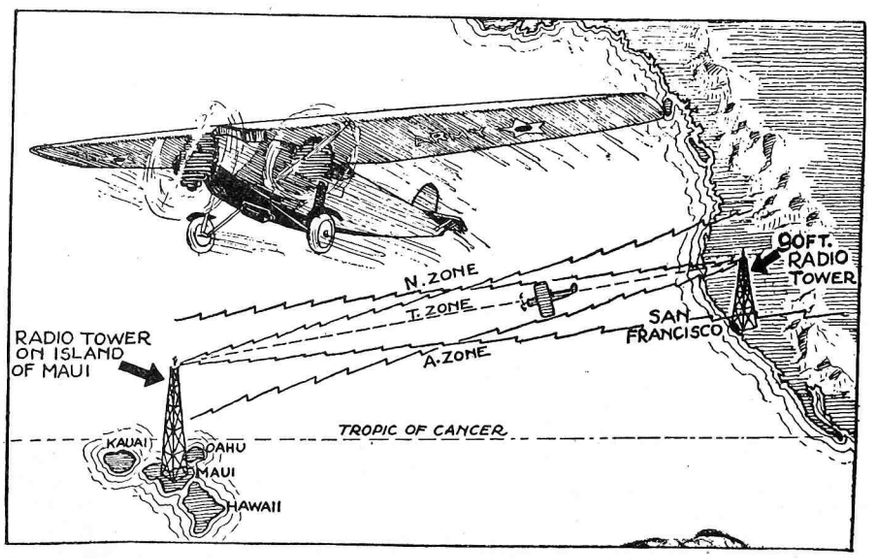


Fig. 1—Sketch showing method of guiding the U. S. Army Plane from San Francisco to Hawaii

Craze for Distance Turning to Quality of Reproduction

Continued from page 3

though this is a very reliable means of controlling the volume, it usually results in a certain amount of loss of the high frequency currents impressed upon the grid.

In some cases, this resistance results in the elimination of extraneous high frequency noises and the reproduction of unnaturally low tones which to some ears are very pleasing, but neither the capacity nor the resistance shunted across the secondary tend to promote high quality reproduction.

Impedance Coupling

The impedance capacity coupled audio frequency amplifier is somewhat of an improvement over the transformer type and it is necessary to observe the same conditions in this type of amplifier as in the transformer coupled type. It would be well to mention here that the impedance type of audio amplifier should never be used with the high mu type of tube on account of the high output impedance of this class of tube. For example, when using a high mu tube having an output impedance close to 50,000 ohms, it would be necessary to use a 300 henry inductance in the plate circuit in order to amplify a 50 cycle note properly. Of course, this size inductance is entirely out of the question and several cases of distortion have been traced to the fact that high mu tubes are used in the impedance coupled type of amplifier.

Whatever frequency distortion takes place in the impedance coupled amplifier is generally in the form of reducing the low frequency currents. The main points to be observed in this type of amplifier are to have a large plate inductance, a sufficiently large capacity for a stopping condenser and a large value of grid leak resistance.

Resistance Coupling

The resistance capacity coupled type of amplifier very nearly approaches the ideal in that it is more nearly an all frequency type of amplifier. However, it possesses several inherent characteristics which are not desirable. If the capacity of the stopping condensers is large enough and the resistance of the grid leaks is properly chosen, the low notes will be amplified well and the high frequency notes are seldom cut off. In some cases, the grids of the tubes may be caused to block on account of high input voltages but this seldom occurs, if the values of the component are properly chosen. Some high frequency distortion does occur in the radio frequency amplifier which is usually attributable to having too large a capacity of condenser inserted in the plate circuit acting as a by-pass condenser. In the resistance capacity coupled amplifier, it is well to choose the value of the capacity of this condenser with care and in most cases, this condenser should be much smaller than when used with the other types of audio frequency amplifiers. If a by-pass condenser and a radio frequency choke is used in the detector

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Aircraft Radio, by J. A. Dowie, Continued

(called lead "fish") on the end of the wire.

The generator was a special Aladdin-Duplex type having two armatures, one for 10 volts, 240 cycles, to light the filament of the UV-203A tube, and the other for 65 volts, 240 cycles to supply the plate transformer which had a 65-volt primary winding and a 900 volt secondary. The generator was driven by an 18-inch propellor, and was mounted on the forward edge of the fuselage in the slip-stream so that at normal speed of the plane, around 100 miles an hour, the frequency of the generator would be 240 cycles. The generator was self-regulating as to voltage.

Keying was accomplished in the primary of the power transformer, two transmitting keys being used, one in the forward cockpit for the pilot, and the other in the rear compartment, where the navigator had his charts.

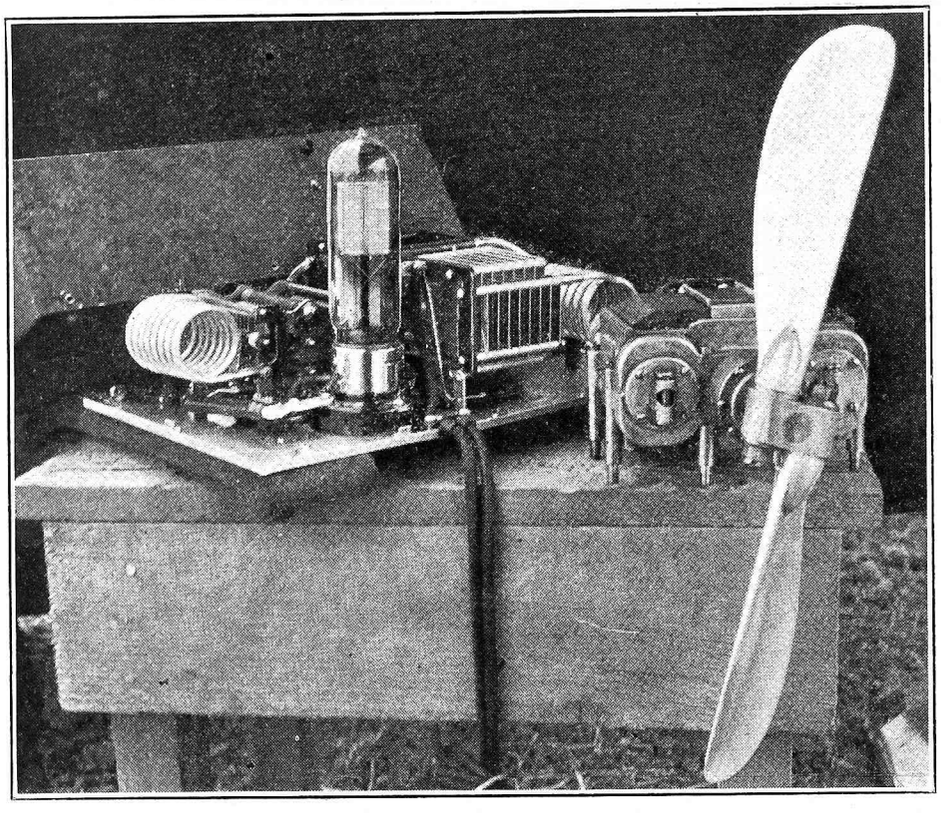

Figure 2—Radio Transmitter and Generator used on the plane "Dallas Spirit"

The keys were kept closed on the plane when no messages were to be transmitted, so that the listeners heard a continuous 240-cycle note. When the tail spin ended the flight in tragedy, the whine of the generator rose to above 500 cycles, indicating that the plane was going at a rate of over 200 miles an hour.

The wiring diagram of this transmitter is shown on page 8.

Aircraft Radio Compass

It is true that at present there is no Radio compass available which is particularly adaptable to aircraft use but the writer can see no technical or other barriers which should prohibit its development in that field to a degree of perfection equal to the marine Radio compass. The use of short waves in this particular field makes possible not only the taking of bearings over enormous distances and low cost of beacon installations, but permits of great conservation of space aboard the plane due to the small physical dimensions of the separate compass parts themselves. Two fixed loops—which need not be more than a foot on a side—set at an angle of ninety degrees to each other and so that each makes an angle of forty-five degrees with the line of flight would form the compass installation proper.

The small size of the loops would permit their being housed inside the wing of a thick-wing monoplane—which seems to be the ultimate in airplane design. Detectors and amplifiers of conventional design might be used to boost the received signal sufficiently to operate an indicating instrument which, so long as the signal received in both loops was equal in intensity (which would mean that the beacon station was dead ahead) would remain in the center of its scale. As soon as the plane would yaw to one side or the other one loop would pick up a greater voltage than the other and cause a corresponding deflection of the indicator. Navigation would then become merely a question of keeping an eye on the indicator.

The task of development is a huge one. The economic angle need not enter into the problem for individual compass installations can be built at a cost below the excellent earth inductor compass and governments would certainly erect beacon stations as they do at present for the marine voyager.

In addition to the equipment just described a secondary rotable loop might

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Craze for Distance Turning to Quality of Reproduction

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plate circuit, the capacity of this by-pass condenser should be considerably lower than when using the transformer coupled type of amplifier.

Motor Boating

Considerable difficulty is experienced with motor boating in the resistance capacity amplifier and especially so if a "B" eliminator is used in which a common impedance is used in the plate circuit of each of the audio frequency amplifiers. This difficulty in most cases can be eliminated by properly choosing the value of the by-pass condensers and using a special regulator tube so as to keep the voltage supplied to the plate, grid and filament constant in all cases.

Power Tubes

By the use of power tubes, a considerable amount of distortion usually found in the audio frequency amplifier can be eliminated. Owing to the fact that the last audio frequency tube is required to handle large grid swings, it is very necessary that power tubes of the correct size be incorporated in a high quality amplifier. When using a power tube, the proper grid voltage must be applied to the grid of the power tube, or wave form distortion will occur. If the voltage applied to the grid of the power tube is sufficient to cause the grid to become positive with respect to the filament, non-linear amplification will result and it is always well to take this fact into consideration when choosing a power tube. There are at the present time a variety of power tubes on the market and it is possible to choose a power tube which will allow a sufficient grid swing and grid bias so as to prevent this form of distortion.

It is important when using power tubes to see that the load impedance into which the power tube works is sufficient to allow the amplification and passing of the low audio frequency notes. Sometimes, it is necessary to load the output of a power tube so as to allow the passage of these low frequency notes. Also, whenever a low note passes through a power tube working at normal rating, low frequency harmonics are generated and the generation of these low frequency harmonics must be kept at a very low value or else serious distortion will occur.

Push-Pull Amplification

The push-pull type of amplifier prevents to a certain extent the generation of distorting harmonics, and wherever the power supply limits the amount of plate voltage obtainable, this type of amplifier is very satisfactory. In fact, no other type of audio amplifier will give quite the results that the push-pull type will when using low plate voltages. For power amplification, the push-pull system offers the advantage that the output transformer core never becomes saturated by direct currents flowing to the plate of the tube. While distortion can arise from this source, it is seldom present except in very large power am-

(Continued on page 10)

Aircraft Radio

(Continued from page 9)

be used to obtain cross bearings on other beacons or stations of known location and the plane's position checked with absolute accuracy in a moment's time.

Aside from the obvious advantages of navigation by means of the Radio compass the system possesses an even greater merit which alone should entitle it to serious consideration. On account of the very nature of Radio waves, a plane holding a course for a Radio beacon would, of necessity, have to follow a great circle.

Whether or not the Radio compass shall be entrusted with the responsibility of safely guiding planes across the oceans only the passage of time can tell, but Radio is sure of at least one task which shall be its own—communication. It is only a question of a very short while before Government regulation will require Radio equipment operators on ocean-flying planes. An aircraft Radio installation must be capable of operation whether the plane be in flight or not. Its antenna must be so located that a forced landing even at sea shall not interfere with it. Trailing wires are taboo. An antenna system concealed within the wings or fuselage or strung from wing tip to stabilizer may be the solution. The use of tube transmitters and the relatively low voltages necessary to operate them banishes many problems of insulation. Air fan generators may be used as a source of power to operate the transmitter but an emergency source of power must be available—possibly in the form of a hand-driven generator. Suitable Radio equipment is already in existence and nearly any amateur operator of experience could assemble a first-rate station for aircraft use.

Two N. R. I. Students get newspaper Publicity

Continued from page 2

and radio signals were constantly picked up from as far away as Washington, D. C. The superheterodyne set demonstrated last night, and constructed at the newly opened plant, retails for $173.95, but neutrodyne sets, without aerials or loud speakers, are kept in stock and sell for as low as fifty dollars, said Mr. Young.

NOTICE

The Editor wants more students and graduates to send in newspaper and magazine clippings of interest—articles about themselves and the work they are doing or that deal with Radio and its progress and future, original jokes, cartoons (undoubtedly some of our students have drawing talent), any items that you think would interest other students. Address them to the Editor, National Radio News, National Radio Institute, Washington, D. C. The Editor would soon like to build up a Students' Department devoted entirely to news items, cartoons, jokes and other material sent in by students and graduates. Another thing, tell us how National Radio News impresses you, what we can do to improve it. It's your paper, you know, and we want to write it to suit you.

Marconi Looks into the Future

Continued from page 1

munication with the sixteen-meter waves.

"How the waves travel around the earth is another question. We used to say they traveled through ether, but now science is discarding the ether theory.

"Another mystery is just how the position and altitude of the sun affects the Radio waves. While we have found that the very short waves are received better by day and in the summer than at night or in winter, we have also found that in long-distance transmission the waves prefer the route which is the least exposed to the sun. In the morning they travel southwestward 14,000 miles from England to Melbourne, in the afternoon they go the other way—only 10,000 miles.

"Another problem is that of skip-distances. Nobody has yet discovered why at one point reception may be perfect while at another point in precisely the same line the waves are not perceptible at all. Some day some radio experimenter will find the reason and the remedy.

"I think the possibilities of the directed short waves are only now beginning to be realized. For the last ten years I have confined my researches to this field, and while the results have been very great, there are even greater possibilities ahead.

"One advantage is the small amount of power required. We use only twenty kilowatts for communications between England and Australia."

What of the application of short waves to broadcasting?

"There are great possibilities, and I look for important results from the experiments being made at station WGY, at Schenectady, with the five-meter waves. At present the value of the short waves in broadcasting is in hooking up distant stations. We can use the reflected short-wave beam for telephony with great economy and splendid results, the same waves carrying telegrams and voice waves. It will be easily possible to hook up the United States with any other part of the world where the short-wave beam system is in operation.

"Incidentally, the new short-wave beam stations just erected on Long Island will, I expect, shortly have the effect of greatly reducing the cost of telephone conversation across the Atlantic."

"What other advances in Radio do you look for?" he was asked.

"I think it certain that there will be great improvements in the vacuum tubes for detecting and amplifying signals," he said, "although the present tubes are a great advance over the primitive coherer."

"In the light of the experience of twenty-five years, have you no predictions to compare with those you made years ago, and which have since come true?" he was further asked.

"From my limited point of view, I should say that the developments in which the directed short wave will play an important part will lie in the fields of direction finding for ships and aircraft, in the control of mechanism at a distance, in the facsimile transmission of messages and pictures over long distances, in television, and in the transmission of power. They may render solar observations and the magnetic compass obsolete.

"America is already far ahead of the rest of the world in the control of mechanism by Radio, for which the beam system is peculiarly adapted. Boats, aircraft, machines, all may be set in motion, directed and stopped by Radio. It is conceivable that a radio wave originating in America may start and stop the wheels of industry in South Africa or Siberia."

Craze for Distance Turning to Quality of Reproduction

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plifiers. By using some of the coupling devices now on the market, this type of distortion can be eliminated when using other than the push-pull type of audio frequency amplification.

The Loudspeaker

The reproducing unit is the final link and too much cannot be said about the quality of this instrument. All the advantages gained by using good design throughout the receiver can be nullified by trying to reproduce high quality amplification on a low quality reproducing unit. It often happens that when a high quality loudspeaker is used in connection with a low quality amplifier, the reproduction is much more natural than when a low quality reproducing unit is used in connection with a high quality amplifying unit.

As very little distortion occurs in the loudspeaker which can be corrected without changing the fundamental design of the loud-speaker, very little can be said along this line except that this point must be taken into consideration when purchasing the unit. High quality reproduction from a horn type speaker depends largely upon the unit behind the horn, the diaphragm, and the design of the horn. Horn type speakers as a general rule reproduce the high notes better than the low notes, while in the cone speaker, the low notes are generally reproduced better than the high notes. Some cone speakers discriminate very badly against the high tones.

The electro-dynamic type of loudspeaker using a small stiff cone more nearly approaches the ideal sound reproducer than any of the other types so far developed. The initial cost of this type of speaker prevents its general adaption.

Recent Vacuum Tube Developments

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the morning and be able to say the next day: "I got Hongkong."

At the present time there is a big demand for converting battery operated sets into A. C. sets using A. C. tubes. This latest tube development will create another and wider demand for set changes so that the Radio service man now has more opportunities than ever to improve receiving sets.