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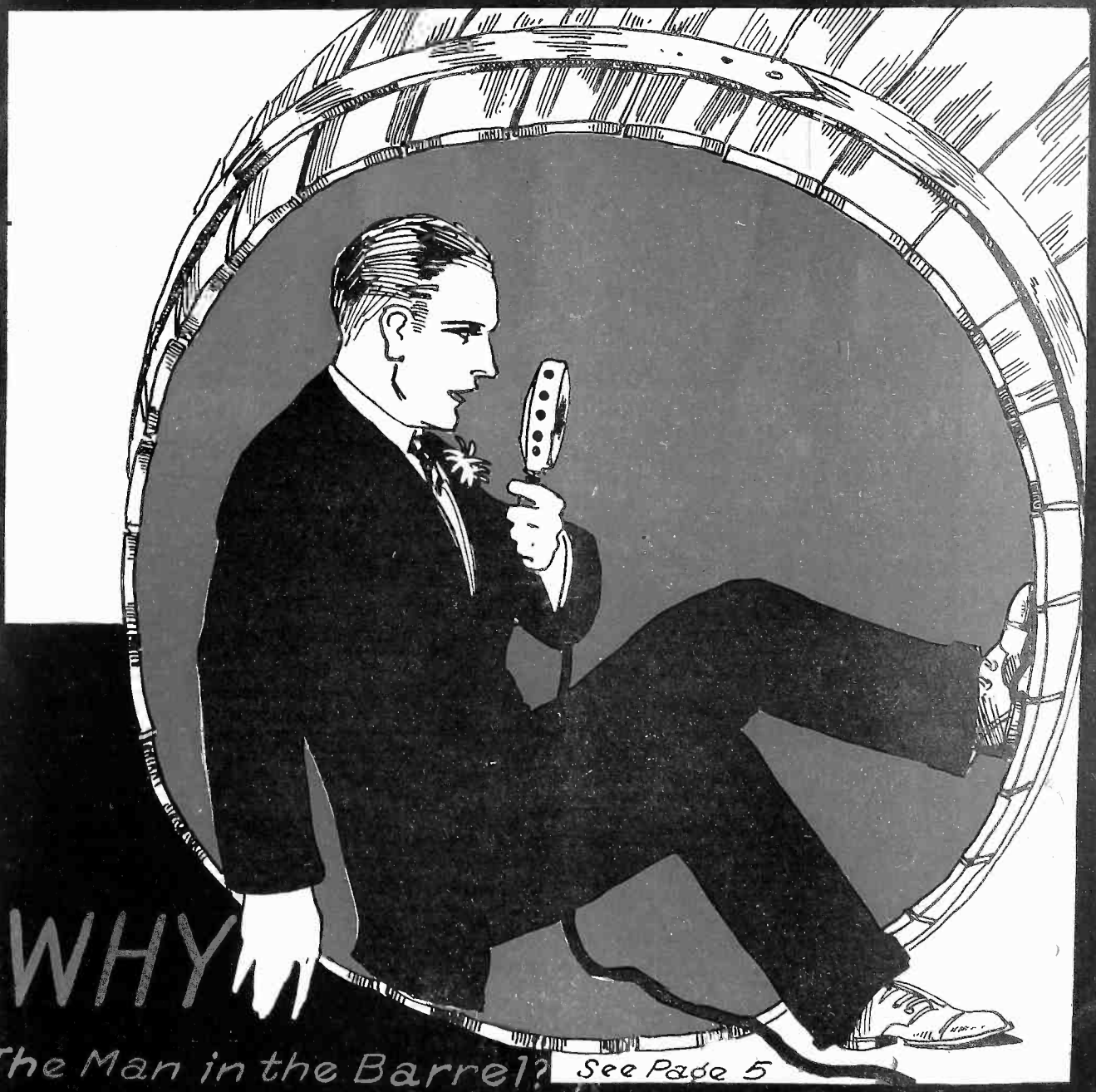

WHY

The Man in the Barrel?

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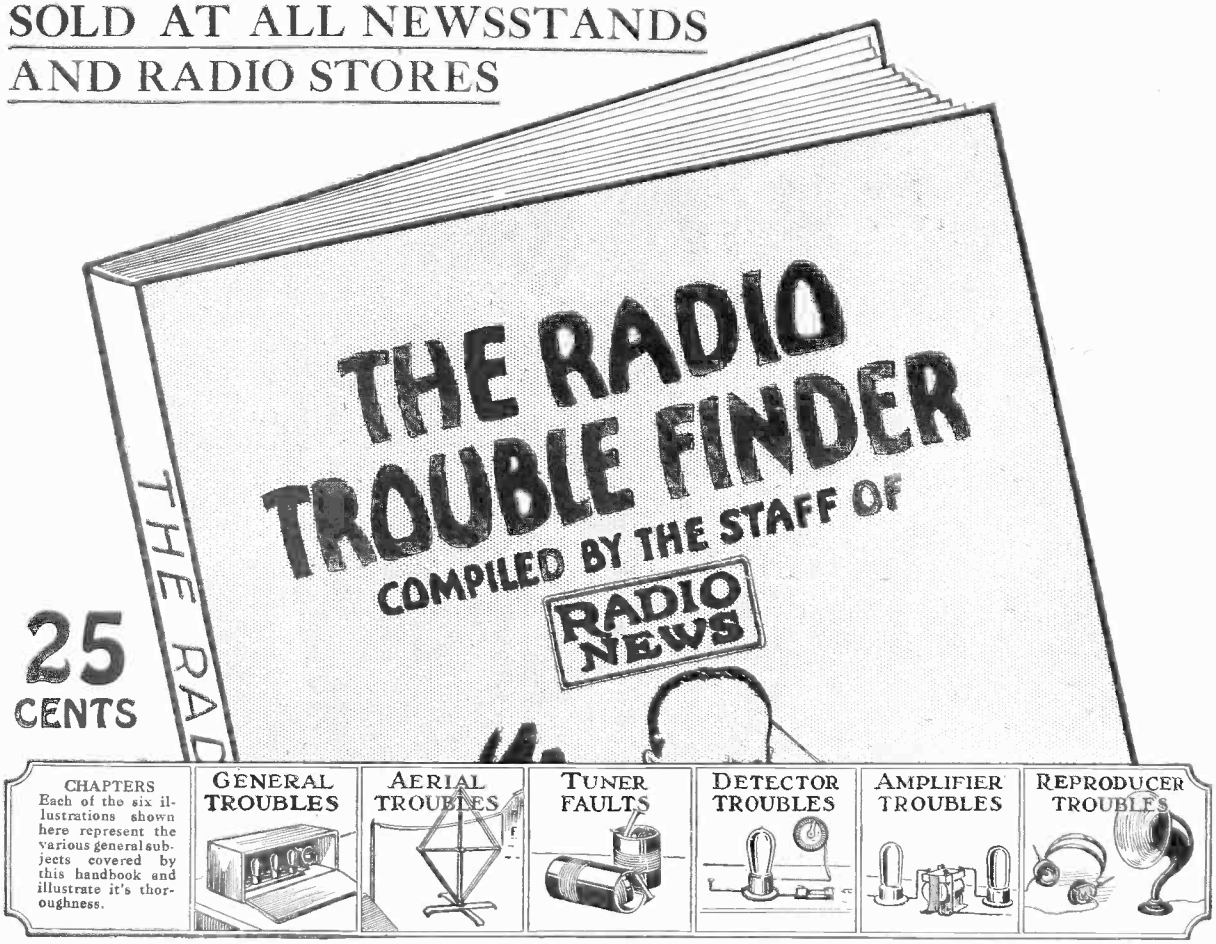

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SIXTH YEAR

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FACTS *Every Real Experimenter* Must Know

By J. E. Anderson
Consulting Engineer
Associate Institute of Radio Engineers

RADIO is a branch of electrical science and that in turn is a branch of the science of physics. Physics is an exact science, and that means that its principles may be expressed accurately by mathematical formulas and by numbers. What is true of physics as a whole is true of any of its branches, provided that the branches have been developed thoroughly. Since radio is a branch of physics, any discussion of radio must necessarily include a great deal of mathematics. In fact, before any complete understanding of radio can be achieved it is necessary to have a fair knowledge of mathematics. A person's possible attainment in radio is directly proportional to his proficiency in mathematcs.

In pseudo-engineering circles it is quite common to sneer at theory. One often hears that theory and experience are at variance and that for this reason it is a waste of time to learn the theory. This is a fallacy of the most vicious sort. Only those sneer at theory who are incapable of generalizations. Theory cannot be at variance with true experience, not for any length of time at least, for theory is nothing but crystallized experience. As soon as one definitely established fact contradicts a theory, that theory is discarded and some other theory is substituted. The new theory must not only be in agreement with all the old facts that the old theory explained but it must also be completely in accord with the new fact which overthrew the old.

Sneer Analyzed

When persons sneer at a theory they merely say that all the experimental investigators in the past were incompetents. They commit the spirits of Faraday, Kelvin, Henry, Ohm, Ampere, Volta, Newton and others to an asylum, and they do it for the simple reason that they do not understand what these illustrious scientists did. Let us repeat that theory cannot be at variance with experience because theory is the essence of experience, tested, refined, criticized, purified and amended up to date.

It is true that the experimental results obtained by a few investigators do not agree with the theory as it stands. Sometimes this is due to an incompleteness of the theory but in the great majority of cases it is due to errors committed by the experimentor himself. You have all heard the statement that "figures do not lie", which is quite true, but that does not prevent errors in the figuring. Many "liars do figure", just as many unqualified experimenters theorize.

Both theory and mathematics are to be used as tools in investigations. Neither tool is infallible per se and each must be handled by a skillful workman.

Knowledge Spares Folly

A radio investigator who can use mathematics as a tool and who understands the theory of this subject will save many hours of work. If he knows the theory he will know what others before him have done and the conclusions that they have reached. He will thus be saved from starting out on many hopeless researches. If he knows both the theory and the mathematics he will be able to predict what he probably will get and what he cannot expect.

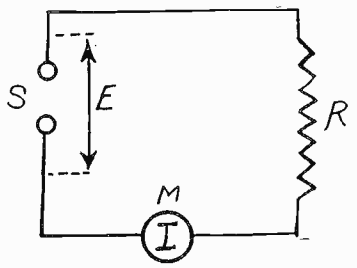


FIG. 1
Circuit illustrating the application of Ohm's law

With this brief defense of theory and mathematics let us proceed with a few of the facts that the radio experimenter should know.

Perhaps the first thing that the experimenter should master is Ohm's law, not because this comes first chronologically but because he will have the greatest use of it. Ohm's law as applied to direct current circuits is simply that the voltage drop in any resistance is directly proportional to the current flowing through that resistance. Another an equivalent statement of the law is that the voltage drop in a resistance is the product of the resistance and the current flowing through that resistance. This is theory, but there is no one fact in electrical science which has been more definitely established. It is the result of the discovery of George Ohm, and it has been confirmed by countless experiments.

Stated mathematically Ohm's law takes the simple form E=RI, where E is the voltage drop in the resistance R when current I flows through the resistance. If the resistance is measured in ohms and the current is measured in amperes, the voltage is expressed in volts. The last statement might seem unnecessary but it must be remembered that volts, ohms and amperes are not the only electricalunits in use, although they are the only practical units employed.

What can be done with Ohm's law? Many things indeed. Since the law connects three electrical quantities in a definite manner, any one of them can be found if the two others are known. Thus we only need to measure two of them to know all three. Let us consider a few practical examples. In Fig. 1 we have a voltage source S, which may be a battery or a generator. In series with this source of voltage is connected a load resistance R and an ammeter M. Now suppose that we know that the voltage E of the source S is 110 volts and that the current as indicated by the ammeter is 2 amperes. What is the value in ohms of the resistance R? We have by Ohm's law that 110=2R, and therefore R=110/2 or 55 ohms.

Finding the Current

Again, we may have a known voltage and a known resistance and desire to know how much current will flow through the resistance when this is connected in series with the known voltage. We may not have an ammeter handy to measure the current. Well, suppose that the voltage again is 110 volts and that the known resistance is 550 ohms. What current will flow? We have 110=550×1. Dividing through by 550 shows that the current I=0.2 ampere. Again, suppose that we do not know what the voltage is but that we do know the resistance and the current. We may put a resistance of 100 ohms in series with the unknown voltage and find from the ammeter that the current is 1.25 amperes. We then have E=1.25×100, or the voltage is 125 volts.

Another example may be of interest. Recently I was in search of a resistor of 20 ohms which could carry a heavy current. The clerk in the store I visited had nothing but a 20-ohm radio rheostat, which was not wound with heavy enough wire to meet the requirement. But there was a heating element designed for a 660 watt heater. Would that meet the requirements? The wire was heavy enough but it remained to determine whether the resistance was close enough to 20 ohms. I happened to have an ammeter and a 4½-volt battery in my pocket. Arranging the circuit shown in Fig. 1, putting the battery in place of S, the current was found to be 0.2 ampere. By Ohm's law then, 4½=0.2R. Dividing through by 0.2 gives a resistance of 22.5 ohms, a value close enough to the required resistance.

If a voltmeter and an ammeter are both available, Ohm's law may be used for determining almost any resistance in the manner in which the above was obtained. The accuracy of the determination depend on the accuracy of the two meters,

FACTS discussed in this ARTICLE

(1) Radio is a branch of electrical science and of physics.

(2) Theory is the essence of experience, tested, criticized and amended to date.

(3) Theory and mathematics are tools with which real experimenters must work.

(4) Ohm's law.

(5) Relationship between frequency, inductance and capacity in a tuned circuit.

(6) The principle of conservation of energy.

(7) Relationship between wavelength, frequency and velocity of propagation of wave motion, with special reference to radio and sound.

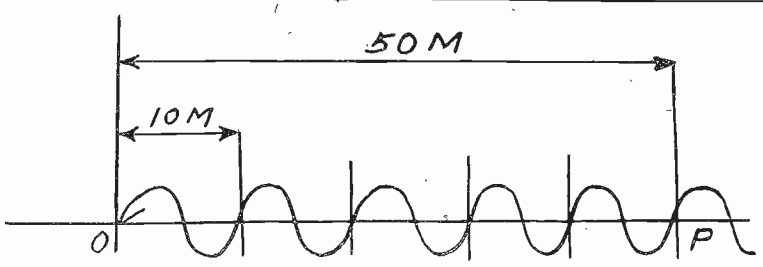


FIG. 2

The velocity of propagation of a wave motion is the product of the length of each wave and the number of waves that pass a given point in one second.

which usually is sufficient for all practical purposes.

Another fact that the radio experimenter should know is the relation between frequency, inductance and capacity when a circuit is in tune. When the circuit is driven, as it is in all radio receivers, this relation is $F=\frac{1}{2\pi\sqrt{LC}}$, or the frequency F is obtained by taking the reciprocal of the quantity $2\pi\sqrt{LC}$, where L is the inductance in the circuit in henrys and C is the capacity in farads. The number 2π is a constant, 6.2832. This formula is used every time that a tuned circuit is designed, and from it any one of the quantities may be obtained if the other two are known.

When we are dealing with radio frequencies it is more convenient to use microhenrys instead of henrys, and microfarads instead of farads. When the above formula is expressed in these units it becomes $F=\frac{1{,}000{,}000}{2\pi\sqrt{LC}}$, or the frequency in cycles per second is obtained by dividing one million by the quantity $2\pi\sqrt{LC}$. Suppose, for example, that we wish to know what the resonance frequency is of a circuit the induction of which is 200 microhenrys and the capacity is .0005 microfarads. The product of the inductance and the capacity then is $200\times.0005=0.1$. The square root of this is 0.316. This is multiplied by 6.2832, which gives 1.986, or about 2. One million divided by 2 is 500,000, which is the frequency of resonance of the circuit in question.

If we wish to know what the inductance should be to tune a circuit to 550,000 cycles with maximum value of capacity equal to .0005 microfarads, the process is inverted. Substitution of the known values and simplifying the formula gives as the required inductance as nearly 153 microhenrys.

Application to AF

It may be more instructive to use the formula at audio frequencies. Suppose that the inductance is 10 henrys and that the capacity is 10 microfarads. The product of these two, expressed in henrys and farads, is .0001. The square root of this number is .01. And 6.2832 times .01 equals 0.062832 the reciprocal of which is 1/.062832 or 15.9 cycles. This frequency is very low but is audible to most persons.

Another fact that the radio experimenter should know is the principle of conservation of energy. Let no one be cowed by the high-brow tenor of this expression. It is of far-reaching importance but it is quite easy to understand. In the simplest terms it means that no one can get anything for nothing. More accurately it means that energy cannot be destroyed nor created. Energy may be transformed from one form to another, but in the transformation no energy is lost and none is created. It is true that some of the energy may be lost to practical use, that is, during the transformation of energy from one form to another, part of it may go into a form which we can not utilize for our present purpose. Although some of the energy slips away from us in this manner no energy is ever created during a transformation.

Examples of transformation of energy will help to understand what is meant. Energy may exist in the form of electricity, of magnetism, of heat, of light, of sound, of motion, of stresses, or position, or chemical composition. All of these various forms of energy can be classed as either kinetic or potential, or combinations of these two. Electric may be changed into magnetic energy, or into any of the other forms listed above. Or a certain quantity of one of them may be changed into several of the other forms in various proportions, but the sum of the partials is always equal to the original quantity.

When we generate electricity from a waterfall many transformations of energy occurs. Energy first exists in the form of potential energy, or energy of position, then at the bottom of the falls it is kinetic, or energy of motion. Then it is converted into electro-magnetic energy. Suppose we use this energy to charge a storage battery. It then becomes chemical. Upon discharge of the battery it may go into motion or heat. When we heat filaments with the energy all goes into heat. During all these transformations there is some that slips through our fingers and which cannot be used. It all goes into heat.

The practical value of knowing the principle of conservation of energy lies in avoiding foolish experiments. No one appreciating this principle will waste any time playing with perpetual motion contraptions. He knows before he starts that the task is hopeless.

Why It Is Foolish

In his machine, no matter what the form of it may be, he must put in at least as much energy as he expects to take out, becuse his machine cannot create any energy. If he appreciates the principle he will also be prepared to put in more energy than he expects to take out, because he knows that some of the energy he puts in will go to overcome friction or to supply the portion which is inevitably changed into unavailable forms. He will spend his time and knowledge in keeping the energy leaks down to a minimum and thus to make his machine as efficient as possible. That is the main problem of the engineer, and he has a big problem.

The man who understands the principle of conservation of energy will also recognize immediately any proposals which would depend on perpetual motion, or which would demand the creation of energy. For example, he will not entertain any thoughts of making crystal amplifiers which will operate without batteries or power driven generators of electric current.

After having read all this about conserving energy the reader would probably like to know just what energy is. The writer would. He would also like to know what life is. One is probably a form of the other. Some might take this opportunity of observing that life may be destroyed, whereas above it was stated that energy cannot be destroyed. If life is a form of energy it cannot be destroyed, it can only be transformed into some other form of energy.

Components of Energy

In the scientific system of units energy is not a fundamental quantity, but is made up of other elements, but that is only in our arbitrary system of measurements In this system time, mass and length are taken as the three fundamental quantities. Every other physical quantity may be expressed in terms of these three units. Energy in this system is a force times a length. Force is not one of the three basic quantities, but is a mass times an acceleration. Acceleration in turn is a length divided by the square of a time. So that energy in our system of units is a mass, a length squared and a time squared, or in symbols it is ML^2/T^2. That expression does not tell us what energy is. It merely tells us how it is related to mass, time and length. Life may have the same relationship to these three basic conceptions. If it does, life is energy.

How is life connected with radio anyway? Well, anybody who expects to get anywhere in radio research must be fully alive. He must have a lot of vital and mental energy.

Relationship of W F and V

A very useful relationship that the radio experimenters should know is the connection between wavelength, frequency and velocity of propagation of the wave. This relation is $WF=V$ where W is the wavelength, F the frequency in cycles, and V the velocity of propagation of the wave motion. This relationship may be proved very easily. Suppose that the length of the wave is 10 meters and that five waves pass a given point every second. The length of the five waves is evidently 50 meters.

At the end of a given second the beginning of the first wave is then just 50 meters away from the point taken as reference point. Hence the wave motion traveled just 50 meters in a second. Since velocity is the distance that a moving body travels in a unit of time it is clear that the velocity of the wave motion in this case is 50 meters per second. That is, the velocity of a wave motion is the product of the length of each wave by the number of waves that pass a given point in a unit of time. The velocity and the frequency must of course be measured in the same unit of time, so that if the frequency is measured in seconds the velocity is also in seconds.

The velocity of a radio wave is the same as the velocity of light, which is very nearly equal to 300,000,000 meters per second (186,000 miles).

Frequency Conversion

The relation $V=WF$ may be used by the radio experimenter in converting wavelength to frequency. For example, if the wavelength of a radio wave is 1,000 meters. Therefore the frequency of the wave? The velocity is 300,000,000 meters per second and the wavelength is 1,000 meters. Therefore the frequency of the wave motion is 300,000 cycles per second, obtained by dividing the velocity in meters per second by the length of a wave in meters.

The relation between velocity, wavelength and frequency is not confined to radio waves but applies to all wave motion. For example, it applies to sound waves in air. The velocity of sound in air is 332 meters per second at zero degrees centigrade and increases at the rate of 60 cm. per second for each degree increase in temperature. Thus at room temperature, which is about 20 degrees centigrade, the velocity of a sound wave is about 344 meters per second. This relationship is sometimes useful in connection with radio in designing loud speaker horns and cone speakers, and also in placing loud speakers so as to minimize singing

(*Concluded on page 7*)

Why the Man in the Barrel?

Nearly Always Too Much Resonance

By Capt. Peter V. O'Rourke

WE sometimes hear the expression that the radio sounds as if someone were talking in a barrel. Persumably everybody at some time or another has talked into a barrel or some similar cavity and noticed the boominess of the sound that is heard. The person speaking does not hear the sound that went into the barrel at all, but a sound very much distorted. It sounds boomy or hollow. It is not necessary actually to talk into the barrel or cavity to hear the boominess. It is sufficient to clap the hands or make some other noise near the opening of the barrel. If there is just a little hole in the side or end of the barrel and if one blows across this hole the boominess may be heard. Why does it boom and why do some radio sets sound as if someone were talking into a barrel?

Before answering that let us mention the Helmholz resonator. This is simply a hollow sphere with a single small hole on the side. There is a little neck attached to this hole and the neck projects out. If a person places his ear near this opening without actually closing the aperture, he will hear a characteristic sound of definite pitch which depends on the physical dimensions of the cavity. To hear this sound it is not necessary to have a whistle generating this tone in the room, but there must be present a certain amount of noise of heterogeneous composition. The greater the amount of noise in the room the louder will be the tone heard in the resonator. Also the larger the cavity of the resonator the lower will be the pitch of the tone heard. If the cavity is very large the sound will be a low rumble. Similar phenomena may be observed by placing the ear near the mouth of a bottle, or near the hole in a barrel, or against a sea shell.

The Barrel is Selective

What causes the noise that is heard? Apparently the noise. But what causes the definite pitch that is heard when no such tone can be heard in the air without listening in front of the hole? It is caused by resonance. Just as a tuned circuit in a radio receiver selects one particular frequency and rejects all others, so a cavity enclosing air selects one sound frequency and rejects all others. The ear hears only that which is selected. This sound is intensified by resonance.

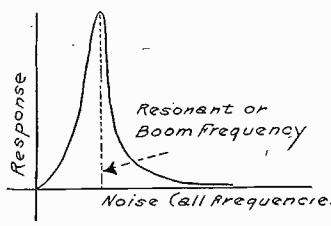


FIG. 1
How too much selectivity cuts off the higher levels of the modulation, causing hollowness of sound.

The similarity between Helmholz resonators and musical instruments is very close. An organ pipe is a long cavity with a small opening at one end. Woodwinds and brasses are similar except as to physical dimensions. When playing, the pitch to which the cavity responds is changed by changing the length of the cavity or by exciting a cavity of different length. Even the stringed instruments have their air cavity with a small opening near the point where the sound is produced, although in this case the cavity is not a true resonator.

Sometimes in broadcasting the studio forms a resonator which seriously affects the pickup of the microphones. The effect is called echo, which is a special type of resonance. This effect often causes blasting of the signal, which is erroneously attributed to the receiver. Even a small part of a studio may form the resonant cavity which might cause trouble.

Magnification by Resonance

For example, if the microphone is placed near the opening of an alcove, the natural frequency of this cavity may be intensified and thus cause distortion. In certain auditoriums the acoustics are very bad. It is almost impossible to understand a speaker, particularly when the hall is empty or nearly so. This is also caused by the barrel effect or by resonance. Certain tones are magnified by resonance to such an extent that all others are lost in comparison.

Nearly all horn reproducers pick out one or two frequencies and magnify them by resonance to the detriment of quality. Even cone speakers have their resonance effects. One well-known cone has the general shape of a Helmholz resonator, having a hole in the back but otherwise being enclosed. A resonance peak from this effect can be expected, but it would not be a boomy tone, because of the short dimension of the speaker. Also it has another natural frequency which is caused by the mass of the moving system and the stiffness of the paper structure. This is a rather low tone, because the stiffness of the paper is not very great, while the moving system is somewhat heavy. This would tend to make the output boomy, but the frequency of this tone is not low enough to make the output objectionably boomy.

But if that is combined with electrical resonance of about the same frequency then the boominess might become quite severe. This often happens where the speaker is not well matched to the circuit feeding it.

Over-Selectivity

Another source of boominess in the output of a radio receiver is super-selectiveness. If the set is made too much regenerative and if the tuning is made too sharp, only the low tones come through, the higher one being cut off in the tuning. This causes very severe boominess, but fortunately it is encountered principally in the reception of distant and weak stations.

Too large capacity condenser across the speaker terminals has about the same boomy effect.

[Other illustration on front cover]

Licenses Are Extended for Ships and Amateurs

After its first official meeting the newly created Federal Radio Commission issued a statement announcing that it had extended indefinitely all radio amateur and ship licenses.

The Commission later held public hearings in Washington after having called on the radio industry and the listening public to aid in the work of fact-finding which the Commission regards as vital to completing its work properly.

Subjects to be considered at the hearings were: widening the broadcasting band, limitation of power, reducing frequency separation, simultaneous broadcasting with same frequency, time division, consolidation of broadcasting service and limiting the number of stations.

The text of the announcement follows:

"The Federal Radio Commission, an independent branch of the Federal Government, held its first formal meeting on call of the chairman, Rear Admiral William H. Bullard. The chairman was unable to be present, but sent a call for the meeting by radio and cable from China.

"For the purpose of effecting immediate organization, the Commission elected Judge Eugene O. Sykes, of Mississippi, as vice chairman. Other members of the Commission present were O. H. Caldwell, New York; H. H. Bellows, Minnesota, and J. F. Dillon, California

"There has been some question in the public mind as to whether the Federal Radio Commission would be able to function owing to the failure of the Second Deficiency Bill to pass the 69th Congress. The Commission will undoubtedly be handicapped, due to lack of funds, and particularly in the matter of personnel, will be unable to establish such a staff as is contemplated in the radio law, on account of inability to pay salaries.

"On the other hand, thanks to the courtesy and consideration of other departments of the Government, the Commission expects to be able to function with reasonable efficiency, and to perform the most important of its tasks without serious handicap. The Department of Agriculture has assigned Sam Pickard, of its Radio Service, to act as Secretary of the Commission for the time being. The Department of Commerce has provided temporary quarters. The Department of Justice has offered the necessary legal assistance, and offers to aid have been generously made by the War and Navy Departments and various other branches of the Government.

"In this way, although the personnel attached to the Commission itself will necessarily be very small, the Commission expects to be able to perform its necessary work without delay.

"The Commission's first order, concerns applications for new licenses by holders of amateur and ship radio licenses. In order that the Commission may devote its immediate attention to the most pressing matters, it has extended the time for sending in applications by the many thousands of holders of amateur and ship licenses, and thus is calling for immediate applications only for broadcasting and point-to-point licenses."

The Nine-in-Line

A Sensitive, Selective Super-Heterodyne

By Lewis Rand

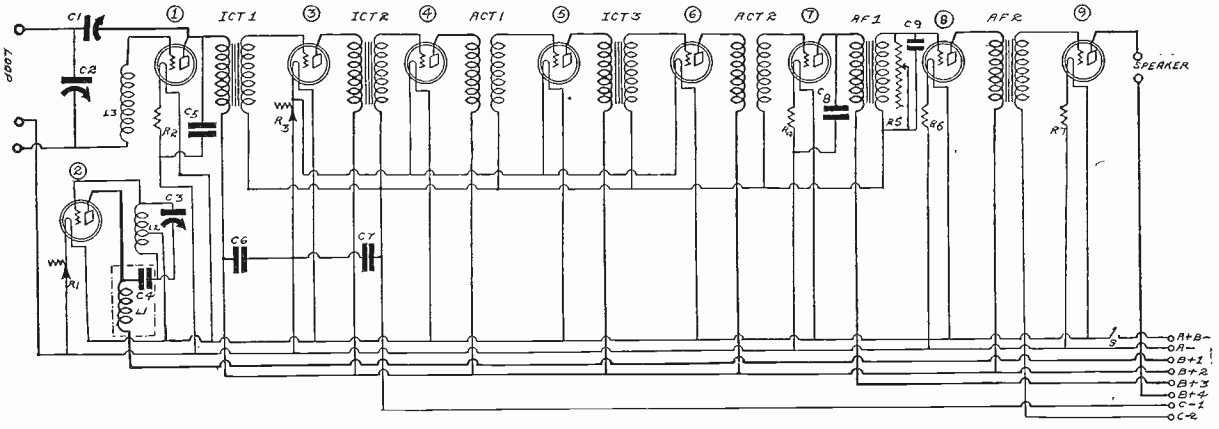


FIG. 1
The circuit diagram of the sensitive 9-tube Super-Heterodyne.

PART I

"IS as highly efficient as it is handsome."

This was only one of the many remarks of praise that were showered upon the Nine-In-Line Super-Heterodyne receiver during the tests held in RADIO WORLD'S Laboratories.

A glance at the photographs will attest to the simplicity, neatness and general attractiveness of this remarkable set. The volume obtainable on both locals and distant stations is so great that only on the most distant of stations it is unnecessary to employ the volume control. The tonal quality is excellent. This is due to the dexterously designed transformers employed in this set. The selectivity is ace high. This receiver, when placed only one-half mile from WRNY, which operates on 373.8 meters, cut right through, without the slightest difficulty in tuning, and brought in KVOO, located in Bistow, Okla., operating on 374.8 meters. And this was done during the evening when practically 95 per cent. of the stations were on the air.

The Intermediate Stages

The average Super-Heterodyne employs three untuned stages of intermediate frequency amplification and a filter stage. In this receiver the signal is first passed through two untuned stages and then fed into a tuned stage. In this way we not only obtain a sharper tuned signal, but one of greater volume. This same signal is now fed into another untuned stage and finally through the filter tuner into the second detector. So that the greatest energy transfer through the untuned stages may be obtained, the transformers should have very flat resonance curves, which the HFL transformers possess. This is accomplished in manufacture by using a paper section coil which has a very high capacity, and a large closed iron core, which consists of a great number of high grade silicon steel laminations. This transformer has a uniform amplification factor over a range of approximately six to eight kilocycles. The tendency for the tubes in these circuits to oscillate is reduced to a minimum in this way.

The first two untuned iron core transformers, ICT1 and ICT2, are made to cover the 32 to 42 kilocycle band, maximum amplification being obtained at about 35.6 kilocycles. The next transformer, ACT1, is tuned to give maximum amplification at this frequency. The third untuned transformer ICT3 possesses the same characteristics as ICT1 and ICT2. The signal is then passed to the second air core transformer, ACT2, which is made in the same manner as ACT1.

Circuit Theory

The incoming signal after being picked up by the loop and detected by the regenerative detector is beat with the oscillator, which is of the Hartley type. The sum or the difference frequencies are then amplified by the radio frequency stages and fed into the second detector, which is non-regenerative. The signal is then amplified at audio frequencies by two low ratio audio frequency transformers, AF1 and AF2.

So that the radio frequency energy generated in the oscillator tube may be kept out of the batteries, and avoid a feedback effect through the other stages, which will make the set erratic, a radio frequency choke coil L1C4 is connected in series with the plate circuit of the oscillator tube. The filament of this tube, it will be noted, is controlled by a rheostat. This is a very important control and adds to the sensitivity of the receiver. A variable condenser C3 which is of the .0005 mfd. type controls the oscillatory action of this tube. It is exigent that the stationary and rotary plate connections of this condenser are carefully connected, since a reversal of these connections will cause noticeable body capacity.

Coil Data

The oscillator unit consists of the pick-up coil L3 and the oscillator coil L2, which is tapped. Oscillations in the detector tube are controlled by the small variable condenser C1, which has a maximum capacity of .00005 mfd. Radio frequency energy in both the battery circuits is by-passed by Polymet 1 mfd. fixed condensers, C6 and C7.

Although the audio transformers are small and outwardly seem as if they would not give very much amplification, they do, and with very fine quality, at that. This is accomplished by using winding wire of the very smallest gauge possible to handle, over a specially-designed core. The high impedance secondary in these transformers with its high capacity effect causes a sharp decline on signals having a greater frequency than 10,000 cycles, which is the highest common audible frequency. In this way, any intermediate frequencies, which may enter in the audio portion of the circuit will not be amplified, thus avoiding distortion. The layout is unique. All the transformers, including the radio, audio, and also the radio frequency choke, are placed in the rear of a sub-panel, which can be purchased already drilled. Immediately in front of these coils the nine sockets are placed. In this way it is possible to use very short leads to the transformers to the sockets. The filament connections are also simplified.

The variable condensers are placed above

(*Concluded on page 7*)

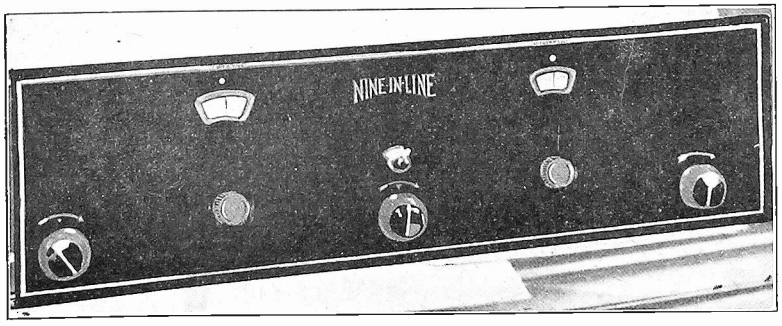


FIG. 2
The panel view of the receiver.

LIST OF PARTS

ICT1, ICT2, ICT3—Three High Frequency Lab., H.210 transformers.

ACT1, ACT2—Two High Frequency Lab. H.215 transformers.

AF1, AF2—Two High Frequency Lab. F.320 transformers.

L2, L3—One High Frequency Lab. L.430 radio frequency transformer (oscillator coil).

L1, C4—One High Frequency Lab. L.425 radio frequency choke unit.

R1—One Yaxley 25-ohm rheostat, type 125-K.

R3—One Yaxley 6-ohm rheostat, type 16-K.

R4, R6, R7—Three 1A Amperites with mountings (R7 may be a 112 Amperite if power tube is to be used).

C2, C3—Two Benjamin straight line frequency .0005 mfd. variable condensers.

C1—One General Radio 50 mmfd. microdenser, type 368 B.

C6, C7—Two Polymet 1 mfd. fixed condensers.

C5, C9—Two Polymet .0005 mfd. fixed condensers.

C8—One Polymet .002 mfd. fixed condenser.

R5—One Centralab 500,000-ohm variable resistance, type 500-M.

1, 2, 3, 4, 5, 6, 7, 8, 9—Nine Benjamin Cle-Ra-Tone sockets. (Without mounting base and for 3-16-inch base).

One Celeron 7x26 inch drilled and engraved panel.

One Celeron drilled subpanel.

One pair of Benjamin self-supporting brackets.

One Yaxley complete cable connector plug.

One Yaxley midget battery switch, complete.

Five Yaxley pup jacks.

Two Mar-Co Illuminated Controls.

ACCESSORIES

Three Eveready 45-volt standard heavy-duty Layerbuilt B batteries, No. 486.

Four Eveready 4½ volt C batteries.

One Corbett, Model C, 7x26 inch cabinet.

Nine CX-301A tubes or eight of these tubes and one CX-371 or 112.

One speaker.

One Qualitone loop.

One 6-volt A battery.

(*Concluded from page* 6)

the sub-panel, holes being drilled thereon for underneath connection to the oscillator coil and loop posts. The oscillator rheostat is placed in the left-hand corner, the radio frequency rheostat next and the variable resistance across the secondary of the first audio frequency transformer, in the right-hand corner. Above the radio frequency rheostat the filament switch is placed. The oscillator coil is placed in the center underneath the sub-panel, close up to the panel.

The grid returns of all the RF, detector and first audio tubes are all connected to a common C battery. The grid return of the last audio tube is connected to a separate C battery. A common C battery for all these tubes was tried, but found not to be as satisfactory as the separate ones.

The —01A tubes should be used throughout the entire receiver, although a power tube may be used in the last stage. Using the —01A's, the B voltages should be as follows: B plus 1 equals forty-five; B plus 2 equals ninety; B plus 3 equals sixty-seven and one-half, and B plus 4 equals 135. Should you use a power tube in the last stage, the B voltage applied should vary according to the tube used. The C bias for RF, detector and first AF tubes is six and one-half. For the last audio, on 135 volts B, use a 9 volt battery. The entire filament supply is controlled by the filament switch S.

The A and B battery output leads are connected to a Yaxley plug, not to individual binding posts. The C battery connections are made to flexible leads. The loop and output connections are made via Yaxley pup jacks. By consulting the list of parts column, you will be able to discern the values of the various parts.

(*Part II, Next Week*)

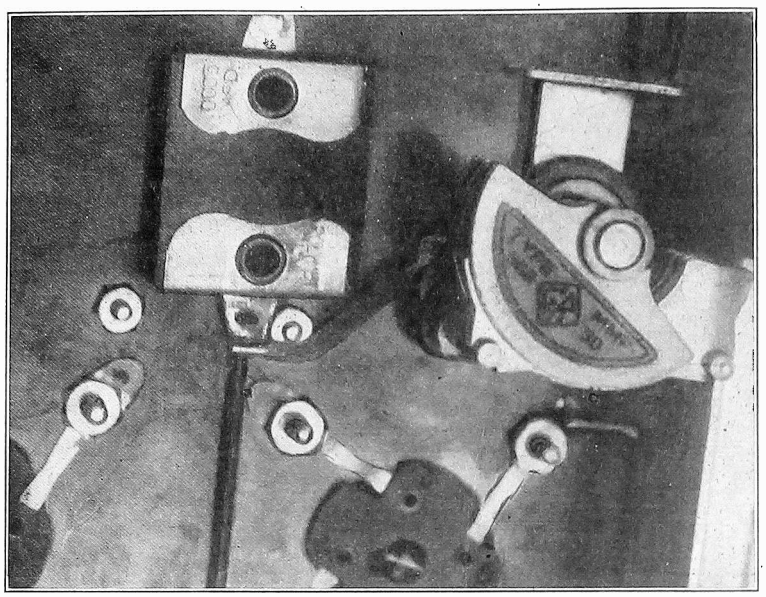


FIG. 3

A closeup view of the midget variable condenser (mounted on the sub-panel), which is used to control the regenerative action of the first detector.

How to Figure Cure for "Singing Speaker"

Distance of Reproducer From Set Affects Its Sensitivity to Magnetic Pickup Harmful to Quality

(*Concluded from page* 4)

of a receiver due to microphonic tubes.

The length of a horn should be about one-half of the wavelength of the lowest tone it is desired to reproduce. Suppose then that it is desired to design the reproducer so that a 60-cycle tone is brought out well. What should be the length of the horn to reproduce the note? Taking the velocity of sound at room temperature to be 344 meters per second we obtain 344=60W, or W is 5.73 meters. The horn should be about half of this, or about 2.86 meters. This is roughly equal to 9 feet.

The "Singing" Speaker

Suppose also that due to a microphonic detector tube the receiver will sing in certain positions of the loud speaker and suppose that the frequency of the singing is 1,000 cycles per second. How far should the speaker be removed to stop this singing? It should be moved a distance equal to about one half wavelength of the sound wave. If the distance moved is just one wavelength it is no appreciable change in the singing, but if it is moved a half wave, more or less, the noise can be completely stopped. Moving the speaker through one complete wave is equivalent to turning the tickler in the radio end of the receiver through one complete revolution.

The equation for this case becomes 344=1000w, whence the wavelength is 34.4 cm. which is about 13.5 inches. If the receiver sings very violently the distance moved should be half wavelength, of about 7 inches. If it sings less violently the proper distance to move the speaker is somewhat less than half wavelength. The proper distance can always be found by trial. In some cases the adjustment is quite critical, particularly when the amplication is large, when the detector tube is very microphonic, and when the loudspeaker is close to the detector tube, say a few feet away.

A tea wagon would be a fine place to put the speaker.

Scott Is Appointed Counsel to Stations

The Radio Manufacturers Association and the National Association of Broadcasters announce the appointment of Frank D. Scott, of Washington, D. C., as their legal representative in Washington. The need of having immediate representation before the Radio Commission in Washington resulted in the assignment for Mr. Scott.

Mr. Scott took a leading part in the preparation and passage of the present radio law, and has a thorough knowledge of what the present law is intended to cover.

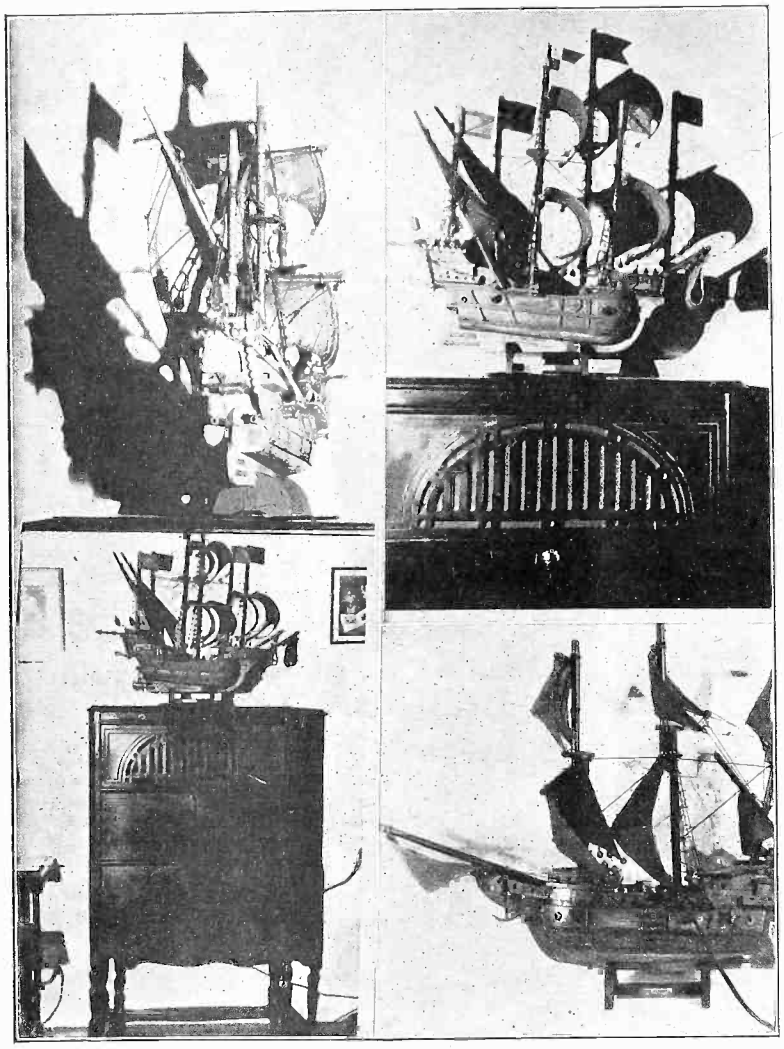
Mr. Scott retired from Congress on March 4 last, after serving for twelve years as Congressman from Michigan. Prior to that he was President of the Senate of the State of Michigan. During recent years Mr. Scott has been Chairman of the Merchant Marine and Fisheries Committee of the House, which committee has held public hearings and has had charge of radio legislation from its inception, three years ago. All of the White bills were handled by Mr. Scott's committee. He was also Chairman of the House Conferees, who finally developed the compromise bill between the Senate and the House.

A Ship Model Speaker

Adds Beauty and Romance to Installation

By Herbert E. Hayden

Photographs by the Author



A STRIKING VIEW of the ship (upper left) as she leaves her home port for adventure and exploration of unknown lands.

THE SHIP under way (upper right) on top of the radio console. A gale is blowing and the ship is pitching lustily.

THE PICTURE at lower left shows the decorative effects that may be obtained in the home with this attractive ship model and a console type radio receiver.

GENERAL view of port side of the ship model (lower right). Note the loudspeaker unit and the cord leading to it.

THE latest in interior decoration are the interesting and historically significant ship models. These not only satisfy the artistic taste of the homemaker, but they also furnish a continual reminder of the romantic days of America's era of discovery, and they serve to place the owner in a mood appreciative of the struggles and hardships that the early pioneers underwent to win religious freedom for themselves and economic affluence for their posterity.

The decorative value and historical significance of these ship models are in themselves sufficient to earn them a permanent place in every American home. In addition to these values the ships may also be given a modern utilitarian value. They can be made part of the radio receiver and serve as a loudspeaker.

How Work is Done

When a speaker unit, e. g., the Ensco, is combined with one of the model ships the hollowed body of the ship is used as a chamber to house the usual unit, or place for it is scooped out. In some of the ship models the hull has already been gouged out and there is nothing else to do but to attach the loudspeaker unit in the most convenient manner. In other ship models the body of the ship may be solid, and then it is merely necessary to gouge out a cavity of sufficient size to meet the requirements of the loudspeaker. This is easily and quickly done. The work may be facilitated by drilling a row of holes along the edges of the proposed cavity as well as in the interior and then the rest can be done with a chisel. See that you don't cut through the hull.

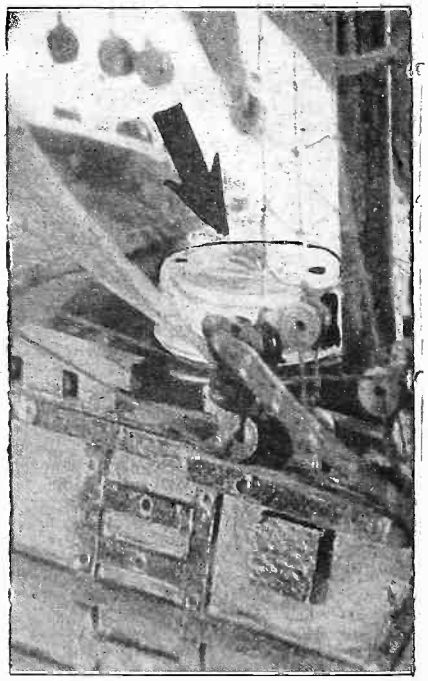
A cardboard horn of suitable dimensions should be made to go into this cavity. The cardboard may be formed into almost any desired shape by first soaking it in water and forming it while wet. It should then be dried without permitting it to assume any other form.

After the horn has dried it should be stowed away in the hull of the ship and the whole concealed from view.

Placement of Unit

The photograph below shows a close-up view of the ship model with loudspeaker installed. An arrow points to the unit. The only thing that can be seen of the loudspeaker is the inverted cup of the speaker unit, which can be seen just ahead of the mast. The horn has been covered up by the decks and the rigging. It is, of course, necessary to leave an opening somewhere for the sound to get out into the air.

The ship models may be obtained in knock-down form, very inexpensively. The assembly is exceedingly simple and can be effected with no other equipment than a small hammer, a few small nails and a pot of glue. The entire work, including the assembly of hull, placement of rigging and sails can be done in a few hours. The addition of the loudspeaker, including the making of the horn, will take a few more hours of very fascinating work.



HOW THE phone unit appears when it is placed over the hollowed body of the ship. The unit is, of course, inverted, so that the sound comes through the horn, placed in the hollow body.

Ensco Kit

The Zoom of Kettle Drums
Splendidly Reproduced on 3-Foot Cone

By Clyde J. Fitch

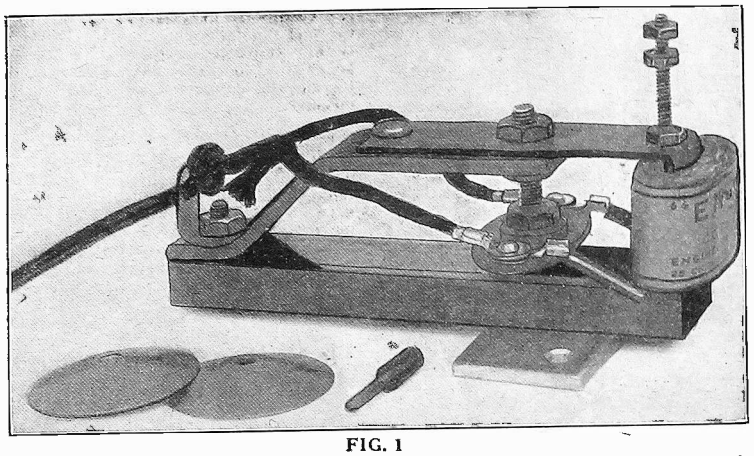


FIG. 1

The rule of simplicity was followed in the construction of the unit. The coil (at right) is a solenoid, and the magnet (pedestal) is straight bar tungsten steel. One pole piece is on the top, at the end of which is the threaded driving rod.

Whole Tonal Range of Music Handled Well by Large Reproducer of Right Type

THE popularity of the three-foot cone speaker has grown so rapidly during the past six months that most persons now believe that by simply connecting any three-foot cone to their radio set, they will greatly improve the quality of reception. While this is true in the majority of cases, it often happens that the results are much inferior to those obtained from the average horn or small cone reproducer. There are two reasons why natural tone quality may not be obtained. One is that the set is defective and the other is that the unit employed in the cone may not respond to the full musical tonal range.

Of course we can easily eliminate the first trouble by employing a good set. If the set chokes back some of the musical tones they cannot be reproduced by he speaker. All that is necessary to correct the set is to employ good transformers in the audio amplifier or to employ a good amplifier if of another type, such as an impedance or resistance coupling. Any radio set, no matter how cheaply constructed, will give as good tonal quality when using a three-foot cone as can be obtained from expensive sets, provided good transformers are employed in the audio amplifier.

LIST OF PARTS

One kit, consisting of Alhambra Fonotex unit, extensions and metal cones.

Two pieces of wood for cross sticks, each 36 x 1¼ x ⅝ inches.

One wooden block for spacer 5 x 3 x 2 inches.

A large cone in itself is not sufficient for high quality reproductions. I have heard many a three-foot cone driven by an inferior type of unit that failed entirely to transmit the lower musical tones, such as the zoom of the bass viol, the kettle drums, etc. Unless the vibrations are present in the unit, the sound cannot be amplified by the large cone.

Does Not Require Big Power

Contrary to the general opinion, power amplification is not required to "force" the low tones through. They come through with perfect ease and fidelity, and do not in any way interfere with or submerge the notes of the upper register.

There are many types of loud speaker units. Nearly all of them comprise some form of permanent magnet, electromagnet and vibrating diaphragm or armature.

In design, the unit, in Figs. 1 and 2, is perhaps the simplest on the market. Only the bare necessities of a loud speaker driving unit are employed, and these are of best quality material. And it was found that by eliminating all unnecessary parts, and making the unit as simple and rugged as possible, unuusual tone quality resulted. For example, the vibration armature was made of the proper size and shape so that the drive pin connecting it to the cone apex could be attached directly over the coil at the free end. By so doing, reducing levers were rendered unnecessary. The air gap between the pole tips is located at the center of the coil, where all the variable magnetic flux from the coil is concentrated, thus giving increased efficiency. The coil in this case is a solenoid.

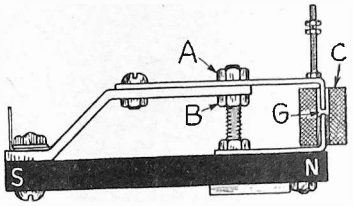


FIG. 2

Two nuts, A and B, are used to adjust the length of the air gap G. C is the coil.

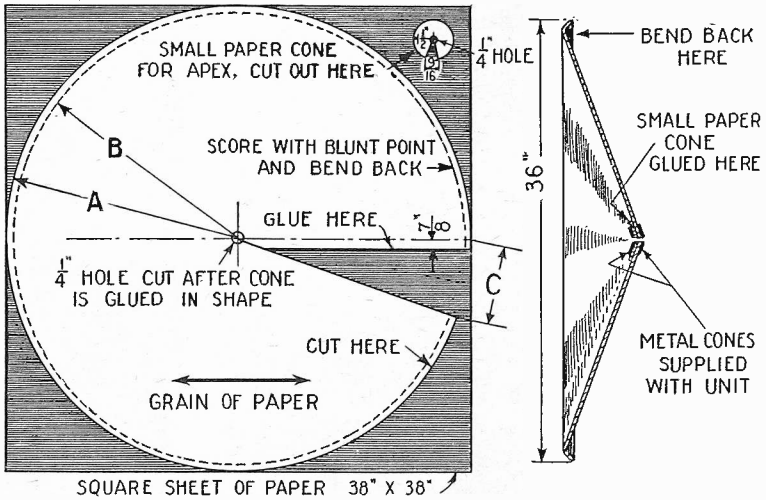
Another point of interest lies in the permanent magnet. Instead of the usual chrome steel horseshoe magnet; a straight bar tungsten steel magnet is employed.

The use of tungsten steel in the shape of a straight bar gives everlasting permanence, both as regards magnetic strength and mechanical stability. No horseshoe magnet, or any type of bent steel magnet, will retain its physical shape indefinitely, but will have a tendency to straighten out with age. Such magnets should be aged several months after bending before being placed in operation.

Requires No Output Filter

The coil of this unit is worthy of comment, in that it is designed for direct operation on the set without necessity for the use of an output transformer or choke coil and condenser combination. It may be so connected when used with a 301-A, 201-A, 112, 371 or 171 output tube with

(*Concluded on page 23*)



NOTE: FOR 36" CONE	A=19"	B=18 3/8"	C=6 1/4"	FOR 30" CONE	A=15 3/8"	B=14 3/4"	C=5 1/4"
FOR 33" CONE	A=17 1/2"	B=16 7/8"	C=5 3/4"	FOR 24" CONE	A=12 3/4"	B=12 1/8"	C=4 1/4"

FIG. 3

Dimensions for cutting cone paper for 36, 33, 30 and 24-inch diameters

The Universal on a Loop
Brings In Stations With Excellent Volume

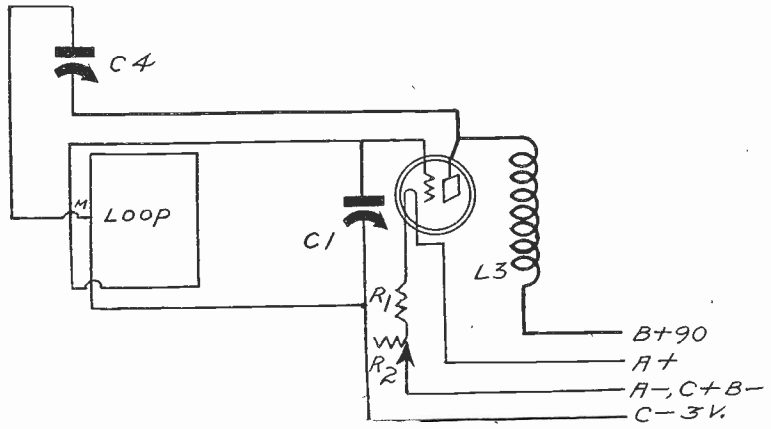


FIG. 1

Skeleton diagram showing how to wire the Universal for loop operation.

THE four-tube Universal receiver may be operated from a loop. While the loop does not pick up as much energy as an outdoor antenna, or even as an inside antenna of the capacity type, nevertheless it picks up enough to bring in all the local stations, and even some distance, on the new Universal.

The loop as a collecting agency is favored by those who have no facilities for erecting an outdoor antenna and who do not care to string any wire around the moulding of a room to constitute an indoor antenna.

Of course the loop is directional in that it will tune in stations at maximum volume when the plane of the loop coincides with the direction of the received wave. In that way many stations can be tuned out completely by rotating the loop, even though the two tuning condensers are at resonance with the wavelength of the station in question. This builds up selectivity of a directional nature and enables one to get rid of all stations interfering, where the interference is caused by a station the wave front of which is in a direction other than that of the station desired to be received.

Gives Good Volume

Fig. 1 shows the wiring of the loop where the Universal is to be built as a receiver not equipped for optional use of an outdoor antenna. If one has an outdoor antenna he should use that exclusively, but if he cannot have an outdoor antenna and wants to have a loop it is perhaps better practice in this receiver to build a set for loop operation exclusively. The volume obtainable even when a loop is used will prove to be considerable. The use of a loop therefore will obviate including the antenna coupler, so that the tuning coils of the receiver consist of the loop as the pickup and L3L4 as the interstage coupler.

The diagram shows the method of connecting the loop and the neutralizing condenser. All the rest of the wiring is done along exactly the same lines as for the receiver built for an outdoor antenna. The wiring diagram, other illustrations and the constructional data were given in the March 12 and 19 issues, with trouble shooting in the March 26 issue.

Mid-tap Question

Those who read the preceding articles no doubt are familiar with the fact that the mid-tap of the secondary of the antenna coupler was connected to C minus 3 volts, while the beginning and end of the secondary went respectively to the rotor of C1 and to the stator of C1 and grid. The neutralizing condenser was connected from plate to aerial.

Neutralizing Condenser

The skeleton diagram, Fig. 1, shows how the neutralizing condenser should be connected if a mid-tap loop is used. M represents the mid-tap. The loop must have the correct inductance to tune with the capacity used for C1. In the laboratory model C1 was a General Radio .0005 mfd. variable condenser. The loop was a mid-tap commercial model wound for tuning with an .0005 mfd. condenser.

Establishing Mid-tap

If no mid-tap is provided on the loop one may be made by scraping the insulation off the wire at the mid-point and soldering the connection thereto. It is not absolutely necessary, however, to use the mid-tap for connection to C4. If you do not desire to scrape the insulation off an existing loop that has no mid-tap then C4 may be connected from plate to grid direct.

Advice on Dials

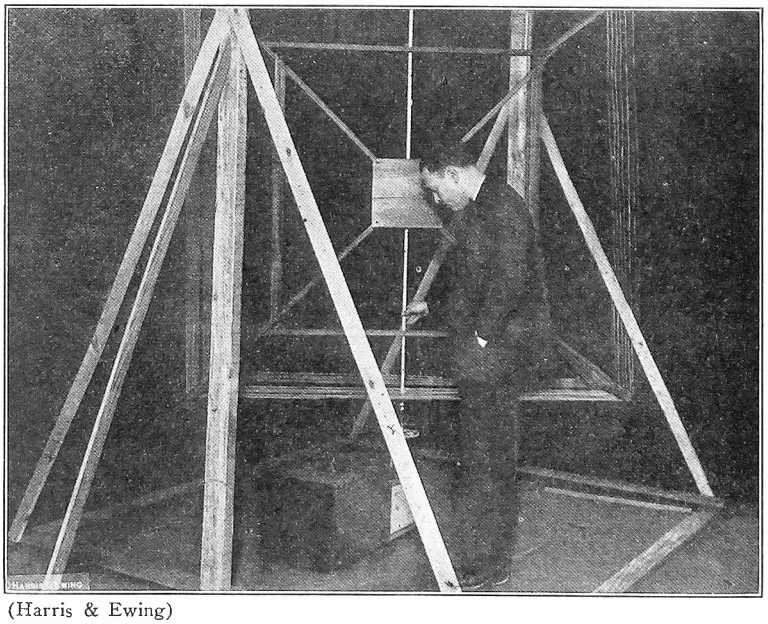
When the loop type receiver is used it is still important to adhere to the admonition that completely insulated dials be used. These present a front view showing no metal. The reason is that exposed metal parts cause body capacity in this circuit, whereas the recommended Karas Micrometric Dials do not.—Herman Bernard.

U. S. Phone Directories Put in London Hotel for Oversea Service

What is believed to be a new record for long distance telephoning was made when John W. Harrigan, of Detroit and Milwaukee, now in London, spoke twice on the same day across the Atlantic on the commercial radio telephone. Both calls pertained to business matters and were made at a two-hour interval. The two talks cost $700.

That the radio telephone has achieved wide popularity with visiting Americans in London is attested to by the fact that the Savoy Hotel has placed in every room New York, Pennsylvania, Maine and Connecticut telephone directories. To improve the audibility on trans-Atlantic radio telephone calls, each telephone instrument has been equipped with an extra receiver.

AN AUTOMATIC LOOP



(Harris & Ewing)

A LOOP, which without the presence of an operator, turns around a predetermined number of revolutions per hour, day or night, so as to cover all directions, enabling one to procure valuable data on fading, static and other radio phenomena, was recently invented by E. B. Judson, of the Special Laboratory for Transmission Research of the Bureau of Standards, in Washington, D. C.

Auto Reception His Hobby

British Captain Has Huge Loop on Outside

By C. J. Fenwyn—Cholmondeley

A GREAT many of us will be taking our vacations shortly, some to the hills, others to the seashore. And the thrill that comes by going by auto can hardly be surpassed, unless it be for the very reason that prompts this narrative—taking a radio receiver with you!

Portable radio receivers have been described time and again. However, Captain Plugge, English radio engineer, felt that at best the so-called portable radio receiver was nothing which its name implied, and so conceived the idea of building his receiver right into the dash board of his car. By doing this, he achieved his main objective—portability in every sense of the word—for wherever he wanted to go, he would do so in his car, and his radio would be right there whenever he wanted it.

Uses Super-Heterodyne

Naturally, the first consideration was the design of the receiver, the best circuit to employ. As the receiver was to be subjected to the severest kind of service, the most sensitive radio amplifier had to be used in conjunction with special features which would adopt the set to the strain and stress of operating over rough roads in poor locations, and above and below sea level which conditions have a decided effect upon the reception of radio waves.

Hence, a nine-tube Super-Heterodyne to which was added two stages or tuned radio frequency amplification was finally decided upon and was found to exceed by far the expectations. But the success of the set rested in a large part, at least, with the loop which was employed to pick up the faint and distant signals.

The Loop Antenna

As can be seen in the accompanying photograph, the loop was a real large business-like affair of sturdy construction and was made weather-proof by a covering of heavy duck canvas which was thoroughly shellached several times. The actual dimensions were 3½ feet square.

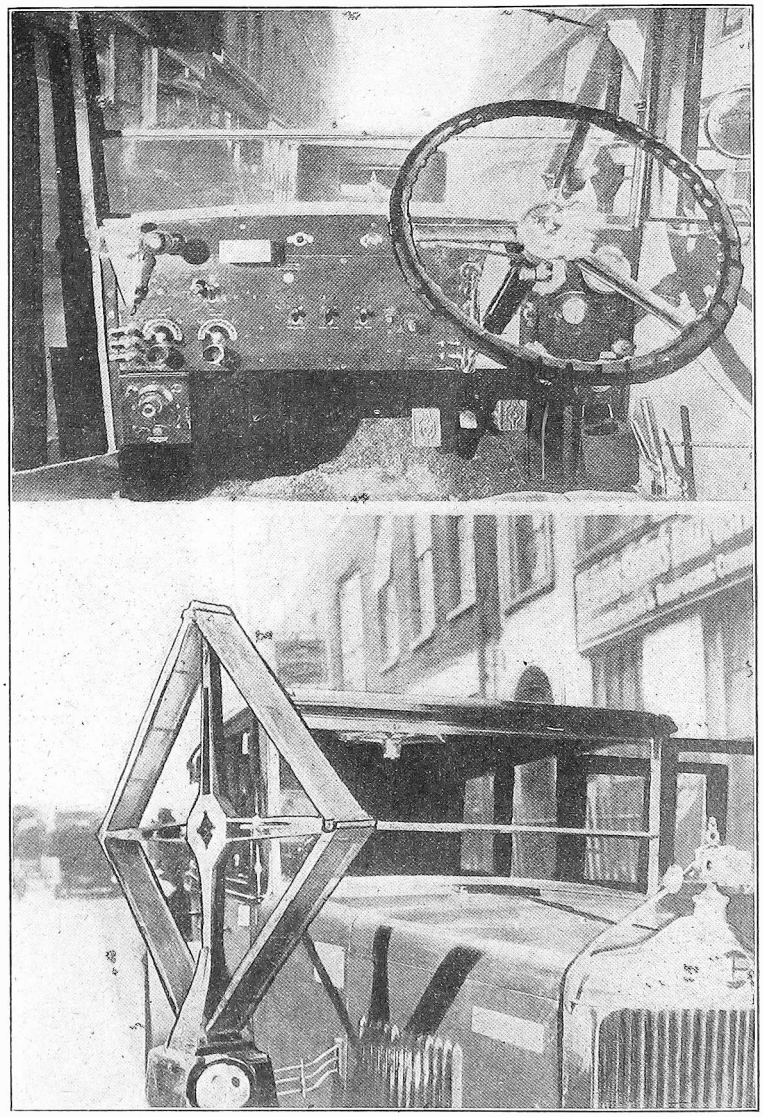
The winding consisted of 12 turns of No. 18 enamelled copper wire and the tuning was accomplished by a .00035 vernier-drive variable condenser of the straight-line frequency type.

The loop was rotated into position by means of a two-foot handle attached to the frame work readily accessible from the driver's seat. The bearing, by the way, was made to fit snugly, so that the friction caused the loop to remain in position regardless of the rocking and swaying of the car.

Some Interesting Experiences

Captain Plugge was at first somewhat reticent to talk of his many interesting experiences, but further coaxing and persuasion finally brought forth some very elucidating statements.

In going through the countryside, several miles from any of the broadcasting stations, it was most amazing to learn of the varying strength of signals. In some cases, the signals faded out completely but would come in strong again a few hundred feet down the same road. No reason other than that possible reflection of the radio waves by nearby metallic ore deposits was suggested for such strange pranks. Again, it was necessary actually to change the position of the loop to what appeared to be at right angles to the proper direction from which the radio waves came, but again the so-called "wave-chute phenomenon was held as the reason.



(Herbert Photos)

An eleven-tube Super-Heterodyne, designed and built by Captain Plugge, of the British army, has proved its mettle and worth. The loop antenna is used in conjunction with the "radioized" car. Its large size is a large factor in contributing to the excellent results which have characterized the operation of the receiver. It is made weather-proof and can readily be demounted.

"Dead Spots" Encountered

Of course, there were found quite a number of "dead spots" in which regions no signals whatsoever could be heard. The same stretch of territory was explored both at night and during the daytime and graphs of the signal strength were made. When these were compared, it was found generally, that, while the strength of the signals received during the night were of far greater intensity than those received during the day, the "dead spot" phenomenon varied!

For instance, where it had been impossible in the evening to obtain even the slightest semblance of a signal in a position located between two high ridges, it was found surprising to receive with fair strength and extreme clarity signals from relatively distant stations even at high noon!

Fun In the City

But when tests were made in the city it was astounding, the manner in which the music from a local station would come in. In going down a street and nearing an intersection, the music would gradually increase, until the car arrived at the corner, when the volume would be tremendous. Often when a machine passed the loop antenna, on the right, as is the London manner, the signal would begin to fade, and, if the machine passed too closely, die out,

(*Concluded on page* 28)

Two Steps of Resistance AF That Afford Ample Volume for a Speaker

By Herman Bernard
Managing Editor; Associate Institute of Radio Engineers

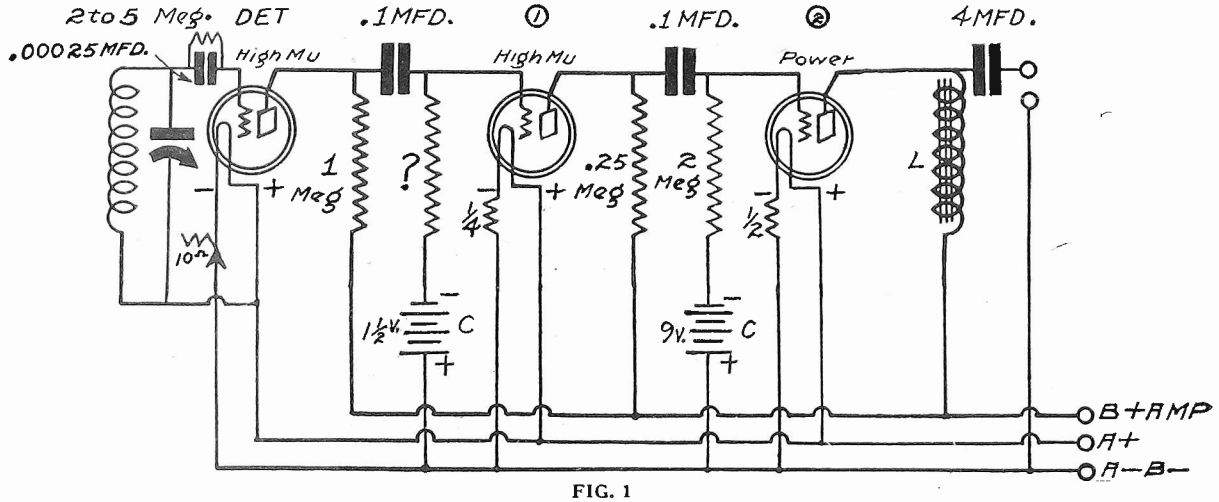


FIG. 1

A two-stage resistance-coupled audio amplifier that operates a loudspeaker with about as much volume as the run of two-stage transformer- coupled amplifiers. The detector stage is shown also, because a high mu tube must be used there. The 1 meg. resistor in the detector plate circuit, and proper value of the grid leak (see question mark) usually will stop even the severest cases of motorboating. Note that the same B plus lead is used for detector and both audio tubes. The applied voltages differ greatly, however, due to voltage drop in the resistors and choke coil. The bias is arranged for 150 volts at the source.

THE advent of the 30 mu tube has made it possible for the first time for home constructors to utilize a two-stage resistance coupled audio frequency amplifier and obtain ample volume to operate a speaker. Heretofore the required volume was obtainable only from three stages because the mu of even the high mu tubes was about 20 or less. The voltage gain in resistance coupled audio amplification depends on the tube characteristics, there being no other step-up, as contrasted with transformers. While the tube itself has a gain of 30, the net gain is about 20, due to the effect of the coupling resistor.

To construct a two-stage resistance coupled audio amplifier and obtain sufficient speaker volume to appease even those who like extremely loud signals it is necessary to use a high mu tube as detector. The same voltage source is applied to the detector plate resistor as to the other plate resistors and the choke coil.

Should Use High Voltage

It is assumed that a high voltage is used for the B plus lead, i. e., 135 volts or more. If the audio amplifier is used in conjunction with an AC B eliminator, when normally 180 volts may be obtained, the same rule of a common B plus lead applies. The voltage drops about 40% in the case of the first audio tube and somewhat more in the case of the detector tube. On the other hand the choke coil, L, drops only about 10 volts, thereby giving the final audio tube the high voltage that it requires for efficient operation.

In the construction of the two-stage resistance coupled audio amplifier, new problems arise, as this field has not been thoroughly explored, due to the prior non-existence of tubes of sufficiently high amplification constant to make the two stages practical for speaker operation. It will be noted of course that with an actual gain of 20 per stage there is reason for favorable comparison between the volume obtainable from the run of two-stage transformer coupled amplifiers and the two-stage resistance circuit. Also, the quality obtainable from the resistance circuit is likely to be better, although audio transformers of the better makes produce such good quality nowadays that many persons cannot notice the qualitative differences by ear.

The Motorboating Problem

Perhaps the outstanding problem in connection with 30 mu tubes is that of motorboating, a low frequency oscillation due to the common impedance of the circuits. Such tubes increase the tendency of the circuit in this direction.

The impedance may be regarded as the obstruction that the resistance offers to alternating current.

A study of any circuit will show that the power sources, i. e., the A, B. and C supplies, are all connected together, the lowest potential being C minus and the other steps being A minus, B minus, A plus and B plus. A diagram of the batteries will show them in that order, and the common connection is inherent and inevitable, but of no particular detriment where the indirect coupling method is used. But the moment that one resorts to direct coupling, particularly resistance, the common impedance is accentuated, there being not only the power source to consider, but also the coupling-isolating condensers which unite the one stage to the other while isolating the high voltage of the DC on the preceding plate from the succeeding grid, and also one must consider the plate and grid loads.

It will be found that the resistor in the plate circuit of the detector tube will have a very great effect on motorboating. The higher the resistance of this unit, the greater the proportion of the load resistance to the total or external resistance, and hence the smaller the likelihood of motorboating. There exists between the detector plate resistor and the first audio grid resistor a compensating effect, due to the opposition of phases.

Opposite Rule for Grid

While the rule is the higher the resistor in the plate circuit the smaller the danger of motorboating, the opposite rule prevails in respect to the audio grid leak. The value of the grid leak of the first audio stage is one that should be obtained experimentally, the objective being to use as high a value as is consistent with absence of motorboating. Therefore resistor values which show up well in tube tests independent of united circuits unfortunately do not give much assistance when one tries to make a practical application of the high mu tube to an operating audio chain, especially of two stages, with an an uneven number of plate circuits (including detector). The 1 meg. resistor in the plate circuit of the detector tube was found to cure motorboating in every instance in which it was encountered, even when B eliminators were used, provided that the succeeding grid resistor was of a sufficiently low value, e. g., .25 meg. It may be necessary to use even a smaller resistor here, despite theoretical objections.

An important consideration in respect to motorboating is the value of the coupling-isolating condenser. In the tests its value was .1 mfd. The plate resistors and the grid leaks in the audio channel are based upon that value of the condenser.

If anything else than .1 mfd. is used then the grid resistor of the first audio tube, identified by a question mark in Fig. 1, may be increased. The heart of the subject-matter is the stifling effect of either the leak or the condenser, or both, on the lower frequencies. If a small enough condenser is used, then there is no danger of motorboating, although frequencies below 100 cycles may be cut off as high as 50%. Low value grid leaks similarly affect lower frequencies.

The Three-Tube Compact
Makes Dandy House Set and Handy Portable

By Jasper Henry

THERE is a three-tube receiver that can easily out perform many five and six-tube radio sets. It is the result of the application of several important refinements which, when combined, produce a circuit which is as sensitive and selective as even present-day needs require.

To obtain sensitivity in a radio circuit it is necessary to reduce to a minimum all forms of losses, such as absorption, radio frequency leakage, hand capacity, distributed capacity in the inductance coils, and to ascertain that the tubes are operated at their proper charatceristics.

The circuit diagram, Fig. 1, shows that a variable primary is used as well as a tickler coil which is movable in the same manner. The coil used in the laboratory set was the Micro-coupler, which has a very minute vernier adjustment and operates so smoothly and finely that one can tune in stations not otherwise obtainable. The set tunes so sharply that to receive some distance stations it is well to have a small vernier condenser, C1, connected across the tuning condenser.

The Rotary Coils

The proper connections for the Micro-coupler, type 3C, are join No 3 to the plate and No. 4 to the B plus detector. The other variable or primary coil is connected in the antenna circuit, while the grid circuit is connected to the secondary.

Reference to Fig. 2 shows the compactness of this set, which consists of a regenerative detector and two stages of audio frequency amplification. The cabinet was purchased from a radio dealer. It was the well-known Atwater Kent compact cabinet. These cabinets are plentiful, as dealers remove sets from cabinets to install the sets in consoles.

The tuning of the set is done with one control, while two other controls are required to sharpen the tuning and "sensitize" the detector. These are the detector rheostat control and the tickler feedback coupling coil control.

Rheostat on Detector

The detector tube filament is controlled with a 20-ohm rheostat while the audio amplifier tubes are automatically fed with the proper current by means of Amperites. In conjunction with the fine control of the detector, the grid return is connected to a miniature single pole double throw switch which allows either positive or zero bias to be obtained, so that the set may have a general purpose tube as detector, with positive return, or a special detector, like the CX-300, with zero bias (negative filament return).

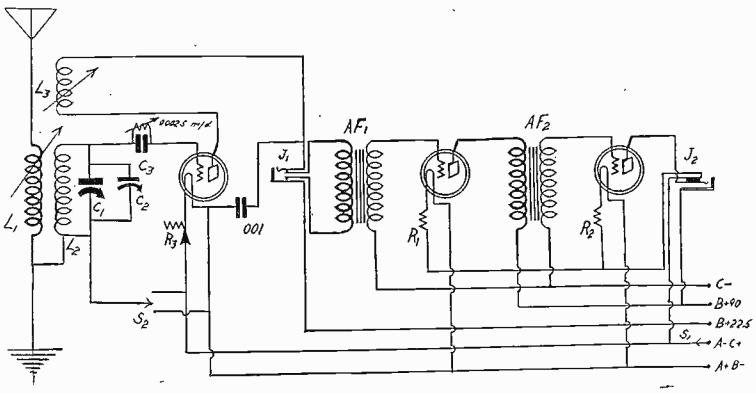


FIG. 2

The circuit diagram shows just what has been incorporated into the receiver.

Note that the grid return of the two audio tubes requires that a C battery be used. This is to insure good quality of reproduction at all times and to minimize the drain on the B batteries. All that is needed for the —01A type tube at 40 volts is a 4½ volt battery, but for two 112 tubes in the audio channel use 9 volts bias at 135 plate volts.

The filament switch turns the set on and off, and by virtue of the manner of the wiring does not affect the ground connection, which is often disconnected in other types of receivers. In this way, the entire circuit is always grounded, a good plan.

Costs Little

What is particularly interesting about this receiver, besides its exceptionally small size, is its low cost of building and upkeep. The seemingly expensive part, the cabinet, was obtained from a well-known concern for a few dollars.

The panel is of mahogany bakelite, size 19½ x 5½ inches, and the baseboard of bakelite, size 18 x 5 inches. The two jacks are mounted so that their frames fasten these items together.

The second jack is a filament control for the two stages of audio frequency amplification. When the phones are being used the filaments of the audio tubes are not lit. The moment the reproducer is plunged into J2, however, all the tubes are lit.

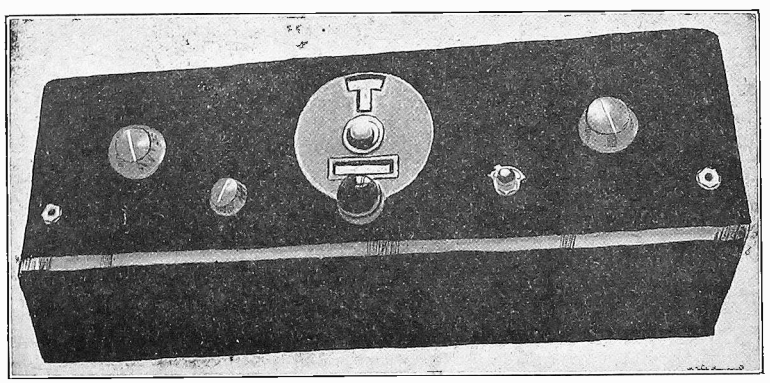


FIG. 1

Due to the small size of the receiver it lends itself very readily to portability, and with this in mind it has been designed for use with either 3-volt tubes or the 6-volt variety.

The excellence of the tuning inductance has been augumented with the small variable vernier three-plate condenser which aids in tuning with such remarkable fineness that one can almost "split hairs." However, nothing is lost from the quality of the reproduction. None of the harmonics or overtones accompanying the music is lost or suppressed due to the elimination of the side bands of the incoming carrier wave, for the side bands are not in any way affected by C1.

LIST OF PARTS

L1, L2, L3—One Micro-coupler.
S1—One Carter Imp. filament switch.
R4—One Bretwood variable grid leak.
C3—One Bretwood .00025 mfd. grid condenser, bullet type.
R3—One 20-ohm rheostat.
R1, R2—Two No. 1A Amperites.
J1—One double circuit jack.
J2—One double circuit filament control jack.
C1—One .0005 mfd. variable condenser.
AF1, AF2—Two audio transformers.
S2—One miniature single pole double throw switch.
C1—Small vernier condenser (three plates).
One Atwater Kent Cabinet.
One Bakelite panel 19½x5½.
One Bakelite sub-panel 18x5.
One vernier dial.
Three sockets.
Seven binding posts.

Is Such Laudation a Matter of Money?

Lives there a musician of some consequence who never has had his or her picture taken beside a radio set, pretending to marvel over the natural quality of this particular set? Is there one among them who has ever heard what the quality of that set is? If so, has that particular exception heard any other set? What is the answer to these questions? If the check is large some persons will have their pictures taken beside anything and permit the advertiser's copywriter to "quote" the sitters as his imagination may direct.

The Power Compact
Socket Operation for all B, One A, One C

By Lewis Winner

Technical Editor; Associate, Institute of Radio Engineers

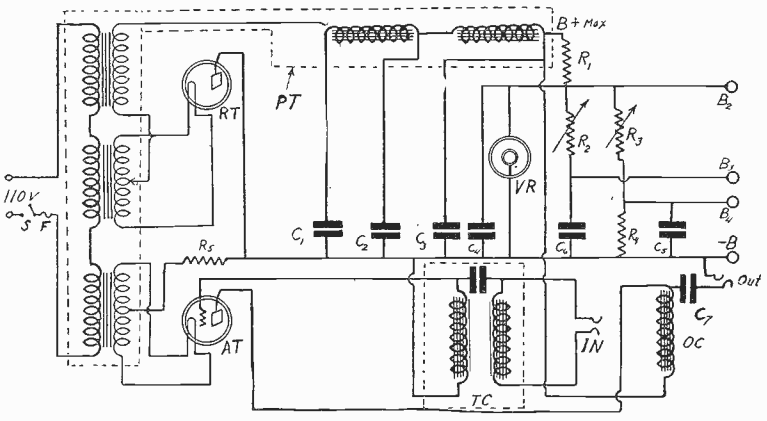


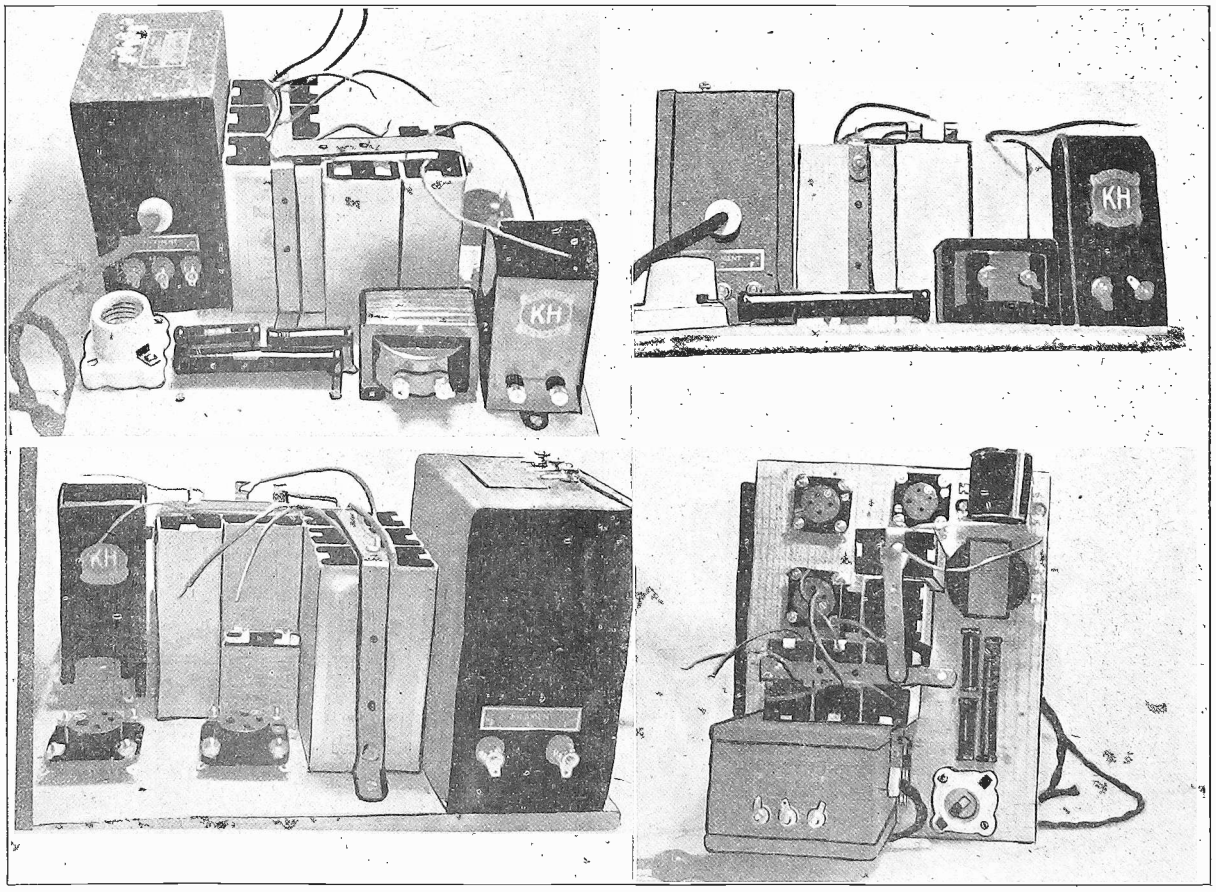
FIG. I.

The circuit diagram of the B eliminator and one-stage power amplifier.

ALTHOUGH it is possible to employ the popular 5-volt tubes in amplifier circuits which will bring out the depth and fullness of signals on both the high and low frequencies with good volume, not until you have tried a stage of power amplification can you realize what real volume and excellent tonal quality your receiver is capable of delivering. The power tube, of course, requires a high plate voltage not readily obtainable from dry B battery blocks. However, the house line can be used to supply this power as well as the B power for the other tubes in your set, and at a very small cost, e. g., approximately equal to that drawn by a 50 watt lamp. A device with which it is possible to do the above is herewith described.

This unit consists of a stage of double impedance audio frequency amplification, (chosen because of its flat curve characteristic on the complete audio frequency range) and a B eliminator capable of delivering 400 volts to the plate of the power tube used in this audio stage as well as B voltages for any set using as high as

(*Concluded on page 29*)



FIGS. 2, 3, 4 AND 5

Four general views of the layout of the eliminator. How the Kroblak resistors are mounted is best seen in the photo in the upper left-hand corner. How the sockets are placed to avoid the tubes from hitting each other as well as allowing plenty of play for the insertion of the tubes is shown in the lower left-hand photo. The upper right-hand photo is another view of the resistor mounting. The lower right-hand photo shows exactly how all the parts are placed.

Radio University

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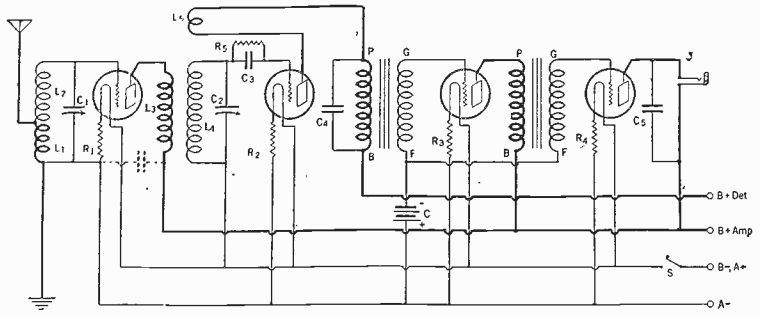


FIG. 532

The circuit diagram of the four-tube receiver requested by Frank Merrils.

PLEASE GIVE me the circuit diagram of a four-tube receiver employing a stage of tuned radio frequency amplification, a regenerative detector, and two stages of transformer coupled audio frequency amplification. I wish to use a single winding tuning inductance in the tuned stage of RF amplification. I have some two and three-quarter-inch diameter tubing, two .0005 mfd. variable condensers and four 1A Amperites.—Frank Merrils, Atlantic City, N. J.

The circuit diagram of this set is shown in Fig. 532. L1L2 is the single winding tuning inductance, which consists of sixty-five turns wound on a piece of the two and three-quarter-inch diameter tubing, which is also four inches long. Use No. 22 double cotton-covered wire. The tap is made at the fifteenth turn from the beginning of the winding. L3 is the primary winding of the three-circuit tuner, which consist of ten turns and is also wound on a piece of two and three-quarter inch diameter tubing. The secondary L4, which is also wound on this tubing, is separated about one quarter inch and consists of forty-five turns. Both these windings are made with No. 22 double cotton-covered wire. The tickler L5 consists of thirty-five turns, wound on a tubing which is only one and three-quarter inches in diameter with No. 26 single silk covered wire. This winding is placed inside of the secondary winding L4, near the end of the winding. The .0005 mfd. variable condensers, C1 and C2, are used to shunt the secondaries. R1, R2, R3, and R4 are the 1A Amperites, which are used to control the filaments of the RF, detector and two audio tubes. C4 and C5 are the .0005 mfd. fixed condensers. S is the filament switch used to connect as well as disconnect the A battery from the filament circuit. The plates of the radio and audio tubes are connected to a common B post, while the plate of the detector tube is connected to a separate B post. The voltage applied to the radio and audio tubes should be approximately ninety volts, while the voltage fed into the detector plate should be forty-five volts. Should you find that the RF tube is oscillating beyond control, disconnect the common AF leads and run to a separate post, or insert a 2000 ohm variable resistance in series with this RF lead and vary the voltage accordingly. The standard .00025 mfd. fixed condenser and 2 megohm grid leak is used in the detector grid circuit. The F posts of both AF transformers are connected to the minus post of a four and one-half volt C battery. A single circuit jack is inserted at the last audio output. This may be supplanted by a pair of tip jacks or binding posts. When placing the coils, do not place them very close to each other. That is, place the RF coil about four inches away from the tuner and at right angles to it. Be sure and keep all the plate and grid wires away from the panel. The —01A tubes should be used throughout.

* * *

COULD THREE two-to-one ratio audio frequency transformers be used to construct a four-tube receiver? I have these transformers and four sockets, as well as two .0005 mfd. variable condensers.—James Hanson, Oakland, Calif.

The circuit diagram of a receiver using these parts is shown in Fig. 533. One of the transformers is used in for reflexing, while the other two are used in the straight audio stages. The .0005 mfd. variable condensers are used to tune the secondaries of radio frequency transformers, which consist of sixty-two turns, wound on two and one-half inch diameter tubing, using No. 22 double cotton-covered wire. The primaries of these RFT consists of ten turns. Each primary is, of course, wound on the same tubing as its respective secondary. Allow one-quarter inch space between the windings. Be sure to label the beginning and the end of each winding. The filaments of the radio and audio frequency amplifiers as well as the detector are controlled by a twenty-ohm. rheostat. The filaments of both audio tubes are controlled by a one-half-ampere ballast resistor. R1 is a 2 megohm grid leak. C4 is a .00025 mfd. fixed condenser. C3 is a .0005 mfd. fixed condenser. The plates of the detector and the RF-AF tubes are each connected to a separate B post. The plates of both audio tubes are connected to a common B post. The A supply is connected or disconnected from the set with the aid of the filament switch S. The grids of both tubes are connected via the secondary winding of each audio transformer, to the minus post of a four and one-half volt C battery. The plate voltage for the audio tubes is ninety. The RF-AF plate voltage is sixty-seven and one-half, while the plate voltage for the detector tube is forty-five. The —01A type tubes should be used throughout. A single circuit jack is connected at the last audio output. The parts for this set may be placed on a baseboard which is twenty-one inches long and seven inches deep. Place the RF coils at right angles to each other, the circumference of one coil being in line with the center of the other coil. Should the volume be too great a variable resistance at about 50,000 ohms should be inserted across the secondary of the audio frequency transformer in the first stage, AFT1. Should you find that the set has a tendency to howl, reduce the number of turns on the primaries of the radio frequency transformers to seven. Also place .0005 mfd. fixed condensers from the plates of both the RF-AF and the detector tubes to the minus A post. A radio frequency choke consisting of about one hundred and fifty turns of No. 30 enameled wire, wound on a one-inch diameter tubing, inserted in series with the G post of AFT3, may also help to cure the howl.

* * *

I HAVE a four-tube receiver using two stages of radio amplification, a crystal detector and three stages of resistance coupled audio frequency amplification. The volume and quality with this set on local stations is excellent. However, I would like to receive some distant stations. The furthest station I can now get is KDKA, and that very low. Would adding a tickler to the first radio frequency transformer increase my distance range any? I know that it is possible to get DX here, because I have had other sets here, and employing the same antenna and ground, obtained wonderful results. The primaries of my RFT consist of fifteen turns, while the secondaries consists of fifty turns, each primary and secondary being wound on a two and three-quarter-inch diameter tubing. I think No. 24 double silk-covered wire is used. The secondaries are shunted by .0005 mfd. variable condensers. How many turns should the tickler contain and on what size tubing should it be wound? I am using —01A type tubes.—Henry Meyers, Schenectady, N. Y.

The tickler will add to the sensitivity of the receiver. The tuning will, however, become more difficult. The winding should consist of thirty-seven turns wound on a one and three-quarter-inch diameter tubing using No. 26 single silk-covered wire. This coil should be inserted near the end of the secondary winding. It is not known if you now have a rheostat connected in the filament circuit of this tube or not. If you haven't, better insert a twenty-ohm type. The resistance wire post is connected to the minus F post of the socket, while the arm post is connected to the minus A post. The grid return of the secondary winding of the RFT in this circuit is connected to the arm post or the minus A post, which is the same lead. It is also suggested that you connect the end of the primary winding of the second radio frequency transformer, which is connected to the plate circuit of the first tube, to a separate B plus lead, applying about forty-five volts at the start.

* * *

I BUILT the six-tube receiver shown diagrammatically on page 13 of the Oct. 16 issue of RADIO WORLD, on a breadboard and am well pleased with it. I would now like to build this set so that I can fit it into a seven-inch high, twenty-four-inch long and eight-inch deep cabinet. (1)—The filaments were all controlled by a single rheostat. The rheostat that I used burnt out. I have, however, a ten and a twenty-ohm rheostat. Could these be used? (2)—In what filament circuits should they be inserted? (3)—I have a 112 and a 1A Amperite. Could these be used? (4)—Where? (5)—Would the selectivity factor of the receiver be improved any, if I disconnected the beginning of the primary winding from the beginning of the secondary winding of the first radio frequency transformer? (6)—I now have the coils placed in the regular neutrodyne angle style on the end plates of the variable condensers. Is this O. K.? (7)—I would like to insert a pilot light. Where should it be connected?—Milton Glickman, Jersey City, N. J.

(1)—Yes. (2)—Insert the twenty-ohm rheostat in series with the negative leg of the filament of the first radio frequency amplifier. The ten-ohm rheostat should be inserted in series with the filaments of the second radio frequency and detector tubes. (3)—Yes. (4)—The 1A Amperite should be used to control the filament of the first audio tube, while, the 112 should be used to control the filament of the two audio tubes connected in parallel. (5)—Yes. (6)—Yes. (7)—Across the A battery line. The connection in the minus A line should be made after the filament switch connection.

* * *

I INTEND constructing the three-tube reflex receiver shown in Fig. 413 in the Radio University columns of the Aug. 21 issue of RADIO WORLD (1)—Could the potentiometer be left out? (2)—Where would the grid returns go to, if this is left out? (3)—Could a ten-turn primary and forty-five turn secondary winding wound on a three-inch diameter tubing with No. 22 double cotton-covered wire be used instead of the single winding antenna inductance specified? (4)—I only have a single circuit jack. Could the double circuit jacks be omitted? (5) Would I receive satisfactory results if I used an antenna which was one hundred feet long, with a lead-in of twenty-five feet?—Joseph, Rimsky, Pittsburgh, Pa.

(1)—Yes. (2)—To the minus A post. (3)—Yes. (4)—Yes. The plate and B plus connections are made directly to the transformer. (5)—Yes.

* * *

DOES STATION WCAD, owned and operated by the St. Lawrence University of Canton, N. Y., use a frequency indicator to keep their frequency of 1140 kilocycles constant?—Charles Aster, Boston, Mass.

Yes.

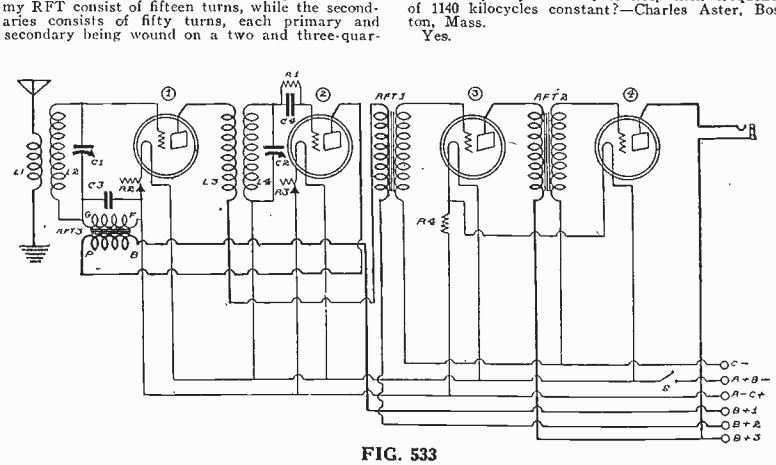


FIG. 533

The four-tube reflex circuit diagram requested by James Hanson.

Photoradio Use In War Envisaged by Sarnoff

'Planes With No Person Aboard May Photograph Enemy Terrain, He Tells the Army War College

In a recent address before the Army War College, Lieut. Colonel David Sarnoff, U. S. Army, Signal Corps Reserve, vice president and general manager of the Radio Corporation of America, spoke of the possible uses of high-speed radio transmission in military operations.

"The development of high-speed facsimile transmission by radio," he says, "opens new and great possibilities in military communicaton."

Military information sent in facsimile will carry its own proof of authenticity to the receiving department and the high speed of transmission will solve the problem of secrecy for military dispatches.

He predicts that before long mechanisms will be available whereby scouting planes soaring over the enemy's lines will be able to send back to headquarters maps and photographs of enemy positions within a few minutes of the time that the photographs were made. We may see the day, he says, when a fleet of aircraft, with no human occupants and loaded with bombs, may be sent against the enemy's lines, with all controlling operations performed by radio, including photography.

Big Possibilities

It may also become possible for the staff at a military base to follow the progress of an air raid more or less accurately by comparing the photoradio maps transmitted with photographs previously taken of the same ground. Thus the progress of the fleet could be plotted and the aircraft steered by radio so that bombs might be dropped when the desired position was reached. After their work had been performed the craft might be steered to return. But even if driven to their destruction they might accomplish their purpose by exploding their charges after they had been brought to the ground.

Colonel Sarnoff goes on to say:

"As the principles of remote control by radio already have been determined it is not impossible to conceive the radio-controlled tank of the future, without human pilotage, being driven toward the enemy's lines.

"Perhaps it would be too fantastic to consider the part that might be played by direct television in the war of the future, but it is not too early to consider the direction which laboratory development should take in its application to military uses.

Television Possibility

"It is conceivable that a radio television transmitter installed in an aeroplane might be useful in transmitting a direct image of the enemy's terrain, thus enabling greater accuracy in gunfire.

"But here, it is believed, is a good point at which to end this address. For while the radio art in its present phases has no more definite limits than the bounds of imagination, it is an admirable principle which commands men to keep their feet on the ground in discussing a subject of practical importance. Yet it is the anomaly of the age we live in that while men may desire to keep their feet firmly planted on Mother Earth scientific progress may whirl the very ground from under them."

Voices of British Actors to Be Trained for Air

Royal Academy of Dramatic Art Institute Course, Following Complaints of Listeners

London.

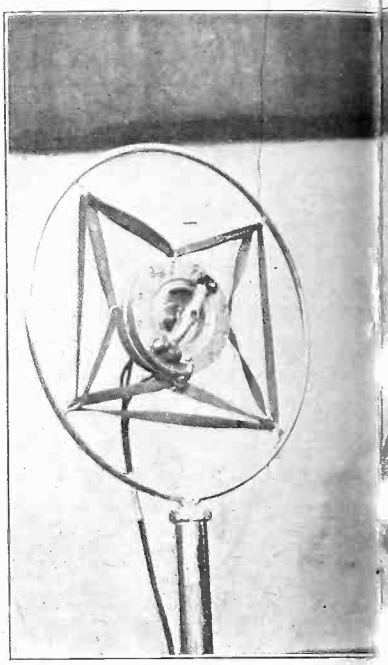
The broadcasting of plays in England has been hampered greatly because of the inability of both actors and actresses properly to gauge the effect of their voices in the microphone and amplifier. The British Broadcasting Company has met with great difficulty in casting radio plays in such a manner that listeners could readily distinguish between the voices of the several members of the cast.

So urgent has become the need for properly trained actors that Kenneth Barnes, principal of the Royal Academy of Dramatic Art, has organized a class where facts about broadcasting acoustics will be taught. Mr. Barnes has chosen a number of his most promising students for this special training and it is hoped they will meet the needs of the radio drama. To further the interest of the students in this course, and to encourage others to familiarize themselves with broadcasting requirements, the British Broadcasting Company has offered substantial prizes for the two students who become most proficient as radio actors.

It has been found that when actors on the radio use their voices as they ordinarily do on the stage that listeners, though they have little difficulty in visualizing the characters, get some unpleasant reactions to those voices. And if the actors use a natural, normal voice, it has been learned that it is extremely hard for listeners to distinguish between them. Consequently, one of the first things the training course will consider will be the proper speaking voice for actors to adopt.

Another thing that has been discovered concerning the problem of play broadcasting is the fact that listeners are often completely lost when actors take up their cues with the same celerity they do in the theatre. Hence an effort will be made to get the actors to make a longer pause than seems necessary in the legitimate theatre.

VOICELESS MAN HE



(Wide World)

A. C. MAHON, who was without a voic recently fitted with a newly perfected de aid of this device, he recently gav

Information o Restricte

Department's Radio Stati Details to Newspapers

An order issued recently by the Navy Department forbids the commandants o naval radio stations to give out to the press or other publicity agencies any information concerning SOS calls that may be received from ships at sea.

Hereafter they may notify only the owners of the vessels in distress, although commandants may "give to agencies o maritime information within their districts such information of casualties a sea which they consider authentic and

Half of Grou In New Yor

That the radio is thought highly of by physicians is demonstrated by the fac that more than half of the New York hospitals in a group of fifty-six non-municipal institutions aided by the United Hospital Fund are now equipped with radio facilities for their patients.

Individual receiving sets are set up in each room and patients are thus enabled to tune in on any program that might suit their fancies for the moment. That this is a great aid and benefit to the sick is heartily acknowledged by Minott A. Osborn, general director of the Fund. It

RD OVER THE AIR

ien his entire larynx was removed, was known as an artificial throat. With the short, address from station WSB.

SOS By the Navy

s Forbidden to Give Any d All Other Inquirers

reliable." Any one seeking information about a vessel will be directed by the Naval stations to the agents or owners of the ship.

The Navy Department took this measure because it believed that information available at one station might be fragmentary and incomplete, thereby possibly resulting in undue alarm to the steamship company and causing unnecessary anxiety and alarm. The companies are very happy that this step was taken.

Hospitals Have Radios

enables them to pass their time in a pleasant manner rather than to spend it in melancholy thoughts about their ills.

Among the twenty-nine hospitals that have installed equipment are St. Luke's, New York Post Graduate, Roosevelt, New York Orthopedic, Lebanon, New York, Beth Israel, New York Eye and Ear Infirmary, Beekman Street, St. Mark's, Sydenham and Park West, the two last-named having had radio wiring systems incorporated in their architectural designs.

Many others are rapidly following suit.

Canada Makes a Bid for Six More Channels

Also Wants Pirating of Its Waves by American Stations Stopped by Federal Government—International Delegates Confer

Canada's request for an increase in her allotment of wavelengths and her complaints against continued interference by American broadcasting stations "pirating" wavelengths already assigned to Canadian broadcasters were the two problems taken under consideration by a special joint commission of the United States and Canada which met at Washington recently.

It is expected that some arrangement will be made to cover the situation until the Federal Radio Commission can act. There is expectation of the establishment of a radio treaty between the United States and Canada unless the Commission is successful.

One possible result of the present conference is a continuation of the "gentlemen's agreement" entered into several years ago, but not adhered to by some American broadcasters. This would afford the new radio commission the opportunity of enforcing observance of the agreement.

Seeks End of Interference

Proper control of the situation would result in Canadian radio stations broadcasting without interference and would enable American radio fans who wish to tune in on Canadian stations to do so without interference. It is not merely the stations located near the Canadian border that cause trouble. Any powerful station in the United States could create interference if it pirated a Canadian wavelength. Officials declared that the eighty-two stations in Canada have lived up to their part of the "gentlemen's agreement" and have adhered strictly to the six wavelengths allotted them.

Want Six More Channels

There are ninety-five available wavelengths in the present broadcasting band. Canada has six of these. The six wavelengths now allocated to Canada, in kilocycles, are 690, 730, 840, 910, 960 and 1,030. If six more channels were given them, as is being contemplated, those free for use in the United States would total eighty-three.

The reduction of the number of channels for use in the United States would increase the difficulties of the Federal Radio Commission. As there are 733 broadcasting stations in this country now and as there are many additional applications before the Radio Commission the problem of allocating wavelengths to all and at the same time preventing chaos in the air is a great one.

The American members of the Joint Commission, which was appointed by request of Secretary Kellogg, are O. H. Caldwell, member of the Federal Radio Commission; W. R. Vallance, assistant to the Solicitor of the State Department, and W. D. Terrell, head of the radio service of the Department of Commerce. The two Canadian members are C. P. Edwards, Director of Radio, and Alexander Johnston, Deputy Minister of Marine and Fisheries.

Minstrel Reunited With Friends After 50 Years

Old-Timer's Broadcast From WGY Heard by Cronies; Glad to Learn One Another Are Still Alive

A broadcasting program, given over WGY, Schenectady, was the means of bringing together a group of persons who had not seen or heard from one another for almost fifty years.

William E. (Big Bill) Winney, widely known old-time minstrel man, recently broadcast a program of old-fashioned minstrel songs and banjo selections. Nearly half a century ago, when the present day vaudeville was known as variety, Mr. Winney, a black-face artist, reached the heights of his theatrical popularity. And evidence that his name had not been forgotten was given him when his work as a member of the Georgia Minstrels of the General Electric Company brought a deluge of telephone calls, telegrams and letters from old-time admirers and co-actors.

Mr. Winney, in talking of his experience, said that he had no sooner completed his numbers when he received three telephone calls from persons he had not heard from in nearly fifty years and each of whom thought the others dead.

It was about 1880 that Mr. Winney became a black-face trouper. His first lessons in black-face singing and banjo playing were given him by Frank Converse and Horace Weston, famous old-time banjo players of the negro school in New York City.

Some fifteen years ago Mr. Winney decided to leave the ranks of the minstrels and went into the restaurant business in Oneonta, N. Y., ad has been engaged in that business since. His broadcasting programs will be continued through Station WGY.

Receivers, Earphones and Speaker on Trains

Plans are being made to equip each chair in the club and observation cars of the Louisville & Nashville Roalroad "Pan-American Flier" with a pair of headphones for the reception of broadcast concerts, according to Frank A. D. Andrea, president of the Fada Radio Corporation. Loop-operated receivers will be utilized. Tests have demonstrated that good reception can be obtained from a loop.

Photoradio Use In War Envisaged by Sarnoff

Planes With No Person Aboard May Photograph Enemy Terrain, He Tells the Army War College

[illegible] address before the Army War College, Lieut.-Colonel David Sarnoff [illegible] Army Signal Corps Reserve, [illegible] and general manager of the Radio Corporation of America, spoke of the possibilities of high speed radio transmission in military operations.

This development of high-speed tactical transmission by radio," he says, "opens new and great possibilities in military communication.

"Military information sent in facsimile with [illegible] proof of authenticity [illegible] the receiving instrument and the high [illegible] of transmission will solve the problem [illegible] for military dispatches.

"The problem that before long mechanical [illegible] available, whereby scouting planes soaring over the enemy's lines will [illegible] send back to headquarters [illegible] photographs of enemy positions within a few minutes of the time that the photographs were made. We may see the day, he says, when a fleet of aircraft, with no human occupants and loaded with explosives, may be sent against the enemy's lines while all controlling operations performed by radio, including photography.

Big Possibilities

"It may also become possible for the land [illegible] military base to follow the progress of an air raid more or less accurately by [illegible] the photographic maps [illegible] with photographs previously taken [illegible] ground. Thus the progress of the fleet could be plotted and the aircraft steered by radio so that bombs might be dropped when the desired position was reached. After their work had been performed the craft might be steered to return. But even if driven to their destruction, they might accomplish their purpose by exploding their charges after they had been brought to the ground.

Colonel Sarnoff goes on to say:

"As the principles of remote control by radio already have been determined it is not impossible to conceive the radio-controlled tank of the future without human passenger, being driven toward the enemy's lines.

"Perhaps it would be too fantastic to consider the part that might be played by direct television in the war of the future but it is not too early to consider the direction which laboratory development should take in its application to military uses.

Television Possibility

"It is conceivable that a radio television transmitter installed in an aeroplane might be useful in transmitting a direct image of the enemy's terrain, thus enabling greater accuracy in gunfire.

"But here, it is believed, is a good point at which to end this address. For while the radio art in its present phases has no more definite limits than the bounds of imagination, it is an admirable principle which commands men to keep their feet on the ground in discussing a subject of practical importance. Yet it is the anomaly of the age we live in that while men may desire to keep their feet firmly planted on Mother Earth, scientific progress may whirl the very ground from under them."

Voices of British Actors to Be Trained for Air

Royal Academy of Dramatic Art Institute Course, Following Complaints of Listeners

London.

The broadcasting of plays in England has been hampered greatly because of the inability of both actors and actresses properly to gauge the effect of their voices on the microphone and amplifier. The British Broadcasting Company has met with great difficulty in casting radio plays in such a manner that listeners could readily distinguish between the voices of the several members of the cast.

So urgent has become the need for properly trained actors that Kenneth Barnes, principal of the Royal Academy of Dramatic Art, has organized a class where facts about broadcasting acoustics will be taught. Mr. Barnes has chosen a number of his most promising students for this special training and it is hoped they will meet the needs of the radio drama. To further the interest of the students in this course and to encourage others to familiarize themselves with broadcasting requirements the British Broadcasting Company has offered substantial prizes for the two students who become most proficient as radio actors.

It has been found that when actors of the radio use their voices as they ordinarily do on the stage that listeners though they have little difficulty in recognizing the characters get some unpleasant reactions to those voices. And if the actors use a natural, normal voice it has been learned that it is extremely hard for listeners to distinguish between them. Consequently one of the first things the training course will consider will be the proper speaking voice for actors to adopt.

Another thing that has been discovered concerning the problem of play broadcasting is the fact that listeners are often completely lost when actors take up their cues with the same celerity they do in the theatre. Hence an effort will be made to get the actors to make a longer pause than seems necessary in the intimate theatre.

VOICELESS MAN HE

Wide World.

A. C. MAHON, who was without a voice recently [illegible] with a newly patterned [illegible] and of this device, he recently [illegible]

Information o Restricte

Department's Radio Stati Details to Newspapers

According [illegible] recently to the Navy Department [illegible] the commandants of naval radio stations to give out to the press or other publicity agencies any information concerning SOS calls that may be received from ships at sea.

Hereafter they may notify only the owners of the vessels in distress, although commandants may give to agencies of maritime information within their districts such information of casualties as [illegible] they consider authentic [illegible]

Half of Grou In New Yo

That the radio is thought highly of by [illegible] is demonstrated by the fact that more than half of the New York hospitals in a group of fifty-six non-profit [illegible] aided by the United Hospital Fund are now equipped with radio facilities for their patients.

Individual receiving sets are set up in each room and patients are thus enabled to tune in on any program that might suit their tastes for the moment. That this is a great aid and benefit to the sick is heartily acknowledged by Minott A. Osborn, general director of the Fund. It

RD OVER THE AIR

hen his entire larynx was removed, was known as an artificial throat. With the short address from station WSB.

SOS By the Navy

s Forbidden to Give Any d All Other Inquirers

reliable." Any one seeking information about a vessel will be directed by the Naval stations to the agents or owners of the ship.

The Navy Department took this measure because it believed that information available at one station might be fragmentary and incomplete, thereby possibly resulting in undue alarm to the steamship company and causing unnecessary anxiety and alarm. The companies are very happy that this step was taken.

Hospitals Have Radios

enables them to pass their time in a pleasant manner rather than to spend it in melancholy thoughts about their ills.

Among the twenty-nine hospitals that have installed equipment are St. Luke's, New York Post Graduate, Roosevelt, New York Orthopedic, Lebanon, New York, Beth Israel, New York Eye and Ear Infirmary, Beekman Street, St. Mark's, Sydenham and Park West, the two last-named having had radio wiring systems incorporated in their architectural designs.

Many others are rapidly following suit.

Canada Makes a Bid for Six More Channels

Also Wants Pirating of Its Waves by American Stations Stopped by Federal Government—International Delegates Confer

Canada's request for an increase in her allotment of wavelengths and her complaints against continued interference by American broadcasting stations "pirating" wavelengths already assigned to Canadian broadcasters were the two problems taken under consideration by a special joint commission of the United States and Canada which met at Washington recently.

It is expected that some arrangement will be made to cover the situation until the Federal Radio Commission can act. There is expectation of the establishment of a radio treaty between the United States and Canada unless the Commission is successful.

One possible result of the present conference is a continuation of the "gentlemen's agreement" entered into several years ago, but not adhered to by some American broadcasters. This would afford the new radio commission the opportunity of enforcing observance of the agreement.

Seeks End of Interference

Proper control of the situation would result in Canadian radio stations broadcasting without interference and would enable American radio fans who wish to tune in on Canadian stations to do so without interference. It is not merely the stations located near the Canadian border that cause trouble. Any powerful station in the United States could create interference if it pirated a Canadian wavelength. Officials declared that the eighty-two stations in Canada have lived up to their part of the "gentlemen's agreement" and have adhered strictly to the six wavelengths allotted them.

Want Six More Channels

There are ninety-five available wavelengths in the present broadcasting band. Canada has six of these. The six wavelengths now allocated to Canada, in kilocycles, are 690, 730, 840, 910, 960 and 1,030. If six more channels were given them, as is being contemplated, those free for use in the United States would total eighty-three.

The reduction of the number of channels for use in the United States would increase the difficulties of the Federal Radio Commission. As there are 733 broadcasting stations in this country now and as there are many additional applications before the Radio Commission the problem of allocating wavelengths to all and at the same time preventing chaos in the air is a great one.

The American members of the Joint Commission, which was appointed by request of Secretary Kellogg, are O. H. Caldwell, member of the Federal Radio Commission; W. R. Vallance, assistant to the Solicitor of the State Department, and W. D. Terrell, head of the radio service of the Department of Commerce. The two Canadian members are C. P. Edwards, Director of Radio, and Alexander Johnston, Deputy Minister of Marine and Fisheries.

Minstrel Reunited With Friends After 50 Years

Old-Timer's Broadcast From WGY Heard by Cronies; Glad to Learn One Another Are Still Alive

A broadcasting program, given over WGY, Schenectady, was the means of bringing together a group of persons who had not seen or heard from one another for almost fifty years.

William E. (Big Bill) Winney, widely known old-time minstrel man, recently broadcast a program of old-fashioned minstrel songs and banjo selections. Nearly half a century ago, when the present day vaudeville was known as variety, Mr. Winney, a black-face artist, reached the heights of his theatrical popularity. And evidence that his name had not been forgotten was given him when his work as a member of the Georgia Minstrels of the General Electric Company brought a deluge of telephone calls, telegrams and letters from old-time admirers and co-actors.

Mr. Winney, in talking of his experience, said that he had no sooner completed his numbers when he received three telephone calls from persons he had not heard from in nearly fifty years and each of whom thought the others dead.

It was about 1880 that Mr. Winney became a black-face trouper. His first lessons in black-face singing and banjo playing were given him by Frank Converse and Horace Weston, famous old-time banjo players of the negro school in New York City.

Some fifteen years ago Mr. Winney decided to leave the ranks of the minstrels and went into the restaurant business in Oneonta, N. Y., ad has been engaged in that business since. His broadcasting programs will be continued through Station WGY.

Receivers, Earphones and Speaker on Trains

Plans are being made to equip each chair in the club and observation cars of the Louisville & Nashville Roalroad "Pan-American Flier" with a pair of headphones for the reception of broadcast concerts, according to Frank A. D. Andrea, president of the Fada Radio Corporation. Loop-operated receivers will be utilized. Tests have demonstrated that good reception can be obtained from a loop.

A THOUGHT FOR THE WEEK

WITH a scratch of the pen, President Collidge made the new radio regulations a part of our Federal law structure. Fine—but don't expect the impossible. First must come order out of chaos; then decided improvement; and finally, an approximation of perfect air control.

SIXTH YEAR

RADIO WORLD

The First and Only National Radio Weekly

Radio World's Slogan: "A radio set for every home."

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HELPFUL HINTS

In soldering, use Lux flux, because it assures clean contact.

To erect an antenna on a tree, it is best to cut off all the limbs so as to prevent absorption of the radio waves. Of course, the best procedure would be to start at the top, so as to insure getting to the higher vantage point in case the neighbors complain.

By reversing the tickler coil winding and at the same time incorporating a harmonic suppressor in the antenna circuit, one can rest assured that he will receive but one station at a time, even if it be the only one at all times. The slogan of radio fans should be "One at a time fellows, that's all we want, when we do want 'em."

Weather: Slightly warmer followed by colder and warmer.

"Intelligensia Dementia"

* * * * *

5-Star Complete Final

THE RADIO TABLOID

Vol. Small, No. Less

Price—What Have You?

NOTED SCIENTIST DISCOVERS UNIQUE WAVE PHASE SHIFTER

Dr. Phumf Makes Startling Discovery When Delving Into the Mysteries of the Effects of Dielectric Hysteresis Upon Ozonized Ionic Rarefied Atmosphere

Working in a sausage balloon nearly four miles aloft, 20 yards abaft a snow cloud, Dr. Titus Aloysius Phumf, with his trusted laboratory technician, Henry McQ. Feitlebaum, chief of applied radio technical mechanics, was able to prove, after many weary months of toil, that the rarefied upper atmosphere contained the medium of the propagation of high frequency sinusoidal currents and that by means of his special wave analyzer he was able to change heterodyning carrier waves into inaudible frequencies of various colors.

Never before has a scientist carried on his work with such zeal and effort as has Dr. Phumf. The most surprising result of his researches has led to the statement that the hypothetical ether has a dielectric hysteresis value of 14.7-in. This is really astounding in the light of the investigations of Beermugs and Heinfinch, who conducted what appears to be a most plausible method of attack and who found the value to lie in the neighborhood of 14.657-in. Such a discrepancy has never been tolerated in scientific circles and a commission to investigate Dr. Phumf's illuminating work has been appointed, but not yet disappointed.

Mr. Feitlebaum, upon the instigation of the learned Doctor, gave the details of the special wave analyzer its modus operandi and its medulla obbligato. In short, it consisted of a super-charged thermo-galvanic electrometer using as a conductive substance the rare metal Nuphonium in which a non-hygroscopic turmoline crystal of pure quartz was sublimated. By employing an intense magnetic field of 3,600 gausses per square millimeter, it was possible to diversify every single oscillation in carrier waves of 30,000 meters to those which consisted of but one one-hundredth of a meter in length and with the proper heterodyning frequency obtain the colors of the spectrum in such varying hues as have never before been achieved.

It is predicted that the art of television may be greatly enhanced by this seeming miraculous discovery.

Point of Optimism In Dread Disease

A strange disease is reported as spreading among the thousands of radio clerks working in the downtown radio section of New York City. The victim's hair stands erect, like the quills of a porcupine, despite the restraining effects of hair glue, and sparks shoot forth from the body, making the patient resemble a Fourth of July pinwheel. The afflicted one is also luminous in the dark. Professor Dimplenoodle, of Wuff University, attributes it to brainstrain, combined with the heavy labor of selling, the body also becoming saturated with electrical particles and radio waves due to the constant handling of radio parts. Savants from all over the world are rushing to New York to study and combat this strange disease. The entire Institute of Radio Engineers has been mobolized. The store proprietors are installing rest rooms for the clerks and quarters for nurses. In fact, it has just been made known that these humanitarian owners have been preparing club rooms and billiard rooms with attached gymnasiums and libraries for their clerks. This is being done in preparation for the strenuous summer season which brings a terrific strain to bear on the employees.

DX VS LOCALS

He: What's the matter with that of set?

She: I'm sure I don't know.

He: Well, that was what I should have expected.

She: Well, if you know your onions, bake this lemon pie!

G. M. G. C. New Fad Invented by OOF

Station OOF of the Good-Morning Glory Club of Hoboken, N. H., has inaugurated a new fad for the over-zealous white collar man who would sleep after his alarm clock has been thrown out of the window. By taxing the members—and by the way, their methods have not been disclosed—it is reported $23.75 was collected. The wavelength is 492 meters, 0.2 meter from EAF.

To become a member of the G. M. G. C. H. to obtain all the benefits, it is necessary only to send your dues, express prepaid. And what are the dues?

Only this: All your old shoes, alarm clocks and stray cats in your neighborhood. You are guaranteed to be awakened in the morning by the strains of "Arouse mit you, station OOF!"

Competition Is Stiff; New Rivals Arrive

A rumor from Wall Street says that a prominent auto manufacturer is to enter the radio business with a line of tin receivers, which, naturally, will be totally shielded. In retaliation, a prominent radio manufacturer who makes the largest sets in the business says that he will turn them out with wheels and an engine in front, thus making a real portable auto set. A foremost independent tube maker, noted for the brilliance of his tubes, in other words, the bright emission, promises to enter the automotive headlight field.

Special automatic filament heater adjustors will be incorporated within each tube.

Complete List of Stations

Corrected up to March 23, 1927

Station	Location	Owner	Meters
KBMH	Detroit, Mich.,	Braun's Music House	352.7
KDGR	San Antonio, Tex.,	Radio Engineers	240
KDKA	East Pittsburgh, Pa.,	Westinghouse, house E. & M. Co.	309.1
KDLR	Devils Lake, N. D.,	Radio Elec. Co.	231
KDYL	Salt Lake City, Utah,	Inter. Bdsctg. Corp.	246.8
KELW	Burbank, Calif.,	E. C. White	535
KEX	Portland, Ore.,	Western Broadcast Co.	447.5
KFAB	Lincoln, Neb.,	Neb. Buick Auto Co.	340.7
KFAD	Phoenix, Ariz.,	Elec. Equip. Co.	273
KFAF	San Jose, Cal.,	A. E. Fowler	217.3
KFAU	Boise, Idaho,	Indep. Sch. Dist. of Boise	280.2
KFBB	Havre, Mont.,	F. A. Buttrey & Co.	275
KFBC	San Diego, Cal.,	W. K. Azbill	380
KFBK	Sacramento, Calif.,	Kinball Upson Co.	535.4
KFBL	Everett, Wash.,	Leese Bros.	224
KFBS	Trinidad, Cal.,	School District No. 1	238
KFBU	Laramie, Wyo.,	St. Matthews Cathedral	374.8
KFCB	Phoenix, Ariz.,	Nielson Radio Supply Co.	238
KFDD	Boise, Idaho,	St. Michael Cathedral	275.1
KFDM	Beaumont, Tex.,	Magnolia Petroleum Co.	315.6
KFDX	Shreveport, La.,	First Baptist Church	236.1
KFDY	Brookings, S. D.,	S. D. State College	299.8
KFDZ	Minneapolis, Minn.,	H. O. Iverson	231
KFEC	Portland, Ore.,	Meier & Frank	252
KFEL	Denver, Colo.,	E. P. O'Fallon, Inc.	254.1
KFEQ	St. Joseph, Mo.,	Scroggin & Co.	268
KFEY	Kellog, Idaho,	Bunker Hill & Sullivan	233
KFFP	Moberly, Mo.,	First Baptist Church	242
KFH	Witchita, Kans.,	Hotel Lassen	267.7
KFHA	Gunnison, Colo.,	Western State College	252
KFHL	Oskaloosa, Ia.,	Penn College	240
KFGN	Aneta, N. J.,	Haraldson & Thingstead	222
KFI	Los Angeles, Cal.,	Earl C. Anthony, Inc.	467
KFIF	Portland, Ore.,	Benson Poly. Inst.	247.8
KFIO	Spokane, Wash.,	North Central High School	272.6
KFIQ	Yakima, Wash.,	First Methodist Church	256
KFIU	Juneau, Alaska,	Alaska Elec. Light & Power Co.	226
KFIZ	Fond Du Lac, Wisc.,	Fond Du Lac Commonwealth Reporter	273
KFJB	Marshalltown, Ia.,	Marshall Electric Co.	248
KFJF	Oklahoma City, Okla.,	Nat'l. Radio Mfg. Co.	260.7
KFJI	Astoria, Ore.,	E. E. Marsh	245.8
KFJM	Grand Forks, N. D.,	Univ. of N. D.	278
KFJR	Portland, Ore.,	A. C. Dixon & Son	263
KFJY	Fort Dodge, Ia.,	Tunwall Radio Co.	246
KFJZ	Fort Worth, Tex.,	W. E. Branch	254.1
KFKA	Greeley, Colo.,	Colo. State Teachers Col.	273
KFKB	Milford, Kans.,	Dr. J. R. Brinkley	434.5
KFKU	Lawrence, Kans.	Univ. of Kans.	275
KFKX	Hastings, Neb.,	Westinghouse, E. & M. Co.	288.3
KFKZ	Kirksville, Mo.,	Cham. of Com.	225.4
KFLR	Albuquerque, N. M.,	Univ. of N. M.	254
KFLU	San Benito, Tex.,	San Benito Radio Club	236
KFLV	Rockford, Ill.,	Swedish Evan. Church	229
KFLX	Galveston, Tex.,	Geo. Roy Clough	240
KFMR	Sioux City, Ia.,	Morningside College	261
KFMX	Northfield, Minn.,	Carlton College	336.9
KFNF	Shenandoah, Ia.,	Henry Field Seed Co.	461.3
KFOA	Seattle, Wash.,	Rhodes Dept. Store	454.3
KFOB	Burlingame, Cal.,	K. F. O. B., Inc.	225.4
KFQD	Anchorage, Alaska,	Anchor. Radio Club	300
KFON	Long Beach, Calif.,	Nichols & Warimer, Inc.	232.4
KFOR	David City, Neb.,	Tire & Electric Co.	226
KFOT	Wichita, Kans.,	College Hill Radio Club	231
KFOX	Omaha, Neb.,	Technical H. S.	248
KFOY	St. Paul, Minn.,	Beacon Radio Service.	252
KFPL	Dublin, Tex.,	C. C. Baxter	252
KFPM	Greenville, Tex.,	New Furniture Co.	242
KFPR	Los Angeles, Calif.,	L. A. County For. Dept.	231
KFPW	Carterville, Mo.,	St. John's Methodist Episcopal Church	258
KFPY	Spokane, Wash.,	Symons Investment Co.	272.6
KFQA	St. Louis, Mo.,	The Principa	261
KFQB	Fort Worth, Tex.,	Searchlight Publishing Co.	508.2
KFQD	Anchorage, Alaska,	Anchorage Radio Club	300
KFQP	Iowa City, Ia.,	G. S. Carson, Jr.	224
KFQU	Holy City, Cal.,	W. E. Riker	230.6
KFQW	North Bend, Wash.,	C. F. Knierim	215.7
KFQX	Seattle, Wash.,	A. M. Hubbard	210
KFQZ	Hollywood, Cal.,	Taft Products Co.	226
KFRB	Beeville, Tex.,	Hall Brothers	248
KFRC	San Francisco, Calif.,	Don Lee, Inc.	267.7
KFRU	Columbia, Mo.,	Stephens College	499.7
KFSD	San Diego, Cal.,	Airfan Radio Corp.	245.8
KFSG	Los Angeles, Calif.,	Echo Park Evan. Assn.	275.1
KFUL	Galveston, Tex.,	T. Goggan & Bros.	258
KFUM	Colorado Springs, Colo.,	W. D. Corley	239.9
KFUO	St. Louis, Mo.,	Concordia Seminary	545.1
KFUP	Denver, Col.,	Fitzsimmons Gen. Hosp.	234
KFUR	Salt Lake City, Utah,	L. L. Sherman	256.2
KFUS	Oakland, Cal.,	L. L. Sherman	256
KFUT	Salt Lake City, Utah,	Univ. of Utah	263
KFUU	Oakland, Calif.,	Colburn Radio Lab.	220.4
KFVD	San Pedro, Calif.,	C. & W. J. McWhinnie	208
KFVE	St. Louis, Mo.,	Benson Bdcstg. Corp.	239.9
KFVG	Independence, Kans.,	First M. E. Church	236.1
KFVI	Houston, Tex.,	Headquarters Troop, 56th Calvary	240
KFVN	Fairmont, Minn.,	C. E. Bagley	227
KFVR	Denver, Col.,	Moonlight Ranch	244
KFVS	Cape Girardeau, Mo.,	Cape Girardeau Battery Station	224
KFVY	Albuquerque, N. M.,	Radio Supply Co.	250
KFWB	Hollywood, Cal.,	Warner Bros. Pic.	252
KFWC	San Bernardino, Calif.,	L. E. Wall	291.9
KFWF	St. Louis, Mo.,	St. Louis Truth Center	214.2
KFWH	Eureka, Calif.,	F. W. Morse, Jr.	254
KFWI	S. South Francisco, Cal.,	Oakland En Society	249.9
KFWM	Oakland, Calif.,	Oakland Educa. Soc.	325
KFWO	Avalon, Cal.,	Lawrence Mott	211.1
KFWU	Pineville, La.,	Louisiana College	238
KFWV	Portland, Ore.,	KFWV Bdcst. Studios	212.6
KFXB	Big Bear Lake, Calif.,	B. C. Heller	352.7
KFXD	Logan, Utah,	Service Radio Company	205.4
KFXF	Denver, Col.,	Pikes Peak Broadcasting Company	430.1
KFXH	El Paso, Tex.,	Biedsoe Radio Co.	242
KFXJ	Near Edgewater, Col.,	R. G. Howell	215.7
KFXR	Oklahoma City, Okla.,	Classen Film Finishing Co.	214.2
KFXY	Flag Staff, Ariz.,	M. N. Costigan	205.4
KFYF	Oxnard, Cal.,	Carl's Radio Den	214.2
KFYJ	Portable, Tex.,	Houston Chronicle Publishing Company	238
KFYR	Bismark, N. D.,	Hoskins-Meyer, Inc.	248
KGAR	Tucson, Ariz.,	Tucson Citizen	243.8
KGBS	Tucson, Ariz.,	A. C. Dailey	227
KGBU	Ketchikan, Alaska,	Alaska Radio and Service Company	228.9
KGBX	St. Joseph, Mo.,	Forster Hall Co.	347.8
KGBY	Shelby, Neb.,	Dunning & Taddikon	202.6
KGBZ	York, Neb.,	Federal Live Stock Remedy Company	333.1
KGCA	Decorah, Ia.,	C. W. Greenle	280.2
KGCB	Wayne, Neb.,	Wayne Hospital	434.5
KGCG	Newark, Ark.,	Moore Motor Co.	234.2
KGCH	Wayne, Neb.,	Wayne Hospital	434.5
KGCI	San Antonio, Tex.,	Liberto Radio Sales	239.9
KGCL	Seattle, Wash.,	Louis Wasmer	238
KGCM	San Antonio, Tex.,	R. B. Bridge	263
KGCN	Concordia, Kans.,	Concordia Bdcstg Co.	235
KGCR	Brookings, S. D.,	Cutlers Broadcasting Service	252
KGCU	Mandan, N. D.,	Mandan Radio Assn.	285
KGCX	Vida, Mont.,	First State Bank	240
KGDA	Dell Rapids, S. D.,	Home Auto Co.	254.1
KGDE	Barrette, Minn.,	Jaren Drug Co.	232.4
KGDJ	Cresco, Ia.,	R. Rothert	405.2
KGDI	Seattle, Wash.,	N. W. Radio Service Co.	416.4
KGDJ	Cresco, Ia.,	R. Rathert	202.6
KGDM	Stockton, Calif.,	V. G. Koping & C. F. Peffer	217.2
KGDO	Dallas, Tex.,	C. H. & Henry Garrett	285
KGDP	Boy Scouts Pueblo, Colo.,	Boy Scouts	260
KGDW	Humboldt, Neb.,	F. J. Rist	241.8
KGDY	Oldham, S. D.,	L. A. Loesch	210
KGDZ	Decorah, Ia.,	New Norwegian Luther Coll.	431
KGEF	Los Angeles, Cal.,	Trinity Meth. Ch.	516.9
KGEH	Eugene, Ore.,	Eugene Bdcst. Station	236.1
KGEK	Yuma, Colo.,	Beehler Elec. Equip. Co.	252
KGEL	Jamestown, N. D.,	E. W. Ellison	225
KGEN	El Centro, Cal.,	E. R. Irey & F. M. Bowles	281
KGEO	Grand Island, Nebr.,	R. D. Chamberlain	271
KGER	Long Beach, Cal.,	C. M. Dobyns	325.9
KGES	Central City, Neb.,	Central Radio Elec. Co.	205.4
KGEU	Lower Lake, Cal.,	L. W. Clement	222
KGEW	Fort Morgan, Colo.,	City of Morgan	256
KGEY	Denver, Colo.,	J. W. Deitz	204
KGFG	Oklahoma City, Okla.,	Full Gospel Ch.	384
KGFH	La Crescenta, Cal.,	Frederick Robinson	218.8
KGFI	Fort Stockton, Tex.,	M. L. Eaves	220.4
KGFJ	Los Angeles, Cal.,	Bon S. McGlashan	340.7
KGFK	Hallbock, Minn.,	Kittson Co. County Enter.	225
KGFL	Trinidad, Colo.,	Trinidad B'rdcasting Co.	222
KGFM	Yuba City., Calif.,	G. W. Johnson	450
KGFP	Mitchell, S. D.,	Mitchell Broadcast Co.	263
KGO	Oakland, Cal.,	General Electric Co.	361.2
KGRC	San Antonio, Tex.,	Gene Roth & Co.	315
KGRS	Amarillo, Tex.,	Gish Radio Service	234
KGTT	San Francisco, Cal.,	Glad Tidings Temple & Bible Inst.	206.8
KGU	Honolulu, T. H.,	Marion A. Mulrony	270
KGW	Portland, Ore.,	Oregonian Pub. Co.	491.5
KGY	Lacey, Wash.,	St. Martins College	277.6
KHJ	Los Angeles, Cal.,	Times Mirror Co.	405.2
KHQ	Spokane, Wash.,	Louis Wasmer	394.5
KICK	Anita, Ia.,	Atlantic Auto Co.	272.6
KJBS	San Francisco, Cal.,	J. Brunton & Sons Co.	220.4
KJR	Seattle, Wash.,	Northwest Radio Serv. Co.	384.4
KKP	Seattle, Wash.,	City of Seattle	260
KLDS	Independence, Mo.,	Reorganized Church of Jesus Christ	440.9
KLIT	Portland, Ore.,	L. I. Thompson	380
KLS	Oakland, Cal.,	Warner Brothers	250
KLX	Oakland, Cal.,	Tribune Publishing Co.	508.2
KLZ	Denver, Col.,	Reynolds Radio Co.	384.4
KMA	Shenandoah, Ia.,	May Seed & Nursery	461.3
KMED	Medford, Ore.,	W. J. Virgin	250
KMIC	Inglewood, Calif.,	J. R. Fouch	387
KMJ	Fresno, Cal.,	The Fresno Bee	234.2
KMMJ	Clay Center, Neb.,	M. M. Johnson Co.	228.9
KMO	Kokomo, Wash.,	KMO, Inc.	249.9
KMOX	St. Louis, Mo.,	Voice of St. Louis	280.2
KMTR	Hollywood, Calif.,	KMTR Radio Corp.	370.2
KNRC	Santa Monica, Calif.,	C. B. Juneau	238
KNX	Los Angeles, Cal.,	Los Angeles Express	336.9
KOA	Denver, Col.,	General Electric Co.	322.4
KOAC	Corvallis, Ore.,	Oregon Agriculture Col.	280.2
KOB	State College, N. M.,	New Mexico College of Agriculture	348.6
KOCH	Omaha, Neb.,	Omaha Central H. S.	258
KOCW	Chickashia, Okla.,	Okla. College for Women	270.1
KOIL	Council Bluffs, Ia.,	Mona Motor Co.	305.9
KOIN	Portland, Ore.,	KOIN, Inc.	319
KOLO	Durango, Colo.,	G. K. Hunter	355.1
KOMO	Seattle, Wash.,	Fisher Blend Station	305.9
KOWW	Walla Walla, Wash.,	F. A. Moore	285
KPCB	Seattle, Wash.,	Pacific Coast Biscuit Co.	521
KPO	San Francisco, Cal.,	Hale Bros., Inc.	428.3
KPJM	Prescott, Ariz.,	Wilburn Radio Service	215
KPPC	Pasadena, Cal.,	Pasadena Presbyterian Church	229
KPRC	Houston, Tex.,	Houston Priting Co.	296.9
KPSN	Pasadena	Star-News, Pasadena, Ca.	315.6
KQW	San Jose, Cal.,	First Baptist Church	333.1
KQV	Pittsburgh, Pa.,	Doubleday Hill Electric Company	275
KRAC	Shreveport, La.,	Caddo Radio Club	220
KRLD	Dallas, Tex.,	Dallas Radio Labs., Inc.	357.1
KRLO	Los Angeles, Calif.,	Freedman Land	440
KROW	Portland, Ore.,	Oregon Bdcst. Co.	231
KROX	Seattle, Wash.,	N. D. Brown	265.3
KRSC	Seattle, Wash.,	Radio Sales Corp.	499.7
KRE	Berkeley, Cal.,	Berkeley Daily Gazette	256
KSAC	Manhattan, Kans.,	Kansas State Agricultural College	340.7
KSBA	Shreveport, La.,	W. G. Patterson	260.7
KSCJ	Sioux City, Ia.,	Sioux City Journal	444
KSD	St. Louis, Mo.,	Pulitzer Publishing Co.	545.1
KSEI	Pocatello, Idaho,	KSEI Bdsctg. Co.	260.7
KSL	Salt Lake City, Utah,	Radio Service Corp.	299.8
KSMR	Santa Maria, Cal.,	Santa Maria Valley R. R.	282.8
KSO	Clarinda, Ia.,	A. A. Berry Seed Co.	405.2
KSOO	Sioux Falls, S. D.,	Sioux Falls Broadcasting Assn.	360
KTAB	Oakland, Calif.,	Ass. Bdcstrs	302.8
KTAP	San Antonio, Tex.,	R. B. Bridge	263
KTBI	Los Angeles, Calif.,	Bible Institute	293.9
KTBR	Portland, Ore.,	M. E. Brown	263
KTHS	Hot Springs, Ark.,	New Arlington Hotel	374.8
KTNT	Muscatine, Ia.,	Norman Baker	333.1
KTUE	Houston, Tex.,	Uhalt Electric	263
KTW	Seattle, Wash.,	First Presbyterian Church	454.3
KUJ	Seattle, Wash.,	Puget Sound Bdcst. Co.	352.5
KUOA	Fayetteville, Ark.,	University of Ark.	299.8
KUOM	Missoula, Mont.,	University of Mont.	243.8
KUSD	Vermillion, S. D.,	University of S. D.	278
KUT	Austin, Tex.,	University of Tex.	272.6
KVI	Tacoma, Wash.,	Puget Sound Bdcst. Co.	342.5
KVOO	Bristow, Okla.,	SW Sales Corp.	374.8
KVOS	Seattle, Wash.,	L. L. Jackson	333
KWBS	Portland, Ore	Schaeffer Mfg Co.	200
KWCR	Cedar Rapids, Ia.,	H. F. Parr	296
KWG	Stockton, Cal.,	Portable Wireless Telegraph Co.	248
KWKC	Kansas City, Mo.,	Wilson Duncan Studios	236
KWKH	Shreveport, La.,	The W. K. Henderson Iron Works and Supply Co.	312.3
KWSC	Pullman, Wash.,	State College of Wash.	348.6
KWTC	Santa Ana, Cal.,	Dr. J. W. Hancock.	263
KWUC	Lemars, Ia.,	Western Union College.	252
KWWG	Brownsville, Tex.,	Chambers of Com.	278
KYA	San Francisco, Cal.,	Pacific Bdcst. Corp.	399.8
KYW	Chicago, Ill.,	Westinghouse E. & M. Co.	535.4
KXL	Portland, Ore.,	KXL Bdcstg.	400
KZKZ	Manila, P. I.,	Electric Supply	270
KZM	Oakland, Cal.,	Preston D. Allen	240
KZRG	Manila, P. I.,	Far Eastern Radio, Inc.	222
NAA	Arlington, Va.,	U. S. Navy	435
WAAD	Cincinnati, O.,	Ohio Mechanical Inst.	258
WAAF	Chicago, Ill.,	Daily Drovers Journal	227.6
WAAM	Newark, N. J.,	Isaiah R. Nelson	263
WAAT	Jersey City, N. J.,	F. B. Bremer	235
WAAW	Omaha, Neb.,	Omaha Grain Exchange.	384.4
WABB	Harrisburg, Pa.,	Harrisburg Radio Co.	204
WABC	Richmond Hill, N. Y.,	Atlantic Bdcst. Co.	315.6
WABF	Pringleboro, Pa.,	Markle Bdcst. Corp.	410.7
WABI	Bangor, Me.,	First Universalist Church	240
WABO	Rochester, N. Y.,	Hickson Elec. Co.	278
WABQ	Philadelphia, Pa.,	Keyston Bdcst. Co.	260.7
WABR	Toledo, O.,	Scott High School	263
WABW	Wooster, O.,	The College of Wooster	206.8
WABX	Mount Clemens, Mich.,	H. B. Joy	246
WABY	Philadelphia, Pa.,	J. Magaldi, Jr.	242
WABZ	New Orleans, La.,	Colis Place Baptist Church	275.1
WADC	Akron, O.,	Allen T. Simmons	258
WAFD	Detroit, Mich.,	A. B. Starfet Co.	312.3
WAGM	Royal Oak, Mich.	R. L. Miller	225.4
WAGS	Somerville, Mass.,	Willow Garages, Inc.	250
WAIT	Tauton, Mass.,	A. H. Waite & Co.	229
WAIU	Columbus, O.,	American Ins. Union	293.9
WALK	Bethayres, Pa.,	(portable) A. A. Walker	285
WAMD	Minneapolis, Minn.,	Radisson Radio Corp., & S. E. Hubbard	243.8
WAOK	Ozone Park, N. Y.,	A. H. Andreason.	247.8
WAPI	Auburn, Ala.,	Alabama Polytechnic Inst.	461.3
WARC	Medford, Mass.,	American Radio & Research	261
WARS	Brooklyn, N. Y.,	Amateur Radio Specialty Co.	295
WASH	Grand Rapids, Mich.,	Baxter Launderers & Cleaners	256.3
WATT	Portable-First Dist.,	Edison Elec. Ill.	243.8
WBAA	W. Lafayette, Ind.,	Purdue, Univ.	273
WBAK	Harrisburg, Pa.,	Pa. State Police	275
WBAL	Baltimore, Md.,	Consol. Gas & Power Co	245.8
WBAO	Decatur, Ill.,	James Milliken Univ.	270.1
WBAP	Fort Worth, Tex.,	Carter Pub., Inc.	475.9
WBAW	Nashville, Tenn.,	Waldrun Drug Co.	236
WBAX	Wilkes-Barre, Pa.,	J. H. Stenger, Jr.	256
WBBC	Brooklyn, N. Y.,	Bklyn. B'dsctg. Co.	267.7
WBBL	Richmond, Va.,	Grace Covenant Pres. Church	228.9
WBBM	Chicago, Ill.,	Atlass Investment	226
WBBP	Petosky, Mich.,	Petosky High School	238
WBBR	Rossville, N. Y.,	Peoples Pulpit Assn	416.4
WBBW	Norfolk, Va.,	Ruffner Junior, H. S.	222
WBBY	Charleston, S. C.,	Wash. Light Infantry	268
WBBZ	Portable, Ill.,	C. L. Carrell	215
WBCN	Chicago, Ill.,	Foster & McDonnell	266
WBES	Takoma Park, Md.,	Bliss Elec. Sch.	222
WBET	Boston, Mass.,	Boston Transcript Co.	384.4
WBKN	Brooklyn, N. Y.,	A. Faske	261.1
WBMS	Union City, N. J.,	G. J. Schowerer	223.7
WBNY	New York, N. Y.,	Baruchrome Corp.	322.4
WBOQ	Richmond Hill, N. Y.,	A. H. Grebe & Company, Inc.	236
WBRC	Birmingham, Ala.,	Birmingham Bdcstg. Corp.	247.8
WBRE	Wilkes-Barre, Pa.,	Balti. Radio Exch.	231
WBRL	Tilton, N. H.,	Booth Radio Labs.	420
WBSO	Wellesley Hills, Mass.,	Babson's	242
WBRS	Bklyn, N. Y.,	Univ. Radio Mfg. Co.	394
WBT	Charlotte, N. C.,	C. Chamber of Com.	275
WBZ	Springfield, Mass.,	Westinghouse E. & M. Company	333.1
WBZ	Springfield, Mass.,	West E. and M. Mfg. Co.	333.1
WCAC	Mansfield, Conn.,	Conn. Agri. College	275

Station	Location	Owner	Meters
WCAD	Canton, N. Y.,	St. Lawrence University	263
WCAE	Pittsburgh, Pa.,	Kaufman & Baer Co...	461.3
WCAH	Columbus, Ohio,	Entrekin Elec. Co....	265.2
WCAJ	University Place, Neb.,	Neb. Wesleyan Univ.	254
WCAL	Northfield, Minn.,	St. Olaf College...	336.9
WCAM	Camden, N. J.,	City of Camden.....	336.9
WCAO	Baltimore, Md.,	Monumental Radio Co., Inc.	275
WCAR	San Antonio, Tex.,	S. Radio Corp....	268
WCAT	Rapid City, S. D.,	School of Mines....	240
WCAU	Philadelphia, Pa.,	Universal Bdcstg Co.	278
WCAX	Burlington, Vt.,	Univ. or Vt.....	250
WCAZ	Carthage, Ill.,	Carthage College....	245.8
WCBA	Allentown, Pa.,	C. W. Heimbach.....	254
WCBD	Zion, Ill.,	Wilber Glenn Voliva....	344.6
WCBE	New Orleans, La.,	Uhalt Radio Co....	263
WCBH	Oxford, Miss.,	University of Miss....	242
WCBM	Baltimore, Md.,	Hotel Chateau.....	229
WCBR	Portable, R. I.,	C. H. Messter.....	234.2
WCBS	Providence, R. I.,	(portable), H. L. Dewing & C. H. Messter	242.5
WCCO	Anoka, Minn.,	Washburn Crosby Co....	416.4
WCFL	Chicago, Ill.,	Chicago Fed. of Labor....	491.5
WCFT	Tullahoma, Tenn.,	Knights Pyth. Home.	252
WCGU	Lakewood, N. J.,	C. G. Ungar.....	350.6
WCLO	Camp Lake, Wis.,	C. E. Whitmore....	231
WCLS	Joliet, Ill.,	WCLS, Inc.....	214.2
WCMA	Culver, Ind.,	Culver Military Academy	258.5
WCOA	Pensacola, Fla.,	City of Pensacola.....	252
WCOC	Columbus, Miss.,	Crystal Oil Co.....	265.3
WCOM	Manchester, N. H.,	172nd Field Artil..	252
WCOT	Olneyville, R. I.,	Jacob, Conn.....	265.3
WCRW	Chicago, Ill.,	C. R. White.....	410.7
WCSH	Portland, Me.,	H. R. Rines.....	499.7
WCSO	Springfield, O.,	Wittonberg College.....	248
WCWB	Milwaukee, Wis.,	Radiocast Corp. of Wisc.	384.4
WCWK	Fort Wayne, Ind.,	C. W. Keen.....	234.2
WCWS	Portable, Conn.,	C. Wm. Selen.....	232.4
WDAD & WLAC	Nashville, Tenn.,	Dad's Auto Access., Inc., & Life & Casualty Ins. Co.....	226
WDAE	Tampa, Fla.,	Tampa Daily Times....	273
WDAF	Kansas City, Mo.,	Kansas City Star....	365.6
WDAG	Amarillo, Tex.,	J. L. Martin.....	263
WDAH	El Paso, Tex.,	Trinity Methodist Ch...	267.7
WDAY	Fargo, N. D.,	Radio Equipment Corp...	260.7
WDBE	Atlanta, Ga.,	Gilham Electric Co.....	270
WDBJ	Roanoke, Va.,	Richardson, Wayland Elec. Corp.	228.9
WDBK	Cleveland, O.,	WDBK Bdcst. Station Co. Inc.	227
WDBO	Winter Park, Fla.,	Rollins College.....	240
WDBZ	Kingston, N. Y.,	Kingston Radio Club.	233
WDEL	Welmington, Del.,	Wilmington Elec. Spec. Co.	266
WDGY	Minneapolis, Minn.,	Dr. G. W. Young...	263
WDOD	Chattanooga, Tenn.,	Chattanooga Radio Co., Inc.	256
WDRC	New Haven, Conn.,	Doolittle Radio Corp.	268
WDWF	Cranston, R. I.,	D. W. Flint, Inc.....	440.9
WDWM	Newark, N. J.,	Radio Industries Bdcst. Co.	280.2
WDXL	Detroit, Mich.,	DXL Radio Corp.....	296.9
WDZ	Tuscola, Ill.,	James L. Bush.....	278
WEAF	N. Y. City,	National Bd'g Co. of Am..	491.5
WEAI	Ithaca, N. Y.,	Cornell University.....	254
WEAM	North Plainfield, N. J.,	Borough of North Plainfield	261
WEAN	Providence, R. I.,	The Shepard Co.....	367
WEAO	Columbus, O.,	Ohio State University..	293.9
WEAR	Cleveland, O.,	Willard Storage Battery Company	389.4
WEAU	Sioux City, Ia.,	Davidson Bros. Co.....	275
WEBC	Superior, Wisc.,	W. C. Bridges.....	242
WEBG	Harrisburgh, Ill.,	Tate Radio Co.....	226
WEBH	Chicago, Ill.,	Edgewater Beach Hotel.	370.2
WEBJ	New York.,	N. Y. Third Ave. R. R. Co..	273
WEBL	Portable, R. C. A.		226
WEBR	Buffalo, N. Y.,	H. H. Howell.....	244
WEBW	Beloit, Wisc.,	Beloit College.....	258
WEBZ	Savannah, Ga.,	Savannah Radio Corp..	263.
WEDC	Chicago, Ill.,	Emil Denemark Bdcstg. Station	249.9
WEEI	Boston, Mass.,	Edison Electric Ill. Co..	348.6
WEHS	Evanston, Ill.,	A. T. Becker.....	241.8
WEMC	Berrien Springs, Mich.,	Emanuel Miss. College	315.6
WENR	Chicago, Ill.,	All-American Radio Corp.	266
WEPS	Gloucester, Mass.,	Matheson Radio Co.	295
WEW	St. Louis, Mo.,	St. Louis University....	360
WFAA	Dallas, Tex.,	Dallas News & Dallas Journal	475.9
WFAM	St. Cloud, Minn.,	Times Publishing Co.	273
WFAV	Lincoln, Neb.,	University of Neb.....	275
WFBC	Knoxville, Tenn.,	First Baptist Church	250
WFBE	Cinc., O.,	Garfield Place Hotel.....	232.4
WFBG	Altoona, Pa.,	W. F. Gable Co.....	278
WFBJ	Collegeville, Minn.,	St. John's University	236
WFBL	Syracuse, N. Y.,	Onondaga, Conn.....	252
WFBM	Baltimore, Md.,	5th Inf. Nat. Guard....	254
WFBR	Galesburg, Ill.,	Knox College.....	254
WFBZ	Galesburg, Ill.,	Knox College.....	254
WFCI	Pawtucket, R. I.,	Frank Crook, Inc....	229
WFDF	Flint, Mich.,	Frank D. allain.....	234
WFHH	Clearwater, Fla.,	Ft. Harrison Hotel..	355.4
WFI	Phila., Pa.,	Strawbridge & Clothier.....	394.5
WFIW	Hopkinsville, Ky.,	The Acme Mills, Inc.	356.9
WFKB	Chicago, Ill.,	F. K. Bridgman.....	217.3
WFKD	Philadelphia, Pa.,	Foulkord Radio Engineering Co.	249.9
WFRL	Brooklyn, N. Y.,	Flatbush Radio Labs..	329.5
WGAL	Lancaster, Pa.,	Lancaster Electric Supply and Construction Co....	248
WGBB	Freeport, N. Y.,	H. H. Carman.....	243.8
WGBC	Memphis, Tenn.,	First Baptist Church.	278
WGBI	Scranton, Pa.,	Scranton Bdcstg. Inc....	252
WGBS	Astoria, L. I., N. Y.,	Gimbel Bros.....	315.6
WGBU	Fulford-by-the-Sea, Fla.,	Florida Cities Finance Company	384.4
WGBX	Oreno, Maine,	Univ. of Maine.....	234.2
WGCP	Newark, N. J.,	May Radio Bdcst. Corp..	252
WGES	Chicago, Ill.,	Oak Leaves Broadcasting Corporation	315.6
WGHB	Clearwater, Fla.,	Ft. Harrison Hotel...	266
WGL	New York City,	Internat'l Bdcst. Corp...	442.4
WGM	Jeanette, Pa.,	Verne & Elton Spencer..	269
WGN	Chicago, Ill.,	Chicago Tribune.....	302.8
WGMU	Portable, N. Y.,	A. H. Grebe & Co....	236
WGR	Buffalo, N. Y.,	Federal Tel. & Tel. Co...	319
WGST	Atlanta, Ga.,	School of Tech....	270
WGY	Schenectady, N. Y.,	G. E. Co.....	379.5
WHA	Madison, Wisc.,	University of Wisc....	535.4
WHAD	Milwaukee, Wisc.,	Marquette Univ....	275
WHAM	Rochester, N. Y.,	Stromberg-Carlson Tel. Mfg. Co.	278
WHAP	New York, N. Y.,	W. H. Taylor Finance Corporation	431
WHAR	Atlantic City, N. J.,	F. D. Cooks Sons	275.
WHAS	Louisville, Ky.,	Courier Journal & Louisville Times	399.8
WHAZ	Troy, N. Y.,	Rensselaer Polytechnic Inst.	379.5
WHB	Kansas City, Mo.,	Sweeney School Co...	365.6
WHBA	Oil City, Pa.,	C. C. Shaffer.....	250
WHBC	Canton, O.,	Rev. E. P. Graham.....	254
WHBD	Bellefontaine, O.,	Chamber of Com.....	222.1
WHBF	Rock Island, Ill.,	Beardsley Spc. Co....	222
WHBL	Portable, Ninth District,	C. L. Carrell.	215.7
WHBM	Portable, Ninth District.	C. L. Carrell	215.7
WHBN	St. Petersburg, Fla.,	First Avenue M. E. Church	238
WHBP	Johnston, Pa.,	Johnston Auto Co.....	256
WHBQ	Memphis, Tenn.,	St. Johns M. E. Ch.	233
WHBS	Rock Island, Ill.,	Beardsley Spec. Co...	221.1
WHBU	Anderson, Ind.,	Riviera Theatre.....	218.8
WHBW	Philadelphia, Pa.,	D. R. Kienzle.....	215.7
WHBY	West De Pere, Wisc.,	St. Norberts College	249.9
WHDI	Minneapolis, Minn.,	W. H. Dunwoody Institute	278
WHEC	Rochester, N. Y.,	Hickson Electric Co., Inc.	258
WHBW	Philadelphia, Pa.,	D. R. KeKienzle.....	215.7
WHFC	Chicago, Ill.,	Triangle Bdcstrs.....	258.5
WHK	Cleveland, O.,	Radio Air Service Corp..	272.6
WHN	New York, N. Y.,	Geo. Schubel.....	361.2
WHO	Des Moines, Ia.,	Bankers Life Co.....	526
WHOG	Huntington, Ind.,	Huntington Bdcstrs. Association	241.8
WHT	Deerfield, Ill.,	Radiophone Brest. Corp..	399.8
WIAD	Philadelphia, Pa.,	Howard R. Miller....	250.
WIAS	Burlington, Ia.,	Home Elec.....	254
WIBA	Madison, Wisc.,	Strand Theatre.....	236.1
WIBG	Elkins Park, Pa.,	St. Paul's Protestant Episcopal Church	222
WIBH	New Bedford, Mass.,	Elite Radio Stores	209.7
WIBI	Flushing, L. I., N. Y.,	F. B. Zittel, Jr.	218.8
WIBJ	Portable, Ill.,	C. L. Carrell.....	215.7
WIBM	Portable, Ill.,	B. Maine.....	215.7
WIBO	Chicago, Ill.,	WIBO Bdcstrs., Inc.....	226
WIBR	Weirton, W. Va.,	Thurman A. Owings	246
WIBS	Elizabeth, N. J.,	Thos. F. Hunter.....	202.6
WIBU	Poynette, Wisc.,	The Electric Farm....	222
WIBW	Logansport, Ind.,	Dr. L. L. Dill.....	220
WIBX	Utica, N. Y.,	WIBX, Inc.....	234.2
WIBZ	Montgomery, Ala.,	A. D. Trum.....	230.6
WICC	Bridgeport, Conn.,	Bridgep't Bdcstg. Sta.	285
WIL	St. Louis, Mo.,	St. Louis Star.....	258
WIOD	Miami, Fla.,	Carl G. Fisher Co.....	247.8
WIP	Philadelphia, Pa.,	Gimbel Bros.....	508.2
WJAD	Waco, Tex.,	Jackson's Radio Engineering Laboratories	352.7
WJAF	Ferndale, Mich.,	J. S. Fernberg Radio Co.	407
WJAG	Norfolk, Neb.,	Norfolk Daily News.....	270
WJAK	Kokomo, Ind.,	Kokomo Tribune.....	254.1
WJAM	Cedar Rapids, Ia.,	D. M. Perham.....	268
WJAR	Providence, R. I.,	The Outlet Co.....	483.6
WJAS	Pittsburg, Pa.,	Pittsburgh Radio Supply House	275
WJAX	Jacksonville, Fla.,	City of Jacksonville	336.9
WJAY	Cleveland, O.,	Cleveland Radio Bdcst. Corp.	435.7
WJAZ	Mount Prospect, Ill.,	Zenith Radio Corp.	329.5
WJBA	Joliet, Ill.,	D. H. Lentz, Jr.....	206.8
WJBB	St. Petersburg, Fla.,	Financial Journal.	254.1
WJBC	La Salle, Ill.,	Hummer Furniture Co..	234
WJBI	Red Bank, N. J.,	R. S. Johnson.....	218.8
WJBK	Ypsilanti, Mich.,	E. F. Goodwin.....	233
WJBL	Decatur, Ill.,	Wm. Gushard Dry Goods Co.	270
WJBO	New Orleans, La.,	V. Jenson.....	267.7
WJBR	Omro, Wisc.,	Omro Drug Stores.....	227.1
WJBT	Chicago, Ill.,	John S. Boyd.....	468.5
WJBU	Lewisburg, Pa.,	Bucknell University..	211.1
WJBW	New Orleans, La.,	C. Carlson, Jr....	270.1
WJBY	Gasden, Ala.,	Elec. Construction Co....	270.1
WJBZ	Chicago Heights, Ill.,	R. G. Palmer.....	419.3
WJJD	Mooseheart, Ill.,	Loyal Order of Moose..	370.2
WJR-WCX	Pontiac, Mich.,	Station WJR, Inc., & Detroit Fress Press.	516.9
WJUG	New York City,	U. B. Ross.....	516.9
WJY	New York, N. Y.,	Nat. Bdcstg. Co. of Amer.	405.2
WJZ	Bound Brook, N. J.,	Nat. Bdcstg Co. of Amer.	454.3
WKAF	Milwaukee, Wisc.,	WKAF Broadcasting Corp.	261
WKAQ	San Juan, P. R.,	Radio Corporation of Porto Rico	340.7
WKAR	East Lansing, Mich.,	Michigan State College	285.8
WKAV	Laconia, New Haven,	Laconia Radio Club	224
WKBA	Chicago, Ill.,	Arrow Battery Co.....	209.7
WKBB	Joliet, Ill.,	Sanders Brothers.....	282.8
WKBC	Birmingham, Ala.,	H. L. Ansley	225
WKBE	Webster, Mass.,	K. & B. Electric Co..	270.1
WKBF	Indianapolis, Ind.,	N. D. Watson.....	243.8
WKBH	La Crosse, Wisc.,	Callaway Music.....	249.5
WKBG	Portable, Ill.,	C. L. Carrell.....	215.7
WKBI	Chicago, Ill.,	F. L. Schoenwolf.....	220.4
WKBJ	St. Petersburg, Fla.,	Gospel Tabernacle, Inc.	280
WKBL	Monroe, Mich.,	Monrona Radio Mfg. Co.	252
WKBM	Newburgh, N. Y.,	J. W. Jones.....	285.5
WKBN	Youngstown, O.,	Radio Elec. Serv. Co....	360
WKBO	Jersey City, N. J.,	Jersey Observer...	472.2
WKBP	Battle Creek, Mich.,	Enquirer & News	265
WKBS	Galesburg, Ill.,	P. N. Nelson.....	361.2
WKBT	New Orleans, Ia.,	First Baptist Church..	252
WKBU	New Castle, Pa.,	H. K. Armstrong.....	238
WKBV	Brookville, Ind.,	Knox Battery & Electric Co.	236.1
WKBY	Danville, Pa.,	(Portable) F. Quick....	220
WKBW	Buffalo, N. Y.,	Churchill Evan. Assn...	362.5
WKBZ	Ludington, Mich.,	K. L. Ashbacker...	256.3
WKDR	Kenosha, Wisc.,	E. A. Dato.....	428.3
WKJC	Lancaster, Pa.,	Kirk Johnson & Co....	258.5
WKRC	Cincinnati, O.,	Kodel Radio Corp.....	422.3
WKY	Oklahoma City, Okla.,	R. C. Hull & N. S. Richards	275
WLAL	Tulsa, Okla.,	First Christian Church..	250
WLAP	Louisville, Ky.,	W. V. Jordan.....	275
WLB	Minneapolis, Minn.,	University of Minnesota	278
WLBC	Muncie, Ind.,	D. A. Burton.....	223.7
WLBE	Bklyn, N. Y.,	J. H. Fruitman.....	230.6
WLBF	Kansas City, Mo.,	E. L. Dellard.....	411.1
WLBH	Farmingdale, N. Y.,	J. J. Lombardi....	230
WLBI	East Weonona, Ill.,	A. Yarc.....	296.9
WLBJ	Cleveland, O.,	H. Grossman.....	300
WLBL	Stevens Point, Wisc.,	Wisc. Department of Markets	278
WLBM	Boston, Mass.,	Browning-Drake Co.....	480
WLBN	Portable, W. E. Hiler		225.4
WLBO	Galesburg, Ill.,	F. A. Trebbe.....	243
WLBP	Ashland, O.,	R. A. Fox.....	220.4
WLBQ	Atwood, Ill.,	E. D. Trout.....	230.6
WLBR	Belvidere, Ill.,	Alford Radio Co.....	335
WLBT	Crown Point, Ind.,	H. Wendell.....	230
WLBV	Mansfield, O.,	J. F. Weimer & D. A. Snick	230.6
WLBW	Oil City, Pa.,	Petroleum Tel. Co.....	321
WLBX	Long Island City,	J. N. Brahy.....	230.6
WLBY	Iron Mountain, Mich.,	Aimone Elec....	249.9
WLBZ	Dover-Foxcroft, Me.,	T. L. Guernsey..	299
WLCI	Ithaca, N. Y.,	Lutheran Assn. of Ithaca.	266
WLIB	Elgin, Ill.,	Liberty Weekly, Inc.....	302.8
WLIT	Philadelphia, Pa.,	Lit Brothers.....	394.5
WLS	Crete, Ill.,	Sears Roebuck Co.....	344.5
WLSL	Cranston, R. I.,	The Lincoln Studios, Inc.	440.9
WLTS	Chicago, Ill.,	Lane Technical High School	258
WLW	Harrison, O.,	The Crosley Radio Corp.	422.3
WLWL	N. Y. C.,	Paulist Fathers.....	384.4
WMAC	Cazenovia, N. Y.,	C. B. Meredith....	275
WMAF	Dartmouth, Mass.,	Round Hills Radio Corp.	440.9
WMAK	Lockport, N. Y.,	Norton Laboratories	266
WMAL	Washington, D. C.,	M. A. Leese Optical Co.	293.9
WMAN	Columbus, O.,	Haskett Radio Station	278
WMAQ	Chicago, Ill.,	Chicago Daily News....	447.5
WMAY	St. Louis, Mo.,	Kings Highway Preb. Church	348
WMAZ	Macon, Ga.,	Mercer University.....	261
WMBA	R. Is. (portable),	L. J. Beebe.....	249.9
WMBB	Chicago, Ill.,	American Bond & Mortgage Co.	250
WMBC	Detroit, Mich.,	Michigan Broadcasting Co., Inc.	256
WMBD	Peoria Heights, Ill.,	Peoria Heights Radio Lab.	279
WMBE	St. Paul, Minn.,	Dr. C. S. Stevens.....	220
WMBF	Miami Beach, Fla.,	Fleetwood Hotel Corp.	384.4
WMBG	Richmond, Va.,	Havens & Martin.....	220
WMBH	Chicago, Ill.,	(portable) E. D. Aber...	280
WMBI	Chicago, Ill.,	Moody Bible Inst.....	288.3
WMBJ	Monessen, Pa.,	W. Roy McShaffrey....	277.6
WMBK	Hamilton, O.,	J. C. Slade.....	360
WMBQ	Bklyn, N. Y.,	P. J. Gollhofer.....	210
WMBR	Tampa, Fla.,	Premier Elec. Co.....	250
WMBS	Harrisburg, Pa.,	Mack's Battery Service	360
WMBU	Pittsburgh, Pa.,	P. J. Miller.....	236.1
WMBW	Youngstown, O.,	Youngstown Bdcstg Co., Inc.	279
WMBY	Bloomington, Ill.,	R. A. Isaacs.....	291.1
WMC	Memphis, Tenn.,	Commercial Pub. Co...	499.7
WMCA	Hoboken, N. J.,	Greely Square Hotel	340.7
WMPC	Lapeer, Mich.,	1st Meth. Prot. Ch.....	202
WMRJ	Jamaica, N. Y.,	P. J. Prinz.....	227.1
WMSG	N. Y. C., N. Y.,	Radio Eng. Corp.....	302.8
WMVM	Newark, N. J.,	E. J. Malone, Jr.....	475.9
WNAB	Boston, Mass.,	Shepard Stores.....	268.2
WNAC	Boston, Mass,	Shepard Stores.....	430.1
WNAD	Normand, Okla.,	Univ. of Okla.....	254
WNAL	Omaha, Neb.,	Omaha Central H. S....	258
WNAT	Philadelphia, Pa.,	Lennig Brothers Co.	230
WNAX	Yankton, S. D.,	Dak. Radio App. Co..	244
WNBA	Forest Park, Ill.,	M. T. Rafferty.....	238
WNBF	Union Station, Endicott, N. Y.,	Howitt-Wood Radio Co.....	205.4
WNBH	New Bedford, Mass.,	New Bedford Hotel	247.8
WNBJ	Knoxville, Tenn.,	Lonsdale Bapt. Ch...	355
WNBK	LeRoy, N. Y.,	H. C. Barton Electric Co.	354
WNBI	Peru, Ill.,	W. M. Romanouski.....	357
WNBL	Bloomington, Ill.,	H. R. Storm.....	495
WNBO	Washington, Pa.,	J. B. Spriggs.....	215
WNBQ	Rochester, N. Y.,	G. P. Brown.....	407.6
WNBR	Memphis, Tenn.,	Popular Radio Shop..	316
WNJ	Newark, N. J.,	J. H. Lubinsky.....	350
WNOX	Knoxville, Tenn.,	Peoples Tel. & Tel. Co.	276.7
WNRC	Greenboro, N. C.,	W. M. Nelson.....	224
WNYC	New York, N. Y.,	Department of Plants and Structures	526
WOAI	San Antonio, Tex.,	Son. Equip. Co.....	394.5
WOAN	Lawrenceburg, Tenn.,	Vaughan Con. of Music	356.4
WOAW	Omaha, Neb.,	Woodmen of the World..	526
WOAX	Trenton, N. J.,	F. J. Wolff.....	240
WOBB	Longacre, Ill.,	Longacre Engr. Const. Co.	555.2
WOC	Davenport, Ia.,	Palmer School of Chiro...	483.6
WOCB	Orlando Bdcst. Co.,	Orlando, Fla.....	293.7
WOCL	Jamestown, N. Y.,	A. B. Newton.....	275.1
WODA	Paterson, N. J.,	O'Dea Temple of Music.	390.9
WOI	Ames, Ia.,	Iowa State College.....	270
WOK	Homewood, Ill.,	Neutrowound Radio Mfg. Co.	217.3
WOKO	Peekskill, N. Y.,	H. E. Smith.....	232.4
WOL	Ames, Ia.,	Ia. State College.....	270
WOO	Philadelphia, Pa.,	J. Wanamaker.....	508.2
WOOD	Grand Rapids, Mich.,	Grand Radio Co..	241.8

(Concluded on page 21)

MR. SECRETARY

(Harris & Ewing)

SAM PICKARD, chief of the Radio Service of the Department of Agriculture, who has been named as acting secretary of the radio commission. Pickard conducted the first air course given from any school, at tre Kansas Agricultural College.

WATCH B BATTERIES

Run-down B batteries are a common cause of broad tuning in many sets.

Diners Glum; Can't Tune in Alma Mater

Failure Leads Copeland to Denounce New Radio Law As Granting Monopoly on Land Wire Link-Up

On the ninetieth anniversary of the founding of the University of Michigan, celebrated recently by 200 members of the University of Michigan Club of New York at a dinner at the Aldine Club, United States Senator Royal S. Copeland denounced the new radio law as prohibiting stations from owning their own wire link-ups with other cities.

One of the features of the elaborate dinner program was to have been the tuning in on a radio program broadcast from Ann Arbor, Michigan, in which President Cook Little of the University spoke.

Couldn't Be Done!

However, atmospheric conditions were such as to make it impossible to receive these radio waves in New York. This circumstance, the source of great disappointment to the alumni assembled at the dinner, caused Senator Copeland to comment on the reason for their failure to hear President Little's address.

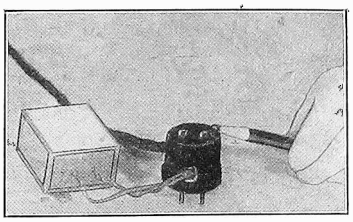
"This legislation was passed," he said, "because the American Telephone and Telegraph Company does not want any competition in the telegraph business.

Tolls Denounced

"If radio stations want to have wire connections with other cities they must pay tolls to this company.

"If radio stations were allowed to own their own wire connections, this would mean a substantial loss of revenue to this telegraph company. On one occasion alone the tolls on messages sent over the telegraph companies' wires from one broadcast ng station to another have amounted to $90,000."

CUTS INTERFERENCE



(Hayden)

AN ELECTRIC heating pad, toaster etc. may cause interference in a radio set, particularly if socket power is used for receiver. A new plug device has provision for connecting in a 1 mfd. condenser which helps remedy the trouble.

WABC Will Test Heaviside Layer

Preparations for a series of tests expected to determine the exact height of the "radio roof," or Heaviside surface, thought to exist about 100 miles above the earth, are being made by engineers at WABC, Richmond Hill, L. I. This ionized region is held responsible for fading and for the mysterious action of short waves when they hop, skip and jump around the earth.

The Heaviside surface is thought by scientists to be a region of rarefied air which acts like a mirror, reflecting the Hertzian waves to the earth so that the radio signals are heard in certain localities but not in others. For example, short waves radiated from Richmond Hill may not be heard in New York, but they may register with good intensity in California because they strike the "radio roof" and are reflected back to earth at that point.

The regular broadcast program of WABC will be used for the tests, observations of which will be made by appointed listeners throughout the United States and Canada. The station will employ the regular wave length for the experiments and the call 2XE will be used. Simultaneously, according to T. Osterman, one of the engineers at the station, short wave station 2ZV, also at Richmond Hill, will broadcast on 20, 40, 60 and 75 meters.

List of Stations

(*Concluded from page 20*)

Station	Location	Owner	Meters
WOQ	Kansas City, Mo.,	Unity School	278.
WOR	Newark, N. J.,	L. Bamberger & Co.	405.2
WORD	Batavia, Ill.,	Peoples Pulpit Assn.	275
WOS	Jefferson City, Mo.,	State Marketing Bureau	440.9
WOWO	Fort Wayne, Ind.,	Main Automobile Supply Co.	227
WPAB	Norfolk, Va.,	Radio Corp. of Va.	329
WPAK	Agri. College, N. D.,	N. D. Agri. Col.	275
WPAP	Cliffside, N. J.,	(see WQAO)	361.2
WPCC	Chicago, Ill.,	North Shore Congregational Church	258
WPCH	N. Y. C., N. Y.,	Concourse Radio Corp.	273
WPDQ	Buffalo, N. Y.,	H. L. Turner	205.4
WPEP	Waugegan, Ill.,	M. Mayer	212.6
WPG	Alantic City, N. J.,	Municipality of Atlantic City	299.8
WPRC	Harrisburg, Pa.,	Wilson Printing & Radio Co.	215.7
WPSC	State College, Pa.,	Pa. State College	261
WPSW	Philadelphia, Pa.,	Phil. Sch. of Wire Tel.	236.1
WQAA	Parkensburg, Pa.,	H. A. Beale, Jr.	220
WQAE	Springfield, Vt.,	Moore Radio News Sta.	246
WQAM	Miami, Fla.,	Electrical Equipment Co.	285.8
WQAN	Scranton, Pa.,	Scranton Times	250
WQAO	Cliffside, N. J.,	Calvary Baptist Church (WPAP, used when Palisade Amusement Park program is on)	361.2
WQJ	Chicago, Ill.,	Calumet Co.	447.5
WRAB	Yellow Springs, O.,	Antioch College	263
WRAF	Laporte, Ind.,	Radio Club, Inc.	224
WRAH	Providence, R. I.,	Stanley N. Read	235
WRAK	Escanoba, Mich.,	Economy Light Co.	256
WRAM	Galesburg, Ill.,	Lombard College	244
WRAW	Reading, Pa.,	Avenue Radio & Electric Shop	238
WRAX	Gloucester City, N. J.,	Fexon's Garage	268
WRBC	Valparaiso, Ind.,	Immanuel Lutheran Church	278
WRC	Washington, D. C.,	Nat. Bdcst. Co. of Am.	468.5
WRCO	Raleigh, N. C.,	Wayne Radio Co.	252
WREC	Whitehaven, Tenn.,	Wootens Radio & Elec. Co.	254
WREO	Lansing, Mich.,	Reo Motor Car Co.	285.5
WRES	Wollaston, Mass.,	H. L. Sawyer	300
WRHF	Washington, D. C.,	Washington Radio Hospital Fund	256
WRHM	Minneapolis, Minn.,	Rosedale Hospital	252
WRK	Hamilton, O.,	Doron Brothers Electric Co.	270
WRM	Urbana, Ill.,	Univ. of Ill.	273
WRMU	Motor Yacht "MU-1",	A. H. Grebe & Co.	236
WRNY	Coytesville, N. J.,	Experimenter Pub. Co.	373.8
WRR	Dallas, Tex.,	City of Dallas	246
WRRS	Racine, Wisc.,	Racine Radio Co.	360
WRSC	Chelsea, Mass.,	The Radio Shop	270.1
WRST	Bay Shore, N. Y.,	Radiotel Manufacturing Co., Inc.	215.7
WRVA	Richmond, Va.,	Larus & Bro. Co., Inc.	256
WSAI	Cincinnati, O.,	U. S. Playing Card Co.	325.9
WSAJ	Grove City, Pa.,	Grove City College	229
WSAN	Allentown, Pa.,	Allentown Pub. Call Pub. Co., Inc.	229
WSAR	Fall River, Mass.,	Doughty & Welch Elec. Co.	322
WSAV	Houston, Tex.,	Clifford W. Vick.	247.8
WSAX	Chicago, Ill.,	Zenith Radio Corporation.	268
WSAZ	Pomeroy, O.,	Chas. Electric Shop	244
WSB	Atlanta, Ga.,	Atlanta Journal Co.	428
WSBC	Chicago, Ill.,	World Battery Co.	288
WSBF	St. Louis, Mo.,	Stix Baer and Fuller	273
WSBT	South Bend, Ind.,	South Bend Tribune.	315.6
WSDA	N. Y. C.,	Seventh Day Adventist Ch.	263
WSEA	Va. Beach, Va.,	Va. Beach Bdcst. Co.	516.9
WSIX	Springfield, Tenn.,	Tire and Vulc. Co.	250
WSKC	Bay City, Mich.,	World's Star Knitting Co.	261
WSM	Nashville, Tenn.,	National Life & Accident Insurance Co.	282.8
WSMB	New Orleans, La.,	Saenger Theatres, Inc.	319
WSMH	Owosso, Mich.,	Shattuck Music House.	240
WSMK	Dayton, O.,	S. M. K. Radio Corp.	275
WSOE	Milwaukee, Wisc.,	School of Engineering of Milwaukee	246
WSOM	Woodhaven, N. Y.,	Union Course Club.	288.3
WSRO	Hamilton, O.,	H. W. Fahlander	252
WSSH	Boston, Mass.,	Tremont Temple Baptist Church	260.7
WSUI	Iowa City, Iowa,	State University of Ia.	483.6
WSVS	Buffalo, N. Y.,	Seneca Vocational Sch.	218.8
WSWS	Batavia, Ill.,	S. W. Straus & Co.	275.1
WSYR	Syracuse, N. Y.,	Clive B. Meredith.	352.7
WTAD	Quincy, Ill.,	Ill. Stock Medicine Brcst. Corp.	236
WTAG	Worcester, Mass.,	Worcester Telegram	545.1
WTAL	Toledo, O.,	Toledo Radio & Electric Co.	252
WTAM	Cleveland, O.,	Willard Storage Battery Co.	389.4
WTAQ	Osseo, Wisc.,	C. S. Van Gordon	254.1
WTAR	Norfolk, Va.,	Reliance Electric Co.	261
WTAW	College Station, Tex.,	Agricultural & Mechanical College of Texas	270
WTAX	Streator, Ill.,	Williams Hardware Co.	231
WTAZ	Lambertville, N. J.,	Thomas J. McGuire	261
WTHO	Ferndale, Mich.,	Fernberg Radio Co.	407
WTIC	Hartford, Conn.,	Travelers Insurance Co.	475.9
WTRC	Brooklyn, N. Y.,	20th Dist. Repub. Club.	239.9
WTRL	Midland, N. J.,	Technical Radio Labs.	280.2
WWAE	Chicago, Ill.,	L. J. Crowley	241.8
WWJ	Detroit, Mich.,	Evening News Association (Detroit News)	352.7
WWNC	Asheville, N. C.,	Asheville Bat. Co., Inc.	254
WWPR	Detroit, Mich.,	Detroit Police Dept.	300
WWL	New Orleans, La.,	Loyola University.	275
WWRL	Woodside, N. Y.,	W. H. Rouman	258.5
WWVA	Wheeling, W. Va.,	J. C. Stroebel	348.6

It Is Hard to Tell Where Blasting Arises

If your radio receiver emits that type of distortion which has been called blasting do not jump at the conclusion that your own set is at fault. The trouble may be at the other end of the "line." Recently an expert noticed very disagreeable blasting on a certain high note of a soprano. There was no reason for seriously suspecting the receiver, yet there was no immediate way of testing the set to determine whether it was to blame. It could have been tuned in on some other station, had such a station been broadcasting a vocal selection of like tonal range at the time, but there was none. Inquiry the next day among the fans who had listened in on the same vocal selection elicited the fact that they also noticed the blasting. It is not reasonable to assume that all the receivers were causing blasting on the same note. Evidently the fault lay with the broadcasting station. Perhaps the trouble lay in the line connecting the station with the studio of origin. Some defect may have developed in the line which the engineers had not had time to remedy. Or again, the trouble may have arisen in the studio of origin itself, in some resonance effect due to a faulty placement of the microphone. If the trouble arose at the other end of the "line" the engineers will soon catch it and remove the defect. This trouble was common in the early days.

Program Judgment Needs a Good Set

When critics are telling their impressions of certain broadcasting events, particularly in connection with new stations, they never fail to say something about the modulation. Sometimes it is excellent, sometimes mediocre, sometimes very bad. Some of these critics listen in with an old type of receiver incorporating so-called audio transformers and tin horn loud speaker. Just fancy these hombres telling the world about the modulation! Some of the critics do not even know what the term modulation means and they cannot distinguish between volumes differing by ten transmission units if the two tones differ slightly in pitch or time.

Fine Quality Obtained from 3-Foot Cone

(*Concluded from page 9*)

plate voltages up to 200 volts. On higher plate voltages, such as are used with the 210 or 310 power tube, it is safer to employ an output transformer between the set and the speaker.

The two nuts, A and B, Fig. 2 are used to adjust the length of the air gap G of the unit. While all units are factory adjusted for operation on sets employing B battery voltages from 90 to 135, a slight change in the adjustment may be found necessary when using the instrument on a 171 or 210 power tube with 180 or more volts of B battery.

A unit of this type is obviously polarized, and the marked lead of the cord should be connected to the plus B battery side of the circuit. If the proper connection is not known, simply connect it one way and the the other, and leave it in the connection that gives greater volume.

Size of the Cone

This little unit with its simple and rugged construction will be found very interesting to the radio experimenter. For example, it can be connected to the radio set and held against a table, window pane, or other large flat surface, and the reproduction will be loud and clear. It works exceptionally well when held against the sound board of a piano.

A simple wooden arm can be clamped to one of the rear members of the piano for supporting the unit, and it will be found that the piano makes an admirable reproducer. Best reproduction, however, will be obtained with the unit attached to the apex of a large cone.

Cones ranging in diameter from 24 to 36 inches seem to give best results, with the larger sizes favored. And the tone depends not only on the size of the cone but also on the method of mounting the unit. With the unit mounted on a solid wooden block weighing from three to five pounds or more, the lower tones come through with greater clearness and volume. A 24-inch cone with the unit mounted on a heavy block sounds as well as a 36-inch cone without the heavy block on the back of the unit.

This is an important factor and should not be overlooked to obtain the maximum of reproducing efficiency. Glued or laminated wood should be avoided because the constant tonal vibrations are likely to cause sectional pieces to set up countervibrations.

Dimensions for cutting 24-inch, 30-inch, 33-inch and 36-inch cones are given in Fig. 3. Before building the speaker it is best to decide which size to use, which depends largely upon the space available and the artistic desires of the lady of the household. For quality of reproduction the larger the cone the better, and if a large cone is too unsightly for wall mounting, it may be placed under the radio table or in a console cabinet with silk draperies across the front.

Decoration Hints

The cone may be decorated with designs or pictures by using stencils, silhouettes or by painting directly on the cone. Oil paint should not be employed, as the oil has a tendency to deaden or muffle the sound. For this reason, ordinary parchment, such as is used for lamp shades, should never be used for cones. Water or show card colors are satisfactory. As a rule the undecorated cone with its plain mottled walnut finish looks much better than a decorated one.

[*Textual data on construction will be published next week.*]

THE NEW UNIVERSAL

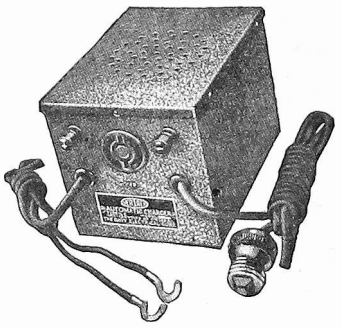
How to build RADIO WORLD'S Four-Tube Universal Receiver fully described by Herman Bernard in the March 12 and 19 issues of RADIO WORLD. Send 30 cents and get these two numbers.

RADIO WORLD,
145 West 45th St., N. Y. City.

CERTIFIED PARTS

Vertrex Dry Charger Works Economically

The Davy Electrical Corp., of Brooklyn, N. Y., manufactures the Vertrex Automatic Charger, shown herewith. This device is an automatic charger that employs no tubes, no liquids, no vibrating parts, and requires no maintenance. It uses the dry rectification principle. There is an inlet for B eliminator feed, so that the switch of the set automatically "controls



everything." The charger works on 60 cycle AC, 105 to 120 volts.

Unitune Foolproof By Ingenious Device

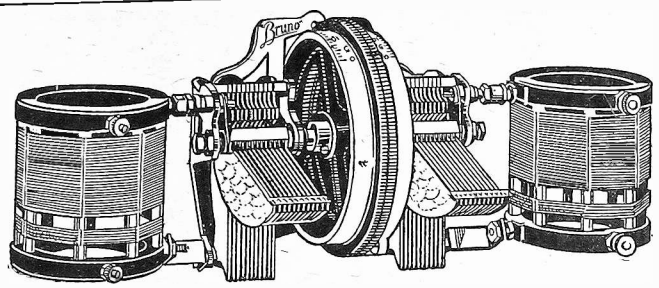
Extreme ruggedness of construction marks the new models of the Bruno Unitune. The device consists primarily of two .0005 mfd. Bruno low-loss straight line frequency variable condensers, attached to a frame and to a pair of drums. As the corrugated drum peripheries are

(*Continued on page* 25)

WHAT CIRCUIT DO YOU WANT?

DUE TO THE GREAT DEMANDS FROM OUR READERS FOR VARIOUS BACK NUMBERS OF RADIO WORLD, OUR STOCK OF THESE HAS BEEN RUNNING LOW RECENTLY. OUR EDITORIAL STAFF IS AT PRESENT GATHERING DATA AS TO WHICH CIRCUITS THERE IS MOST DEMAND FOR AND THESE WILL BE REPUBLISHED IN COMING ISSUES OF RADIO WORLD. THERE ARE MANY RECENT EXPERIMENTERS WHO WOULD LIKE TO PROBE THE POSSIBILITIES OF THE OLDER CIRCUITS, BUT WHO CANNOT OBTAIN THE NECESSARY INFORMATION. LET US HEAR FROM OUR READERS AS TO WHICH CIRCUITS THEY WOULD LIKE TO SEE PUBLISHED AGAIN. IN WRITING US PLEASE MENTION ONLY THE CIRCUITS WHICH HAVE APPEARED IN RADIO WORLD.

TO INSURE YOUR GETTING ALL OF THIS INFORMATION, SEND IN YOUR SUBSCRIPTION NOW FOR ONE YEAR AT $6.00. THIS WILL ENTITLE YOU AS A PREMIUM TO MEMBERSHIP IN THE RADIO UNIVERSITY THROUGH WHICH YOU WILL GET ALL YOUR RADIO QUESTIONS ANSWERED FREE DURING THE PERIOD COVERED BY SUBSCRIPTION. OR IF YOU PREFER ANOTHER RADIO PUBLICATION, AS A PREMIUM, TURN TO ANOTHER PAGE IN THIS ISSUE WHERE YOU CAN CONSULT OUR PREMIUM SUBSCRIPTION OFFER AND MAKE YOUR CHOICE OF THE OTHER PUBLICATION. IN SUBSCRIBING FOR ONE YEAR YOU ARE ENTITLED TO ANY SINGLE ONE OF THESE PREMIUMS. SUBSCRIPTION DEPARTMENT, RADIO WORLD, 145 W. 45TH ST., N. Y. C.



(*Continued from page 24*)

side by side and extend through the front panel and bronze face plate, one finger may tune two circuits. The model 2C consists of the condensers and drums, assembled on the frame at the factory, and the beautiful bronze plate. Other models include coils, e. g., the model RF, shown in the illustration. The Bruno quartzite low-loss coils, matched for the condensers, are used.

The drum turns the condenser through 180 degrees, without friction against the panel opening, the face plate or the other drum. An ingenious device, built into the Unitune, keeps the drums perfectly aligned and safeguards the condenser plates against touching. This is a new improvement.

The Bruno Unitune permits single tuning control, yet with positive, negative or zero grid return for each separate circuit, as the condensers are insulated from each other(with no common shaft) and from the frame.

Tickler models for regenerative sets are manufactured, these being licensed under the regenerative patent.—H. B.

340 Tube Increases Resistance AF Gain

The new Cunningham tube CX-340, has an amplification factor or mu of 30 and is particularly valuable in resistance coupled

(*Continued on page 26*)

Good Back Numbers of RADIO WORLD

The following illustrated articles have appeared in recent issues of RADIO WORLD: 1926:

June 19—Selectivity's Amazing Coil, by J. E. Anderson. The Light 5-Tube Portable Set, by Herman Bernard.

July 3—Set with a 1-Turn Primary, by Herman Bernard. Part 2 of the Victoreen Portable, by H. Bernard. Trouble Shooting Article for The Light 5-Tube Portable.

July 10—A Rub in Single Control, by Herman Bernard. A DX Double Regenerator, by Capt. P. V. O'Rourke. A 2-Tube Dry Cell Receiver, by Samuel Schmaltz.

July 31—What's Best in an AF Amplifier, by Herman Bernard A 6-Tube Reversed Feedback Set, by K. B. Humphrey.

Aug. 14—The Improved Browning-Drake, by Herman Bernard (Part 1). Storage Batteries, by John A. White.

Aug. 21—A New Stabilized Circuit, by E. H. Loftin and S. Y. White (Part 1). The Browning-Drake by Herman Bernard (Part 2).

Aug. 28—The Constant Coupling, by E. H. Loftin and S. Y. White (Part 2). The Browning-Drake, by Herman Bernard (Part 3).

Sept. 4—The Four Rectifier Types, by K. B. Humphrey. A Simple Battery Charger, by J. E. Anderson.

Sept. 11—The Beacon (3-tubes), by James H. Carroll. The 1927 Model Victoreen, by Herman Bernard.

Sept. 18—The 1927 Victoreen, by Arthur H. Lynch. Eliminator in a Cash Box, by Paul R. Fernald.

Sept. 25—The Lynch Lamp Socket Amplifier, by Arthur H. Lynch. Wiring up the Victoreen, by Herman Bernard.

Oct. 2—The Victoreen (Continued), by Herman Bernard. New Equamatic System, by Capt. P. V. O'Rourke.

Oct. 9—A Practical "A" Eliminator, by Arthur H. Lynch. Building the Equamatic, by Capt. P. V. O'Rourke.

Oct. 16—The Bernard, by Herman Bernard. How to Box an "A" Supply, by Herbert E. Hayden.

Oct. 23—The 5-tube P. C. Samson, by Capt. P. V. O'Rourke. Getting DX on the Bernard, by Lewis Winner.

Oct. 30—The Singletrol Receiver, by Herbert E. Hayden. How to Get Rid of Squeals, by Herman Bernard.

Nov. 6—Reduction of Interference, by A. N. Goldsmith. Variations of Impedances, by J. E. Anderson.

Nov. 13—The 4-tube Hi-Power Set, by Herbert E. Hayden. A Study of Eliminators, by Herman Bernard.

Nov. 20—Vital Pointers About Tubes, by Capt. P. V. O'Rourke. The 4-tube Diamond of the air, by Herman Bernard.

Nov. 27—The Antennaless Receiver, by Dr. Louis B. Blan (Part 1). Short Waves Yield Secrets, by M. L. Prescott.

Dec. 4—The Regenerative 5-Tube Set, by Capt. P. V. O'Rourke. The 8-tube Lincoln Super, by Sidney Stack. The Antennaless Receiver, by Dr. Louis B. Blan (Part 2). Winner's DC Eliminator, by Lewis Winner.

Dec. 11—The Universal Victoreen, by Ralph G. Hurd. Some Common Fallacies, by J. E. Anderson.

Dec. 18—Selectivity on One Tube, by Edgar Speare. Eliminating Interference, by J. E. Anderson. The Victoreen Universal, by Ralph G. Hurd (Concluding Part).

Dec. 25—A New Coupling Device, by J. E. Anderson. Functions of Eliminators, by Herman Bernard.

Jan. 1, 1927—The 2 Tube DeLuxe Receiver, by Arthur H. Lynch. The Twin-Choke Amplifier, by Kenneth Harkness.

Jan. 8—Tuning Out Powerful Locals, by J. E. Anderson. A Choice Superheterodyne, by Brunsten Brunn. The 2-Tube De-Lux Receiver, by Arthur H. Lynch (Part 2).

Jan. 15—The DeLuxe Receiver, by Arthur H. Lynch (Part 3). The Simple Meter Test Circuit by Herbert E. Hayden. The Superheterodyne Modulator Analyzed, by J. E. Anderson.

Jan. 22—The Atlantic Radiophone feat, by Lewis Rand. An Insight Into Resistors, by J. E. Anderson. A Circuit for Great Power, by Sidney Stack.

Jan. 29—The Harkness KH-27 Receiver (Part 1), by Kenneth Harkness. Use of Biasing Resistors, by J. E. Anderson.

Feb. 5—5-Tube, 1 Dial Set, by Capt. P. V. O'Rourke. The Harkness KH-27 (Part 2), by Kenneth Harkness. What Produces Tone Quality, by J. E. Anderson.

Feb. 12—Phone Talk Put On Speaker, by Herbert E. Hayden. All Batteries Eliminated, by Herman Bernard. The Harkness KH-27 Receiver, by Kenneth Harkness (Part 3) conclusion.

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(Continued from page 25)

amplifiers. As the gain in volume in resistance coupled audio is due to the mu of the tube, the CX-340 high mu tube affords most volume. In fact, a speaker may be operated though only two stages of resistance coupled audio are used. The CX-340 tubes are used as detector and first audio. Thus the tube puts the resistance form of amplification on the economical plane of the transformer coupled circuit. The filament voltage is 5, although the tube works well even on only 4½ volts. The effected voltage applied to the plate should not exceed 180 volts with suitable bias. With a .25 meg. plate resistor this means the voltage source may be 300.

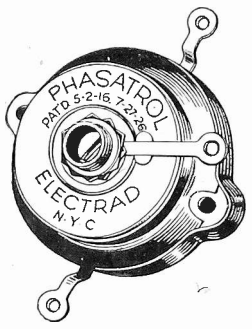
Tinkerbox Assortments

Dealers and jobbers who pride themselves upon always having complete stocks of radio hardware always on hand, especially the hard-to-get kind, will be interested in the "Tinkerbox" assortments put out by the Weber Electric Works, Brooklyn Station, Cleveland, Ohio. These can be had in an attractive display box, cloth covered, with label showing retail prices allowing a quick selection of desired sizes. There are several assortments at varied prices, covering all kinds of lugs, washers, hexagon nuts, terminals.

Can I Be of Assistance to You in Great Britain?

An Englishman now in New York, and of excellent standing in his home country, is about to return to England for a temporary visit on an important radio matter. If you are seeking high-class radio connections in Great Britain address Box G, care Radio World.

Phasatrol Popular Neutralizing Unit



The Phasatrol, a compact device consisting of a variable resistor and a fixed condenser, invented by John F. Rider and manufactured by Electrad, Inc., 175 Varick St., New York City, simply and efficiently neutralizes any receiver. It may be mounted on the subpanel, either by the single mounting hole method, so that the Phasatrol is underneath the subpanel, or on the baseboard, fastening it down with two wood screws in the holes provided therefor in the casing of the Phasatrol.

The variable resistor incorporated in the unit is the famous Royalty and it is adjusted by inserting a screwdriver or sharpened dowel stick and turning the shaft by applying tension to the slot. After the Phasatrol is once set it need not be touched again and the receiver will be neutralized for any practical value of plate voltage and grid bias. The electrical operation is that the correct amount of resistance which is cut into the circuit by adjustment shifts the phase so that the balance between the voltage and current phases will stifle oscillation. The connection is very simple to make and the Phasatrol can be installed in any set in a few minutes.

WATCH EXPIRATION OF YOUR SUBSCRIPTION!

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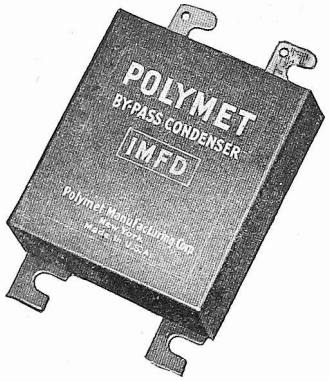
RADIO WORLD, 145 West 45th St., New York City. (Phones: Bryant 0558-0559.)

New CeCo Type K Has High Constant

The newest type of tube to be added to the list of tubes manufactured by the C. E. Manufacturing Co., of Providence, R. I., is the CeCo type K, especially designed for radio frequency amplification. The tube is also a good detector and audio amplifier. The type K is especially suitable for tuned radio frequency stages and for the Super-Heterodyne intermediate amplifying channel. It draws .25 ampere at 5 volts filament. Its amplication factor is 13.

K

Polymet Condenser



The by-pass condenser illustrated is one of a varied line of products manufactured by the Polymet Manufacturing Corporation, 599 Broadway, New York City. These high voltage condensers are guaranteed against a 1000-volt breakdown test. They incorporate finest insulating paper, best foil and specially prepared impregnating compounds.

Condensers of such exceptionally high voltage breakdown test were produced only after years of extensive research.

THE BROAD APPEAL

The magnificence of radio broadcasting can be approached by no other system of communication. By no other means than the radio can the same thought or the same appeal be conveyed by one living voice speaking to vast multitudes simultaneously.

Karas Micrometrics Have Fine Vernier

The Karas Micrometric Vermier Dial, manufactured by the Karas Electric Co., 1143 Association Building, Chicago, is completely insulated from the condenser shaft or any other metal part, an excellent safeguard against body capacity, and has a 63-to-1 vernier ratio.

Close tuning is made easy by this high ratio, combined with the smooth, fluid-like action of the dial mechanism. The Karas Micrometric dials are specified for RADIO WORLD's four-tube Universal receiver, described in the March 12, 19 and 26 issues.

Prexto Tube Making Great DX Records

Six times as sensitive as the ordinary —01A tube and ability to add miles and get stations never before reached is the guarantee of the Prexto Mfg. Co., of Beaumont, Texas, for their new Double Volume and Power Prexto tube, which they are selling direct. This Prexto tube is inserted in the detector socket. It is of long life, 3,000 hours being guaranteed. Manufacturers report the sale of over 25,000 in four weeks.

4-tube Universal described in March 12, 19, 26 issues. Send 45c to RADIO WORLD for these issues.

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One of the pioneer houses in the panel business is the New York Hard Rubber Co., 212 Centre Street, New York City. Specializing in hard rubber products for many years, they were one of the first to turn to the radio end and are, in point of fact, probably the oldest established cutters of precision panels rods and tubing. Their shops are equipped with the latest and most modern machinery for the most intricate work, from the single panel, turned out while you wait, to quantity production. Radion and hard rubber panels are carried in stock and panels of any material can be furnished.

Special hard rubber parts are made to specification and for surgical and experimental purposes. All work is turned out under the personal supervision of Herman Schiffer and his two brothers who have earned an enviable reputation for excellent work for this pioneer concern. A price list will be sent on application to all interested.—J. H. C.

New Igrad Condensers

Stoner & Heath, Inc., sales agents, 122 Greenwich Strtet, New York City, have taken over the distribution in the East of the Igrad condenser line made by the Igrad Condenser & Mfg. Corporation, 26 Avenue D. Rochester, N. Y. The line is complete, ranging in size from a .1 mfd. to units of many microfarads for all voltages up to several thousand. Their 1,000 volt 4 mfd. condenser for B eliminator use is 1¾ x 2 x 4¾ inches, being one of the smallest of this capacity and working voltage on the market. Their condensers are rated as to the actual working voltage, each one being tested and the test date stamped thereon. The compactness of these condensers should appeal to those who are limited as to space in their power amplifier cabinets. The insulation resistance is very high, which is a great factor in preventing blow outs due to surges in the apparatus. Full information and prices will be furnished by the Igrad Company at the Rochester address.

Bathgate Branches Out

Walter E. Bathgate, maker of the WEB wave trap, has entered the condenser field with a fine line of condensers of all capacities, especially guaranteed to stand high voltage. These will be marketed under the trade name of WEB, the same as the wave trap. These condensers will be made for B and A eliminators, power packs and all uses requiring reliable high-voltage types. The Venus Radio Corporation, well-known in the radio field, under the able direction of Sol Angstreich, has been appointed distributor in this territory. The manufacturer is desirous of getting in touch with good jobbers and dealers all over the country. Address, W. E. Bathgate Co., 65 West Broadway, New York City.

The Captain's Loop

(*Concluded from page* 11)

then increase in intensity as the passing car sped on.

It was real fun. With the volume control located on the steering wheel itself it was possible to provide the neighborhood with classical entertainment and at the same time adjust the volume to suitable proportions without the inconveniences of bending down or sweating beady perspiration in an attempt to enjoy the program.

One of the most valuable uses which was found for the outfit and which well repaid the constructor was the tracing of power loss interference which, when reported to the power and lighting company, brought the reward of a complete set of valves and a tank full of petrol, together with the undying praises of the officials.

In fact, if Captain Plugge remained in the vicinity of the post office department's edifice, he would no doubt have been crowned Lord Mayor or something to that effect.

The writer is of the opinion that if the American radio fan followed and pursued this valuable suggestion, a great field for enjoyment would be opened to the traveling motorist. "Radioize" your car. Equip it with a complete receiver installation, in the most logical space you can find for it, on or in the dashboard, if possible, and you will find that your car will be the envy of every fellow radio enthusiast you meet.

SILVA FLUX SOLDER

Something of a revolution in the art of soldering has made its appearance on the market. This comprises a small bottle of flux known as Silva Flux and with it an orange colored carton of solder. This flux and solder were tried in the laboratories of the RADIO WORLD and found excellent, the non-corrosive fluid leaving no residue and making a joint which was very clean and solid.

LIST OF PARTS

PT—One Thordarson R210 Power Compact Unit.
C1, C2, C3, C7—Four WEB 2 mfd. high voltage fixed condensers.
C4, C5—Two WEB 1 mfd. fixed filter condensers.
C6—One WEB 4 mfd. fixed filter condenser.
TC—One KH double impedance.
OC—One KH output choke.
R1—One 8000-ohm Kroblak wire wound fixed resistor.
R4—One 10,000-ohm Kroblak wire wound fixed resistor.
R2, R3—Two Centralab 0 to 50,000-ohm heavy duty Radiohms, type 50 M.
R5—One 1,000-ohm Kroblak wire wound fixed resistor.
1, 2, 3—Three Benjamin Cle-Ra-Tone sockets, with mounting base.
SO—One porcelain base socket.
S-One toggle switch with plate.
RT—One CX-316B rectifier tube.
AT—One CX-310 power tube.
VR—One CX-374 voltage rectifier tube.
F—One 5-ampere fuse.
Two Electrad open circuit jacks.
One Imperial B-Case.
Five sockets.
Six 4-inch brass mending plates.
Six 2-inch corner braces.
One hard rubber brushing for output.
Nine one-half inch 6/32 flat head machine screws and nuts.
Two dozen one-half inch flat head wood screws.

The Power Compact

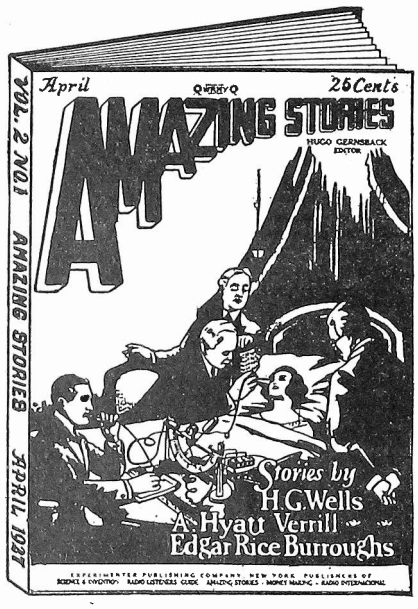
(*Continued from page* 14)

ten —01A tubes. The parts are placed in a metal housing which is 8 inches high, 10 inches wide and 12 inches deep, indeed very compact. The filament of the amplifier tube is heated off the house line also, making the unit a complete AC electrically operated device. Instead of using a separate transformer and two chokes, the Thordarson R210 power compact unit, which contains all of these units and which is only 3½ x 5¾ x 6½ inches, was employed. Not only does this save space, but wiring as well.

The half-wave CX-316 B rectifier tube is used. So that the voltage which is fed into the plates of your AF, RF or detector tubes may be kept constant, a voltage regulator tube, the CX-374, is employed. An 8,000-ohm Kroblak wire wound fixed resistor is used to drop the high plate voltage applied to the plate of the amplifier tube to 90. From this 90-volt post, two 50,000 ohm heavy-duty Centralab variable resistances are connected. These voltage drops are for use with the plates of the RF and detector tubes in your receiver.

The placing of the parts is important. Therefore, follow the layout exactly as shown. It will be noted that the sockets for the tubes are so placed that there is plenty of room to put your hand in to get at the tube. This applies to the fuse socket as well. To mount the Kroblaks, spread apart the lugs, using one as a mounting foot, the other for connecting. The condensers are held in place with the aid of 4-inch long brass mending plates and 2-inch brass corner braces, which can be purchased in any hardware store. Wood screws, ½ inch long, with flat heads, are used to bolt the transformer, sockets, etc., down. The toggle switch, when purchased, contains the plate and mounting screws. important and should be done with care.

[*Concluded next week*]



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THE PLAGUE OF THE LIVING DEAD
By T. S. Stribling
THE REMARKABLE CASE OF DAVIDSON'S EYES *By H. G. Wells*
JOHN JONES'S DOLLAR *By Harry Stephen Keeler*
WHITE GOLD PIRATE *By Merlin Moore Taylor*
THE MAN IN THE ROOM
By Edwin Balmer and William B. MacHarg
HICKS' INVENTIONS WITH A KICK
The Automatic Self-Serving Dining Table
By Henry Hugh Simmons
THE BALLOON HOAX *By Edgar Allan Poe*
THE LAND THAT TIME FORGOT
(A Serial in 3 Parts) (Part III)
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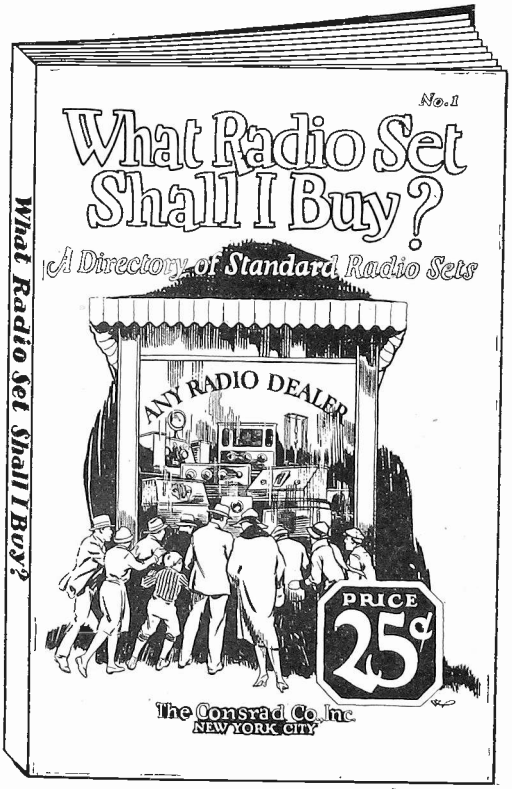

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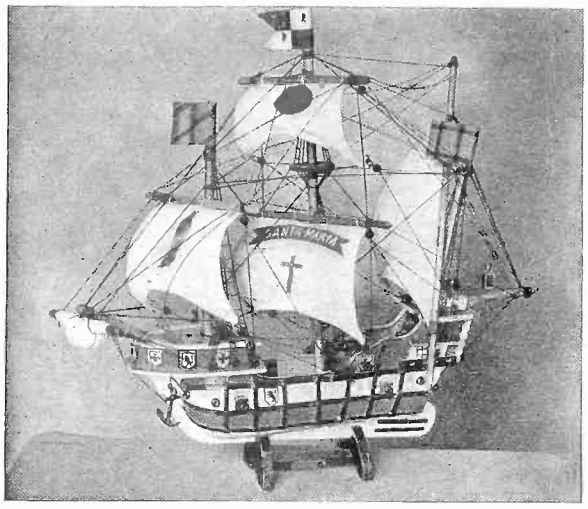
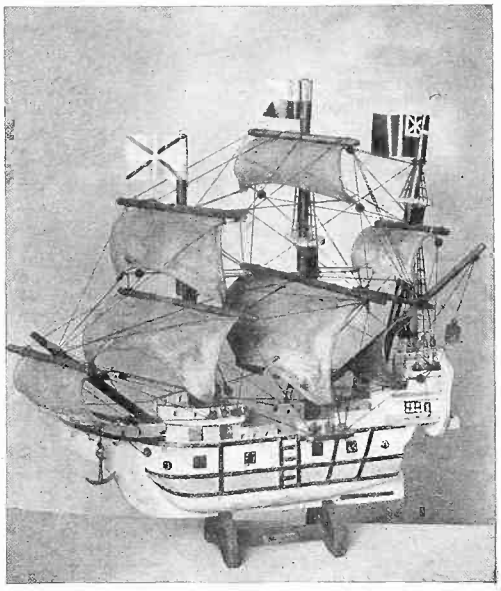


SANTA MARIA
THE FLAG SHIP OF COLUMBUS IN THE DISCOVERY OF AMERICA IN 1492
Size: Height, 25 in. Width, 11 in. Length, 27 in.



MAYFLOWER
THE SHIP THAT BROUGHT THE PILGRIMS TO AMERICA
Size: Height, 25 in. Width, 9 in. Length, 27 in.

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You have been looking for a loud speaker that combines beauty as well as usefulness. Here it is. You need look no further. This Idea can't be beat.

Can you think of anything more attractive than a beautiful Ship Model sitting on top of your Radio Cabinet that can be used as a loud speaker?

WE, THE WORLD'S LARGEST BUILDERS OF SHIP MODELS, supply you with all the parts, cut to fit, and ready to put together for either the Santa Maria or the Mayflower, and either of these two models can be used as a Radio Loud Speaker. It takes only a few hours to build, and you will have something that will last a lifetime. The pleasure derived from building one of these Models, beside the fact of the beauty and usefulness, is worth many times the purchase price.

Mrs. Clara J. Bierbower of Philadelphia, Pa., after completing a Model of the Santa Maria from our $4.98 cut to fit parts, was so pleased and delighted with the Model that she entered it in a Model Contest held by the publishers of Science and Invention Magazine. This Model was entered against hundreds of other Models from all parts of the country, and was awarded the Grand Prize for its Decorative Beauty and Simplicity of Construction. While Mrs. Bierbower was delighted, she said, "that it was not a surprise as the Model was the most beautiful of its kind that she had ever seen." The Parts We Will Send You Are Identical with the Ones Used by Mrs. Bierbower. There Were No Extra Parts Used in This Prize-Winning Model Other Than Those Supplied in Our Regular $4.98 Complete Kits.

We supply you with every part to build either the Santa Maria or the Mayflower Models, with a full detailed diagram and instruction sheet showing and explaining every operation. Hull and parts are of Wood. This is not a cheap cardboard imitation.

See Herbert E. Hayden's article on page 8 on how to convert a Ship Model into a Radio Loud Speaker.

Write for Our Beautiful Free Illustrated Booklet on Ship Models and Their History

MINIATURE SHIP MODELS
3818-20-22-24 BARING STREET
PHILADELPHIA PENNA.

LIST OF PARTS SUPPLIED FOR "SANTA MARIA"; space does not permit describing the parts for MAYFLOWER, but it is just as complete in every detail. Hull and keel, 3 pieces; rudder; rudder support; 6 hause pipe rings; 6 cannons; 6 port shutters; 11 shields; front and poop deck sides; railings; upper deck with decorated stern; colored picture for stern; rigging channels; anchor; lamp and bracket; crow's nest; bowsprit and yard arm; 3 masts, fore, main and mizzen; spanker boom; jib yard arm; fore mast yard arm; main sail yard arm; top sail yard arm and lateen sail yard arm; wire for sails; brass name plate; rigging cord (light and heavy); brads; staples; glue; pullies or blocks and falls; rear balcony; rear balcony railings; side balconies; side cabins; flags; ladders; 18 bumping strips; jib sail; fore sail; main sail; top sail and mizzen sail; stand, 3 pieces; hull and parts are made of wood. This is not a cheap cardboard imitation. Shipping weight, 6 pounds; all Canadian and foreign orders must be accompanied by Money Order for $4.98 plus a sufficient amount for Parcel Post charges.

MINIATURE SHIP MODELS. Dept. 11
3818-20-22-24 Baring Street, Philadelphia, Pa.

Please send me at once the complete set of cut to fit parts, and ready to assemble for the Model .....

I will pay the postman $4.98 plus postage (a few cents).

PLEASE PRINT NAME AND ADDRESS

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