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THE HORN SPEAKER

Radio Telegraphy

By GUGLIELMO MARCONI

The most striking point in Senator Marconi's lecture before a joint meeting of the American Institute of Electrical Engineers and the Institute of Radio Engineers, held in New York City on June 20th, was the suggestion that the shorter wavelengths have been practically abandoned by experimenters and commercial interests. Due to recent advances in the radio art, especially the development of the vacuum tube, effective signalling on short waves is now possible. Mr. Marconi suggested that this will undoubtedly stimulate a great interest in American amateur radio circles which should result in further radio success. In speaking of his parabolic reflector system, he mentioned wavelengths of 15 to 20 meters, which, it would seem, are hardly possible for the average amateur worker, for the erection of a reflector 15 meters high covering an area 15 or 20 meters in diameter would involve a considerable expenditure. For the most part, American amateurs will have to devote their efforts to short wave propagation without the use of the reflector, and it is interesting to note that, even prior to Mr. Marconi's lecture, American amateurs have made some very successful attempts to communicate by this method. Space does not permit us to reproduce Senator Marconi's entire lecture, but the following material covers the most salient points he made about radio telegraphy's past, present and future.—THE EDITORS.

THE first occasion on which I had the honor of speaking before the members of the American Institute of Electrical Engineers was of a very festive nature.

It is more than twenty years ago, to be exact, on January 13, 1902; (there was not then any Radio Institute in existence) and on that date, memorable for me, I was entertained by more than 300 members of your Institute at a dinner at the Waldorf-Astoria in this City. I was offered that dinner following my announcement of the fact that I had succeeded in getting the first radio signal across the Atlantic Ocean.

Many men whose names are household words in electrical science were present, men such as Dr. Alexander Graham Bell, Professor Elihu Thompson, Dr. Steinmetz, Dr. Pupin, Mr. Frank Sprague, and many others.

The function was one I shall never forget, and displayed to the full American resource and originality, as only forty-eight hours' notice of the dinner had been given, but what has left the greatest impression on my mind during all the long twenty years that have passed is the fact that you believed in me and in what I told you about having got the simple letter "S" for the first time across the ocean from England to Newfoundland without the aid of cables or conductors.

It gives me now the greatest possible satisfaction to say that, in some measure, perhaps, your confidence in my statement was not misplaced, for those first feeble signals which I received at St. John's, Newfoundland, on the 12th of December, 1901, had proved once and for all that electric waves could be transmitted and received across the ocean, and that long distance radio telegraphy, about which so many doubts were then entertained, was really going to become an established fact.

I propose to-night to bring to your notice some of the recent results attained in Europe and elsewhere and to call your attention particularly to what I consider a somewhat neglected branch of the art; and which is the study of the characteristics and properties of very short electrical waves. My belief is always that, only by the careful study and analysis of the greatest possible number of well authenticated facts and results, will it be possible to overcome the difficulties that still lie in the way of the practical application of radio in the broadest possible sense.

A very great impulse has been given to radio telegraphy and telephony by the discovery and utilization of the oscillating electron tube or triode valve based on the observations and discoveries of Edison and Fleming, of those of De Forest and of those of Messiner in Germany, Langmuir and Armstrong in America, and H. W. Round in England, who have also brought it to a practical form as a most reliable generator of continuous electric waves.

THE VACUUM TUBE

AS THE electron tube, or triode valve, or valve, as it is now generally called in England, is able, not only to act as a detector, but also to generate oscillations, it has supplied us with an arrangement which is fundamentally similar for both transmitter and receiver, providing us also by a simple and practical method with the means for obtaining beat reception and an almost unlimited magnification of the strength of signals.

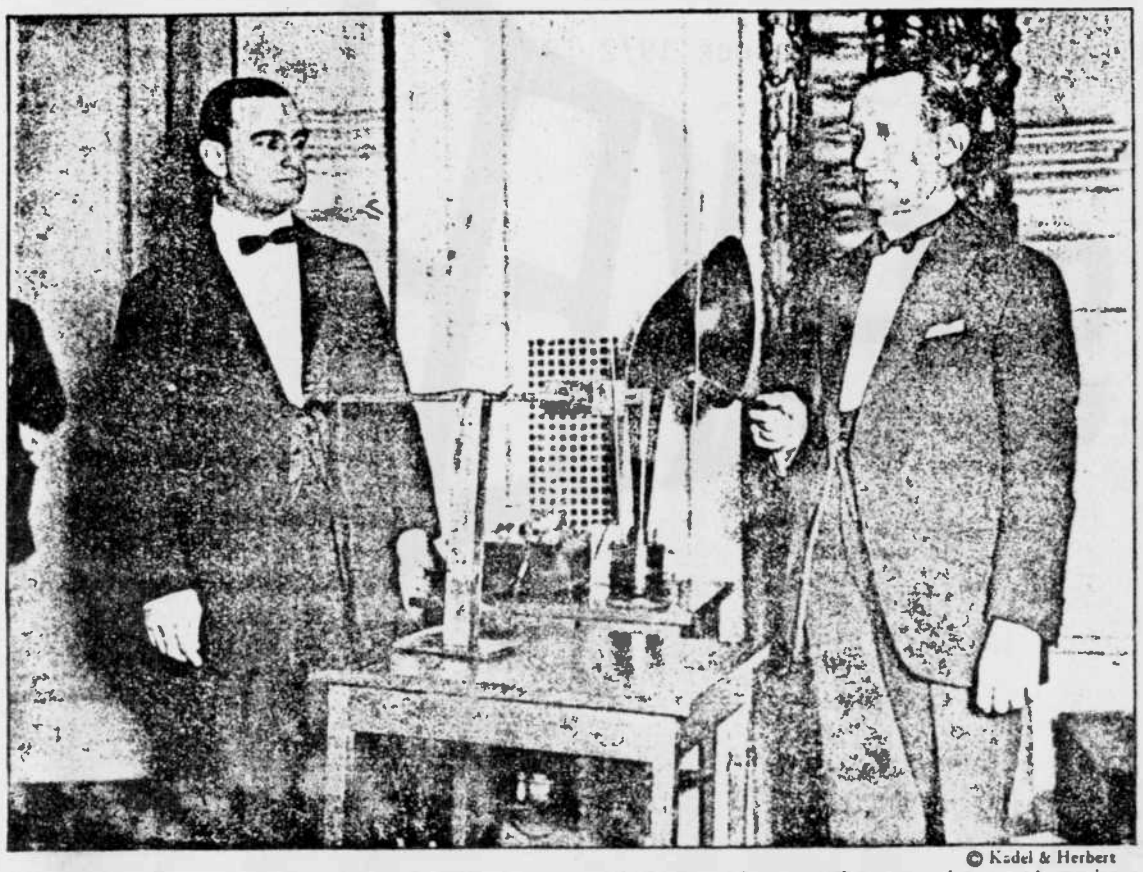
A result of the introduction of the triode valve has been that the basic inventions which made long distance radio telegraphy possible have become more and more valuable.

It has been so far our practice to use a plurality of tubes in parallel at our long distance stations. High power has been obtained in practice up to 100 kilowatts in the antenna by means of a number of glass tubes in parallel, and for the present we are standardizing units capable of supplying 4 kilowatts to the antenna, in the numbers required and sufficient for each particular case.

Some difficulty was at first experienced in paralleling large tubes in considerable numbers, but no difficulties now occur with groups of sixty bulbs working on voltages of 12,000 on the plate.

I am told that no insurmountable difficulty would be encountered if it were desired to supply 500 kilowatts to the antenna from a number of these bulbs. The life of the bulbs has been very materially increased and the 4-kilowatt units are expected to have a life, which, based on a great number of tests carried out both in the laboratory and at our Clifton station, should be well in excess of 5,000 hours.

The development of single unit tubes of considerable power is also progressing. We have lately concentrated on the production of high power tubes made of quartz, and two sizes of each bulb are now being made, one for 25 kilowatt to the antenna, and another for 75 kilowattss but it is not expected that the efficiency of the high power single units will be as good as that of the multiple units, and the work on the large tubes is being considered so far as experimental.



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Marconi demonstrating the effect of placing a tuned inductance between the transmitter and receiver of a short wave directive system. Where the inductance is of the same wavelength as the wave of the transmitter, the signals at the receiver are entirely cut out when the shield is between the two stations. The signals are considerably augmented, however, if the tuned inductance is placed behind the receiving antenna. Where reflectors are employed at the receiving station, the signal intensity is increased approximately five times. The gentleman at the left is Dr. Alfred Goldsmith, President of the Institute of Radio Engineers

EFFICIENCY OF TRANSMITTERS

IN transmission work, a large amount of investigation has been carried out during the last two years on the efficiency of the circuits and in regard to the best way of utilizing the available energy.

Considerable increases in efficiency have been obtained in the aerial or antenna circuits and also in minimizing the losses in the attendant loading coils, and the latest results indicate that it is possible to obtain efficiency of radiation into space as high as fifty per cent. on wavelengths as long as 20,000 meters, when, in this particular case, towers of a height of 250 meters would, of course, have to be used, owing to the length of the wave.

Very careful investigations have been carried out by Mr. H. W. Round of all the losses in the loading coils and other parts of the tube circuits, and actual measurements on considerable power have shown that an over-all efficiency from the input power on the plates of the tubes to the aerial of seventy per cent. is possible with a complete avoidance of harmonics, that is an efficiency from the power input to the plates of the tubes to actual radiation into space of about thirty-five per cent.

On shorter wave stations it is quite practicable still further to increase this efficiency although possibly it is hardly worth the extra expense involved. We have at present one station in England working on a 3,000 meter wave length with a height of mast of 100 meters which has an efficiency from plates to radiation into space of 40 per cent.

In high speed transmission, we are maintaining public services at 100 words per minute to two places in Europe, namely, Paris and Berne, using a single aerial transmitter with two wavelengths on the same aerial, and although the operation of utilizing a single aerial for two wave lengths is not an advisable one for high power work, it has certain points to recommend it in medium power work, where the consequent loss of efficiency can be made up for by a slight increase of power.

These two waves are working duplex to both Paris and Berne and practically all traffic is taken on printing machinery, although there are occasions when, because of static, reception has to be done on undulator tape, and, in some rare cases, on the telephones, by sound.

The reception at these shorter distance stations is carried out by means of a cascade arrangement of high and low frequency tuned amplifier circuits attached to the directional aerial system of the Bellini type, arranged for unidirectional reception when necessary. Very great care is taken in the receiving circuits to shield them so that the tuned circuits come well into action and to prevent any direct effect or influence of the aerial on circuits other than those intended to be acted upon. The characteristics of all these circuits have been very accurately measured so as to give filter curves suitable to the required speeds of working, and the adjustments are easily performed by the operators. Aside from the protection from interference given by directional reception, a close filtering, and an element of saturation, no particularly sensational methods or ideas in regard to static elimination have been so far introduced into practice.

WHERE STATIC COMES FROM

DURING my present journey across the Atlantic on board the Yacht *Elettra*, we noticed that up to about half way across (apart from the effects of local storms, static interference appeared to be coming mainly from the European and African continents, while at more than half way across they were coming from westerly directions, that is, from the American continent.

The changing over of the direction of origin of these disturbances has also been noted under similar circumstances by Mr. Tremellen in crossing the Pacific.

The protection of receivers against the troubles of atmospherics or static can only be, and is likely to continue to be, a relative matter, as

Marconi's yacht, the *Elettra*, which is fitted with a very complete radio laboratory. While the yacht was in the Hudson River Mr. G. Mathieu, who accompanied Marconi, received signals from Europe with remarkable intensity, by a system of amplification he has perfected, using a loop antenna

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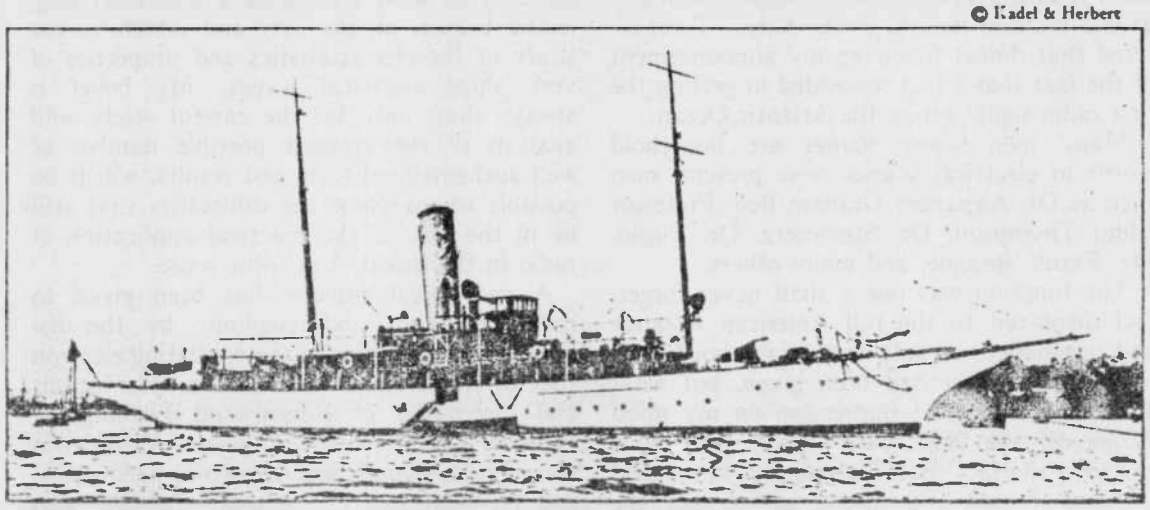

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it is quite obvious that a static eliminator under certain conditions will cease to be effective, where the static arrives with much greater intensity than had been anticipated, and will also frequently fail when, in consequence of the weakness of the received signals, amplification has to be increased to any considerable extent.

RECENT DEVELOPMENTS

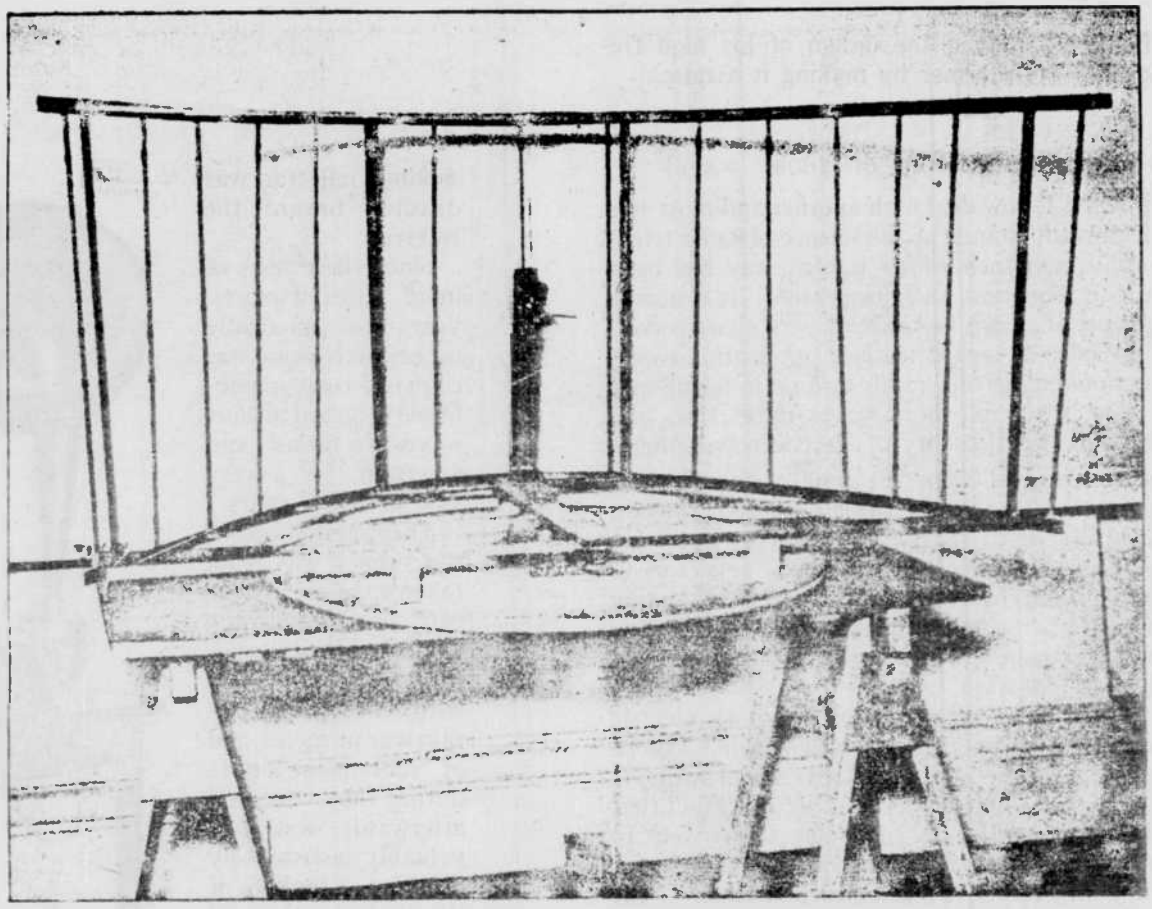
IT WOULD be really interesting to know how much the increased number of C. W. transmitters, the development in directional reception and the improvements in tuning that has taken place during the last few years have really increased our speed of readability and reliability over given distances.

As the development has been gradual the tendency is toward pessimism, but I think we are now able at the same expense to work at about 8 to 10 times the effective speed that we were able to work at in 1912 under the same atmospheric conditions.

Interference from other stations has, of course, enormously increased, and this has perhaps somewhat checked the increase of speed, but fortunately prevention of interference from other radio stations is a very much easier problem than the prevention of the disturbances caused by natural electric waves, or static.

Amongst the different types of tube amplifiers used in modern radio receiving stations, the tuned high frequency and audio frequency amplifier is probably the one which excites the greatest technical interest. In fact, its selective qualities, combined with the comparatively better ratio of signal strength to interference which it secures, justifies such interest.

If those researches were generally not quite successful in regard to preparing or fixing the



The transmitter Marconi used to demonstrate his directive transmission system for extremely short wave work. The table supports a pivoted disc which carries the transmitting antenna and the parabolic reflector. The direction of transmission is altered by orientating the reflector. The upright rods in the reflector are insulated from each other and are of one and one half the transmitting wavelength. Directional transmitting of this nature on 15 or 20 meters would present great difficulties for the amateur to overcome due to the complexity of building the reflecting system. However, where the transmitter could be installed on the roof of a building and a higher building was adjacent to it, the reflecting wires could be suspended and insulated from the latter

A very good idea of the receiving antenna may be had from this photo. The young man is demonstrating the effect of placing a tuned inductance between the transmitter and receiver. A slight movement to one side or the other permits the signal to be received, but when it is placed directly before the receiving antenna signals are entirely cut off. If we are to have directional, short wave transmission it would seem as though both sending and receiving stations would have to be high enough to offset the possibility of any shielding objects coming between them. Operation in large cities would be quite difficult. The receiving rod is slightly shorter than the reflector rod because the former is connected to a circuit having a certain amount of inductance

Courtesy Radio Corporation of America

design of practical apparatus, they however indicated that the main difficulty to be overcome was to combine considerable amplification with stability and that the solution of the problem became rapidly more difficult with the increase of the number of tubes used in cascade.

By stability, in this case, I mean the freedom from any sudden generation of oscillations in any part of the circuits of the amplifier.

RECEIVING DEVELOPMENTS

IN 1920, however, an important step was made by Mr. G. Mathieu, as to the path to be followed out in order to obtain a practical solution of the problem. This consisted in the design of a new type of air-core tuned intervalve transformer arranged in such a manner as to possess only an extremely electrostatic capacity between the windings, and having its effective primary impedance about equal to the effective internal plate to filament resistance of the tube in use when the secondary circuit was brought into resonance with the frequency of the oscillations to be amplified.

The results to be achieved during the first tests of these new transformers appeared to be quite amazing, the amplification factor for one tube having passed suddenly from 5 to about 15 for the particular tube tested, whilst the stability proved incomparably better than what had been obtained previously, even when the grid of the tube was kept to a negative potential of 1 or 2 volts.

The same principle has proved quite as successful when applied to the design of iron-core low frequency transformers. In this case, however, it was found necessary to adopt an iron magnetic shunt between the windings so as to provide a sufficiently loose coupling between the primary and secondary circuits of the transformer. Recently Mr. Mathieu has

further improved the design of his high frequency transformer by making it astatic.

THE IMPORTANCE OF SHORT WAVES

I SHALL now deal with another and most important branch of the science of radio telegraphy; a branch which I might say has been a long time most sadly neglected. It concerns the use that can be made of very short waves, especially in regard to their application to directional radio telegraphy and radio telephony.

The study of short waves dates from the time of the discovery of electric waves themselves, that is, from the time of the classical experiments of Hertz and his contemporaries, for Hertz used short electric waves in all his experiments, and also made use of reflectors to prove their characteristics and to show among many other things that the waves, which he had discovered, obeyed the ordinary optical laws of reflection.

As I have already stated, short electric waves were also the first with which I experimented in the very early stages of wireless history, and I might perhaps recall the fact that when, more than 26 years ago, I first went to England, I was able to show to the late Sir William Preece, then Engineer in Chief of the British Post Office, the transmission and reception of intelligible signals over a distance of 1¾ miles by means of short waves and reflectors, whilst, curiously enough, by means of the antenna or elevated wire system, I could only get, at that time, signals over a distance of half a mile.

The progress made with the long wave or antenna system, was so rapid, so comparatively easy, and so spectacular, that it distracted practically all attention and research from the short waves, and this I think was regrettable, for there are very many problems that can be solved, and numerous most useful results to be obtained by, and only by, the use of the short wave system.

Sir William Preece described my early tests at a meeting of the British Association for the Advancement of Science, in September, 1896, and also at a lecture he delivered before the Royal Institution in London on the 4th of June, 1897.

On the 3rd of March, 1899, I went into the matter more fully in a paper I read before the Institute of Electrical Engineers in London, to which paper I would recall your attention as being of some historical interest.

DIRECTIONAL TRANSMISSION

AT THAT lecture I showed how it was possible, by means of short waves and reflectors, to project the rays in a beam in one direction only, instead of allowing them to spread all around, in such a way that they could not affect any receiver which happened to be out of the angle of propagation of the beam.

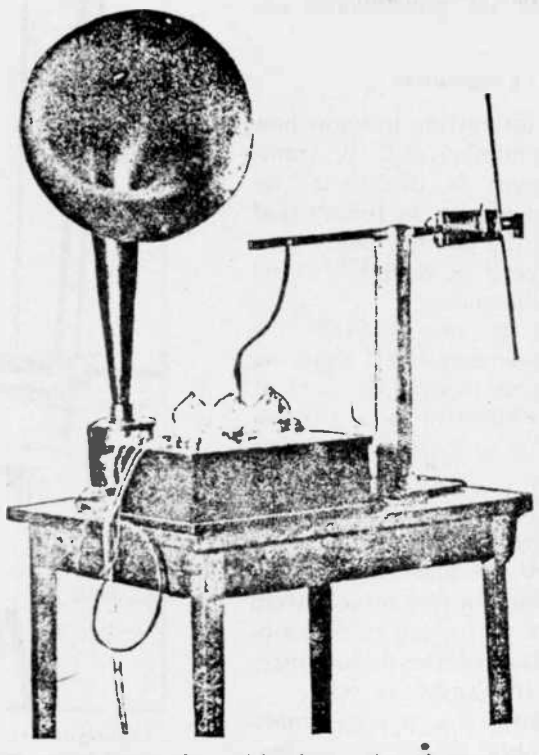
I also described tests carried out in transmitting a beam of reflected waves across country over Salisbury Plain in England, and pointed out the possible utility of such a system if applied to lighthouses and lightships, so as to enable vessels in foggy weather to locate dangerous points around the coasts.

I also showed results obtained by a reflected beam of waves projected across the lecture rooms, and how a receiver could be actuated and a bell rung only when the aperture of the sending reflector was directed toward the receiver.

Since these tests of more than twenty years ago, practically no research work was carried out or published in regard to short waves, so far as I can ascertain, for a very long period of years.

The investigation of the subject was again taken up by me in Italy early in 1916 with the idea of utilizing very short waves combined with reflectors for certain war purposes, and at subsequent tests during that year, and afterward, I was most valuably assisted by Mr. C. S. Franklin, of the British Marconi Company.

Mr. Franklin has followed up the subject with thoroughness, and the results obtained have been described by him in a paper read before the Institution of Electrical Engineers in London on the 3rd of April, 1922.



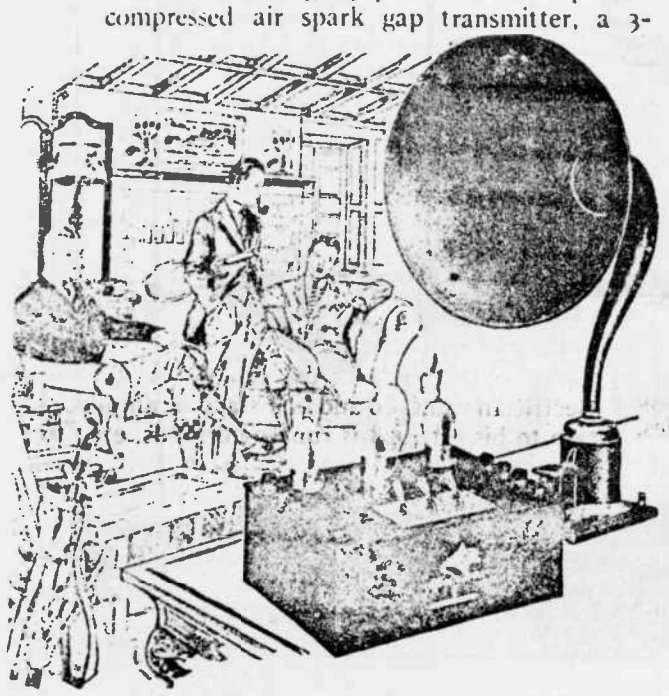
The receiving outfit used by Marconi to demonstrate the reception of extremely short waves sent out by a directive antenna. For the demonstration, he used a loud speaker of American make so that the audience could observe the effect of his directional antenna. The signals of extremely short waves are picked up and then pass through a circuit similar to the superheterodyne and thus changed to a wavelength of six hundred meters. Although six hundred meters is the wavelength for ship use no interference is experienced from this source because only those waves which influence the detector circuit are passed on. This feature of the receiver was not pointed out by Marconi and is therefore not generally realized

Most of the facts and results which I propose to bring to your notice are taken from Mr. Franklin's paper.

The waves used had a length of 2 meters and 3 meters. With these waves, disturbances caused by static can be said to be almost nonexistent, and the only interference experienced came from the ignition apparatus of automobiles and motor boats.

The receiver at first used was a crystal receiver, whilst the reflectors employed were made of a number of strips of wires tuned to the wave used, arranged on a cylindrical parabolic curve with the aerial in the focal line.

The tests were continued in England at Carnarvon during 1917. With an improved compressed air spark gap transmitter, a 3-meter wave, and a reflector having an aperture of 2 wavelengths and a height of 1.5 wavelength, a range of more than 20 miles was readily obtained with a receiver used without a reflector.



In 1919 further experiments were commenced by Mr. Franklin at Carnarvon for which electron tubes or valves were used to generate these very short waves, the object being to evolve a directional radio telephonic system.

A 15-meter wave was chosen, which could quite easily be generated by the type of electron tube employed.

As a result of the success of these experiments it was decided to carry out further tests over land across a distance of 97 miles between Hendon (London) and Birmingham.

The power supplied to the tubes employed is usually 700 watts. The aerial is rather longer than half a wavelength and has a radiation resistance which is exceedingly high. The efficiency input to the tubes to aerial power is between 50 and 60%, and about 300 watts are actually radiated into space.

With the reflectors in use at both ends, speech is usually strong enough to be just audible with a ¼ to ½ ohm shunt across a 60-ohm telephone.

With both reflectors down and out of use, speech is only just audible with no shunt.

By means of suitable electron tubes or valves, it is now quite practicable to produce waves from about 12 meters and upward utilizing a power of several kilowatts, and it is also practicable to utilize valves in parallel.

Reflectors besides giving directional working, and economizing power, are showing another unexpected advantage, which is probably common to all sharply directional systems. It has been noted that practically no distortion of speech takes place, such as is often noticed with non-directional transmitters and receivers, even when using short waves.

It has thus been shown for the first time that electric waves of the order of 15 to 20 meters in length, are quite capable of providing a good and reliable point to point directional service over quite considerable ranges.

I have brought these results and ideas to your notice as I feel—and perhaps you will agree with me—that the study of short electric waves, although sadly neglected practically all through the history of wireless, is still likely to develop in many unexpected directions, and open up new fields of profitable research.

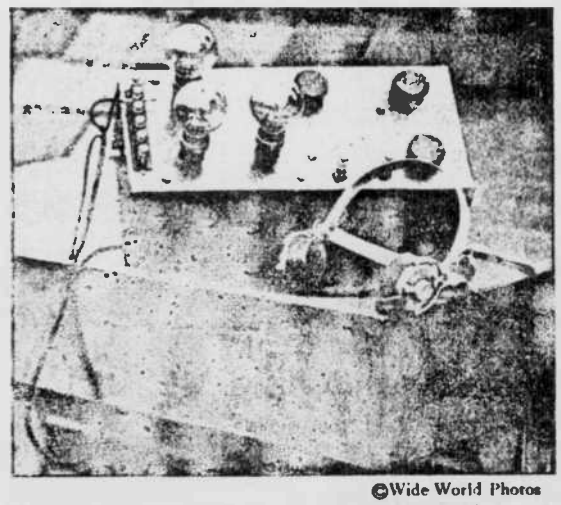
BROADCASTING

NO REMARKS from me or from any one else are required to tell you what has already been done with radio in America, as a means of broadcasting human speech, and other kinds of sound which may also be entertaining if not always instructing.

In thousands of homes in this country there are radiotelephonic receivers, and intelligent people, young and old, well able to use them—often able to make them—and in many instances contributing valuable information to the general body of knowledge concerning the problems, great and small, of radio telegraphy and radio telephony.

But I think I am safe in saying that if radio has already done so much for the safety of life at sea, for commerce, and for commercial and military communications, it is also destined to bring new and, until recently, unforeseen opportunities for healthful recreation and instruction into the lives of millions of human beings.

RADIO BROADCAST, AUGUST 1922



©Wide World Photos

The English Marconi Company produced this broadcast receiver for home use.

Salt-Box Reception in Yoakum, Texas

This interesting letter, describing the experiences of one family with a home-made receiving set of the simplest type, needs only the plain statement of facts to show clearly how important a place radio holds among those who live in remote localities all over the country. The Orrs wound their coil on a salt-box and backed the family chariot up near the set when they needed a storage battery for their vacuum tube—and they tuned in Detroit, 1,230 miles to the northeast! There is no telling how far Billie and his mother and father will hear when the "chief electrician" gets one stage of amplification.—THE EDITOR.

Yoakum, Texas
Dec. 3, 1922.

RADIO BROADCAST,
Garden City, N. Y.
DEAR SIRS:

This is a composite letter written by a 13-year old boy, acting as chief electrician; his dad, some fifty years of age, as supervisor and reader of technical papers; and the silent partner, the mother (age not mentioned), enthusiastic listener and giver of hard-saved nickels when needed. I mention these details to show how radio can and does grip people of all ages.

We live in a small town, and last spring we caught the fever, so after much reading and talking, we built a set, consisting of a variometer and condenser. Alack and alas, nothing doing but a little of the now familiar rat-ta-ta. What was wrong? After much study and thought, it was decided the lack of sufficient inductance was responsible. We made a tapped coil on the old standby—a cardboard salt box—hooked it up, and presto, we had it! How good that music sounded, and when we heard the announcer say, "Our next selection—Mr. Watkins on the pipe organ," we felt like throwing our hats in the air. Now, after months of experimenting and learning, we often think of our first thrill on getting this music out of the air.

How far do we hear? Bless your heart, we hear all over. We have heard Detroit, 1230 miles, Louisville, 930 miles, Atlanta, 840 miles, Davenport, 960 miles, Denver, 870 miles (our limits so far), and numberless stations between, St. Louis, Kansas City, Fort Worth, and Dallas are as familiar to us as the girl in our local phone exchange. We have also heard other stations, which we do not count, as in fairness to ourselves and friends, no stations are listed unless we hear the call letters, the name of the city, and at least two numbers on the programme.

What do we hear on? A tuning coil consisting of a cardboard salt box wound with some discarded No. 22 wire, tapped every ten turns for ten taps and every two turns for ten taps, a variometer in the plate circuit, a .001 condenser variable in the aerial, one tube and accessories. This set has been copied by several friends and it works. The aerial consists of a single wire, about ninety feet long (counting lead-in), strung up between two 2 x 4 x 20's on the roof, height above ground about forty feet. The aerial and guys consist of discarded telegraph wire, the total cost of the aerial, guy wire and masts being sixty-four cents. The filament current is supplied by our old automobile, which we drive close to the set, which we maintain in the shop where dad makes his living. Part of our success, we believe to be due to the fact that all joints are tightly soldered, all connections made of bare, hard-drawn copper wire No. 14, and all leads to the coil covered with spaghetti. From experience, we can say that loose connections are responsible for half the troubles in a set.

Now, Mr. Editor, if this letter is worth printing in your magazine, do so, and as the chief electrician wants to add one stage of amplification to his set, and is running errands, etc., to buy the parts, and you feel disposed to give him a helping hand, he will be grateful to you. We mention this in view of the statement made on page 61 (insert) November RADIO BROADCAST.*

Cordially in radio
BILLIE ORR,
Dad and Ma

Progress of Radio in Foreign Lands

IN RADIO, at least, Great Britain has much to learn from us, even if we are a much younger country. Until the present the British radio amateur has been operating under the most adverse and discouraging circumstances, and if his numbers have increased despite all the obstacles placed in his path, it is due to the attraction which radio holds for so many of us. The problem of licenses in Great Britain has become very acute. Just so long as the amateur was satisfied to receive and perhaps to send with extremely limited power, there was no objection to his activities. But now that the amateur is getting more ambitious, the problem is getting serious. Another thing is the lack of public broadcasting in Great Britain. The British amateur, as well as the clockmaker, receives his time signals from Paris, Moscow, and other centers—second-hand Greenwich time, to be sure; but since his country does not broadcast its own official time, he must get it from abroad. The British ether is filled with dots and dashes, but practically no radiophone broadcasting. The amateurs are now clamoring for a central broadcasting station like those operating in the Hague and in Paris, and it appears that their demands will be granted in the very near future.

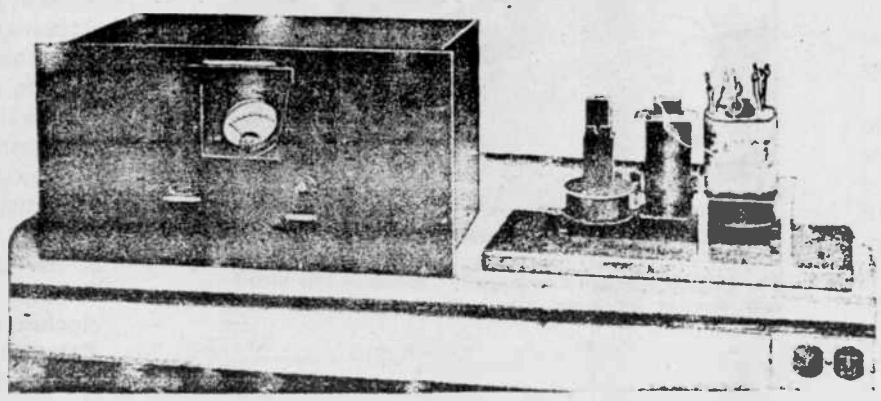
GREAT BRITAIN'S WORLD-WIDE RADIO PLANS

THE publication of the report of the commission appointed to study the problem of world-wide radio communication for the British Empire discloses a number of interesting facts bearing on present-day radio. To begin with, the commission suggests that the communication should be effected in steps of about 2,000 miles, which is considerably less than the more ambitious jumps of a few years ago. Then the suggestion is made that vacuum tubes be employed to generate the radio energy used in transmitting. The excellent results obtained with a set of 48 vacuum tube oscillators used in the Carnarvon station with an input of 100 kilowatts, which was pushed up to 150 during the trial, are referred to. Messages were successfully transmitted to the United States, India, and Australia with this arrangement. It is stated that valve or tube renewals will be from 50 to 60 per cent heavier if alternating current is used instead of direct current, presumably due to the use of thermionic rectifiers. With regard to wavelength, it has been found by actual tests between Horsea and Egypt that the best results over this distance can be obtained by the use of relatively short waves during the night and of a long wavelength during the day time. It is recommended that the masts be of steel, 800 feet high, insulated not only at the base but at intermediate points. Counterpoises are recommended instead of ground connections. With regard to duplex working, it is recommended that each receiving station should have a separate antenna and receiving apparatus for each distant station with which it may have to communicate, so as to allow of simultaneous reception from all. As a temporary expedient, it is suggested that arc generators be used. However, these are to be replaced as soon as possible with tube oscillators. It is interesting to note that no reference is made to high-frequency alternators.

RADIO BROADCAST, JULY 1922

Radio News for May, 1931

Testing Power Transformers



A view of the test set-up employed by the author for detecting shorted turns in transformer coils

This simple apparatus provides an accurate and effective means for detecting shorted turns in power transformer windings and should be of interest to engineers and others engaged in inspection and production work

By Herbert M. Isaacson

THE engineering department of most well-planned radio manufacturing organizations is composed of two divisions. First, there is the research and design division, which is concerned with the development of new models embodying the fructification of advanced knowledge, and, second, there is the test engineering division. It is among the duties of the latter to see that the set in production conforms to the specifications set down by the design division. To do so it must devise test equipment which is sensitive enough to find minute and elusive faults, rapid enough in operation to be practical for production purposes, and yet simple enough to be handled by the average factory operator. Often this is an ingenuity-taxing job.

Shorted Turns

For illustration, we shall consider the matter of shorted turns in coils. In some pieces of apparatus the presence of shorted turns has no deleterious effect, in some it is desirable, but in others it is disastrous. Filter choke coils may have a comparatively large percentage of shorted turns with no more serious effects than a decrease in inductance and a resultant decrease in the effectiveness of the filtering—usually not enough to be detected by ear. A certain percentage of shorted turns in an audio-frequency transformer will flatten out peaks in its amplification vs. frequency curve and are therefore rather desirable. On the other hand, a single shorted turn in a power transformer may result ultimately in its destruction.

Consider, for a moment, the design of the average power transformer. It probably has five turns per volt, a high-voltage secondary of No. 30 enamel wire and a rated temperature rise under load of about 40° Cent. The average length per turn in the high-voltage secondary is 6 inches. It has a resistance at normal operating temperature of approximately 0.065 ohm. Assume this turn to be shorted on itself through a negligible contact resistance—it becomes practically a unity-power-factor load of 0.065 ohm across a 1.5-volt supply. The current flowing will be $\frac{0.2}{0.065}$ or 3 amperes. This is 30 times normal current and the heat generated will be 900 times normal. This heat from the single shorted turn will be conducted to adjacent turns, and their insulation will be broken down. (Enamel insulation will not withstand a temperature much in excess of 100° Cent.) The action is progressive—a vicious circle being created—shorted turns generating heat which causes more shorted turns which in turn generate still more heat, until the entire transformer is destroyed.

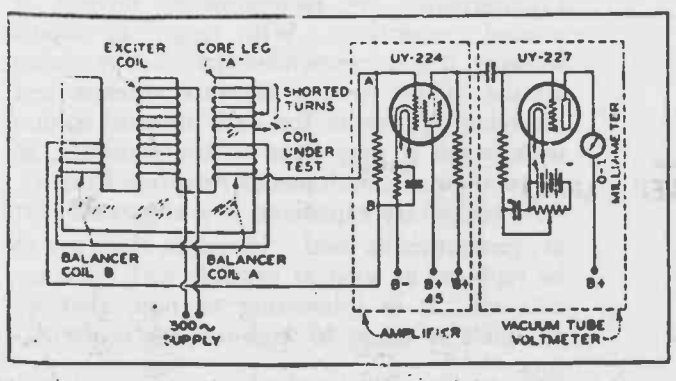


Figure 1. (At left) The schematic circuit of the apparatus shown at the top of the page

Detection of Defects

A wattmeter or ammeter might be used to detect the presence of this initial shorted turn by the added primary power or current. However, variation in the core material or assembly might account for the increase of a half watt in power as easily as would the shorted turn. Further, if the contact resistance is not of negligible value, as assumed in our illustration (and it usually is not), then the increase of power would be so slight as to render its detection by a wattmeter altogether impossible. Even if a wattmeter did detect the shorted turn, there would be the expensive waste of having completely assembled the transformer, and then rejecting it and reassembling it with a perfect coil. The ideal test method would detect the shorted turn in the coil before it was assembled into a transformer.

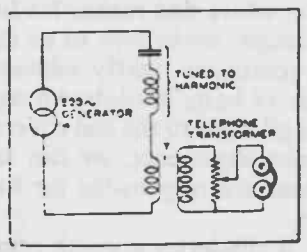


Figure 2. A method for determining the relative amplitude of harmonic frequencies in the output of a generator

A Better Method

Such a method is herein described. It is stable, simple to use and capable of testing 2000 coils per day. It can be made to have almost any degree of sensitivity desired. However, with a single-stage amplifier, as shown in Figure 1, holding a single loop of No. 30 wire, 6 inches in diameter, a distance of one inch *above the top* of core leg A will cause a deflection of the vacuum-tube voltmeter. If the wire is brought flush with the top of the core, a 0-01 ma. meter is driven off scale. Figure 1 shows the circuit of the apparatus. If the two balancer coils have the same constants and the magnetic paths from the exciter through each of them has the same reluctance, then the voltage induced in balancer coil A will be equal to and 180 degrees out of phase with that induced in coil B and no potential difference will exist across A B.

The coil to be tested is slipped over core leg A. If it is perfect, there is no deflection of the vacuum-tube voltmeter. However, if there is a shorted turn present, the induced current will generate flux which by Lenz's law is 180 degrees out of phase with the flux causing it. If it were not for the leakage flux all of this counter flux would thread back through the primary, lowering its counter e.m.f. and thereby increasing its current just enough to offset this counter flux. The net result then would be that the flux through core leg A remains constant. However, because of the high reluctance of the path between the primary (the exciter coil) and secondary (the shorted turn), all of the counter flux set up by the shorted turn which threads coil A does not thread back through the primary. Considerable of it goes through the shunt air path. The primary current is not increased sufficiently to offset it and there is a resultant *decrease* in the flux through leg A. The net voltage induced in balancer coil A is reduced, and a voltage is generated across A B. This voltage is amplified and causes a deflection of the vacuum-tube voltmeter, thus giving the operator visual evidence of the presence of shorted turns.

The deflection is proportional to the current flowing in the shorted turn. If the contact resistance is appreciable, it limits the current. For this reason the exciter coil should have about one-third as many turns as has the transformer coil primary. The induced voltage will then be sufficient to break down contact resistance and give positive indication of a shorted turn.

The two balancer coils should have as many turns of wire as possible in order that a small change of flux due to a shorted turn will cause a large voltage difference between them. Sensitivity is further increased by an increase in frequence of the exciter voltage. The reason for this is rather interesting. If the shorted turns are few in number, the resistance component of their impedance will be large in comparison with the reactance component. The current then will be fairly independent of frequency. Since the flux is proportional to the number of turns and the current flowing through them, the *flux they generate is independent of frequency*. The voltage induced in balancer coil A by shorted turns is a function of the number of maxwells which thread it (but do not thread the exciter coil) and of the frequency, from the well-known equation, $E = 4.44fN\phi_{max}10^{-8}$. Since the flux is constant, as just shown, the voltage induced in balancer coil A will increase with frequency.

The distributed capacity of the coil limits the frequency which may be used, since any current flowing through the coil under test due to capacity sets up counter flux just as shorted turns do. It seems that current having a frequency of 500 cycles is near the upper frequency limit with the average power transformer coil,

VRP

Ray Poindexter, featured speaker at the banquet, entered radio in 1946 after serving as a Naval officer in World War II. His diversified experience includes announcing, news, programming, sales and management. Radio history is his advocation.

VINTAGE RADIO & PHONOGRAPH SOCIETY CONVENTION AND AUCTION

Call: (214) 337-2833,

(214) 681-5866 or (214) 436-3944

October 18-20, 1985
Holiday Inn, Duncanville, Texas

for information write
Vintage Radio & Phonograph Society INC.
P.O. Box 165345, Irving, Texas 75016

Items scheduled for the auction:
24" Champagne bottle radio, 7" Sentinel T.V., Neutrowound with covers, DeForest Interpanel, Radiola Grand, Radiola Special, Radiola IV, Radiola X, Radiola 104 loudspeaker and many more choice sets.

Accuses Radio Trust

RADIO AGE, March 1924

MONOPOLY in the radio apparatus and communication, both domestic and transoceanic, is charged in a complaint issued by the Federal Trade Commission. Efforts to perpetuate the present control beyond the life of existing patents, is likewise charged.

Radio Corporation of America, General Electric Company; American Telephone & Telegraph Company; Western Electric Company, Inc.; Westinghouse Electric & Manufacturing Company; The International Radio Telegraph Company, United Fruit Company, and Wireless Specialty Apparatus Company, are named as respondents and are alleged to have violated the law against unfair competition in trade to the prejudice of the public.

In the language of the complaint "the respondents have combined and conspired for the purpose and with the effect of restraining competition and creating a monopoly in the manufacture, purchase and sale in interstate commerce, of radio devices and apparatus, and other electrical devices and apparatus, and in domestic and transoceanic radio communication and broadcasting."

To attain the present control alleged, the complaint recites that the respondents: (1) acquired collectively, patents covering all devices used in all branches of the art of radio, and pooled these rights to manufacture, use and sell radio devices, and then allotted certain of the rights exclusively to certain respondents; (2) granted to the Radio Corporation of America, the exclusive right to sell the devices controlled and required the Radio Corporation to restrict its purchases to certain respondents; (3) restricted the competition of certain respondents in the fields occupied by other respondents; (4) attempted to restrict the use of apparatus in the radio art manufactured and sold under patents controlled by the respondents; (5) acquired existing essential equipment for transoceanic communication and refused to supply to others necessary equipment for such communication; and also excluding others from the transoceanic field by perferential contracts.

2,000 Patents Involved

From the series of contracts referred to in the complaint it appears that the Radio Corporation of America has the right to use and sell under patents of the various respondents which relate to the radio art. It has also given to various respondents the right to manufacture under these patents. Thus there has been combined in the hands of these corporations patents covering the vital improvements in the vacuum tube used in long distance communications and other important patents or inventions in radio which supplement this central device. Approximately 2,000 patents are involved.

The report of the federal trade commission on the radio industry states that the gross income of the Radio corporation in 1922 was $14,830,856 and that its capital stock on Dec. 31, 1922, was $33,440,033. The holdings of the several respondents in the Radio Corporation of America are given as follows: General Electric company, 620,800 preferred, 1,876,000 common; Westinghouse Electric and Manufacturing Company, 1,000,000 preferred, 1,000,000 common; American Telephone and Telegraph company, 400,000 preferred, no common; United Fruit company, 200,000 preferred, 160,000 common.

It is further stated that up until 1922, the Radio Corporation had an absolute monopoly in the manufacture of vacuum tubes and for the first nine months of 1923 sold 5,509,487 tubes. During the same period the only other concern having the right to make and sell tubes, sold 94,100 tubes.

In the communication field, while the Radio Corporation has some competition in ship-to-shore communication, it has a practical monopoly in transoceanic service. It controls all the high power stations in this country except those owned by the United States government. Agreements of an exclusive character have been entered into with the following countries or with other concerns in control of the situation in those countries, namely, Norway, Germany, France, Poland, Sweden, Netherlands, South America, Japan and China. Arrangements have also been made with the land telegraph companies in this country whereby messages will be received at the offices of the Western Union and Postal Telegraph companies.

The Contracts

A summary of the contracts between the respondents as recited in the complaint is: First, the organization of the Radio Corporation of America in 1919, under the supervision of the General Electric Company, which company received large holdings in the stock of the Radio Corporation for capital supplied and for its service in connection with the acquisition of the American Marconi Company. An agreement entered into between these companies granted to the Radio Corporation an exclusive license to use and sell apparatus under patents of the General Electric Company until 1945; and the Radio Corporation granted to the General Electric Company the exclusive right to sell through the Radio Corporation of America only, the corporation agreeing to purchase from the General Electric Company all radio devices which the General Electric Company could supply. Subsequently this arrangement was extended to include the Westinghouse Electric & Manufacturing Company, the business of the Radio Corporation being apportioned between the General Electric Company and the Westinghouse Company; sixty per cent to the General Electric and forty per cent to the Westinghouse Company.

Meanwhile in July, 1920, the General Electric Company, and the American Telephone and Telegraph Company, made an arrangement for mutual licensing on radio patents owned by each and providing for traffic relations. The terms of this agreement were extended to the Radio Corporation of America and the Western Electric Company and thereafter to the Westinghouse Company.

The Radio Corporation in March, 1921, made an agreement with the United Fruit Company, which operated a number of long distance radio stations in Central and South America by which licenses under radio patents of the Radio Corporation and of the United Fruit Company and its subsidiary the Wireless Specialty Apparatus Company, were exchanged, and arrangements made for the exchange of traffic facilities, and the definition of their respective fields adopted between the Radio Corporation and the United Fruit Company. Provisions of the agreements between the Radio Corporation of America, the General Electric Company, the American Telephone and Telegraph Company and the Western Electric Company were extended to the United Fruit Company.

Philco

Philco

NEW BOOK FOR PHILCO COLLECTORS

Seattle, WA, September 23rd. ARS Enterprises announced today the publication of its latest speciality service manual.

The new book is title: MOST OFTEN NEEDED 1926-50 PHILCO DIAGREAMS AND SERVICE INFORMATION.

This is the latest in a long line of technical service manuals, published by supreme publications since the 1930s. Supreme is now a part of ARS Enterprises.

"This new book covers most Philco set collectors and repair shops are likely to come across from that era," said Kristine H. Beitman, who compiled this manual. Ms. Beitman continued: "We have covered more than 250 Philco models and chassis in 177 fact-filled pages."

The book is done in the standard Supreme format of approximately 8 1/2" by 11". It is priced at $17.00.

For more information, contact ARS Enterprises, P. O. Box 997, Mercer Island, WA 98040.

RADIO PARTS

ANTIQUE ELECTRONIC SUPPLY IS EXPANDING

Antique Electronic Supply of Tempe, Arizona has announced that they are moving into a larger facility in November of 1985. The location at 688 West First Street, will give them 3000 square feet for stocking tubes, parts, books and other items of interest to antique radio enthusiasts.

Antique Electronic Supply was started by George H. Fathauer of Mesa, Arizona and his son George A., of Phoenix in the summer of 1982. George H. had just retired from a career in radio design, where he had accumulated 75 patents, including the circuit design of the first Bearcat scanning receiver. George A. had already been involved in antique radio restoration, when he called his father one day with the idea of buying a collection of 40,000 early tubes from a Phoenix man and starting a business. George H. agreed that it would be a fun way to use his electronic knowledge and together they opened Antique Radio and Tube Company at 1725 W. University in Tempe, Arizona. The store featured a large display of collectable radios for sale, stocked all types of tubes and provided radio servicing. They were soon sending tube price lists to needy collectors all over the nation and in the fall of 1983 launched a mail order division under the name Antique Electronic Supply. The business now employs 2 additional persons and finds 5 percent of its sales in mail order.

Mailbox

Dear Mr. Cranshaw:

I would appreciate very much any help that you can offer in my past attempts with twice having written to an advertisement that had appeared in the february 1985 of THE HORN SPEAKER. The ad was by Mr. Pipat W. Poolpol, 9 Soonthon Kosa road, Klong toey, Bangkok IOII, Thailand, who was asking for an assortment of articles such as radio, T.V., phono.

I was interested in knowing whether he was willing to sell me some of the radios in particular, since my wanting to add one or two models from Asia in particular. I guess my letters arrived OK since not returning. I wonder what his policy may be with regards selling outside the country. It would be very expensive for me having any item shipped, but worth the while.

Let me know what can be done to establish any sales. If his ad is still being run, it well may be that he is still in business.

Your's truly,
D'Arcy Brownrigg
Chelsea, Quebec
Canada, JOX 1NO

Dear Jim,

Do you think you can scrape up some information on negative mutual coupling in R.F. stages used in T. R. F. and neutrodynes of the past?

Maybe someone out there may have some info on the subject to put in the paper.

Thank you and 73
A. A. Bruno

Dear sir,

My collection is very general in nature. I am currently interested in acquiring Zenith Stratosphere, Scott, McMurdo Silver and a Mickey Mouse radios

round out my present
llection.

My number one goal is to find
Zenith Stratosphere.

If you could direct me to an
quaintance who might have some
these radios, I would appreciate
aring from them.

New subscriber
James E. Bragg Sub'd
14217 Runnymede
Van Nuys, CA 91405

VERTISE IN THE HORN SPEAKER
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OTO ADS ..... $5.00 extra.

flea market

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FOR SALE: THINWALL, BLACK BAKELITE TUBING. 4" DIA $3.75/FT. 3 1/2" DIA $3.50/FT. 3" DIA $3.00 PER FT. WILL CUT TO ANY SIZE, 12" MINIMUM. BOB, W6ME, 4178 CHASIN STREET, OCEANSIDE, CA 92056.

****

FOR SALE. RIDERS, HOWARD SAMS, RCA, PHILCO, ZENITH SERVIE DATA. RADIO PARTS, TUBES TEST EQUIPMENT. LIST 3/85 50 cents AND SASE. UNLISTED ITEMS SEND WANTS AND SASE. KRANTZ, 100 OSAGE AVENUE, SOMERDALE, NJ 08083.

****

FOR SALE- CATHEDRAL, battery and AC radios. List four times a year. Send S.A.S.E. J. Albert Warren, Box 279, Waverly, PA 18471.

****

FOR SALE: TUBES, PARTS, SCHEMATICS, custom power supplies. SASE for list to: Los Locos, 1201-74 Monument Blvd., Concord, CA 94520.

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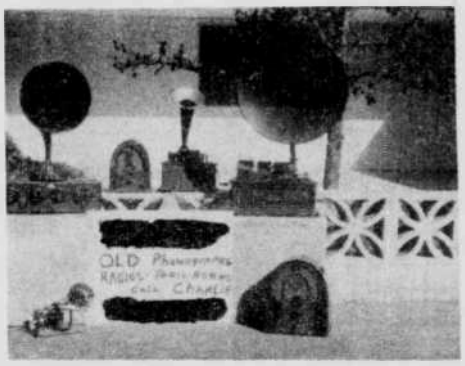

DIVORCED- SELLING OUT. Hallicrafters Super Skyrider SX28. - Stewart Warner bar radio 1940s - Majestic 440 cathedral radio - RCA model 96T, Gilfillan wood table model, Stewart Warner magic dial console - Knight head radio - Coca Cola radio - Airline console - Webster Chicago wire recorder - Sony AV8600, video recorder - Challenger PA amp. no. CH30 - Atwater Kent system K June 1912. Grundig Box 59 - Philco air cooler wood looks like old radio. Serial old - CRTs for TVs - 3" 5" 7" plus 3 old TV sets. Call (503) 474-5966 days.

****

The above ad is from Charles Seidel, 925 Starlite Pl., Grants Pass, OR 95726. Photo — Oct. 1979

****

ANTIQUE CROSLEY BATTERY RADIOS. CROSLEY JR. CATHEDRAL WORKS $49.00 - ATWATER KENT IN DESK FLOOR CABINET, WORKS $135.00 - ZENITH 1930S BIG BLACK-DIALER, WORKS $49.00 - BEAUTIFUL WOOD FLOOR MODEL PIN BALL GAME, NOT ELECTRIC, RARE 1930S $125.00. SEND S.A.S.E. TO ARTHUR HARRISON, 1021 FALCON DRIVE, COLUMBIA, MO 65201.

****

NOW! TWO BOOKS
from ALLABOUT BOOKS
ALL ABOUT METERS. History of the developement of electrical meters; build simple meters representive of the historical types.
ALL ABOUT CRYSTAL SETS. Theory and construction of crystal set radios.
$7.95 each, ppd USA. Send to Dept. H, P. O. Box 4155, Fremont, CA 94539.

****

RIDER RADIO AND TV SERVICE MANUALS. HOWARD SAMS, RCA, PHILCO, ZENITH, PLUS MORE. RADIO PARTS, KNOBS, DIAL BELTS, TUBES, SPEAKERS, TUBE TESTERS, SIGNAL GENERATORS, VOLUME CONTROLS. WRITE WANTS. SASE. KRANTZ, 100 OSAGE AVENUE, SOMERDALE, NJ 08083.

****

SELLING: 380 RADIO MAGAZINES, 1919-1927. RADIO NEWS, RADIO, RADIO AGE, WIRELESS AGE, WIRELESS WORLD, POPULAR RADIO, RADIO BROADCAST. SASE FOR LIST. W6ME, 4178 CHASIN STREET, OCEANSIDE, CA 92056.

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FOR SALE— 8 PAGE LIST RADIO ITEMS— 50 cents and SASE. Krantz, 100 Osage Avenue, Somerdale, NJ 08083.

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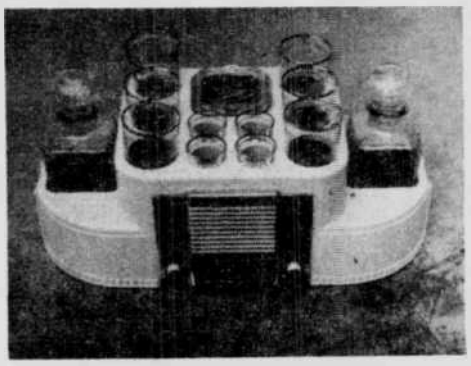

DIVORCED— SELLING EVERYTHING. 64 phonographs— Edisons, Victors, Columbias, all kinds, some have wood horns, Operas to Gems, 35 extra horns, 830 cylinder records, disc records in albums, parts, sell one or all, must sell— moving to coast. Call (503) 474-5966 days.

****

The above is another ad from Charles Seidel.

****

FOR SALE — CATHEDRAL, BATTERY, AND A. C. radio. Photo list four times per year. Send S.A.S.E. to J. Albert Warren, Box 279, Waverly, PA 18471.

****

WANTED

WANTED: SILVER MARSHALL PLUG IN COILS TYPE 114, PLUGS INTO RING TYPE SOCKET. COIL FORMS OK. ALSO HAMMARLUND OR SHORTWAVE AND TV LABS COIL FORMS. BOB, W6ME, 4178 CHASIN STREET, OCEANSIDE, CA 92056.

WANTED - ZENITH RADIO SIGNS. DISPLAYS, ADVERTISING, ETC. PRE 1935. CALL MONDAY THRU FRIDAY. 8 TO 5. (312) 357-4955.

S.A.S.E. is a self addressed stamped envelope.

EICO MODEL 147 SIGNAL TRACER in excellent condition with probes and manual. Also want Motorola Portable Radio Model 5A5. Roy Schmitt Rt. 1, Box 800 Lot 84, Converse, TX 78109. (512) 658-2669.

WANTED, INSTRUCTION MANUAL OR ANY other set manual, including schematic for Kennedy 110. Zerox OK. Bill Pugh, 2126 E. Myrtle, Phoenix, AZ 85020.

WANTED: RADIO TUBES (45'S, 50'S), Western Electric Tubes, Amps., Consoles, Drivers, Horns, Speakers, Parts and Tannoy Speakers, McIntosh or Marantz Tube Amps. David Yo, P.O. Box 382, Monterrey Park, CA 91734. Tel. (818) 576-2642.

WANTED: DYNASCAN 1000 IN STILL GOOD CONDITION. OK ON SMALLER TUBES MISSING. CONDITION ON C.R.T. IF KNOWN?. IT MAY BE REJUVINATED IF NOT COMPLETELY DONE IN, SHOULD HAVE SOME EMISSION, NO SERIOUS SCREEN DEFECTS LIKE HALOS OR SILVERING. KNOWN SUBSTITUTE?. DYNASCAN PICKUP AND RF GENERATOR USING 931-A. GOOD CONDITION PREFERABLE. OK ON MISSING TUBES SAVE PHOTOMULTIPLIER. CBS COLOUR WHEELS, COLOUR SLAVE 15"-17" GOOD CONDITION. COLOUR PHOTOS, SLIDES 16MM COLOUR MOTION PICTURES FROM STUDIO MONITOR OR OTHER. WOULD WELCOME CORRESPONDENCE FROM COLLECTORS OF CBS MATERIAL. D''ARCY BROWNRIGG, P. O. BOX 292, CHELSEA, QUEBEC, CANADA, JOX 1NO.

VINTAGE AUDIO TUBES AS 2A3, 50 W.E.'S 101B/F, 104B/D/F, 205B/D/F, 211D/E, 242A/C, 252A, 262A, 274A/B, 275A, 276A, 284D, 300A/B, 301A, 347A, 348A, 350B, 351A, VT-2, VT-4B, VT-25, VT-25A, VT-52, D-86326, D-86327. New condition are welcome. SHIGERU MIURA, 5-14 3 CHOME, TOKIWADAI ITABASHI-KU, TOKYO JAPAN— P.S. VT-62, 801A, PX25, 6B4-G, DA30, RE604, R120, TM100 WELCOMED TOO.

WANTED: ELECTRON TUBES AND EARLY audio/ stereo equipment. Ex. — Marantz, McIntosh, W.E., etc. Tubes - 50, 250, 350, 450, 45, 245, etc. — plus many W. E. types. Please contact me with anything of interest. Charles Dripps, 4331 Maxson Road, El Monte, CA 91732 (818) 444-7079.

SPEAKER FOR SCOTT ALLWAVE 23, speaker and power supply for Scott Allwave 12. Howard 500, 501 or 501 Deluxe. Kennedy model 66, such as 266B, 366A, 366B, 766B, 866B. Also 16 tube Superheterodyne Deluxe Kennedy. Will be at VRPS/AWA Convention in Dallas, in October. Thomas Peters, P. O. Box 3925, McAllen, TX 78502.

COIL WINDER TO REBUILD ALL TYPES of transformers, offering no more than $150.00. Jody Darby, 119 Wilbon Circle, Simpsonville, SC 29681.

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THE HORN SPEAKER

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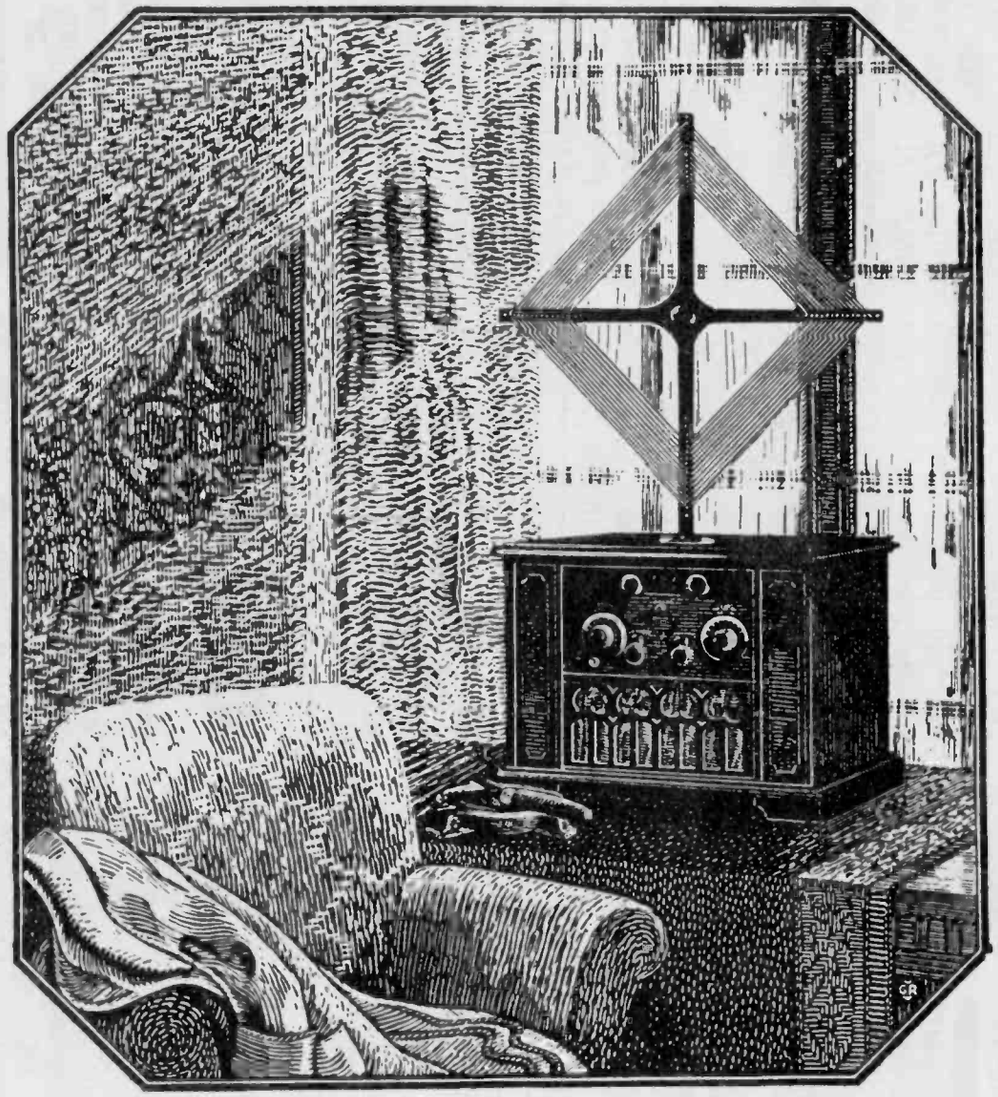

DE FOREST D-12 RADIOPHONE

1925