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THE HORN SPEAKER

THE NEWPAPER FOR THE HOBBYIST OF VINTAGE ELECTRONICS AND SOUND

What Everyone Should Know About Radio History

By Prof. J. H. MORECROFT

PART I

AT A recent dinner attended by the writer, the principal speakers of the evening both took as their theme the complacence with which we Americans take for granted the many conveniences and comforts surrounding us, which the application of modern science has made possible. They were both foreign born, both had come to America when young, and both had achieved remarkable success scientifically and financially after adopting the United States as their new home. Both of them are endowed with keen intellects and sound judgment of men and events, which attributes no doubt contributed largely to their success, but both of them expressed the opinion later that they really saw and appreciated the advantages and opportunities of America so much more than the average American that, in the race for achievement, the native born was actually much handicapped because he took so much for granted, without inquiring how wonderful the things about him really were and how they came to be developed.

WHAT AN IMMIGRANT BOY SAW

Professor Pupin, one of our best known and most successful scientists, is fond of relating his early impressions of America; the first walk he took after landing at Castle Garden was through the lower part of New York where the streets were lined with poles carrying hundreds of telephone and telegraph wires. Having been told that signals and speech were being conveyed over these wires from city to city, scores of miles, he was filled with awe and amazement; what an opportunity there must be, he thought, in a land where such things were a part of the every day life of the people! To the native New Yorker these wire-laden poles meant nothing; he had seen them gradually installed around him, and they incited in him neither awe nor inspiration. But to young Pupin, fresh from a land of no scientific development, they spelled all kinds of possibility and opportunity; he didn't merely take them for granted, but inquired as to how and when and where and why these speech-carrying wires came about, how they operated, and later how their operation might be improved. The inspiration he received started him on that career which brought him fame and reward and made him finally the best known scientist in the field of telephone communication.

AFTER A CENTURY OF EFFORT

An art or science is of importance to mankind in direct proportion to the benefits men derive therefrom; the appreciation of radio, and to a certain extent the pleasure arising from it, will be greatly increased by a knowledge of its principles and development. The accomplishments of the early workers, marking out the trail which was to lead to the present state of the art, make interesting reading and serve well to lay the background for discussing the work of the later scientists and inventors whose contributions are directly incorporated in the radio receiving and transmitting equipments of to-day.

Every one is now becoming more or less familiar with radio communication, and it will soon be taken for granted as much as is the telephone; to the average person the radio entertainment every evening will soon cause no more wonder or interest than do the phonograph or movies. Actually, the simple receiving set of to-day, picking up music or speech from a transmitting station many miles distant, represents the result of nearly a century of effort and development by scores of scientists and inventors; before we become too complacent in the matter, and take the radio telephone in the same matter of fact way we do the rest of our applied science miracles, it is worth while to review their labors and progress, as a knowledge of their work will make the evening's radio concert the more pleasurable and appreciated. It is with this idea in mind that the following brief story of the wireless telegraph has been written.

The earlier name for communication between two stations without the use of connecting wires was the wireless telegraph, but for reasons to be shortly pointed out the term radio telegraph or radio communication is now generally used and preferred. There are three closely allied developments in the growth of the radio of to-day, all of which contributed their share toward our knowledge of the art. The first has to do with the early attempts to carry on ordinary telegraph communication without wires, the earth's surface forming the conducting medium between the two stations. A great deal of work was done in this field by many workers; the reward for a successful solution would have been great as it might have made unnecessary, to some extent, the very expensive cables being installed for transoceanic telegraphy. This scheme of using the earth for conductor found application during the war just past for communication from the front line trenches and is well known to those acquainted with the work of the Signal Corps, where it goes by the abbreviation of its French name, T.P.S. (Telegraphie Par Sol).

THEN THE IDEA OF INDUCTION WAS TRIED

A second line of work used no conducting medium whatsoever between the two stations; comparatively slow change of current in one coil was used to induce currents in another coil in the vicinity and these induced currents, by some prearranged code, were used to convey information. This work was begun in England and the United States at about the same time, by independent workers; it did not apparently promise much success at the time, but with our present knowledge of the art it seems that some of the experimenters missed the real solution of the problem by a very narrow margin. This scheme has recently received much public notice because of its application to the guiding of vessels into a harbor during the night or in a fog, when ordinary methods of navigation are not available. In this method of navigation, a cable laid in the channel is traversed by alternating current and coils placed on the sides of the vessel's hull receive induced currents from the cable and the navigator can maneuver his vessel by the relative strengths of the signals received on the two sides.

The third line of work involved the same general idea as the foregoing, but the changes of current were thousands of times as rapid as those formerly used; instead of using the ordinary phenomena of induction, as explained by Faraday and Henry, a new concept of *radiated power* was invoked and with this step taken, success was assured. As long as the communication between the two stations depended upon the induction ideas of Faraday and Henry the possible separation of the two stations was but a few times the dimensions of the coils used at the stations; when high frequency radiated power was utilized, the possible distance of communication was increased thousands of times and made feasible the transmission of signals between any two points located upon the surface of the earth.

THE FIRST EXPERIMENTS BY STEINHEIL

In 1837 Professor Steinheil, of Munich, while making some experiments with the telegraph apparatus ordinarily using two wires, one for the outgoing current and another for the return, found that it was possible to dispense with one of the two wires hitherto thought necessary, and use only one wire. This one wire was connected, at the transmitting end through battery and key, to large plates buried in the earth and at the receiving end it was similarly connected to ground through whatever type of receiving apparatus was used. He thus showed that the ordinary one wire telegraph system of to-day, using the earth as the return was possible. This experience evidently aroused Steinheil's imagination, as he suggested, in 1838, when discussing the results of his experiments, that it might be possible to carry on communication with no connecting wires at all between the two stations!

PROFESSOR MORSE'S WIRELESS

In 1842, Professor Morse in America, actually did establish telegraphic communication between two stations on the opposite banks of a river, there being no wires at all crossing the river. Along one bank of the river he laid a wire in which were contained his sending battery and key; this wire terminated in two metal plates placed in the river itself. These plates were separated from each other by a distance greater than the width of the river. A similar wire and set of plates was used on the opposite side of the river, the plates on one bank being opposite those on the other. The receiving galvanometer was inserted in series with this second wire. When the sending switch was closed it sent current through the river water from one plate on the sending bank to the other. The current spread throughout the river and some of it strayed to the opposite bank, flowing through the opposite plates and wire and thus through the receiving instrument. Although but a small part of the current reached the opposite bank it was sufficient to actuate the galvanometer used for receiving, and thus *wireless telegraphy was an accomplished fact.* It may be noted that quite long wires were necessary on the two banks of the stream so it could not logically be called wireless communication, but it must be remembered that such is always the fact with our present radio stations. In a modern radio trans-Atlantic station the sending antenna may contain 50 miles of wire in the overhead net work and perhaps even more buried underground. The essential point in wireless communication is that there must be no wires connecting one station with the other.

MICHAEL I. PUPIN

BRITISH SCIENTISTS WHO CONTRIBUTED

In 1859, in Dundee, Lindsay was working along the same lines that Morse had followed, apparently unacquainted with Morse's experiments. He made many tests and endeavored to find the laws of transmission distance in terms of the size of plates used, length of land wires, size of galvanometer coil, etc. He came to the conclusion that if two plates were immersed in the ocean, one off the most northerly part of Scotland and the other off the southern coast of England, if a powerful set of batteries was used for sending, and if a galvanometer coil weighing two hundred pounds were used at the receiving station, it would be possible to send messages from England to America through the ocean water. We know now that the laws he deduced were not quite correct and that such a scheme is not feasible. The idea of a receiving coil weighing two hundred pounds is interesting when we consider that the coil of the galvanometer actually used to-day weighs less than an ounce.

In 1845 Wilkins, in England, suggested that Morse's scheme be used in establishing wireless communication with France, across the English Channel, the same feat that was to make Marconi famous fifty years later, using a different and more effective form of transmission.

Many more experimenters than the few mentioned here worked in this field, endeavoring to eliminate the connecting wire between the two stations, among them Professor Trowbridge, of Harvard. He reached the conclusion that trans-Atlantic communication by Morse's scheme might be possible if the two plates to be submerged in the ocean were as far apart as are Nova Scotia and Florida. The wire thus required to connect the two plates would be as long as the distance to be traversed, a statement which gives the approximate range for this type of wireless transmission. The laws of the spreading of current were better known to Trowbridge than they were to Lindsay when he first put out his project, and furthermore the telephone receiver had been invented in the mean time which gave to the scheme a receiver much more sensitive than anticipated by Lindsay.

Trowbridge also put forth the quite feasible scheme of fitting a ship with submerged plates in bow and stern (or bow plate and a trailing insulated wire astern, carrying the second plate at its end) and sending out into the ocean an interrupted current which would spread out all around the ship; another ship similarly equipped with plates and a telephone receiver for listening, would be able to detect the presence of the first ship, thus rendering collision in case of fog much less likely. If the

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present scheme of radio communication had not come into the field, it seems likely that Trowbridge's scheme would have been universally adopted. If the trailing wire should be one quarter of a mile long, a second ship would be able to detect the presence of the first at a distance of about one half a mile and this would evidently give sufficient warning to prevent collision.

ALEXANDER GRAHAM BELL'S EXPERIMENTS

In 1882 Alexander Graham Bell tried out the scheme of using two charged metal plates immersed in water for communication. Using boats with a submerged plate at the bow and the second plate at the end of a trailing wire one hundred feet long, using interrupted current in one boat and the telephone receiver for the detector in the other, he was able to get signals when the boats were separated about one half a mile. This possible distance will be much less when the boats are in salt water than when in the fresh water of a river, however.

In the T. P. S. scheme of the army, two iron stakes are driven into the earth at a separation as great as feasible; a powerful buzzer, with battery and key, is placed in series with the wire which connects these two stakes. If two other stakes are driven into the ground some distance behind the front line trench where the first pair of stakes is driven, and this second pair of stakes is connected by a wire in series with which is a sensitive telephone receiver, the system forms a possible communication link from a position where other types of communication are impossible.

HOW MODERN RADIO DIFFERS

It is to be noticed that in the schemes of communication so far described the sending and receiving stations each connect two points on the earth's surface and the transmitting and receiving apparatus are connected between these two points; low frequency currents are caused to traverse the earth's surface and a small part of the transmitted current reaches the surface where the receiving points are located. This is true wireless telegraphy, as much so as the type used to-day for radio broadcasting, and the two methods have many points in common. The line connecting the two contact points at the receiving station should be essentially parallel to the similar line at the transmitting station; the transmitted power is sent in all directions in both schemes so that but a very small fraction of the transmitted power is actually received. In the modern radio scheme each station uses two points in a similar manner, but one of them is on the earth's surface and the *other is up in the air*. The transmitting and receiving antennae should both be vertical, that is, parallel to each other as in the foregoing schemes. The essential difference of the two schemes lies in the frequency of current used in the transmitting antenna, and the factor of height of the two stations.

THE IDEA OF MUTUAL INDUCTION

A second possible method of wireless communication was opened up when the laws of electro-magnetic induction, discovered independently by Faraday in England and Henry in America, were made known. When a current flows through a coil, a magnetic field is set up in the space surrounding the coil. When the current in the coil is varied, the magnetic field will correspondingly vary, and if another coil is placed in proximity to the first, and so situated in the magnetic field, the changing magnetic field will set up a voltage in the second coil and if this is connected to some detecting device (such as a telephone or galvanometer) any change of current in the first will be recorded in the second. In this method real wireless communication is possible, there being no connection to the earth at either station. The amount of current which can be set up in the second coil by the changing current in the first decreases very rapidly with increasing distance between the two coils, so much so that the scheme is useful over only small distances. Thus if we have two coils say ten feet in diameter, the possible distance of communication would be probably less than two hundred feet.

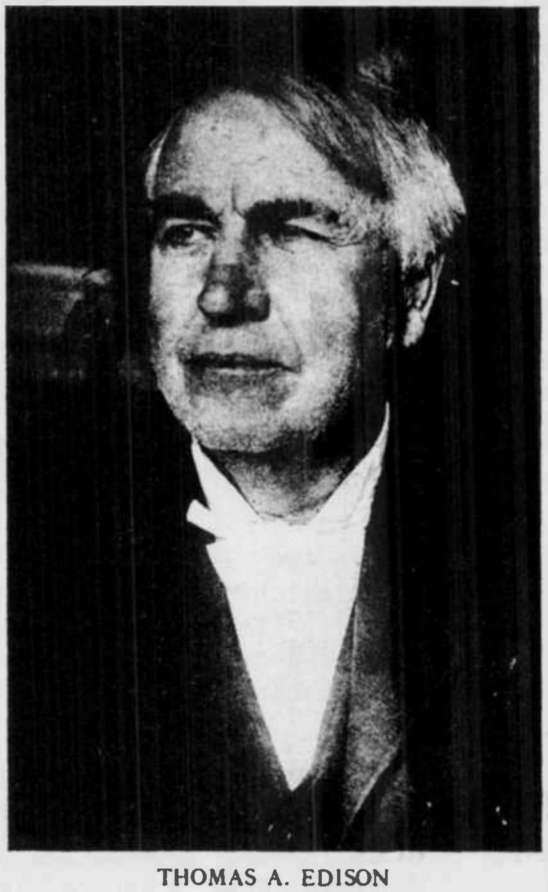
Remarkable as was the discovery of electromagnetic induction it contributed but little directly to the problem of wireless transmission of signals over appreciable distances; it is of course used throughout the transmitting and receiving sets wherever two circuits are coupled together magnetically, but in so far as the actual transmission of the power is concerned it gave but little promise. In 1891, however, Trowbridge suggested an interesting use of this principle, which, had it come about, would have much resembled a modern radio installation. His idea involved the installation of large coils in the rigging of a ship, these coils to be as large as could be carried from the ship's spars. If the current in the coil of one

ship should be interrupted many times a second, a telephone receiver connected to the coil of a neighboring ship would receive a signal and so permit the transmission of messages. Trowbridge further pointed out that such coils would permit the determination of the relative direction of the two ships from each other, a rôle filled to-day by the radio compass.

DOLBEAR, EDISON, AND STEVENSON

In 1883 Dolbear described his scheme for wireless signaling in which he used at each station an elevated wire, grounded on only one end; he was able to get communication over a distance of half a mile and some of his notes on the working of his scheme indicate that he was very close to a real solution of the problem.

In 1885 Edison and his associates devised a scheme for signaling to moving trains by induction from the telegraph wires running parallel to the railroad tracks. The currents induced in the train receiving apparatus were received with the train at high speed and the system had the advantage that the same wires could be used simultaneously for regular telegraph traffic. In Edison's apparatus the currents had to "jump" from the telegraph wires to the train, a distance of thirty to forty feet; it was evidently to this extent a system of wireless telegraphy.



THOMAS A. EDISON

The most remarkable achievement using the principle of magnetic induction was accomplished by Stevenson in England in 1892; he was able to establish reliable communication from the mainland to an island half a mile distant, using at his two stations large horizontal coils two hundred yards in diameter. In the transmitting coil the current from a few cells was interrupted by scratching a contact on a file and in the receiving coil a telephone receiver was used for detecting the induced currents.

WHY "WIRELESS" CHANGED TO "RADIO"

We have now come to the point in the development of wireless communication where the really important work begins; it is worth while to review what had been done in the rather more than half century which had elapsed since Steinheil had used the earth for one of the conductors of his telegraph system and had then put forth the proposition to do away completely with any wire connecting the two stations communicating with each other. A host of experimenters had worked on Steinheil's idea of using the earth or water as the only connection between the two stations, with some success, the most promising being the work of Bell; the feasible distance of communication by this scheme, however, seemed to be sharply limited to a few miles at most. Electrostatic as well as electromagnetic induction had both had their adherents, and considerable success had rewarded their efforts as evidenced by Edison's telegraphy with moving trains and Stevenson's transmission from mainland to island. The promise of much greater distance was rather slight with all of these schemes, however, and the time was ripe for the introduction of some new and radical step in the problem.

This new step was rapidly forthcoming; the energy radiated by very high frequency alternating currents and some simple scheme for detecting the high frequency currents, were the new concepts which were to give the development the wonderful progress which it so soon showed. Incidentally, the new idea of using radiated energy, as contrasted to the previous schemes, gives us the reason for the change of name from *wireless* telegraphy, up to now a proper name for the art, to that of *radio* communication, indicating that the power used in carrying the message was not due to conduction through the earth's surface, or to magnetic induction, but to energy which was actually shaken free from the transmitting station antenna, and left to travel freely in all directions.

MAXWELL'S THEORY OF RADIATED POWER

The theoretical work of Clerk Maxwell carried out during the period from 1860 to 1870 and published in complete form in 1873 showed that energy may be radiated from an electric circuit and that this energy shaken free from the circuit follows the same laws as does ordinary light. In fact, Maxwell made light and radiated electric energy exactly the same kind of a disturbance in the universal ether. Maxwell had, of course, no idea of the usefulness of this startling concept; he was a scientist, of the pure kind as contrasted to the applied, and his work was done in the spirit of pure science. It was the truth regarding certain natural phenomena as he saw it, and it is in the pursuit of the truth about Nature's activities that men like Maxwell pass their lives. Their material reward is generally nil, but that matters to them not at all; the joy of finding out the secrets of nature is the only reward required to keep them stimulated for further work. We shall point out later the work of another pure scientist who predicted theoretically that the modern vacuum tube was possible; others made the tubes and reaped the financial reward. To those buying the tubes to-day it undoubtedly seems that they are still reaping their reward.

Maxwell's theory of radiated power was the subject of much scientific argument and discussion; for many years this theory lacked any experimental evidence, either for or against it. The English scientists in general adopted the theory, but those of the continent were against it as being more complex and difficult to understand than the older theories of light and electricity. At the suggestion of von Helmholtz, probably the best known of German physicists, Heinrich Hertz was pursuaded to take up the problem of connecting experimentally the behavior of light and electromagnetic waves. Hertz had almost given up the idea of carrying out this experiment wh he noticed a peculiar event taking place in a other experiment he was working on. He w discharging a condenser through a spiral i ductance coil, when he noticed that anoth coil in the vicinity produced small sparks ever time the discharge took place in the first ci cuit. This phenomenon is the same as take place every time a spark transmitter is operate to-day; the current in the antenna of a spar set is excited by the oscillatory discharge in th so-called local circuit.

AN ACCIDENT STARTED HERTZ

The sparks in the second coil took place with such regularity that Hertz decided to investigate their action. It will be noticed that this beginning of Hertz's remarkable work was the result of accident; if the second coil had not been in the neighborhood of the first when the discharges were taking place, no spark would have been noticed in the second and probably nothing further on the problem would have been done by Hertz and some one else might have carried out his epoch-making work; in fact, Professor Oliver Lodge, in England, would have been almost sure to have carried out the work if Hertz had not started when he did.

Hertz's own report of his brilliant and important experiments is available, as the original papers of Hertz have been translated into English and published under the title of "Electric Waves"; for the most part the book is non-mathematical and makes very interesting reading. As Hertz felt his way in this new field his reports had all the fascination of those of the explorer of unknown lands. His various papers followed one another so rapidly that in the space of only two years, 1887-1889, he had covered practically the whole field and had established firmly the laws of electric wave propagation as we know them to-day. He showed that the waves sent off from an electric circuit carrying high frequency current traveled with the same velocity as does light, that these waves could be reflected by mirrors and refracted by prisms and lenses just the same as light. He measured the length of the waves with which he was experimenting, and found that his detecting circuit must be of the same natural frequency as the transmitter if the response was to be appreciable. As one reads the account of these experiments he feels that Hertz's laboratory was really the birthplace of the radio art and cannot help feeling regret that this keen experimenter could not live long enough to see the wonderful practical benefits which mankind was to receive as the direct result of his work, carried out in the interest of pure science. It is because of the results following from the work of such men as Hertz that our most highly developed industries are to-day spending millions of dollars annually in the support of purely scientific research; the directors of these immense laboratories know too well that no real scientific truth can be discovered without bringing with it some application which will benefit the industry itself.

Very shortly after the death of Hertz in 1894 the world began to hear of the modest successes of Marconi, whose optimism and aggressiveness, combined with the wonderful foundation of knowledge which Hertz had given, soon showed that the possible reliable distance of radio communication was probably limited only by the extent of the earth's surface. In our next number will be taken up the work of the later and better known inventors and scientists, Marconi, Fleming, De Forest, Fessenden, Armstrong and others, who, building on the work of those earlier experimenters we have mentioned in this number, have given us the modern radio telephone.

(To be continued)

RADIO BROADCAST, July 1922

SERVICE

All in a Day's Work

MR. R. L. WOOLLEY of Seattle, Washington, ran into a queer one with a Crosley, model 706. "The complaint was poor volume and distortion. When one of the –71 power tubes was removed, the volume was normal and the quality cleared up. The tubes, circuit, current and voltage readings tested okay. An examination showed that, when loaded with the two power tubes, an arc existed in the dynacone four-wire cable. The obvious replacement permanently cured the trouble."

A Few Pointers on Philcos

J. E. Deines, service manager with the Kansas Light and Power Company, writes:

"In some Philcos you will find three posts for antenna circuit connections. One is marked 'antenna,' one 'ground' and the other 'LOC.' Post 'LOC' is connected to the ground when the antenna is not used. If you employ this last arrangement, better results will often be secured by reversing the electric plug in the socket.

"We receive many complaints from Philco owners, who maintain that their sets are very noisy around the middle of the dial, and, in this locality, only one station is received, and that weakly, in the case of such complaints. We find, in nearly every instance, that the set is either working on ground alone, or with a poor ground, or with antenna and ground reversed.

"It is a habit with some Philcos for the tubes to work up in the sockets. Check this first on the complaint of no reception."

Repairing Cones

"Having had numerous occasions to repair cone type speakers, as well as cones in the dynamics, I am glad to pass on the following information to other servicemen.

"When a section on the periphery becomes separated, the edges should be coated with a good glue, and held securely with paper fasteners or the spring clip type clothes-pins until dry.

"Dents may be removed by holding the cone over live steam spouting from a tea kettle. Do not permit the paper to become wet (nor the steam to penetrate the glued portion at the edge.) The paper should be moist and hot. Shape and form the paper with the hands until it is dry and cool.

"Even barely perceptible dents in the cone will impair quality, as a rule resulting in a rattle on certain notes.

—"WARREN J. GRAHAM, Marboro, Mass."

Radiolas and Majestics

James A. Robinson, radiotrician of Methuen, Mass., recommends a quick glance at the local-distance switch "when the complaint is low volume and few stations on many of the Radiola, Westinghouse and Graybar models. This switch is often inadvertently snapped, particularly when there are children in the family, and generally results in a hurry call for the serviceman.

"Complaints of noise, due to faulty tubes of the heater type, are common in the experience of the busy serviceman. The filament type of tubes rarely give trouble in this respect. But I have recently run into several cases where new –45s left satisfied clients. One case was a Majestic Number 20. The noise was particularly bad, and was accompanied with a faint flicker in the dial light. Everything tested perfect with my Jewell kit, and for apparently no reason at all new –45s did the trick. Probably something microphonic in the base.

"A somewhat similar difficulty was experienced with a Westinghouse W.R.5. Reception would be perfect for about ten minutes; and then the volume would drop to almost nothing. Heater tubes were naturally suspected, but once again it turned out to be the –45s.

"Watch out for heavy rubber covered lead-ins when the complaint is noise and a fluctuating signal. I ran into trouble with one of these that I had installed two years before. I knew the antenna was okay, and as far as I could see the lead-in was equally good. However, shaking it brought on the trouble, and it was finally located as a broken wire that had not injured the insulation. A fairly good way of definitely locating antenna or lead-in troubles is to drop a coil of wire out of the window as a temporary antenna.

Emergency Tools

"When you haven't the right tool for a certain operation, use the next best.

"To drill a hole in such material as bakelite or hard rubber when you haven't a drill large enough, use a countersink on both sides of the panel, and finish the hole with a sharp jack-knife. A hole can be easily enlarged by using a three-cornered file in the chuck of a hand-drill, or, better yet, in a brace.

"A piece of beeswax should always be kept in your tool kit. When you wish to start a screw in an inaccessible place, rub a bit of the wax into the slot. The screw will then stay with the screw-driver until safely started.

"Two or three thicknesses of friction tape are more durable than paper, and will stay in place much better when curing grounds between the under parts of socket, and the like, and shielding.

"A copper shield that has been bent in the cutting, can be smoothed with a rolling-pin. A short piece of two-inch steel shafting is very useful in truing the edges and corners of a shield. It is used after the technique of a rolling-pin, but its weight and small size make it more effective for small work."

Protecting A.C. Tubes

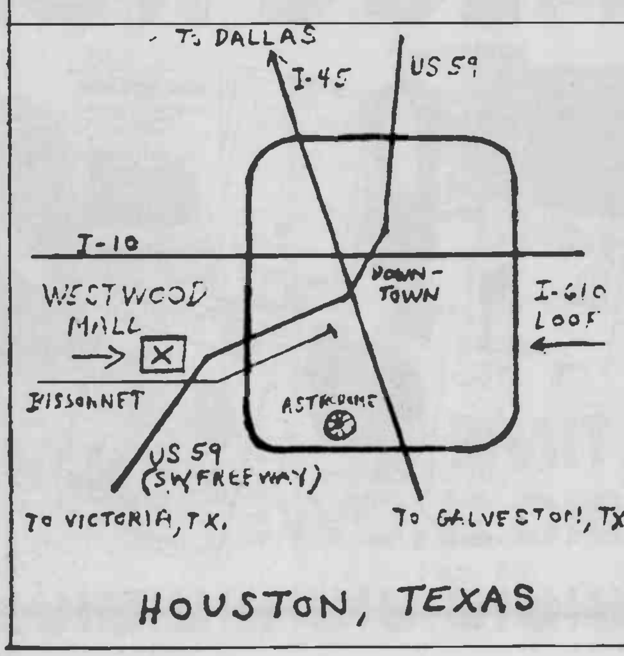
"Some poorly designed a.c. receivers, and some well-designed receivers operated in certain localities, are very hard on tubes. The former sometimes deliver abnormal filament and plate voltages to the tubes, while the latter are affected by high line voltages. In either case the tubes are short lived. When regulators have not been convenient, I have, in several cases, inserted a 100-watt lamp in the cord to the lamp socket. It is only necessary to cut one wire and connect a porcelain socket in the gap. The lamp can be accommodated within the cabinet in most cases. In sets that require more current a bank of two 100- or 150-watt lamps is required. The correct amount can be determined by starting with one 100-watt lamp, and adding a smaller one the value of which will be determined by experiment."

RADIO NEWS FOR APRIL, 1931

HOUSTON, TEXAS

RADIO SHOW and AUCTION

THE HOUSTON VINTAGE RADIO ASSOCIATION WILL HOLD ITS FOURTH ANNUAL SHOW AND AUCTION MAY 21 FROM 10 AM TO 6 P.M. AT WESTWOOD MALL LOCATED AT THE INTERSECTION OF U.S. 59 AND BISSONNET



THE RADIO SHOW AND AUCTION WILL BE LOCATED IN THE MALL, JUST WEST OF SEARS ROEBUCK

FOR ADDITIONAL INFORMATION CALL:
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OR
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Taps at +135, +90, +67, +45, +22, and -3, -4.5, -9 & -22 Volts — $74.00

Spec sheet and picture sent on request.

LITERATURE

1. ATWATER KENT RADIO SERVICE MANUAL. Reprint of 1927 A.K. service information. Covers models 10, 10-B, 12, 19, 20, 21, 30, 32, 33, 35, 50, "B" Power Unit, Horn type speakers and Model "E" speaker. Also explains radio theory and general trouble-shooting procedures. $7.00
2. ATWATER KENT RADIO PARTS LIST. Reprint of 1927 AK parts list. Shows all parts for above listed radios, plus original prices. $6.00
3. ANTIQUE RADIOS, RESTORATION AND PRICE GUIDE. by David and Betty Johnson. Teaches basics of radio theory, trouble shooting, and restoration of early radios. Also contains pictures of many collectable radios, and current market price guide to 1000 different sets. $10.95
4. COLLECTING OLD RADIOS AND CRYSTAL SETS. by Max Alth. Covers evolution of radio, components, manufacturers, repairing and collecting. Includes many photographs and pricing information. $7.95
5. VINTAGE RADIO 1887-1929 by Morgan E. McMahon. A pictoral story of pioneer days in wireless and radio. Over 1000 pictures of 263 pages. $9.95
6. A FLICK OF THE SWITCH 1930-1950. by Morgan E. McMahon. Picks up where the Vintage Radio book leaves off, with the year 1930, and continues into the beginnings of television. Over 1000 pictures on 312 pages. $9.95
7. 1921-1932 RADIO COLLECTOR's GUIDE. By Morgan E. McMahon. Lists key information on over 9000 radio receivers made by some 1,200 companies prior to 1933. Gives manufacturer, year, original price, cabinet type, and technical information. $9.95
8. MOST OFTEN NEEDED 1926-1938 DIAGRAMS. Reprint of Morris Beitman's Supreme Publications book, shows circuit diagrams for 600 radio models. $9.95
9. RCA RADIOLAS, RADIOTRONS, AND ACCESSORIES. Reprint of RCA promotional literature. 20 pages of pictures, descriptions, and original prices of mid 20's radios, speakers, tubes and accessories. $4.50
10. RADIO ENTERS THE HOME. Reprint of 1922 RCA publication. Excellent 128 page book filled with pictures of home scenes as well as technical shots of apparatus. $12.50
11. 70 YEARS OF RADIO TUBES AND VALVES. A new book by John W. Stokes. A thorough history of tube development and with hundreds of excellent illustrations. 250 pages, hardcover. $21.95
12. THE VICTOR. Reprint of Victor Talking Machine. Booklet cataloging Victor I through VI and Victrola X through XVI photographs, horns, needles, etc. 32 pages of discriptions, pictures, and original prices. $5.75
13. RIDER- PERPETUAL TROBLE SHOOTER MANUAL.

Volume 1	$95.00	Volume 16-19	$10.00
Volume 2	$70.00	Volume 20-22	$20.00
Volume 3-5	$20.00	Volume 1-5 Abridged	$20.00
Volume 6-15	$ 7.00		

MISCELLANEOUS

Vintage Headphones. Good condition. $7.00

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Radio Humor

Left: Abstracted from the N. Y. Globe

Right: Abstracted from the N. Y. Evening Telegram

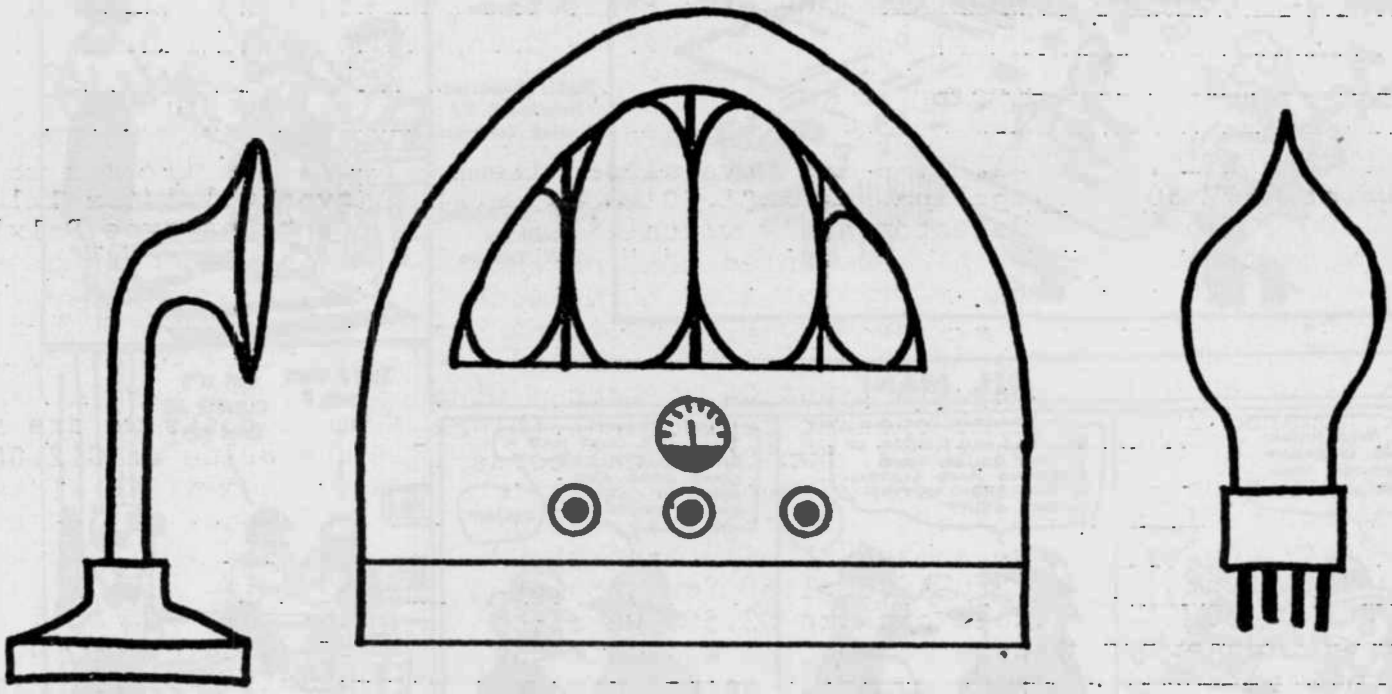
Below: Abstracted from the N. Y. Tribune

OH, MAN!

CREDIT GIVEN

Last month we published puzzle drawings entitled "Simplified Radio". By an oversight, we failed to give credit, for suggesting these, to Mr. Edward Bratter of New York who submitted rough sketches of the drawings. We correct this with apologies to Mr. Bratter.

ANTIQUE RADIO SHOW AND AUCTION



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— PUBLIC INVITED —

letters

Dear Jim,

..... With obtaining a good Kennedy set last month, from a friend of mine in this area. You might say the thrill of collecting old radios was set off once again. It is always nice to read about different articles in your monthly issues. ....

Sincerely,
Gerald Thuring
150 Highland Cross
Rutherford, NJ

Dear Jim,

What a thrill to see the two tube Magnavox horn/ amplifier on the cover of the April 1983 THE HORN SPEAKER. For at least 40 years I've had the base less the horn. This winter I visited Floyd A. Paul, the prolific writer on horns and old radios, at his Glendale, California home/ museum. For a very nominal fee he sold me a spare horn which I brought home on my lap on United Airlines Consternation. I now have a working unit.

G. C. Hadsell
11714 Shirley St.
Omaha, NE 68144

I would be interested in knowing of anyone in Austin area who is an old radio enthusiast.

W. J. Wilson
3300 Arrowhead Circle
Round Rock, TX 78664

Dear Jim,

Perhaps you can help me out? I am in need of a 185/R.4 tube for my R. H. Macy radio. I have tried to find one, but no luck.

Can anyone tell me of a substitute tube or knows where I can obtain a 185/RH?

George Friedrich
7162 Jacqueline
Lake Lane
Custer, WI 54423

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WANTED

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WANTED CRYSTAL DETECTOR FOR GE ER 753, Basil Abbott, 4 Bunker Hill, Richardson, TX 75080.

CHASSIS AND SPEAKER for Majestic Radio Receiver, model 90, (floor model) Grigsby Grunow Company, Gus Galiardo, P. O. Box 1719, Burney, CA 96013

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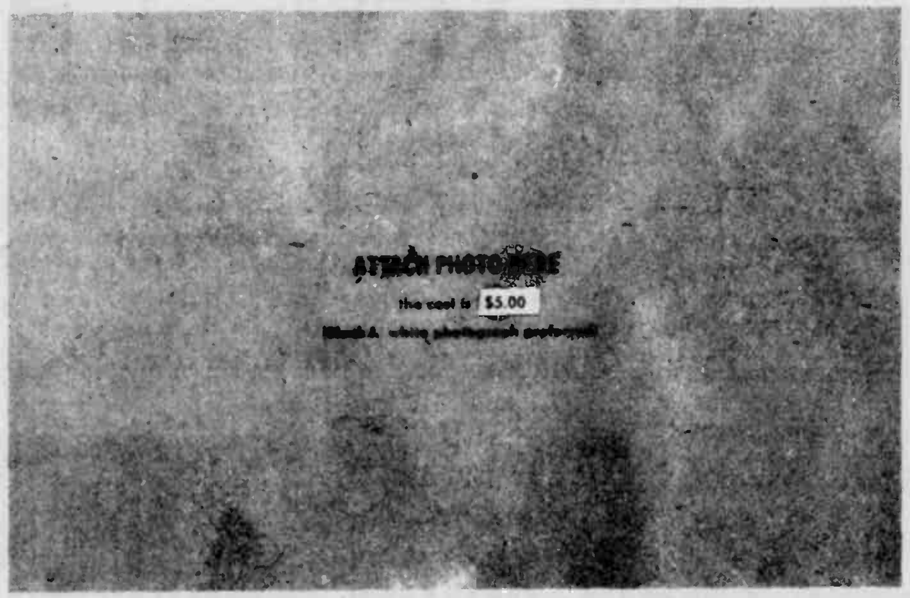

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WCAX University of Vermont.......
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WCBC University of Michigan......
WCBD Wilbur G. Voliva............
WCBE Uhalt Radio Co.............
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WCBH University of Mississippi.....
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WCBJ J. C. Mans ....
WCBK E. Richard Hall, 2801 Centra... S...
WCBL Northern Radio Mfg. Co.....
WCBM Charles Schwarz, Charles and
WCBO Radio Shop (Inc.) ....
WCBQ First Baptist Church ....
WCBR Charles H. Messter..........
WCBT Clark University ....
WCBU Arnold Wireless Supply Co..
WCBV Tullahoma Radio Club......
WCBW George P. Rankin, Jr., and
WCBY Forks Electrical Shop.....Bu...
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WCCO Washburn Crosby Co., 200 Chamber of Commerce,
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