BROADCAST NEWS

Oct. 1936

RCA INSTITUTE

RCA MANUFACTURING COMPANY, INC., CAMDEN, N. J.

RCA Manufacturing Company, Inc.

A Service of Radio Corporation of America

Camden, N. J.

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POWER RADIOTRONS
BROADCAST TRANSMITTERS
POLICE TRANSMITTERS
POLICE RECEIVERS
AVIATION RADIO EQUIPMENT
SPECIAL COMMUNICATION EQUIPMENT

BROADCAST NEWS

REG. U. S. PAT. OFF.

E. T. JONES
Editor

PAUL V. LUTZ
Associate Editor

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RCA MANUFACTURING COMPANY, INC.
CAMDEN, NEW JERSEY, U. S. A.

A TREATISE ON PIEZO-ELECTRIC QUARTZ CRYSTALS

An Exhaustive Study of Their Application in Broadcasting

By W. F. DIEHL

This article is the first of a series which will be continued in future issues.

"The Dowager Empress." Ten inch ball cut from a single quartz crystal.

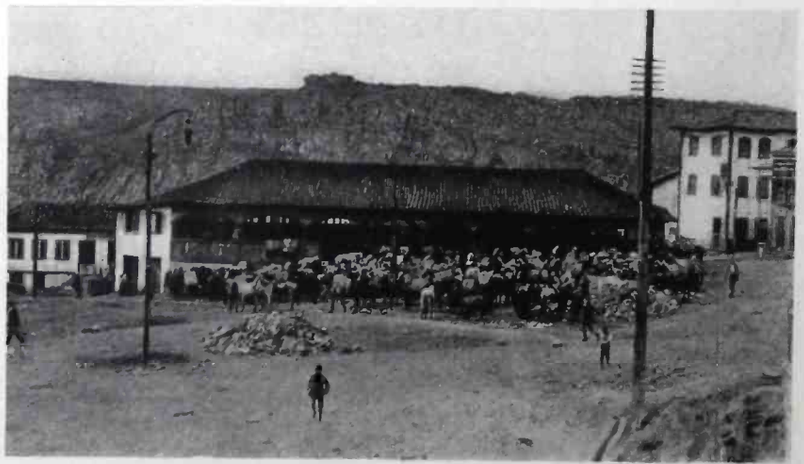
THE term piezo-electric is derived from the Greek expression "piezein" which means "to press." Piezoelectricity, or electrical polarization resulting from pressure, is said to have been known to Coulomb[1] as early as 1780. He discovered that certain substances when subjected to pressure exhibited electrical charges on opposing surfaces. In 1833 Becquerel[2] published the results of his measurements on the piezo-electric effect in various substances. In 1880 J. and P. Curie[3] published the results of their experiments on quartz and determined the quantity of electricity generated by unit pressure along the various axes. In 1881 Lippman[4] predicted from mathematical calculations the "converse effect," i. e., deformation of the substance resulting from the application of an electric field. The Curies[5] verified this experimentally and pointed out that any piezo-electric substance which generates electricity when subjected to pressure will conversely be strained upon the application of voltage.

In 1881 Hankel[6] introduced the term piezo-electric effect, which in its present usage applies to both the direct effect and its converse. Based on the geometry of the crystal, and certain known constants which depend on the crystal structure, Voigt[7] in 1890 showed how the electric polarization can be calculated corresponding to a force in any direction.

Modern Experiments

In 1918 Langevin[8] applied the piezo-electric properties of quartz to the transmission of ultra-sonic waves under water. In the same year Nicolson[9] applied the piezo-

[1] Piezo-electric Microphones by A. L. Williams, Journal Soc. Motion Picture Engineers, 1934.
[2] Becquerel, A. E.: Annales de Chemie et de Physique, 22 1833, p. 5.
[3] Curie, J. and P.: "Hemihedral Crystals," Compte Rendu, No. 91, pp. 294, 383, 387.
[4] [5] Vigoureux, P., Quartz Resonators and Oscillators, 1931, pp. 13, 14.
[6] Hankel, Abh. Sachs. Ges. d. Wiss. 12, page 462, 1881.
[7] W. Voigt, Abhandl, Ges. d. Wiss, Gottingen, 36, 1890 and Lehrbuch Der Kristallphysik, Leipzig, 1910.
[8] Vigoureux, P., Quartz Resonators and Oscillators, p. 13.
[9] A. Mc L Nicolson, U. S. Patent No. 1,495,429.



Headquarters of quartz prospectors in Brazil.

electric effect in Rochelle Salt to telephone transmitters and receivers. In 1920 Cady [10] introduced the piezo-electric resonator and showed how the piezo-electric effect in crystals could be used to furnish the necessary coupling mechanism at radio frequencies. He also worked out the equivalent circuit for the quartz resonator, applied it to the vacuum tube for control of frequency, (crystal controlled oscillator), suggested its use as an element of electrical wave filters, and introduced it as a wavelength standard.

Many Substances Available

While a great many substances were known to be piezo-electric; —only three, namely, Rochelle Salt, Tourmaline, and Quartz were found to be suitable for commercial use. Of these three materials, Quartz, because of its excellent mechanical properties, was early recognized by Cady to be the only material suitable for frequency control and frequency standardization.

Subsequently, the modes of vibration in piezo-electric quartz rods and plates were studied, resulting in new cuts and methods of mounting. Developments in vacuum tube technique have since made possible still greater frequency stability and an extension of the upper frequency limit of a single tube crystal controlled exciter. The investigation of the temperature coefficient of quartz plates cut at certain angles with respect to the crystallographic axes has resulted in the reduction of the temperature coefficient to substantially zero. This in turn has made possible the elimination of temperature control for some applications, and for others has reduced the expensive, cumbersome, heat box to a relatively inexpensive unit requiring little space;—as for example the RCA type TMV-129-B.

The piezo-electric quartz oscillator with frequency multipliers and dividers has made possible our primary standard of frequency and time with an accuracy of one part in from ten to thirty million. It has also increased the accuracy of measuring frequency through the use of piezo-electric frequency monitors and calibrators, such as the RCA Type TMV-133-A. Its use has made possible the increase in the number of transmitters possible in a given channel, and without it the present precise frequency stability* of broadcast transmitters would not be possible. The quartz oscillator and vacuum tube multiplier has recently made possible precision frequency stability of ultra high frequency transmitters, and the quartz single signal filter has made possible extreme selectivity in receivers. Through the use of exacting manufacturing technique and precision equipment, quartz plates held to close tolerances as regards temperature coefficient and frequency can now be manufactured in quantity.

A quartz mine in operation. Primitive methods of mining and transportation are still used.

The Engineering Department of the RCA Manufacturing Company, Inc., has contributed considerably to the piezo-electric art and the development of quartz plates and their applications. The information contained in this series of articles deals with the engineering and manufacturing information on the preparation and use of piezo-electric quartz crystals for communication use.

Piezo-Electric Materials [11]

While the piezo-electric effect has been observed in approximately fifty substances,[11] only three, namely, Rochelle Salt, Tourmaline and Quartz have been used commercially. Rochelle Salt is grown from seed crystals, source of supply is practically unlimited, and it is the cheapest of the three substances; — $0.13 per pound, as compared to $450.00 per pound for Tourmaline and $6.00 per pound for Quartz.

Rochelle Salt has the highest piezo-electric constant, approximately 1000 times that of either tourmaline or quartz, the figures

[10] Cady, "Piezo-Electric Terminology," Proc. I.R.E. 1930, Dec. p. 2136.

A photograph showing the rough terrain in which the deposits are located.

* F. C. C. requires broadcast transmitters to hold within ±50 cycles of specified frequency. RCA transmitters are designed for ±10 cycles and many of our transmitters are holding to within a few cycles.

[11] Cady, "Electroelastic and Pyro Electric Phenomena," Proc. I.R.E. 1930, July, p. 1247.

Bloomenthal, "Use of Piezo-Electric Effect in Rochelle Salt Crystals, loc. cit.

Bloomenthal, "The Growth of Piezo-Electric Crystals for use in Acoustical Apparatus, loc. cit.

(Continued on Page 25)

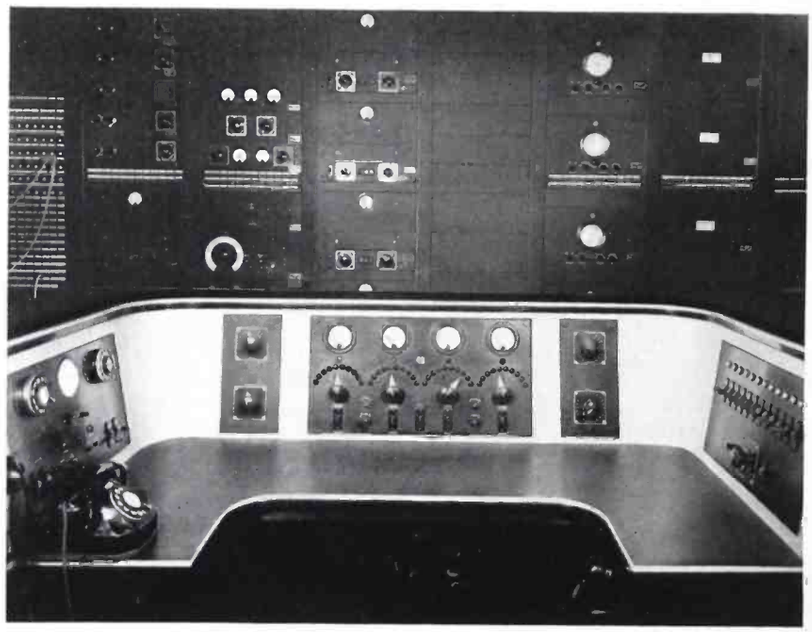
A TECHNICAL CLOSEUP OF WGN

A Detailed Description of Equipment and Its Function

By A. R. HOPKINS

IN this article we will not attempt to cover the entire layout which would include air conditioning, acoustic treatment, theatre and stage lighting, interior decorations and furnishings, but will confine ourselves to the radio equipment and facilities for handling programs.

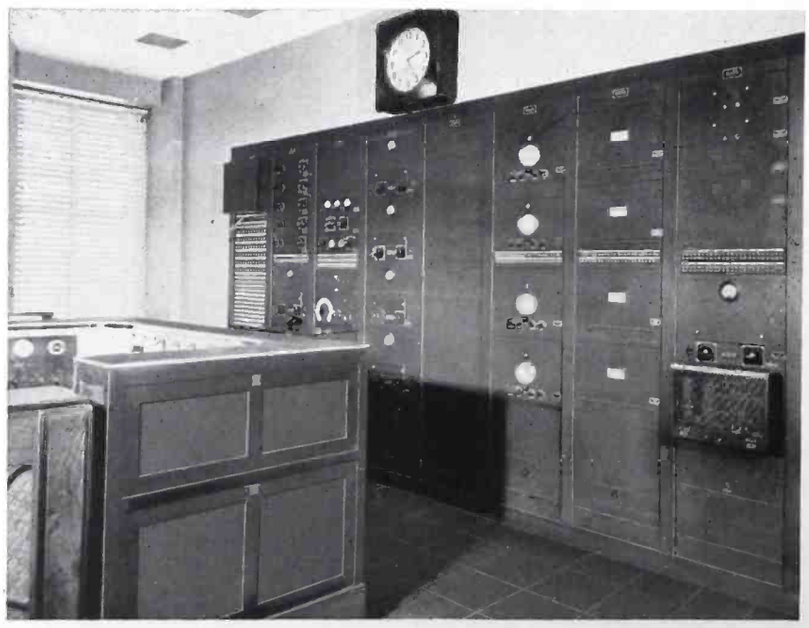
The program control system and automatic signalling system between master control and individual studio control rooms were designed and built especially for this installation and constitute a unified system complete in every detail, simple and positive in operation yet sufficiently flexible to take care of every possible condition conceivable. Possible failures have been anticipated and means provided to avoid loss of time if and when they should occur.



The master control desk.

Master Control Room

The master control room has facilities for the control of ten studios and for feeding four different outgoing programs simultaneously. Any studio may feed any one or any combination of the four outgoing channels. The master control operator seated at the master control desk has full control at all times of all program switching. Four volume indicators are provided to give him visual indication of the program level at all times on each of the four outgoing channels, and four master gain controls are also provided to permit the master operator to correct the level in case of emergencies.



The speech input equipment layout.

Method of Switching

All master control room switching is accomplished by relays and the rotary controls shown on the center panel of the master control desk are for presetting a desired switching operation. Prior to the time for program change this control may be set to the studio which is to provide for following program. In addition to setting up the relay control circuits for the necessary switching operation to follow this also operates the corresponding signal light on the studio booth control console at the new studio location. This indicates to the studio operator that he is "pre-set to feed a certain "channel" or channels" as the case may be, so that he may, by the use of the dial selector system, monitor that particular channel for "cue." He can also permit the preceding program to be heard in the studio until the final switch is made in the master

control room which gives him the "go ahead" light, when by one operation, he can cut off the monitor in the studio and go "on the air." The actual switching operation is accomplished in the master control room by the momentary operation of the key switch located below the pre-selector switch on each of the four channels. When this key is depressed the first studio is disconnected and when it is released the desired studio is connected. The green signal light under each VI meter indicates to the master control operator when the studio operator has closed his line relay.

"Master Release" Key

Another feature of this pre-selector master control switching system, to facilitate in the handling as many as four outgoing programs simultaneously without confusion is the "master release" key. When each of the four channels are "pre-set" the "release" keys may be set in the "up" position whereby all four channels may be switched to the new studio locations simultaneously with one touch of the "master release" key. This system permits the master control operator to "set-up" the proper switching operations ahead of time when he has plenty of time to double check with his schedule, relieving him of everything except a mere "tripping operation to be performed at the critical time.

The left panel of the master control desk provides controls for two monitoring amplifiers and associated high quality speakers. Either may be connected to any one of the four outgoing channels. One monitor, by use of the automatic electric dial system, may also be connected to any one of the four high quality radio receivers for "air" monitoring. The interphone dial and a clock are also located on this panel.

Line Extension Panel

The right hand panel is a line extension panel for handling remote or transcription programs direct through the master control room. This is desirable at times when the studios are not in use, possibly early mornings or late at night, it eliminates the need for an additional operator. Key switches and signal lights are provided here for six order wires and six program circuits.

The studio control equipment is identical in all studios including the two in the Tribune Tower with the exception of No. 1 studio which is the Auditorium. In each studio control booth is located a rack of equipment consisting of pre-amplifiers, program amplifier, monitoring amplifier, jack panels, meter panel and relay panels, the studio control console, monitoring speaker, monitor control unit and talk-back microphone. Four balanced ladder type mixers are used with "OFF" "ON" relays in the input circuit to each mixer. In the "OFF" position of each relay a normal resistance load is substituted to maintain the proper impedance match. This allows the mixers to be pre-set at a pre-determined setting while the various microphones may be cut in or out at will by the push button relay controls. This is not always desirable but it is a definite advantage in most cases.

By use of the lines to master control room a remote program may be fed through any mixer in any studio. This is done in a number of programs where the theme song or any other part may originate at a remote location. In such programs the artists

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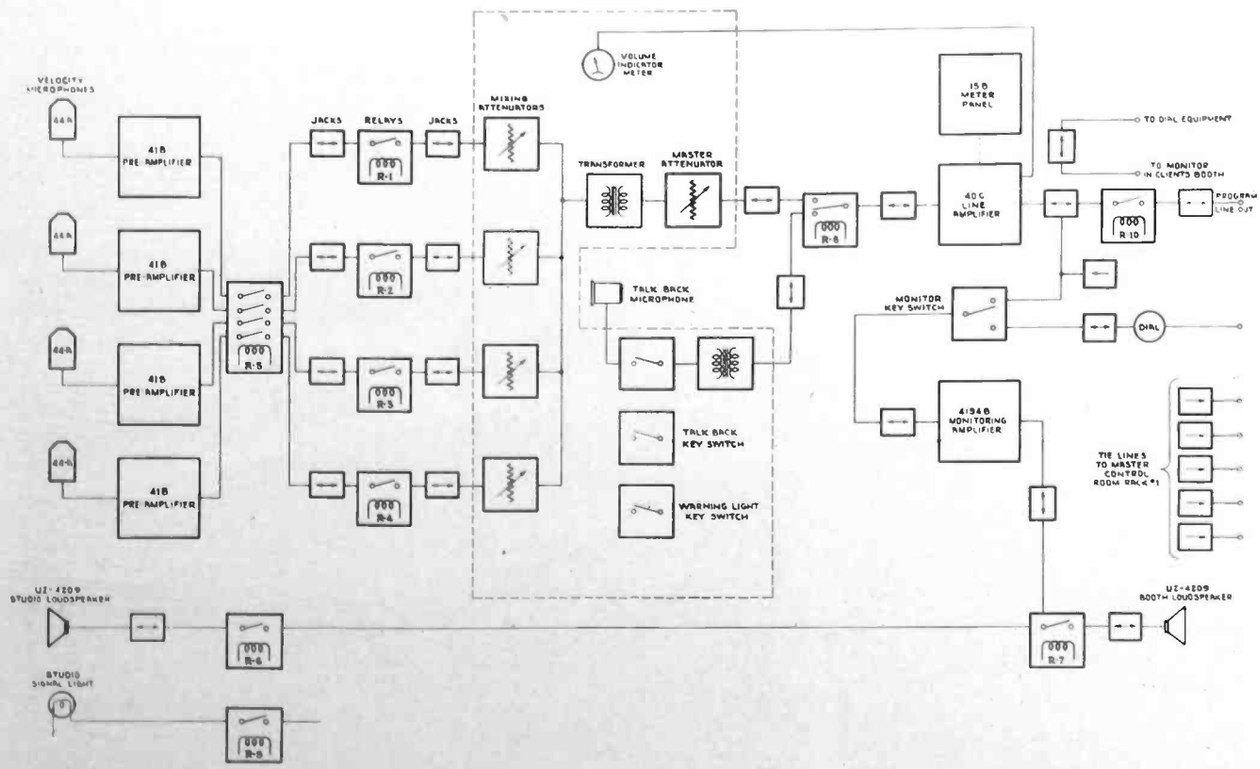


Block schematic of studio equipment

AN ENGINEER REPORTS

The Story of the Second Byrd Anarctic Expedition Broadcasts

By JOHN N. DYER

The author in the Radio Shack aboard the S.S. Jacob Ruppert.

EDITOR'S NOTE: The following report on the broadcasts conducted by the Byrd Expedition is an intensely interesting document. The cold, simple statements of fact have been stripped of even the slightest elements of the dramatic. Days and weeks of labor under the most trying conditions are covered in a single phrase or sentence. To the author it was "just another job."

THE second Byrd Antarctic Expedition left Norfolk on the S. S. Jacob Ruppert on October 22, 1933 bound for Little America, Antarctica. Installed in the radio shack was a complete relay broadcast transmitter of 1 kw output power which was to be used for a series of weekly programs to be re-transmitted over the Columbia Broadcasting System. General Foods was the sponsor.

Testing with New York was commenced while the ship was still at the dock at Balboa, C. Z. and was continued almost daily with preparation for the first program which was put on while the ship was near Easter Island in the Pacific. RCA Communications handled the pick-up of the signals from the ship and from Little America and also furnished one or two transmitters for communication and cue channels. The pick-up of the ship's signals was made from one of several points. Riverhead, L. I., N. Y., Buenos Aires, Point Reyes, Cal., and Koko Head, Hawaii were all used and were linked with New York by radio or wire circuits. During the voyage across the Pacific, Koko Head was most often used as the ship went south from New Zealand towards longitude 150W and latitude 65, and Buenos Aires began to receive the best signal. At Little America, the great majority of programs went through Buenos Aires, the remainder direct to New York.

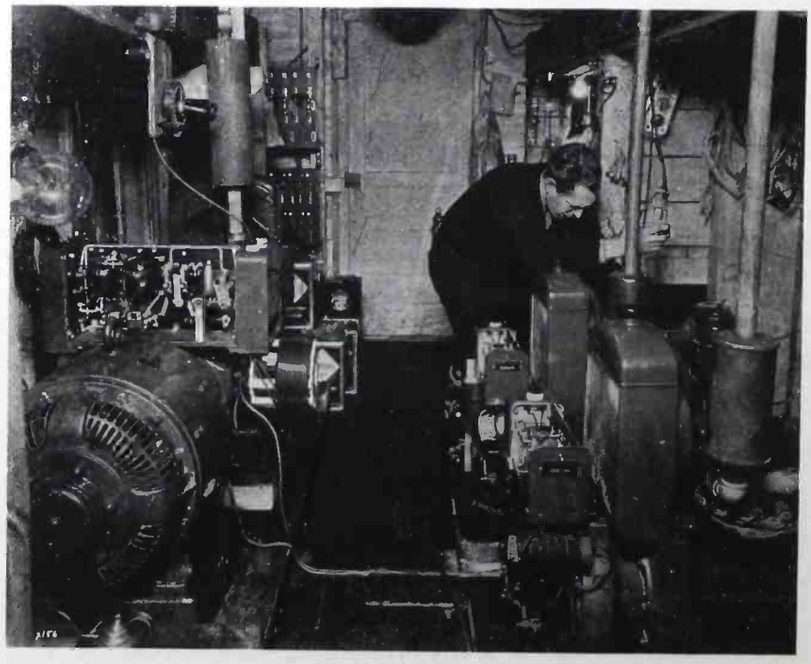
Studio Facilities Limited

Studio facilities were rather limited on the ship. At first, the radio operators bunk room adjoining the shack was used, but it was so crowded that it was impossible to get more than three or four people in the room at one time so lines were run to the crew's quarters aft where more space was available. Aside from trouble with the noise from the steering engine, this was a much more satisfactory studio.

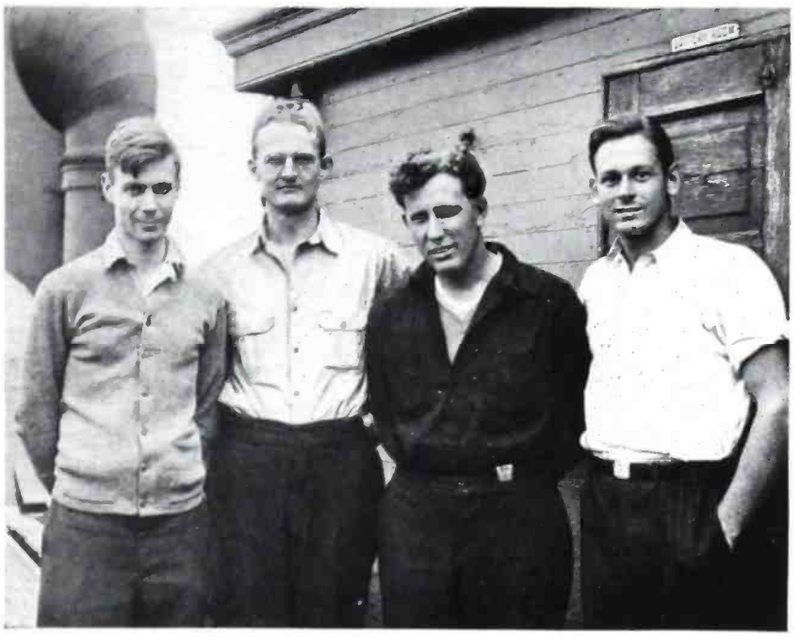
Twelve shows were put on from the S. S. Jacob Ruppert and the average C.B.S. intelligibility rating was 62%.

Equipment Transferred

After reaching the Bay of Whales, in the Ross Sea, preparations were made to transfer the equipment to the expedition base at Little America. Immediately after the last broadcast from the ship, the equipment was dismantled and was hoisted ashore. The largest unit was sent to Little America by dog team and most of the remaining equipment was taken in by plane. A tent was



A. H. Waite, Jr., working with equipment in the Kohler Shack.



The Radio Staff of the expedition aboard ship.

pitched on the snow near the old radio towers used by the first Byrd Antarctic expedition and the 1 kw transmitter was set up inside. A 1.2 wavelengths horizontal doublet was installed between these old towers at a height of about 50 feet with the direction of maximum radiation towards Buenos Aires. A five kilowatt, 110-220 volt 60 cycle Kohler gasoline driven generator set up on the snow fifty feet from the tent, furnished power to the transmitter, and d. c. power for a receiver converter and for phonograph turntables was supplied by a 1 kilowatt gasoline driven generator.

Microphones were set up in the Old Mess Hall, one of the buildings used by the previous expedition and lines run up to the transmitter. The installation was completed within a week and it was possible to put on the regular scheduled broadcast on Saturday, February 3, 1934. This broadcast was very successful, a report of 90% intelligibility being received from New York.

Transmitter Building

Work was started on the radio shack as soon as the lumber was brought over from the ship by the tractors. It was a building 30 x 15 feet divided into two sections, one to be used for the transmitting equipment and for operating and the other for a studio and living quarters for six men. The walls were sheathed on inner and outer surfaces with ⅞" lumber and the space between filled with scrap wool insulation. The studio was shielded to prevent r-f pick-up in the microphone amplifiers. This was accomplished by laying copper screening under the sheathing and was put on the ceiling and the three walls towards the transmitting equipment, there being insufficient screening available to put it on all sides. This was found to be valuable as even with the screening, it was often difficult to avoid r-f feedback into the audio equipment. Occasionally on a certain frequency, the feedback would be quite severe and by moving the microphones a few feet would be entirely eliminated.

A Kohler shack was built 50 feet back of the radio shack and contained three Kohlers and a storage battery bank. A tunnel lined with boxes of radio equipment connected the two buildings.

Antenna Erected

As soon as possible, work was started on the first directive antenna. It was supported on four telephone poles forming the Bruce type of diamond array. Unfortunately, the antenna had to be laid out from a survey made five years previously, the magnetic compass deviation not having yet been obtained and it was found later to be in error when more accurate surveys were available. This necessitated shifting three of the four poles of that antenna. The first antenna was to be directed at Buenos Aires and later two others were installed bearing on New York and San Francisco. The poles were supported with three guys, broken by insulators, the butts of the poles set on crossed hatch covers.

The completed B. A. antenna was connected to the transmitter

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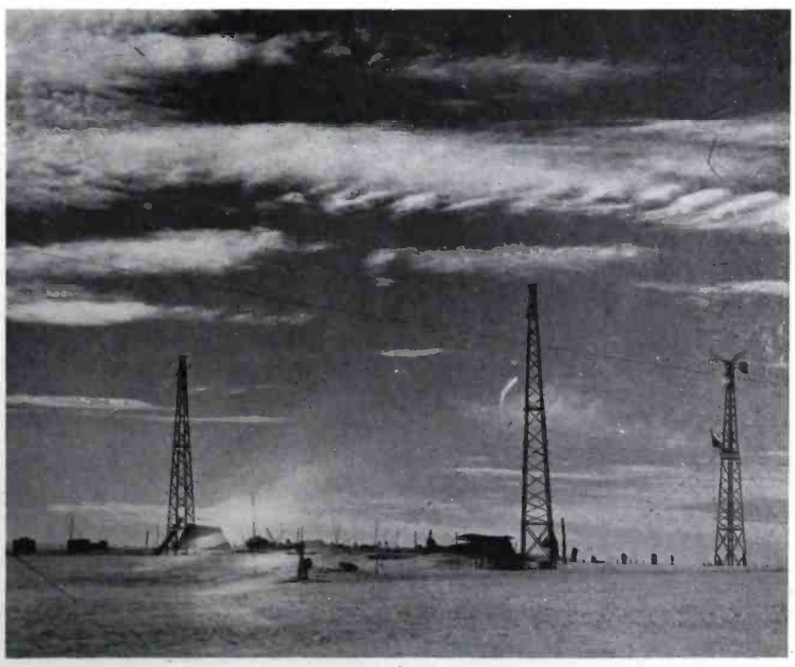
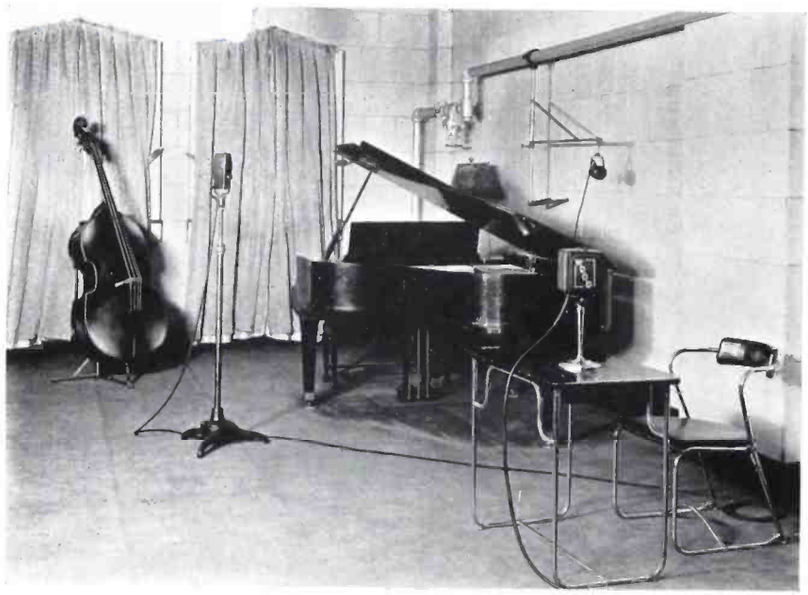


The three radio towers in Little America. Note the wind generator (1½ KW) with 20 M.P.H. or more wind.

SOME THOUGHTS ON STATION MANAGEMENT

Methods Used at WDOD Have Proved Successful

By FRANK S. LANE



An attractive studio at the Chatanooga station.

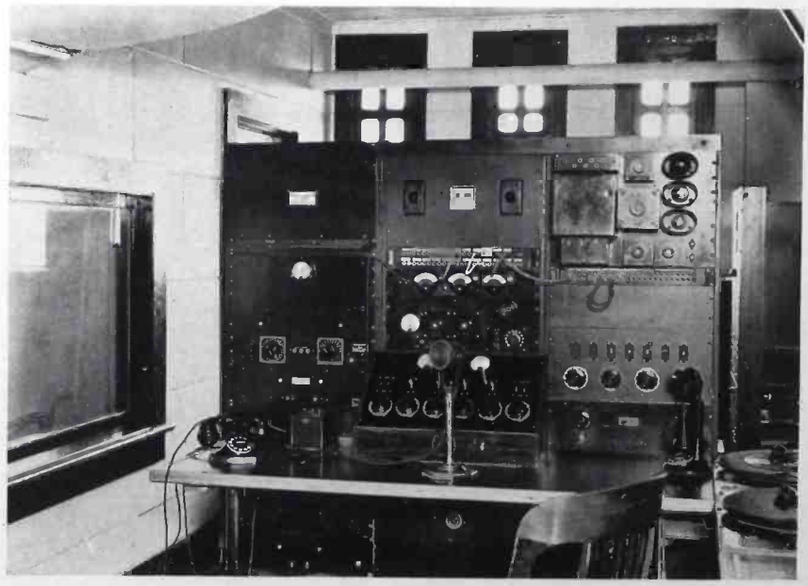
IN presenting this article on Radio Station Management, the writer fully realizes that, in all probability, nothing will be said that has not already been said many times before. However, we have been asked to tell how we manage our own station, and perhaps the repetition may serve to refresh the memory concerning things that may have been temporarily forgotten.

We believe that in order to be successful, the first and most important requisite is listening audience. The only way that audience can be secured, is through a well-balanced schedule, offering the biggest variety of entertainment that it is possible to present in order to appeal to the greatest possible number of listeners. At our own station we present the programs of a national network, subscribe to a good transcription service, and to a reliable, reputable news service. We have found news broadcasts to be great audience builders, greatly increasing the value of the preceding and following programs, and we believe that every station that can possibly afford it should have some sort of accurate news service. In addition to the items that have been mentioned, we try to follow closely things of local civic interest, public events; broadcast professional and amateur sports, and other items which we believe will have an appeal to the great mass of our audience. By capitalizing on our summer sports broadcasts, we have never suffered the excessive summer slumps in business experienced by a number of stations.

We believe that any station, regardless of size or location, can, if it is on its toes, design and present a program schedule that will maintain its listening audience, in face of any competition. We realize that this means a great deal of effort that may at the moment seem in vain, but you never can tell when some little something you put on the air may strike a responsive chord with a listener, or a group of listeners, that may sometime pay you big dividends, either financially or in listener acceptance and good will.

Local Advertising Leads

Our station is geographically located away from the center of population, that is, out of the area north of the Ohio River and east of the Mississippi, consequently, years ago, in analyzing our prospects for business, we decided that, due to our location away from this center of population, that for financial return, which any successful station must have, that



Some of the equipment at WDOD.

we would have to develop our own local advertisers to the point where our returns from them would be more than adequate to assure successful operation.

With this idea uppermost, we secured competent salesmen, already well-versed in the science of advertising, and set them to work building up our local business. These men had the ability and vision to create and sell advertising campaigns that would secure results for the clients. Naturally advertisers did not fall all over themselves to try a new medium, but the success story of one would lead to a campaign from another, and as the result, our local business continued to expand.

Client's Interest Most Important

Right here let me say that our interest in the client goes further than merely being an advertising medium. When we sell an account we try to become an advertising counselor and an important part of that client's organization, just as much interested in his success as he is himself. We have succeeded in doing this and have found that it promotes a much closer relationship between the client and the station, with the result that it brings more business to us. In dealing with our advertisers, if we are of the opinion that they are selecting the wrong idea for their business, we quite frankly tell them so, and have many times stated that we would rather not sell them the service that they asked for, with the explanation that we would much prefer to retain their friendship than to have them fail in their campaign.

However, do not get the idea from this, that if the client proved to be one of the hard-headed type who "had to have it or else," that we refused to accept his business. In each instance we would make it very clear that the responsibility was his and not ours, and as the result, if the advertiser did pick a "bloomer," and in practically every case where this came up, he did, then the responsibility was his, and it left him open-minded to any suggestions that our sales department might have.

Programs Must Produce Sales

Much has been said about the institutional value of radio advertising, and that radio advertising was more of an institutional nature than other mediums. We do not concur in this belief. Our conception of the purpose of advertising is to make sales. With our local accounts we have found that we can hold our own in making direct sales with any of our competitive mediums.

We sell our advertisers on the idea of getting results, a return for every dollar spent, and let me tell you that we are checked pretty closely on it. In our town most of the owners of businesses are close enough to the cash register to hear it ring, and close enough to be able to tell what medium of advertising is making it ring. We have succeeded in selling practically every line of business in Chattanooga, even including the "bugaboo of radio," department stores. The majority of our accounts stay with us year after year, and many of them have been with us for five or six years of continuous broadcasting. We do not wish to appear boastful, but as evidence of the soundness of our ideas, we still get fully 75% of our volume from local advertisers. I believe that the average for the country as a whole, is approximately 50% local and 50% national.

Efficient Staff Required

We firmly believe in an efficient and adequate staff of announcers. It has been our observation that a great number of stations will employ expensive salesmen to secure business, good writers to prepare continuity, and then entrust all of that costly effort to an announcer, who through lack of experience, ability, or initiative, may butcher the entire thing when it is presented to the audience. Everyone knows that the announcer is a sales representative of the advertiser when he steps in front of the microphone. It is his job to sell the program, or the merchandise. He has to deliver all the promises that the salesmen have made, measure up to the client's expectations, and please the audience. It so happens in radio that each department is so closely dependent on the other that, in order to assure the success of the whole, we cannot lay too much emphasis upon efficient announcing and presentation.

On our station we carefully select every employee for the assignment that he is to do. By so doing, it enables us to operate our station efficiently with the least number of people necessary for successful operation, yet at the same time gives us the efficiency desired. Our staff consists of eighteen full-time employees, which, of course, does not include any talent or any one used on a part-time basis.

High Quality Equipment

In closing let us say that our station has the finest of mechanical equipment, and we are constantly adding improvements as fast as they are produced. We know that it is the desire of every station to have the best in equipment.

But in order to have an efficient station that will operate successfully, let us say that you must first have good programs to create listeners who buy the advertiser's product, secondly you must have an efficient sales organization to sell your station to the advertiser, third, your presentation must be good enough to sell the listening audience sufficiently to convince the client that you have a good medium so that he will continue to be a customer. If you have these three things, you will then have the means of purchasing the equipment so highly desired. It is a sort of a case where the "Music Goes 'Round and 'Round," and if all the notes are thrown in at the proper place the result will be pleasing.

As we said before there is probably nothing stated in the article not already known, however, these are the things that we continually strive for at WDOD, and firmly believe are the elements that have been responsible for our success.

NEW COMMUNICATION SERVICE POSSESSES VAST COMMERCIAL POSSIBILITIES

New York-Philadelphia UHF Circuit Considered A Leading Engineering Achievement

A contrast in equipment. The new facsimile recorders beside a replica of Morse's first telegraph recorder.

RADIO communication hailed the approach of new services by which business men will send one another entire letters by telegraph instead of terse ten word telegrams and in which social notes will speed through space to be received and delivered in the exact handwriting of the senders. The occasion was the first demonstration of RCA's new ultra-short wave radio circuit connecting New York and Philadelphia. The circuit is unique in that it employs ultra-short radio waves with automatic relay stations and enables the transmission of drawings, type matter, handwriting and other visual material in facsimile, along with the simultaneous operation of automatic typewriter and telegraph channels. It is a completely secret system.

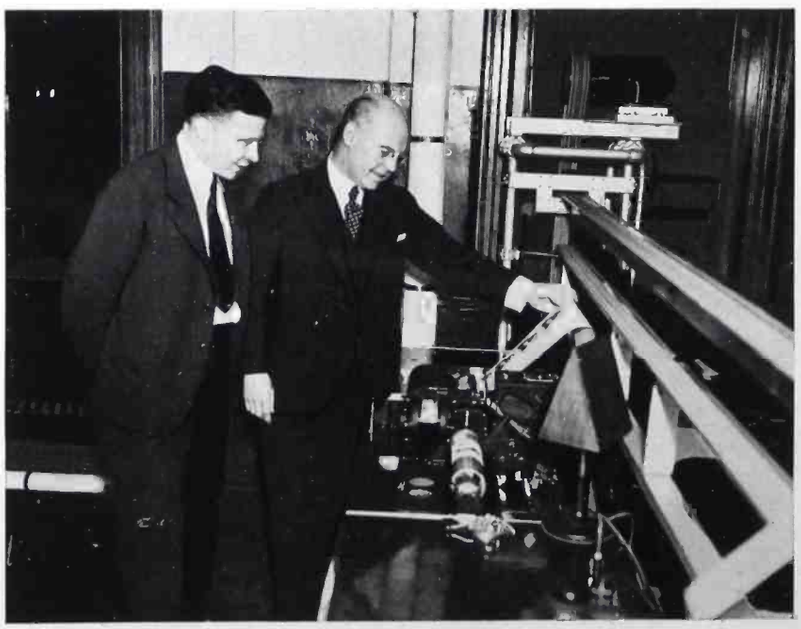
Joint Demonstration

The two institutions which were first to recognize the importance of the electric telegraph of Samuel F. B. Morse a century ago celebrated this new era in communications by exchanging greetings. In 1836 Professor Morse gave the first demonstration of his new instrument to his colleagues at New York University. He gave the next demonstration outside New York City before the membership of Franklin Institute, in Philadelphia. In the recent demonstration, Chancellor Harry Woodburn Chase of New York University and Vice-President W. Chattin Wetherill of the Franklin Institute, Philadelphia, exchanged pictures and greetings by radio facsimile. Models of the first Morse apparatus were connected to the circuit and operated simultaneously with the newest facsimile equipment.

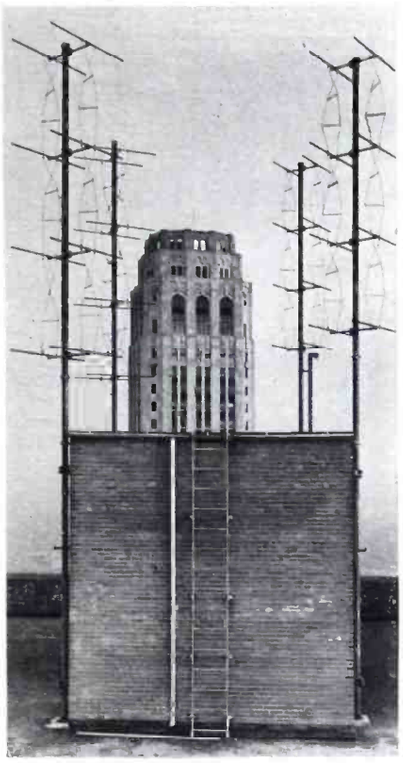
In a statement to guests present at the New York end of the radio circuit for the occasion, David Sarnoff, President of the Radio Corporation of America, said: "Radio communication is today placing in useful public service, a region of the radio spectrum which only yesterday was virtually unexplored and scientifically unconquered territory. Having developed a technique of operation for the three meter band of radio wave lengths, we find in that region, a medium of transmission unlike anything that we have ever known.

Most Efficient Circuit

"The most significant feature of the new communications development is that it marks the attainment of a radio circuit so efficient that we are challenged to take full advantage of it. This is very important, for radio communication has, from its beginning, struggled to provide even better connecting radio channels between transmitter and receiver. Now we find that the ultra-short wave portion



Dr. H. M. Partridge of New York University and William A. Winterbottom (right), Vice President of RCA Communications examining the new equipment.



Transmitting Antennas at the New York terminal of the circuit.

of the radio spectrum gives us a medium of almost unbelievable possibilities. We can send messages in facsimile not only as fast as present equipment will allow, but we can send two pictures simultaneously, and on the same radio wave we can also add two automatic typewriter channels and a telegraph channel. Of course, this means that we do all those things in both directions at the same time.

Multiple Transmission

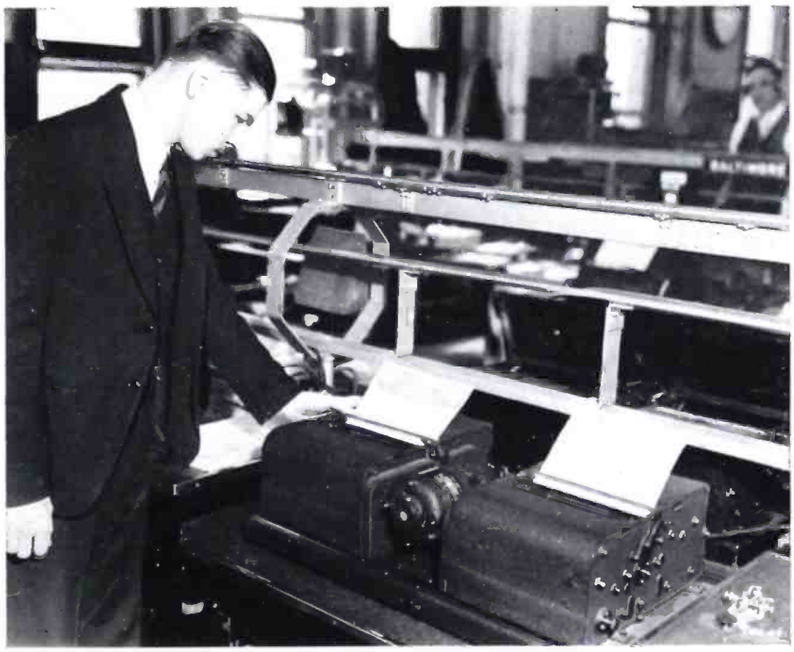
"The possibilities of multiple transmission are still not exhausted. Perhaps this single illustration will give some idea of the traffic handling possibilities of the circuit. If we were concerned only with communication on a word basis, we could, with increased power and filter systems, operate enough automatic typewriters to carry a total of twelve thousand words per minute in both directions between New York and Philadelphia.

"Such flexibility, in being able to accommodate so many separate services simultaneously offers important commercial advantages. But we intend to continue this development further with the object of creating new devices for higher speeds of transmission on the individual channel. There would be little point in our using the new system merely to add another hundred or two automatic typewriter channels between these two cities when adequate wire facilities for such services already exist. We cannot be content merely to duplicate present practice at this stage of radio's development. Now that we have the circuit, we shall turn again to the laboratory to find out how best to make use of it. Of course radio wants its share of telegraphic traffic, but it looks also at the much bulkier mail bags."

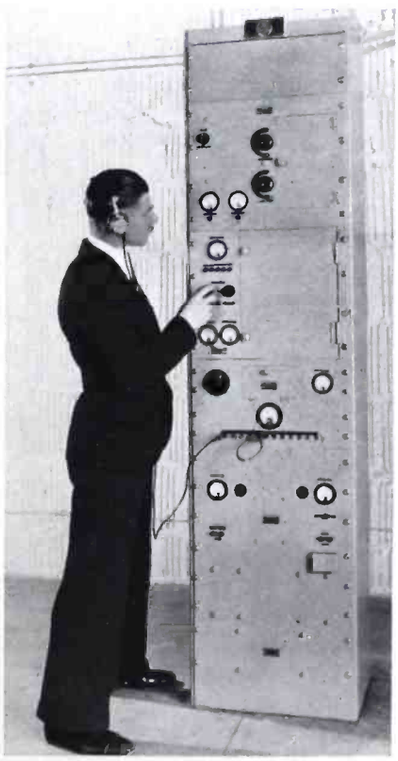
The equipment developed for the new circuit is regarded in engineering circles as a modern marvel. The automatic repeater stations, which catch the microwaves flying in both directions and fling them on to their destinations at New York and Philadelphia, are located at New Brunswick, New Jersey, and Arney's Mount, near Trenton, New Jersey. Since the range of three meter radio waves is virtually limited to line-of-sight, the points of reception and transmission for each of the stations were selected to provide the most distant optical horizon. In New York and Philadelphia therefore, the antennas are located atop tall office buildings, whereas the intermediate points of New Brunswick and Arney's Mount were chosen for their favorable terrain.

Each of the repeater stations employs two different transmitting wavelengths, or one for each direction. The two terminal stations each use one sending wave, making a total of six wavelengths, or

(Continued on Page 28)



(Above) Facsimile receiver employed in RCA ultra-short wave radio circuit connecting New York and Philadelphia.



One of the receivers in the set-up.

MICROPHONES AND MICROPHONES

The Reasons for the Existence of Various Types and Their Uses

Type 44-B De Luxe Velocity Microphone

IT IS a far cry from the strange assortment of microphones used in the early days of broadcasting to the present group, carefully designed both from the standpoint of appearance and performance. In the September, 1935, issue of Broadcast News, an article by Joseph D'Agostino of NBC on Microphone Progress emphasizes this advance most forcibly.

But new designs were brought about not merely to improve appearance and performance. The rapid growth of the industry created very definite problems which it was imperative to solve. Large groups of artists in place of the lone performer, on-the-spot broadcasts, pick-ups from remote points; plus the increased critical attitude of the listening audience, created a demand for special microphones for special purposes.

De Luxe Velocity Microphone —44-B

The first and probably the most important is the new Type 44-B Velocity Microphone, for use wherever the finest obtainable reproductive fidelity is required. It provides a number of improvements including: higher output, adjustable frequency response and a more modern appearance. It is unquestionably the outstanding broadcast microphone developed to date from viewpoints of performance, convenience and reliability. It is well suited to practically all types of studio pickups and especially adapted for various special types of pickups which are difficult or impossible with other microphones. It can be used with any existing speech input system and does not require a closely linked pre-amplifier. It is completely fool-proof and is able to stand more hard usage than any other microphone. A quality microphone for quality stations, the 44-B is designed with emphasis on fidelity rather than cost. Nevertheless, because of the huge production facilities of RCA, it costs but little more than far less satisfactory types.

This type is a modification and improvement of the well known Type 44-A Velocity Microphone. While the principal of operation and directional characteristic remain unchanged, the magnetic circuit has been redesigned to increase the sensitivity 6 DB. This increase in sensitivity allows much greater freedom from hum and thermal agitation noises. Also means have been provided for shifting the low frequency characteristic from flat to one which will give flat response when the microphone is placed one foot from a point source of sound. The change is made by shifting a link on the terminal board of the microphone. The position of the link may be noted through a small hole in the cover of the transformer housing.

The Type 44-B Velocity Microphone is intended for general studio use. It is unsurpassed in smoothness of response, extent of response and constancy of directional characteristic regardless of frequency. Its bi-directional characteristic lends itself to control over adverse studio conditions.

The Junior Velocity Microphone —74-A

The 74-A, a modification of the 44-B, solves an entirely different problem. For many pickups outside of the studio, particularly at banquets and for similar occasions, microphone size is of importance not only because of considerations of portability, but also because it is undesirable to obstruct the speaker's view with an unnecessarily large microphone. The Type 74-A Microphone offers advantage in this respect, in that it is somewhat smaller than the deluxe model—the overall dimensions being 7⅝" high, 4" wide and 2½" deep.

Directional Characteristic

The directional characteristic of the Type 74-A Junior Microphone is of the now well-known bi-directional pattern, and is practically the same as that of the Deluxe Type 44-B Microphone. This pick-up configuration has been found

Type 74-A Junior Velocity Microphone

Type 77-A Uni-Directional Microphone

in actual practice to represent the maximum in convenience and adaptability. The two unique features—that is, first the pickup from two sides and second, the minimum (practically zero) pickup in line with the microphone—provide unusual flexibility of arrangement, and can be used to advantage in many special applications, as well as being unusually well-adapted to regular studio pickups.

In the average oblong-shaped studio the "figure-eight" pattern of the Velocity Microphone has two outstanding advantages: first, it corresponds more closely than any other pickup pattern to the usual placement of artists (whether arranged on one or both sides) and second, it is particularly effective in reducing undesired pickup due to reflection from side walls. Again, at remote pickup points, such as night clubs and the like, or when an audience is present in the studio, the microphone may be tilted to utilize its line of minimum sensitivity in reducing undesirable pickup of audience and other extraneous noises.

The various applications for which the Type 74-A Microphone is particularly suited will be immediately evident to broadcast and sound engineers. Most obvious, and probably most important, of these will be at remote pickup points—particularly those of the semi-fixed type, such as night clubs—where lines, and other limiting factors, make the extended response of the deluxe model unnecessary. At the Republican National Convention sixty were in use on the floor and functioned perfectly.

An Entirely New Type of Microphone—the 77-A

The RCA Type 77-A Uni-directional Microphone is a spectacular new type of microphone—a microphone which has a directional pickup pattern totally different from that of any other microphone. It presents studio engineers and production men with a new tool—one which has any number of unique possibilities, and which is certain to greatly facilitate many types of pickups now made with difficulty. It is not, most definitely not, just another model of the standard Velocity Microphone.

While it resembles the Velocity Microphone in appearance and construction, and in fact devolved from research and development work on the latter, it is not strictly velocity-actuated, but rather combines velocity and pressure operation. Because of this, it secures in surprising degree the best features of each type. Of its several unusual features the most striking, and the one which gives it its name, is the ability to pick up sound arriving from one direction — or, more accurately, from one side — while almost completely rejecting sound from the other side. This characteristic and the other advantageous properties of this microphone are derived from the radically new design, which is totally different from that of any other microphone, and is an exclusive RCA development.

The Type 77-A Uni-directional Microphone is certain of its acceptance, because it was literally demanded by the leaders among the group of engineers who will use it. RCA recognizes that the men who are using equipment in the field, day in and day out, are often better able to see the need for a particular item of equipment than are the men who develop equipment in the laboratory. From this viewpoint, the demand for the Uni-directional Microphone is a logical and easily understood development. The engineers who have the responsibility of solving the many varied

(Continued on Page 21)

At the Republican Convention sixty 74-A's were used.

A NOTE ON THE PLACEMENT OF THE COIL IN A SECTIONALIZED ANTENNA

By DR. G. H. BROWN

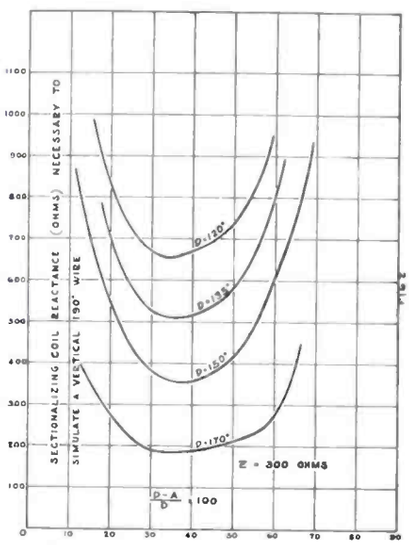


Figure 1

I. Introduction

THE "sectionalized" antenna consists of a straight vertical wire or tower with a coil inserted at some point along the antenna. This coil is so adjusted that the vertical radiation characteristic simulates that of a straight vertical wire of greater height than the antenna in question. Generally, the coil is adjusted to give the characteristics of an antenna which is 190 degrees (0.53λ) tall. All calculations in the following discussion are made on the assumption that the coil reactance is such that the 190 degree characteristic has been obtained.

It has been shown[1] that, for a given overall antenna height, the sectionalizing coil may be positioned arbitrarily and still yield the desired vertical radiation pattern.

However, factors which enter into the practical design of a sectionalized antenna definitely fix the position of the sectionalizing coil. These factors are the size of the coupling coil, the voltage across the coupling coil (and across the sectionalizing insulators), and the losses in the coil. It is the purpose of the present discussion to examine these factors quantitatively.

II. The Reactance of the Sectionalizing Coil

We will use the following notation:

d = total height of the antenna

a = distance from the ground to the sectionalizing coil

b = length of sine wave which would be above the coil point if the coil and top section of antenna were replaced by a straight wire or tower section of the same cross section as that below the coil point

$$D = \frac{2\pi d}{\lambda} \text{ radians} = 360\,\frac{d}{\lambda} \text{ degrees}$$

$$A = \frac{2\pi a}{\lambda} \text{ radians} = 360\,\frac{a}{\lambda} \text{ degrees}$$

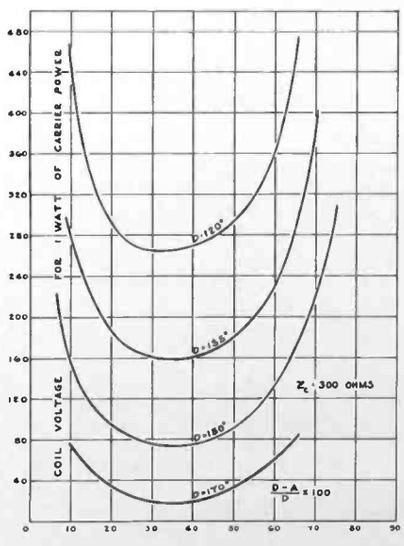


Figure 2

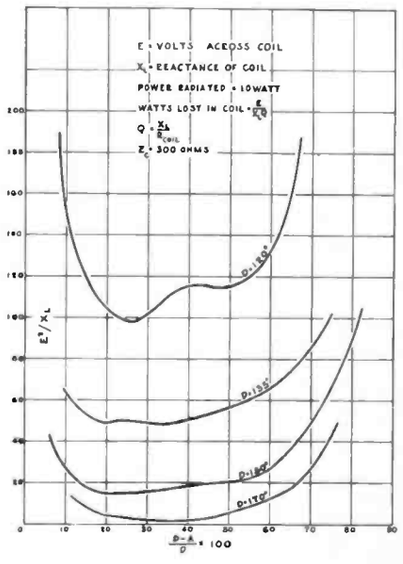


Figure 3

$$B = \frac{2\pi b}{\lambda} \text{ radians} = 360\,\frac{b}{\lambda} \text{ degrees}$$

Z_e = Effective characteristic impedance of the antenna.

The reactance of the coil plus the reactance of the top section of the antenna must equal the reactance of the fictitious length, b. Thus, in accordance with simple transmission line theory,

$$jX_L - jZ_e \cot (D - A) = -jZ_e \cot B \quad (1)$$

$$\text{or } X_L = Z_e [\cot (D-A) - \cot B] \quad (2)$$

where X_L is the reactance (ohms) of the coil which will give a 190 degree antenna characteristic.

Equation (2) may be written

$$X_L = Z_e \left[\cot \left\{ \frac{(D-A)}{D} \times D \right\} - \cot B \right] \quad (3)$$

For a given value of D and $\frac{D-A}{D}$, the correct value of B is obtained

[1] G. H. Brown, "A Critical Study of the Characteristics of Broadcast Antennas as Affected by Antenna Current Distribution." Proc. IRE, Vol. 24, No. 1, January, 1936, pp. 57-59.

from Figures 13 and 14 of the previously cited reference.

Figure 1 shows X_L as a function of the quantity, $\frac{D-A}{D} \times 100$, for a number of antenna heights. It should be noted that $\frac{D-A}{D} \times 100$ is simply the amount of antenna above the sectionalizing coil expressed as a percentage of the total antenna height.

The results shown in Fig. 1 are based on an effective characteristic impedance of 300 ohms. This value was chosen since it is a high average value for a tower construction and a low average value for a vertical wire. In any event the reactance is directly proportional to the characteristic impedance.

III. The Coil Voltage

For a given radiated power, the current through the sectionalizing coil is

$$I_{coil} = \sqrt{\frac{W}{R_r(coil)}}$$

where

W = radiated power (watts)

$R_r(coil)$ = radiation resistance referred to the coil point.

Values of this radiation resistance have already been published.[1]

[1]Loc. cit.

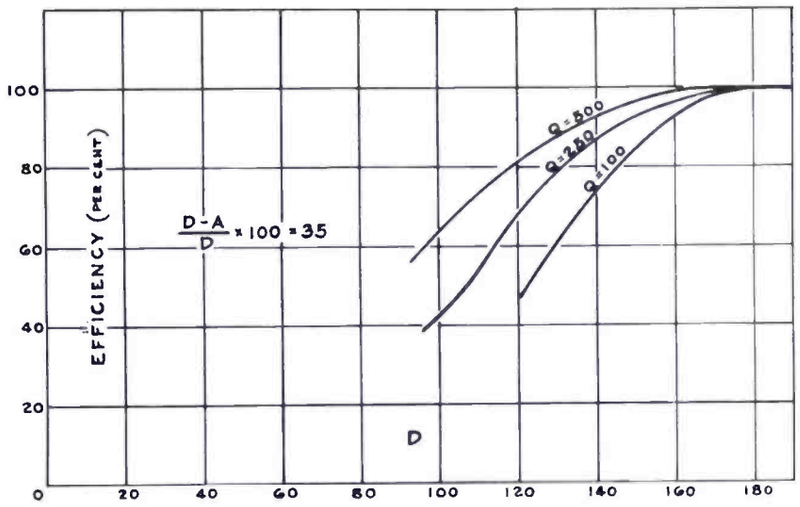


Figure 5

Then the voltage across the coil for one watt of radiated power is

$$E = I_{coil} X_L = \frac{Z_c}{\sqrt{R_r(coil)}} [\cot (D-A) - \cot B] \quad (4)$$

This voltage is shown by Fig. 2 for a number of antenna heights, and $Z_c = 300$. When the radiated power is W watts, the values of Fig. 2 should be multiplied by $\sqrt{W}$. The values of Fig. 2 represent r.m.s. voltages when only carrier power is present. To obtain the peak voltage existing under conditions of 100 per cent modulation, the values of Fig. 2 should be multiplied by 2.828.

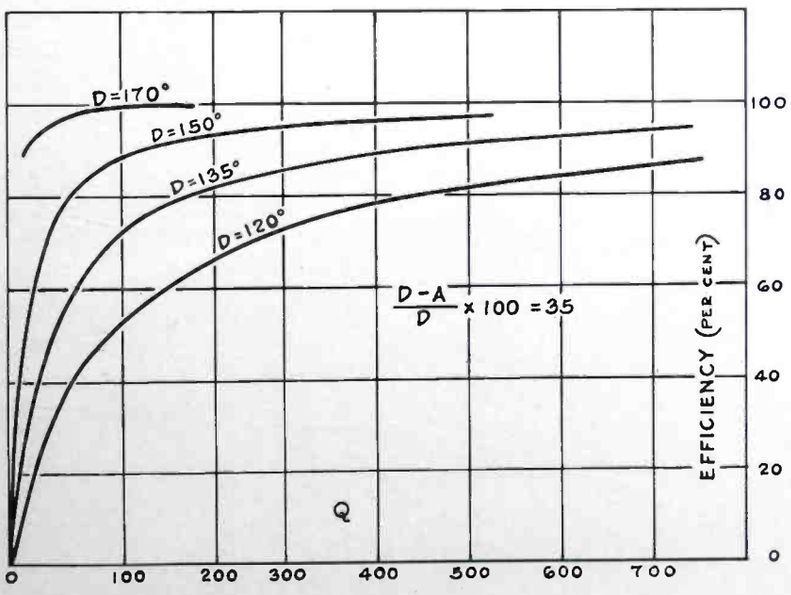


Figure 4

IV. The Power Lost in the Coil

Since Figs. 1 and 2 give the coil voltage and reactance, it is a simple matter to compute the amount of power consumed by the coil if the resistance of the coil is known. We will express the coil resistance in terms of the selectivity factor, Q, and the coil reactance, X_L.

$$Q = \frac{X_L}{R_L}$$

Since Q is a number much greater than unity, the power lost in the coil for one watt of radiated power is $\frac{E^2}{X_L^2} R_L = \frac{E^2}{X_L Q}$ watts.

The quantity, E^2/X_L, is plotted in Fig. 3.

We have seen that the coil reactance and coil voltage reach minimum values when the distance from the top of the tower to the coil point is approximately 1/3 of the total antenna height. The curves expressing power lost in the coil are less critical.

The efficiency of the antenna is expressed as

$$\text{Eff} = \frac{\text{Watts radiated}}{\text{Watts radiated} + \text{Watts lost}} \times 100$$

Disregarding all except the coil losses,

$$\text{Eff} = \frac{1}{1 + \frac{E^2}{X_L Q}} \times 100$$

(Continued on Page 26)

WBT DEDICATE

Charlotte Station Mainta

WITH a large audience of Carolinians in the studios and thousands of others grouped about receiving sets, WBT, Charlotte, N. C., southern key station for Columbia, formally dedicated its new home and at the same time observed the 15th anniversary of its continuous broadcasting service on Thursday, July 16.

WBT's new studios and offices, occupying an entire floor in the Wilder Building, in the heart of downtown Charlotte, revealed to the south on July 16th the newest developments in radio microphones and control equipment just out of the RCA laboratories.

New Principles of Design

Contrary to precedent, WBT's studios have low ceilings purposely built along new principles rather than the customary twenty feet high or more, so prevalent in past years. The development of the low ceiling studios was accomplished by the Engineering and Construction Department of the Columbia Broadcasting System. CBS has already put into use such a studio at its New York headquarters.

Master Control Desk at WBT.

Some of the innovations include alternate dead and live end sections in studios, together with floating wall sound isolation. The general appearance of the entire new home of WBT, including offices, reception room, audience rooms, and studios, is ultra-modern in trend.

Studio "B" facing the Observation Room.

In an effort to standardize all Columbia owned and operated stations, WBT has carried its modernism along identical lines with that employed at Columbia's New York headquarters. This harmony has included exact duplicates of decoration throughout offices, corridors, reception room, and studios. Actually, WBT's new home is an exact duplicate, although on a smaller scale, of Columbia Broadcasting System's New York studios and offices.

No Time Lost

WBT engineers accomplished practically the impossible in constructing these new studios while operating from the old studios located on the same floor, without missing a minute of time on the air during the entire construction service which lasted more than three months. Radio listeners at times were undoubtedly puzzled by hammering which occasionally filtered through the microphones and into their loudspeakers.

Innovations which were shown to the public for the first time on July 16th included the very latest RCA ribbon type high velocity

NEW STUDIOS

s Reputation for Progress

microphones, which gave WBT the opportunity of being the first station in the country to actually use these improved high fidelity reproducing devices. Likewise, WBT was the first radio station, outside of CBS's WABC, New York, to purposely construct low ceiling studios to obtain high fidelity acoustics.

The very latest design of monitoring amplifiers and an entirely new control room, including replacement of every piece of wire used and all auxiliary equipment, when added to WBT's recently completed high fidelity 50,000-watt transmitter, 10 miles south of Charlotte, give WBT high fidelity transmission second to none.

Air-conditioning and refrigeration has been provided for all studios, control room, audience rooms, transcription rooms, etc.—a complete innovation in the south, as heretofore broadcasting studios in this section of the country lacked proper air-conditioning and especially refrigeration.

Additional Space Provided

Although adequate space has been provided in the studios for visitors, the station has also provided glass enclosed audience chambers in which visitors may view the program through glass while they listen over loudspeaker systems.

Looking into the Control Room from Studio "B".

The program for the occasion was in three parts; a network show from New York City, dedicated to WBT by Columbia; a program from the WBT studios; and a program dedicated by Hal Kemp (Charlotte boy who has made good along harmony lane) to WBT.

Columbia dedicated its "Tomorrow's Headliners" to WBT. These assembled starlets with Leith Stevens and an orchestra, presented the first half-hour of the dedicatory program, beginning at 8:00 o'clock.

At 8:30 o'clock the dedication proper was started from Charlotte. The station presented an elaborate production of its DIXIE MAMMOTH MINSTRELS, which used a total of 40 people, including some of the finest talent in the business. A 20-piece orchestra supplied the background for the songs and minstrel tales. This minstrel has been voted the most popular show by the stations making up the Dixie Network, and is well-known and widely liked especially through the south, where listeners feel that the company of minstrels have really caught the spirit of old-time minstrelry.

Just before the curtain went up on the minstrel, H. H. Baxter, of the Charlotte city council spoke briefly in behalf of official Charlotte, and Maj. Paul Younts, Charlotte postmaster, spoke as a representative of the Federal government.

View of Studio "A" with Control Room in background.

(Continued on Page 29)

POPULAR FORT WORTH STATION INCREASES POWER

New Transmitter at KFJZ Strengthens Signal Over Wide Area

By ELBERT HALING

IT'S a big year for Fort Worth in more ways than one. Not only is a successful exposition drawing attention to this North Texas metropolis but the new equipment recently installed at KFJZ is rapidly placing this station in the attention-getting class. The new transmitter definitely strengthens the signal in the primary area and places KFJZ on par with the best equipped low power units in the country.

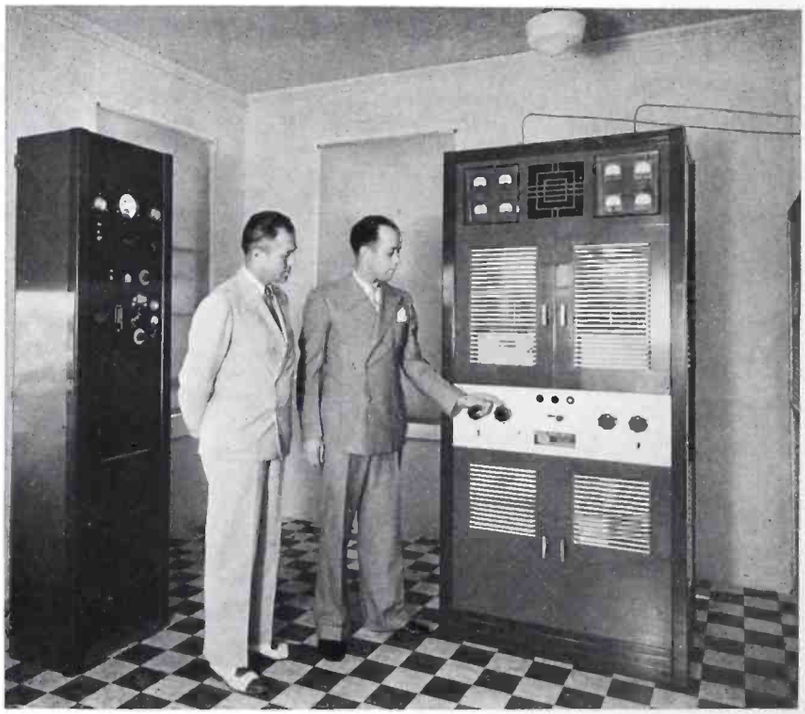
In May, permission was granted by the Federal Communications Commission to boost power to 250 watts. Immediately arrangements were made to install modern apparatus throughout. Since the principal market for KFJZ is local, a thorough advertising and publicity campaign was used to acquaint the general public with the improved facilities.

Prominent advertisers were informed through the medium of an attractive station brochure. When the campaign was concluded, Fort Worth knew that things were happening in the local radio world.

"From the technical standpoint," said Mr. Truett Kimzey, KFJZ technical supervisor, "the new installation made an immediate difference in the quality and 'lifelike' presentation of recorded as well as studio features." One of the outstanding characteristics of the new equipment is its ability to "stay on the air" without fail.

Consistent and high quality transmission is not confined to the primary area alone but during the dedicatory program telegrams were received from towns located one hundred miles distant.

The experience of KFJZ as a 100 watt night and 250 watt day time station indicates conclusively that low power stations can utilize high fidelity equipment to secure maximum beneficial results from their power permits.



Truett Kimzey, Technical Director at KFJZ, explains operation of the new ET-4250 to R. S. Bishop, Station Manager.

AN ARTIST LOOKS AT DETAILS

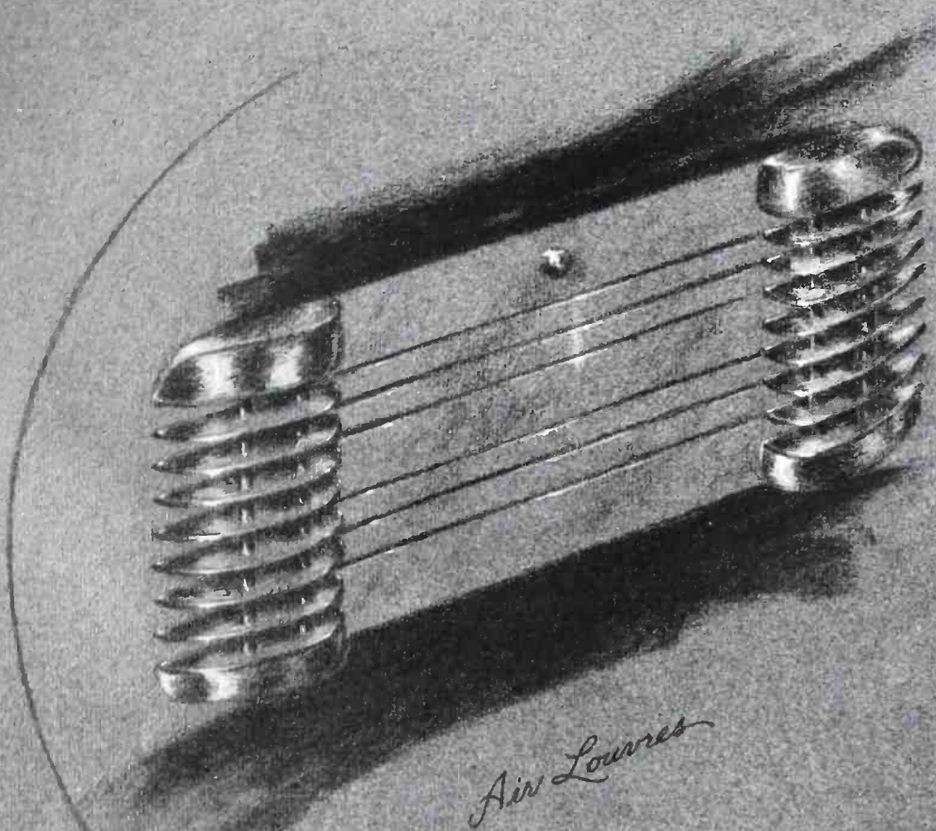
By JOHN VASSOS

THE problem that the artist designer faced in enhancing the beauty of RCA Speech Input Equipment, was tackled primarily from the point of view of functionalism. The main elements were visibility, accessibility, and then form.

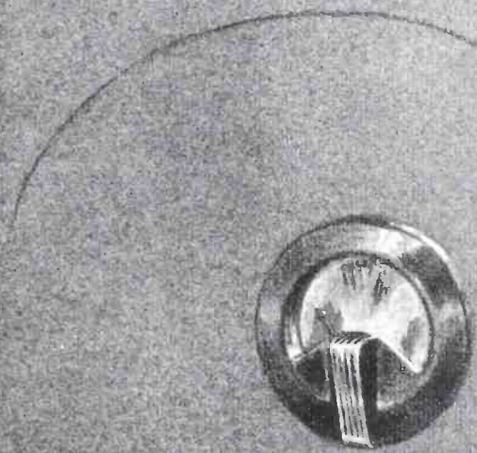
It is the first unit of its kind to have air conditioning louvres, reflecting their purpose in a fin-like design, yet blending with the main panel, and giving maximum cooling efficiency. This unit is also the first to incorporate illuminated meters, insuring maximum visibility at any angle, and specially streamlined knobs, which were developed after many tests and surveys, for the convenience and comfort of the operator, whose duty it is to tune and also relax his hands while doing so.

The rear of this new RCA Speech Input Equipment was given equal thought and consideration, resulting in a hinged chassis which makes accessibility a simple problem for the engineer. Finished in a satin silver, the tubes and shields reflect beauty in design. Even the Monitoring Speaker, a separate unit presenting a very unruly form and a most difficult grille problem, was solved with simplicity and efficiency of purpose.

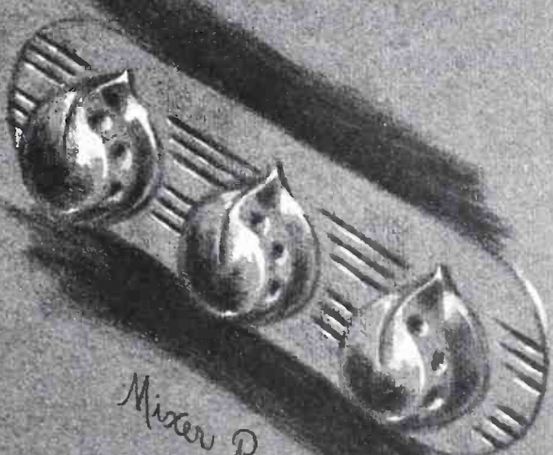
All the elements of streamlining have gone into this equipment, and although streamlining is associated with automobiles and airplanes, actually—to streamline means to maintain the undisturbed and efficient form, primarily reflecting the function it is meant to serve.



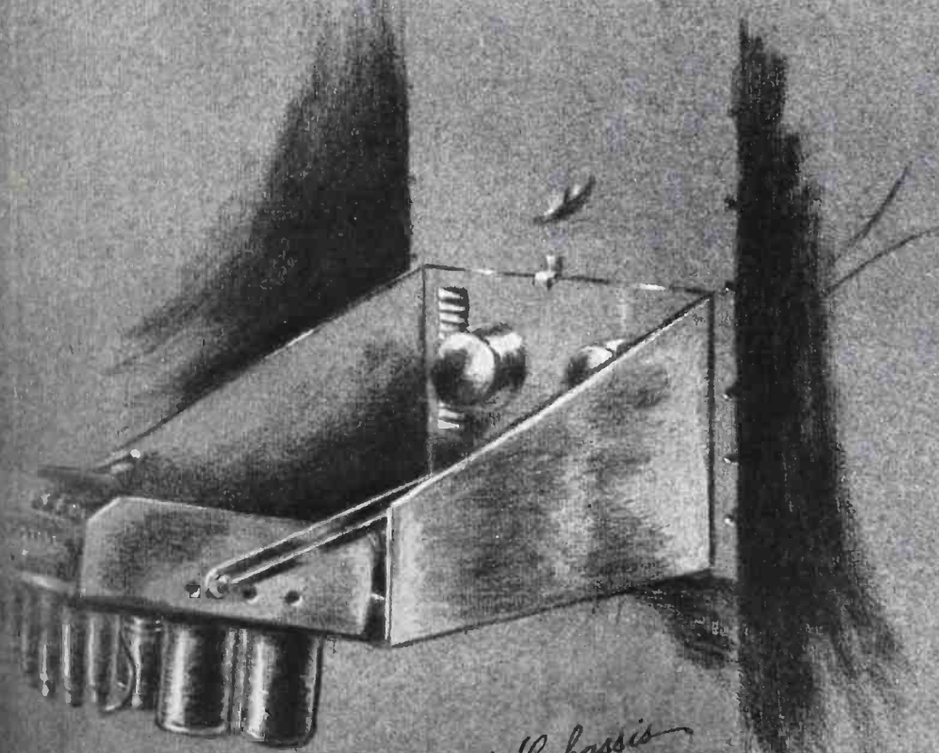
Air Louvres



Illuminated Meter



Mixer Panel



Hinged Chassis

Streamline Knob

TECHNICAL CLOSEUP OF WGN

(Continued from Page 5)

in the studio may listen to the part of the program originating on the outside by simply operating the upper right hand key switch on the control console, to the "remote" position. This automatically cuts off all studio microphones and the studio red light and connects the studio speaker. This feature also permits an announcer to be located in any studio to make the announcements on an entire outside program. If necessary, one announcer and one operator can handle an entire evening's programs originating from any number of remote locations.

Convenience

For the convenience of the production man during rehearsals a portable push button talk-back switch with four feet of flexible cord is provided and operates in parallel with the talk-back position of the upper right hand key. Either the operator or the production man may operate the talk-back.

The entire system is electrically interlocked to prevent the possibility of acoustic feed-back between the studio speaker and microphones and the proper output load is maintained on the monitoring amplifier at all times.

A separate low voltage rectifier and filter is used for relay control in each studio. Power is applied to this rectifier when the main power switch at the bottom of the rack is turned on. Voltage regulation of this relay control voltage is maintained regardless of the number of relays and signal lights that may be on at any one time. The four pre-set lights and the four go ahead lights are controlled by the rectifier in the master control room, to insure their operation even if the studio channel has not been turned on.

Theatre Equipment

The Auditorium studio has a seating capacity of 588 and is completely equipped for use as a theatre as well as a studio. The theatre equipment includes complete RCA High Fidelity photophone and two powerful spots in the projection booth as well as a very elaborate system of stage lighting and drops. A pre-set system similar to that in the master control room described above is used for obtaining various color combinations and intensities of stage lighting. Three different predetermined effects may be set up in advance and the gradual and complete change from one to another is accomplished by the operation of a single switch. Additional remote controlled spot lights are located in the ceiling, concealed by a sliding panel which is also remote controlled. All these controls are located on a built-in panel in the control booth directly above the radio control booth on the left side of the stage.

Client's Booth

On the right side of the stage is a client's booth equipped with a high quality monitor and dial selector and an observation booth. A client's booth similarly equipped and an observation booth seating approximately 20 persons and equipped with a monitoring speaker is also provided in connection with two of the smaller studios, studio two and studio three. Both of the studios in the Tribune tower have observation booths and high quality speakers with dial selectors.

The equipment and facilities in the radio control booth for the auditorium are similar to that described above in connection with the other studios except that provisions are made for the use of eight microphones simultaneously. That is, eight pre-amplifiers along with an eight position mixer. A forty watt amplifier located in the master control room and two concealed 6 ft. photophone speakers provide sound reenforcement in the auditorium when needed.

Master Control Room

The equipment located in the master control room includes a line terminating rack providing ring down relays and signal lights for forty-two incoming lines, jack termination of all studio tie lines, line extension panels and the five adjustable line equalizers. Number 2 rack includes the five equalizers. A 40-C program amplifier and a 41-B pre-amplifier used in handling remote programs direct through master control; the 41-B is for announcements in cases of emergency. Number 3 rack consists entirely of test equipment, including a beat frequency audio oscillator flat from 30 to 15000 cycles, a 110 db attenuator variable in steps of 1 db, two V1 meters, two line isolation transformers and variable attenuators.

Test Equipment

This test equipment provides all the facilities required for quickly checking the gain, frequency response or noise level of any studio channel from microphones to the program line.

The fourth rack contains the four bridging line amplifiers for the four outgoing program channels, while rack number five is a spare to provide room for additional equipment that may be required due to expansion.

Rack number six contains four high quality monitoring receivers. These receivers are of special design and with the "range switch" in full range position the audio frequency response is substantially flat from 60 to 9000 cycles. The range switch has five positions, each for a different audio frequency cut-off. The five ranges are 4000, 5000, 6000, 75000 and 9000 cycles. The change in audio frequency range is accomplished by changing both the IF resonance curve and the cut-off frequency of the four stage AF filter simultaneously.

Interference Eliminated

Although these receivers employ the superheterodyne circuit they are so designed as to successfully eliminate the usual oscillator interference between the different receivers even when operated on the same antenna. The outputs of the four receivers are 500 ohms impedance and feed a zero level signal to the 500 ohm monitoring circuits through the dial selector system.

Rack number seven contains four monitoring amplifiers, two of which are used for the master control room and two are used to

Control operator's desk in the main studio.

feed the sixteen house monitoring speakers located throughout the building.

Rack number eight located at the extreme right contains the four isolation amplifiers for isolating all monitoring circuits from the four program lines. This avoids the possibility of program interference or interruption from monitoring switching, at the various locations throughout the building.

Throughout the entire system all inputs and outputs of all amplifiers are normalled through jacks thus providing the utmost in flexibility and facilities for testing individual units as well as making it easily possible to quickly substitute one amplifier for another in case of emergency.

In the installation lead covered wiring was used throughout. Junction boxes are located back of the rack in the master control room. Metal lined trenches with removable covers are used for all wiring between the junction boxes and the equipment. In the junction boxes all circuits are properly segregated to avoid interference between high and low level circuits.

In the entire installation there are some sixteen racks of equipment, thirty-seven 41-B pre-amplifiers, fourteen 40-C amplifiers and twenty-four 4194-B monitoring amplifiers.

Type 44-A velocity microphones are used throughout, a total of thirty are now in use.

The overall frequency response from any microphone to program line is flat ±1 db from 30 to 1000 cycles and the distortion is less than .5% arithmetic sum at normal operating level.

MICROPHONES AND MICROPHONES

(Continued from Page 13)

pickup problems of modern broadcasting, as they became acquainted with the various types of microphones available, gradually analyzed the possibilities of these.

Advantages of Uni-Directional Pickup

The advantages of the uni-directional characteristic of the Type 77-A Microphone will be so evident to the experienced engineer that it is almost unnecessary to stress them. On the front side this microphone has a very uniform response, while on the back side sounds are attenuated an average of 20 db.—giving a 10-to-1 ratio of desired to undesired pickup. Numerous advantageous applications will be immediately apparent. First, and perhaps most important, of these will be those pickups of the type which occur in the case of auditorium-type studios, and other large studios, where a sizeable audience is present in the studio—and in remote pickups at theatres, night clubs, and the like. In all such situations the audience noise presents a serious problem.

In some cases the standard Velocity Microphone can be oriented so as to overcome this. However, the same effect can be obtained to a much greater degree, and with much greater ease, by simply placing a Type 77-A Uni-directional Microphone with its dead-side toward the audience. When placed close to the footlights, or in an equivalent position, the 20 db. discrimination provides the desired attenuation of audience noise, while the broad pickup angle — useful through nearly 150 degrees — will afford pickup of the whole stage, or that part of the studio in which the artists are located. The wide pickup angle of the Type 77-A Microphone is the second important feature. It is practically twice as wide an angle as that of the diaphragm-type microphones, and even wider than that of the lobes of the standard Velocity Microphone. As a result, one of these microphones will nearly always suffice for any type of pickup, and will often take the place of two or three microphones of other types.

The Inductor Microphone—50-A

The Type 50-A Inductor Microphone is a pressure-type microphone the quality of which is surpassed only by that of the Velocity Microphone. Moreover, it has all of the qualities which are so particularly desirable in a microphone for outside use, namely, (1) insensitive to wind and mechanical vibration, (2) unaffected by temperature and humidity, (3) requires no external excitation or power supply, (4) requires no closely-linked amplifier, and (5) is well suited for close-talking. In all of these features as well as in sensitivity and quality the Inductor Microphone invites point-by-point comparison with any type of microphone.

Because of other controlling factors—such as line characteristics, poor acoustics and high background noise—it is not practical to attempt to obtain in field pickups the wide range of audio frequencies attained in the best equipped studios. Nevertheless the audio range utilized for this type of service has in the last few years nearly doubled and it appears probable that it will be somewhat further extended. It is, therefore, desirable that a microphone for this use have a fairly uniform response over the full range likely to be utilized. The response characteristic of the Type 50-A Microphone is fairly uniform throughout its range of 60 to 10,000 cycles. This uniformity, while not as good as that of the Type 44-A Velocity Microphone, is considerably better than that of most other microphones.

The 50-A Inductor Microphone

MAKING RADIO WAVES BEHAVE

Broadcast Stations Find Constant Check Valuable

By E. C. RUNDQUIST

Aerial view of long wave and frequency measuring center.

THE stringent regulations laid down by the Federal Communications Commission limiting the tolerances of deviation of radio transmitters from assigned frequencies make imperative vigilant supervision of the emitted signals.

Occasional Drifts

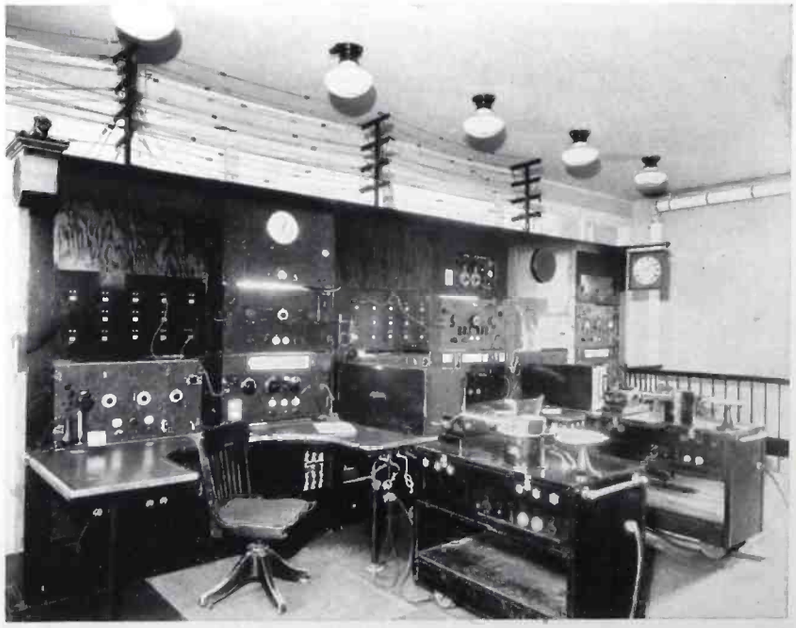
While modern transmitters are stable and reliable when skillfully operated and maintained, they are not totally immune to occasional frequency drifts. Unfortunately, these drifts often occur when they are least expected. Therefore it is extremely important that they be detected and corrected before they assume serious proportions. Local checking equipment is of course of considerable value for this purpose, but naturally such equipment cannot be relied upon unless it is occasionally calibrated against standards of unquestioned accuracy. To meet this need R. C. A. Communications, Inc., offers an unexcelled frequency measuring service.

At present two measuring laboratories are maintained, one at Riverhead, Long Island, and the other at Point Reyes, California. These offer 24-hour service and, due to their geographical locations, can adequately serve any station requiring frequency measurements. The Frequency Measuring Laboratories, which form a part of R. C. A. Communications, Inc., great International Radio Receiving Stations were established primarily to monitor the frequencies of international radio telegraph transmitters operated by or received by R. C. A. services. They were also designed to supervise the stability of other transmitters operating in the same frequency bands to facilitate prompt elimination of any interference which might develop.

These laboratories, which make several thousand measurements per month, have gained an unrivalled background of many years of experience in systematic, precise measurements of the frequency of R. C. A. and foreign commercial radio stations, operating on frequencies ranging from 15 kilocycles to 100 megacycles.

Special Receivers

The equipment of the measuring laboratories comprises a number of receivers specially con-



The interior of the RCA Communications Laboratory, Riverhead, Long Island.

structed to enable comparison of the radio frequency of the signal to be measured with accurately known frequencies developed in the laboratories. These known frequencies are derived from either of two elaborate 100-kc quartz-crystal-controlled oscillators, which are operated under constant temperature and air pressure to insure extreme constancy. One of the standard oscillators drives a synchronous electric clock through the medium of two 10 to 1 frequency dividers.

The time interval upon which all measurements are based is the standard second, which is the 1/86,400th part of the mean solar day. The standard frequency is referred to the standard second by checking the frequency-controlled clock daily against standard time signals sent out from the Naval Observatory at Washington.

Comparative Measurements

Comparative measurements are made regularly on the standard frequency transmissions of the U. S. Bureau of Standards. These transmissions are certified by the Bureau as accurate to within 1 cycle in 5,000,000. The measurements show an average deviation of less than 2 cycles in 5,000,000, or an accuracy approximately 100 times greater than that required by broadcasting transmitters themselves.

Foreign Comparisons

Further checks are obtained by making comparisons with frequency standards abroad from time to time by simultaneously measuring at Riverhead, Point Reyes, and at one or more foreign laboratories the frequency of some convenient radio telegraph transmitter.

The accuracy of the standard oscillators has been found to be better than one part in a million. Taking into account the inherent errors of the system and those encountered in making a measurement, the total probable maximum error at a frequency of 6000 kc amounts to ±28 cycles or 0.00047 per cent, and at 20,000 kc ±59 cycles or 0.0003 per cent. In the method used in measuring broadcast transmitters a measurement may be made to 0.01 cycle. However, the error of the standard limits the accuracy of the measurement to 0.2 cycle.

A view of the Research Division and Frequency Measuring Buildings. Marconi towers in the background.

The photograph shows the three measuring positions at the Riverhead laboratory. Directly above the racks are the antenna transmission lines which lead to various types of directive antennas. These transmission lines terminate at each measuring position, where the engineer may select an antenna which is most suitable for receiving the signal he desires to measure.

Each measuring position occupies two bays of the rack. The units from top to bottom in the first bay, at the left, are: anenna panel, harmonic generator unit; second bay; radio-frequency amplifier, measuring receiver. Above the amplifier unit is the clock controlled by the standard oscillator. On the table, at the right of the receiver, is a heated box for the receiver coils. In the foreground is one of the tape recorders used for counting beats and monitoring code signals. The measuring equipment is duplicated at each position.

Close Supervision Maintained

The regular procedure of scanning all frequency bands permits close supervision of the accuracy of any transmitter subscribing to the measuring service. As a result of this frequent coverage any excessive frequency deviation or development of spurious radiations in a subscriber's transmitter is detected, and notification by telephone or telegraph is made immediately. This particular feature has been found very valuable by many of the subscribers. Numerous broadcasting, police, aviation, and commercial stations throughout the United States, and in Canada, Mexico, and the West Indies rely with confidence upon this R. C. A. service. Not the least valuable adjunct of this service is the fact that measurements made by these laboratories are acceptable to the Federal Communications Commission.

A complete technical description of this measuring system will be found in an article, "The Precision Frequency Measuring System of R. C. A. Communications, Inc.," by H. O. Peterson and A. M. Braaten, in the June 1932 issue of the Proceedings of the I. R. E.

WORLD CONGRESS OF BROADCASTERS MEETS IN PARIS

*International Radio Problems Discussed at Sessions in French Capital**

(Continued from the Previous Issue)

Program Committee**

The meeting of the Program Committee proposes that, following the example of European concerts organized by the U. I. R. with great success for the past few years, a series of worldwide concerts be organized. These concerts, of a duration of about thirty minutes shall preferably consist of the following kind of music:

(a) Orchestra music of special character.
(b) Typical national music.
(c) Famous soloists.

The meeting suggests that the first of these world-wide concerts be organized by the United States of America on September 20, 1936; the second by the National Broadcasting Association of the Republic of Argentine during the month of February, 1937, on the occasion of the annual Tango Contest held in Buenos aires; the third by the NIROM (Dutch East Indian Radio Omroep Maatschappij—Dutch East Indies.)

Additional information in connection with this third concert will be furnished at a later date. In the event that good conditions should not prevail it will be replaced by a transmission of negro music originating in the Belgian Congo.

The meeting suggests that thereafter the office of the U. I. R. be invited to undertake the organization of these concerts in cooperation with those organizations which will offer same.

The Program Committee recommends that the general assembly invite all broadcast organizations of the world to develop the exchange of relays including:

(a) spoken reporting, news events;
(b) national manifestations or national holidays;
(c) short spoken reports on large industrial activities.

The inter-continental broadcast meeting requests the International Broadcast Union to establish contact with all administrations of the world, for the purpose of obtaining regular communication covering detailed information on the subject of actually available circuits, of facilities at disposal, as well as on the subject of general possibilities varying according to the climate, seasonal, or other conditions. The meeting suggests that all new information of this nature will be incorporated in the respective chapters of the pamphlet on relays of the U. I. R.; it requests the Union to examine the conditions subject to which it could distribute the complete information among extra-European broadcasting organizations.

The Program Committee recommends that whenever inter-continental communications are involved the expense of inter-continental commercial circuits be borne in equal shares by the organizations which participate in the relays with their own circuits. The telephone line expenses in any continent do not appear to present a debatable matter to the inter-continental meeting.

The delegate of the League of Nations declared to the Program Section that in order to facilitate the relay of conferences broadcast over the League of Nations station during an important session of the council or the assembly, he will announce by radio the hours at which the discussions of the statesmen shall be regularly broadcast. The Programs Section recommends to the general assembly that those organizations which may desire to receive this information by telegraph should be invited to register their intention with the office; the latter shall thereupon transmit this information by telegraph, provided that the expenses resulting therefrom be borne by the concerned organizations.

The Program Committee recommends that the General Assembly of the Union compile as soon as possible a list of important events which will be repeated at regular intervals and which might be susceptible to provide suitable material for worldwide broadcasts. This list shall be accompanied by explanatory comments, which could be used as a permanent documentation. It would be likewise desired that the union be advised of improvised events of interest to other countries. It would then assume the duty to inform its members.

The inter-continental broadcasting meeting of Paris deems it desirable that in all countries reporters on radio broadcasting ought to be put on equal footing with the members of the Press in matters concerning facilities genrally accorded to same for the collection on the spot of useful information to enable them to fulfil their mission.

The inter-continental broadcasting meeting of Paris (1936) expresses the opinion that it would be desirable to simplify as much as possible the present custom facilities applying in various countries to reporters on radiobroadcast events, carrying the necessary equipment required by them for their particular functions (microphones, receivers, etc.) The inter-continental broadcasting meeting requests all delegates to put this before their respective administrations for the purpose of introducing the principle of triplicate affidavits, or issue a special pass in favor of the concerned parties.

Juridical Committee

The meeting is of the opinion that it would be useful to exchange information concerning the question of authors' equity between oversea countries and European broadcasters. For this purpose the latter could communi cate to the office of the U. I. R. at

(Continued on Page 26)

* Transcript of the proceedings submitted by Dr. C. B. Jolliffe.
**The complete text of the minutes is available for consultation if desired.

QUARTZ CRYSTALS

Continued from Page 3)

being 8100 x 10^{-6}, 5.98 x 10^{-6} and 6.94 x 10^{-6}, respectively. Rochelle Salt, however, has a high temperature coefficient, an upper temperature limit of approximately 50 degrees centigrade, its mechanical properties are not suitable for frequency control, and its characteristics vary widely with temperature and humidity. Its low cost and high piezo-electric constant, however, have made it suitable for devices in the frequency range of 0 to 20,000 cycles, where its use has been confined to microphones, loudspeakers, galvanometers, electro-acoustical and electro-mechanical pick-ups (vibration pickup) and other low frequency devices.

Qualities of Tourmaline

Tourmaline is a semi-precious stone found in the United States, Russia, Brazil and other countries, most of the supply coming from Brazil. This material has a negative temperature coefficient of frequency of 46.5 parts per million per degree centigrade, as compared to quartz which can now be cut to have substantially zero temperature coefficient. The source of supply of tourmaline crystals is rather limited, its cost is excessive, and its only advantage lies in its frequency constant K** which is 146.5 x 10^6 as compared to quartz which is 113 x 10^6 for the X cut, and 78 x 10^6 for the Y cut, approximately 100 x 10^6 for low temperature coefficient crystals for high frequency use and 66 x 10^6 for low temperature coefficient crystals for low frequency use.

Because of the small natural crystals, special sawing equipment is required for tourmaline but this material because of its flexibility can be worked to thinner dimensions than quartz and it has therefore been used experimentally for frequency control up to 150 megacycles, but quartz with multiplier stages will give superior performance at a lower cost.

Piezo-Electric Quartz

The material used for piezo-electric applications is low quartz, or alpha quartz, which has a piezo-electric constant, D_{14} of 6.94 x 10^{-6}, a density of 2.654 and a specific inductive capacity of 4.55. It is one of the varieties of silica, SiO_2, which forms 58% of the earth's surface. Its properties remain fairly constant over a temperature range of —200 degrees centigrade to +200 degrees centigrade, above which the piezo-electric constant gradually falls off to a temperature of 573 degrees centigrade, at which temperature the material becomes beta quartz which is not piezo-electric. Quartz has extremely low internal losses ("Q" figures from 10,000 to 250,000 have been reported), it cannot oxidize, and it cannot be attacked by acids, except hydrofluoric, and a few related minerals which do not occur free in nature.

Various Types

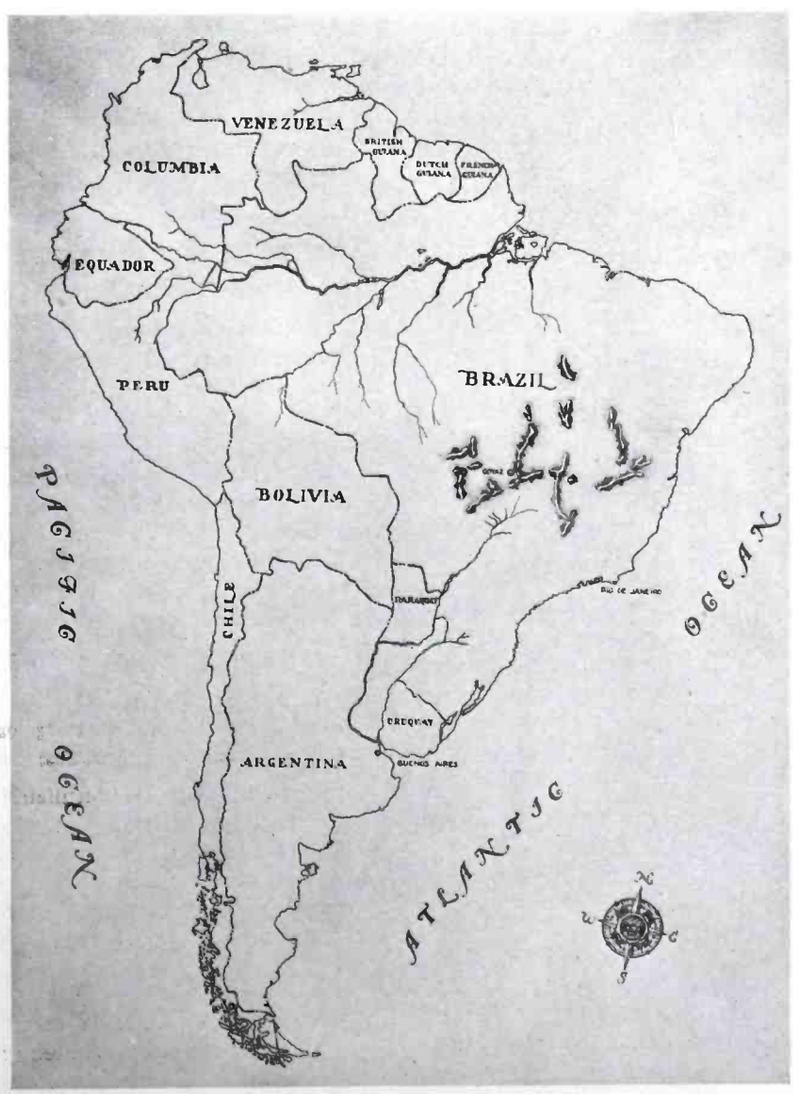
While quartz occurs in various colors: smoky gray, brown, black, red, etc., the optically clear, colorless variety only is suitable for piezo-electric use. Quartz crystals, therefore, must be selected with care and while quartz crystals are found in the United States, Madagascar, Japan, Australia and Brazil, the most satisfactory material is Brazilian quartz.

Source of Supply

Quartz crystals are found in two areas in Brazil; one extending from Cayuba to Forteleza, especially the provinces of Goyas, and Minas-Geras, the other territory of Minaos. This territory is generally at a considerable distance from villages or means of transportation, and is covered with dense foliage and igneous rocks. Mining is done with pick and shovel and the material is loaded on burros which carry approximately 50 pounds and travel a distance of from 40 to 60 miles to

(Continued on Page 27)

** K = frequency, F, in cycles per second multiplied by the thickness in mils (.001 inches) F = K/thickness mils.



Map of South America indicating location of quartz.

WORLD CONGRESS OF BROADCASTERS

(Continued from Page 24)

Geneva all information concerning their respective countries, the office being at their entire disposal to furnish reciprocally all information which might be necessary concerning the status of actual legislation in the various European countries.

The problem of protection of emissions was examined by the Judicial Commission and the results at which they arrived have served as a basis of discussion by the Judicial Committee.

1. After an exchange of opinions the latter concluded that it might be necessary that the broadcasters study the following questions concerning inter-continental relays:

(a) Does authorization to effect a relay involve the right to proceed to a registration of the emission in view of a deferred emission?

(b) If the answer is Yes, under what conditions?

2. It appeared that all delegates were in accord that if an authorized retransmission is utilized by a third party, the original transmitter will not have to respond to any demand or claim emanating from eventual interested parties pertaining to utilization of the transmission in question.

The international Reunion of Radio Broadcasting (Paris 1936) having under consideration broadcast relay transmissions from a point of origin within the territory of one country and point of transmission within the territory of another country consider it desirable to continue the study of the question so as to know whether International Radio Broadcast services containing speech should enjoy the same liberties of communication as those enjoyed by the press in their international services.

The Inter-continental Reunion of Radio Broadcasting (Paris 1936) considering the regulatory advantages accorded to transmissions of press news over the international telecommunication circuits, expresses the desire that the administrations would kindly:

1. Examine the possibility to treat in their interior telecommunication services communications addressed to radio broadcast organizations concerning information and programs destined to listeners or for publication by the press whenever use of ordinary circuits is made equal to that accorded senders of press messages (messages and telephone conversations).

2. Investigate whether the same advantages might be accorded as those quoted under paragraph 1 in particular arrangements with other countries.

3. To propose to the International Telecommunications Conference at Cairo (1938) to accord the above advantages within the international domain.

The Inter-continental Union of Radio Broadcasting (Paris 1936) are of the opinion that it would be opportune for the International Union of Radio Broadcasting to examine the possibility to complete its present monthly bulletin by producing information originating in overseas countries.

COIL IN A SECTIONALIZED ANTENNA

(Continued from Page 15)

The efficiency as a function of Q, for a number of antenna heights, is given by Fig. 4. Fig. 5 shows the results of Fig. 4 in a slightly different fashion. These last two figures illustrate the importance of providing a low-loss sectionalizing coil. It is also seen that even with a low-loss coil it is undesirable to use an antenna whose height is less than 120 electrical degrees (1/3 λ).

V. The Effect of the Capacity of the Sectionalizing Insulator

In general, the sectionalizing coil is shunted by the capacitance of the sectionalizing insulator. This shunting capacitance increases the effective inductance and resistance of a given coil.

Let

X_L = effective value of reactance required (values of Fig. 1)

X_e = reactance of sectionalizing insulators

X_L' = actual reactance of coil

$k = X_L/X_e$

Then $X_L' = \dfrac{X}{1+k}$,

and the power lost in the coil is

$$\frac{E^2}{X_L Q}(1+k)$$

The shunt capacitance thus decreases the size of the coil required and increases the amount of power lost in the coil.

Increasing the effective cross-section of the antenna decreases the effective characteristic impedance of the antenna, thus decreasing the term E^2/X_L in the expression for the power lost in the coil. At the same time, the quantity k ($= X_L/X_e$) tends to become smaller because of the decrease in X. Since the characteristics impedance changes but slowly with the cross section of the tower, it becomes necessary to use a rather large cross section. Then, because of the structural strength required, the insulator capacity becomes large enough to overcome the desirable effects of decreasing the characteristic impedance by increasing k a great deal.

VI. Conclusions

The conclusions to be drawn from the previous discussion are as follows:

a. From the standpoint of insulator and coil voltage, size of reactance coil, and power loss in coil, it is evident that the most desirable position of the coil lies approximately one-third of the way from the top of the antenna to the ground.

b. Low loss coils are important. ($Q > 250$)

c. The shunt capacitance should be as small as possible.

d. Even when low-loss coils are used, the antenna should be at least one-third of a wave length tall. ($D = 120$ degrees). A limit of $D = 135$ degrees is preferable because of the possibility of flash-over or heating at the sectionalizing insulator.

NEW ANTENNA FOR WJZ

Completion for Tenth Anniversary Celebration Planned

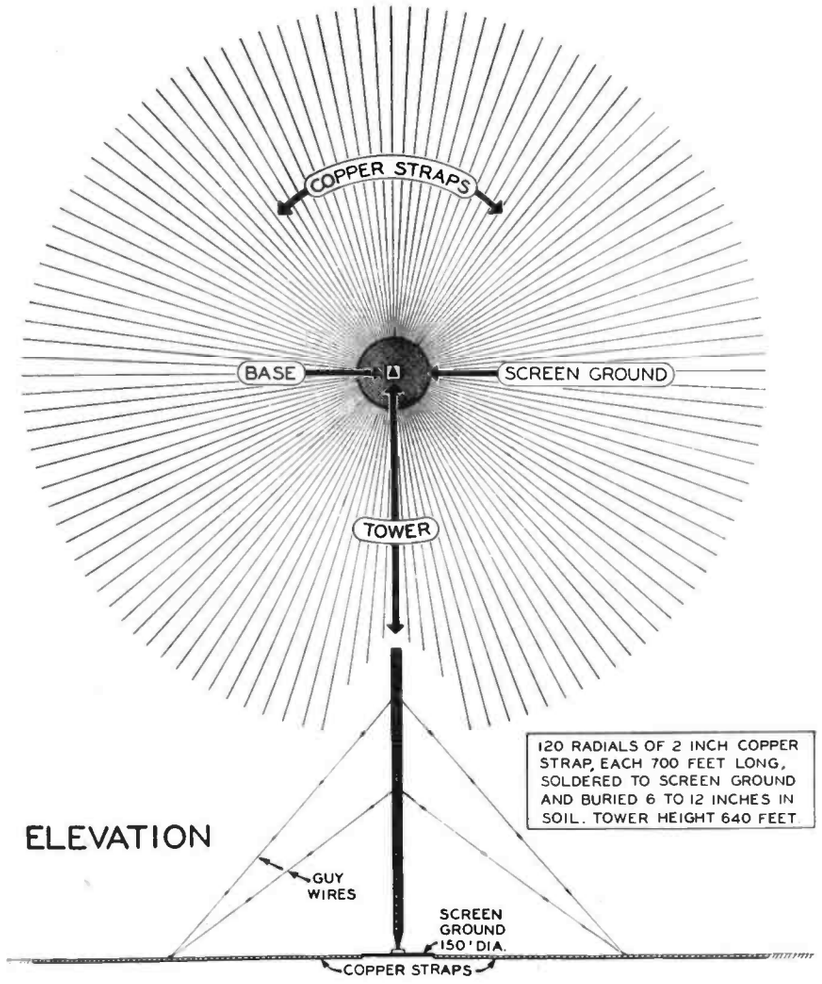
CONSTRUCTION has been started on a new 640-foot vertical radiator antenna for NBC Station WJZ, at Bound Brook, New Jersey, designed to make the key outlet of the National Broadcasting Company's Blue Network one of the world's most modern radio stations.

The new antenna will be completed in time for operation on NBC's Tenth Anniversary, November 15, 1936.

Permission to erect the antenna was granted by the Federal Communications Commission late in March. Contracts were immediately let to construction companies, manufacturers of wire, cable and insulators, and makers of structural steel and concrete.

One of the most interesting features of the new antenna is the lighting system, worked out by engineers of the National Broadcasting Company, the Department of Commerce, and technicians of the air transport companies in the metropolitan area. On top of the tower will be located an aviation beacon with duplicate filament bulbs of such intensity that, under favorable conditions, the light beam will be visible beyond Philadelphia. The huge light will flash 40 times to the minute, and will be supplemented by stationary lights on the three sides of the slender triangular tower. When the new antenna is completed it will represent all the latest advances in radio broadcasting, according to Raymond Guy, NBC Radio Facilities Engineer.

Some of the more important statistics on the new antenna show that more than 300,000 pounds of concrete will be used as a base for the towering structure. The antenna will be held in place by two sets of guy wires, capable of withstanding a pull of 162,000 pounds. The combination of the weight of the steel in the tower and the downpull of the guy wires results in a thrust toward the earth at the base of more than 230,000 pounds. This entire load is carried by a comparatively small porcelain insulator which, despite its size, is capable of bearing 1,250,000 pounds. The entire tower and auxiliaries will withstand a far greater wind velocity than has ever been recorded in New York.



The ground system for the new antenna will consist of 90,000 feet of copper ribbon buried in radial trenches centering at the base. The tower itself will be connected with the WJZ transmitter by a transmission line consisting of an outer metal tube 10 inches in diameter surrounding an insulated inner conduit approximately three inches in diameter.

QUARTZ CRYSTALS

(Continued from Page 25)

Bahia or Rio where the material is shipped by boat to the States. Since this material is used for ornaments, fused quartz, inexpensive jewelry and other applications, the quantity of good grade material is rather limited and often the natural crystals are broken up and many of the identifying marks are destroyed.

The natural rock crystals (classified as "Brazil pebbles" for import purposes) are imported into the States duty free. These crystals are then examined at the importers and acceptable material is shipped to Camden where it is subjected to a second and more thorough examination in the quartz crystal laboratory.

(To Be Continued)

NEW COMMUNICATION SERVICE

(Continued from Page 11)

frequencies, for the complete circuit. It was explained that if it should be desired to extend the circuit beyond either terminal point, those six micro waves could be used over and over again in the same sequence. Thus, two waves of the same length would be generated at points about one hundred miles apart, and would not interfere with each other, because of the line-of-sight limitation to their range.

Receivers Always "Alive"

One of the most interesting engineering features of the new circuit is the method by which the unattended relay stations may be turned on or off from either one of the terminal stations by radio. The receivers at each of the four stations are always alive and ready to catch impulses from their assigned transmitters. When it is desired to make the circuit ready for traffic, New York or Philadelphia starts up its transmitter and sends a certain musical note which the receiving circuits are pre-set to "recognize."

At the unattended receiver at New Brunswick the tone passes through electrical filters somewhat like a key passes through the tumblers of a lock. Electrical circuits "accept" the tone and relays are actuated, turning on the power for the "south" transmitter, which, when in operation, passes the tone on by radio to the Arney's Mount station. There the operation is repeated.

Transmitter Automatically Turned on

When the tone signal reaches the Philadelphia station, the transmitter at that city is also automatically turned on, and the tone starts on its return journey, back to New York. Operators in New York know that when the tone comes back to them from the "north" transmitter at New Brunswick the entire circuit is in full operation and ready for traffic. The constant presence of the tone keeps the relays closed, and the circuit in an operating condition. When the tone is withdrawn from the circuit, relays click in the same succession over the round trip to Philadelphia, and one by one the transmitters are automatically turned off. Philadelphia has the same control over the circuit as New York.

Transmitter used for three meter waves in ultra-short wave radio circuit of RCA between New York and Philadelphia.

The new circuit is described by RCA officials as an outstanding example of the value of coordinated research and engineering in many special phases of the radio art. There being no precedent for building commercial apparatus for commercial operation on three meters, the equipment developed is unlike anything ever seen. Antennas, because of their curious form, are characterized as "Christmas trees" and "turnstiles."

Odd Design Required

Certain parts of the receivers look like small steam engines and the transmitters might be taken for hot water boilers. Engineers explained that these odd shapes result from the application of the principle of "resonant lines" to both transmitters and receivers. That principle, developed by RCA for this use eliminates crystal control and provides economical and efficient means of maintaining radio equipment in steady tune at extremely short wave-lengths.

"Acorn" Tube Used

The heart of the receiver is the "shoe button" or "acorn" tube, so dubbed because of its minute dimensions, and in the transmitters there are new power tubes specially designed for microwave service. These special tubes, along with the antenna, transmitter, receiver, facsimile and terminal control apparatus were all developed in a group of RCA laboratories, each specializing in a separate phase of the work.

Improvements Being Developed

It was revealed that, even before the completing of the new circuit, the development of improvements which promise measurably to simplify design of future installations was already under way. These improvements also contemplate increasing both the speed and the number of communication channels which can be handled simultaneously on a single radio wave.

WBT OPENS NEW STUDIOS

(Continued from Page 17)

In connection with a description of the new studios and offices given over the air as a part of the program, the first microphone used by the station when it went on the air in 1921 was used for a moment. This home-made carbon microphone was described as looking like a rusty coffee can with a sink drain attachment at one end, strung up with a lot of rubber bands. Again it was said to resemble something like a cross between a mouse trap and a bird nest. This neat piece of showmanship demonstrated to listeners the vast improvement between that instrument and the new high velocity mikes with which the station is equipped.

AN ENGINEER REPORTS

(Continued from Page 7)

in the tent by feeders about 400 feet long run in trenches dug in the snow.

As soon as the radio shack was completed, the equipment was dismantled and moved in. The installation was again completed without missing a broadcast. For a while troubles developed, due to the equipment having been outside and having been filled with snow, something it was impossible to avoid during the many blizzards. The moisture formed when the equipment was brought indoors and warmed up caused transformer failures and insulation breakdowns. It was possible to make repairs in most cases.

Weekly Schedule Maintained

The installation having been completed, broadcasting settled down to a routine business and the weekly schedule was continued throughout the year. Some programs went through very satisfactorily, others were very poor, usually during periods of unusual magnetic activity of the earth's magnetic field called magnetic storms. The average CBS intelligibility report of the air shows was 63%, of the tests (which were practically discontinued in July 1934) 69%. Ordinarily, the best signal was received at Buenos Aires, but occasionally the direct route to New York was better. Reception of the New York program was usually good, especially when the New York directive antenna was not used on the transmitter, since it then was available for the receivers. It was fed into the studio on a loudspeaker and was available for the two-way conversations which were held between Harry Von Zell and Charlie Murphy as well as between expedition members and their families in the U. S. A. At the same time, both the New York and the Little America program was fed through a monitor amplifier to loud speakers located in two other buildings so that the men could hear them.

Several times, KFZ served as a relay station to send a program from another point up to New York. At one time, an attempt was made to put the Condor, which was in the air about 100 miles away, into the program. This was only partially successful due to poor intelligibility. Another broadcast originated from the Bay of Whales by means of battery operated portable equipment. Several times, signals from parties on the trail several hundred miles away were put on the air and Admiral Byrd's signals from the Advance Base were often re-transmitted.

Aluminum Records Used

Sound effects were, in every case, recorded on aluminum records and then used on the program. Recordings of this type were used for the sign-on and sign-off sound effects, the Ruppert's whistle and the howling of the huskies at Little America. Recordings were also made of special program material where dogs were involved since may repitions were necessary to obtain the desired effect. Seals in the Bay of Whales and penguins were recorded in this way.

At the close of the expedition in January 1935, the equipment was taken by tractor to the Ruppert and re-installed to put on the final broadcast of this series. One other program was put on as a Columbia sustaining feature a week later and then broadcasting was completely discontinued.

Summary of BAE II Log Sheets (CBS)

Average of KJTY Air Shows
62% Intelligibility
Average of KFZ Air Shows
63% Intelligibility
Average of KJTY Tests
64% Intelligibility
Average of KFZ Tests
69% Intelligibility
(Discontinued 340909)
Number of KJTY Air Shows 13
Number of KFZ Air Shows 53
Number of KJTY Tests 38
Number of KFZ Tests 46
Average field strength (when measured) Riverhead, N. Y.:
KJTY .....4.5 microvolts/meter
KFZ .....3 microvolts/meter

Conclusions

A considerable loss of quality in the Little America-Buenos Aires-New York circuit was apparently due to side-band cutting in each of the receiving stations. While either one alone was not too bad, when the loss was doubled by going through two such steps, it became quite noticeable. It was definitely noted, in several instances, that the direct signal at Riverhead, L. I. was of better quality than that relayed through Buenos Aires. An attempt was made at Little America, to improve the situation by cutting out all frequencies below 200 cycles, but it was little better.

Transmitting equipment for use on such a job should be made as light and compact as possible. Without the unusual transportation facilities, airplanes, dogs and tractors, which were available, it would have been difficult to have established such a station as KFZ. The radio equipment weighed, exclusive of the 12 telephone poles and antenna equipment, at least four tons, which was not exactly easy to transport and handle. The efficiency of the transmitter is very important, since the weight of the power equipment and of the gasoline required is directly related to it. One ton of gasoline was required for broadcasting purposes at Little America. It is believed that better antenna supports can be found than the telephone poles which were used. They are unnecessarily heavy and are extremely difficult to handle.

A REVIEW OF BROADCAST ENGINEERING

Articles in Leading Publications, April - June, 1936

Reviewed by
J. P. TAYLOR

ADVANCED DEVELOPMENT

A Method of Reducing Disturbances in Radio Signaling by a System of Frequency Modulation, by E. H. Armstrong, IRE Proc., May 1936, Pg. 689.

The complete paper (which has previously been reviewed) describing in detail Professor Armstrong's newly-perfected transmission system, which utilizes frequency modulation to obtain increased noise discrimination. Detailed theoretical development and results of field tests are given. One of the outstanding papers of the year.

High Power Frequency Modulation, Electronics, May 1936, Pg. 25.

Brief note on Professor Armstrong's plans for operation of a high-power frequency-modulated experimental transmitter.

Frequency Modulation Propagation Characteristics, by M. G. Crosby, IRE Proc., June 1936, Pg. 898.

A short note on phenomena encountered in frequency modulated transmission. Interesting in connection with above.

A Study of Noise Characteristics, by V. D. Landon, Broadcast News, June 1936, Pg. 6.

An extremely interesting consideration of noise characteristics, including a description of experimental work carried out to check the theoretical relation of amplitude and "crest factor" to band width. Also of bearing on the above.

Electric Wave Guides, by G. C. Southworth, Bell Labs Record, May 1936, Pg. 283.

Waves Guides, Communication & Broadcast Eng., June 1936, Pg. 17.

The original paper (and reprint) providing the first authentic information on a surprising new development tentatively labeled "Wave Guide Transmission." Waves which are similar to Radio Waves, in that they are configurations of electric and magnetic fields, are directed through hollow pipes and di-electric rods.

Applying Predistortion to Broadcasting, by L. F. Jones, Comm & Broadcast Eng., May 1936, Pg. 5.

A short but authentic note on this interesting subject. Describes an actual test installation in which an improvement in transmission fidelity corresponding to an increase of 530 percent in power was obtained.

High-Fidelity Radio Broadcasting, by E. L. Owens, Bell Labs Record, June 1936, Pg. 325.

Some notes on the installation at WOR, including the curves of over-all transmission fidelity and harmonic distortion.

ALLOCATION

Notes on the FCC Allocation Hearing, by R. C. Powell, Comm. & Broadcast Eng., June 1936, Pg. 22.

A brief resume of the opening of the FCC hearing on the allocation of high frequencies.

New High-Frequency Allocations, Electronics, June 1936, Pg. 31.

New rules and new assignments of the FCC relating to operation of broadcast services at frequencies above 1500 kc. (promulgated May 21st). Also a table of these Broadcast Service Assignments.

FCC Rejects East-West Duplication, Broadcasting, May 1936, Pg. 62.

Note on the FCC decision in the "640 Case," which is interpreted as a rejection of the plan for east-west coast duplication.

FCC Likely to Set Precedents on Super-Power and Transfers, Broadcasting, May 1, 1936, Pg. 18.

Joint Hearing on Super-Power May Result from 500 KW Pleas, Broadcasting, May 15, 1936, Pg. 16.

FCC plans for holding a "Superpower" hearing on the pending applications for 500 KW operation.

ANTENNAS

A Study of the Electromagnetic Field in the Vicinity of a Radiator, by F. R. Stansel, IRE Proc., May 1936, Pg. 802.

A short development of the equations for the field in the vicinity of a radiator, with tables intended to facilitate computation for a finite radiator.

Directional Antenna Design, by E. A. Laport, Electronics, April 1936, Pg. 22.

Methods for the design of two element directional arrays applicable to coverage and fading problems.

The "Turnstile" Antenna, by G. H. Brown, Electronics, April 1936, Pg. 14.

Theory and construction of the ingenious antenna array designed by Dr. G. H. Brown for high frequency broadcast stations. A noteworthy contribution to this development.

A Simple Method of Adjusting Top Loaded and Sectionalized Antennas, by Dr. G. H. Brown, Broadcast News, April 1936, Pg. 14.

A practical method of adjusting top loaded antennas for maximum skywave suppression. Direct measurements in the vicinity of the antenna replace tedious observations at distant points.

Typical Broadcast Antenna Installations, Comm. & Broadcast Eng., April 1936, Pg. 19.

A number of photographs of various constructions adapted for broadcast installations.

APEX

W8XH, New High Frequency Station, by R. J. Kingsley, Broadcast News, April 1936, Pg. 22.

A short note on the new high frequency broadcast installation at W8XH (WBEN) Buffalo, reprinted from Electronics.

RMA-SAE Study Noise, Electronics, May 1936, Pg. 22.

Plans of the RMA-SAE Committee—for which Dr. L. C. F. Horle is consultant. Investigation of noise levels and developments of standards of measurements are the first objectives.

FIELD INTENSITY

Broadcast Coverage, by R. F. Guy, Electronics, May, 1936, Pg. 16.

First of two articles describing the methods adopted by NBC in making the most comprehensive survey of actual network coverage ever attempted.

Radio Field Intensity and Distance Characteristics of a High Vertical Broadcast Antenna, by S. S. Kirby, IRE Proc., June 1936, Pg. 859.

Results of actual measurements made on WBT transmissions before and after installation of a vertical radiator. Probably the most practical information yet made available on the subject.

Directional Radiation Patterns, by A. J. Ebel, Electronics, April 1936, Pg. 29.

Chart (and explanation) of two-element patterns with different spacing and current phasing.

FCC Prescribes Basis for Field Measurements of Broadcast Stations, Broadcasting, April 15, 1936, Pg. 38.

New regulations on measurements made in lieu of complying with minimum required antenna height.

Optical Paths of Limiting Transmission at Ultra-High Frequencies, Comm. & Broadcast Eng., April 1936, Pg. 11.

Graphs showing limiting distance for various antenna heights (according to optical path).

An Urban Field Strength Survey at Thirty and One Hundred Megacycles, by R. S. Holmes and A. H. Turner, IRE Proc., May 1936, Pg. 755.

Methods and results of field surveys at 30 MC and 100 MC. Interesting in relation to high frequency broadcast and television development.

FREQUENCY CONTROL

Elastic Vibrations of Quartz, by G. W. Willard, Bell Labs Record, April 1936, Pg. 250.

An interesting and unusually lucid explanation (in non-mathematical terms) of the considerations which must be given attention in manufacturing quartz crystals of definite properties.

MEASUREMENTS

A New Modulation Monitor, by A. R. Hopkins, Broadcast News, April 1936, Pg. 23.

A description of the features and a resume of the characteristics of the RCA Type 66-A and 66-B Modulation Monitors.

A Broadcast Frequency Measuring Set, by W. M. Kellogg, Bell Labs. Record, May 1936, Pg. 307.

A brief description of a new equipment designed to measure deviations from assigned frequency of local or distant broadcast transmitters. Indirect comparison of the unknown with a local standard is utilized.

Calibrating Microphones by Means of a Rayleigh Disc., by M. Rettinger, Comm. & Broadcast Eng., April 1936, Pg. 5.

Article on the classic method of measuring the wave response of a microphone.

Portable Sound Measurements. by C. A. Anderson, Electronics, April 1936, Pg. 26.

Description of a practical method for determining sound attenuation. Details of the equipment are given.

A Laboratory-Type Beat-Frequency Audio Oscillator and R. F. Signal Generator. Part I, QST, April 1936, Pg. 45, by C. B. DeSoto.

An A-C Operated Beat Oscillator. by S. J. Haefner, and E. W. Hamlin, Electronics, May 1936, Pg. 20.

A Beat-Frequency Oscillator. by L. B. Hallman, Jr., Comm. & Broadcast Eng., May 1936, Pg. 10.

Three articles on the design and construction of A-C- operated beat-frequency oscillators. Schematics and important circuit constants are given in each.

OPERATION

What the Euorpeans Are Doing. by L. M. Clement, Broadcast News, Apr. 1936, Pg. 2.

Brief resume of broadcasting in Europe, with particular attention to distribution, cost and characteristics of receivers. Refutes a number of widely-prevalent fallacies.

NBC Sound Effects Technique. Broadcast News, June 1936, Pg. 14.

Some notes on the surprising growth of the use of sound effects. Photographs and non-technical description of some NBC sound machines.

POLICE

Stabilized U. H. F. Mobile Transmitters. by H. B. Calvert, Radio, June 1936, Pg. 35.

Description (with schematics and constants) of a 5-meter mobile transmitter used by the Pasadena Police.

Crime Control with Radio. by David Sarnoff, Broadcast News, June 1936, Pg. 2.

A short but effective resume of the importance of radio in crime control and crime prevention, with some interesting sidelights on the operation of police radio under actual conditions of use.

POWER SUPPLY

Automatic Compensation for Class B Bias and Plate Voltage Regulations, by R. J. Rockwell and G. F. Platts, IRE Proc., April 1936, Pg. 553.

Method of automatically compensating for the effect of bias and plate voltage regulation in Class B stages, which obviates the use of heavy bleeders on the rectifier bias supply.

SPEECH INPUT

Better Mixer Controls, by E. Thiessen, The General Radio Exp., April 1936, Pg. 1.

A brief description of the General Radio 653M series of mixers, which incorporate several improvements over the 653 series.

Power Amplifier Design. by P. Adorjan, Radio Eng., June 1936, Pg. 12.

A short but excellent treatment of the method of predicting harmonic distortion and maximum power output of Class B and Class AB Amplifiers from the static characteristics.

Phase-Shifting Network, by C. E. Smith, Comm. & Broadcast Eng., May 1936, Pg. 21

Phase-shifting networks of the T-Section type using pure reactive elements.

Improving Low-Frequency Response, by R. D. Rettenmeyer, Radio Engineering, June 1936, Pg. 21.

A review of methods for improving the low frequency response of loudspeaker cabinets. A subject of timely interest.

Audio Compensating Systems, by A. W. Barber, Radio Engineering, June 1936, Pg. 5

Some methods of providing audio compensation, with emphasis on the necessity of considering transient as well as steady state response.

High Q Audio Reactors. by P. F. Bechberger, Electronics, May 1936, Pg. 22.

A note on the possibility of using coupled resonant circuits at audio frequencies. The means being the use of one or more external inductances.

Chart for Computing Reactive Attenuation, Electronics, May 1936, Pg. 39.

Useful chart (with explanation) for the calculation of attenuation in series and parallel circuits where reactive components must be considered.

The New Permanent Magnet Alloys. Electronics, May 1936, Pg. 30.

An unusually good review of the history and characteristics of the recently introduced magnetic alloys—particularly Alnico and Nipermag.

A Two-Channel Program Amplifier, by A. C. McClellan, Comm. & Broadcast Eng., April 1936, Pg. 7.

Layouts and diagrams of a two-channel speech system. Includes schematics and constants.

CBS Expands, Modernizes, by A. B. Chamberlain, Broadcast News, April 1936, Pg. 6.

Description of the new equipment and studio layout of the CBS New York Studios. Interesting data on the characteristics of the equipment used and the dimensions of the new studios is given.

NBC's New Hollywood Studios, by O. B. Hanson, Broadcast News, Apr. 1936, Pg. 12.

Description of the new NBC Hollywood Studios. Several photographs.

Beauty and Utility Combined in New Studios, by C. Meyers, Broadcast News, April 1936, Pg. 12.

A fairly extended description of the unusually interesting new studio plant of WGN, Chicago.

New Styles in Broadcast Studios, by M. S. Cummings, Radio News, April 1936, Pg. 583.

Another article (with illustrations) on the new studios of NBC in Hollywood and WGN in Chicago.

Southwest Hears New WKY, by E. C. Hull, Broadcast News, June 1936, Pg. 12.

Description—with a number of good illustrations—of the eight-rack studio installation at WKY, Oklahoma City. An unusually well-planned station installation.

Unusual Studios for WMEX. Broadcast News, June 1936, Pg. 20.

Photographs and short description of studio interiors at WMEX, Boston.

Recorded Sound Effect Equipment Also Makes Notable Progress, by R. H. Heacock, Broadcast News, Pg. 22.

A description of the most pretentious sound effect equipment yet designed. Utilizes three turntables, with special prespotting mechanisms, and a total of fourteen loudspeakers.

TELEVISION

The Electron Image Tube. by Dr. V. K. Zworykin, Broadcast News, Apr. 1936, Pg.4.

A brief explanation, with illustrative reproductions, of the electron image tube. An outstanding contribution to the television and telescopic fields.

Scanning Sequence and Repetition Rate of Television Images, by R. D. Kell, A. V. Bedford, and M. A. Trainer, IRE Proc., April 1936, Pg. 559.

Important consideration of factors effecting apparent steadiness of television images—with particular attention to the ratio of alternating current ripple frequency and frame frequency.

Television in Germany, by H. Gibas, IRE Proc., May 1936, Pg. 741.

A general resume of the status of television development in Germany up to the fall of 1935. Illustrative photographs.

Television Today—The Status Quo, Electronics, June 1936, Pg. 27.

A good review of television developments in the United States during the past two years. Gives a good picture of the present status.

TRANSCRIPTION EQUIPMENT

A "Mass-Less" Pickup, by W. N. Weeden, Electronics, May 1936, Pg. 36.

Description of a pickup of new design for which a number of advantages are claimed.

Practical Volume Compression, Electronics, June 1936, Pg. 15.

Detailed description of an automatic volume compressing system in use at WSFA for several months. An interesting contribution to a subject on which there is much difference of opinion.

TRANSMITTER DESIGN

A New Power Amplifier of High Efficiency, by W. H. Doherty, Bell Labs. Record, June 1936, Pg. 333.

A New Power Amplifier of High Efficiency, by W. H. Doherty, Comm. & Broadcast Eng., May 1936, Pg. 7.

A New Linear Amplifier of High Efficiency, by W. H. Doherty, Radio, June 1936, Pg. 18.

This is the paper delivered at the Cleveland IRE Convention by Mr. Doherty in which he described a new type of linear amplifier in which relatively high efficiency, independent of modulation degree, is obtained by automatic adjustment of the load between two parallel output amplifiers.

A New, High-Efficiency Linear Amplifier, by J. N. A. Hawkins, Radio, May 1936, Pg. 8.

Notes About Our Contributors

DR. G. H. BROWN. Biographical notes concerning Dr. Brown have appeared in the December, 1935 and April, 1936 issues of Broadcast News.

W. F. DIEHL. Mr. Diehl was educated in the New York City Public Schools, Flushing High School, and Columbia University. He started his radio career in 1917, with the Weston Electric Company, and later joined the E. J. Simon Company. During 1918-19, he served as Instructor and Inspector, U. S. N. R. F., and upon the close of the war, entered A. H. Grebe & Company, serving as Chief Engineer until 1928.

In 1928 he joined the Victor Talking Machine Company as Assistant Engineer in charge of Radio. He continued as Division Engineer in charge of Test Methods and Equipment from 1929 to 1933. In that year he became Engineer in charge of laboratory Methods and Equipment and remained in this position until he was placed at the head of the Piezo-Electric Applications Section. Mr. Diehl is a Fellow of the I.R.E.

JOHN N. DYER. Mr. Dyer received his B. S. from the Massachusetts Institute of Technology in 1931. Following his graduation he engaged in Acoustical and Radio Research. In 1932 he returned to M.I.T. to take advanced work in the Graduate School. When the second Byrd Antarctic Expedition was being prepared Mr. Dyer was chosen as chief radio engineer. Upon his return to the United States he became associated with the CBS Engineering Department where he is located at the present time.

ELBERT HALING. Mr. Haling, who contributes the story on KFJZ, is associated with that station.

A. R. HOPKINS. A brief story of Mr. Hopkins' activities appeared in the September, 1935 issue of this publication.

FRANK S. LANE. Mr. Lane entered the radio field February 13, 1925, which makes him some sort of a veteran. He spent a little over two years with KVOO in Tulsa, Oklahoma and then took over the management of WDOD nine years ago at a time when the entire staff consisted of himself and an operator. That made Lane, announcer, advertising department, program director, and general all round handyman as well as being the manager. He has watched and helped his station grow into one of the best in the entire South.

Lane is married and has a fine five-year-old boy. When he can get away from radio he spends his time on the banks of a nearby lake, either catching fish or giving worms swimming lessons. He was originally a native of Oklahoma, but now describes himself as a Tennessee hill-billy.

E. C. RUNDQUIST. After attending Kansas State College and Columbia University, Mr. Rundquist became Radio Electrician in the Aviation Division of the U. S. Navy, 1917-1919. From 1920 until 1922, he was a Radio Instructor in New York City, and in 1923 became associated with the Radio Corporation of America, Stations WJZ and WRC. He transferred to the Transatlantic Receiving Station at Riverhead, N. Y., in 1923, where he remained until 1932. Since 1932 he has been connected with the Engineering Staff of R. C. A. Communications, Inc., and at present is in charge of the Frequency Measuring Laboratory of that Company.

JOHN P. TAYLOR. The April and June issues of Broadcast News give thumbnail sketches of Mr. Taylor's activities.

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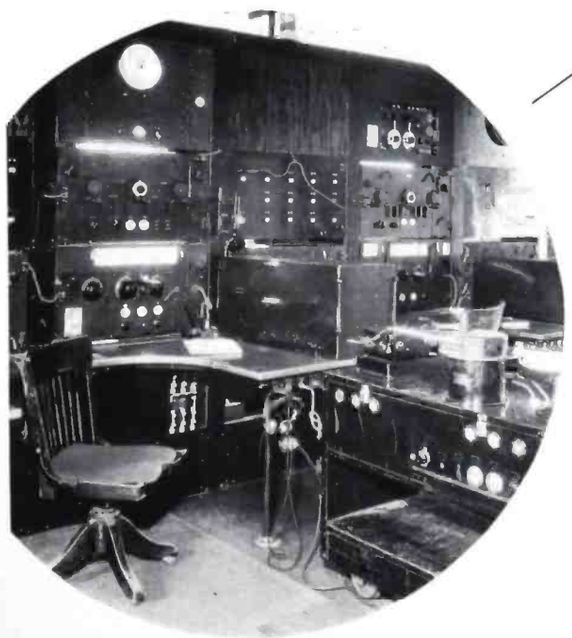

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Beat Frequency Oscillators

Cathode Ray Oscillographs

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