BROADCAST NEWS

To Our Broadcasters

Who, by breathing life into scientific
mechanisms, have made them
instruments of humanity—

Who have given inspiration, knowledge,
and laughter to the world's millions—

Who take "Peace on earth, good-will to
men," not as a Utopian maxim,
but as a formula for the day's work.

Health, Prosperity and Happiness in 1938!

David Sarnoff

In This Issue

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.

PAUL V. LUTZ, Editor

NUMBER 27 DECEMBER, 1937

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

MODERN IN EVERY DETAIL

CKCK An Outstanding Canadian Station

BACK in the days of the cat whisker and crystal sets station CKCK, owned by the Regina Leader-Post, Regina, Sask., was a pioneer of radio in Canada's Prairie Provinces. Since July 29th, 1922, when the first program was broadcast the station has built up a record of 15 years' continuous radio service to the people of Saskatchewan.

Among the highlights of its history is one of the world's first broadcasts of a church service and the first play by play description of a hockey game. This latter is also believed to be the first sports broadcast ever attempted.

On November 1st this old timer of the airwaves put into service with an inaugural broadcast its new suite of modernistic, up-to-date studios and new transmitter with a power increase from 500 to 1000 watts. CKCK is RCA equipped throughout. Installation of every unit has been performed in accordance with the advice of RCA Victor technicians. The improvements represent an investment of $85,000.00. Though not the largest, the new studios are the most modern and most scientifically designed in Canada. More than $20,000.00 was spent on their construction, exclusive of equipment.

Three studios, two control rooms, offices for station manager and sales manager, production department offices, a general office and a lobby for the public comprise the new layout. The modernistic design employed in decoration is most pleasing — particularly the use of color. Studio A, the main studio is finished in blue and white, studio B in red and black, and studio C in green and black.

Each control room is a complete unit and can handle programs from any studio. They can if necessary feed the regular station broadcast and programs to three other networks at one time, while two other programs coming in at the same time can be recorded and broadcast later if so desired.

There are sound locks at the entrance to each studio to eliminate outside noises. The outside door of the lock closes automatically before the door to the studio opens. Specially constructed, the inner doors weigh 250 pounds each. At the bottom of each door automatic mechanism drops a rubber blanket against the floor when closed thus completely sealing the studio.

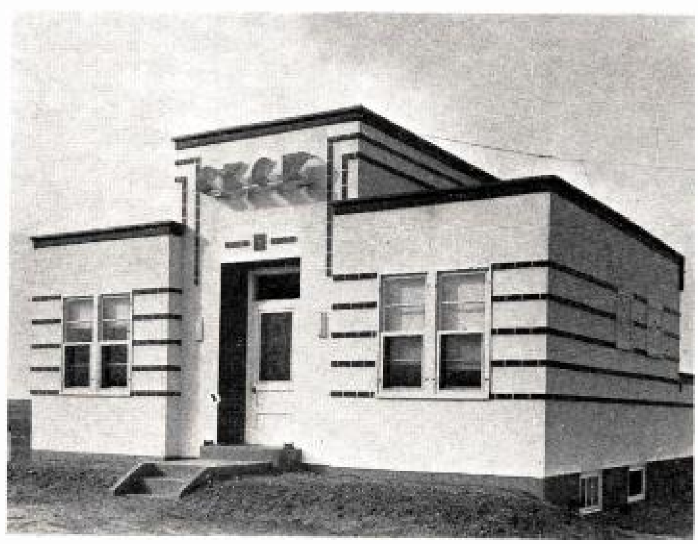
The new 1-D transmitter at CKCK.

Studio Treatment

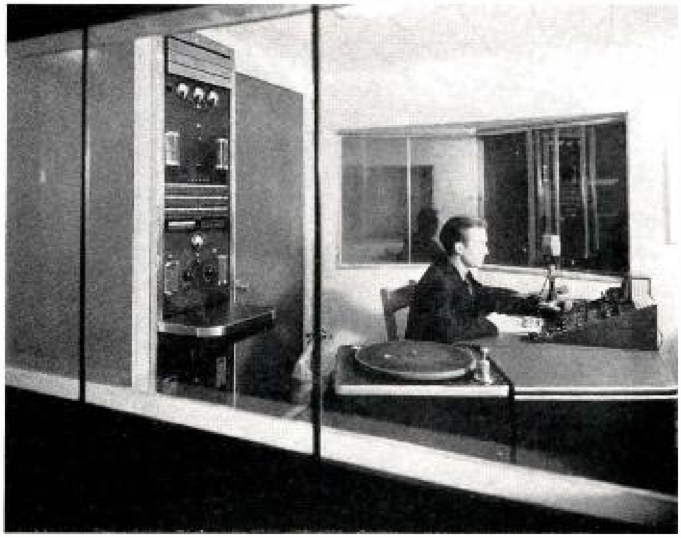
All studios and control rooms are of the latest "floating" construction. That is, there is a room within a room, supported on thousands of springs. The main walls are of special sound absorbent tile. On it are mounted the springs which support the inner wall of the studio. Floors and ceilings are similarly treated. Thus no slightest vibration can either penetrate or escape from the studio.

Studio and offices are air conditioned throughout. This is particularly important in the studios since the pitch of many musical instruments is greatly affected by changes in temperature and humidity.

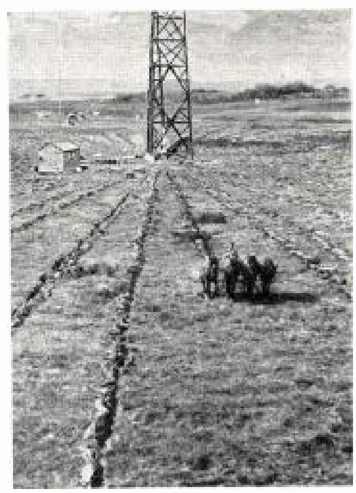
From this lobby visitors may watch programs in progress in the main studio through four layers of specially constructed glass. Two plates are joined together by a jelly like substance to form one pane. There are two of these panes in the inner and outer walls. Each of the individual layers is twice as impervious to sound as ordinary plate glass.



Modern to the last detail is this home for the CKCK transmitter.



(Above): Speech input and transcription units.



(Right): The plow that broke the plains for the ground system.

All studio lighting is sunk into the ceiling so that it is flush to prevent echoes from protruding fixtures. An interlocking lighting system signals both in the studios and on the outside when the station is about to go on the air and when it is actually broadcasting.

The new Transmitter Station, its modernistic design in keeping with that of the studios, has been built on Victoria Plains, seven miles east of Regina. The location was chosen after four months' careful search for the best possible site. The transmitter building contains the new RCA 1-D 1000 Watt Transmitter, sleeping quarters, kitchenette, small dining room and a two-car garage.

Four hundred feet away in an old creek bed known as Boggy Hollow stands the new 257 foot aerial tower, tallest structure in the province. The location for the tower has been chosen because the best grounding is obtained in wet soil, and this spot will always be damp, may even be covered with water. This will insure a perfect connection. Two and a half feet below the surface lies six and one-half feet of wet sand, and beneath this a heavy clay which will further insure a good ground connection.

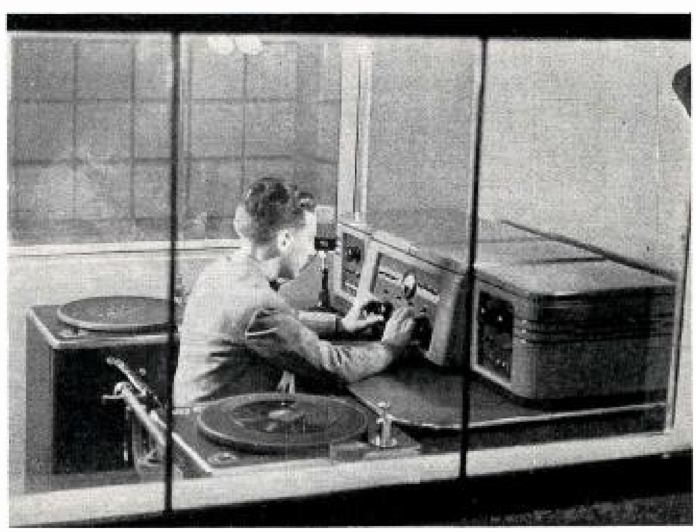
Wood Antenna

To prevent power leakages the tower is built of wood. No guys are needed and its strength is calculated to withstand a wind velocity of 100 miles an hour — far higher than any ever recorded in this country. The three legs of the tower are set in concrete piers sunk 14 feet into the earth. High frequency energy is transmitted from the station house to the antenna through a coaxial cable, recent development of radio engineering.

The aerial itself is a copper wire running vertically to full height of the tower and is suspended four feet from the ground. At the bottion of the aerial is special equipment to tune the antenna to its proper frequency. The vertical antenna prevents high angle radiation and thus improves reception in the area which the station serves. The old style horizontal aerials give reception at greater distances due to their high angle radiation, but at the expense of local reception.

The ground system required eight and a half miles of copper wire, radiating like the spokes of an enormous wheel, with the foot of the tower as hub. Each "spoke" buried 18 inches below the surface of the soil, has a length of 405 feet (.412 wave length). The area covered by the wheel is about 10 acres.

In the construction of tower and ground systems, CKCK has followed the latest RCA recommendations, and the system is scientifically correct. There will be a minimum of leakage and the best possible reception within the CKCK range.



The 76-A Consolette in operation at the Regina station.

NEW HIGH POWERED SOUND PROJECTORS

Improved Quality a Distinctive Feature

By MAX L. GRAHAM

IN the modern P.A. system there is an increasing demand for greater power, and coupled with this increased power requirement, is the insistence upon improved quality and fidelity of reproduction. P.A. microphones and amplifiers have been made available which are capable of providing high fidelity reproduction; but loudspeakers, with the ability to handle large powers, have done so at the sacrifice of tone quality and frequency range. The new RCA Sound Projectors were developed in order to match these exacting rquirements of power and frequency range. The smaller unit is capable of handling 60 watts of power and the larger unit handles 100 watts. Both of the units have a frequency range essentially flat from 100 to 7000 cycles per second.

Design Requirements

In addition to the power handling capacity and frequency range requirements, other demands were made on the final design. One of the most exacting of these additional requirements was that all parts of the speaker must be weather-proof. Most of the P.A. systems using high powers are open air installations where the speakers are being constantly subjected to the most severe weather conditions. It was therefore essential that all parts of the speaker be built in such a manner as to be unaffected by even the most severe weather conditions.

Space limitations in some installations made it desirable that the overall length be not greater than 40 inches.

Diaphragm

The diaphragm had to be sufficiently large to handle the very low frequencies ever at the highest rated power. A seven inch diameter diaphragm was decided upon for this purpose. The diaphragm is of the molded resin type and it has been found capable of withstanding unusually severe abuse without damage. Other tests on the material were made by placing the diaphragm alternately in a salt-water spray and in ultra-violet light for a period of over two days. At the end of this period there had been no perceptible change in the diaphragm.

Fig. 2.

It is desirable in most speaker applications to place the fundamental resonance of the unit well below the lowest useful frequency. Such a condition tends to create a smoother response at the low frequency end. Therefore, the resonance of the vibrating system was placed at approximately 50 cycles per second.

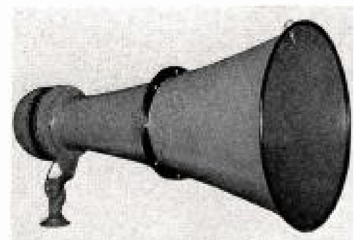


Fig. 3.

Horn and Throat

In order to avoid bulkiness, an overall length limitation of 40 inches was placed on the Sound Projector and, as was previously mentioned, the maximum length of the horn was definitely fixed.

The horn is of the exponential type with the cut off frequency due to flare being at 80 cycles per second. Although the Sound Projector is not intended to work as low as 80 cycles per second, by placing the flare cut-off below the useful region of the speaker, a smoother response can be obtained at the low end of the frequency range. Such an arrangement has the additional advantage of permitting the use of an extension on the horn which would change the low frequency cut-off to approximately 80 cycles per second.

The mouth area was chosen to be of such a size that the reflection dips due to the mouth would fall in the voice fundamental regions. The relationship between mouth area, flare and horn length has been worked out in an unpublished paper by Dr. H. F. Olson. On this particular case the diameter of the bell is approximately 19 inches.

With the horn length fixed, the mouth area and flare chosen to have particular values for stated reasons, the throat diameter was of course fixed by the other factors. In an exponential horn hav-

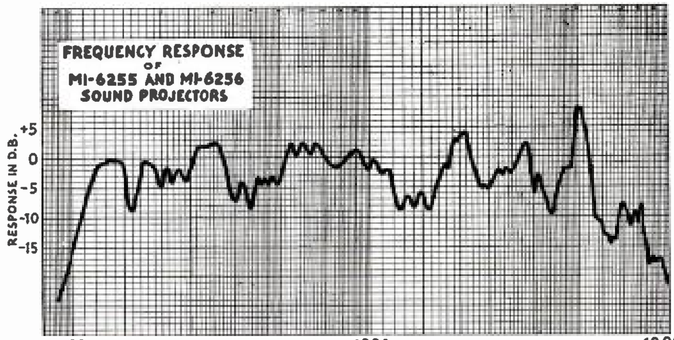


Fig. 1.

ing a cut-off due to flare of 80 cycles per second, the rate change in the diameter of the horn is quite gradual. As a result, the diameter of the horn at the throat is relatively large, being approximately six and one-half inches. While this condition provides good loading on the diaphragm at the low frequency end, there is not horn loading at the high end and, unless some special arrangement were made, the response would start to drop off slowly above 1,000 cycles per second.

Dr. H. F. Olson has shown in an unpublished paper how use can be made of a double flare horn arrangement to provide proper diaphragm loading at both the low end and high end of the frequency spectrum being used. Such an arrangement was employed in the design of the horn for these speakers. The cut-off frequency due to the flare of the main portion of the horn remains at 80 c.p.s., but near the diaphragm a second flare is provided which, in combination with the stiffness due to the throat, results in an increased efficiency of radiation at the high end of the frequency range.

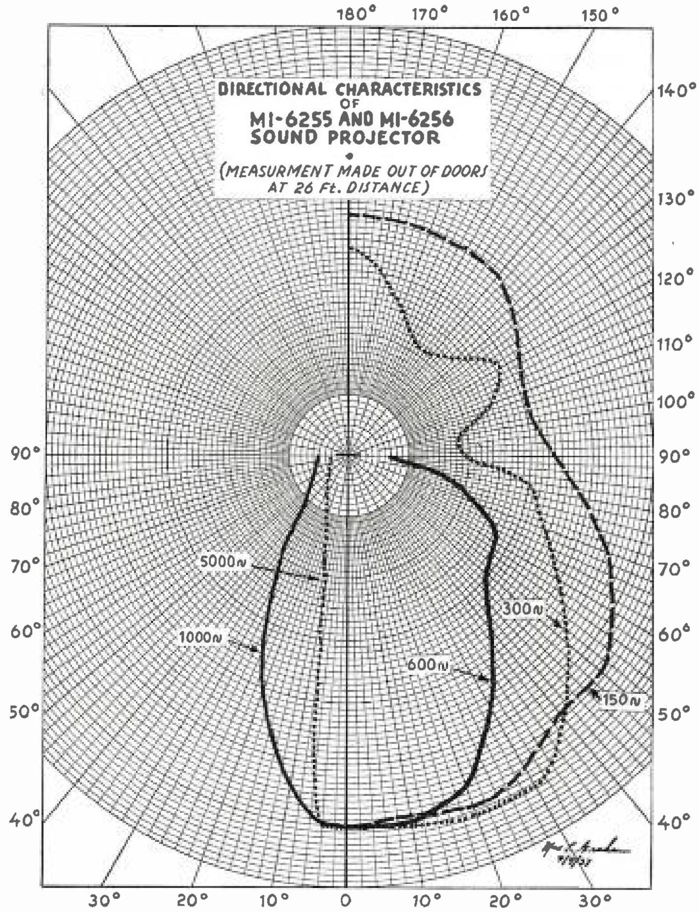


Fig. 4.

Field Structure

In outdoor public address installations, the speakers are often located at a point remote from the amplifier and power supplies. The use of electromagnetic fields in the speakers entails expensive wiring and is a possible source of trouble. In large installations the power consumed by the fields becomes an appreciable item. In order to avoid such conditions the magnetic field in these speakers is supplied by powerful permanent magnets. The magnets used on the 100 watt sound projectors are probably the largest permanent magnets that have ever been built for loudspeakers.

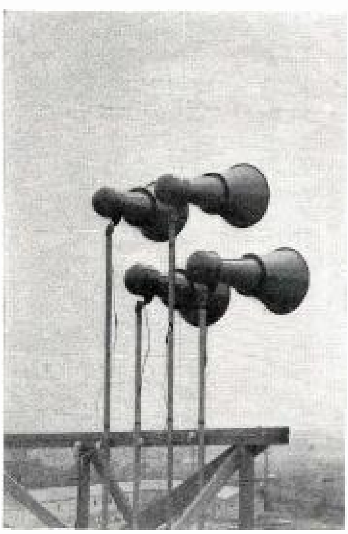


Fig. 5

Response and Directional Characteristics

The response and directional characteristics of both the 60 watt and 100 watt sound projectors are identical. The sound pressure response (in db) vs. frequency is shown on Figure 1. Figure 4 shows the sound pressure at various angles in percentage of the sound pressure on the axis for a number of frequencies.

General

The general overall appearance of the Sound Projectors is shown in the photographs (Figures 2 and 3.) Since the horn and back cover are the same for both units, their outside appearance is identical. It will be noted that a streamline styling has been adhered to as far as possible. The body color is a deep gray with black strips for trimming. The appearance is attractive and practical for outdoor use.

Figure 5 shows a recent demonstration installation in which four 100 watt Sound Projectors were driven by eight 50 watt amplifiers, two amplifiers in parallel driving each speaker unit. The performance of the units and the quality of the reproduced sound received a great deal of favorable comment from all who heard it.

A single unit was demonstrated in Atlantic City recently to illustrate how it could be used to insure greater safety at bathing beaches and aid in rescue work. During the demonstration, life

(Continued on Page 19)

A MODERN COMMUNITY STATION

WROK Emphasizes Local Events

By ALLAN O. BROPHY, Publicity Director

WITH its antenna tower sticking up from the exact center of as rich a farming countryside and industrial area as exists anywhere in the United States, WROK, at Rockford, Illinois, combines a policy of community service with modern, expertly operated equipment that places it in the front rank of independent stations.

WROK is an outgrowth of KFLV, ten watter which originally was licensed in 1923, so it also takes place among the pioneers of the radio industry.

The station, licensed to operate on 1410 kilocycles, now uses 1,000 watts of power daytimes and 500 after local sunset.

WROK's general manager, and the man largely responsible for the excellent rating of the station, is Lloyd C. Thomas, former manager of local sales for NBC-owned stations, himself widely known as a pioneer in radio, having begun his radio career at KFKX at Hastings, Neb., in 1923 as manager. Its program manager is John C. McCloy, who joined the station from KDKA, after extensive experience.

Studios

Studios of the Rockford station are in the imposing News Tower on the east bank of Rock river and in the heart of the city. Its thoroughly modern transmitter is located four miles northwest of the city on the Kilburn avenue road. There, a 238 foot Truscon steel tower puts out programs for an attentive audience of some 130,000 families who regard WROK as its home-folks station because of the intimate, friendly type of entertainment, instruction and news it broadcasts.

The WROK home in the News Tower has two studios within view of the Control room, in one of which a visible audience of about 50 may be comfortably seated. There is also a third smaller studio. In addition there is an artists' bureau, a transcription library, private offices for the general manager, program director, auditor, sales manager and chief announcer, a news room and offices for announcers, program department, sales and publicity and promotion.

Lloyd C. Thomas, General Manager of WROK.

In January, 1937, WROK completed a thorough revamping of its equipment. A few months previously a completely new and modern speech input system was installed in the studios. Final touches on installation of a new transmitter, RCA 1-D, were completed in January, insuring high fidelity broadcasting throughout. During the month when the change-over was taking place, the station broadcast remote programs, studio programs and transcriptions through use of a portable remote amplifier.

Two Channel Set-up

In the control room the panel has a complete two channel set-up with six mixer positions. There are provisions in the control room for any number of remotes, and at present fifteen are in use. Dynamic microphones are used. Over-all frequency responses range from 30 to 12,000 cycles.

At WROK transcriptions are handled in the control room, where there are two turn-tables, one for both lateral and vertical cut discs, the other for lateral cut only. One is equipped for the making of transcriptions. The studio has several portable playback sets.

The new RCA 1-D transmitter is housed in an attractive tile and stucco building on a sixteen acre tract. A bungalow for an engineer and a garage are also on the property. The building is steam-heated.

Operations Manager Thomas C. Cameron in the control room at WROK.

Maurice Nelson, Engineer, looking over the new 1-D.

Feed from the transmitter to the antenna, which rears upward 250 feet away, is by concentric cable. The ground system consists of five miles of one inch copper ribbon soldered to a half-inch mesh screen beneath the tower.

Operations Manager Thomas C. Cameron and his four assistants are proud of the fact that WROK's frequency deviation averages no more that 2 to 3 cycles.

A Modern Station

In line with the policy of the station as set up by General Manager Thomas when he took over his position in 1934, WROK has kept abreast of the best in the industry at all times. Early this year a mobile unit was purchased. It is a 40 watt transmitter housed in a house trailer pulled by a Chrysler sedan. The trailer, even with radio equipment installed, is capable of lodging a crew. The transmitter, WAAR, is licensed to operate on frequencies of 1646, 2090, 2190 and 2830 kilocycles. In practice 2190 is used. It is powered by a gasoline motor in the trailer or from domestic power lines. A 225 foot antenna is carried, together with a collapsible mast.

To aid in airing remotes, a pack transmitter also is carried in the trailer. It has the call letters W9XQV and has battery power of two watts. The pack set has a range of about two miles and is licensed to use frequencies of 31,100; 34,600; 37,600 and 40,600 kilocycles. In practice the first named frequency is used.

During the late summer and autumn of 1937, WAAR was in use daily for the broadcasting of an oil company-sponsored program originating in Beloit, Wisconsin, some fifteen miles airline from the WROK transmitter. The program, featuring interviews with motorists in their cars, stopped by the announcer with the aid of a traffic policeman, and with a free grease job as a reward, came through with few exceptions, perfectly.

The mobile unit also has been used for many other programs, notably the Trask Bridge Picnic, largest one day farm outing in the world, which last summer attracted a crowd of sixty odd thousand persons.

WAAR when operating in downtown Rockford, has been heard as far away as Pontiac, Illinois, 101 miles distant by air line.

WROK has five licensed operators. Besides Operations Manager Cameron, they are Maurice Nelson, in charge of the transmitter; Karl Hanson, in charge of the control room, Garth Bowker, and Elmo Reed.

A corner of the control room.

WROK serves a primary area which includes ten northern Illinois counties and four counties in southern Wisconsin.

OHIO STATE UNIVERSITY BROADCAST ENGINEERING CONFERENCE

February 7-18, 1938

Monday, Tuesday and Wednesday (February 7th to 9th, inclusive), 9 A. M. to 11 A. M., Field Strength Surveys, J. F. Byrne, Collins Radio Company; 11 A. M. to 1 P. M., Coupling Networks, W. L. Everitt, Ohio State University; 2:30 P. M. to 4:30 P. M., Studio Acoustics, George M. Nixon, National Broadcasting Company.

Thursday and Friday (February 10th and 11th), 9 A. M. to 11 A. M., Ultra-high Frequency Propagation, H. H. Beverage, Chief Research Engineer, R. C. A. Communications, Inc.; 11 A. M. to 1 P. M., Propagation of Broadcast Frequencies at Night, J. H. Dellinger, Chief Radio Section, Bureau of Standards; 2:30 P. M. to 4:30 P. M., Studio Acoustics, George M. Nixon, National Broadcasting Company.

Saturday (February 12th), 9 A.M. to 11 A. M., Demonstrations of Phenomena of Interest to Radio Engineers.

Second Week

Monday and Tuesday (February 14th and 15th), 9 A. M. to 11 A. M., Broadcast Antenna Design, George H. Brown, Consulting Engineer; 11 A. M. to 1 P. M., High Power Radio Frequency Amplifiers, W. H. Doherty, Bell Telephone Laboratories; 2:30 P. M. to 4.30 P. M., Modulation and Distortion Measurements, A. E. Thiessen, General Radio Co.

Wednesday (February 16th), 9 A. M. to 11 A. M., Broadcast Antenna Design, George H. Brown, Consulting Engineer; 11 A. M. to 1 P. M., High Power Radio Frequency Amplifiers, W. H. Doherty, Bell Telephone Laboratories; 2:30 P. M. to 4:30 P. M., Indicating Instruments, H. L. Oleson, Weston Instrument Company.

Thursday (February 17th), 9 A. M. to 11 A. M., Broadcast Antenna Design, George H. Brown, Consulting Engineer; 11 A. M. to 1 P. M., High Power Radio Frequency Amplifiers, W. H. Doherty, Bell

(Continued on Page 22)

COMBINATION HORN AND DIRECT RADIATOR LOUD-SPEAKER

A Complete Description of the 64-A Unit

By H. F. OLSON and R. A. HACKLEY

Reprinted through the Courtesy of Proceedings of the I. R. E.

THE efficient transformation of electrical variations into the corresponding acoustical vibrations over a wide frequency range is, in general, restricted by practical limitations. The two extreme ends of the audio-frequency range are the most difficult to reproduce with high efficiency. Low efficiency at the high frequencies is primarily the result of the inherent mass reactance of the vibrating system. Inefficiency at the low frequencies is primarily due to small radiation resistance. It is quite well known that a mass controlled diaphragm, driven by a constant force and mounted in an infinite baffle radiates the same energy for all frequencies below the ultimate impedance. However, when such a system is located in a small baffle, three to five feet square, or in a cabinet of the equivalent dimensions, considerable attenuation occurs at the lower frequencies due to a loss in acoustic resistance incurred by circulation from front to back. The response of a practical system mounted in a cabinet is further modified by various resonances of the enclosure, stiffness of the suspension, etc.

Number of Methods

There are a number of methods available for obtaining reasonably good efficiency at the lower frequencies when the system is mounted in a small baffle or cabinet. A large radiation resistance may be obtained by using a large diaphragm or cone. A tortuous path or labyrinth coupled to the back of the cone provides another method [1,2] for increasing the radiation resistance by introducing a long path between the front and back of the cone. A horn may be used to increase the radiation resistance presented to a diaphragm. The use of a horn makes it possible to obtain a large ratio of radiation resistance to reactance in the vibrating system at the lower frequencies.

Among the methods referred to above it may be shown that the horn is particularly suitable for use in a wide range loud-speaker system. Smooth response and wide directional characteristics at the high frequencies may be obtained by employing a cone of small diameter. Of course, a small diaphragm operating as a direct radiator is not suitable for low-frequency reproduction because of the limited power output and the large ratio of reactance to radiation resistance as well as a large ratio of reflected electrical impedance to the impedance of the vibrating system. By coupling a horn of suitable impedance to a small diameter cone good efficiency may be obtained at the low frequencies. The effective radiation resistance of a small cone and horn is equivalent to a large cone. It does not have the undesirable features of a large cone, such as equal radiation from both sides, resonance phenomena when mounted in a cabinet, and a heavy vibrating system.

Wide Range Loud-speaker

From the above discussion, it follows that a wide range loud speaker may be built consisting of a long horn[1] coupled to one side of a small dynamically driven diaphragm or cone for the reproduction of low frequencies and an acoustic filter for changing the output from the horn to the open side of the diaphragm for the reproduction of the mid- and high-frequency range.

It is the purpose of this paper to describe a combination of a horn and a direct radiator loud-speaker of such a size as to be suitable for use in radio receivers of the console type, or for other installations in which the available space is relatively small.

Theory

The addition of a horn to a cone loud-speaker provides a means of improving the low-frequency efficiency by increasing the effective radiation resistance. A relatively long horn is required to reproduce efficiently at the low frequencies. Consequently, the horn must be folded to incorporate a suitable system into a cabinet of the conventional size. No measurable loss due to folding occurs if the dimensions at any bend are a fraction of a wave length. For small cabinets of the radio receiver and monitoring type there is no advantage in using a horn for the reproduction of the higher frequencies because the small direct radiator is sufficiently efficient in the mid- and high-frequency ranges. Furthermore, the intensity level of reproduction in small rooms is considerably less than the intensity level of the original sound, and as a consequence some accentuation of low-frequency response is required. Coupling a horn to one side of a direct radiator loud-speaker provides a system of good low-frequency efficiency and makes it possible to use a small light vibrating system for the efficient reproduction and distribution of the mid- and high-frequency ranges from the open side.

Mechanism

A combination of a horn and direct radiator loud-speaker is shown in Fig. 1. The mechanism consists of a six-inch corrugated cone driven by an aluminum voice coil. The back of the cone is coupled to an acoustic capacitance which, in turn, is coupled to

* Decimal classification: R365.2. Original manuscript received by the Institute, September 9, 1936.

[1] J. S. High, U. S. Patent 1,794,957. Filed 1927, Westinghouse.

[2] Benjamin Olney, "Jour. Acous. Soc. Amer.", vol. 8, no. 2, p. 106, (1936).

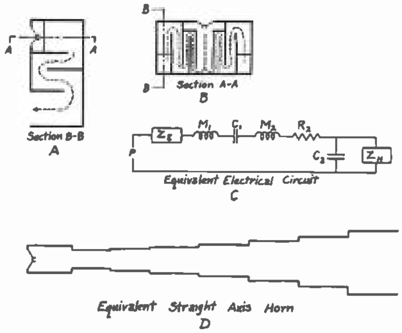


Fig. 1—Combination horn and direct radiator loud speaker.

A. Vertical cross-sectional view.

B. Horizontal cross-sectional view of the top portion.

C. Equivalent electrical circuit of the acoustical system.

D. Equivalent straight axis horn.

the throat of the horn. The equivalent straight axis horn coupled to the cone is shown in Fig. 1D. The equivalent electrical circuit of the vibrating system is shown in Fig. 1C.

Performance

The performance of the system may be predicted from an analysis of the equivalent electrical circuit. At low frequencies the impedance of the capacitance C_2 is large compared to the impedance Z_H. Furthermore, the radiation resistance of R_H of the horn is larger than the radiation resistance R_2 of the front of the cone. Therefore, the energy is dissipated in R_H and radiated from the horn. In the mid-frequency range the impedance of the capacitance C_2 and the horn throat impedance Z_H are practically the same. Furthermore, the resistance R_2 is comparable to the combination of Z_H and C_2. In this region radiation occurs from both the horn and the direct radiator. At high frequencies the impedance of the capacitance C_2 is small compared to Z_H and the dissipation in the horn is negligible compared to the direct radiation from the cone. The above description gives a physical picture of the action of the direct radiator and horn combination loudspeaker.

The horn used in this loudspeaker, Fig. 1, has a cutoff, due to flare of 34 cycles. The length of the horn is 92 inches. The mouth area is 300 square inches. The acoustic impedance Z_H at the throat computed from the conventional formulas[3] is shown in Fig. 2.

Expressions for the resistive and reactive components of the air load upon a piston in an infinite baffle have been derived by Rayleigh.[4] The acoustic resistance R_2 and reactance X_{1A} characteristics for the front side of a six-inch cone computed from these formulas are shown in Fig. 3.

The acoustic reactance of the air chamber behind the cone is given by

$$X_2 = -\frac{1}{\omega C_2}$$

where,

$\omega = 2\pi f$

f = frequency, cycles per second,

$C_2 = \dfrac{V}{\rho c^2}$, acoustic capacitance,

V = volume of the chamber, cubic centimeters,

ρ = density of air, grams per cubic centimeter,

c = velocity of sound, centimeters per second.

The reactance characteristic of the air chamber is shown in Fig. 3.

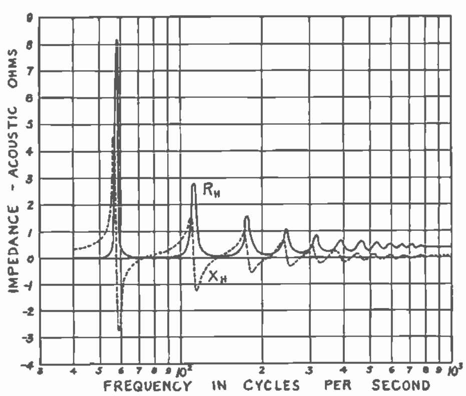


Fig. 2—The acoustic impedance characteristic Z_H at the throat of a horn having a cut off due to flare of 34 cycles, a length of 92 inches, and a mouth area of 300 square inches. R_H = resistance component. X_H = reactive component.

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[3] Olson and Massa, "Applied Acoustics," p. 188, P. Blakiston's Son and Co., Philadelphia, Pa.

[4] Rayleigh, "Theory of Sound," Vol. II, paragraphs 278 and 302, Macmillan, New York, N. Y.

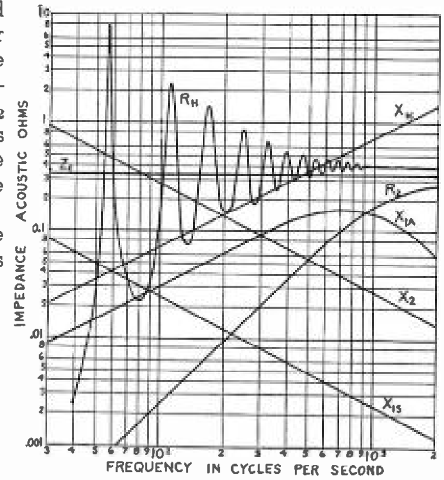


Fig. 3—Acoustic impedance characteristics of the system depicted in Fig. 1.

R_H = acoustic resistance at the throat of the horn.

R_2 = acoustic resistance due to the air load upon the front of the cone.

X_{1C} = acoustic reactance due to the mass of the cone and voice coil.

$X_{1A} = \omega M_2$ = acoustic reactance due to the air load upon the front of the cone.

X_2 = acoustic reactance of the capacitance due to the volume behind the cone.

X_{1S} = acoustic reactance of the cone suspension system.

Z_E = acoustic impedance due to the electrical circuit.

Note: X_2 and X_{1S} are negative.

The acoustic reactance of the cone and voice coil is given by

$$X_{1C} = \frac{\omega m}{A^2} = \omega M_1$$

where,

m = mass of the cone and voice coil, grams,

A = area of the cone, square centimeters,

M = inertance of the cone and voice coil.

The acoustic reactance of the suspension system is given by

$$X_{1S} = -\frac{S}{\omega A^2} = -\frac{1}{\omega C_1}$$

where,

S = stiffness of the suspension system, dynes per centimeter,

C_1 = acoustic capacitance of the suspension system.

The acoustic reactance characteristics of the mass and suspension stiffness of the cone are shown in Fig. 3.

(Continued on Page 14)

RAPID GROWTH FOR IOWA STATION

KGLO Forges Ahead in Mid-West

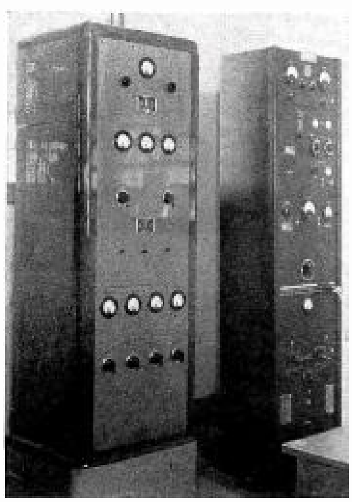
ONE of America's fastest growing stations, KGLO, in Mason City, Iowa, officially opened on Jan. 17, 1937. With modern studios and offices in the Hanford Hotel, with an up-to-date transmitter house two miles west of the city on U. S. Highway 18, and with high-fidelity RCA equipment throughout, KGLO gives to over half a million people in Northern Iowa and Southern Minnesota radio service of the highest standard.

On July 27, KGLO joined with the Columbia Broadcasting System to bring to its large number of listeners the advantages made possible only by affiliation with a large network.

On August 5, KGLO augmented its radio family by increasing power from 100 to 250 watts, adding the RCA type 250-EM modulator unit to its equipment.

Now before the Commission are applications for construction permit for a mobile unit, the completion of which will bring to KGLO listeners an ever increasing variety of entertainment and enhanced service to the public. In addition to the principal 125 watt short wave transmitter, the mobile unit will contain an ultra-high frequency pack transmitter and receiver, portable transcription recording equipment, public address systems, and a miniature studio.

The station control room with the RCA transcription turntables conveniently located for the operator.



The transmitting equipment at KGLO.

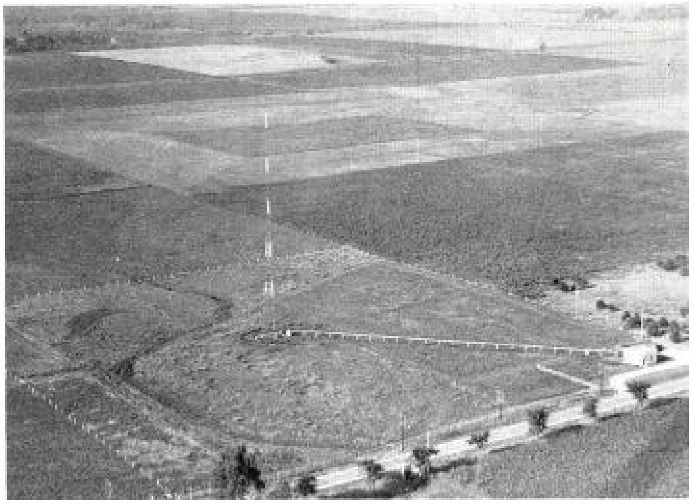
The station ground is surrounded on three sides by a white wooden fence plainly visible from the road, and on the side parallel with the highway extends an aluminum coated steel fence. The air photograph shows a small stream running across the property, as well as the tower, antenna house, transmitter house, and the transmission line. The stream is dammed near the highway by a concrete dam thereby aiding in keeping the ground moist.

Transmitter House

A white stucco transmitter house contains the RCA 250-E transmitter, associated RCA line and monitor amplifiers, together with the frequency and modulation monitors. Facilities are provided at the transmitter to permit going on the air at a moment's notice in the event that trouble is experienced at the studio. KGLO programs are radiated by means of a 400 foot concentric cable transmission line filled with dry nitrogen gas and feeding a 290 foot Truscon steel tower. Although the ground conductivity is abnormally good, 180 radials are buried around the tower totalling over ten miles of wire. The excellent location, transmitter efficiency and antenna system provide unusually good coverage and many regular KGLO listeners are located over a hundred miles from Mason City.

Control Room

The control room in the Hanford Hotel houses the RCA type 78-A speech input equipment which has been enlarged by the addition of a spare 40-C amplifier and two additional 33-A jack panels. The latter panels were made necessary by the extremely large number of remote control lines which KGLO uses. Frequently as many as fourteen remote programs have been carried in a single day. RCA remote ampli-



Across the broad acres of Iowa's level terrain the programs from KGLO are sent into thousands of homes.

fier type 62-A and the 50-A inductor microphones are employed to obtain high quality on all remote broadcasts.

Varied Programs

From the Surf ballroom on the north shores of beautiful Clear Lake, dance orchestras of national reputation have been featured over KGLO, emanating from the control room adjacent to the stage at the Surf. From the miniature studios at the Mason City Globe-Gazette, nine newscasts every day are fed to the control room at the Hanford. From the specially constructed Wagner-Mozart Music Hall comes the music of the Mason City national champion high school band and orchestra. Naturally the extensive remote programs require a rather large staff which will necessarily be augmented by the completion of the mobile unit and the introduction of the plan to bring KGLO studios to every community in its coverage area.

The photograph of the control room shows the relative and convenient location of the 70-A turntables on which are mounted 71-A vertical tone arms and one 72-A recording unit. This latter unit has provided a highly satisfactory means of making permanent records of important KGLO features and is also used extensively to record special transcribed announcements for KGLO sponsors.

The best equipment, a fine management, an ingenious production staff, and a competent technical department have been united into an effective organization which has continually demonstrated its ability and which has well earned for KGLO the title of the "Fastest Growing Station in America."

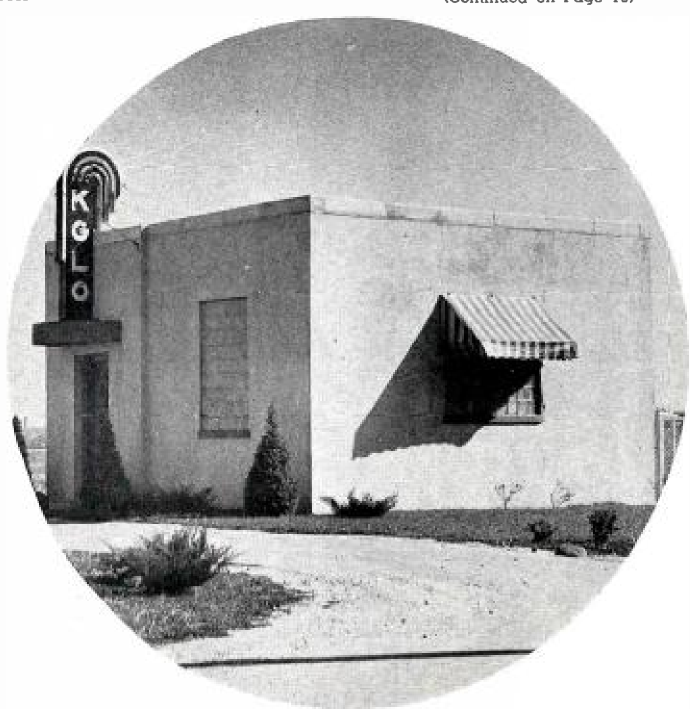
AVIATION RADIO LOG ISSUED BY RCA

A handy little book, containing a mine of valuable information for professional and sportsmen pilots, has been made available by the Aviation Radio Section of the RCA Manufacturing Company.

Its 132 pages are full of useful information and data for planning flights, and for "blind" instrument flying. Compiled after nearly a year of effort and with the wholehearted cooperation of more than 600 radio broadcasting stations, the book has data on aircraft radio, radio-compass flying, obtaining true bearings of broadcast stations from nearest airports, distances from airports, obstruction lighting, height of towers, radio call letters and the frequencies of transmitting stations. The stations are listed alphabetically by state and city.

U. S. Radio-Beacon Weather Stations are listed alphabetically by state and city, by frequencies and by identification letters, as are also the U. S. Airport Traffic Control Stations. Of special value for use with radio-compass is the data on the U. S. broadcasting stations.

(Continued on Page 19)



The compact transmitter house.

WJDX INSTALLS FIRST AI

Mississippi Station Maintai

By WILEY

DEDICATION of the new power and equipment of WJDX, the Lamar Life Station, in Jackson, Miss., on December 7, marked the development of one of Mississippi's outstanding stations from 1000 watts at day eight years ago to a 5000-watt day station of wider coverage today.

On this eighth anniversary of WJDX, "The Voice of Mississippi," Governor Hugh L. White, of the state and President P. K. Lutken of the Lamar Life Insurance Company, station owner, participated in the broadcast dedication.

Percy G. Root, chief engineer at WJDX.

Consistent Growth

During its eight years of consistent growth and development, WJDX has used RCA equipment. Back in 1929, the Lamar Life Insurance Company installed an RCA Type 1-A transmitter for the first radio station in Mississippi's capital city and the first station in the state to become affiliated with a network. Transmitter site is 3½ miles north of Jackson on the Jackson-Memphis highway. The studios are in the Lamar Life Tower, 11 floors up in the Lamar Life Home Office building, just across Capitol Street from the Governor's Mansion in Jackson.

Eight years ago WJDX was assigned the regional frequency of 1270 kilocycles, power of 1000 watts day and 500 watts night. The station was formally dedicated on December 7, 1929, and began operation as an affiliate of the NBC. One of the first network programs presented to the WJDX listeners was the now famous "Major Bowes' Family."

Edward M. George, assistant engineer at WJDX.

The RCA 5-D transmitter, first air-cooled installation made.

In 1930, WJDX was authorized to increase its night power to 1000 watts.

New Ground System

In 1934, WJDX, ever ready to expand, was authorized to increase its day power to 2500 watts. Conversion of the 1000 watts RCA Type 1-A transmitter to 2500 watts was affected by Fred O. Grimwood, radio engineer, Evansville, Ind. Seven years after the station was in operation, Mr. Grimwood supervised the installation of a new ground system of 132 radials of a half-wave minimum length, using ten miles of copper wire. The radials, terminating in a copper sheet of 30 feet square, covered the entire base of the present tower.

R-COOLED TRANSMITTER

ıs Reputation for Progress

P. HARRIS

Increased Power

During the past summer WJDX was authorized to increase its day power to 5000 watts and install a vertical radiator. In increasing this authorized power, WJDX completed the installation of a 330 foot Truscon tower, constructed with

Weldon Shows, chief operator at WJDX.

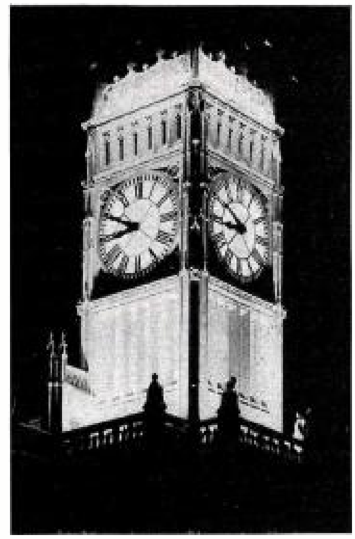
sectionalized insulators 88 feet from the top where a sectionalizing coil is mounted.

The new 5-D transmitter, now in use, was purchased through D. A. Reesor, RCA's representative. Test of the new equipment began in October and the final adjustments were accomplished by J. E. Eiselein of RCA. WJDX's installation was the first air-cooled 5 KW. transmitter. The new equipment and new tower have produced extremely satisfactory signal strength, giving an average of better than 250 MV/M at one mile.

To the ear of the untrained listener the quality of transmission is definitely superior. This is well borne out by the mass of technical data compiled during the installation.

Continual progress has been one of the motivating principles in the station's creed. New equipment and new ideas have been adopted as its listener area spread over the state. With the new transmitter, WJDX is in a much better position to adequately cover its increased market.

Owner of the progressive and expanding WJDX in Mississippi is the Lamar Life Insurance Company, a 32-year old legal reserve company operating in six Southern states and with home offices in Jackson, Miss. P. K. Lutken is president of the Company. Wiley P. Harris is director of WJDX, "The Voice of Mississippi," an NBC associate.



Lamar Life Building Tower surmounts Studios of WJDX.

WJDX Transmitter Building. Modern structure houses modern equipment.

COMBINATION HORN

(Continued from Page 9)

The acoustic impedance due to the electrical impedance of the vacuum tube and voice coil reflected into the acoustic system is

$$Z_E = \frac{(Bl)^2}{ZA^2} \times 10^{-9}$$

where,

B = flux density in the air gap, gauss,

l = length of the conductor, centimeters,

Z = electrical impedance of the vacuum tube and voice coil, ohms.

The acoustic impedance characteristic Z_E of the vacuum tube and voice coil is shown in Fig. 3.

Expressions for the impedance characteristics of the important components of the vibrating system have been stated in the preceding discussion. The characteristics for a certain set of constants are shown in Figs. 2 and 3. By means of the equivalent circuit and the impedance characteristics the performance of the loud speaker may be computed.

In the overlap region where the output changes from the horn to the direct radiator it is important that the phase of the output from the front of the cone and the horn be the same. The choice of constants for the correct phase may be determined from a theoretical analysis.

The power output characteristic of the loud-speaker computed from the equivalent electrical circuit and the characteristics of Figs. 2 and 3 is shown in Fig. 4.

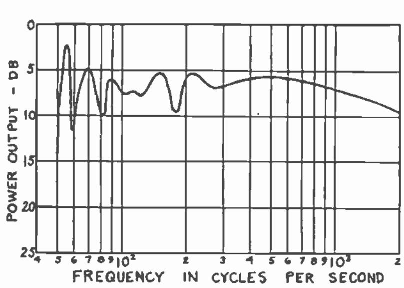


Fig.4—Power output characteristic of the loud-speaker of Fig. 1 computed from the equivalent electrical circuit and the characteristics of Figs. 2 and 3.

It is interesting to note that in spite of the large variations in the horn impedance at the lower frequencies the output is quite uniform.

In the range above 600 cycles the action is the same as that of a conventional direct radiator loud-speaker. The radiation resistance attains its ultimate value at 2500 cycles and remains constant above this frequency. In the case of a mass controlled system the velocity is inversely proportional to the frequency and consequently the output falls off with frequency above the frequency of ultimate resistance. By employing a suitably corrugated cone the effective mass may be reduced and constant output maintained in the region in which the radiation resistance is a constant. With an aluminum voice coil and a six-inch corrugated cone reasonably uniform response may be maintained to 7000 cycles. If it is desired to extend the range a double voice coil[5,6,7] may be used to maintain constant output to 12,000 cycles and above.

Description of Combination Horn and Direct Radiator

The speaker mechanism used in the combination horn and direct radiator shown in Fig. 1 consists of a six-inch corrugated paper cone with an aluminum voice coil. The cone has a leather outside suspension, and a solid izarine center suspension. The air-gap flux density is 12,000 gauss with ten watts field dissipation. A frequency response curve taken on the axis of the speaker mounted in a flat baffle is shown in Fig. 5, curve *C*.

The folded horn used in this combination is equivalent to a straight axis exponential horn having a mouth area of 300 square inches, a throat area of 16 square inches, and a length of 92 inches. The throat area was chosen so that the surge impedance at the throat of the horn matched the combined acoustical and electrical impedance of the vibrating system and its associated electrical circuit. The length

[5] H. F. Olson, "Proc. I. R. E.," vol. 22, pp. 33-46; January, (1934).

[6] A. Ringel, U. S. Patent 2,007,746.

[7] H. F. Olson, U. S. Patent 2,007,748.

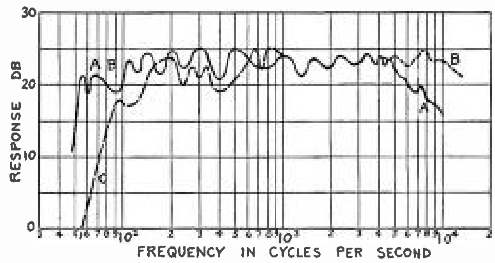


Fig. 5—Experimentally determined response characteristics.

A. Combination horn and direct radiator loud-speaker with single aluminum voice coil mechanism.

B. Same as A with double voice coil mechanism.

C. Single aluminum voice coil mechanism in a large flat baffle.

and mouth area of the horn were then determined so as to give as low a cutoff frequency as was practical with the space available.

Fig. 1B shows a horizontal cross section of the top portion of the horn. The sound comes off the back of the cone and goes into a cavity between the back of the cone and the throat of the horn. This cavity serves the purpose of providing space for the speaker field, and, in addition acts as an acoustic capacitance which helps to limit the high-frequency response of the horn. Each of the first four sections of the horn is divided into two equal parts. These eight half sections are arranged symmetrically on both sides of the cavity. Thus, the sound, in passing from the cavity to the fifth section of the horn, follows two parallel paths. The fifth, sixth, and seventh sections of the horn occupy the space directly below the top portion of the horn described above, as is shown in Fig. 1A. The sound paths through the various sections of the horn are shown by the broken lines on Figs. 1A and 1B.

The over-all dimensions of this combination speaker are: 27½ inches wide, 15 inches deep, and 30½ inches high.

A photograph of a commercial design[8] of this loud-speaker is shown in Fig. 6.

Performance Characteristics

An over-all measured response frequency characteristic of the

[8] The commercial design of the loud-speaker shown in Fig. 5 was carried out by J. Vassos and J. D. Seabert.

combination horn and direct radiator loud-speaker is shown in Fig. 5. The measured response is the sound pressure at a distance of five feet on the axis of the loud speaker. The measured response does not take account of the directional characteristics. Above 100 cycles the directional characteristics do not vary appreciably with frequency. Below 100 cycles the radiation pattern is somewhat broader. The theoretically predicted power output, Fig. 4, indicated uniform response above 50 cycles. The slight deviation between Fig. 4 and Fig. 5 is due to a broadening of the directional pattern below 100 cycles which causes a corresponding reduction in the measured sound pressure in this range. The uniform measured response, Fig. 5, and the close agreement with Fig. 4, substantiates the analyses of the action and performance of the combination horn and direct radiator loud-speaker.

A comparison of the response of the combination loud-speaker with the response of the same speaker mounted in a large flat baffle, Fig. 5C, shows the increase in response due to the horn. Fig. 3 shows that the radiation resistance of the horn, R_H, below 200 cycles, is fifteen or more times that of the front of the cone, R_2, and is comparable with the acoustic impedance of the electrical circuit, Z_E. Since R_2 is the radiation resistance of a six-inch cone in an infinite baffle, this explains the increase in response due to the horn. Furthermore, it shows that the low-frequency response is limited in a small cone, mounted in an infinite baffle, due to the large value of Z_E in comparison with R_2. By employing a large cone it is possible to obviate this difficulty. To equal the response of the horn, with all other constants the same, would require a cone diameter of from 18 to 24 inches. However, a large cone is undesirable for the reproduction of high frequencies due to the inefficiency incurred by its large mass reactance. The very narrow beam of high-frequency radiation which results from a large vibrating area is another disadvantage of a large cone.

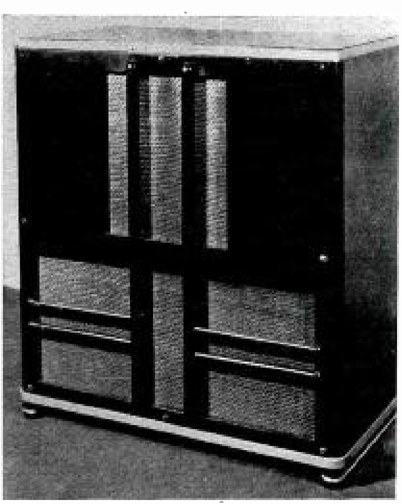


Fig. 6—Commercial design of the combination horn and direct radiator loudspeaker.

The radiation resistance R_2 does not increase but remains a constant above 2500 cycles. Therefore, to maintain constant output above 2500 cycles it is necessary to reduce the effective mass of the vibrating system. This is accomplished by suitable corrugation of the cone. The corrugations also serve to maintain uniform directional characteristics due to progressive phase shift between sections. Referring to Fig. 5 it will be seen that uniform response is maintained to 7000 cycles with a single aluminum coil. The loss in response above 7000 is due to the mass reactance of the coil. For certain applications it is desirable to maintain uniform response above 7000 cycles. By employing a double coil[5] driving system the effective mass is reduced, and good response may be maintained to 12,000 cycles as shown in Fig. 5.

Conclusion

The combination horn and direct radiator-loudspeaker incorporates the following features: a light vibrating system for the efficient production of high-frequency radiation; a small diameter cone for wide angle distribution of the high-frequency radiation; a horn coupled to the vibrating system for the efficient production of low-frequency radiation.

The speaker is suitable for applications requiring a relatively small acoustic power output and a wide audio-frequency range, and where the amount of space available is definitely limited. Such speakers are desirable for wide range radio receivers, broadcast monitoring, sound motion picture recording monitoring, centralized radio, etc.

F. R. DEAKINS APPOINTED VICE-PRESIDENT

The appointment of F. R. Deakins as Vice-President of the RCA Manufacturing Company was recently announced.

Mr. Deakins has an unusual background in the electrical and radio industries. After completing his course in Electrical Engineering at the Alabama Polytechnic Institute, he joined the General Electric Company at Schenectady. Later he became active in the sale of power equipment. When the radio department was formed in 1921, Mr. Deakins was transferred to this new activity and subsequently became Assistant Sales Manager, and, seven years later, Sales Manager. When the radio manufacturing activities of the General Electric and Westinghouse Companies were transferred to Camden, Mr. Deakins joined RCA Victor as Assistant to the President. A year later he was appointed Sales Manager of Engineering Products. In 1932 he was appointed Executive Vice-President of the Victor Talking Machine Company of Canada, with headquarters in Montreal. He returned to Camden in 1934 to take charge of the Engineering Products Division. In 1935, he was appointed to supervise the Photophone sound-film recording and reproducing activities, and the Company's foreign subsidiary companies, in addition to his other duties.

AN ULTRA SENSITIVE D-C METER

An Interesting Application of the Feed-Back Principle

By JOHN M. BRUMBAUGH

THE d.c. meter has been developed to fulfill a long-standing need for a sensitive and accurate d.c. measuring device which would also be portable, rugged, stable in adjustment, and not easily burned-out or thrown off calibration when measuring small fractions of a micro-ampere. This meter satisfies the above requirements, and, on its most sensitive range, gives full-scale deflection for .02 microamperes. Provision is also made for multi-range voltage measurements at unusually high resistance (50 megohms per volt, on the most sensitive range), and for direct resistance measurements from .1 to 1000 megohms with less than .5 volts applied potential. (Measurements up to 200,000 megohms may be made by use of a 90 volt external battery.)

Semi-Suspended Type

Heretofore, the most sensitive portable meters available for weak current measurement have been of the semi-suspended type, having sensitivities of about .3 microamperes full scale—or about .0024 microamperes per millimeter. Such meters, however, are necessarily very delicate and rather easily damaged by overload or other mis-handling.

In many cases where very weak currents are to be measured, as in vacuum tube investigations, a potential drop of a fraction of a volt in the measuring device is not objectionable. Thus, it would seem that unusual current sensitivities might be attained by passing the current through a relatively high resistance, providing that a stable high gain amplifier is available to drive an indicating instrument from extremely small input power. This, of course, is a more or less standard method of weak current measurement, but heretofore the sensitivity of such devices has been somewhat limited by available amplifiers. Special "push-pull" and bridge circuits are normally used to improve stability and minimize drift, but frequent adjustment and calibration are usually necessary unless a relatively small amount of gain is employed.

Mr. A. W. Vance, of the RCA Electronics Research Department, has succeeded in developing a new type of d.c. amplifier which is ideally applicable to this problem. (See Review of Scientific Instruments, December 1936). In this design the effects of supply voltages and tube characteristics on calibration or gain have been reduced to small second-order effects, and the tendency toward drifting has likewise been reduced to negligible proportions. This is accomplished by the use of negative feed-back circuits, wherein the ability of an amplifier to give large amplification is utilized, not to produce large voltage gain but to provide small voltage gain of great constancy and accuracy, and give large power gain for driving a sturdy indicating meter.

The use of this principle has resulted in a rugged, self-contained and portable instrument having a maximum current sensitivity which is roughly equal to that of the most delicate suspension-reflection galvanometers — or about .00022 microamperes per millimeter deflection.

The Stock No. 9819 Ultra-Sensitive d.c. meter essentially consists of a group of input circuits (selectable through a range switch), a d.c. negative feedback amplifier, and an indicating meter. The amplifier circuit is so arranged that any d.c. potential V_1, applied to the circuit, causes a voltage V_0 to appear across a low resistance in the amplifier output, having a

$$V_0 = V_1\left(1 - \frac{1}{1+G}\right),$$

value determined by the equation where "G" is the voltage gain of the amplifier without feed-back connection, and its normal value is about 1000 in this instrument. Thus, it becomes evident that a low potential developed across a very high resistance input circuit can be indicated by comparatively rugged voltmeter across the low resistance output. This indication is negligibly affected by comparatively large variations in amplifier gain "G," and the accuracy is primarily determined by input resistor and output meter tolerances.

Many Uses

By using a wide range of input resistances (R_1), the instrument becomes an ammeter with corresponding wide ranges. By using high resistance dividers in place of R_1, it becomes a multi-range voltmeter with unusually low current drain. Connecting a "standard" potential, in series with an unknown resistance, across R_1 converts the instrument into a direct-reading ohmmeter (with properly calibrated scale) capable of very high resistance measurements with low applied voltage.

The Stock No. 9819 meter provides these three functions of current, voltage and resistance measurement in 22 different ranges, available by means of a selector switch, a sensitivity button and three pairs of binding posts. The tolerances on the input resistors and the meter are such that an overall accurancy of ± 2% of full-scale reading is obtained for ambient temperatures between 50 degrees and 100 degrees F, and normal values of relative humidity. Very special precautions have been taken, in the way of component parts and wiring, to minimize errors due to very high humidities. The output circuit of the amplifier is so designed that its saturated output is insufficient to damage the meter. The input circuit is such that it will withstand tremendous over-loads, and the instrument thus becomes practically foolproof.

The instrument is battery operated and self-contained in a case having dimensions of 13 x 9 x 8¾ inches. The weight, with batteries, is about 20 pounds. Standard, low-priced batteries are used, and will give about six months of eight-hour-per-day operation — except for the filament batteries, which are good for at least two months on this basis.

As may be seen in Fig. 2, all parts and batteries are mounted on an integral chassis and panel, which may be lifted from the case as a unit. Tubes and batteries are thus readily accessible.

The following controls are mounted on the panel, making for simple operation in all types of applications:—

(a) An "off-on" battery switch

(b) A zero adjustment for setting meter deflection to zero

(c) A selector switch which provides various current, voltage and megohm ranges.

(d) A push button which multiplies by five the sensitivity indicated on any position of the range selector switch.

(e) A switch which reverses the polarity of the "high" input terminal for current or voltage measurements.

(f) A zero adjustment for the megohm scales

(g) A switch for checking filament battery voltage with the meter.

The following table gives a complete list of available measurement ranges for the eleven positions of the selector switch:—

Unit	Full-scale reading Normal	Push button depressed
Microamperes	.1	.02
"	1.	.2
"	10.	2.
Milliamperes	.1	.02
"	1.	.2
"	10.	2.
Volts	.5	.1
"	5.	1.
"	50.	10.
"	500.	100.

HAVANA RADIO CONFERENCE

Delegates From Many Countries Present For Discussion of International Problems

DURING the month of November, at Havana, Cuba, the second Inter-America Radio Conference was held. Delegates from all countries, excepting a very few, were sent with technical advisers to take part in a complete discussion of the radio spectrum as it is used at present by the nations of this hemisphere and to suggest and discuss modifications of these uses in order to provide better utilization of the bands from the standpoint of service area requirements, interferences, and application.

This Conference presented the opportunity for RCA Manufacturing Company to show its latest products to a suitably qualified group of radio people who would appreciate their value, the fine workmanship and engineering, and pleasing appearance.

Through the close cooperation of our distributors, Humara y Lastra, arrangements were made for the temporary importation of the apparatus, and for the complete occupancy of the display part of the store of the Universal Music & Commercial Company, one of their dealers whose location on San Rafael is one of the best in Havana.

Engraved announcements of the display were sent to all the delegates having official status at the Conference, to all unofficial delegates, and to all broadcasting station owners and engineers in Cuba.

The display was well received by everyone including the laymen of Cuba. During the day and in the evenings crowds gathered at the window. From the laymen the usual questions of a comical nature were brought forward. One lady desired a demonstration of the 250-D as an electric stove. Another gentleman desired to know if the 76-A Consollette was the latest in receivers.

Arrangements were made for the disposal of nearly every item of apparatus on display.

RCA Victor equipment on display in the store of the Universal Music and Commercial Company, Havana, Cuba.

RECEPTION BEGINS IN THE ANTENNA

Better Home Antennas Increase Receiver Effectiveness

By C. W. HORN

THE broadcasting stations, and incidentally, of course, also the advertisers who sponsor programs, have one main desire, and that is, to produce an excellent signal in all of the receivers within their territory. The broadcasting stations on their part, have increased power, replaced equipment, erected more modern antennas, and many of them have instituted studies including measurements of their signal strength, in order to determine just how well they are operating and serving their audience. The receiver manufacturer, on the other hand, has also been active in increasing the efficiency of the apparatus he sells, both as to reproductive quality or fidelity, and also the sensitivity of the receiver.

In spite of this effort on the part of the broadcaster and the manufacturer of receivers, there is a rather large percentage of the public which is not receiving efficient service. Carefully studying the situation and investigating many complaints has lead to several conclusions which will be explained here.

There are some listeners who are satisfied with the service, which is inferior to that which they might obtain if the installation of their receiving set was up to standard. There is no excuse for any listener who lives within a reasonable distance of the broadcasting station, not receiving a relatively clear signal, free from disturbances, provided he has the equipment properly installed.

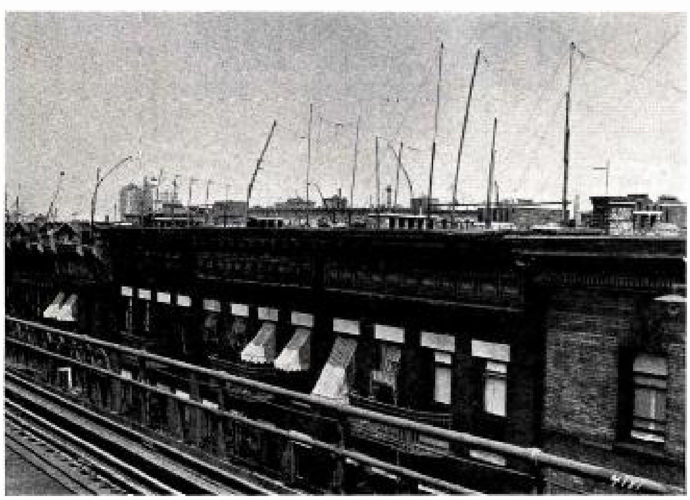
Inductive Interference

The greatest complaint is from "noise," by which is meant interferences from electrical devices, particularly equipment which has some defect, which produces inductive interferences. Luckily, inductive noises cannot carry far through space, and the main reason that so many receivers experience this interference is because the installation of the antenna and the receiving set is such as to provide a very close coupling with the wiring circuits in a home. Older receivers may not be properly shielded, and may directly pick up such noises; but those which have been built in the last several years, if of reputable manufacture, are so designed as to pick up no energy except through the antenna. Then, if we arrange the antenna system in such a manner that it will give us a high ratio of signal to noise, we may expect good results.

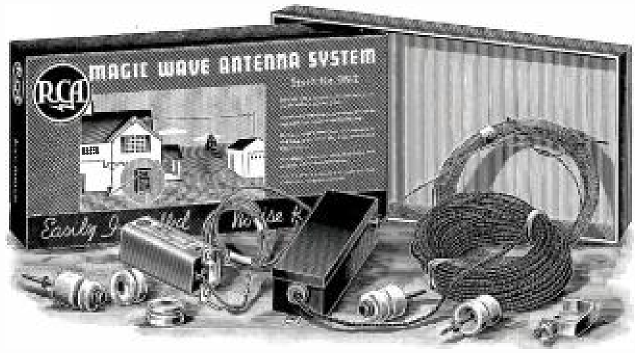
Antenna Installation

The solution to the problem is simple. If the receiver is an old one, and if not properly shielded, it should be junked and replaced with a more modern type. If the receiver is okay, then particular attention should be paid to the antenna installation. An ordinary wire run down the side of the house, and in through a window to the receiving set, and sometimes down through the basement and into the house, up to the receiving set, could not be better designed if the objective was to pick up as much noise as possible. What is needed, is an antenna strung up free and clear above or away from the house, as great a distance, within reason, as possible, and then connected to the receiving set through a transmission line type of conductor. This may consist of a pair of twisted wires with proper terminating impedances or transformer. The lead-in wire is therefore balanced, and cannot act as an antenna, but merely as a connecting link between the antenna itself and the receiver.

Electrical noises on the wiring circuits in the home will therefore not be picked up by this "transmission line," as would be the case if a single wire were brought in. As the antenna itself is some distance away from the wires and conductors in the home which produce the electrical noises and interferences, and as these disturbances cannot travel far through space, comparatively little energy from such sources will be picked up by the antenna. This gives us a high ratio of signal as against noise. Such an installation is simple and comparatively cheap, as prepared kits can be purchased from dealers complete with ample instructions. Care should be taken that the antenna



Even today antenna arrays similar to this can be seen in every large city.



The sketch above shows the Magic Wave antenna, a modern design, which greatly increases the effectiveness of the receiver.

is not suspended near or parallel to the electric transmission lines along the street, or telephone wires.

Give the Receiver a Chance

Many receivers in cities such as mid-town New York suffer because they receive very little energy from the radio wave. Many such receivers use aerials which are wires strung about the room; and as all of the buildings are of steel, which acts as a shield, the results are bound to be very poor. It is true that receivers are supplied with a remarkable degree of sensitivity, but this does not help, as the final determining factor is the ratio of signal as against noise; and if an indoor antenna is used, particularly in a building with metal lath and steel beams, the signal is so low that the noise ratio is bound to be high. Such installations are the same as blindfolding a person and expecting him to grope through life with but a dim light to guide him, when he is perfectly capable of seeing if we removed the blindfold which prevented him from seeing. Therefore, remove the obstacle which surrounds the average installation of a radio receiver, and give the receiver a fair chance to perform, by giving it an antenna so that it can respond to a reasonable signal. In steel buildings, such as apartment houses, etc., there is no substitute for an antenna on top of the building. Such an antenna should be connected to the receiver by means of the transmission lines described above.

As such buildings may have hundreds of tenants, it becomes a problem to accommodate a large number of antennas. This can be accomplished by the tenants chipping together, or the management providing a system which makes use of but one antenna and a distribution arrangement which will supply good signal to all of the receivers. There are a number of methods of doing this, and the only advice I can give here, is that they be sure to contact and have installed a system manufactured by a recognized concern, for, as in other fields, there are some systems which are not worth installing, and which are a waste of money.

If this article were written for general public distribution, such as a newspaper or magazine, I would end with a plea to the owners of receiving sets to be a little more humane, and to permit a fine piece of mechanism known as a "receiving set" to perform to the best of its ability, by feeding it a fair amount of radio signal. I feel that the reason so many receivers are improperly installed, is due to lack of instructions and publicity on the subject. I believe that this is a task for the dealers and jobbers to take upon themselves, for after all, customer satisfaction is an important item in any sale.

This subject is of extreme importance, and has been discussed at hearings before the Federal Communications Commission, where recommendations were made to increase the signal allowed over a city, particularly the great metropolitan centers where steel acts as a shield, in order that the public may be better served. However, without the cooperation of the public, which in this case I feel includes the dealer and the service man, very little progress can be made. The answer, therefore, to better radio reception is primarily up to the owner of the receiver, and depends upon better antenna.

SOUND PROJECTOR

(Continued from Page 5)

guards went out in their boats and maneuvered according to directions they received through the Sound Projector. Such an arrangement would make it possible to direct the crowds at beaches, to call them back when they ventured out too far, and to give direction in emergencies. Similar applications can be used wherever large numbers of people are assembled.

AVIATION LOG

(Continued from Page 11)

While intended primarily for aviators, the new aviation radio book will also be of interest to many others in the radio and aviation fields. A limited number of copies are available at 25 cents each from the Aviation Radio Section of the RCA Manufacturing Company, at Camden, New Jersey.

RANDFORCE CIRCUIT SIGNS RCA SERVICE

The sound equipment in the forty-seven theaters of the Randforce theater circuit will be serviced by the RCA Photophone engineers in accordance with a new contract announced by Edward C. Cahill, RCA Photophone Service Manager.

Under the new service contract these theaters will receive the benefit of RCA Photophone's extensive technical facilities and experienced personnel. A recently added feature of RCA Photophone's theater service is in the portable emergency sound units which can be instantly utilized to compensate for any failures in the electrical system of the sound apparatus, whether in the speakers, the amplifiers or the sound-head. The contract was negotiated with Louis Frisch, President of Randforce Theaters, by Bernard Sholtz, Photophone's sales executive of 411 Fifth Avenue, in New York.

DIRECTIONAL ANTENNAS

A Development of Analytical Methods Applicable to General Problems in Array Design

DR. G. H. BROWN

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IV. Two Driven Antennas (Cont.)

It now seems desirable to discuss a numerical example in order to illustrate the theory we have outlined. Let us suppose we are confronted with the following problem. The service area of a certain radio station is split into two parts. The most important part of the service area lies due south of the transmitter site, while the area of secondary importance lies due north. It is desired to operate on a power of 500 watts with a directional antenna which will do three things; namely, suppress the radiation in the direction of another station on the same frequency assignment lying 500 miles due east of our station, send as much signal as possible to the south in a broad beam, and give a signal at least equivalent to 500 watts in the northern direction. We wish to know the electrical constants of the array as well as the radiation characteristics.

Then, by various devious means, we decide to use an array of two antennas, one-quarter wave tall, and separated a quarter wave length. The antennas lie on a line which runs due north and south. Antenna 0 is the northernmost antenna. The antennas are to be so excited that the current in the south antenna is 67.0 per cent of the current in the north antenna. The current in the south antenna lags the current in the north antenna by 160 electrical degrees. Then, from (24),

$$I_1 = MI_0 \angle + \alpha$$
$$= 0.67 I_0 \angle - 160 \text{ degrees} \qquad (54)$$

$$M = 0.67 \qquad (55)$$

$$\alpha = -160 \text{ degrees.} \qquad (56)$$

The self-resistance of each antenna is 36.6 ohms while the reactance is +21.25 ohms.

To determine the reactance which will appear at the terminals of each antenna when the array is in correct adjustment, we turn to Figs. 13 and 14 and find

$$(X_0 - X_{00})_{M=1} = +6.5$$
$$(X_1 - X_{11})_{M=1} = +20.2.$$

From (38) and (40),

$$X_0 = 0.67 \times 6.5 + 21.25$$
$$= +25.6 \text{ ohms}$$

$$X_1 = +\frac{20.2}{0.67} + 21.25$$
$$= +51.35 \text{ ohms.}$$

Thus we see that it would not be proper to resonate the antennas individually without due consideration to the coupling effects.

In the same fashion, from Figs. 11 and 12,

$$(R_0)_{M=1} = 12.5 \text{ ohms}$$
$$(R_1)_{M=1} = 22.5 \text{ ohms.}$$

Then from (37) and (39),

$$R_0 = 0.67\,[12.5 - 36.6] + 36.6$$
$$= +20.5 \text{ ohms}$$

$$R_1 = \frac{1}{0.67}[22.5 - 36.6] + 36.6$$
$$= +15.5 \text{ ohms.}$$

The total power (500 watts) is

$$20.5 I_0^2 + 15.5 I_1^2 = 500.$$

Since $|I_1| = 0.67\,|I_0|$

$$I_0^2[20.5 + 15.5 \times 0.67^2] = 27.45 I_0^2$$
$$= 500$$

$$I_0 = \sqrt{\frac{500}{27.45}} = 4.27 \text{ amperes}$$

$$I_1 = 2.86 \text{ amperes.}$$

The power fed to each antenna is,

$$P_0 = 4.27^2 \times 20.5 = 373.0 \text{ watts}$$
$$P_1 = 2.86^2 \times 15.5 = 127.0 \text{ watts.}$$

We are now ready to calculate the distribution patterns by means of (26). In (26), the electric intensity is given in volts per centimeter when the distance, r_0, is measured in centimeters. If we measure r_0 in miles and change the constant, 60, to 37.25, our answer is then expressed in millivolts per meter. Then when r_0 is one mile, (26) becomes

$$F_\theta = 37.25 I_0 K f(\theta)$$
$$\left[1 + M \angle \alpha - \frac{2\pi d}{\lambda} \sin\theta \cos\phi\right]. \qquad (57)$$

But,

$I_0 = 4.27$ amperes

$K = 1.0$ for a quarter-wave antenna

$f(\theta) = \cos(90° \cos\theta)/\sin\theta$

$M = 0.67$

$\alpha = -160°$

$$\frac{2\pi d}{\lambda} = \frac{\pi}{2} \text{ radians} = 90°.$$

Then (57) becomes

$$F_\theta(mv/m) = \frac{159.0 \cos(90 \cos\theta)}{\sin\theta}$$
$$[1 + 0.67 \angle -160° - 90 \sin\theta \cos\phi] \qquad (58)$$

$$F_\theta(mv/m) = \frac{159.0 \cos(90\cos\theta)}{\sin\theta}$$
$$\sqrt{1.449 + 1.34 \cos(160 + 90 \sin\theta \cos\phi)}. \qquad (59)$$

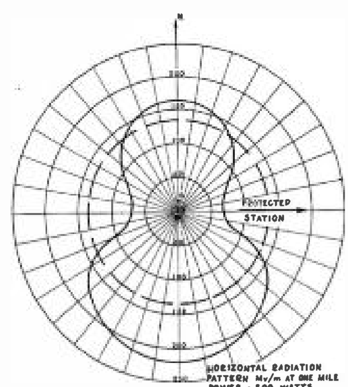


Fig. 17

Fig. 17 shows the horizontal plane distribution characteristic obtained from (59) by setting $\theta =$

90 degrees, and letting ϕ take on values from zero to 360 degrees. The broken circle indicates the value that would be obtained with a power of 500 watts in a single quarter-wave antenna.

Fig. 18 shows the vertical radiation patterns in a vertical plane which coincides with the line of antennas. The broken curves are again the values obtained from a single antenna operating under the same power. It is interesting to see that the ground signal is

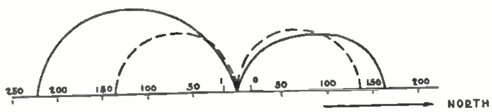
$$M' = \frac{1}{M}. \qquad (62)$$

Then (60) becomes

$$\sqrt{1 + (M')^2 + 2M' \cos(\alpha - kd \sin\theta \cos\phi)} \qquad (63)$$

and (61) becomes

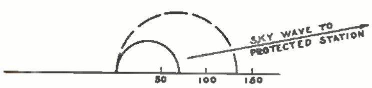
$$I_0' = \frac{\sqrt{P}}{\sqrt{36.6(1+M'^2) + 2M'R_m \cos\alpha}}. \qquad (64)$$



VERTICAL RADIATION PATTERN
(Mv/m AT ONE MILE)
POWER 500 WATTS
Fig. 18

increased with the directional array, while the high angle radiation, which causes fading, remains equal to or less than that obtained from a single antenna.

Fig. 19 is the vertical radiation pattern in the direction of the station to be protected. It is to be noted that the signal in this direction is the same as would be obtained with 125 watts in a non-directional antenna.



VERTICAL RADIATION PATTERN
(Mv/m AT ONE MILE)
POWER = 500 WATTS
Fig. 19

In (57), the shape of the diagram is determined by the term

$$\left[1 + M \angle \alpha - \frac{2\pi d}{\lambda} \sin\theta \cos\phi \right]$$

$$= \sqrt{1 + M^2 + 2M \cos(\alpha - kd \sin\theta \cos\phi)}. \qquad (60)$$

The scale is determined by the magnitude of I_0. From (43), I_0 is given as

$$I_0 = \frac{\sqrt{P}}{\sqrt{36.6(1+M^2) + 2MR_m \cos\alpha}}. \qquad (61)$$

The shape and size of the diagram is determined by the product of (60) and (61).

Let us now choose a new current ratio, M', of such a value that

Substituting (62) in (64),

$$I_0' = \frac{\sqrt{P}}{\sqrt{36.6\left(1+\frac{1}{M^2}\right) + \frac{2R_m}{M}\cos\alpha}}$$

$$= \frac{M\sqrt{P}}{\sqrt{36.6(1+M^2) + 2R_m M \cos\alpha}}. \qquad (65)$$

Making the same substitution in (63) yields

$$\frac{1}{M}\sqrt{1 + M^2 + 2M \cos(\alpha - kd \sin\theta \cos\phi)}. \qquad (66)$$

Thus the product of (65) and (66) is identical with the product of (60) and (61). We thus arrive at the conclusion that the radiation pattern will be unaltered in size or shape when the current ratios are interchanged. That is, the condition

$$I_1 = MI_0 \angle + \alpha$$

will yield the same result as the condition

$$I_1 = \frac{1}{M} \cdot I_0 \angle + \alpha.$$

Let us now see how our terminal conditions are altered in the example we have been considering.

From (65) we see that now

$$I_0 = 2.86 \text{ amperes}$$

and,

$$I_1 = 4.27 \text{ amperes.}$$

Then,

$$R_1 = 0.67[22.5 - 36.6] + 36.6 = 27.18 \text{ ohms}$$

and,

$$P_1 = 4.27^2 \times 27.18 = 495.0 \text{ watts}$$

while.

$$R_0 = \frac{1}{0.67}[12.5 - 36.6] + 36.6 = 0.61 \text{ ohms}$$

and,

$$P_0 = 2.86^2 \times 0.61 = 5.0 \text{ watts.}$$

Thus we see that a very small amount of power will be fed into antenna 0. In fact, it is so small that we need not feed this antenna at all but can simply operate it as a parasitic reflector by properly tuning it.

V. Multielement Driven Arrays

The two-element arrays are limited in use since the horizontal space pattern is symmetrical about the line of antennas. Furthermore, we say that it was not possible to increase the field strength more than ninety per cent over that obtainable with a single antenna. It is often desirable to use more than two antennas to distort the pattern in a variety of ways when more than one station is to be protected. In short-wave practice, a number of elements are used to concentrate the energy in narrow beams.

The method of attact will be illustrated by an example. Suppose that a station, at present operating on a power of 500 watts,

(Continued on Page 22)

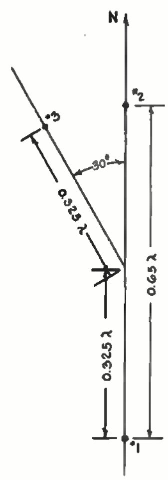


Fig. 20

DIRECTIONAL ANTENNAS

(Continued from Page 21)

contemplates increasing the power to 1000 watts. The main service area lies west of the station, with areas of secondary importance lying east and south of the station. Three other stations, on the same or adjacent channels must be protected. Station A lies due north, while Station B is located forty degrees south of west, with Station C forty-five degrees south of east. The array which gives the desired results, consists of three one-quarter wave antennas disposed as shown in Fig. 20. The currents are related as follows:

$$\left.\begin{array}{l} \bar{I}_1 = \bar{I}_2 \\ \bar{I}_3 = +0.5 \cdot \bar{I}_1 \angle -90^\circ \end{array}\right\}. \quad (67)$$

The mutual impedances are

$$\left.\begin{array}{l} \bar{Z}_{12} = 13.2 \angle -168^\circ \\ \bar{Z}_{13} = 12.0 \angle -152^\circ \\ \bar{Z}_{23} = 30.0 \angle -8^\circ \\ \bar{Z}_{11} = \bar{Z}_{22} = \bar{Z}_{33} = \\ \quad 36.6 + j21.25 \end{array}\right\}. \quad (68)$$

Then the three circuit equations become

$$\left.\begin{array}{l} \bar{V}_1 = \bar{I}_1\bar{Z}_{11} + \bar{I}_2\bar{Z}_{21} + \bar{I}_3\bar{Z}_{31} \\ \bar{V}_2 = \bar{I}_1\bar{Z}_{12} + \bar{I}_2\bar{Z}_{22} + \bar{I}_3\bar{Z}_{32} \\ \bar{V}_3 = \bar{I}_1\bar{Z}_{13} + \bar{I}_2\bar{Z}_{23} + \bar{I}_3\bar{Z}_{33} \end{array}\right\}. \quad (69)$$

Substituting (67) and (68) in (69),

$$\left.\begin{array}{l} \bar{V}_1 = \bar{I}_1[36.6 + j21.25 \\ \quad + 13.2 \angle -168^\circ \\ \quad + 0.5 \times 12.0 \angle -242^\circ] \\ \bar{V}_2 = \bar{I}_2[36.6 + j21.25 \\ \quad + 13.2 \angle -168^\circ \\ \quad + 0.5 \times 30.0 \angle -98^\circ] \\ \bar{V}_3 = \bar{I}_3\left[36.6 + j21.25 \right. \\ \quad + \dfrac{30.0}{0.5} \angle +82^\circ \\ \quad \left. + \dfrac{12.0}{0.5} \angle -62^\circ \right] \end{array}\right\} \quad (70)$$

or,

$$\left.\begin{array}{l} \bar{V}_1 = \bar{I}_1[20.89 + j23.845] \\ \bar{V}_2 = \bar{I}_2[21.61 + j3.72] \\ \bar{V}_3 = \bar{I}_3[56.2 + j59.55] \end{array}\right\}. \quad (71)$$

We thus see that the resistance and reactance of each antenna is greatly affected by the neighboring elements. The total power is

$$P_T = 20.89 \cdot I_1^2 + 21.61 \cdot I_2^2 + 56.2 \cdot I_3^2 \quad (72)$$

or,

$$P_T = [20.89 + 21.61 + 0.5^2 \times 56.2] I_1^2 = 56.55 \cdot I_1^2. \quad (73)$$

When the power is 1000 watts,

$$I_1 = I_2 = \sqrt{\frac{1000}{56.55}} = 4.21 \text{ amperes}$$

and $I_3 = 2.105$ amperes.

Then the power in each antenna is

$$\left.\begin{array}{l} P_1 = 4.21^2 \times 20.89 = 370 \text{ watts} \\ P_2 = 4.21^2 \times 21.61 = 383 \text{ watts} \\ P_3 = 2.105 \times 56.2 \ = 247 \text{ watts} \end{array}\right\}. \quad (74)$$

The horizontal pattern is given by

$$\begin{array}{l} F(mv/m \text{ at one mile}) \\ = 37.35\ [2\,|I_1|\,\cos\,(117^\circ \cos\phi) \\ \quad + |I_3|\ \angle -90^\circ \\ \quad + 117^\circ \cos\,(\phi - 30^\circ)] \\ = 312.0\ [\cos\,(117^\circ \cos\phi) \\ \quad + 0.25 \angle -90^\circ \\ \quad + 117^\circ \cos\,(\phi - 30^\circ)] \end{array} \quad (75)$$

where ϕ is measured counter-clockwise from north. The horizontal polar diagram is shown by Fig. 21.

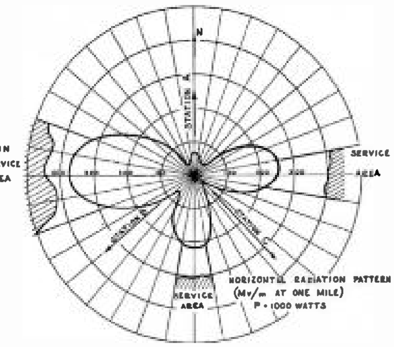


Fig. 21

(To Be Continued)

BROADCAST CONFERENCE

(Continued from Page 7)

Telephone Laboratories; 2:30 P. M. to 4:30 P. M., Snow Static Effects on Aircraft, H. M. Hucke, Chief Communications Engineer, United Air Lines.

Friday (February 18th), 9 A. M. to 11 A. M., Broadcast Antenna Design, George H. Brown, Consulting Engineer; 11 A. M. to 1 P. M., High Power Radio Frequency Amplifiers, W. H. Doherty, Bell Telephone Laboratories; 2:30 P. M. to 4:30 P. M., Aeronautical Ground Radio Station Design, P. C. Sandretto, Communications Engineer, United Air Lines.

For additional information those interested should write to Professor W. L. Everitt, The Ohio State University, Columbus, Ohio.

Messrs. J. C. Bell, Secretary-Treasurer, and K. G. Marshall, Vice-President, Birmingham Broadcasting Corporation, signing the order for the RCA 5-D transmitter now in operation at WBRC, Birmingham, Alabama.

A REVIEW OF BROADCAST ENGINEERING

Articles in Leading Publications, July-September, 1937

Reviewed by
J. P. TAYLOR

ACOUSTICS

Relation Between Loudness and Masking, by H. Fletcher and W. A. Munson, Jour. A.S.A., July 1937, Pg. 1.

Development of a quantitative relationship between loudness and masking, which provides a formula for calculating the loudness of sound.

Notes on Some Practical Comparison Tests Made Between Several Acoustic Measurement Methods, by E. T. Dickey, IRE Proc., Sept. 1937, Pg. 1136.

Account of an interesting experiment in which a radio receiver was successively shipped to five different laboratories in each of which it was subject to overall acoustic measurements. The various methods used and the divergence in results obtained form an interesting comment on one of the problems of audio reproduction.

ADVANCE DEVELOPMENT

Some Fundamental Experiments With Wave Guides, by G. C. Southworth, IRE Proc., July 1937, Pg. 807.

A detailed description of the methods and procedures employed in identifying the various types of guided waves and determining some of the fundamental properties. Emphasis on methods and apparatus as contrasted to theoretical development in previous papers on guided waves.

ALLOCATION

Addition of 11 New Stations Brings Total for Year to 31, Broadcasting, July 15, 1937, Pg. 26.

New stations licensed during first week of July.

ANTENNAS

Some Factors in the Design of Directive Broadcast Antenna Systems, by W. A. Duttera, RCA Review, July 1937, Pg. 81.

Outline of an unusually clean-cut method of computing directional antenna performance. Two- and three-element arrays are considered in detail, and the effect of high-angle characteristics discussed.

Directional Array Field Strengths, by A. R. Rumble, Electronics, Aug. 1937, Pg. 16.

Another method of computing the performance of directional antenna arrays.

The Use of Coaxial and Balanced Transmission Lines in Filters and Wide-band Transformers for High Radio Frequencies, by W. P. Mason and R. A. Sykes, The Bell System Tech. Jour., July 1937, Pg. 275.

An extended discussion of the use of transmission lines as selective filters and low-loss transformers in high frequency circuits—as, for instance, in the circuit used to connect a short wave transmitter-receiver system to a dual-purpose antenna.

MEASUREMENT

Amplifier Measuring Technique, by E. F. Keirnan, Electronics, July 1937, Pg. 18.

A general discussion of methods of measuring the frequency response of audio transformers and of computing the performance under working conditions.

Portable High-speed Level Recorder, by A. W. Niemann, Comm. & Broadcast Eng., July 1937, Pg. 15.

Discussion of the operation of an equipment designed to enable rapid recording of levels—as, for instance, of the frequency response of an amplifier or similar equipment.

A. F. Curve Tracing With an Oscilloscope, Service, July 1937, Pg. 412.

A method of visually observing the frequency response of an amplifier or other equipment. A long-persistance screen is used so that several curves made successively can be viewed superposed on each other—a valuable feature in making adjustments affecting frequency response.

Crosstalk Measurements, by R. S. Alford, Bell Lab. Record, Aug. 1937, Pg. 377.

Brief resume of methods used to measure crosstalk on land lines.

POLICE

Indiana's Police-Radio System, Communications, Sept. 1937, Pg. 22.

Non-technical description of facilities of Indiana State Police system. Layout of stations is given.

POWER SUPPLIES

A 300-KW Grid-Controlled Rectifier, by J. M. Willems, Comm. & Broadcast Eng., July 1937, Pg. 5.

A brief note on the 20,000 volt grid-controlled mercury-arc rectifier recently placed in use by RCA Communications at Rocky Point.

Voltage Regulators Using Magnetic Saturation, by K. J. Way, Electronics, July 1937, Pg. 14.

A general discussion of the use of saturated transformers and reactors as a means of obtaining constant voltage.

Battery Performance from the R.A.C. Power Supply, by G. Grammer, QST, Aug. 1937, Pg. 14.

Voltage regulator circuits satisfactory for use with speech input and similar equipment.

PROPAGATION

Characteristics of the Ionosphere and Their Application to Radio Transmission, by T. R. Grilliland, S. S. Kirby, N. Smith, and S. E. Reymer, IRE Proc., July 1937, Pg. 823.

Results of Ionosphere measurement for May 1934 to Dec. 1936—with a brief discussion of the relation of the properties of the ionosphere to radio transmission.

Recording Ultra-High Frequency Signals Over Long Indirect Paths, Part II, by R. A. Hull, QST, July 1937, Pg. 10.

Description of an equipment used for recording U.H.F. signals received over indirect paths.

Day Propagation at Medium Frequencies, by R. M. Bell and P. S. LeVan, Comm. & Broadcast Eng., Aug. 1937, Pg. 5.

Some experimental data on day propagation in the broadcast band.

The Surface Wave in Radio Propagation, by C. R. Burrows, Proc. of Radio Club of America, Aug. 1937, Pg. 15.

The paper, previously published in IRE Proc., describing experiments undertaken to obtain accurate measurements of radiated intensity under conditions for which the Summerfeld and Weyl formulas predict different results. Results indicate that simple antennas do not generate a surface wave.

The Physical Reality of Space and Surface Waves in the Radiation Field of Radio Antennas, by K. A. Norton, IRE Proc., Sept. 1937, Pg. 1192.

A discussion which relates to the preceding paper, and which places a different interpretation on the results obtained, and according to the author indicates that a so-called surface wave does, in fact, exist.

RECORDING

Performance of a Direct Lateral Recording System, by F. W. Stellwagen, Comm. & Broadcast Eng., July 1937, Pg. 12.

A description of a complete recording-playback system together with curves showing the overall performance.

Choosing the Proper Connecting Link Between the Crystal Generator and Amplifier, by C. K. Gravley, Brush Strokes, Aug. 1937, Pg. 4.

Brief note on the proper calculation of impedance match between a crystal microphone or pickup and the amplifier into which it is fed.

Disc Recording, by T. L. Dowey, Communications, Sept. 1937, Pg. 11.

Some general considerations effecting transcription recording — with particular emphasis on studio acoustics.

SPEECH INPUT

Mixer Circuits, Part II, by A. Preisman, Comm. & Broadcast Eng., Aug. 1937, Pg. 9.

Continuation of a comprehensive analysis of mixer circuits.

Mixing Circuits for Speech Input Equipment, by J. E. Tarr, Pickups, Sept. 1937, Pg. 14.

A very excellent treatment of mixer circuits—including a discussion of design factors, different types of mixers, and similar considerations.

Negative Feedback Applied to Class B Audio, by L. L. Nalley, Radio, July 1937, Pg. 54.

A short discussion of the application of feedback to Class B, including some practical suggestions.

A High-Quality Headset for Monitoring, by F. S. Wolpert, Bell Lab. Record, July 1937, Pg. 353.

Description and characteristics of a high-quality headphone set employing receivers of the moving coil type.

Phase-Shifting Circuits, by Engineering Dept., Aerovox Corp., All-Wave Radio, July 1937, Pg. 365.

Discussion of several simple methods of introducing phase shift.

Some T and PI Pad Tables, Comm. & Broadcast Eng., Aug. 1937, Pg. 12.

Data, in tabular form for the construction of pads of various sizes and impedance ratios. Particularly useful for broadcast work since all ordinarily used forms and sizes are provided for and correct values for the series and parallel elements given.

Console Type Speech-Input Equipment, by J. P. Taylor, Communications, Sept. 1937, Pg. 13.

Description of the standard console-type speech input equipments. Photos and schematics are included.

Simplifying BC Operators' Job, by G. Ing, Electronics, Sept. 1937, Pg. 24.

How-to-make-it article on a simplified control panel used at KONO.

Midget Remote Amplifier, by L. C. Sigmon, Communications, Sept. 1937, Pg. 24. Description of a remote equipment developed by KCMO engineers. Photos and diagram.

Tapped Transformer Impedances, by M. Apstein, Service, Sept. 1937, Pg. 521.

A very useful formula for determining unknown impedances in terms of the impedances given by the manufacturer. Particularly handy in matching output transformers to loudspeakers, etc.

An A.V.C. Controlled Pre-Amplifier, by J. Hanson, QST, Sept. 1937, Pg. 42.

An Electronic Volume Compressor, by R. E. Bullock and H. N. Jacobs, QST, Sept. 1937, Pg. 37.

Two articles on application of volume control to speech amplifiers for amateur use.

TELEVISION

Standards in Television, by H. M. Lewis, Electronics, July 1937, Pg. 10.

An important discussion of the differences existing between the present British standards and the proposed American standards—particularly as regards polarity of transmission, transmission of dc component, and type of synchronizing signal, in which a marked variation is noted.

Television Studio Designs, by R. M. Morris and R. E. Shelby, RCA Review, July 1937, Pg. 14.

The most complete description yet to appear of the layout of studio facilities utilized in the NBC-RCA television tests. Some of the problems encountered and their solutions are indicated in a particularly interesting account.

Television Transmitters Operating at High Power and Ultra-High Frequencies, by J. W. Conklin and H. E. Gihring, RCA Review, July 1937, Pg. 30.

Interesting features in the design of high power transmitters for operation at television frequencies. Includes close-up views of some of the new-type circuit elements required at these frequencies.

Television Studio Considerations, Part IV, by W. C. Eddy, Comm. & Broadcast Eng., July 1937, Pg. 17.

Continuation (see previous review).

Repeaters for the Coaxial System, by K. C. Black, Bell Labs Record, Aug. 1937, Pg. 385.

Interesting description of repeater designed for use on the New York-Philadelphia coaxial line.

Video Amplifier Design, by R. L. Freeman and J. D. Schantz, Electronics, Aug. 1937, Pg. 22.

Some practical data and suggestions on the design of amplifiers of wide-band characteristics.

Development of the Projection Kinescope, by V. K. Zworykin and W. H. Painter, IRE Proc., Aug. 1937, Pg. 937.

A discussion of the development, present status, and future possibilities of Kinescope tubes suitable for projection of television images on medium-size screens.

High Current Electron Gun for Projection Kinescopes, by R. R. Law, IRE Proc., Aug. 1937, Pg. 954.

This paper concerns the problem of obtaining the additional light output and increased definition necessary for projection viewing, and describes an electron gun giving the large beam current and small spot necessary to accomplish this. This gun is based on the theory developed in the investigation referred to, namely, the necessity of obtaining a small intense first cross-over—a final focusing being provided in order to reimage this crossover on the fluorescent screen.

Theoretical Limitations of Cathode-Ray Tubes, by D. B. Langmuir, IRE Proc., Aug. 1937, Pg. 977.

Theoretical investigation of the current density obtainable in a cathode-ray beam—and of factors which bear on this.

A Circuit for Studying Kinescope Resolution, by C. E. Burnett, IRE, Proc., Aug. 1937, Pg. 992.

Description of methods and procedures employed in making a detailed investigation of the characteristics of Kinescope tubes.

An Oscillograph for Television Development, by A. C. Stocker, IRE Proc., Aug. 1937, Pg. 1012.

Description of the RCA Type TMV-136-B Oscillograph—an instrument of advanced design developed particularly for television research.

The Brightness of Outdoor Scenes and Its Relation to Television Transmission, by H. Iams, R. B. Janes and W. H. Hickok, IRE Proc., Aug. 1937, Pg. 1034.

Experimental and calculated brightness of typical outdoor scenes as related to the sensitivity of present day systems.

Television Pickup Tubes With Cathode-Ray Beam Scanning, by H. Iams and A. Rose, IRE Proc., Aug. 1937, Pg. 1048.

A general discussion of television pickup tubes—different designs, materials, etc.

Theory and Performance of the Iconoscope, by V. K. Zworykin, G. A. Morton and L. E. Flory, IRE Proc., Aug. 1937, Pg. 1071.

A resume of the operation and performance of the Iconoscope developed to date, with a consideration of means by which the sensitivity might be increased by the use of such devices as secondary emission multipliers.

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Plate Efficiency of Class "B" Amplifiers, by P. Adorjan, Radio Engineering, July 1937, Pg. 14.

A method for the calculation of the plate power dissipated in Class B amplifiers under any condition of operation—and for determining the optimum condition of operation.

Making Life More Simple, by F. A. Everest, Radio, July 1937, Pg. 26.

A resume of the graphical method of Class C amplifier design.

The Low-Power Transmitters, Part II, by J. P. Taylor, Comm. & Broadcast Eng., July 1937, Pg. 19.

Continuation (see previous review).

Class B Audio Design, by E. I. Anderson, QST, Aug. 1937, Pg. 43.

A brief review of the principles involved in Class B operation, with a simplified method for determining correct operating conditions.

TUBES

A Power Amplifier Tube for Ultra-High Frequencies, by A. L. Samuel, Bell Lab Record, July 1937, Pg. 344.

Description and characteristics of a double-pentode tube providing power amplification at frequencies as high as 300 megacycles.

Developments in High-Power, U.H.F. Tubes, QST, Sept. 1937, Pg. 45.

Short notes on the RCA-887, the RCA-888, and the WL-461.

MISCELLANEOUS

Condenser Discharge Chart, Electronics, Sept. 1937, Pg. 20.

A useful nomogram for calculation of charge and discharge through a series resistor in terms of time and the R C product.

RCA Model ACR-111 Receiver, All-Wave Radio, July 1937, Pg. 368.

Detailed description of a 16 tube receiver designed for amateur and communication purposes.

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