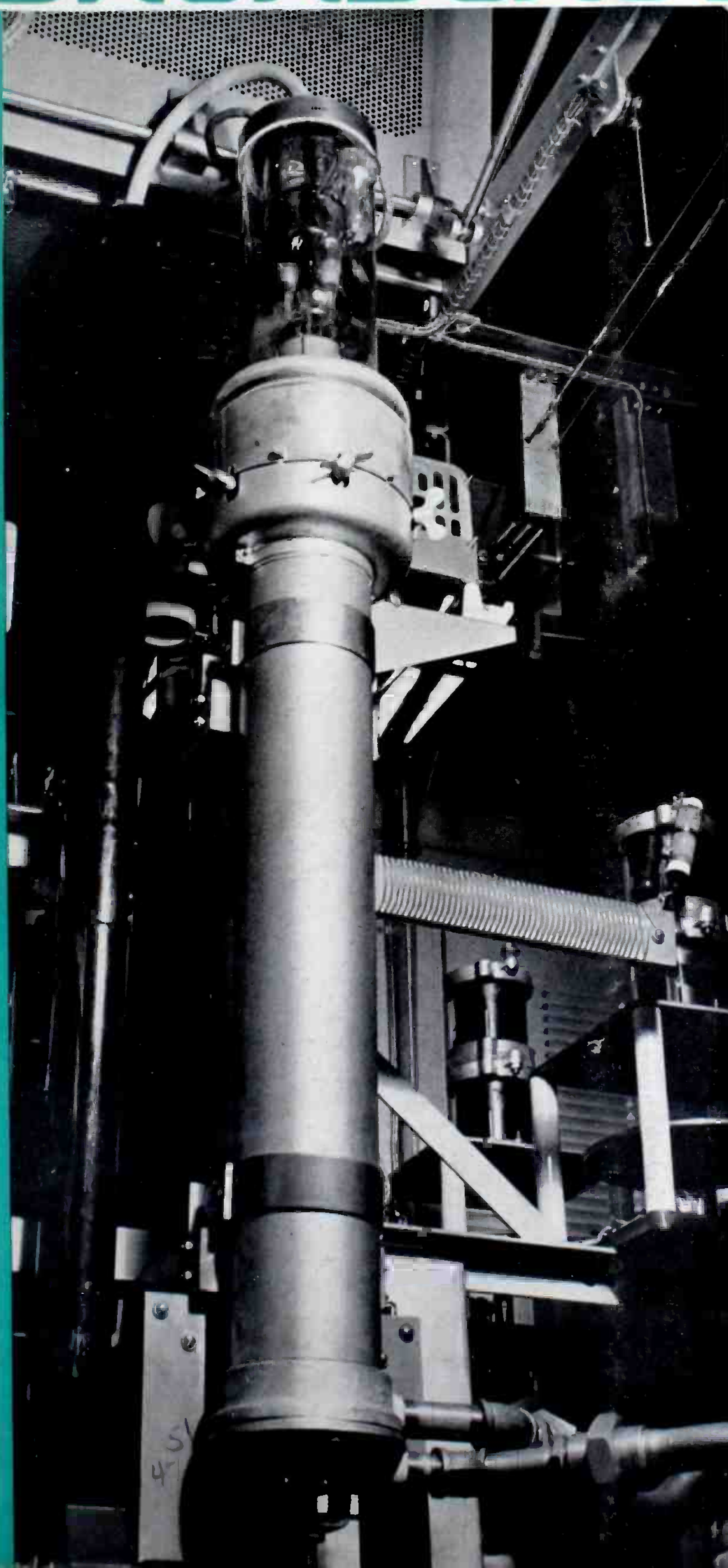
BROADCAST NEWS



RCA

In this Issue

RCA MANUFACTURING COMPANY, Incorporated

Camden, N. J.

NUMBER 19 APRIL, 1936

PRICE 25c

RCA Manufacturing Company, Inc.

A Radio Corporation of America Subsidiary

Camden, N. J.

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BROADCAST NEWS

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E. T. JONES
Editor

PAUL V. LUTZ
Associate Editor

NUMBER 19 — APRIL, 1936

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WHAT THE EUROPEANS ARE DOING

By L. M. CLEMENT
Vice-President in Charge of Engineering
RCA Manufacturing Company, Inc.

Photos from the L. M. T. Plant, Boulogne, France

THE wit who said that radio reception resembled a form of exercise and a game of chance probably had in mind certain types of European receivers on the market, on which it was necessary for one to turn numerous dials and then, if lucky, one heard a program. Such a state of affairs is no longer typical of Europe. But it is true that radio conditions in Europe, as I found them during the past four years, were much different from American conditions.

Component parts assembly line in the Boulogne plant.

Interest Keen; Two to Four Tube Sets Predominated in 1932

Perhaps the greatest difference lay in the fact that European receivers were mostly two, three, and four tube T. R. F. units, many with magnetic type loud speakers. Selectivity was largely dependent upon regeneration, and the power output was surprisingly low. In most of the countries broadcast transmitters were of good quality. Many were 60-120 kw. output, including a 500 kw. station in Moscow. Interest in radio was and is very high. In many of the countries the home set builder was a serious competitor of the set manufacturer. Superheterodyne receivers were being slowly introduced, but were poor in operation and complicated in construction. For instance, in a certain Hungarian set, a sort of AVC action was accomplished by the use of a Neon tube which would operate when the tube was flashed over.

Main assembly line—this picture might have been taken in an American factory.

Tubes Radically Different

By far the strongest reason for the difference between European and American radio practice was due to the tubes available. European tube designs differed radically from American designs, and reflected the influence of the older battery type tubes. In these old battery sets, battery life was a major problem and tubes were designed with the highest possible mutual conductance so that the smallest number of tubes could be used. This trend was accelerated by the license practice of basing royalty on the number of tube sockets. (This practice has since been discontinued in most countries.)

High Cost of Tubes

The technique of tube design based on high mutual conductance made the tubes extremely difficult and expensive to build. Consequently, high cost of tubes was a further incentive for the receiver manufacturer to keep the number of tubes low.

It became a matter of pride and competition for each manufacturer to produce a higher slope tube than his competitor. As the cathode lengths increased and the grid-cathode spacings decreased in this competitive effort toward high slopes (mutual conductance), the uniformity of the tubes decreased, as standard limits became wider and wider.

The introduction of the superheterodyne receiver, however, largely curbed this trend. In the attempt to produce highly sensitive, highly selective receivers without recourse to regeneration, uniform tubes became a virtual necessity.

Listening conditions, tastes, and purely local practices have a decided effect on European receiver design, as will be made clear by the brief description and explanation of these conditions in England, France, Belgium, Germany, Austria and other countries.

Another view of a component parts assembly line.—Nothing behind the times here.

Local Programs Popular in England—Except Sundays

The local programs are usually of greatest interest to the British public, largely because a knowledge of foreign languages is not common, and because of the relatively good quality of the programs broadcast. But for a large portion of the listening public this interest does not hold on Sundays, because on that day the British Broadcasting Company does not broadcast any popular or light musical programs, but confines the programs to religious and serious subjects. Consequently, the average listener on Sunday tunes in Luxembourg or Paris. These two stations cater to this English practice and broadcast advertising programs in English. They also broadcast sweepstake and football gambling pool results that are of great interest to Britain's working classes. The International Broadcasting Company is an English company, and broadcasts programs in English over the following stations: Paris; Luxembourg; Normandie; and Athlone, Ireland.

Because of these conditions, the people demand receivers capable of receiving all the local British programs, and in addition programs originating in France, Luxembourg, and the Irish Free State. This trend has largely reduced the demand for the very cheap single tuned circuit three tube set that was very popular in England until a year or two ago. Yet even today there are probably over one hundred thousand of these receivers sold each year.

French girls assembling loud speakers.

Forty Per Cent of British Receivers Battery Type

Today about 40% of the receivers sold in Great Britain are of the battery type—and only a year or two ago that percentage was much higher. The reason is that 40% of the English houses are not wired for electricity. Battery sets are largely of the three-tube type. Maximum battery drain is 8-10 milliamperes (HT), and 0.5 ampere for the 2 volt filament supply (LT). Usually a single cell storage battery is used, and every week or so this battery is recharged at the local "wireless" store for sixpence (12c).

Class B amplifiers are not popular because the small battery available at small cost (120 volt,

(Continued on Page 26)

THE ELECTRON IMAGE TUBE

A Brief Explanation of One of Modern Science's Most Important Advances

By DR. V. K. ZWORYKIN

Figure 1.

Construction of the Electron Telescope.

Figure 2.

Illustrating the curvature of the image field.

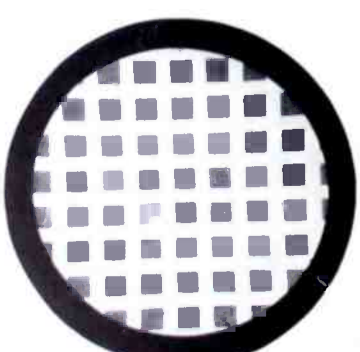

Figure 3.

The corrected image obtained by the curve in the cathode.

CERTAIN surfaces, such as cesiated silver, emit photoelectrons under the influence of radiation extending from the ultra-violet, through the visible, and well into the infra-red. If we could watch the electrons leaving such a surface when an infra-red image was projected on it, we would see close to the surface an "electron image" which is identical with our original projected image. However, these electrons move in all directions so that at a very short distance from the photoelectric surface, the electron image blurs into a random cloud which bears no resemblance to the original picture. At first sight, it seems impossible that these electrons can ever be reassembled into an image again, but at this point electron optics come to our aid and make possible the reconstruction of the image. This reconstructed image can then be made visible to the eye by directing it against a fluorescent screen.

Comparatively New Science

Electron optics is a comparatively recent branch of the science of electronics, based on the similarity of electron paths through certain types of electric fields and those of light rays through ordinary lenses. This field of study shows that it is possible to shape electrodes in such a way that the electric field between them will act as an "electron lens," capable of focusing the electrons leaving a cathode into an image of that cathode. Such an "electron lens" is found to have properties almost identical with those of an ordinary glass lens. For example, the image must be in focus if it is to be sharp; the magnification is determined by the distance from electron source or object to the lens and from the lens to the object; and, furthermore, the image will be inverted as is the case with an optical image. Just as the camera

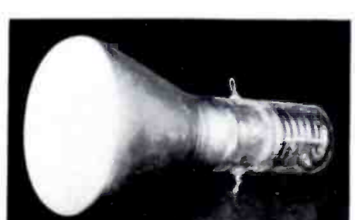

Figure 4.

Typical image tube.

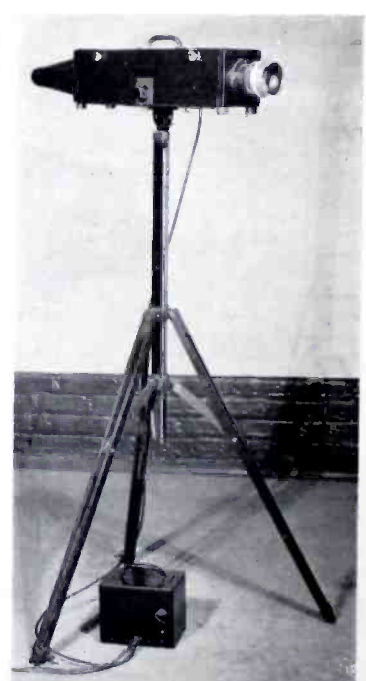

Figure 5.

The tube mounted for use as a terrestrial Telescope.

lens must be corrected if the image is to be free from distortion, so must the electron lens be corrected in order to obtain a perfect image.

Electron Lens System

The electron image tube makes use of just such an electron lens system to reassemble the electrons from the photoelectric cathode and to focus them onto a fluorescent screen which becomes luminous when bombarded by electrons. Fig. 1 shows diagrammatically how this lens system is constructed. A high positive potential V_1 is supplied to the long anode cylinder to accelerate the electrons to a high velocity in order to produce fluorescence on the viewing screen. The anode, together with the focusing rings, form the "lens" system which can be adjusted by varying the potential V_2. This lens system will image a rectangular grid into an image as is shown in Fig. 2.

In order to correct for the pin cushion distortion and curvature of the image field existing in Fig. 2, the cathode is made curved as shown in the diagram. A photograph of the final corrected image obtained by this tube is shown in Fig. 3.

Finally, in order to be able to vary the magnification of the lens system, an aperture is introduced between the anode cylinder and the focusing rings. Varying the potential V_3 of this aperture in effect "shifts" the position of the lens, causing a variation in magnification. Fig. 7 illustrates this arrangement.

Additional Applications

A typical image tube with 9" viewing screen is shown in Fig. 4. An interesting use to which this type of tube may be put is exemplified in Fig 5. A large aperture lens is mounted so as to image the scene towards which the telescope is pointed onto the infra-red sensitive cathode of the tube. This image is in turn reproduced on the fluorescent screen of the image tube, thus enabling the observer to "see" by infra-red radiation. Such a device can be used to test haze and smoke penetration by infra-red, for secret signalling, etc.

Excellent Image Fidelity

Another use is in connection with infra-red microscopy. Fig. 6 shows an image tube and microscope arranged for infra-red work. The visible image on the fluorescent screen of a micro-specimen is shown in Fig. 8.

The next two photographs (Figs. 9 and 10) were made by photographing the fluorescent screen of an image tube while an infra-red picture was projected onto the cathode. They illustrate fairly well the resolution and fidelity of the image obtainable.

Figure 7.

Indicating the aperture which "shifts" the position of the lens.

Figure 8.

The visible image of a micro-specimen on the fluorescent screen.

Figure 9.

Veterans of the fluorescent screen who prove the fidelity possible.

Figure 10.

A "shot" from a news reel.

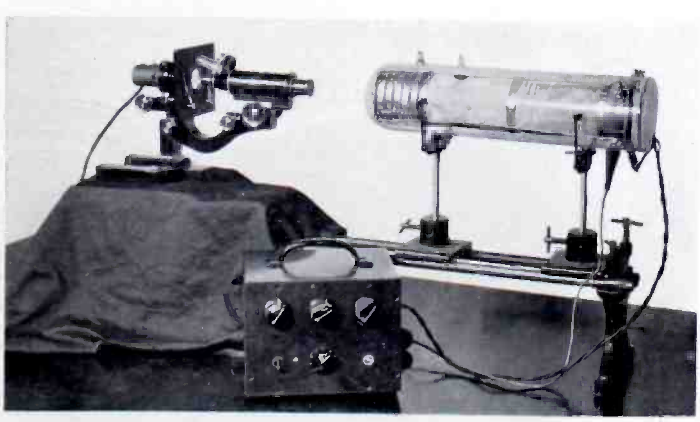

Figure 6.

An arrangement which permits the viewing of images cast by a microscope on the photoelectric cathode.

CBS EXPANDS, MODERNIZES

Studios Rebuilt and New Playhouses Established

By A. B. CHAMBERLAIN, Chief Engineer CBS

THE main studios of the Columbia Broadcasting System, Inc. are located in the Columbia Broadcasting System Building, 485 Madison Avenue, City of New York. These studios were recently rebuilt and completely re-equipped to conform with the most modern practices of sound insulation, acoustical treatment, ventilation, broadcast pickup technique, and engineering knowledge.

Technical Advantages and Innovations

The following is a brief description of the important engineering developments which have been incorporated in the new larger CBS studios. The smaller studios are more conventional in design, although they possess an acoustical characteristic similar to the larger studios.

The scope and the nature of the studio changes should quickly correct any impression that the work recently completed in these studios had as its purpose a "redecoration." The fact that an entirely new decorative scheme appears on the altered premises reflects, really, an absence of any surface decoration.

In the new studios, what is visible is functional. Every factor in the new appearance of the studio is an engineering factor, an acoustical factor. The studios, in effect, are stripped acoustical chassis, unencumbered by decorative "bodies."

All of this constitutes a voluntary scorning of conventional or petty theories of design and decoration. To the casual eye, the resulting effect may appear modern. To the more discerning eye, the result is modern only in its absence of meaningless, superficial decoration. The studio reveals, in effect, a structural X-ray of advanced acoustical principles.

Figure 2. Reconstruction work in one of the old CBS studios.

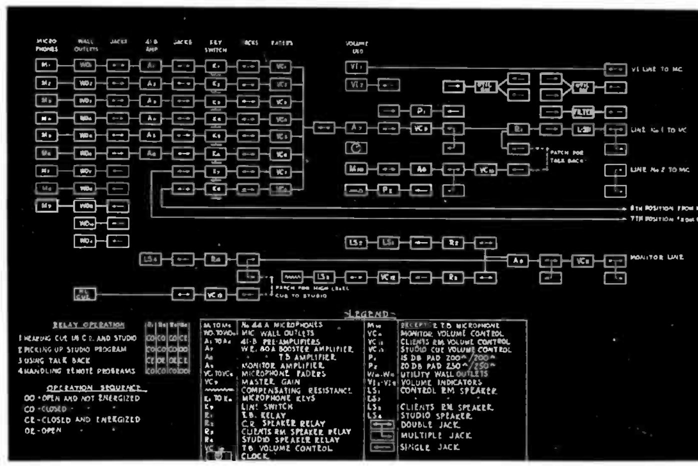

Figure 3. A skeleton block schematic diagram of a typical studio S. I. E. set-up.

Figure 1. A corner in one of the new studios.

Studios Have Zones

In conventional studio design, all parts of the studio have, in general, the same acoustical character. In the larger of the new studios, different parts or zones, in each studio, have different acoustical characteristics. This provides a variable placing of instrument, voice or sound effects, allowing a choice and a control of decided acoustical effect.

Broadly, the acoustical zones referred to above are:

A "dead end" characterized by a relatively high degree of sound absorption.

A "live end" characterized by a high degree of sound reflection.

A "middle area" with an intermediate degree of liveness.

The entire "back" wall of the studio has been constructed as a series of resonance diaphragms of seasoned wood. These are held in suspension with air chambers behind them.

This introduces into the studio principles of resonance similar to those involved in the wood sounding chamber of a violin or 'cello. It is, we believe, the first time that wood has been used in broadcasting studios for this purpose, according to exact acoustical specifications.

The specifications for the studios include an adequate thickness of the wood, the proper degree of

Figure 4. Studio Control Room Equipment.

rigidity in its mounting and other technical factors. They are important in providing the desirable degree of resonance.

Resonance Plane

The "back" wall, described above, serves not only as a resonance diaphragm, but as a controlled echo plane. It is highly selective. About one-third of each adjoining wall is likewise panelled in wood, with this important difference: the wood panels on the side walls are placed on slanted surfaces, so that the side walls form shallow "V's" running from ceiling to floor. These "V's" are so placed that the side wall surfaces are not parallel to one another. This procedure eliminates standing waves which are usually noted by the presence of sound wave "flutter." Nevertheless, because these walls are highly reflective surfaces, reverberation is achieved, a highly desirable quality in broadcast studios which adds life and brilliance to speech and music. The balance of the studio surfaces are acoustically treated, in the proper proportion, utilizing four-inch rock wool blankets covered with a light gauge perforated metal.

It is the combination of the single controlled "echo" from the back wall (not audibly perceptible as such), together with the additional liveness obtained by using properly designed reflective surfaces (minus flutter) plus the proper amount and placement of sound absorption material which add a quality of lustre, sparkle and richness to the programs originating in these studios.

Figure No. 1 is a photograph of a corner of one of the new studios. Figure No. 2 is a photograph of the interior of a studio under construction.

Acoustically, these new studios are essentially "flat" from 50 to 8000 c.p.s., a very desirable condition, and one which allows optimum results, providing the microphones and associated control and amplifying equipment used in the studios are modern.

The reverberation period of the studios varies, according to room volume, from 0.5 to 1.2 seconds at 1000 c.p.s. Sound insulation of 60 db at 1000 c.p.s. is provided.

The studio control rooms and client booths are acoustically treated for a "dead" condition consistent with modern practice.

Five well-equipped, spacious audition rooms have been provided, located on the seventeenth, eighteenth, nineteenth and twentieth floors of the Columbia Building.

New Studio Speech Input Equipment

All the speech input equipment, from microphone to line, is new, completely A.C. operated, and is standardized in all control rooms. Figure No. 3 is a skeleton block schematic diagram showing a typical layout of studio speech input equipment. Figure No. 4, a photograph of one of the studio control rooms, indicates the type of installation employed. The S.I.E. layout was designed, the equipment assembled and wired, and the entire installation supervised by the CBS Engineering Department. Most of the equipment used is of RCA manufacture, including type 44-A velocity microphones, 41-A pre-amplifiers, 4194-B amplifiers with UZ-4209 monitoring loudspeakers, 40-c program

(Continued on Page 31)

Figure 5. Control Room at the CBS 45th Street Playhouse.

THE AUDIO FREQUENCY DISCRIMINATOR

Concerning the Design and Operation of Apparatus Which Allows Amplitude Control of Individual Octaves in the Audio Frequency Range 20 to 10,000 Cycles.

By M. A. McLENNAN

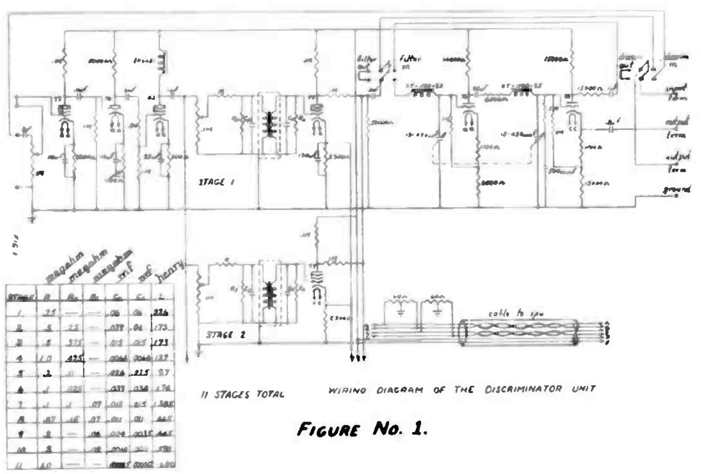

FIGURE No. 1.

The audio discriminator is a compound filter and amplifier, provided with a system of controls allowing its frequency characteristic to be quickly altered to almost any desired extent. This control of the frequency characteristic is effected by a division of the audio range of the amplifier, namely 20 - 10,000 cycles into eleven filter bands, the gain in each band being individually under control. The bands overlap at the sides and are so phased at these points that the combined overall response may be made substantially flat. The individual bands are slightly less than one octave in width at the overlap point, and have a range of amplitude control averaging —12 DB both up and down from the flat characteristic.

General Data

The characteristics of the filters, singly and in combination, are shown on Figures 4-10. The circuit diagram of the discriminator is shown in Figure 1. In order to simplify the diagram, only two of the eleven filter stages are actually drawn, the rest being replicas. The values of resistance, capacity and approximate inductance of the transformer windings are noted on the accompanying table. The wiring diagram of the output amplifier and power supply units is shown in Figure 2.

Operation of the Discriminator

The discriminator has been designed primarily for use in conjunction with a reproducing system of the type commonly employed in modern radio receivers. The instrument may be inserted into the audio amplifier circuit allowing changes to be made from the normal frequency response of

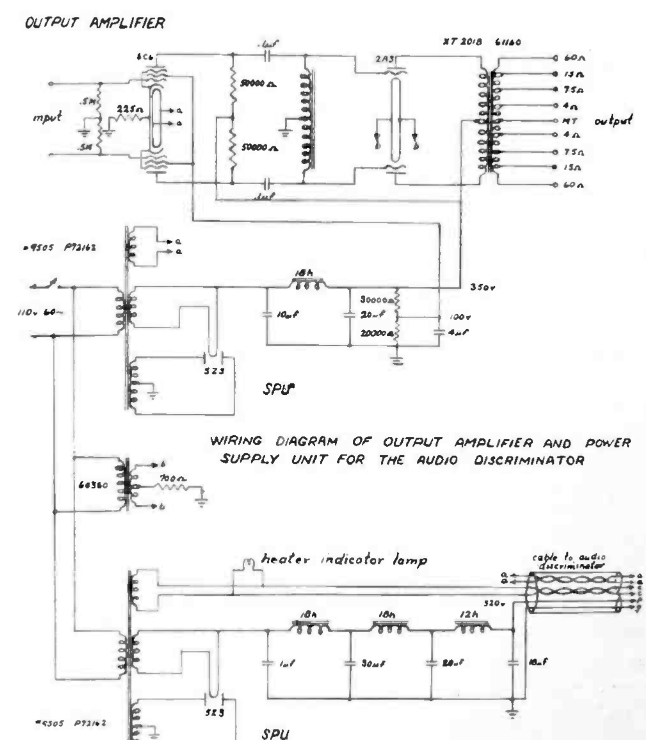

FIGURE No. 2.

the receiver. In order to facilitate work of this kind, the output level has been adjusted for operation between the diode detector and the first audio tube, that point being easily available in most present day receivers. As illustrated in the sketch of Figure 3, the input to the discriminator may be taken from the grid lead of the first audio, the output returning to the grid cap on the tubes. The discriminator also may be used in other circuits at the discretion of the engineer if the limitations on gain and output level are observed. (See operation notes).

A switch has been provided on the panel, by means of which the entire discriminator may be disconnected, allowing a quick and direct comparison with the normal frequency characteristic of the system under consideration.

The discriminator may also be used in conjunction with its own output amplifier for testing speakers or acoustical systems. Connections are made as illustrated by dotted lines in Figure 3.

Description of the Equipment

As noted in Figure 3, the complete apparatus consists of two separate units. The filters and the preliminary amplifier are housed separately from the power supply and output amplifier. A plug terminated cable furnishes all permanent interconnection between the two units. Since the entire discriminator is built around the band filters, the discussion will center about that portion of the circuit.

The filter unit proper starts, following the 42 power amplifier (3rd tube from left) in Figure 1. Here the channel is split into the eleven filter bands, resistors R serving as the input and isolating impedances. On the output side the filters feed into the grids of the paralleled amplifier system. The various bands are recombined in the resistance network interconnecting the plates of these tubes. The circuits preceding the filters serve to provide the proper impedance match for the filter input attenuator system, and to raise the signal level to take care of the subsequent filter and attenuator loss.

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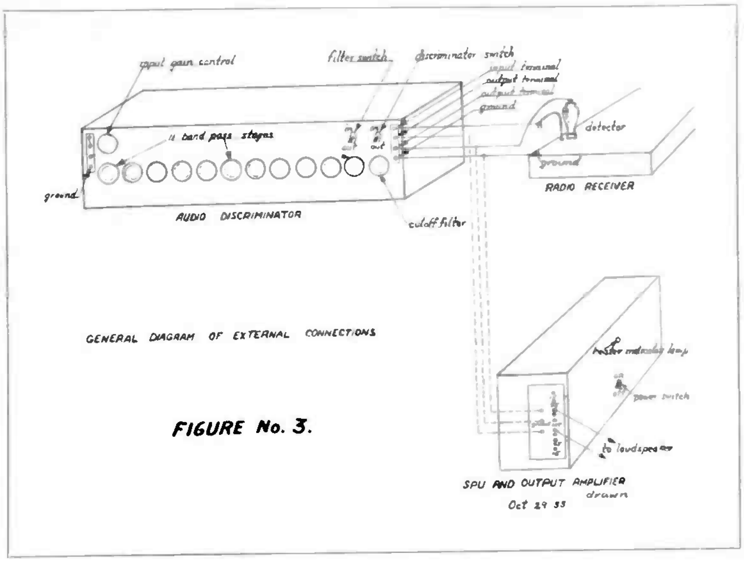

FIGURE No. 3.

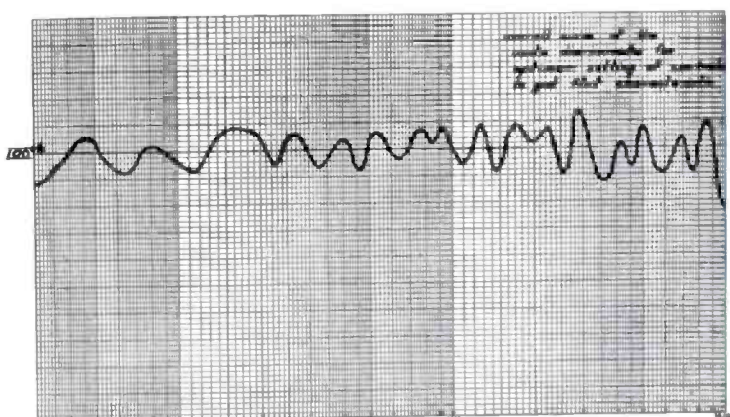

FIGURE No. 4.
FREQUENCY IN CYCLES PER SECOND

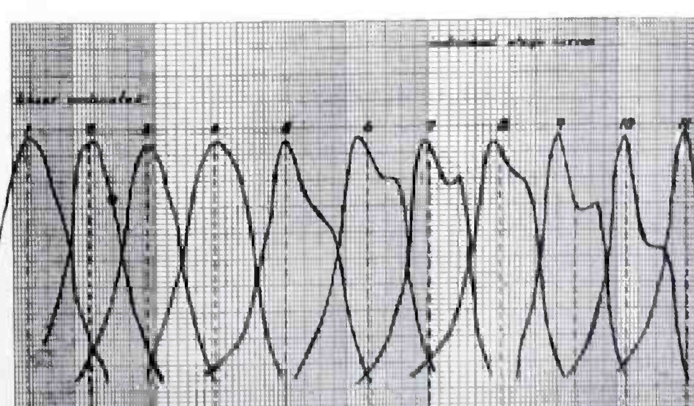

FIGURE No. 5.
FREQUENCY IN CYCLES PER SECOND

KFBK, 5000-WATTER

Celebration Marks Step-up From 100 Watts of Sacramento Station

By NORMAN WEBSTER, Chief Engineer

Exterior of Sacramento's popular station.

AN all-day dedication program on January 11, 1936 featuring the Governor of the State of California, prominent city and county officials of Sacramento and well known movie and radio stars introduced to Pacific Coast radio listeners the new KFBK, the 5,000 watt station of the Sacramento Bee and one of the most modern installations on the entire Pacific Coast.

Sacramento formerly was served with a 100 watt station also owned by the Sacramento Bee and one of the five stations operated by McClatchy Newspapers in Sacramento, Bakersfield, Fresno, Stockton and in Reno, Nevada. However, Sacramento is the center of one of the richest agricultural communities in the entire United States, the famous Sacramento Valley and also is the Capital of the State of California. Manifestly this vast area could not be served by a 100 watt station with its necessarily restricted coverage area. And so the new 5,000 watt KFBK came into being.

With the granting of the construction permit by the Federal Communications Commission in June, 1935, immediate steps were taken to provide Sacramento with the finest radio facilities money could buy. Engineers of the RCA Manufacturing Company were called in by Mr. Hamilton to devise the most modern of transmission facilities. Outstanding engineers contributed their suggestions to the construction of the studios. No expense was spared —only the finest would do. And the result has proved the wisdom of such a course.

A new building houses the three beautiful studios, the colorful reception room and the offices. The largest of the studios will seat more than 150 persons exclusive of artists and is designed according to the latest acoustic science. It is thirty feet in width, fifty feet long and has a twenty foot ceiling. The live end-dead end principle is utilized with the live end of the room being paneled in Australian Mahogany. These panels are unique in that they are fastened only on the ends, leaving them free to vibrate as the sound waves strike them. The rest of the studio is finished in acoustic tile—perforated metal panels holding back of them six inches of rockwool. The other two studios are smaller but identical in design and acoustic treatment.

Each studio has its own control room equipped with RCA speech input equipment. The master control room is located so as to give vision into both A and B studios although B studio also has its own control panel.

The lobby, paneled in Australian Mahogany, features an intricate floor design in inlaid linoleum depicting a map of Cali-

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Studio A with program in progress.

MEASURING EAR SENSITIVITY

Tests of 135 People Reveal Interesting Deficiencies

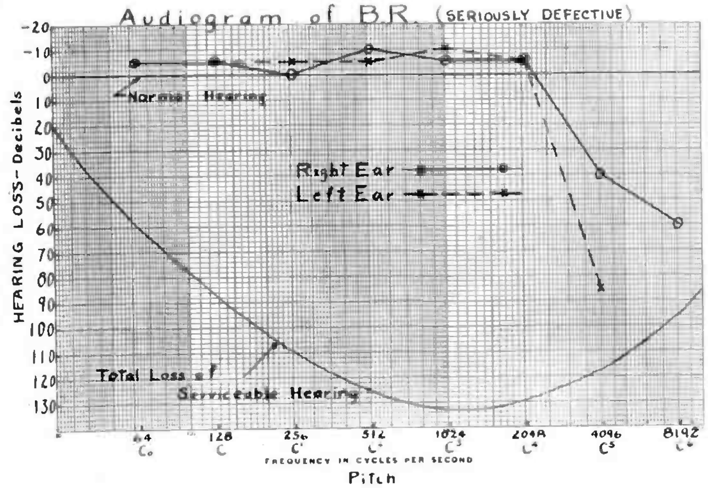
IT is well known that ears vary greatly both in sensitivity and frequency characteristics, but until recently no effort had been made by the RCA Manufacturing Company to classify the hearing of employees responsible for the acoustic quality of various RCA products. During the past month 135 people were tested for their hearing sensitivity and frequency characteristics. The method of test was the use of a device which measures the subject's threshold level and frequency characteristics. Eight different audio frequencies are used from 64 to 8192 cycles per second. The subject indicates the weakest point audible for each frequency. Both ears are tested individually. It is interesting to know that the power measured in the ear is of the order of 4×10^{-10} microwatts corresponding to .0004 dyne per square centimeter.

Object of Tests

The primary reason for this check was to explain certain disagreements in opinion at listening tests and to present data permitting proper weighing of comments at future tests.

The results were as follows:

No. of People Tested	Satisfactory Hearing (normal and slightly below)	Seriously Deficient
	79%	21%
135	107	28



Men	127
Women	8

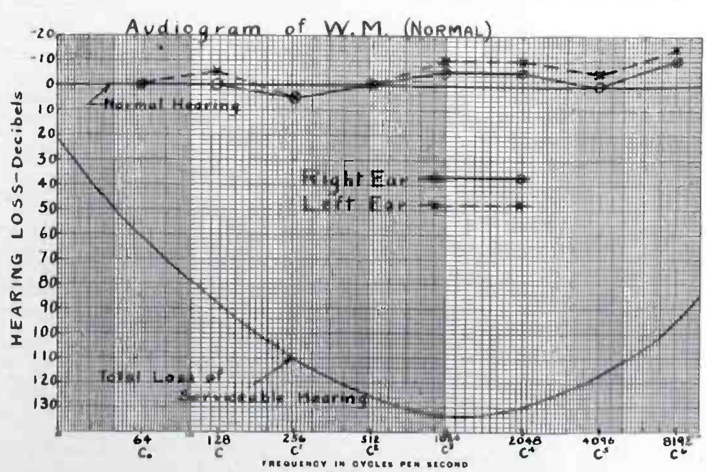
Breaking this down showed that the three departments, viz., Engineering, Sales and Manufacturing, each had about the same ratio of normal to sub-normal. All eight women tested had normal hearing. Of seven aviators tested, all had normal hearing.

Extent of Deficiencies

The data were collected in the form of graphs called "Audiograms." On the Audiogram the entire region of normal hearing is represented, the threshold of hearing (a smooth average) being designated as "Normal Hearing," and the threshold of feeling as "Total Loss of Serviceable Hearing." The chart shows at a glance the extent and character of the hearing deficiencies. The horizontal scale represents pitch and the vertical scale the intensity in decibels. The threshold of hearing is automatically corrected in the audiometer to be a straight line (in absolute units it is a curve).

Those "Seriously Deficient" were nearly all insensitive at 4000 and 8000 cycles. The amount of this sensitivity below normal averaged about 40 decibels down (only 1% of normal). A number were more than 60 decibels down (1/10 of 1% or normal). The high frequency cutoff was as low as 5400 cycles per second—that is, no tones above this could be sensed by the ear regardless of intensity level.

The importance of these data can probably best be illustrated by assuming a person who is 1/1000 of normal sensitivity (not unusual) at 4000 cycles and above, and normal below 2000 cycles, to be listening to a "high fidelity" set against a standard one. The difference between the sets in the extension of the range from 4000 cycles to 6500 cycles. This person, down 60 decibels, would hear little or perhaps no difference between the receivers. To him, sounds heard over a radio are perhaps the equal of the original, and noise which would be bothersome to others would be unheard.



NBC'S NEW HOLLYWOOD STUDIOS

An Exceptional Plant in the Movie Capital

By O. B. HANSON

Chief Engineer of NBC

IN dedicating its new Hollywood, California, studios on December 7th, 1935, the National Broadcasting Company extended to the capital of the movie industry its chain of thoroughly modern studio installations. The ever increasing number of programs originating from this point testify to the necessity for providing these added facilities. The latest types of RCA equipment coupled with NBC engineers' experience in the design of the Radio City studios have provided the best possible facilities. In addition to providing added broadcast facilities, the new studio installation centralizes NBC's Southern California activities under one roof.

Earthquake Proof Construction

The new studio building, located at 5515 Melrose Avenue in the center of the movie colony, is the first building in NBC history utilized solely for broadcasting. It is thoroughly modern both in design and construction. White stucco with black and aluminum trim set off the large vertical neon "NBC" sign over the main entrance. It is fire and earthquake proof and is built in accordance with the general principles followed in the design of the New York Radio City installation together with improvements made since those studios were completed late in 1933.

The original building itself was used by the Consolidated Film Industries prior to a disastrous fire there several years ago. The main building, two stories high, is 140 feet long and 75 feet deep. The smaller adjacent building, one story high, is 72 feet long and 31 feet wide. The main building houses three studios and the various offices, the smaller building one studio and its associated observation room. Conditioned air makes working conditions ideal the year 'round.

Radio City Design Followed

Sound control and sound isolation follow the pattern of that used in Radio City although the problem of sound isolation is considerably simplified due to the presence of extremely thick concrete walls and floors which are part of the earthquake proof construction. Studios A and B located on the second floor of the main building are counterparts of Studio 8G in Radio City. They take the form of small auditoriums with stages 28' x 45' in size and provision for 276 and 222 spectators respectively. Motor operated draw curtains and multi-colored spot and flood lights complete the stage equipment. Adjacent to and separated from the stages of these two studios by double panes of glass are the control and monitoring booths used by the production engineers and clients' agency representatives. Each is equipped with a control console identical with those used in Radio City, a type AZ-4175-C high fidelity loudspeaker and three racks of amplifying and switching equipment. The equipment racks house seven 41-B preamplifiers, a 40-C studio amplifier and AA-4194-B monitoring amplifiers for studio and public address use, rectifier, and relays for program switching together with circuit breakers for a c control. Each booth contains, in addition, the switchboard for control of the stage curtain and the studio lights. The control console houses a seven-position mic-

Below: The center of radio activity in the movie capital.

Typical control room which permits full vision into the studio.

rophone mixer for combining the outputs of the 44-A velocity microphones, the keys and lamps associated with the channel switching system, jack strips for circuit "patching," a microphone for studio "talk-back" use during rehearsals and telephone facilities.

Studio "C," located in the small adjoining building is approximately 30 x 50 feet in size. At one end, separated by a glass partition, is an observation room equipped with 55 theatre type seats and several lounge chairs. The control booth associated with this studio is equipped identically to those associated with Studios A and B.

Studio "D" is located on the first floor of the main building in the center of a group of operating offices. It is approximately 34 x 23 feet in size. Its control booth is equipped similar to those of the other studios.

Main Equipment on First Floor

The Main Equipment Room is located on the first floor of the main building and is adjacent to the lobby. In it are contained the channel relay switching system, the office monitoring system, line amplifiers associated with the five outgoing channels, three high-fidelity radio receivers, line termination and test equipment, a TMV-52D audio frequency oscillator, private line turret, teletypewriter and operating desk. The main AC power and lighting switchboard and the Main Distributing Frame are also located in this room as are also the intercommunicating telephone equipment wtih its storage batteries. This 24-volt storage battery which is part of the telephone and relay switching systems is the only battery supply in the building, all broadcast equipment being ac operated.

The private intercommunicating telephone system is of the automatic dial type and provides right-of-way communication between studios, Main Equipment Room and Engineering and Program offices. A separate system is provided for communication between executive offices.

Programs May be Monitored from Principal Offices

All of the principal offices are equipped with AZ-4175 cabinet loudspeakers by which the occupant of the office may monitor the output of any one of the studios, outgoing lines or high fidelity radio receivers. This selection is accomplished through a dial-controlled automatic selector system. A control box containing selector, a dial, and pushbuttons for turning the loudspeaker on and off as well as raising and lowering volume is part of each office monitoring installation.

Spare studio amplifiers are provided in the Main Equipment Room which may be switched by means of interlocked relays to any studio whose amplifier fails. An automatic chimes machine completes the array.

Frequency runs taken on the entire equipment lineup indicate that a substantially flat response from 30 to over 12,000 cycles between microphone and the outgoing line is obtained.

Below: Studio A, located on the second floor, is a counterpart of Studio 8G at Radio City.

A Simple Method of Adjusting Top Loaded and Sectionalized Antennas

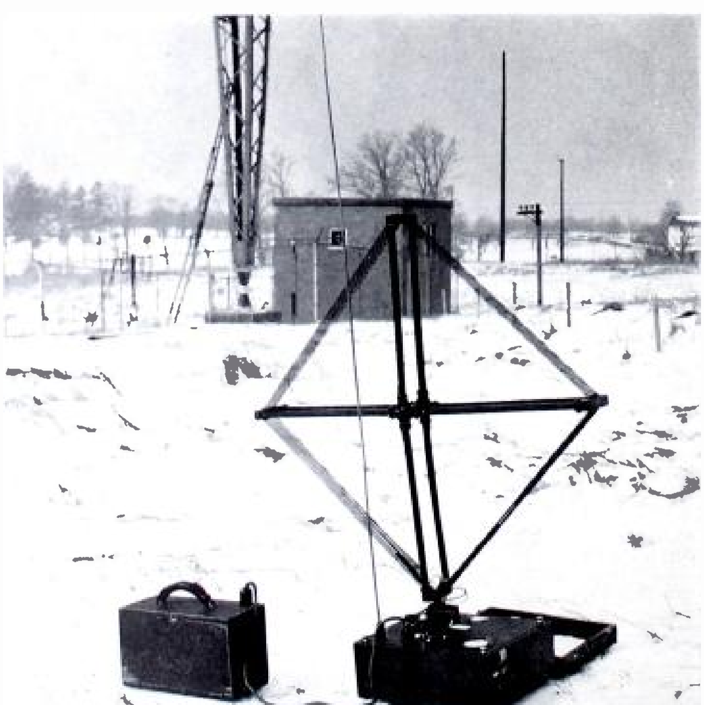
A Description of the BF-90 Meter

By DR. G. H. BROWN

A FEW antennas have been constructed and several are now being constructed which have an inductance coil placed somewhere along the antenna length. One arrangement places a hat or ring at the top of the antenna, which is usually a steel tower. This hat is insulated from the tower proper and then connected to the antenna through a variable inductance coil. A modification of this arrangement which becomes important for structural reasons is the sectionalized tower. Here the insulator is placed some distance down the tower so that the portion above the insulator is actually a radiating section instead of a simple capacity area. The coil is again placed across the sectionalizing insulator. In both cases the coil is inserted so that the current distribution on the antenna below the coil point may be modified to suit a useful purpose. The use of the coil enables one to obtain from a tower of a given height a field intensity at the horizon and a vertical radiation characteristic which would ordinarily exist for a simple antenna of greater physical height. Thus, the use of a coil and insulator is a very convenient means of conserving on tower height, and obtaining the desired radiation characteristic.

When one of these schemes is used, the coil is adjusted to give one of two conditions, depending on the power rating of the station. The coil may be adjusted to give maximum field strength along the ground. This adjustment is easily made by observing the field strength at some fixed point on the ground several wave lengths from the antenna. The power input to the antenna is held constant as the coil is adjusted. It may, however, be desired to adjust the coil so that the greatest suppression of sky wave is attained. This adjustment is usually made by observing and recording fading phenomena night after night at a distant point as the coil is adjusted. The purpose of this discussion is to show a means of arriving at the desired adjustment by means of measurements made in the immediate vicinity of the antenna.

The BF-90 Meter in Operation.



II. The Field Conditions Near a Straight Vertical Antenna

We can best approach the theoretical development by first examining the field conditions near a straight vertical wire antenna located over the earth. We will consider this earth to be perfectly conducting. A rigorous analysis for a few special cases in which the finite conductivity was considered showed that the assumption of perfect conduction was quite justifiable for purposes of this analysis.

Suppose we have the antenna shown in Fig. 1. The antenna height is a. The current is distributed sinusoidally along the antenna. At a point, P, which lies on the conducting plane there exists an electric vector, F, and an electromagnetic vector, B. The orientation of these vectors is shown in the figure. The electric intensity is vertical and the electromagnetic flux lies horizontal to the earth in circles surrounding the antenna. There is no horizontal component of electric intensity at the surface of the earth, but this component is present a very short distance above the earth.

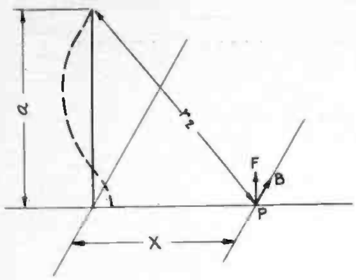


Figure 1

The electromagnetic flux density at the point P is

$$B = \frac{j\mu}{2\pi x}\,\frac{I_0}{\sin A}\left[\epsilon^{-jkr_2} - \cos A\,\epsilon^{-jkx}\right] \text{ (webers/cm}^2\text{)} \quad (1)$$

where

λ = wave length.

$k = 2\pi/\lambda$.

$A = ka$.

$r_2 = \sqrt{a^2 + x^2}$.

a = antenna height.

x = distance along the ground from base of antenna to point P.

I_0 = current at the base of antenna.

$j = \sqrt{-1}$.

μ = permeability of free space $(4\pi \cdot 10^{-9})$.

B = electromagnetic flux density (webers per cm²).

The vertical electric intensity is

$$F = \frac{j\mu c}{2\pi}\,\frac{I_0}{\sin A}\left[\frac{\epsilon^{-jkr_2}}{r_2} - \cos A\,\frac{\epsilon^{-jkx}}{x}\right] \quad (2)$$

where $c = 3 \times 10^{10}$, the velocity of propagation of light in free space. Equation (2) has been written to yield the vertically downward electric intensity.

We see that at great distances from the transmitting antenna the electric and magnetic fields are in phase with each other and apparently are not in phase near the antenna. We first examine the particular case when $a/\lambda = 0.597$ or $A = 215$ degrees. Fig. 2 shows the F and B vectors in their proper phase positions for a number of values of x. In Fig. 2, both sets of vectors have been multiplied by **x** to keep the vectors on the page. This is immaterial since we are only interested in the phase positions. We see that at one-half wave length from the antenna, the F vector leads the B vector by only a slight amount. As we come closer to the antenna, the angle between the two vectors becomes greater and greater until at the base of the antenna the F vector lags by about one-quarter of a cycle. We see that during this process there is one condition at which the B and F vectors are in phase quadrature. This occurs at slightly less than 0.2 wave lengths. It is this condition of phase quadrature that we will make use of in adjusting the coil type antennas.

For a straight vertical wire antenna, the critical point of phase quadrature is dependent on antenna height. It is present only when the antenna height is a half wave length or greater. This critical distance will be denoted as x_1. Then Fig. 3 shows x_1 as a function of antenna height for a straight vertical wire antenna.

III. The Antenna With Top Loading

The arrangement of the antenna with top loading is shown by Fig. 4. As the coil is increased in magnitude, the current cross over point on the antenna is moved up-

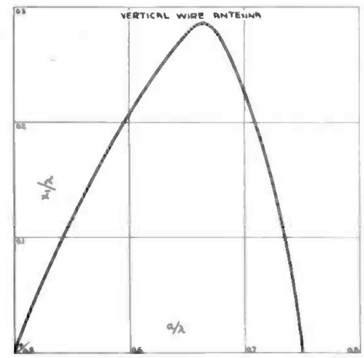


Figure 3

ward, thus changing the vertical radiation characteristic. In this figure,

a = actual height of antenna.

b = length of sine wave suppressed.

$A = 2\pi a/\lambda$ radians $= 360a/\lambda$ degrees.

$B = 2\pi b/\lambda$ radians $= 360b/\lambda$ degrees.

$G = A + B$.

$k = 2\pi/\lambda$.

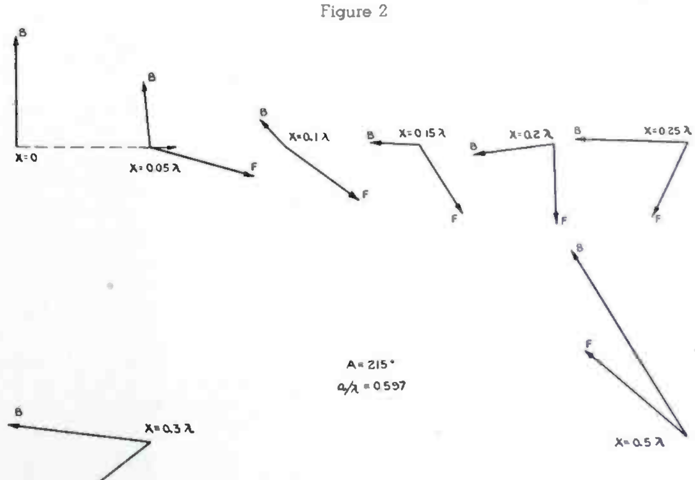
x = distance measured along the ground from the base of the antenna.

$r_2^2 = a^2 + x^2$.

Then the electromagnetic flux density at the surface of the earth a distance, **x**, from the base of the antenna is

(Continued on Page 28)

Figure 2



MODERN TRANSMITTER HOUSE

A Suggestion for the Treatment of Interior Details

By JOHN VASSOS

THE opposite page deals with the interior of the WRCA transmitter house, which we published in the last issue.

We will take you first into the reception lobby of this modern station. Immediately upon entering, you gaze across the length of the lobby (a distance of approximately 30 feet) at a huge mural, which can be executed in photomontage, painted in fresco style, or in black, white, and gray. The mural depicts the Spirit of Radio, particularly the part which the transmitter itself plays in sending out into the ether all the multiple activities which take place in the radio broadcasting art. This is the union between Art and Industry Art serving Industry through music, drama, and comedy. The synthesis of this mural is expressed by blown-up coils, tubes, inductances, screens, circuits, and so forth, with the composition finally achieving its rhythm in an orchestral grouping, showing the conductor, violin bows, horns, etc. To the right we see big buildings massive structures—expressing business, and industry at large.

Horizontalism Featured

Directly under it we find the horizontalism which exists on the outside of the building—horizontal glass reaching from one end of the wall to the other, allowing a perfect view of the transmitter itself, with the engineer on duty. It is through here that one gazes at the compact, yet so functional, transmitter unit, silhouetted against the new Pyrex Glass Brick, which allows the blue of the sky to shine through softly.

The walls choose a horizontal trim on either side, and are done in terra cotta color, with white metal trim. The doors are ebony black, and the floor is black terrazzo. Above the color line, the walls and ceiling are oyster white. These walls are softly lighted by an indirect arrangement of light, which consists of two huge metal members reaching to the ceiling on either side of the room. These lights indirectly illuminate only the side walls, the mural being spot-lighted with shielded spotlights inside and above the entrance.

For the convenience of visitors, we have included a lounge, and a long table, upon which literature may be placed.

The entrances to the two executive offices are on either side, no direct entrance to the transmitter being shown, except through these offices.

Simplicity Emphasized

The simplicity of the arrangement of this hall, which reaches well above two and a half stories in height, combined with the tremendous message of the mural, proves an effective and most impressive production.

In the upper right hand corner I show a Van Dyke view of the transmitter control desk. It is done in a halfmoon shape, and from the point of view of function and accessibility, it is obvious in its design. The top of the desk is blue linoleum, the sides ivory formica, trimmed with white metal. The base is set back in black. The desk is equipped with a telephone switch, remote control of the entire transmitter, typewriter and utility drawers. The desk chair is morocco red fabrikoid, constructed of chromium steel tubing. The control panel unit is black, with edge light dials. A minute clock is set obliquely in the center.

The lighting of this room is indicated roughly by a cone-shaped reflector chandelier. Four of these suspended chandeliers will light the entire room. A stream lined control knob is shown at the left.

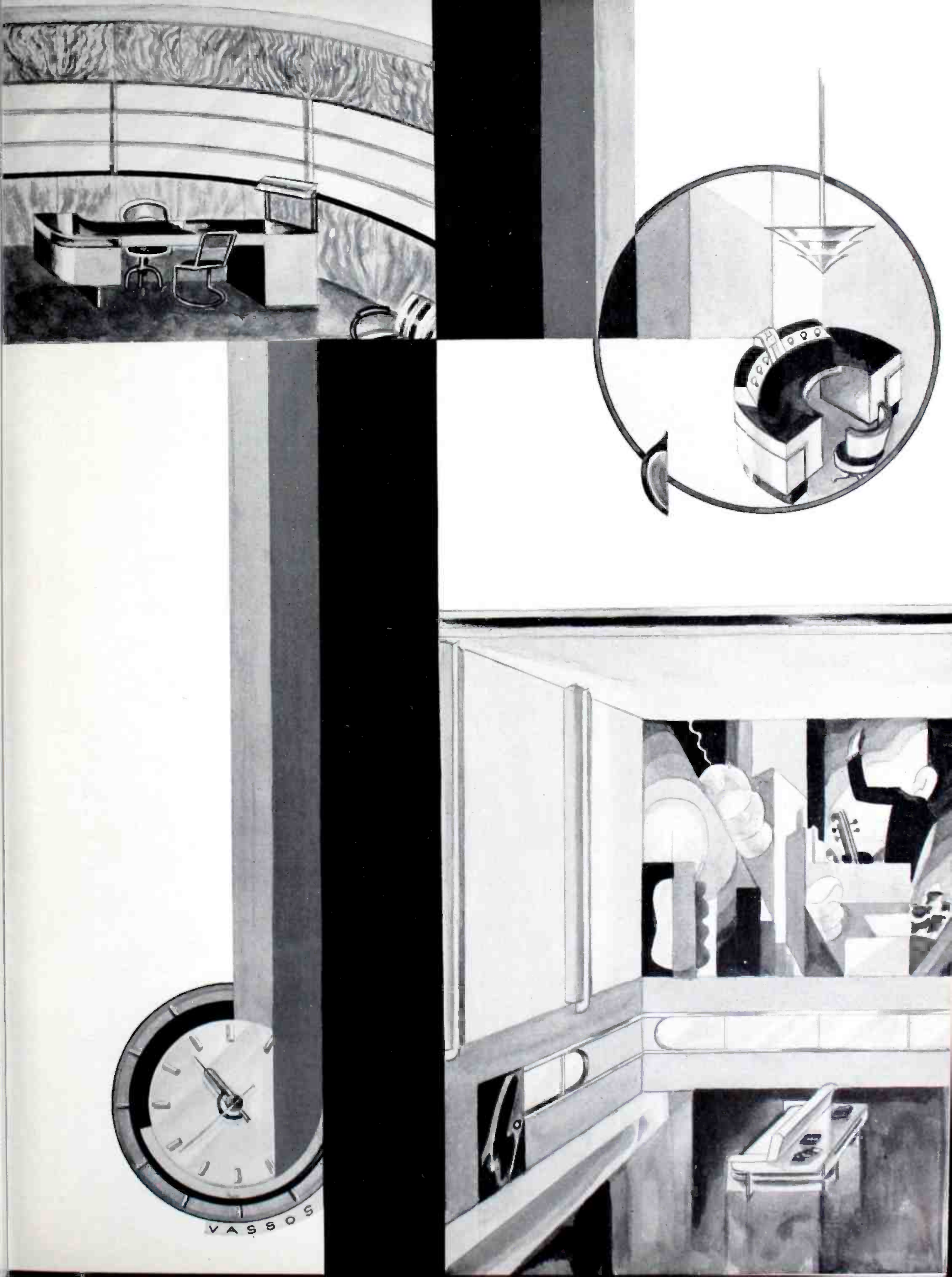
The upper left hand corner shows a section of one of the executive offices which is lighted from the left and back. This room is also indirectly lighted by a center light, which illuminates only the ceiling. For direct, efficient desk light, we have, to the left, a desk lighting arrangement which floods the light on the desk proper. This huge, double-purpose desk may be used by the caller in going over plans, for consultations, etc. It is built of American walnut, with linoleum top, and aluminum metal edging. The telephones and switches are to the right of the desk in a slide back drawer. These and all other utilitarian objects are in the utility drawer, thus affording clear desk space. Note that the desk curves on one side allowing additional space for the executive's notes, etc.

Modern Severity Retained

There is also a comfortable lounge in this room, which is not shown. The room is carpeted with a warm brown chenille carpet. The walls are of flexwood, the grain running horizontally in opposite directions, and the ceiling is white. The room is masculine, and very severe.

To complete the decorative high lights, a suggestion is made (see lower left hand corner) for a clock which may be placed in all the executive rooms (including the transmitter room. It is of black bakelite, with streamlined pointers in white metal. The outer edge of the clock is sunk in the wall, and edge lighted in a manner showing the minute's progress. In other words, a beam of light moving clockwise shows clearly the progress of the minute around the face of the dial, indicating that a quarter of a minute has been completed, a half, three quarters, and finally going out temporarily as the full minute is completed.

The decorations of this interior are of course limited by the lack of color, but the fundamental principles of design are evident.


VASSOS

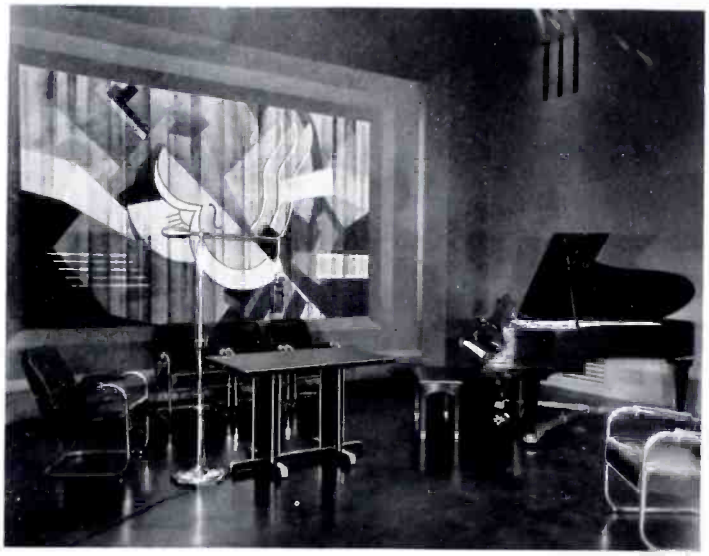
BEAUTY AND UTILITY

WGN Furnishes Fine And Design in

By CARL MEYERS,

THIS is WGN, Tribune Square, Chicago. This announcement made from the new $600,000 radio studio building adjoining Tribune Tower on upper Michigan Avenue of Chicago's north side, marked another mile-stone in the development of WGN, the Chicago Tribune radio station.

WGN, for many years the outstanding station of the middle-west, has always been a pace setter. The opening of the new distinctive Gothic styled stone building housing the major studios of the station gives a setting of stone and steel, beauty and utility to the spirit which makes for finer programs, better presentation of radio features and added facilities for visiting guests and listeners.



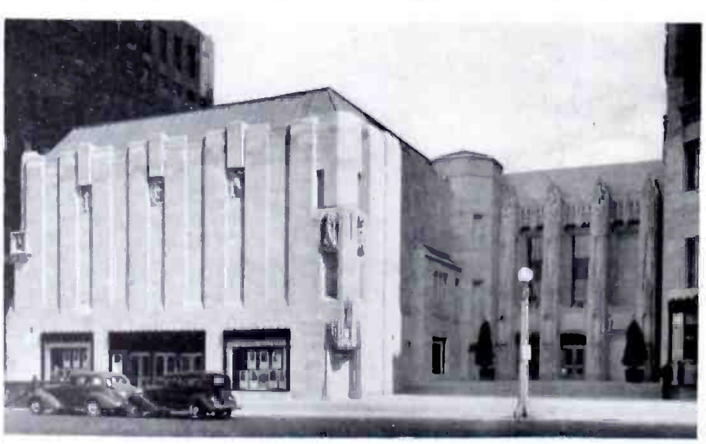
Modernism exemplified in Studio Two.

A Practical Workshop

First of all, the new WGN Studio Building is a practical workshop for the production of better radio broadcasts. Second, it is a fitting structure to match with the general architectural scheme of Tribune Square, the principal unit being the beautiful Tribune Tower itself. The finest materials, equipment and workmanship were combined to construct this great building which is devoted exclusively to the production of WGN's programs.

WGN's new building is the third step in the development of Tribune Square, a building plan which, when completed, will occupy an entire block facing one of Chicago's principal streets, aristocratic and beautiful Michigan Avenue, which is the main thoroughfare bordering the shores of Lake Michigan. The first step in building Tribune Square was the erection of the Chicago Tribune Plant building, housing the first of the printing press units and other mechanical and editorial departments necessary to publish The Chicago Tribune at the new location on Chicago's near north side. The plant building was placed in service in 1920. In 1923 the Tribune Tower was started and this great main unit of Tribune Square, a model of art and architecture, was completed and occupied in 1925.

The new WGN studio building adjoining the Tribune Tower.



Equipment Specially Designed

The WGN studio structure, the third unit of Tribune Square, was started in August, 1934, and was completed thirteen months and one week later in September, 1935. More than 600 artisans, in their respective fields, were employed in building the new structure, which, when completed, cost more than $600,000. The furniture and fittings were selected from special designs submitted by various manufacturers.

Novel Features

A great many novel features went into the construction work. The entire building was designed to provide maximum efficiency in the production of the best in radio programs. All of the studios are acoustically perfect for radio

COMBINED IN NEW STUDIOS

Example of Craftsmanship Modern Layout

Chief Engineer, WGN

broadcasting and the installation of this phase of construction provided the largest individual contract of the year for the acoustical treatment company which was employed.

Prize Competitions

When plans for the building were announced in The Chicago Tribune in 1934, a nation-wide competition for interior decoration of Studio One was announced and 189 designs were submitted by architects and decorators from every section of the country. Prizes totaling $5000 were offered. The judges of the competition were Mrs. Robert R. McCormick, Mr. W. E. MacFarlane, Mr. Edward S. Beck, Mr. Holmes Onderdonk and Mr. Carey Orr.

The first prize was awarded to Ernest A. Grunsfeld, Jr., of Chicago, and it was from the design submitted by Mr. Grunsfeld that the main studio of the building, Studio One, which seats 588 persons and in which the principal programs are produced, was constructed and decorated. Mr. Grunsfeld was then retained by WGN to supervise the execution of his designs and decorations for the studio and entrance lobby to Studio One.

The living room studio. An unusual design to place the occasional speaker at ease.

Colorful Studios

It is the main attraction of the new building. This great studio, the largest studio in the country outside of New York City, presents a colorful picture. It is a great room, more than 70 feet long and 65 feet wide with 588 comfortable opera chairs placed in permanent rows and tiered from the front of the house to the rear wall, giving each seat an unobstructed view of the platform on which the radio productions are presented.

Powder blue walls, silver leaf ceiling and side decorations, mouse gray carpeting and the flashy Morocco red seats combine to make the interior a colorful sight. The floor of the concert platform is black while the backdrop is of eggshell white velour. The concert stage is large enough to accommodate an entire symphony orchestra and all the metallic cornices and bands are of white bronze.

The show goes on the air from one of the large studios.

Colored Lighting Effects

The wall construction is of transite backed with rock wool as required for acoustical correction. The floor carpeting is installed over ozite padding to absorb sound. The doors are red Formica covered. Five bands of light around the sides furnish the main lighting for the studio and the platform is equipped with every modern lighting device used in theatres, with the exception of footlights. There are several rows of border lights concealed behind the curtain valances above the platform. The white backdrop of the platform reflects the colored lighting effects. In the center of the ceiling of the studio is a large trap door through which the spotlights are played upon the various entertainers on the platform, while additional spotlights are located on either side at the rear of the house and in the projection booth above at the rear of the studio. In this projection booth also are located two ultra-modern picture projection machines completely equipped with sound apparatus.

The control and observation booths are located at the sides of the platform. Facing the platform the lower booth to the left is the engineer's control booth. Above is the lighting control booth where the lighting engineer changes the effects as the program progresses. The two booths to the right of the platform are observation booths for clients and other guests.

A view of the RCA Speech Input Equipment installation.

Public Address System

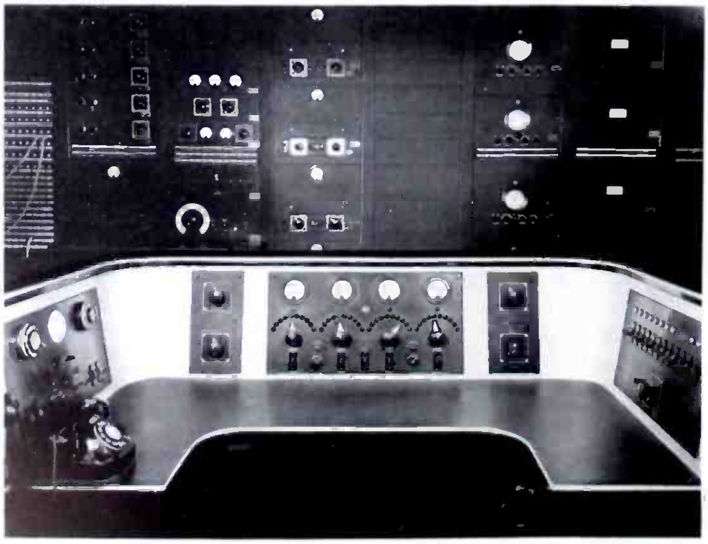
This studio is also equipped with the latest development in public address systems, which enables the house audience to hear the program just as it would be received through a home radio set. The giant speakers for this house address system are located behind the panels at the top of the two tiers of booths.

Included in the equipment for Studio One is an organ console on the concert platform. It is connected with the tone producing instruments in Studio Three and when operated, the organ music is picked up on microphones in Studio Three and fed out to the audience through the huge speakers.

New Type Doors

Guests to a broadcast in Studio One enter directly through the Michigan Avenue lobby. The lobby walls here are of marble and the ceiling is silver leaf. Straight ahead is a check room where checking service is supplied free to those who attend the public broadcasts. The doors to the street are of novel design being especially constructed for easy opening against strong wind pressure. It is the first time this new type door has been used in Chicago.

"Finger tip" control for the S. I. E. layout.



Two more studios, the main reception room, the studio building manager's office, a lounging room for the men artists and announcers and a sound effects laboratory and property room are located on the first floor of the building. The studios are Two and Three and these were decorated from designs submitted in the prize competition conducted by the Tribune.

Studio Three houses the giant Kimball organ. The organ, which is valued at more than $35,000, has many musical making devices installed in the special sound chamber which is located at the south side of the room.

Mural Decorations

Studio Two was designed especially for the broadcasting of the many sketch programs and smaller musical units which furnish programs for the station. On the back wall is a mural, "Music on the Air," which was submitted in the contest and personally executed in this studio by Robert Bruce Tague and Raymond Schwab of Chicago.

The reception room, the manager's office and the lounging room are all furnished with modern furniture and are colorfully decorated. The reception room walls as well as the walls of all of the corridors of the building are natural finished white oak flexwood. The ceilings are of Sanacoustic tile and the floors tan rubber.

Master Control Room Completely RCA Equipped

On the second floor of the building is located the master control room where all of the programs terminate before being transmitted over the special telephone lines to the WGN transmitter at Elgin, Ill., forty miles from the studio building. Here is a model control room for radio engineers, resplendent in black and chromium and a regular maze of switches, dials, meters and small signal lights. Here, too, in this room which has rightly been called the "heart" of the radio station, is the spcial pickup equipment which furnishes the radio speakers in the various offices and public rooms and the control rooms of the building with programs, not only of WGN origin, but of the other radio stations of Chicago and the three major networks. This equipment is operated by a control system of a dial, similar to a telephone dial, and push buttons.

Special New Studios

Studio Five is located next to the master control room. This is a small studio where an announcer is constantly on duty to give the program announcements, news bulletins, service announcements or any emergency programs which may be necessary. Special wires from the Press Radio Bureau and the Chicago Tribune News department supply the news bulletins to the announcer.

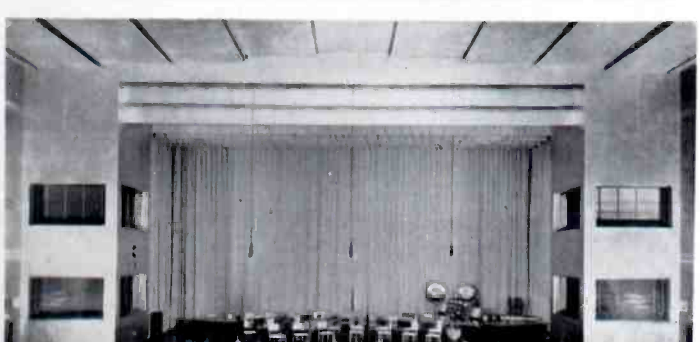
Off this second floor corridor also are located the public observation rooms to studios Two and Three, two private dressing rooms for special artists, the lounging room for the women of the WGN artists staff and the lighting control booth for Studio One.

On the third floor are two studios, Four and Ten, a special studio where the transcription programs are originated and where the equipment for making recordings of programs is located. The air-conditioning room comprising three separate units for the entire building are installed here together with the musicians' locker room, the office of the dance orchestra director and a workshop for the engineers.

Studio Four is another studio which was decorated from a design submitted in the prize competition. It has a large control room in which space is allotted for a few special guests. The mural on the three walls in this studio was painted from part of the contest design submitted by Mr. Millard Sheets of Los Angeles, in collaboration with Mr. Eric Webster and Adrian Wilson.

Studio Ten is one of the most interesting and beautifully decorated and furnished rooms in the building. The walls are of butternut wood paneling and the acoustical treatment is hidden behind the drapes. A fireplace at one side of the room and the beautiful furniture lends a cheery, homelike atmosphere. This is a special studio for the presentation of guest speakers.

A view of the main studio showing radio and lighting control rooms at the left.



Control operator's desk in the main studio.

On the fourth floor is the office of the musical director of the station and the music library, which houses thousands of special musical scores used in the production of programs. Here, too is the attic to Studio One which houses the distributing air supply ducts, the battery of ten spotlights which are used for special lighting on the platform during a program and the dimmers for lighting effects all interconnected by catwalks.

Sound Proof Construction

In all of the studios, perfect sound proof construction and acoustical treatment was employed. The studios are in reality rooms within rooms in order to obtain absolute exclusion of outside noises during broadcasts.

WGN also has three modern working studios located on the eleventh floor in Tribune Tower. The entire floor is occupied by WGN's executive offices and these studios and several of the station's programs originate here each day.

Large Staff Required

More than 150 persons are permanently attached to the WGN staff and the number of artists employed on programs is several times that number. Several programs are presented in the main studio each week to capacity audiences. Admission to these performances is by ticket but without charge of any kind. Page boys also conduct several tours each day for parties visiting the building and these parties are taken to every point of interest in the entire building. The number of persons attending the

(Continued on Page 32)

W8XH, NEW HIGH FREQUENCY STATION

By R. J. KINGSLEY, Technical Supervisor, WBEN, Buffalo

Courtesy of "ELECTRONICS"

RADIO has suffered from three major reception troubles: static, fading and weak signals. Thanks to the ingenuity of radio design engineers these troubles have been largely overcome.

In these modern times we are, however, afflicted with another source of interference, namely inter-station interference between broadcast stations on the overcrowded 550-1500 kilocycle band, which limits the frequency range of all stations in this band. The listening public is demanding more faithful reproduction over the musical range and under the present operating conditions, this is limited to about eight thousand cycles. Actually only 5000 cycles can be transmitted without causing interference in adjacent channels.

The solution to some of these problems may lie in utilization of the high frequency bands for broadcasting purposes. The present experiments, such as W8XH is carrying on, should produce information which will determine just how useful these frequencies may be. These experiments also may indicate whether they can be utilized in the present broadcast band, as well as to define some of the limits their use will set up in their respective fields.

Station WBEN has pioneered in short wave broadcasting and was the first station to go on the air with regularly scheduled musical programs. On March 18th, 1934, general experimental station W8XH went on the air on a frequency of 51,400 kc. and a power of 50 watts. Later the operating frequency was changed to 41,000 kc. and today the Buffalo area has many listeners to the W8XH programs on this frequency.

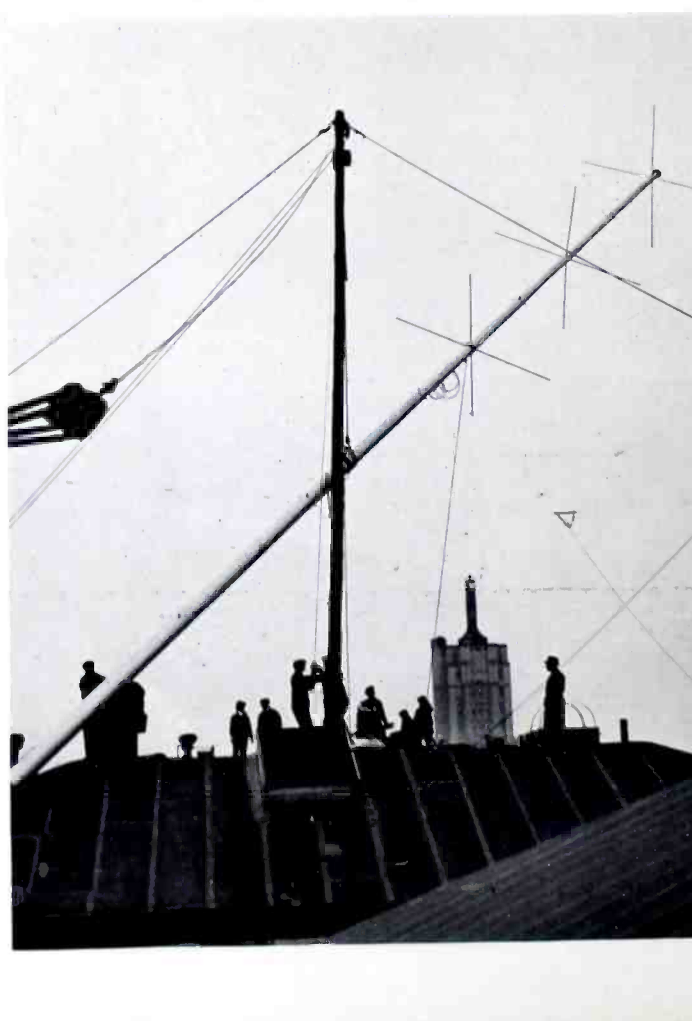
The interest which this station has aroused all over the country is attested by the thousands of inquiries received from interested persons in the Buffalo area who wish to receive the programs and from broadcast station executives who are wise enough to recognize the possibilities of the ultra high frequencies for broadcast purposes.

The installation will broadcast programs of the highest possible fidelity on a frequency of 41,000 kc. The transmitter was especially built for the job by the RCA Manufacturing Company at their Camden, N. J. plant. It has an output power of 100 watts and is capable of full 100 per cent high level modulation. The transmitter is crystal controlled and operates through three frequency-doubling stages to its operating frequency. An intermediate stage and modulated power amplifier complete the line-up. Preliminary tests have shown the transmitter to be very stable in operation.

The antenna system was designed by Dr. G. H. Brown, of the RCA Manufacturing Company, and is known as a Turnstile antenna array. The polarization is horizontal. The antenna is erected on a self-supporting steel pole, 70

(Continued on Page 31)

Erecting the special antenna atop the Hotel Statler.



A NEW MODULATION MONITOR

Designed to Meet the Requirements of the Recent F.C.C. Ruling

By A. R. Hopkins

A front view of the 66-A.

THE new 66-A and 66-B Modulation Monitors are instruments for measuring the degree of modulation of broadcast transmitters and for furnishing an instant warning when the degree of modulation exceeds a selected specific value. It was designed to meet the specifications of the Federal Communications Commission as set forth in Rule 139, Section (b), as amended October 29, 1935.

"The specifications pursuant to Rule 139, section (d), are as follows:

1. A DC meter for setting the average rectified carrier at a specific value and to indicate changes in carrier intensity during modulation.
2. A peak indicating light or similar device that can be set at any predetermined value from 50 to 120 percent modulation to indicate on positive peaks, and/or from 50 to 100 percent negative modulation.
3. A semi-peak indicator with a meter having the characteristics given below shall be used with a circuit such that peaks of modulation of duration between 40 and 90 milliseconds are indicated to 90 percent of full value and the discharge rate adjusted so that the pointer returns from full reading to 10 percent of zero within 500 to 800 milliseconds. A switch shall be provided so that this meter will read either positive or negative modulation and, if desired, in the center position it may read both in a full-wave circuit.

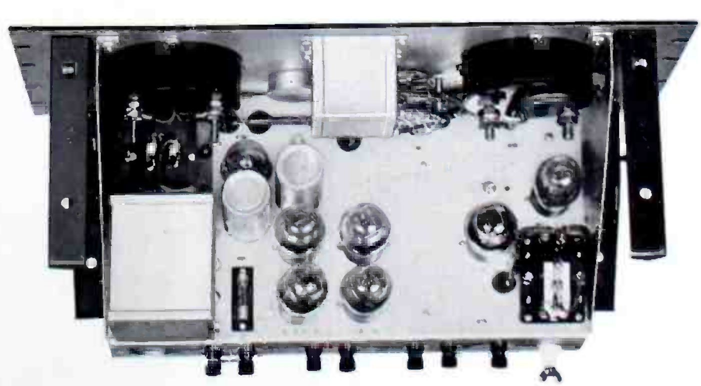
   The characteristics of the indicating meter are as follows: Speed—The time for one complete oscillation of the pointer shall be 290 to 350 milliseconds. The damping factor shall be between 16 and 200. The useful scale length shall be at least 2.3 inches. The meter shall be calibrated for modulation from 0 to 110 percent and in decibels below 100 percent with 100 percent being 0 DB.

   The accuracy of the reading on percentage of modulation shall be + 2 percent for 100 percent modulation, and + 4 percent of full scale reading at any other percentage of modulation.
4. The frequency characteristics curve shall not depart from a straight line more than + ½ DB from 30 to 10,000 cycles. The amplitude distortion or generation of audio harmonics shall be kept to a minimum.
5. The modulation meter shall be equipped with appropriate terminals so that an external peak counter can be readily connected.
6. Modulation will be tested at 115 volts + 5 percent and 60 cycles, and the above accuracies shall be applicable under these conditions.
7. All specifications not already covered above, and the general design, construction, and operation of these units must be in accordance with good engineering practice."

The operation of the monitor may be described as follows: The R. F. signal to be monitored is impressed across the input binding posts, controlled by the "R.F. Input" control, and rectified by the first diode (RCA-1-V). The R.F. component is then filtered out of the signal allowing a pulsating direct current to flow in the first diode load resistor. The "Carrier"

(Continued on Page 30)

Rear view with cover removed.



AUDIO FREQUENCY DISCRIMINATOR

(Continued from Page 9)

The general arrangement of the iron core transformers is shown in Figure 11. Long E type core punchings were utilized with interleaving straight pieces bridging the outside legs, leaving an appreciable air gap in the center leg. A large air gap is necessary in the magnetic circuit, in order to make the characteristics of the filter independent of voltage amplitude across the coil. The air gap is placed in the center leg, to minimize inductive hum pickup, which is particularly troublesome on the low frequency bands. The air core coupling is secured by cardboard spacers inserted between coils, the combination being taped together.

Line-Up Procedure

The general line-up procedure is described in the following. For practical reasons the center band (No. 6) was the first to be adjusted. Adjoining stages were progressively fitted to either side. Coupling was first made very loose, in the case of the iron core units, by sliding the two E stacks with their respective coils well apart (½ air gap in center leg). By means of variable capacitors, the two coils were tuned for maximum response at the center frequency. The coupling was then increased until approximately the desired band-width was obtained. If net losses were low, and the curve obtained sharply double-peaked, the primary or secondary circuits, or both, were loaded with shunt resistors, it sometimes being necessary to juggle both the coupling and the shunt resistances. When the curve shape was judged final, the variable capacitors were removed and fixed capacitors of the correct value substituted.

In practically all cases, the individual curves are not symmetrical, the double peaks purposely being made unequal to compensate in the combined response curve for the wider low side skirt

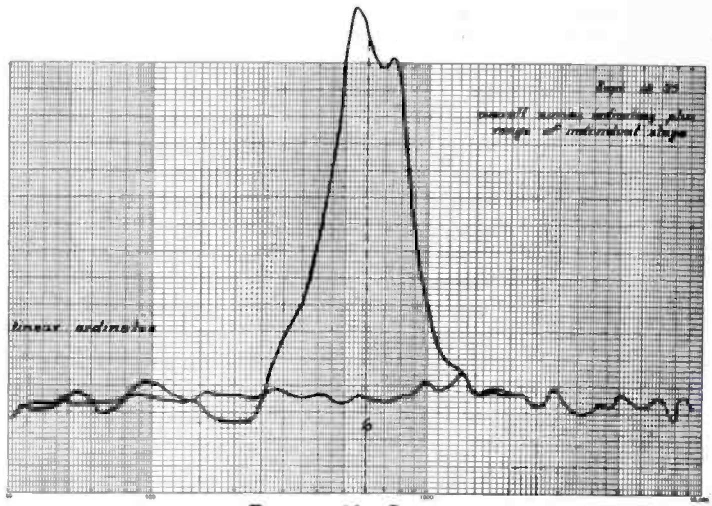


FIGURE No. 6.
FREQUENCY IN CYCLES PER SECOND

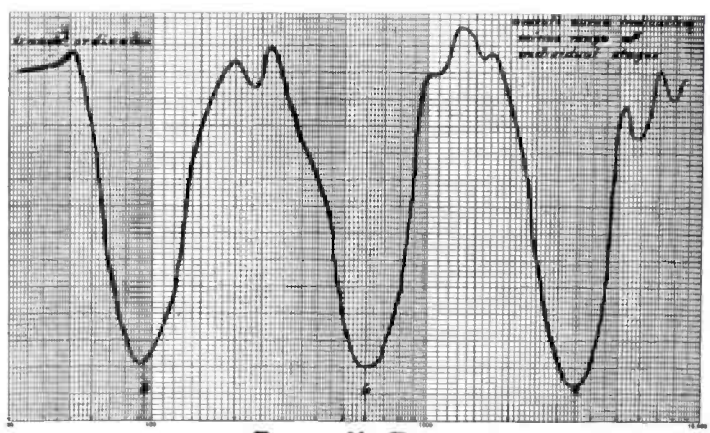


FIGURE No. 7.
FREQUENCY IN CYCLES PER SECOND

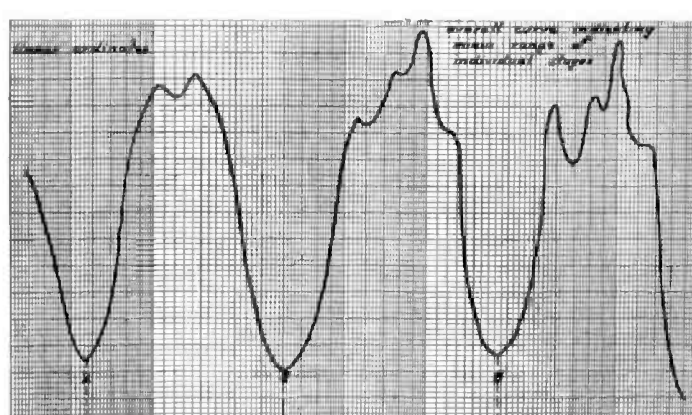


FIGURE No. 8.
FREQUENCY IN CYCLES PER SECOND

flare characteristic of broadly tuned coupled circuits of this type. From an inspection of the individual and combined response curves (Figures 4 and 5) this effect may be noted. It was also necessary to reverse one winding in each alternate coupled circuit to secure correct phasing at the overlap points. If this were not done, abrupt peaks and dips would appear in the overall characteristic.

When all coupling adjustments were complete, and the overall characteristic judged satisfactory, the transformers were sealed permanently in their cases, with transformer compound to preserve adjustment. In some cases it was necessary to make a final readjustment of the values of the tuning capacitors to compensate for capacity changes in sealing units, and to smooth out the overall characteristic.

High Frequency Cut-Off Filter

In order to increase its utility in receiver response work, the discriminator is provided with a continuously variable high frequency cutoff filter. This filter operates independently of the band filters and allows a much finer degree control of the upper limit of the tonal range than does the band filter. As indicated by the curves (Figure 10) the cutoff filter gives an approximately vertical cutoff over its entire range, being similar in characteristic to the cutoff obtained in the better class radio receivers.

The cutoff filter is arranged so that it may be switched in and out of the circuit. This flexibility is very desirable under certain conditions.

Operation Notes

1. With all controls set at zero, overall characteristic is approximately flat with net gain of unity.

2. Calibration of individual bands is only approximate. The figures on the dials indicate relative gain near center of band

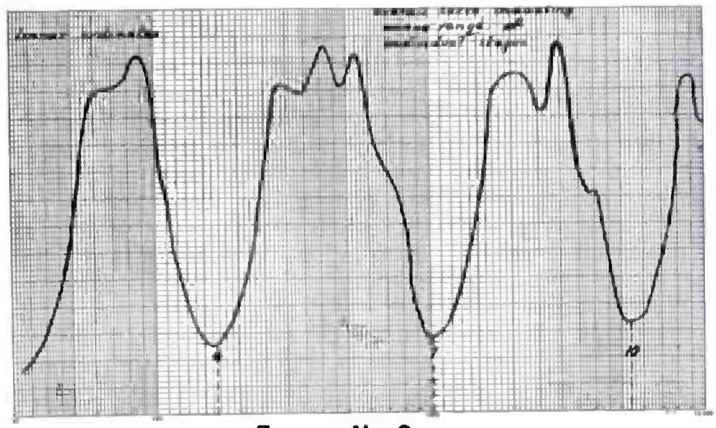


FIGURE No. 9.
FREQUENCY IN CYCLES PER SECOND

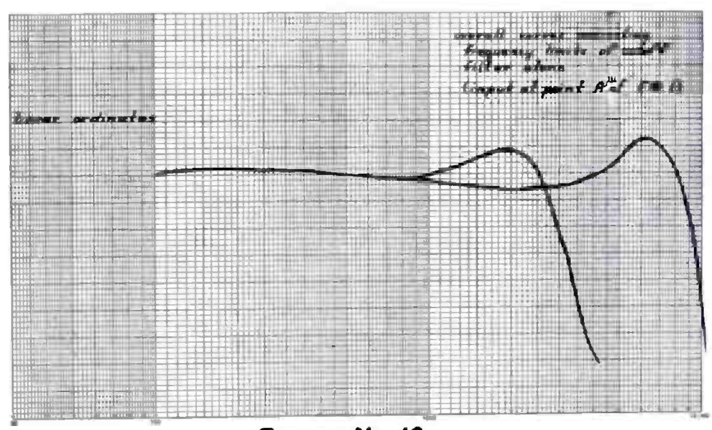


FIGURE No. 10.
FREQUENCY IN CYCLES PER SECOND

when all immediately adjoining controls are set at zero.

3. Output level should not be allowed to rise above ¼ volt. If this limit is not exceeded, the net distortion should not exceed 2½%.

4. Impedances: Input 1,000,000 ohms; output 32,000 ohms.

5. Maximum gain with flat characteristic is approximately 20 DB.

6. Output amplifier may be used only with cutoff filter in circuit.

7. Calibration figures on cutoff filter refer to frequency at which response has dropped to 90%.

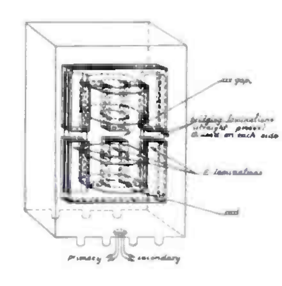


FIGURE No. 11.

WHAT EUROPEANS ARE DOING

(Continued from Page 3)

$1.50) would not stand the peak current requirements. Superheterodyne receivers are not popular in the battery set field because they all exceed the maximum battery consumption requirements mentioned. Price agreements also greatly affect receiver design. Tube prices are very high according to the American point of view. Set manufacturers pay about $7.50 for a five-tube receiver set of tubes. These tubes would cost about $2.50 in the United States. The list price of the European tubes would be about $16.00. To keep the receiver costs low, therefore, English set designers are forced to use the minimum number of tubes. Chassis costs are not much greater than comparable American chassis costs.

Testing component parts.

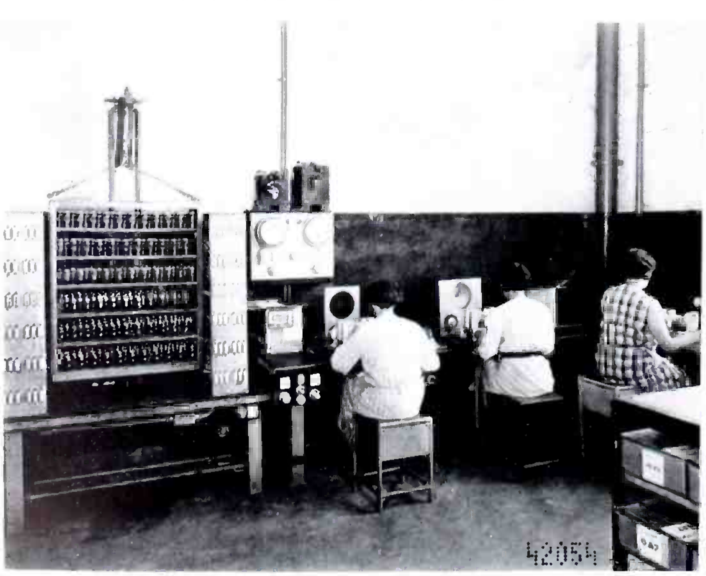
Majority of French Broadcasts Below Average

The great majority of French broadcast stations are below the average of other European stations in quality. Consequently, the French people in general listen to foreign broadcasts, and therefore require better sets of higher sensitivity and greater selectivity. The simple regenerative receivers were never very popular in France.

American type tubes are popular in France. A large number are made there, and others are imported from the United States. The prices of these tubes are high, however, because of the quota, and tend to curb the number of tubes used in the design of the receivers. In fact, the import quota has a decided effect on French receivers. It limits the importation of foreign receivers, and makes manufacture more difficult and expensive because of the limitation on the importation of certain components not readily available in France.

French receivers, however, employ five or more tubes, and are high in selectivity. The design is close to that of the American receiver, with the exception that little interest is shown in short-wave reception.

Incoming inspection of valves and lamps.



Belgium Similar to France

The Belgians, like the French, want to listen to foreign broadcasts, and their receivers are designed for selectivity. American tubes are widely used, and American types are manufactured in Belgium. Belgium and French receiver sets are quite similar.

Local Interest Programs Predominate in Germany

Conditions in Germany differ from those in most other countries. Programs of local interest predominate, and an extremely inexpensive receiver is produced by the German radio manufacturers. Consequently, the poorly paid classes can afford radio reception. This condition is not entirely due to manufacturer activity, as it is strongly sponsored by the German Government. These low priced German sets sell for 75 RM ($30.00). They consist of three tubes, including rectifier, and are of the regenerative detector audio amplifier type.

German receivers above the minimum requirements of the people's receiver (Volks Empfanger) are designed for foreign reception, and are highly selective. Selectivity in most cases predominates at the expense of fidelity. These receivers are expensive.

Radio programs are good, but include much propaganda.

Austrian Stations and Programs Excellent

In spite of the fact that Austrian stations and programs are excellent, the receivers sold in Austria are largely for foreign reception. Many people want to receive the Munich broadcasts through strong local signals. This Munich transmitter is interesting for political reasons, and is separated in frequency only 9 kc. from the Vienna transmitter. Budapest is also a popular station, and is separated in frequency only 30 kc. from the 120 kw. local transmitter. Field strength of local stations in parts of Vienna is several volts.

The Austrian sets are mostly of the four or more tube superheterodyne type with extremely great selectivity (16 kc. band with 60 db down); high Q coils, low loss components and many tuned circuits are used to obtain these results. Quality of reproduction is of secondary importance.

European Receiver Costs Higher Than American

The prices of European receivers without exception are greater than the American equivalents. As a basis of comparison, we can take a five tube superheterodyne receiver of 2 watts output, with a sensitivity of 50 microvolts for 50 M. W. output, 2 wave bands (A and X), and dynamic loudspeaker. This is the type of set which is most widely sold in Europe.

The price of this set in various countries would be approximately:

England	12 Guineas	$65.00
Belgium	1950 Belgian Francs	65.00
Hungary	400 Pengo	80.00
Austria	450 Austrian Schillings	86.00
France	1450 French Francs	97.00
Germany	280 R. Marks	110.00

An equivalent American set, but with three wave bands, would sell for about $40.00. Dealer discounts in these countries run from 27% to 40%.

Comparative Labor Costs

In view of these high prices, it might be interesting to see what labor costs and salaries are in these countries. Approximate hourly wages for a girl operator on chassis wiring, are:

England	6-8 pence	12-16 cents
France	4-5½ Francs (French)	26-37 cents
Belgium	3-4 Francs (Belgium)	12-16 cents
Hungary	30-35 fillers	5-6 cents

A good radio engineer of 4-5 years' experience, college graduate or the European equivalent, receives about the salary indicated below, per week:

England	5 Pounds	$25.00
France	650 FF	40.00
Belgium	700 FB	28.00
Austria	75 A. S.	15.00
Hungary	70 Pengo	15.00

Number of Sets Sold Per Thousand Population

In spite of these low salaries paid, there are considerable numbers of sets sold in Europe. The following are some figures on sets per 1000 population for most countries in 1934:

Denmark	154
U. S. A.	153
Great Britain	136
Sweden	113
Germany	82
France	35

By way of comparison, here are some figures based on motor cars in use in 1934:

U. S. A.	1 car per	5 people
France	1 car per	24 people
Great Britain	1 car per	27 people
Hungary	1 car per	1000 people

American Cars Exported to Balkans Must be Radio Equipped

The General Motors people at Antwerp equip a number of their cars with radio receivers, and all G. M. cars sold in the Balkans are radio equipped. A radio set on a car is considered a part of the car. If sold separately, it could not be imported at all in some Balkan countries because of import restrictions.

The number of sets sold per year (1934) in several countries, were approximately as follows:

England (United Kingdom)	1,200,000
Germany	1,000,000
Austria	75,000
Hungary	35,000
Belgium	100,000
France	600,000

Who Pays for European Broadcasting?

The broadcast programs are supported in most European countries by Government Administrators or companies sponsored by the Government. These companies receive their income from license fees collected from listeners.

In England the fee is 10 shillings per year, four-sixths of which ($1.10) is used for programs and the balance for transmitters and administration.

In France the broadcasting is both government owned and independently owned. In all likelihood within a few years the French will be operating on a system similar to that used by the English.

In Germany, as in Austria, Hungary, Czechoslovakia, and many other countries, broadcasting is handled by the Administrations.

The following table shows the license fees required (1935) in each of the countries listed:

Austria	Registering	AS 24	$3.86
Belgium	Annual License Fee	60 Fr. (Bel.)	2.40
Czechoslovakia	Set Tax	120 Crowns	3.30
France	Set Tax	15-50-100-200 F. F.	
Germany	Set Tax	24 R. M.	10.00
Hungary	Set Tax		8.82
Italy	Set Tax		6.84
Holland	Set Tax	Register	No fee
Switzerland	Set Tax	15 S. F.	4.95
England	Set Tax	10 s.	2.50
U. S. S. R.	Set Tax	3-12-24 rubles	

Differences in Power Supplies

I would like to correct a mistaken impression that most American engineers have about power supply systems in Europe. The supply mains in England are very largely 200-250 volts, 50 cycles, and on the Continent mostly 110 volt, 50 cycles, with the exception of Germany which is 230 volt, 50 cycles. There are exceptions to this, however, but they do not represent a large percentage. D. C. mains represent about 10% of all supplies and there are some 25, 42, 45, and 60 cycle supplies, and some 150 volt supplies.

	Voltage	Frequency
Austria	110-220	50 cycles&D.C.
	110-220	50 cycles
Bulgaria	110-150-220	50 cycles
Czechoslovakia	120-220	50 cycles
Denmark	220	D. C.
	110-127	D. C.
	220	50 cycles
France	115-220	D. C.
	110-220	D. C.
	110-190	25 cycles
Germany	230	50 cycles
	220	D. C.
Hungary	110	D.C.&50 cycles
Szeged	100	42 cycles
Debreszen		50 cycles
Italy	100-150-220	50 cycles
Milan	225-160	42 cycles

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ADJUSTMENT OF SECTIONALIZED ANTENNAS

(Continued from Page 15)

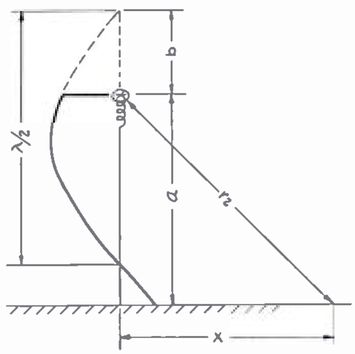


Figure 4

$$B = \frac{j\mu I_0}{2\pi x \sin G}\left[\cos B\,\epsilon^{-jkr_2} - \cos G\,\epsilon^{-jkx} - j\frac{a}{r_2}\sin B\,\epsilon^{-jkr_2}\right] \quad (3)$$

The vertical electric intensity at the same point is

$$F = \frac{j\mu c I_0}{2\pi \sin G}\left[\frac{\cos B}{r_2}\epsilon^{-jkr_2} - \frac{\cos G}{x}\epsilon^{-jkx} - \frac{a}{kr_2^3}\sin B\,\epsilon^{-jkr_2} - j\frac{a}{r_2^2}\sin B\,\epsilon^{-jkr_2}\right] \quad (4)$$

Thus for any particular coil adjustment, we can find the critical point by calculating F and B from (3) and (4) for several values of x until we find the critical point. Thus, if we wish to attain this coil adjustment, we merely set our measuring equipment at the critical distance, x_1, from the antenna base and adjust the coil until a measurement indicates that the critical phase relations are in existence at the point x_1.

As yet we have not mentioned what the indicating equipment consists of. This will be taken up later. For the present we will assume that we have such a device.

The particular coil adjustment and antenna current distribution to which any antenna will be adjusted is determined by examining the vertical characteristics for a particular antenna height and for a number of coil adjustments. The information concerning the vertical characteristics for this type of antenna is given elsewhere.*

In general, when it is desired to gain the best suppression of sky wave for elimination of fading, the best vertical characteristic is that given by a straight vertical wire which is 190 degrees high (0.528λ) with no loading at the top. With top loading, it is possible to achieve the same vertical radiation characteristic with an antenna lower than 190 degrees. The amount of top loading of course depends on the height of the antenna. Fig. 5 shows the number of degrees of suppression required to make an A degree antenna simulate a 190 degree antenna. Values from this curve

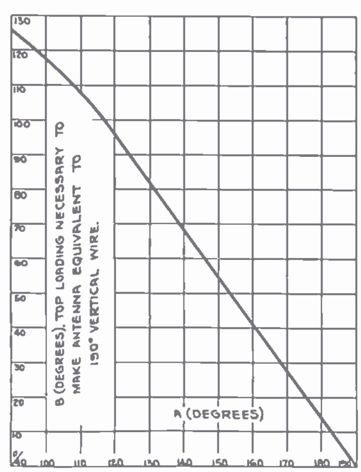


Figure 5

were substituted into equations (3) and (4) to determine the critical distance, x_1. The results of this computation are shown in Fig. 6. This curve shows the distance to the critical point for particular antenna heights.

IV. The Sectionalized Tower

The general arrangement of the sectionalized tower is shown in Fig. 7. The total antenna height is d, while a is the distance from the earth to the coil. The length of sine wave which would be above the coil point if the coil and top section of the antenna were replaced by a straight wire is b.

* G. H. Brown, "A Critical Study of The Characteristics of Broadcast Antennas As Affected By Antenna Current Distribution" Proc. IRE, Vol. 23, pp.53-59, January, 1936.

$D = 2\pi d/\lambda$ radians $= 360d/\lambda$ degrees.

$A = 2\pi a/\lambda$ radians $= 360a/\lambda$ degrees.

$B = 2\pi b/\lambda$ radians $= 360b/\lambda$ degrees.

$k = 2\pi/\lambda$.

$x =$ distance measured along the ground from the base of the antenna.

$r_2^2 = a^2 + x^2$.

$r_3^2 = d^2 + x^2$.

Then the electromagnetic flux density at the surface of the earth a distance, x, from the base of the antenna is

$$B = \frac{j\mu I_0}{2\pi x \sin G}\left[\cos B\,\epsilon^{-jkr_2} - \cos G\,\epsilon^{-jkx} + \frac{\sin B}{\sin(D-A)}\left\{\epsilon^{-jkr_3} - \epsilon^{-jkr_2}\cos(D-A)\right\}\right] \quad (5)$$

The vertical electric intensity at the same point is

$$F = \frac{j\mu c}{2\pi}\frac{I_0}{\sin G}\left[\frac{\cos B}{r_2}\epsilon^{-jkr_2} - \frac{\cos G}{x}\epsilon^{-jkx} + \frac{\sin B}{\sin(D-A)}\left\{\frac{\epsilon^{-jkr_3}}{r_3} - \frac{\cos(D-A)}{r_2}\epsilon^{-jkr_2}\right\}\right] \quad (6)$$

Thus, once A, B, and D have been decided upon, equations (5) and (6) will tell what the critical distance is. The relations of use in choosing A, B, and D have already been published.*

* Loc. Cit.

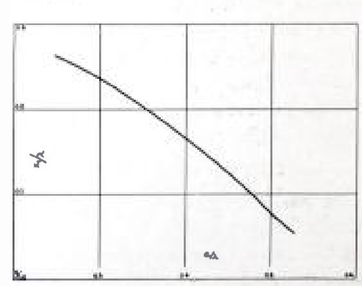


Figure 6

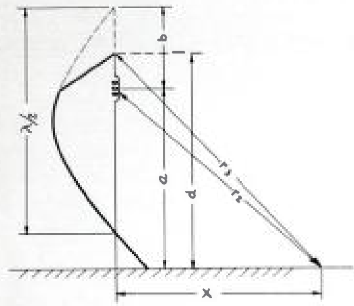


Figure 7

V. The Method and Apparatus for Determining the Correct Adjustment

Up to this point, we have not described the apparatus which will detect the phase quadrature of the electromagnetic and electric fields. A simple arrangement which will do this is shown in Fig. 8. Two separate receiving antennas are used. One, a loop antenna, L, induces a voltage on the grid of an amplifying tube, T_1. The other is a vertical rod antenna which impresses a voltage on the grid of another amplifier, T_2. The output of these two tubes feeds into a common resistor, R_1. The voltage across this resistor is measured by means of the vacuum tube detector, T_3. The loop, L, is tuned to resonance by means of the capacitance, C. The voltage induced in the loop is in time quadrature with the electromagnetic flux which links the loop. Since the loop circuit is resonated, the voltage on the grid of T_1 is in phase with the electromagnetic flux linking the loop. The voltage induced in the rod antenna and consequently on the grid of T_2 is in phase with the vertical electric intensity along the rod. Then from the parallelogram law, it is seen that if the B and F vectors are in time quadrature the reading on meter M will be unchanged as switch S is changed from position 1 to position 2, or vice versa. If the F and B vectors are in any other phase relation except the quadrature position, a change in the position of S will result in a change in the reading of the meter M.

To adjust an antenna with this apparatus, the following procedure is followed. The critical distance, x_1, is first determined by calculation. The apparatus shown in Fig. 8 is placed at this distance from the antenna to be adjusted. The transmitting antenna is then excited at the operating frequency with a very low power. The loop, L, is next tuned to the operating frequency, and is pointed at the transmitting antenna. The position of the tap on the coil of the transmitting antenna is then varied. At each position of the tap, the switch S on the detecting apparatus is thrown to its two positions. This procedure is followed until the tap position is found which yields the same reading on meter M for both positions of the switch, S.

The above apparatus is especially adapted for making the adjustments with a small amount of power into the transmitting antenna.

It may at times be desirable to check the adjustment of an antenna while full power is being applied. This can be done very simply by using the apparatus shown in Fig. 9. As before, a rod and loop antenna are used. The accompanying circuits have been modified as shown and the outputs applied to the plates of a cathode ray oscillograph. In this case, the voltage across the pair of plates connected to the loop will be in phase with the B vector, while the voltage on the other pair of plates will be in quadrature with the F vector. Thus when the B and F vectors are in time quadrature, the image on the cathode ray oscillograph will appear as a straight line. (See Fig. 9).

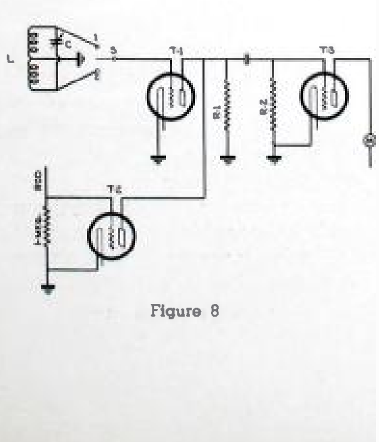


Figure 8

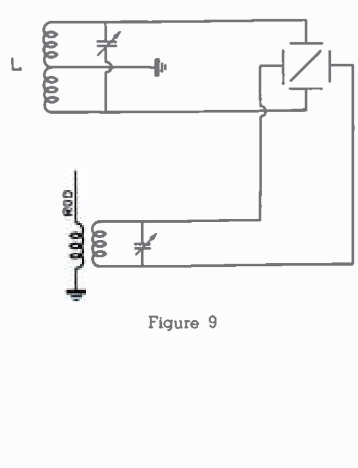


Figure 9

WHAT EUROPEANS ARE DOING

(Continued from Page 27)

	Voltage	Frequency
Naples	105	60 cycles
Rome	110-115	45 cycles
Holland	110-220	50 cycles
Roumania	105-210	50 cycles
Cluj	380	50 cycles
Spain	110-150-160	50 cycles
Switzerland	220	50 cycles

External Difference

European receivers differ from American receivers principally in the dial and scale arrangements. In the U. S. A., all stations are separated by 10 kc. from the next channel. In most large cities there are over thirty local stations from which to choose a program. The broadcast chains bring programs from the entire U. S. A. to the local stations. The kilocycle scale is therefore most convenient and serves the entire country.

In Europe there are indeed few places where there are more than two local stations. The channels are separated by 9 kc. and nearly all over Europe the station wave length rather than the frequency is referred to. The public demands that the scales show the station name in addition to the frequency or preferably the wave length. Some of the scales are quite complex and expensive. The Kino Scala, for instance, projects the station name on a small screen on the face of the cabinet.

Summary of European Radio Conditions

We might summarize as follows:

The better radio receivers in Europe today are more modern and provide reception on 2, 3, or 4 wave bands, 12-30, 18-52, 200-600, and 1000-2000 meters.

The demand in general is for table type receivers and prices are distinctly higher than U. S. A. prices due principally to tube prices.

NEW MODULATION MONITOR

(Continued from Page 23)

meter reads the average value of this direct current, which is proportional to the average carrier voltage. The audio component of the voltage across this load resistor excites two indicating devices —one a meter, calibrated directly in modulation percentage and decibels, the other, a flasher alarm circuit for providing a warning when a certain degree of modulation is exceeded.

The previously referred to audio component is rectified by the second diode detector (RCA-76-2) and charges a condenser. The voltage across this condenser is impressed across the grid circuit of a voltmeter tube (RCA-76-3) which has the modulation meter in its cathode circuit. The unusual feature of this voltmeter tube circuit is its indifference to plate voltage changes. A high resistance connected across the condenser, referred to above, gives the modulation meter the characteristic of rapid increases and slow decreases in readings. This feature serves two important functions. It makes for better readability of the meter, since the needle does not fluctuate as violently as if it were allowed to try to follow the audio voltage, and it allows the meter to read peaks of shorter duration than it otherwise would be capable of indicating.

To excite the peak indicating light and high speed relay, the same audio component referred to above is impressed across the grid circuit of a triode detector (RCA-76-1). The output of this detector exists across the cathode resistor and is impressed across the grid circuit of the relay tube, RCA-885. The bias on the relay tube is controllable from the front panel, and this control is calibrated from 50 to 120, representing percent modulation. The relay tube is normally biased to cut-off, and when the audio voltage exceeds a value determined by the "Peak Level" control the tube passes current and operates the relay and lamp which are connected in its circuit. The contacts of the relay are connected to binding posts so that the relay may be used to key a counter or an auxiliary alarm system such as a buzzer, bell, or additional lamp.

Two binding posts are provided for shunting the "Carrier" meter with a resistor which will be furnished with the monitor. The function of this resistor is to change the calibration of the modulation meter by 10 decibels. With this shunt the zero level becomes —10 D.B., —20 D.B. becomes —30 D.B., etc. The purpose of this added range is to make the instrument more accurate at lower percentages of modulation which is an advantage in taking amplitude characteristics of the transmitter.

Two binding posts are provided for the insertion of one or more additional meters when desired. These two posts are shorted by a link when not in use. A switch is provided for selecting the polarity of the audio peak being monitored. This is effective on both the meter and flasher circuits.

With reference to the F. C. C. specifications copied above:

1. A meter having a 3 11/32 inch scale is provided for this purpose. Over 2½ inches of deflection is used as standard level.

2. A light is provided, also a relay, and the flash control is calibrated from 50 to 120 percent. Naturally, it can be used only up to 100 percent when monitoring negative peaks.

3. The meter used has a useful scale of 3 11/32 inches. All of the stipulations of (3) are met in the instrument.

4. The frequency characteristic is within ± ½ D.B. from 30 to cycles.

5. Binding posts are provided as described above.

6. A variation of ± 5 percent from 115 volts gives no change in indicated percentage. The flasher and relay calibration changes approximately 2.5% change in line voltage.

To operate the instrument, supply it with 110-120 volt, 60-cycle power at the plug marked "115-V," and with a portion of the signal to be monitored at the "RF Input" binding posts. Only about .16 watts of RF power are required by the indicator on normal range. By means of the "RF Input" control adjust the input so that the "Carrier" meter reads 100. The "Modulation" meter now reads the percentage modulation directly, and of such polarity as is shown on the "Polarity" switch. If the modulation percentage exceeds the setting of the "Peak Control," the indicating lamp will light and the "Alarm Contacts" binding posts will be shorted by the relay. The unit is designed for either rack or cabinet type mounting, a cabinet replacing the dust cover for table mounting.

ULTRA VIOLET RAY NOW USED IN RECORDING

A NEW development in sound recording, which eliminates the lisping and hissing effects that have marred the voices of many screen celebrities, was recently described in a paper presented by Glenn L. Dimmick, RCA Photophone Engineer, before the Society of Motion Picture Engineers in New York City. Use of ultra-violet light, which is located in a narrow frequency band above white light, instead of ordinary light for recording, permits more accurate focusing of the recording light, thereby giving greatly improved voice and musical reproduction.

Like Improving Photograph

The advantages of the new ultra-violet system result from improvements in the photographic process. In this case the photograph is the picture of the sound on the film. Acknowledging some earlier research along similar lines by Carl Louis Oswald, the RCA Photophone engineers, working in the research laboratories of the Radio Corporation of America at Camden, N. J., discovered that by restricting the light focused on the film negative, during recording, to a narrow band in the ultraviolet range, sharper focusing of the lenses in the optical system and controlled penetration of the light on the negative emulsion made it possible to photograph the sound patterns with a sharpness and delineation which cor-

(Continued on Page 32)

CBS EXPANDS

(Continued from Page 7)

amplifiers and 55-A bridging amplifiers. The latter two amplifier types are installed in Master Control. The overall electrical characteristics of a typical studio "channel" are as follows:

1. Frequency characteristic 1 db at 1000 c.p.s. from 30 to 8000 c.p.s.

2. The r.m.s. harmonic distortion equals 0.30% at 400 c.p.s.

3. The unweighed noise and/or hum level is 55 db below 0 level (0 db = 6 m.w.).

CBS PLAYHOUSE

The 44th Street Columbia Playhouse was placed in service in February 1934. A technical description of this auditorium studio was published in the May 1934 issue of "Broadcast News," entitled "The Columbia Radio Playhouse," by Howard A. Chinn. This Playhouse is in continuous operation and with such a degree of success as to justify the operation of two additional auditorium studios, the CBS 44th Street Little Theatre and the 45th Street Radio Playhouse. All three Playhouses are similarly equipped and operation at these points has proven to be very successful. Figure No. 5 is a photograph of the control room at the CBS 45th Street Radio Playhouse.

The new CBS studios and Playhouses are noted for their excellence in program transmission, and represent another progressive step forward in anticipating high fidelity broadcast standards of the future.

The entire project was directed by E. K. Cohan, CBS Director of Engineering. The audio equipment installation was under the direction of A. B. Chamberlain, Chief Engineer for the Company. Studio construction was supervised by G. Stanley McAllister, Manager of Construction and Building Operations.

A Few Statistics—CBS Studios

City of New York

Studio 1	43'x41'x15'6"
Studio 2	38'6"x21'6"x13'6"
Studio 3	41'x28'x13'6"
Studio 4	38'x21'6"x13'6"
Studio 5	23'6"x14'x13'6"
Studio 6	25'6"x12'6"x8'6"
Studio 7	30'x22'x8'6"
Studio 8	8'x8'6"x9'
Studio 10	27'6"x25'6"x9'
44th Street Radio Playhouse	91'x67'
45th Street Radio Playhouse	88'x49'
44th Street Little Theatre	78'6"x49'6"
44th Street Little Theatre Auxiliary Studio	34'6"x22'6"x10'
Total Studio Floor Area	27,037.50 sq. ft.
Audience Capacity:	
44th Street Radio Playhouse	1,050
45th Street Radio Playhouse	750
44th Street Little Theatre	550
Velocity Microphones, Total Number	50
Amplifiers, Total Number	180
Volume Controls, Total Number	325
Volume Indicators, Total Number	66
Equipment Racks, Total Number	60
Dial Monitoring Stations, each allowing selection of 10 programs	25 (capacity 41)
Loudspeakers, Total Number	102
Radio Receivers, Dial System Vacuum Tubes, in Continuous Service	775
S.I.E. A.C. Load	40 KW
Microphone Outlets, Total Number	114

KFBK, 5000-WATTER

(Continued from Page 10)

fornia superimposed upon a compass. Indicated on the map are each of the five McClatchy Radio Stations.

The transmitter, a new RCA type 5-C, has an overall RMS distortion at 100% modulation at 400 cps, 1.5%. These measurements were taken with a 40-C program amplifier in the circuit. This low distortion coupled to a satisfactory hum level of —59 db and an overall frequency response of from thirty to eight thousand cycles to within one db from microphone to antenna gives KFBK a signal which we are justly proud of.

The new antenna at KFBK, the first of its kind, was built by Truscon. It is an unguyed vertical radiator with an even cross sectional diameter of 23 feet throughout its length. Sectionalizing insulators are provided at a point 110 feet from the top to provide top loading.

It is planned to load the antenna from its present .52 wave electrical height to .58 wave when weather conditions permit. At the present the sectionalizing insulators are shorted out.

The physical height of the tower is 334 feet above the insulators on top of the transmitter building.

NEW HIGH FREQUENCY STATION

(Continued from Page 22)

feet high, located on the roof of the Hotel Statler. The total height above street level is 350 feet.

In the design of the transmitter, special attention was given to the matter of audio-frequency response with the result that the transmitter itself is flat within two decibels from 30 to 17,000 cycles.

While field strength measurements are yet to be taken on the new transmitter, past measurements and listener reports indicate that very good broadcast reception will be obtained up to a distance of between twenty-five and thirty miles. Thus, it can be readily seen that a broadcast station operating on the ultra high frequencies has as good coverage as the night-time coverage obtained by most one thousand watt regional stations operating in the 550-1500 kilocycle band, and this with considerable less power output. It also appears that receiver manufacturers are recognizing the importance of extending the receiving range of receivers into the ultra high region. There are now a number of sets on the market which will do this and more are soon expected to follow.

ZEPPELIN'S MAIDEN FLIGHT TO BE BROADCAST BY NBC

The thrill fifty passengers aboard the giant new transatlantic Zeppelin LZ-129 will experience when Dr. Hugo Eckener gives the order to "Up-ship!" for the craft's maiden flight to Lakehurst, N. J., will be shared by listeners in America when the takeoff from Frankfort, Germany, is broadcast over National Broadcasting Company networks on the evening of May 6.

Max Jordan, NBC's continental European representative, will be a passenger aboard the big ship and will describe not only the takeoff but progress of the ship on its westward voyage.

Besides the takeoff and broadcasts enroute, Jordan will describe the landing at Lakehurst, which is expected to take place early in the morning of May 10, or about eighty hours after the takeoff at Frankfort.

BEAUTY AND UTILITY COMBINED IN NEW STUDIOS

(Continued from Page 21)

public broadcasts and making the tours reaches into the thousands each month.

Brief History

WGN's call letters were first used in 1924 when The Chicago Tribune took over the operation of old station WDAP, one of the pioneers of radio, located on the roof of the Drake Hotel. Previous to that time The Tribune Company had entered radio through the use of special programs on the three other Chicago radio stations, KYW, WEBH and WDAP. These early programs being unsatisfactory, The Tribune Company acquired WDAP by lease in 1924 and in 1926 purchased the station and all of its equipment. The Tribune Company also acquired the old Charles E. Erbstein stations, WTAS and WCEE, in 1925, through the purchase of these two stations and changed the call letters of WTAS to WLIB for the magazine, The Liberty Weekly. In September, 1928, the three stations, WGN, WLIB and WCEE were all merged into one station by The Tribune Company and assigned to one cleared channel for broadcasting, 720 kilocycles, which WGN now occupies for its broadcasting. The consolidation of the three stations into one was accomplished by The Tribune in order to assist the Government in reducing the number of wave-lengths which were then in use in this, the fourth zone.

Increase in Power

The increase in broadcasting power of WGN also swept along with the evolution of the station. The original power of WGN was 1,000 watts. Then followed increases to 10,000 watts in 1926, 25,000 watts power two years later and finally on March 29, 1934, the new WGN 50,000 watt super-powered transmitter was placed in service.

The story of the call letters of WGN also is interesting. The call initials were acquired from Mr. Carl D. Bradley, operator of a coal carrying steamship which was named for him and which was operating on the Great Lakes. The ship owner relinquished the letters as a courtesy to the Tribune.

Plans for this WGN studio building were in the making for two years before actual construction work was started. As far back as 1932, the Management of WGN realized that the old quarters which consisted of four studios built in the penthouse on top of the Drake Hotel were inadequate. Actual construction work for this building was started on August 15, 1934 and was completed September 22 of 1935, thirteen months and a week after the first foundation work was started. More than 600 workmen were engaged in the various tasks of construction.

The exterior of the building has attracted comment from many famous artists and decorators. The cloister connecting the building and Tribune Tower is one of the most charming nooks in all Chicago.

Embedded in the limestone walls of the new building are stones from structures of architectural wonders of the world, some of them dating back 5600 years.

Ancient Structures Contribute Material

One of the stones is from the Great Pyramid built in 3700 B. C. Another is from the Roman coliseum, another from the Great Wall of China and one of the stone panels is from the "Holy Door" of St. Peter's in Rome, with the papal arms and the date carved upon it. These interesting objects were collected by Tribune correspondents all over the world and are supplementary to the many interesting pieces which are imbedded in the walls of Tribune Tower.

Most of the carving of the stone decorations was done on the scene of construction. Stone carvers, artists all of them, worked for many weeks on high platforms and scaffolds carving the decorations to the entrance of the receptios room in the courtway between the studio building and Tribune Tower.

WGN's studio building, both as a practical radio studio working unit and from an artistic standpoint, stands as one of the showplaces of the country.

ULTRA VIOLET RAY

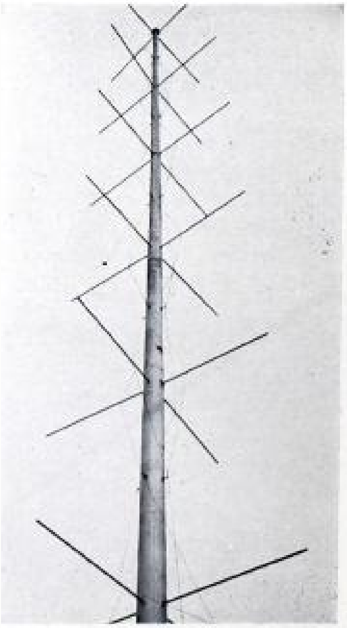
(Continued from Page 30)

responds more closely to the characteristics of the original sound than ever before.

Impossible to Focus White Light

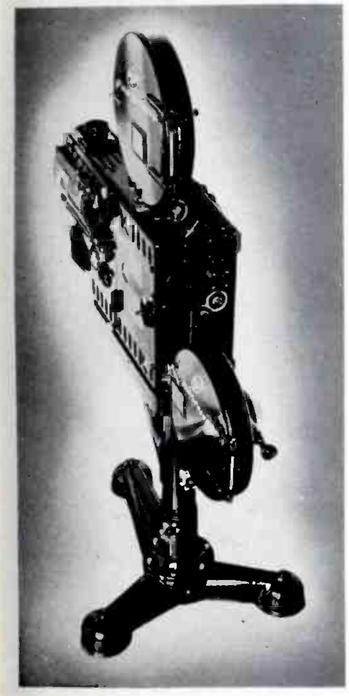
Ordinary white light is composed of a great many different wave-lengths. Since it is impracticable to focus all of those wave-lengths exactly at one time, those that are even slightly out of focus blur the edges of the sound pattern on the negative and introduce distortion in the reproduction. Additional distortion of the sound results when the light penetrates too deeply into the film emulsions and scatters.

The new ultra-violet method involves only a few simple adjustments in existing High Fidelity sound recording systems, consisting in the main of an adjustment of the lenses in the optical system for sharper focusing, and in the use of a light filter over an ordinary incandescent lamp, which limits the radiant light energy focused on the film to a narrow band, invisible to the unaided eye. The same method permits a much wider latitude in the process of making accurate positive prints for the theatres.



The turnstile antenna at W8XH.

NEW RCA PRODUCTS



NEW PROJECTOR

RCA Photophone presents a new Sound Projector with factory built-in Photophone High Fidelity Soundhead. Features: Famous RCA Rotary Stabilizer; simplified threading and operation; compactness; ease of servicing and Installing. Accurately reproduces all sound frequencies from 40 to 10,000 cycles.

ACT-40 AMATEUR TRANSMITTER

A highly efficient low cost 40 watt Amateur Phone and C.W. Transmitter. Built in sections like a bookcase, permitting economical growth without obsolescence. Section 40-R—the RF Unit, contains the complete crystal controlled oscillator, buffer-doubler, power amplifier and power supply. Modulator 40-M, Antenna Coupler 40-A and Cabinet Rack 40-C units can be added as the pocketbook permits.

AR-60 RECEIVER

A communication receiver designed for commercial and amateur use. Uses a single-signal superheterodyne circuit. Continuous band spread from 1500 to 25,000 kilocycles. 3 i.f. stages, and optional use of a crystal filter with band width control to obtain rejection of interfering signals a fraction of a kilocycle removed. Power supply allows operation from either 110 or 220 volts, 40-60 cycle AC source or from batteries.

ACR-175 AMATEUR RECEIVER

Especially designed to meet the rigorous requirements of receiver performance necessary to maintain communication in the crowded popular amateur bands. 5 to 600 meters, continuous ultra selective crystal filter, Electron-ray-tube tuning and signal strength indicator. Signal input read directly in microvolts. Iron core i.f. transformers. 11 tubes (2 i. f. stages). Greater band spread. Individual coils for each band. Separate 8" dynamic speaker.

RCA-834

The RCA-834 is a three-electrode transmitting tube for use as a radio frequency amplifier and oscillator, particularly at the higher radio frequencies. RCA-834 may be operated at maximum ratings at frequencies as high as 100 megacycles; it may be operated at reduced plate voltage and input up to 350 megacycles. As plate-modulated r-f power amplifier, operating Class C, approximately 58 watts output may be obtained. For telegraphic purposes, operating Class C, approximately 75 watts output may be obtained.

A DIGEST FOR THE RADIO READER

Recent Articles in Leading Publications

Reviewed by

By J. P. TAYLOR

ADVANCE DEVELOPMENT

Phase-Frequency Modulation. Radio, Dec. 1935, Pg. 6.

Frequency Modulation. Comm. & Broadcast Eng., Dec. 1935, Pg. 12.

Phase-Frequency Modulation. Electronics, Nov. 1935, Pg. 17.

Three resumes of the paper by Prof. E. H. Armstrong on his phase frequency modulating system—perhaps the year's outstanding development in radio transmission. Simplified diagrams and a few illustrations.

Secondary Emission Electron Multipliers. Electronics, Nov. 1935, Pg. 10.

An exceptionally good review of the paper and demonstration by Dr. V. K. Zworykin D. A Morton and L. Malter at the October meeting of the New York Section of IRE Enlarged photographs and explanatory diagrams of several types of these unusually interesting new tubes.

New High-Gain Low-Noise Tube. Comm. & Broadcast Eng Nov. 1935 Pg. 17.

A short note on the same paper by Dr. V. K. Zworykin. One photograph and several diagrams.

Recent Developments in Miniature Tubes. by B Salzberg and D G Burnside, IRE Proc Oct 1935 Pg. 1142.

Paper presenting the development and some of the characteristics of the new miniature or acorn tubes. Exceptional illustrations, together with a not too-technical writeup, give a good idea of the interesting possibilities of these novel tubes

ALLOCATION

FCC Ponders Super-Power, More Stations, by S Taishoff Broadcasting, Oct. 15, 1935, Pg. 7.

FCC Advances Plan for Station Power Boosts, by S Taishoff Broadcasting, Nov. 1 1935 Pg 9

Joint Hearing Planned on Power Boosts, by S Taishoff Broadcasting Nov. 15, 1935, Pg 7.

Successive reports on the consideration being given by the FCC to a plan for a general increasing of station powers. The situation is discussed in some detail and the changes expected to be made, and channels to be affected listed The information is unofficial but reflects usually accurate sources

ANTENNAS

The WLW "Suppressor" Antennas, by J. C. Findley Comm & Broadcast Eng., Nov. 1935 Pg 14.

Description of the suppressor antenna system employed by WLW to prevent increase of interference in the Toronto area when operating at 500 KW. Particularly interesting in view of possibility of additional 500 KW grants. Schematic of the feed circuits to the suppressor antennas and a simplified contour-map of the resulting power distribution are included.

Filtering for Double Radiation, by V. Andrew, Electronics, Oct. 1935, Pg. 13.

A very brief note on the simultaneous use of the same radiator by KRNT (1320 kc) and KSO (1430 kc). A simplified schematic of the antenna coupling systems is given.

FACSIMILE

Facsimile Looms as Press Rushes into Radio, by S. Taishoff, Broadcasting, Oct. 1, 1935, Pg. 7.

Non technical discussion of possibilities of newspaper use of facsimile. Interesting to broadcast engineers in view of probable tie-in with present broadcast services.

Photoradio Apparatus and Operating Technique Improvements, by J. L. Callahan, J. N. Whitaker, and H. Shore, IRE Proc., Dec. 1935, Pg. 1441.

A general review of the development and present status of photoradio transmission. Discussed in semi-technical terms and includes numerous illustrations.

FIELD INTENSITY

An Analysis of Continuous Records of Field Intensity at Broadcast Frequencies, by K. A. Norton, S. S. Kirby, and G. H. Lester, IRE Proc., Oct. 1935, Pg. 1183.

Analysis of a large number of records of field intensity made at the National Bureau of Standards. Average curves of field intensity versus distance, and empirical formulae based on these curves, are particularly interesting.

Field Strength Measuring Equipment, by E. L. Gove and C. E. Smith, Comm. & Broadcast Eng., Oct. 1935, Pg. 12.

Description of the design and operation of the field intensity measuring equipment used by the engineers of WHK.

A Field Intensity Slide Rule, by H. E. Gihring, Broadcast News, Dec. 1935, Pg. 26.

Interesting and valuable note on a practical method for determining the location of transmitter and predicting field strength. Typical examples and tables of measured conductivities are given.

General Considerations of Tower Antennas, by G. H. Brown and H. E. Gihring, Broadcast News, Dec. 1935, Pg. 14.

Final installment of what is perhaps the best paper yet written on this engrossing subject. Reprinted from IRE Proc.

MODULATION

High Power Outphasing Modulation, by H. Chireix, IRE Proc., Nov. 1935, Pg. 1370.

First authoritative description of the "Chireix" or "phase" system of modulation now being used by Radio-Paris and several other high-power continental stations. In this system a modulated output is obtained by varying the phase relation of two separate class C amplifiers from opposition to addition—improved efficiency being gained, although adjustment is complicated. The method is described and the mathematical treatment given.

Some Further Thoughts on Modulation, by L. E. Barton, Broadcast News, Dec. 1935, Pg. 8.

A short article, by the well-known authority on high-efficiency modulation, in which several of the lesser-known systems of modulation such as the "controlled plate efficiency system," "the Chireix" system," and the "separate side band (Class X) transmission system" are compared in non-technical terms with the Class B high-level system of modulation.

MONITORING

Broadcast Monitor P-A System, by H. L. Short, Radio Eng., Nov. 1935, Pg. 20.

Description of a simplified equipment for monitoring and auditioning. The device consists essentially of a power amplifier which may be driven by a built-in r-f tuner or from either of two microphone inputs or, by means of a simplified mixing system, from any combination of the three.

"Zero Level," by W. N. Weeden, Electronics, Oct. 1935, Pg. 19.

Humorous skit emphasizing (almost painfully) the still unsolved problem of riding gain.

Type 559-B Noise Meter, by H. H. Scott, The General Radio Exp., Nov. 1935, Pg. 5.

Brief note on a new model of this well-known instrument explaining the altered calibration, which is now based on the new zero reference level (threshold) recommended by the A.S.A.

The New Modulation Monitors, by A. E. Thiessen, The General Radio Exp., Dec. 1935, Pg. 1.

Description of a new modulation monitor designed to comply with the new ruling (Rule 139). The device is offered subject to approval by the FCC.

A Note on the Measurement of Meter Speeds, The General Radio Exp., Dec. 1935, Pg. 5.

A brief note on the ingenious method used to measure the response speed of the indicating meter employed in the above monitor.

A Direct-Indicating Audio-Frequency Meter, by F. K. Clapp, The General Radio Exp., Dec. 1935, Pg. 6.

First description of a new direct-indicating instrument in which the amplified audio frequency is applied to the grids of two gas discharge tubes in such a way that the current reversals actuate an indicating circuit consisting of a diode switching-tube and the indicating meter.

Modulated Emissions Added to WWV Standard Frequency Service, QST, Oct. 1935, Pg. 47.

Announcement of the new WWV standard frequency transmissions which have now been augmented by the addition of modulated emissions.

OPERATION

Broadcast Maintenance Costs, Electronics, Nov. 1935, Pg. 25.

Average maintenance costs (including replacement, depreciation and salaries) of eighty-six broadcast stations—as compiled from a recent survey by Electronics.

High-Fidelity Technique, by J. V. L. Hogan, Electronics, Nov. 1935, Pg. 26.

Reports to the FCC by station W2XR, the 1550 KC station operated by J. V. L. Hogan. Investigations on high-fidelity receiving systems and phonograph record compensation are reported in this first of a series of articles.

A Symphony Broadcast from the Inside, by Davidson Taylor, Broadcasting, Dec. 1, 1935, Pg. 16.

Short but interesting article on CBS pick-ups of the Philharmonic Symphony. Microphone placement and technique are explained.

POWER SUPPLIES

Hum Elimination Methods, Commercial Radio, 1935, Pg. 16.

A brief note on some recently-advocated methods of reducing AC hum components in broadcast and other equipment. Short biography.

Waveform Errors in the Measurement of Power Transformer Losses, The General Radio Exp., Nov. 1935, Pg. 1.

Brief note on harmonic distortion at commercial power frequencies — a factor too often neglected in fidelity considerations.

REGULATIONS

New Antenna Regulations Promulgated by FCC, Broadcasting, Nov. 1, 1935, Pg. 63.

Graph and explanatory note on the minimum physical height or minimum effective field intensity required where Rule 131 of the FCC must be complied with. This is an excerpt from the general information sent all stations.

SPEECH INPUT EQUIPMENT

Network Resistances for Balanced Attenuators, by R. E. Blakey, Electronics, Nov. 1935, Pg. 33.

A short table for computing the components of several types of balanced attenuators for any desired attenuation value from 0.25 db to 40 db.

A Self-Powered V.T. Voltmeter of High Sensitivity, by D. C. Duncan, QST, Oct. 1935, Pg. 42.

Description of a convenient self-contained vacuum tube voltmeter for general use. A schematic and all circuit constants are given.

STATION DESIGN

High Fidelity for WREN, by F. Wheeler, Broadcast News, Dec. 1935, Pg. 18.

General description of the installation at WREN, which includes a new RCA 5 KW transmitter and new studios. Several illustrations and a curve of harmonic distortion.

The Voice of Labor on the Air, by M. Marquardt, Broadcast News, Dec. 1935, Pg. 3.

General Description of the installation at WCFL, which includes a new RCA 5 KW transmitter and a 490 ft. vertical radiator. Views of the transmitter room and of the interesting sectionalized radiator.

STUDIO AND ACOUSTICS

A New Method of Measuring Studio Reverberation, by A. W. Barber, Comm. & Broadcast Eng., Oct. 1935, Pg. 7.

Description of a novel method (employing a cathode-ray oscillograph) of measuring studio reverberation time, together with some of the results obtained by this method at W2XR.

TELEVISION

Television as the British Will View It, Broadcasting, Nov. 1, 1935, Pg. 17.

Details (including scanning speeds, etc.) of the transmissions which will be provided on the opening of the Alexandra Palace ultra-short-wave station. The full statements issued by the Baird and Marconi-EMI Companies are given.

Looking-In on RCA Television at Camden, by M. Codel, Broadcasting, Dec. 15, 1935, Pg. 8.

The well-known publisher of BROADCASTING magazine presents the layman's reaction to television as it exists today in the laboratory.

TRANSCRIPTION EQUIPMENT

Practical Volume Expansion, by C. M. Sinnett, Electronics, Nov. 1935, Pg. 14.

A Brief Discussion of the Dynamic Amplifier, by C. M. Sinnett, Broadcast News, Dec. 1935, Pg. 4.

The 6L7 as a Volume Expander for Phonographs, Radio Eng., Dec. 1935, Pg. 24.

Three descriptions of the volume expander employed in the RCA Model D-22 Phonograph-Receiver. The first is particularly complete, including characteristics, and is of interest to broadcast engineers because of possible future bearing on the design of broadcast equipment.

Evolution of the Pickup, Commercial Radio, Nov. 1935, Pg. 12.

A short note on the history of pickup design, in which several general types of movements are briefly pointed out. Includes simplified drawings.

TRANSMITTER DESIGN

Nomogram for Single-Layer Solenoids, by C. P. Nachod, Comm. & Broadcast Eng., Dec. 1935, Pg. 16.

A nomogram and explanatory note for the calculation of single-layer solenoids. Based on the U. S. Bureau of Standards Circular No. 74 which has been out of print for some time.

Alsimag 196—, by H. Thurnauer, Radio Eng., Nov. 1935, Pg. 15.

Discussion of the properties and application of the steatite group of insulating materials. Tables comparing physical and electrical properties of Alsimag 196, Alsimag 35 and Commercial Steatite with other insulating materials are given.

The Grid-Bias Cell, Radio Eng., Dec. 1935, Pg. 16.

Data on, and discussion of, the Mallory "grid-bias cell"—an interesting development advocated for use in pre-amplifiers.

XM-262, Radio Eng., Dec. 1935, Pg. 17.

Short note on a new type of phenolic insulation material of low dielectric loss, suitable for small fixed condensers.

R-F Insulator Voltage Limits, by R. Lee, Electronics, Oct., 1935, Pg. 11.

A note on the limitations of conventional voltage ratings where radio frequencies are considered. Curves showing change of operating voltage with frequency are given.

Comparative Analysis of Water-Cooled Tubes as Class B Audio Amplifiers, by I. E. Mouromtseff and H. N. Kozanowski, IRE Proc., Oct. 1935, Pg. 1224.

A study of several water-cooled tubes as Class B audio amplifiers. Actual performances of four tubes (863, 207, 848, and WL-491A), differing only in amplification factor, are analyzed in detail.

MISCELLANEOUUS

Power That Radio Uses—A Utility Bonanza, by O. E. Dunlap, Broadcasting, Oct. 15, 1935, Pg 11.

Interesting data on the increase in power consumption in the New York area during outstanding broadcasts such as the Louis-Baer fight. Reprinted from the New York Times.

Notes About Our Contributors

DR. G. H. BROWN. Dr. Brown was born at North Milwaukee, Wisconsin, in 1908. After completing his course in Electrical Engineering at the University of Wisconsin, he continued work for his M. S. and Ph.D. degrees at the same institution. Dr. Brown has been a frequent contributor to this publication, and his authoritative work on antennas has been universally recognized.

A. B. CHAMBERLAIN. Mr. Chamberlain first entered the radio field in the U. S. Navy. He later became Chief Engineer at WHAM, Rochester, followed by the dual offices of Vice President and Technical Director of the Buffalo Broadcasting Corporation. At the present time he is Chief Engineer for the Columbia Broadcasting System. Mr. Chamberlain is the author of numerous technical papers, particularly those dealing with Antenna Systems.

L. M. CLEMENT. Mr. Clement, Vice President in Charge of Engineering and Research, contributes the interesting story on European Radio Conditions to this issue. The material is based entirely on his personal acquaintance with the facts. Since 1914, Mr. Clement has been well known in the Radio World both here and abroad. A more complete sketch of his activities appears in the September issue of this publication.

O. B. HANSON. Mr. Hanson, Chief Engineer of the National Broadcasting Company, began his radio career at the Marconi School in New York in 1912. With the formation of the National Broadcasting Company in 1926, Mr. Hanson became associated with NBC, and since that time has directed their technical operations and engineering activities. His work in the creation of the studios at Radio City has attracted world-wide attention.

R. J. KINGSLEY. Mr. Kingsley is the technical supervisor of Station WBEN, Buffalo.

CARL MEYERS. Carl Meyers, who contributes the interesting story on WGN, is Chief Engineer of the station.

M. A. McLENNAN. After graduating from the University of Michigan, Mr. McLennan joined the General Electric Company, where he remained until 1930. In that year he came to RCA, where he engaged in receiver design and development, specializing in audio frequency applications. Very recently he entered business in Detroit.

JOHN P. TAYLOR. Mr. Taylor, who has reviewed the literature of radio, is connected with the RCA Engineering Department, and is well known to radio engineers through his frequent contributions to technical publications.

JOHN VASSOS. John Vassos was previously listed in this column as one of America's leading designers. In addition, he is noted as the designer of New York's first pent house, where built-in principles and indirect lighting were introduced as necessities of daily living. Extremely versatile, Mr. Vassos has illustrated many important books and at present is preparing a series of articles on the much discussed subject of human "Phobias."

NORMAN WEBSTER. The author of the story on KFBK, Sacramento, is the Chief Engineer of that Station.

DR. V. K. ZWORYKIN. Dr. Zworykin was born in Russia in 1889. He received his degree in Electrical Engineering from the Petrograd Institute of Technology in 1912, where he also started his experiments in Television. Later he studied in Paris and with the coming of war, served in the Radio Corps of the Russian Army. Dr. Zworykin came to the United States in 1919 and joined the Westinghouse Company. He received his Ph.D. from the University of Pittsburgh and in 1929 came to RCA, where at present he is Director of the Electronic Research Laboratory.