Communication and Broadcast Engineering

VOL. 2 NO. 1

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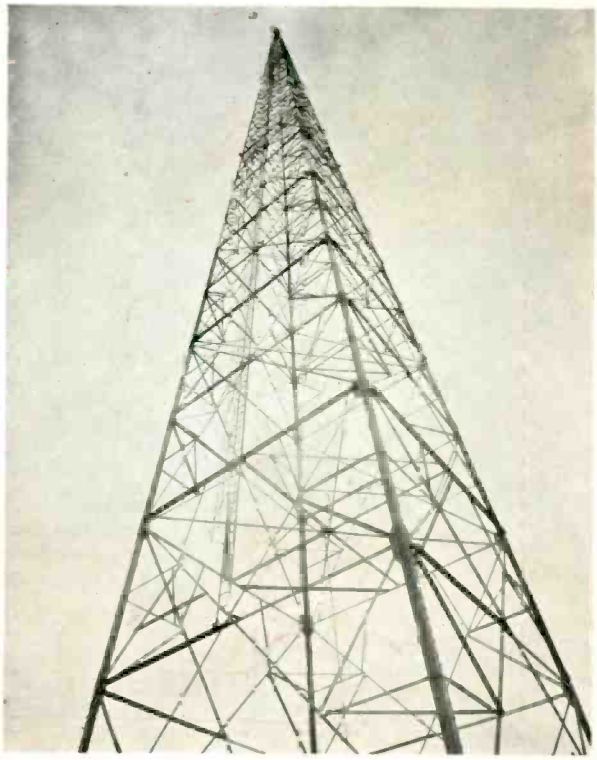

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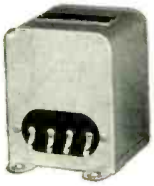

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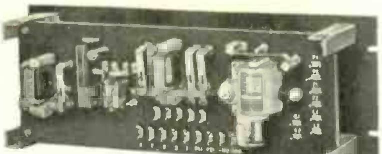

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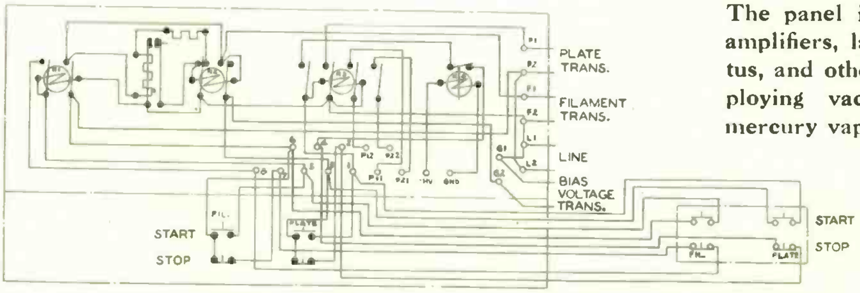

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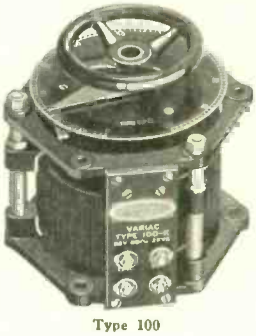

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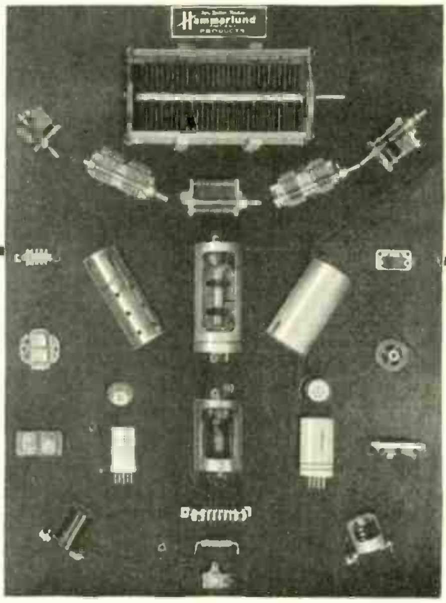

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EDITORIAL

THE NEW YEAR

THERE IS A DEFINITE business upturn in evidence. The heavy industries remain comparatively sluggish and it is conceded that until these industries regain some of their lost momentum, no substantial gains can be made in national welfare. However, the heavy industries are bound to move in sympathy with the general trend. The Federal Housing Administration program has proven quite effective and large-scale building in the early spring seems to be a foregone conclusion. Other government projects, designed to take the heavy industries out of the doldrums, are under way and more than likely will be in full swing before winter is over.

There is one point with regard to governmental planning that should be of particular significance to the communication and broadcast fields, namely, decentralization. We who are in the midst of rapidly-changing events cannot foretell the outcome of governmental moves to establish sound social and economic conditions. It is difficult to picture, for instance, the degree of social and industrial decentralization that may be created by governmental applications, or the degree of decentralization brought about as a normal outgrowth of scientific progress. If governmental long-range planning is to be super-induced upon the flow of commerce, the consequent transitions may be rapid.

Decentralization includes the establishment of new residential and industrial areas. These areas may be created by centralized power projects, by real estate developments, and by the wholesale transplanting of agricultural communities. Each of these will call for new extensions of communication facilities. If such areas are well populated, new broadcast services may also be required.

The introduction of modern, high-speed rail transportation may bring about another large population shift, as it will permit the location of residential, and possibly industrial, communities at much greater distances from the cities than is now practical or convenient. Such communities, even though small or sparsely settled, will have to be served. If they are provided with proper communication facilities and broadcast services, there will be a tendency toward increased development of the communities with the result that they will prove capable of supporting any type of service provided them.

The huge operating costs of rail transportation have not permitted a population spread. That such spread is now within reason is due to the engineering developments made in train design. The speed and economy of operation of the new units reduce the time and cost of commutation. Electrification of a road is not an essential, and single units can handle the transportation requirements of wide areas.

Large operating and maintenance costs have also been a part of wire communication systems and certain types of broadcast services. So long as such costs remain high, the small community cannot be effectively served—and if the service is poor there is little chance of community growth. However, the communication companies are in a position to follow the advances of the rail lines by resorting to the use of low-cost ultra-short-wave radio links for serving such communities. The extension of wire lines by means of radio should reduce operating and maintenance costs to the point where profit can be made. The radio links could be replaced by permanent wire lines when the size of a community warranted their use.

As for broadcast services, there is also the possibility of employing ultra-short-waves for linking local low-power stations and tying these stations in on existing commercial chains. In this manner it should be possible to provide quality programs at low cost over large but sparsely settled areas inhabited by people in the medium- and high-income class.

How rapidly, and to what degree, decentralization may come about, remains to be seen. In the meantime, the purchasing or rental of communication and broadcast services should show marked increases over last year, and this in turn should pave the way for the commercial application of the latest engineering developments. Many new opportunities for the extension of services will present themselves and the time appears ripe for their institution.

COMMUNICATION & BROADCAST ENGINEERING

FOR JANUARY, 1935

COMMERCIAL RADIO TRENDS

A Review of Radio Communication in the Fixed Services for the Year 1934*

By HARADEN PRATT

Vice-President and Chief Engineer

MACKAY RADIO AND TELEGRAPH CO.

THE FIELD OF RADIO communication in the fixed services, including as it does, a fair share of the total point-to-point telecommunication in the world, is one of major importance. This paper is intended to present a very brief review, largely from an engineering viewpoint, of the more important developments in this field during the year 1934. Detailed information on developments is not included. Such information can be found in other published papers.

RADIO-TELEGRAPH CIRCUITS

During 1934, the following important new international radio-telegraph circuits were placed in service:

Between Shanghai and London.

Between Tokyo and Rome.

Between Honolulu and Papette, Tahiti, via RCA Communications.

Between New York and Syria via RCA Communications.

Between England and Australia for public facsimile service.

Between Aden and Ethiopia.

Between West Africa and Canary Islands.

An additional circuit was opened between San Francisco and Tokyo via Mackay Radio and Telegraph Company.

A new circuit between New York and Santiago, Chile, via Mackay Radio and Telegraph Company.

Within United States Territory new domestic radio-telegraph circuits were opened by RCA Communications between the following points:

New York and Boston.

New York and Washington.

New York and Chicago.

New York and New Orleans.

Mackay Radio and Telegraph Company opened a new domestic radio-telegraph circuit between New York and Washington, extending new circuits opened late in December, 1933, between

New York and New Orleans.

New York and Chicago.

New York and Seattle.

San Francisco and Chicago.

HARADEN PRATT
Vice-President and Chief Engineer
Mackay Radio & Telegraph Co.

RADIO-TELEPHONE SERVICES

New radio-telephone services opened in 1934 from the United States via the Bell System were:

A direct circuit between San Francisco and Java, Java previously having been served from the United States on an interconnected basis through London.

A direct circuit between Miami and Baranquilla, Colombia, forming the second circuit to that country, the first having been established to Bogota in 1934.

Existing services to Europe from both the United States and South America have been augmented by extensions to Algiers, Tunisia, the city of Beyrouth, Syria and the city of Saigon, Indo China. Existing services to India and Palestine have been augmented to include the remainder of the important cities in those countries.

Some radio-telephone extensions have been made in Egypt.

On December 8 of this year, the Bell System opened a new direct high-frequency radio-telephone circuit connecting San Francisco with Tokyo, which service directly reaches about 380,000 telephones distributed throughout Japan's most important cities.

RCA Communications opened a radio-telephone service between Manila and Tokyo and added two new points to the Philippine interisland public radio-telephone network.

International Telephone and Telegraph Corporation during December

*Presented at the December 5, 1934, New York meeting of the Institute of Radio Engineers as part of an annual review of radio developments.

opened new direct radio-telephone circuits between Buenos Aires and Lima, Peru; Buenos Aires and Bogota, Colombia; and between Bogota and Lima and between Buenos Aires and Vatican City. These additional facilities in South America greatly increase the reliability of service between Bogota, Lima, and European points which are reached via Buenos Aires to the several European radio terminals located at London, Berlin, Paris, Madrid and Vatican City.

Other international radio-telephone services opened were:

Between Tokyo and Manchukuo.
Between Tokyo and Formosa.
Between Tokyo and Java.
Between Moscow and Tiflis.
Between Bogota and Caracas.
Between Bogota and Baranquilla.

ULTRA-HIGH-FREQUENCY LINKS

Intended primarily for experimental purposes but being operated in the regular commercial service, is an ultra-high-frequency radio link established by the Bell System between Green Harbor and Provincetown, Mass., which points are on opposite sides of Massachusetts Bay. The radio equipment is unattended and the circuit terminals appear on the switchboards at Boston and Provincetown in such a manner that the radio link may be used interchangeably with wire toll circuits. This experiment is looking forward to providing telephone service where natural barriers make it difficult or expensive to construct ordinary telephone lines.

International Telephone and Telegraph Corporation, through its Spanish Telephone Company, is installing a similar ultra-high-frequency radio-telephone system between Barcelona and Mallorca in the Balearic Islands. Tests have indicated that the reliability of such a system will be considerably greater than that of the existing service on longer waves established several years ago between Madrid and Mallorca.

A 17-centimeter wavelength circuit across the English Channel for teleprinter operation was placed in service in January, manufactured and installed by companies in the International Telephone and Telegraph group.

In England, an ultra-high-frequency radio-telephone link has been in commercial service across the Bristol Channel, and investigations are under way for similar circuits between the mainland and some of the Channel Islands.

Very effective use has been made of two-way radio-telephone ultra-high-frequency installations operating at low power, for communications between all points involved in the construction of the San Francisco-Oakland Bay Bridge, such as the individual piers in the bay. A similar system is being found valuable in the construction of the new aqueduct for carrying water over the mountains from the Colorado River to the City of Los Angeles.

NEW STATIONS

With regard to these new services, entirely new radio stations were completed in 1934 by RCA Communications at Boston, Washington, Chicago and New Orleans, with others at Seattle, Los Angeles and Detroit, on which construction has commenced.

New stations completed by Mackay Radio and Telegraph Company are at New Orleans, Washington, Seattle and Chicago, with construction under way for new stations at Atlanta and Kansas City. This company is also constructing a new large central transmitting station for international and domestic communication on a 1,100-acre tract near Brentwood, Long Island, for the purpose of replacing overcrowded facilities at its station near Sayville[1], Long Island.

Press Wireless, Inc. opened during the year a new station near San Francisco for Hawaiian and transpacific service, in which locality a new receiving station has been planned. This company is constructing a new station at Washington and reconstructing its station at Chicago.

BYRD EXPEDITION

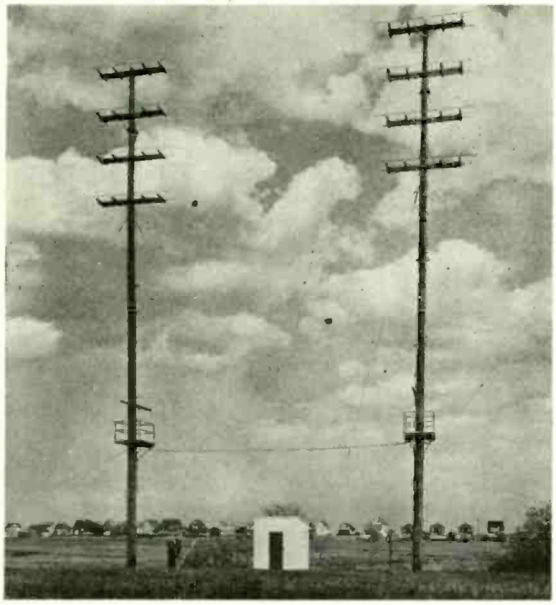
In addition to the services described, an outstanding example of long-distance radio communication during the year is that with the Byrd Expedition near the South Pole. Radio-telegraph service is direct via Mackay Radio through either its New York or San Francisco stations. Radio-telephone service used for supplying material to American broadcast stations is usually relayed via the Transradio station at Buenos Aires to RCA Communications at Riverhead, Long Island. The transmitting power at the Antarctic station is about one kw. A three-unit diversity receiving system is used at Buenos Aires. Occasionally when transmission conditions are favorable, the relay at Buenos Aires is dispensed with and the signals received direct at Riverhead, Long Island.

The domestic radio-telegraph circuits operated in the United States by RCA Communications and Mackay Radio and Telegraph Company offer a class of service for which the same charge is made for a minimum of 15 words as is made by the wire-telegraph companies for 10 words.

"NEWSCAST" SERVICE

Press Wireless, Inc. has recently inaugurated a "newscast" service which consists of simultaneous telegraph transmissions on two or three high frequencies occurring two or three times a day for periods of from one-half to one hour duration each. At present, this service is supplied by Radio Press Bureaus on a paid multiple-address message basis and is received by broadcast stations at from 85 to 92 points widely distributed in the United States and Canada, and employed as material for news programs. This service is now operated from New York and may also be established later for transmission from San Francisco.

Globe Wireless, Inc. inaugurated a new deferred radio-telegraph service between San Francisco and Honolulu and



The ultra-short wave antenna system at Green Harbor, Massachusetts, a part of the land-line telephone extension by radio, from Green Harbor to Provincetown, across Cape Cod Bay.

(Photo, courtesy Bell Telephone Labs.)

1 ("New Mackay Station on Way," page 11, August, 1934, RADIO ENGINEERING.—Editor.)

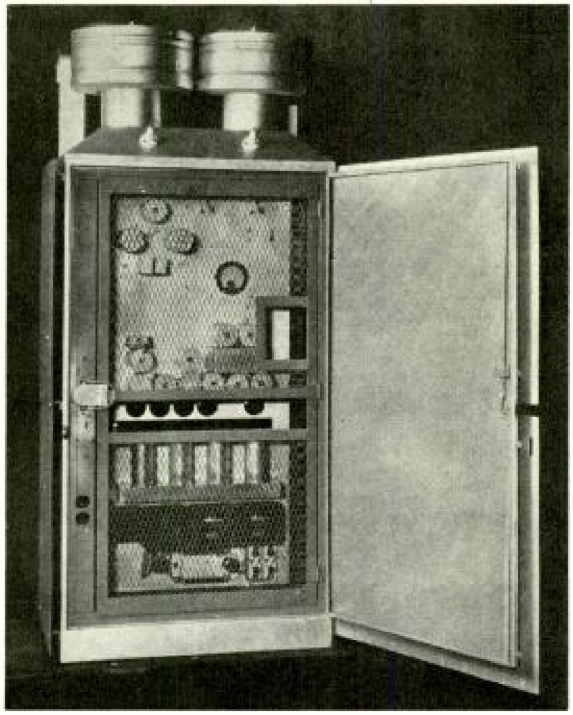
Manila, featuring the pick-up and delivery of telegrams at the terminals by mail.

GENERAL TECHNICAL TRENDS

Technical advances during the year have been, in general, largely along the lines of improving existing plant and adapting previously made developments to commercial operation, rather than in the introduction of radically different methods of communication or of operation.

The tendency toward higher powered short-wave transmitters for transoceanic communication has continued, and a number of large transmitters were installed during the year. The larger short-wave telegraph transmitters, now in operation, have actual radio-frequency outputs of the order of 50 kw with 80 kw developed and still higher power under investigation. The larger short-wave radio-telephone transmitters have carrier outputs of about 20 kw capable of 100 percent modulation.

The need for increased power is being particularly felt on the New York-European circuits to improve the reliability of communication during periods of magnetic disturbance. This area is one of those most vulnerable to such disturbances which is of interest since it is also the seat of the greatest radio-communication activity. Special power-amplifier tubes capable of providing 50-kw high-frequency power output per tube are under development. The trend seems to be towards steel-tank type mercury-pool polyphase rectifiers rated at several hundred kilowatts having voltage outputs from 14,000 to 20,000 volts, to supply the anode power for operating the large power-amplifier tubes.[2] Mackay Radio and Telegraph Company installed such a rectifier at Palo Alto, California, in July, and RCA Communications have an installation under way at Rocky Point, Long Island, these equipments being of American manufacture. Some important European stations utilize similar rectifiers of European manufacture.



The ultra-short-wave transmitter used for extending land-line telephone services. This unit is designed for pole mounting, being housed in a metal container.

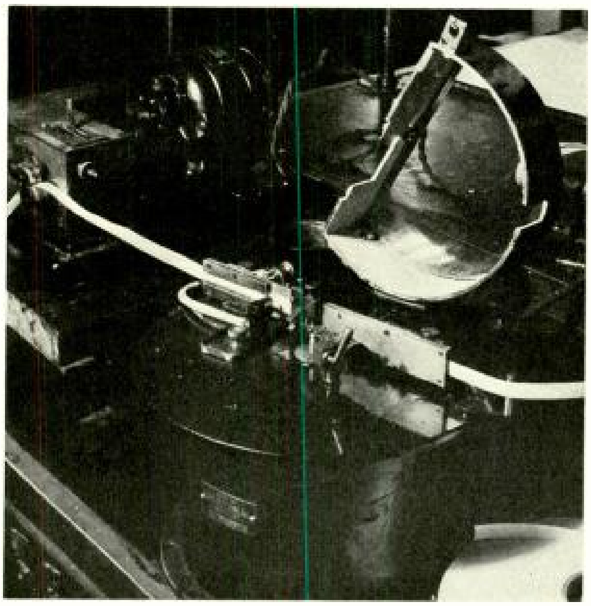
(Photo. courtesy Bell Telephone Labs.)

Together with the general trend toward higher power, there has been a very consistent increase in transmitter frequency stability throughout the stations of the world. As a result, high-frequency transmitters generally are now operating with considerably closer tolerances than those recommended by the Madrid Convention. In this country, the recently developed zero-temperature coefficient crystal cut, is providing a simplification of transmitter frequency control by greatly reducing frequency variations due to crystal temperature changes.

Class B high-level audio modulation, developed several years ago, has been increasingly applied to radio-telephone transmitters and developments have been made in methods of screen-grid and pentode-grid modulation[3]. The "Compandor"[4] and similar devices[5] have found extended use on several radio-telephone circuits to automatically adjust the transmitter input level in response to variations in speech intensity. Average transmitter modulation is thus increased and the received signal-to-noise ratio improved.

RECEIVING METHODS

There seem to have been no striking developments in receiving methods. The



Ink recorder, used by RCA Communications, Inc., in reception of high-speed radiotelegraph signals.

[2] ("Steel Rectifier Tubes," page 16, May, 1934, RADIO ENGINEERING.—Editor.)

[3] ("Developments in Aircraft Radio, by W. P. Lear, page 9, December, 1934, COMMUNICATION AND BROADCAST ENGINEERING.—Editor.)

[4] ("The Voice-Operated Compandor," by N. C. Norman, page 7, November, 1934, COMMUNICATION AND BROADCAST ENGINEERING.—Editor.)

[5] ("Extending Volume Range," page 7, November, 1934, RADIO ENGINEERING.—Editor.)

use of diversity reception continues and the closer spacing of transmitter frequency assignments made possible through improved frequency stability has urged forward the design of more selective receivers. Crystal-type filters in superheterodyne receivers have attracted interest. RCA Communications reports the adoption of a triple-detection superheterodyne receiver utilizing two intermediate frequencies, making it possible to adjust its response to the bandwidth required for the type of service involved.

TRANSMITTING-RECEIVING SYSTEMS

A definite trend has been noted towards the automatic operation of transmitters and in some cases receivers, particularly at small, unattended stations. This trend is most pronounced in the case of ultra-high-frequency communication apparatus.

Printer operation of radio-telegraph circuits is receiving attention. During past years, both Mackay Radio and RCA Communications have operated successful circuits of this type, the former between Los Angeles and San Francisco, California, and the latter between San Francisco and Honolulu. RCA Communications this year placed in service a two-channel multiplex printer system on its New York-London circuit. Each channel operates normally at a speed of 50 words per minute. That company has developed and used a three-channel multiplex printer system normally rated at a speed of 60 words per minute per channel.

Mention is made of the newly-developed facsimile transmitting and receiving system named the "Constant Frequency Variable Dot" system, which was recently described before the Institute of Radio Engineers, and which is now in operation on transoceanic and other long circuits, resulting in a marked improvement of the picture-transmission services available to the public.

Much attention has been given to ultra-high-frequency equipment and wave-propagation phenomena, primarily for the development of short-distance communications in the fixed services. Such systems are capable of transmitting wide communication bands, and are particularly suited for short-distance work where the direct wave only is employed and signal-strength variations are minimized as reflections from the ionosphere do not play a part. Special measuring equipments have been developed and transmission studies as short as 70 centimeters and lower are under way.

Special systems employing stable master oscillators and power amplifiers with harmonic generators to multiply the frequency to the desired value have been successfully developed, RCA Communications in particular reporting a power output of 115 watts at a wavelength of 70 centimeters having been thus obtained.

The present tendency in the design of high-gain directive high-frequency antennas is to avoid too great a directivity in the vertical plane. Power gains of the order of 19 db above a single half-wave radiator are considered reasonable. Where applicable, aperiodic types of directive high-frequency antennas are in much favor, having the distinct advantage of being useful on any one of a number of different frequencies as well as being unidirectional. Such antennas are desirable where traffic requirements do not justify expensive antenna investments but where more than one frequency must be employed.

Concentric tubular transmission lines for high-frequency antennas continue to be employed. Low-loss lines of this type sufficiently flexible to be wound on reels and suitable for burying directly in the ground like power cable have been developed in Germany.

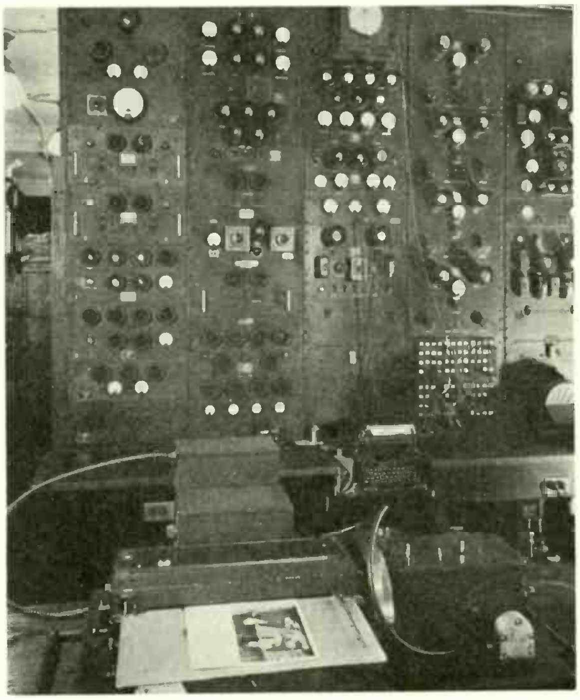
TRANSMISSION MEDIUM

A great deal of interest has been directed towards the study of the transmission medium, the structure of the ionosphere and its influence on wave propagation[6]. A considerable mass of observed data and derived conclusions has been published, including much speculation as to the mechanics of wave travel. Communication organizations are studying these factors and seeking to correlate them with the results secured in their commercial operations. There is promise that the reliability of radio-communication circuits will be improved when these studies have been advanced to a more conclusive stage.

C. C. I. R. MEETING

During the year, the third meeting of the C. C. I. R., or International Radio Consultative Committee, was held in Lisbon. These meetings have been a great aid to international radio communications not only by providing a forum where technical questions of consequence to operating organizations could be discussed among experts, but by promulgating opinions serving as technical operating standards or practices of minimum requirements capable of being met by any one reasonably well versed in the art. The Lisbon meeting, like its predecessors, has promulgated such opinions for future guidance, besides reviewing opinions issued at former meetings and making modifications and substitutions where necessary, to harmonize with new knowledge and advanced experience.

The writer desires to acknowledge valuable contributions of material for this review, courteously provided by officials of the American Telephone and Telegraph Company, RCA Communications, Inc., and Press Wireless, Inc. Commander Horiuchi of the Imperial Japanese Navy also extended assistance.



Radio facsimile equipment of RCA Communications, Inc., at Broad Street, New York, used for transmission and reception of pictures.

6 ("Direction of Arrival of Waves," by C. B. Feldman, page 14, May, 1934, RADIO ENGINEERING.—Editor.)

A METHOD OF CONTINUOUS AURAL FREQUENCY MONITORING

By ROBERT C. MOODY
CHIEF ENGINEER, KDB

THE PROBLEM OF frequency monitoring is not solved, in the opinion of the writer, until means are provided for both continuous visual and continuous aural monitoring. The carrier frequency can drift a surprising amount in the half hour between measurements and the human element plays a large part in spreading the measurements to the full thirty minutes of each half hour. If continuous visual and aural monitoring are provided there is no excuse other than negligence on the part of the operator for transmission outside of the limits prescribed by the Federal Communications Commission. No commercial monitor provides both of these advantages. Most types on the market have means for continuous visual monitoring while at least one type provides means for continuous aural monitoring with the use of an additional amplifier and loudspeaker. The problem was solved at KDB at a very low cost and while the method to be outlined is not applicable in all cases it does have the value of being easily applied in a large number of cases.

A Western Electric Type 1-A Frequency Monitor is used at KDB. In this monitor a jack for headphones is provided so that the operator may listen to the beat between the oscillators of the transmitter and the monitor when it is beyond the range of the frequency-indicating meter. At or near zero beat the program being broadcast can be heard very plainly, the level pulsating with the frequency difference.

BASIS OF SYSTEM

The headphone jack on the 1-A Monitor is in the cathode circuit of the detector and by plugging in a meter the plate current of the detector may be measured. While doing this in a moment of curiosity it was found that the plate current of the detector increased as the frequency difference between the transmitter and the monitor increased. This was the germ of an idea. An amplifier was hastily assembled with the first tube biased to about cut-off plate current and the last tube operated as a straight audio amplifier. Then, as the transmitter frequency changes, the average plate current of the detector changes and the grid of the first amplifier tube is made more positive, causing the loudspeaker to operate with the rat-tat-tat of a machine gun, each tat corresponding to one cycle frequency difference.

After some experimentation with the bias on the first amplifier tube and the radio-frequency input to the monitor it was found that the loudspeaker remained silent until the frequency difference between the transmitter and the monitor exceeded ten cycles. As the frequency of this station is maintained within two or three cycles of assigned frequency this adjustment meets all requirements. The monitoring speaker for programs is not interfered with and the aural frequency monitoring speaker operates positively and at high level when the drift is beyond plus or minus ten cycles while remaining perfectly silent within these limits.

The amplifier was then mounted on a standard nineteen-inch panel and mounted with the speech amplifiers on the relay racks. It has never failed in two years' use.

VISUAL MONITORING

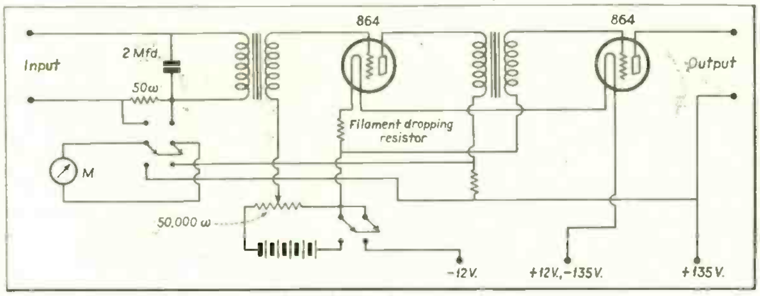
To solve the continuous visual monitoring requirements a milliammeter was mounted on the panel in full view of the operator. This meter is connected in series with one leg of the circuit between the amplifier and the frequency monitor thereby measuring the plate current of the detector continuously. The meter indicator pulsates at the frequency difference and is useful up to about ten cycles difference. While it must be confessed that the meter is useless above ten cycles difference its range is adequate for the purpose. The object of this article is to explain the original idea and the writer's experience with it and let each individual engineer work out the system to his own requirements.

AMPLIFIER DATA

The diagram is self-explanatory but it might not be amiss to go over a few details. It was found, for instance, that the C battery is a weak spot. A plate voltage drop might be used instead. Means should be provided to adjust the bias from time to time as this is desirable. Correct bias on the first amplifier tube is largely governed by the radio-frequency input to the monitor. Standard audio-frequency transformers are used, although the first transformer might better be a line-to-grid type. This has not been tried. A 2-mfd condenser is shunted across the primary of the first transformer to eliminate a slight blasting of the speaker on modulation peaks. Tubes of the 864 type are used but heater cathode tubes would give more trouble-free operation and make the bias problem easier. A switch is provided to change the milliammeter from the detector plate circuit to the first amplifier plate circuit to aid in bias adjustment. This is a refinement and is not necessary as the bias is easily adjusted experimentally. The connection between the amplifier and the headphone jack on the monitor is made with a patch cord. This plug is removed from the jack when the regular half-hour frequency check is made on the monitor and at this time the operation of the system is checked by pushing the frequency difference button on the monitor.

It was found advantageous to mount the monitor several feet from the speech amplifiers to eliminate induced hum. The operation of this equipment in no way interferes with the operation of the monitor itself.

As a closing thought, this same general idea might be applied to monitors whose frequency is one-half kilocycle removed from the transmitter frequency by the use of a tuned circuit series resonant to 500 cycles.



Circuit of the amplifier used for continuous aural frequency monitoring.

TEMPORARY VERTICAL RADIATOR

Construction and Erection of the 80-Foot Mast at WSPD for Field Measurements

By GEORGE BROWN

A SHORT TIME ago WSPD at Toledo, Ohio, was granted permission to increase its daytime power from 1,000 to 2,500 watts. The present location, atop the Commodore Perry Hotel, is unsatisfactory due to many dead spots about the town, and the owners therefore decided to look for a better site for the new equipment.

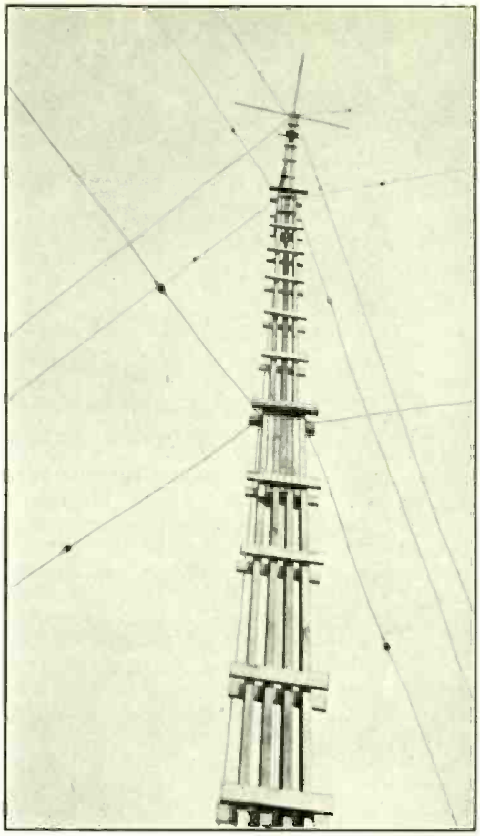


FIG. 1. VIEW OF THE COMPLETED 80-FOOT MAST.

The first tests were run in Storer Field, Maumee, Ohio, a distance of six miles from the present location. An eighty-foot mast, shown in Fig. 1, was constructed to furnish support for a vertical antenna. The antenna was fed by a 250-watt portable transmitter housed in the station's truck (see Fig. 2). Tests were made during the early hours of the morning while the regular transmitter was off the air. Another truck with standard measuring equipment made a field-intensity survey.

MAST CONSTRUCTION

The mast, which was erected by the engineering staff of the station, is made

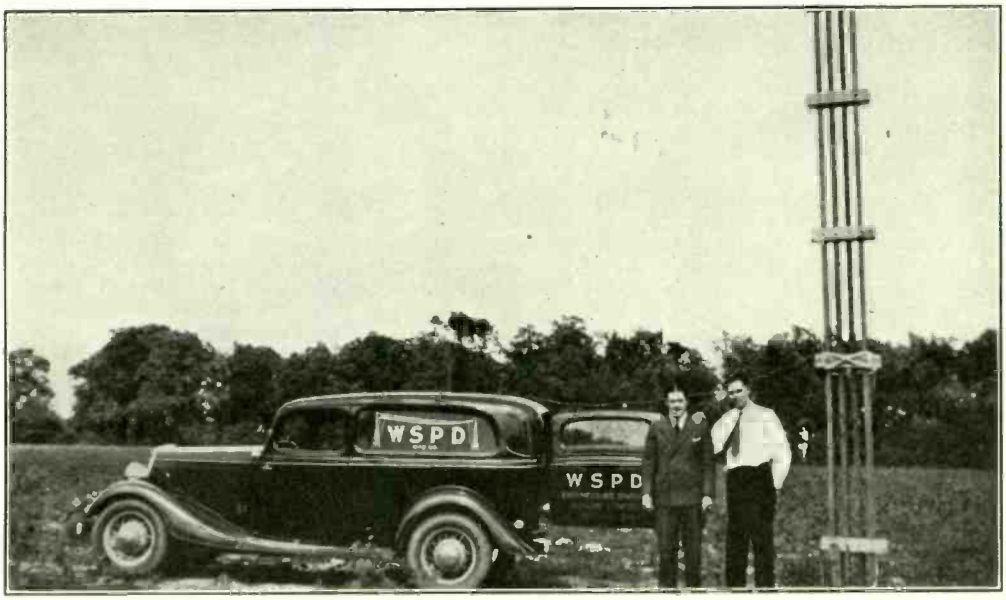


FIG. 2. CARS USED AT WSPD FOR ERECTING THE MAST.

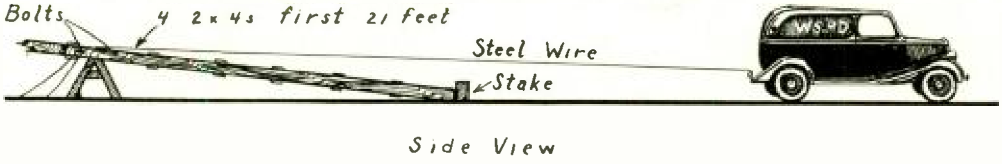


FIG. 3. MANNER IN WHICH BOTTOM SECTIONS OF MAST WERE RAISED.

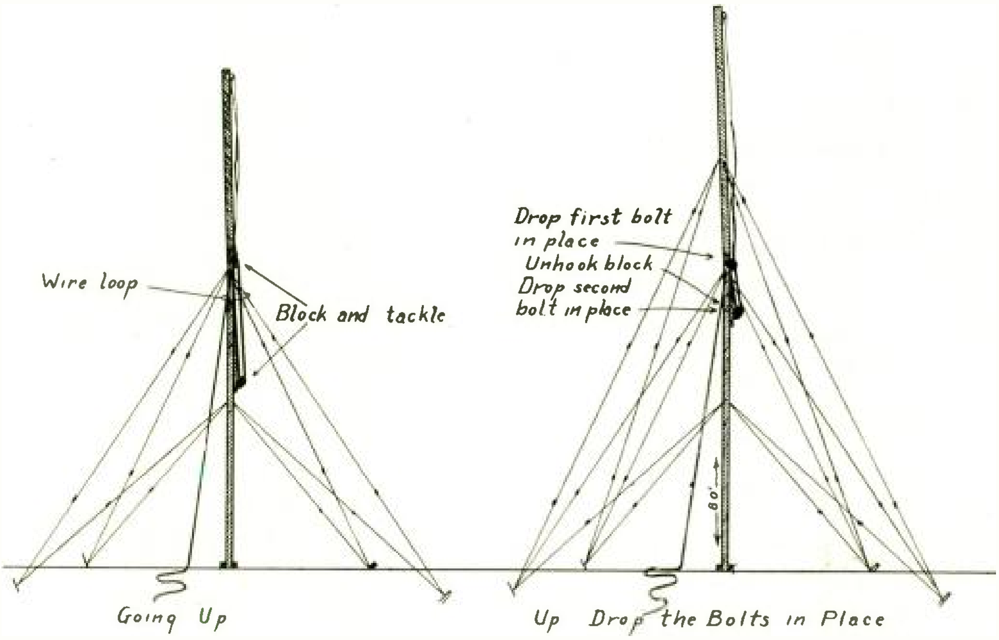


FIG. 4. SHOWING ARRANGEMENT OF GUY WIRES.

up of ten, 24-foot, two by fours. Four spars are used in the first section, three in the second, two in the third and one in the fourth. Each section is telescoped four feet into the one below and fastened with bolts. The two bottom sections are held together by one by four inch strips nailed horizontally every three feet. They project about four inches to form a ladder for climbing the mast. These strips were nailed on both sides of the first section and on one side of the second to allow the top sections to be telescoped into place. Four steel guy wires are fastened at 20, 40 and 60 feet.

ERECTING THE MAST

The mast is first assembled on the ground after which the two bottom sections are unbolted from the top, the base fastened and the upper end raised as high as possible with a carpenter's horse. A man is then put on each top guy wire and an automobile used to raise the two bottom sections, as illustrated in Fig. 3. After the bottom sections are raised and securely guyed (Fig. 4) the next two sections are raised alongside by means of a block and tackle fastened at the top of the 40-foot section and the bottom of the upper section. One man stationed at the 40-foot level telescopes the sections and slips the bolts in place, the respective steps in this process being shown in Figs. 4 and 5. Four others take care of the guys on the ground while the upper section is being raised.

WSPD found the mast quite satisfactory for the purpose and the erection cost very reasonable.

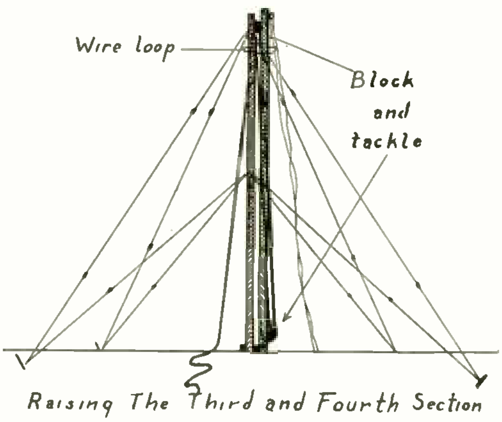


FIG. 5. MANNER IN WHICH UPPER SECTION IS RAISED

Pre-Amplifier Design

Data on Units for Use with Low-Level Microphones

By J. G. KUNZ
Chief Engineer
KENYON TRANSFORMER CORP.

WITH THE ADVENT of the popular adoption of the velocity and crystal microphones the problem of developing a stable high gain ac-operated pre-amplifier is of great practical importance. It is the purpose of this paper to outline the requirements and design of a unit of this type which can be used with any of the low level microphones.

REQUIREMENTS OF THE SYSTEM AND THEIR EVALUATION

The pre-amplifier should have a voltage gain equivalent in decibels to the power level of the input source plus the output power level of the main amplifier less the voltage gain of the main amplifier expressed in decibels. Expressing this in the form of an equation:

Gain (pre-amplifier) = Input Level (source) + Output Level (main amplifier) — Gain (main amplifier).

The level of various input sources is given in the accompanying Table. This table gives the voltage gain in decibels required to bring any of the microphones mentioned up to zero level of 1.73 volts across 500 ohms, or a power level of .006 watt.

It might be well to point out here that this table was compiled from data supplied directly from the manufacturer of the respective input devices listed. Unfortunately all manufacturers of microphones do not employ the same method of calibrating these units, and for that reason this data is not as accurate as it might be if all of these devices were rated on the basis of actual sound pressure measured in dynes per square centimeter required to bring the unit to zero level of .006 watt, or by rating the microphone on the basis of the amount of amplification required to develop an open circuit voltage of one volt per bar. Certainly some relationship between the output level of the microphone at various distances from a given and fixed source of sound should be provided. This has been done by the Bell Telephone Laboratories and is shown in Fig. 1, which is reproduced here with their permission.

From the Table the first factor in the equation previously set forth can be determined . . . Input Level (source).

The power output level of the main amplifier is usually expressed in watts and is determined by the power output rating of the tubes in the final stage of the main amplifier. This power rating in watts should be converted to a power level in the decibel system. This can be done by consulting Fig. 2.

Example: Given an amplifier using push-pull parallel 45 tubes in class AB and delivering a power output of 36 watts. What is the power level expressed in decibels? Find the diagonal labeled 10 to 60 watts. The point 3.6 then represents 36 watts on the power abscissa. Referring this point to the decibel ordinate it is found that a power output of 36 watts represents a power level in decibels of 37.8 db.

The voltage amplification or gain in the main amplifier is dependent on the circuit constants of this unit and can easily be computed. For the purpose of this paper it will be assumed that this figure is known in decibels.

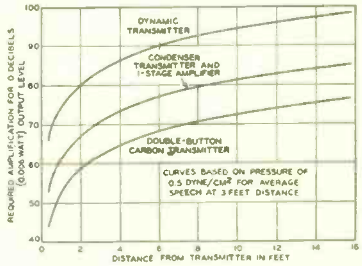


Fig. 1. Output levels of microphones at various distances from source of sound.

COMPUTATION OF GAIN

Sufficient information is now available to compute the gain required in the pre-amplifier for a given set of conditions.

Example: Given a Brush G-1 Crystal Microphone and a public-address amplifier which has a power output of either 18 or 36 watts and a voltage gain of 80 decibels. Consulting the Table, it is found that the G-1 Crystal Microphone has an output level that is 90 db below reference level (zero level). Consulting the table given in Fig. 2 it is found that 36 watts is a power level of approximately 38 db above zero level. Substituting these values in the equation given:

Gain (pre-amplifier) = 90 + 38 — 80 = 48 db.

If the 18-watt amplifier is used, the power level is approximately 35 decibels.

Gain (pre-amplifier) = 90 + 35 — 80 = 45 db.

If a double-button microphone, such as the Western Electric 600A, is used, the input source requires an amplification of 42 db to bring it to zero level.

Gain (pre-amplifier) = 42 + 38 (36 watts) — 80 = 0.

Which indicates a pre-amplifier is not

DATA ON VARIOUS MICROPHONES

Manufacturer	*Type No.*	*Principle*	**Amp. Req'd.*
Western Electric Co.	337	Single Button Carbon	15 db
Western Electric Co.	395	Single Button Carbon	8 db
Western Electric Co.	323 / 615A	Single Button Carbon	10 to 15 db
Western Electric Co.	387W / 600A	Double Button Carbon	45 db
Western Electric Co.	618A	Dynamic	80 db
Thomaston Labs.. Inc.	MC30	Dynamic	86 db
Bruno Laboratories	RA-2	Velocity-ribbon	89 db
Bruno Laboratories	RA-3	Velocity-ribbon	78 db
Bruno Laboratories	RV-3	Velocity-ribbon	69 db
Amperite Corporation	SR-80	Velocity-ribbon	90 db
Amperite Corporation	RE-1	Velocity-ribbon	90 db
Amperite Corporation	RAE	Velocity-ribbon	90 db
RCA Victor Co., Inc.	44A	Velocity-ribbon	78 db
RCA Victor Co., Inc.	50A	Inductor	67 db
Brush Development Co.	—2S2P	Crystal	74 db
Brush Development Co.	—4S6P	Crystal	60 db
Brush Development Co.	G-1	Crystal	90 db
Brush Development Co.	G-20	Crystal	80 db
Astatic Microphone Lab., Inc.	D-104	Crystal	60 db

*Amplification required to bring this unit to zero level of .006 watt.

needed when a double-button carbon microphone is used—enough gain being provided in the main amplifier.

The gain of the amplifier should be obtained with a minimum increase in the noise level and hum level. Thermal agitation noise, shot effect noise, and such miscellaneous noises as caused by secondary emission, ionization, etc., must be kept to an absolute minimum.

NOISE PROBLEMS

Much has been said about the difficulties involved in building a high-gain amplifier system, but little seems to be understood about the subject. The hum problem has been alternately magnified and minimized. The noise problem with respect to thermal agitation and shot effect has been appallingly neglected by many who profess to present design information on high-gain audio units. Unfortunately the combined effects of thermal agitation and shot effect are the most serious problems in this type of work and represent the factors which limit the gain of such a unit.

J. B. Johnson and F. B. Llewellyn in a paper entitled "Limits to Amplification," in the November issue of *Electrical Engineering,* point out, "The signal-to-noise properties of any system are considered satisfactory when the total output noise differs only slightly from that produced by thermal agitation in the input circuit alone and this difference may be measured by eliminating the input thermal noise (as by the short circuit method) and noting the change produced in the output noise."

Thermal agitation is caused by the random movement of electrons in the conductor in the input circuit of an amplifier. It is not dependent on the vacuum tube but is caused by free electrons moving in the conductor, resistor, inductor, or transformer primary. The thermal voltage is proportional to the resistance component of the impedance in the circuit, the absolute temperature of the impedance, and the width of the frequency band being passed.

The following formula gives a quantative evaluation of the voltage produced by thermal agitation.

$$E^2 = 4KT \int_{f_1}^{f_2} R\, df$$

E^2 = Square of effective value of thermal-agitation voltage
K = Boltzman's constant = 1.374×10^{-23}
T = Absolute temperature (Kelvin (273 + °C).
R = Resistance component of the impedance across which voltage of thermal agitation appears
f = Frequency.

Where the resistance component of the impedance is constant over a given frequency band f_1 to f_2 (as in the case of audio-frequency transformers) this formula becomes

$$E^2 = 4\, KTR\, (f_2 - f_1).$$

Example: Calculate the thermal voltages developed across the grid impedance in the first stage of the amplifier shown in Fig. 3 and having the following characteristics:

Freq. Response = 30 — 10,000
Voltage Gain = 90 db
Output Level = + 15 db
Z = 80,000 = resistive component of secondary
T = 300 K

$E^2 = 4 \times 1.34 \times 10^{-23} \times 300 \times 80{,}000 \times 10{,}000 = 5.36 \times 10^{-18} \times 24$

$E^2 = 128.64 \times 10^{-18}$

$E^2 = 12.0 \times 10^{-12}$

$E = 3.6 \times 10^{-6}$ volts

What is the power level developed by this voltage with respect to reference level of .006 watt?

$$P = \frac{E^2}{R}$$

$$P = \frac{12.9 \times 10^{-12}}{80{,}000} = \frac{12.9 \times 10^{-12}}{8 \times 10^{4}}$$

$$P = 1.6 \times 10^{-16}$$

$$Ndb = 10 \log_{10} \frac{.006}{1.6 \times 10^{-15}} = \frac{6 \times 10^{-3}}{1.6 \times 10^{-16}} = 10 \log_{10} 3.75 \times 10^{13}$$

$$Ndb = 135$$

If this amplifier is used with a microphone whose power level is down 90 db the noise-level output caused by thermal agitation will be down —45 db with respect to zero level. This is the most serious source of noise in audio amplifiers. It can only be eliminated by cooling the conductor to absolute zero—a practical impossibility—or by reducing the frequency range, which is almost equally impractical.

SHOT EFFECT

Another source of noise in an amplifier is shot effect which is caused by irregularities in the electron stream from cathode to plate. The presence of a space charge in the tube smooths the irregularities in this flow of current. It is, therefore, important to operate the tube at such a point that the emission of the cathode is capable of developing and maintaining an adequate space charge between cathode and plate. Since the emission of the cathode is a function of a heater temperature and the heater

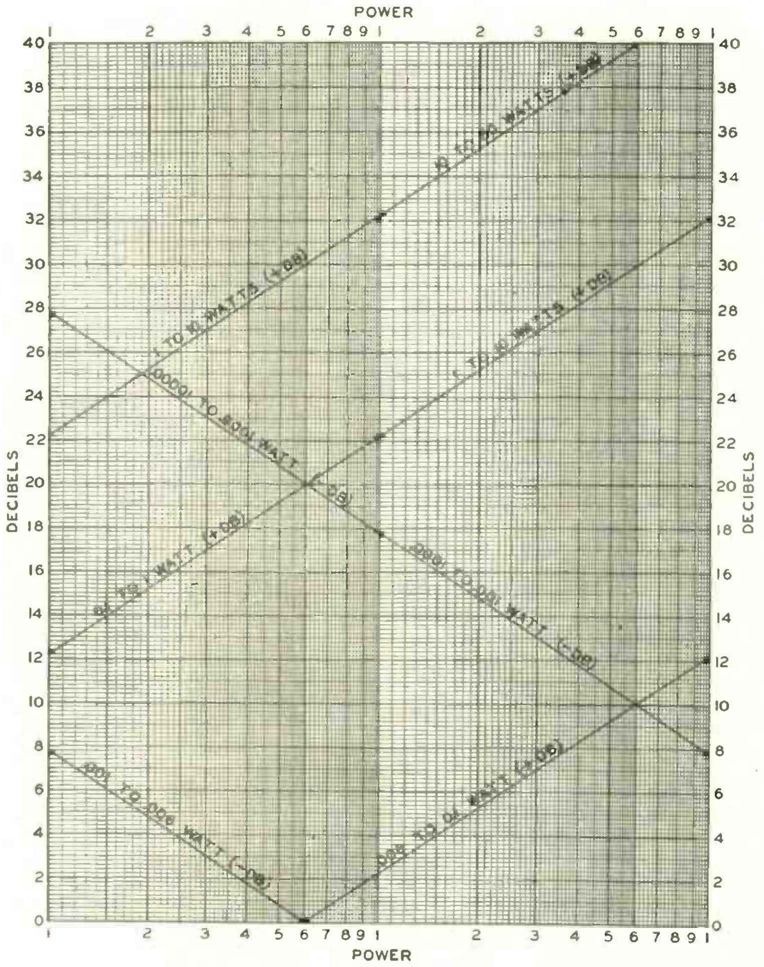


Fig. 2. Chart for the conversion of power rating in watts into a power level expressed in decibels.

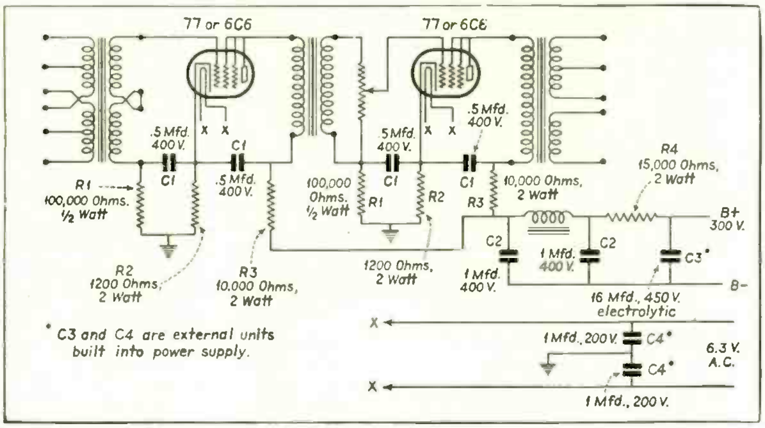


Fig. 3. Schematic diagram of complete ac-operated pre-amplifier. Note tapped input and output transformers for providing impedance matching.

temperature is constant, the space charge can only be increased by lowering the potential which attracts the electrons from the cathode—that is, lowering the plate voltage. The noise caused by shot effect is negligible when compared with the noise produced by thermal agitation as are such noises produced by ionization of residual gas in the tube envelope, leakage from grid to cathode, and photoelectric emission from the grid due to light from the filament.

The hum problem is next to be considered. Much has been said about this subject. Evidently it has been the only problem which has been considered in pre-amplifier design. The causes of hum are listed below.

1—Heater-cathode, heater-grid, hum

2—Plate-supply hum

3—Electromagnetic coupling between the input transformers (and associated input equipment) and any unit generating a strong ac field

4—R-F interference.

Heater-cathode hum is caused by the field of the heater modulating the electron stream from cathode to anode. Heater-grid hum is caused by the field of the heater inducing a 60-cycle voltage in the grid leads.

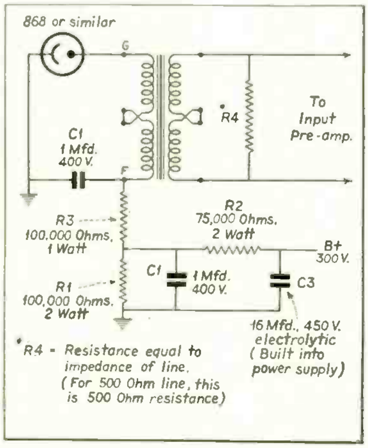


Fig. 5. How a photoelectric cell is matched up to the input of the pre-amplifier.

Plate-supply hum is a common fault in high-gain units using over-rated plate

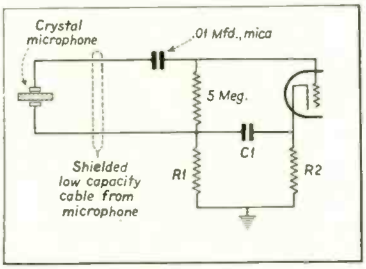


Fig. 4. Modified crystal microphone circuit which may be used in pre-amplifier.

filter reactors. It can be easily eliminated with careful design of the filter system.

Electromagnetic coupling between the input transformer or associated input equipment is the real bugbear in the elimination of hum in a high-gain amplifier. Transformer design, both audio and power, can do much to cut this to a minimum. Complete electrostatic shielding is necessary.

Radio-frequency interference generated by current pulses taking place in the high-voltage rectifier may be carried to the amplifier by the heater leads. Detection of this r-f might occur in the first tube of the pre-amplifier. This can be eliminated simply and completely by bypassing the heater winding to ground and by total shielding of all heater leads.

FREQUENCY RESPONSE

The frequency response in the amplifier should be consistent with that of the main amplifier unit and the input source.

The unit must be stable. The electrical circuit should be of conventional and tested design. Standard input and output lines of either 50, 200 or 500 ohms should be provided.

The amplifier must be entirely ac-operated.

The pre-amplifier should possess sufficient mechanical versatility to be adaptable to either rack or panel, or horizontal table mounting.

The unit must be practically non-microphonic.

THE AMPLIFIER

The unit described in this paper has a voltage gain of 60 db. When this pre-amplifier is used in conjunction with a main amplifier having a gain of 80 db and a power output of 18 or 36 watts, it is possible to drive a signal whose power level is —90 db to full power output of either 18 or 36 watts. This combination will provide a complete public-address amplifier system which can be operated from any commercially available microphone; velocity, crystal, dynamic or carbon.

The pre-amplifier uses two type 77 or 6C6 tubes operated as triodes, as shown in Fig. 3. The characteristics of both of these types are given below.

Filament Voltage	6.3 volts
Filament Current	0.3 amp.
Control Grid Voltage	—8.0 volts
Plate Voltage	250 volts
Plate Current	7 ma
Plate Resistance	10,500 ohms
Amplification Factor	21
Mutual Conductance	2,000 micromhos
Load Resistance	15,000 ohms
Power Output	300 milliwatts

According to information received from the Engineering Service Division of the R. C. A. Radiotron Co., there is little to choose between these two types when they are used connected as triodes and as audio-frequency amplifiers. The advantages of these tubes are fourfold:

1—The electromagnetic field developed by the low heater current is considerably less than that developed by any of the 2.5-volt tubes.

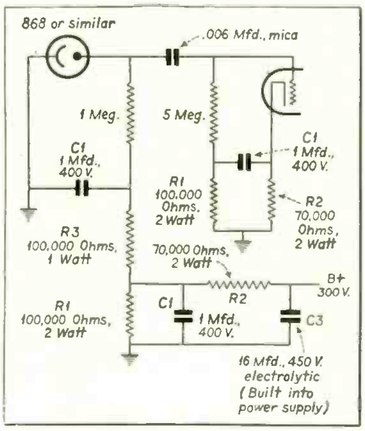


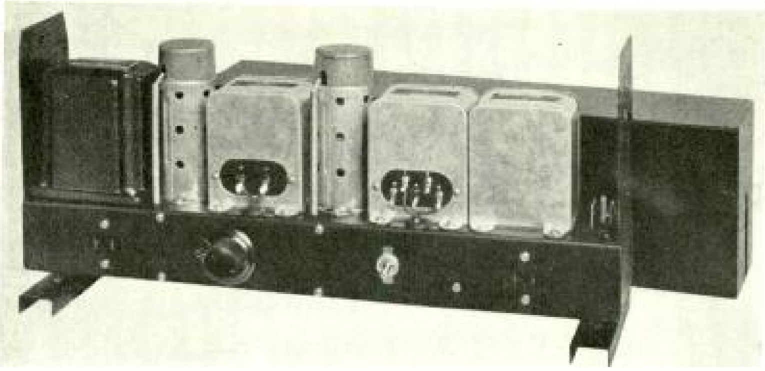
Fig. 6. A resistance-coupled circuit for the photoelectric cell which may be used instead of the arrangement shown in Fig. 5.

2—The helical wound heater is so constructed to be almost non-inductive and thus helps eliminate stray fields from the region of the grid.

3—The control grid of this tube comes out of the top of the tube, removed from heater leads and consequently removed from any field they might set up.

4—The tubes possess an amplification of 21 against 13.8 of the conventional triode.

The controlling factor in amplifier noise is thermal agitation. Nothing can be done about this but nevertheless it must be remembered that this factor determines the lowest possible noise level and all design should point to an optimum noise level of —135 db with respect to zero level. By the proper choice of plate voltage and grid bias the shot effect has been kept low. Under ideal conditions with a noise level of —135 db and a signal level of —90 db the signal-to-noise ratio is 45 db. Measurements on the unit described show this pre-amplifier to develop a signal-to-noise ratio of 35 db. This represents an economical optimum which cannot be materially improved.



The same pre-amplifier as shown below, but assembled for table mounting. Note spring suspension underneath chassis.

CONTROLLING NOISE

The hum level of the unit has been controlled by a number of methods. Heater-cathode hum, as explained above, is a function of the tube structure and can be kept to a very low value by the use of such tubes as the 77 and 6C6. Heater-grid hum in both of these tubes is negligible.

The plate-supply hum has been eliminated by the use of an economical series of resistance-capacity filters in the plate circuit of each tube together with main section of inductance capacity filtering, shown in Fig. 3.

Electromagnetic coupling between the input transformer (and input equipment) and any ac power unit, is by far more difficult to combat. It is quite possible to shield all input lines and all transformers handling low levels and still not prevent this coupling. There is no doubt that if sufficient high-permeability shielding were applied to these units that this coupling could be eliminated. But there is a practical and economical limit to the amount of shielding to any one amplifier. It is for that reason that a special input transformer is used on this amplifier. It is decidedly more economical and therefore more practical to use this unit which employs a coil and core structure designed to buck out the effect of external fields than it would be to use elaborate external shields. This transformer structure is used on all low-level units and is probably the greatest single factor contributing to the success of the ac-operated, high-gain units using these parts. The input transformer is also provided with a complete electrostatic shield between primary and secondary which results in the removal of the effects of all longitudinal line currents which may be developed in the input line.

Radio-frequency interference is eliminated from the heater leads by the use of the dual condenser filter shown in the schematic diagram. All heater leads are carefully shielded with copper braid shielding. The unit can be operated from any 300-volt source of dc.

Standard input lines of 50, 125, 200, 333 and 500 ohms are provided. When a dynamic microphone is used it may be worked directly into the 50-ohm winding. The velocity microphone usually has a transformer built into the microphone case which brings the extremely low-impedance ribbon up to 50, 200, or 500 ohms. The primary of the input transformer used can match any of these lines. When a crystal microphone is used a special transformer is used to couple from crystal to line. It is also possible to modify the amplifier, as shown in Fig. 4, for operation with a crystal input source. A photoelectric cell may be used with the unit as shown in Figs. 5 and 6.

The frequency response of the amplifier is uniform from 60 to 8,000 cycles, which is more than adequate for any public-address system.

MECHANICAL CONSTRUCTION

The unit is absolutely stable in operation. The dust cover and shield which fits over the pre-amplifier acts as additional shielding from stray fields, and also isolates the low-level amplifier from the main amplifier, completely eliminating any tendency of the complete unit from singing (the amplifier supplying its own input).

It is desirable that the pre-amplifier be adaptable to any type of installation. With that object in view the chassis was so designed that it can be wired either for rack-and-panel mounting or horizontal mounting in carrying case or sound truck.

Because it is quite impossible to obtain a vacuum tube that is not microphonic, the designers of this unit have taken precautions to make the entire pre-amplifier on eight conical springs. phonic effects. This end has been accomplished by suspending the complete pre-amplifier on eight conical springs. This results in a system whose period of mechanical oscillation is extremely low. The dust cover and shield also act as an acoustic shield and it, too, is spring suspended.

The pre-amplifier, with dust cover, for rack mounting.

Low-Power

By R. C. Powell

Formerly Editor, "THE BROADCAST ENGINEER"

• SOME ENGINEERING AND ECONOMIC FACTORS ENCOUNTERED IN THEIR ERECTION AND OPERATION

IN WRITING THE Communications Act of 1934, it was recognized that in spite of technical advances in broadcasting which have permitted the operation of more stations and the use of higher power, there are still areas of population which are not receiving satisfactory service. Under the authority provided by this act, certain federal regulations have been revised to allow the operation of additional stations. These revisions were announced on October 10, 1934.

LOCAL RADIO SERVICE

To satisfy all existing demands for local radio service, stations should be established in practically every population center in the country. Engineers know that this is impossible if stations are to use the frequencies at present assigned for broadcasting. The nearest approach will be made through the licensing of a maximum number of stations in the lowest power rating, 100 watts. How many new stations will be licensed cannot be foreseen just now. That their number will not be limited by any lack of demand is indicated by the flood of applications which has been received at the offices of the Federal Communications Commission during the past three months.

Determination of the right to operate will be based on the need for better reception in the proposed service area. Unfortunately the fact that listeners want local programs does not in itself provide the means for sustaining the station. Many such stations have started with the most hearty endorsement of the local residents only to die a lingering death for want of financial support. That so many have continued to operate is a tribute to the ingenuity of their owners.

NEW STATIONS

When one looks back over the history of small station operation he will probably reach the conclusion that it is an exceedingly hazardous business. The turnover in ownership has been large and might have been larger had it not been so difficult to obtain a license for a new station. The selling price of broadcast stations has been based on a lack of available channels rather than on earning power or asset value. Owners have usually held on until exhaustion of working capital has forced them to sell to others willing to risk more.

Much can be learned from the experiences of the pioneer station owners. Outstanding is the fact that the smaller the station the higher must be its operating efficiency if it is to make money. Some of the factors to be considered in the establishment and operation of a local station are discussed here. Some of the pitfalls encountered by this type of station are enumerated.

PRELIMINARY SURVEYS

The citizens of Blanktown decide that they want a broadcast station. It is assumed that the station is to be supported by local and national advertising. What chance has the station to succeed? Some time ago the Federal Radio Commission examined the operating records of some 200 local stations. They decided that the smallest area which a local station could serve economically is one in which a population of 25,000 receives a signal intensity of 2 millivolts per meter[1].

The radius receiving this signal value from the average 100-watt station is 10 miles. The minimum allowable separation between 100-watt stations operating at night is 185 miles. At this separation the average ratio of interfering signal to local signal at the 2 mv/m limit is expected to be 1 to 20[2].

If the separation between the station to be established and those already in operation on the same frequency exceeds the specified minimum, greater than average coverage may be possible. Whether this is so depends upon the propagation conditions between the stations and the average conductivity of the soil in the service area. These facts must be determined by surveys before the station is erected.

Additional surveys should show the location and arrangement of the surrounding population, within this classification the radio set ownership and within this second classification the buying power of set owners. National advertisers, who may be expected to become more interested in local stations during the next few years, will base their selection upon facts and figures and the station owner who has not the above information will lack an essential sales argument.

TRANSMITTER LOCATION

When the various areas of population have been segregated according to their economic value to advertisers, a transmitter site must be found from which the areas can be most effectively served. If the service area is roughly circular it is usually best to locate the transmitter at a central point. If it is irregular, or divided into two or more groups, a directional antenna may be used. Further use may be made of directional antennae where two closely separated stations on the same channel are willing to cooperate to keep an interfering signal out of the other's service area. Other factors to be considered are the character of the soil and terrain, the location of high buildings and the blanket area of the station.

Nothing is more important in the establishment of a broadcast station than proper location. In a series of measurements made a few years ago it was found that the coverage efficiency of a certain group of stations varied from 5.7% to 57%. The variation was due solely to the design and location of the radiating system[3]. If the least efficient station has increased its efficiency to equal that of the best station found in the survey the increase in signal strength would have been equivalent to raising power from 1000 to 10,000 watts.

As a further example of the importance of antenna and location, a 250-watt regional station in New York City found that the audience within its serv-

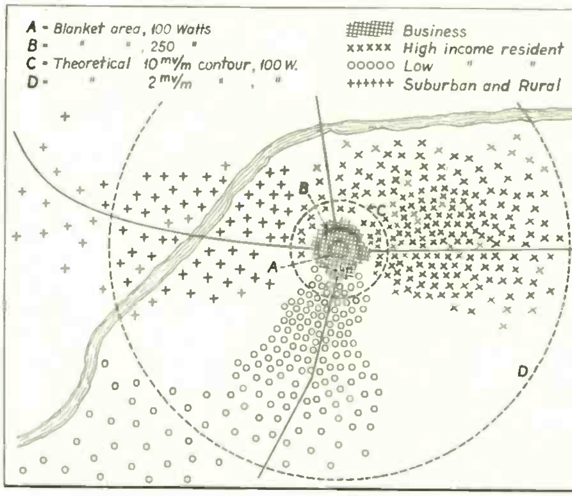
[1] C. B. Jolliffe, paper delivered before I.R.E., N. Y. Section, Jan. 2, 1935.
[2] A. D. Ring, Proc. I.R.E., April 1932.

[3] "Location of Transmitters of Broadcasting Stations": Bulletin issued by the Federal Radio Commission, 7/15/32.

Broadcast Stations

ice area could be doubled if the transmitter were moved a few miles. Subsequent surveys showed that the service of the nearest station on the same channel would not be seriously restricted if the power of the New York station were increased to 1000 watts. As a result of increased power, relocation and an efficient antenna system, the audience coverage was increase 350%*.

The success or failure of a station may often be determined before the first program is broadcast.



Typical city of 30,000 to 50,000 population, showing local station coverage and areas under consideration.

ANTENNAE

How much is it worthwhile to invest in the antenna system?

Assuming that the choice is between a quarter-wave and a half-wave radiator, or between a quarter-wave radiator and a directional system, the decision rests with the answers to these additional questions: How much more will the station be worth as an advertising medium if the signal strength is doubled? How many more listeners will be reached if the good service radius is extended 50%? What is the cost per listener in the additional service area?

Many 100-watt stations will never be permitted to use greater carrier power. With the cost of antenna structures becoming steadily lower, an investigation of their possibilities is well worthwhile.

EQUIPMENT

The purchase of broadcast equipment is the largest expenditure in the erection of the station. Hotel managers or building owners can usually be found willing to provide space for studios and offices. Local dealers often exchange pianos, furniture and office equipment for advertising. As far as the writer is aware no equipment manufacturer has ever offered to install a plant on this basis. Good broadcast equipment is expensive. It is difficult to design, costly to manufacture in the quantities used. The production of the first model of a transmitter costs at least ten times as much as succeeding units of the same design. The rate of development and consequent obsolescence in transmitting equipment make new designs almost a yearly occurrence.

Important questions which should be asked concerning any type of equipment are: Will it deliver full carrier power with complete undistorted modulation? Will it maintain its operating frequency? Will it respond to the range of musical frequencies now considered standard? Will it give uninterrupted operation? What are the operating and maintenance costs? What is the manufacturer's guarantee of maintenance and what is it worth? Equipment performance should be demonstrated to the satisfaction of a competent engineer both before the purchase and after installation.

Some station owners have attempted to save money by building their own equipment. It is doubtful whether the books of a single composite station will show that any money has been saved. Experimenting with equipment simply wastes time which might otherwise be devoted to the sale of advertising or the building of programs.

One of the most useful grants made to broadcast stations is permission to operate their transmitters by remote control. It is one of the opportunities least used. Well designed, properly adjusted transmitters will operate for months on end without supervision other than daily inspections. The use of a remotely-controlled transmitter gives more latitude in the selection of a good location, saves personnel and the cost of transmitter buildings and encourages the operation of the equipment within its rated power. Tubes and transmitting equipment have developed much faster than the average engineer's confidence in them. They won't stand much more abuse but they will operate longer under suitable conditions. Three stations, with which the writer is familiar, have lost less than 5 minutes of program time in the past two years due to transmitter failure. The employment of an operator simply to watch a 100-watt transmitter is costly insurance against such minor delays. It would be less expensive to install an emergency transmitter.

PROGRAMS, ADVERTISING AND ORGANIZATION

The local station is inescapably confronted with a scarcity of program material and advertisers. In most cases electrical transcriptions form the major part of its musical offerings. To date the leased musical library system has been the best available source of programs. Recordings made up of groups of 3- to 4-minute selections are used in various combinations with commercial announcements introduced between selections. While such program material is the best offered today it is by no means the ultimate service which the local station might desire. It compares in musical quality with network programs but cannot compete with them in program structure, freshness and news value. A service furnishing a daily or weekly supply of inexpensive transcriptions would be a welcome development. Such a service could only be supported by cooperative effort among the local station owners which would permit the cost of programs to be divided among one hundred or more stations.

Firms representing groups of stations for the sale of advertising have done much to promote the use of spot broadcasting by national advertisers. Chiefly because the coverage and audience of the small station has been an uncertain

(*Continued on page 24*)

*C. M. Jansky, Jr., paper delivered before I.R.E., N. Y. Section, Jan. 2, 1935.

Ultra-High Frequencies . . . the solution to small-area problems in police radio practice: The first of two articles dealing with the trend in developments, and the newly constructed 30.1-megacycle radio system placed in operation by the Newark, New Jersey, Police Department.

View of the radio room at the Newark, N. J., Police Headquarters, with maps showing the position of all police cars. In the background is the telephone switchboard where all calls to be handled by radio enter.

Ultra-High-Frequency

POLICE RADIO SYSTEM

By PAUL F. GODLEY
Consulting Radio Engineer

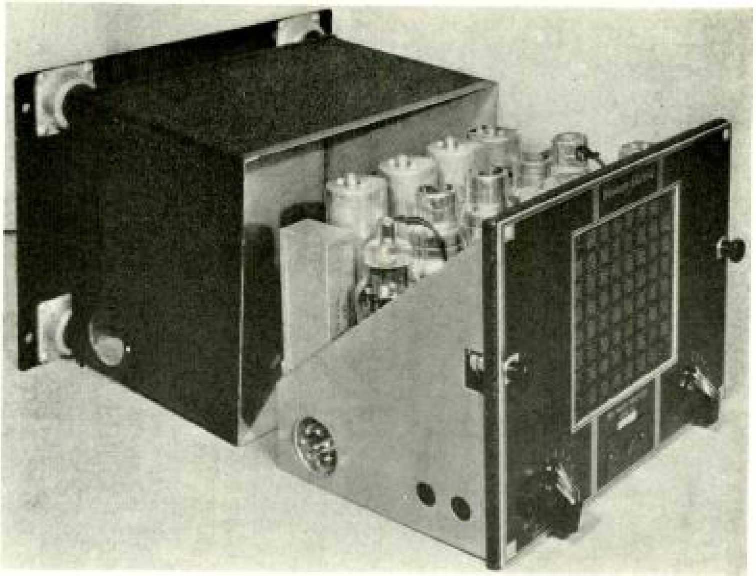
RADIO IS ONE of the most effective tools ever placed in the hands of the police. There has been no evidence developed to the contrary. Almost every municipality large enough to have police problems can effectively put radio to work to secure either greatly improved police protection, a considerable reduction in cost, or both. Municipalities of various sizes, but not numbering more than two or three hundred, have been using radio. The number of police installations has been increasing at an extremely rapid rate during the past year or two. This is particularly true since the advent of low power, ultra-high-frequency equipment, which has made it possible to provide a system for a town or city of moderate size at a relatively low cost. Because ultra-high-frequency waves are quasi-optical in character, no serious interference problems have developed, for the reason that most of the installations have been in areas where the towns and cities equipped are pretty well isolated by a large surrounding rural territory.

SMALL-AREA REQUIREMENTS

The problem of meeting the radio requirements in a relatively small area filled with a great number of individual municipalities is, on the other hand, not so simple. To be specific, the rather thickly populated area immediately adjacent to New York City, including Long Island, lower New York State, Connecticut, and Northern New Jersey, contains hundreds of towns and cities, each with its own separate police force and policing problem. Under these circumstances, if an attempt were to be made to provide each with an individual radio police alarm system, several hundred communication channels would have to be available, or some arrangement made for a division of operating time on a small number of channels. In the face of the limited number of channels now available, or to become available, it would obviously be impossible to find facilities so that each of the towns in the metropolitan area could have its own individual frequency. In the case of time division, even where a very carefully worked out plan is pursued, frequent interference between stations would result, beside which, time division could not always satisfy requirements for immediate and at-the-moment instructions to roving cars. The available frequency assignments being limited, the application of radio to police work in the majority of the larger towns in this area very definitely calls for cooperation.

FREQUENCY ASSIGNMENTS

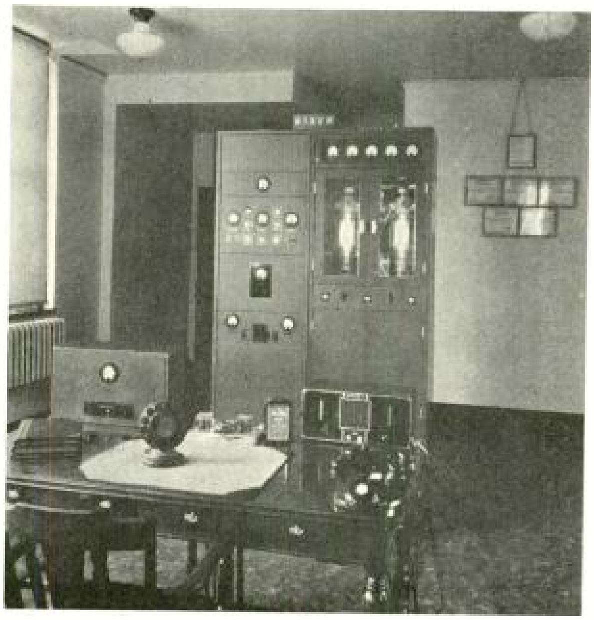
A few channels available for municipal police work lie in the vicinity of 2400 kilocycles (125 meters). Some additional assignments lie in the vicinity of 1600 kilocycles (180 meters). These last-named are nominally for State police use, although, lacking use by the state to which they had been assigned. they have been violated to some extent for municipal service. The region in the vicinity of 2400 kilocycles is in use by larger cities scattered over the country. At night, near the outer edge of the normal service area of these stations, interference problems have to be dealt with. These are minimized by observing the maximum possible brevity in the broadcasting of alarms, and by a repetition of the alarm. notwithstanding which, a number of cases are on record where roving cars in one city have raced to the addresses broadcast but to find that the alarm had originated in another city.



Open view of the ultra-high-frequency receiver for use in the police cars. This is the type of receiver being used in the Newark Police Radio System. These sets are pre-tuned to the working frequency of the transmitter at headquarters.

ULTRA-HIGH-FREQUENCY BAND

Upon the opening of the experimental ultra-high-frequency band, five channels within the band were thrown open by the Federal Authorities for police use. Assignments on these channels may be duplicated over and over again insofar as the country as a whole is concerned, because of the aforementioned quasi-optical character of ultra-high-frequency radiation. Repetition of assignment of these frequencies within a limited area cannot, on the other hand, be made successfully, even though the powers are held to low figures. In the metropolitan area of New Jersey alone, we find these five ultra-high-frequencies now assigned and in use. On one of these channels the assignment is in duplicate, the separation being about thirty miles. If very low powers are used, some additional duplication of this same sort could be had, providing geographical separations of this same order were adhered to. In the case cited. the two towns using the same frequency assignment are approximately on the extreme northern and southern edges, respectively, of the New Jersey metropolitan area. Also, in this case, there is no assurance that both stations hold operation to the exact assigned frequency, since the transmitters are not crystal controlled. The future will find crystal controlled operation a necessity.



The panel at the left is the 50-watt ultra-high-frequency transmitter. The one at the right is the 500-watt amplifier. On the left corner of the dispatcher's desk in the foreground is the control unit and on the right corner a station-house receiver used for monitoring.

NEWARK SYSTEM

In attacking the problem of providing a police broadcasting system for the City of Newark, thought was given to the future requirements of the New Jersey area. Immediately adjacent to Newark, and including but two or three towns outside of the county of which Newark is the county seat, some eighteen or twenty towns, ranging in size from 10,000 to 100,000, could, at the present time, advantageously employ radio for police work. It appeared that complete coverage for the majority of these towns could be had with a minimum of interference and a minimum of initial cost, as well as a minimum of upkeep, if one high-power plant were so located and set up as to provide for access to the transmitter on the part of any one or all of these adjacent towns. An ultra-high-frequency assignment was decided upon. The site chosen for the antenna was the tip of the steel flagpole upon the tallest skyscraper in the City of Newark. The power chosen, 500 watts, is the highest power ever used for police work in the ultra-high-frequency band, and, based upon surveys made from an antenna erected on an adjacent building of approximately the same height (700 feet), it was expected that the above transmitter would give satisfactory coverage to all of the important towns within Essex County, and some towns contiguous to Newark within Hudson County.

CRYSTAL CONTROL

Specifications called for crystal control of the transmitter, another departure insofar as ultra-high-frequency police practice was concerned, and the superheterodyne receivers put into service were designed so as to permit of the application of a quartz crystal for the control of the frequency of the oscillator of the superheterodyne, if, in the future, crystal control of the receiver became a necessity because of the crowding of the ultra-high-frequency portion of the spectrum. Further, the use of a crystal control in the receiver would greatly simplify operation in the more remote sections of the area to be served, where noise levels due to motor-car ignition systems might be relatively high. And, finally, the use of crystal control for the receiver would obviate all tuning controls on the receiver.

THE ANTENNA SYSTEM

The transmitter, located on the 34th floor of the National Newark and Essex Bank Building, is approximately 200 feet below the tip of the flagpole, the 270° (three-quarter wave) antenna being an extension of the flagpole. Inasmuch as the operating frequency assigned is 30.1 megacycles, this gives an antenna length over-all of approximately 22 feet. The energy is fed from the transmitter to the antenna through a concentric transmission line which passes out of the base of the transmitter through cement floors, walls, along steel girders, and is finally fished through a hole in the base of the steel flagpole and out through the tip of the steel flagpole. This type of feed was essential in order that the normal functions of the flagpole might not be interfered with. At the tip of the pole, the outer conductor of the transmission line is grounded to the flagpole, the inner conductor coming out through a special bushing insulator and paralleling the lower 90° of the antenna, it being so spaced from the antenna as to provide a suitable "match" between the transmission line and the antenna. Obviously, only the upper 180° of the antenna functions as a radiator.

THE TRANSMITTER

The transmitter, as may be seen from the photograph, has two panels. The one to the left is in itself a complete crystal controlled, 50-watt, ultra-high-frequency unit, the output of which is fed through a short concentric transmission line to the input of the power-amplifier stage contained in the panel on the right. The output stage of the 50-watt unit is Class B modulated. Air-cooled tubes are used throughout the transmitter, direct-current power being supplied through suitable rectifiers. Due to the compactness of the design as a whole, forced draft cooling is provided in both panels by blower fans. These fans take air in near the base of the panels at the rear, through air filter screens, and exhaust the air at the top of the transmitter. The crystal used for the generation of the fundamental frequency is cut so as to have a zero temperature co-efficient, no crystal oven being used.

RECEIVER FOR CARS

The receiver illustrated is a 6-tube superheterodyne, and the receiver cabinet houses the speaker. But two controls are available after the receiver has been put into service; the one on the left is a combination off-and-on switch and volume control. The control on the right is a "trimmer" condenser in the superheterodyne oscillator circuit. Once the set has "warmed up," the oscillator "trimmer" control need not be touched. Access to an antenna "trimmer" condenser is had by sliding the rectangular plate, which may be seen at the center near the bottom. Normally, this plate is held in position by screws and need never be touched by the operators. The receiver circuits are, of course, "lined up" at the time the unit is placed in service.

The metal receiver case is mounted upon a metal base, through rubber shock-absorbers, directly back of the seat, in such position as to be immediately adjacent to the ears of both driver and passenger. The antenna used is essentially the same as that provided by the Ford Motor Company in this class of coupe. On the other hand, an extra heavy-duty storage battery and a special type of heavy-duty charging generator with automatic voltage regulator have been substituted for stock equipment.

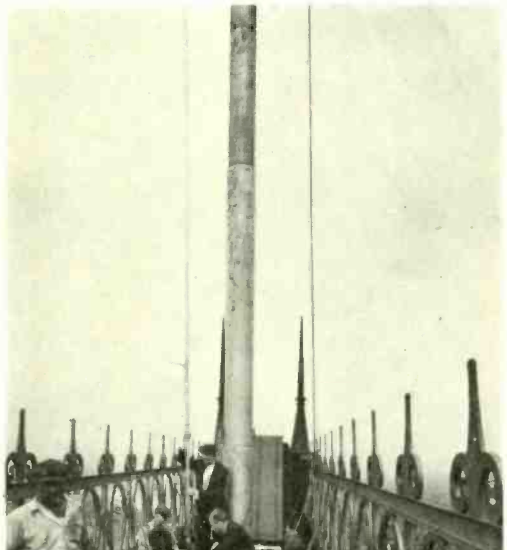
DISPATCHING TECHNIQUE

The dispatching of police alarms for the City of Newark is done at police headquarters, approximately one-half mile from the site of the transmitter. Here, within three adjacent rooms, are concentrated the telephone switchboards handling City telephone calls, the Inter-State police teletype system, with its receivers and transmitters, and the radio dispatch room. Telephone facilities within the dispatcher's room itself provide for some twenty incoming direct trunks, any one of which may be patched through direct to the broadcast station for use by participating organizations outside of Newark. Here, also, a large-scale map of the City of Newark is divided and placed upon two tables, between which the officer in charge spends his time. Small models, very closely resembling the units used in the Newark police work, and each numbered to correspond with the numbers assigned to the cars themselves, are spotted upon the map within the assigned districts. When an alarm is dispatched to one of these cars, the model is turned on its side, indicating assignment. Upon the completion of an assignment, the patrolmen report by telephone, and the model is set upright, indicating re-availability.

Of course, the microphone is also within the dispatcher's room. It feeds into an ac-powered speech amplifier, which, in turn, feeds a telephone line terminating at the broadcast station, where the speech passes through another amplifier and into the transmitter.

The installation has completely borne out expectations based upon the original survey.

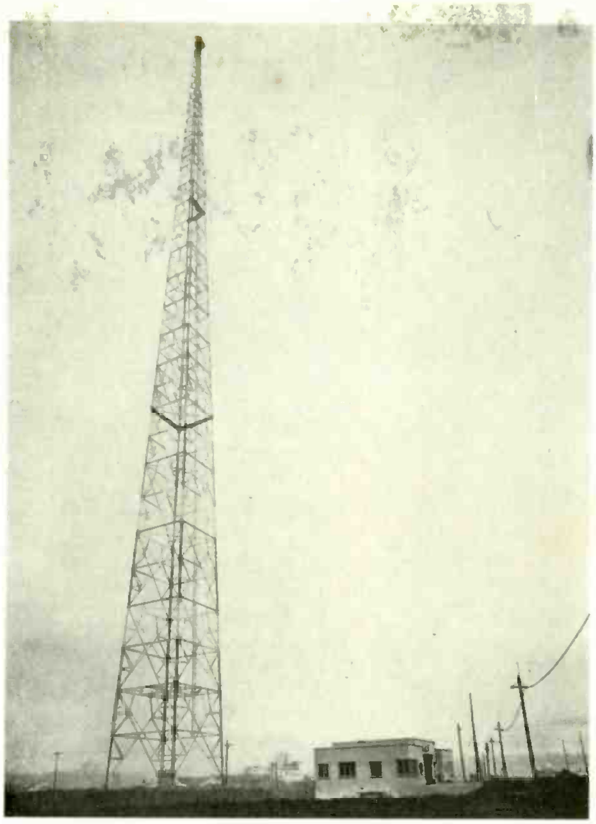
(To be continued)



The Newark Police Radio antenna system under test. The tapering brass tube, 22 feet high, tops the flagpole. The inner tube of the transmission line parallels the brass tube for 7 feet as may be seen in the photo. The remaining 15 feet of the tube serve as the actual antenna 600 feet above street level. Paul Godley, radio consultant for the city of Newark, is kneeling at the right, and O. W. Towner, Bell Laboratories engineer, is holding the antenna tube.

NEW KOL STATION

Has tallest self-supporting vertical radiator in nation, towering 490 feet in the air. New ground screen used to reduce dielectric losses



The new 490-foot self-supporting tower at KOL, Seattle, Washington. Another view of this tower is shown on the front cover. The alternate sections of the mast are painted orange for the sake of visibility. The new, modernistic, transmitter house, close to the base of the tower, is shown in the illustration below.

ERECTING THE NATION'S tallest self-supporting radio antenna, more than doubling its daytime power, and installing a new 5,000-watt transmitter, station KOL, Seattle, CBS outlet, is expected to have a vastly increased listening area.

Towering nearly 200 feet higher than the Statue of Liberty (490 feet as contrasted with 305 feet), the new vertical radiator is a good 20 feet higher than any similar radio tower in the United States. From its heavy reinforced concrete base just a few feet above sea level on Harbor Island, the 126,000-pound steel mast rises majestically above Seattle's tallest hilltop.

TOWER SUPPORT

The tower is supported by four huge insulators, each nearly five feet tall, specially designed to support the entire weight of the tower plus uplift and compression during high winds. Early antennae of this type were partially supported by guy wires, but by careful designing they have been done away with in this instance. This is to eliminate any absorption of the radio signal due to guy wires. It is interesting to note that during the course of construction, lacking guys and reinforcing cross bars, the tower withstood a semi-hurricane wind of over 80 miles an hour without the slightest damage.

RADIATOR EFFICIENCY

More than 80 percent efficiency is expected from KOL's new radiating system located on filled-in tide flats. Much of this increased efficiency will be due to the patented ground screen and the copper wire radials buried in the salt water soaked soil surrounding the tower. The ground screen effectively reduces the dielectric losses common to a self-supporting vertical mast of the type used, by minimizing the high voltage impressed across the earth at the tower base.

ANTENNA LIGHTING SYSTEM

The United States Department of Commerce, Bureau of Aeronautics requirements dictated that the antenna should be painted in orange and white stripes and well lighted to warn aviators. A dual lighting system has been so arranged that if one light in either group burns out the second group of lights will automatically turn on, thus assuring continuous lighting of the tower. In addition there are two 1,000-watt narrow beam "ceiling" lights

View of the transmitter room at KOL, Seattle, Washington. The transmitter is a 5000-watt job, crystal controlled, 100-per cent modulated. Air-cooled rectifier tubes are employed.

placed at diagonal corners of the base of the tower focused straight up into the air flooding the structure and, in clear weather, extending beyond to a height of nearly a mile.

Lightning, naturally, is expected to strike the mast from time to time, so, in order to protect the transmitter and other property, ball gaps have been installed at the base of the tower which will instantaneously ground the lightning without harm to the equipment.

THE TRANSMITTER

A 5,000-watt, crystal controlled, 100-percent modulated transmitter embodying all the latest improvements to be adopted by the industry, has been designed by A. D. Gunston, KOL's chief engineer, and constructed in the station's laboratory at Gunston and his assistant engineers, Clyde Bond and Albert Henderson. Nearly $1,800.00 worth of tubes alone are used in the new set, among them the latest type air-cooled rectifier tubes for the power supply.

Entirely automatic throughout, the transmitter can be started and stopped with a single push button. If a speaker or singer should "blast" the microphone too loud, the set will instantly go off the air and, ten seconds later, come back on without the touch of a human hand. As a safety precaution the power is automatically cut off when any window or door in the wire cage surrounding the transmitter is opened. A dual power supply that will cut from one to the other automatically within two seconds should one fail, guarantees that KOL will maintain all schedules.

Twenty gallons of pure distilled water per minute are required to cool the two big power tubes. Should the temperature rise above 160 degrees or the water pipe become obstructed, the transmitter will automatically shut off.

THE TRANSMITTER HOUSE

The new transmitter house, built expressly for the new equipment, also has an auxiliary studio and a small apartment for the night watchman.

Simultaneously with the installation of the new transmitter, speech amplifying equipment and vertical antenna, KOL commenced broadcasting on an increased power of 2,500 watts daytime and 1,000 watts after sundown.

John L. Hall, Seattle engineer, supervised the erection of the huge tower, the actual work being done by the E. & M. Transfer Company of Seattle. The mast was designed and fabricated by the International Stacey Company, of Columbus, Ohio. McClelland and Jones were the architects who designed the special transmitter house.

KOL's magnificent pipe organ, broadcasting studios and executive offices will remian in the Northern Life Tower, Seattle, Washington.

LOW-POWER BROADCASTERS

(*Continued from page* 19)

quantity the development of this source of income has been slow. A coordinated effort among small station owners to stimulate the interest of advertisers in the entire group would be helpful in this respect. The networks present very definite and conclusive figures on coverage which justify their use by advertisers. Some local station owners have no proof of what their single station has to offer.

Standardization of the equipment used in local stations would bring about a major saving in operating expense. If those planning to install new stations joined with those planning to replace their equipment they would find manufacturers quoting very attractive prices on the group order. The equipment requirements of this group are identical both at the time of installation and for maintenance.

Many small stations have come and gone in the last ten years. Those which have fallen by the wayside have had one characteristic in common—a tendency to ape the larger stations in such matters as employing extensive personnel, installing large groups of studios and offices with expensive furnishings, even pipe organs, taking unprofitable business for the sake of prestige, wasting money on futile trips to Washington to obtain more power or time.

The successful station owner has recognized that he is operating an advertising medium, that his signal is the means of reaching his listeners and since he cannot hope to please them all he must have as many as possible, that his programs are the means of attracting and holding the attention of listeners and finally that the local station is essentially a small business and must be operated as such.

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AIR COMMERCE RADIO REGULATIONS

SECTION 4 of Chapter 5, (115), of the Law of Scheduled Operation of Interstate Air-Line Service states the following in regard to the *Radio Operator*: "The first pilot or co-pilot may serve in the capacity of 'radio' operator. Where, because of the nature of the route, equipment, or mode of operation a full-time radio operator is considered necessary, then he shall serve as a separate member of the aircraft crew."

Section 3, *Radio*, of Chapter 8 on *Flight Operations* reads as follows:

"147. (A) If and when operating over airways on which the ground facilities have been established as part of the airway equipment, all aircraft shall be provided with at least one approved radio-receiving system for the purpose of receiving radio range-beacon signals and weather broadcasts. If the airways have not been provided with radio ground facilities, an adequate visual signalling system, approved by the Bureau of Air Commerce, may be used in lieu of the receiving radio equipment required herein. On or before January 1, 1936, two-way radio communication shall be installed and operating."

"148. (B) Two separate radio-receiver systems are preferable in aircraft operating over clouds and over or through fog or overcast." (*Air Commerce Bulletin*, December 15, 1934).

TELECOMMUNICATION

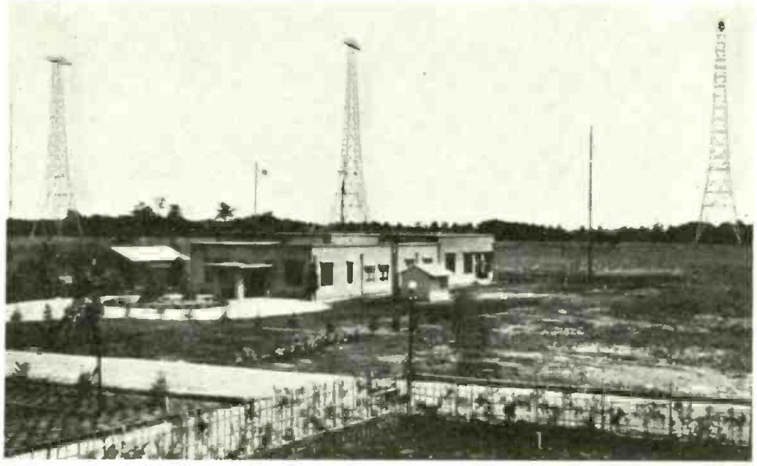
PANORAMA OF PROGRESS IN THE FIELDS OF COMMUNICATION AND BROADCASTING

TRANSPACIFIC RADIO-TELEPHONE LINK

DURING DECEMBER a new short-wave radio-telephone channel connecting Tokyo, Japan, and San Francisco, California, a distance of 5,130 miles, was formally opened. This was the fourth link to be set up by the Bell Systems connecting the United States with countries on the other side of the Pacific Ocean, the other transpacific radio-telephone links connecting San Francisco with Honolulu (2,400 miles), Manila (7,000 miles), and Bandoeng (8,700 miles).

Outgoing telephone calls are handled from tne switchboards of the Pacific Telephone and Telegraph Co., in San Francisco, are sent over wire lines to the transmitting station at Dixon, California, 20 miles southwest of Sacramento, and there broadcast. This signal is picked up at Komuro, Japan, and sent over wire lines to Tokyo. The Japanese transmitting station is located at Nazaki while its associated receiving station on the American side of the Pacific is at Point Reyes, California, this latter site being 35 miles north of San Francisco.

Special circuits run from the two California stations to a control room in the San Francisco Long Distance office. Here technical operators make constant adjustments to give the greatest intelligibility under varying atmospheric conditions. Adjustments are also made to compensate for weak and strong voices.



A VIEW OF THE RADIOTELEPHONE RECEIVING STATION AT KOMURO, JAPAN, SHOWING THE ANTENNA SYSTEM AND THE BUILDING HOUSING THE RECEIVERS AND AUXILIARY EQUIPMENT FOR USE ON THE NEW RADIOTELEPHONE CIRCUIT LINKING UNITED STATES AND JAPAN.

UNITED STATES

JAPAN

Transpacific radiotelephone operator at board of Pacific Telephone and Telegraph Company, in San Francisco, plugging in on our "next-door neighbors" only 7,000 miles away, a few of whom are shown inspecting the equipment at Nazaki, Japan.

"MINIMUM AND OTHER RATES"

AT A GENERAL SESSION of the Federal Communications Commission held at its office in Washington, D. C., on the 14th day of December, 1934, the Commission having under consideration the matter of the requirement that every common carrier shall file with the Commission schedules showing all charges for itself and its connecting carriers pursuant to the provisions of Section 203 (a) of the Communications Act of 1934, or changes made in such charges under section 203 (b) of said Act; and it appearing that statements of proposed "minimum and other rates" are required to be shown in response to the Commission's forms of Application for Radio Station License, and of Application for Radio Station Construction Permit:

It was ordered, that such statements of "minimum and other rates" required by the Commission's forms of Application for Radio Station License, and of Application for Radio Station Construction Permit, or other similar statements submitted pursuant to any other form of questionnaire now or hereafter required by the commission in executing its duties under the law, shall not be construed as a filing of schedules of charges within the meaning of Title II of the Communications Act.

CLASS A TELEPHONE CARRIER

At a regular meeting of the Telephone Division of the Federal Communications Commission, held on the 20th day of December, 1934, the Telephone Division, having under consideration the returns heretofore made by carriers engaged in telephony subject to the Act, pursuant to Telephone Division Order No. 6, and also having under consideration the provisions of Section 210 of the Act, to regulate the use and issuance of franks and passes, or the granting of free service, or services at less than regular charges, in interstate and foreign communication by such carriers:

It was ordered, that each Class A Telephone carrier subject to the Act shall, on or before March 1, 1935, make a full and complete response, under oath, in duplicate, to the supplemental form questionnaire, for the period January 1, 1934, to December 31, 1934.

It was further ordered, that effective January 1, 1935, all Class A telephone carriers subject to the Act, shall keep their records in such manner as will enable them to furnish the Commission with the information requested in said form questionnaire for any month or months, subsequent to December, 1934, as may be requested by the Commission.

It was further ordered, that all Class A telephone carriers subject to the Act, shall retain in their possession all original records containing the data used in compiling the response to the said form questionnaire, until such time as the Commission shall specifically authorize the destruction thereof.

ORDER NO. 14-A

In a regular meeting of the Telegraph Division of the Federal Communications Commission, January 2, 1935, the Telegraph Division, having under consideration its Order No. 14:

It was ordered that the proposed Rules governing the issuance of telegraph franks as set forth therein, be amended by the addition of the following paragraph:

4(a) *No frank or franks shall be issued by any carrier purporting to authorize any person to send messages the regular charges on which in the aggregate would exceed* $10.00 *in any calendar year; nor shall any person use or attempt to use in any calendar year any frank or franks issued by one carrier for the sending of messages the aggregate charges on which, at regular rates, would exceed* $10.00 *in any calendar year.*

On January 4, the Federal Communications Commission adopted the following Resolution upon the resignation of Hampson Gary as a member of the Commission, effective January 1, 1935:

"Whereas, the Honorable Hampson Gary has by resignation terminated his membership in the Federal Communications Commission, therefore be it

Resolved, that the remaining members of that body, assembled this date en banc, desire to place themselves on record as deeply appreciative of the great value to this Commission of Mr. Gary's service, as manifested by the wisdom of his counsel, the intelligent helpfulness of his cooperation, and the consistent earnestness of his devotion to the work of the Commission; and be it further

Resolved, that in conveying their individual and collective regrets at his departure from this field of his activities, his late colleagues do assure him of their continued interest in his welfare and their hope that opportunity will be afforded for the exercise of his talents in some worthwhile avenue of public service."

APPLICATIONS GRANTED FOR NEW STATIONS

Telegraph Division

December 19, 1934.

UNITED GAS PUBLIC SERVICE CO., aboard NC-14249, granted license, 3105 kc, 50 watts.

CITY OF BIRMINGHAM, Alabama, granted construction permit (2 applications) for portable-mobile equipment, frequencies 30,100, 33,100, 37,100, 40,100 kc, 5 watts.

MARYLAND STATE DEPT. of Forestry, granted construction permit for portable equipment (Laurel, Md.), frequencies 31,600, 35,600, 41,000, 38,600 kc, 50 watts; same for Hillmeade, Prince George County, Md. Also granted construction permit, Burtonsville, Md., frequencies 31,600, 35,600, 38,600, 41,000 kc, 50 watts.

THE LORAIN COUNTY RADIO CORP., granted construction permit (2 applications) for portable equipment (Ohio), frequencies 2118, 2158, 2182, 2738 kc, 50 watts.

AERONAUTICAL RADIO, Inc., So. Washington, Va., granted construction permit, frequencies 2930, 6615 kc, 400 watts.

CITY OF DECATUR, Ill., Police Dept., granted construction permit, 30,100, 33,100, 37,100, 40,100 kc, 100 watts.

PAN AMERICAN AIRWAYS, Inc., Martin M-130 X-14714, granted authority to operate aircraft radio station for purpose of testing equipment aboard plane. Operation is authorized on Orange Chain frequencies with 50 watts power, pending receipt and action on formal application for station license.

CITY OF EVANSVILLE, Indiana, granted construction permit, frequencies 30,100, 33,100, 37,100, 40,100 kc, 50 watts, to communicate as municipal police station in emergency service on experimental basis only.

CITY OF DETROIT, Michigan, Dept. of Public Works, granted construction permit and license covering, 278 kc, 15 watts.

December 26, 1934.

AERONAUTICAL RADIO, INC., Louisville, Ky., granted construction permit, frequencies 2922, 2946, 2986, 4122.5, 5652.5 kc, 20 watts. The same was also granted for Macon, Ga., and Chattanooga, Tenn.

R. N. SANDQUIST, Candle, Alaska, granted license to cover construction permit to use transmitter already constructed as point to point telegraph (KIKO), working frequency 425 kc, calling frequency 500 kc, 60 watts.

VILLAGE OF SCARSDALE, N. Y., granted construction permit, frequencies 30,100, 33,100, 37,100, 40,100 kc, 25 watts. Also granted license covering same.

OPERADIO MFG. CO., Chicago, granted construction permit (2 applications) for portable-mobile equipment, 30,100 kc, 10 watts.

RCA VICTOR CO, Inc., Wilburtha, N. J., granted construction permit, 1610 kc, 1000 watts.

CITY OF BUFFALO, N. Y., Water Department, granted construction permit, 87,000, 90,000 kc, 5 watts. Same also granted City of Buffalo, Water Department, Water Intake Crib, Buffalo Harbor, N. Y.

STATE OF INDIANA, Dept. of Public Safety, Culver, granted construction permit, 1634 kc, 1000 watts.

STATE OF MISSOURI, Highway Patrol, North Jefferson City, granted construction permit 1674 kc, 2500 watts day, 1000 watts night.

January 2, 1935.

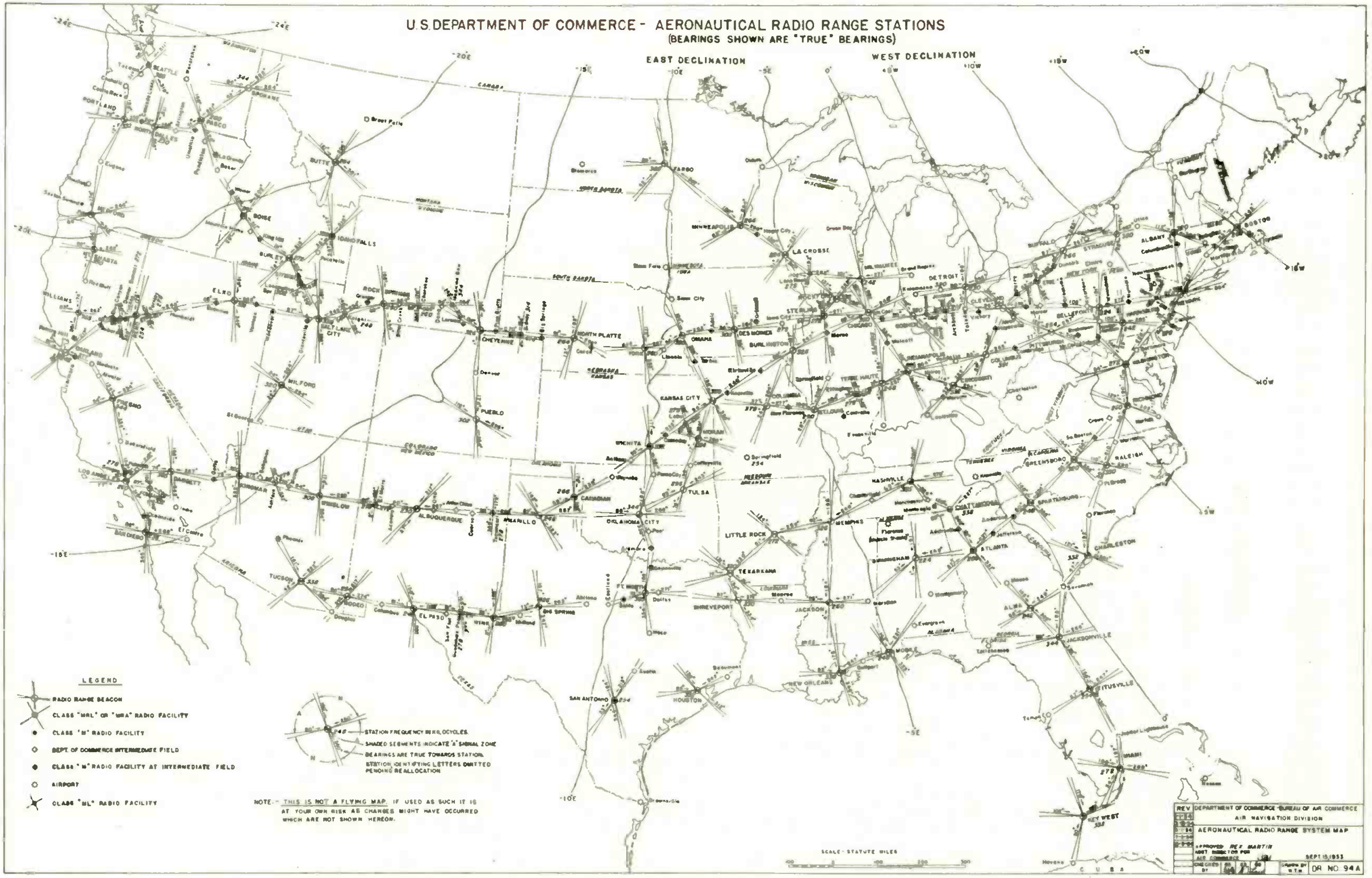
PACIFIC ALASKA AIRWAYS, Inc., Mulato, Alaska, granted construction permit (Aviation Aero. and Aero. pt. to pt.), (a) 3082.5, 5692.5, 8220 kc, unlimited, (b) 2648, 3082.5, 4125 kc, unlimited, 6570, 8015 kc day only, power 100 watts.

PACIFIC ALASKA AIRWAYS, Inc., Nome, Alaska, granted construction permit, (a) 3082.5, 5692.5, 8220 kc unlimited. (b) 2648, 3082.5, 4125, 6570, 8015 kc, 100 watts; same for Tenana Crossing, Alaska, except for 20 watts power; same for Livengood and Bethel, Alaska, 58, 30 00 N —134 10 00 w; same 62 50 00 N —141 30 00 W. Alaska; same for Kotchikan, Alaska, except 100 watts power.

PACIFIC ALASKA AIRWAYS, Inc., McGrath, Alaska, Juneau, Alaska, granted construction permits, frequencies (a) 3082.5, 5692.5, 8220 kc unlimited, (b) 2648, 3022.5, 4125 kc unlimited; 6570, 8015 kc day only, 100 watts.

RUFUS P. TURNER, Boston, Mass., granted construction permit 4797.5 kc, 50 watts.

CITY OF CINCINNATI, Ohio, granted construction permit (2 applications) portable-mobile equipment, 30,100, 33,100, 37,100, 40,100 kc, 20 watts.



MAP No. 2--*Aeronautical Radio Range Stations*

THE SECOND OF A SERIES OF MAPS TO BE PUBLISHED MONTHLY, PROVIDING COMPLETE DATA ON THE VARIOUS CLASSES OF U. S. COMMUNICATION AND BROADCAST NETWORKS. THE ABOVE MAP, PREPARED BY THE U. S. DEPARTMENT OF COMMERCE, IS REVISED UP TO OCTOBER 3, 1934. THIS IS NOT A FLYING MAP AND SHOULD NOT BE USED AS SUCH.

VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

W. J. McGonigle, Secretary, 112 Willoughby Avenue, Brooklyn, N. Y.

A. F. WALLIS

"MACKAY RADIO announces the appointment of Mr. Arthur F. Wallis as Marine Superintendent of its Atlantic Division." The foregoing is the substance of news items appearing in Metropolitan papers several months ago.

Mr. Wallis pioneered in the radio field, having had the distinction of installing and operating some of the earliest Navy radio equipment, as far back as 1903, when the Navy had few radio stations ashore or afloat. He served as radio operator and chief operator aboard Naval ships and at shore stations for eight years, resigning from the service in 1910. During his Navy days attended and graduated from several Naval Technical Schools—radio, electrical, gunnery and special Naval communications.

He joined the National Electric Signaling Company (Fessenden System) and assisted in installing radio stations in Boston, New York and other cities for this company in 1911. Assisted in the Fessenden installation of the first Naval high power station at Arlington (NAA) in 1913 and acted as contractor's operator during the acceptance test that year. The transmitter at NAA was the highest power synchronous rotary equipment in the world . . . 100 kilowatts. His service with the National company included laboratory research in which he assisted in the development of heterodyne reception and one-dial tuning.

He entered the Navy in 1917, at the outbreak of the war, as Communications Officer attached to the Third Naval District in New York. Served as Radio Censor, Radio Sealing Officer, Traffic Officer and Officer in Charge of Aircraft Radio. Assisted in the selection of sites and the laying out of the early radio compass stations in 1919. In 1920 transferred to Guantanamo Bay, Cuba, as Officer in Charge of Naval Radio Stations in that area.

Mr. Wallis resigned his commission in 1921 to join the Independent Wireless Telegraph Company in the Commercial Department. On leaving the Independent company in 1925 he joined the Tropical Radio Telegraph Company as Station Engineer in charge of the high-power station of that company, at Managua, Nicaragua. In 1927 the Tropical company promoted him to position of Commercial Representative, with headquarters in New York. He traveled throughout the country in the interest of Tropical Radio's commercial activities.

In 1931 with the Electrical Research Products Company, distributors of Western Electric Sound Picture Equipment, as sales representative, where he established a fine sales record in equipping steamships and theatres with sound equipment.

In 1932 established his own publicity business handling publicity and advertising for many New York firms. Rejoined the Tropical company as Commercial Representative in 1933. Resigned in 1934 to enter employ of Mackay Radio Company as Commercial Representative. Mr. Wallis was promoted to his present position of Marine Superintendent of the Atlantic Division of the Mackay Company in July 1934.

Mr. Wallis has had broad experience in the marine radio field. He was Radio Superintendent for the Luckenbach Steamship Company in 1917. He is a former Lieutenant in the Communication Section of the Naval Reserve; Life Member in the Veteran Wireless Operators Association, former Secretary and Director, candidate for Vice-President this year. Holds an extra first-class radio operator's license, very few of which are issued . . . a bachelor . . . member of the Elks . . . recipient of a Testimonial Scroll from the V. W. O. A. for his radio work with the Navy at the Messina, Italy, earthquake in 1908 for which the Secretary of the Navy cited him.

A. F. WALLIS

DINNER-CRUISE

The event of the year is in the offing. The Arrangements Committee has engaged the entire banquet facilities on the roof of the Montclair Hotel—the Casino-in-the-Air, Cocktail Lounge and Cafe Chantant, which contains one of the most striking modernistic bars extant. Our Annual Dinner-Cruise will again this year be of the Dinner-Dance order and since it is our *tenth* and this year is the Tenth Anniversary of the founding of the Veteran Wireless Operators Association, every effort will be made to make it the most outstanding affair of our making. George Clark is Chairman of the Entertainment Committee and those who know George—and who doesn't—realize that the entertainment program will be of the finest. A popular radio orchestra will be engaged for dance music. The facilities of the Casino-in-the-Air are such that there will be dancing during and after the dinner. We have been promised a motion picture demonstration of television a la 1999. The televisor to be demonstrated, it is said, outdoes the best efforts of Stoopnagle and Budd with their See-Backograph and their other marvelous inventions. A Year Book will be issued in conjunction with the dinner, a complimentary copy of which will be presented to each diner. William J. McGonigle, Secretary, was appointed Chairman of the Year Book Committee by the President.

The Awards Committee have under consideration the award of a Gold Medal and several Testimonial Scrolls to operators who have distinguished themselves in the performance of their duties. The awards will be made at the dinner some of the details of which will probably be broadcast from the Casino-in-the-Air over one of the metropolitan radio stations. This feature promises to be one of the highlights of the dinner.

The committee will endeavor to have on hand several of the recipients of awards.

Radio contacts with the Byrd Expedition at the South Pole as well as several other distant points will be attempted from the dinner. Other interesting features, some of which promise to be startling, too numerous to mention, are planned.

The Montclair Hotel is at Lexington Avenue and Forty-Ninth Street (opposite the Waldorf Astoria) in New York City. The Casino-in-the-Air, one of the favorite rendezvous of the smart set during the summer season, is extremely well appointed for winter functions. An excellent full course dinner will be served. Tickets for the Dinner-Cruise are obtainable from the Secretary. Subscription:—Gentleman and Lady $5.00; Individual $3.00.

Members of the V. W. O. A., their friends, and anyone interested in the work of the Association, are cordially invited to be with us at this gala function.

Of course, THE DATE:—FEBRUARY 11, 1935, at 8 P. M.

We hope to see many of our out-of-town members and their friends on that evening. Remember . . . the following day is a holiday.

GREETINGS

From the South Pole:—"To Members, Veteran Wireless Operators Association: —All good wishes for Christmas and the New Year—(signed) Carl O. Petersen."

Mr. Petersen is with the second Byrd Expedition as Paramount Sound News photographer and sound technician in addition to his radio operating aboard the planes on their exploration trips. A message of greetings was dispatched to Carl via Mackay Radio.

We thank Peter R. Cuda, the operating personnel of Station KLK, George Clark and others for their Christmas greeting cards.

PERSONALS

Harry Chetham, who for the past three years has been Acting Chief Operator at the Somerville, Mass., police radio station, was recently appointed permanent chief. Harry is a pioneer in the field of police radio and a true veteran operator. On several of the Civil Service examinations for Chief Operator he obtained perfect marks. He is also conducting classes in radio technique for policemen and firemen at the Massachusetts Police Institute . . . A short note from Willard S. Wilson, our resident agent in Wilmington, Del. Hope to see you at the Dinner WSW . . . Members are requested to notify the Secretary of any change of address . . . Fred Klingenschmitt at the December meeting. Glad to see you again FK. . . .

OVER THE TAPE...

NEWS OF THE RADIO, TELEGRAPH AND TELEPHONE INDUSTRIES

DR. ALEXANDERSON HONORED

Dr. Ernest F. W. Alexanderson, Consulting Engineer of the General Electric Company, noted for his contributions to radio, has been elected to membership in the Royal Academy of Science of Sweden.

WBZA EMPLOYS J. C. EDDY

Mr. J. C. Eddy, former Ship-to-Shore Operator for the United Fruit Line has become Station Operator of WBZA in Springfield, Massachusetts. Mr. Eddy was associated with WEAF in 1926 and 1927 and since that time has been with the United Fruit Line.

ELECTRICAL MEASUREMENTS

A monthly Technical Bulletin, titled "Electrical Measurements," and said to be of material interest to engineers in the communication field, will be mailed on requests to the Sensitive Research Instrument Corp., of 4526 Bullard Ave., Bronx, N. Y. This Bulletin is said to cover in detailed form new and modern methods of making electrical measurements.

ALDEN CATALOG

The Alden Products Co., 715 Center Street, Brockton, Mass., have available their 14-page, 1935 catalog covering the following Na-Ald (trade mark) products: Analyzer plugs and associated adapters, laboratory test prods and accessories, sockets, cable connectors, microphone cables, plug-in coils, dials, short-wave condensers, victron insulated short-wave and transmitting products.

GENERAL ELECTRIC BULLETIN GEK-86

"Modern Money Saving" is the title of a recent Bulletin released by the General Electric Co., Schenectady, N. Y., on Metal-Enclosed Switchgears. This 4-page and well-illustrated release gives the advantages to be derived from the use of the units and lists the following as the types of Switchgears that are shipped assembled: Metal-clad switchgear and cubicles for the control and protection of machine and feeder circuits, metal-enclosed units for light-duty distribution circuits, and enclosed air-circuit-breaker boards for industrial service and low-voltage distribution.

If detailed information is desired, address the nearest G-E office, or General Electric,

BEARD HEADS WESTINGHOUSE'S POLICE-RADIO ACTIVITIES

Walter C. Evans, manager of Westinghouse's Radio Division, announces the appointment of J. G. Beard as manager of all of the Company's police-radio activities. His duties will include the design, manufacture, and sale of this line of equipment. Mr. Beard has been actively associated with radio developments since 1918, and for the past five years has been with the Westinghouse Co. at Chicopee Falls, Mass.

WBZA OPERATOR JOINS NAVAL RESEARCH LABORATORY

Mr. H. R. Miller, former Westinghouse Engineer and Operator at WBZA, recently left for the Anacostia Station of the Naval Research Laboratories. In his new position, Mr. Miller will be engaged in the designing and testing of ultra-high-frequency radio equipment.

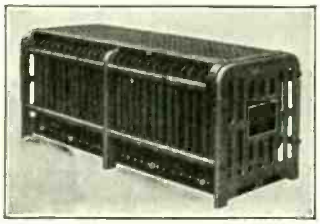
Mr. Miller comes from South Burwich, Maine, and is a graduate of the University of Maine. His experiences include work at the Norfolk Navy Yard, 1917 to 1919, assistant in the Navy Department Bureau of Engineering, 1919 to 1923, Boston Navy Yard, 1923 to 1929, Westinghouse Engineer in the design and manufacturing of aircraft equipment, 1929 to 1933, and associated with Westinghouse Station WBZA in East Springfield, 1933 to date.

THE MARKET PLACE

NEW PRODUCTS FOR THE COMMUNICATION AND BROADCAST FIELDS

TYPE WG RESISTOR

The Type WG Resistor shown in the accompanying illustration is designed for use in radio transmitters and switchboards or test tables where a large fixed resistor is required. It is designed for mounting on wall or switchboard frame work by the addition of suitable brackets which may be



readily attached to the aluminum end pieces.

Frames are available in sizes to hold up to 36 units without the middle support. The frames are light in weight as most of the metal used is aluminum, the 30-unit frame weighing only 12 pounds including units. A Type WG Resistor having 30 of the 2½-ampere units will dissipate 8¼ kilowatts, or by using thirty 460-ohm units, a resistor of 1380 ohms, ¼ ampere which may be tapped every 460 ohms is available.

The insulation between the units and the frame is designed to withstand an operating voltage of 2000 volts. For higher voltage additional insulation may be added to the frame support.

Further information regarding the Type WG Resistor may be obtained from The States Company, Hartford, Conn.

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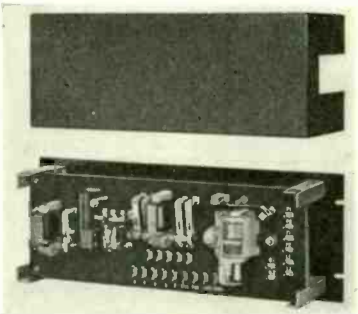
AUTOMATIC CONTROL PANEL

Ward Leonard Electric Co., of Mount Vernon, N. Y., has recently developed a combination of their standard relays which gives complete control and protection of equipment using vacuum and mercury-vapor tubes.

Two momentary contact switches and four relays are mounted on a standard 19" relay-rack panel, the rear enclosed in a dust shield. Pressing the starting switch closes the line to all tube filaments. After an interval of 15 to 45 seconds, according to adjustment desired, a second relay closes, applying grid bias voltages and completing the circuit to the relay in the power-transformer line. Pressing the operating switch applies high voltage. All relays and switches are interlocking making it impossible to apply voltages in improper sequence. The equipment may be restored to operating condition instantaneously after momentary overloads.

The panel is designed to become a part of low-power transmitters, amplifiers and laboratory apparatus. Up to 15 amperes at 110 volts a-c. is safely handled by the contactors.



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SAPPHIRE RECORDING NEEDLES

The Meyer Koulish Company, Inc., 64 Fulton Street, New York, N. Y., has the following Sapphire Needles and Points that are of interest:

The Type AW needle, shown in an accompanying illustration, has a point that is cut to a special angle and radius which makes it suitable for cutting and recording on blank aluminum discs. It has been designed to work on nearly all commercial recording machines now on the market as well as on home-constructed equipment, it is said.

The Type AWS is a modified AW with point and angle made especially to cut on eraydo metal and on aluminum where lightweight cutters or lower powered motors are used.

The point of the Type BW, also shown, is made for recording and reproducing on pre-grooved materials such as the Victor type black composition, home-recording discs or pre-grooved celluloid. It will also make recordings on pre-grooved aluminum discs.

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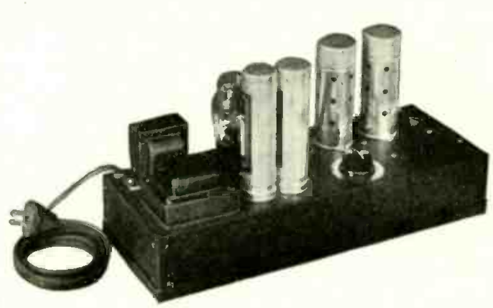
TURNER LINE AMPLIFIER

The unit shown in the accompanying illustration is a Line Amplifier produced by the Turner Company, Cedar Rapids, Iowa, for broadcast station and public-address men. This is a two-stage unit using two 57's and one 80, and it has a total gain of 70 db.

The frequency response of this amplifier is said to be flat from 30 to 12,000 cycles. The input impedance is 5 megohms, while the output impedance is 200 or 500 ohms as specified. Other output impedances can be supplied. The power supply is for 110 volts, 60 cycles, the power consumption being 25 watts. The maximum output level is plus 5 db. The overall dimensions are 15" by 5½" by 7½", with the chassis finished in black crystalline.

The parts are mounted on an electro-metal, non-magnetic chassis, and it is said that the entire chassis and input is highly shielded, eliminating possibility of line pickups.



The new Turner Line Amplifier for broadcast station and public-address use.

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CRYSTAL PHONOGRAPH PICK-UP

A new Crystal Phonograph Pick-up is announced by the Ansley Radio Corporation of New York, who are using it on their Radio-Dynaphone Combinations. In addition to the light weight and high fidelity, characteristic of crystal pick-ups, the manufacturer claims other advantages, such as, built-in sponge rubber suspension which insulates the pick-up from speaker and motor vibration, and a "vertical pivoting" arrangement which reduces friction to a minimum. While it was developed primarily for use in the Ansley Dynaphones and Combinations, the pick-up will also be sold separately to dealers and distributors.

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NEW GATES CRYSTAL MIKE

The Gates Radio & Supply Company of Quincy, Illinois, announces the release of a new crystal microphone for general broadcast and high quality public-address service. This microphone incorporates a genuine Brush sound unit of latest design and frequency response is uniform from 30 to 10,000 cycles, it is said.

The microphone is supplied complete with pre-amplifier, which incorporates a pair of 6C6 tubes and the output impedance is 200 ohms. It is supplied with 20-foot cable, plug and socket and requires 6 volts A supply and 180 volts B supply. It is beautifully finished in baked black lacquer with fittings of nickel and highly polished.

Fully described on Bulletin 6D, which can be obtained by writing the Gates Radio and Supply Company of Quincy, Ill.

THE Group Subscription Plan for COMMUNICATION AND BROADCAST ENGINEERING enables a group of engineers or department heads to subscribe at two-thirds the usual yearly rate.

The regular individual rate is $3.00 a year. In groups of 4 or more, the subscription rate is $2.00 a year. (In Canada and foreign countries, $3.00.) Each subscriber should print his name and address clearly and state his occupation—whether an executive, engineer, department head, plant superintendent, or foreman, etc.

Possibly your associates would be interested in this group plan

(Communication and Broadcast Engineering)
BRYAN DAVIS PUBLISHING CO., Inc.
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