Communication and Broadcast Engineering

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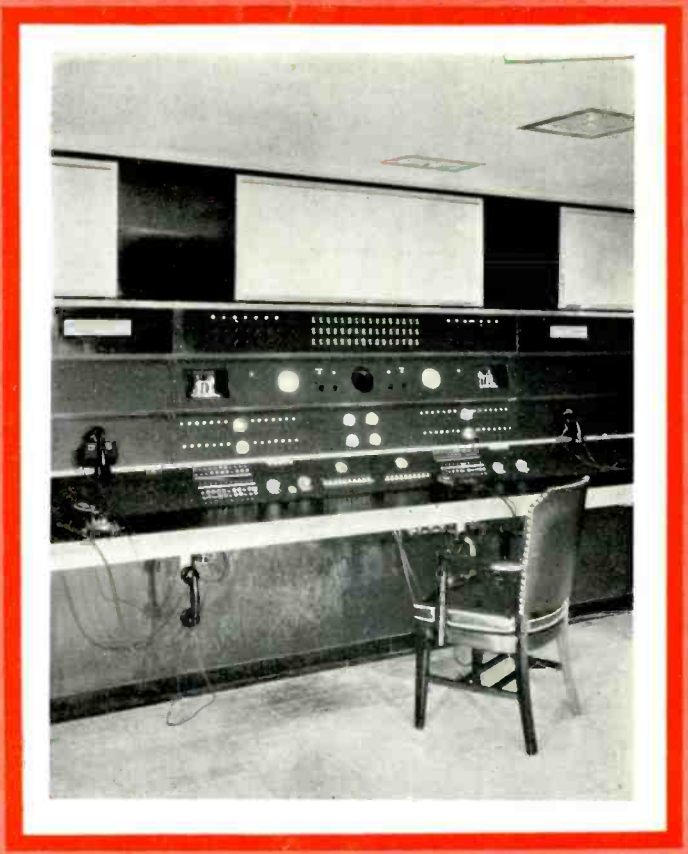

The Journal of World Communication

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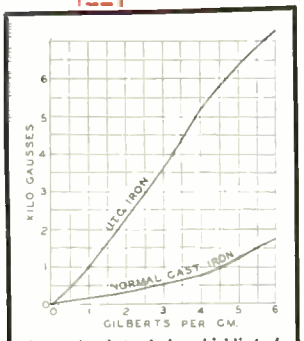
Transformers of the type illustrated are specifically designed to withstand continuous hard usage under unusually adverse humidity conditions.



Curve showing relative shielding effect (permeability) of UTC high permeability cast iron and normal cast iron used for transformer housings. It is seen that the ratio of shielding afforded by UTC housings is 5 to 1.

2A3 amplifier and power supply with perforated protective covers fully mounted. The undistorted Class A output is 15 watts, the gain is 80 DB. The amplifier is uniform in response from 30 to 12,000 cycles. List price of transformer kit is $152 (Circuit data is given in our new Manual U1100A). Includes drilled decks and perforated covers—all transformers mounted at factory—standard discounts to Universities and Broadcast Stations.

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EDITORIAL

SHORT-WAVE BROADCASTING

THE WIDE INCREASE in the sale of all-wave receivers in the United States may be indirectly attributed to a political imbroglio on the Continent: The governments of Europe having exhausted the efficacy of regional broadcasts, and sensing the importance of formulating the opinions of peoples living in distant protectorates, turned to the all-encompassing qualities of the higher frequencies as a means of a more widely distributed influence. This in turn led to a general belief that the political, social and financial ideals of a government are of interest to the whole world, with the result that there developed extensive competition between nations in short-wave broadcast power increases. It soon became apparent to the American people that these high-power stations of Europe could be intercepted in the United States with ease, a matter not easily accomplished at the outset.

Short-wave listeners have increased to such an extent that now the situation is nearly reversed; where a few foreign broadcasters developed a new audience, the audience is now developing foreign—and local—short-wave broadcasting. It may be judged, therefore, that short-wave broadcasting will grow in importance.

The American radio manufacturer has profited by the sale of all-wave receivers; the American broadcaster should also profit by it.

At the present time American short-wave broadcasting is more or less of a sub-strata of sponsored programs originating in the standard band. These programs may hold to a chain a group of people who have "dug down under" through the medium of their all-wave receivers, and also add to the audience a large group of listeners in foreign countries. Whether or not a part of the domestic radio audience is so held is problematical—people "dig down under" not to hear what can be heard better on the standard band, but to listen to something quite different. There is no doubt a large foreign audience is tacked on to the sponsored program transmitted at a high frequency, but the dollars-and-cents value of this audience must be small to any advertiser excepting one concerned with exports.

An exceedingly odd situation has arisen in the last year: With the increased sale of all-wave receivers and the consequent increase in the number of short-wave listeners, many members of our cherished audience are not with us during the very hours of the evening when American advertisers are selling their wares in the standard band. These people have wandered down to the 31- or 49-meter band and are listening to London, Rome, Madrid, Germany and the Central American stations. To combat this trek to the lower bands, a few American concerns are holding these recalcitrant listeners by popping up in foreign broadcasts. A clever scheme to say the least, but one that may in time produce a river of money flowing out of this country rather than into it.

Fortunately (so far) the American people are not so nationalistic of mind that they will listen with any patience to strictly political broadcasts from foreign countries. Nevertheless, the foreign stations exert an appeal not easily dissolved. There is, for one thing, the fascination of the foreign tongue, the foreign flavor and the complete difference of atmosphere, that is hard to ignore. Then, there is that old saying: "Distance lends enchantment."

Certainly, nothing should be done to damage the well-established and well-developed all-wave receiver market in the United States, for the mere purpose of regaining a group of listeners during the "peak hours." But, it might be advantageous to everyone concerned if the broadcasters of this country were to cooperate for the purpose of instituting a short-wave broadcast set-up, representing each state in the Union and the U.S. possessions. Advertisers could, if they wished, sponsor "local color" programs developed by selected representatives of each state and possession.

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COMMUNICATION & BROADCAST ENGINEERING

FOR MARCH, 1935

NBC's STUDIO CONTROL SYSTEM

By T. H. PHELAN

PROBABLY THE MOST highly publicized architectural work of the last few years is the Rockefeller Center project in New York City. Everyone has heard of its enormous size and its ultra-modern design. And through a network of broadcasting stations scattered all over the country everyone has heard its name. "Radio City."

For, among its many other claims to distinction, this small square of land in the heart of New York bears the headquarters of the National Broadcasting Company, the largest group of broadcasting studios in the world. These studios, like the rest of the project, are of ultra-modern design, and were especially designed and built, from the ground up, specifically for broadcasting purposes. They even include certain special provisions for that wonder of the future—television.

From these studios, programs are distributed over telephone wire lines, to the eighty-eight broadcasting stations in the NBC networks. The connections between the studios and the broadcasting stations are necessarily made quickly, and as quickly changed, to give the smooth transition from program to program to which radio listeners have become accustomed. These switching operations, as well as many other operations about the studios, are completed quickly and accurately, through the use of several systems of remote-control employing relays and switches of the same general types as those used in automatic telephone exchanges.

The use of these modern means of remote-control was decided upon because of the size and complexity of the studio layout and the broadcasting equipment which it serves. A brief description will serve to outline the problems encountered and solved.

The NBC headquarters at Radio City comprises an 11-story section added, on the west, to the 70-story RCA Building. The two lower floors are given over to reception rooms for visitors and artists, and to audition rooms, used for the testing and selection of new talent. The two upper floors contain the air conditioning equipment which supplies air to the entire studio section of the building, over what is regarded as by far the most intricate air-conditioning system ever constructed.

The central portion of the building, from the third to the ninth floors inclusive, comprises the studio section proper. Here are twenty-seven studios, of all sizes—one of them the largest in the world, and some smaller than an average-sized room. On the fifth floor is the centralized broadcasting equipment—approximately in the center of the studio section, thus permitting a symmetrical layout for cabling and power distribution. The equipment on this floor includes practically everything that is required for broadcasting, excepting only that small amount of equipment which is necessarily installed in the studios and studio control rooms.

The broadcasting equipment was thus centralized in order to simplify routine inspections and maintenance, and to facilitate location and correction of trouble. The centralization has been made entirely practical through the use of modern remote-control systems which make it possible to control the equipment from studios and other points in the studio section.

There are over 3500 telephone type relays in this remote-controlled switching system. They are mounted on standard telephone equipment racks, in the

STUDIO "8-H"—GENERAL VIEW.

Main Equipment Room, which also houses all the centralized equipment. The relay equipment is made up in units, on twenty-four-inch relay panels, each bearing thirty-three double-arm relays. Some of these relays have as many as twenty-two contact springs. The units are internally wired to telephone terminal blocks, on which the exterior connections are made, and are provided with dust covers on the front and rear of the panels, to protect the relays and wiring from mechanical injury as well as dust and other foreign materials.

Every program leaving Radio City must pass through several sets of relay contacts, and since it is essential that all the relays function properly at all times, several precautions were taken in the design of the relay equipment. The normal operating voltage applied to the relays is fourteen volts, but to preclude any possible trouble arising from emergency conditions, the relay coils are designed to operate on any voltage from 8 to 15 volts, dc. Contact metals were investigated, and it was found that Code No. 4 palladium contact material was best suited for speech and operating circuits. The contact pressure on all these contacts was adjusted to have a minimum of twenty grams, and in actual use this pressure exceeds thirty grams. As a further precaution against any failure, all major circuits passing through the relay system have paralleled contacts.

The eighty-eight broadcasting stations in NBC networks are arranged on 14 "channels," and the remote-control equipment provides facilities for connecting any of the studios to any of the channels as well as for controlling the transmitting equipment. The control is applied at three points: A Master Control Desk, on which the channel to be used is pre-selected and preset; a studio control room, a small room beside the studio and separated from it by a large plate-glass window, where microphones are switched on and off, and volume controlled; finally, the announcers control console in the studio, which, among other things, allows the announcer to connect the studio to, or disconnect it from, whatever program channels have been preset at the Master Control Desk.

THE MASTER CONTROL DESK

This is the central point, and the most spectacular feature of the studio-connecting system. It is twenty-seven feet long, and contains on its face approximately 3700 signal lamps and control keys, for controlling and monitoring the distribution of programs. The desk is divided into three sections, of which the left and right are identical, and perform identical functions. Either one, or both, may be used at one time.

On the upper part of each of these sections are small groups of lights and keys, each designed as being associated with a particular studio. One row of indicating lamps in each group shows the status of the equipment in the control room of the studio. Another row contains eight turn keys, each with an associated lamp. Turning one of these keys connects the studio telephone line to one of eight "switchbanks" at the lower portion of the desk.

Each "switchbank" consists essentially of fourteen lamps (one for each of the outgoing channels), and an associated turn key for each channel. Turning one of these keys will complete the connection to the corresponding channel. Thus, by operating one of the upper keys (associated with the proper studio) to select a switchbank, and then operating one or more of the keys in that switchbank to connect to the proper channels, any studio may be connected to any or all of the stations in the NBC networks.

THE STUDIO AND STUDIO CONTROL ROOM

The operation of the keys on the Master Control Desk, and the consequent selection of the channels to be used by any particular studio, is always completed before the studio is to go "on the air." The connection is completed by the announcer, at his control console in the studio. This switching system thus provides the means of selecting a channel so that at switching time the studios going "off" and "on" will respectively drop and pick up their proper channels.

When a studio is to go "on," the announcer receives a green lamp signal, and thereupon presses a set-up button which automatically picks up the preset channel. The engineers in the studio control room then make any changes needed in volume, and in switching various microphones in and out of the circuit. At the end of the broadcast period the announcer pushes a "release" button which drops the channels.

In the studio control booths a small relay panel is utilized in conjunction with the announcer's control console for switching microphones, loudspeakers and performing other local switching operations. The relays on these panels are held to the same specifications as the main switching system. In addition, several two and one-half volt, sixty-cycle ac relays are utilized in connection with the loudspeakers, to transmit a dc voltage for indicating lamps, to several parts of the installation.

To provide the engineer at the Master Control Desk with a final check on the operation of the switching system, the desk is provided with loudspeakers and visual volume indicators. It also provides facilities for controlling the final switching operation, in case of oversight on the part of the announcer.

It is well to note, in following the circuits we have traced through the control desks that the connections are actually not completed in the desks, but through the contacts of the relays which they control.

MISCELLANEOUS FUNCTIONS

The central, or supervisory, section of the Master Control Desk is provided with push-buttons and indicating lights, by means of which the control supervisor may connect a loudspeaker and volume indicator to any of the outgoing or incoming program lines. He also has a small telephone keyboard, with direct telephone lines to important locations, and switching facilities for the connection of a key and sounder to any of the available telegraph circuits.

PROGRAM MONITORING

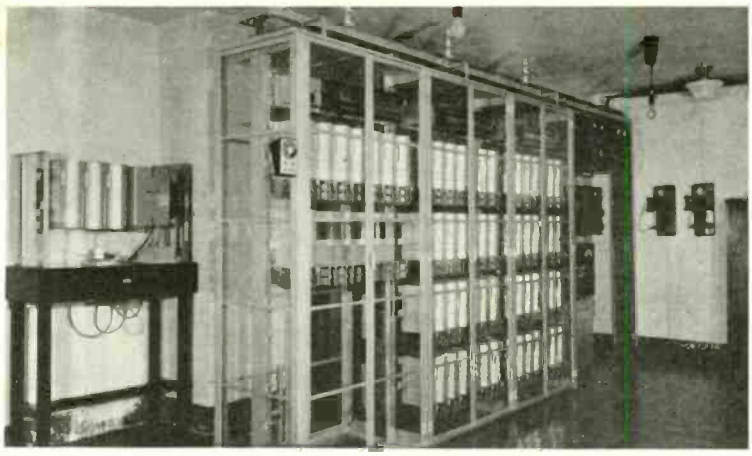
Adjacent to the Main Equipment Room is a small room wherein is located a complete program-monitoring system for the loudspeakers in executive offices. This system makes it possible for an executive in any office to connect

MASTER CONTROL DESK.

his loudspeaker to any program by means of dial-controlled automatic switching equipment.

The switching equipment consists of one standard two-motion switch for each loudspeaker, controlled from a small box at the loudspeaker. The switches are mounted in a standard mounting frame, and are wired essentially the same as for automatic telephone service, except that a separate pair of operating wires are provided, in addition to the pair connected to the wipers and used for program transmission. At the present time, one hundred twenty switches are installed, and provision is made for ultimate expansion to 250 switches. A fully automatic charging system is provided, to semi-float the 48-volt battery which operates the switches.

The control box at each loudspeaker contains a dial, a re-dial button, and four push-buttons for turning the speaker on and off, and for controlling the volume. The speaker circuit is opened and closed by a relay mounted in the speaker chassis, and the volume is regulated by means of a small ac motor connected to the volume control of the amplifier, which is in the Main Equipment Room. By merely dialing while seated at his desk, the executive may listen to any of the more important radio stations in the metropolitan area, the two NBC networks, any audition room, or any studio in the building that happens to be in use, either for rehearsing or actually broadcasting.



MAIN EQUIPMENT ROOM (PROGRAM MONITORING).

COMMUNICATION SERVICES

Special communication services are provided, in addition to the remote-control facilities. For example, two standard automatic telephone systems provide inter-communication between various parts of the studio building.

Furthermore, although all known precautions have been taken, it is understood that failures may occur. To minimize any delays arising from such failures, a Trouble Alarm system has been provided. This is basically a common-talking telephone system connecting the various studios with the supervisory points on the fifth floor. When failure occurs in any studio and is reported from the telephone in the control room, an audible alarm sounds at all the supervisory points, and they are connected on a common telephone circuit for handling corrective orders, while an indicating lamp shows the studio number.

BOOK REVIEW

AIR LAW—OUTLINE AND GUIDE TO LAW OF RADIO AND AERONAUTICS, by Howard S. LeRoy, published by Randolph Leigh Publishing Company, 725 Fifteenth St., Washington, D. C., 120 pages, stiff cloth cover, price $3.00.

With the rapidly increasing growth in the fields of radio and aviation numerous new legal problems presented themselves. It naturally follows that the regulatory evolution has been determined by legislation, administration, and determination of cases. Hence the author, feeling that a concise and comprehensive survey of available legal material was needed in this field, has presented this outline and guide to Air Law, including Radio Aeronautics, and Air Rights as related to realty.

The first part of this book covers Radio Law, considering it from the standpoint of Municipal Radio Law and International Radio Law. Next in line comes Municipal and International Aeronautic Law, and this is followed by Air Rights as related to real property (Statutes and Decisions). To complete the subject a very comprehensive bibliography is included. This bibliography, which covers some 20 pages, includes the following: Texts and sources, periodicals, government publications, articles and monographs, and reports.

As a strictly reference book to the law of Radio and Aeronautics, this book is to be highly recommended.

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MOTOR CLUB FINDS AIRWAY WEATHER INFORMATION VALUABLE

AIRWAY WEATHER INFORMATION received over the local teletypewriter circuit by the Chicago Motor Club has proved of great benefit, according to this organization.

At 7 a. m., 10 a. m., and 3 p. m., the Chicago Motor Club notes the general weather conditions, temperatures and any other miscellaneous information which might be of help to them in conveying notice of conditions to motorists. This gives a complete picture of the existing weather conditions along the highways.

Where the territory is affected by snow, the information received does not tell them whether the road is open or closed, but after receiving these reports it is comparatively easy to see just which territory has been affected by snow. They follow this up by sending as many telegrams as necessary to automobile clubs, chambers of commerce, etc., asking them to advise them of the condition of roads.

Complete weather charts are compiled by the Chicago Motor Club and sent to the various substations in Chicago, and are available at all times to the general public. (*Air Commerce Bulletin*, January 15, 1935.)

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BRITISH TELEVISION SERVICE

A PUBLIC SERVICE of high-definition television is to start in London in the latter half of this year, according to a report from the Electrical Division of the U. S. Department of Commerce.

Programs will be received over a range of about 25 miles. Operation will be by the B.B.C. Two television systems are to give alternate programs; one is the Baird Television Company's system, and the other is that of the Marconi-E.M.I. Company.

All the receivers to be manufactured must be capable of receiving either system.

(Copies of the report of the Television Committee, presented by the Postmaster-General to Parliament by Command of His Majesty, January 1935, may be purchased directly from H. M. Stationery Office, Adastral House, Kingsway, London, W.C.2. Price, 6d net.)

"HIGH-FIDELITY"

By JOHN P. TAYLOR

● SELF-CONTAINED SPEECH-INPUT UNIT FOR FIELD WORK, WHICH MAY BE OPERATED FROM A BATTERY OR AC SUPPLY.

AMONG BROADCAST engineers there is nothing which is more often the subject of animated debate than the question of what constitutes the best design and arrangement of equipment for outside pickup use. The reason for this special, and almost universal, fascination is hard to understand—but it is an observable fact that there is nothing in the average engineer's station which he will defend with more ardor than his remote equipment. Many engineers who buy everything else insist on building their own remote equipment—and even those who do not are given to saying that, if they had the time, they could build an equipment superior to anything they can buy. All of which is by way of saying that it is almost impossible in a single equipment of this kind to satisfy all broadcast engineers—or even, perhaps, a majority of them.

However, there is one thing on which nearly all agree—namely, the desirability of improving the quality of outside pickups. And from this viewpoint, at least, the equipment described here will be of interest to all, since it inaugurates (at least in so far as equipment of standard manufacture is concerned) a standard of quality which, with due regard to the limitations of outside operation, may be termed "high-fidelity."

"HIGH-FIDELITY" IN THE FIELD

In the past inferior quality on remote pickups was taken for granted. The fact that there were no high-quality microphones suitable for field use and that it was difficult to build a portable high-gain amplifier seemed to make this unavoidable. However, both of these difficulties have now been overcome, and the only remaining limitations on the quality obtained on remote pickups are those imposed by the characteristics of the remote line and the acoustics of the pickup point. While these may, particularly on short-notice pickups, offer difficulties, it is usually possible, when sufficient set-up time is available, to overcome them. When this is done—and there are now many remote-pickup programs which justify the effort—quality closely comparable to that of studio pickups can be obtained.

In view of the possibility—and desirability—of doing this, up-to-date remote equipment must be nearly as good as up-to-date studio equipment, which means, in short, close approach to high-fidelity standards. The frequency range for high-fidelity reproduction has been set* at 50 to 8000 cycles. The equipment described here is designed to provide this range and something more.

*"The Specific Transmitter Performance Required for High Fidelity," by L. F. Jones, *Broadcast News*, February, 1935.

FIG. 1. A GENERAL VIEW OF THE HIGH-QUALITY REMOTE PICKUP EQUIPMENT DESCRIBED IN THIS ARTICLE. THIS EQUIPMENT CONSTITUTES A COMPLETE SPEECH-INPUT SYSTEM IN MINIATURE AND MAKES POSSIBLE QUALITY APPROACHING THAT OBTAINED WITH THE BEST STUDIO EQUIPMENT.

A COMPLETE SPEECH-INPUT EQUIPMENT

It should be noted that it is an equipment rather than an amplifier that is considered here. The mistake is often made of speaking of such equipment as an outside pickup amplifier—and, in truth, the equipment actually reserved for this use in many stations is little more than an amplifier. Arguments for simplicity to the contrary, this is not good practice, and if high-fidelity standards are to be approached such half-way methods must give way.

The equipment necessary to pick up a program in the field and send it over a wire to the studio constitutes a complete speech-input system in miniature. All of the functions of a studio speech-input system, namely, sound pickup, microphone mixing, amplifying, gain control, monitoring and switching are required in some degree. In a well-balanced equipment all of these functions must be provided for—and in an up-to-date equipment they must be provided for according to "high-fidelity" standards. The equipment shown in Fig. 1, and described below, is such a complete system.

THE QUESTION OF MICROPHONES

When quality was not all-important the relatively high output of carbon microphones made them the obvious choice for remote pickups. However, poor frequency characteristic, high background noise and blasting rule them out if high-fidelity is to be approached. Condenser microphones have a somewhat better characteristic but have the disadvantage of a built-up amplifier. Crystal microphones provide a good characteristic, but, like the condenser, require an associated amplifier. Velocity microphones, while they do not require a closely-linked amplifier, do not have a sufficiently high output for completely satisfactory low-level mix-

REMOTE PICKUP EQUIPMENT

ing—also they are affected by wind and are thus not well-adapted for outside use.

Eliminating the foregoing, the possibilities are reduced to the two remaining types, viz., the dynamic and inductor. The latter was developed especially for use with the remote pickup equipment described here. It has a frequency characteristic which is quite uniform throughout the range of 60 to 10,000 cycles—and the output is high enough for satisfactory low-level mixing. Used with the equipment described here, this microphone provides reproduction approaching high-fidelity standards. For field use it may be conveniently provided with a collapsible stand such as that shown in Fig. 1, or with a camera-type tripod.

Although the equipment shown is specifically intended for use with inductor microphones, it can also be used with any of the other types. In particular, sufficient gain has been provided so that one or more velocity microphones may be used if desired—and, if care is exercised to keep the mixers well down, such operation is quite satisfactory. When carbon, condenser or crystal microphones are used it is, of course, necessary to provide extra battery connections.

IMPORTANCE OF THE MIXERS

High-fidelity reproduction requires that every link in the system possess a good frequency response. The simplified mixing systems formerly used did not pass all frequencies uniformly, and therefore did not meet this requirement.

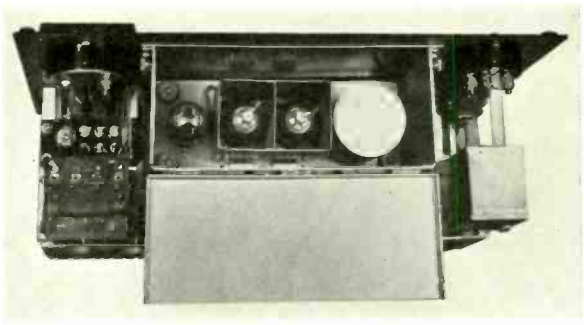

FIG. 3. TOP VIEW WITH THE SHIELD-CANS OPEN TO SHOW THE DOUBLE SHIELDING AND CUSHIONING OF THE FIRST TWO STAGES. NOTE ALSO THE HEAVY SHIELDING OF THE INPUT TRANSFORMER. THE 105 DB GAIN OF THIS AMPLIFIER REQUIRES THESE PRECAUTIONS IF INSTABILITY AND MICROPHONICS ARE TO BE ELIMINATED.

Moreover, the cheap faders employed were mechanically inadequate and soon became noisy and unreliable. Such handicaps cannot be tolerated if high-fidelity is to be considered.

In the design of the equipment shown here it was decided that since quality approaching studio standards was desired, mixers equivalent to those employed in studio equipment were necessary—and it was found that identical mixers were the best answer.

The mixing system includes three of these mixers, which are of the variable H-pad type, so connected that the system has no effect on the overall frequency characteristic. The attenuation of any one of the faders is entirely independent of the setting of the other two.

HIGH GAIN WITHOUT MICROPHONICS

The microphones suitable for remote use, that is, the inductor and the dynamic, have an output in the neighborhood of —70 db for average pickups. This output must be brought up to about zero level before being fed to the line. Also there must be some leeway for less than average pickups, and for mixing of outputs. Altogether, then, the overall gain necessary is 90 to 95 db, and since there is a loss of 10 db in the mixers, this means the amplifier must have a gain of 100 db or better.

This high gain would have been considered impossible until very recently because of the limited number of tubes that could be used and the tendency to howling and microphonics. But use of improved multi-element tubes, together with more extensive precautions against microphonics, have overcome these difficulties. The amplifier in the equipment shown here is a striking example of what can be accomplished along this line.

The first secret of this amplifier is in the choice of tubes which are capable of providing the high gain required and are relatively free from microphonics. Type 77's for the first two stages and a type 41 in the last stage meet this requirement.

Most of the gain is concentrated in the first two stages, the tubes being used as tetrodes and connected into resistance interstage-couplings. The type 41 provides an efficient output coupling stage. This tube line-up provides an amplifier gain of 105 db, with a frequency characteristic within ±1 db from 60 to 8,000 cycles.

The second secret of this amplifier is in the unusual shielding and cushioning used. As will be seen from Fig. 3, the first two tubes are mounted on cushioned bases in individual shield-cans. These individual shield-cans, together with the input transformer and the output tubes, are in turn mounted on a large cushioned base within an outer

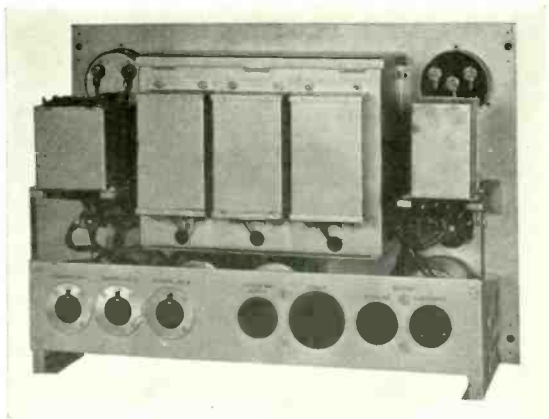

FIG. 2. REAR VIEW OF THE AMPLIFIER—CONTROL CHASSIS. ALL PARTS ARE MOUNTED SO THAT TERMINALS WILL BE EASILY ACCESSIBLE AND THE WHOLE ASSEMBLY HAS BEEN MADE AS SIMPLE AND STRONG AS POSSIBLE.

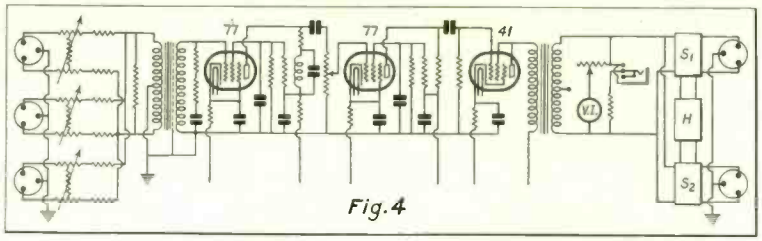

Fig. 4

SIMPLIFIED SCHEMATIC DIAGRAM OF THE REMOTE EQUIPMENT SHOWN ABOVE. THE POWER SUPPLY CIRCUITS WHICH ARE OMITTED FOLLOW CONVENTIONAL LINES.

shield-can. The mixers and other components are each individually shielded as can be seen in Fig. 2. In addition, the entire amplifier control box is shielded.

As a result of these extensive precautions the high gain of this amplifier has been obtained without any tendency to instability, and with complete freedom from microphonics. Thus the necessary gain, uniform frequency response and low background noise necessary for high-fidelity are assured.

ACCESSIBILITY EMPHASIZED

In order to provide the greatest possible insurance against mechanical failure under hard usage, the amplifier and other components are rigidly fixed to the front panel. Accessibility of all components is emphasized and the assembly made as simple as possible. The quite remarkable simplification achieved can be seen in Fig. 2.

All terminals can be reached without disassembling any part and, in addition, the mixers and gain control are mounted on a small panel so that they may be removed from the front for inspection. Inlet and outlet connections are grouped on a sub-panel which comes flush with an opening in the rear of the case when the assembly is in place. In order to save weight all parts of the assembly, including the front panel, are of duralumin.

ADEQUATE MONITORING

High fidelity requires a wide volume range. But the volume range accommodated by presently-used telephone lines is only about 30 db, a range which at best is too limited. It is therefore imperative that the program fed to such a line be so adjusted that the allowable range is fully used.

To accomplish this adequately, visual monitoring of output is necessary. In the equipment shown here this is provided by a volume indicator of the copper-oxide type having a —2 db to + 2 db scale. A calibrated attenuator in series with the V. I. extends the scale so that readings from —10 db to + 8 db are provided. Since remote equipment must often be used in poorly lighted locations, this meter is illuminated by a small shielded lamp. In addition to this visual indicator there is, of course, a jack in the output for aural monitoring of quality.

SIMPLIFIED METERING

Satisfactory operation, and quick location of failures, requires metering in all plate and filament circuits. In previous remote equipments several meters, a number of jacks and a patch cord were required to accomplish this. In the equipment shown here metering has been greatly simplified. A single dc volt-milliammeter is, through the medium of a rotary selector switch, employed to measure all of the plate currents and the filament voltage. The switch may be operated without introducing any disturbance in the output.

STRENGTH VERSUS WEIGHT

Remote equipment is subjected to hard usage, a fact which requires that it be as strongly constructed as possible. Opposed to this is the requirement that it be as light and compact as possible. Metal cabinets are out of the question because of weight. In the past strong wooden cases have been used, but the weight of the high-fidelity system described here made still lighter cases imperative. The answer was found in light wooden cases lined inside and out with heavy gray fiber and reinforced at the corners with metal. These are probably the most practical field equipment cases yet devised.

BATTERY BOX AND CONNECTIONS

As can be seen from Fig. 1, the complete equipment is contained in two of these cases—each approximately 20½" long, 15" high and 8½" deep. All of the speech equipment is contained in one, and the batteries in the other. A six-foot rubber-covered cable connects the two cases.

Little has been said regarding the battery box as every engineer has his own idea as to the most suitable types of batteries. However, the battery box shown is designed to provide space for a small storage battery and four vertical-type B batteries, with sufficient remaining space for three microphone heads and cables.

SEMI-PERMANENT INSTALLATION

Many stations have one or more pickup points where equipment is left over extended periods of time. For such semi-permanent installations ac supply is desired, and for such use the equipment shown here is supplied with an ac power unit—all circuits having been originally arranged so that this unit or battery supply may be interchangeable. In addition, the amplifier control panel is standard width so that it may, if desired, be mounted on a rack.

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PLAN FOR CONTINUOUS WATCH ON 3,105 KC DEFERRED

THE PLAN to have Bureau of Air Commerce radio stations stand continuous listening watches on 3,105 kilocycles after January 1, 1935 has been deferred to a later date pending the acquisition of the necessary additional equipment. The present system of maintaining listening watches on air transport chain frequencies and on 3,105 kilocycles upon request will be continued until further notice. (*Air Commerce Bulletin*, January 15, 1935.)

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WIRELESS AS STANDBY

WIRELESS APPARATUS IS to be installed in the telegraph offices of all important cities in Japan, in order to insure smooth-working communications in any emergency. This step has been taken by the Ministry of Communications as a result of the experience of the serious conflagration at Hakodate, in which all land wires (which were the only means of communication) were destroyed. (*Electrical Foreign Trade Notes*, No. 351, December 15, 1934.)

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SURVEY OF RADIO-EQUIPPED AIRPLANES

RADIO-EQUIPPED AIRPLANES in commercial and private operation in the United States number 775, according to a survey made by the Bureau of Air Commerce*. Government-owned airplanes, such as those operated by the Army, Navy, Bureau of Air Commerce, other Federal agencies or State Governments, were not included in this report.

The scheduled air lines lead in number of radio-equipped aircraft, having a total of 345. Private owners have 246 planes with radio installations, while business firms have 135. The remaining 49 are listed as miscellaneous commercial operators. Further, 326 of the 775 airplanes that have radio installations are equipped with two-way apparatus. The other 449 have receiving equipment only.

*Air Commerce Bulletin, December 15, 1934, page 151.

MAINTAINING and MEASURING TRANSMITTER FREQUENCY

Dealing with the fundamentals. Subsequent articles will deal separately with the subjects of frequency maintenance and frequency measurement.

PART I

By VICTOR J. ANDREW, Ph.D.

Chief Engineer,

DOOLITTLE & FALKNOR, INC.

FUNDAMENTALS

THE MEASUREMENT of the frequency of broadcast transmitters is probably the most precise measurement in any branch of engineering. Frequency is simply another expression for time, the length of time occupied by one cycle. Time is the most accurately measurable of the fundamental units, and the accuracy of the best piezoelectric oscillators is of the same order as the most precise standard clocks of the pendulum type.

The complex circuits involved in controlling and measuring may be easily visualized if we separate them into elements, each element representing one function or process which occurs in the apparatus, and then combine these elements into systems. These elements must not be confused with the electrical or mechanical units such as successive vacuum tubes, since often several tubes are used for one function, or one tube is used for two functions. The various elements are oscillator, amplifier, buffer amplifier, mixer, frequency multiplier, and frequency divider.

OSCILLATORS

An oscillator produces a frequency, while each of the other elements merely acts on the existing frequency. There are two types of oscillators in common use, self-controlled and piezoelectric. The self-controlled oscillator is used wherever it is necessary to adjust the frequency over a continuous range greater than one percent. Piezoelectric oscillators are used almost exclusively where a very constant frequency is needed.

A piezoelectric oscillator is a mechanical vibrator coupled to an electrical circuit in order to obtain alternating current of the frequency of the mechanical vibration. The vibrator is a flat plate of quartz cut from a natural crystal. The plate is usually called a crystal. The coupling between the motion of the vibrating crystal and the electrical circuit is obtained by the piezoelectric effect. This phenomenon practically amounts to squeezing electricity out of a crystal when it is bent or compressed. It is due to a peculiar arrangement of atoms which permits many electrons to move in one direction when pressure is applied. As a result, an electrode connected to one side of the crystal shows a negative charge and one connected to the other side shows a positive charge. The effect is reversible, which means that a voltage connected across the two electrodes causes the crystal to distort.

If a vibrator is to continue vibration indefinitely, energy must be supplied sufficient to replace that lost by friction and other loads. This is accomplished in the piezoelectric oscillator by taking ac from the electrodes, amplifying it in a vacuum tube, and then applying the amplified energy back to the electrodes to drive the crystal. In the usual crystal circuit, shown in Fig. 1, the coupling from the plate circuit back to the crystal occurs through the plate-grid capacity of the tube.

The frequency of any mechanical vibrator depends on its size and rigidity. The important dimension determining the frequency of a quartz crystal is usually the thickness. For a frequency below 200,000 cycles, the crystal is cut in a manner which makes the length determine the frequency. The frequency varies inversely as the thickness or length.

There are several factors which have some influence on the frequency of a piezoelectric oscillator. Temperature influences both the thickness and the rigidity of the crystal. The crystal used in a precision oscillator is enclosed in a chamber where the temperature is automatically maintained constant within 0.01° Centigrade. The electrical characteristics of the associated tube circuit, such as grid-cathode capacity and plate resistance, influence frequency slightly. A variable condenser is sometimes connected across the grid circuit for the purpose of adjusting the oscillator frequency as much as fifty parts in one million.

CRYSTAL CUTS

The angle at which the natural crystal is cut to obtain the oscillator crystal is very critical. There are several methods of cutting which produce crystals of different characteristics. The most used types are known as X, Y and A cut. An X-cut crystal, sometimes called a zero angle or Curie cut, decreases in frequency about fifteen parts in a million when the temperature is raised one degree Centigrade. This cut has the advantage of greater thickness and consequently greater strength than either of the others for a given frequency. The Y-cut, sometimes called the thirty-degree cut, increases in frequency about fifty parts in one million when the temperature is raised one degree. This cut has the advantage of oscillating more easily than the X-cut. The A-cut, which is quite a recent development, has the very great advantage that its frequency changes only about one-half or one part in one million per degree change in temperature.

The remaining elements are divided into two classes. The first is amplifiers, which do not change the frequency. The second is frequency changers.

AMPLIFIERS

Amplifiers in turn are of two kinds. One is the normal amplifier which increases power or amplitude. The other is the buffer amplifier in which little or no amplification is obtained, but which serves as a non-reversible output coup-

(*Continued on page 17*)

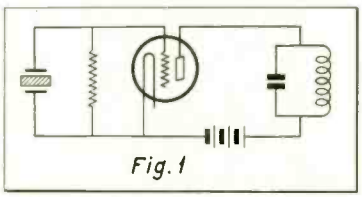


Fig. 1

SIMPLE CRYSTAL OSCILLATOR CIRCUIT.

Inter-City POLICE RADIO

By A. M. HOWERY
Engineer, WPFO
Knoxville Police Dept.

● A PLEA FOR SANCTIONING AND EFFECTIVE ESTABLISHMENT OF INTER-RELATED POLICE COMMUNICATION.

MANY MUNICIPALITIES are unable to finance the installation of a complete police communications system, but are in a position to maintain receiving contacts with nearby police radio stations. In this manner they keep in touch with major events and the protection thus offered by nearby stations is of vital importance with regard to law enforcement.

The matter of stations using their facilities for inter-city communication is now a problem calling for consideration. Not until recently did communication between cities become commonplace. This practice has grown rapidly, until now, it is of vital importance to cities having conventional equipment.

POLICE RECOMMENDATIONS

At a recent meeting of the Associated Police Communication Officers, the problem of inter-city communication was discussed and their recommendations were sent to the F. C. C. and the Association of Chiefs of Police. On February 4th, the Federal Communications Commission sent to all police stations Form 11974, which reads:

"In view of the growth of the practice which has been observed of intercommunication between municipalities in the exchange of various messages in regard to police business, the Commission initiated an investigaton into the propriety of such communications with a view to determining to what extent they might be permitted, if at all, and under what conditions. A questionnaire on this subject was transmitted to the licensees of all municipal police stations on December 6, 1934, inquiring into the extent inter-city communication was carried on by the station licensee, the nature of the traffic handled, and the method of traffic dispatch. Replies have been received from the majority of the cities involved.

"There appears to be no question but that a rapid and efficient means of exchange of messages between municipalities is very important, particularly with the development of rapid means of transportation. The volume of traffic that may be expected is far beyond that which can be carried by the frequencies now available for municipal police purposes.

"A meeting was held of the Associated Police Communication Officers, January 21 to 24, at St. Louis, Missouri, at which one of the subjects on the agenda was the study of this question. As a result of this convention a committee has been designated to prepare a plan for an inter-city radio-telegraph police communication system. It is understood that this plan when prepared is to be submitted to the International Association of Chiefs of Police and also to the Commission, and the Division of Investigation of Department of Justice. The committee's report, which was adopted by the Associated Police Communication Officers, recommends that mobile police frequencies be not used for point-to-point communication.

"Until the proposed plan has been prepared and considered by the Commission, Rule 331 is to be strictly complied with, that is, messages may be exchanged between municipalities provided they are of immediate importance to the mobile police units. It is believed that messages which lose much of their value by the delay incident to relay from city to city are of no immediate importance to mobile units and, therefore, the relaying of messages from city to city, except in rare cases, is prohibited."

Now, as a result of the action of Associated Police Communication Officers, all stations are faced with a real problem. The Commission is in favor of lending every assistance; but is the proposed system the answer to our needs?

Most of you who are interested in this question are thoroughly familiar with some form of municipal government. All cities are in grave financial condition and further expenditures for Police Radio Systems will be met with opposition.

INTER-CITY CONTACTS

Such a system as is proposed for inter-city communication would cost much more than a city under 200,000 population can reasonably afford. Without a question, every city should have a direct communication channel with neighboring cities, but compared to the cost of telegrams, such a system as they propose is not warranted. The demand for such a system is not yet experienced by enough Police Departments to make it worth while.

In the Northern states, where the inter-city radio-telegraph would be most efficient and needed, teletype systems and direct phone connections are in use. Thus, the relatively few cities that could entertain such a plan would be comparatively few, and the system as a whole would lose its potentiality by failing in connecting all of the cities.

The writer does not offer a solution to this problem, but wishes to point out that the American Airways stations handle a huge amount of traffic on relatively few frequencies and experience little trouble. Brevity in messages, the best in receivers, accurate schedules and organization, make it possible for them to depend on radio communication.

SECONDARY COVERAGE

Original radio installations for police use were made on the basis of coverage within the bounds of the enforcement territory. This is called primary coverage by commercial broadcast stations. Police stations, upon tests, have proven valuable for additional or secondary coverage. This additional coverage at night, with the present frequencies, is of such potential use that a network of inter-city activity has developed "overnight."

Until circumstances justify the additional system of radio-telegraph, the F.C.C. should cooperate with the various

(*Continued on page* 21)

COUPLING THE BROADCAST ANTENNA TO THE TRANSMISSION LINE

By PAUL ROSEKRANS

● A PRACTICAL ARTICLE DEALING WITH THE ADJUSTMENT PROCEDURE AND CALCULATIONS NECESSARY TO PROPERLY COUPLE A BROADCAST ANTENNA TO ITS TRANSMISSION LINE.

IT IS OUR BELIEF that many of the six hundred odd broadcast stations in the United States do not have and can not afford specialized equipment for use in working out their antenna problems. However, each does have an antenna and with it an antenna problem. Some stations have solved their problem but the probabilities are that more have not. Much has been written on the subject, especially in the past few years, yet it would seem that there is much more to be said. For this reason this discussion is offered with the average broadcast engineer in mind and not forgetting his lack of equipment to work with. The job can be done in shorter time with proper equipment, it is true, but the following method is given as being one which will give definite results and an accurate check of those results.

There are so many variables to be considered that it is not difficult to get a set-up which is apparently correct but actually quite wasteful of power. Power radiated from a transmission line can hardly be considered as being radiated with any degree of efficiency, yet this is what is being done with an improper termination for the line.

EQUIPMENT AND CAUTIONS

The equipment shown in Fig. 1 will be used as it is most commonly used. It is quite efficient and is probably as easy to adjust as any other.

As is well known, our transmission line will act as a line of infinite length when terminated with a non-reactive load, the value of which, in ohms, is equal to the surge impedance of the line. Let it be said here that this surge impedance may be computed as closely as it can ordinarily be measured.

With the set-up shown it is not difficult to change the tank impedance but the rub comes in knowing when we have all of the variables properly set at the same time. Possibly it can be shown more clearly if we take a practical case and work through the whole process. So let us assume that our power into the antenna is to be five kilowatts, the frequency one thousand kilocycles and the surge impedance of the line six hundred ohms. A portable oscillator of sufficient power output to give satisfactory readings on our meters is a convenience but by no means a necessity. We have a crystal-controlled transmitter at the other end of the transmission line which may be used nicely by cutting down the power to a suitable value. However if we pipe the r-f down the transmission line there are one or two things to avoid. First do not use the tank coil, even though the condenser is disconnected, to excite the antenna; and do not use the antenna coupling coil to couple r-f into the tank. Use a separate coil across the transmission line and inductively couple this to the tank or antenna. Also use as loose coupling as is possible.

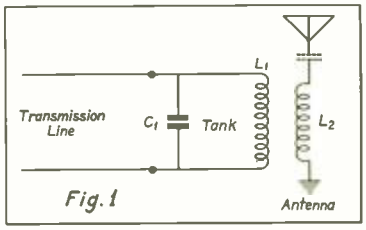
The first step is to measure the antenna resistance and it is suggested that this be done with the antenna connected direct to ground, except for a few turns of coupling coil necessary to get sufficient r-f into the antenna. While this is being done be sure that the tank circuit is open. About four o'clock in the morning this item is quite often overlooked and some rather peculiar readings are sometimes obtained. For the purpose of this discussion we will assume we have a measured resistance of sixty ohms.

This gives us four factors necessary to the solution of our problem:

1—Power 5 kw
2—Frequency 1,000 kc
3—Surge impedance of the line 600 ohms
4—Antenna resistance 60 ohms.

CIRCULATING TANK POWER— ANTENNA POWER RATIO

Before going further we need one other value and we fall back on experience in selecting it. It will be necessary to know the ratio between the circulating power in



TYPICAL CIRCUIT OF TRANSMISSION LINE COUPLED TO ANTENNA.

the tank and the power to be put into the antenna. A large circulating kva in the tank might be used but we have no r-f power to waste in the form of heat. We have known of coupling houses where a heating plant would have been a great convenience but r-f heating would be rather expensive. We are not concerned with stability to the extent that we are in setting up an output tank circuit for an oscillator or a r-f power amplifier. Nor is the problem of harmonic suppression of any great importance as they should not reach this end of the transmission line anyway, although they sometimes do, of course. Experience tells us that kva/kw should equal a value of about four. A little more or less is not

important but for the case before us we will use the value four.

TANK CONDENSER CALCULATIONS

There are several formulae for figuring the value of tank condenser necessary to give us the desired ratio. These have been published in a number of periodicals and will not be repeated here. They are all evolved in one way or another from the method used here and give the same results. The rms voltage across the transmission line can be figured using Ohm's Law. . . . Voltage squared, E^2, equals power times surge impedance and in this case $E^2 = 5000 \times 600$ and $E = 1732$ volts. The current in the capacitive branch of our tank will be found from KVA/KW = 4, or $1.732 \times$ amperes/5 = 4, being 11.547 amps. Knowing this and through the use of the formula $I_C = 2\pi fCE$ we find that the total tank capacity should be 1061.6 mmfd. Of course, if a split capacity with the center grounded each half should be twice the value given above.

ADJUSTMENT PROCEDURE

With the antenna coil, L_2, open we can now complete our tank and resonate it at our operating frequency. When this is done, leaving all tuning adjustments alone, open up the tank. Then using about two and one-half or three turns in the antenna coupling coil resonate the antenna at the operating frequency. Then with all tuning adjustments as we have just left them we are ready to reconnect our tank, inserting a 0-15 ampere r-f ammeter in the capacitive branch. We insert an 0-10 ampere r-f ammeter in the antenna at a point just above any loading we may be using to tune with. The antenna current for the conditions as outlined will be 9.128 amperes. With the transmission line connected across the tank we are ready to test with power.

What we are after is 11.547 amperes in the capacitive branch at the same time we have 9.128 amperes in the antenna. If we find that the antenna current is high and the tank current low we have an indication that we are using too many antenna coupling turns. With low antenna current and high tank current of course the indication is the opposite. If both readings are low the indication would be that we needed more coupling at the transmitter end. Each time the antenna coupling-coil turns are changed the antenna must be resonated . . . and don't forget to open the tank circuit when resonating the antenna. This is especially easy to forget.

A tip, which will save much time in tuning the antenna where capacitive loading is used, is to use a variable condenser of good quality for the tuning and then with the use of a small grid-dip oscillator set up the series condenser to the value of the variable. It might seem that this would take more time but it doesn't and is probably more accurate than the usual method. With antennas where the resistance is considerable the resonance peak is very broad and at the time of night when antennas are most often worked on, power variations are generally at their height. All of this tends to make tuning rather difficult.

But to get back to our adjustments—after a few trials we should have our antenna tuned and each of the meters reading the proper value. We now have one more adjustment to make and the job is completed. This is a reduction in the inductance of L_1. This is necessary to tune our tank to unity power factor and in so doing furnish the non-reactive load for the transmission line. When the tank is at unity power factor there will be a certain definite ratio I_C/I_L, where I_C is the current in the capacitive branch of our tank and I_L the current in the inductive branch. When the current in the antenna is correct and the currents in the two branches of the tank are correct at the same time our job is complete.

DETERMINATION OF I_L

To find what I_L should be is quite simple through the use of the following formulae, the derivation of which is given at the end of this article. We will figure the value needed for this particular case first.

$\frac{Z_O}{X_C} = \frac{X_L}{R}$ where

Z_O is the impedance across the tank.

X_C is the reactance of the tank condenser.

X_L is the reactance of the tank inductance.

R is the resistance of the tank inductance plus the coupled-in resistance due to the presence of the antenna coupling coil.

Substituting values already known,

$$\frac{600}{149.9} = \frac{X_L}{R} = 4 \text{ and } X_L = 4R.$$

As will be shown later,

$$Z_O = \frac{R^2 + X_L^2}{R} \text{ and } X_C = \frac{R^2 + X_L^2}{X_L}.$$

Substituting 4R for X_L

$$Z_O = \frac{R^2 + (4R)^2}{R} = 17R.$$

600 So = 17R and R = 35.29 ohms; also $X_L = 141.16$ ohms.

Knowing the voltage across, and the reactance of, L_1 we find the current I_L from $I_L = \frac{E}{X_L} = 12.27$ amperes.

Now with 12.27 amperes in the inductive branch, 11.547 amperes in the capacitive branch and 9.128 amperes in the antenna the task is completed and we know definitely that we have the proper termination. It might be noted that

$$\frac{KVA}{KW} = \frac{X_L}{R} = 4.$$

FORMULAE DERIVATION

The following is given without comment and carried through to the formulae used above. The resistive component of the capacitive branch has been considered as being zero, which assumption we believe will not be contested.

In a parallel tuned circuit the impedance across it equals the reciprocal of the sum of the admittances.

$$Z = \frac{1}{Y_T}$$

$$Y_T = Y_L + Y_C$$

$$Y_L = \frac{1}{R + jX_L}$$

$$Y_C = \frac{1}{0 - jX_C}$$

$$Y_T = \frac{1}{R + jX_L} + \frac{1}{0 - jX_C} = \frac{R + j(X_L - X_C)}{X_L X_C - jRX_C}$$

$$Z_O = \frac{1}{Y_T} = \frac{X_L X_C - jRX_C}{R + j(X_L - X_C)}.$$

Rationalizing

$$\frac{(X_L X_C - jRX_C)\ [R - j\ (X_L - X_C)\ ]}{R^2 + (X_L - X_C)^2} =$$

$$\frac{RX_LX_C - RX_LX_C + RX_C^2 - jR^2X_C - j(X_L^2X_C - X_LX_C^2)}{R^2 + X_L^2 - 2X_L X_C + X_C^2}$$

$$= \frac{RX_C^2}{R^2 + (X_L - X_C)^2} + \frac{j\ (X_L X_C^2 - X_L^2 X_C - R^2 X_C)}{R^2 + (X_L - X_C)^2}.$$

For unity power factor the j component must equal zero so

$$X_L X_C^2 - X_L^2 X_C - R^2 X_C = 0$$
$$X_L X_C - X_L^2 - R^2 = 0$$
$$X_L X_C = R^2 + X_L^2$$
$$X_C = \frac{R^2 + X_L^2}{X_L}$$

and $$Z = \frac{RX_C^2}{R^2 + (X_L - X_C)^2} = \frac{RX_C^2}{R^2 + X_L^2 - 2X_L X_C + X_C^2}.$$

Substituting $X_L X_C$ for $R^2 + X_L^2$

$$Z = \frac{RX_C^2}{X_L X_C - 2X_L X_C + X_C^2} = \frac{RX_C}{X_C - X_L}$$

and substituting $\frac{R^2 + X_L^2}{X_L}$ for X_C

$$Z = \frac{R\left(\frac{R^2 + X_L^2}{X_L}\right)}{\left(\frac{R^2 + X_L^2}{X_L}\right) - X_L} = \frac{\frac{R^3 + RX_L^2}{X_L}}{\frac{R^2 + X_L^2 - X_L^2}{X_L}}$$

$$= \frac{R^2 + X_L^2}{R} = Z.$$

$$\frac{R^2 + X_L^2}{X_L} = X_C \text{ or } \frac{Z}{X_C} = \frac{X_L}{R}.$$

It is hoped that this discussion will be of some help in understanding the problem in the tuning house and will save many weary hours.

MAINTAINING AND MEASURING TRANSMITTER FREQUENCY

(*Continued from page* 13)

ling for an oscillator. It is used to protect the oscillator so that changes in the succeeding circuit will not disturb the oscillator frequency.

MIXERS

The simplest kind of a frequency changer is a mixer in which two frequencies are combined to produce a new frequency which is the sum or the difference of the original frequencies. The difference is often called a beat. The detector is the commonest kind of a difference producing tube. In modulating a transmitter, two sidebands are produced which are the sum and the difference respectively of the carrier frequency and the modulation frequency.

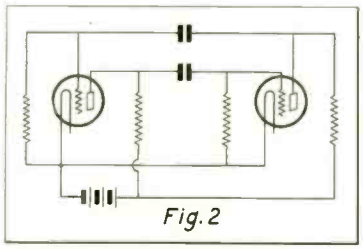
FREQUENCY MULTIPLIERS

The next type of frequency changer is the multiplier or harmonic generator. This is a vacuum tube which has one frequency impressed on the input, and which has an output consisting of the fundamental (input frequency), second harmonic (twice the fundamental frequency), third harmonic (three times the fundamental frequency), fourth harmonic, etc.

The circuit used for frequency multiplication is very similar to that used for addition or subtraction in a mixer tube; it is a tube operating on a non-linear portion of its curve, so the output waveform is not proportional to the input. Such a circuit gives an output which usually contains every frequency which may be described by multiplying each of the input frequencies by any positive or negative integer or zero, and then adding them together. This definition includes both beats and harmonics. While all of these frequencies are present in the tube output, the associated filter or tuned circuit usually eliminates the useless ones. Of course all of these frequencies are not of equal strength in the output. The amplitude of harmonics usually decreases at least as fast as the reciprocal of the square of their number.

FREQUENCY DIVIDERS

The remaining kind of frequency changer is the divider. Division is a much more difficult process than the other ones. There is no simple or direct method of accomplishing it. It can be done only by operating a second oscillator near the desired frequency, which is called a sub-harmonic or a sub-multiple frequency. A small amount of energy at the fundamental frequency is then introduced into the oscillator circuit. The two oscillators thus operating in approximately harmonic relationship influence each other in such a way that they are put into exact harmonic relationship. In order that the lower frequency oscillator should be the one that changes frequency, a buffer amplifier is used in the output of the higher frequency oscillator. Further, the lower frequency oscillator circuit is one that has a particularly unstable frequency. An oscillator with a wave-form differing considerably from a sine wave meets this requirement. A wave-form with an abrupt bend is easily controlled because the second wave can "take hold" of the abrupt point and advance or delay it enough to make it fall just where the second wave is at a maximum.



MULTIVIBRATOR CIRCUIT USED FOR FREQUENCY DIVIDING OR MULTIPLYING.

The multivibrator circuit, shown in Fig. 2, is very popular for frequency division because it produces an approximately square wave-form. It is a two-tube oscillator using resistance coupling. In this, as in any other oscillator circuit, a signal on the grid is amplified and then returned to the grid in its initial phase. In the ordinary oscillator the phase is reversed once in the tube and once in the magnetic feedback coupling. With resistance coupling it is not possible to reverse the phase because the same side of both input and output must go to the cathode. Consequently two tubes are necessary to reverse the phase twice.

The use of the controlled oscillator is not necessarily confined to frequency division. It may be used for amplification where a very large gain is desired.

(*To be continued*)

An Efficient REMOTE AMPLIFIER

Construction Details of Portable Unit Used by WLW

By J. C. BAILEY
Engineer,
WLW-WSAI

WITH THE CONCENTRATED attention during the past few years on improving transmitter quality, studio acoustics and microphone technique, it is an evident fact that remote equipment and conditions have been completely neglected.

The equipment herein described was designed to meet the present call for better all-around quality and efficiency in programs to be picked up remotely from the studio. It is portable to the extent that it can be set up or taken down in less than a minute, can be carried easily through large crowds, set up on football fields or can be used on dance or symphony programs where the outputs of two or three microphones have to be carefully mixed.

FEATURES INCORPORATED

In the design of this equipment the outstanding features to be incorporated were:

(1). An amplifier that would have a frequency response equal to or better than present-day studio equipment.

(2). Everything (except microphones) was to be included in one case that could be handled by one man.

(3). Weight not to exceed fifty pounds, complete.

(4). The amplifier and accessories to be efficient and flexible in operation and maintenance.

(5). A three-position mixer system.

GENERAL SPECIFICATIONS

A circuit using resistance coupling between the stages was used in order to save transformer weight and because of its unusually high frequency response. This partly accounts for the fact that the amplifier has a useful frequency range from 30 to 11,000 cycles and has an essentially flat curve from 80 to 9,000 cycles.

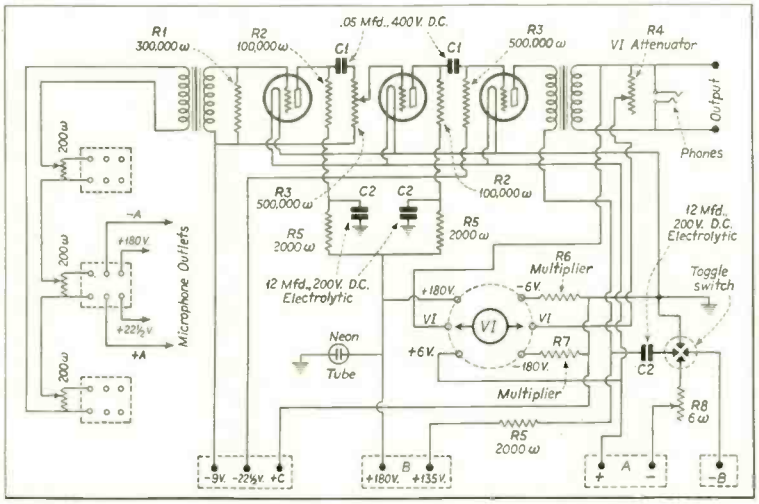
All equipment (except microphones) is enclosed in one carrying case 17 inches wide, 16 inches high and approximately eight and a half inches deep. The front side is hinged and fastened with snaps in such a manner that the power supply is readily accessible while the amplifier is in operation. The lower half of the box is divided in two parts, one for the power supply and the other for the output cable, headphones and spare tubes. The power supply consists of two, one and one-half volt dry cells, four 45-volt dry "B" batteries and a 22½-volt dry "C" battery. The total weight, including a ten-foot output cable, headphones, spare tubes and batteries, is 42 pounds.

COMPLETE ASSEMBLY, SHOWING CARRYING CASE DETAILS.

DETAILED SPECIFICATIONS

The amplifier circuit utilizes three stages, resistance coupled, with an overall gain from input to output of 42 db. The first two stages use 230 triodes while the third stage utilizes a 231 power-amplifier triode. The use of the two-volt tubes was a great factor in keeping the total weight as low as possible saving the added weight of dry cells sufficient to operate the higher voltage tubes.

Plug-in positions are provided on the panel for three condenser microphones. However, with the proper connections, dynamic- or inductor-type microphones may be substituted. The mixing of each individual microphone is accomplished by a 200-ohm resistor connected in the mixing circuit as a potentiometer. The master gain control of 500,000 ohms is

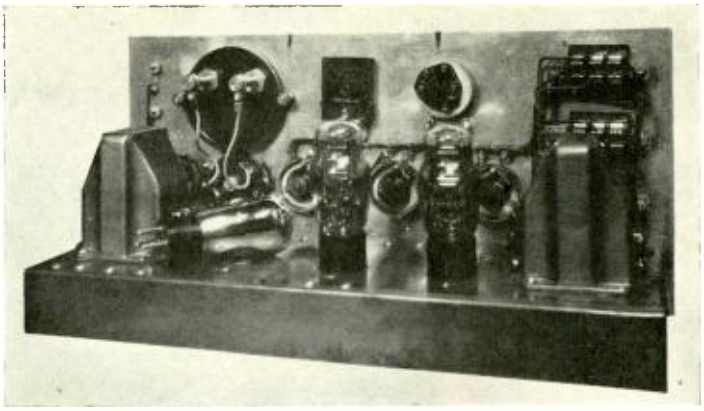


CIRCUIT DIAGRAM OF PORTABLE SPEECH-INPUT EQUIPMENT DESCRIBED IN THE ARTICLE.

connected in the grid circuit of the 230 tube in the second stage. Line-to-tube and tube-to-line transformers are matched on the output side to the usual 500-ohm line.

The amplifier is turned off and on by means of a four-way toggle switch mounted conveniently on the amplifier panel. The switch, by making or breaking four circuits at a time, prevents the dry batteries from discharging through the three electrolytic condensers, and at the same time breaks the battery circuits when the switch is in the "off" position. A very small neon bulb is used as a visual precaution against leaving the amplifier turned on when not in use. In the upper right-hand corner of the panel are the output terminals and just below a six-ohm variable resistor for keeping the filament voltage of the tubes at rated value. The drain on the power supply is extremely low as might be expected using the 230 type tubes. The "A" current is about .25 ampere at two volts. The "B" current is about 14.5 mils at 180 volts. This gives a satisfactory life for the "A"s of about fifty hours and the "B"s of about two hundred hours. The headset, used as an auxiliary aid to monitoring, connects directly across the secondary of the output transformer through a jack on the front of the panel.

The box enclosing the equipment was carpenter made, using five-ply half-inch veneer with supporting framework. The outer exposed surfaces are covered with black leatherette, a very inexpensive material that gives the box a neat business-like appearance. The inside of the two lower compartments, the lid and the inside of the front cover are finished with one coat of flat black stain.

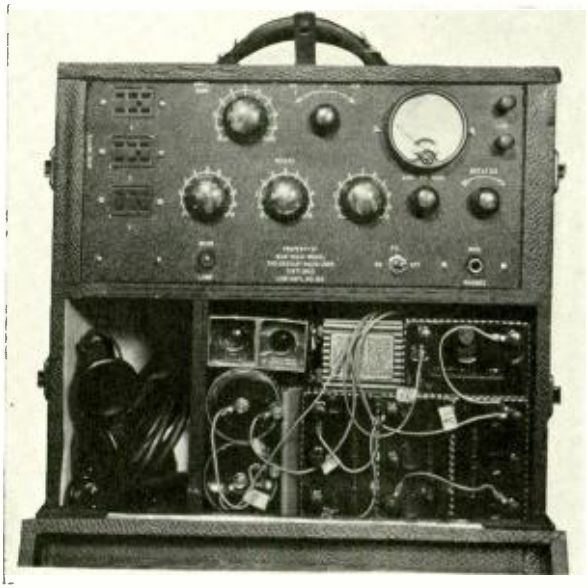


SHOWING PLACEMENT OF PARTS ON PANEL AND SUB-PANEL.

VOLUME INDICATOR

Most composite amplifiers used by smaller stations have no level-indicating device at all, or if they have it is usually in no condition to be relied upon. The job very often is left to the engineer, on duty at the studio or transmitter, to run levels on remote programs.

Believing that a method of checking levels, where the program originates, and the ability to send a constant peak level to the studio, is almost as important as the amplifier itself, this outfit includes one of the most recent developments in a general-purpose power-level indicator; that is, the new Weston model 301 dry rectifier type meter reading directly in db. The face calibration is from —10 db to +6 db. There are three distinct advantages to this type meter. It saves the use of another tube for rectification and hence reduces "A" power consumption. The movement closely follows the envelop of speech and music, having a pointer action of .2 second to give indication at "0" power level. It has an overshoot of .5 db or less at "0" level as compared from 2 to 4 db overshoot on the older type meter. In this particular installation the meter serves still another purpose. By being calibrated with external multipliers and adding another scale, the meter will read filament and plate voltages. The operation of changing from one scale to the other is accomplished by a three-position switch (see circuit diagram), with the meter connected across the movable arm. For the value of the variable resistance in series with the meter it will be necessary to refer to the tag attached to the meter case. This is specified by the manufacturer as so many ohms to be put in series to read "0" level on the scale. As an example, the meter in the unit described required 3,230 ohms.



FRONT VIEW, SHOWING FRONT PANEL ARRANGEMENT; AND TWO LOWER COMPARTMENTS HOUSING BATTERIES AND ACCESSORIES.

CONCLUSION

The amplifier described in this article, with its carrying case and accessories, is the result of four years' practical experience with almost every combination of remote equipment, including ac operated, dry-battery operated, completely portable, semi-portable and permanent installations. When a station can only afford one, or possibly two remote amplifiers, and yet is required to pick up programs from widely separated points under adverse conditions, this amplifier certainly fills the bill. It can be carried around as easily as a suitcase, in crowded elevators, in private cars and the like, and yet presents a dignified appearance in the most aristocratic supper clubs.

Twelve of these amplifiers have been in constant daily use by the Crosley stations WLW and WSAI for the past five months.

AN ACCOUNTING SYSTEM FOR THE BROADCAST ENGINEER

By R. C. POWELL

COMPARATIVELY FEW broadcast station engineers are directly concerned with the financial aspects of station operation, despite the fact that they are the only ones capable of valuating, accurately, the physical property involved. Only in the larger organizations are the activities of the engineering department subject to a strict system of accounting. An appraisal of the station properties, a knowledge of operating and maintenance expense and methods of handling depreciation and obsolescence are essential to the proper management of the station and become of paramount importance if the properties are to change ownership.

COVERAGE SURVEYS

The value of a broadcast station may, of course, be based primarily on two figures: (1) how many *can* listen and (2) how many *do* listen. The former figure can be determined by the engineer. He can produce the results of field strength surveys to prove his statements and he knows that his coverage is roughly dependent upon the size and efficiency of his plant both of which can be measured. The latter depends upon programs, good will, the competitive situation and other intangible factors which have been the subject of controversy and the despair of advertising agencies since commercial broadcasting began. Fortunately the engineer has never had to interview 49,006 housewives to find out what is going on in his department. He deals with physical properties which may be measured with a satisfactory degree of accuracy. A method of placing a value on these properties and accounting for their use is described here.

SERVICE LIFE OF ITEMS

All business properties consist of a number of major items and a variety of small parts and accessory equipment. The uses of the individual items and their life in service vary so widely that any attempt to keep track of them singly would result in a maze of detail. Thus it is convenient to divide the property into groups according to their expected life in service. Land, for example, is permanent. Buildings and like structures may be expected to last fifty years or more. The life of a transmitter is limited only by obsolescence resulting from technical development. Small amplifier tubes give useful service for a year. The larger transmitting tubes may last one or two thousand hours.

The sum of the physical properties of a broadcast station, plus a few intangible items mentioned hereafter, constitute the fixed capital investment upon which the successful station earns a return. Earnings in excess of a reasonable return on the fixed capital may be capitalized under good will, listener preference, the station license or any other heading which accounts for normal income in excess of that required for all normal charges.

PROPERTY CLASSIFICATIONS

The properties of a broadcast station may be grouped under the following classifications:

(1). Land.

(2). Structures, such as transmitter building, antenna towers, antenna and ground system, sound treatment in studios, and other items which form a part of such structures, such as ventilating ducts, heating equipment, lighting, plumbing, etc.

(3). Transmitting equipment, including radio transmitter, associated amplifiers, power-supply equipment, water cooling system and control equipment.

(4). Studio equipment, including microphones, microphone stands, input equipment, power supply associated with input equipment, microphone stands, cords, signalling system and loudspeakers.

(5). Remote-control equipment, including portable amplifiers, microphones regularly used for outside installations, etc.

(6). Special equipment, including frequency monitor, audio oscillators, portable level indicators, modulation-measuring equipment, distortion-measuring equipment, etc.

(7). Accessory equipment, including all spare parts regularly kept on hand and required for the operation of the equipment.

(8). Tools and shop equipment regularly required for repairs and maintenance.

(9). Furniture for studio and office equipment, including desks, chairs, pianos, music stands, file cabinets, typewriters, and other business machines and furnishings.

(10). Reserve equipment, including all usable equipment and parts having value but not required for the normal operation of the station either as regular or spare equipment.

INTANGIBLE FIXED CAPITAL

Intangible fixed capital may include:

(1). The actual cost of obtaining and defending the station license, including all legal and incidental expense.

(2). Organization expense, including cost of incorporation, taxes, cost of promotional material, cost of stock sales, etc.

(3). Miscellaneous patent or other rights and any other items constituting fixed capital but not included in the above accounts.

Most of the property included under fixed capital will undergo depreciation or become worn out in service. Most of it will require periodical repairs. It is often difficult to separate charges for depreciation to the capital account and maintenance expense. As a general rule, changes or repairs which do not materially affect the value of the existing equipment may be charged to maintenance. Where a major item, included in fixed capital, becomes inoperative it is retired from fixed capital account and the cost of replacement added to fixed capital. For example, if the brushes of a generator were replaced the cost might be charged to maintenance. If a tower blew down in a storm, the cost of the tower and its erection would be deducted from fixed capital and the cost of labor and material to replace it with a new tower would be added to fixed capital. The cost of removing the remains of the old tower from the premises would be charged to maintenance.

REPLACEMENTS

Tubes are replaced more frequently than any other part in a transmitter. Two spare tubes for each socket in the station equipment may properly be in-

cluded in fixed capital. It is a common practice to replace all tubes in amplifier equipment every six months. Larger transmitting tubes may be replaced in the same way if the equipment has been in operation a sufficient length of time to determine an average life for the group of tubes used. The large tubes may be handled individually if more accurate records are to be kept.

DEPRECIATION

Depreciation may be estimated in two ways. There is the so-called straight-line depreciation where the life of property is assumed to be a given number of years and a deduction made each year for the value supposed to have been lost. By the second method a deduction is made at each appraisal for the amount of expense required to place the property in "new" condition. The latter method is frequently applied to buildings, since by applying a straight-line depreciation it is often found that a well-constructed building is in perfect condition after its life, as estimated, has expired.

OBSOLESCENCE

Obsolescence is more rapid than depreciation in all types of radio equipment. The straight-line method of making deductions has been generally applied to radio broadcast stations, the rate in common use being 25% annually. Any survey would show a large number of plants which have been in operation for six to eight years without material change in equipment. Looking back to 1925 it would not have been unreasonable to have assumed a life of two years for a broadcast transmitter. Whether a period of rapid development in equipment design will again take place during the next few years cannot be foreseen. Any straight-line method for making these deductions starts with a guess.

Because of the uncertainty in applying depreciation and obsolescence, many concerns simply set up a reserve for these charges, adding large amounts to the fund in good years and smaller amounts when earnings have been low. Using this method there is an opportunity each year to look over the progress being made in equipment design and the condition of the existing equipment and to apportion the deductions more accurately.

OPERATING EXPENSES

The operating expenses of the station may be grouped conveniently under the following heads:

(1). *Plant expense,* including supervision, engineers and operators' salaries, maintenance of buildings and structures, maintenance of equipment and apparatus and miscellaneous operating department expense, power and program circuits.

(2). *Production expense,* including cost of programs and talent, announcer's salaries, and miscellaneous program expense.

(3). New business expenses, such as salesmen's commissions and salaries, sales promotional material and advertising, and cost of soliciting.

(4). *General expense,* including administrative salaries, general office salaries, office supplies, legal expense, insurance, and undistributed general expense.

The above division of accounts makes it possible to segregate the activities of the three major sub-divisions of station management and to determine the relative cost of each.

CONCLUSION

The system of accounting outlined here may appear to be needlessly elaborate for a relatively small business. Little effort is required, however, to keep the necessary records and it provides a clear picture of the current value of the plant and the operating costs.

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INTER-CITY POLICE RADIO

(*Continued from page* 14)

police departments, as they have expressed a willingness to do, and effect a plan that can be adopted by all existing stations without involving further expenditures. The suggestions offered by the Associated Police Communication Officers will certainly be of interest to the Commission since it is an opinion handed down by a representative group of men who are engaged in police communication activities, and should represent a good concensus of opinion. Had this group of communication officers taken the problem into consideration, and placed their recommendations into the hands of all of the stations affected, polled opinions, and then made recommendations accordingly, it would have provided the Commission with a report that would be instrumental in their final action.

With things as they are, it will be impossible to make definite recommendations or suggest the perfect plan. If, however, your ideas are sent to the Commission, it will be possible for them to consider other means and possibly approve a plan that will be beneficial to all stations.

POINT-TO-POINT TRAFFIC

For instance, any station can handle the bulk of the traffic during the daylight hours, thus keeping the channel clear for more distant messages during night hours. This is especially true where the stations are close together. East Lansing, WRDS, can handle emergency traffic with almost every state in the Union. Is it your belief that the members of the Commission would effect measures to destroy this potential service?

Point-to-point traffic, on a schedule basis, greatly enhances the law-enforcement work of any police department and is highly desirable. The need for such an organized plan of communication is certainly apparent. Under the present conditions, messages are increasing, yet the existing facilities are not overworked.

With every police radio department voicing their opinions to the Commission, perhaps a better plan could be contrived. If the plan could include a basis of time-frequency-power-distance regulation on schedules, this would help greatly. This alone would minimize possible interference between other cities engaged in inter-city communication. With the Commission's supervision of the contacts each station made, and with a few of the State stations intercepting the distant messages, it would be possible to form a very efficient organization. This may call for a more liberal interpretation of the existing radio laws.

INTERLINKING MESSAGES

Such messages as "missing persons," checking of license numbers, checking police records of suspicious characters, reports of stolen vehicles, stolen goods, and the like, are all important and should be allowed the privilege of intercity broadcast. Many people throughout the United States have short-wave receivers and through their use are able to report valuable information to the police departments from time to time.

Police departments are not expecting the radio systems to supplant other forms of communication. Where secrecy is essential, other forms of communication, such as telegraph, telephone and mail, will continue to be used.

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CUBA SUSPENDS PERMITS FOR NEW RADIO STATIONS

THE COUNCIL of Secretaries of the Cuban Government has approved the request of the Secretary of Communications to suspend temporarily the granting of permits for new radio stations. This decision was made in anticipation of new radio legislation. It affects all radio stations, radio telegraphy and radio telephones. (Walter J. Donnelly, Com'l Attache, in *Electrical Foreign Trade Notes*, No. 350, December 5, 1934.)

TELECOMMUNICATION

PANORAMA OF PROGRESS IN THE FIELDS OF COMMUNICATION AND BROADCASTING

WDOD'S NEW SELF-SUPPORTING RADIATOR

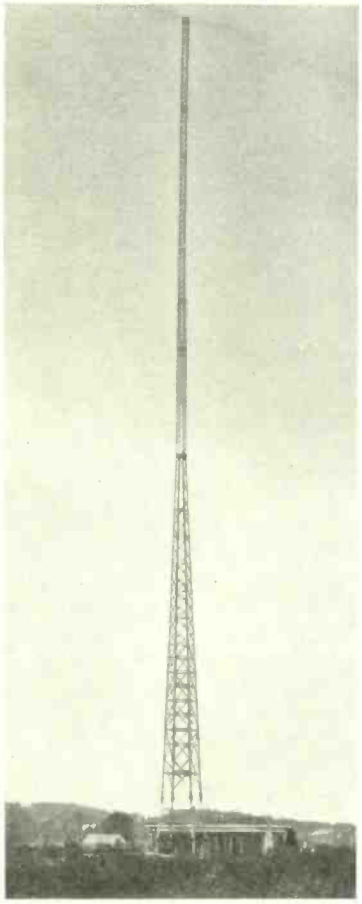
The 320-foot self-supporting, vertical radiator recently installed at radio station WDOD, Chattanooga, Tenn., is said to have greatly improved station performance. According to an engineering report based on surveys made on the old T-type antenna and after installation of the new vertical radiator (at the same site) the performance of WDOD has been tripled without any increase in power input. This report states:

"A large series of measurements were made along various short radials from the station to permit the determination of the correction factor to be applied to the actual average measurements for 1 kw at one mile. From these the average absorption was computed by two different methods and the field strength corrected for attenuation for 1 kw at one mile was found to be between 235 and 240 mv/m. It is believed that 235 mv/m for average conditions is a conservative value. . . .

". . . The use of the new antenna at WDOD has resulted in an increase in service as great as would have resulted from the use of 9.25 kw in the old antenna. In addition the fading at night within the service area of WDOD has been greatly reduced if not entirely eliminated. . . ."

Each station has an individual economic and technical problem which requires careful study. The selection of a new antenna to increase the output of a station for a given transmitter input depends upon many factors.

The Truscon Steel Company, Youngstown, Ohio, designers of the antenna installed at WDOD, are anxious to cooperate with station operators, consultants, and other radio engineers in order to work out the most efficient and economical design for each individual condition.



320-FOOT SELF-SUPPORTING RADIO ANTENNA AT WDOD, CHATTANOOGA.

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BRITISH RADIOPHONE LINK

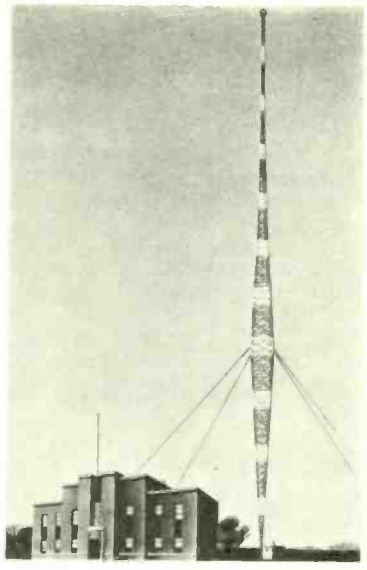
T. T. PARTRIDGE, M.I.E.E., M.I. Struct. E., Superintending Engineer of the Post Office Engineering Department of Northern Ireland, has given full details of the experiments which are being carried out by his department with the object of providing an ultra-short-wave telephone system between Northern Ireland and Great Britain.

The site of the new station is at Mount Gilbert, 800 feet above sea level at Ballygomartin, where huts have been erected to house the apparatus. Aerial poles have also been erected, and the apparatus will be in operation shortly. Good headway is also being made with the site at Portpatrick, where the complimentary station will be situated.

In the course of his statement, Mr. Partridge said: "We have been experimenting for a considerable time with an ultra-short-wave telephone system, and the experiments have reached a stage when it is felt that they should be carried out between Northern Ireland and the mainland, because if they are successful they will prove a valuable additional link in the telephone service between Northern Ireland and Great Britain. The need for such additional links has become specially urgent in view of the excellent manner in which the public have responded to the reduced telephone charges recently inaugurated by Sir Kingsley Wood.

"At the present time all the telephone services to Great Britain are by means of submarine cables, and the expense of providing additional submarine cables would be very great. The experiments now being carried out will enable additional services to be provided without the use of additional submarine cables, and the Post Office Engineering Department is, of course, most anxious that the experiments should be pressed forward with all possible speed."—(*Electrical Equipment Division, U. S. Department of Commerce.*)

THE 520-FOOT VERTICAL RADIATOR RECENTLY ERECTED ON THE SITE OF STATION WHO, DES MOINES, IOWA. THE LATTICE STEEL TOWER WAS DESIGNED AND INSTALLED BY BLAW-KNOX.



MAP No. 4--*National Broadcasting Company Network*

COMPLETE NBC NETWORK REVISED UP TO JANUARY 28, 1935. DESIGNATIONS ARE GIVEN FOR THE FOUR PRINCIPAL NETWORKS.

FEDERAL COMMUNICATIONS COMMISSION REPORTS

FOREIGN COMMUNICATIONS RECOMMENDATION

THE FEDERAL COMMUNICATIONS COMMISSION submitted, on February 5, the following recommendation for additional legislation:

No new wire or radio circuit intended for direct or indirect communication between the United States and any foreign country shall be opened or operated except after a finding by the Commission that American interests will be protected and served thereby; and all contracts, agreements or arrangements for or relating to the establishment or operation of such new circuits shall expressly provide that they are subject to the approval of the Commission. In determining whether or not any such proposed new circuit will protect and serve American interests, the Commission shall consider all facts and circumstances having to do with or leading up to the proposed establishment of the circuit including all acts done or promises made in such manner as to create a reasonable belief that they were performed or made with the intention or effect of influencing the establishment or operation of the circuits or any contract relating thereto, whether or not the persons performing such acts or making such promises are subject to this Act. There shall be a legal presumption that no new circuit will serve or protect American interests where the division of tolls or other compensation, terminal charges, out-payments, charges for equipment, payment of commissions, absorption of costs, solicitation of traffic, or any other matter which might influence the flow of traffic or communications is less favorable to American interests than in the case of any other circuit which is directly or indirectly handling traffic or communications which may be diverted to the new circuit.

SUSPENSION

The Commission shall have the right to suspend the opening of the circuit or the operation of any contract, agreement or arrangement for a reasonable time to permit it to make any necessary investigation in connection therewith. Should any cause or circumstance arising or first coming to the knowledge of the Commission subsequent to its approval of the opening or operation of such new circuit be brought to the attention of the Commission which would have led to the withholding of approval for the opening or operation of such new circuit had the Commission been in possession of such information at the time of the approval thereof, the Commission shall have authority to withdraw or suspend its approval of the operation of any circuit so approved and thereupon the operation of the circuit shall be discontinued. The Commission shall not approve the establishment, opening or operation of any circuit for foreign communication upon terms which are less favorable to American interests than the most favorable terms upon which the same communication service is being rendered by any American company, or if it shall appear that the conditions under which such communication service is to be rendered are less favorable than those of any expiring contract which has been in effect if the Commission has reason to believe that such contract was not renewed because of anticipation of a new contract on terms less favorable to American interests.

The provisions shall apply to all circuits opened subsequent to the enactment of this section, irrespective of the date of the contracts for or relating to such circuits, and to the continuation of existing circuits beyond the first date upon which they are terminable under any existing contract.

REASONS

Competition has its worst effects in the field of foreign communication. Communications in most foreign countries are handled as a monopoly. Where the monopoly has two competing American companies offering to establish circuits, it can drive progressively harder bargains to the detriment of American interests. As existing contracts expire or are terminated, it will undoubtedly develop that those which replace them will be upon terms much more adverse to American interests.

The proposed amendment would give the Commission some degree of control over this situation. Where one American company has an established circuit to a foreign country, a competing company wishing to establish a similar circuit will be tempted to take less favorable terms than the established company. If the establishment of the circuit is subject to the right of the Commission to see that American interests do not suffer, it will be possible for the Commission to keep this generosity to the foreign company from running riot.

Some American communication companies are affiliated with manufacturing companies in the United States or abroad, and with operating companies abroad. It is thus at least theoretically possible for a contract made by a carrier subject to the Act to be fair on its face and yet have been induced by actions taken or terms made by American or foreign companies not subject to the Act, which are detrimental to American interests. For instance, an affiliated manufacturing company might give equipment free of charge, if the communication company were to receive the right to open a circuit. The Commission's jurisdiction to examine into all the phases of the transaction, therefore, must necessarily extend to persons not subject to its jurisdiction.

The proposed amendment will not operate to prevent a lowering of international rates. If an existing contract provides for an equal division of tolls between the American and the foreign company, a new contract providing for a lower rate with the same equal division of tolls would obviously not be contrary to American interests. In practice, the newer contracts have not provided for lower rates; rather they keep the same rates in effect, but they may have been induced by a surrender on the part of the American company of some of its proceeds under the contract.

In the opinion of the Commission, legislation such as that suggested is essential if the control of international communications is not to pass out of American hands.

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LLEWELLYN REINSTATED

At a special meeting of the Commission held at 4:00 p.m., on February 12, attended by Commissioner Prall, Acting Chairman, and Commissioners Case, Brown, Payne, Stewart and Walker, the following resolution was adopted:

Whereas, by virtue of the action taken by the Federal Radio Commission under date of December 2, 1932, Mr. George Llewellyn was removed from the service of that Commission upon charges preferred by the Federal Radio Commission upon information furnished by his immediate chief, Mr. Landon C. Herndon;

Whereas, upon hearing recently granted, the Federal Communications Commission finds that the charges preferred against the said Mr. George Llewellyn were insufficient in fact or in substance to warrant the action taken or to justify the removal of Mr. Llewellyn from the service of the Federal Radio Commission;

And whereas, the Federal Communications Commission is by law the successor to the Federal Radio Commission to all intents and purposes and possessed of the necessary authority to conduct the hearing of Mr. Llewellyn;

It was resolved, that said Mr. George Llewellyn should be reinstated to his former position at the grade and salary which he had at the time of removal, and the commission directs that the application for reinstatement be handled accordingly.

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ACTION ON TELEPHONE COMPANIES

The Telephone Division, composed of Paul A. Walker, Chairman, and Commissioners Case and Sykes, on February 14, took the following action:

Decided that the Big Eddy Telephone Company, Narrowsburg, New York, and the Rogerson Telephone Company, Rogerson, Idaho, are subject to the jurisdiction of the Commission.

Recommended that the case of the Cass County Telephone Company, Harrisonville, Mo., the Inter-County Telephone Company, Gallatin, Mo., and the Rochester Telephone Corporation, Rochester, N. Y., be referred to an Examiner for hearing, to determine whether the companies are subject to the jurisdiction of the Commission.

The Telephone Division determined that the Barneston Mutual Telephone Company, Barneston, Nebraska, and the Belmont Telephone Exchange, Nashville, Ind., are subject to the jurisdiction of the Commission.

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SCHEDULES OF CHARGES

At a Special Session of the Federal Communications Commission held at its office in Washington, D. C., on the 16th day of February, 1935, the Commission having under consideration the matter of schedules of charges under section 203 of the Communications Act of 1934:

It was ordered, that, until otherwise prescribed by the Commission, changes may be made, by carriers subject to the Act, in the charges, classifications or regulations relating to interstate or foreign communications which have been filed with the Commission only after thirty days' notice to the Commission and to the public; and that changes in schedules which have been filed with the Commission which do not involve a change in charges, classifications or regulations may be made only after five days' notice to the Commission and to the public; provided, that under special circumstances and conditions, and upon application

and for good cause shown, the Commission, or the appropriate Division, may allow any such schedules to become effective on not less than one day's notice, on such conditions as the Commission or the Division may prescribe.

It was further ordered, that the notice required shall begin on and include the day that the schedule is received by the Commission.

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INSPECTION DISTRICT NO. 21

The Federal Communications Commission has established radio inspection district No. 21, embracing the Territory of Hawaii with headquarters in Aloha Tower, Honolulu.

James M. Chapple, formerly Inspector in Charge at Los Angeles, California, has been appointed Inspector in Charge at Honolulu and placed in charge of this district. Mr. Chapple sailed from Los Angeles for Honolulu, February 8, and opened the office upon arrival. All radio matters originating in or pertaining to the Territory of Hawaii will be handled by this office.

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Broadcast Division

December 18, 1934.

WM. SCHIELD, SYDNEY R. LEWIS AND HAROLD SMITHSON, Trustees of Golden Empire Broadcasting Co., Ltd., Chico, Calif., granted construction permit for station to operate daytime on 950 kc, 250 watts. Site to be determined.

NICHOLS AND WARINNER, INC., granted construction permit for portable-mobile equipment to be used for general experimental purposes, frequencies 31,100, 34,600, 37,600, 40,600 kc, 2 watts; also granted same except 30 watts power.

LEWIS WASMER, INC., granted construction permit for portable equipment to be used for broadcast pickup, 1606, 2020, 2102, 2760 kc, 100 watts.

PAUL Q. CALLISTER, Salt Lake City, Utah, granted permission to take depositions in support of his application for a new station to be located at Salt Lake City.

January 15, 1935.

ATTALA BROADCASTING CORP., Clarksdale, Miss., granted construction permit to erect station to operate on 1210 kc, 100 watts, unlimited time.

January 29, 1935.

THE ASHLAND BROADCASTING CO., Ashland, Ky., granted construction permit, 1310 kc, 100 watts, unlimited time.

JAMES R. DOSS, Jr., Decatur, Ala., granted construction permit, 1370 kc, 100 watts, daytime.

BELL TELEPHONE LABS., Inc., Whippany, N. J., granted construction permit, special experimental service, 560, 900, 1340 kc, 5 kw, time of operation 12 to 6 a. m.; also granted license covering same.

A. H. BELLO CORP., granted construction permit for portable-mobile equipment to be used in Texas for general experimental purposes, 31,100, 34,600, 37,600, 40,600 kc, 3 watts.

A. M. ROWE, Inc., Fairmount, W. Va., granted construction permit, general experimental, 31,600, 35,600, 38,600, 41,000, 86,000-400,000 kc, 25 watts. Location, Hotel Fairmont. Authority is granted to transmit regular programs in order to carry out the proposed program of research and obtain estimate on number of listeners and their reaction to high-fidelity programs transmitted on very high frequencies subject to understanding that authority is on temporary basis only and may be cancelled without notice or hearing, etc., and station shall not be used to rebroadcast programs of any other station or to transmit any commercial-sponsored programs or communication involving advertising either directly or indirectly.

February 5, 1935.

MIDLAND BROADCASTING CO., Inc., Kansas City, Mo., granted construction permit for general experimental purposes, 31,600, 35,600, 38,600, 41,000, 86,000-400,000 kc, 50 watts; same also granted for portable-mobile equipment; same except for 1½ watts power.

MISSISSIPPI BROADCASTING CO., Inc., E. St. Louis, Ill., reconsidered and granted application for construction permit for station at East St. Louis, Ill., 1500 kc, 100 watts.

EVANGELINE BROADCASTING CO., Lafayette, La., granted authority to take depositions at Shreveport and Lafayette, La., in support of application for construction of station at Lafayette to operate on 1310 kc, 100 watts, unlimited time.

February 12, 1935.

MILWAUKEE BROADCASTING CO., Milwaukee, Wis., granted construction permit, 1310 kc, 100 watts, daytime, site to be determined.

E. R. IREY AND F. M. BOWLES, granted construction permit for broadcast pickup, portable (Calif.), 31,100, 34,600, 37,600, 40,600 kc, 30 watts.

GENERAL ELECTRIC CO., Schenectady, N. Y., granted special temporary authorization to operate a broadcast pickup station at Lake Placid, N. Y., with power of 50 watts on transmitter already constructed pending filing of formal application and to be used in connection with bobsled elimination runs for 1936 Olympics, 1606, 2020, 2102, 2760, 31,100, 34,600, 37,600, 40,600 kc.

Telegraph Division

January 30, 1935.

AERONAUTICAL RADIO, Inc., Peoria, Ill., granted construction permit (aviation), 3222.5 kc day only, 3127.5, 3238.5, 3242.5, 3257.5, 3447.5, 3487.5, 3467.5, 3485, 4917.5, 5602.5, 5612.5, 5632.5 kc unlimited, 50 watts.

AIRCRAFT SERVICE, Inc., NC-985-W, granted aviation license, 3105 kc, 5 watts.

WASH. INST. OF TECHNOLOGY, College Park, Md., granted experimental construction permit, portable-mobile equipment, 86,000-150,000 kc, 1000 watts. Also granted construction permit 38,600, 40,100, 40,600, 41,000 kc, 350 watts.

CITY OF NEW ROCHELLE, N. Y., granted construction permit, general experimental, 30,100, 33,100, 37,100, 40,100 kc, 50 watts.

TOWN OF HARRISON, N. J., granted construction permit, general experimental, portable-mobile, 30,100, 33,100, 37,100, 40,100 kc, 9 watts.

CITY OF HIGHLAND PARK, Ill., granted construction permit, general experimental, 41,000 kc, 15 watts.

DOOLITTLE AND FALKNOR, Inc., granted construction permit, general experimental, portable-mobile, State of Illinois, 31,600, 86,000-400,000, 401,000 kc and above, 10 watts. Also granted similar construction permit: Portable, State of Illinois, 31,600, 41,000, 86,000-400,000, 401,000 kc and above, 100 watts.

CITY OF BRISTOL, Va., granted construction permit for police service, 2450 kc, 50 watts.

CITY OF EL CENTRO, Calif., granted construction permit for police service, 2490 kc, 50 watts.

STATE OF INDIANA, Dept. of Public Safety, Jasper, granted construction permit for police service, 1634 kc, 1 kw.

CITY OF DANVILLE, Ill., granted construction permit, 30,100, 33,100, 37,100, 40,100 kc, 15 watts; also to communicate as municipal police station in emergency service.

February 6, 1935.

AERONAUTICAL RADIO, Inc., Charlotte, N. C., granted construction permit, 2922, 2946, 2986, 4122.5, 5652.5 kc, 20 watts.

WESTERN AIR EXPRESS CORP., NC-13306, Co. No. X-6; NC-13309, Co. No. X-9; NC-13315, Co. No. X-15; granted license, 2906, 3072.5, 3088, 3105, 4937.5, 4952.5, 4967.5, 5672.5, 5692.5 kc, 50 watts.

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

CITY OF KINGSPORT, Tenn., granted construction permit, 30,100, 33,100, 37,100, 40,100 kc, 25 watts.

CITY OF GALVESTON, Texas, granted construction permit, 1712 kc, 50 watts.

CITY OF DUNCAN, Oklahoma, granted construction permit, 2450 kc, 50 watts.

THE NORTHROP CORP., NC-13760, granted aviation-aircraft license, 3105, 3082.5, 5692.5, 3130, 4688, 5360, 5500, 5555, 6866 kc, 50 watts.

COUNTY OF OKLAHOMA, Okla., granted construction permit, portable-mobile on aircraft, 2450 kc, 50 watts, Emission A3.

February 13, 1935.

WJR, THE GOODWILL STATION, near Wyandotte, Mich., granted construction permit (aviation), 229.2 kc, 30 watts.

CITY OF QUINCY, Mass., granted construction permit (general experimental), portable-mobile, 40,100 kc, 4.5 watts.

UNITED AIR SERVICE, Ltd., granted construction permit, 5 applications, mobile (near Los Angeles), 38,600, 41,000 kc, 5 watts.

INTERNATIONAL STACEY CORP., near Columbus, Ohio, granted construction permit, experimental and special experimental service.

MACKAY RADIO AND TELEGRAPH CO., Inc., Brentwood, N. Y., granted license to cover construction permit, 6927.5 kc, 50 kw.

CARTER COUNTY, Tenn., Elizabethton, Tenn., granted construction permit, police service, 2474 kc, 100 watts.

UNIVERSITY OF CHICAGO, Dept. of Physics, granted general experimental license, free balloon, 12,862.5, 17,310 kc, 5 watts.

AERONAUTICAL RADIO, Inc., Pendleton, Ore., granted construction permit, 278 kc, 15 watts.

PAN AMERICAN AIRWAYS, Inc., NC-14258, granted temporary authority to operate aircraft radio station aboard plane on Orange Chain frequencies for ferry flight from Burbank, Calif., to Havana, Cuba, pending receipt and action on formal application.

Telephone Division

January 10, 1935.

BELL TEL. LABS. granted special temporary authority for special experimental station (portable-mobile) on frequency 2110 kc, 50 watts, to communicate with station W1XY.

February 7, 1935.

PACIFIC TEL. AND TEL. CO., granted license for period ending June 1, 1935, portable-mobile equipment (use on boats and trucks in 11th, 12th and 14th Radio Districts), 2398 kc, 50 watts.

VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

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

MEMORIAL SERVICE TO ERNEST E. DAILEY, U.S.N.

A FIFTEEN MINUTE memorial broadcast, dedicated to the memory of Ernest Edwin Dailey, U. S. Navy, who lost his life while endeavoring to direct rescue ships toward the United States Dirigible *Macon*, on which he was chief radioman, was held over the National Broadcasting Company's blue network, from coast to coast, at five p.m., February 18, 1935.

After the announcement, a requiem "Under the Wide and Starry Sky" by Robert Louis Stevenson, was sung by Miss Alma Kitchell. Immediately following this, a eulogy to the departed operator was delivered by Mr. George H. Clark, President of the Veteran Wireless Operators Association, against a background of music from a twelve-piece stringed orchestra directed by Mr. Joseph Littau. Mr. Clark said:

"Friends, listening in the security of your own homes, let me paint a picture to you of drama in the skies. . . . The huge, silver-colored United States Dirigible *Macon*, pride of the Navy and Queen of the air, has completed her scouting duties with the Pacific Fleet and is returning to her base. . . . Some strange accident, as yet unexplained, happens to her, and control is lost. . . . Floating along peacefully one moment, the next she slants sharply into the higher skies, and then begins to slide back into the ocean. . . . The Commanding Officer makes a hurried survey and sees that disaster is inevitable. . . . The radio operator, in his tiny compartment at the bow of the huge structure, receives instructions to call for help, and he at once does so. . . . The dread signal of S O S fills the air. . . . Every ship of the United States Navy maneuvering in the Pacific hears it. . . . The entire crew is ordered to abandon ship, but the radio chief stays at his post. . . . His last spoken words are "I'll stay here to send out direction signals' . . . The crew, with one exception, has gathered at the windows of the control room, ready to leap into the ocean as the ship nears it, or has gained the momentary safety of the upper fabric, there to await the assistance which they know is coming. . . . The now helpless hulk strikes, stern first, its bow high in the air. . . . Communication is now no longer possible, and so the operator at last abandons his post and hastens to an observation window. . . . Apparently no rope is available on which he can slide to safety, and so he dives from that dizzy height. . . . Some say the bow was over one hundred feet in the air at the time, higher than a twelve story building. . . . He apparently does not control his dive sufficiently, strikes on his back, and is seen no more. . . . Ships scout the water for hours; all of the survivors are recovered; but Ernest Edwin Dailey, radioman first class, United States Navy, is not among them, nor is his body found. . . . Another hero of the radio key has gone to join his brother immortals.

"Friends, listeners, there are many brave men and women in this world. . . . Oftentimes, they are long unrecognized, until it happens that someone who has seemed only ordinary in his everyday tasks develops heroism when necessity comes. . . . Radio operators are not men set aside by their fellows; they are just ordinary folk. . . . But the very nature of their calling makes for a special sacrifice when some disaster occurs. . . . The passengers may all leave the ship; the engineers may desert their engines when there is no further need for them: but the operator must stay until the very last moment. . . . He must not only send the call for help, the S O S; he must continue to speak with the vessels which answer him. . . . He must give them more and more detailed account of his position: he must, where possible, aid in obtaining by the radio compass the exact point on the sea where lifeboats will be found. . . . Thus it is often that the radio operator, immersed in his duty, stays too long, and forfeits his life for the safety of others. . . . Thus it was with radioman Ernest Edwin Dailey of the United States Navy..

"No better picture of the esteem in which radioman Dailey was held by his brother officers, or of their appreciation of his great deed, can be given than is written in this paragraph appearing in a press report of the disaster. . . .

> "Dailey's calmness and courage in sticking to his key constitute another incident of the unflagging devotion to duty long a heritage of seagoing radio men. It was an example of duty well done in accordance with the highest traditions of Naval service.'

"There is a monument in Battery Park, at the lower end of New York City, dedicated to radio operators who have thus given their lives to their duty. . . . This monument is jointly administered by the Radio Corporation of America, which founded it, and the Veteran Wireless Operators Association, a group of old-time operators, which attends to its upkeep. . . . The name of Ernest Edwin Dailey will be placed on this monument. . . . In addition, a bronze medal of remembrance, given by the Veteran Wireless Operators, his associates, will be sent to his widow, Mrs. Lucille Margaret Dailey, at fifty-five South Sixth Street, San Jose, California.

"A message outlining this award and this broadcast has been sent to the widow and to the relatives of this heroic lad. . . . Their words of reply will be read to you by the Secretary of the Association, Mr. William McGonigle."

Mr. McGonigle spoke as follows:

"The following message, addressed to the Association, was received from radioman Dailey's widow, in Mountain View, California:-

'APPRECIATE YOUR MEMORIAL OF TRIBUTE COMMEMORATING THE SERVICES OF MY BELOVED HUSBAND ERNEST E. DAILEY.

Lucille M. Dailey.'

"His father wired the Association from North Bend, Oregon, as follows:

'ERNEST WAS THE YOUNGEST OF FOUR SONS AND A BOY ANY FATHER MIGHT FEEL PROUD OF. I CANNOT COMPLAIN FOR HIS WAS A RISKY SERVICE AND I HAVE THE SATISFACTION OF REMEMBERING HIM AS A DEVOTED SON AND A SUCCESS. MY GREATEST REMAINING SORROW IS THAT I CANNOT TENDERLY LAY THE BODY AWAY WITH FLOWERS.

George Irving Dailey.'

Mr. Clark then introduced the next speaker:

"The father of all our radiomen is Mr. Edward J. Nally, former president of the Radio Corporation of America, and of the Marconi Wireless Telegraph Company of America, its predecessor. . . . He has seen the radio operator's profession grow from nothing to its present magnitude, and to him all the operators always have been, and still are, his 'boys' . . . To all radiomen listening, who know that they have in him a true friend; to all others, with whom he has an immediate sympathy for their troubles, I am glad to present Mr. Edward J. Nally."

Mr. Nally's speech ran as follows:

"It is always a very sad moment to me when I hear once more of the passing away of some brave wireless operator who gave his life in his devotion to duty.

"I have indeed seen the growth of wireless operators from a mere few in the early days to the many who sail the sea and the air today. To me they are all, in truth and feeling, 'my boys.'

"Having served more than sixty years of close association with the workers in the various fields of electrical communication,—the telegraph, telephone, cable, and wireless,—I am convinced that they are endowed with a very high quality of intelligence, skill, and daring.

"The history of these great public agencies is replete with many instances and stories of splendid heroism—not only of the pioneers who helped to spread and operate the first lines of the network of communication to remote regions, but those brave men and women who, true to the best traditions of the service, remained at their posts during times of war, pestilence, and disaster.

"The development of wireless with its new duties and demands called for a new class of volunteers. The response was immediate and impressive.

"There followed the formation of groups of young men truly representative of the best of their respective communities. These men after they had completed their training accepted service wherever assigned and cheerfully took up and performed their duties whether their post was on a great ocean liner or the smallest craft to sail the Seven Seas—or on the ships and planes that sail the air overhead.

"Wireless operators have proven themselves to be worthy of the association with their shipmates and have made their own contribution to the long annals of heroism of sea and air.

"There have been no instances of failure to do their duty and numerous are the cases where fulfilment meant to make the supreme sacrifice.

"Such was the case with the man whose

(*Continued on page* 30)

OVER THE TAPE...

NEWS OF THE RADIO, TELEGRAPH AND TELEPHONE INDUSTRIES

ISOLANTITE PLANS FOR EXPANDED BUSINESS

Isolantite, Inc., of Belleville, N. J., manufacturers of ceramic insulators, have acquired the property and buildings of the former Lyons Storage Battery Co., of Belleville. The purchase, which was made on an all-cash basis, was to provide facilities immediately for enlarged business and to permit further expansion which is anticipated.

The transaction included a group of buildings, the largest one being approximately 50 x 200—two stories high. The additional facilities will enable the company to improve its service.

Isolantite, Inc., maintains sales offices in the Woolworth Building, at 233 Broadway, New York City. The company, which has been in business since 1922, has pioneered in the manufacture of specialty and custom-made ceramic insulators. The low electrical loss character of the product mechanical strength and precision of dimension, made it suited to radio work and it is in this field that it has gained its greatest distinction. Some of the radio products of the company are inductance forms, resistor tubes, antenna insulators, vacuum-tube sockets, bases and internal spacers, condenser insulators and concentric transmission lines. Other products are oil burner ignition insulators and complete assemblies, chemical valves, nozzles and tower packing.

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E. S. COLLING TRANSFERRED

Ernest S. Colling for the last two years with the National Broadcasting Company, was transferred to the Radio Corporation of America, RCA Building, Radio City. He is now in the Department of Information of that company, under Frank Mullen.

Mr. Colling formerly was a feature writer in the NBC press department and was heard on the air frequently in broadcasts of special events such as the *Morro Castle* disaster, the Fleet review, and as an interviewer. Before coming to NBC he was in theatre, movie and newspaper work here and abroad.

The RCA Department of Information is the central source of news of developments within the RCA companies. The new member of the department had technical training at Lehigh University and has had many years' experience in advertising, sales-promotion and publicity work.

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ELECTRONICS AND ELECTRON TUBES

Three publications on theoretical and experimental electronics and electron-tube applications, originally published for educational institutions have now been made available to the public, at a nominal charge, by General Electric Company, Schenectady, N. Y.

"Electronics and Electron Tubes" was written by E. D. McArthur of the G-E vacuum tube engineering department in response to requests from schools and colleges for a publication giving, in easily understood language, the fundamentals underlying the vacuum tube, and including simple experiments to illustrate these fundamentals. References are included which enable the reader to delve more extensively into many subjects treated in the 48-page booklet. Designated by General Electric as publication GET-568-A, it is priced at 25 cents.

The other two publications, GET-566 and GET-620, deal with laboratory experiments on electron-tube theory and on electron-tube applications, respectively. The former is intended as an experimental supplement to McArthur's "Electronics and Electron Tubes," while the latter is a laboratory manual covering a number of fundamental electron-tube applications. The two booklets are obtainable as a combination priced at 25 cents. Address: Educational Section, General Electric Company, Schenectady, N. Y.

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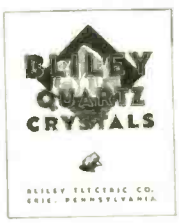
BLILEY ELECTRIC BULLETIN

The Bliley Electric Company has recently issued an eight-page bulletin describing its complete line of quartz crystals for transmitters, single-signal filters and standard-frequency bars.

A separte section devoted to special crystals between 7 kc's and 15 mc's is of special interest to the radio engineer and



experimenter. Copies of this bulletin may be secured by writing to the Bliley Electric Company, 201 Union Station Building, Erie, Penna.

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COMMUNICATION MEN DINE

RCA Communications, Western Union, and Postal Telegraph companies were represented at a dinner of executives and engineers held at the Hotel Lafayette, New York, on the evening of February 23. The purpose of the dinner was to plan the organization of a club of communication men local to New York. About one-half of those present were ex-telegraph officials and engineers now engaged in other lines of work. The objects of the club will be social. At this initial get-together dinner Donald McNicol acted as toastmaster.

•

COLLINS MOVES TO SALMON TOWER

The Collins Radio Company, of Cedar Rapids, Iowa, which equipped the second Byrd Antarctic Expedition with all its radio communication and transmission sets, have moved their Eastern offices to the Salmon Tower, 11 West 42nd Street, New York City. Morton B. Kahn, who assisted in the installation of the Collins equipment on the Byrd expedition, is Eastern Manager of the company.

Models of the various types of short-wave transmission and receiving sets will be on display in the new offices of the company in the Salmon Tower.

•

NEW NAME

The Eastern Coil Company of 56 Christopher Avenue, Brooklyn, New York, manufacturers of microphone stands and quartz-crystal holders, announces that it is now known as Eastern Mike-Stand Company. Due to the fact that the manufacture of microphone stands is the greater part of the business, it is felt that the latter name is more appropriate.

For convenience of New York City customers a show room has been opened at 135 Liberty Street, Room 301, where the complete line of stands is on display.

A new catalog sheet, describing stands for use with carbon, crystal, velocity, dynamic and condenser microphones, is available. Address all communications to Brooklyn.

•

WARD LEONARD BULLETINS

The Ward Leonard Electric Co., Mount Vernon, New York, have recently released bulletins on Vitrohm Plaque Resistors, DC Magnetic Contactors, and AC Magnetic Contactors. These bulletins give very complete information concerning these various units, and their numbers are 22, 1901, and 4401, respectively.

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TRANSFORMER COMPONENTS

The United Transformer Corporation, 264-266 Canal Street, New York City, New York, have available a catalog on Transformer Components. This 24-page catalog contains a great amount of technical data, circuit diagrams and the like. Also included is a very useful chart for determining values of L, C and R at different frequencies.

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I. T. & T. ASSOCIATES SHOW GAIN

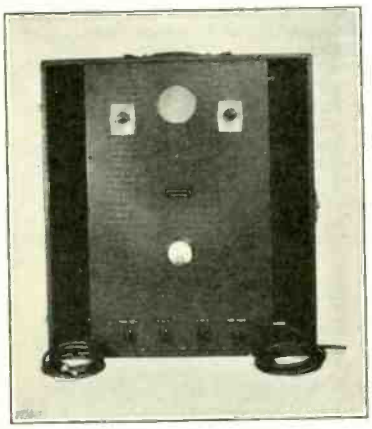
The improvement in business conditions in various parts of the world during 1934 was reflected in a net gain of 50,673 telephones by associated companies of the International Telephone and Telegraph Corporation. All telephone companies in the I. T. & T. system had gains for the year. Figures for January, 1935, show that the increase is continuing.

The National Telephone Company of Spain had a net gain of 22,537 telephones last year. Argentina accounted for approximately 10,000. The telephone system of Rumania and the Shanghai Telephone Company gained approximately 5,000 each. The telephone systems of Cuba and Puerto Rico and the other I. T. & T. telephone companies in Mexico, Chile, Peru and southern Brazil all contributed increases. Cuba, which had lost heavily in telephones for several years prior to 1934, showed a slight net gain for the year, and continued to advance during January.

RADIOTONE RECORDING UNITS

The Radiotone Recording Company, Hollywood, Calif., have recently developed a new instantaneous recording unit designed to meet requirements of broadcast stations and recording studios. This unit the A-78, is shown in one of the accompanying illustrations.

Some of the features incorporated in this unit are: A positive overhead screw-feed mechanism, belt driven; adjustable cutting head carriage allowing for the correct



stylus angle when recording on Acetate; screw feed designed to cut outside in or inside out 96 or 115 lines per inch; counter balanced recording head allowing for the correct needle pressure when recording on Acetate; cutting-head impedance 500 ohms; playback pickup 200 ohms, and a special recording motor operating from 50/60-cycle 110-volt ac line.

As a suitable recording channel for broadcast-station or studio work, the Radiotone Recording Company have designed the A-2 Amplifier, shown, and radiotimer allowing for recording by either microphone or direct radio pickup.

A switching arrangement is incorporated in this unit allowing for radio recording, microphone recording, radio reception,

playback of records or as an audition or public-address system.

In addition for broadcast stations and recording studios requiring suitable 33-⅓ transcription equipment, this company is manufacturing a single and a dual 16", 33-⅓ rpm Recording Chassis.

Another recent development in the instantaneous recording field is the Radiotone Acetate Recording Discs and claims by the manufacturer are that these discs when properly recorded have less surface noise and give comparable quality to the finest commercial pressings.

Further technical information on these recording units may be obtained by writing the Radiotone Recording Company.

RESONANCE CALCULATOR

The Lightning Calculator Co., 8 Henry Street, Bogota, N. J., will soon have available their model LCP Resonance Calculator.

All Lightning Calculators are made up of a number of movable dials mounted on a backboard and provided with a celluloid indicator.

The model LCP has been designed to calculate problems in resonance by simple dial settings and thus eliminates the necessity for the more laborious method of actual calculation. It is provided with the following ranges: Capacity, .001 mmfd to 10 farads; inductance, 1 mh to 1,000 henries; reactance, 1 to 10,000 ohms; and frequency, 1 cycle to 10 megacycles. Each of these ranges are engraved on separate scales and calibrated directly in the values given.

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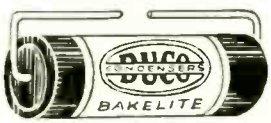
DUCO SELF-HEALING CONDENSERS

The Dumont Electric Co., Inc., 453-455 Broome Street, New York City, has announced its new type Self-Healing Condensers. These units are said to have had their life extended to nearly five times the



life of the usual condenser. Among other features is low cost and compact size, with a guarantee for two years, it is further stated.

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MOBILE OR FIXED RADIOPHONE

The Radio Transceiver Laboratories, 86-27 115th St., Richmond Hill, New York, have available a complete ultra-high-frequency transmitter and receiver in a single 7½ x 5 x 8-inch cabinet, which is shown in the accompanying illustration.

This unit, which is known as the TR-53-6A6, contains a transmitter employing a push-pull unity coupled oscillator, Class B modulator and Class A driver. Twin triodes are used exclusively in the transmitter; type 53 for ac operation and type 6A6 for mobile use. The carrier power is 10 watts and modulation is said to be complete. Provision for a single-button microphone is incorporated.

The receiver uses three tubes. A 56 or 76 is employed as a super-regenerative detector. Another is used as a first a-f stage and a 2A5 or 42 pentode feeds the 5-inch dynamic speaker. An r-f stage with 57 or 6D6 is incorporated when radiation must be eliminated, but some sensitivity is sacrificed. The use of the r-f stage is recommended in areas of strong signals only. Power supplies operated from ac are available complete with cables. Special dynamotors operating from a 6-volt source and delivering 250 volts at 175 ma are made for this organization.

Loudspeaker reception up to five miles is customary in a car using a TR-53-6A6 and working with another TR-53-6A6 at a fixed station. The car antenna is a 4- to 6-foot aluminum rod fed by twisted wire acble. Distances from 25 to 100 miles may be covered with high or directional antennas. Bulletins on the above will be supplied on request.

•

AC LIGHTING PLANTS

D. W. Onan and Sons, 43 to 51 Royalston Ave., Minneapolis, Minn., has announced its 1935 line of individual lighting plants for farms or other places where central-station service is not available. One

of these units is shown in the accompanying illustration.

These Plants, offered in 350, 660, 1,000 and 2,000 watts capacity, provide 110-volt, 60-cycle, alternating current, which will operate any standard appliance that would be used on city-line service up to the capacity of the generator. Each is of unit construction with generator mounted directly at the crank case of the engine. The engines are four-cycle, air-cooled, using six-volt ignition, float-feed carburetor, mechanical governor, six-volt starting motor and storage battery with remote control for self-starting. Gasoline and oil-driven models are available.

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V. W. O. A. NEWS

(*Continued from page 26*)

memory I honor today—Ernest Edwin Dailey, who died that others might live. True to the finest traditions of the Navy, he remained at his post, knowing that he was sacrificing his slender chance for being rescued. To Ernest Edwin Dailey's memory, I add my tribute to that of the Veteran Operators. To his bereaved wife, his father, and others of his family, my heartfelt sympathy goes out, but with a feeling of pride that once more has duty called to one of our great fraternity, and once more it was met bravely."

Mr. Nally's speech was followed by another solo by Miss Kitchell, "Crossing the Bar". Mr. Clark then concluded the eulogy:

"With these tributes . . . with a bronze tablet added to the others now placed on the monument to radio heroes . . . with a medal of remembrance to his bereaved wife . . . and with his memory aways before us . . . we, his fellow operators, say farewell to Ernest Edwin Dailey, radioman first class, United States Navy."

Taps were then sounded by the bugler, and as the last slow notes died away, the announcer completed the program.

INDEX TO ADVERTISERS

Yes!

Subscribers may date back their subscriptions to include the first number (October) of Communication and Broadcast Engineering.

A limited number of extra copies have been printed so that files may be kept complete.

The subscription rate is $3.00 yearly. Foreign and Canada $4.00 yearly.

Bryan Davis Publishing Co., Inc.

19 East 47th Street

New York City

WQDM - CKCP - WMAZ - PITX - KGVO - W...

"Bruno" RV-3 VELOCITY-MICROPHONE

wins new friends

with FAITHFUL PERFORMANCE

...WDBO - WLWL - KGGM - WDZ - WINS - WMBQ...

PAT. PEND.

For complete information ask for Bulletin Series "CB"

Radio Station WQDM says:

"Your RV-3 velocity microphones are the best investments we have as yet made in our speech equipment. Compared to our other microphones, ranging from $100.00 to $200.00 in quality the RV-3 surpasses them all.

"Hoping for your continued success."

(Signed) E. J. REGAN, Chief Engineer.

Radio Station WLWL says:

"Your RV-3 Microphones are used in the studio as well as in the Paulist Church without regard for temperatures encountered while moving from studio to church.

"It is our intention to replace all our other microphones with RV-3's to make each studio channel a high fidelity set-up."

(Signed) JOSEPH F. DEPPE, Chief Engineer

Radio Station KGGM says:

"It pleases us to advise that the performance of the RV-3 is superior to that of any microphone that we have ever used. It is our plan to equip our station exclusively with Bruno Microphones."

(Signed) J. H. SPECK, Mgr.

Radio Station WMBQ says:

"We have been using the Bruno RV-3 Microphones along with units at more than twice their price, and we are very well pleased with the results.

"We highly recommend the Bruno RV-3 Microphones as truly efficient in every respect."

(Signed) PAUL J. GOLLHOFER,
Mgr. & Chief Engineer

The above reports are typical of the many we have received from broadcasting stations, recording studios, public address systems, etc. All are enthusiastic over the fine performance and remarkable fidelity of the RV-3.

These reports lead us to believe that all claims made by Bruno for the characteristics of the RV-3 are highly conservative. It also means that you can absolutely depend on the RV-3 to meet or better the following guaranteed specifications:

Frequency response of 30 to 14,000 C.P.S.

Output level—69 db. (0 level = 6 m.w)

High gain; highly directional; low feed back.

So accurate are the RV-3's characteristics, that many industrial organizations use them not only as a microphone but also for the calibration of standards.

The Model RV-3 features magnets of 36-42% Cobalt; pole shoes of specially treated ARMCO Alloy; ribbon of special Duralloy, specially treated and hand beaten to .0001 in.

BRUNO LABORATORIES

20-22 WEST 22nd STREET NEW YORK CITY