Communication and Broadcast Engineering

VOL. 7 NO. 2

- Broadcast Transmission
- Recording
- Sound Projection
- Television
- Facsimile
- Aeronautical Radio
- Police Radio
- Marine Radio
- Carrier Transmission
- Beam Transmission
- Radio Telegraphy
- Radio Telephony
- Wire and Cable Telegraphy
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COMMUNICATION & BROADCAST ENGINEERING

FOR FEBRUARY, 1937

TELEGRAPH POWER PLANTS

By C. T. HORTON

Engineering Department
WESTERN UNION TELEGRAPH COMPANY

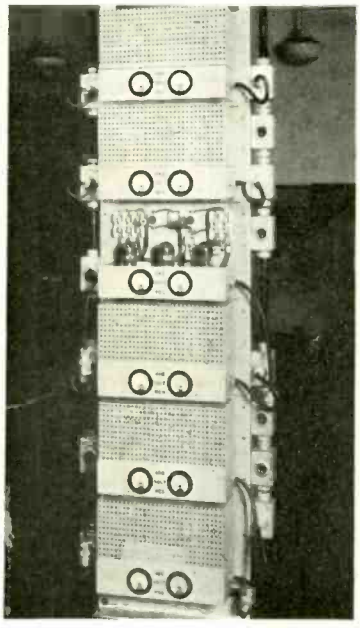
TELEGRAPH POWER PLANTS may be divided into two general classifications—regular power and reserve power. Regular power covers the various types of power which telegraph equipment has grown to require. This power is obtained from commercial power supplies which are available throughout the country. Emergency power plants cover the equipment required for providing telegraph power without interruption in the event of failure of commercial power supplies.

TELEGRAPH POWER REQUIREMENTS

Telegraph equipment requires for its operation not only power for sending signals over the lines but also power for the operation of the local circuits and local equipment in the offices at the ends of the lines. Power for sending signals over the lines, or line potential as it is commonly called, consists of both positive and negative polarities and is required at various voltages depending upon the type of equipment and the condition of the lines. The usual line-potential requirements are for 160 volts and for 240 volts; and in some offices there is need for 320 volts for operation over long lines and in wet weather. These potentials, it will be noted, are multiples of 80 volts and have their origin in the 80-volt banks of batteries which originally supplied them.

In the early days when power for local circuits was obtained from batteries, it was economical to design the local equipment for operation on as low a voltage or as few a number of cells as possible. With the substitution of generators for batteries and with the growth of the equipment and the number of local circuits in the offices it became more economical to use higher and higher voltages for local power until today the standard local voltage is 115 volts. The standardization of 115 volts has been due in part to the fact that many of the original commercial power supplies were 110 or 115 volts d-c and it was possible to use this power, without any conversion equipment, directly on the local circuits and to some extent also as main-line power. The 115-volt potential has also permitted the use of lamps and motors with standard voltage ratings. With the standardization of 115 volts for locals and the speeding up of circuits, the use of 80 volts has been gradually eliminated and is to be found now in only the older or storage-battery offices.

FIG. 2. GROUP OF SIX RECTIFIERS WHICH TAKE THE PLACE OF MOTOR-GENERATORS SIMILAR TO THOSE SHOWN IN FIG. 1.



SOURCES OF POWER

At present there are 30 Western Union central offices which are served with 115 volts direct-current power supply and in which the locals are operated directly from this service. To obtain the main-line potentials it has been usual to provide booster motor-generators and connect them in series with the 115-volt commercial supply where one side or the neutral is grounded. A 45-volt motor-generator in series with the 115-volt service furnishes 160 volts and a 125-volt motor-generator in series furnishes 240 volts. In this way there is a minimum of loss of power in conversion and therefore from the point of view of telegraph power alone, direct-current services have been preferred to those of alternating current, all other things being equal. Unfortunately, direct current, as a commercial power supply, cannot be transmitted and distributed as economically as alternating current, with the result that the direct-current services are gradually being replaced by alternating current. It is

quite probable that all new central offices in the future will be operated from a-c commercial power and that eventually all of the 30 offices now operating on direct current will be converted to alternating current.

Although there is a loss of power whenever alternating current must be changed into direct current, alternating current does have its advantages when compared to direct current as a commercial service. As a rule there are fewer serious interruptions, due to the ease of dispatching loads; and especially in the recently-installed secondary-network systems, the voltage regulation is very close. In these secondary-network systems all of the secondaries of the distribution transformers are tied together so that it is possible to put one or more of the transformers completely out of service without materially affecting the voltage of the system.

In the past there have been a great many types of a-c services, differing in number of phases, frequency and voltage; but recently there has been a tendency to standardize on the 3-phase, 4-wire system with 3-phase, 208-volt power available for motors while single-phase, 3-wire, 120-volt power is available for lighting circuits, all from the same secondary distribution system.

CONVERSION EQUIPMENT

There are at the present time three general ways in which commercial power is converted into direct-current potentials for telegraph purposes. The first is by means of storage batteries, charged usually by means of rectifiers or by motor-generators, the second is by motor-generators alone and the third is by rectifiers alone.

Comparatively speaking, storage batteries have been found to be a very expensive source of power. Their first cost is high, they take up an excessive amount of space and the maintenance costs both in time and material are well nigh prohibitive. But in spite of this there are times when no other type of equipment can satisfactorily take their place. In the cable service storage batteries seem to be almost indispensable and in some of those offices where power failures are frequent or where 24-hour power service is not available they are thoroughly essential.

The functions of a good battery for telegraph power service are first to be able to deliver a constant potential over an extended period of time, from a minimum of 24 hours to a maximum of about a week; and second, to be capable of taking a quick charge and repeat the performance consistently for as many cycles of operation as may be commensurate with its price and relative cost of maintenance. Lead-plate batteries have been found to be most suitable for this service.

Among the lead batteries there is a choice between the Plante types and the pasted-plate types. Of the two, the pasted-plate types (as used in automobile batteries) are much the cheaper but they do not have the ability to perform for as many cycles as the Plante types. An average figure for the life of pasted-plate batteries is 200 cycles, which means that depending upon the strenuousness of the service the battery can be expected to last only from two to at best five years. The Plante plates which are "formed" plates, may be expected to outlive three sets of pasted plates in equivalent service.

A battery with a modified or improved form of Plante plates is being made and is called the chloride accumulator. This battery contains button positives and usually box negatives, though sometimes ordinary pasted negative plates can be used to advantage with the button positives. These chloride accumulators are the batteries to be found in all Western Union cable stations and the ones which have given the most satisfaction in continual charge and discharge service, or cycling. The button positive plate is one in which the positive material or lead peroxide is contained in little buttons of rolled up corrugated ribbons which are pressed tightly into holes in lead plates. It is thus possible to use large quantities of the positive material in each plate and the difficulty ordinarily encountered in the pure peroxide or Plante plates with growing or warping is eliminated by the fact that the holding plates are made of an alloy of lead with a comparatively small surface and are therefore not subject to growth.

The more usual type of power plant to be encountered in the average telegraph office is the motor-generator plant. Beginning in 1888 a start was made toward replacing the then existing gravity-cell plants with dynamos, but due to the general lack of commercial power and the general increase in power requirements, it was not until 1903 that the motor-generators attained an ascendency over the gravity batteries. Increased requirements for power since that time have resulted in a huge growth in the number of motor-generator plants.

In recent years the designs of most of the equipment which comprises a motor-generator plant were improved and standardized and the costs reduced wherever possible. Benches on which the dynamos are mounted were changed from concrete to steel with slate tops and finally to all steel; panel material was changed from slate to asbestos composition; metering, switching and control equipment were made as nearly fool-proof as possible, and by cooperating with the manufacturers the cost of motor-generators was reduced while their efficiency and other operating characteristics were improved. A typical motor-generator plant is shown in Fig. 1. To fill a need in the smaller offices, a so-called wall-type bench and panel was designed which permits a group of 3 motor-generators up to ¾ kw size to be mounted one over the other on a steel framework with a control panel at the top.

Rectifiers, the third form of conversion equipment, have been fully covered in other articles. Rectifiers are now used in most new installations. Fig. 2 shows a rack-mounted installation of mercury-vapor rectifiers. Such an installation serves the same purpose as the motor-generator plant in Fig. 1.

The subject of emergency power is

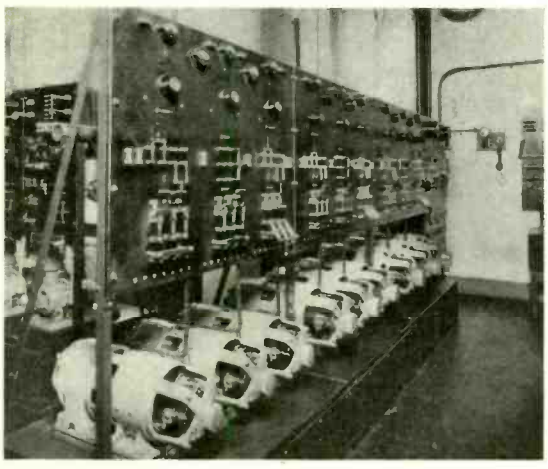


FIG. 1. A GROUP OF NINE MOTOR-GENERATORS FOR SUPPLYING 110, 160 AND 240 VOLTS, POSITIVE AND NEGATIVE.

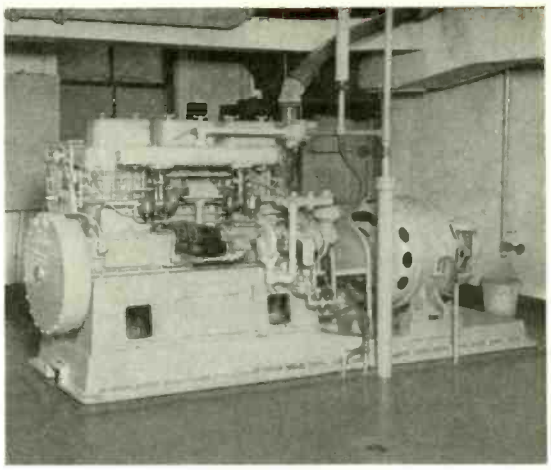
somewhat removed from that of telegraph power, for it has very little to do with the actual telegraph potentials. It has only to do with the assurance of continuity of these telegraph potentials. The need for emergency power is largely a matter of policy. The commercial department of the Western Union has pictured the company to the public as a utility always reliable and always available regardless of the failure of other utilities. To maintain such a standard of service the traffic department insists upon and requires an infallible power supply. The average commercial power service is far from being infallible, especially during times of storm and disaster. Emergency power was required and was used during the Miami hurricane several years ago. It was required and used in McCook, Nebraska, during the floods along the Burlington Railroad. It was required and used in Helena, Montana, at the time of the severe earthquake. Almost every early morning wire report carries the brief story of a power failure somewhere, and usually there is mentioned the length of time the office was carried by the emergency source of power. In addition to these are many more failures that are never recorded in the early morning wire reports.

Emergency plants may be divided into three classes: first, those which consist of independent power service or separate feeders; second, engine-generators on the premises; third, storage batteries on the premises.

Separate feeders as emergency power supply were used quite extensively prior to 1920. In many cases feeders were installed to separate generating stations such as hotel plants, the plants in nearby office buildings and occasionally feeders were obtained from competing power companies. In one case reserve power was obtained from a laundry plant. But the merging of competing power companies and the taking over of many private plants by the power companies so frequently destroyed the value of reserve feeders as an emergency supply that today any proposal of a reserve feeder would be subject to severe criticism and investigation before acceptance as a real emergency power supply. There are now only about 18 offices with reserve feeders as the sole source of emergency power.

Because of the questionable future of reserve feeders and because they all are subject to the same type of failure as the regular supply, i.e., strikes, street explosions, fire, flood and the lack of fuel and water, the value of having a source of power on the premises has been recognized. Accordingly, a program was entered upon during and after the war which has resulted in the installation of about 113 emergency engine-generator plants and 5 large purely emergency battery plants.

FIG. 3. A FORTY-KILOWATT EMERGENCY ENGINE-GENERATOR UNIT.



No engines were on the market that would meet telegraph requirements, especially as to operating characteristics and necessary accessory equipment. Marine or industrial engines had to be adapted and modified in many ways before they could be called suitable for telegraph service. First of all they must be thoroughly safe from the point of view of both physical and fire hazards; they must be capable of being started quickly by the average telegraph man and they must be able to generate power with sufficiently close speed and voltage regulation to operate delicately-adjusted high-speed circuits. Units to meet these requirements have necessarily been custom built and each one has been closely supervised from the time of its planning to its final tests at the factory. Through the engineers' continuous work in cooperation with the engine manufacturers over a period of 10 or 12 years, the engines have been developed to a high degree of reliability and safety. A typical emergency unit is shown in Fig. 3.

Among the modifications and changes which have had to be made were: the enclosure of all moving parts to prevent any possibility of injury to operators, the selection and occasionally the design of a governing arrangement with sufficient control to keep the speed of the engine constant at all loads, the design of a safety device to prevent runaway speeds in the event of failure of the governor, the arrangement of a fuel-supply system on the engine sufficiently fool-proof to prevent any possibility of a fire and to permit the substitution of gasoline for kerosene as a fuel, the mounting of complete units on springs to prevent the transmission of vibration to the floors and other parts of the building, and the automatic regulation of cooling water through the cylinder water jackets.

The storage of fuel and the method of supplying it to the engine have been important factors in the design and installation of a great many emergency plants. In San Francisco the refusal of the City Fire Marshal to allow more than fifty gallons of gasoline to be stored in any one place in the downtown area led to the installation of a full diesel engine for reserve power for that office. In New Orleans, San Antonio and Tulsa, in order to allow the engines to be installed on upper floors of the buildings, special pumping systems were laid out to supply gasoline in sufficient quantities to operate the engines and in such a manner as not to make or increase any fire hazards. The system includes a motor-driven pump in a fireproof room on the first floor and a small concrete-enclosed tank located near the engines and provided with an overflow back to the main storage tanks.

This system of gasoline supply is rather expensive and in order to avoid it engines are therefore usually installed either on the first floor or in the basement where the pumps on the engines can draw fuel directly from the main storage tanks. Basement installations are frequently complicated by the necessity for ventilation, for gasoline vapors might easily collect in dangerous amounts in an engine room if any small gasoline leaks should develop unnoticed in the supply system of the engine. In order to keep the amount of fuel in an engine room at a minimum only about a pint is stored in a small tank on the engine. The carburetors are fed by gravity from this tank and it is kept filled by the engine pumps.

Storage facilities for large quantities of gasoline have been designed, taking every possible safety precaution, including the complete enclosure of the tank in concrete, the enclosure of all underfloor pipes in concrete, the provision of distant-reading tank gauges, and the venting of the tank at a point well in the clear of any building openings. All of these provisions were more rigid than any underwriter's or municipal regulations. There has never been a case of a fire in connection with any of these gasoline storage systems and with the exception of the San Francisco instance it has always been possible to obtain the approval of all authorities for as much gasoline as was required.

An effort was made about a year ago to take advantage of the higher speeds and the lower costs of the automotive production engines which have been developed recently. A unit has been built by a manufacturer in Detroit in accordance with Western Union engineers' suggestions and is now available to our offices. It consists of an eight-cylinder Ford truck engine, direct connected through a flexible coupling to a 25-kva alternator and its cost is less than half that of a standard emergency unit of the same rating. Fig. 4 shows one of these units.

Storage batteries constitute the third general type of emergency power plant. They serve a purpose which no other

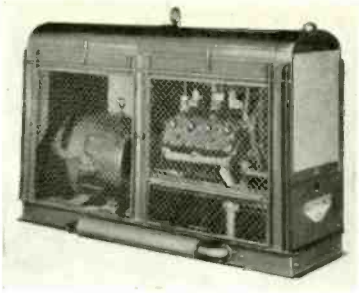


FIG. 4. A 25-KW. HIGH-SPEED PORTABLE EMERGENCY ENGINE-GENERATOR UNIT.

type of emergency power can possibly serve. With storage batteries and a good automatic switch it is possible to substitute emergency for regular power in less than a twentieth of a second. Several engine manufacturers have developed automatic engine-starting equipment to such a degree that engines can now be placed on the line automatically from cold start in less than 30 seconds. This speed of starting, however, is still insufficient since any interruption of much more than a twentieth of a second will cause synchronized telegraph equipment to drop out of step, especially on the faster circuits.

Since reserve storage batteries are required relatively infrequently, their life is practically shelf life and batteries are chosen for this service with more regard to their capacity to deliver high current than to the possible number of cycles of charge and discharge in the life of the battery. Pasted-plate batteries, similar to those used in automobile starting and ignition work, are therefore perfectly satisfactory for this use.

In view of the fact that almost every office has its own emergency engine-generator unit it has frequently been suggested that the company might in some cases be able to generate its own power more economically than to purchase it. It has been found, however, that in cities where the telegraph loads are of sufficient size to justify generation, the power rates are very low and conversely, where the rates are high the telegraph load is too small.

Another factor is that where a power company installs feeders, metering equipment, etc., which may be used at only infrequent periods, a special rate, much higher than the regular rate, is charged, thus nullifying any saving which might be made. This rate is intended to apply to those consumers who generate their own power regularly or obtain it regularly from some other source, using the commercial power only in emergencies. It has therefore been found advisable in general to depend upon commercial power companies rather than attempt to generate power on the premises.

A RADIO-FREQUENCY OUTPUT METER

By P. M. HONNELL

THE RADIO-FREQUENCY output power meter is an instrument which reads directly the amount of power a radio-transmitter is capable of delivering. Essentially, it consists of a resistance load, indicating meter and variable condenser all connected in series similar to the usual artificial antenna, but with the added convenience of a direct-reading scale. This feature is of considerable value for production tests on small radio-transmitters, particularly when conducted by technically unskilled personnel, as well as for routine testing and experimental work.

The complete power meter, illustrated in Fig. 1, is contained in an aluminum cabinet 5 inches by 7 inches by 4 inches, the indicating meter, load resistance and variable condenser all being mounted on the front panel. The actual connections, shown in Fig. 2, are such as to minimize the effects of stray capacitances on the accuracy of the meter, and to that end the tap-switch of small physical dimensions on which the resistance-wire load is soldered for mechanical

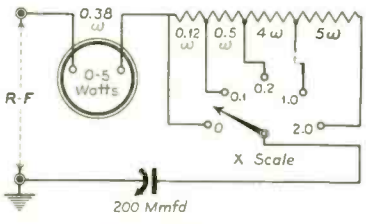


FIG. 2. CIRCUIT DIAGRAM FOR R-F METER.

FIG. 1. THE R-F OUTPUT METER.

support as well as electrical contact is of the low-loss type used for band-changing in high-frequency receivers.

The direct-reading indicator — the heart of the instrument—is a 0-1 Weston Model 507 thermoammeter with its original scale replaced with one calibrated linearly from 0-5 and stamped "WATTS." The linear power scale arises from the fact that the deflection of the thermoammeter is proportional to the square of the current, and that the power dissipated in the load resistance is also proportional to the square of the current; thus the meter deflection is linearly proportional to the power dissipated in the load resistance. The actual values of the resistance load for each multiplying factor (shown in Fig. 2) were chosen such that the maximum power capacity is 10 watts, although resistances up to 50 ohms with correspondingly increased power-dissipating capability are feasible. The resistance load should be wound with Manganin or similar resistance wire of

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THE ACORN TUBE ON THE REMOTE JOB

By W. E. STEWART

Chief Engineer

WOI

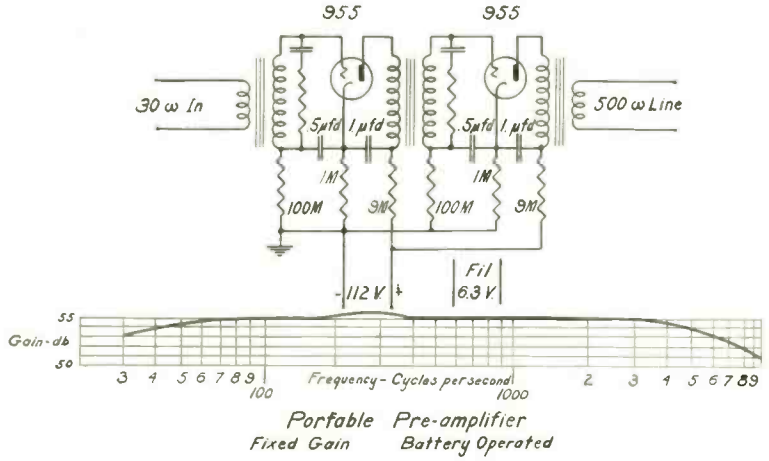


FIG. 1. SCHEMATIC DIAGRAM OF PORTABLE PREAMPLIFIER USING 955 TUBES.

A STUDY of the 955 (acorn triode) reveals that a number of its characteristics make it desirable for use in portable preamplifiers for remote-control work. Most important of these characteristics is the reasonably low plate resistance combined with a comparatively high amplification factor. The low filament current makes the use of light A batteries possible, and the small size and weight of the tube aids in compactness and portability. The heater cathode simplifies circuits somewhat, also, and makes a-c operation of the filaments possible. A comparison of the 955 and other tubes suitable for low-level portable amplifiers convinced us that it should at least be tried.

There were on our shelves three comparatively old but good transformers which had the right combination of windings to make the circuit shown in Fig. 1. These were built into the amplifier pictured open in Fig. 2. Five 22½-volt batteries and eight standard flashlight cells furnish the power for this amplifier. It has a gain of about 55 decibels and weighs 18 pounds including the batteries. Its small size and weight made it immediately popular wherever a fixed-gain, one-channel remote was possible. It has been used an average of about once a day (about three-quarters of an hour each) for four months.

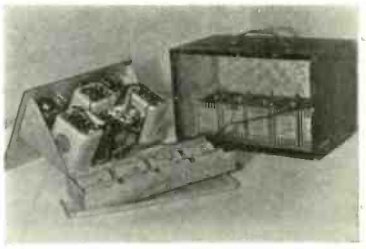


FIG. 2. AN OPEN VIEW OF THE AMPLIFIER OF FIG. 1.

Test-tip sockets were installed on the front of the amplifier and connected to the batteries. The battery voltages are checked each time before the amplifier leaves the equipment room. It has been discovered that the filament batteries can be used until the voltage drops to about five volts, below which distortion

(*Continued on page* 19)

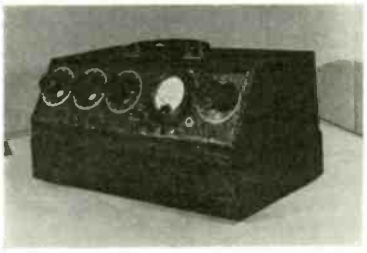
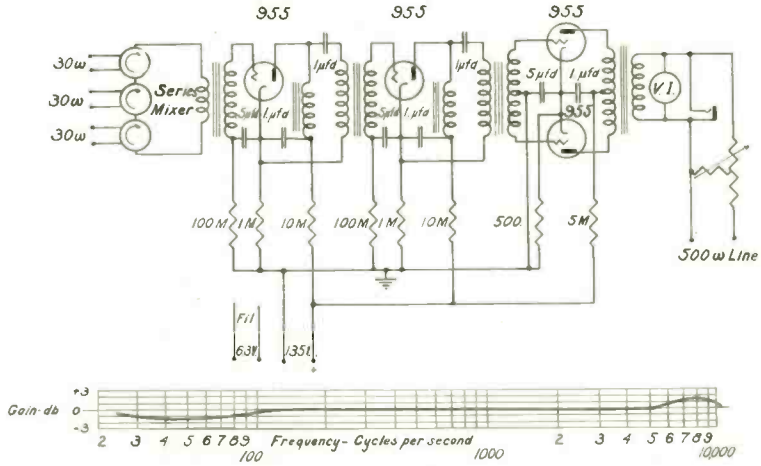


FIG. 4. THE THREE-STAGE AMPLIFIER DESCRIBED IN THE ACCOMPANYING TEXT.

FIG. 5. AN OPEN VIEW OF THE AMPLIFIER SHOWN IN FIG. 4.

FIG. 3. A THREE-STAGE AMPLIFIER USING MIDGET TRANSFORMERS AND 955 TUBES.



REVERBERATION-TIME CALCULATIONS

By A. JAMES EBEL

Transmission Engineer

WMT

THE ACOUSTIC PROPERTIES of various types of rooms is an important element of the broadcasting problem. On the one hand the transmission from a studio must contain a certain amount of reverberant energy in order that it will sound natural to the listener, while at the same time the room must be such that the sounds generated within it are natural to the performer. The necessary compromise can only be made after the room has been studied quantitatively.

The most important element of the problem is the determination of the reverberation time of the room. This is defined as the time required for a sound to decrease to one millionth of its original intensity after the source has been stopped. This is a drop of 60 db.

The correlation of the reverberation time of a room with the character of its absorbing surfaces was pioneered by W. C. Sabine[1] who established the empirical formula

$$T = 0.049V/aS$$

where T = reverberation time, V = volume of room, S = area of exposed surface, a = average coefficient of absorption.

This formula is surprisingly accurate considering the conditions under which it was established. Later W. S. Franklin[2] derived the same formula (except the constant was 0.050 instead of 0.049) by assuming continuous absorption and complete diffusion of the sound. The absorption is discontinuous, however, so the formula holds for rooms of small absorption and high reverberation only since these conditions more nearly satisfy a condition of continuous absorption. The dotted curve on Fig. 1 is a plot of the Sabine formula and tends to show the extent of its inaccuracy. By assuming a discontinuous absorption, and by replacing the walls with an image for each reflection, Eyring[3] established the following relation for reverberation time

$$T = \frac{0.05\ V}{-S \log_e (1-\alpha)}$$

It is on the basis of the above formula that Fig. 1 was prepared. The several curves represent different ratios of volume to exposed surface. The average coefficient of absorption is determined by

$$\alpha = \frac{\alpha_1 S_1 + \alpha_2 S_2 + \alpha_3 S_3 + \ldots\ldots}{S_1 + S_2 + S_3 + \ldots\ldots}$$

where α_1, α_2, α_3 = absorption coefficients of various surfaces; S_1, S_2, S_3 = areas of corresponding surfaces.

To illustrate, a typical studio will be considered. The characteristics of the various surfaces are shown in Table I. Absorption coefficients for various surfaces may be obtained from a circular issued by the Bureau of Standards. The coefficient for any given surface varies with frequency, generally increasing with frequency, so it is necessary to state at what frequency the time is to be determined. The calculations made here are for a frequency of 512 cycles. The dimensions of this room are 30 × 20 × 8.5 feet.

TABLE I

Surface	Area	Coeff.	Absorption Power
Floor, rug covered	600	0.370	222.0
Ceiling, celotex	600	0.470	282.0
Walls, painted plaster	610	0.020	12.2
Windows	200	0.027	5.4
Doors, etc., wood	40	0.100	4.0
	2050		525.6

$$a = 525.6/2050 = 0.25$$
$$V/S = 5100/2050 = 2.38$$

Since V/S for this room lies between two and four it will be necessary to interpolate between those two curves. Doing this we find the reverberation time of this room to be 0.41. It is well to note here that acoustical measurements in general never reach the accuracy of electrical measurements. In a problem of this type they are even less accurate because of a number of uncontrollable factors such as variations in the absorbing surfaces with time, presence of foreign materials, and incomplete diffusion of the sound into odd-shaped portions of the room.

Measurement of the reverberation time of a room is very difficult unless special equipment is obtainable. A number of methods have been developed and may be found in the literature[4]. However, in the case of large rooms and auditoriums the method of W. C. Sabine with certain refinements is entirely satisfactory. A source of sound of known intensity is established which an observer can stop as he simultaneously starts a stop watch. When the sound drops below audible level the watch is stopped and the time recorded. The level is then dropped a known amount and the time taken to decay below audibility again recorded. With this data the following relation may be used:

$$T = \frac{60\ (t_1 - t_2)}{I_1 - I_2}$$

where

t_1 = time of decay of first sound
t_2 = time of decay of second sound
I_1 = intensity of first sound in db
I_2 = intensity of second sound in db.

I_1 and I_2 may be referred to any arbitrary level since only

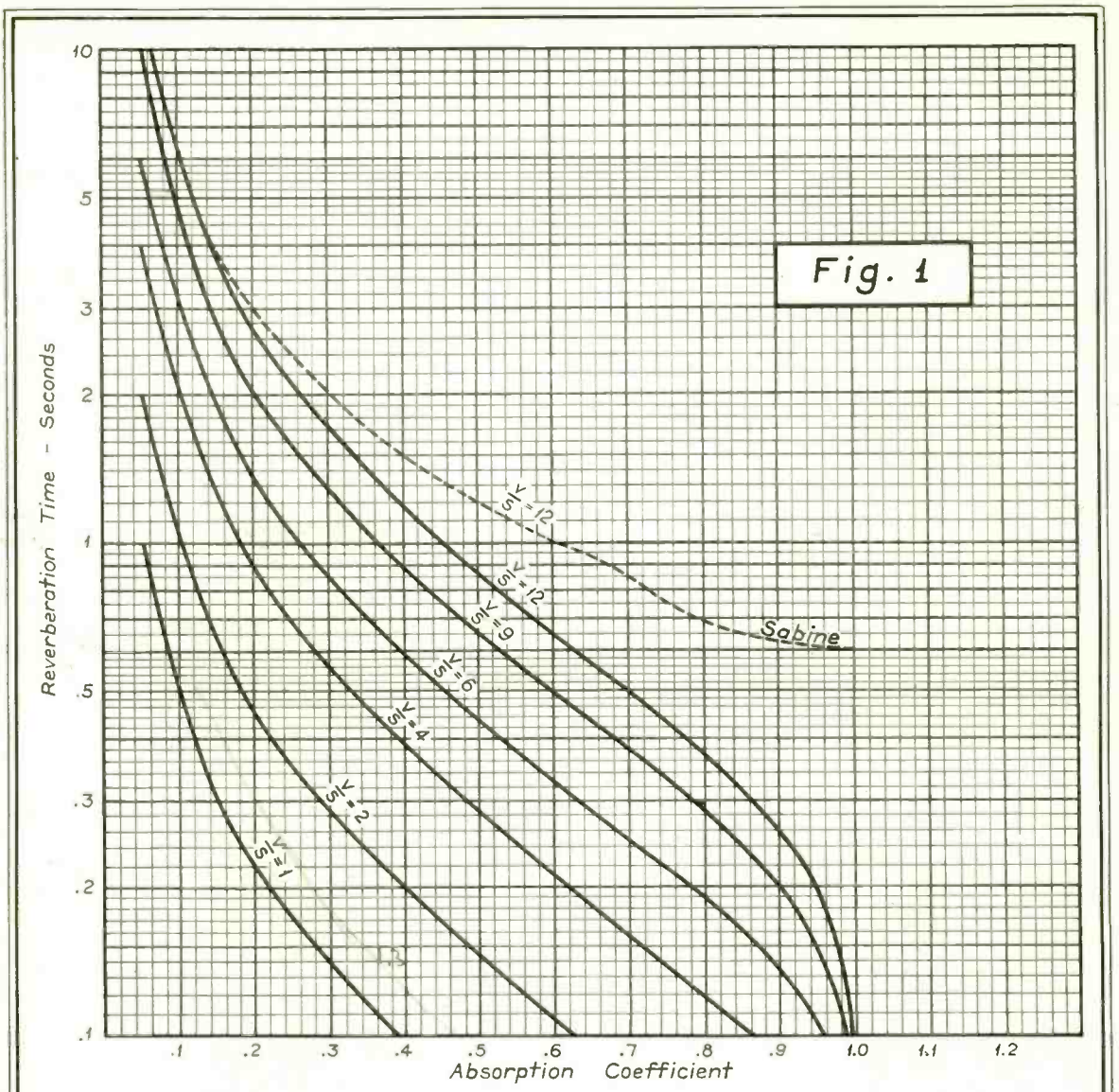
(*Continued on page* 16)

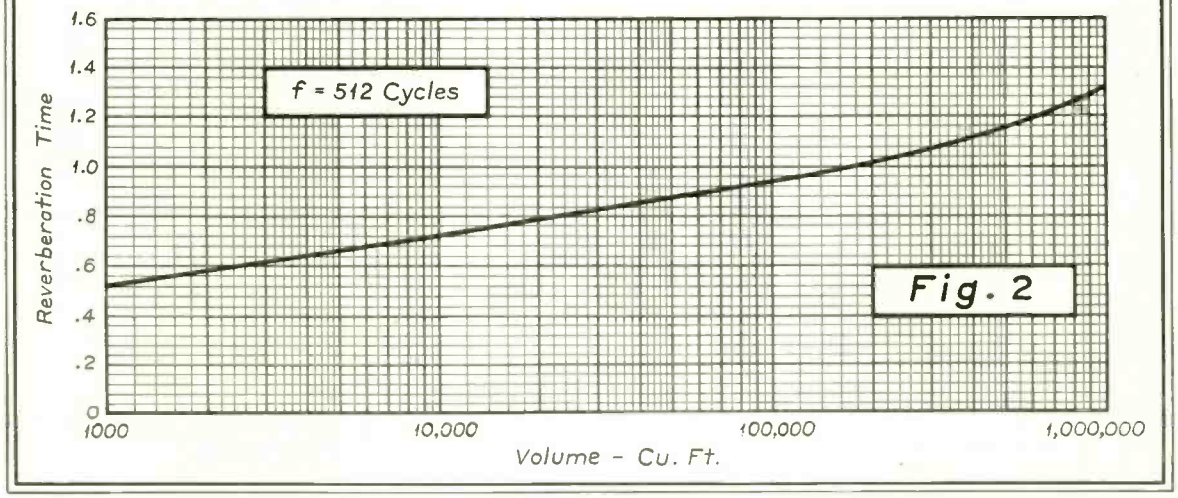
[1]Sabine, W. C., "Collected Papers in Acoustics," Harvard University Press.

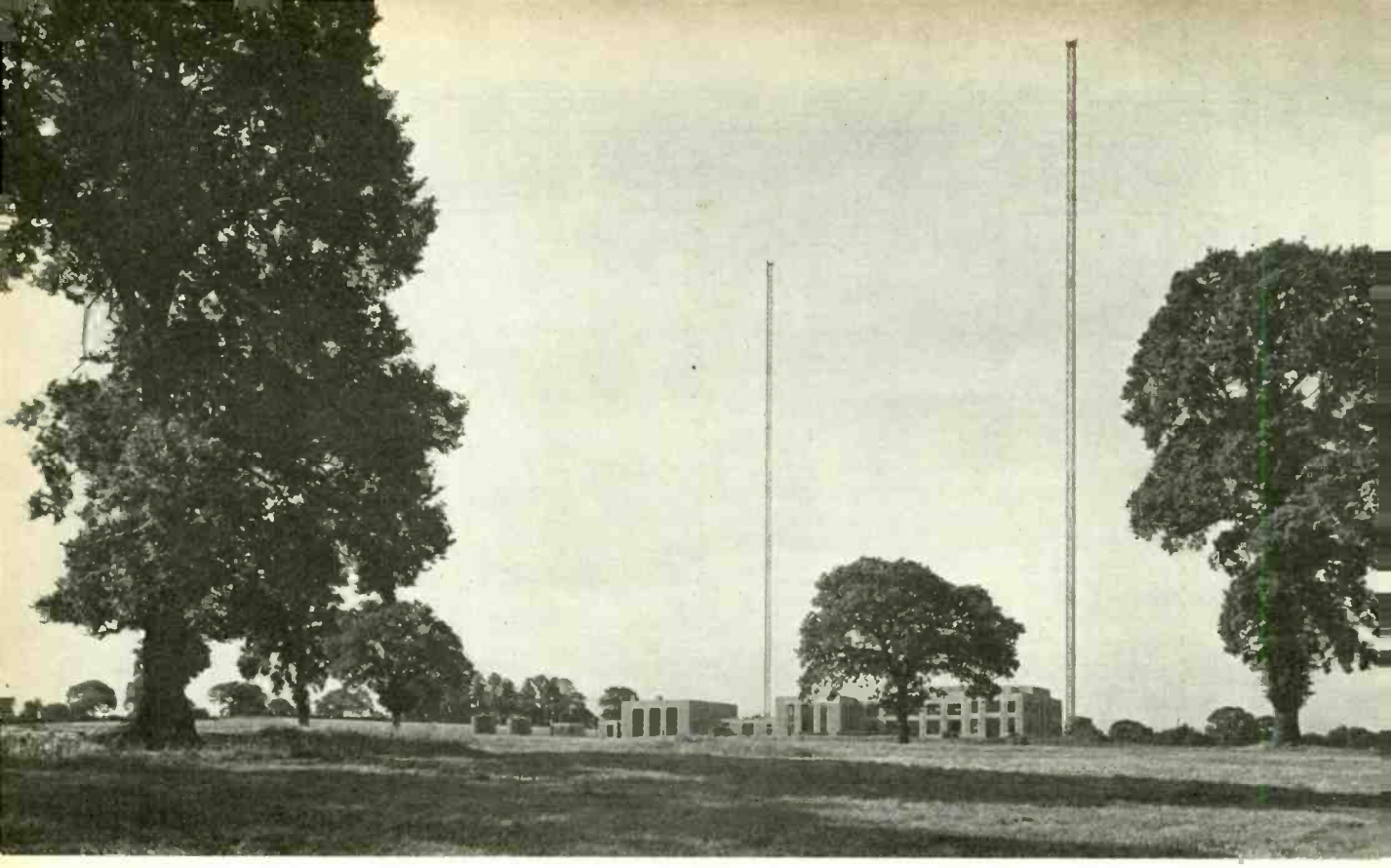
[2]Franklin, W. S., *Physical Review*, Vol. 16, p. 372, 1903.

[3]Eyring, C. F., *Journal Acoustical Society of America*, Vol. 1, No. 2, p. 217, 1930.

[4]Olson, H. F., and Massa, F., "Applied Acoustics," P. Blakiston's Son and Co., Chapt. XII.







GREAT BRITAIN'S LARGEST BROADCASTING STATION. DROITWICH.

Photos courtesy BBC

THE BBC PROGRAM TRANSMISSION SYSTEM

By DOUGLAS HALLAM, Jr.

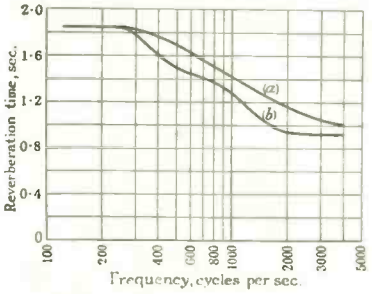
FROM A TECHNICAL STANDPOINT the principal aim of the BBC is to provide programs of good strength and quality to listeners throughout England, Scotland and Northern Ireland. A somewhat abbreviated description of the BBC studio, distribution and transmission system should be of interest.

The main studios are located in London at Broadcasting House and at another building known as the Maida Vale studios. Other studios are situated at various important points in Great Britain.

Each studio is acoustically designed to particularly suit the type of program for which it is usually used. A great deal of care has been taken with the reverberation time of the various studios. (Reverberation time is the time taken for a sound to decay 60 decibels after its emission.) Reverberation times at various frequencies in the concert hall at Broadcasting House are shown in Fig. 1. Curve (a) is for normal conditions, while curve (b) is with additional seating.

The program distribution system (see map on page 14) is made up of special shielded pairs carried in the regular General Post Office underground telephone cables. This shielded pair, which incidentally weighs 40 pounds per mile, contains 16-millihenry chokes every 2,000 yards in order to correct the frequency response. The General Post Office maintains repeaters with about fifty-mile spacing and the BBC operates booster amplifiers at its various control points. Equalizers for frequency-response correction are also utilized. These are quite useful in compensating for slight response changes perpetrated by temperature conditions.

FIG. 1. REVERBERATION CHARACTERISTIC OF CONCERT HALL, BROADCASTING HOUSE. (H. L. KIRKE AND A. B. HOWE. IEE JOURNAL, APRIL, 1936.)



The fidelity of the transmissions of all BBC stations is limited at present only by transmission-line characteristics and is at least substantially flat from 30 to 7,000 cycles. An exception, however, is the Daventry short-wave group of transmitters which have a response to about 5,600 cycles, but nevertheless the higher part of the scale carried is slightly accentuated in order to compensate for the sideband cutting in a large percentage of the short-wave receivers now in use.

London National, owing to the use of special low-definition experimental television lines, is capable of a flat response up to 18,000 cycles on programs originating at Broadcasting House.

The audio-frequency response characteristics of programs as radiated by the Droitwich long-wave transmitter are shown in Fig. 2. This includes the control-room equipment at Broadcasting

House, the transmission line, and the checking receiver used. The error incurred by the checking receiver is small.

In Europe two broadcast bands are in general use. One of these is known as the long-wave band and extends from 150 to 300 kilocycles, and the other, which is known as the medium-wave band, extends from 540 to 1,500 kilocycles. There are fifteen broadcast transmitters in Great Britain, not including the Daventry short-wave stations, one of which operates on the long-wave band. They are shown on the accompanying map. Those labelled "National" generally carry what is known as the National program, while the "Regional" stations carry the Regional program.

The design of the new 150,000-watt Droitwich long-wave transmitter is in some ways unique. One of the outstanding features of the station is the use of series modulation. This type of modulation is capable of a higher linearity than other types, and is undoubtedly a step forward in high-power transmission. Unless special precautions are taken the r-f and i-f stages in a receiver will attenuate the higher audio frequencies of the received program. This

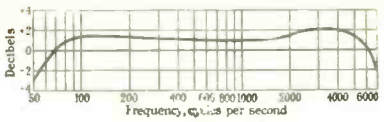


FIG. 2. OVERALL FREQUENCY CHARACTERISTIC OF DROITWICH NATIONAL TRANSMITTER. (SIR NOEL ASHBRIDGE, H. BISHOP, AND B. N. MACLARTY. IEE JOURNAL, OCT., 1935.)

is also true with transmitters with tuned circuits and stages between the modulated stage and aerial. The resonance-peak characteristics of the aerial itself can make quite a difference in the audio response of a station. At Droitwich a special correcting network between the final stage and aerial is used. This accurately compensates for the high-note attenuation due to the causes just mentioned. Two 700-foot masts 600-feet apart support the aerial for the Droitwich 150-kw transmitter. One of these also supports the vertical radiator and reflector system for the 70-kw Midland Regional transmitter.

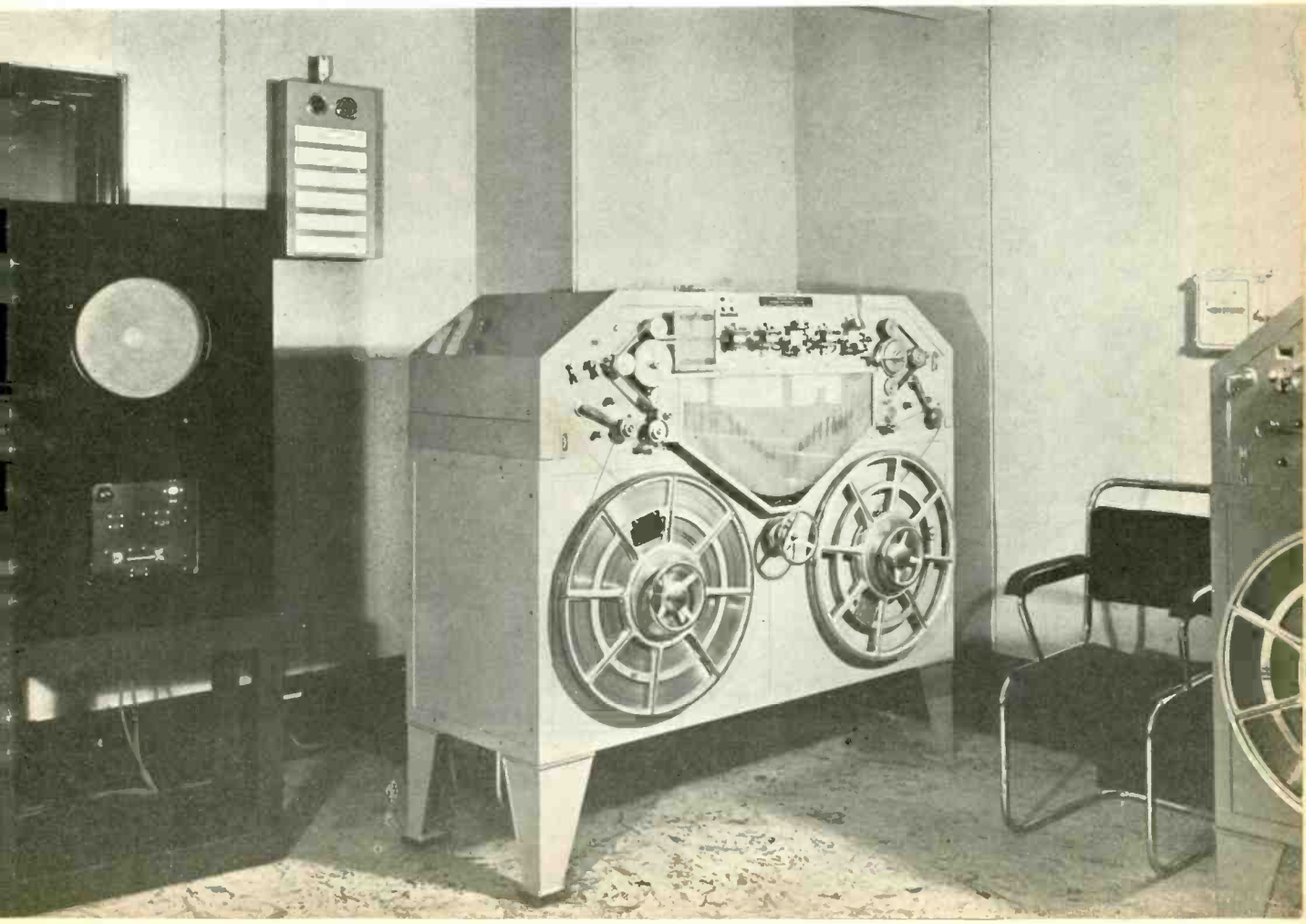
The high-powered medium-wave transmitters are all of approximately the same design. Heising low-power modulation is employed, in most cases at an r-f stage operating with an unmodulated output in the neighborhood of 250 watts. An exception to this is the new 100-kw Northern Ireland Regional transmitter which uses series modulation in the penultimate amplifier, the same system used at Droitwich.

Every BBC transmitter is capable of a modulation effort of 100 percent, but in the interest of quality a peak in the neighborhood of 80 percent is adhered to on all transmissions. An operating peak modulation somewhat below 100 percent is practiced at practically every world broadcast transmitter.

Two new broadcast transmitters are now being planned for service in Scotland and Northern Ireland. The service is at present good enough to give crystal reception of both National and Regional programs to most listeners in Great Britain.

The frequency synchronization of the London, North and West, National transmitters is carried out by the multiplication of the frequency of a thermostat-controlled mechanical tuning fork which has a fundamental of a little over a thousand cycles. The frequencies of all of the BBC stations are maintained within 10 cycles and in some cases as low as half a cycle.

ONE OF THE BBC BLATTNERPHONE RECORDING MACHINES ON WHICH THE PROGRAMS ARE RECORDED BY A MAGNETIC PROCESS FOR EMPIRE BROADCASTING.



find the division or patrol car having jurisdiction or on patrol duty over the particular street number reported. The turret operator then does one of two things, according to the nature of the complaint.

If the complaint is of a nature that can best be handled from a station house, he calls the division headquarters by telephone and passes the information to the officer on duty. If the call is of a nature requiring immediate action by radio car, he passes the message blank directly to the dispatcher, or in extreme emergencies he may go on the air direct from the turret desk. The dispatcher then establishes contact with the appropriate patrol car on the street by means of the police-radio system. In cases where a crime has been committed and directions are given to a patrol car to apprehend the criminals, the message is sent on the air direct, in which case it is received by all radio-equipped cars in the department. Such messages, where a crime has been committed, are passed by the dispatcher directly to the teletype operators who immediately transmit them over the local teletype machine to all divisions and units in the city, and, if necessary, over the state teletype machine to all cities and towns and to the state police and the metropolitan district police.

THE PUBLIC TELEPHONE SYSTEM

The main telephone switchboard, which is a private branch exchange served from the central office of the telephone company, is located in a separate room called "telephone room." Through this switchboard the ordinary commercial telephone service is available and used for communication with other police departments and the public for general purposes. This private branch exchange has extensions to offices in the headquarters building, and in addition has one or more tie lines to each of the several police divisions, the city hospital, the city prison, the state prison, the fire department and numerous other places which are called frequently by the police in the transaction of department business. This switchboard is tied in with the radio system making it possible for an officer in a radio car to call any telephone point in the United States, or to be contacted from any point. The only manual operation necessary on this switchboard is for outgoing toll calls or incoming trunk calls. There are at least two operators on duty at the main switchboard at all times.

PRIVATE AUTOMATIC TELEPHONE SWITCHBOARD

An automatic telephone switchboard is installed for the internal service of the department. This is located in a separate room at the headquarters building and associated with telephone circuits connecting with all necessary points in the headquarters building and with each of the division patrol-box switchboards. From the latter, connections can be made to telephones located at various points in the division station houses, or by means of the "officers recall system" to a desired officer located at a patrol box, permitting conversation from any patrol box to any point in the department, or to an officer in a radio car or any point outside of the department.

TELETYPE EQUIPMENT

Three teletype networks are used by the Boston Police Department. The first we shall call the "local network," as it connects a sending teletypewriter at headquarters with each of the police divisions, the Bureau of Criminal Investigation and the Special Service Squad at headquarters. The teletype machines at the division station houses, at the present time, are arranged for receiving only. There is a teletype switchboard through which it is possible to send a message to only one, any number, or all of the police units as may be desired. This switchboard also provides for the future installation of teletype machines in the police divisions for both sending and receiving.

The second teletype network, which is called the "metropolitan network," connects the Boston Police Department with the police departments in surrounding cities and towns, with the metropolitan district police, with the state police and the district attorney of the adjoining Middlesex County. There are also eight other state broadcasts available through the state police. All of the instruments on this network are arranged for both sending and receiving, so that any one of the connected police departments may transmit information to all the others on the network.

The third network, which is called the "long-distance network," makes direct connections with six state police departments, ten large city police departments in the west and middle west, thirty-seven offices of the Federal Bureau of Investigation and the Post Office Inspectors Branches throughout the country. This machine is used for messages of a confidential nature or ones requiring a speedy answer.

TELEGRAPH EQUIPMENT

A Western Union teletype machine and a Postal teletype machine are installed in the Bureau of Operations at Police Headquarters. These machines provide direct connections with the central offices of the telegraph companies for sending and receiving messages. This does away with the messenger boy and makes possible a more rapid and accurate service.

PATROL-BOX SYSTEM

The patrol-box system, with patrol boxes located conveniently on the streets, is connected by electric circuits to the police station houses through equipment which:

Enables any police officer on the streets to communicate at any time by recorded signal and by telephone with police stations, commanding officers, radio cars, general headquarters, or points outside of the department.

Enables a police officer at any patrol box to cause visual signals (flashing lights) to be displayed at the patrol boxes in a particular area and in the division police station, which signals call other patrol officers and radio cars to his particular location.

Enables any civilian, by pulling a hook (known as the citizens' alarm) at a patrol box, to display like visual signals on the patrol boxes in his neighborhood and in the division police station, to call the patrol officers and radio cars to his particular location.

Enables the officer in charge at a police station to display visual signals at the patrol boxes in a particular section or over the entire division, which signals call the patrol officers or radio cars to any nearby box to receive instructions or other information by means of the telephone service included in the patrol-box system.

REVERBERATION-TIME CALCULATIONS

(*Continued from page* 10)

the difference between them is used. The accuracy of this method is increased if a number of determinations are made and the resulting times plotted against intensity. The average decay curve should be a straight line drawn through these points from which the reverberation time is calculated.

The optimum reverberation for a broadcasting studio is not an exact quantity, for it varies with the type of material being presented, and with the number of people and other absorbing objects present. The ideal solution to the problem is to provide a method for varying the reverberation time of the studio. In case this is not feasible the best compromise for all conditions may be obtained from Fig. 2 although the values are not critical.

COMMUNICATION & BROADCAST ENGINEERING

Registered U. S. Patent Office
Member of Audit Bureau of Circulations

RAY D. RETTENMEYER
Editor

F. WALEN
Associate Editor

VOLUME 4 | FEBRUARY, 1937 | NUMBER 2

COVER ILLUSTRATION

A DIRECTIONAL TRANSMITTING ANTENNA RECENTLY INSTALLED BY AMERICAN AIRLINES AT THEIR GLENDALE, CALIFORNIA, TERMINAL. (SEE "DIRECTIONAL AIRCRAFT ANTENNA" ON PAGE 22.)

CONTENTS

FEATURES

DEPARTMENTS

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EDITORIAL

AUTOMATIC VOLUME COMPRESSION

FROM ALL REPORTS, broadcasting's most permanent limitation to fidelity, namely, ten-kilocycle station separation, seems destined to continue for some time to come. As a result, little can be done to extend the frequency range of our transmission system beyond its present status. However, as we have often pointed out, a wide frequency range is only one of the requirements for a high-quality system of transmission and reception. It is equally important that such a system have an adequate volume range.

It is well known, of course, that the volume range that can be broadcast is limited on one hand by distortion caused by overloading and on the other hand, by various types of noise. Between these limits there remains only a range of forty or forty-five decibels. However, a volume range of sixty-five or seventy decibels may be secured at the listener's loudspeaker by employing a system of compression at the transmitter and incorporating expanders in the receivers.

It seems to us that it is up to the broadcasters to start this move toward increased volume range. Receiver engineers have had considerable experience in designing expanders in connection with phonographs, and if the broadcasters were to adopt some uniform system of automatic volume compression, it seems logical to believe that the receiver manufacturers would soon place expanders in their receivers.

Actually, the incorporation of compressing equipment in transmitters would have little if any detrimental effect on the quality of present-day radio receivers (in many cases it might result in improved quality) and it would cost but little, since it involves only a few changes in speech-input equipment. It should also be remembered that stations installing this type of equipment would enjoy an appreciable improvement in the signal-to-noise ratio in their service area.

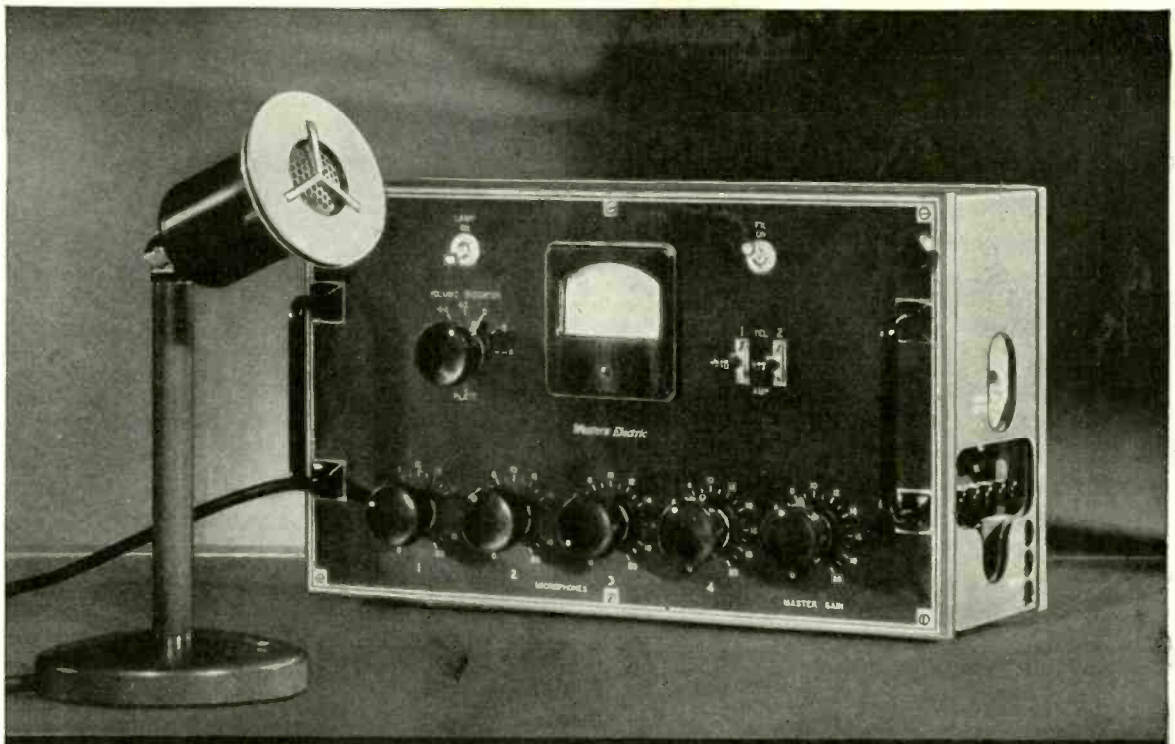
FACSIMILE FOR AIRCRAFT COMMUNICATIONS

IN OUR EDITORIAL for June, 1936, we pointed out a number of the uses to which facsimile transmission has been adapted. We also mentioned the possibilities of incorporating this type of transmission in police-radio communication systems, "home printing presses," and the like. Recent investigations into aircraft accidents has served to remind us that this form of transmission might well be used in aircraft communications to provide an automatic and visual record of all messages as well as to furnish pertinent weather data or other information to airplanes making long-distance flights. In this way, additional and more detailed information could be transmitted to an airplane without placing any additional strain on the radio operator.

TELEVISION PROGRESS

DURING THE PAST YEAR considerable progress was made in the art of television broadcasting. Most notable was the single set of standards proposed by the television committee of the RMA which was composed of representatives of the General Electric Company, Farnsworth Television, Inc., Hazeltine Service Corporation, Philco Radio and Television Corporation, and the RCA Manufacturing Company (see COMMUNICATION AND BROADCAST ENGINEERING for July, 1936). The active workers in the field have now altered or are altering their equipments to conform with these standards and are again conducting field tests.

Despite the progress, however, there are still a great many technical difficulties to be overcome before the final system is evolved, such as, the development of a single-sideband system of transmission, high-power, ultra-high-frequency transmitters, more sensitive pickup tubes, better picture tubes and simpler receiver circuits. While these problems will probably be overcome by the television engineers, commercial television cannot become a reality until the Federal Communications Commission sees fit to approve technical standards and issue commercial licenses. It appears that the future of television is really in their hands.



Paired for Remote Pick-up!

★ NEWCOMERS ★

(1) Hang it up.

(2) Left: as a non-directional mike. Right: as a directional mike.

633A MIKE—Here's Western Electric's newest—the 633A "Salt-shaker" mike. Like the famous "8-ball," it's a 2-in-1 mike: (1) Non-directional, (2) Directional, when you snap on the scientifically designed acoustic baffle.

Designed by Bell Telephone Laboratories, the 633A is small, sturdy, ideal for every remote pick-up job. *Its unusually low price will surprise you!*

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High spot features you'll like: stabilized feedback—frequency characteristic flat from 30 to 10,000 cycles—low distortion—operation from 115 volt 50/60 cycle AC supply or batteries—4 mike mixers and main gain control—completely factory wired and tested. Delivery?—in stock ready to ship!

For full details on these two new aids to better broadcasting, write Graybar Electric Co., Graybar Building, New York—or telephone Graybar's nearest branch.

Western Electric

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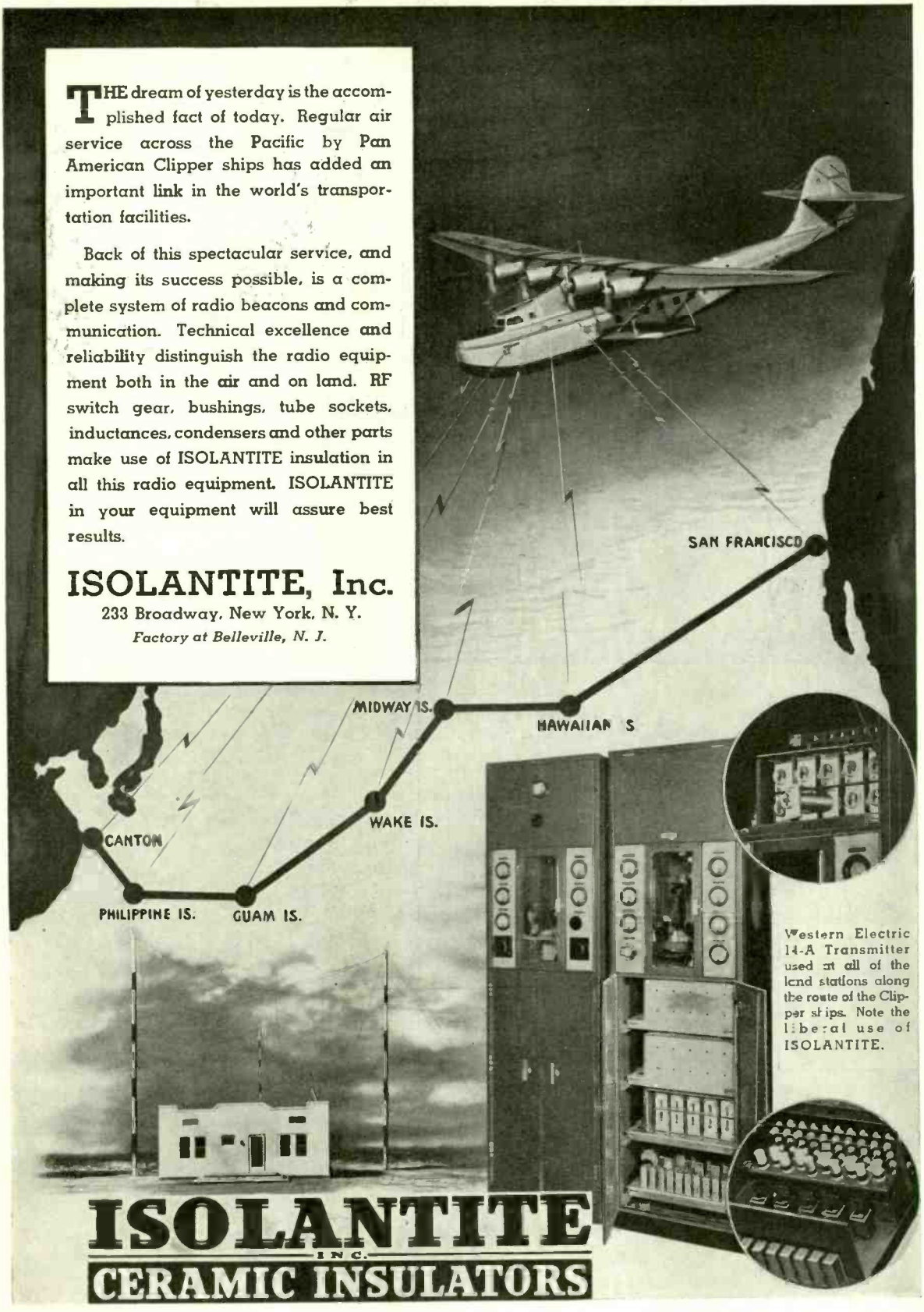
RADIO TELEPHONE BROADCASTING EQUIPMENT



THE dream of yesterday is the accomplished fact of today. Regular air service across the Pacific by Pan American Clipper ships has added an important link in the world's transportation facilities.

Back of this spectacular service, and making its success possible, is a complete system of radio beacons and communication. Technical excellence and reliability distinguish the radio equipment both in the air and on land. RF switch gear, bushings, tube sockets, inductances, condensers and other parts make use of ISOLANTITE insulation in all this radio equipment. ISOLANTITE in your equipment will assure best results.

ISOLANTITE, Inc.
233 Broadway, New York, N. Y.
Factory at Belleville, N. J.

Western Electric 14-A Transmitter used at all of the land stations along the route of the Clipper ships. Note the liberal use of ISOLANTITE.

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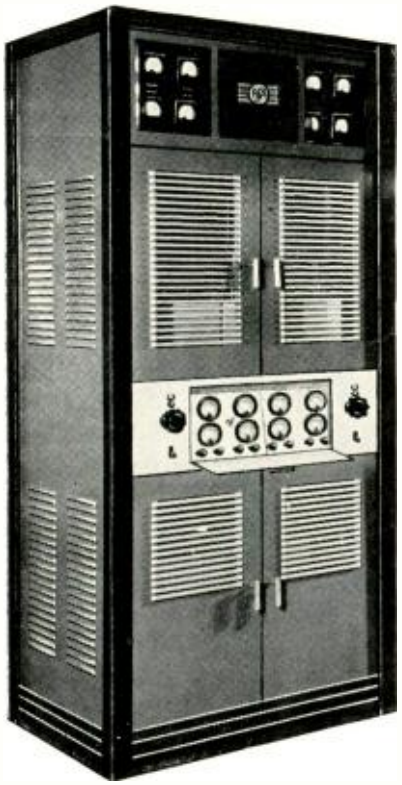
CERAMIC INSULATORS

Get the facts and features about

RCA's Two New Transmitters

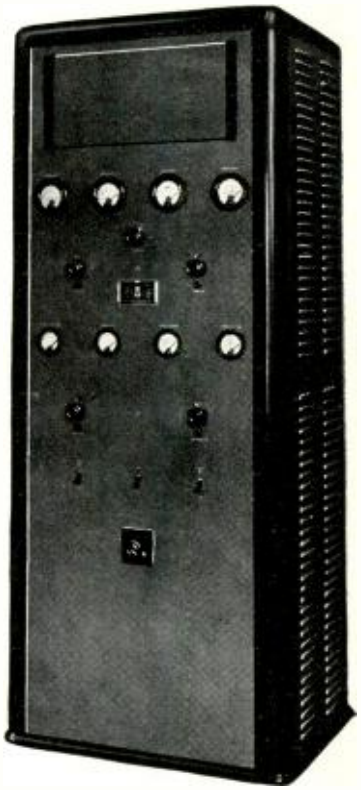


The RCA 250-G HIGH FIDELITY TRANSMITTER and RCA 250-D TRANSMITTER provide many splendid features

Space won't permit us to tell you one-tenth of all the fine features RCA has built in these two new transmitters.

Both are RCA's newest. Into them go the same quality workmanship and materials which for years have distinguished RCA equipments. They are the latest addition to a line of transmitters which have received the approval of broadcast engineers from coast to coast.

You'll want to know more about them, so drop us a line. We'll send you the facts and features about these transmitters that tell you more than a thousand fancy words. There's no obligation, of course. Just ask—and the information is yours!



NEW RCA TRANSMITTER 250-D

...rated at 250 watts and 100/250 watts. A low power transmitter and a basic exciter unit. Simple, efficient operation. Fine performance. Easy accessibility. Low operating cost. Most modern design. 16 operating meters, conveniently located. Inter-locking doors for safety. Easy installation.

NEW RCA HIGH FIDELITY TRANSMITTER 250-G

...a complete broadcast transmitter rated 100/250 watts (also available for 100 watts as "Type 100-G"). Includes space for Type 66-A Modulation Monitor. Provides unequalled performance to prevent early obsolescence and assure high fidelity. Generous safety factors and conservative tube operation make certain uninterrupted programs. Low operating cost because of low power input. Easy accessibility. Has four chassis—High Voltage Rectifier—Modulator—Low Level R.F. and Low Level Rectifier—High Level R.F.—each of which may be removed simply and quickly.

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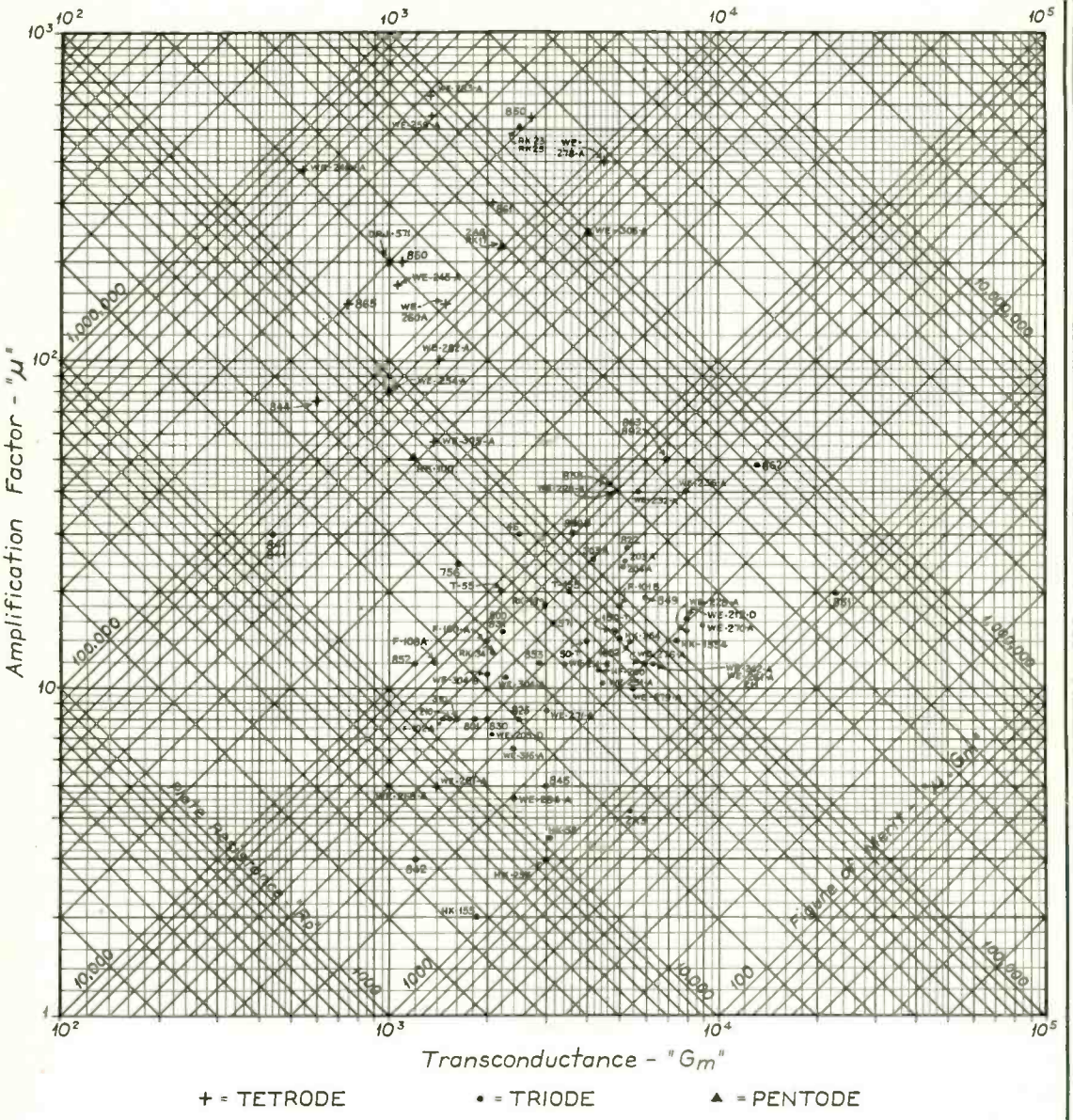
Characteristics of Transmitting Tubes

Prepared by J.G. Sperling, WNEW



This chart is analogous to one for circuit problems involving frequency, reactance, capacity and inductance, described by T. Slonizewski in the Bell Laboratories Record, for November, 1931.

Having plotted the amplification factor as ordinate and the grid-plate transconductance as abscissa, there is a point on this chart for every vacuum tube. Since plate resistance Rp is the ratio of these two quantities, one of a family of diagonal lines will indicate the value Rp for any tube.

While this chart is not complete, additional or new tubes may be included as desired.

(*Continued from page 9*)

becomes noticeable. Therefore, batteries are changed when the voltage drops to 5.25 volts with the filaments lighted. A set of eight cells lasts about a month under these conditions. The B batteries have not dropped appreciably in voltage although they have been in use for four months.

Immediately after using the tubes so successfully in this amplifier, a three-stage amplifier was built using new midget-type transformers and 955 tubes in the circuit of Fig. 3. The completed amplifier is shown in Figs. 4 and 5. Since this is used for longer programs such as football games and symphony orchestra concerts, heavier batteries are used. An a-c power pack was also built for it.

The maximum gain from microphone channel to the volume indicator on the output is 96 decibels. The weight of the amplifier with batteries is 36½ pounds, and with the a-c power pack is 27 pounds. While the shape is not the most convenient for carrying purposes, it is convenient for operating and servicing. Tubes, batteries and attenuator contacts can be reached in a moment. The whole amplifier chassis can be dropped out in about a minute. It has been used with the same batteries about twenty hours in the last four months, mostly in two hour runs, and the batteries show little drop in voltage.

In general we have found the 955 very satisfactory. In the smaller amplifier the tubes are not cushioned and have taken many severe jolts without damage. Tube noise from shot effect, and the like, is apparently not higher than in most tubes, but some trouble was met in eliminating microphonics in the three-stage amplifier. Since the input from the microphone could be considerably lower due to the mixer system on the input, such noises could become high in comparison with the program level. It was desired to operate the amplifier with an output of zero level (.006 watt), so the amplification was cut down at the grid of the second tube until the attenuators could normally be operated near their zero position when the output was zero level. This increased the signal-to-noise ratio on the input and placed the background noise below a minus fifty on the output. New type attenuators with zero insertion loss are a help in accomplishing this. The whole amplifier chassis is mounted on sponge rubber cushions. Microphonics are still the most prominent background sound. Attenuator contact noise is next and thermal effects, and so on, are below these, but all are far in the background under normal operation.

TELECOMMUNICATION

PANORAMA OF PROGRESS IN THE FIELDS OF COMMUNICATION AND BROADCASTING

MOBILE TELEGRAPH OFFICES

THE TELEGRAPH has now come to the highway in the new and novel form of mobile telegraph offices located in trailers. This innovation by the Western Union Telegraph Company follows the trend that is placing a growing proportion of the nation on wheels along the main routes and in trailer and cabin camps.

Trailers will be rushed to the scene of major news events, whether sporting or otherwise, which occur at a distance from regular telegraph offices but where wire facilities are or can be made available. Arriving on the scene, the mobile office is parked and immediately provides a telegraph headquarters for newspapermen and the general public.

DIRECTIONAL AIRCRAFT ANTENNA

TO REDUCE radio traffic congestion by eliminating numerous relay stations along their 3,000-mile coast-to-coast route, American Airlines recently installed at their Glendale, California, terminal a directional transmitting antenna, capable of spanning the continent with code and having a 500-mile range for voice communication.

Trained on a point midway between Fort Worth, Texas, and New York City, the new antenna directs its maximum radiation substantially along the airline's route, providing greater range for the given power and avoiding interference with communications elsewhere. Some 800 watts are available for code messages, and better than 400 watts for voice communication with aircraft in flight.

A novel feature of the installation is the coaxial feeder line from the transmitter to the antenna (see front cover). The wire is centrally suported by Isolantite beads within a copper duct, from which the air was exhausted and replaced by nitrogen gas under pressure. This provides an excellent insulation since the nitrogen gas, unlike air, is not affected electrically by variations in temperature and moisture content.

An unusual method of keying and press-to-talk control is used. A fixed oscillator generates a 4,100-cycle signal, which activates tubes in the transmitter control unit. These tubes control a relay which turns on the high voltage when the 'phone channels are used, or allows the application of screen voltages to the doubler and intermediate stages when keying. Many relays are eliminated in this manner, and facsimile speeds are possible with this feature. A 400-cycle filter is used with a sharp cut-off below 400 cycles, to prevent modulation of the station carrier on this audio frequency.

The frequency changing is accomplished by means of a remotely-controlled motor-driven multiple switching unit. This unit, controlled by a telephone dial system, drives a single insulated shaft mounted vertically in the center of the transmitter, and tunable air-dielectric condensers replace the conventional fixed units in the higher power stages.

Henry W. Roberts

WEATHER OBSERVATION STATIONS

A DENSER NETWORK of weather observation stations, better synchronized and designed primarily to provide information for more detailed and more frequent forecasts for fliers, has been announced by the U. S. Weather Bureau. About 100 new off-the-airway stations started making observations, Friday, January 15. Temperature, precipitation, barometric pressure, visibility, ceiling, dew-point, etc., are recorded at 1:30 and 7:30, both a.m. and p.m., Eastern Standard Time.

The new observations are coded immediately and wired either to Oakland, Calif., or Chicago, Ill., where they are relayed by radio or teletype over the entire airway weather system and also to regular Weather Bureau stations. The fifty or so off-the-airway stations already in operation and about one hundred selected stations on the airways are equipped with the same kind of instruments. Extra observers will be assigned to under-staffed stations where more observations are to be made.

GUARDING ANTENNAS AGAINST ICE

SATISFACTORY INSULATION of airplane antennas is now receiving considerable attention, for under icing conditions, it is not infrequent that a flash-over occurs at the high-power end of the transmitting antenna, causing destruction of the transmitting equipment aboard the plane.

A simple solution of this problem has been devised by engineers of United Air Lines and applied to its entire fleet of planes. A streamlined varnish-baked bakelite stub mast is attached to the vertical fin of the tail structure, projecting to a height of about six inches. This height, clear of the airplane structure, has been found adequate under operating conditions.

•

R-F METER

(*Continued from page* 8)

the smallest practical diameter to reduce skin-effect to a minimum.

The accuracy of the r-f power meter will vary with frequency but below 2 megacycles should approach the accuracy of the indicating meter, or 2 percent. At higher frequencies the indications will be in error due to skin-effect in the resistance-wire load, shunt capacitances reducing the effective resistance of the load, etc., but in all cases should be as accurate as the more common artificial antenna.

When measuring the output of a radio-transmitter the indicated power will, in general, be different on the several power scales unless the impedance presented to the output tubes is changed to correspond with the change in the resistive component of the power-meter input impedance. This is most easily accomplished by changing the plate tap on the transmitter output tank circuit.

The practical utility of the power meter will immediately be apparent to all users of the device, both for routine tests or transmitter warm-up periods. Experimental results obtained are also of much interest. For instance, the reduction in available output power from a radio-transmitter caused by increasing output tank-circuit losses resulting from large antenna-to-plate impedance transformation ratios are immediately apparent. Another interesting result is the 50 percent increase in average antenna power for 100 percent carrier modulation with sinusoidal tone, provided no carrier-shift or appreciable envelope distortion are present.

(*Continued from page 20*)

ers," "Aerials," "Aerial Arrays," "Problem of Reception and Simple Receivers," "Commercial Receivers," "Commercial Wireless Telephone Circuits," "Commercial Transmitters and Circuits," and "Ultra-Short Waves."

The following five appendices are also contained in this book: "Introduction to Load Characteristics," "Expression for RMS Value of Modulated High-Frequency Waves," "Calculation of Characteristic Resistance of Feeders from Dimensions," "Calculation of Feeder Efficiency," and "Valve Inter-Electrode Capacities."

Numerous selected references also add to the value of this book.

PRINCIPLES OF RADIO ENGINEERING, by R. S. Glasgow, published by the McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York City, N. Y., first edition, 520 pages, price $4.00.

This book, written by R. S. Glasgow, associate professor of electrical engineering at Washington University, is intended primarily as a text for students, and is based upon the lecture notes used by the author in a course on radio communication. As the author states, the aim of this book is to give a thorough presentation of the fundamentals of radio communication and the application of these principles to the art.

The first chapter presents a review of alternating-current theory, beginning with the well-known equation for induced emf and ending with a discussion of nonsinusoidal waves. This is followed by chapters on resonant circuits, properties of coils and condensers, coupled and oscillatory circuits.

The fundamentals of vacuum tubes and audio-frequency amplifiers are discussed in considerable detail. Succeeding chapters are devoted to r-f amplifiers for reception, oscillators and r-f power amplifiers, modulation, detectors, receiving systems, and antennas and wave propagation. The author, recognizing the importance of the subject, has devoted some 180 pages to the chapter on antennas.

Each chapter is followed by a series of questions to be answered by the student, and frequent reference is made to published papers, particularly to recent developments.

This book will be found valuable not only as a textbook for students, but also as a reference book for engineers.

THE MARKET PLACE

NEW PRODUCTS FOR THE COMMUNICATION AND BROADCAST FIELDS

REMOTE EQUIPMENT

Shown in an accompanying diagram is the 22A portable speech-input equipment recently announced by the Western Electric Company, 195 Broadway, New York City.

The 22A consists of two units. One is a combination amplifier-control unit and a carrying case. The other is a power-supply unit and may consist of either a rectifier for a-c operation or a battery holder or both, together with a carrying case and power-supply cords.

The amplifier-control unit has four mixing controls and a master gain control. Two toggle-switches are provided; one for the lamp that illuminates the volume-indicator meter and the other for the filament circuit. A rotary-type volume-indicator switch changes the sensitivity of the volume indicator so that output levels from 4 db below to 6 db above 6 milliwatts may be measured. The same switch controls the meter so as to indicate the filament and plate voltages. Two output keys switch the output of the amplifier or the order-wire telephone set to either of two lines, permitting immediate interchange of program line and order-wire line.

The equipment includes a four-channel mixing circuit designed to work with 30-ohm dynamic microphones or other 30-ohm sources of comparable level. The output circuit includes a line isolation pad and is designed to work into an impedance of either 150 or 600 ohms. The output impedance may be changed readily by means of a screwdriver-operated switch.

Feeling that a new demand for high-quality pickup is gathering momentum as schools, hospitals, hotels, etc., have begun to realize the importance of fidelity in their sound systems, Western Electric have announced the 633A dynamic microphone, shown with the remote equipment. The microphone may be suspended directly by a cord, or it may be screwed into its stand or into a swivel joint. When suspended or inserted directly into its mounting, the microphone is in a vertical position and performs as a non-directional unit.

A swivel joint is available which permits the angle of the microphone to be varied from the vertical to the horizontal, bringing into play the directional characteristics. A baffle attachment may be used to accentuate this directional effect. This is a disc, 3-¼ inches in diameter, which fits snugly over the face of the microphone and is held in place by friction (see illustration).

INSTRUMENT SWITCHES

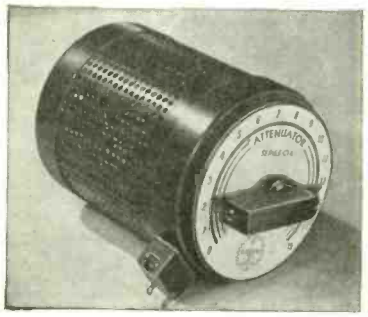
Small, rugged, rotary switches with a volume and surface leakage of 10^{12} and employing a ceramic switch plate, either single or double deck with brass or silver contact points, have been announced by the Shallcross Manufacturing Co., Collingdale, Pa. These switches may be used in output meters, tube checkers, decade boxes, thermocouple banks, analyzers, etc. Write for Bulletin 530-S2.

EIMAC 1000UHF

Eitel-McCullough, Inc., San Bruno, California, have announced their type 1000-UHF tube. This tube is said to be designed for high power outputs on frequencies as high as 150 megacycles. This tube is physically small in size in order to minimize lead inductance. It is designed to operate with forced draft on the glass bulb. Provision is made to force cool the grid and plate stems. The plate dissipation under forced air draft is 1000 watts. Further information may be obtained from the manufacturer.

ATTENUATOR

A constant-impedance attenuator capable of handling considerable power with low insertion loss, has been announced by the Clarostat Mfg. Co. This control (Series C1A) is designed as an output level control for power amplifiers, or as an input attenuator for individual loudspeakers in a public-address system. It dissipates 25 watts of power continuously, regardless of setting, and has a minimum insertion loss



of 1.3 decibels. Standard surge or input impedances available are 8, 15, 50, 200, 250, and 500 ohms. Other impedances available to order.

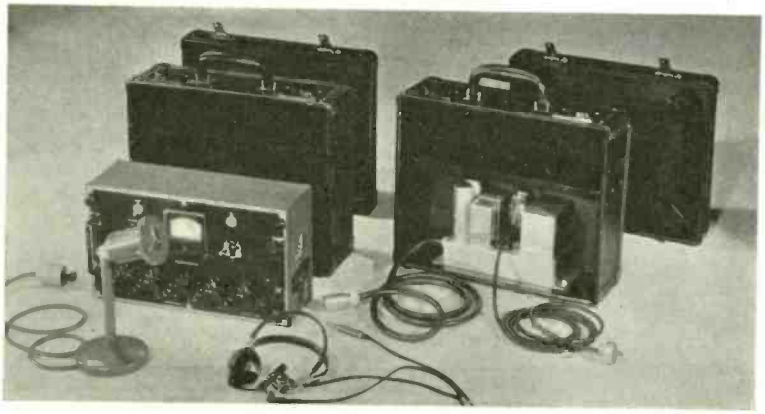
Made by the Clarostat Mfg. Co., Inc., 285 North Sixth Street, Brooklyn, N. Y., the new attenuator is in the from of a compact control with perforated metal case. It is provided with black circular metal dial plate and bar-type knob. A special detent-action switch selects the 16 attenuation values, and prevents "in between" switch positions.

NATURAL GAS MOTOR-GENERATOR PLANTS

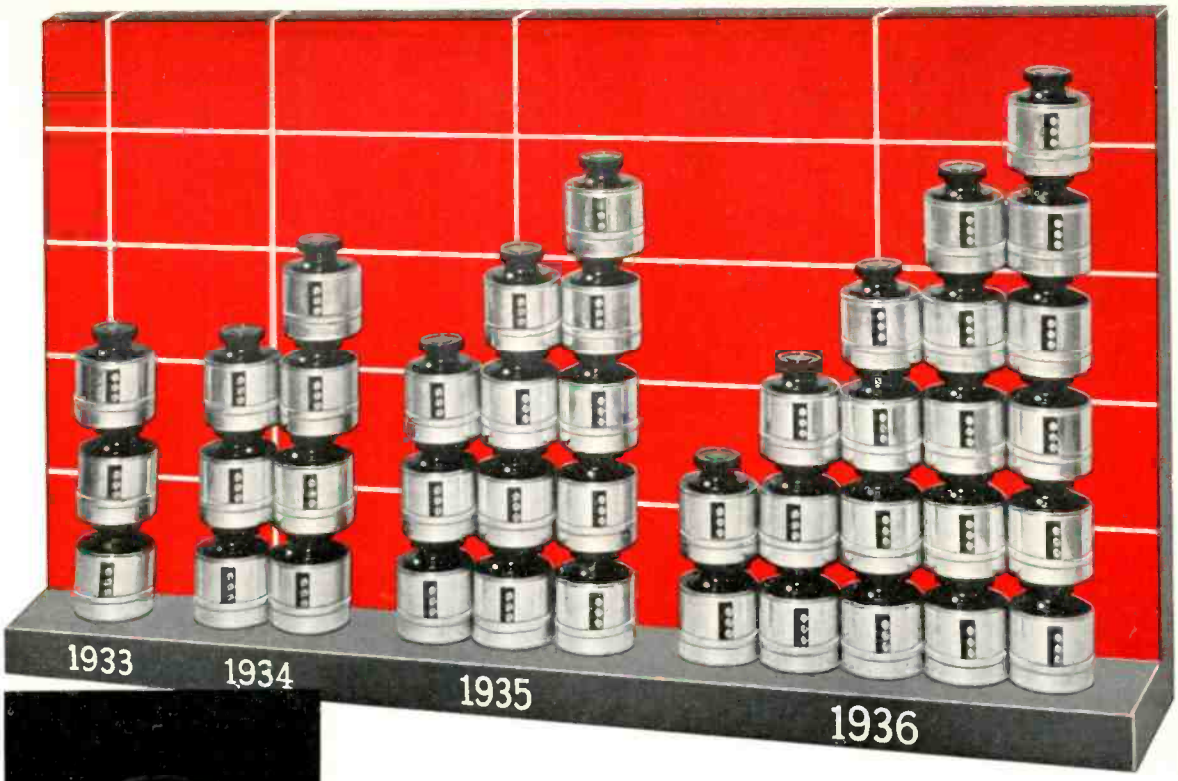
Electric light and power out of a gas pipe is the newest way for radio stations and radio store owners to cut their light bills. Consequently the recent announcement of the Lycoming Manufacturing Co., Williamsport, Pa., of a gas motor-generating unit engineered for 100,000 hours of continuous duty, is of interest. The perfecting by Lycoming of a natural gas motor of high efficiency and low operation costs together with an entirely automatic generating unit is said to have made considerable savings possible in the cost of electrical energy.

The plant, automatic in operation, requires little attention and is easy to install, merely requiring the connection of a gas pipe to the motor. Sizes range from 10 kw to 60 kw, generating either a-c or d-c. For the smaller user of electric energy a single-motor unit is available. For businesses that require 24-hour continuous service a dual-motor unit, composed of two motors and one generator, is offered. Either motor on this latter unit can be operated singly or both together, one motor automatically cutting off when the additional driving power to carry the electrical load is not needed.

The gas motor which has been developed by Lycoming for use in this light and power plant is said to be quiet, clean and vibrationless. It produces no smoke or odor and runs cool. The company makes it clear that it is engineered to use natural or manufactured gas only and is in no way an adaptation of a gasoline engine to use gas.



INDEX TO ADVERTISERS



Commercially Acceptable

TO be generally accepted by any number of users, any piece of apparatus must not only be correctly designed, carefully manufactured and rigidly inspected, but must also bear the stamp of approval, "Commercially acceptable". "Will the user like it?", is the big question which faces every manufacturer.

Four years ago General Radio introduced the Type 653 Volume Control, the first of its kind. That this control, incorporating a number of new mechanical features last year, is what radio, talking picture and public address system engineers want is attested to by the sale of thousands of units to these users. 1937 sales will be higher than ever!

The G-R Type 653 Controls have these important features recognized and appreciated daily by hundreds of satisfied users:

- Extremely low noise level
- Complete cut-off
- Substantially constant impedance
- Small behind-the-panel depth
- Finger index button
- Removable dust cover
- Convenient terminals
- Long Life
- Four stock impedances: 50, 200, 250 and 500 ohms
- Moderate price: $12.50 for any model

If you haven't tried a G-R Type 653 Volume Control, order one or more on approval. Try them in your own circuits under your own operating conditions for 10 days. Then, if you are not entirely satisfied we will refund the purchase price. Address: 30 State Street, Cambridge, Massachusetts.

Write For Bulletin 108-K

GENERAL RADIO COMPANY

We took plenty of time—

to do a thorough job of designing the 12H. Months were spent to develop it in the laboratory and before it was released we made sure that it had every facility that you need to do a really COMPLETE job. We are talking, of course, about the new COLLINS CONSOLE TYPE SPEECH ASSEMBLY. It doesn't cost any more but it does a lot more things — and does them better.

the 12H, alone, has these features---

★ UNIVERSAL INPUT IMPEDANCE

This feature, available only in Collins Speech Equipment, was first introduced in the well-known 12X Remote Amplifier. "Universal Input" means that any type of microphone and transcription equipment can be used interchangeably. The best conditions of impedance match are maintained without the use of external transformers or matching pads.

★ AUDITION CHANNEL

The 12H has two main amplifiers providing dual channels for program, monitoring, and audition. When the second channel is used for rehearsal it is available for instant talk-back to the audition studio. A regular program may be carried through the program channel of the 12H without interruption during auditions.

★ COMPLETE TRANSCRIPTION FACILITIES

A two-way mixer with universal input impedance connections is used in combination with a separate one stage pre-amplifier to give complete control of two turntables. No external switches, faders or mixing controls are required, and the pre-amplifier included assures adequate gain for proper use of any modern transcription equipment.

★ LOWEST NOISE LEVEL

All a-c fields which would be detrimental if present in the 12H cabinet are eliminated by use of an A.C. Isolation Unit, which is a small case built for mounting under the control desk. An interconnecting cable is furnished to simplify installation. Many other features of the design contribute to the extremely low overall noise level.

★ AUTOMATIC SPEAKER AND WARNING LIGHT CONTROL

Three speaker control relays are arranged for interconnection with microphone keys to silence studio and control room speakers when corresponding microphone circuits are in use. In addition, circuits are provided for connection of an auxiliary external relay (furnished as standard equipment) to control studio "On the Air" lights.

★ INTERCHANGEABLE UNIT CONSTRUCTION

The 12H is not an oversize receiver chassis, but is in effect a horizontal rack cabinet with individually mounted amplifier and control units. The wiring between units is formed as a separate removable cable. The many proven advantages of rack type assembly are retained.

★ COMPLETE SHOCKPROOFING

Even the best audio tubes available are slightly microphonic. The effect of table vibrations and jars due to fast operation of switch keys would seriously impair operation of a console type speech assembly which did not have the shockproof protection used in the 12H. Each amplifier is floated on special rubber mountings so designed that the weight of the amplifier components and the resiliency of the mountings completely eliminate microphonic effects.

★ FULL MONITORING FACILITIES

The second main amplifier in the 12H is also available for loudspeaker monitoring across the program line. Headphone monitoring of program line and incoming remote lines is also possible.

★ LARGE SCALE LEVEL INDICATOR

A new type extra large level indicator, with a correctly damped high speed movement is conveniently located directly above the main program gain control. Range extension from 0 to +20 db in steps of 2 db is provided.

★ FINGERTIP SWITCHING

Twelve positive key switches are arranged to give control over all circuits as completely and flexibly as if an elaborate jack and patch cord system were used. The key switches control six incoming lines, four microphones, two turntables, signal lights, main amplifier input, monitor-audition amplifier input, headphone monitor, speaker cut-off relays, and two outgoing lines.

★ HIGH LEVEL MIXING

In spite of its compact design, the 12H uses five pre amplifiers for the individual microphone and turntable inputs. No compromise is made with the proven Collins policy of using high level mixing and switching to assure high fidelity performance at all times. Low level mixing is unavoidably at a disadvantage in respect to noise level when compared with Collins high level mixing.

COLLINS

COLLINS RADIO COMPANY

CEDAR RAPIDS, IOWA ★ NEW YORK, 11 West Forty-Second Street