Communication and Broadcast Engineering

VOL. I NO. I

OCTOBER, 1934

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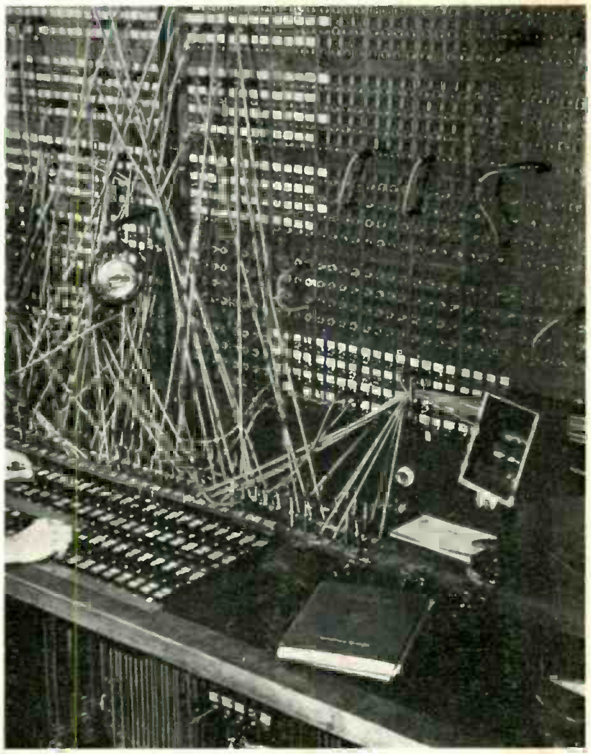

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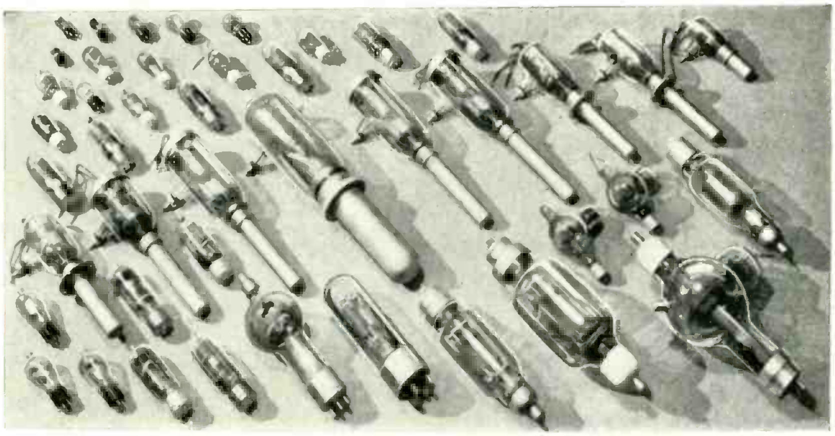

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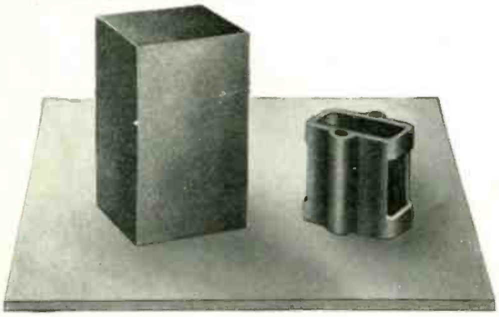
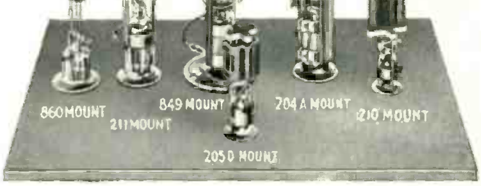
More than half of the broadcasting stations in the country are either partially or entirely SYLVANIA equipped.

Engineers in steadily increasing numbers are specifying SYLVANIA. This is true not only in the broadcast field but in all other fields of radio communication and for industrial applications where dependable heavy duty service is demanded.

The SYLVANIA line spans the entire range of popular air-cooled and water-cooled types.





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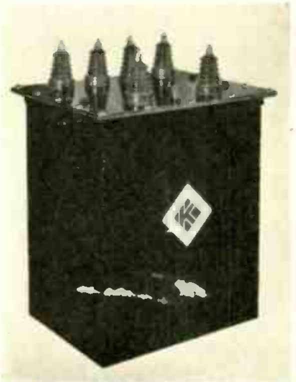

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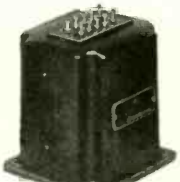

The ultimate in perfection for those engaged in high fidelity reproduction and sound amplification, broadcast engineering, laboratory technicians and test equipment manufacturers. Housed in a high permeability iron casting which provides excellent electromagnet shielding, these efficient, long life audio transformers afford frequency characteristics of ±1 db from 30 to 15,000 cycles.

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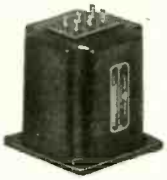

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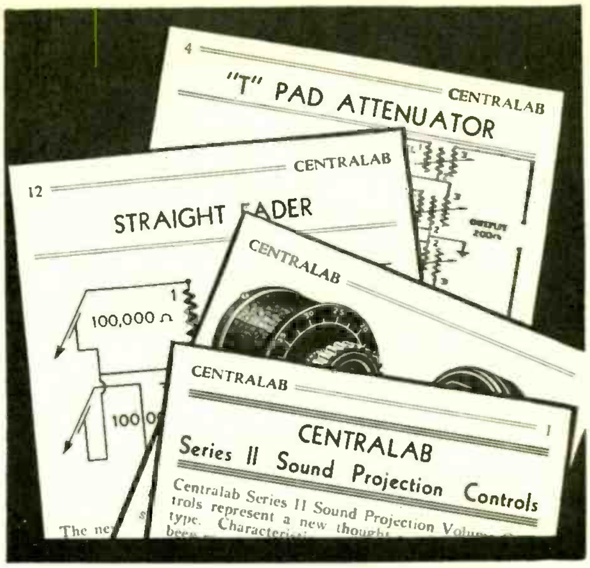

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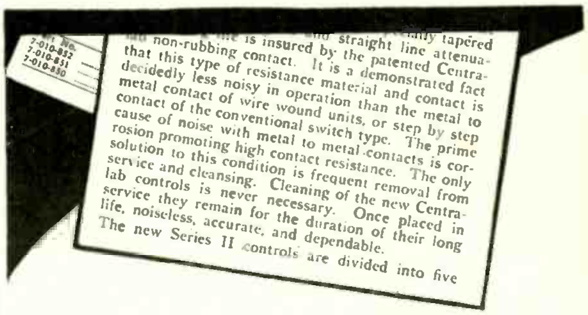

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EDITORIAL

TELECOMMUNICATION

THE EVOLUTION OF THE Protozoa from its simple beginning as a one-celled animal, through centuries of trial and error, to a physical structure with millions of nerve channels and a "central switchboard" having over a trillion interconnections, bears a striking resemblance to the evolution of man's communications systems.

From sign language, signal drums, crude speech, and eventually the written word, man has developed his means of intercommunication to the point where the knowledge of one man may become the common knowledge of all men.

More recently, man has evolved new methods of intercommunication through the utilization of electricity, and his system has taken on the aspect of a modern Ulysses —the vast, pulsing networks of wire and ether channels appearing much like a supplementary brain contrived by man himself, and patterned after his own mental image.

The similarities hold other inferences: Brain cells are interdependent and function by coordination. The world-communication empire of today is also composed of interdependent units whose proper and complete functioning likewise calls for coordination. A transoceanic phone link is incomplete without radio; the radio telegraph is incomplete without local wire facilities; the wire telegraph is incomplete without supplementary radio services; and lastly, radio broadcasting is incomplete without wire feed lines for remote and chain services.

Interdependence is also apparent in the engineering structure of the three carrier systems. Whereas at one time the engineering research and developments were disassociated, they are today definitely interlinked. The telegraph engineer, the telephone engineer and the radio engineer are serving common purposes. Their work and their technical viewpoints are in the same focus.

Engineering work in the field of wire telegraphy has influenced the radio telegraph system. The development of automatic, high-speed transmission and reception equipment for wire and cable telegraphy clearly marked the path of progress to be followed in radio communication systems.

The telephone engineers have contributed a vast amount of knowledge of inestimable value to wire and radio practice. Much of this specialized knowledge has been instrumental in the rapid growth of radio broadcasting. Basic telephone engineering is evident in the design of radio transmitting and receiving equipment.

The engineering developments in the radio field have had much to do with the formation of the world-communication system. The vacuum tube and the oscillating tube circuit have made possible long-distance wire telephony, the advanced multiplex telegraph systems, carrier-current transmission over low- and high-power feed lines, ether links for transoceanic, ship-to-ship and ship-to-shore telephony, and so on.

A third inference may be drawn from the original simile: Communication practice has evolved from the simple use of interrupted direct currents, through a more intelligent employment of audio-frequency currents, to the final utilization of currents at radio frequency. Modern systems using superimposed combinations of currents are nearly as complex, compared to early direct-current systems, as man is to the Protozoa.

Because of the similarity in the engineering methods of approach, much of the equipment used in the fields of telegraphy, telephony and radio is practically identical. No electrical communication system exists that is independent of the basic conceptions and developments now deeply rooted in the world-communication engineering structure.

Since the efforts—and the results—of the telegraph engineer, the telephone engineer and the radio engineer have become so closely inter-related in recent years, it is natural that a publication should appear whose purpose will be to serve their common needs. To do this effectively, it is necessary that the publication maintain a satisfactory balance in its editorial contents so that the data presented the readers will be of immediate or reference value to all engineering branches served. It is likewise necessary that the publication be up-to-the-minute, authoritative, and free of duplicative effort. Accomplishing these points, the publication will offer a much-needed and specific service, heretofore unprovided.

These are the aims of COMMUNICATION AND BROADCAST ENGINEERING. Every effort will be applied to carry out this policy consistently and effectively.

COMMUNICATION & BROADCAST ENGINEERING

FOR OCTOBER, 1934

KYW-PHILADELPHIA

By R. N. HARMON

General Engineer, Radio Broadcasting Depts.,
WESTINGHOUSE ELEC. & MFG. CO.

THE ORIGINAL ESTABLISHMENT of KYW grew out of a conversation between officials of the Commonwealth Edison Company, in Chicago, and the Westinghouse Electric & Manufacturing Company, in regard to the possibility of broadcasting the offerings of the Chicago Civic Opera Company during the season of 1921. Accordingly, a 500-watt transmitter was constructed at the Westinghouse plant at East Pittsburgh. This transmitter was installed in a penthouse on top of the Commonwealth Edison Company's building. It was ready for operation on the night of November 10, 1921, and on Armistice Day, November 11, 1921, the first program was broadcast from the stage of the Auditorium Theater. This was followed by a broadcast of all operas given by the Metropolitan Company that season.

KYW was Chicago's first radio broadcasting station and the fourth or fifth in the United States. Many of the early developments in broadcasting were used at KYW. High-voltage rectifiers, quartz-crystal frequency control, and condenser microphones were used as early as 1922.

KYW was the first western station to go to 10 kw power. With the power on a frequency of 570 kc, excellent coverage was obtained and KYW was heard consistently throughout a large portion of the central United States.

KYW'S SYNCHRONIZED BOOSTER STATION

On November 11, 1929, a re-allocation of frequencies by the Federal Radio Commission placed KYW on 1020 kc. Immediately difficulty was experienced in covering certain sections of Chicago. A synchronized booster station located eight miles from the main transmitter was installed to overcome some of the dead spots. The booster station was only partially satisfactory and a construction permit was obtained in the spring of 1929 to move the transmitter to the western edge of Chicago. Operation of KYW at the new location started in the fall of 1929 and has continued to the present time with satisfactory coverage.

SECOND-ZONE PLANS

The original allocation of the 1020-kc frequency was made to the second zone. Chicago is in the fourth zone. On October 27, 1933, after considerable litigation, the Federal Radio Commission granted Westinghouse a construction permit to move KYW to Philadelphia, which is in the second zone. The construction permit was granted on the operation of a directional antenna which would restrict radiation toward the 1010-kc channel in New York City and Charlotte, North Carolina; the 1000-kc channel at York, a daytime station, and the 1000-kc channel at Baltimore, Md.

ABOUT DECEMBER OF THIS YEAR, WESTINGHOUSE WILL PLACE IN OPERATION A COMPLETE NEW RADIO BROADCASTING STATION LOCATED NORTHWEST OF PHILADELPHIA. THE ANTENNA WILL BE ARRANGED SO AS TO DIRECT ITS OUTPUT TO SERVE THE GREATEST POPULATION WITHOUT INTERSTATION INTERFERENCE. THE TRANSMITTER IS A NEW DESIGN JUST COMPLETED AND RATED AT 50 KW, BUT MODIFIED FOR 10-KW OPERATION. IT PRESENTS SEVERAL RADICALLY NEW FEATURES IN RADIO TRANSMITTER DESIGN.

Directional antennas for broadcast frequencies are not new. In fact, a directional antenna was used by KDKA as early as the spring of 1930. Now, in order to meet the interference requirements mentioned at the new KYW station, a four-element directional antenna has been designed.

KYW DIRECTIONAL ANTENNA

The directional antenna is composed of four quarter-wave radiators, one on each corner of a rectangle whose long side is one-half wavelength and whose short side is one-third wavelength. Each radiator is two hundred and forty-five feet high and is made up of a forty-five

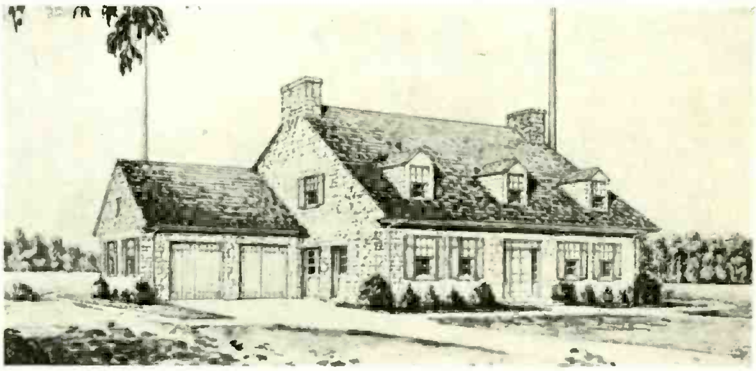


Fig. 6. The station building—a Dutch Colonial mansion in outward appearance, giving little indication of the technical nature of its contents.

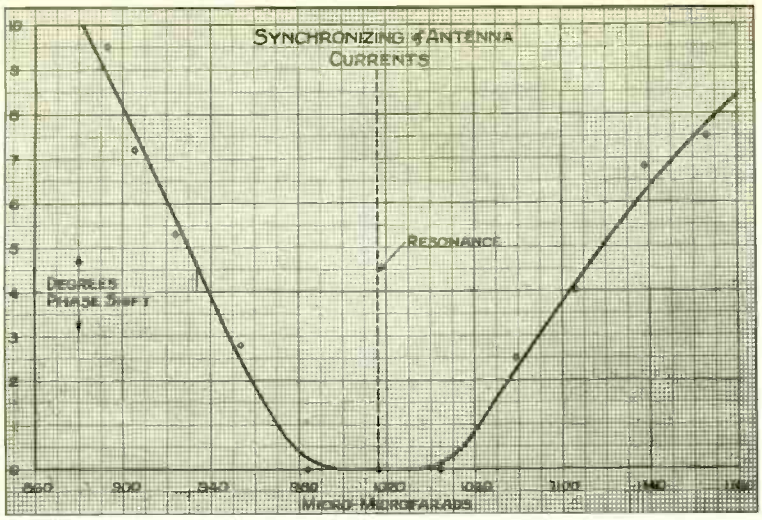


Fig. 1. The degree of phase stability which is expected from the antenna system is a phase shift of two degrees for a change of antenna capacity of 60 mmfd.

foot wood tower carrying a two-hundred foot self-supporting metallic tube anchored and insulated at the top of the wood tower. A smaller metallic tube, connected to the bottom of the self-supporting tube and running downward into the coupling house at the base of the tower, completes the radiator circuit. Each of the four radiators work into a circular counterpoise of 200-foot diameter, ten feet above the ground. The computed capacity of each radiator to ground is 1036 mmfd, ninety of which occurs in the first forty-five feet above ground. The resistance of each radiator at the base is calculated to be about 40 ohms.

TRANSMISSION LINE SYSTEM

The transmission line system for this antenna runs from the transmitter building to the center of the array where it splits into two lines which in turn split again, making four lines. One of these four lines is connected to each radiator. The length and phasing of these lines is such that the radiators on the long side of the rectangle are excited in phase and those on the short side out of phase.

Special care has been taken to design multi-wire transmission lines in order to reduce radiation from them as well as to keep the phasing of the individual radiators constant with respect to each other.

The stability of the space pattern radiated by directional antennas is dependent on the phase and amplitude of the current in each radiator remaining fixed. This problem has been discussed before. The degree of phase stability which is expected from this antenna is a phase shift of two degrees for a change of antenna capacity of 60 mmfd. This is shown in Fig. 1. The substitution of a counterpoise for an earth ground will tend to decrease any change of radiator capacity to ground. A change of about 12 mmfd capacity to ground on a single radiator would be expected if the actual level of the electrical ground were lowered by ten feet. It is quite unlikely that all four radiators will be affected by any such large change of earth ground level as this.

RADIATION

The horizontal polar diagram of radiation from this antenna over uniform terrain is a figure eight, as indicated in Fig. 2. One beam will be directed over Philadelphia and the other toward Allentown, Pa.

The field strength on the beam is 36 db above that at 15° from the null line.

The restriction of radiation through the vertical angles in the null zone is in the same order as that along the ground (Fig. 3). This is the chief advantage of a four-element directional radiator, as approximately the same figure eight ground pattern can be produced with a two-element radiator. However, a large amount of vertical radiation exists in the null zone of a two-element antenna and, in the present case, this would produce serious interference. The picture, Fig. 4, shows the large volume of vertical radiation present at 90 degrees from the main beams on a two-element radiator.

The choice of the transmitter site was restricted to the territory to the northwest of Philadelphia because of the directional antenna. The attenuation in this section of Philadelphia is somewhat higher than that to the east of the Delaware River. However, the density of population is greatest on the west side

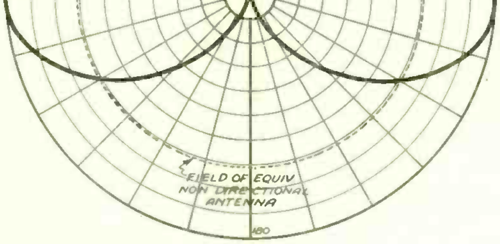


Fig. 2. Horizontal ground pattern for 4-element directional antenna.

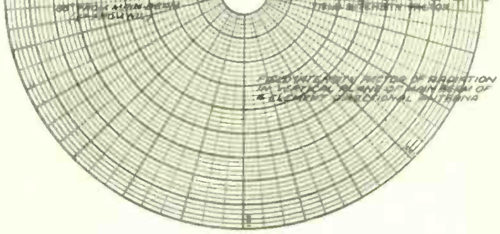


Fig. 3. Field intensity factor of radiation in vertical plane of main beam of 4-element directional antenna.

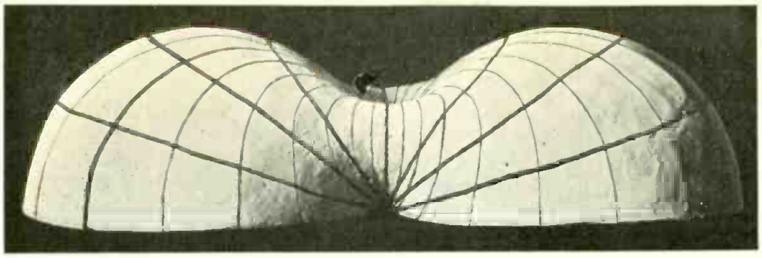


Fig. 4. Three-dimensional figure showing field of 2-element directional antenna.

of the river which tends to locate the territory which will be most difficult to serve closest to the transmitter.

Results of the preliminary survey with a 50-watt test transmitter indicate that most of the city of Philadelphia will receive a signal of 10 mv/m or more, with a carrier power of 10 kw. These results, showing the particular attenuation features of Philadelphia are drawn in Fig. 5.

THE TRANSMITTER BUILDING

The transmitter building is of the residential type, Dutch Colonial style, which is quite common in this section. It is a two-story stone building with the entire transmitter located on the first floor. There is no basement in the building. The architects' sketch of the structure is shown in Fig. 6.

The elimination of rotating equipment and installation of high efficiency Class B audio and Class C radio equipment has decreased the space required for the transmitter to the point where it is practical to install a transmitter as large as fifty kilowatts on one floor of an attractive residential type of building.

The 60-cycle power to operate the transmitter is brought in by two separate 3-phase, 4-kv lines of the Philadelphia Electric Company. These two lines are brought in underground from the pole line along the road fronting the property and terminate in two interlocked oil switches only one of which may be closed at a time.

POWER EQUIPMENT

These two switches may be connected to the station 4-kv bus which in turn feeds power to the high-voltage rectifier breaker and the distribution transformer breaker.

The high-voltage rectifier breaker is connected to an induction voltage regulator which in turn is connected to the high-voltage rectifier transformer. This transformer is connected to six gas-filled rectifier tubes of the 69-A or 57 type. The maximum output of this rectifier is either 5 amps at 12,000 volts dc or 17 amps at 12,000 volts. By tap-changing connections on the rectifier transformer in conjunction with the induction regulation, the dc output voltage can be varied continuously from 7200 to 12,000 volts.

The distribution oil switch is connected to a 75-kva-4 kv to 220-v transformer which supplies power for filaments of all tubes, intermediate 3000-volt rectifier, bias rectifiers, control, water pumps, deep well pump, water cooler and oil furnace.

A separate house transformer of 15-kva capacity is directly connected to the 4-kv bus. This transformer supplies power to all the audio equipment and the heat boxes on the frequency control apparatus as well as all house lights and miscellaneous power to the antenna and rotating hazard beacon.

The direct connected transmitter load with 10-kw carrier at zero modulation is expected to be 33.8 kw, and 42.1 kw with 100-percent modulation. If operated at rated output and zero modulation, 108.5 kw, and 162.5 kw for 100-percent modulation. The total station load will exceed these figures by about six kilowatts made up mostly of lighting circuits.

Program is carried to the transmitter over two telephone cable circuits loaded out to 8000 cycles. The second line normally acts as an emergency pair.

Other additional circuits are in the form of order wire service. All telephone facilities are brought from the pole line on the road to the transmitter building by underground cable.

THE CONTROL EQUIPMENT

The transmitter part of the building is divided into three rooms: a control room, a transmitter room and a machine room. Other parts of the building are incidental to the actual operation of the transmitter.

The control room contains the audio- and frequency-control equipment, the main transmitter switching and control panels, and the control desk.

The entire transmitter is housed in the transmitter room, which is immediately behind the main switch and control panel. The audio- and frequency-control equipment is mounted in five relay racks at the side of the control room. All audio- and frequency-control equipment is in duplicate so that in event of failure to any unit, quick change to the spare is possible. The frequency-control equipment is expected to hold the carrier frequency within plus or minus five cycles of the assigned frequency. The location of the frequency-control apparatus remote from the main transmitter permits adjustments to be made to the spare unit while the transmitter is in operation. The operating condition of the transmitter proper is shown by indicating meters on the front of the switching and control panels. The transmitter proper is normally started and stopped from the control desk located at the center of the room. For testing and locating trouble, separate control over each unit of the transmitter is available on the various panels of the switchboard. Access to the transmitter room is possible only through two interlocked doors located

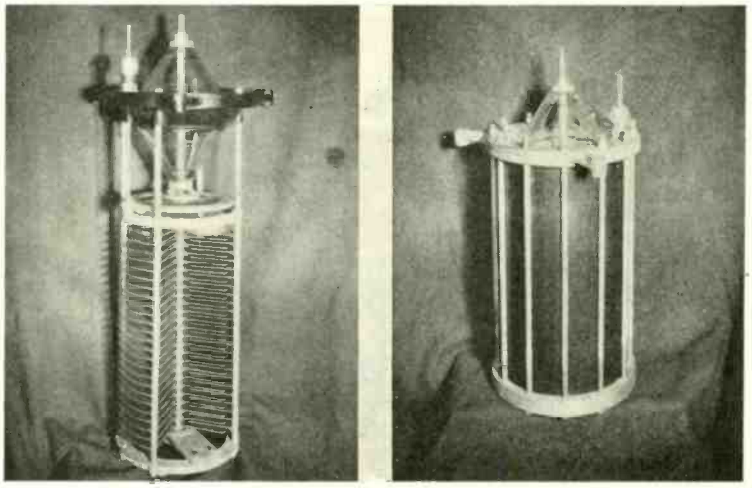


Fig. 7. KYW plate tank condenser, rating: 1500 mmfd, 50 kv, 1 mc, 100-amp., nitrogen filled, 300 pounds.

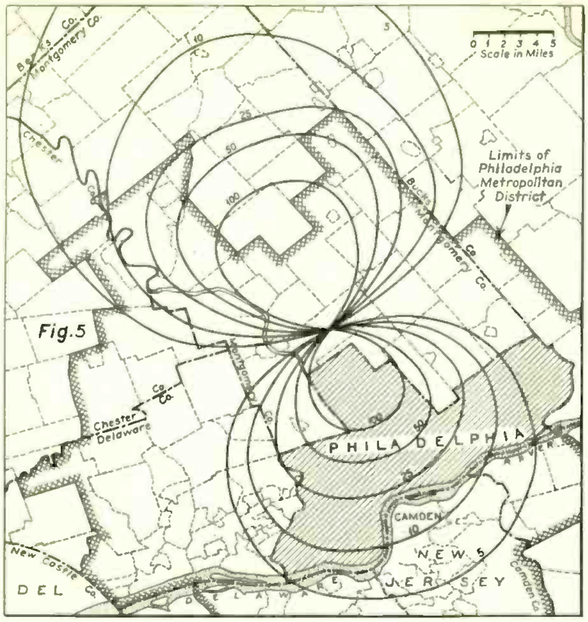


Fig. 5. Results of preliminary survey with a 50-watt test transmitter indicate that the city of Philadelphia will receive a signal of 10 mv/m or more, with a carrier power of 10 kw.

one on each side of the switchboard. Each consists of a double door, the first of sheet steel and not interlocked, the second interlocked and of open steel framework sufficient for good vision of the transmitter but impossible to climb through without opening it, which operates the interlock and grounding switches.

The power transformers and chokes for the transmitter are located immediately behind the outside wall of the transmitter room. Connecting leads from these transformers are carried into the transmitter through porcelain wall bushings.

THE TRANSMITTER TUBES

The transmitter tube component for 10-kilowatt carrier includes an 850, 852, 849 and two 207's in the radio frequency stages and four 211's, two 849's and two 848's in the speech stages.

For normal 50-kw carrier the tube complement would be for radio stages: one 850, one 852, two 849's, eight 207's and the speech stage becomes four 211's. four 849's, four 848's.

HUM ELIMINATION

The operation of all filaments from 60 volts eliminates all filament machines. Little difficulty has been found in such filament operation on air-cooled tubes, but considerable difficulty has been experienced with ac on the filaments of water-cooled tubes. The problem has been satisfactorily solved. Preliminary tests indicate that the overall hum level out of the transmitter will not be more than 60 db below the carrier.

The entire transmitter has been designed to have a frequency fidelity of 2 db from 30 to 10,000 cycles with harmonic distortion at 100-percent modulation considerably below the limit of 10 percent. In starting up the filaments excessive current is avoided by insertion of a variable reactor in the primary circuit of the filament bus. The reactance of this choke is varied by saturating it with a variable dc current. After the filaments have been brought up to normal this reactor is cut out of the circuit and a motor-controlled induction regulator holds the filaments at normal voltage.

PLATE-CIRCUIT CONDENSERS

The plate-circuit condensers on the water-cooled output stage are two small pressure condensers filled with nitrogen gas. They are variable and have a maximum capacity of 1500 mmfd each and are rated at 100 amps at 1 megacycle with 50-kv breakdown. All tuning controls are brought out to the main switching and control panels by flexible drive. The use of these condensers for broadcast transmitters is not common and, for this reason, is a new design feature. The condenser is shown in Fig. 7.

A more detailed discussion of the transmitter is beyond the scope of this paper and will be left for a later paper to be written after the transmitter has been installed.

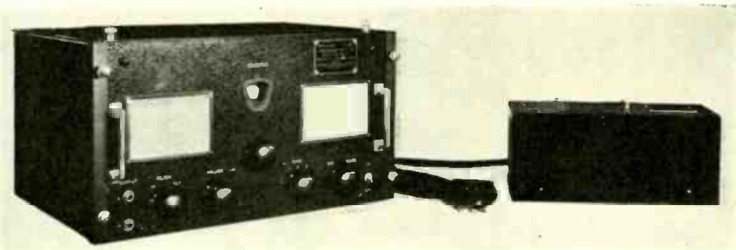
SIGNAL CORPS RECEIVER

CONTRASTED WITH the latest U. S. Army receivers, the usual broadcast receiver is as a carving knife compared with the finest razor. For the Army receivers are capable of slicing a 10-kilocycle band, which is looked upon in usual broadcast practice as the limit of selectivity division, into ten channels if necessary in getting the utmost communication service out of those portions of the ether assigned to our Army communications.

100- TO 1000-KC COVERAGE

The most rigid specifications ever issued with regard to radio reception have been met by the ninety Sylvania intermediate-frequency receivers recently delivered to and accepted by Army officials. Each receiver is designed to cover the three Army communications service bands between 100 and 1,000 kilocycles by means of fixed coils and a selector switch. Both CW and voice are handled. In the case of CW, the receiver is designed for an extremely sharp cutoff, so that only a 1,000-cycle width of signal is admitted to the loudspeaker.

What this means in practical communication terms may be gathered from a typical instance. The Army wishes to receive CW messages from Fort Hayes, located at Columbus, Ohio, through interference from a local transmitter but a mile away from the message center near Washington, D. C. The two frequencies—wanted and unwanted signals—are just 4% apart in frequency. The unwanted signal may have a strength as great as 2 volts, while the desired signal is but an insignificant fraction of that level. Nevertheless, the receiver must bring in the desired signal, clean, strong and reliably, for Army communications service demands practically direct-wire results.



Receiver and power supply designed for the Army Signal Corps.

VOLUME INDICATORS

Low-Speed, General, and High-Speed Indicators For Specific Purposes

By F. X. LAMB
Engineer
WESTON ELECTRICAL INSTRUMENT CORP.

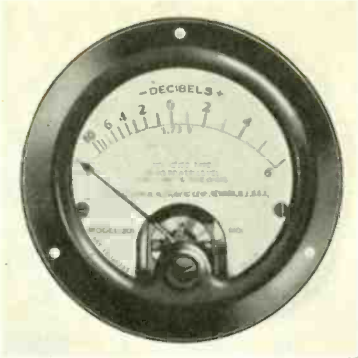


Fig. 1. Type of volume indicator previously used, which had a 0.5-second pointer action and an overshoot of 3 db.

VOLUME INDICATORS, as the name implies, are electrical instruments used to measure sound level or noise level. When the instrument is being used to measure the level of a sound already present, such as the noise in a street, it is called noise level; whereas when the instrument is in the circuit which is producing or amplifying sounds, such as come over the radio, it is called sound level. The instrument itself, however, is impartial and indicates correctly regardless of the nature of the sound or noise.

OXIDE RECTIFIERS REPLACE TUBES

Up until a few years ago volume indicators consisted of a direct-current permanent moving-coil type of instrument used in conjunction with a vacuum tube arranged to act as a rectifier so that the dc which passed through the instrument indicated the magnitude of the ac in the circuit. Due to the non-linear relation between the ac and the dc sides of the tube and the fact that the correct circuit, equipment, etc., was not always available, the volume indicator was not used to the same extent as it is today. The introduction of small copper-oxide rectifiers which can be mounted inside the instrument and calibrated directly with it has changed the picture completely by eliminating the vacuum tube and its complicated circuit and calibration. The instrument manufacturer now furnishes the instrument completely adjusted and correctly calibrated directly in decibels.

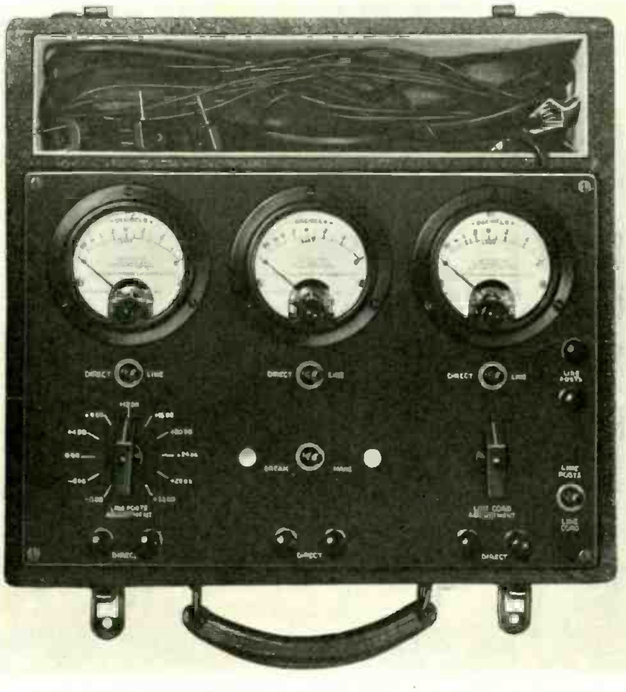


Fig. 2. Demonstration unit having a high-speed and a slow-speed volume indicator at the left and right respectively, and a general-purpose volume indicator in the center.

Along with the changes in circuit as explained above there also have been some major improvements in the instrument itself. One improvement has been in pointer action resulting in turn in more nearly correct indications and better volume control.

LOW- AND HIGH-SPEED INDICATORS

Up until about six months ago the type of instrument most generally used had a pointer action which required about 0.5 second to give an indication. Also, it had an overshoot of about 3 db on the dial, figured —10 to + 6 db as shown in Fig. 1. It has recently been realized that the one indicator could not possibly meet all the requirements because of the great diversification of applications to which db indicators are put. For example, in a studio it is required to indicate the momentary peaks of speech and music so that the volume can quickly be controlled to prevent distortion. This necessitates a high-speed pointer action, fast enough to indicate syllables or short bursts of music. In monitoring booths in motion picture projection rooms a high-speed indicator is not required as the peaks have been previously taken out. Here a slow-speed pointer action is required so that an average sound level can be maintained. This same slow-speed indicator can be used to advantage in public-address systems, noise-measuring apparatus, etc., where it is necessary to know the average level only. In some cases both the high-speed and the slow-speed indicators are used in the same circuit, one to indicate peaks and the other to indicate average level.

GENERAL-PURPOSE INDICATOR

The general-purpose indicator is used as an intermediate between the high-speed and slow-speed indicators and cannot be substituted for either without certain errors resulting. These errors are explained in a subsequent paragraph.

In order to better understand what is meant by "high-speed," "slow-speed"

(Continued on page 19)

TELEGRAPH INTERFERENCE

Part 1 of two articles on the effect of low-frequency power induction on telegraph operation

(From a paper delivered at the Chicago Convention of the American Railway Association)

By L. M. JONES
& C. M. BROWN
Engineers
WESTERN UNION TELEGRAPH CO.

IN THE EARLY DAYS of the commercial telegraph industry, it was not necessary to consider the susceptibility of the circuits to interference from external sources. Today, with the widespread use of wire networks for communication and power transmission, and the development of large urban areas which often necessitates the construction of power and communication leads in close proximity, the adverse effects of stray-power current on telegraph signals becomes a real problem.

MULTIPLEX TRANSMISSION

Before discussing the effect of induction, it is advisable to review a few of the principles of telegraph operation. Since the methods used in hand operation are well understood and since the fundamentals of all automatics are incorporated in multiplex transmission, this review will, in general, be limited to that type of operation.

The multiplex printing telegraph system is designed to be used in connection with duplex circuits, and is often arranged to permit the simultaneous automatic transmission and reception of as many as four messages in each direction over a single line wire.

As shown in Fig. 1, at each end of

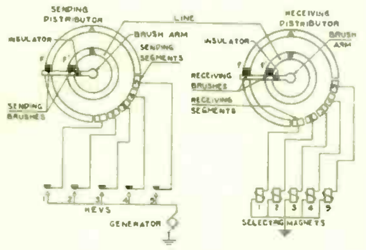


Fig. 1. Fundamental multiplex circuit.

the line there is a distributor consisting of two concentric metallic rings which are insulated from each other. The inner ring is solid and functions as a collector ring to which the line wire is attached. The outer ring is divided into segments insulated from each other. The brush arms at either end of the line make an electrical connection between the inner and the outer rings and rotate in exact synchronism and phase with each other. Thus the two arms hold the same relative positions at all times so that, disregarding line lag, when the sending brush is in contact with sending segment No. 1 the receiving brush is in contact with receiving segment No. 1, and so on.

If we close any combination of the keys and hold them closed until the brush arms have completed one revolution, current will flow through these keys, thence through the distributor at the sending station, the line, the distributing segments at the receiving station, the corresponding selector magnets, and finally will return through the ground.

DIFFERENTIAL POLAR DUPLEX CIRCUIT

To carry the development a step further, let us consider this system operating on a differential polar duplex circuit with the transmitting and receiving sets on a single distributor. Fig. 2 shows this arrangement for one terminal. For each revolution of the receiving brush arms, the line relay, which is a differential polar relay, receives a combination of five signals. Every time a marking signal is received, a current flows locally through the marking contact of the line relay, the relay tongue, and the receiving rings to the proper selecting magnet. For a spacing signal, the line relay tongue is held on its spacing contact which is dead, so that the proper selecting magnet is de-energized.

Transmission is accomplished by applying either marking or spacing battery to the apex of the line relay through the keys and the distributor, five signals being sent per revolution. Since a duplex circuit is employed, these signals will not affect the relay at

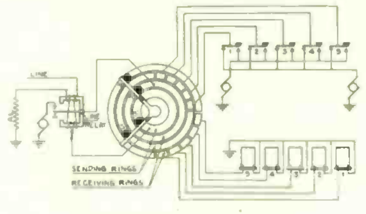


Fig. 2. Duplexed multiplex set.

the home terminal but will operate the one at the distant end of the line. This arrangement accomplishes the same result as the previous circuit, and gives the additional advantages of double-current, two-way communication. Here we have all the essential features necessary for the operation of the multiplex system. With this preliminary we can more intelligently discuss the effect of induction.

A satisfactory telegraph system must afford communication of very nearly 100 per cent accuracy. The ideal telegraph circuit reproduces signals at the

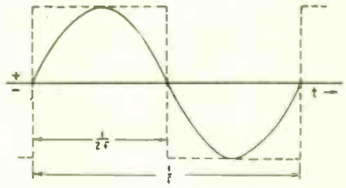


Fig. 3. Actual and ideal received waves.

receiving terminal identical to those transmitted. On such a circuit, a telegraph system can be operated at normal voltages with a satisfactory operating margin and with minimum regulating attention at speeds limited only by the characteristics of the terminal apparatus. On the practical circuit, however, the ideal condition cannot be attained. The attenuation along the line and the characteristics of the terminal apparatus affect the shape of the received signal in such a manner as to make it more susceptible to extraneous interference.

WAVE-FORMS

In order to illustrate this effect, let us consider the ideal signal wave, represented by the dotted line in Fig. 3, in which there is an instantaneous reversal of the received current from a positive maximum to a negative maximum. With this ideal condition, the telegraph signals will be received correctly if the interference is less than the received signaling current, but transmission losses will occur if the extraneous current is opposing and equal to or greater than the received signaling current.

A wave shape that more nearly approaches an actual received current

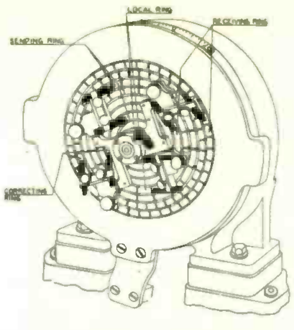


Fig. 7. Multiplex distributor head.

wave is shown superposed on the ideal wave. It can be seen that it approaches sinusoidal form and that it reaches its steady-state value for only a fraction of the time between reversals. Consequently, there is an interval of time in which the current is building up to its maximum value. During this interval, the receiving relay is susceptible to interfering currents of a magnitude which may be less than the steady-state value of the received signal, but which exceed the instantaneous value. It can readily be seen that the slower the current builds up, the greater will be the possibility of extraneous currents distorting the received signal. Therefore, since the rate at which the current builds up is largely dependent upon the circuit characteristics, it is evident that a disturbing current of a given magnitude may cause more distortion on one circuit than on another.

LONG AND SHORT LINES

Perhaps the principles just outlined would be somewhat easier to visualize if we considered the actual received signals for two different line conditions:

(1) A short telegraph line.

(2) A long telegraph line.

Fig. 4 shows the current waves received over two such circuits when free from induction and also when each is subjected to the same magnitude of 60- and 180-cycle interference. Fig. 4-A indicates that the extraneous currents have not only altered the shape of the signal received over a short telegraph line but have also shifted its position. Therefore, in this case there is a small transmission loss.

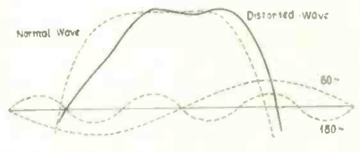


Fig. 4-A. Received signal waves over short telegraph circuit.

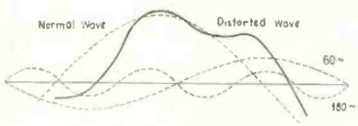


Fig. 4-B. Received signal waves over long telegraph circuit.

Fig. 4-B shows the distortion and time shift experienced on a long telegraph circuit. A comparison of this figure with Fig. 4-A shows that a given amount of extraneous current on a long telegraph circuit not only distorts the wave-shape to a greater extent than in the previous case but also causes an additional decrease in the effective length[1] of the signal.

OSCILLOGRAPHIC STUDY

We have presented sketches of ideal waves and waves affected by distortion. It might be of interest at this point to inspect some oscillograms of actual telegraph signals.

Curve A in Fig. 5 is an oscillogram of transmitted telegraph signals operating at a frequency of 50 cycles per second over a 300-mile line composed entirely of No. 9 copper wire. Curve B is the corresponding received signals. A comparison of these two curves shows that although we transmit a wave which

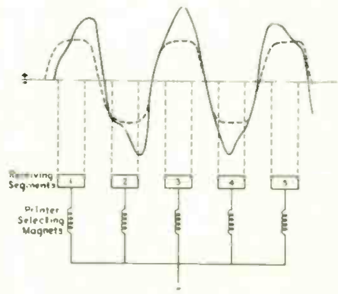


Fig. 8. Effect of distortion on range.

approximates the ideal condition, the natural attenuation along the line so alters it that the received wave is not only of smaller magnitude but requires a longer time to build up to its maximum value.

A comparison of these received signals, without induction, with those in Fig. 6 shows the manner in which signals are affected by 60- and 180-cycle extraneous currents. As pointed out previously, all received signals will not be affected in exactly the manner illustrated here but the tendency in all cases will be to lengthen some signals and shorten others with a resulting variation in effective lengths.

From the foregoing, it is apparent that on a circuit that is subjected to any amount of extraneous interference the received signals may be altered in shape, in length, and in location. The effect of this distortion on telegraph transmission, regardless of the type of circuit operation, is reflected in decreased circuit efficiency.

HAND-OPERATED CIRCUITS

In the case of hand-operated circuits, where the signals are received by listening to a sounder, the effect of a given amount of distortion will differ depending upon the particular receiving operator. In general, however, operators will be in fairly close agreement as to the point at which a circuit becomes unsatisfactory. The distortion at this point may be considerably lower than the amount necessary to cause an appreciable reduction in accuracy of reception but will be sufficient to confuse the operator with a resulting nervous strain and fatigue. It is usually true that the greatest loss experienced on a hand-worked circuit is not due to inaccuracies but rather to the inability of operators to receive efficiently for a long period of time.

MULTIPLEX TRANSMISSION

In the case of multiplex transmission, accuracy is dependent upon the maintenance of synchronism between the transmitting and the receiving brushes. However, it might be well to point out at this time that some variation is allowable before printing errors will occur. The lengths of the distributor sending and receiving segments are not equal. The receiving segments are modified so as to use that portion of the incoming wave which is most reliable. Furthermore, the receiving ring is not rigidly connected to the other rings and therefore can be moved a small amount with respect to them. Thus we can rotate the receiving segments with respect to the incoming signals, both clockwise and counterclockwise, until a point is reached in each direction where false signals are recorded.

Obviously the relative position of receiving segments to signals must be kept within the above limits and the

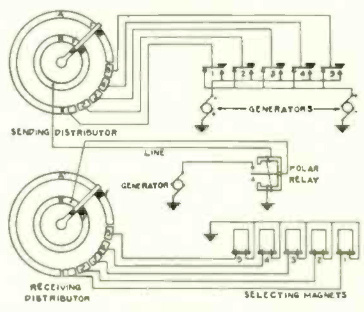


Fig. 9. Sending and receiving circuits with synchronized distributors.

[1]The effective length of a received signal may be defined as that length, measured along the time axis, which would be common to both the normal and distorted waves if they could be transmitted simultaneously over identical circuits, one of which is free from induction. Any reduction in the effective length of a received signal results in an increase in the transmission loss.

most desirable position for the receiving segments is located midway between the failure points. This procedure of determining the arc through which the receiving segments may be turned without causing transmission errors is known as "taking range." It gives the circuit operating margin and is a means of comparing circuit transmission qualities. A scale and pointer mounted on each distributor, as shown in Fig. 7, facilitates these measurements.

This arrangement is perhaps better understood by reference to Fig. 8. In this figure, we have pictured an incoming wave affected by 60- and 180-cycle interference superposed upon a wave free from inductive effects. We have also pictured the receiving segments through which the signals operate the selecting magnets. You will note that the receiving segment in each case is centered with respect to the undistorted (dotted) signal but that there is no common central position with respect to the irregularly distorted signals. It is thus apparent that we can shift the receiving ring clockwise and counterclockwise a considerably greater distance without causing transmission errors when the signal is unaffected by induction. It follows, therefore, that induction results in reduced operating margin.

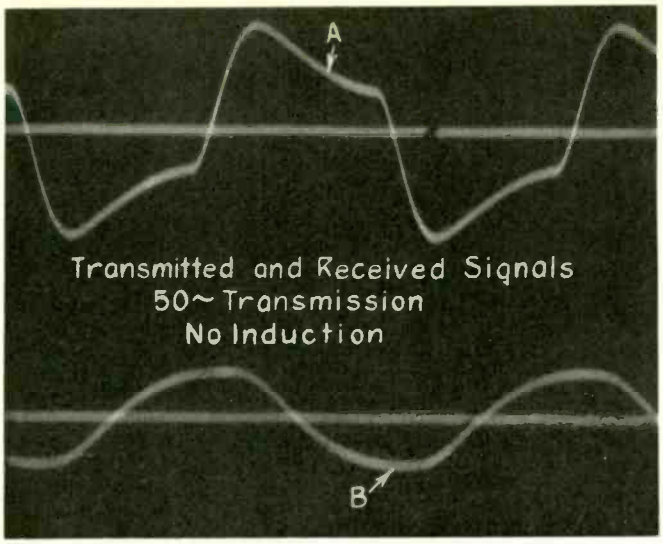


Fig. 5. Oscillograms of transmitted and received signals operating at a frequency of 50 cycles over a 300-mile line composed entirely of No. 9 copper wire.

SERIOUS DISTORTION CONDITIONS

The examples used in the discussion thus far have indicated distortion of a magnitude sufficient to cause a reduction in the circuit margin. We will now consider the more severe condition where erroneous characters result. Referring to Fig. 8, let us imagine a disturbance on the line such that the first signal pulse is lengthened until it controls the polar relay shown in Fig. 9 not only during the time that the brushes are in contact with segment No. 1 but for an appreciable part of the time that they are in contact with segment No. 2. Then, the actual received signals will energize selecting magnets 1, 2, 3 and 5 instead of the intended 1, 3 and 5. It follows that a printing error will occur and therefore the operating margin will have entirely disappeared.

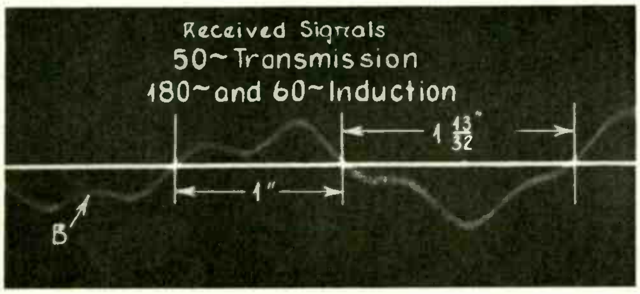


Fig. 6. Oscillogram showing effect of 60- and 180-cycle extraneous currents.

One method of increasing margin is to reduce the multiplex speed. This permits the transmission of longer pulses, and the displacement caused by induction is a smaller percentage of the transmitted signal.

Experience has taught our operating forces that in order to have a circuit work satisfactorily through varying weather conditions, it is desirable that the working margin at the time of "line up" be above a fixed minimum. Therefore, since satisfactory operation is imperative, it is generally necessary to decrease the operating speed whenever the margin is reduced below the accepted minimum. Regardless of whether the effect of the distortion is reflected in reduced signaling speed or in reduced operating margin, the efficiency of the circuit is reduced, and the cost of transmitting messages correspondingly increased.

(To be continued)

TRANSFORMERS FOR CLASS B MODULATION

By M. J. OMAN
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KENYON TRANSFORMER CO.

THERE ARE A NUMBER of problems which must be mastered in the construction of a Class B driver transformer. The source of power is a Class A stage with whose characteristics we are familiar. This presents no unusual difficulties. The secondary load of the Class B grids, however, varies from practically nothing on the negative travel of the grid potential to a quite finite and low value depending on the type of tube and how far positive the grids are driven It can be seen that only one-half of the secondary is loaded at any instant and that this load will vary between wide limits. In order that this varying load shall not affect the wave shape of the voltage applied to the grids, the transformer must have a relatively low secondary impedance as compared to the lowest value reached by either grid in the most positive point of its travel. Its regulation as affected by either resistance or leakage reactance must be kept low.

The leakage reactance factor requires more than usual attention because of the fact that only one-half of the secondary is loaded at any instant while the other half of the winding has no current flowing in it, and, therefore, offers no resistance to the passage of leakage flux other than the normal air path re-

(Continued on page 29)

A *FLOATING* RADIO OFFICE

WHEN TWO YACHTSMEN from opposite sides of the Atlantic met off Newport in their test of skill with a primitive means of marine transportation, a curious contrast was provided by the ultra modern methods of communication employed to flash news of the outcome to far corners of the world.

FLOATING RADIO OFFICE

Radio was present at the races in a variety of services. The Diesel yacht *Norsaga*, especially chartered for the events by three of the subsidiaries of the Radio Corporation of America, was transformed into an extremely busy radio office, from which reports were flashed by dots and dashes to newspapers across the earth and by words to the NBC studios in the RCA Building, for transmission over the networks.

View of the receiving and dispatch positions in one of the cabins on the Norsaga. Note the Navy receiver to the left, the automatic tape senders, and the short-wave receiver.

DESCRIPTION OF APPARATUS

The following description of the *Norsaga's* special radiotelegraph apparatus was supplied by Charles J. Pannill, Executive Vice President of the Radiomarine Corporation of America. "In the after cabin there were two short-wave, 150-watt, marine radiotelegraph transmitters," he said. "Probably no marine transmitters ever cleared traffic as quickly as these units, for they were connected to automatic tape senders capable of operating speeds up to 200 words a minute. The transmitters were equipped with master oscillators in order that the motion of the yacht—and there was plenty on some occasions—would not alter the frequency on which operation was being accomplished.

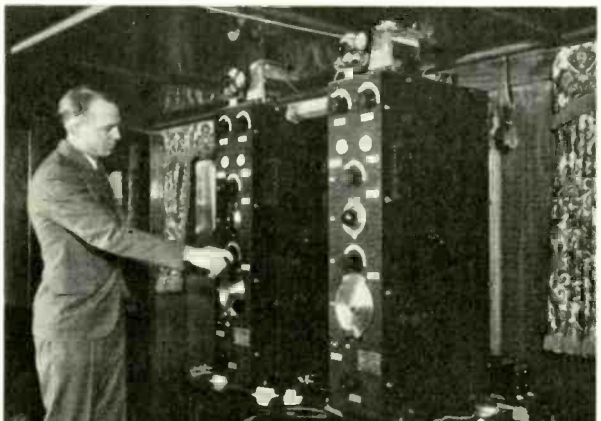
OPERATING HOOKUPS

"One transmitter was assigned to handle messages from the yacht to American addresses. These were received instantly in the RCA central office in New York City, after having passed automatically through the RCA receiving station at Riverhead, L. I. Through the second transmitter, signals destined for England automatically operated high-power RCA transmitting stations at Rocky Point, Long Island, from their point of reception at Riverhead. The wireless operators on the yacht at sea were thus in direct control of the radio stations on land."

Announcers and engineers of the National Broadcasting Company occupied the forward cabin, which was equipped with their special broadcasting gear. The words of the commentators were received by a mobile radio station on shore directly connected with the Company's studios in the RCA Building at Radio City, New York. Broadcasting stations at Bound Brook, N. J., and Schenectady, N. Y., which are part of the NBC national network, sent the programs by short wave to England and other countries.

On the *Norsaga* alone, NBC employed one short-wave transmitter, one short-wave and one ultra-short-wave receiver. The 50-watt short-wave transmitter was used to send the comments of announcers on the *Norsaga* to the mobile station on shore, and the short-wave receiver, operating on a different frequency, received the broadcasting "cues" from the same shore mobile station which passed the program on to the New York studios.

The ultra-short-wave receiver was employed to receive reports from the Committee Boat *Wilhelmina*, and when it was desired to have announcements from that vessel put on the broadcasting networks, an ultra-short-wave receiver was connected to the transmitter of the mobile unit. In some instances the committee boat was too far at sea for direct reception of ultra-short waves on shore, and on these occasions the signals were automatically relayed by short wave from the *Norsaga*. This is believed to be the first successful double radio relay of voice through marine facilities.



Interior view of one of the cabins on the Norsaga, showing the 150-watt marine radiotelegraph transmitters.

SHORT-WAVE AIR TRANSPORT

Two-way, short-wave communication system blankets country and is equivalent to thousand-mile telephone party line with ten to forty subscribers

THE RAPID GROWTH of air transportation is due, in a large measure, to the vision of a few leaders in the aviation field who saw that fast, scheduled service must be given on frequent, dependable departures. The increase in cruising speeds to around 200 miles an hour and the scheduled arrivals and departures at one eastern airport alone of over 100 transport planes per day shows how successful these pioneers have been in their endeavors. The dependability of scheduled flights is limited mainly by weather and while man cannot control the elements he can utilize his knowledge of these conditions so as to take advantage of, or circumvent them.

Radio, therefore, was required to link the trained observers on the ground with the pilot flying the airway. One of these radio aids for air transportation is supplied by the Department of Commerce. Radio beacon signals guide the pilot from airport to airport by their invisible path along the airways while weather reports by radio telephone are given him at frequent intervals. This radio transmission is on frequencies between 220 kilocycles and 365 kilocycles. As considerable information has already been published on the aids provided by the Department of Commerce, we will devote most of our attention to two-way communication.

TWO-WAY COMMUNICATION

The other radio aid is supplied by the transport lines themselves and provides two-way radio telephone communication between planes in flight and ground stations located at strategic points along the airway. This transmission is on short waves, the day communication being on frequencies in the neighborhood of 5 megacycles while communication after dark is in the region of 3 megacycles.

Each air transport route is assigned certain frequencies for its individual use. The planes and ground stations of an individual line are, therefore, on a common frequency at all times. This gives the radio communication system the appearance of a party telephone line 1,000 or more miles long with from 10 to 40 subscribers who may talk so that all of the others can hear their transmission simultaneously. As an example, Transcontinental and Western Air, operating from Los Angeles to New York by way of Kansas City, carries on transmission east of Kansas City on a frequency of 4987½ kilocycles in the daytime and 3088 kilocycles at night. The division west of Kansas City operates on a frequency of 4967½ kc in daytime and 3072 kc at night. In referring to the map (Fig. 1), it will be noted that nine ground stations, together with all aircraft along the eastern section of the air way, operate on a single frequency. This same splitting of frequencies exists on United Air Lines and American Airways, each of which has four day and four night frequencies, respectively. The remaining air transport lines, because of their shorter runs, have a single day and night frequency.

GROUND STATION EQUIPMENT

There are in operation over 100 ground station radio telephone transmitters similar to the one shown in Fig. 2. In this photograph, the unit at the right is the Western Electric 2-B Rectifier which operates from a three-phase, 60 cycle, 220 volt line. It delivers power to the 9-B Radio Transmitter which is shown at the left. The transmitter employs in this circuit a temperature-controlled quartz crystal oscillator operating at one-half the carrier frequency followed by a doubler stage, a 50-watt modulating amplifier and a power amplifier. Three 50-watt vacuum tubes in parallel, form a single stage audio amplifier furnishing audio-frequency power to completely modulate the carrier in the modulating amplifier. The carrier frequency is held to within .025 percent of its assigned frequency by the use of a temperature-controlled quartz crystal frequency control. This unit is very interesting because of its ruggedness and small size. It is used interchangeably between aircraft transmitters and ground stations and a similar unit is also used in the short-wave receivers for both aircraft and ground station use. This quartz-crystal oscillator is a small plug-in unit weighing approximately 5 ounces. Because of the low temperature coefficient of the crystal, the temperature-regulating system can be discarded for most applications. A full discussion of this radical development in quartz crystals is published in the *Bell System Technical Journal* of July 1934.

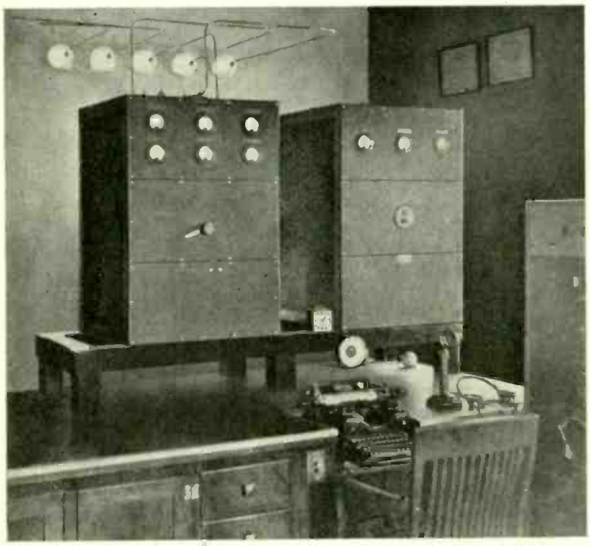


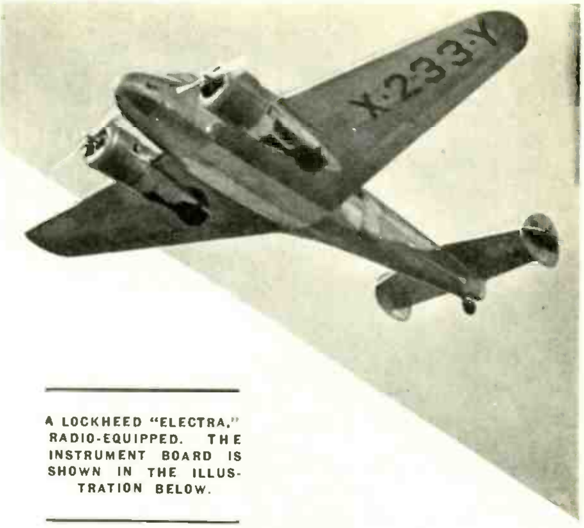
Fig. 2. Close-up of the radiophone equipment in the Western Air Express ground station at Las Vegas, New Mexico, showing the 400-watt transmitter at the left and the rectifier unit at the right.

ANTENNAE SYSTEMS

The power output of the transmitter is 400 watts and is capable of complete modulation. The carrier is controlled by means of a key which is a part of the desk stand. The operator merely

COMMUNICATION

By F. C. McMULLEN
WESTERN ELECTRIC CO.



A LOCKHEED "ELECTRA," RADIO-EQUIPPED. THE INSTRUMENT BOARD IS SHOWN IN THE ILLUSTRATION BELOW.

presses the key to talk and when he has finished releases the key, thus stopping the carrier. The antennae used for transmitting are almost universally of the half-wave type, a separate antenna being used for each frequency. The transmitter is designed to work into a transmission line of 500-ohms impedance. A single-wire transmission line of this characteristic impedance is used to couple the output of the transmitter to the antenna and a dummy antenna of 500-ohms resistance incorporated in the transmitter is of great assistance in making the original installation and also serves as a check for subsequent readjustments.

THE RECEIVER

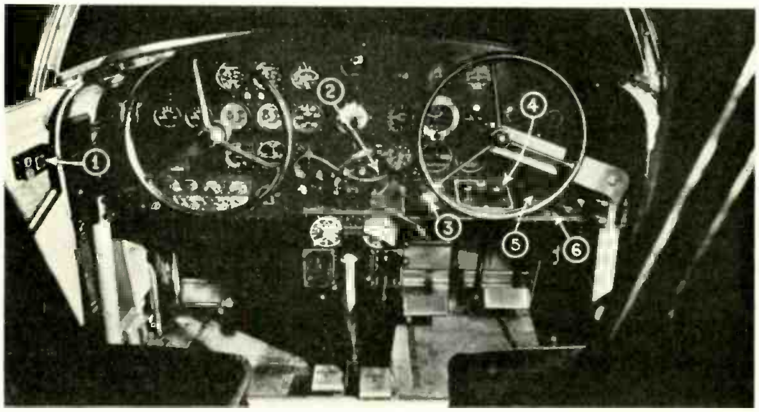
The 11-A Radio Receiver shown at the right of the operator's chair in Fig. 2 is of the superheterodyne type. It is used in this particular installation in conjunction with a remote antenna system located about 1,000 feet from the receiver. The day and night frequency antennae are coupled to the receiver by means of a lead-covered transmission line buried in the ground. This arrangement allows the antennae to be placed at suitable distances from radio frequency disturbances arising from a local power plant which is located very close to the operating room. Switching from the day to the night frequency antennae is accomplished by means of a snap switch in the operating room. Some airport locations are so noisy that the receiver must be located many miles away from the operations office and in such situations the 11-B Radio Receiver is used. This receiver is very similar to the one shown in the illustration except that the control of volume and frequency selection is made by the operator over a telephone line. This receiver is tuned to two fixed frequencies and the oscillator frequency is controlled by means of two quartz-crystal oscillators of the type described.

PREPARATION OF AIRCRAFT FOR RADIO INSTALLATION

It is necessary that the airplane be prepared for the installation of radio equipment. When the very high sensitivity of the high-frequency receiver is compared with that of a standard automobile set, the problem of quieting the electrical disturbance arising from 36 or 54 sparking plugs will be appreciated. In the aircraft, the entire ignition system must be shielded and the plugs are given special attention by housing them in individual shield cans. The entire electrical system of the plane, including lighting, instrument and battery wiring is usually shielded by means of aluminum conduit and all metal members of the plane are bonded together, making this metallic structure a continuous low-impedance path for radio-frequency currents. When this work is done thoroughly and is properly maintained, the full sensitivity of the receiver can be utilized down to the static level and reception is not distorted by local radio-frequency disturbances arising from the plane itself.

ANTENNAE FOR USE ON AIRCRAFT

It is obvious that the antennae used for high-frequency reception and transmission should be as efficient as can possibly be installed. A variety of antennae are used by transport lines, one type in general use being the loaded mast type. The increase in cruising speed has brought this type into disfavor, since the present trend is toward an antenna offering less resistance to airflow. On night mail ships, these fixed antennae also suffer from icing and may break away from their supporting structures. Several large transport companies are experimenting with a trailing wire antenna which comes out of the tail cone of the plane and extends to the rear in a horizontal position. It is held in this position by the speed of the ship. This antenna is efficient and has the further advantage of being remote from the disturbances arising from the engines and electrical equipment located near the nose of the ship. A separate antenna is required for the weather and beacon receiver. This ordinarily takes the form of a vertical mast but due to the air resistance of such a structure and its tendency to gather ice, the trend is toward a sloping wire extending from the fuselage to the vertical stabilizer, or other types



(Photo courtesy Lockheed Aircraft Corp.)

Instrument board of the Lockheed "Electra." The units are: (1) microphone-headset jack box; (2) microphone and headset; (3) remote tuning control for long-wave receiver; (4) control unit for short-wave receiver; (5) remote control unit for transmitter; (6) crystal-heating switch.

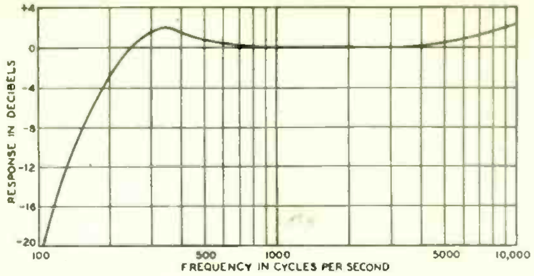


Fig. 4. Overall audio-frequency characteristic of transmitter.

of wire antennae offering low air resistance.

POWER EQUIPMENT

Plate power for the radio equipment is normally secured from two dynamotors operating from the airplane's 12-volt battery. It is a requirement that radio equipment be operated while the plane is at rest on the ground with the engines dead so that communication can be maintained in case of an emergency landing at some isolated field. It is for this reason that the dynamotor source of power supply is universally used by all airlines in the United States. The 200-volt dynamotor operates while the radio receivers are in use, while the high-voltage dynamotor, which delivers 1050 volts to the radio transmitter, operates only when the pilot presses the microphone button to talk. Because of the relatively heavy load drawn by this transmitting dynamotor, a 50-ampere charging generator directly coupled to the engine is normally used to keep the battery charged. One large airline is using a recently developed double voltage, engine-driven generator which may be used as a dynamotor or as a generator, as the pilot desires. This one unit replaces the battery-charging generator and high-voltage dynamotor.

AIRCRAFT INSTALLATION

It is very desirable that the aircraft be able to change instantly between day and night frequencies while in flight. This condition is due to the large number of planes in the air at the time when the ground stations desire to shift frequencies from day to night or night to day. Since all ground stations and aircraft within a division operate on the same frequency, it is necessary that the change be accomplished simultaneously throughout the entire division, which may be 1,000 or 1,500 miles long, in order to preserve uninterrupted communication facilities with all stations.

The aircraft equipment, therefore, is arranged so that the pilot can make this frequency shift by turning a knob on a control unit located in the cockpit. This control knob links the transmitter and receiver mechanically and a warning lamp in the cockpit glows until the frequency shift has been completed.

PILOT'S RECEIVER

The 12-A Short-Wave Receiver is an 8-tube superheterodyne. It employs quartz crystal oscillators to maintain the oscillator frequency constant. This insures positive tuning of the receiver to the correct carrier frequency without attention on the part of the pilot. The sensitivity of this receiver is such that an input of but one microvolt at the antenna will give satisfactory output for headphone operation. The action of the automatic volume control is extremely important in aircraft receivers for, in addition to the usual fading due to variation in the transmission path, there is a very large change in signal strength due to the speed of the plane. The field strength may vary from 500,000 microvolts when the plane is near the transmitting antenna to a few microvolts when it is out on its course. The automatic volume control employed

Fig. 1. Airline routes using two-way radio communication. Location of ground stations is indicated by dots. The stations referred to in the text are circled.

in the 12-A Receiver allows the audio output to be held within satisfactory operating limits with a variation in signal input of 10,000 to 1. A manual gain control is provided in the cockpit so that the pilot may adjust it as he desires, though under normal flight conditions no adjustment is necessary.

PILOT'S TRANSMITTER

The companion unit to the 12-A Radio Receiver is the 13-A Radio Transmitter. The principal circuit features are shown in the simplified schematic of Fig. 3. The radio-frequency circuit consists of a quartz crystal oscillator and two stages of radio-frequency amplification employing special screen-grid tubes, thus eliminating the necessity of neutralization. The coupling transformer between the oscillator and first amplifier and between the first and second amplifiers have band-pass characteristics. It is not necessary to tune these units, as the correct input transformer for the required frequency band may be plugged in its receptacle. The antenna circuit is the only one requiring adjustment and this is necessary because of the widely different characteristics of antennae commonly employed in aircraft work. There are three channels provided in the 13-A Radio Transmitter and the usual practice is to use one channel for day and one for night frequency, while the third may be used on 3106 kilocycles or for any other frequency the transport operators may desire.

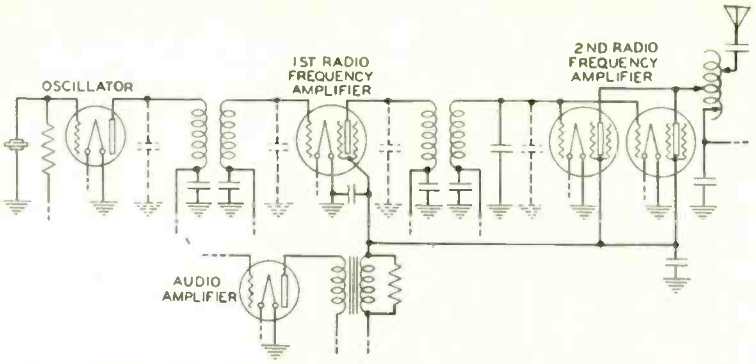


Fig. 3. Simplified schematic of transmitter showing only one frequency channel and omitting the dc circuits.

The modulation system employed in the 13-A Radio Transmitter is directly responsible for its very satisfactory overall efficiency. Deep modulation of the 50-watt carrier is accomplished with about one watt of audio-frequency power. The overall audio-frequency characteristics of the transmitter are shown in Fig. 4. The low frequencies are purposely attenuated in aviation work to reduce the amplitude of the airplane noise picked up by the microphone.

OPERATION OF PLANE EQUIPMENT

The operation of the radio equipment on the airplane is extremely simple. The pilot merely turns on a switch when he takes charge of the airplane on the ground and his radio receiving equipment is placed in operating condition. When he wishes to transmit, he flips another switch, presses his microphone button and talks. During the two-way communication he merely presses the microphone button to talk and releases it to receive, and upon completion of his conversation throws the second switch to the "off" position until he is ready to transmit again.

While there are many other aspects of short-wave communication in the air transport service, the foregoing covers the essential features of the equipment now used by the major air lines throughout the United States. The need for radio communication has more than proven itself in the past few years. It has steadily become an increasingly important factor and is now considered essential in a system of safe and dependable air transportation.

VOLUME INDICATORS

(*Continued from page* 11)

and "general-purpose" indicators, a brief statement of facts pertaining to them seems in order.

CHARACTERISTICS OF INDICATORS

The "high-speed" indicator was purposely designed to be very fast in action and to have a minimum overshoot of the pointer. It requires about 0.2 second to give an indication and the overshoot does not exceed 0.5 db at "0" level.

The "slow-speed" indicator was intentionally designed to be very slow in action and to have no overshoot at all. This meter indicates the average level over a time interval of approximately 2 seconds.

The "general-purpose" indicator has a medium pointer action requiring about 0.5 of a second to indicate. The pointer overshoots about 3 db at "0" level.

To really see the advantage of each of these indicators and to better understand the purpose of each it is necessary to parallel the three of them on the same system and watch them in action. The three indicators can be mounted as shown in Fig. 2 with the "high-speed" at the left; the "general-purpose" in the center and the "slow-speed" at the right. Fig. 2 shows a demonstration which was used to show the relative advantages of the three indicators. It was fitted with keys, circuit chopper, etc., to artificially produce various electrical impulses in case circuits were not available to which the indicators could be connected.

TABLE I

	High Speed	*General Purpose*	*Slow Speed*
Scale	(—10)—0—(+6)	(—10)—0—(+6)	(—10)—0—(+6)
Approx. time to indicate	0.2 second	0.5 second	2 seconds
Overshoot at "0" db	0.5 db or less	Approx. 3 db	None

The results shown when the three meters are paralleled are somewhat surprising because it shows that under certain conditions the general-purpose indicator will overshoot and indicate +3 db when the level is actually "0" db. It is also noticed that under other conditions the general-purpose indicator will read —3 db when the level is actually "0" db. This time, however, the error is caused by actual slowness of the meter as it is not fast enough to get all the way up to "0" before the level begins to drop off. On both of these occasions the high-speed indicator faithfully indicates "0" db which is the true level. It is also noticed that there is a very pronounced correlation between the eye and the ear when watching the high-speed indicator. This is still true to some degree with the general-purpose indicator but not nearly so markedly.

The slow-speed indicator at all times indicates the average power level over approximately 2 seconds interval.

The characteristics of the three indicators are summarized for comparison in Table I.

Db indicators are normally adjusted to indicate "0" db with 1.73 volts if for use on a 500-ohm line, or 1.89 volts if for use on a 600-ohm line. In both cases "0" db corresponds to 6 milliwatts. The indicators have a resistance of 5000 ohms at "0" db. Indicators can also be adjusted down 10 db by reducing their resistance.

POLICE-

By M. B. SLEEPER

This is the first of two articles by a specialist in the field. It points out some successes and failures, and suggests future developments

(Photo courtesy Western Electric Co.)
In the radio room at Police Headquarters, New York City, the announcer is sending out an alarm. The panel at the right is the speech input equipment.

TALKING TO POLICE and municipal officials in many cities east of the Mississippi, and visiting police headquarters where radio signalling systems are in operation or are projected, it is very clear that high-pressure radio sales tactics have put the police departments very much on the defensive, as a result of conflicting technical arguments advanced by some salesmen who, without any knowledge of police arganization and methods, have been called upon to sell the products of the factories they represent, regardless of the adaptability to conditions under which the equipment must be used.

FAILURES KEPT UNDER COVER

For example: A city of 20,000 population, which is large enough to have a well-organized police department, purchased two-way radio equipment for three cars. The chief spoke enthusiastically about the installation, the dependable operation and the saving effected by cutting out six signal boxes which were connected to headquarters over leased wires.

But what a different story came from the officer whose job it was to service the apparatus. The notes made at the time of the visit record the complaints of the radio officer:

1. Something was going wrong all the time with the car equipment, and never the same thing twice. On the average, two cars were on the road, and one in the garage.

2. Tube life in the ultra-frequency headquarters transmitter was so short that, for reasons of economy, they had eliminated the half-hour test signal. NOTE: *The cars were on patrol duty only* 15 *hours in* 24.

3. Batteries in the cars had to be removed for charging every four or five days. Such frequent changing wore out the terminals, and required repairing.

4. Vibrating B eliminators were overloaded, and required constant service and replacement.

5. The frequency of the car transmitters was unstable, and called for correction every few days.

6. The operation of the system was splendid when everything was in order, but owing to the general instability of the equipment, that condition was impossible to maintain.

7. The total cost of service and replacements was much higher than the saving effected by cutting out police boxes.

EVERY OFFICER MUST KEEP HIS JOB

It is not to be inferred that the chief intended to mislead me by his statement of satisfaction. Not at all. But no radio officer can pass his troubles on to his chief. It's his job to keep the radio going, no matter what happens, nor how much over-time he must put in. And even if the chief knows that the equipment is falling below the representations of the manufacturer, he cannot very well admit that the purchase was a mistake. He must carry on with what he has, and make the best of it.

So the radio officer shoulders the burden, and the chief writes glowing recommendations to the manufacturer, whose salesmen, with honest enthusiasm sell more ill-suited equipment in other cities.

POLICE RADIO ISN'T A BROADCAST STATION

Police radio is still so new that, despite its short-comings, it still registers success to the officials, just as it did to the public in the days of headphone broadcast reception. In fact, many police transmitters are of a design originally intended for broadcasting, but of designs now obsolete for that kind of service.

To the radio engineer, a good transmitter is a good transmitter—until he has an opportunity to become familiar with the special requirements of police signalling, and the conditions of operation.

For one thing, in a police station, the radio equipment is given its place among the other appurtenances of the department, and is given like consideration in the hands of men who have been trained in a rough-and-ready school of heavy-fisted means for meeting emergencies. These are the men who are responsible for the use and maintenance of the station. Officers for the cars are selected for their ability to think, act, and shoot quickly. The car equipment is in their hands.

Considering these conditions, it is obvious that transmitters designed to be attended by broadcast station engineers, and car apparatus suitable for pleasure vehicles, is out of place in police departments.

There are several cases on record where police transmitters have been off the air four hours or more just because a small resistor or fixed condenser broke down. These failures occurred in broadcast station types of transmitters where small parts were hidden away in box-like units. The delay was not caused by the time required for making the actual replacement but by the delay in removing other parts and wires in order to reach the faulty part. Elaborately cabled wiring, a nightmare to police radio servicemen has caused other serious delays.

Only one manufacturer, to my knowledge, has expressed an understanding of the necessity for making every part of the transmitter instantly accessible by suitably distributing the various elements on quick-removable panels.

Another serious error is the use of transceivers in the cars. When something goes wrong, both the transmitter and receiver are put out of commission. Furthermore, it is customary to mount two-way car equipment at the rear, where it is subjected to the most severe pounding.

TRANSMITTER MUST BE INACCESSIBLE TO CRIMINALS

It is no wonder that municipal officials are wary of claims and statements made by radio sales representatives, for competition calls for sharp wits and since they have no skill in planning installations best suited for police use, and for efficient cooperation with existing signal equipment, they fall back on technical smoke screens.

The antenna design and its cost has been used repeatedly as a smoke screen for trading purposes. In one mill city, a lengthy discussion which nearly resulted in the erection of the antenna and transmitter in a park two miles distant from headquarters, proved to be one representative's method of diverting attention from the high price of inferior apparatus. He claimed that the park, being the high point in the city, was the only place from which efficient and dependable communication could be obtained. That he was entirely mistaken was proved subsequently when the station was installed at headquarters.

But, in his attempt to use trading tactics to get the order, he very nearly led the police department into a very serious mistake: Police radio performs many vital functions in maintaining peace during times of labor trouble. The park where the police were urged to erect the radio station is always used for meetings during strikes. At any time it would be easy to put the entire police radio system out of commission, and at such an exposed location, it would be impossible for the police to protect the station during emergency conditions.

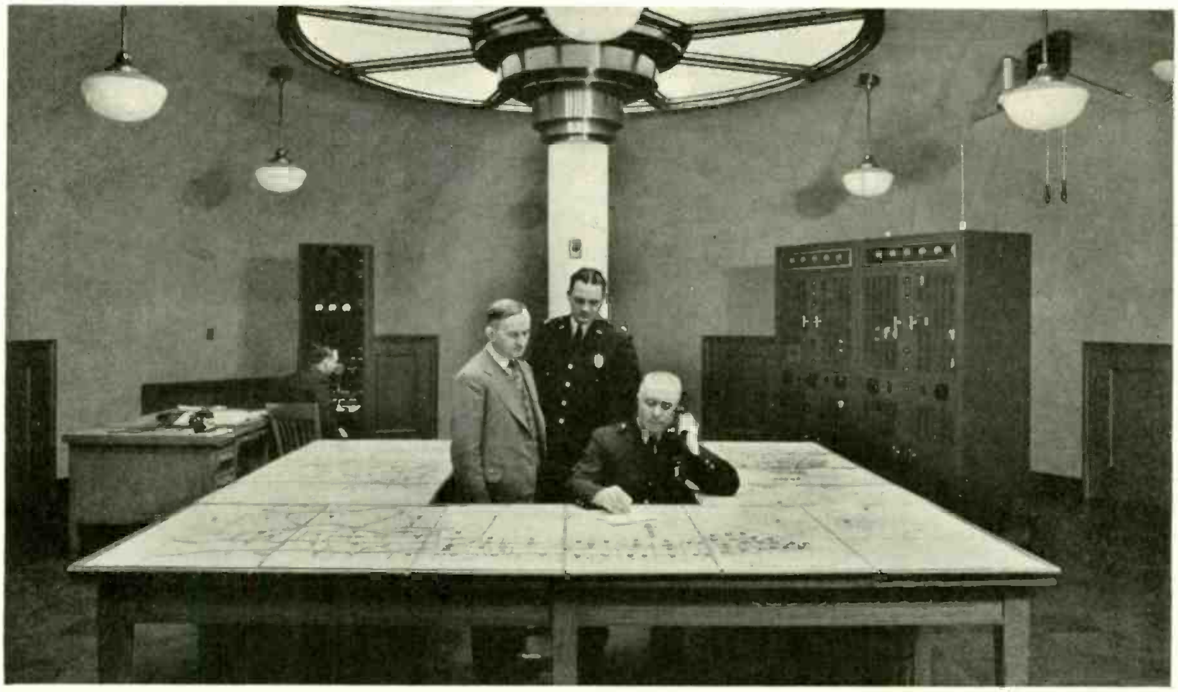
For this reason, the transmitter belongs at headquarters, and the antenna and the lead-in must be so installed that they cannot be tampered with by unauthorized persons.

RADIO MUST MEET EMERGENCY CONDITIONS

It is true that in most cities police departments have more trouble in getting appropriations for technical equipment than the fire departments. Criminal activities have somewhat modified this condition in the last year, but it is still true that the funds available to the police are too often inadequate. It is also true that manufacturers have sold much police radio apparatus at an actual loss.

For example, the sales and development expense is so high—something that municipal officials cannot understand—that a 50-watt transmitter and six car receivers of proper design cannot be installed for $3,000. Prices, unfortunately, are largely affected by local amateur competition. In one city, the chief

(*Continued on page 25*)



(*Photo courtesy Western Electric Co.*)

In the radio room at Police Headquarters, New York City, Chief Engineer Rochester and Captain Morris of the Telegraph Bureau are observing the dispatcher who is taking down an alarm. At the left rear, the announcer is sending out an alarm.

44775

ULTRA-SHORT-WAVE BROADCASTING

By R. J. KINGSLEY
CHIEF TECHNICIAN
WBEN — BUFFALO

TO ULTRA-SHORT-WAVE station W8XH, located on the top of the Hotel Statler, in Buffalo, N. Y., goes the honor of being the first broadcaster to transmit programs for the direct entertainment of the general public on an ultra-high-frequency channel.

7.3-METER BROADCASTING

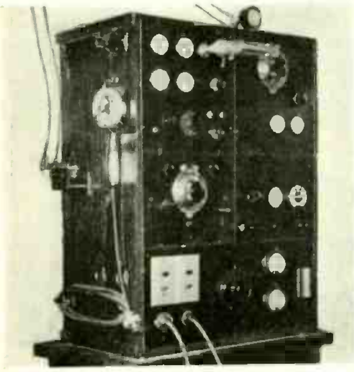
W8XH is owned and operated by WBEN, Inc., and operates daily schedules on a frequency of 41,000 kilocycles or a corresponding wavelength of 7.3 meters. Its operating schedule covers a period of approximately five hours daily and the programs broadcast are as carefully prepared as are the programs of any broadcasting station. The station has its own program director and technical staff. It is, of course, operated on a non-commercial basis due to the experimental nature of the work.

The 7.3-meter broadcasts are for the purpose of determining the possibilities of the ultra-high-frequency band as a means of broadcasting musical programs in local city areas and to determine the public reaction by the actual broadcast of high-quality programs.

W8XH went on the air officially for the first time on March 18, 1934, with two one-hour schedules a day. It now averages five hours per day and it is expected that the schedule will be increased even more in the near future.

ULTRA-SHORT-WAVE COVERAGE

WBEN engineers for the past two years have been studying ultra-short-wave transmission. With the completion of the new transmitter a field survey of the radiated signal indicated that practically the same coverage could be obtained on the ultra-short-wave as is obtained by the average low-power regional broadcasting station and with a great deal less power into the transmitting antenna.

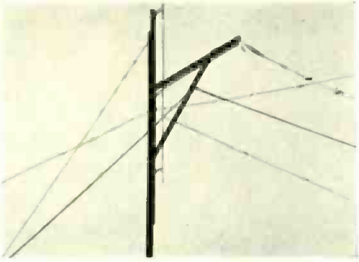


W8XH transmitter—41,000 kc.

ADVANTAGES OF ULTRA-SHORT WAVES

When these facts are considered it is realized that the ultra-short-wave channels hold very wonderful possibilities for the broadcaster. The over-crowded broadcast band could be devoted entirely to high-power, clear-channel stations and would be used for country-wide coverages. The local or regional stations would operate in the ultra-short-wave band and would serve local city areas which is really all that a local regional broadcasting station now does.

There are also other advantages such as freedom from static and fading and the possibilities of very high-quality transmission due to the wide frequency range which could be used. The only interference experienced is from automobile ignition systems which radiate about half a block and cause a popping sound in the receiver. This, however, is a condition which can be overcome by means of proper receiver antenna locations and shielding of the interference at its source.



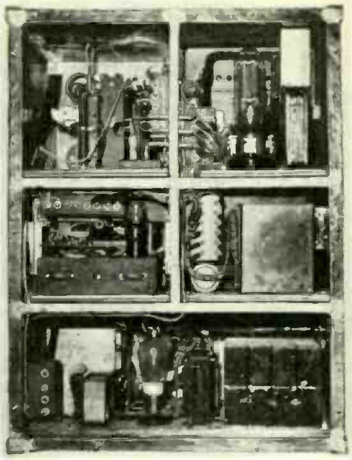
Vertically-polarized antenna at W8XH.

HIGH-FIDELITY TRANSMISSIONS

It will be seen then that stations operating on the ultra-short-wave band would not need to be restricted to a channel only ten kilocycles wide but could be assigned to a channel 15 or even 20 kilocycles wide. This would permit the full, rich, wide range of frequencies to be broadcast. Stations could operate on the same frequency without interference from each other providing they were spaced about two hundred miles apart.

VERTICALLY-POLARIZED ANTENNA

In the case of W8XH the transmitter is located in the downtown Buffalo district on the top of the Hotel Statler which gives the antenna a heighth of about three hundred feet above the ground. The antenna is a one-half wave vertically polarized system which is fed over a tuned two-wire transmission line seventy feet long. The transmitter is designed so that it can be used either for stationary or mobile work as the occasion may require. Incorporated as a part of the transmitter unit is an ultra-short-wave receiver and a complete broadcast receiver. The broadcast receiver is used for starting cues in case the transmitter is used for a remote pickup job for WBEN.



Rear view of W8XH transmitter.

LISTENER REPORTS

Reports from listeners up to sixty miles from the transmitter are that the signal is strong and does not fade. At such a distance however, the receiver must of course have a favorable location. Up to twenty-five or thirty miles loudspeaker volume can be obtained in the average home with the vertical receiving antenna located on the second floor or in the attic and a single-wire transmission line brought down to the receiver.

SIGNAL STRENGTH

Within the so-called primary area of the transmitter little trouble is experienced by large building shadows. Steel viaducts have no effect on the signal. However, as the outer limits of this primary area are approached, large buildings and viaducts between the transmitter and the receiving point will lower the signal strength. The fact remains, however, that with a high transmitter location in the center of a city, that city, with all its outlying residential districts can be completely covered with an ultra-high-frequency signal of sufficient strength to operate satisfactorily the receiving set loudspeaker.

High-Fidelity Broadcast

Class B Modulation

By I. A. MITCHELL

Chief Engineer

UNITED TRANSFORMER CORP.

THE KEYNOTE OF broadcast transmitter design over the past few years has been "high fidelity." The importance of this trend is apparent when we consider, for example, the case of one broadcasting system which spent $200,000 more than normal cost on studio and transmitter equipment to obtain high-fidelity operation rather than have mediocre performance.

HIGH-FIDELITY REQUIREMENTS

High fidelity in broadcast transmission can be narrowed down to a few major requirements. The first and most important of these requirements is frequency response. Considerable improvement has been made in this respect quite recently, the major factor being the improvement of audio-frequency transformers with respect to frequency range. Figs. 1 and 2 illustrate the response of typical high-fidelity audio transformers available for modern commercial systems. Many refinements in the design of audio-frequency transformers have been made necessary by these high-fidelity requirements.*

A good deal of work has also been done in the television field. While television transmission is yet in its experimental stage, audio transformers have already been developed whose response will cover the entire frequency band necessary for such work. Fig. 3 illustrates the characteristic of an output transformer used for impedance matching in television operation.

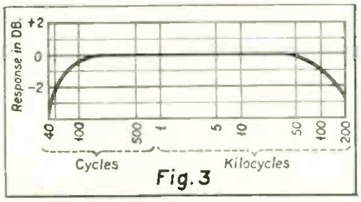
*Design of Wide-Range Audio Transformers, by I. A. Mitchell, page 22, RADIO ENGINEERING, April, 1934.

WAVE-FORM DISTORTION

The second factor governing fidelity of broadcast transmission is the wave-form distortion in the output. While the requirements of the FCC call for a maximum of 10 percent total audio harmonic content, true fidelity necessitates a harmonic content of not much greater than half this value. This harmonic distortion can be due to a number of causes. Overloading or improper operation, or poor matching of the audio modulators will often introduce serious distortions. Other distortions which cannot be classed as harmonics are also often encountered. Foremost among these are the parasitic oscillations frequently set up in power amplifiers when signal is applied, and also the transients which are often produced in amplifiers by fast changes in signal amplitude. Tests with steady modulation conditions will rarely show up these secondary distortions which are not periodic in nature.

The third important factor in high-fidelity operation is the ratio of hum to signal level. The modern trend toward ac operation of all apparatus, including speech input equipment, has made necessary very great precautions in shielding and power-supply filtering to maintain low hum level.

Hum and noise level in high-fidelity equipment should be at least 50 db below maximum modulation level.



Characteristic of output transformer used in television operation.

SPEECH INPUT AMPLIFIER

A typical speech input voltage amplifier is illustrated in Fig. 4. This is an excellent example of inexpensive high-fidelity design.

The 6C6 tubes are used in triode fashion, affording a mu of 20 with only 12.500 ohms plate impedance. The use of a rugged tube construction tends to eliminate microphonics and proper internal shielding of the tube minimizes tube pickup. To eliminate inductive pickup, all transformers are shielded in high permeability cast alloy shields. A total of 400 henrys and 54-mfd of filtering eliminates plate-supply hum.

The overall gain of an amplifier of this type is 53 db, the frequency characteristic is uniform from 30 to 14,000 cycles, and the available output is + 7 db. The power supply and audio amplifier each mount on a 3½" x 19" rack panel.

ECONOMY OF OPERATION

In addition to high-fidelity requirements low initial cost and economy in operation are also to be considered in the design of modern broadcast transmitters. The most radical development along these lines has been the use of Class B audio amplification. The full economy of Class B is readily apparent if we compare the initial and operating cost of the 1000-watt Class B amplifier discussed below with the old Class A system of modulation.

In the Class B system. two 849's are used; the no-signal load from the source of plate supply is only 300 watts, the maximum signal load is 1800 watts, and

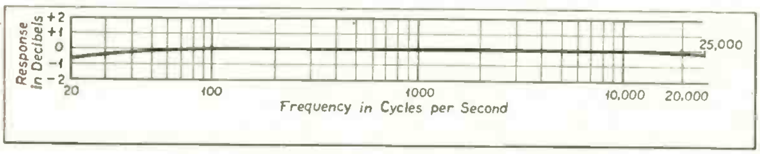


Fig. 1. Characteristic curve of a line-matching transformer.

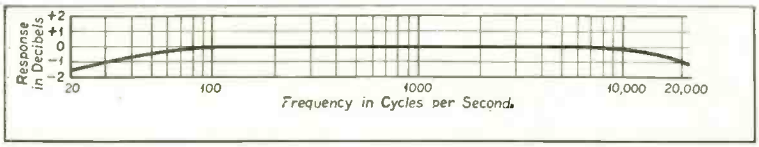


Fig. 2. Characteristic curve of an output transformer, with coupling exceeding .999.

the average less than 1 kw. If Class A were used, ten 849's would be necessary and the continuous load from the plate supply source would be over 3 kw. The saving in cost and tube upkeep for only one year in the average broadcast station would pay for complete changeover from Class A to Class B amplification. The audio quality from Class B is as good as any equivalent Class A system if proper precautions are taken in design and construction.

CLASS B AMPLIFIER DESIGN

One of the factors retarding the rapid acceptance of Class B amplification is the poor response which is often obtained when the amplifier design is not correct. The problems associated with the development of Class B equipment are much more complex and are widely divergent from those of Class A amplification. Fig. 5 illustrates the schematic circuit of a complete driver; a class B stage capable of delivering 1-kw audio power with 5 percent distortion. The factors governing Class B design and their complementary solution in the illustrated amplifier are readily enumerated:

(1) In Class B tube operation, the grid is made positive with respect to cathode and appreciable grid current flows during a portion of the cycle, reducing the tube input impedance to several hundred ohms. If the input source reflects a high impedance to these grids, considerable distortion will be generated. To eliminate this, the input transformer must be designed so that the instantaneous grid voltage is independent of the variation in grid impedance. This makes necessary a high step-down ratio in the input transformer. Due to this high step-down ratio, it becomes necessary to have considerable driving power to drive the grids to their maximum value. For low distortion it is necessary that the driving power be equal to at least 5 percent of the Class B output. In the circuit shown, 845 tubes, operated A Prime and with fixed bias, afford a substantial reserve power to take care of peak grid loads. The input transformer ratio is such that at maximum steady Class B output, the driver tubes are still considerably below their maximum output, and at a point where their harmonic content is very low. To help maintain good grid-circuit regulation, stabilizing resistors of 10,000 ohms are shunted across each input transformer secondary winding, limiting the maximum impedance reflected to the primary.

SEPARATE BIAS SUPPLY

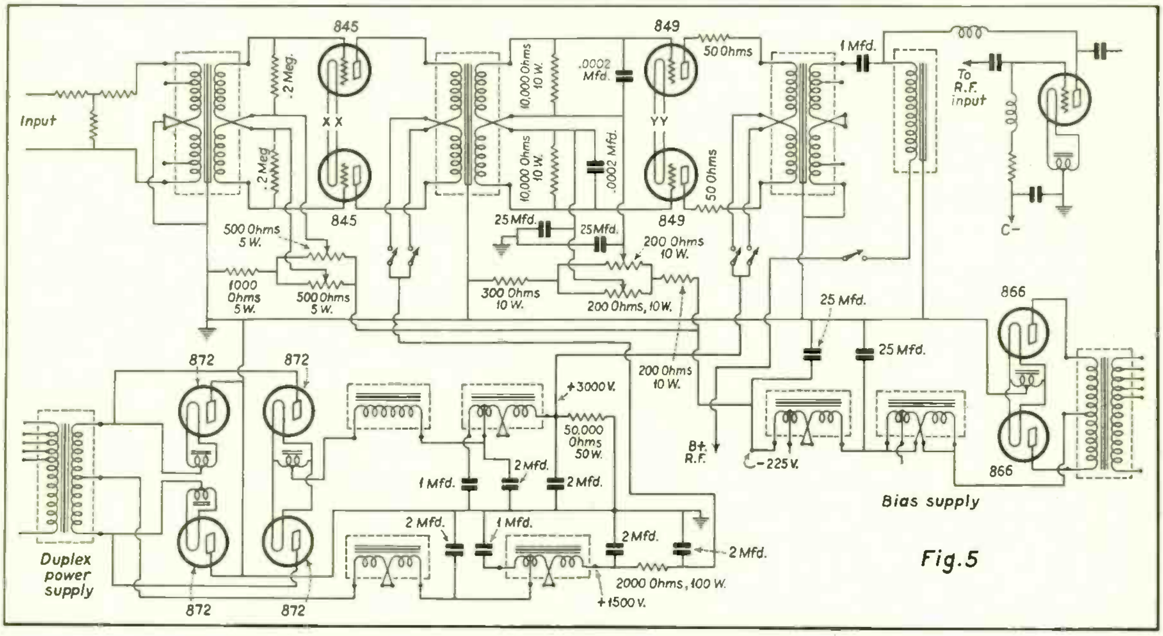
(2) In keeping with the above statement regarding the impedance variation of the grid circuit, it is also necessary that the bias voltage be maintained constant through the wide change in grid load impedance. This is accomplished in the circuit shown by using as the bias supply a separate mercury-vapor rectifier system having a choke-input filter and very good regulation. The same bias supply takes care of both driver and output tubes. Due to the fact that each Class B tube operates on only one-half the cycle, it is imperative that their operation be perfectly balanced. To effect this, provision is made for varying the tube bias so that the tube plate currents can be balanced. This precaution is also taken in the driver stage.

(3) Care must be taken to prevent the parasitic oscillations which are readily set up in a Class B circuit. These are considerably affected by the leakage reactance of the input transformer which should be kept very low. In addition to this, a small resistor is placed in series with each plate lead and a small condenser shunts each grid circuit.

PLATE-SUPPLY REGULATION

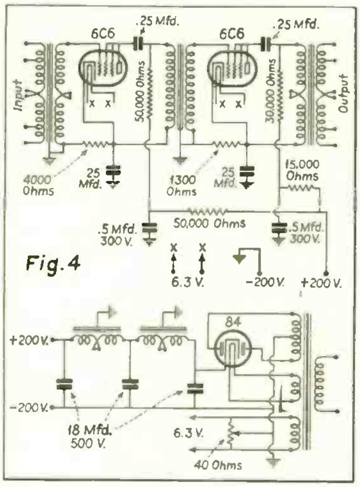
(4) The plate-supply regulation must be very good, as the plate current of the Class B tubes varies almost directly with the input voltage. If the plate voltage varies with the plate current, amplitude distortion will result. Fortunately, slight variation is permissible as these effects will not occur during an audio cycle if sufficient capacity is available in the plate circuit to carry over the peaks of plate current. Good regulation is obtained in the circuit shown through the use of low resistance chokes, a high-efficiency plate transformer, and a saturated input reactor. This saturated input reactor maintains the filter circuit as choke input at low plate currents and as a modified condenser input at high plate currents. The output voltage consequently tends to increase with plate current and can be balanced to effect almost perfect regulation.

In the circuit shown, input for the 845's is obtained through a 500-ohm line



Complete schematic diagram of the 1000-watt Class B modulator power stage including plate and bias voltage supplies.

from the studio amplifier. This level need be only + 25 db. The 845's are operated with 1250 volts on the plate and approximately 200 volts fixed bias. These tubes are then coupled to the Class B grids through an input transformer having high transfer efficiency and low resistance and leakage reactance. The 849's are operated with 3000 volts on the plate and approximately 150 volts bias. They are coupled through a choke-condenser combination to the r-f load. While many attempts have been made to pass the r-f plate current through the modulator transformer secondary, it is impossible to do this without increasing the harmonic content. The reason for this becomes apparent if the transformer flux relationship is examined. During ½ cycle, the flux caused by the audio voltage is in the same direction as the direct current,



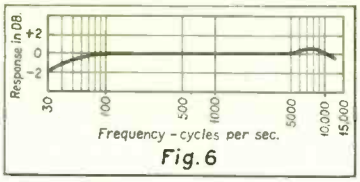
Circuit of speech input voltage amplifier and its power-supply unit.

while during the other ½ cycle they are in opposite directions. Consequently, the primary inductance is increased during ½ cycle and decreased during the other. While an extremely large core in the output transformer would minimize this effect, the size would be impractical and it would still be impossible to obtain perfect operation. The output transformer shown affords a number of secondary impedances so that the most efficient match can be obtained.

CLASS B TRANSFORMER DESIGN

There are numerous points in the design of Class B transformers which are different from that of Class A, and which are of definite importance. As stated above, the input impedance of the tube is low, being in hundreds of ohms, and due to the operation of the tube in the positive grid range, grid current of appreciable magnitude is drawn. Upon analyzing the component distortions, we find that the third harmonic is the strongest. If the driver transformer feeding the Class B tube is so designed as to develop a small amount of third-harmonic distortion, this third harmonic will be in direct opposition to that in the output of the push-pull stage, and balance out.

Two things must be taken into consideration as governing this method of distortion reduction; the fact that the third-harmonic content is not constant over the full power range and that the input transformer has leakage reactance. The first point is covered by choosing an optimum value of input distortion which will cover the full range fairly well. The leakage reactance can be kept low in the transformer design, so that the phase shift between input and output distortion is negligible. It is also important that the output transformer



Characteristic curve of the power stage.

design take into consideration the fact that in Class B only one tube is operating at a time. This means that the effective leakage reactance from *each half* of the primary to the secondary must be low to minimize the attenuation of the higher frequencies.

THE DUPLEX POWER SUPPLY

The power supply is of the duplex type. High voltage f r the Class B tubes is obtained from the entire secondary winding in br ge connection. This is filtered with a saturated first choke and a trap resona t second choke. The low voltage for the 45's is obtained from a full-wave circuit using the center tap on the high-voltag winding. One of the two chokes for this filter system is also tapped for trap resonance. This duplex plate supply completely isolates the outputs for the driver and Class B tubes, which is of considerable advantage in the reduction of degenerative effects.

The bias supply is of the standard full-wave type with choke-input filter. The low resistance bleeder tends to stabilize this voltage and nullifies the tendency for change in bias voltage as against grid current.

The overall gain of this power stage is 27 db. The frequency characteristic is illustrated in Fig. 6. It is evident that Class B amplification lends itself well to modulator use in high-fidelity systems.

POLICE-RADIO PRACTICE

(*Continued from page* 21)

laughed at the prices asked by established manufacturers. "Why," he said, "one of our local boys has a station that talks to Australia, and it cost only $200. We're going to give him $1,000, and he says he can build us the finest thing there is."

Well, if the police department can do that, why doesn't the fire department have some local electrician put in the fire alarm equipment? There are two reasons.

Fire departments have had years of experience with failures, and every detail of the signal systems is surrounded by self-monitoring devices to show up by audible or visible means the development of any fault. This protection is augmented by the constant supervision of men long trained in the routine of supervision. So critical is the attitude of fire departments in the matter of equipment that the chiefs take the attitude that they are better off to do without a device than to try to use it if it is susceptible to failure under emergency conditions.

The other reason is that the Fire Underwriters have taken a hand in the acceptance of fire signal systems, and have established rules and regulations covering the signal equipment and its installation. Thus definite standards have been set up, and manufacturers are required to meet them.

HAVE STANDARDS FOR POLICE RADIO

There is no direct relation between life insurance, for example, and the degree of police protection afforded to private citizens, and there probably never will be, because people die from causes with which the police have little concern. The amount of premiums paid for burglary and hold-up insurance is small compared to fire insurance premiums, so no great pressure will be brought to bear from that angle.

However, when the experience of police departments has progressed to the point of complete understanding of the faults and failures and the requirements of the service, standards will unquestionably be set up, and the competition of systems which are cheap because they are inferior will be eliminated.

Now, and for some time to come, data should be gathered which will show the manufacturers the proper trends to follow in the future.

But at the present time, some concerns who should be leading the way are forced by local amateur competition to offer equipment which was not intended for police signalling, and which they know is not suited to that service.

(*To be continued*)

FEDERAL COMMUNICATIONS COMMISSION

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The members of the Federal Communications Commission. Seated, from left to right, are: G. H. Payne, Irvin Stewart, Thad H. Brown, E. O. Sykes, Chairman, P. A. Walker, N. S. Case, and Hampson Gary. Standing are: Paul Spearman, General Counsel, H. L. Pettey, Secretary, and Dr. C. B. Jolliffe, Chief Engineer.

Its Members, its Set-up, and its Divisions of Jurisdiction

UNDER THE COMMUNICATIONS Act, the Federal Communications Commission on July 17 organized, at their formative conference held in Washington, D. C., into three separate divisions. These divisions, composed of three members each and with Chairman E. O. Sykes serving on each division, were assigned the duties of regulating the interstate and foreign wire and radio communications. These divisions were assigned as follows: Division No. 1—Broadcasting; Division No. 2—Telegraph; and Division No. 3—Telephone.

BROADCAST DIVISION

The Broadcast Division has as its members Commissioner Hampson Gary, Chairman; Commissioner Thad H. Brown, Vice Chairman; and Commissioner E. O. Sykes. This Division has jurisdiction over all matters concerning broadcasting.

TELEGRAPH DIVISION

The members of the Telegraph Division are Commissioner Irvin Stewart, Chairman; Commissioner George Henry Payne, Vice Chairman; and Commissioner E. O. Sykes.

All matters connected with record communication by wire, radio or cable, and all classes of mobile and fixed radio-telegraph services and amateur services are handled by Division No. 2.

TELEPHONE DIVISION

Division No. 3, the Telephone Division, is concerned with all matters connected with telephone communications by wire, radio or cable, including fixed and mobile radio-telephone service and excluding broadcasting.

SECTION PERSONNEL

On October 3, the Federal Communications Commission announced its set-up of sections which provide for a staff of nearly 595 people.

Herbert L. Pettey, Secretary of the full Commission, has the following sections and personnel under his jurisdiction: Accounting, 7; Dockets, 4; Duplicating and Supplies, 9; License, 36; Minutes, 3; Press, 3; Public Reference, Correspondence and Records, 25; and Sub-Clerical, 5.

ENGINEERING DEPARTMENT

The Engineering Department, with Dr. C. B. Jolliffe as Chief Engineer, has prospects of being the largest department of the Commission. The total number of employees is 174, of whom 110 have been placed in the field force to check the frequency of broadcast stations and thus insure proper radio reception. This department has five sections, namely: Telegraph, Broadcast, Telephone, International and Field, having as their chiefs E. K. Jett, Andrew D. Ring, W. G. H. Finch, Gerald C. Gross and W. D. Terrell respectively. The Telegraph section is composed of 23 persons, the Broadcast section of 18, Telephone of 17, International section of 4 and the Field section of 112.

OTHER SECTIONS

The Accounting, Statistics and Tariff section will probably be the second largest unit, the personnel being 160. This section will analyze and summarize the reports which the telegraph companies, telephone companies, and radio stations will and have filed. The chief accountant of this section is Arnold C. Hansen, who has been Senior Examiner of the Interstate Commerce Commission in the bureau of formal cases for a number of years, and who assisted Dr. W. M. W. Splawn in the House investigation of Communications Holding Companies.

The third largest section will most likely be the Valuation Department. The tentative set-up of this unit calls for 117 employees.

The Examiners' Unit and the Law Department, whose General Counsel is Paul D. P. Spearman, have not completed organization activities. Frank Roberson, Pelham, N. Y., and George B. Porter, Des Moines, Iowa, were recently appointed by the Commission as Assistants to the General Counsel.

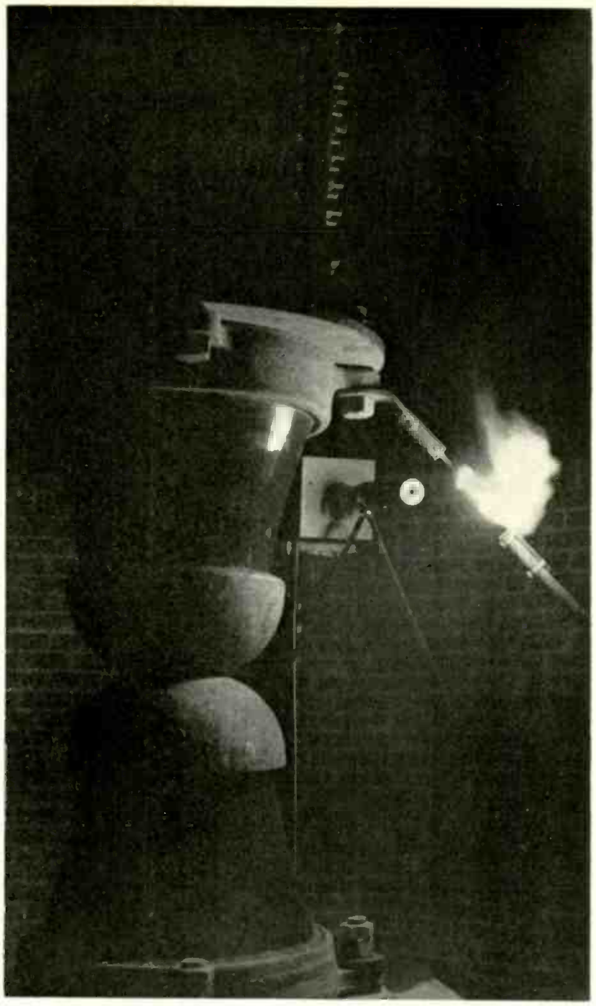
ARC
QUENCHER

WHILE WLW's new vertical radiator antenna increased the station's efficiency from 50 to 100 percent, it was soon discovered that unfortunately the huge 450-ton steel tower also served admirably as a giant lightning rod. It became the problem of WLW engineers to ground the electrical energy thus collected from the atmosphere while at the same time preventing the grounding of the stupendous 500,000 watts power generated by the transmitter.

ARCING PROBLEMS

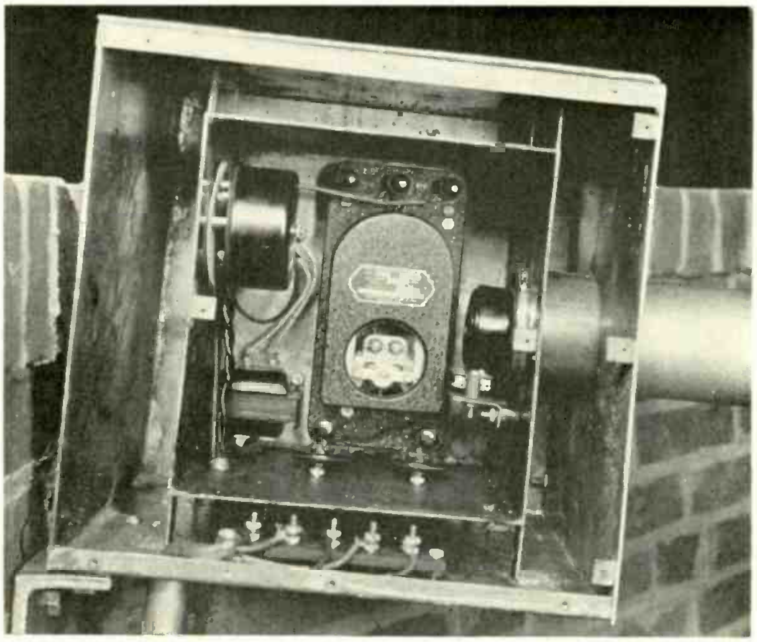
The use of the photo-electric cell was resorted to after the ordinary method, that of providing a direct lightning path to the ground by means of a safety gap across the base of the tower, was found to be unsuccessful. In adjusting the gap it was discovered that one wider than two inches failed to provide complete protection while with one less than two inches the normal peak voltages due to modulation on the 500,000-watt carrier would, on occasion, cause discharge across the gap.

An even more serious problem, according to Joseph A. Chambers, WLW Technical Supervisor, presented itself when it was found that once the arc was started across this gap, either by lightning discharge or by an abnormally high voltage, the arc could not be extinguished as power from the 500,000-watt transmitter kept it alive, draining practically all of the station's power from the antenna into the ground.



Right: Power follow-up arc at the base of WLW's steel tower. Note photo-electric arc extinguisher in background, "aimed" at the arc.

Below: Close-up view of the interior of the photo-electric arc extinguisher installed at the base of WLW's vertical radiator.



RELAY REMOVES PLATE VOLTAGE

After various types of gaps, current transformers and rectifiers were tried unsuccessfully, WLW engineers resorted to the use of the photo-electric cell device. A Weston photronic cell, with its associated relays, was installed in a double shielded box on the brick wall surrounding the antenna base insulator. A long tube containing light baffles was installed so that only light from a point directly in the safety gap could strike the photo-electric cell. The relay operated by the "electric eye" was connected in such a manner as to remove the station's plate voltage to the final amplifier whenever the photo-electric cell was excited and to reapply it the instant the arc was extinguished. Due to the high speed of the control circuits, the interruption to service is so slight as to be barely perceptible to the ear.

VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

WILLIAM J. McGONIGLE

Born in Brooklyn, little more than a quarter of a century ago, of Irish (not Scotch, for there is no "a" in the prefix of the surname) parents. Attended Brooklyn Technical High School and simultaneously completed a correspondence course in Applied Electrical Engineering.

A profound interest in the mystery, romance and possibilities of wireless telegraphy prompted him to leave High School to attend the Radio Institute of America. Obtained a First Class Commercial Radio Operator's License at fifteen years of age. Continued for a short time thereafter in the, then, lucrative field of radio servicing.

First trip to sea as a commercial wireless operator at sixteen, as second operator on a Dutch passenger ship, the *Commewjne*. Returned as a passenger on another ship of the same line. Next assignment was to the yacht, *Corsair*. This was followed by numerous assignments to passenger and freight ships of several lines, visiting many ports along the coasts oi the United States and South America.

"MOST INTERESTING TRIP"

After approximately four years at sea, assigned to a freighter making a round-the-world trip. The ship had just been equipped with the latest model Radiomarine Corp. vacuum-tube transmitter with an output of 500-750 watts and a wavelength range of 600-2,500 meters. An IP-501 receiver (3 tube regenerative type), with long-wave attachment, was provided. Maintained contact with Tuckerton, N. J., until well up the Mexican coast enroute to Hawaii.

The efficiency of the vacuum tube equipment over the spark type transmitter was amply demonstrated on a trip from Panama to Hawaii and thence to the Philippines. In communication with San Francisco station KPH every night of trip from Balboa to Manila on approximately 625 meters. Approximately 6,000 miles from SF to Manila. In contact with Alaskan Naval station several nights of trip.

On return trip via Suez Canal, after having visited a number of the Philippine Islands, Borneo, Java, Straits Settlements, etc., and encountering no difficulty in communicating with stations at the ports visited (tube equipment was practically an unknown quantity aboard ships traversing the waters of the Far East at that time—tube transmitters emit a sharper wave than do spark transmitters) and while passing through the Red Sea had occasion to communicate with a Dutch passenger ship in the Holland-Dutch East Indies trade and was surprised, not at the fact that the Dutch operator spoke English well (telegraphically, of course) but, that he used many idiomatic expressions with apparent ease. Questioned concerning this, the Dutch operator stated that he had spent several years in the Holland-America trade and had spent much time in New York.

The first night out of Port Said, Egypt, communicated with Chatham, Mass., radio station WCC on 2,100 meters. Continued to contact Chatham every night of return trip to New York. When passing Gibraltar at 10 A.M. again contacted Chatham and maintained daylight communication from that point to New York. When about 2,000 miles east of New York, relayed numerous medico messages for two ships, on one of which the second mate was suffering from acute appendicitis, and on the other ship a member of the crew had broken a leg. Relays continued for about a week and the treatment of the appendicitis case, by radio advices, was so successful that a scheduled stop at Bermuda, for purpose of obtaining surgical services, was cancelled and the ship proceeded to Charleston, S. C. (Medical advice by Staff of Broad Street Hospital, New York City.)

WM. J. McGONIGLE
Secretary, V. W. O. A.

After return from round-the-world trip, Mr. McGonigle "left the sea" and engaged in a radio service practice. A desire to continue education conflicted with exacting requirements of self employment, and in February, 1929, he entered the employ of the New York Telephone Company as a student in the Dial Training School. In April of that year, he was appointed Instructor in Electrical Theory. Continued as Instructor—instructing in circuits involving vacuum tubes, repeaters, etc., as well as Panel Dial circuits and the adjustment and maintenance of Panel Dial and Step-by-Step equipment. Transferred in September, 1933, to the staff of the Dial Engineer of the South Brooklyn Division, assigned to checking test apparatus.

Hobby: Radio telegraphing; operates Amateur radio station W2ASN; holds First Class Radiotelegraph License with First Class Radiotelephone endorsement, as well as Amateur First Class License and a First Class Commercial Operator License issued by the government of the Philippine Islands. Editor of the V. W. O. A. Bulletin since 1931; Secretary V. W. O. A., 1933-34. Contributor of numerous articles to the Radio Section of the New York Sun and to Wireless Age when that publication was the House Organ of the Radio Corporation of America.

PERSONALS

V. Ford Greaves, formerly Assistant Chief Engineer of the Federal Radio Commission, at Washington, now receives his mail in care of the Federal Communications Commission, Customhouse, San Francisco, Calif. We wish him much success in his new assignment . . . Lee L. Manley, a Director of our Association, formerly Service Manager with the RCA Victor Company, at Camden, is now associated with the H. H. Eby Manufacturing Company with offices at 21st Street and Hunting Park Avenue in Philadelphia . . .

Wm. G. H. Finch resigned as Manager of the Hearst Radio Service to accept the position of Telephone Engineer with the Federal Communications Commission. . . . Charles D. (Jerry) Guthrie continues to greet operators with a smile and a cheerio at the Mackay office in South William St. . . . A. J. Costigan, Traffic Superintendent of the Radiomarine Corp., left recently bound for Lisbon to attend an International Convention on Radio Regulations. Bon Voyage AJC, and a pleasant voyage. . . . R. Wm. Coffey is assisting Fred Muller in his radio practice. . . . Arthur A. Isbell, Manager of the Commercial Department of the RCA Communications Company, appeared hale and hearty at the last Directors' meeting. . . . David Sarnoff, Life Member V. W. O. A., President, Radio Corp. of America, delivered an exceptionally illuminating address on the romance and progress of radio communication at a recent RCA Victor dealers convention at the Waldorf Astoria, which Ye Sec'y had the pleasure of attending as guest of a dealer friend. . . .

WEST COAST

Our Association is extremely well represented in the Pacific Coast area. To enumerate but a few: Thomas Stevens, a Director of our Association, General Superintendent Radiomarine Corporation of America, San Francisco. . . . P. D. Phelps, West Coast representative for the Mackay Radio and Telegraph Company, San Francisco. . . . J. Maresca, formerly Association Secretary, sound technician with one of the larger movie companies at Hollywood. . . . Ray Meyers of Submarine "Nautilus" fame, now of the operating personnel of the Radiomarine station, Marshall, Calif. . . . Gilson V. Willetts, Charter Member, newspaper feature writer and contributor of stories to many periodicals, San Francisco. . . . Captain Robert B. Woolverton, United States Army Signal Corps, San Francisco. . . . V. Ford Greaves, Federal Communications Commission, San Francisco. . . .

With such representation we should not lack West Coast News.

CONTRIBUTIONS

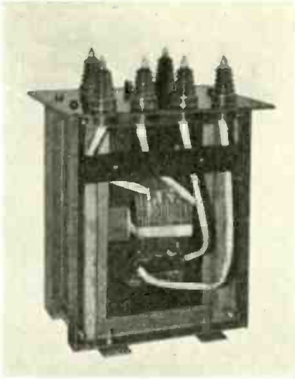
Much and varied material is needed to fill this page each month. We request that all our members institute a thorough search of their archives for interesting items concerning the past years of radio development, with particular emphasis on the "human interest" side of Radio's progress. Contributions should be mailed to the Secretary, V. W. O. A., 112 Willoughby Ave., Brooklyn, N. Y.

TRANSFORMERS FOR CLASS B MODULATION

(*Continued from page* 14)

luctance. In the smaller units this difficulty can be taken care of by interleaving the layers of primary and secondary coils. In larger units however it may be necessary to use a multiple section pie type of winding in order to minimize the capacity effects resulting from this interleaving.

The output transformer design offers difficulties parallel to those met with in the driver transformer. In this case, however, it is the source impedance which is somewhat variable and feeds into only one-half of the primary at any one moment. The secondary load is a pure resistance. The size is increased over that of the driver transformer to take care of the increased power and higher voltage. Because of increased size, capacity effects become more serious.



Interior view of Class B transformer.

For high-fidelity units, it is desirable to reduce size as much as possible. Towards this end the direct current of the Class C stage may be removed from the secondary by impedance coupling to the load. Standard core laminations will usually have too much winding space as compared to their core section. Other shapes can be built up taking advantage of this fact, thus reducing the size of the coil and giving lower leakage and capacity effects.

It is not at all desirable in most cases to tap the secondary in any manner resulting in unused turns because of increased leakage reactance that will exist at the lower impedance taps.

If care is taken in the design of these transformers it is possible to produce units meeting the most exacting requirements. The increased cost of units is generously offset by the effected economies in power and associated equipment requirements.

I.R.E. ROCHESTER FALL MEETING PROGRAM

THE ANNUAL FALL meeting of the Institute of Radio Engineers is to be held at the Sagamore Hotel, Rochester, New York, November 12, 13, 14, 1934. All engineers should plan to attend.

An outstanding program has been arranged for this year's meeting. A number of important conferences will be conducted by the RMA, with the RMA Engineering Committees officiating.

RADIO INTERFERENCE DISCUSSIONS

Considerable time is to be given discussions on the desirability of the reduction of radio interference, from the viewpoint of the Consumer, the Public Utilities, the Radio Manufacturer, the Radio Dealer, and the Federal Communications Commission.

The complete program follows:

MONDAY, NOVEMBER 12

9:00 A. M. Registration
Opening of Exhibits

10:00 A. M. Technical Session

IRON CORE TUNING SYSTEMS
A. Crossley, Consulting Engineer

HIGH-FIDELITY REPRODUCERS WITH ACOUSTICAL LABYRINTHS (With Demonstration)
B. Olney, Stromberg-Carlson Telephone Mfg. Company

12:30 P. M. Group Luncheon

2:00 P.M. Technical Session

AUTOMATIC REACTANCE CONTROL SYSTEMS
Charles Travis and *Murray Clay*, RCA License Laboratory

PUTTING THE ULTRA-HIGH FREQUENCIES TO WORK (With Demonstration)
L. C. F. Horle, Consulting Engineer and *C. J. Franks*, Radio Frequency Laboratories

DIODE COUPLING CONSIDERATIONS
J. R. Nelson, Raytheon Production Corporation

4:00 P. M. Inspection of Exhibits
Meeting of RMA Committee on Receivers
Meeting of RMA Committee on Television

6:30 P. M. Group Dinner

8:00 P. M. Joint Session with Radio Club of America

TRANSMISSION AND RECEPTION OF CENTIMETER WAVES (With Demonstration)
I. Wolff, *E. G. Linder*, and *R. A. Braden*, RCA Victor Company

TUESDAY, NOVEMBER 13

9:00 A. M. Registration

9:30 A. M. Technical Session

THE USE OF CATHODE RAY TUBES IN RECEIVER DISTORTION MEASUREMENTS (With Demonstration)
Henry W. Parker, Rogers Radio Tubes Ltd. and *F. J. Fox*, Rogers Majestic Corporation

CONVERTER TUBES AT HIGH FREQUENCIES
W. A. Harris, RCA Radiotron Company

INPUT LOSSES IN VACUUM TUBES AT HIGH FREQUENCIES
B. J. Thompson and *W. R. Ferris*, RCA Radiotron Company

12:30 P. M. Group Luncheon

2:00 P. M. Technical Session

NEW EQUIPMENT FOR THE RADIO DESIGNER AND ENGINEER
C. J. Franks, Radio Frequency Laboratories

DETECTOR DISTORTION
Kenneth W. Jarvis, Consulting Engineer

4:00 P. M. Inspection of Exhibits
Meeting of RMA Committee on Vacuum Tubes
Meeting of RMA Committee on Sound Equipment

6:30 P. M. Stag Banquet
W. E. Davison, Toastmaster
Entertainment

WEDNESDAY, NOVEMBER 14

10:00 A. M. Joint Technical Session with RMA Engineering Division on Radio Interference.

Brief Discussions on Desirability of Reduction of Radio Interference from the Viewpoint of:

The Consumer—*O. H. Caldwell*
The Public Utilities—*J. O'R. Coleman*
The Radio Manufacturer—*L. F. Muter.*
The Radio Dealer—*Benjamin Gross*
The Federal Communications Commission—*C. B. Jolliffe*
Summary—*A. N. Goldsmith*

INVESTIGATION AND SUPPRESSION OF INDUCTIVE INTERFERENCE
H. O. Merriman, Radio Branch, Department of Marine, Canada

12:30 P. M. Group Luncheon

2:00 P. M. Technical Session on Radio Interference (Continued)

Discussion by Interested Organization on Promotion of Interference Reduction

OVER THE TAPE...

NEWS OF THE RADIO, TELEGRAPH AND TELEPHONE INDUSTRIES

CHICAGO ADDED TO INTER-CITY RADIO TELEGRAPH SERVICE

Chicago has been added to the new inter-city radio telegraph service of RCA Communications, Inc., making a total of six large cities now in the RCA domestic network. The service previously has connected New York, Boston, Washington, D. C., San Francisco and New Orleans. Within a short time, Seattle, Detroit and Los Angeles will be brought into the system and other important cities will be added later.

Cities included in this domestic radio-telegraph service also have direct radio contact with the international networks of RCA centering at New York and San Francisco. The new domestic system is consequently augmenting the importance of New York City as the radio communications capital of the world.

All collection and delivery facilities of the Western Union in the cities on the inter-city chain, as well as the offices maintained by RCA, are available for the handling of domestic radio messages. This is an extension of the previous cooperative arrangement through which Western Union offices throughout the United States collect and deliver RCA's transatlantic and transpacific radiograms and radiograms exchanged with ships at sea.

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THORDARSON CATALOG 343-A

Catalog 343-A for the fall of 1934, on Transmitting, Plate, Filament, and Audio Transformers has been issued by the Thordarson Electric Manufacturing Company, 500 W. Huron Street, Chicago, Illinois.

Catalog 343-A contains illustrations, charts, curves, schematic diagrams, and a great deal of technical information on their transmitting, plate, filament, and audio transformers.

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WIRELESS SHOP NOW AUDIO PRODUCTS CO.

The Audio Products Company, formerly The Wireless Shop of 150 Glendale Boulevard, has recently moved to new and larger quarters, their new address being 4185 West Second Street, Los Angeles, Calif.

The Audio Products Co., are manufacturers of speech-input equipment for broadcast and sound picture installations, communication and public-address systems, and they maintain a complete laboratory for testing and research work.

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AMERICANS DECORATED BY KING OF ITALY

Among the Americans decorated by the King of Italy for aid rendered the mass flight to the United States led by General Balbo in 1933 are ten men who served the radio communications requirements of the expedition. All are members of the International Telephone and Telegraph Corporation and its associates, Mackay Radio and Postal Telegraph. It will be recalled that the I. T. & T. companies provided all communication services for the flight on this side of the Atlantic and assisted the Italian Air Force with its communication arrangements in Europe, and that the handling of communications received special commendation from General Balbo when the flight was over.

The following awards to communication men have been announced:—Grand Officers of the Crown of Italy: Colonel Sosthenes Behn, President of the International Telephone and Telegraph Corporation, and Mr. Ellery W. Stone, Operating Vice President of Mackay Radio; Commanders of the Crown of Italy: Mr. H. H. Buttner, Vice President of Mackay Radio, and Captain Pilade Leoni, International Telephone and Telegraph Corporation; Chevaliers of the Crown of Italy: Mr. Edgar D. Thornburgh, Advertising and Press Manager, International Telephone and Telegraph Corporation; Mr. T. E. Nivison, General Superintendent; Mr. J. A. Bossen, Marine Commercial Manager; and Mr. W. O. Lee, Manager Sayville Station, Mackay Radio; and Mr. T. N. Powers and Mr. Charles W. Oram, traffic experts of Postal Telegraph.

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CETRON BULLETIN

The Continental Electric Company, St. Charles, Illinois, has an interesting and useful bulletin on Cetron Photo Cells. This bulletin covers the advantages and characteristics of their photo cells and a number of uses to which they are now being employed, such as, industrial, light control, counting, safety uses, grading, traffic applications and the like.

Also included in the bulletin is electrical and mechanical data on some 21 types of tubes, and a partial list of sound equipment and the correct cell for use with each. Numerous curves, illustrations, and wiring diagrams are likewise given.

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LENZ CATALOG

The Lenz Electric Manufacturing Company, 1751-57 N. Western Avenue, Chicago, Ill., have brought out their Catalog Number 20, on Radio Products. This catalog covers the following: Push-back wire, indoor aerial, auto-radio cable, microphone cable, short-wave lead-in, shielded wires and cables, speaker and headset cords, battery and speaker extension cable and flexible rubber-covered lead-in wire. This catalog contains a number of illustrations and descriptions of each item listed above.

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NEW AUDIO AND ACOUSTICAL COURSE

The Capitol Radio Engineering Institute, Inc., Riggs Bank Building, Washington, D. C., have announced a completely new series of lessons, covering audio and acoustical work, which has been added to the regular extension courses.

All the work covered is taken up in actual practical problem form. Design of various types of audio amplifiers and studios, and other problems are discussed in detail, step by step. This series of lessons has been prepared directly from the notes and problems on this work as covered in the class room and laboratory of their residence school, it is stated.

In adding this new series of lessons no other lessons have been deleted. It will be available to all extension course students regardless of which course the student may select. These lessons are now being printed.

The Capitol Radio Engineering Institute, also, have a new catalog containing a detailed outline of the work covered in the new Audio and Acoustical lessons. This catalog contains, in addition, new photographs of equipment and much new data on the school and courses. Copies of the new catalog will be sent free on request.

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GENERAL CABLE BULLETINS

The General Cable Corporation, 420 Lexington Avenue, New York, N. Y., have recently made available two interesting bulletins.

One bulletin, entitled Aerial Cables, gives general specifications, advantages and uses for their Aerial Cable.

The second bulletin covers Lead Encased Building Wires and Cables. Included are the following wires and cables; stranded, single conductor, parallel twin conductor, and three-conductor twisted. All of these items are rubber insulated. Mechanical and electrical specifications are also included.

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PEASE APPOINTED CHIEF ENGINEER OF WINS

Charles H. Pease has been appointed chief engineer of Station WINS, R. L. Ferguson, manager of the station has announced. Pease will have complete charge of the engineering department of the station.

Mr. Pease has been associated with radio broadcasting for the past thirteen years, and has been connected with the engineering staff of the National Broadcasting Company in Chicago, and WISN, Milwaukee.

A few years ago Mr. Pease owned and operated his own radio station, WCAY, in Milwaukee.

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W. E. EQUIPMENT DISPLAY

An entirely new line of studio and station equipment was displayed by the Western Electric Company in connection with the convention of the National Association of Broadcasters in Cincinnati, September 16-19. The display included equipment covering virtually every requirement of speech input for broadcasting.

The features of the studio equipment are compact cabinet assembly, complete ac operation eliminating all batteries, turret control and high-quality amplifiers. The exterior of the apparatus is of modernistic design, composed of gray metallic finish with satin chrome trim.

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NORTH ELECTRIC BULLETINS

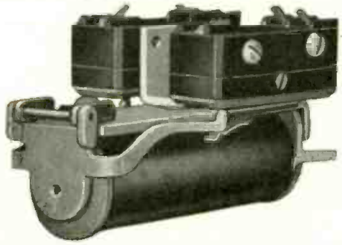
The North Electric Manufacturing Company, Galion, Ohio, have recently made available two very interesting bulletins, namely, A Private System of Telephones, and The North All-Relay Automatic Telephone System. The first bulletin is an introduction to the advantages of private ownership. The second is an insight into the evolution and advantages of the "All-Relay" Exchange.

THE MARKET PLACE

NEW PRODUCTS FOR THE COMMUNICATION AND BROADCAST FIELDS

AUTELCO MICRO-SWITCH RELAY

The accompanying illustration shows one of the new series of relays developed by Automatic Electric Company for miscellaneous remote-control purposes and which are suitable for switching ac loads with very small dc controlling currents. Each unit consists of an Autelco relay, equipped with one or two Burgess micro-switches. The latter device is a well-built, sturdy



switching assembly, which gives fast, positive snap action with minimum motion of the relay armature. Operate time is only .002 to .010 second and release time .005 to .250 second. The contacts of the micro-switch are rated as: break contacts, 10 amperes; make contacts, 6 amperes, at 110 volts, ac. The contacts are not rated for dc loads.

The relay is furnished only to operate on dc from 6 to 220 volts. One or two micro-switches, of make, break, or break-make type, can be furnished. The relay may be mounted on an angle bracket, with no provision for a cover or on a bakelite base with cover, the base being equipped with studs for switchboard mounting.

NEW DELAYED-ACTION RELAY

Automatic Electric Company, Chicago, has recently developed a new delayed-action relay, illustrated here, which operates

on alternating current without requiring a series condenser in its circuit. This relay is the oil-dashpot type, similar to the direct-current relay of the same series.

The time delay interval between the closing of the coil circuit and the operation of the contacts can be varied from 5 seconds to 1.5 minutes by merely turning the outer dashpot cylinder. The release time of the relay is .010 second, and is non-adjustable.

The relay can be furnished to operate on various voltages and frequencies and can be provided with a variety of contact combinations.

NEW TYPE AC RELAY

A new type of inexpensive ac quick-acting relay for 50/60-cycle operation, shown in the illustration, has recently been developed by Automatic Electric Company. This unit is a standard Autelco horizontal type relay, equipped with a "shading ring" which provides firm, chatterless contact closure on alternating-current circuits, it is stated.

The relay can be furnished for operation on any current within the range from 6 to 220 volts, 50/60 cycles, and with a variety of spring combinations. Its operate and release periods are about the

same as those of the corresponding dc relay with similar spring load. An individual slip-on cover of sheet steel, aluminum finished, can be supplied when specified.

NEW EARPHONE-MICROPHONE

Universal Microphone Co., Inglewood, Calif., has started to manufacture a combination earphone-microphone to be mounted and designed in a style similar to the French hand-set telephones. It will be adapted for use on five-meter transmitters, and also on the new five-meter transceivers.

In order to ensure portability, the device will be compact and lightweight with a maximum weight of nine ounces. The handle will be rubber-covered.

The device is to be a high-output microphone in conjunction with a 2000-ohm lightweight receiver. There will be a five-foot cord terminal in three-'phone terminals which gives microphone and earphone connection with one common to both.

ALL-METAL VACUUM SWITCH

A new small vacuum switch, made almost entirely of steel and designed to take advantage of the absence of an arc when breaking a circuit in a high vacuum, has been announced by the General Electric Company. Although this new vacuum switch is only about ¾ of an inch in diameter by 1½ inches long and can be operated by a fraction of an ounce of pressure, it is capable of interrupting as much as five horsepower as fast as thirty times a second. Designated as the Type FA-6 vacuum switch, this new device is rated at 10 amperes, 250 volts dc or 440 volts ac . . . or 5 amperes at 500 volts dc.

The G-E Type FA-6 vacuum switch is made of steel, hydrogen-copper-brazed and exhausted to a high vacuum through a hollow steel operating stem. This operating stem passes into the vacuum contact chamber through a thin steel end-wall whose flexibility permits the slight motion necessary for operation of the contact. The leading-in wires to the contacts are sealed in tiny glass beads inside small Fernico alloy thimbles which are inserted through the heavier opposite end-wall of the chamber.

With this construction, the Type FA-6 vacuum switch can be used in almost any location, including those subject to severe shock and vibration, it is stated.

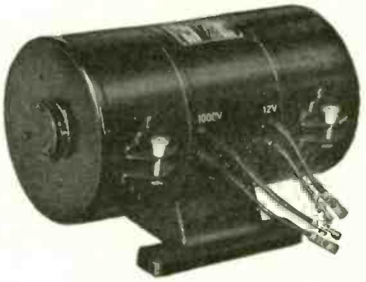
AIRPLANE DYNAMOTORS

New dynamotors for the operation of radio transmitters and receivers on airplanes, and other applications where light weight is important, incorporating the latest improvements in design have just been developed by the Electric Specialty Company of Stamford, Conn.

Light weight is obtained by the use of aluminum and magnesium alloy castings, and by electrical and mechanical design so as to utilize the active materials effectively.

High efficiency is obtained by the use of laminated-steel fields, special silicon-steel armature laminations, precision ball bearings, and special brush-box construction to reduce friction.

It is said that low ripple voltage, allowing the use of very simple filter equipment, is obtained by special design of the magnetic



circuit and armature slots, by the special brush-box construction, and by the use of a large number of commutator bars in both the low-voltage and high-voltage commutators.

Reliable operation under severe conditions is insured by the totally enclosed construction, by the use of non-corrodible parts throughout, by the vacuum impregnation of all windings, and by low temperature rise.

These dynamotors are usually furnished to operate from 12-volt storage batteries and may be supplied to deliver a maximum of 1500 volts and any capacity up to 500 watts

MORRILL PRECISION MULTIPLIER

The Morrill Six-Range Precision Multiplier, Model A, is a device that eliminates the expense of a set of voltmeters and which, in connection with a suitable milliammeter, provides a safe and convenient method of making accurate and dependable voltage measurements covering all values generally encountered in electronic work, it is stated.

This device may be used for either ac or dc measurements, and in conjunction with an 0-1 milliammeter, voltage measurements from 0.1 to 1,000 volts, dc or ac, at 1,000 ohms per volt in six ranges, namely, 5-10-50-100-500-1,000 volts, may be made. This multiplier may also be used in conjunction with 100, 200, and 500 microampere meters.

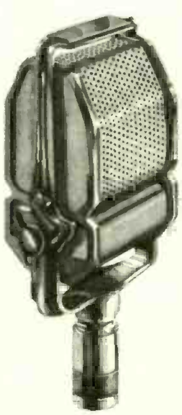
Further, this unit, built into a bakelite case measuring 3"x4½"x1½", has, it is said, an accuracy within plus or minus one percent. Further information may be obtained from Catalog 4210 of Morrill and Morrill, 30 Church Street, New York, N. Y.

•

AMPERITE STUDIO MICROPHONE

A new Amperite Velocity Microphone, Model SR-80, has been specially designed for studio work. Its frequency range is said to be 30 to 14,000 cycles. While enclosed diaphragms or ribbons tend to have a cavity resonance as well as to limit the frequency range, the open construction of the SR-80 prevents cut offs at either high or low frequencies, it is stated.

The duraluminum ribbon is hand-hammered down to 0.00015" to insure maximum sensitivity. A nickel alloy (per-



malloy) core transformer preserves the output and frequency range of the free ribbon.

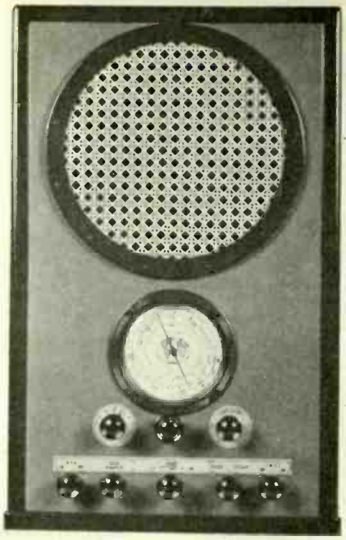
Magnetic shielding prevents the pickup of inductive noises, while an elastic coupling between the microphone and stand absorbs all shocks and mechanical vibrations.

Because of the wider area of coverage. the SR-80 can be used to replace several diaphragm-type microphones in studio work, it is said. The "dead" angle of the microphone is useful in giving instructions to the performers while "on the air".

•

RCA VICTOR AVR-5A AVIATION RECEIVER

The RCA Victor Model AVR-5A General Purpose Receiver shown in the accompanying illustration. is a self-contained, ac-operated. superheterodyne unit developed to provide an efficient and re-



liable, easily installed and operated set capable of receiving either continuous wave or modulated transmission within the frequency range covered.

This unit has a frequency range of 150 to 18,000 kc in five bands; namely, 150 to 400 kc, 540 to 1,500 kc, 1,500 to 3,900 kc, 3,900 to 10,000 kc, and 8,000 to 18,000 kc. It uses a double-ended needle pointer, which operates at a ratio of 55 to 1 through 180°, on an open-face, illuminated. airplane-type dial on which the five frequency bands are clearly indicated to correspond to the switching mechanism and with each of the five bands calibrated to show all frequencies. The newly developed switching mechanism is of the rotary type, to permit the selection of the frequency band, which operates five different three-coil groups (fifteen coils in all), each of which is individually connected to the switch.

Three 58 tubes are used. two as r-f amplifiers and one as an i-f amplifier. A 2A7 tube is employed as first detector and oscillator, while the second detector and automatic volume control is combined in a 2B7. The driver tube and the beat-note oscillator are both 56's. Finally, a 53 is used for the Class B output, and an 80 as rectifier.

This set has an undistorted output of 6 watts and a maximum power output of 10 watts. Operation is from 110- or 220-volt, 50/60-cycle, single-phase ac power supply.

•

RCA VICTOR AVR-1 AIRPORT RECEIVER

The RCA Victor Model AVR-1 Airport Receiver is a completely self-contained, ac-operated, 8-tube superheterodyne unit developed specifically for the reception of the Airways Radio Stations of the Department of Commerce, entertainment, and transport line airport-aircraft communication. Many other uses will, naturally, become apparent to the reader.

The eight-tube superheterodyne circuit employs three 58 type tubes, two as r-f amplifiers and one as an i-f amplifier. A 2A7 and a 2B7 are used for first detector and oscillator and for second detector and automatic volume control respectively. The driver is a 56, the rectifier an 80, and the Class B output tube a 53.

The switching mechanism is newly developed and of the rotary type, to permit the selection of the frequency band, which operates five different three-coil groups, each of which is individually connected to the switch. The open-face, illuminated, airplane type dial, on which the five frequency bands are clearly indicated to correspond with the switching mechanism, uses a double-ended needle pointer which operates at a ratio of 55 to 1 through 180°. The five bands cover the frequency range from 150 to 18,000 kc.

The maximum power output is 12 watts (6 watts undistorted), and operation is from 110- or 220-volt, 60 cycle single-phase ac power supply.

•

RCA VICTOR RADIOBEACON RECEIVER

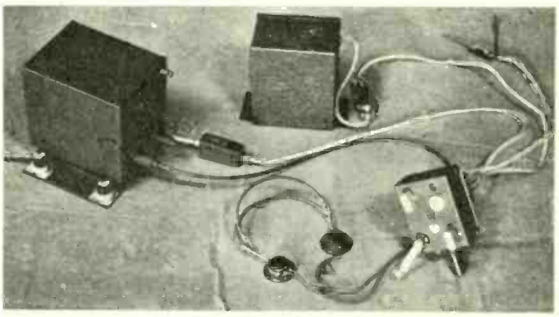
The RCA Victor Model AVR-2 Aircraft Radiobeacon Receiver was developed specifically for use in aircraft, and when properly installed and operated gives exceptionally satisfactory reception of any modulated radio service operation in the frequency band of 200 to 410 kc, it is stated. This permits complete coverage of all Airways Radio Stations operated by the Airways Division, U. S. Department of Commerce, and individual airport, radio traffic control stations.

Tuning is continuously variable on this unit, and it requires only a small antenna on aircraft. preferably of the mast or "T" type for most satisfactory operation. The six-tube superheterodyne circuit uses three 39's or 44's for the r-f amplifier, first detector, and i-f amplifier. The second detector and first a-f amplifier tube is an 85, while the output tube is an 89. A 37 is used for the oscillator.

Other characteristics of the AVR-2 are: Combined "on-off" switch and manual volume control; crank type tuning control; indirectly lighted and calibrated dial; twin phone jacks; dynamotor type power unit which derives its primary power supply from the standard 12-volt storage battery; power output of 1½ watts; and complete shock mounted and vibration proof construction.

The receiver, dynamotor power-supply unit, remote control. and headphones are shown in the accompanying illustration.

"Airplane" view of the RCA Victor Radiobeacon Receiver with its power-supply unit. headphones and remote control.



PRESTO RECORDING AMPLIFIER

The Presto Recording Corporation, 139 West 19th Street, New York, N. Y., have introduced a three-stage, resistance-coupled, triple push-pull recording amplifier that has an output of 10 watts and a gain of 92 db. The microphone supply is built in and is of the variable type, so that any carbon mike can be used and the current adjusted for maximum efficiency. The loudspeaker is also of the built-in dynamic type.

This amplifier uses the following tubes: Two 57s, two 56s, two 2A3s, and one 5Z3.

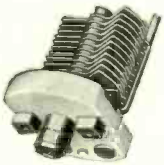
The motor used is of the 1/20 hp, 110-volt, 60-cycle, General Electric constant speed type. The speed is 78, or 78 and 33-1/3 rpm.

•

MIDGET AIR TUNED PADDING CONDENSER

In the laboratories of the Hammarlund Manufacturing Company, 424 West 33rd Street, New York City, a true midget, space saving, Isolantite based, air padding and tuning condenser, particularly useful in marine, aircraft and police work, has just been evolved. The largest of the type, 100 mmfd, measures only 1 7/32" x 15/16" x ½".

Brass stator rotor and stator plates of



.015-inch thickness, spaced the same distance, are employed. A phosphor bronze spring plate affords perfect rigidity. Every other metal part is pure brass, for highest conductivity and lowest loss. Being of this air type construction, is provides absolute maintenance of constant capacity under any conditions of vibration, temperature, and humidity, it is said. It is applicable for short-wave or ultra short-wave work, or for tuning i-f transformers, trimming r-f coils and gang condensers, antenna tuning, fixed tuning of r-f coils or plug-in coils, and for padding purposes in general.

The approximate capacity per air gap is 4 mmfd.

•

NEW MIDGET EQUALIZING CONDENSERS

An unusually interesting and efficient midget equalizing condenser has just been developed in the Hammarlund laboratories, 424 West 33rd Street, New York City.

The size of the base is only ⅝" x ¾". It is so light in weight that it is self-supporting in the wiring of circuits. With its Iso-

lantite base, special mica dielectric, and phosphor bronze springplates, it may be used for trimming of r-f tuning coils, and other similar applications.

•

NEW HAND-SETS FOR PORTABLE TRANSMITTERS

Two new hand-sets, especially designed for portable and mobile radio transmitters, have been announced by Shure Brothers Company, 215 West Huron Street, Chicago. Each hand-set unit consists of a high-output microphone transmitter and a sensitive telephone receiver conveniently combined in a special hand mounting.

The Model 6A Transceiver Hand-Set has a 70-ohm receiver unit and is furnished with a three-lead cord, one side of microphone and receiver using a common conductor. This unit is suitable for use with equipment designed to work with ordinary telephone hand-sets.

The Model 6B Transceiver Hand-Set is similar to the 6A, but has a 2,000-ohm receiver and is supplied with a four-lead cord so that entirely isolated microphone and receiver circuits may be employed if desired. The Model 6B is recommended where the receiver is to be connected directly in the plate circuit of a vacuum tube.

Both hand-sets afford excellent quality of reproduction over the voice-frequency range it is stated. Dimensions have been carefully worked out so that the microphone is held at exactly the proper position to secure adequate output level and best quality of reproduction. Six-foot color coded cordage is furnished. The hand-set itself is finished in baked rubber-black enamel.

•

WIRELESS EGERT CATALOG

Wireless Egert Engineering, Inc., 179 Varick Street, New York, N. Y., have a new and interesting catalog which describes in full the items they manufacture. This particular issue is known as Catalog "C", and includes full descriptions, and in many cases the theory, of the following units: Microvernier airplane dial, battery-operated signal generator, all-wave signal generator, ac-dc operated amateur-band monitor, non-inductive logarithmic attenuator, beat-frequency oscillator, standard signal generator, distortion analyzer, 1,000-cycle oscillator, five-point filter system, vacuum-tube voltmeter, logarithmic vacuum-tube voltmeter, ac-operated direct dial-calibrated beat-frequency oscillator, battery-operated beat-frequency oscillator, ac-operated high-level beat-frequency oscillator, and special apparatus.

All instruments in this catalog are of recent design, it is stated.

•

RCA VICTOR LAPEL VELOCITY MICROPHONE

The new Lapel Velocity Microphone, Type 30-A, is a recent development of the RCA Victor Company, which, it is stated, is so small that the audience can barely detect it and so light that the speaker will hardly notice it. The Type 30-A measures 1⅜ inches by 1-5/16 inches by 5/16 inch and weighs 3¼ ounces, while the associated transformer for the unit is 1¼ inches by 1⅜ inches in diameter and weighs 3¼ ounces.

The output of the Type 30-A Microphone as normally used is the same as that of the standard velocity microphones placed four feet from the sound source, and the pick-up of background noises is much less than that of previous designs of lapel-type microphones. The overall response in use is substantially flat, being 2 db over the range of 80 to 7,000 cycles with a 7.5-db rise at 5,000 cycles, and is practically independent of head movement.

This unit is especially adaptable, it is said, for those artists who, when broadcasting, find it necessary to have considerable latitude of movement.

•

IRC ADJUSTABLE RESISTANCE UNITS

The International Resistance Co., Philadelphia, Pa., has introduced IRC adjustable resistance units. These are available in ratings of from 10 to 150 watts and in all resistance ranges. Although a majority of requirements can be met promptly with standard resistors, special designs and styles are obtainable.

These adjustable resistors, in the larger sizes, are supplied with convenient mounting brackets. All sizes come equipped with one adjustable slider band, which is moved along the exposed track of resistance wire to any desired position. Additional bands may be added and various taps brought out so that units may be used as voltage dividers.

The new IRC Catalog, CB-25, describing these new units in detail as well as numerous other IRC resistance products for radio, electrical, communication and industrial use will be sent on request to International Resistance Company, Philadelphia, Pa.

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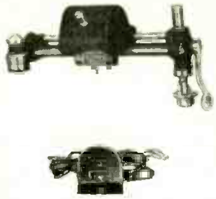

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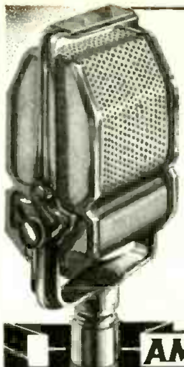

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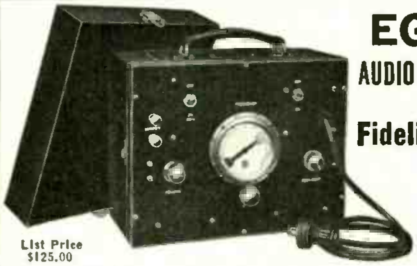

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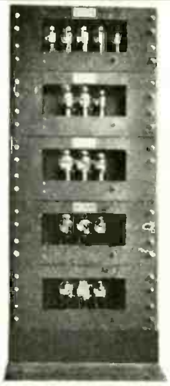

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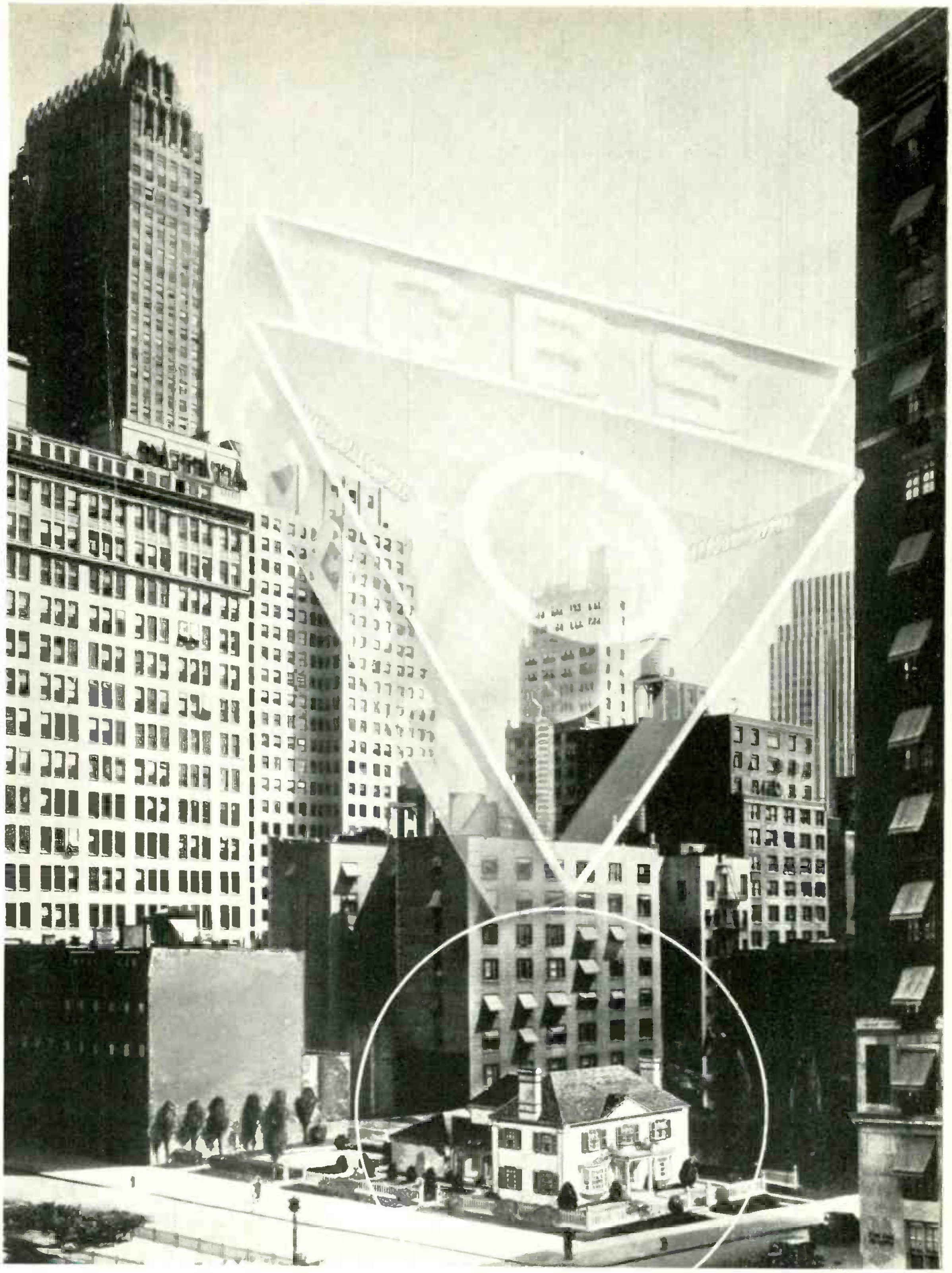

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