May 3, 1939

ERRATA SHEET

Note - Change all volume levels, i.e., values in terms of reference volume, by adding 8 db algebraically to all values given in the text and associated drawings of this Section, designating the result in "vu."

PRINTED IN U.S.A.

TIME ANNOUNCEMENT SYSTEM - PRELIMINARY NOTES ON TRANSMISSION FEATURES

SYNOPSIS

This bulletin discusses the transmission aspects of the time-of-day system for multi-office areas, the equipment features of which were described in a set of D. & R. Notes transmitted with P.E.C. 535. It is essentially a high quality one-way distribution system, to which a subscriber in any part of the area may be connected. Any subscriber so connected will hear an announcement of the time from a single announcer at a central time bureau. The loudness and clarity of the announcement will be practically the same wherever the subscriber may be located, and irrespective of the number of other subscribers simultaneously connected. The means for securing this high quality and uniformity of transmission are discussed in the bulletin. Provision is also made to ensure that if a subscriber attempts to speak to the announcer, he cannot be heard by her, nor by anyone else who may be connected to the system. There is no necessity for communicating with the announcer, as the announcements are made at quarter-minute intervals, and if the subscriber fails to understand the first he may listen for another. Following each announcement, a brief tone indicates the precise second.

Since the issuance of P.E.C. 535, there have been certain further developments, the transmission aspects of which are included in this bulletin. The most important of these new developments are:

1. Time announcement trunk circuits for use at tandem offices.

2. Arrangements for making transmission maintenance tests on a time announcement system while it is in operation.

The time announcement trunk circuits for use at tandem offices permit time service to be extended by way of the tandem system to offices for which it is felt that the volume of time traffic may not be sufficient to justify the installation of individual amplifier equipment, or the exclusive use of a connecting circuit. The service given by way of the tandem system is somewhat inferior from the transmission standpoint to that provided through an amplifier located in the same building as the central office, and more operating effort or equipment time is required, since with an amplifier in the same building all time calls are completed locally. The two methods of supplying time service can, of course, be operated together. Also an office served via tandem may at any time be equipped with an amplifier and supplied locally.

Since the time announcement system is continuously in service, transmission measuring arrangements must be such that the necessary tests can be made during operation. This is accomplished by taking advantage of the 800-cycle tone, which, as already noted, is used to indicate the exact time. This tone is adjusted to a known value at the time bureau, and rectifier-type meters are employed for reading the level of the tone at each office where a time system amplifier is installed. In this way a check can readily be obtained at any time of the 800-cycle equivalent of any branch of the system. Equipment is also included to permit the checking of the condition of the vacuum tubes in each office.

The new transmission testing apparatus is being provided with all new time announcement equipment. It can also be added to existing equipment.

TIME ANNOUNCEMENT SYSTEM - PRELIMINARY NOTES ON TRANSMISSION FEATURES

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D. & R.	Title	Classification	Transmitted By
Notes	Preliminary Notes on Time Announcement Equipment		P.E.C. 535
Bulletin No. 403	Information on New Apparatus Units for Program Pick-Up and Public Address Systems	Program Supply Practices Section 4-D	P.E.C. 326
Bulletin No. 463	Preliminary Notes on Room Noise and Its Measurement	Exchange Area Transmission Practices Section 8-A	P.E.C. 539
Bulletin No. 529	Preliminary Notes on the Sound Meter		P.E.L.1415

TIME ANNOUNCEMENT SYSTEM - PRELIMINARY NOTES ON TRANSMISSION FEATURES

0. General Transmission Features

The time announcement system is essentially a one-way speech distribution system having terminals in local central offices or tandem offices to which subscribers requesting the time may be connected. The general transmission circuit arrangement of the time announcement system is illustrated schematically on Drawing 909-3068. The time announcement is made by an operator to a transmitter at the time bureau. From this transmitter and its associated transmitting amplifier the announcement is distributed to inter-amplifier circuits which carry it to intermediate or terminating amplifiers. The intermediate amplifiers are used when required for secondary distributing points and to provide amplification between the transmitting amplifier and distant terminating amplifiers. From an intermediate amplifier the announcement is distributed over inter-amplifier circuits to terminating amplifiers. Connected to the output of each terminating amplifier are a number of outlets designated as time announcement trunk circuits to which calling subscribers may be connected. From the transmission standpoint two types of these announcement trunk circuits are employed: (1) Those for use in local central offices which allow subscribers' lines to be directly connected to the time system through local central office equipment. For connections of this type, terminating amplifiers are located in the same buildings as the local offices. (2) Time announcement trunk circuits for use in tandem offices which allow subscribers' lines in outlying offices to be connected to the time system by means of regular tandem trunks. For this second method of making time connections, terminating amplifiers are located in the same buildings as the tandem offices.

Due to the fact that the time announcement system is one-way it does not allow a subscriber to request a repetition if an announcement is not clearly understood. Instead the subscriber must wait until the next announcement. For this reason, and also due to the fact that the essential information provided is a series of numbers, the time announcement system has been designed to insure a high quality of transmission. The transmitter arrangements and amplifiers which are employed have been designed particularly for this service and equalization is provided for the inter-amplifier circuits.

With the time announcement system in proper operation, the volume of the time announcement delivered to a single subscriber's line connected to a time announcement trunk circuit of a local central office will be -22 db with respect to reference volume. Volume indicator tests show that on local telephone connections the volume received at the local office nearer the talker ranges from about 0 to about -30 db, with an average of about -15 db. The -22 db volume entering a single subscriber's line connected to a local announcement trunk circuit is, therefore, approximately equivalent to that entering the listener's loop on a local interoffice telephone connection, the talker's voice and loop being average and the interoffice trunk having an equivalent of 7 db.

The variation of the received volume with the number of subscribers simultaneously connected to a single time system terminating amplifier is held to a very small amount by the design of the terminating amplifier and the time announcement trunk circuits. The design of these elements is also such as to prevent interference between simultaneously connected subscribers.

The time announcement trunk circuits for use in tandem offices have been developed to provide an alternative means for supplying time service which in some cases might be more economical than the provision of a terminating amplifier for each central office building. Tandem office time announcement trunk circuits may be used to provide time terminals in:

1. Manual tandem switchboard multiple.
2. Distant office selector multiple in panel areas.
3. Panel sender tandem district or office multiple.
4. Step-by-step tandem selector multiple.

If there are local central offices in the same building as the tandem office time service for all the offices may be supplied from a single terminating amplifier, the tandem office announcement trunk circuits and the local office announcement trunk circuits all being connected to the output of the one amplifier.

From the transmission standpoint the time announcement trunk circuits for tandem offices differ from those for local central offices in that the tandem announcement trunk circuits can be adjusted to allow for the losses in the connections from the local offices to the tandem office. Since, however, only a single fixed value of adjustment can be made, it is not possible to deliver the same volume at each of the offices to be served as is done where there is a terminal amplifier individual to each central office building. The volume received at any one office served over the tandem system will, therefore, vary from the standard volume of -22 db, by the amount that the loss of the tandem trunks to that

office differs from the value of loss on which the adjustment of the associated announcement trunk circuits was based. This will be in addition to differences in the subscribers' receiving loop losses, which would, of course, affect equally the announcement supplied from local central office time announcement trunk circuits from an amplifier in the same building. These differences will tend to be greater in suburban offices than in city offices, where the loop limits are usually low. In general, therefore, there will be a substantially greater variation in received volume of the announcements in an office served by the tandem system.

It may be desirable to consider this variation in volume in connection with the economic study of the manner of providing time service to outlying central offices. If the variation is excessive, too loud volumes will be experienced by certain subscribers, and too low volumes by others. The effect of the first will be to make the reception of the announcement unpleasant, and that of the second to make the announcement difficult to understand. Such difficulty would make it more likely that a subscriber would be obliged to listen for a second announcement and would, therefore, tend to increase the average holding time. An increased holding time would be particularly objectionable in this case since tandem trunks and tandem office equipment would be involved. In addition to the greater variation in received volume which may be introduced by providing time service by way of the tandem system it may also be noted that there is no means for equalizing the portion of the time connection comprising the tandem trunk. It is probable, however, that in many cases these effects will be insufficient to offset the economies of using the tandem system, particularly to supply small suburban offices, and that the service given will be entirely adequate.

1. Transmission Characteristics of System Elements

1.1 Time Bureau

1.11 Operator's Transmitter*

For the pick-up of the time announcer's voice there is used a high quality granular carbon transmitter, No. 615-B. The transmitter should be used at a distance of about six inches from the announcer's lips. This distance is recommended instead of the greater distance given in the notes transmitted by P.E.C. 535 since it appears to be more comfortable for the announcer and does not result in any noticeable differences from the standpoint of speech quality. The shorter distance has the added advantage of reducing the ratio of room noise and transmitter carbon noise to the announcer's speech. When used in the manner prescribed here the 615-B transmitter provides a particularly high quality voice pick-up arrangement. Associated with the announcer's transmitter is a filter, consisting of a series retard coil and a shunt condenser, to prevent packing of the carbon by high-frequency surges resulting from switching operations. Such packing would introduce voice distortion and would tend to increase transmitter deterioration by burning.

In order to reduce the pick-up of noise caused by the advancement of the position clock and noise caused by the announcer accidentally striking the desk, it is desirable to place the transmitter stand on a piece of sponge rubber about one inch thick.

1.12 Location of Announcement Desk

As a result of the manner in which the announcer's transmitter is used it is more sensitive to room noise than the ordinary telephone set transmitter. For this reason the announcer's desk should be located in a position where the maximum room noise will not be more than 15Ō noise units, measured as described in D. & R. Bulletin No. 463 or an equivalent amount as measured by a sound meter. For the sound meter described in D. & R. Bulletin No. 529, the equivalent reading is 43 db. It will probably be desirable to place the desk in a separate room, preferably along an inside wall or court. If this room is formed by partitioning off part of an operating room the partition to be used may require special consideration. Also to obtain proper ventilation from a window of the announcing room or from an adjacent room, without introducing excessive noise, it may be necessary to use special apparatus. Section 5 discusses problems associated with room noise limitation and ventilating arrangements. The acoustic treatment of the announcing room to limit reverberation effects is also discussed.

1.13 Volume Control Pad*

The output of the operator's transmitter is coupled through a step-up transformer to a variable attenuation pad which is under the control of the volume control key on the announcer's turret. When this key is normal a 5 db pad is inserted in the circuit. When it is thrown to the (+) position, the circuit is connected directly through and when it is thrown to the (-) position, a 10 db pad is inserted in place of the 5 db pad. This key, therefore, allows the transmitting gain to be increased or decreased 5 db to allow for variation in the speech volume of the announcing operators. The output of this volume control pad is connected to the input of the transmitting amplifier.

1.14 Transmitting Amplifier**

The transmitting amplifier is generally similar from the transmission standpoint to one side of the 44-A-1 repeater used for

* Drawing SD-90253-01.

* Drawing SD-90253-01.
** Drawing SD-90400-01.

long four-wire toll circuits. The principal difference lies in the fact that the time announcement transmitting amplifier is equipped with an output transformer which gives it an output impedance of about 12 ohms. The output vacuum tube of the transmitting repeater is of the 101F type. This tube when connected to a load impedance which is two or more times its own output impedance permits, for a high quality circuit, an output volume of 6 db above reference volume without noticeable distortion due to overloading. These output characteristics of the transmitting amplifier have been provided to allow the announcement to be delivered at a -14 db volume to each of a maximum load of 36 inter-amplifier circuits, each circuit having a 1000-cycle impedance of about 800-900 ohms as seen through the associated outgoing supply circuit. The combined impedance of this maximum load is about 24 ohms. The ratio between the maximum load impedance and the amplifier output impedance is thus 2:1. For smaller loads, that is, fewer inter-amplifier circuits, this ratio would be higher. The existence of a ratio higher than unity between load impedance and amplifier output impedance reduces the speech distortion caused by the non-linearity in the characteristic of the output vacuum tube. It also, of course, introduces reflection loss. The value of 2:1 for this ratio for maximum load conditions is a compromise between speech distortion and reflection loss. For a -14 db volume delivered to each of 36 inter-amplifier circuits the transmitting amplifier output volume is required to be about +2 db. The margin between the normal operating output volume and the limiting output volume is, therefore, about 4 db. The maximum gain of a transmitting amplifier is about 40 db.

1.15 Volume Indicator*

To provide a means for checking the level of the announcer's voice, there is located on the announcer's turret the meter of a volume indicator which is connected across the multipled inter-amplifier circuits. The volume indicator used is coded as the 203-C panel and is similar to the volume indicator coded as the 203-B panel,/ except that it has a battery terminal for use with an 18-volt filament supply battery. In order to increase the sensitivity of the 203-C panel so that it can be used to measure a volume of -14 db it is connected to the time circuit through a high ratio transformer.

1.16 Outgoing Supply Circuits**

Each inter-amplifier circuit from the time bureau is connected to the transmitting amplifier output through an outgoing supply circuit. From the transmission standpoint each outgoing supply circuit consists of a 94-type repeating coil with a 4-mf. condenser at the midpoint of the line side. Information for the specification of these 94-type repeating coils is given on Drawing SD-90257-01. As shown on Drawing 909-3068 the drop windings of these coils may be connected either in parallel or in series aiding. For the parallel connection of the coil, terminals 4 and 8 and 3 and 7 are strapped and the drop terminals are 4 and 3. The reason for this optional connection is discussed in Section 1.2. The information given on Drawing SD-90257-01 is intended to provide coils which with series connections will transform the 1000-cycle impedances of the inter-amplifier circuits to about 800-900 ohms. A maximum of 36 circuits with series connected coils may be connected to the output of a transmitting amplifier. Each trunk having the associated 94-type repeating coil drop winding connected in parallel aiding should be counted as four trunks of the maximum of 36.

1.2 Inter-Amplifier Circuits Outgoing From Time Bureau

The inter-amplifier circuits from the time bureau connect the outgoing supply circuits associated with the transmitting amplifier of the time bureau with the incoming supply circuits* of intermediate or terminating amplifiers. They are generally non-loaded or loaded cable circuits of the types employed for exchange area trunks.

To avoid the possibility of excessive noise, crosstalk or distortion, it is desirable to place a limitation on the volume to which the announcements are allowed to fall in any part of the system, and hence on the attenuation of the inter-amplifier circuits employed. The values indicated on Drawing 909-3068 will give satisfactory results in practically all cases. Non-loaded circuits having attenuations higher than 14 db appear to be undesirable due to the difficulty of equalizing their transmission characteristics. Loaded circuits having attenuations greater than 14 db may be employed by using the parallel connection for the repeating coils of the associated outgoing supply circuits (Section 1.16), or, if the circuit noise and crosstalk are sufficiently low, by employing a greater amount of gain in the associated intermediate or terminating amplifier. The available amplification is sufficient to take care of about 5 db of additional circuit attenuation. The parallel-aiding connection of the outgoing supply circuit repeating coil makes the higher attenuation possible due to the fact that with this connection the volume delivered to the inter-amplifier circuit is -8 db or 6 db higher than with a series-aiding connection. The circuit attenuation can therefore be 6 db higher for the same received volume.

Due to the necessity of insuring a high transmission quality for the time announce-

* Drawing SD-90253-01.

** Drawing SD-90257-01.

/ O. & R. Bulletin No. 403.

* Drawings SD-90256-01 and SD-90260-01.

ment system, it is desired that the inter-amplifier circuits should be of a good grade. Uniform loading and spacing are desirable if the circuits are loaded. The use of high cutoff circuits will, of course, improve the quality of transmission. Before a circuit is connected into the time announcement system it is desirable that tests be made to check its essential characteristics. These tests may consist of a 1000-cycle attenuation measurement and a measurement of the metallic circuit noise. The noise measurement should be made from the end of the circuit which will be connected to the input of the receiving intermediate or terminating amplifier. The other end of the circuit should be terminated by a 600-ohm resistance. If the circuit is normal the measured noise should not exceed about 30 noise units. If the inter-amplifier circuits of the time system are normal in this respect and the minimum volumes do not fall below -28 db the measured noise at the terminals of a local time announcement trunk circuit should not exceed about 100 noise units. This value does not allow for any room noise picked up by the announcer's transmitter.

1.3 Intermediate Amplifiers*

Intermediate amplifiers are used to provide secondary distributing centers. The use of secondary distributing centers is necessary where the number of terminating amplifiers to be served from the time bureau is greater than 36. Secondary distributing centers may also be used where there are a number of terminating amplifiers to be located in central office buildings at large distances from the time bureau. In such an instance the distant central offices may be divided into groups and an intermediate amplifier located in a central office of each group. The terminating amplifiers of a group are connected to the intermediate amplifier which is in turn connected to the transmitting amplifier of the time bureau.

The inter-amplifier circuit incoming to an intermediate amplifier from the time bureau is connected to the input of the amplifier through a 94-type repeating coil** having a 4-mf. condenser at the midpoint of the line side. The intermediate amplifier is the same as the transmitting amplifier and has the same output arrangements for supplying inter-amplifier circuits to terminating amplifiers. (See Sections 1.14 and 1.16.) When -14 db volume is delivered to the inter-amplifier circuit supplying an intermediate amplifier the volume delivered to each inter-amplifier circuit connected to the output of the intermediate amplifier should be also -14 db. The method of adjusting the gain of an intermediate amplifier so this volume relation will exist is described in Section 3.4.

* Drawing SD-90400-01.
** Drawing SD-90256-01.

1.4 Artificial Loads of Intermediate Amplifiers

For the general stability of the system, and particularly for the purposes of the transmission tests and vacuum tube tests, it is desirable that the load of each intermediate amplifier be at all times approximately equivalent to full load, 36 800-900 ohm inter-amplifier circuits. Since the number of inter-amplifier circuits connected to the output of an intermediate amplifier may be any number up to 36, this requires an adjustable artificial load which can be used to build out the actual load to the equivalent of 36 trunks. Such an artificial load is associated with the output of each intermediate amplifier.

1.5 Inter-Amplifier Circuits Outgoing From Intermediate Amplifiers

The inter-amplifier circuits outgoing from each intermediate amplifier connect the outgoing supply circuits associated with the intermediate amplifier output to the incoming supply circuits of terminating amplifiers. The requirements for these inter-amplifier circuits outgoing from intermediate amplifiers are the same as those given in Section 1.2 for inter-amplifier circuits outgoing from the time bureau.

1.6 Terminating Amplifier Office

1.61 Terminating Amplifier*

At each terminating amplifier office the inter-amplifier circuit from the time bureau or from an intermediate amplifier is connected to the terminating amplifier through a 94-type repeating coil** having a 4-mf. condenser at the midpoint of the line side. The terminating amplifier is the same as the transmitting amplifier except that it is equipped with an output transformer which gives it an output impedance of about 4 ohms. This low output impedance in conjunction with the characteristics of the time announcement trunk circuits prevents interference between simultaneously connected subscribers. These factors also reduce the variation in the volume of the announcements delivered to a single subscriber's line due to variations in the number of subscribers' lines which may be simultaneously connected to the output of the same terminal amplifier. These functions are discussed further in Section 1.62.

The load impedance connected to a terminating amplifier will generally be very high with respect to its output impedance. Under such conditions an amplifier with a 101F output vacuum tube used in a high quality circuit can deliver an output volume of 10 db above reference volume without noticeable distortion due to overloading. The normal operating output volume for a terminating amplifier is +7 db. The margin against over-

* Drawing SD-90400-02.
** Drawing SD-90260-01.

loading and distortion is, therefore, 3 db. The maximum gain of a terminating amplifier is about 40 db.

1.62 Time Announcement Trunk Circuits*

To the output of each terminating amplifier there are connected in multiple a number of time announcement trunk circuits, which provide the terminals to which calling subscribers are connected. A single terminating amplifier installation can be employed to supply time service to all of the telephone offices located in a single central office building. These offices may be all local central offices or there may be included one or more tandem offices. The equipment items of all the time announcement trunk circuits associated with a terminating amplifier are located with the amplifier and two-wire or three-wire circuits connect them with the appearances in the various central offices.

The local central office announcement trunk circuits each consist, from the transmission standpoint, of two 1200-ohm series resistances and two 2-mf. series condensers (Drawing 909-3068). The series condensers are required only for blocking signaling currents.

When time service is supplied through the tandem system to subscribers in outlying offices a connection between a subscriber's line and a tandem office time announcement trunk circuit is made by means of the local central office equipment, a tandem trunk and the tandem office equipment. From the transmission standpoint each tandem office time announcement trunk circuit consists of a 94-F repeating coil (1.5:1 ratio) with a 2-mf. condenser in series with the line (high) side and a resistance in series with the drop (amplifier output) side which resistance may be varied in steps of 100 ohms from zero to 2000 ohms. The drop windings of the 94-F repeating coil may be connected either series aiding or parallel aiding. This arrangement is provided to permit the tandem announcement trunk circuit to be adjusted in each particular case to allow for the attenuation introduced by the associated tandem trunks and the tandem office equipment. The resistance values and the coil connections for various values of representative tandem trunk plus tandem office loss are given by a curve on Drawing 909-3069. The determination of the coil connection and the resistance to be used for a particular case are discussed in Section 3.3.

As stated in Section 1.61, the low output impedance of the terminating amplifiers and the characteristics of the time announcement trunk circuits are intended to prevent interference between simultaneously connected subscribers and to reduce the variation in the volume of the announcements delivered to a single subscriber's line due to variations in the number of subscribers' lines which may be simultaneously connected to the output of the same terminating amplifier. The essential elements of the time announcement trunk circuits with reference to these effects are the series resistances. The two 1200-ohm series resistances of the local time announcement trunk circuits together with the 4-ohm output impedance of the terminating amplifiers insure a minimum loss of about 66 db between any two simultaneously connected subscribers' lines. The series resistances of tandem time announcement trunk circuits are adjusted to allow for the attenuations of the associated tandem trunks. Due to the fact that in a specific case some of the tandem trunks may have attenuations less than the value for which the associated time truck circuits were adjusted, the minimum loss between subscribers may be less than about 66 db for subscribers connected through tandem offices. It is estimated that in any case the value of this loss will not be less than about 50 db with which loss interference would not be serious if a subscriber should attempt to speak to the announcer.

The effect on the volume of an announcement delivered to a single subscriber's line of other subscribers' lines simultaneously connected to the same terminating amplifier depends on the type of time announcement trunk circuits which are involved in the connections. If all the announcement trunk circuits are of the local central office type the effects are as given by Table A.

TABLE A

Number of Simultaneously Connected Subscribers' Lines (Through Local Central Office Time Announcement Trunk Circuits)	Reduction in Volume Delivered to A Single Subscriber's Line - Db
1	0
100	1.0
200	1.9
300	2.7
400	3.5
500	4.1

The effect of each additional simultaneous connection through an announcement trunk circuit of the tandem office type depends on the adjustment of the series resistance of the announcement trunk circuit and the connection of its repeating coil. The relations between the effects of additional simultaneous connections made through tandem office announcement trunk circuits and through local office announcement trunk circuits for various arrangements of tandem office an-

* Drawings 8D-12848-01, 8D-15148-01, 8D-21452-01, 8D-21734-01, 8D-31362-01, 8D-31822-01.

nouncement trunk circuits are shown by the curves on Drawing 909-3070. These curves show this relation by giving for any arrangement of a tandem announcement trunk circuit the number of simultaneous connections through local office announcement trunk circuits which would have the same effect on volume.

2. Transmission Testing Arrangements

The principal transmission tests which are required for the time announcement system are those necessary to adjust and maintain the gains of the intermediate and terminating amplifiers at proper values. The gains of the transmitting amplifiers are adjusted to provide the required pick-up amplification for the operators' voices. This adjustment is discussed in Section 3.4.

The transmission tests for adjusting the gains of the intermediate and terminating amplifiers consist of transmission level tests using the 800-cycle time signal tone as the testing current and rectifier-type meters as indicating elements. One meter is located at the time bureau and one with each intermediate or terminating amplifier installation. For a time signal of proper intensity a potential of about .6 volt is required across the transmitting amplifier load. This voltage has, therefore, been taken as the reference level voltage. Exactly .6 volt is obtained at the transmitting amplifier load by the adjustment of the variable pad in the tone circuit. When the proper levels exist at the intermediate and terminating amplifiers, a tone signal potential of .6 volt is also obtained across each intermediate amplifier load and across the vacuum tube test load of each terminating amplifier. This vacuum tube test load is the 10-ohm resistance shown on Drawing 909-3068 associated with the rectifier-type meter of a terminating amplifier. Its purpose is discussed below.

The rectifier-type of meter is used for this time system testing arrangement since it provides a relatively inexpensive and rugged meter which is sufficiently sensitive and sufficiently fast for the measurement of a time signal tone, the average duration of which is about .5 second. In view of the voltage conditions discussed above the meters employed have a sensitivity such that a potential of .6 volt produces a steady-state deflection at midscale. They have a db scale covering a range from -3 to + 3 db, the 0 db mark corresponding to the .6 volt steady-state deflection point. Their readings therefore indicate the deviation in db of the level of the tone signal from the proper level. The meters have high impedances compared with the output impedances of the amplifiers and, therefore, introduce negligible bridging loss. Each rectifier-type meter is associated with the circuit through a non-locking key. The directions for making a meter reading are as follows:

1. Provide a call-waiting condition by calling for the time from a nearby telephone or blocking operated the ST relay* of a terminating amplifier. This is necessary at the time bureau in order to have the tone sent out and at intermediate and terminating amplifier offices in order to close the transmission circuit from the inter-amplifier circuit to the input of the amplifier.

2. Monitor on the time system.

3. As soon as the announcer stops speaking, throw the key connecting the meter to the circuit and hold it until the time signal has ceased.

4. The meter needle will be deflected by the tone signal and will momentarily pause at the steady-state position before it returns to the 0 input position. The steady-state position should be used for the reading. It may be necessary to make several observations to obtain a satisfactory reading. This is due to the fact that the tone signal duration varies from .2 to .8 second. With the shorter tones there will be no definite pause at the steady-state position.

The intermediate and terminating amplifier gains are properly adjusted when a 0 db reading is obtained on the time bureau rectifier-type meter and 0 db readings (between -.5 db and +.5 db) on each of the intermediate and terminating amplifier rectifier-type meters. The output volume of the tone circuit is sufficiently constant so that no close correlation between the tests at the different offices is required.

In addition to providing means for adjusting and maintaining the intermediate and terminating amplifier gains, the transmission testing equipment provides a means for testing the filament activity of the vacuum tubes of the intermediate and terminating amplifiers without removing the tubes from their sockets. These tests are made by measuring the transmission level at the output of an amplifier for two values of filament current through each of the two vacuum tubes. The two values of filament current are the normal value and 6 per cent less than normal. The change in filament current for each of the two tubes of an amplifier is obtained by the operation of a key having three positions, "TEST 102-F", "NORMAL" and "TEST 101-F". With this key in the "NORMAL" position normal current flows through the filament of each tube. With it in the "TEST 102-F" position the current flowing through the filament of the 102F tube is about 6 per cent less than normal, and with it in the "TEST 101-F" position the current through the filament of the 101F tube is about 6 per cent less than normal. If the change in

* Drawing SD-90260-01.

level with the 6 per cent reduction in filament current is greater than a specified value the tube under test is replaced. The limits are given in Section 4.5. These vacuum tube test keys should be in the "NORMAL" position except when tube tests are being made.

Since this vacuum tube test is a filament activity test, it is essentially a measurement of the change in the plate circuit impedance of the tube with a definite change in the filament current. In order to provide a sufficiently sensitive test it is necessary that the load on the vacuum tube be of about the same order of magnitude as the vacuum tube plate impedance. Also in order that the same test limits apply at all times it is necessary that this load be constant. The loads of the 102F vacuum tubes of the amplifiers are the windings of the 212-C input transformers. The load on the 101F vacuum tube of an intermediate amplifier is provided, when the output of the amplifier is used to the maximum extent, by the connected inter-amplifier circuits. Since the number of connected inter-amplifier circuits may differ and may be considerably less than the maximum number, there is provided with each intermediate amplifier installation an artificial load which is used in each case to build out the load of the intermediate amplifier to the equivalent of full load.

Normally, the load on a 101F vacuum tube of a terminating amplifier is a very high impedance, which will vary in magnitude, depending upon the number of connected subscribers. In order to provide a load impedance of a magnitude more suitable for testing the 101F vacuum tubes of terminating amplifiers, and to allow the use of the same limits as for the 101F tubes of the intermediate amplifiers, there is included in the rectifier-type meter circuit for the terminating amplifier a resistance shunt of 10 ohms. This resistance shunt is only connected to the output of the terminating amplifier when the meter key is thrown. If the procedure for making a meter reading given above is followed, this shunt will only be connected during the transmission of the signal tone and not the voice. The effect of bridging a 10-ohm shunt across the output of a terminating amplifier is to introduce a loss of about 3 db between the amplifier and any connected subscriber. Such a loss for the signal tone will have no detrimental effect. If the meter key is thrown during an announcement, all or part of the announcement will be reduced in volume by 3 db. This would be undesirable and should be avoided.

Since the signal tone does not pass through the transmitting amplifier, this means of testing the vacuum tubes in their sockets cannot be used for the 101F and 102F vacuum tubes used therein. Generally, however, there are time system terminating amplifiers installed in the same office and the tubes of the transmitting amplifiers can be substituted in these terminating amplifiers for test.

The time signal as adjusted by the rectifier-type meter at the time bureau provides a standard a-c. voltage for the calibration of the volume indicators of the time bureau. The method of calibrating these volume indicators is discussed in Section 3.4.

3. Transmission Adjustments

The principal transmission adjustments to be made on the time announcement system consist of:

1. Setting of the amplifier equalizers.
2. Adjustment of the intermediate amplifier artificial loads.
3. Adjustment of time announcement trunk circuits of tandem offices.
4. Adjustment of amplifier gains so that proper volume relations will be obtained.
5. Adjustment of volume indicators so that normal reading will be obtained with -14 db volume delivered to inter-amplifier circuits associated with the transmitting amplifier.

The first three adjustments can be made in connection with the installation of the apparatus. The last two require the system to be in a working condition with the inter-amplifier circuits connected.

3.1 Equalization

The amplifiers of the time announcement system are equipped with transmission equalizers similar to those of 44-A-1 repeaters. The equalizers of the transmitting amplifiers are employed to give them a substantially uniform transmission-frequency characteristic. The equalizer of each intermediate or terminating amplifier is used to equalize the transmission-frequency characteristics of the amplifier and also to equalize the outgoing supply circuit and inter-amplifier circuit immediately preceding the amplifier. To avoid the expense and complication of making and interpreting complete transmission-frequency characteristics for the whole system satisfactory arrangements have been worked out for adjusting the equalizers on an empirical basis. Tests have been made, using a time announcement amplifier, to determine the best equalizer connections for amplifiers terminating various types of inter-amplifier circuits of typical lengths. From the results of these tests there have been derived the data given in Table I, showing the equalizer connections to be used for various lengths and types of inter-amplifier circuits. To obtain the equalizer connections to be used by an amplifier terminating a particular circuit it is necessary to se-

lect the type of trunk and range of lengths listed in Table I which represents the circuit under consideration. The corresponding equalizer connections are the ones to be employed. If the type of circuit which is to be used is not included in Table I or the length does not fall in one of the ranges given, the equalization to be used is that for the condition most nearly corresponding to the actual circuit.

3.2 Artificial Loads of Intermediate Amplifiers

The artificial loads of the intermediate amplifiers are adjusted in accordance with information given on the circuit drawing.

3.3 Adjustment of Time Announcement Trunk Circuits of Tandem Offices

When time service is supplied by way of a tandem office it is desired that the volume of the announcements transmitted to the tandem trunks be such that the volume delivered to the subscribers' lines in the various central offices served will be about -22 db. If all of the tandem trunks involved have about the same attenuation it will be easily possible to adjust the tandem office time announcement trunk circuits to satisfy this condition for all the central offices involved. In this case the common tandem trunk loss plus the tandem office loss will be used to determine from Drawing 909-3069 the value to which the variable resistance of each tandem time announcement trunk circuit should be adjusted and in what manner the 94-F repeating coil should be connected.

In many cases, however, the tandem trunks to the offices to be served will vary considerably in attenuation and it will be necessary to choose a compromise value of tandem trunk loss to use in determining the resistance and coil connections to be used for the tandem announcement trunk circuits. This compromise or representative value of tandem trunk attenuation may be a mean value or it may be biased in any particular case to prevent too low or too high volume. In general, it does not appear desirable to allow the volume delivered to a subscriber's line to drop below -25 db or to be above -19 db. It should be noted that, in addition to the effects of trunk variations, the variation in subscriber's loop receiving losses increases the variation in the volume received by the subscribers.

In the case of a panel sender tandem office, a distant office frame or a manual tandem office, the effects of trunk variations may be reduced by having two or more groups of time announcement trunk circuits, each group being accessible to a particular group of tandem trunks. For the manual tandem office this assumes that it will be feasible to segregate incoming trunks. The resistances and coil connections of the announcement trunk circuits of each group are made suitable for the associated group of tandem trunks. With such a multiple group arrangement the total number of announcement trunk circuits required will, of course, be greater than if only one group of time trunk circuits is used for the whole office.

In the case of a step-by-step tandem office or where the above grouping procedure is undesirable the effects of tandem trunk variations may be reduced by serving more of the offices of the area by the amplifier per building method, using local central office time announcement trunk circuits. Such offices located in the same building as the tandem office or distant office frame would, of course, be served from the same terminating amplifier as that used to supply the tandem announcement circuits.

If the tandem announcement trunk circuits are connected to the same terminating amplifier as the time announcement trunk circuits of one or more local central offices, or if there are a large number of tandem announcement trunk circuits, consideration should be given to the possible effects of the variation in the terminating amplifier load on the volume transmitted to any one subscriber. Data regarding the effect of the variation in total load on the received volume are given in Section 1.62. Variations in volume due to changes in the load on a terminating amplifier probably should not be allowed to exceed about 3 db.

3.4 Adjustment of Volume Indicators - Adjustment of Amplifier Gains

When the time signal tone circuit is adjusted so that a reading of 0 db is obtained on the time bureau rectifier-type meter the tone signal may be used to adjust the volume indicators so that when normal speech deflection is obtained on the volume indicator meters the speech volume delivered to each inter-amplifier circuit connected to the transmitting amplifier load will be about -14 db. To make this adjustment the dial and key of each volume indicator should be set so that the initial deflection of the volume indicator needle for the time signal will be about 50 scale divisions. The resulting dial and key setting will probably be the same as the setting determined by the Western Electric Company calibration tests.

The gain of each transmitting amplifier should be adjusted by means of the taps on the 208-M input transformers and the dial* of the 212-C input transformers so that the correct reading of the volume indicator can easily be obtained by the adjustment of the volume control key on the desk turret and by slight adjustments of operators' voices.

The time announcer will make a statement similar to:

"When you hear the signal the time will be ten twenty-seven and three-quarters."

* Drawing SD-90400-01.

If the operator is speaking correctly and the volume control key is set properly most of the large swings of the volume indicator obtained during this announcement will carry the needle up to about midscale (between 25 and 35 scale divisions or between the -2 and +2 scale marks). The volume indicator is assumed to have been calibrated as described above.

The intermediate and terminating amplifier gains should be adjusted so that readings between -.5 and +.5 are obtained on the associated rectifier-type meters for the tone signal. This assumes, of course, that the tone signal circuit has been adjusted so that a 0 db reading is obtained on the rectifier-type meter of the time bureau. These amplifier gains are adjusted by means of the taps on the 208-M input transformers (about 5 db per step) and by the dial of the 212-C input transformers (about 1 db per step)*.

4. Transmission Maintenance

4.0 General

As a general check on the transmission of the time announcement and the signal tone it is desirable to make frequent test calls from the local offices to which time service is supplied. Such test calls provide, of course, only rough observations of the operation of the time system and should be supplemented by transmission measurements. These transmission measurements should check:

1. The level of the time signal tone at the time bureau.
2. The adjustment of the time bureau volume indicators.
3. The transmitted volume.
4. The gains of the amplifiers.
5. The amplifier vacuum tubes.

4.1 Level of Time Signal Tone at Time Bureau

Since the level of the time signal tone at the time bureau is used as a reference for transmission tests it is desirable that it be adjusted with sufficient frequency to limit its maximum deviation of .5 db. It is not expected that this will require frequent adjustment since the output of the 6-D oscillator** used in the tone circuit is quite constant. If either of the vacuum tubes of an oscillator is changed the tone level should be checked.

4.2 Time Bureau Volume Indicator

The adjustment steps for the 203-C panel are relatively coarse, 2 db. It should, therefore, be feasible to maintain the volume indicator adjustment so that the setting will not be more than one step from the correct setting. An adjustment should be made any time the vacuum tube of a volume indicator is changed.

4.3 Transmitted Volume

The volume delivered to the load of the transmitting amplifier should be checked at regular intervals to determine whether the operators are correctly using the announcement desk equipment and whether the transmitting amplifier gain is correct. Such a check can be made using either the volume indicator meter on the announcer's turret or the meter on the 203-C panel. As discussed in Section 1, the margin between the normal operating volume and the volume required to overload the terminating amplifiers is about 3 db. Therefore, if the volume transmitted to the time bureau inter-amplifier circuits approaches or exceeds about -11 db, overloading of the terminating amplifiers will occur and speech distortion will result. This speech distortion due to overloading will produce a rasping quality in the received announcement. The amount of distortion will, of course, depend on the amount by which the transmitted volume exceeds -14 db. In addition to this distortion the received speech may be objectionably loud particularly in the case of subscribers served through a tandem office over the lower attenuation tandem trunks.

If the transmitted volume becomes lower than -14 db the received volume will, of course, be reduced and there may be some difficulty in understanding the announcement. Longer holding times may result with possibly some service complaints. The effects of low volume will be most noticeable for subscribers served through a tandem office over the higher attenuation tandem trunks or for subscribers on long loops.

4.4 Gains of Amplifiers

The gains of the transmitting amplifiers are adjusted to accommodate the voices of the announcing operators. Their adjustment, therefore, depends on the difficulty experienced by the operators in maintaining the proper output volume. The gains of the intermediate and terminating amplifiers should be adjusted with sufficient frequency so that their gains will not deviate by more than 1 db from the proper value.

4.5 Vacuum Tubes

The equipment for making filament activity tests on the vacuum tubes of the amplifiers of the time announcement system is described in Section 2 which section also discusses the method of making such tests. Limits which may be used in conjunction with vacuum tube maintenance tests are given in Table M:

*Drawings 8D-90400-01 and 8D-90400-03.

**Drawing 8D-90554-01.

TABLE B

VACUUM TUBE TEST LIMITS

Type of Tube	Maximum Deviation - Db: Tubes Tested Weekly	Maximum Deviation - Db: Tubes Tested Monthly or Bi-Monthly
101F	1.5	1
102F	1	1

A vacuum tube should not be tested until it has been turned on for about ten minutes. Also the applied plate voltage and filament current should be within required limits at the time of the test.

In addition to these filament activity tests it will be desirable to make visual inspections of the vacuum tubes for bright spots and blue haze. Tubes which have developed incandescent spots or which have a pronounced blue haze are unfit for service.

5. Noise and Reverberation in Announcing Room

5.1 Noise

As stated in Section 1.12, the announcer's desk should be located in a position where the maximum room noise will not be more than 150 noise units, measured as described in D. & R. Bulletin No. 463 or an equivalent amount as measured by a sound meter (43 db as measured by the sound meter described in D. & R. Bulletin No. 529). To obtain such a result it will probably be necessary to locate the desk in a separate room and possibly to provide special ventilating arrangements.

Generally it will be found desirable to partition off a corner of an operating room so as to make the announcing room convenient to the supervisors tending a line of switchboard. A single partition of steel or wood and glass should be suitable for a room in such a location. Resonances should be avoided in a partition of this type by adequate bracing and by tight joints between the glass panes and the sash. If the windows of the announcing room are located on an inside wall or court they should require only a single pane. If they are exposed to street noises double panes may be necessary.

Where the noise outside the windows of an announcing room is not higher than 200 noise units measured according to Bulletin No. 463 (46 db as measured by the sound meter described in D. & R. Bulletin No. 529), the windows can probably be employed to ventilate the room. If the outside noise exceeds this value or if there are no outside windows in the announcing room special ventilating arrangements may be required. The problem of ventilating a room such as an announcing room without introducing excessive noise is being studied. This work has not as yet reached the stage where definite recommendations can be given for the design of a ventilating system. The preliminary work has, however, indicated certain general features to be desirable.

Where a ventilating system is necessary, the use of ducts for supplying air to a room and for exhausting air from a room has advantages from the standpoint of the acoustic attenuation provided by ducts to outside noises. The attenuation is greater for ducts of smaller diameters although a duct should not be so small as to require a high air velocity. The acoustic attenuation of a duct is increased if it is lined with a sound absorbing material. Right-angle turns also increase the attenuation.

In order to drive a sufficient amount of air into a room through a duct a blower may be required. The blower used should not, of course, introduce excessive noise. If the blower is installed near the intake end of an input duct the acoustic attenuation of the duct will reduce the blower noise which is heard in the announcing room.

5.2 Reverberation

Where the announcer's room has a volume of less than 5000 cubic feet and is equipped with a large rug or carpet the effects of room reverberation should be negligible. If reverberation effects are objectionable when the time system is in operation, the announcer's room may be given additional acoustic treatment. The ceiling can be equipped with a panel of sound absorbing material, and, if necessary, the side walls can be similarly treated. If the announcing room is treated to reduce room reverberation, the room noise will also be reduced.

Attached:

Table

Drawings 909-3068
909-3069
909-3070

TABLE I

TIME ANNOUNCEMENT SYSTEM

ADJUSTMENT OF EQUALIZERS OF AMPLIFIERS

Inter-Amplifier Circuit			Connection of Equalizer Leads*					
			82-H Retard Coil Terms.					N
Type of Circuit	Range of Length (Thousands of Feet)	Strap S	V	W	X	Y	Terminal of 208-M Input Trans.	Terminal of I (102F) Vacuum Tube Socket
Zero	Zero	Closed	Open	Open	Open	Open		P
26 ST N.L.	0-15	Closed	Open	Open	Open	Open		P
	15-25	Open	Open	Open	1	2	12	
24 ASM N.L.	0-15	Closed	Open	Open	Open	Open		P
	15-25	Open	Open	Open	1	2	12	
	25-35	Open	Open	Open	1	3	12	
22 BSA N.L.	0-15	Closed	Open	Open	Open	Open		P
	15-25	Open	Open	Open	1	2	12	
	25-40	Open	Open	Open	2	6	12	
22 BSA M-88	40-75	Open	2	4	2	5	12	
	75-90	Open	2	5	2	7	12	
22 BSA H-88	40-60	Open	Open	Open	1	2	12	
	60-90	Open	Open	Open	2	3	12	
19 CNB M-88	60-100	Open	2	3	1	5	12	
	100-150	Open	1	2	1	8	12	
19 DNB H-135	60-150	Open	2	5	2	4	12	
	150-250	Open	2	6	1	3	12	
19 DNB H-175	60-100	Open	Open	Open	1	8	12	
	100-150	Open	1	4	2	4	12	
	150-200	Open	1	4	2	8	12	
	200-250	Open	1	3	1	3	12	

* Drawings SD-90400-01 and SD-90400-02.

Note: The equalizers of the transmitting amplifiers should be adjusted as for a zero inter-amplifier circuit.

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TIME ANNOUNCEMENT SYSTEM

VOICE FREQUENCY TRANSMISSION FEATURES

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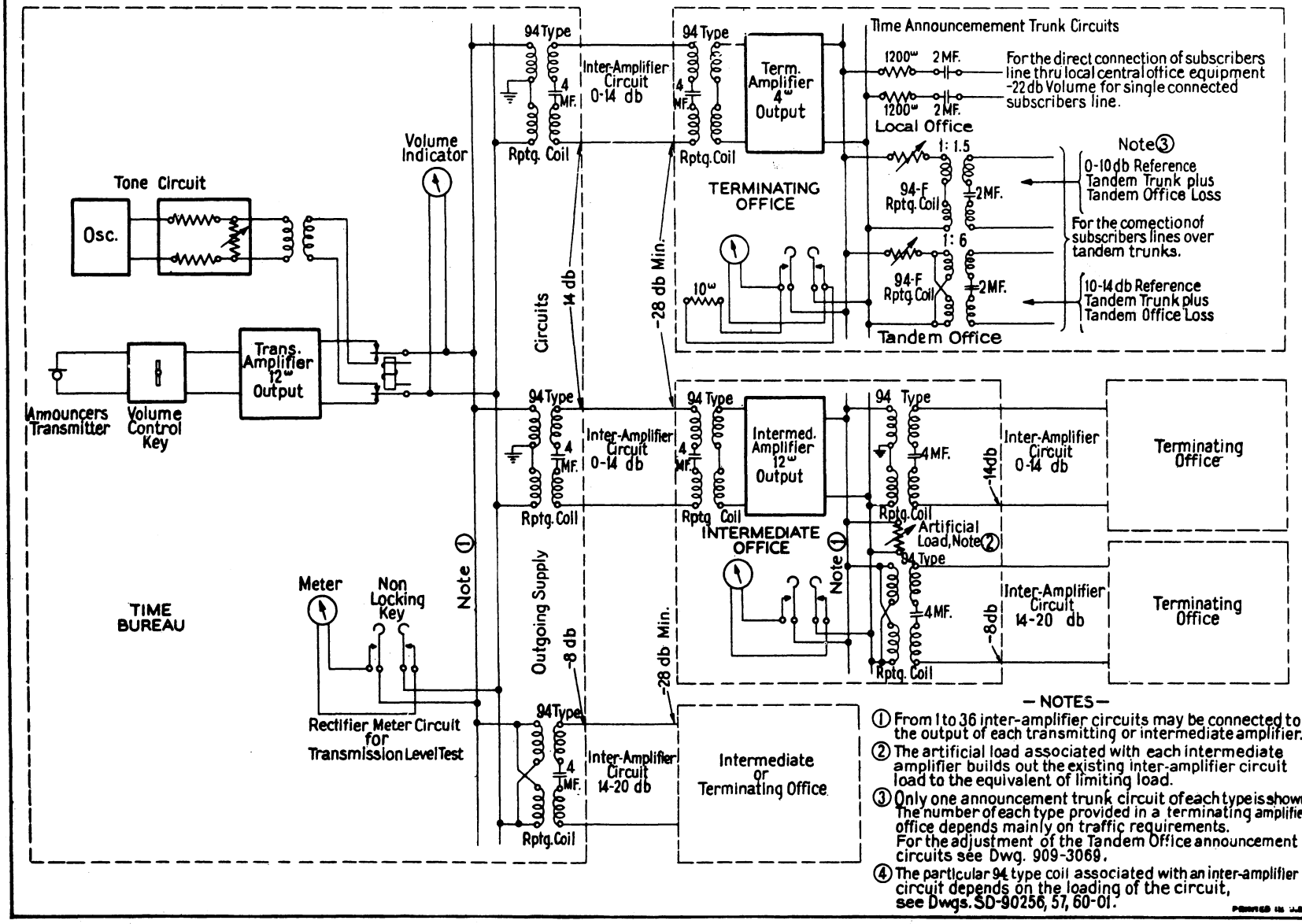

— NOTES —

① From 1 to 36 inter-amplifier circuits may be connected to the output of each transmitting or intermediate amplifier.

② The artificial load associated with each intermediate amplifier builds out the existing inter-amplifier circuit load to the equivalent of limiting load.

③ Only one announcement trunk circuit of each type is shown. The number of each type provided in a terminating amplifier office depends mainly on traffic requirements. For the adjustment of the Tandem Office announcement circuits see Dwg. 909-3069.

④ The particular 94 type coil associated with an inter-amplifier circuit depends on the loading of the circuit, see Dwgs. SD-90256, 57, 60-01.

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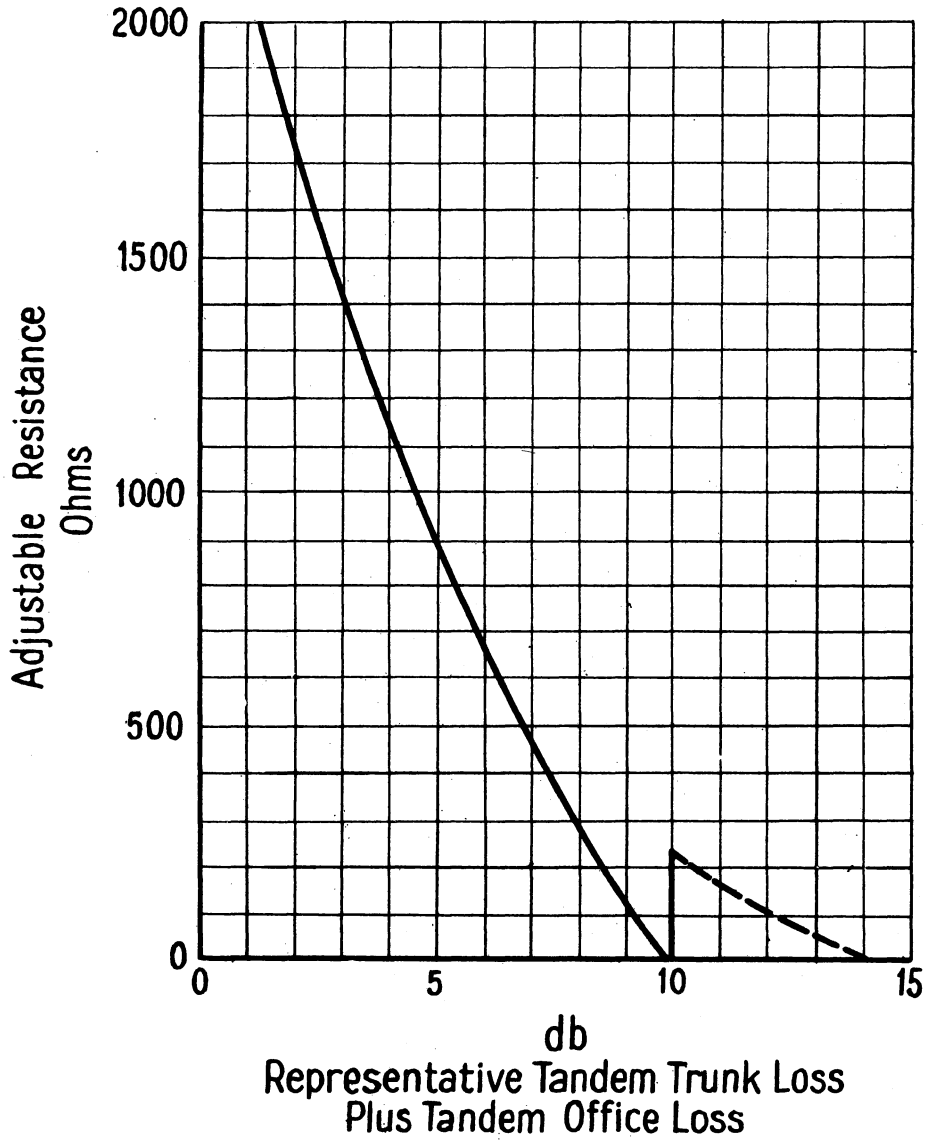
TIME ANNOUNCEMENT TRUNK CIRCUITS FOR TANDEM OFFICES

Method of Adjustment.

For circuit Dwgs. see: SD-15146-01, 21734-01, 31622-01

Solid Curve: 4-3, 8-7 Windings of 94-F Repeating Coil Series Aiding.
Dashed Curve: 4-3, 8-7 Windings of 94-F Repeating Coil Parallel Aiding.



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TIME ANNOUNCEMENT TRUNK CIRCUITS FOR TANDEM OFFICES

Effects With Simultaneous Connections.

Solid Curve: 4-3, 8-7 Windings of 94-F Repeating Coil Series Aiding.
Dashed Curve: 4-3, 8-7 Windings of 94-F Repeating Coil Parallel Aiding.