OPERATORS' TELEPHONE CIRCUITS

TRANSMISSION CONSIDERATIONS

CONTENTS

1. GENERAL

1.01 This is the first section in a series of practices covering operators' telephone circuit transmission. It presents information concerning the general transmission aspects of operators' telephone circuits and the transmission rating of the 52-type operator's telephone set.

1.02 Information concerning specific engineering considerations is contained in related practices as follows: Section AB22.171.2 - Operators' Telephone Circuits - Induction Coils; Section AB22.171.3 - Operators' Telephone Circuits - Telephone Sets; Section AB22.172 - Intercepting Service; Section AB22.173 - Information Service.

1.03 A telephone operator is known as the "voice with a smile." Good transmission enables her to "smile with her voice."

1.04 It is of prime importance that operators be provided with good transmission in order to assist them in maintaining a high grade of service. This is dependent upon the provision of the correct facilities and the proper use of these facilities, especially the head telephone set. The subject matter of the conversation, the skill and practice in the use of the telephone, noise and bridging conditions are different from those encountered in normal subscriber-to-subscriber conversations. Poor transmission reduces the quality of service rendered to the public by increasing the possibility of wrong numbers and other traffic irregularities. It also tends to increase the cost of operating.

1.05 Operators' transmission may involve operator-to-operator and operator-to-subscriber transmission. Operator-to-operator transmission generally is determined by intervening trunk losses and will improve as the program of reducing the losses of interoffice, tandem, and toll connecting trunks progresses. Operator-to-subscriber transmission may involve either loops, or loops and trunks. In situations involving loops and trunks, it is imperative that trunk losses be controlled.

2. OPERATORS' TELEPHONE CIRCUIT

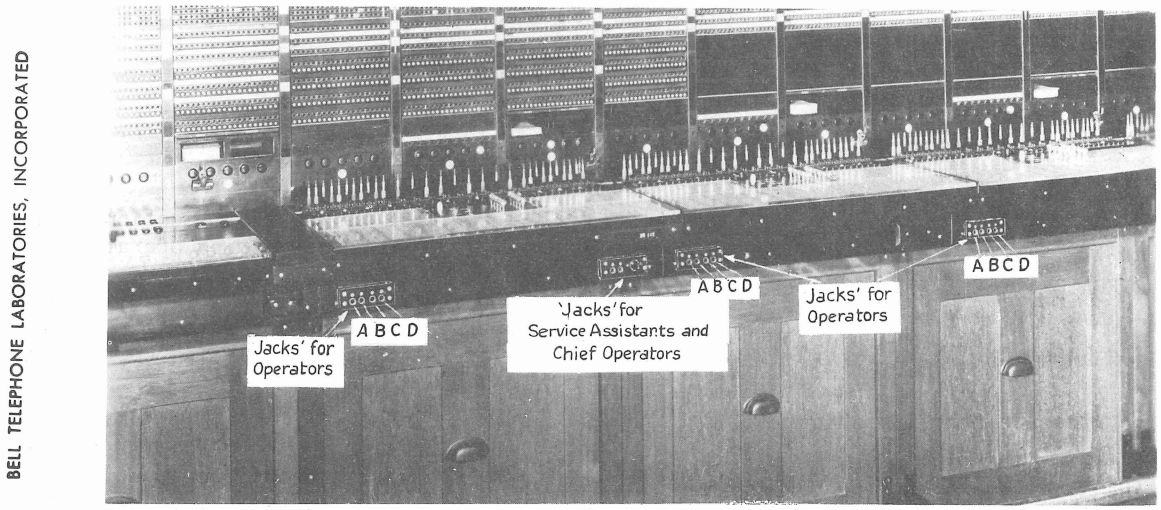

Fig. 1

(A) General

2.01 As shown in Fig. 1, a standard operator's position has two sets of jacks located in the lock rail on the left side of the position for plugging an operator's telephone set into the operator's circuit. The telephone set plug is normally inserted in the "CD" or right-hand pair of jacks. However, when an operator is in the process of relieving the operator on duty, she places her telephone plug into the "AB" jacks, until the "CD" jacks become available. She should change as soon as they are free as her receiving transmission is 10 db poorer in "AB" jacks.

2.02 The schematic drawing shown in Fig. 2 is a typical operator's telephone circuit for use in common battery type central offices. It consists basically of a transmitter and a receiver unit in conjunction with an induction coil, balancing network, capacitors, repeating coil, and a retardation coil battery supply circuit.

(B) Transformer (Induction Coil)

2.03 The 181B induction coil shown in Fig. 2 is a universal type of induction coil introduced in 1952 as standard for all types of 2-wire operators' circuits both for terminating

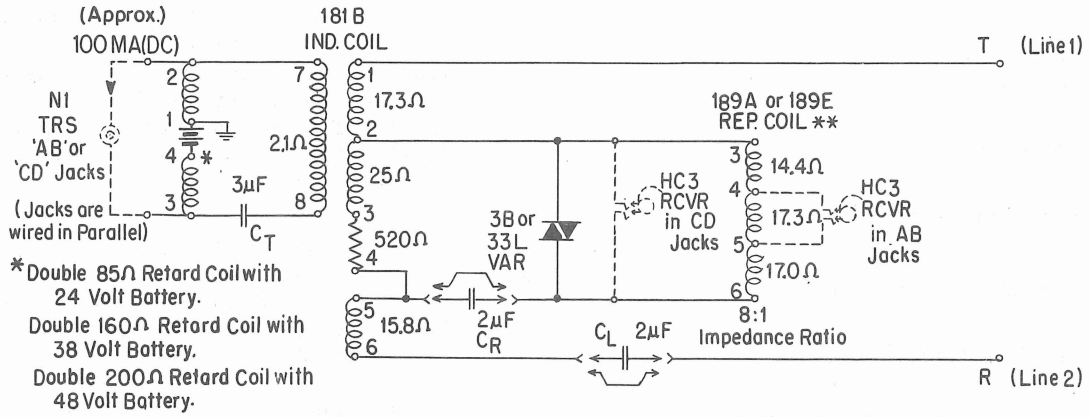

Fig. 2 - Operator's Telephone Circuit for Common Battery Type Central Offices

and switched calls (including via net loss switching) and also as a maintenance replacement for any of the older types of coils. More specifically, the 181B coil will be used in local, PBX, intercept, information, toll, and special service operators' circuits.

2.04 The 181B induction coil is of the anti-sidetone type, arranged for either a balanced or unbalanced-to-ground connection. The sidetone balancing network is provided by the 520-ohm noninductive resistor between terminals 3-4 supplemented by the 25 ohms of resistance in winding 2-3. Additional information on this coil and its features as a replacement for earlier type coils are provided in Section AB22.171.2.

(C) Receiver Monitoring Transformer (Repeating Coil)

2.05 As shown in Fig. 2, the 189A or 189E repeating coil is the standard for providing a high impedance bridge across the receiver terminals for monitoring the operator. In some older arrangements the 161A repeating coil was used. The 161A, 189A, and 189E coils may be regarded as electrically equivalent, differing chiefly in mechanical detail. Each of these coils provides an impedance step-up of 8:1.

(D) Line Monitoring Transformer (Repeating Coil)

2.06 An additional transformer not shown in Fig. 2 is provided in most operators' telephone circuits for line monitoring. It is made available by operating the listening key of the cord circuit to the "monitoring" position. The receiver is then bridged across the line through a 43.5:1 ratio monitoring coil as shown in Fig. 3. However, when the listening key is operated to the "talk" position the circuit connection is as shown in Fig. 2.

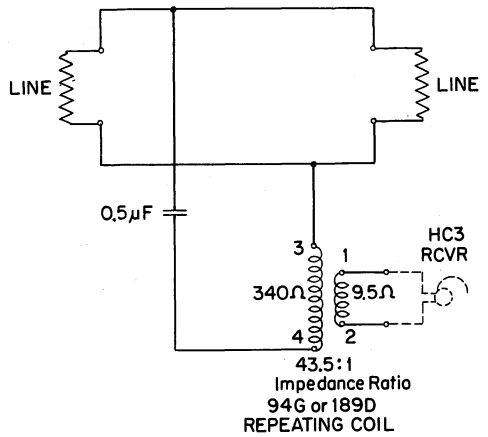

Fig. 3

(E) Telephone Sets for Operators

2.07 The 52-type telephone set is currently standard for operator's circuit use at all switchboards, desks, and multiple PBX positions. There is a 53-type head telephone set that is available for use as a handset with the same transmission characteristics as the 52-type set. For further information and details, refer to Section AB22.171.3.

(F) Capacitors

2.08 The function of capacitor C_T shown in Fig. 2 is to confine the battery supply current entirely to the transmitter. It is necessary to use a relatively high value of capacitance (3 uf) in order to prevent the introduction of excessive loss in the transmitter branch of the circuit. Capacitor C_L is used on an optional basis when needed to block dc from the line into the telephone circuit. Capacitor C_R is used to improve return losses by increasing the low-frequency impedance of the telephone circuit and is required at all switchboard operator and testboard positions in offices where trunks are terminated in their via net loss (VNL) condition.

(G) Varistors

2.09 The varistor, bridged across the receiver as shown in Fig. 2, is provided to limit the amplitude of acoustic disturbances in the operator's receiver.

2.10 The varistor is a nonlinear device having a high impedance at voltages corresponding to normal speech levels, but having a low impedance at high voltage levels, thereby effectively shunting the disturbance from the operator's receiver.

2.11 The currently standard varistors for use in operators' circuits are the 3B and the 33L. These varistors are electrically equivalent but differ in mechanical details. These varistors are more effective than all prior types.

3. TRANSMISSION

3.01 In this section the transmission losses of operators' telephone circuits are treated on a loop-loss basis. It is therefore relatively easy to obtain an over-all expression of operator-to-operator and subscriber-to-operator transmission in the same terms as subscriber-to-subscriber transmission.

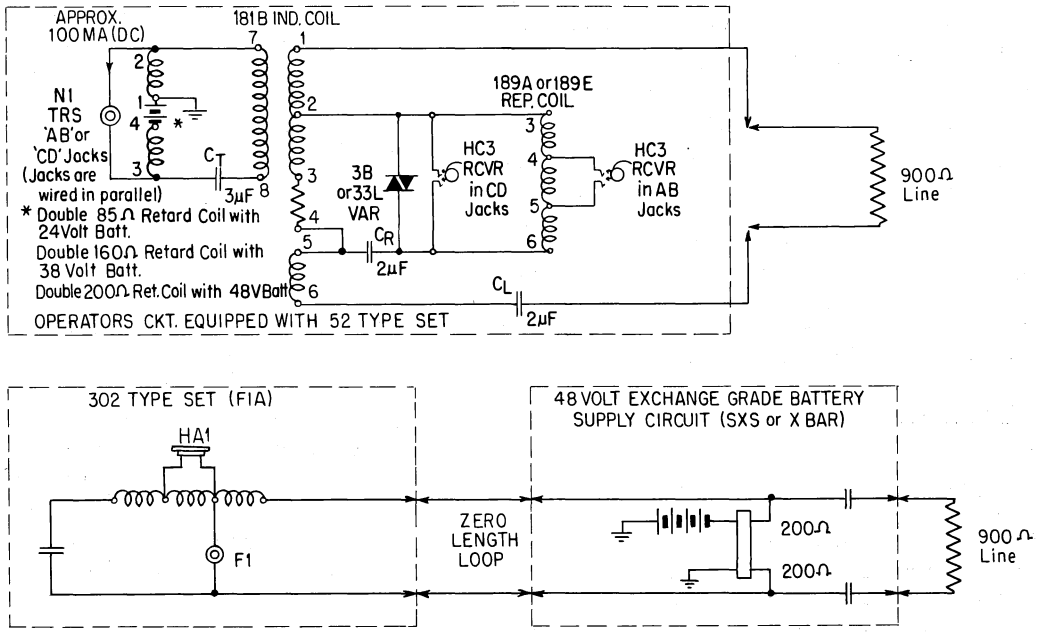

Fig. 4 - Transmission Comparison of Operators' and Subscribers' Circuits on a Loop-Loss Basis

3.02 Fig. 4 shows a 52A operator's telephone set and circuit compared with a No. 302 subscriber telephone set on a zero length-loop connection. The following tabulation gives values based on currently available data for the respective transmission losses of the two arrangements. For the assumptions specified, the operator's effective loss is about 1.5 db (T+R)/2 poorer than the subscriber's. These data assume the same low or moderate room noise in each case, and are based on the operator using the "CD" jacks with the "AB" jacks unterminated.

	Effective Loss in db	
	No. 52A Operator Telephone Set and Circuit	No. 302 Subscriber Telephone Set
Transmitting Loss	- 5	-10
Receiving Loss	-10	- 8
T+R	-15	-18
(T+R)/2	- 7.5	- 9

3.03 With respect to the superseded operator's telephone set (396-528) instruments, the No. 52A operator's telephone set provides an effective transmission gain of about 5 db (T+R)/2.

3.04 The 189A or 189E repeating coil (shown in Fig. 2) or the 161A coil, provides an impedance step-up of about 8:1. The insertion of a No. 52A telephone set in the AB jacks introduces a receiving impairment to the operator (plugged in the CD jacks) of about 0.7 db. The receiving efficiency of the telephone set connected to the "AB" jacks is about 10 db below that of the telephone set connected to the "CD" jacks.

3.05 The above paragraph applies for the cord circuit listening key in the "talk" position. If the operator remains on the circuit with the listening key in the "talk" position after establishing a connection, a bridging loss is introduced. This loss will range from about 2 to 5 db, depending on the line impedance. In view of this relatively high loss, any necessary monitoring should be done with the listening key in the "monitor" position, which introduces a bridging loss of only about 0.2 db. This low loss is obtained by the use of the 94G or 189D repeating coil which provides an impedance step-up of 43.5:1 as shown in Fig. 3. With this connection the operator's receiving efficiency is lowered about 9 db as compared to her normal receiving condition (listening key in "talk" position and connected to a single subscriber).

3.06 Room noise has an effect on operators' transmission. Improvements have been made in noise levels by the installation of sound absorbing materials and changes in equipment and operating procedures. For details and further discussion, refer to Section AB22.377.

3.07 Some older types of operators' circuits employed a one uf capacitor in the transmitter circuit, instead of the 3 uf capacitor (C_T) shown in Fig. 2. While this one uf capacitor was satisfactory for use with the 396 transmitter, it introduces a substantial loss when an N1 transmitter is used, as in the 52- and 53-type operators' sets. For details and further discussion, refer to Section AB22.171.2.

4. SERVICE ASSISTANTS' CIRCUITS

4.01 Generally, one service assistant's circuit is provided for each six operators' positions. Service assistants' telephone set jacks are located in the lock rail as shown in Fig. 1 and are usually provided on the basis of one per three positions.

4.02 Service assistants use a 52B head telephone set having a switch in the cord for cutting the transmitter in or out of the circuit. A typical service assistant's telephone circuit is shown in Fig. 5. This arrangement is the same as that shown in Fig. 2 except that the receiver monitoring repeating coil is omitted and only one pair of jacks is provided.

4.03 For talking to an operator, the service assistant uses the operators' "AB" jacks (see Fig. 1 and Fig. 2). However, monitoring jacks associated with each position may be provided at the end position. A 94G or 189D repeating coil arrangement is used similar to the arrangement shown in Fig. 3. While plugged in a monitoring jack the receiving efficiency of a service assistant's telephone set is about 9 to 10 db lower than that of the operator's telephone set in the CD jacks.

5. ASSISTANT CHIEF OPERATORS' AND CHIEF OPERATORS' CIRCUITS

5.01 Assistant chief operators and chief operators have a telephone circuit of the type shown in Fig. 5. Jacks for this circuit appear at convenient locations within the operating room.

5.02 Assistant chief operators and chief operators use a 52B head telephone set and for assisting an operator the assistant chief operator or chief operator plugs into the same jacks as would be employed by a service assistant for the same purpose. Thus in order to go in on a circuit with an operator, the assistant chief operator or chief operator must use the jacks associated with that particular position.

5.03 The chief operators have special monitoring circuits for connecting to positions under their jurisdiction. These monitoring circuits are of the type shown in Fig. 3 using the 94G or 189D repeating coil arrangement. Therefore, while connected to these circuits the receiving efficiency of the chief operator's telephone set is about 9 db lower than that of the operator. This monitoring arrangement introduces a bridging loss of about 0.2 db.

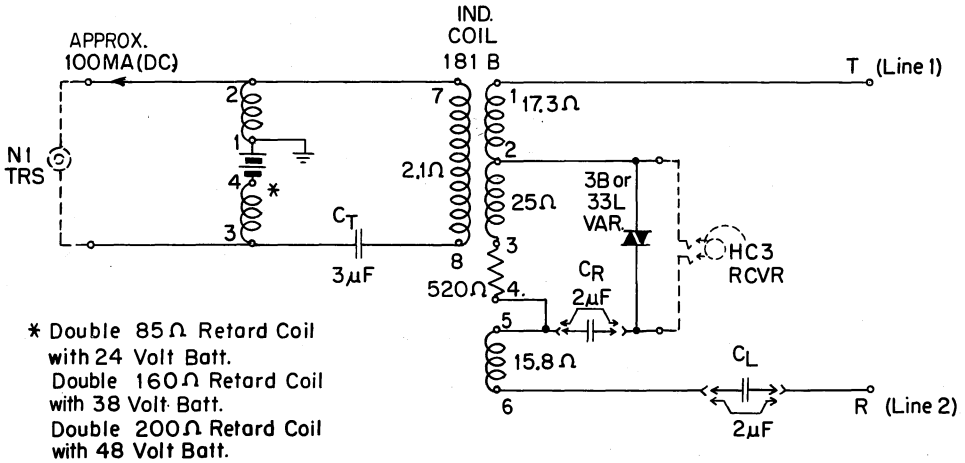

Fig. 5 - Telephone Circuit for Service Assistant and Chief Operator in Common Battery Type Central Offices

6. CENTRALIZED AUTOMATIC MESSAGE ACCOUNTING

6.01 Centralized automatic message accounting imposes no new special operator transmission problems. Equipment losses are given on the SD drawings and must be accounted for in the design of the toll and exchange trunks. If the CAMA operator is located remotely from the CAMA equipment, the loss of the trunk between the two locations must be included in the determination of the operator-to-subscriber loss. Due to the nature of the calls this extension trunk must be designed to a low value preferably not in excess of 3 db.

7. DSA OPERATORS

7.01 In dial exchanges if a subscriber desires assistance in completion of a call he will dial "0" thereby (in most cases) reaching the Dial System "A" board operator who assists him in the completion of the call.

7.02 DSA operators employ the 52A head telephone set in an operator's circuit as shown in Fig. 2. In multioffice exchange areas for centralized DSA service the subscriber-to-operator transmission is impaired by the inclusion of a trunk to the centralized point. For further information and design detail, refer to Section AB22.126.

8. PBX ATTENDANTS

8.01 The PBX attendant participates in each incoming and some outgoing calls. Therefore it is desirable that the grade of transmission provided for the PBX attendant be at least as good as that provided for the stations connected thereto. PBX attendants use a type of telephone circuit similar to that shown in Fig. 5. For PBX installations (except for the cordless type) the attendant's battery supply is obtained from the PBX battery on all calls. The attendant's grade of transmission depends upon the loss in the PBX trunks, the receiving and transmitting efficiency of her telephone set and the transmitter current.

8.02 The N1 transmitter unit used (except for cordless type) in an attendant's telephone set (52- or 53-type) is designed for maximum efficiency at about 100 milliamperes. For lower transmitter currents the output efficiency is reduced. For example, there will be about a 4 db reduction in transmitter output for 50 milliamperes vs 100 milliamperes. Therefore, at all PBX installations, it is imperative that the attendant's telephone set receive adequate battery supply at all times. Some PBX installations require special attention to prevent the battery supply from dropping too low under heavy traffic conditions.

8.03 Recently designed PBX's provide double 200-ohm retard coils in the battery supply of the attendant's telephone circuit. Unless the PBX voltage is maintained at 48 volts, the attendant's transmitting efficiency may be greatly impaired in comparison with that of a PBX subscriber station.

8.04 In general, PBX stations are treated as other subscriber stations, and further transmission information may be found in Sections AB22.075.1 and AB22.076. Supervision requirements are given on range charts and appropriate sections of the "A" practices.

9. INFORMATION SERVICE

9.01 Information operators provide a means for subscribers to obtain telephone numbers which they are unable to find in their directories. For transmission considerations concerning information service, refer to Section AB22.173.

10. INTERCEPT SERVICE

10.01 Calls made to vacant or unassigned numbers are routed to an intercepting position, either machine or operator. The calls may have been made in error or to subscribers whose numbers have been changed or disconnected, etc. The intercepted traffic may be handled either in the office in which the call is terminated (local intercepting service) or the call may be routed to a centralized intercepting board (centralized intercepting service). Centralized intercepting service often involves extensive lengths of trunk circuits which require special transmission considerations. For design considerations, refer to Section AB22.172.

11. EQUIPMENT AND TRANSMISSION TEST REQUIREMENTS

11.01 Transmission tests are provided in accordance with the "A" or "B" series of BSP's relating to the particular type of office or PBX. In general, measured transmitting, receiving and monitoring losses are compared with limiting values shown on standard circuit drawings. These tests are made to locate unsatisfactory or defective conditions in accordance with standard Bell System procedures.

11.02 It should be pointed out that transmission test loss data are unsuitable for use in determining typical operating losses. One reason for this is that the test requirements are based on artificial test conditions which generally differ appreciably from typical conditions of circuit usage. Another reason is that the test requirements represent not the average loss of the manufactured product, but the loss extremes which are just tolerable from a transmission standpoint.