INTERCEPTING SERVICE - TRANSMISSION FEATURES

CENTRAL OFFICE ARRANGEMENTS

CONTENTS

1. GENERAL

1.01 This section presents general information on the transmission features for central office arrangements used in intercepting service.

1.02 The introduction of announcing machine facilities for intercepting service requires that the step-by-step, panel, and crossbar systems recognize the difference between calls that should be routed to the announcing machine and those that should be handled by an operator.

2. RECOGNITION OF CALLS FOR INTERCEPT

(A) Panel Type Central Offices

2.01 In panel type central offices, telephone calls are routed to intercepting service by means of cross connections at the intermediate distributing frame (IDF). In addition to its tip, ring, and sleeve appearance at the IDF, each telephone number has intercept terminals associated with it consisting of tip, ring, and sleeve. When a telephone number is to be intercepted, the tip, ring, and sleeve terminals are cross-connected (or strapped) to the tip, ring, and sleeve intercept terminals. Telephone numbers in each group of 100 numbers are multipled at the IDF as required to their corresponding intercept terminals which are a multiple of a common trunk. For centralized intercepting service this line pickup trunk terminates on a trunk finder which is associated with a trunk to the centralized point. Fig. 1 shows this arrangement using one pickup trunk per 100 numbers; however, two or more trunks may be employed. If the calling rate is high for a group of numbers, such as in business areas, usually more than one trunk is assigned per 100 telephone numbers to reduce the possibility of a subscriber receiving a "busy" instead of intercepting service. This reduces the number of bridged terminals and is desirable from a transmission viewpoint.

2.02 As shown in Fig. 1 the difference in routing between calls to an operator and machine intercepting is a reversal of the tip and ring in the cross connections to the intercept terminals (line 1 vs line 2 arrangement in Fig. 1). Thus ringing current is passed to the line pickup trunk over the ring conductor for intercepting by operators and over the tip conductor for announcing machine intercepting.

2.03 The trunk finder cuts through to an outgoing intercept trunk circuit which has a relay to trip ringing current, and proceeds in the routing of the call.

2.04 When a line is in trouble, a plug may be inserted at the main distributing frame and connection made through a plugging up circuit to the intercept trunk finder. The finder recognizes trouble calls by their location on the switch. When the finder makes connection to any of these trouble terminals, it grounds a special lead to the intercepting trunk circuit, thereby routing the call to a trouble intercept operator.

(B) Step-by-Step Type Central Offices

2.05 In step-by-step type central offices, intercepting service in general is handled by cross connections to intercept terminals at the intermediate distributing frame (IDF) as described in the preceding paragraphs for panel type offices and shown in Fig. 1. This applies to intercepting service from "connector level." In general, intercepting service is from "connector level" except that nonassigned groups of telephone numbers (vacant levels) may be intercepted at selector level.

2.06 In step-by-step central offices, usually a group of about 10 connectors serves 100 terminals or telephone numbers. As discussed

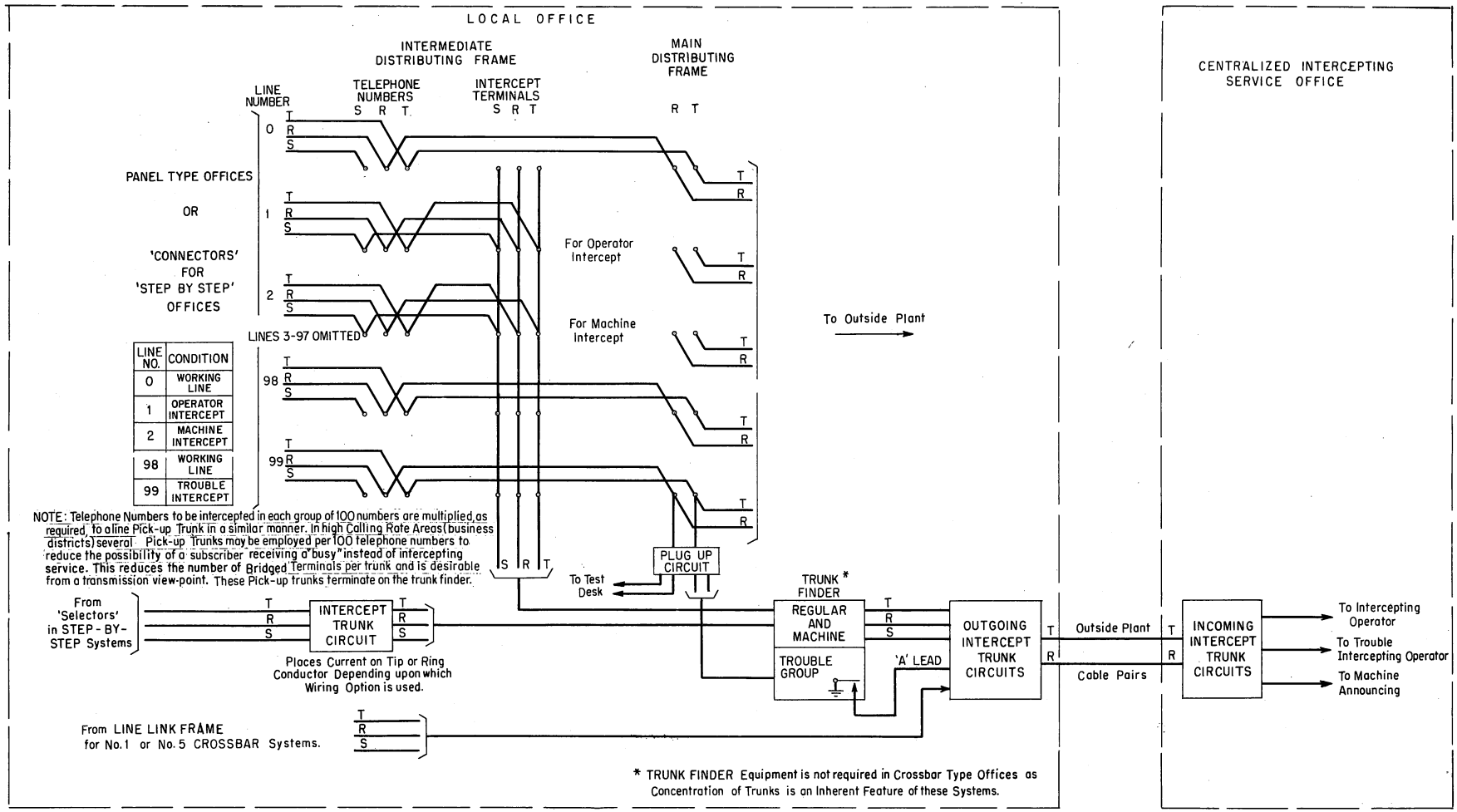


Fig. 1 - Arrangements for Intercepting Connections in Central Offices

in the previous paragraph, all numbers requiring intercept in this group of 100 numbers are connected at the IDF to one or more line pickup trunks which terminate on an intercepting trunk finder. This applies to terminal per station type central offices and to terminal per line type offices where the whole line is vacant. In terminal per line type offices, intercepting service is not generally provided on partially filled party lines as a relay circuit is required per vacant station. Out of a normal working group of 100 telephone numbers, usually there are about five or six numbers on intercept. However, during interim periods (especially, just after new central office additions) there may be a large number of unassigned terminals requiring intercept. During this time, consideration may be given to assigning two or more pickup trunks per 100 numbers, thus reducing the number of bridged terminals per trunk. If intercept numbers from several groups of 100 numbers are multipled to a common line pickup trunk with one appearance on a trunk finder, a subscriber may receive a "busy signal" instead of intercepting service due to a call in use from another group of numbers. Also multipling of several groups to a common trunk increases the bridged capacitance and will result in some added transmission loss.

2.07 Nonworking levels or unassigned numbers may be intercepted at selector level. Selectors are mounted on shelves with the bank wiring terminated in such a way that it is possible to tie together or multiple the corresponding levels of a number of shelves. It is possible to have as many as 320 selectors multipled together in a line-up with a common distributing terminal assembly. One vacant bank level for these 320 selectors when multipled to a single trunk, may represent a bridged capacitance loss of about 1.5 db, assuming purified textile insulation central office cabling, which has been used since about 1930. Central offices installed prior to 1930 employed the nonpurified type cabling and in these offices, this loss may be as high as 3 db. Multipling of additional vacant bank levels to a single trunk will result in added transmission losses.

2.08 In general, multipling of large numbers of vacant bank levels of selectors for intercepting service is done only in the local exchange group of selectors and only local telephone calls are subjected to this relatively large bridging loss, as described in the preceding paragraph. Toll selectors employed on intertoll calls are less in number and a different arrangement is used on the bridging of vacant terminals so that the maximum bridging loss encountered from vacant toll selector levels will probably be in the order of 0.2 db.

2.09 Where intercepting service is from selector level, an intercepting trunk circuit is required between the selector bank multiple and the trunk finder (see Fig. 1). An option is provided on this intercept trunk circuit so that direct current is provided on the tip conductor for calls to be routed to an announcing machine, or on the ring conductor for calls to be routed to an operator. This circuit is not required where intercepting service is handled at connector level as the connector provides ringing current over the ring conductor and, as previously discussed, cross connections at the IDF places this current on the tip or ring conductor to the trunk finder.

2.10 The trunk finder cuts through to an outgoing intercept trunk circuit which has a relay to trip the ringing current from "connectors," also a relay for direct current operation when associated with selectors.

(C) Crossbar Type Central Offices

2.11 In crossbar No. 1 and No. 5 type central offices a line is intercepted by means of cross connections in the number group. In completing a call, the marker enters the number group for the location of the called number. Cross connections or absence of cross connections in the number group provide the marker with the information necessary for routing the call via an intercepting trunk to an announcing machine or to an operator. On a trouble intercept call, the marker makes its line test and encounters battery and ground potential over tip and ring from the plug of the plugging up line circuit. The marker recognizes this as a trouble call and proceeds to route the call to a trouble intercept operator via an intercept trunk.

2.12 In crossbar No. 1, each intercept trunk has a tip and ring appearance on the line link frame and three auxiliary sleeve appearances on the line distributing frame for cross connection in the number group circuit. These three sleeve appearances provide the intercept trunk with separate signals for distinguishing among operator, trouble operator, and machine intercepting. A separate terminal number is required for each class of routing.

2.13 In crossbar No. 5, each intercepting trunk has two appearances of tip, ring, and sleeve on the line link frame, one for machine

type calls and one for operator type calls. These two appearances provide the intercept trunk with separate sleeve signals for distinguishing intercept by machine and intercept by operator. With division of intercept on the basis of operator, trouble operator, and machine, both operator and trouble operator calls are connected to the same line link appearance and ringing current is applied to the tip or the ring conductor to distinguish between them. Connection to the second line link appearance identifies machine intercepting.

3. INTERCEPT TRUNK CIRCUITS

3.01 As described in preceding paragraphs, in step-by-step, panel and crossbar type central offices, three distinguishing signals are provided for the routing of calls to intercepting service.

3.02 When the operators and machine announcement are located in the same building as the intercepted line, the trunk circuit itself will connect the calling line to either an operator or trouble operator at the switchboard or to a machine announcement.

3.03 When the operators and announcing machine are in a remote location (centralized intercepting service) the connection from the "outgoing intercept trunk," see Fig. 2, is extended on a 2-wire basis (over the talking circuit) to the centralized point, and an "incoming intercepting trunk" as shown in Fig. 3 makes the final connection to an operator, or trouble operator, or to the machine announcement. Three distinguishing signals to provide this selection must be passed over the talking pair, usually a cable pair from the local office to the centralized location.

3.04 This signaling is accomplished from the "outgoing intercept trunk" by use of reverse battery and ground signals on the trunk tip and ring and a simplex signal over tip and ring. These signals cause the operation of the proper relays in the "incoming intercept trunk" (see Fig. 3) for applying these polarity and simplex signals. On a trouble call, relay (RV) in Fig. 2 is operated preparatory to closing battery and ground to the tip and ring conductors to the "incoming trunk." Relay (TRO) operates on both trouble and regular calls, the condition of (RV) determining the polarity of battery and ground to tip and ring. On a machine call, relay (M) operates to connect the simplex signal to the "incoming trunk circuit."

3.05 As shown in Fig. 3, relay (P) responds to polar signals received from the outgoing intercept trunk circuit, directing the routing to either an operator or trouble operator. The (SX) relay, operated by a simplex signal, directs the routing to the announcement machine.

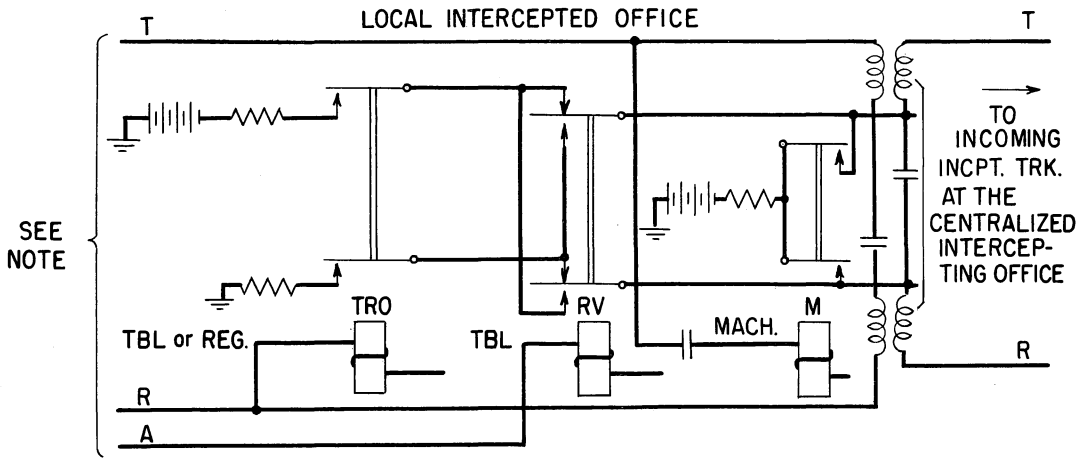
3.06 A "counting circuit" usually employing a minor switch which "steps" for each machine announcement is located in the "ROUTING FUNCTION" of the INCOMING INTERCEPTING TRUNK, see Fig. 3. This switch can be arranged to step from 1 to 9 times; however, it is usually strapped so that at the end of the second announcement the call is automatically switched to an operator and usually a distinctive signal is provided to indicate that the call has been cut through from the machine announcement.

4. TRANSMISSION CONSIDERATIONS

4.01 Since a number of calls must be handled simultaneously through a central office, multiple appearances are required for flexibility. In crossbar type central offices this flexibility is provided with no ill effects from added bridged capacitance encountered on intercepting service. However, in step-by-step and panel type central offices, this flexibility is obtained by permanently multipling various terminal appearances, which will result in an added transmission loss where the amount of bridged capacitance is large.

4.02 The amount of transmission loss caused by the bridged capacitance depends upon the impedances between which the central office cable is bridged, the type cable, temperature and humidity conditions, percentage line fill, length of tie cables, etc. There are, of course, an unlimited number of combinations of these variables. In view of the magnitude of the effects of the above variations, and the necessity for using a compromise value in any case, for calculation purposes, it is reasonable to employ a flat loss of 0.5 db per 1000 feet of purified textile insulation 6000-type cable and to convert lengths of other types of cable and the final or connector terminals to equivalent lengths of this type of cable. See Paragraph 4.05.

4.03 In step-by-step type offices, include the cabling from the connector banks (both local and toll) on a per terminal (telephone number) basis to the intermediate distributing frame, and from the IDF to the main distributing frame for those offices where the telephone numbers appear on the MDF.



NOTE:
'MAKE BUSY CKT.' IS OMITTED THEREFORE SLEEVE CONNECTION IS NOT SHOWN.

FIG.2 OUTGOING INTERCEPTING TRUNK

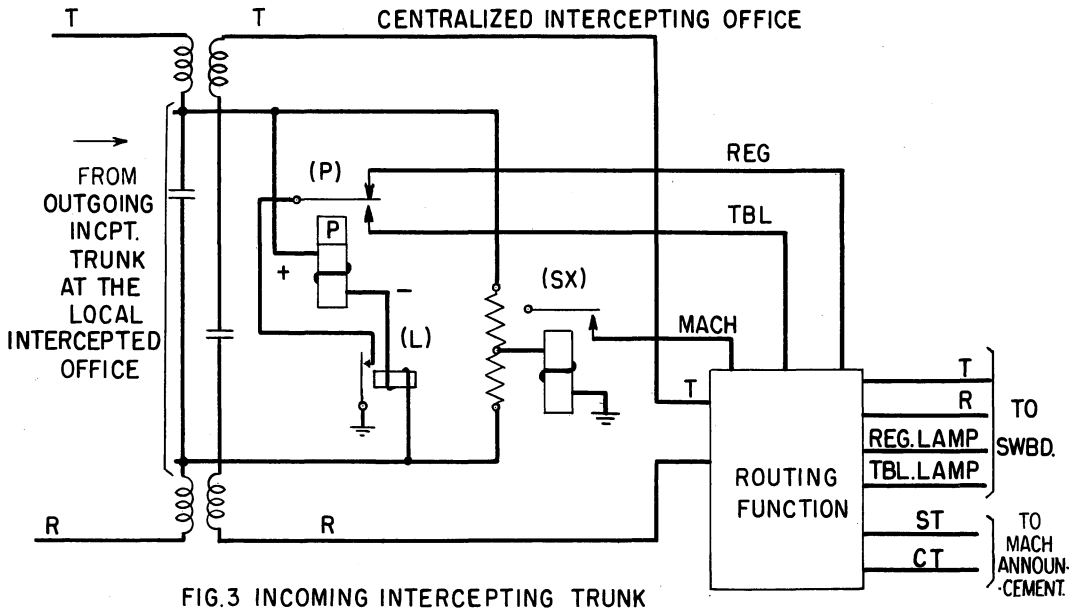


FIG.3 INCOMING INTERCEPTING TRUNK

4.04 In panel type offices, include the cabling from the final frame multiple bank to the IDF on a per terminal basis. For those cases where a number of final frames are included in one final choice of 500 lines, it will also be necessary to include this additional capacitance. In those offices where the final terminals (telephone numbers) appear on the HMDF it will be necessary to include the cabling from the HIDF to the HMDF.

4.05 After determining the lengths of cable involved, it is necessary to convert equipment terminals with their wiring to equivalent lengths of cable, so that one equivalent total length may be determined. The following table may be used for this purpose.

	Equivalent Lengths of Purified 6000-Type Cable (Feet)
6000-Type Cable - Per Foot:	
Nonpurified Textile Insulation	2.0
1000-Type Cable - Per Foot:	
Nonpurified Textile Insulation	1.2
Purified Textile Insulation	0.7
Panel Bank - Per Terminal: (Includes an average length of interbank wiring)	25.0
Step-by-Step Connector Bank - Per Terminal: (For shelf of 11 connectors with wiring)	10.0
Step-by-Step Selector Bank - Per Terminal: (For shelf of 10 selectors with wiring)	10.0

4.06 Intercepted calls in step-by-step and panel type central offices are subjected to normal central office losses, plus an additional bridging loss due to the multipling of unassigned or vacant terminals at the IDF, see Fig. 1. This bridged capacitance loss is, in general, higher in panel type offices than in most step-by-step offices, as the final terminals are higher capacitance than the connector terminals and the central office cable runs for panel type offices are usually longer than for step-by-step type offices.

4.07 The bridging loss on intercepting service is usually higher in panel ground cutoff relay type offices than in panel battery cutoff relay type offices. In the former, each vacant terminal is connected to intercept, whereas, in the latter, only the highest numbered terminals in a group of consecutive vacant terminals, and any individual vacant terminals are connected to intercepting service.

4.08 It is desirable that measurements or a study be made in each central office to determine the average order of magnitude of the additional bridged capacitance loss encountered on intercepting service for that particular office, as local conditions vary considerably.

4.09 Step-by-step type offices with the line finder group and terminal appearing on the horizontal side of the main distributing frame have less bridged loss on intercepting service than those offices where the connector terminals (telephone numbers) appear on the HMDF. Correspondingly, panel offices with the line relay appearing on the HMDF have less loss on intercepting service than those offices where the final terminal (telephone numbers) appear on the HMDF, especially where there is considerable distance from the IDF to the MDF. Also, offices placed in service prior to 1930 employed nonpurified textile insulation cabling, which has nearly twice the loss of purified textile insulation cabling employed subsequent to 1930.

4.10 It is difficult to give any figures which represent the average order of magnitude of the bridged capacitance loss encountered on intercepting service in step-by-step and panel type offices. However, the estimated general average appears to be as follows:

	Approximate Additional Bridged Capacitance Loss Encountred on Intercepting Service
Step-by-Step Type Central Offices:	
Purified textile insulation cabling	0.5 db
Nonpurified textile insulation cabling	0.8 db
Panel Offices - Battery Cutoff Relay Type:	
Purified textile insulation cabling	0.9 db
Nonpurified textile insulation cabling	1.6 db
Panel Offices - Ground Cutoff Relay Type:	
Purified textile insulation cabling	1.4 db
Nonpurified textile insulation cabling	2.2 db

Note: The above data are based on about 6% of the terminals (telephone numbers) in an office on intercept, employing concentrating equipment (trunk finder) in a manner similar to the arrangement shown in Fig. 1. It includes offices with and offices without the telephone numbers (final terminals or connector terminals) appearing on the MDF.

4.11 During periods of low percentage fill, especially after equipment additions, it is desirable to assign pickup trunks (see Fig. 1) on a fairly liberal basis to avoid excessive bridged loss. While it is recognized that during interim periods, this loss must of necessity be relatively high, the objective is as low as economically feasible, depending upon local conditions.