

**MODIFICATION REQUIREMENTS
FOR LINE LOAD CONTROL
AND ASSOCIATED TRAFFIC LOAD INDICATING DEVICES
EQUIPMENT DESIGN REQUIREMENTS
NO. 1 CROSSBAR AND PANEL SYSTEMS**

1. GENERAL

Scope

1.01 This specification, together with the supplementary information listed herein, covers the equipment design requirements for the modification of existing No. 1 crossbar and panel offices for line load control and associated traffic load indicating devices.

1.02 This specification is being reissued to bring it into conformity with the general Plant Series numbering plan as a multinumber practice and to add a new BSP number 815-007-152. This specification last appeared under BSP 816-045-150 as Issue 3 and under AA388.056 as Issue 2 and Appendixes 1, 2, 3, and 4.

Capacity

1.03 The capacity of the various frames to be modified is not affected by the line load control feature. It is assumed however, that the lines served by each line link frame, line finder group or line switch group will be classified for line load control as approximately 10% in Class "A" and 45% each in classes "B" and "C". The capacity of the line load control wall cabinet for crossbar and panel offices is 120 line link frames, line finder groups or line switch groups with line group overload indicating lamps. Each of the other traffic load indicating devices may be included in the line load control cabinet but with a corresponding reduction of the line load control capacity of the cabinet as shown on ED-91803.

Description

1.04 *Line load control*, as applied in the two types of offices, is an arrangement for insuring the service on certain essential lines, by denying originating service temporarily to other lines during an overload. In order to do this, the lines served by each line link frame, line finder frame or line switch group are divided into three classifications. Class "A" will include those lines

whose originating service must be insured. This class will comprise about 20% of the lines in the office uniformly distributed over the various line link frames, line finder groups or line switch groups. Classes "B" and "C", comprising about 40% each, may be denied originating service temporarily in order to make the facilities available for the class "A" lines. The equipment and circuit arrangements provided permit the service of either class "B" or class "C" to be interrupted before that of the other. In addition, if one entire class is removed from service, it may be restored one line group at a time, if this should be desirable as the temporary overload decreases. Common equipment, including keys and lamps, is located near the activity center of each office for controlling the traffic during the overload and relays are required on each line link, line finder, or line switch frame for interrupting the originating service of the class "B" or the class "C" lines. The terminating service of these lines will not be affected. Provision is made for locating a multiple appearance of the master control keys and lamps in the shelter area of the telephone building.

1.05 As an aid in the administration of the line load control feature, *line group overload indicating* (G) lamps may be included in the line load control cabinet (or at the incoming trunk test frame in some crossbar offices) at the option of the Telephone Company. These lamps are red and are furnished in the cabinet on the same basis as the (B) and (C) lamps, that is one (G) lamp per line link frame, line finder group or line switch group. A lighted (G) lamp indicates an overload in the switching facilities available to the particular line group. In crossbar, this indication is taken from the line link controller delay register and shows a controller delay due to lack of line links, district junctors, subscriber

sender links or subscriber senders. In the panel systems the indication is taken from the district selector group register; the subscriber link overflow register or the subscriber link overflow register in multiple with the district group overflow register and indicates in panel line switch offices all district selectors busy; in line finder sender selector offices, all districts busy and a call waiting and in line finder link type offices a call waiting and either all districts busy or all sender links busy.

1.06 Dial tone speed register equipment provides a measure of the adequacy of service in dial offices. This is accomplished by originating test calls in rotation over selected spare subscriber line circuits scattered throughout the office and recording on traffic registers the total number of test calls originated and the number on which the time required to receive dial tone exceeds three seconds. *Dial tone speed indicating equipment* may be used in conjunction with the dial tone speed register circuit to indicate visually the number of dial tone intervals exceeding three seconds on each cycle of the dial tone speed register circuit and to give an alarm if a predetermined number of such intervals occurs on any cycle. Thus it will indicate an overload condition on originating dial equipment and may therefore serve as a basis for the administration of line load control. Where used for this purpose, the dial tone speed indicating equipment will be located with the line load control lamps and keys if space permits.

1.07 An office load meter, which will indicate approximately the total office 48 volt current drain and which will therefore, give an indication of the total office traffic load may be furnished as a further aid in administering the line load control feature. This is a Western Electric Company Type G1 millivolt meter with a scale reading from 0 to 100, adjusted to read 100 at 50 millivolts. It will be arranged to mount in the line load control wall cabinet.

1.08 A sender load meter consisting of a direct reading milliammeter arranged to show the load condition of a sender group, is to be made available for panel offices. In addition to providing an alarm when say 90% of the senders are busy, it will provide a continuous indication of the number of idle senders available for handling calls, so that an increase in load can be

noted before the alarm is sounded. It is planned to arrange this meter so that it can be mounted in the line load control cabinet.

1.09 In crossbar offices, the sender load lamps and the sender subgroup busy lamps at the sender make busy frame show the load condition of the senders and may therefore be used for administering line load control. It is recommended that the other traffic indicating devices referred to above, where ordered by the Telephone Company, be located as near as possible to the line load control lamps and keys. Where space does not permit their location in the line load control cabinet or at the incoming trunk test frame, a separate cabinet should be furnished and so located as to permit ready observation from the line load control equipment.

Crossbar System

1.10 In the crossbar system, *line load control* is applied at the line link frames by opening the "ST-" leads of the various subgroups of 10 lines assigned to classes B and C. The only complication which enters into the treatment of these frames arises from the fact that each line link frame is a line group which may vary in size from 180 to 690 lines. It is assumed that the classification of lines on a 10 per cent-45 per cent-45 per cent basis will be applied. This being so, the number of lines in each class will vary with the size of the group. The number of class A lines on a frame, for instance, may vary from 18 to 72 (approximately 10 per cent of 180 or 690). In addition, class A lines should be allocated on the frame so that they have access to as many of the 100 links available on the frame as possible.

1.11 Each line group is made up of a series of vertical groups or "Columns" of lines, each column containing ten subgroups of usually, ten lines each. These columns are, from a circuit point of view, numbered from 0 to 6 and on a particular line link frame the number of columns will vary with the number of lines served. Class "A" lines should be allocated first, beginning with the lowest numbered subgroup on column "O" and continuing through the succeeding subgroups of ten lines until all class "A" lines have been allocated. If more than 90 lines must be in class "A", due to the size of the line group, the allocation will continue with subgroup "O" in

column 1. Class B will then be allocated beginning where class A leaves off and continued consecutively by subgroups through succeeding columns until approximately 45 per cent of the lines have been allocated to class B. Class C will then be allocated to consecutive subgroups through the highest numbered columns.

1.12 The "ST" leads of the class "B" and class "C" lines will be opened by U type relays controlled from keys at the common equipment. Each (B-) or (C-) relay has a capacity of 10 "ST-" leads. Provision is made for furnishing two such relays per column of lines in accordance with whether the lines in the respective column are class "B", class "C", or both. No (C-) relay is furnished for column 0 as it can be assumed that the lines in that column will always be either class "A" or class "B". The modification work in a crossbar office, therefore, consists of installing the various (B-) or (C-) relays on the line link frames, connecting them as required to the "ST-" leads and connecting the various line link frames to the common load control equipment.

1.13 The (B-) and (C-) relays on the various line link frames are operated from a common control circuit. At this common point an individual "B" and "C" class key is provided for each line link frame and a master "B" and "C" class key for the office. The operation of the master key for either class will take out of service the lines of the corresponding class on all line link frames whose individual keys are operated. Lines may be restored to service by releasing the individual frame keys until all frames have been restored to service.

1.14 In crossbar offices there are two optional locations for the line load control common equipment. Obviously, this equipment must be located at a central point, preferably in the maintenance center, not only to permit operation during an emergency but also to provide a visual indication should any of the "B" or "C" class frame relays become operated falsely. One of the optional locations is on the incoming trunk test frame which offers spare space in which the relays, lamps, keys, etc, required may be located. Where the telephone company does not wish to use this space for this purpose, a relay rack unit and lamp cabinet arrangement has been provided. The wall cabinet containing both the frame and master keys and lamps should be

located on a wall or pillar in the maintenance center in a place where it can be readily seen and at a convenient height for operating the keys. Where more than one cabinet is required for line load control and associated traffic indicating devices, sufficient vertical space must be left between cabinets to permit satisfactory cabling. The line load control relay rack unit may be located anywhere. Where group busy lamps or dial tone speed indicating equipment is located in the line load control cabinet the associated relay rack equipment should be located adjacent to the line load control relay rack equipment. The dial tone speed register and speed indicating should be located on the rack as covered in J99231.

Panel System

1.15 In the panel system *line load control* is applied at the line finder frames or (in older offices) at the line switch frames. There are a number of varying frame arrangements which make it advisable to discuss each case individually. A single equipment arrangement has been provided for all types of offices for the common equipment which is the same relay rack unit and wall cabinet discussed above for the crossbar system. The same principles apply for locating this equipment in a panel office except that where there is not a true maintenance center, the wall cabinet should be located in the most important activity center in the office.

1.16 The *present standard line finder frame* is characterized from an equipment point of view by an 80-capacity line unit and is used with panel links. The capacity of each line group is 400 lines, each line unit containing two trip circuits serving 40 lines each and using 211-type transfer switches for connecting to the emergency trip circuit. Line load control will be applied to this frame by operating the release (R) relay of those trip circuits allocated to classes B and C. Except on frames equipped for two classes of service, class A lines will ordinarily be allocated to trip circuits 0 or 1; therefore, the trip circuit assigned to class A will not be wired to the load control relays. Trip circuits 0 or 1 to 9 will be arranged to be allocated to either B or C class as required. Any one trip circuit (40 lines), however, must be in the same class. Four R relays are required to arrange the frame for line load control, two for class B and two for class C.

In addition, two sets of transfer springs must be added on the 211-type switch and minor internal wiring changes made in each trip circuit (including the emergency) to prevent a trip circuit alarm when the load control feature is operated. For the sake of uniformity these changes should also be made on class A trip circuits.

1.17 Immediately preceding the present line finder frame in the development of the panel system was the **40 capacity line unit** frame. Each line group serves 400 lines arranged to be controlled by ten trip circuits serving 40 lines each and is used with both panel links and rotary links. It uses the multiple plug and jack for switching to the emergency trip circuit. The general method of arranging this frame for line load control is the same as for the 80 capacity line unit frame except for the location and wiring of the line load control relays. No new contacts are required on the plugs and jacks used for switching to the emergency trip circuit, but there are minor internal wiring changes in the trip circuit.

1.18 *The 400 point line finder frame for use with sender selectors* immediately preceded the 40 capacity line unit frame. This frame has the line finder circuit relays mounted on the line finder frame instead of on the district, and has ten trip circuits with the multiple plug and jack arrangement for switching to the emergency trip circuit. The problem of arranging it for line load control differs from the others only in that there is no spare space on existing mounting plates on the frame for mounting "R" relays. Accordingly, two U type relays are used and mounted on a special mounting plate designed to be located on a terminal strip bracket at the top of the frame. This plate will accommodate two sets of line load control relays when required. This being the case, if there is no space available for mounting the plate on certain frames, those frames can be served by relays located on a frame immediately adjacent.

1.19 A **300 point line finder frame** preceded the 400 point frame with sender selectors. It is also used with sender selectors but has a 300-line group with 15 trip circuits. Six R type relays and twelve 18-type resistances are required per frame for line load control. Trip circuits 0, 5, or 10 may be assigned to class A and the ones so assigned will not be wired to the line load control relays. The R type relays and asso-

ciated resistances should be located on a mounting plate at the top of the line relay bay as indicated on the equipment drawing. This equipment should be mounted and wired to the trip circuits by the installer in accordance with the Telephone Company's assignments.

1.20 The first panel offices used individual **rotary line switches** with the line switches and associated line circuits mounted together on line switch frames. In general these frames consist of 180 line switches and associated line circuits located on a frame on 9 shelves of 20 circuits each. District groups, i.e. line switches having access to the same districts may be spread over several such frames and also the line switches on one frame may be served by one or more district groups. Line load control will be applied on a district group basis so that there may be class "B" or class "C" lines in the same district group on one or more line switch frames. Line load control is applied by opening the battery supply leads of those 20-circuit shelves assigned to classes "B" and "C" through the contacts of an (LB) or an (LC) relay respectively. Accordingly, there should be one of these relays on each frame for a maximum of six shelves assigned to the same class in the same district group. Where more than six shelves in the same district group on the same frame are assigned to the same class two (LB) or (LC) relays should be furnished on the frame for that class. Each relay should be located by the installer on a small mounting plate in the position of a designation card holder on one of the shelves with which it is associated. These designation card holders where furnished should be relocated by the installer in a convenient place as near as possible to their respective shelves. No (LB) or (LC) relay should serve a shelf on another frame than the one on which it is mounted.

1.21 *Switchman's talking line jacks* shall be furnished as specified by the Telephone Company and located on the line load control cabinets or at the incoming trunk test frame in the manner indicated on the equipment drawings.

Fusing Arrangements

1.22 In connection with the application of line load control, the Telephone Company may wish to reconsider the suitability of their present fusing arrangements. Although the

operation of fuses during overloads has not been a serious problem in the past, they have been informed of steps which may be taken to reduce the possibility of the operation of fuses during heavy overloads. The Telephone Company may therefore consider it desirable, in conjunction with the line load control project, to substitute fusetrons or larger fuses to reduce the fusing hazard. No changes are to be made, however, in the fusing requirements shown on Laboratories circuit or equipment drawings for this purpose.

2. SUPPLEMENTARY INFORMATION

815-000-000 — Panel Systems Index
 816-000-000 — No. 1 Crossbar System Index
 J27401 (815-100-150) — Line Finder Frame — 40 Capacity Line Unit — Panel Systems
 J27402 (815-100-151) — Line Finder Frame — 80 Capacity Line Unit — Panel Systems
 J27450 (816-429-150) — Line Link Frame — Crossbar Systems
 J27753 (816-601-150) — Incoming Trunk Test Frame — Crossbar Systems
 J27950 (816-503-150) — Sender Make Busy Frame — Crossbar Systems
 J29212 (815-071-151) — Sender Load Indicating Equipment — Panel System
 J99206 — Relay Rack Unit — Common Systems
 J99208 — Lamp Signal Cabinets — Common Systems
 J99231 (815-071-150, 816-041-150) — Dial Tone Speed Register and Indicating Equipment

3. DRAWINGS

Circuits

Common

SD-96387-01 — Line Load Control Circuit — Panel and Crossbar Systems

Crossbar

SD-25003-01 — Line, Line Link, and Group Controller Circuit
 SD-25071-01 — Crossbar System No. 1 — Traffic Register Circuit
 SD-25317-01 — No. 1 or Tandem Crossbar Office Traffic Register Circuit

SD-25087-01 — No. 1 or Tandem Crossbar Office Aisle Pilot Circuit

SD-96403-01 — Dial Tone Speed Register Circuit

SD-96419-01 — Dial Tone Speed Indicating Circuit

Panel

SD-20141-01 — Miscellaneous Registers — Panel System

SD-21127-01 — Miscellaneous Registers — Battery on C.O. Panel Offices

SD-21537-01 — Miscellaneous Register Circuit for Battery on C.O. Panel Offices

ES-20241-01 — Miscellaneous Alarms for Link Type Offices

SD-21203-01 — Floor Alarm Board Misc. and Aux. Alarm Ckt.

ES-207042 — Miscellaneous Registers — Panel Systems

ES-266102 — Miscellaneous Alarms

ES-226189 — Miscellaneous Alarms

80 Capacity Line Unit

SD-21626-01 — Line, Trip, Start and Link Ckts.

SD-21713-01 — Trip and Start Circuit

40 Capacity Line Unit

ES-20128-01 — Line, Trip, Start and Link Ckts. — Ground on C.O. — Rotary Link

ES-20229-01 — Line, Trip, Start and Link Ckts. — Battery on C.O. — Rotary Link

SD-20294-01 — Line, Trip, Start and Panel Link Ckts. — Battery on C.O.

SD-20294-02 — Line, Trip, Start and Link Ckts. — Modification of SD-20294-01

ES-20298-01 — Line, Trip, Start and Panel Link Ckt. — Ground on C.O.

SD-20298-02 — Line, Trip, Start and Link Ckts. — Modification of ES-20298-01 and SD-21463-01

SD-21460-01 — Line, Trip, Start and Link Ckts. — Battery on C.O. — Panel Link

SD-21460-02 — Line, Trip, Start and Link Ckts. — Modification of SD-21460-01

SD-21462-01 — Line, Trip, Start and Link Ckts. — Rotary Link — Modification of ES-20128-01

SD-21463-01 — Line, Trip, Start and Panel Link Ckts. — Modification of ES-20298-01

400 Point — Sender Selector

- SD-21461-01 — Line and Trip Ckts. — Modification of ES-240292
- ES-240292 — Line and Trip Ckts.
- SD-21777-01 — Starting Circuit — Modification of ES-240293
- ES-240293 — Starting Circuit — Panel System

300 Point — Sender Selector

- ES-20693-01 — Line and Trip Ckts. — Two-Party Message Rate — Battery on C.O.
- SD-21464-01 — Line and Trip Ckts. — Modification of ES-226617 or ES-226909
- ES-207196 — Line and Trip Ckts.
- ES-226617 — Line and Trip Ckts. — Two-Party Message Rate
- ES-226909 — Line and Trip Ckts.
- ES-207197 — Starting Circuit — Battery Grounded at End — Panel System
- ES-240056 — Starting Circuit — Panel System
- SD-21776-01 — Starting Circuit — Modification of ES-207197 and ES-240056

Subscriber Line Switch

- SD-21525-01 — Modification of ES-207698
- ES-207698 — Individual Line Switch Circuit
- ES-207868 — Individual Line Switch Circuit — Arranged for Two-Party Message Register Service

Framework

- ED-90782-01 — Relay Rack Unit Frameworks — Common Systems
- ED-91858-01 — Lamp Signal Cabinet Assembly — Common Systems
- ED-92856-01 — Wall-Mounted Cabinet for Shelter Area
- ES-299085 — Line Finder Frame Assembly — 400 Point for use with Sender Selectors — Two Line Relay Bays — Panel System
- ES-299173 — Line Finder Frame Assembly — 400 Point for use with Sender Selectors — One Line Relay Bay — Panel System

Equipment

Common

- ED-92515-01 — Line Load Control Relay Rack Units

- ED-91803-01 — Line Load Control Wall Mounted Cabinet
- ED-91819-01 — Dial Tone Speed Register Unit Equipment
- ED-91829-01 — Dial Tone Speed Indicating Wall Mounted Cabinet Equipment
- ED-91830-01 — Dial Tone Speed Indicating Control Unit Equipment
- ED-81147-01 — Power Plant Mounting Details — Ammeter Shunt Lead Fuses
- ED-92857-01 — Auxiliary Wall Mounted Cabinet for Shelter Area

Crossbar

- ED-25031-01 — Line Link Frame — All Classes
- ED-25032-01 — Line Link Frame — 2-Party Message Rate — 10 Vertical Primary Switches
- ED-25166-01 — Line Link Frame Switchboard Cabling Details — MR1, FR & Coin — No Line Distributing Frame
- ED-25167-01 — Line Link Frame Switchboard Cabling Details — 2 Party — No Line Distributing Frame
- ED-25273-01 — Incoming Trunk Test Frame Switchboard Cabling Details — Crossbar
- ED-26829-01 — Incoming Trunk Test Frame
- ED-25322-01 — Line Link Frame Switchboard Cabling Details — MR1, FR & Coin — For use with Line Distributing Frame
- ED-25358-01 — Line Link Frame — 2-Party Message Rate — 19 Vertical Primary Switches
- ED-25359-01 — Line Link Frame Switchboard Cabling Details — 2 Party — For use with Line Distributing Frame
- ED-25678-01 — Line Link Frames — All Classes

Panel

- ED-20606-01 — Line Finder Frame Equipment — 80 Capacity Line Unit
- ED-20607-01 — Equipment for Line and Start Units — 80 Capacity Line Unit
- ED-20245-01 — Equipment for Start and Emergency Trip Ckt. — 40 Capacity Line Unit
- ES-225815 — Line Finder Frame and Line Relay Rack Equipment — 300 Point — For use with Sender Selectors

- ES-225911 — Equipment for Start and Emergency Trip Ckt. — 40 Capacity Line Unit
- ES-299128 — Equipment — 40 Selector Group — 400 Point Line Finder Frame — For use with Sender Selectors
- ES-299183 — Equipment — 60 Selector Group — 400 Point Line Finder Frame — For use with Sender Selectors
- ES-299184 — Equipment — 28 Selector Group — 400 Point Line Finder Frame — For use with Sender Selectors
- ES-299197 — Equipment — 80 Selector Group — 400 Point Line Finder Frame — For use with Sender Selectors

4. GENERAL NOTES

4.01 The procedures to be followed in modifying existing crossbar and panel offices for line load control and associated traffic load indicating devices is outlined in the following

SIZE OF LINE GROUP

EQUIP RELAYS IN COLUMN

	0	1	2	3	4	5	6
180 or 190	(B0)	(B1) & (C1)	—	—	—	—	—
280 or 290	(B0)	(B1) & (C1)	(C2)	—	—	—	—
370 or 390	(B0)	(B1)	(B2) & (C2)	(C3)	—	—	—
470 or 490	—	(B1)	(B2)	(C3)	(C4)	—	—
560 or 590	—	(B1)	(B2)	(B3) & (C3)	(C4)	(C5)	—
660 or 690	—	(B1)	(B2)	(B3)	(C4)	(C5)	(C6)

4.03 Basic Units — 180 and 190 Lines: These basic units include two columns of lines served by the "ST0" and the "ST1" leads respectively. The ten subgroups of lines served by the "ST0" leads (Column 0) have these leads connected at the (L1) relay in each subgroup. The subgroups in column 1 have the "ST1" leads connected at relay (L9) in each subgroup. These leads are carried from the various subgroups to the terminals of the correspondingly numbered (H0-9) relays and from there to the terminals of the associated multicontact relays (HG0-9). In connecting the "ST0" or "ST1" leads to the (B-) or (C-) relays, the following procedure is recommended in order to avoid interruption of service during the modification.

paragraphs. All the necessary wiring and cabling shall be in accordance with the standard practices obtaining for the particular type of office.

Crossbar System

Line Load Control

4.02 The major problem on crossbar line link frames is to add the (B-) and (C-) relays in the locations shown on the equipment drawings and to connect the "ST-" leads to their contacts without interrupting service on working frames. On the basic unit these relays are added in spare positions on mounting plates inside the casing with the controller equipment. On supplementary primary units they are located on added mounting plates at the top of the frame. Unless the Telephone Company specifies otherwise, the (B-) and (C-) relays shall be equipped as follows strictly in accordance with the size of the line group:

4.04 Connect contacts 2B, 4B, etc, and 2T, 4T, etc, of the (B0) relay to contacts 2T of relays (L2) in those subgroups of column 0 which are to be placed in class "B". Similarly, connect the contacts of the (B1) or (C1) relays to contacts 2T of relays (L8) in the subgroups of column 1. Connect contacts 1B, 3B, etc, and 1T, 3T, etc, of the (B0) and (B1) or (C1) relays to terminals 6 or 7 of the (HG-) multicontact relays. The new leads should be connected at the multicontact relays without disconnecting the "ST-" leads already occupying the terminals. When the above leads have been run and connected the old "ST-" leads of the subgroups to be controlled through the (B-) or (C-) relays may be disconnected. The "ST0" leads should be disconnected at the (L1) relays and the "ST1" leads at the

(L9) relays. The leads so disconnected should also be cut at the (H0-9) relays. The "ST0" and "ST1" leads should be assigned to the (B-) and (C-) relays in accordance with the size of the line group as follows:

When 10% of Lines Are Class A

SIZE OF LINE GROUP	AT RELAY	COLUMN 0		COLUMN 1
		B0	B1	C1
190		2-9	0	1-9
290		3-9	0-6	7-9
390	Connect	4-9	0-9	—
490	ST- leads	5-9	0-9	—
590		7-9	0-9	—
690		8-9	0-9	—

When 5% of Lines Are Class A

SIZE OF LINE GROUP	AT RELAY	COLUMN 0		COLUMN 1
		B0	B1	C1
190		1-9	0	1-9
290	Connect	2-9	0-5	6-9
390	ST- leads	2-9	0-9	—
490		3-0	0-9	—
590		3-0	0-9	—
690		4-9	0-9	—

4.05 Where the basic unit uses 19 vertical primary switches, the lines in each subgroup in column 1 may be numbered 0-8. Where this is the case read relays (L7) and (L8) respectively for relays (L8) and (L9) in paragraphs 4.03 and 4.04.

4.06 The wiring described above shall be superimposed on the existing local cable. In addition to the "ST-" lead wiring described above, wiring from the (B-) and (C1) relays is required to the miscellaneous terminal strip at the top of the frame for connection to the common unit and wiring to the terminal strip at the bottom of the frame is required if there are supplementary units associated with the frame. (See Cross-Connections on SD-25003-01)

4.07 Basic Units — 90 Lines: Some of the early MR2P line link frames have 100 point 5W primary switches on the basic unit and in this case only the (B0) relay will be mounted on the basic unit if column 0 has lines to be put in class "B". In this case that part of the preceding paragraphs which applies to the "ST0" leads will also apply here. Wiring to the common unit and to supplementary units will also be required.

4.08 Supplementary Primary Units: The "ST-" leads from the line circuits on supplementary primary units are connected to terminal strip punchings at the bottom of each unit. From this point they are carried to the basic unit in a local form running across the bottom of the frame. The (B-) and (C-) relays located on these units will therefore interrupt the "ST-" leads between the line circuits and the terminal strips at the bottom of the unit. The terminal strip punchings are bifurcated with the "ST-" lead from the line relays on one portion of a terminal and the lead to the basic unit on the other. In connecting a (B-) or (C-) relay to an "ST-" lead, a lead should be run from the subgroup of lines to the relay contact, and from the relay to the associated terminal strip punching. Care should be taken not to disturb the two leads already on the punching when this connection is made. The "ST-" leads shall be connected at the (B-) and (C-) relays in accordance with the size of the line group as follows:

When 10% of Lines Are Class A

Size of Line Group and ST- Lead

COL	REL	290	390	490	590	690
2	B2	—	0-1	0-7	0-9	0-9
	C2	0-9	2-9	8-9	—	—
3	B3		—	—	0-3	0-8
	C3		0-9	0-9	4-9	9
4	B4			—	—	—
	C4			0-9	0-9	0-9
5	B5				—	—
	C5				0-9	0-9
6	B6					—
	C6					0-9

When 5% of Lines Are Class A

Size of Line Group and ST- Lead

COL	REL	290	390	490	590	690
2	B2	—	0	0-6	0-9	0-9
	C2	0-9	1-9	7-9	—	—
3	B3		—	—	0-1	0-6
	C3		C3	0-9	2-9	7-9
4	B4			—	—	—
	C4			0-9	0-9	0-9
5	B5				—	—
	C5				0-9	0-9
6	B6					—
	C6					0-9

4.09 The chain leads connecting the various (B-) and (C-) relays of succeeding columns shall be superimposed on the local form across the bottom of the frame and connected at the terminal strip punchings at the bottom of each unit as indicated on SD-25003-01. These relays shall be connected to the chain leads in numerical order.

4.10 100 Line Supplementary Units: In order to avoid interrupting service the (B-) or (C-) relay should be connected to the subgroup "ST-" leads at the (L1) relay in each subgroup and also at the corresponding terminal strip punchings at the bottom of the frame. After these connections have been made and tested through the relay contacts the old "ST-" leads may be cut at the (L0) relays and at the terminal strips.

4.11 200 Line Supplementary Units: The (B-) or (C-) relay for the left-hand column should be connected to the subgroup "ST-" leads at the (L1) relay and for the right-hand column at the (L8) relay. After these connections and those between the relays and the associated terminal strip punchings are in and tested the present "ST-" leads may be disconnected at the (L0) and (L9) relays and at the terminal strip punchings. On supplementary primary units using 19 vertical switches numbered 0-9; 0-8 connect to the "ST-" leads for the right-hand column at the (L7) relay and disconnect at the (L8).

4.12 Incoming Trunk Test Frame: In some offices the line load control common circuit per SD-96387-01 may be located on the incoming trunk test frame as shown on ED-26829-01. Where this is the case the lamps and keys for this circuit will be located in the lamp panel and the relays and resistances on mounting plates located immediately beneath the writing shelf. The cross-connections for SD-96387-01 show all leads from the line link frames carried through terminal strips at the top of the incoming trunk test frame. Where the equipment is being added to this frame on a modification basis, however, it is suggested that the leads to the apparatus on the mounting plates be wired through the terminal strips but that the leads to the apparatus on the lamp panel be carried direct to the apparatus in switchboard cable. This method may also be followed on new jobs if the number

of line groups to be served exceeds 100. Wiring for the load control equipment shall be superimposed upon the test frame local cable.

4.13 Relay Rack Equipment and Wall Cabinet:

Where the telephone company does not wish to make use of the spare space on the incoming trunk test frame for the line load control common equipment, relay rack equipment and a wall cabinet will be required. These are illustrated on ED-92515-01 and ED-91803-01, respectively. The cabinet should be placed on a wall or column in the maintenance center where it can be readily seen at all times and at a convenient height for operating the keys.

4.14 Switchboard Power Cable and SDPTS:

The cabling from the individual line link frames to the common equipment shall be run in switchboard power cable through an SDPTS. Since no SDPTS has heretofore been furnished for line link frames, this will have to be added on jobs to be arranged for line load control. The distance from the common control circuit to the first SDPTS shall be not less than 50 feet of 24 gauge cable.

Line Group Overload Lamps

4.15 The line group overload (G) lamps per SD-96387-01, Fig. 4, should be mounted in the lamp cabinet per ED-91803-01 or on the incoming trunk test frame per ED-26829-01 when this feature is specified by the Telephone Company. If group busy lamps are not ordered space shall be reserved for the future addition of the lamps unless the Telephone Company specifically states that space shall not be reserved for this equipment. The (G) relays and (C) resistances per Figs. 4 and 5 of SD-96387-01 shall be located on the relay rack in accordance with ED-92515-01 as near as possible to the line load control relay rack equipment. All wiring to the relay rack equipment shall be run direct to the apparatus by the installer. The "H", "E" and "B" leads to the delay registers shall be connected to the register at the vertical side of the traffic register distributing frame or to the relay terminal strip on the older style traffic register relay racks arranged per ED-25308-01 in accordance with the circuit cross-connections. The relay rack equipment per ED-92515-01 shall be furnished in accordance with the number of (G) relays and (C) resistances required.

Panel System

Line Load Control

4.16 With the exception of line switch frames, the general method of interrupting the service of the class "B" and class "C" lines in the panel system is by grounding the windings of the release relays in the various trip circuits on the line finder frames from the contacts of the (LB-) or (LC-) relays, respectively. This being the case, when modifying working frames, care should be taken to avoid grounding the release relays accidentally during the modification process. As will be pointed out later, interruptions to service caused by opening essential operating leads should also be avoided.

4.17 400 Point Line Finder Frame — 80 Capacity Line Unit: This frame uses 211B switches on each of ten trip circuits. These switches should be modified by the addition of two sets of transfer springs in position 18. The next step is to mount the load control relays in position 13 of the trip switch mounting plates (see ED-20607-01) as follows:

RELAY	TRIP CKT.
(LB1)	2
(LB2)	3
(LC1)	6
(LC2)	7

On those jobs having a 69B resistance in position 13, the load control relays should be located in position 12. In these trip circuits the contacts of the (LB-) and (LC-) relays should be wired to the terminal strips of the line units on which they are located in the manner indicated on the circuit cross-connections. In addition, in all trip circuits the "HB" or "HC" and "GA", "GB" or "GC" leads should be wired to the corresponding unit terminal strip punchings. The "HB" or "HC" lead in each trip circuit is a connection between the trip circuit "H" lead and a terminal strip punching. It is recommended that this connection be made at one of the line relay terminals rather than at the switch. Preferably, a line relay should be selected for which there is only one wire on the common "H" terminal and care should be taken to avoid opening the "H" lead to other line relays in the process. The "GA", "GB" or "GC" lead in each trip circuit is a connection between one of the new springs on the 211B switch and a terminal punching. All in-

ternal wiring changes within the trip circuit should be made with the associated lines working on the emergency trip circuit.

4.18 In addition to the trip circuit wiring described above additional wiring is required to be superimposed on the frame local cable. The "AC", "AB", "B", "C", "LB", and "LC" leads to the common line load control unit or wall cabinet shall be run from the respective unit terminal strips to the miscellaneous terminal strip at the top of the bay. The "HB" or "HC" leads of the various trip circuits (release relay windings) shall be connected to the (LB-) or (LC-) relays in accordance with the Telephone Company's assignment of the trip circuits to class "B" or class "C". These connections will be between punchings 65 or 66 and 67-72 of the same or other unit terminal strips. Where the connections are between different units they shall be superimposed on the frame local cable. In a like manner the "GB" or "GC" lead of each trip circuit should be connected to the (LB-) or (LC-) relays by means of leads between line unit terminal strip punchings 12 or 13 and punching 14 of the same or other units. This connection for the "GB" or "GC" lead should be made before the internal wiring of the trip circuit is changed.

4.19 400 Point Line Finder Frame — 40 Capacity Line Unit: On this frame four R type relays are required and these should be located on the top mounting plate of the start circuit unit as indicated on ED-20245-01. Where the equipment arrangement per ES-225911 has been used an additional mounting plate should be furnished for this purpose. No added springs are required on the trip circuit jacks.

4.20 The contacts of the (LB1), (LB2), (LC1), and (LC2) load control relays should be wired to the miscellaneous start unit terminal strip punchings as assigned on the associated circuit cross-connections. These assignments have been made as nearly uniform as possible for the various circuits which may be mounted on this frame and should be followed as closely as possible for those circuits which do not have cross-connections. The "HB" or "HC" and "GA", "GB" or "GC" leads of the various trip circuits should be wired to the punchings of the associated line unit terminal strips. The "HB" or "HC" lead for each trip circuit is a connection

between the trip circuit "H" lead and a terminal punching. It is recommended that the connection to the "H" lead be made at a line relay terminal, preferably one on which there is only one wire and that care be taken to not open or ground the "H" lead to other line relays in the process. The "GB" or "GC" lead is a connection between jack spring 19 and a terminal punching.

4.21 The various trip circuits may be placed in class "B" or class "C" by connecting the trip circuit "H-" leads to leads 1 to 6 from the (LB-) or (LC-) relay contacts and the trip circuit "G-" leads to leads "GB" or "GC" by means of connections between the line unit terminal strips and the start unit terminal strip superimposed on the frame local cable. It is recommended that this work be done before modifying the internal trip circuit wiring. Each trip circuit should be modified with the associated lines on the emergency.

4.22 400 Point Line Finder Frame — For use with Sender Selectors: On this frame there is no spare mounting space for "R" relays. Accordingly, a mounting detail for "U" relays has been prepared which can be mounted in a vacant terminal strip position at the top of the frame and adjacent to the line relay bay as shown on the equipment drawings listed in this specification. This mounting detail, as designed, will accommodate two sets of line load control relays. If there is no space available for this plate on certain frames, the line group affected may be served by relays located on a frame immediately adjacent. Two "U" relays are mounted on this bracket and their purpose is to operate the (O) relay of those trip circuits in class "B" or class "C". The operation of this relay prevents calls being originated by these trip circuits when the line load control feature is in operation. The contacts of the line load control relays (LB) or (LC) must be wired to the various trip circuits by means of leads "HB" or "HC", "GB" or "GC", and "TA", "TB" or "TC" depending upon the class of the associated lines. It is recommended that these leads be wired in each trip circuit to vacant punchings on the trip circuit unit terminal strip.

4.23 The "HB" or "HC" lead in each trip circuit is a connection between the trip circuit "O" lead and a terminal punching. It is

recommended that the connection to the "O" lead be made at a line relay terminal, preferably at a terminal on which there is only one wire. Care should be taken not to open or ground the "O" lead to other line relays. The "TA", "TB", or "TC" lead in each trip circuit is a connection between the (BA) and (BA1) relays and a terminal punching. In each case one of these leads will replace the battery on the terminals of these relays with battery from the load control relays. When the connection from the load control relays is in place the old battery may be disconnected. The "GB" or "GC" lead in each trip circuit is also a connection between the (BA) and (BA1) relays and a terminal punching but in this case the ground on the relay terminals is to be replaced by a ground from the load control relays. It is recommended that care be taken not to interrupt the ground supply to the (BA) and (BA1) relay contacts or to other relays while the new lead is being placed. In order to accomplish this a supplementary ground lead should be run to supply the remaining apparatus after the existing ground lead is cut and the "GB" or "GC" lead from the load control relays should be connected at the (BA) and (BA1) relays before the old ground is removed.

4.24 The contacts of the (LB) and (LC) relays should be wired as required in accordance with the Telephone Company's assignment of the various trip circuits to class "B" or class "C", to the trip circuit terminal strip punchings. The wiring for this purpose may be superimposed on a horizontal local cable arm of the top trip circuit unit and on the vertical form which feeds the various trip circuit unit terminal strips.

4.25 300 Point Line Finder Frame — For use with Sender Selectors: The method of operation for line load control is similar to that for the 400 point sender selector frame in that the line load control relays operate the (O) relay in the various trip circuits. The line load control apparatus required per line group consists of six R type relays designated (LB1-3) for class "B" and (LC1-3) for class "C" and twelve 18 type resistances (B1-6) and (C1-6). This apparatus should be mounted on a 627C mounting plate located at the top of the associated line relay bay as shown on ES-225815. The connections

from the (LB-) and (LC-) relays to the trip circuits are the "HB" or "HC" leads and the "BB" or "BC" leads. The wiring for the line load control apparatus and for the leads to the trip circuits shall be superimposed on the local form and connected direct to the apparatus as there are no available terminal strip punchings to accommodate the additional leads.

4.26 In each trip circuit the "HB" or "HC" lead is a connection to the subgroup "O" lead. It is recommended that this connection be made at a terminal of one of the line relays in the subgroup, preferably on a relay terminal on which there is only one wire. Care should be taken not to open or ground the "O" lead to other line relays. The "BA", "BB", or "BC" lead should be connected at the contacts of the (BA) and (BA1) relays to replace the "B" lead to the line finder time alarm circuit now on these terminals. A new lead to the time alarm circuit should be run from the load control relays.

4.27 Line Switch Frames: Line switch frames have shelves of 20 line circuits and associated line switches each. Such a frame may include shelves served by one or more district groups and on the other hand a district group may serve shelves on several frames. Line load control is applied on a district group basis and it is assumed that the shelves served by a district group will be allocated to classes A, B, and C on approximately the 10 per cent-45 per cent-45 per cent basis. This being the case several (LB) or (LC) relays may be required to open the battery supply leads of the class "B" and class "C" shelves of a given district group since one relay will serve six shelves and in addition should not serve shelves on another frame than the one on which it is located. Each relay should be located on one of the shelves it is to serve on a mounting detail designed to fit in the position of the designation card holder at the left of the respective shelf. Where these designation cards are furnished, those displaced by line load control relays should be relocated by the installer in a position as close as possible to their respective shelves. The relays should be located as close as possible to the shelves they are to serve so as not to increase the length of the battery supply leads unnecessarily. Where several relays serve the same class in the same district group they are operated in cascade, one relay being con-

sidered the "first" and another the "last". The "first" relay shall be considered as that one located on the lowest numbered frame or shelf and the "last" on the highest numbered frame or shelf. All connections shall be made with 20 gauge wire and all (LB) and (LC) relay armature contact terminals and connecting leads shall be protected with varnish impregnated sleeving as covered in the specification on General Equipment Requirements—Protection of Cable Forms and Skinners and Repair of Insulation.

4.28 An examination of the wiring diagrams for these circuits will show that in most cases there is one battery supply lead to the shelf for the line relays and associated resistances. This lead is connected to the shelf battery clip with two leads from this punching to the line circuits, one lead per ten line relays. In addition, it will be found that for each line circuit there is a battery lead from the line relay to the associated (MB) resistances. The battery supply to these resistances must not be interrupted by the load control relays. The method of rearranging the battery supply for line load control is as follows. A lead from the battery clip should be strapped or otherwise wired across all (MB) resistances for the shelf and the leads between the (L) relays and their associated resistances disconnected. One battery lead should be made continuous for all twenty line relays on the shelf and this lead should be connected through a contact of the (LB) or (LC) relay. The associated armature of the relay should be connected to the battery clip for the shelf. On those shelves having one battery lead for the relays and another for the resistances it is only necessary to run the battery leads for the relays through an (LB) or (LC) relay contact. All new wiring shall be 20 gauge type F wire. Leads from the common circuit shall be run direct to the line load control relays on the line switch frame.

4.29 Line Switch Offices: In panel line switch offices the operation of the line load control feature removes battery from the line relays. If one or more of these lines are plugged to service observing line equipment at this time a circuit combination is set up which permits a line relay to operate falsely from battery thru the service observing equipment. In order to

prevent the false operation of the line relays under these conditions a modification is necessary in the service observing equipment involving the addition of one U type relay per each ten service observing line circuits. The operation of this relay through ground over the SO lead from SD-96387-01 will open the lead from the (LS) relay of the service observing line circuit to the jack (G) on the line switch frame thus preventing battery from being returned to the line relay. The added relays shall be located on a mounting plate in the same or adjacent relay rack bay as the associated service observing equipment. The following service observing line circuits have been changed to show the added relay referred to above: SD-21425-01, SD-20212-01, SD-20625-01, SD-90580-01, SD-96029-01, SD-96111-01, SD-96162-01, and ES-239566. The connection from line load control circuit SD-96387-01 is shown as "Z" wiring.

4.30 Common Equipment: Normally the common equipment per SD-96387-01 will be located in a wall cabinet per ED-91803-01 and on a relay rack unit per ED-92515-01. In buildings containing both panel and crossbar units the Telephone Company may wish to locate the line load control equipment for the panel line groups on the crossbar incoming trunk test frame with that for the crossbar line link frames. Where this is the case the information covered in paragraph 4.12 should be followed.

4.31 The leads to the common circuit for line load control from the (LB-) and (LC-) relays may be wired through the DPTS if punchings are available or line load control grouping terminal strips, centrally located with respect to the lineups of frames, may be provided to facilitate running these leads. The distance from the common control circuit and the first DPTS or grouping terminal strip shall be not less than 50 feet of 24 gauge cable.

Line Group Overload Lamps

4.32 The line group overload (G) lamps per SD-96387-01, Fig. 4 should be mounted in the lamp cabinet per ED-91803-01 when this feature is specified by the Telephone Company. If group busy lamps are not ordered, space shall be reserved for the future addition of the lamps unless the Telephone Company specifically states

that space shall not be reserved for this equipment. The (C) resistances per Fig. 4 of SD-96387-01 shall be furnished in accordance with the number of line groups to be served and located on the relay rack in accordance with ED-92515-01. All wiring to the relay rack equipment shall be run direct to the apparatus by the installer. The "G" leads from the lamps to the traffic register contacts shall be run to a new terminal strip on the IDF, and cross-connected to the associated district selector group busy register contacts in panel line switch offices. Where desired, the (G) lamps may be cabled direct to the terminal punchings associated with the register contacts at the IDF instead of cross-connected. Where the register contacts are not cabled to the IDF but appear on terminal strip punchings at the top of the traffic register rack the "G" leads shall be cabled to these punchings. Where the register contacts do not appear on the IDF or on punchings on the TRR the "G" leads shall be run direct from the lamps to the register contacts. In line finder sender selector offices, the "G" leads from the lamps shall be connected to the associated line finder overflow register contacts except where separate registers for link overflow and district overflow are provided, in which case the "G" lead shall be connected to the link overflow register and be multiplied to the district overflow register as shown in Figs. 22 and 23 of SD-20141-01.

4.33 In line finder link type offices having single traffic register operation in the start circuits with 48 volt registers, the (OF) relay, ordinarily furnished in the start circuit for use with 24 volt registers, must be added in order to clear the associated register contact for connection to the (G) lamp. This relay is not required in start circuits arranged for double register operation and no additional circuit change is required in sender selector or line switch offices.

Common

Dial Tone Speed Indicating

4.34 Dial tone speed indicating equipment and the method of installing it are covered in detail in specification J99231. However, where this feature is used in conjunction with line load control, the key and lamp equipment may be located in the upper portion of the line load control

cabinet per ED-91803-01, if the number of line link frames, line finder groups or line switch groups to be served is such that there is available space in the cabinet. In crossbar, offices having the line load control equipment located on the incoming trunk test frame, the dial tone speed indicating equipment may also be located at this frame as shown on ED-26829-01.

4.35 Subject to the limitations set up in J99231, the dial tone speed register control unit and the dial tone speed indicating control unit should be located on the relay rack as near as possible to the line load control relay rack equipment.

Office Load Meter

4.36 A Western Electric Company Type G millivolt meter with a scale reading 0 to 100 arranged to read 100 at 50 millivolts is available as an indicator of the total office traffic load. This meter is applicable in any office where an ammeter on the power switchboard indicates the total office 48 volt load and where this ammeter is provided with an external shunt designed for a 50 millivolt drop at full scale. Each millivolt meter will be calibrated with connecting leads of sufficient length to give correct meter readings depending on the distance from the power board shunt. The leads will also be equipped with 20 ampere fuses to be inserted at the point of connection with the shunt. The meter together with the various lengths of connecting leads are covered as follows:

G1H — 200-foot shunt leads

G1J — 300-foot shunt leads

Note: Meter codes G1F, G1G, G1K, and G1L, previously listed, are rated "Mfr. Disc." Meters with shunt leads other than 200 and 300 feet in length, when required, shall be furnished on a job basis.

4.37 The meter may be located in the line load control cabinet or at the incoming trunk test frame (in crossbar offices) if the number of line frames, line finder groups or line switch groups to be arranged for line load control permits. If there is no available space with the line load control equipment the meter may be mounted in a separate cabinet per ED-91858-01, located near the line load control cabinet. The Bell Telephone Laboratories, Incorporated
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meter leads and their associated fuses should be connected to the power board shunt in the manner indicated on ED-81147-01. The meter leads, if too long, shall be stored on the cable rack and in no case shall they be cut to length since this would interfere with the correct reading of the meter.

Switchman's Talking Line Jacks

4.38 Switchman's talking line jacks, where furnished for use with line load control shall be located on the cabinet as indicated on ED-91803-01 or at the incoming trunk test frame as indicated on ED-26829-01. These jacks, furnished as required in accordance with the number of talking lines to which the line load control operator must have access, shall be cabled to the MDF or IDF for cross connection to the various talking lines. The leads required shall be run to the line load control cabinet, with other leads and formed to the jacks through the bottom of the cabinet.

Aisle Pilot

4.39 In offices where the alarm circuits are arranged to give aisle pilot signals, the line load control circuit shall be connected to the aisle pilot nearest the line load control cabinet or incoming trunk test frame. In the event that there is no aisle pilot adjacent to the line load control cabinet, a separate aisle pilot may be furnished, if desired, and connected as indicated on the circuits.

Auxiliary Cabinet for Shelter Area

4.40 The equipment shown on ED-92857-01 provides for extending the master control key operation to a shelter area in the building. A wall-mounted steel cabinet encloses a panel on which appear multiples of the class B and C master keys and lamps and the alarm release key. A multiple appearance of the office load meter also may be furnished. Under this plan, the individual frame keys in the lamp cabinet in the maintenance center are operated as demanded by the situation, final control being exercised from the cabinet in the shelter area in accordance with readings observed on the office load meter. The latter shall be bridged across the same shunt that serves the office load meter in the maintenance center.