

Lesson No. 1

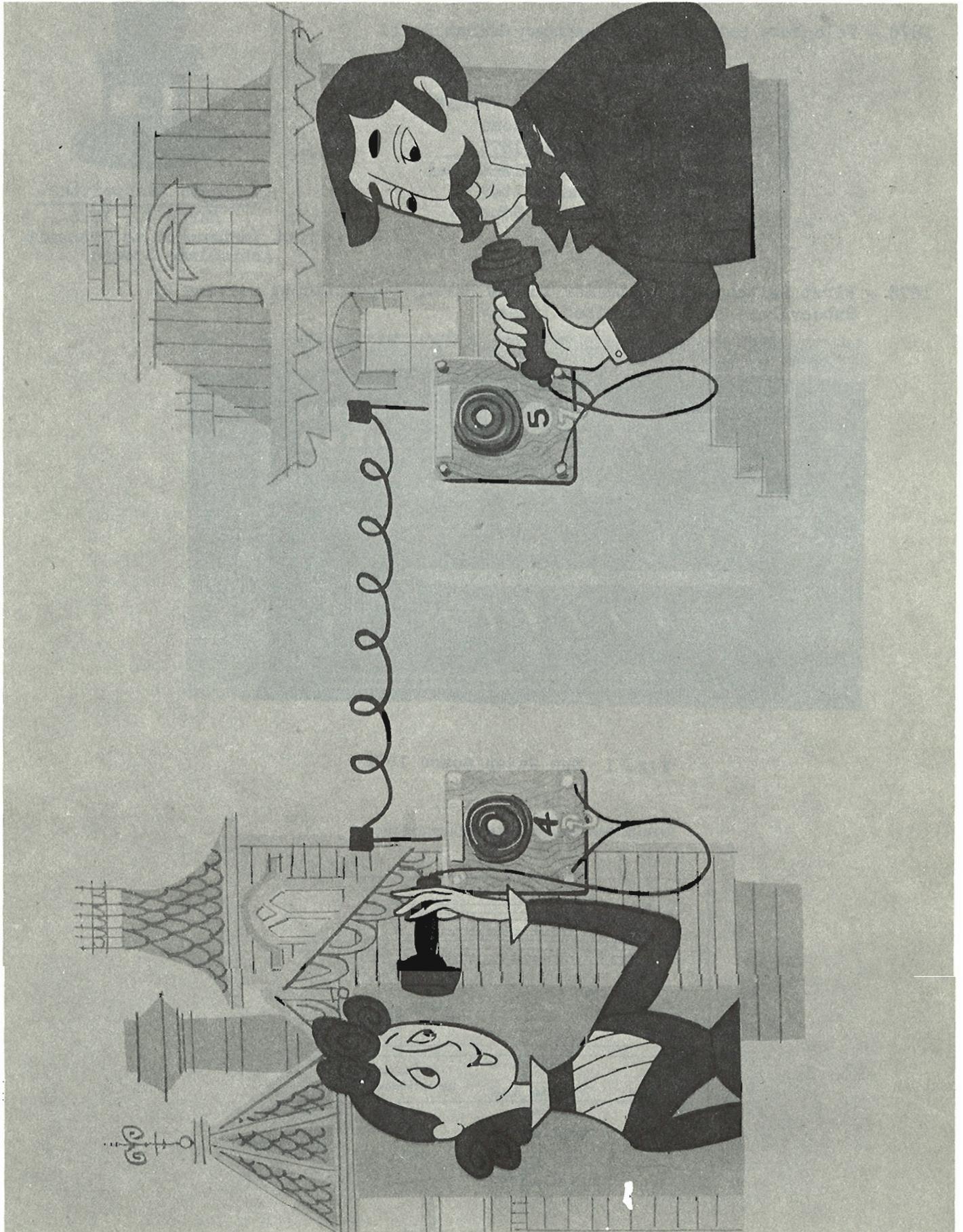
FUNDAMENTALS OF TELEPHONY

Section 8

The Manual Switching System

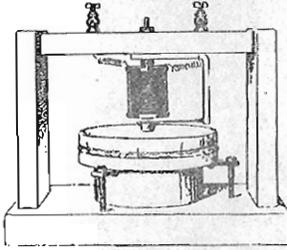
<u>CONTENTS</u>	<u>Page</u>
The Telephone Patent	90
The First Switchboard	90
Growth of Manual Switching	91
Direct and Tandem Trunking	93
Switchboard Equipment	94
Elevation Plan of a Manual Office	100
Manual Central Office Terminal Room	101
Typical Manual Central Office Cable Layout	102
Cabling Between Distributing Frames and Switchboards	103
Local Test Desk and Repair Service Desk	103
Methods of Handling Calls Through the Manual Switching System	104
Completion of a Call Using No. 1 "A" and "B" Switchboards	104
Completion of a Call Through a Combination Switchboard	110



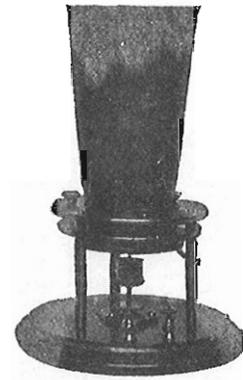


THE MANUAL SWITCHING SYSTEM

1876 - Telephone patented by Alexander Graham Bell.



"Gallows Frame"  
Telephone  
June, 1875  
First Electrical  
Transmitter of  
Speech Sounds.



Liquid Transmitter.  
March 10, 1876  
First Instrument to Transmit  
Articulate Speech

1878 - First Switchboard installed in New Haven, Connecticut; serving 21  
Subscribers on 8 Subscriber Lines.

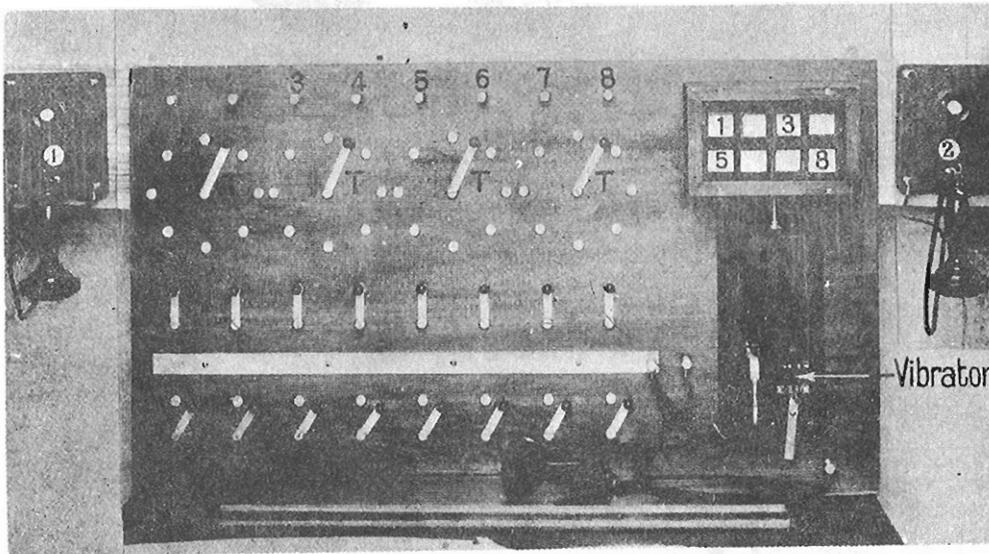
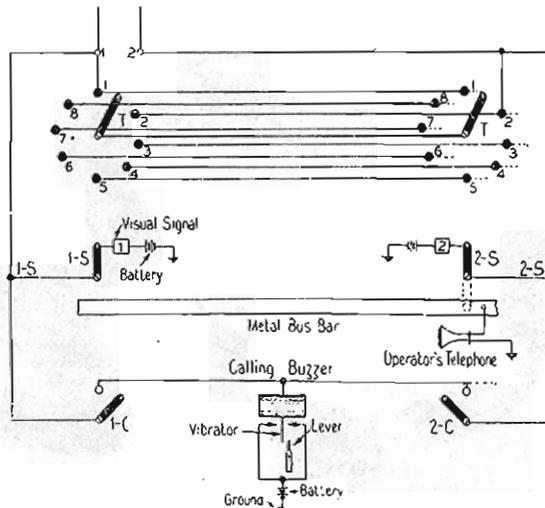


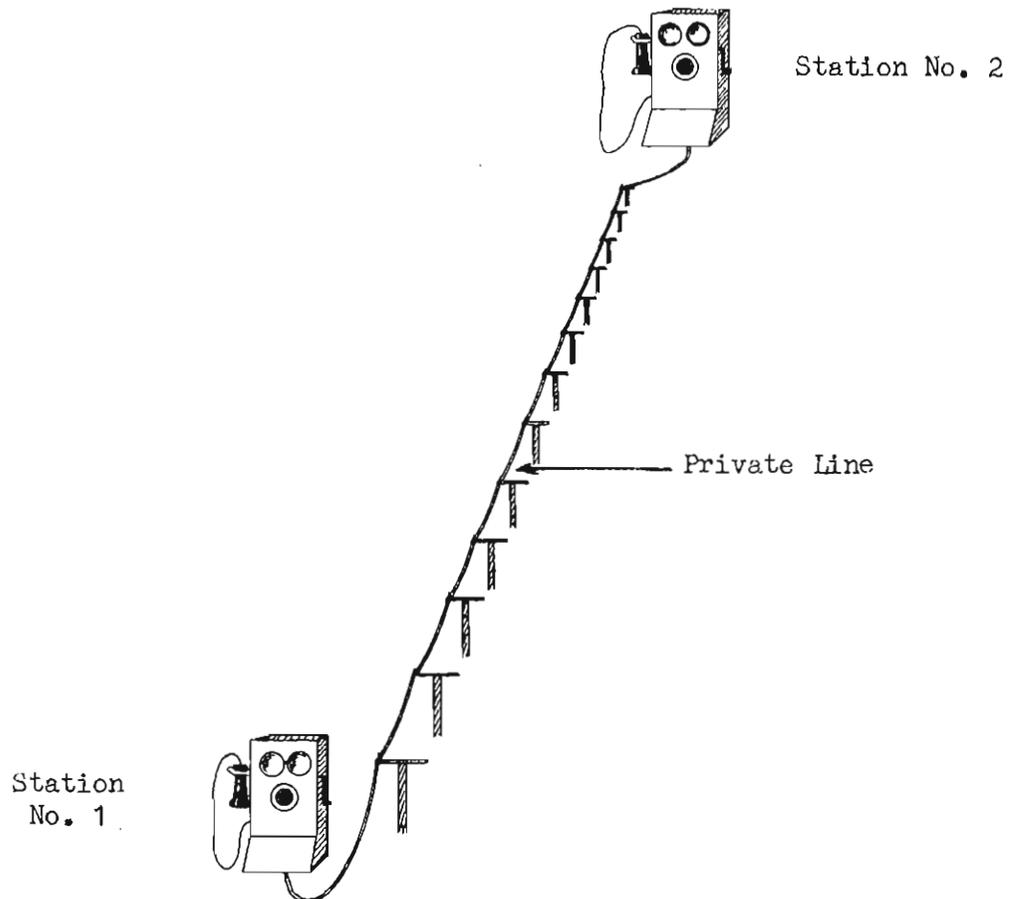
Fig. 1 New Haven Board 1878

SCHEMATIC WIRING DIAGRAM OF NEW HAVEN SWITCHBOARD

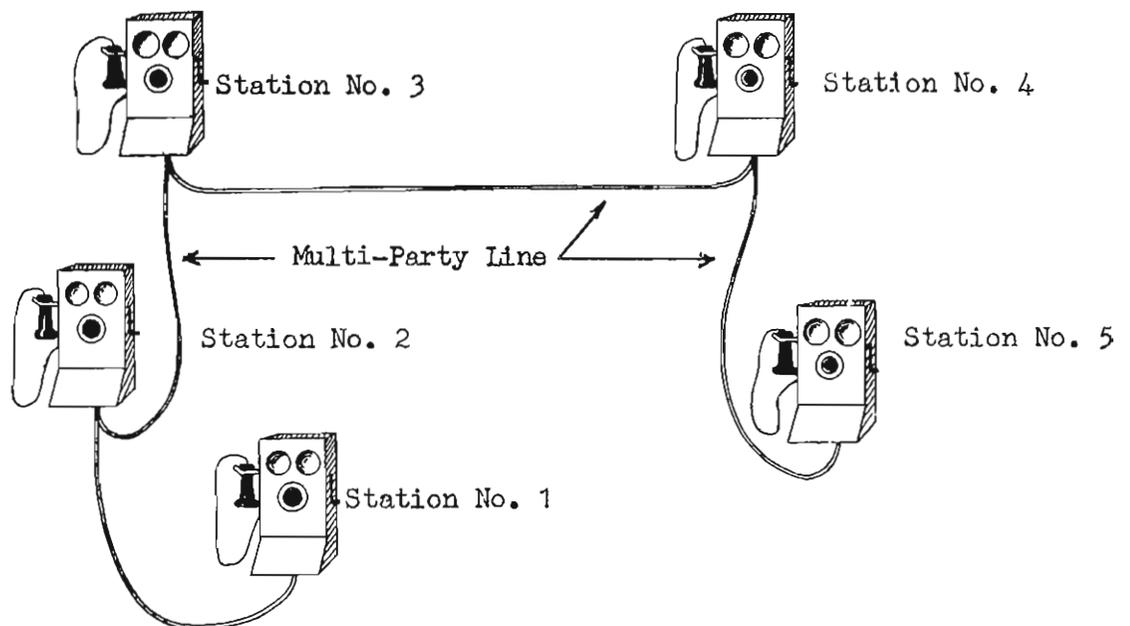


Growth of Manual Switching:

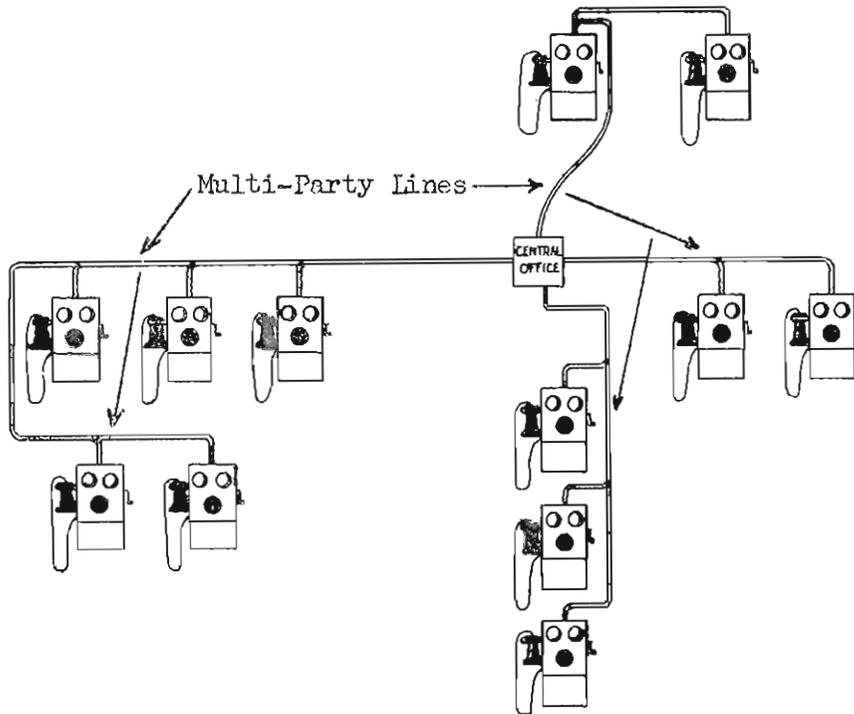
- 1) Private Line - Two Subsets permanently connected to a pair of wires.



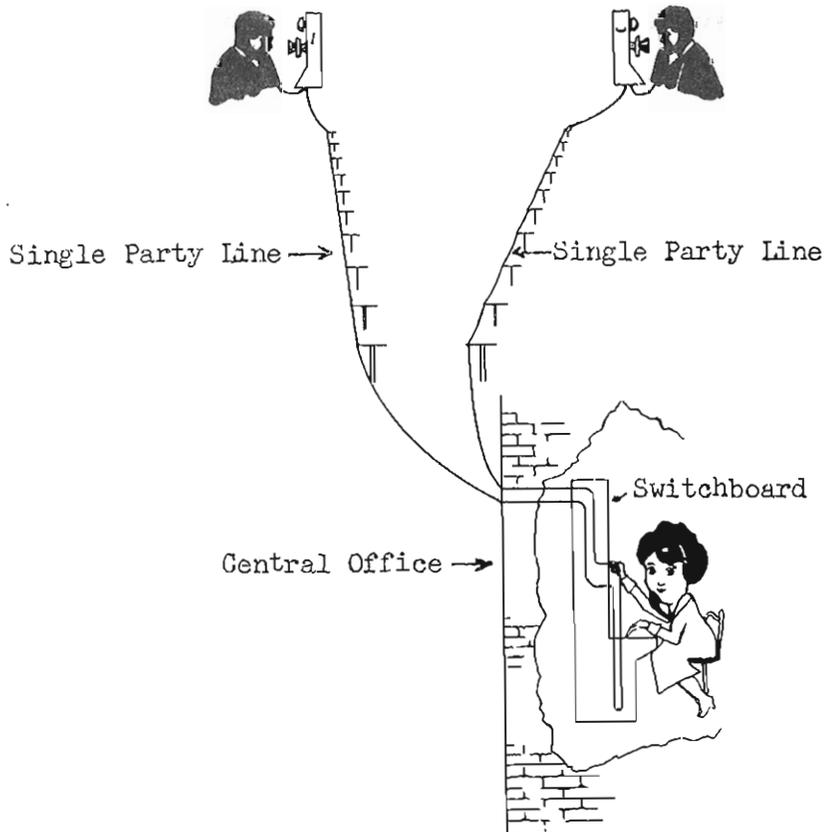
- 2) Multi-Party Line - Several Stations connected to the same pair of wires.



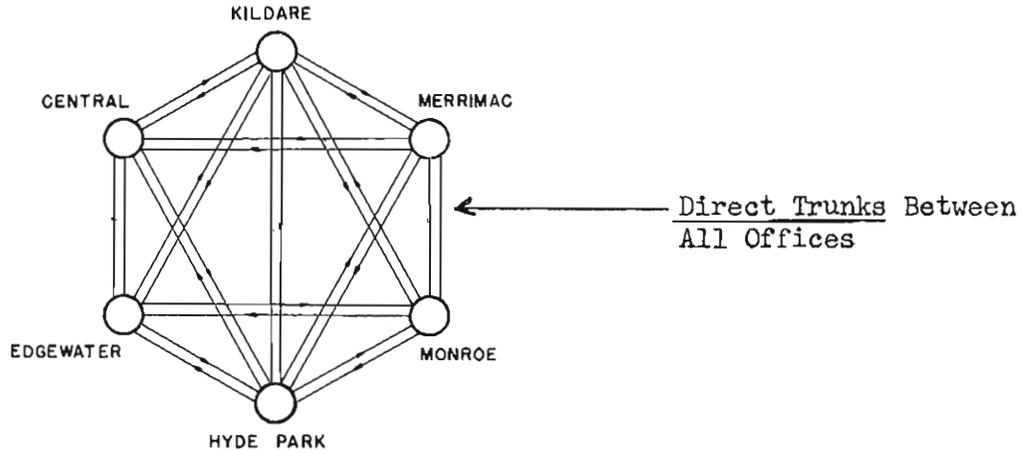
- 3) Several Party Lines Connected to a Switchboard located in a Central Office.  
A Subscriber on one party line is connected to a Subscriber on another party line by an Operator at the Switchboard.



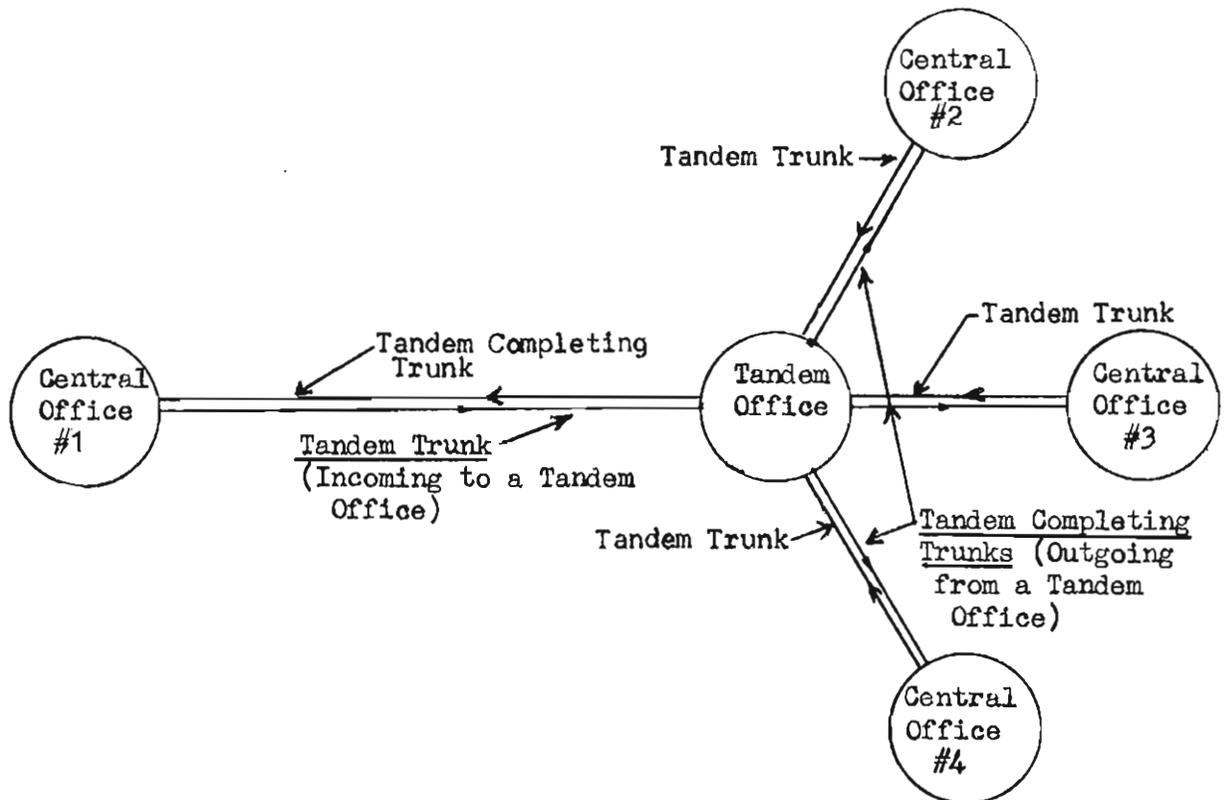
- 4) Two Single-Party Lines connected together by an Operator at the Central Office Switchboard.



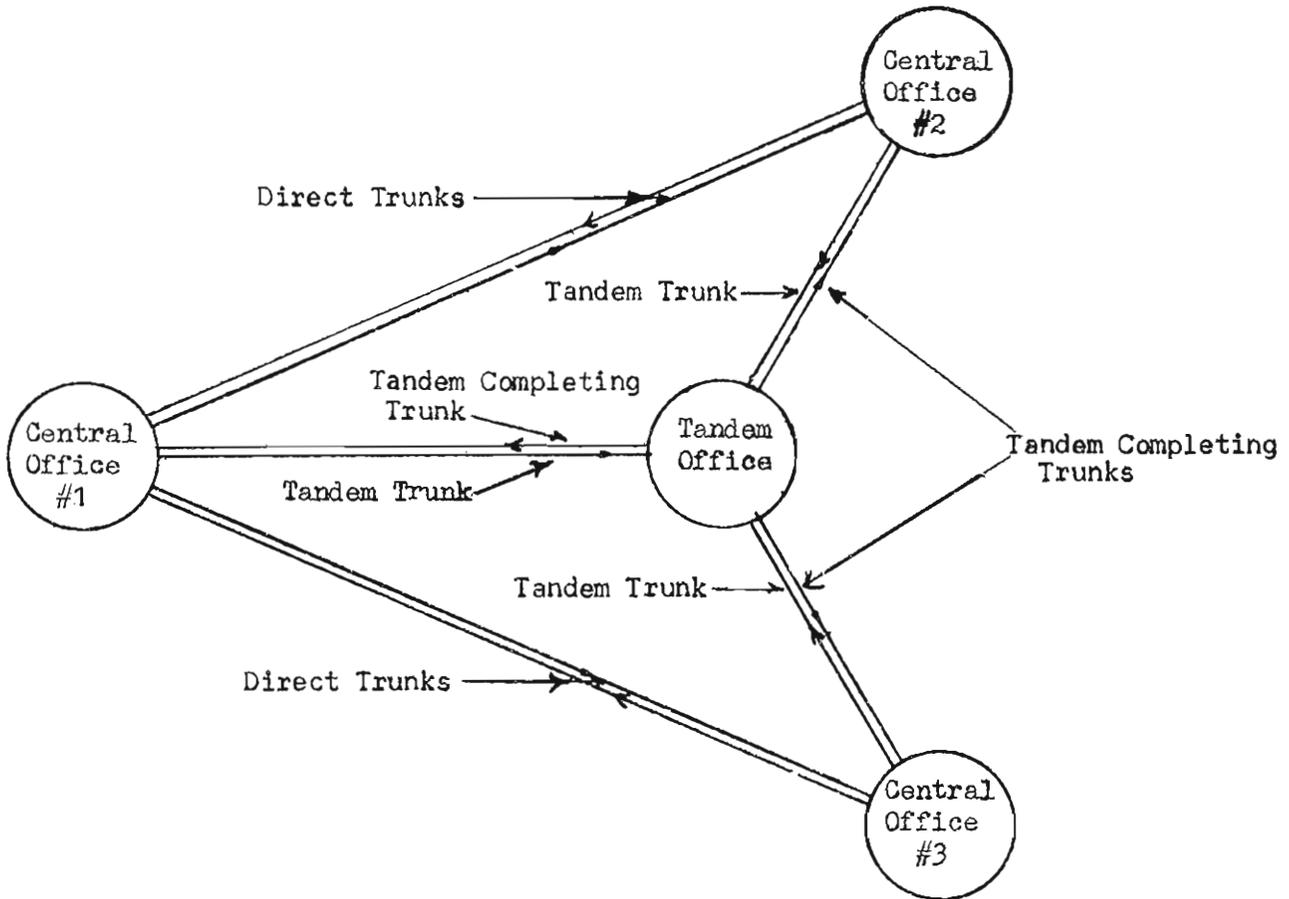
- 5) Several Central Offices, interconnected by Trunks, required to service a large Exchange Area.



- 6) Tandem Office - A Central Office used as an intermediate switching point for traffic between other Central Offices, and affording:
- 1) Economical trunking between outlying offices with low traffic volume.
  - 2) Alternate Routes between all Central Offices in an Exchange Area handling overflow traffic from Direct Trunks.

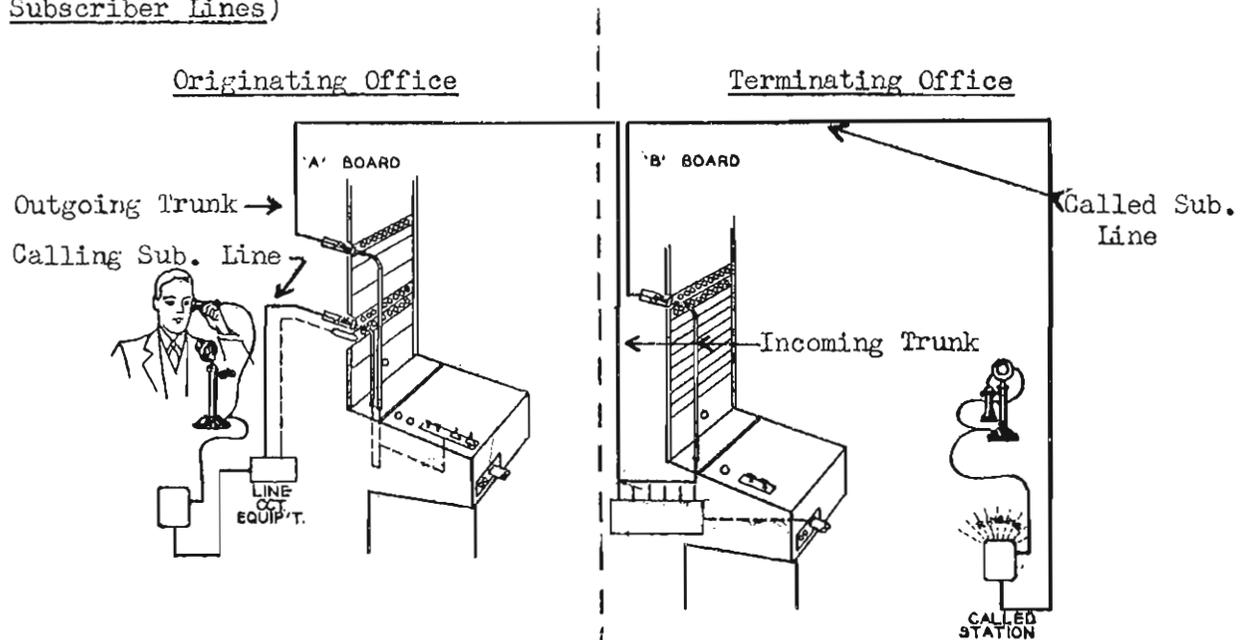


7) A combination of Direct and Tandem Trunking provides the most economical method of handling traffic between several Central Offices.

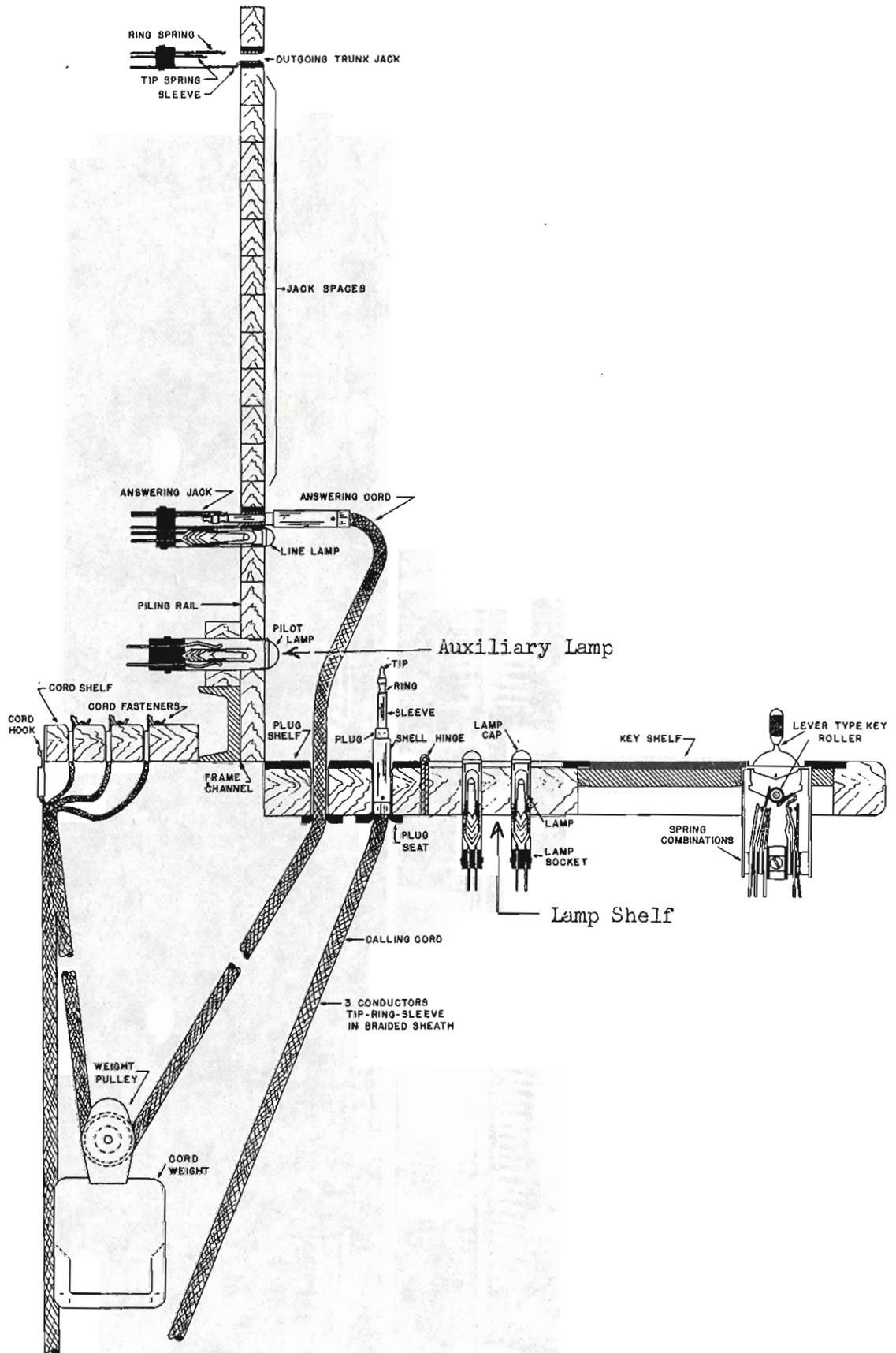


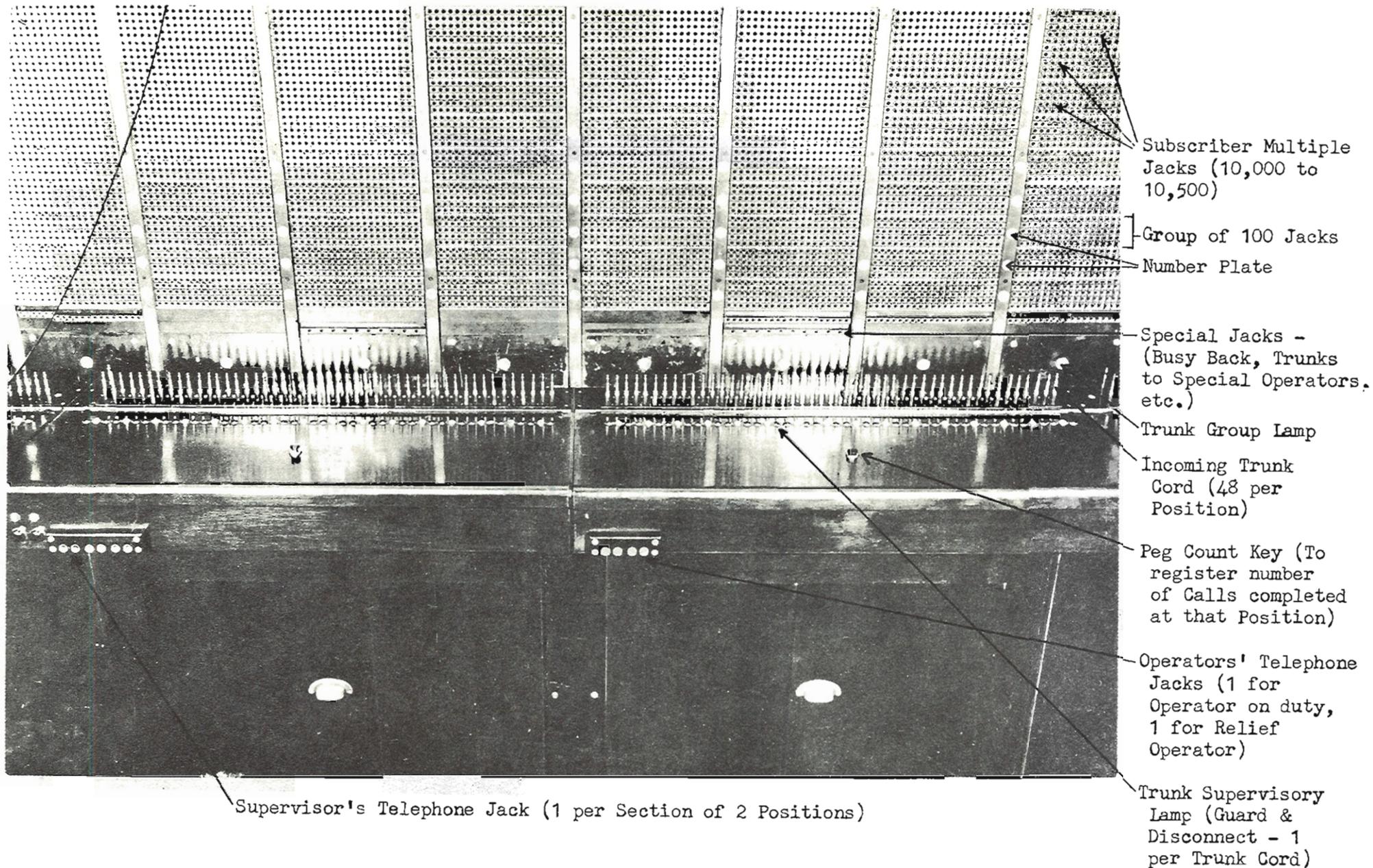
SWITCHBOARD EQUIPMENT

Subscriber Lines  
 and  
Outgoing Trunks ) - appear on the "A" Switchboard in the Originating Office.  
Incoming Trunks  
 and  
Subscriber Lines ) - appear on the "B" Switchboard in the Terminating Office.

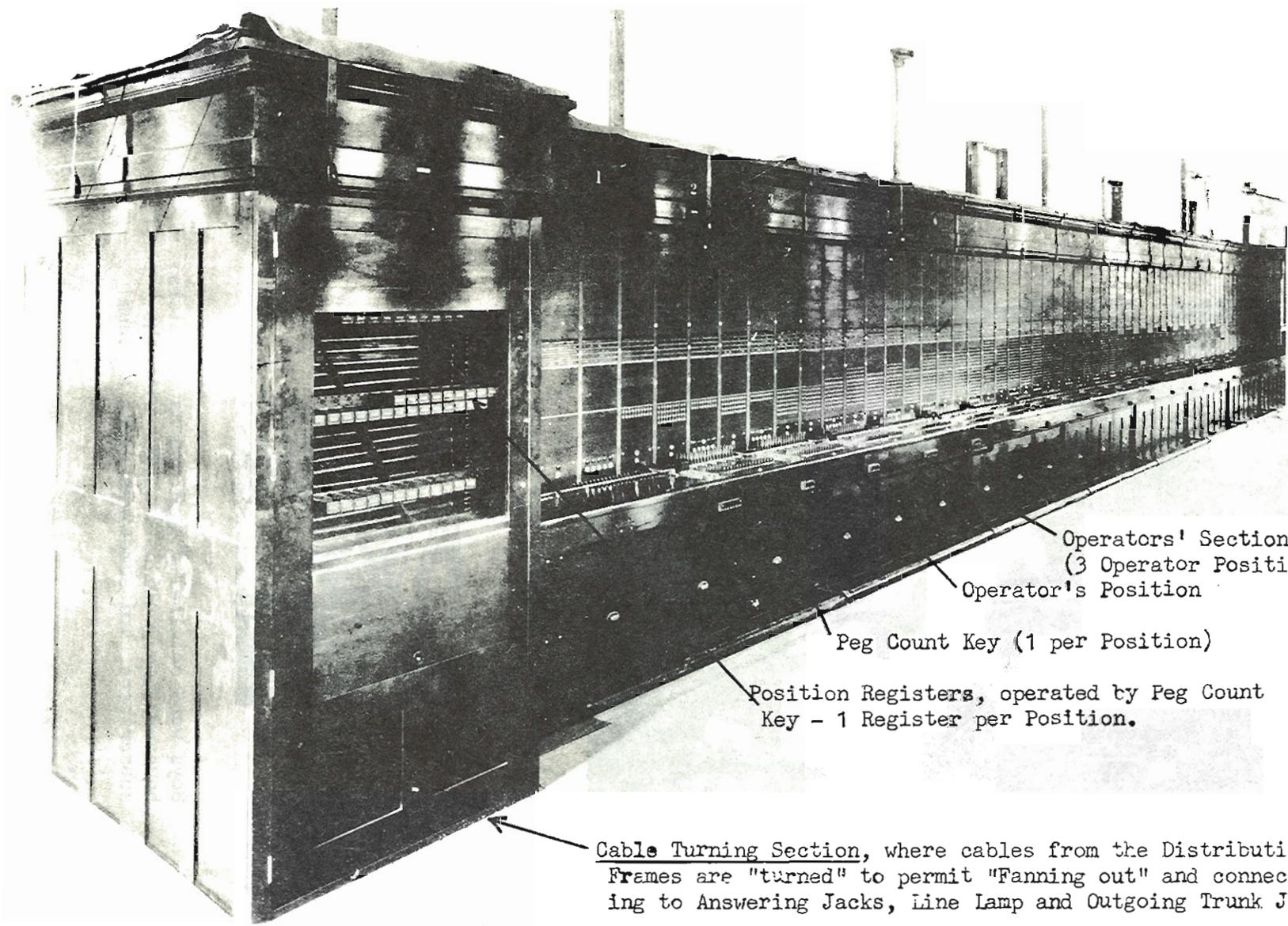


"A" Switchboard Equipment





"B" Switchboard Equipment



Operators' Section  
(3 Operator Positions)

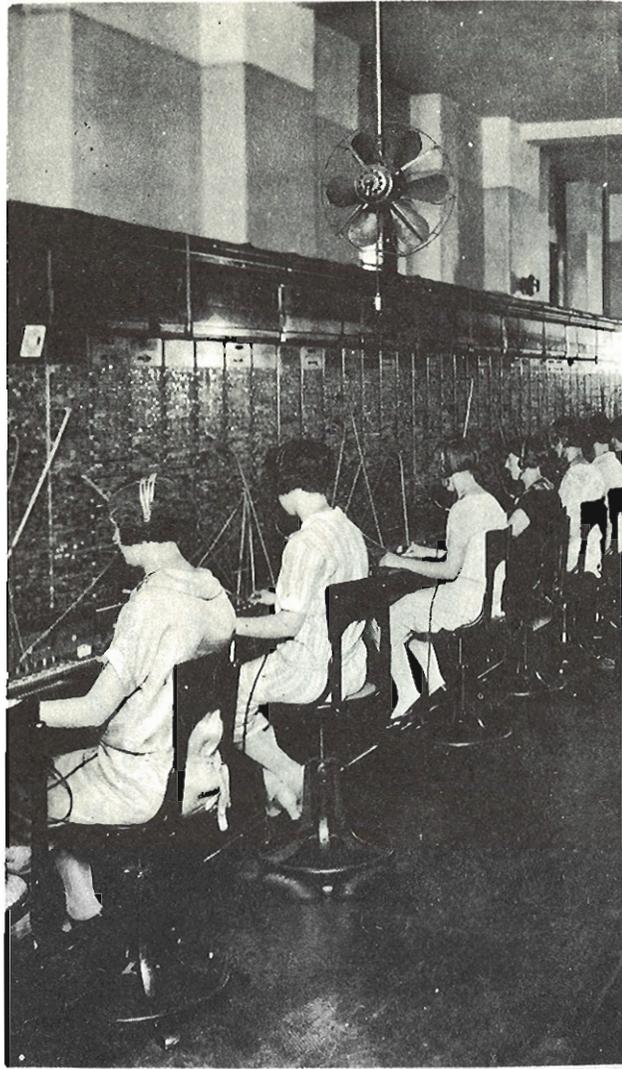
Operator's Position

Peg Count Key (1 per Position)

Position Registers, operated by Peg Count  
Key - 1 Register per Position.

Cable Turning Section, where cables from the Distributing  
Frames are "turned" to permit "Fanning out" and connect-  
ing to Answering Jacks, Line Lamp and Outgoing Trunk Jacks.

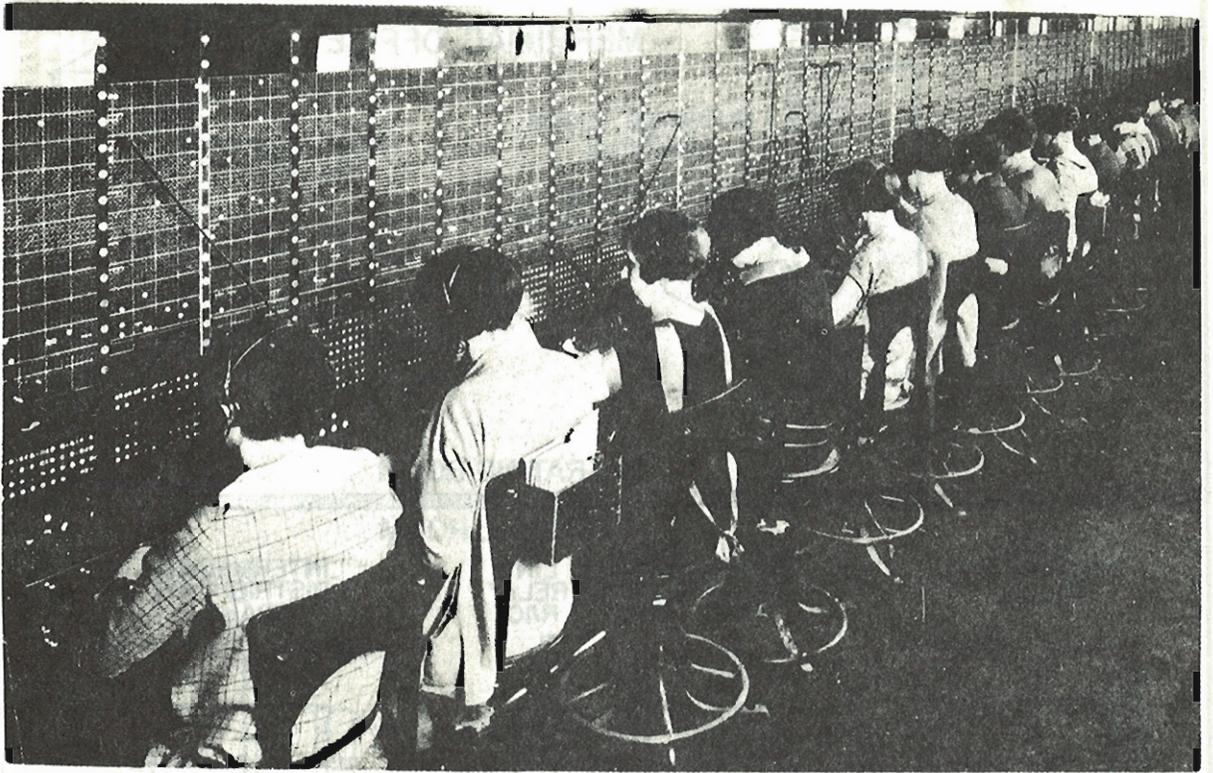
"A" Switchboard Lineup



A Portion of a "B" Switchboard Lineup



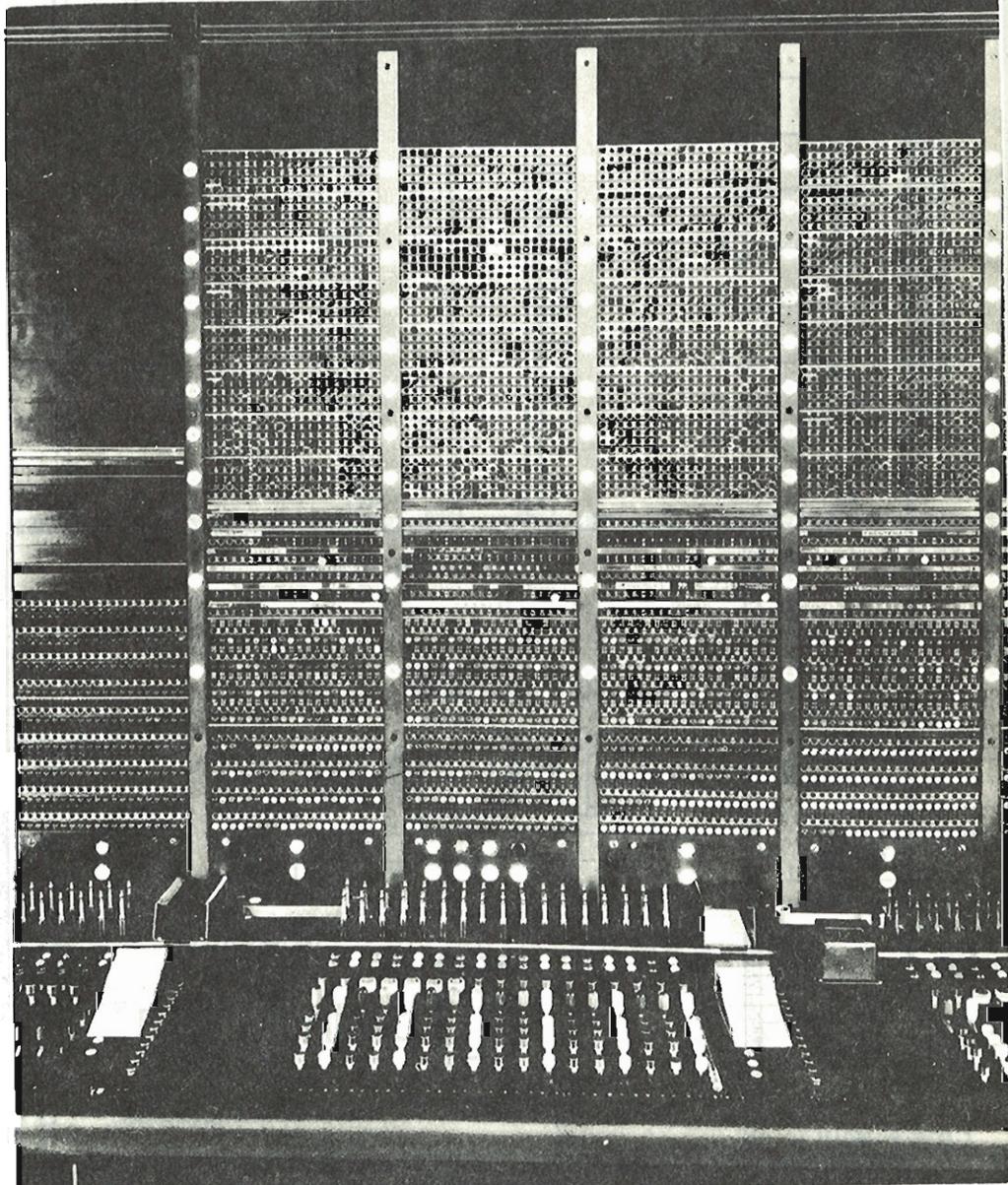
Boys were originally employed as operators; however they would often argue with the subscribers, and sometimes swear at them!

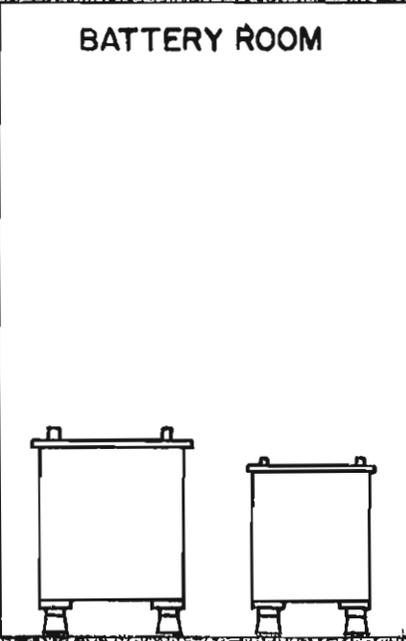
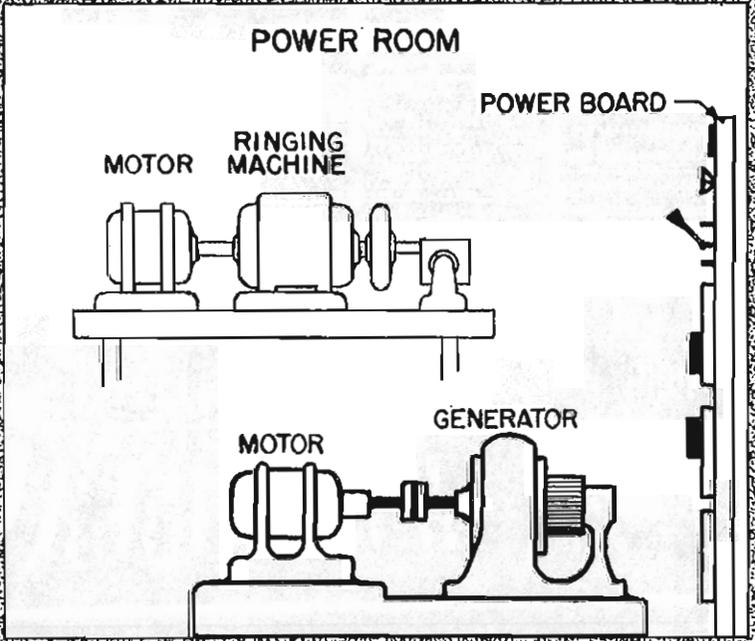
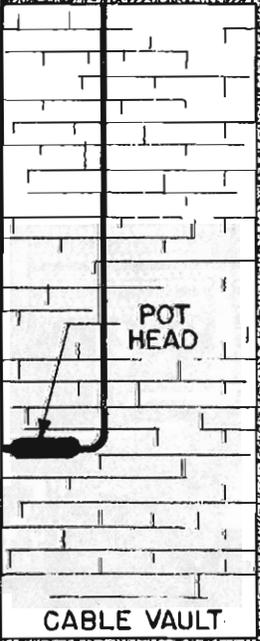
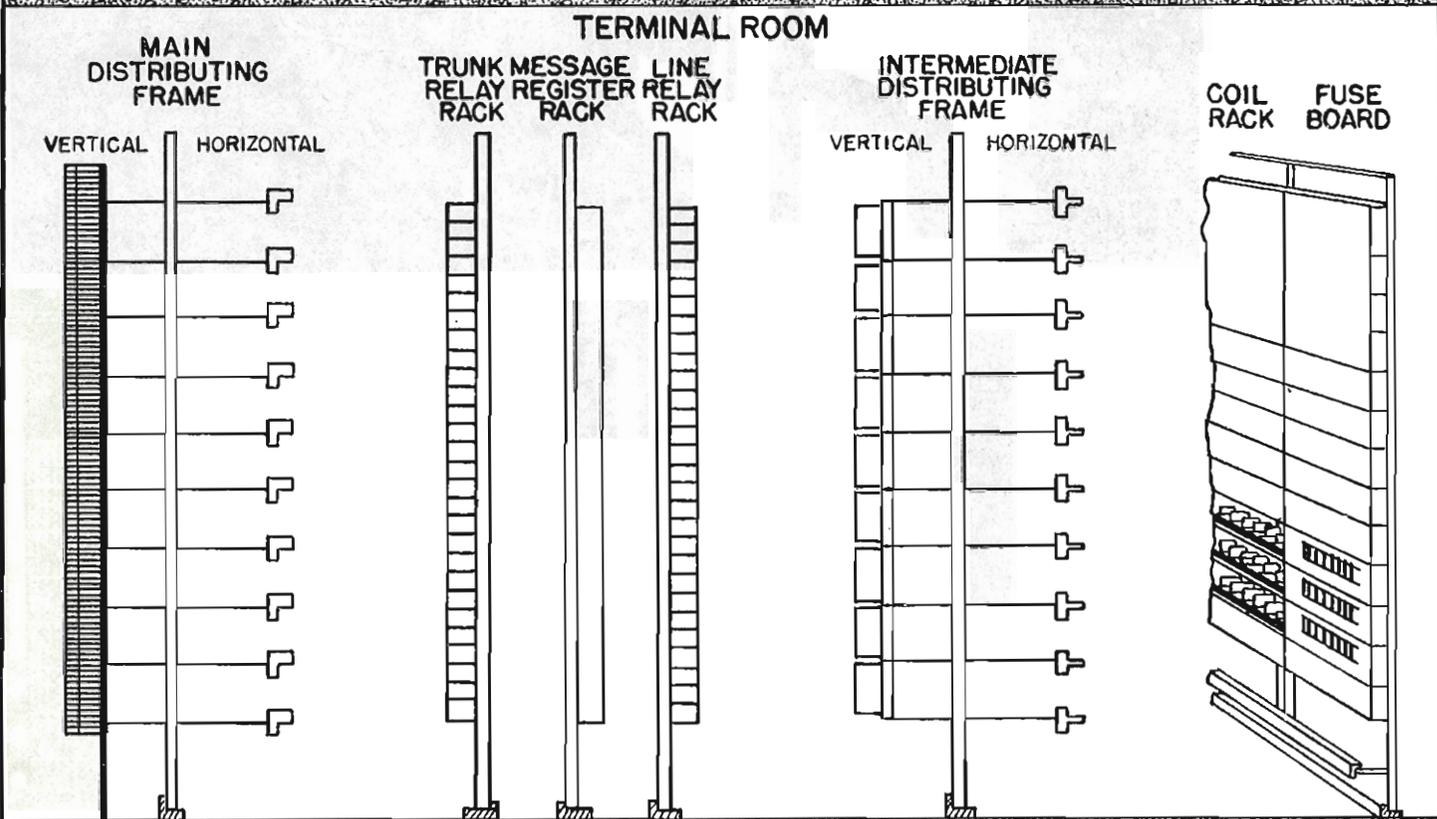
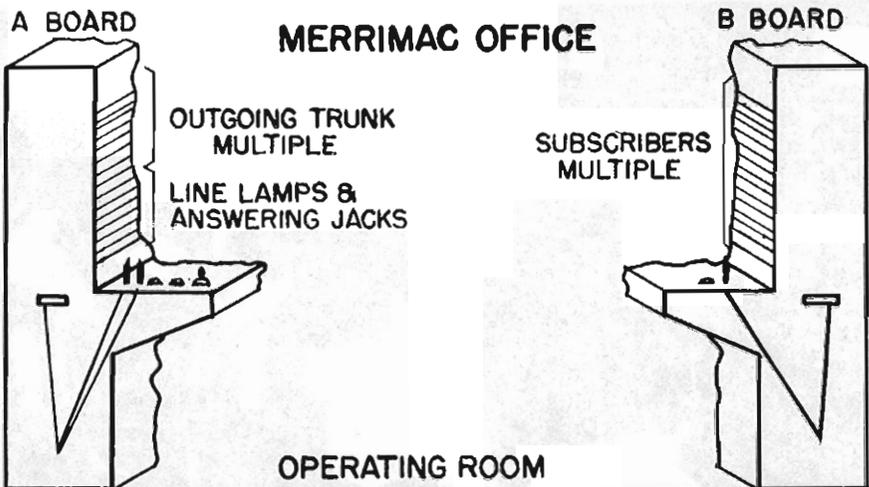


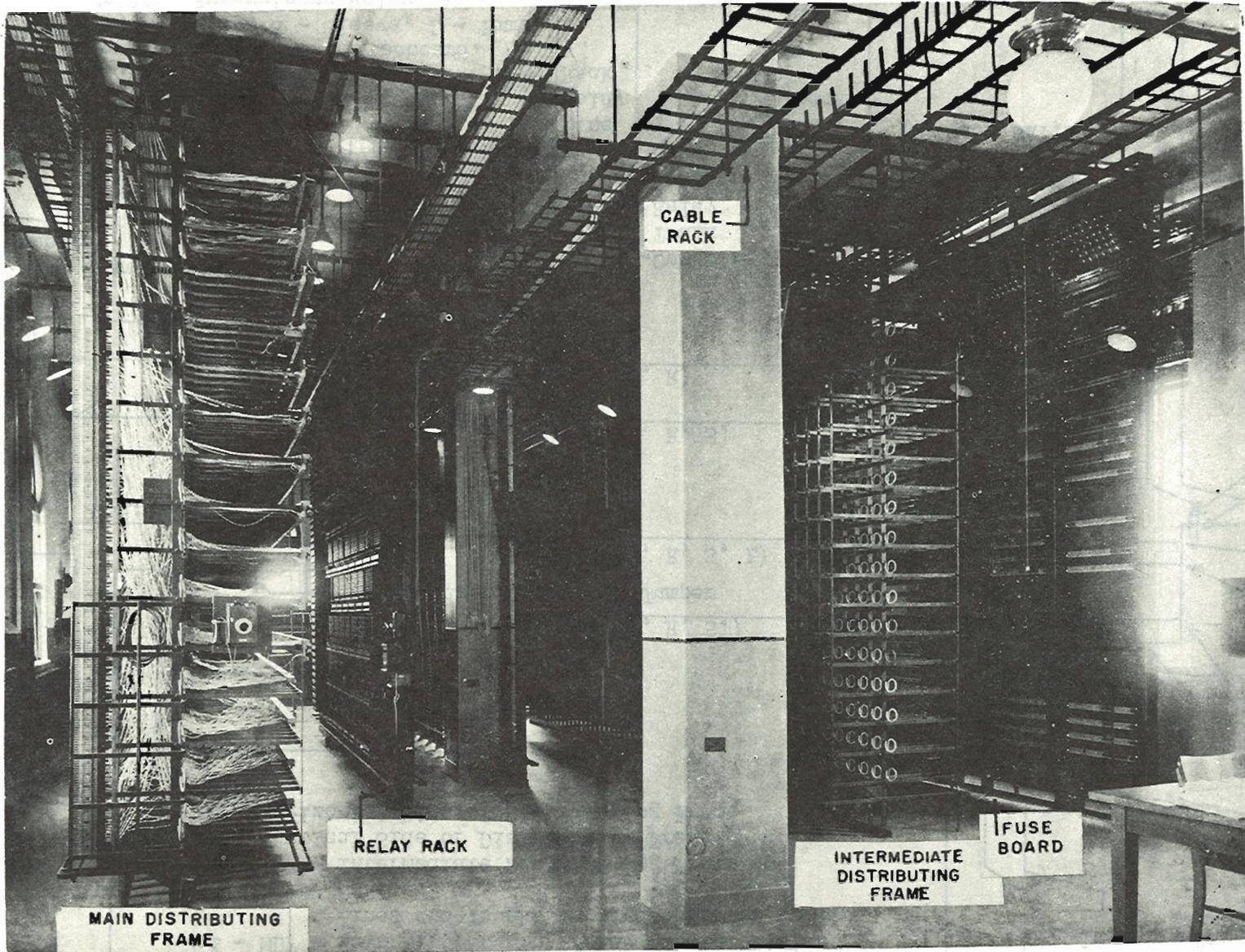
Combination  
Switchboard  
Lineup



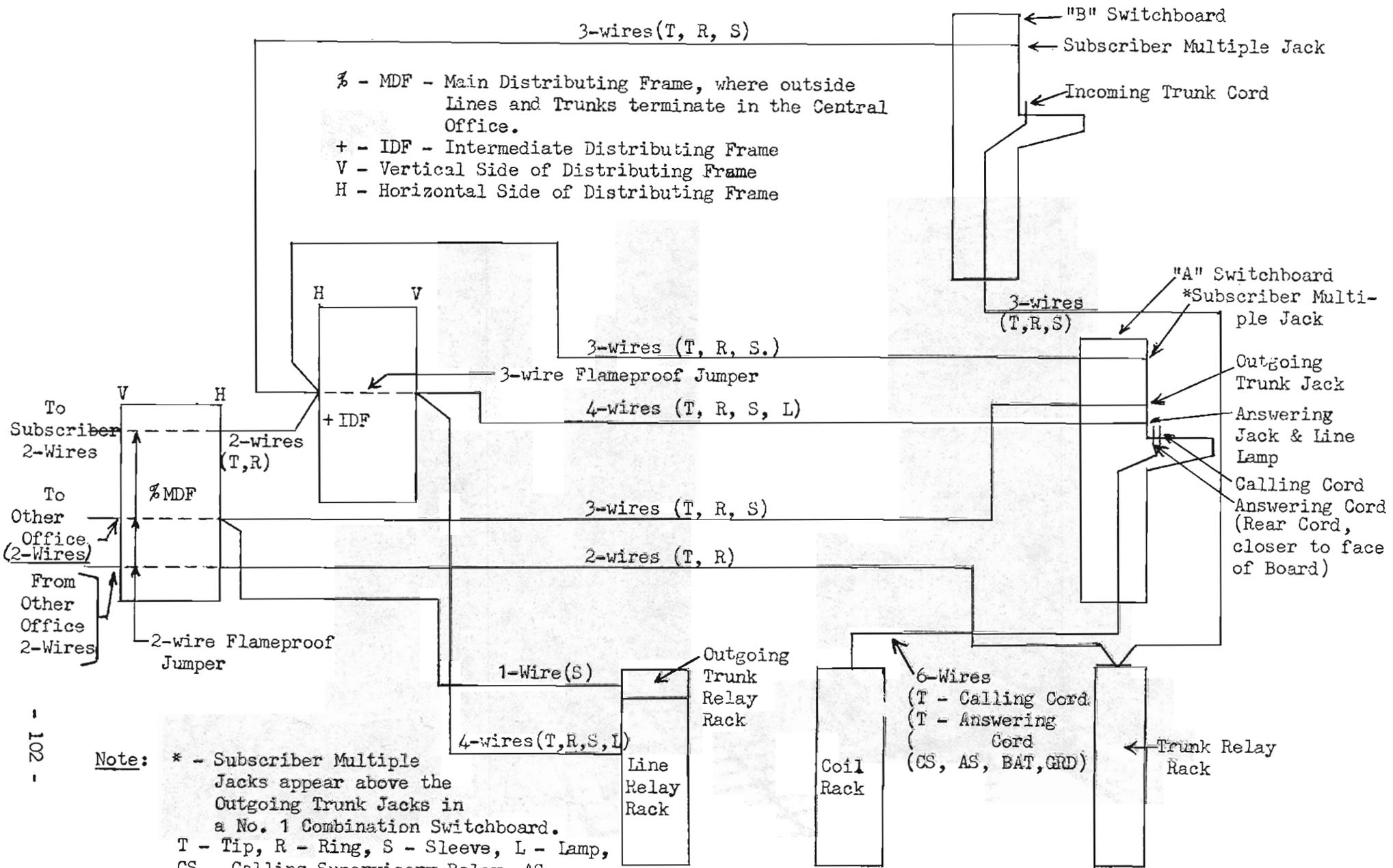
Combination Switch-  
board Position  
Equipment





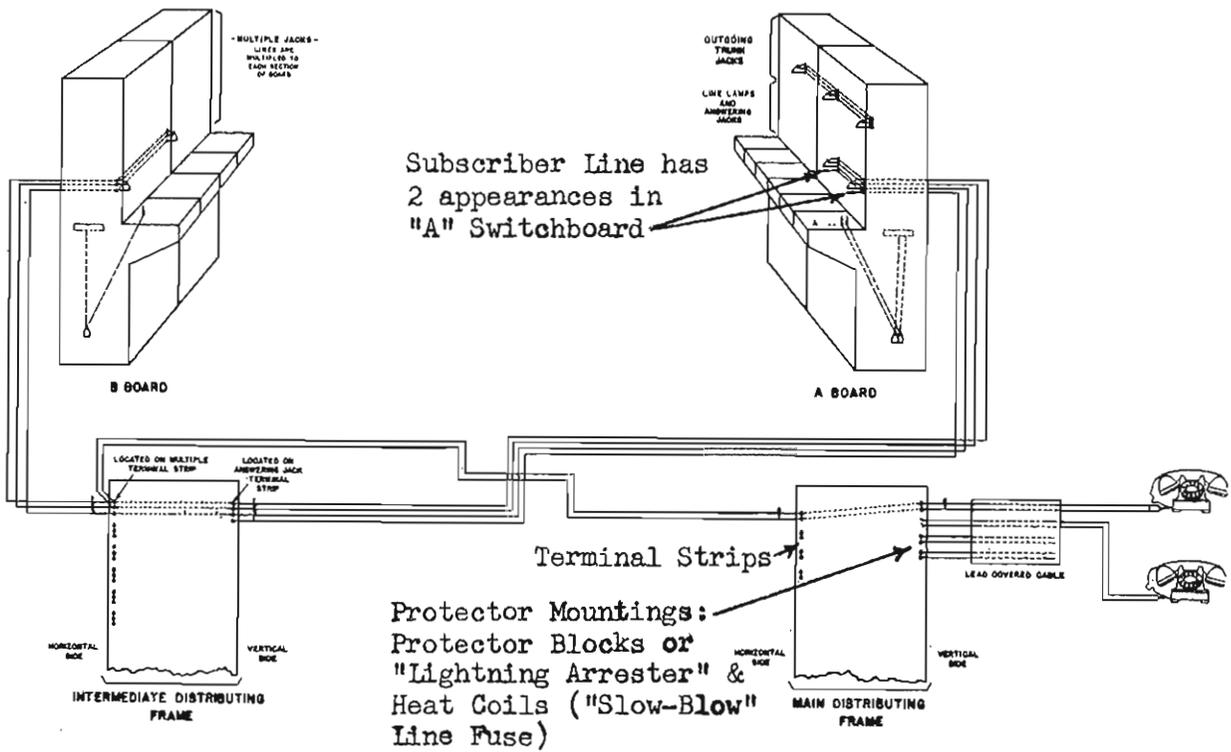


Manual Central Office Terminal Room



**Note:** \* - Subscriber Multiple Jacks appear above the Outgoing Trunk Jacks in a No. 1 Combination Switchboard.  
 T - Tip, R - Ring, S - Sleeve, L - Lamp,  
 CS - Calling Supervisory Relay, AS - Answering Supervisory )  
 Relay, BAT - Central )  
 Office Battery, GRD-Ground)

Typical Manual Central Office Cable Layout



MANUAL CENTRAL OFFICE  
Cabling Between Distributing Frames and Switchboards

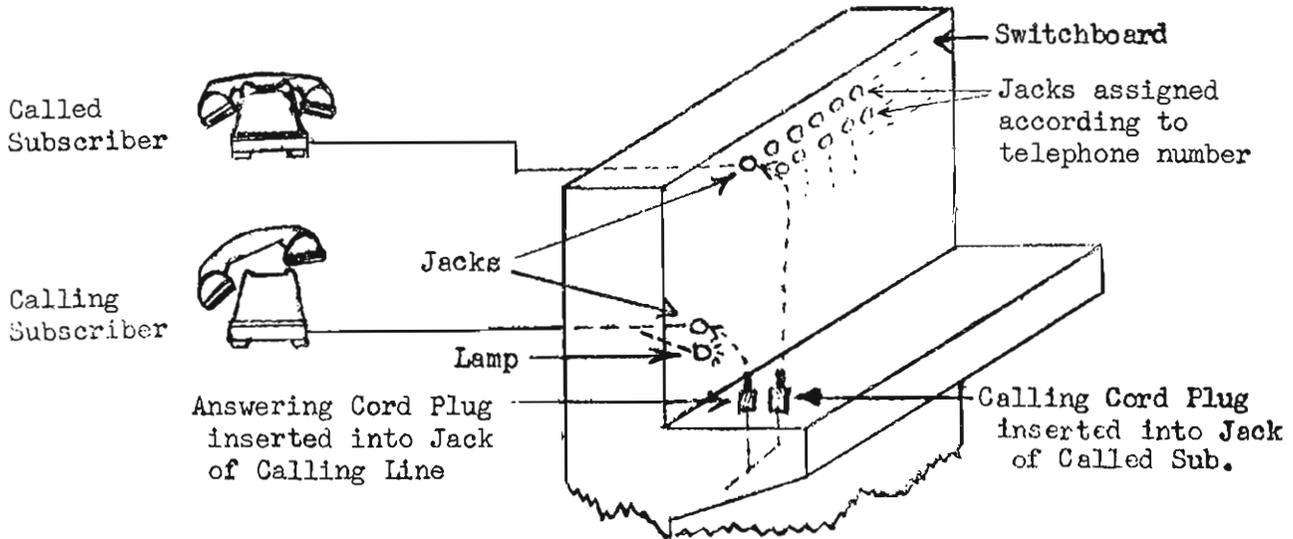


← LTD - Local Test Desk, for checking outside Subscriber Lines and Trunks that are in trouble.

← Repair Service Desk, where Trouble Record Cards are filed. Subscribers report trouble to Repair Service Clerk.

METHODS OF HANDLING CALLS THROUGH  
THE MANUAL SWITCHING SYSTEM

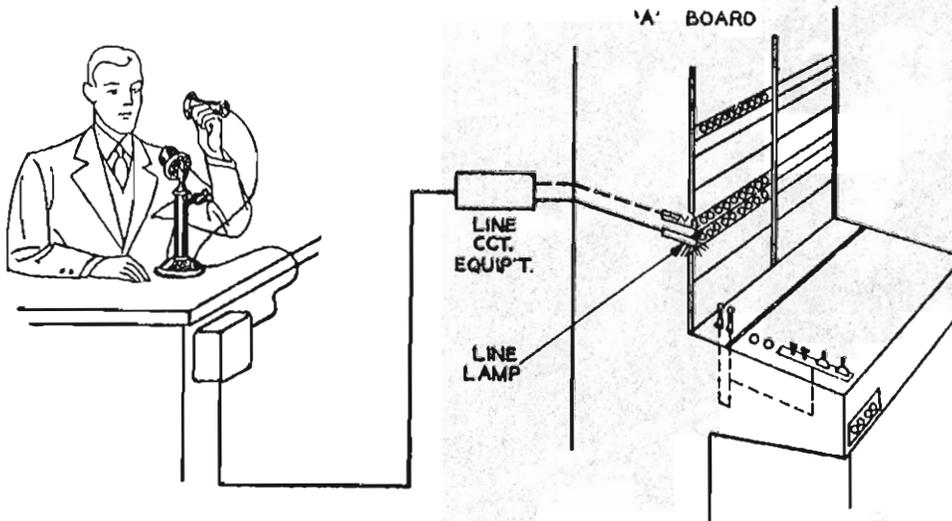
In the Manual Switching System, Subscriber Lines are cabled to Jacks mounted in the face of a Switchboard. Operators temporarily connect two Subscriber Lines together to build up a Talking Path by inserting Plugs on the ends of Cords into Jacks.



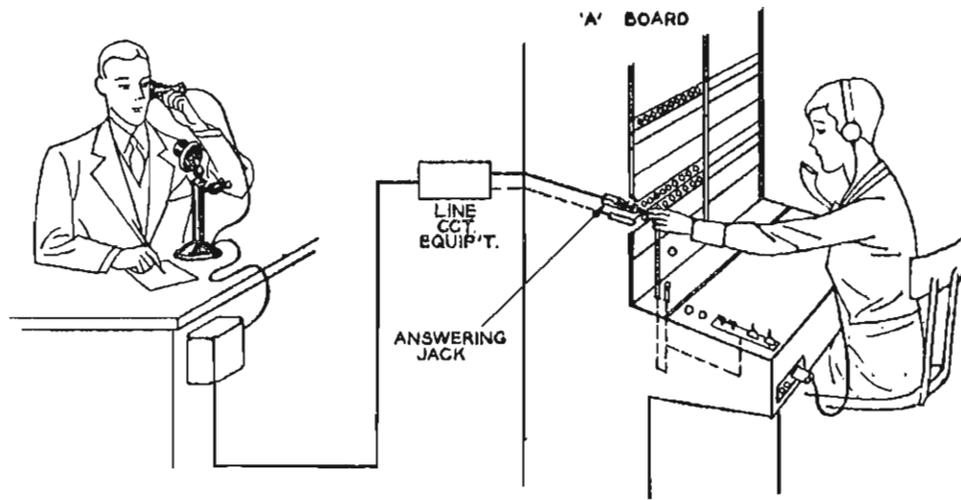
In a Multi-Office Exchange Area, two separate Switchboards are used:

- 1) The Subscriber or "A" Switchboard, and
- 2) The Trunk or "B" Switchboard.

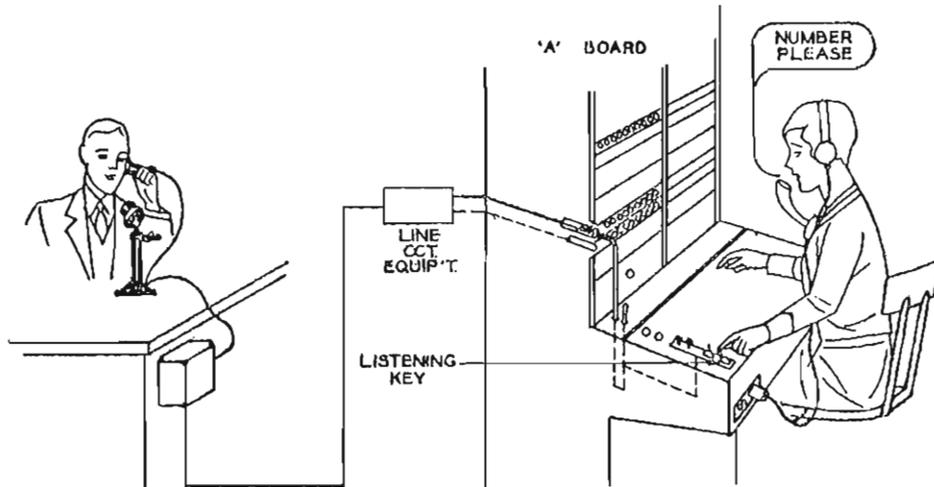
Completion of a Call Between Manual Offices  
Equipped With No. 1 Type Switchboards



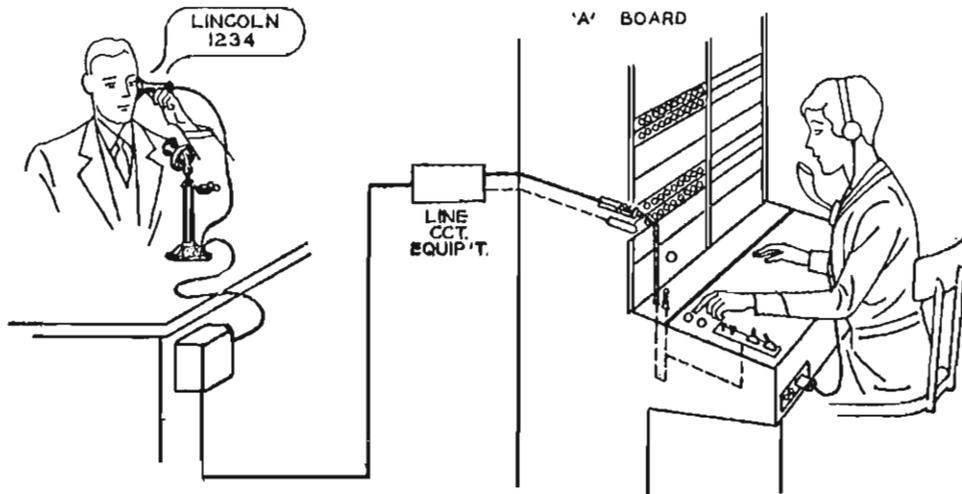
The removal of the Receiver from the Switchhook by the Calling Subscriber lights the Line Lamp in front of the "A" Operator.



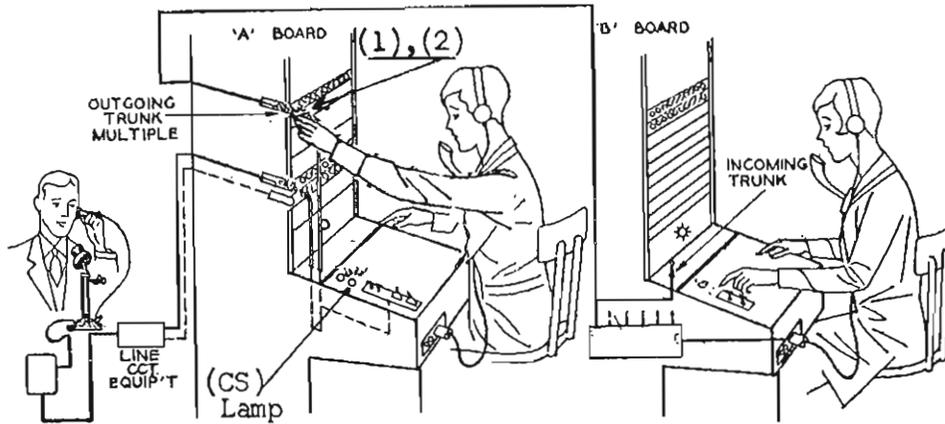
The "A" Operator inserts the Answering Cord Plug in the Calling Subscriber Answering Jack.



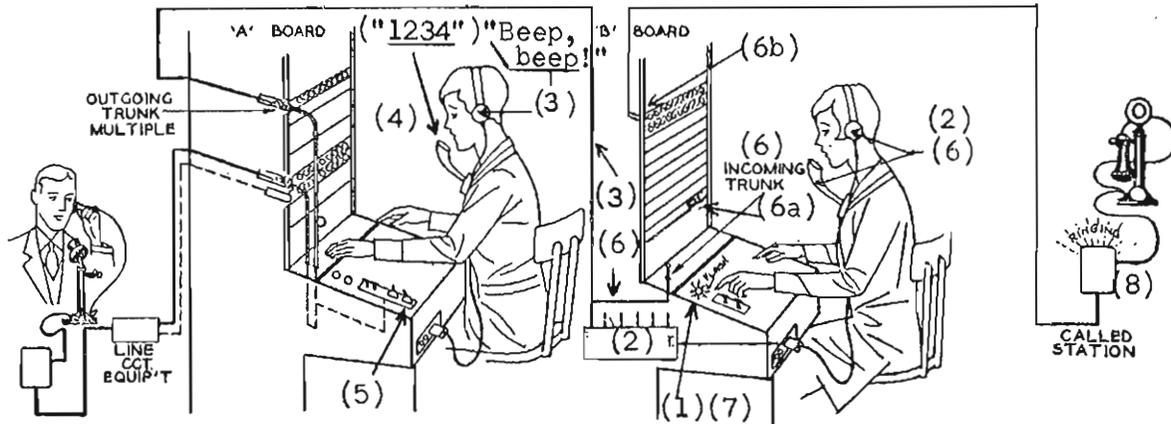
The "A" Operator connects her Telephone Set to the Answering Cord by operating the Listening Key, and challenges on the Line by saying, "Number, please."



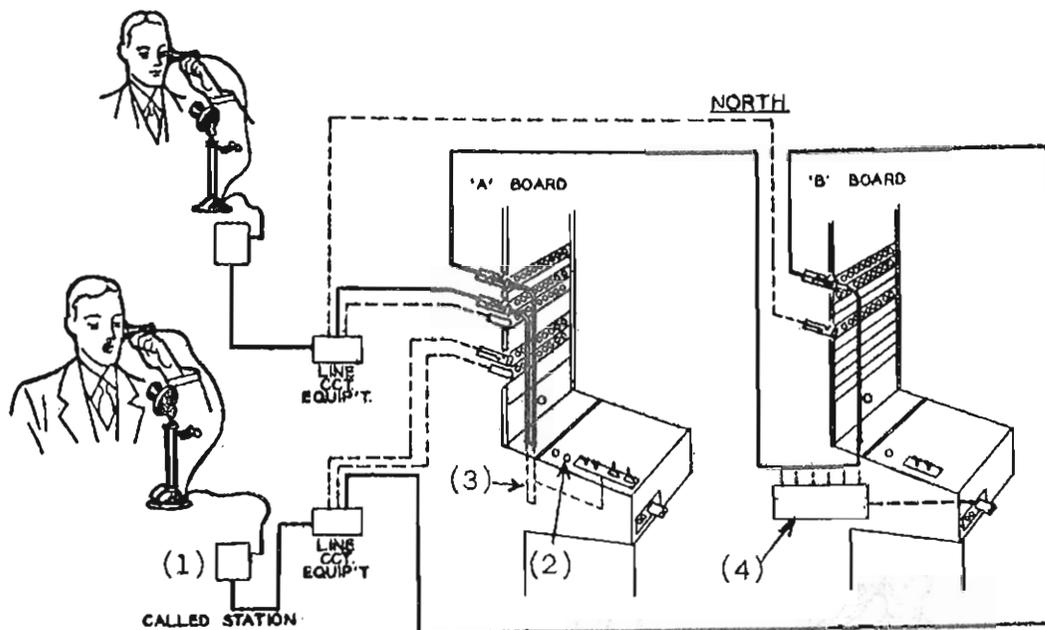
The Calling Subscriber passes the Office Code (Lincoln) and the Called Subscriber Number (4 digits) to the "A" Operator.



- 1) When the "A" Operator hears the Central Office Name or Code, she tests for an Idle Outgoing Trunk to the "B" Switchboard in the Called Office by touching the Tip of the Calling Cord Plug to the Sleeve of the Outgoing Trunk Jacks:
  - a) A "click" in the "A" Operator's Headset indicates a Busy Trunk.
  - b) No "click" in the "A" Operator's Headset indicates an Idle Trunk.
- 2) The "A" Operator inserts the Calling Cord Plug into an Idle Outgoing Trunk Jack, lighting the Calling Supervisory Lamp at the "A" Switchboard.

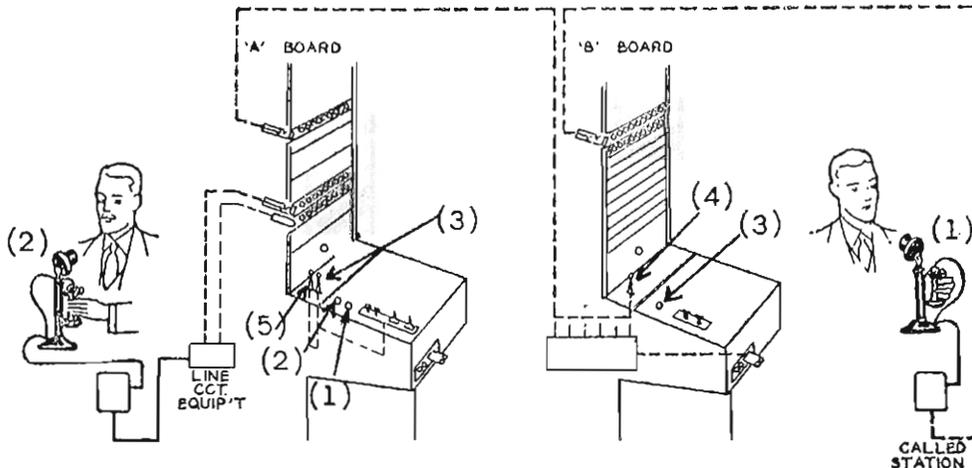


- 1) When the "B" Operator becomes Idle, the Trunk Supervisory Lamp at the "B" Switchboard flashes 60 times per minute.
- 2) The "B" Operator's Telephone Set is connected automatically to the Incoming Trunk Cord with the flashing Trunk Supervisory Lamp.
- 3) Two spurts of Tone (Beep, beep!) are placed on the Trunk.
- 4) Upon hearing the Order Tones, the "A" Operator repeats the Called Number, "1234," to the "B" Operator.
- 5) The "A" Operator releases the Listening Key. (The Calling Supervisory Lamp is still lighted.)
- 6) The "B" Operator makes a Busy Test of Subscriber Multiple Jack "1234."
  - a) If the "B" Operator hears a "click" (Called Subscriber Line Busy), she inserts the Trunk Cord Plug into a Busy-Back Jack, transmitting Busy Tone to the Calling Subscriber.
  - b) If the "B" Operator hears no "click," indicating the Called Subscriber Line is Idle, she inserts the Trunk Cord Plug into Subscriber Multiple Jack "1234."
- 7) Plugging up the Call extinguishes the flashing Trunk Supervisory Lamp at the "B" Switchboard.
- 8) Ringing Current is applied automatically to the Called Subscriber Line.



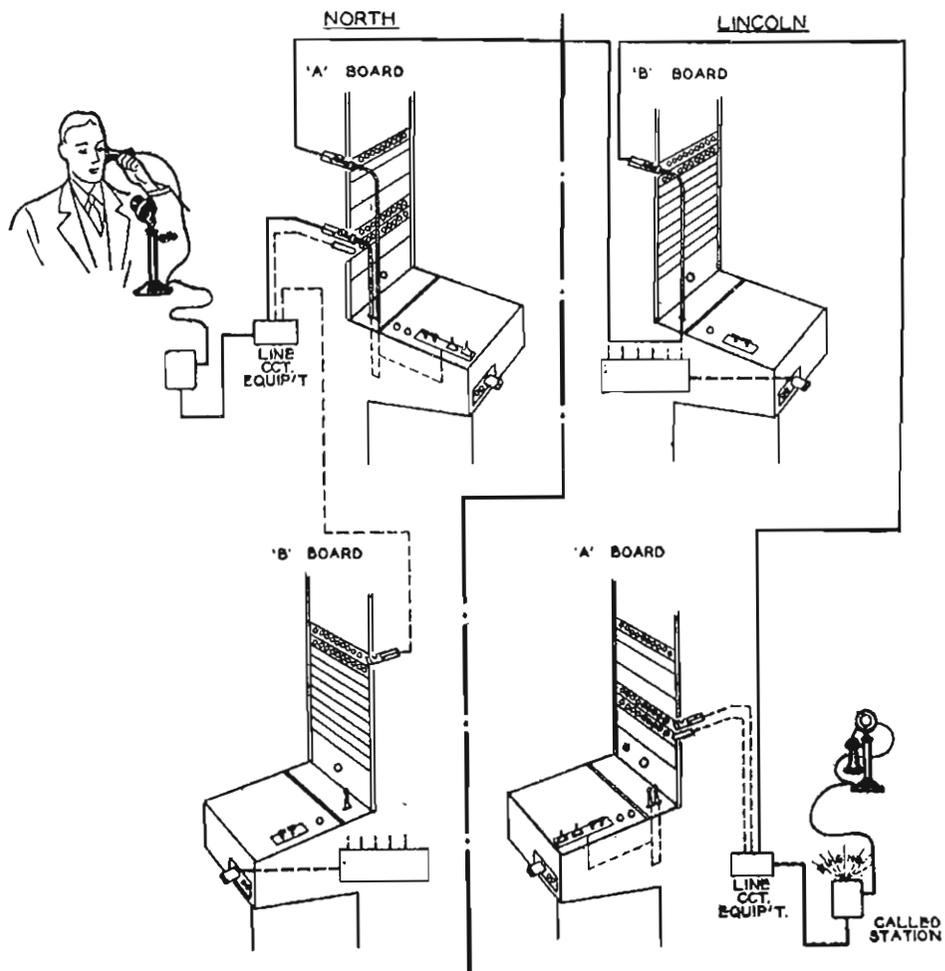
When the Called Subscriber answers (Called Handset OFF Switchhook):

- 1) Ringing Current is "tripped" (cut-off) automatically.
- 2) The Calling Supervisory Lamp at the "A" Switchboard is extinguished, signaling the "A" Operator that the Call has been completed.
- 3) Talking Battery and Ground are supplied to the Calling Subscriber by the "A" Switchboard Cord Circuit.
- 4) Talking Battery and Ground are supplied to the Called Subscriber by the "B" Switchboard Cord Circuit.

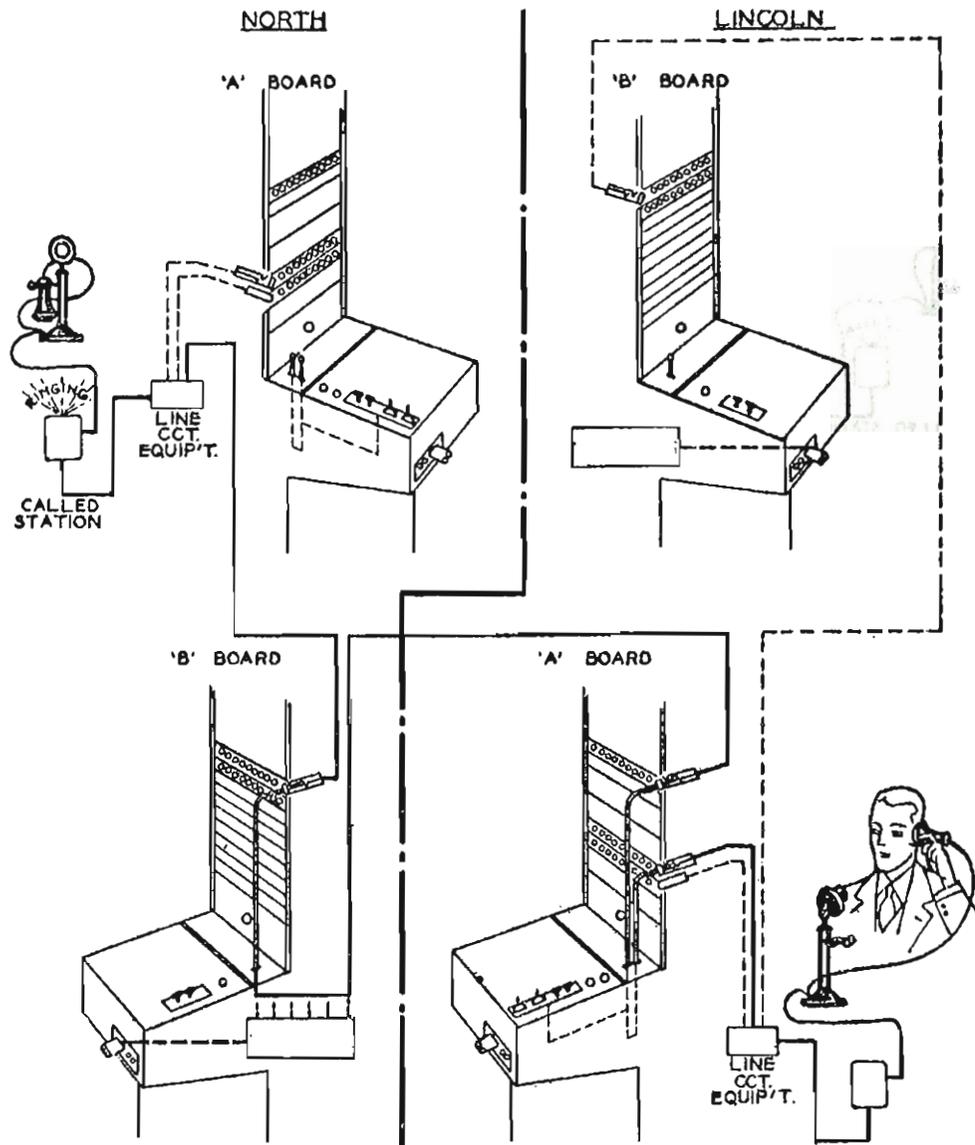


When the Manual Subscribers finish talking and replace their Handsets ON Switchhook, a "double-disconnect" signal appears at the "A" Switchboard.

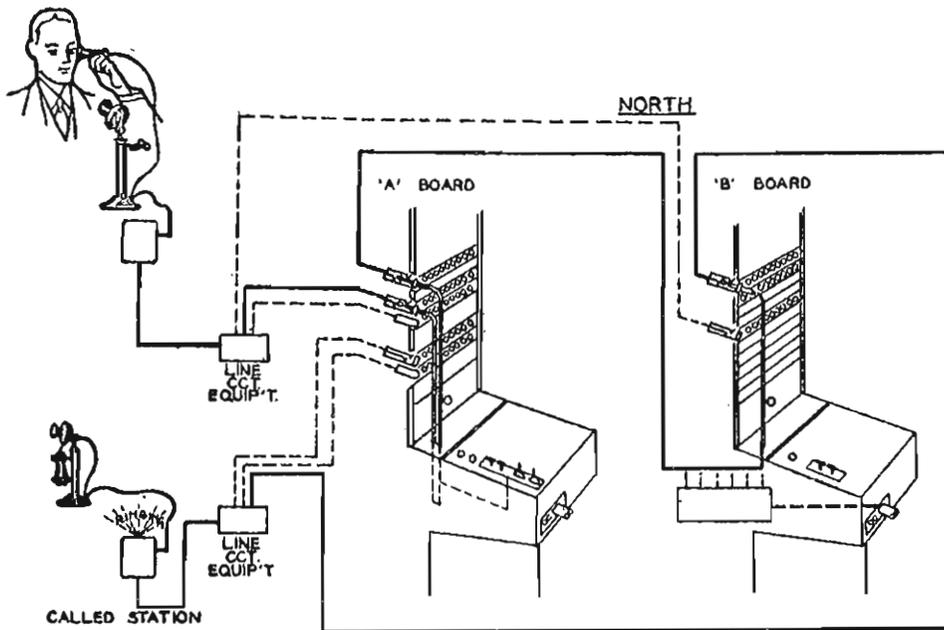
- 1) The Called Handset ON Switchhook lights the Calling Supervisory Lamp at the "A" Switchboard.
- 2) The Calling Handset ON Switchhook lights the Answering Supervisory Lamp at the "A" Switchboard.
- 3) The "A" Operators takes down the Calling Cord at the "A" Switchboard, extinguishing the Calling Supervisory Lamp and lighting the Trunk Supervisory Lamp at the "B" Switchboard.
- 4) The "B" Operator takes down the Trunk Cord at the "B" Switchboard, extinguishing the Trunk Supervisory Lamp and restoring the "B" Switchboard to normal.
- 5) The "A" Operator withdraws the Answering Cord Plug from the Answering Jack, extinguishing the Answering Supervisory Lamp and restoring the "A" Switchboard to normal.



A Call from a Subscriber in the North Office to a Subscriber in the Lincoln Office is completed from the North Office "A" Board to the Lincoln Office "B" Board, as shown above.



A Call from a Lincoln Office Subscriber to a North Office Subscriber is set up on the Lincoln "A" Board and the North "B" Board.

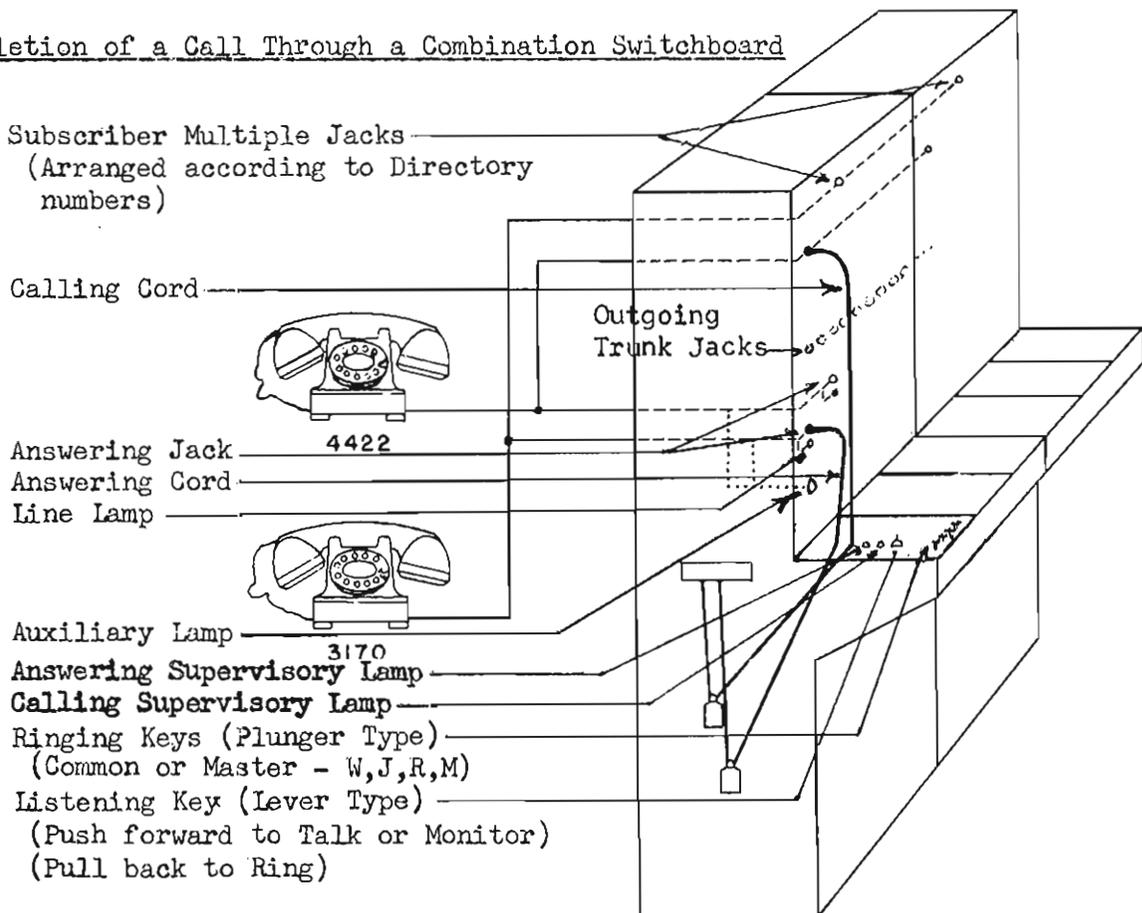


A Call between two North Office Subscribers is completed through the North "A" and "B" Boards.

In a small Exchange Area, a Combination Board combines the functions of the "A" and "B" Boards:

- 1) Outgoing Trunks to Toll ("Long Distance") and other Local Offices appear directly above the Answering Jacks and Line Lamps.
- 2) Subscriber Multiple Jacks appear above the Outgoing Trunk Jacks.
- 3) A single Operator performs all operations in handling a Local Call.

Completion of a Call Through a Combination Switchboard



Steps in Completing a Call Through a Combination Switchboard  
(Refer to Drawing on Preceding Page)

- 1) Subscriber No. 3170 removes his Handset, lighting the Line and Auxiliary Lamps.
- 2) The Operator inserts the Plug of an Idle Answering Cord into the Answering Jack above the lighted Line Lamp, extinguishing the Line and Auxiliary Lamps.
- 3) The Operator pushes forward the Listening Key of the selected Cord Circuit and says, "Number, please!"
- 4) The Calling Subscriber (No. 3170) passes the Called No., "4422," to the Operator.
- 5) The Operator picks up the Calling Cord of the pair selected for this call and makes a Busy Test of the Called Subscriber Line by touching the Tip of the Calling Cord Plug to the Sleeve of Subscriber Multiple Jack 4422. A "click" in her Telephone Receiver indicates the Called Subscriber Line is Busy--no "click" indicates an Idle Subscriber Line.
- 6) If the Called Subscriber Line checks Busy, the Operator so advises the Calling Subscriber, who replaces his Handset ON Switchhook. The Operator then takes down the connection.
- 7) Should the Called Subscriber Line check Idle, the Operator:
  - a) If the Switchboard is equipped for MANUAL Ringing:
    - 1) Inserts the Calling Cord Plug into Subscriber Multiple Jack No. 4422, lighting the Calling Supervisory Lamp.
    - 2) Pulls back on the Listening Key, applying Ringing to the Called Subscriber Line.
    - 3) For a Call completed to a Multi-Party Line, the Operator depresses one of the Common or Master Ringing Keys, "W, J, R or M," before operating the Cord Circuit Listening Key to apply Ringing.
  - b) If the Switchboard is equipped for MACHINE Ringing:
    - 1) The Operator inserts the Calling Cord Plug into Subscriber Multiple Jack No. 4422, lighting the Calling Supervisory Lamp.
    - 2) Ringing is applied automatically to the Called Subscriber Line.
- 8) The Called Handset OFF Switchhook extinguishes the Calling Supervisory Lamp, signaling the Operator that the Call has been completed. In the case of MACHINE Ringing, Ringing is tripped automatically by the Called Handset OFF Switchhook.
- 9) The Called Handset ON Switchhook, following )  
completion of conversation, relights the )  
Calling Supervisory Lamp. )  
- "Double-Disconnect"  
Signal
- 10) The Calling Handset ON Switchhook lights the )  
Answering Supervisory Lamp. )
- 11) The Operator takes down both Cords, extinguishing the Cord Supervisory Lamps, restoring the Switchboard to normal.