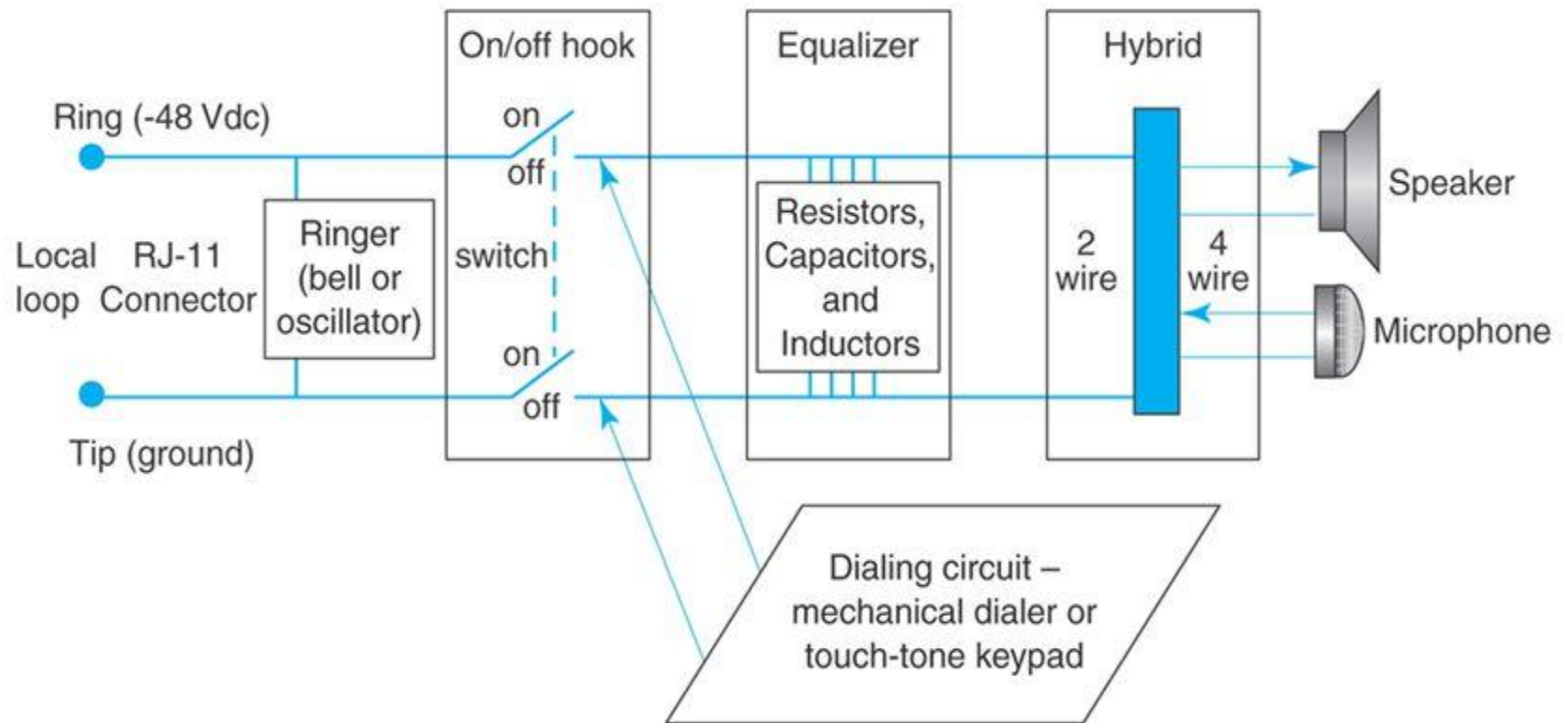


Block Diagram of a Telephone Set



Essential Components

- Ringer Circuit
 - Electronic oscillator
 - To alert the destination party of the incoming calls
- On/Off Hook Circuit
 - Simple single throw-double-pole STDP switch
 - Placed across the ‘tip’ and ‘ring’
 - On hook (idle, open switch), off-hook (in use, closed switch)

Essential Components

- Equalizer circuit
 - Combination of passive components (resistors & capacitors)
 - To regulate the amplitude & frequency response of the voice signals
- Speaker/receiver
 - Converts electrical signals received from the local loop to acoustical signals (sound waves)
 - Enclosed in the handset of the telephone along with a microphone

Essential Components

- Microphone
 - Transmitter
 - Converts acoustical signals in the form of sound pressure waves from the caller to electrical signals
- Hybrid network
 - Hybrid coil/duplex coil
 - Special balanced transformer used to convert 2-wire (local loop) circuit into 4-wire (telephone set) circuit
 - Outgoing signal –1 to 2V, incoming – half of outgoing signal

Essential Components

- Dialing circuit
 - Enables the subscriber to output signals representing digits
 - Rotary dialer/Electronic dial pulsing circuit/touch tone keypad

Functions of the Telephone Sets

- Notify the subscriber when there is an incoming call with an audible signal – bell or visible signal – flashing light
- Provide a signal to a telephone network verifying when the incoming call has been acknowledged & answered
 - Receiver is lifted off hook
- Convert speech energy to electrical energy (Tx) and vice versa (Rx)
 - Microphone, Speaker

Functions of the Telephone Sets

- Incorporate some method of inputting and sending destination telephone numbers
 - From tel. Sets to central office
 - ‘pulses’ rotary dialer
 - ‘frequency tones’ touch tone
- Regulate the amplitude of the speech signal
 - To avoid crosstalk
- Notify the tel. Office when a subscriber wishes to place an outgoing call (handset lifted off hook)
 - Dial tone

Functions of the Telephone Sets

- Ensure that a small amount of the transmit signal is fed back to the speaker
 - Feedback signal- sidetone/talkback
- Provide an open circuit (idle condition) to the local loop when the telephone is not in use (on hook)
 - Closed ckt – busy (off hook)
- Provide a means of transmitting & receiving call progress signals between the central office switch & the subscriber
 - On & off hook signal, busy, ringing, dial tone

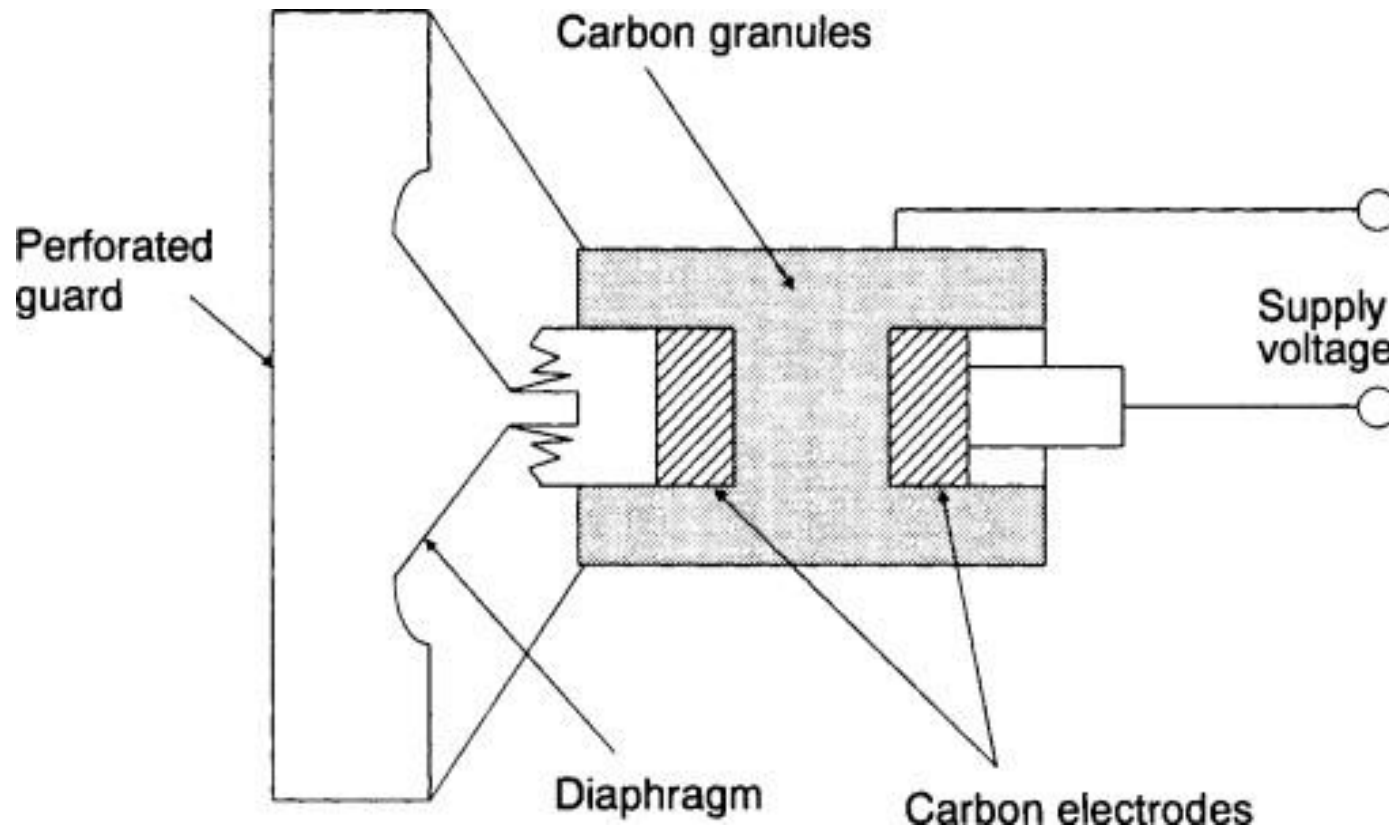
Components of a Telephone Sets

- Transmitter
- Receiver
- Ringer Circuit

Components of a Telephone Sets

- **Transmitter:** The transmitter is essentially a tiny microphone located in the mouthpiece of the telephone's handset. It converts the vibrations of the speaker's voice into variations in the direct current flowing through the set from the power source.
- In traditional carbon transmitters, developed in the 1880s, a thin layer of carbon granules separates a fixed electrode from a diaphragm-activated electrode. Electric current flows through the carbon against a certain resistance. The diaphragm, vibrating in response to the speaker's voice, forces the movable electrode to exert a fluctuating pressure on the carbon layer. Fluctuations in the carbon layer create fluctuations in its electrical resistance, which in turn produce fluctuations in the electric current.

Components of a Telephone Sets



Telephone Lines

R1 500K

C1 1uF

C2 0.1uF

R2 12K

Q1 BC107

Q2 BC 157

R3 2.2K

R4 2.2K

Q3 BC107

Q4 BC 107

D1 LED

R5 1K

S1 SPST Switch

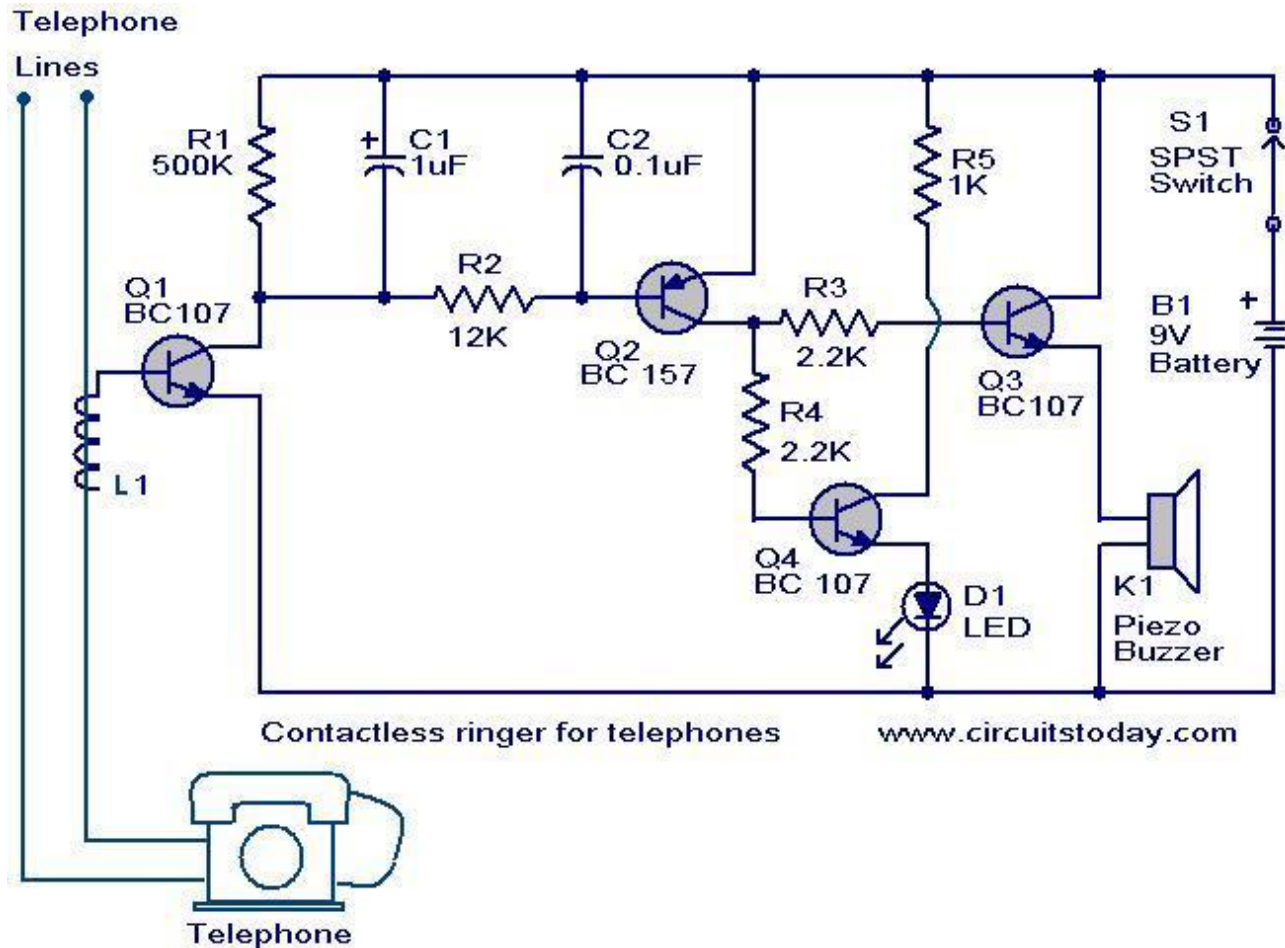
B1 9V Battery

K1 Piezo Buzzer

Telephone

Contactless ringer for telephones

www.circuitstoday.com

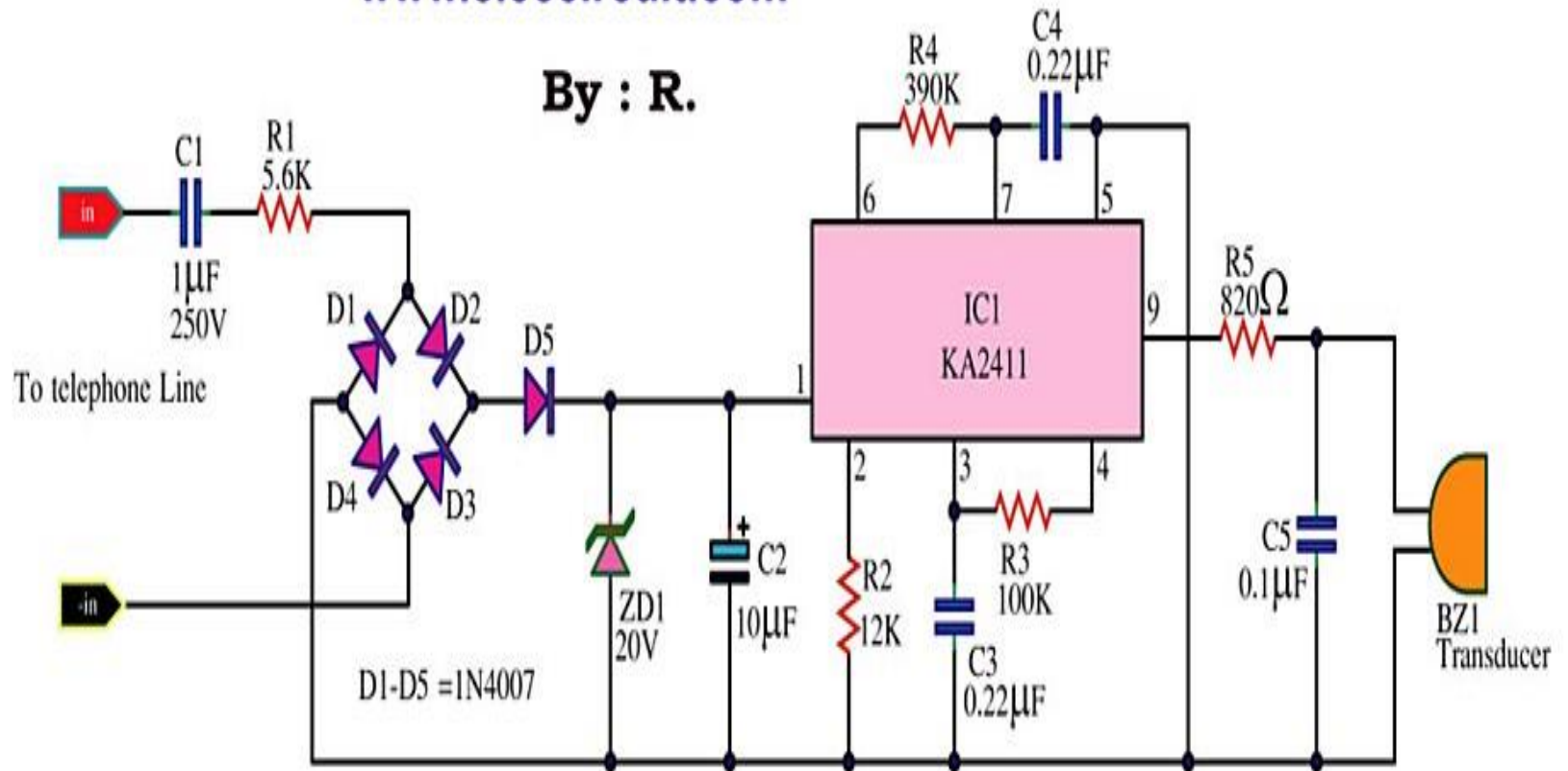


Ringer Circuit

- When the telephone rings 60 Hz AC signal is generated which produces a proportional magnetic field around the telephone lines. These magnetic field will be picked up by the coil L1 due to electromagnetic induction. A proportional voltage is developed across L1 and it will bias transistor Q1 to on. This results in the conduction of transistors Q2, Q3 and Q4. The buzzer will ring and the LED will glow. The switch S1 acts as an ON/OFF switch.

www.eleccircuit.com

By : R.

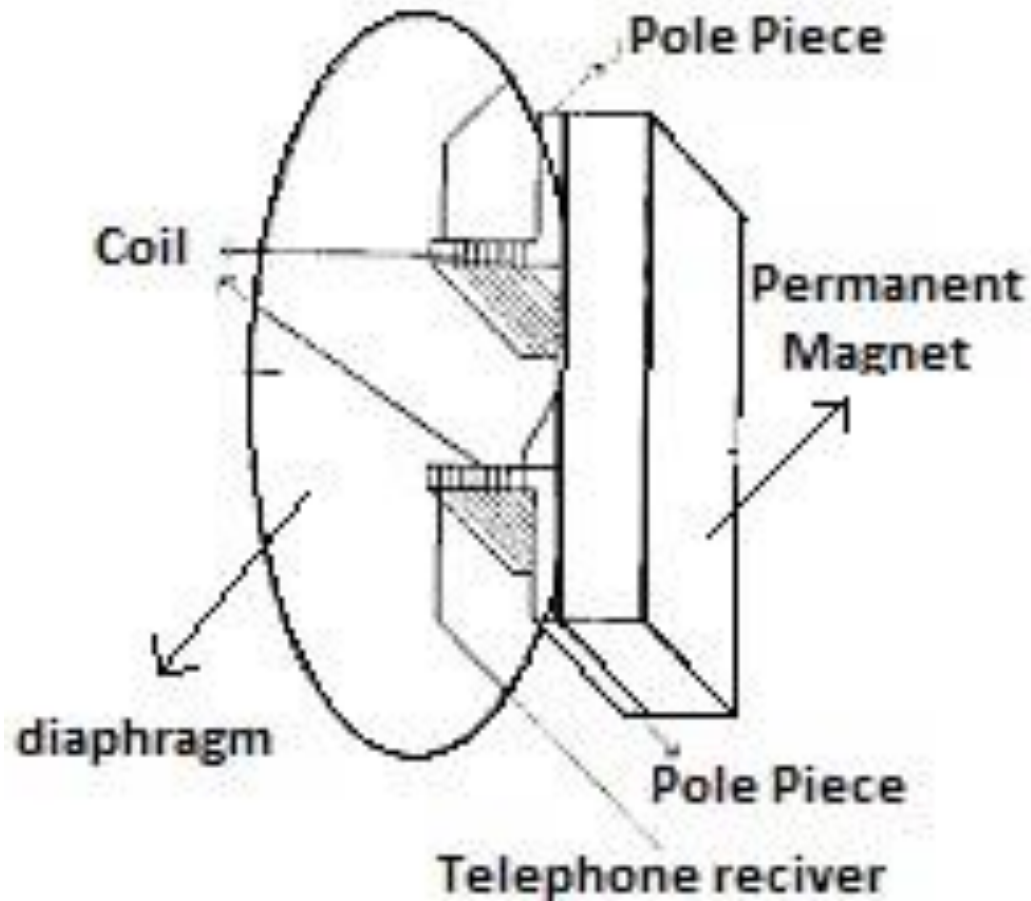


Simple Telephone Ringer Circuit

Components of a Telephone Sets

- **Receiver:** The receiver is located in the earpiece of the telephone's handset. Operating on electromagnetic principles, it converts fluctuating electric current into sound waves that reproduce human speech. Fundamentally, it consists of two parts: a permanent magnet, having pole pieces wound with coils of insulated fine wire, and a diaphragm driven by magnetic material that is supported near the pole pieces. Speech currents passing through the coils vary the attraction of the permanent magnet for the diaphragm, causing it to vibrate and produce sound waves.

Components of a Telephone Sets



Sidetone?

- Sidetone is **a small amount of your own voice that's piped into your ear speaker as you speak**. This sound confirms that your microphone is operating properly, and allows you to adjust your speaking volume to a proper level (not too loud, and not too quiet).

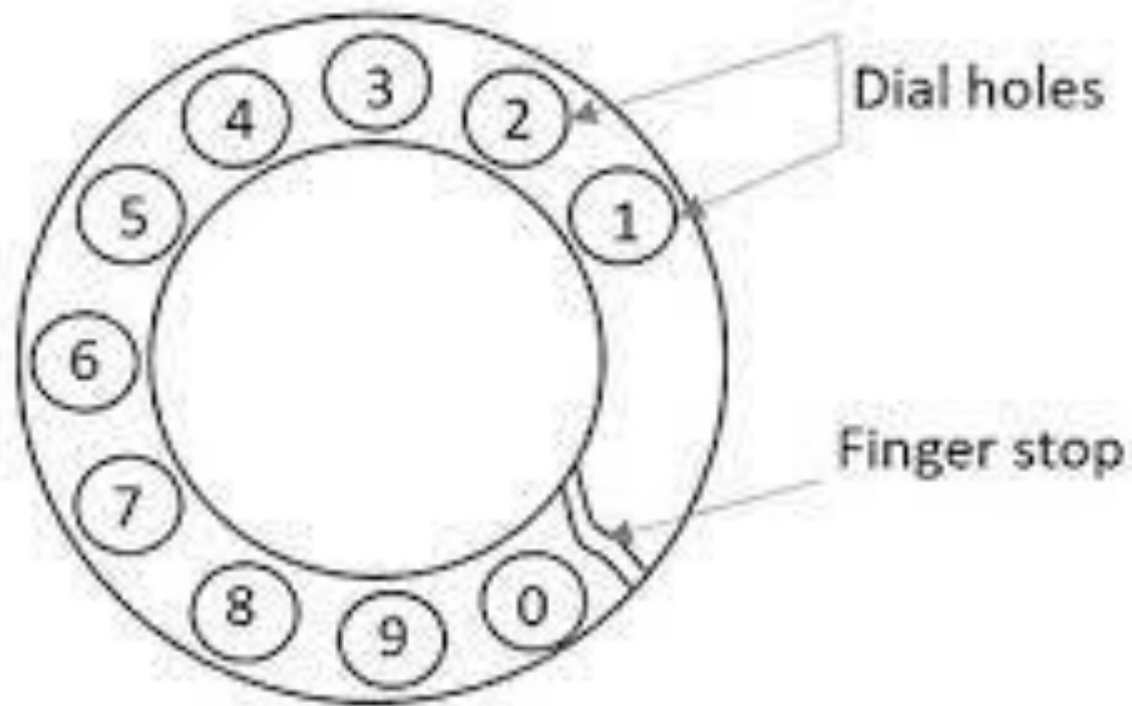
Pulse Dialing Mechanism

- **Pulse dialing** is a signaling technology in telecommunications in which a direct current local loop circuit is interrupted according to a defined coding system for each signal transmitted, usually a digit. The most common device to produce such pulse trains is the rotary dial of the telephone, lending the technology another name, **rotary dialing**.

Rotary Dial

- The first dials worked by direct, forward action. The pulses were sent as the user rotated the dial to the finger stop starting at a different position for each digit transmitted.
- Operating the dial error-free required smooth rotary motion of the finger wheel by the user, but was found as too unreliable. This mechanism was soon refined to include a recoil spring.

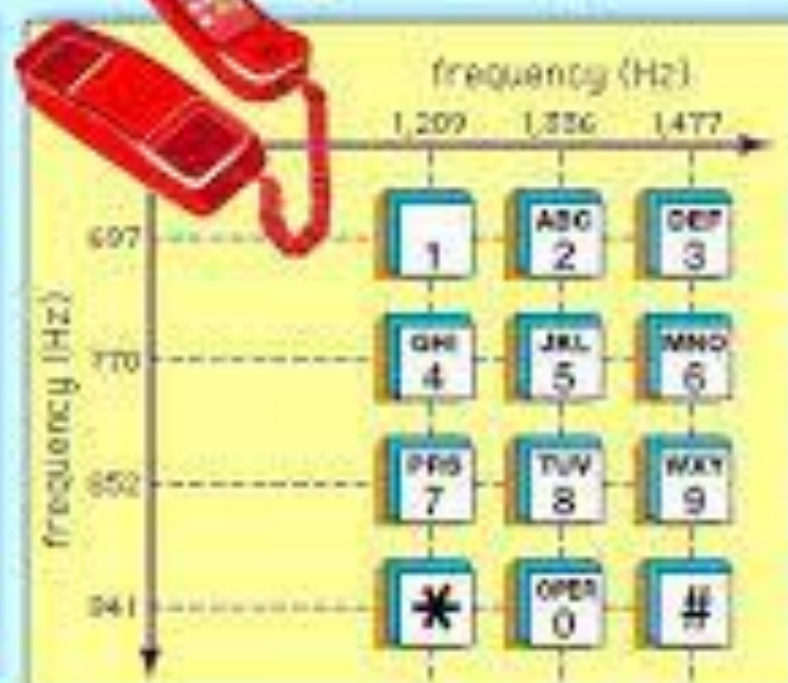
Rotary Dial



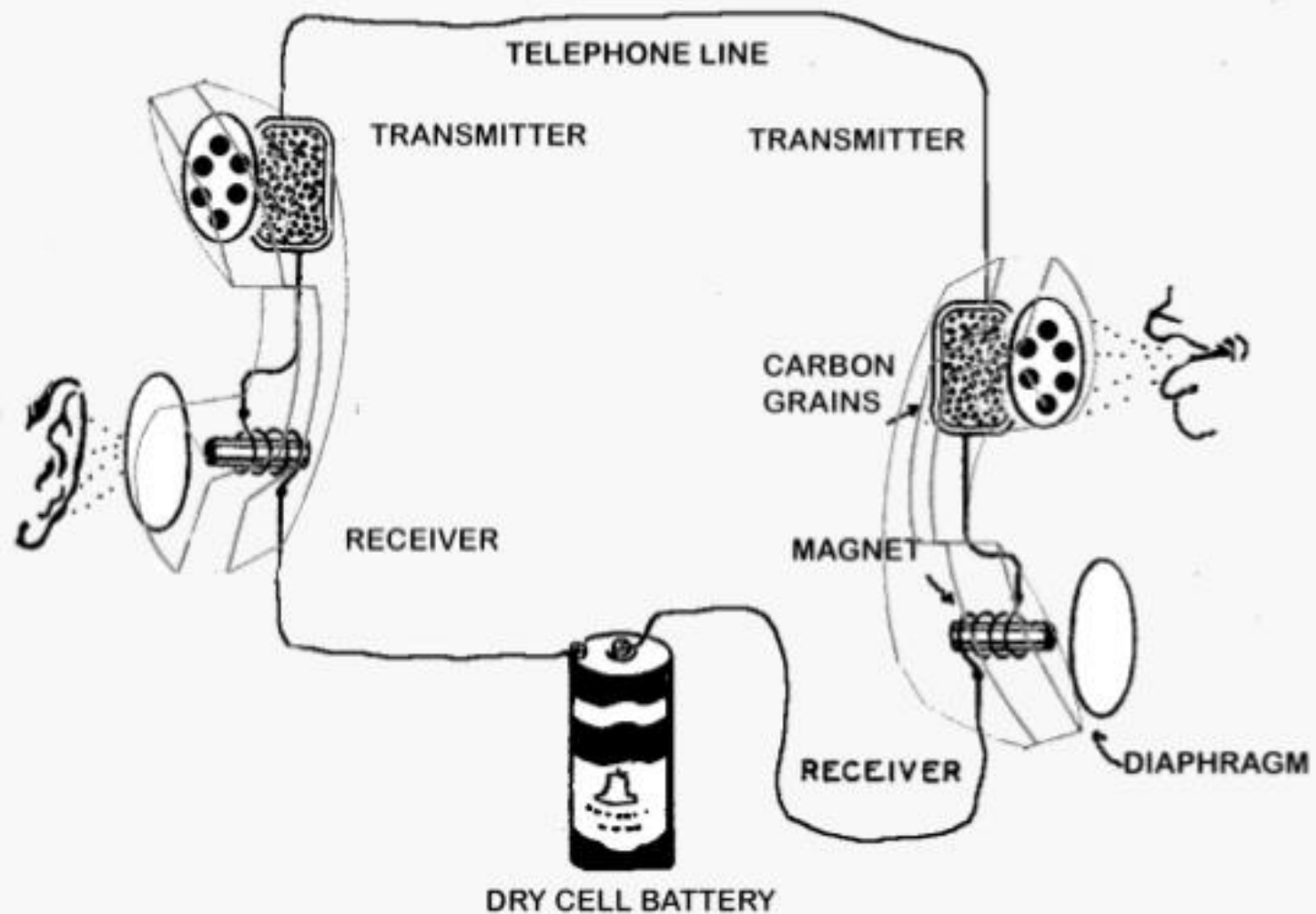
Rotary dialing



Push-button dialing



THE TELEPHONE LINE DIAGRAM



Traffic Engineering

CCR: Call Completion Rate: The ratio of successfully completed **calls** to the total number of attempted **calls**. Note: This ratio is typically expressed as either a percentage or a decimal fraction.

The CCR parameter is used in dimensioning the network capacity. Networks are usually designed to provide an overall CCR of over 0.70. A CCR value 0.75 is excellent network.

BHCA: The number of call attempts in the busy hour is called Busy Hour Call Attempts (BHCA), which is an important parameter in deciding the processing capacity of a common control or a stored program control system of an exchange.

Busy hour calling rate is defined as the average number of calls originated by a subscriber during the busy hour.

Traffic Intensity: The traffic on the network may be measured in terms of the occupancy of the servers in the network. Such a measure is called the traffic intensity which is defined as: **$A_0 = \text{period for which server is occupied} / \text{total period of observation}$**

Example: An exchange serves 5000 subscribers. If the average BHCA is 15000 and the CCR is 70%, busy hour calling rate may be calculated as: Average busy hour calls = BHCA * CCR = 15000 * 0.70 = 10500 calls

Busy hour calling rate = average busy hour calls/ total no. of subscribers = 10500/5000 = 2.1.

The busy hour calling rate is useful in sizing the exchange to handle the peak traffic.

EXAMPLE 8.2 In a group of 10 servers, each is occupied for 30 minutes in an observation interval of two hours. Calculate the traffic carried by the group.

Solution

$$\begin{aligned}\text{Traffic carried per server} &= \frac{\text{occupied duration}}{\text{total duration}} \\ &= \frac{30}{120} = 0.25 \text{ E}\end{aligned}$$

$$\text{Total traffic carried by the group } 10 \times 0.25 = 2.5 \text{ E}$$