

ME 371

PROJECT:TELEPHONE

INSTRUCTOR:Dr. A. MUKHERJEE

GROUP I-E(ENDEAVOUR)

GROUP MEMBERS:-

1. ANAND PRAKASH (97050)
2. ANSHUL PRADHAN (97062)
3. BHAVIK GUPTA (97096)

[NEXT](#)

INTRODUCTION

Tring Tring...Tring Tring... the phone rings,one picks up the reciever and calls out into itHello!...irrespective of the caller! A hurried exchange apprises one of the identity of the caller , and conversation which ensues is happily oblivious of the separation between the speakers . Or perhaps what strikes us - the hostelities much more is the clear voice of our families providing us with the words of comfort and encouragement , or perhaps the sweet , seranading voice of each of our girl friends - when on the phone, constantly titillate us by reminding of relativity - time seems to fly much too quickly , while those waiting for their turn , find longer than an unbiased clock would indicate. A businessman or an executive making deals , or journalist reporting to his newspaper , a student contacting his professor for advice , gossiping amongst friends or perhaps even more frivolously , a wife calling up her husband every hour to keep a tab on him!

Amid this gamut of emotions , diversity of cultures and communication across the miles , what was probably most striking was how we overlooked the mediums, the instrument the telephone - the product of the marriage between the disciplines of Electrical & Mechanical engineering.

Thus, an examination of this device , which in its plethora of styles and forms , has proliferated to almost every home ;is the objective of our present discussion.

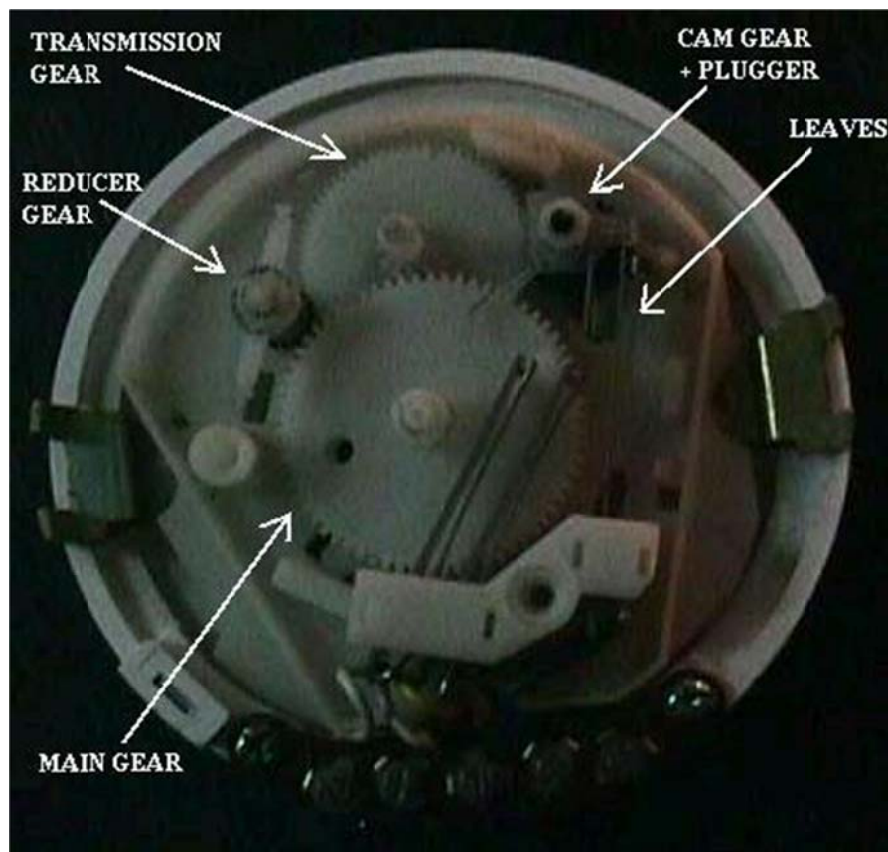
- [Mechanical System](#)
- [Electrical Systems](#)
- [A Final Word](#)

MECHANICAL SYSTEM

- [DIALLER SYSTEM](#)
- [CRADLE SYSTEM](#)

[BACK TO TOP](#) DIALLER SYSTEM

DESCRIPTION OF DIALLER COMPONENTS



1. DIAL

It is a circular plastic disc with small circles cut along its periphery, through the finger can be passed to actuate the dialling. The sheet of numbers is pasted to the base below it, which remains fixed.



2. MAIN GEAR

It is directly connected to the shaft on which the dial is mounted and essentially transmits to the rotation of the dial to the internal dialling mechanism. It has two small projections, the pushers; and has 66 teeth.

3.DIALLER SPRING

It is a torsion spring which is connected between the dial and the base. It is this spring which results in the return of the dial once a digit has been dialled.

It further provides a limit to the dial by becoming tightly wound around the shaft.

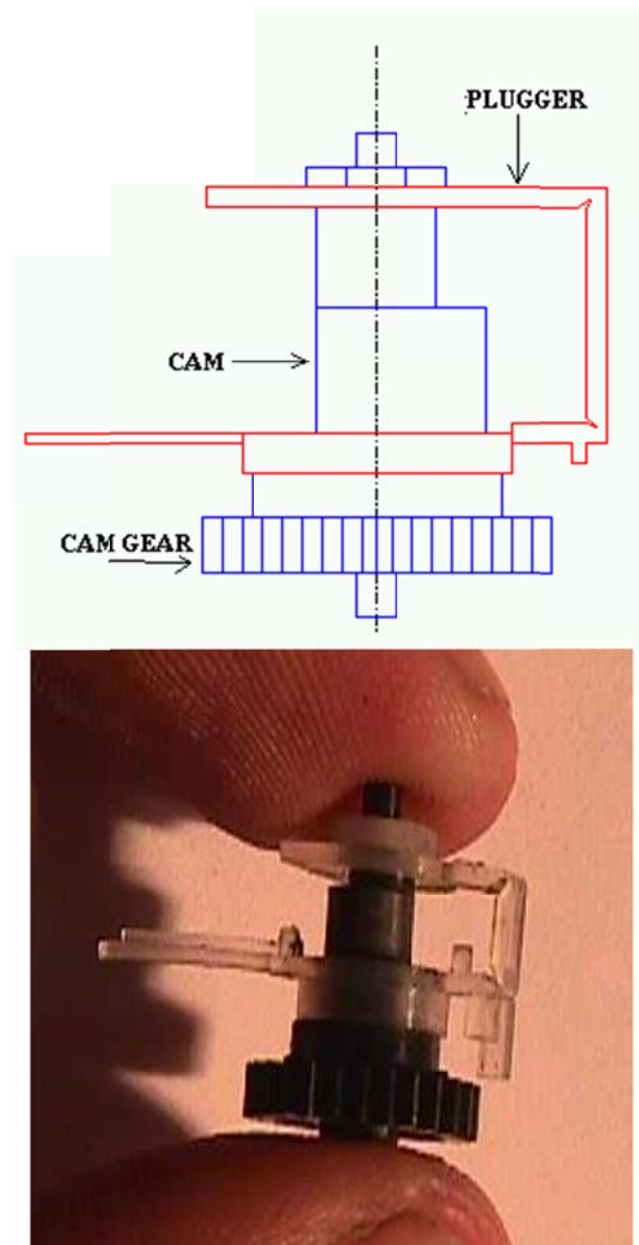
4. TRANSMISSION GEAR

It is a system of two gears mounted on a single shaft. The smaller one acts as the pinion to the [MAIN GEAR](#) while the larger transmits this motion to the [CAM GEAR](#) and the [REDUCER GEAR](#). The pinion has 11 teeth and the gear has 64 teeth. .

5.CAM GEAR & PLUGGER

The cam gear consists of a gear and a cam on a common shaft. The gear meshes with the TRANSMISSION GEAR while the cam transmits the pulse motion to the electrical contacts.

The plugger manifests itself in holding one of the electrical plates fixed, so that the motion of other would lead to an alternating loss and maintenance of contact. The cam gear has 28 teeth.

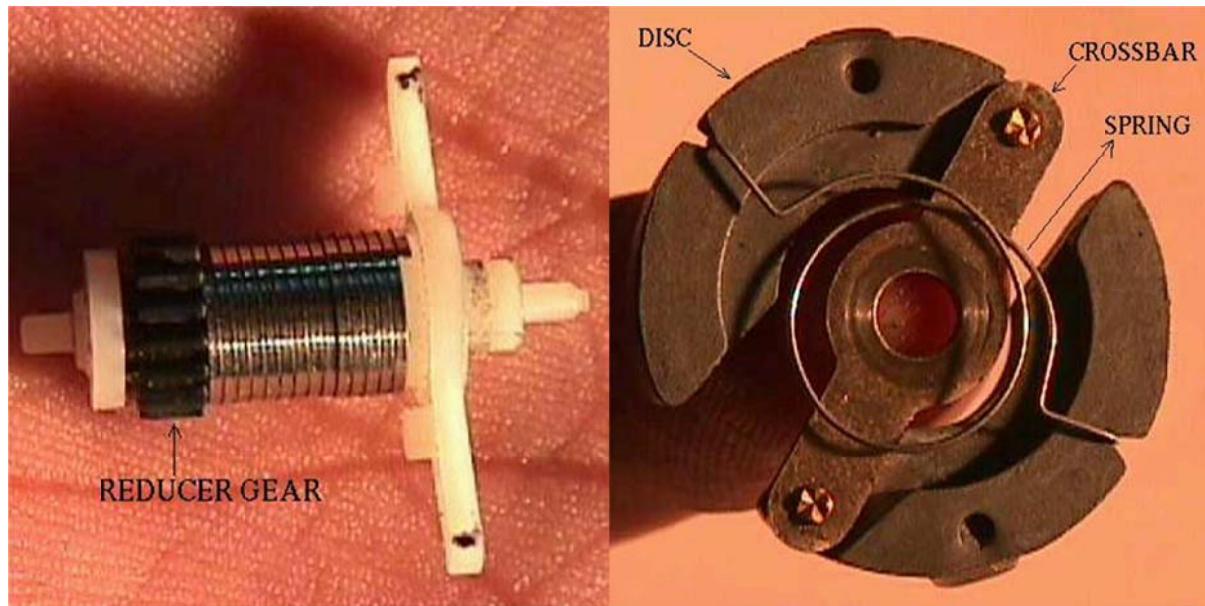


6. ELECTRICAL LEAVES

The electrical leaves are in the form of leaf springs, which under normal conditions stay together. One of these is in contact with the cam of the [CAM GEAR](#) and thus moves in accordance with it .

7. REDUCER GEAR

It consists of two separate half discs which are joined together by a crossbar , which allows the discs to be separated. These are held together by a spring . This arrangement accommodates one of the reducer gear which transmits motion to & from the reducer. The reducer is enclosed within a circular ring, the inside of which is metallic. The reducer gear has 16 teeth.



[BACK TO TOP](#)

MECHANISM OF DIALLER

The dialling mechanism is that part of the telephone instrument which converts the information of the dialled telephone number into electrical impulses which are thus transmitted to the exchange for the required connection.

The impulses as mentioned above are electrical in nature and are generated by the alternating loss of contact and making of contact of the electrical leaves. The contact is broken as many times as the dialled digit.(the explanation of which will follow shortly)

The electrical leaves act as leaf springs, which are prestressed such that normally remain in contact. The inner leaf presses against the cam throughout the dialling cycle and thus as the cam rotates , the inner leaf oscillates along with it. If the outer leaf is free to move , it would remain presses against the inner leaf , thus moving along with it and maintaining electrical contact. But , if the outer leaf is held back physically;as the inner leaf oscillates it would alternately make and break contact with the outer leaf, thus generating the impulse signal. This , precisely forms the basis for the working of the dialling mechanism.

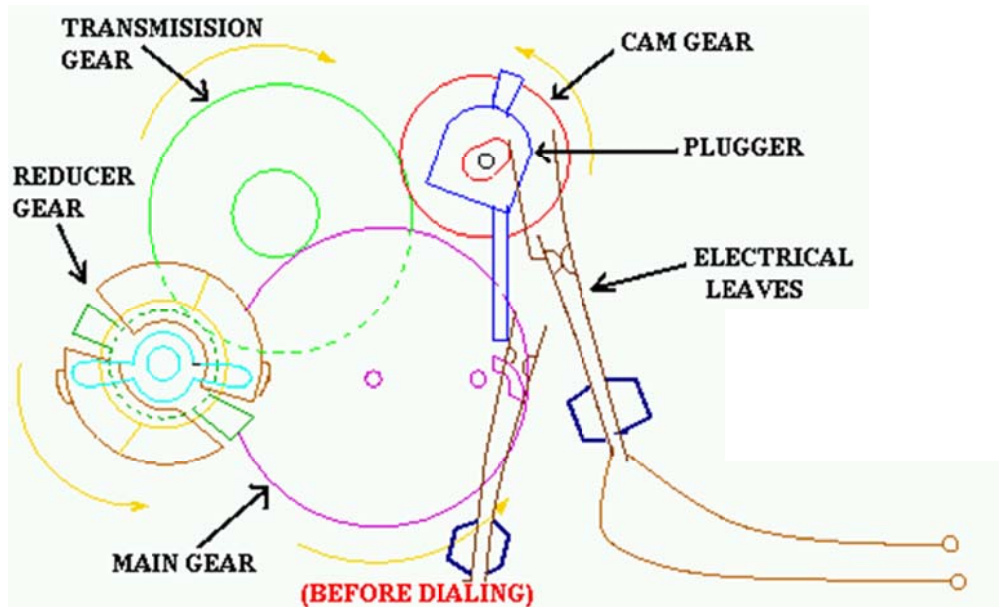
Having understood the basic principle behind the dialling process , we now proceed towards a logical , step by step explanation of the actual process from the dialling of the number through dialler to the generation of the electrical impulses at the electrical leaves.

CONSTRUCTION

The main gear meshes with the smaller one of the transmission gear,the larger transmission gear meshes with the cam gear and the reducer gear.The reducer gear shaft is attached with a reducer, which consists of two half disks.The plugger is attached with the cam gear

shaft. There is a spring attached to the base of the main gear shaft which brings back the dialler to its original position after the number has been dialled.

DIALLER MECHANISM



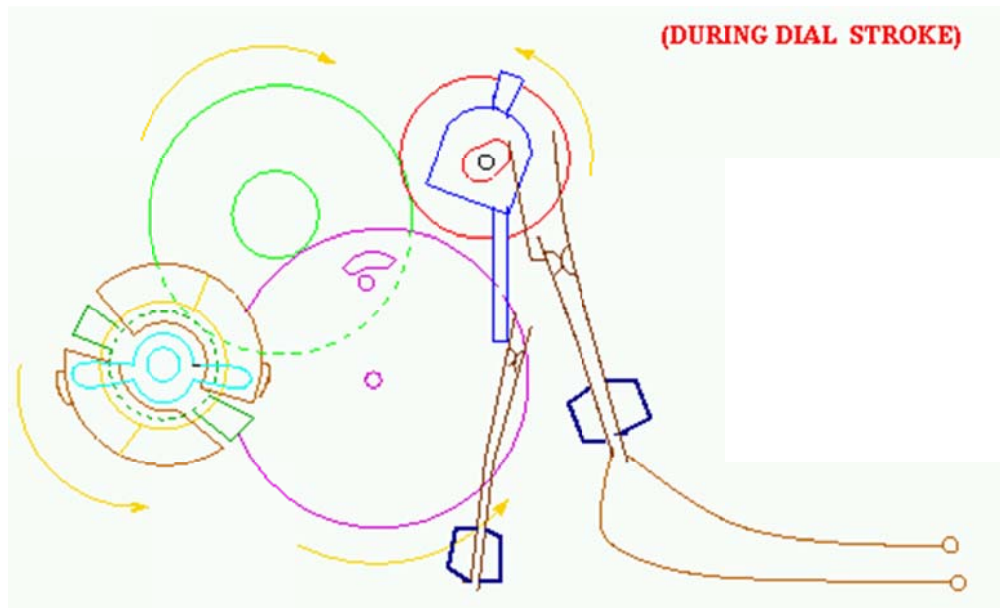
The process of dialling a digit begins with the turning of the dialler by the caller . This directly results in two things - first ,precisely the same motion is transmitted to the [main gear](#) which is mounted on the same shaft as the dialler and second , it gives rise to stressing of the dialler spring which would bring the dialler back when it is released.

Let us at this point, divide the dialling cycle into two parts:

- (a) The dial stroke during which the cradle rotates the dialler.
- (b) And the release stroke during which the dialler returns to its original position by virtue of the spring torque of the dialler spring .

Consider the dialing mechanism from the BACK side , thus revealing the internal mechanism. During the dial stroke the [main gear](#) rotates anticlockwise which thus rotates the [transmission gear](#) clockwise which in turn rotates the [cam gear](#) anticlockwise. This leads to the following:

- (a) the plugger, which is situated on the cam gear and is linked to it by friction thus tries to rotate anticlockwise too and hence remains at one extreme position - the position at which it doesn't hinder the motion of the outer leaf.



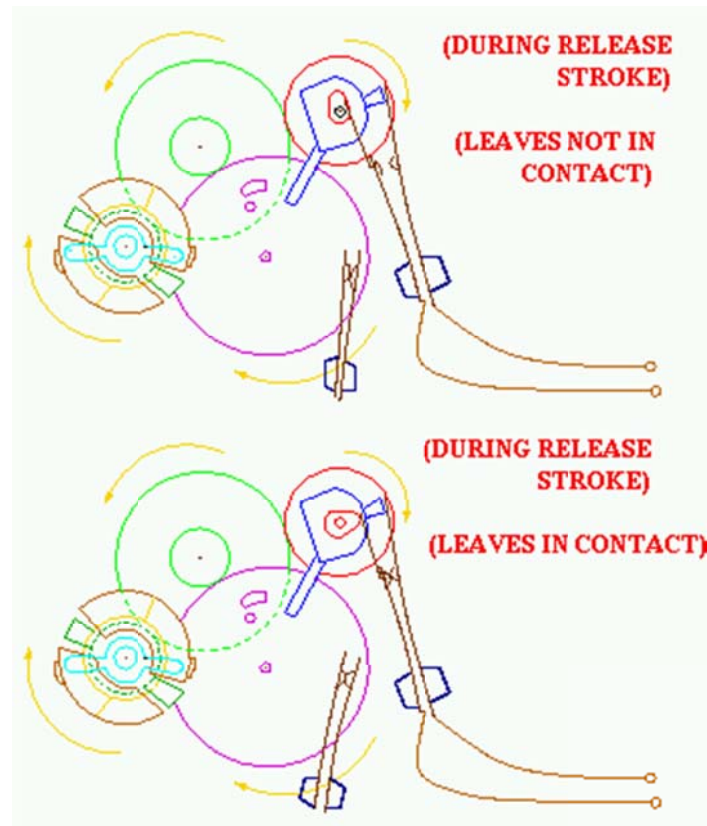
(b) and since the plunger doesn't interfere with the outer leaf , it continues to move along with the inner leaf, thus maintaining contact throughout the dial stroke . The inner leaf ofcourse maintains contact with the cam and thus oscillates along with the rotation of the cam.

The dialling stroke is complete when the caller has turned the dial by the appropriate amount.This information is stored in the dialler spring and gets converted into the electrical signal finally , to be sent to the telephone exchange

Next as soon as the caller releases the dial ,the [release stroke](#) commences.As mentioned earlier , during this stroke the dial is brought back to its original position by the torsional dial spring. This rotates the [main gear](#) in the clockwise direction which moves the [transmission gear](#) in the anti clockwise direction which in turn rotates the [cam gear](#) in the clockwise direction.This leads to the following:

(a) the plugger, which is located on the [cam gear](#) and linked to it by friction also rotates in the clockwise direction along with the cam gear until it comes to its clockwise extreme position wherein it fixes the position of outer leaf , constraining it.

(b) this leads to the making and breaking of contact between the leaves as explained in the "basic principle of impulse generation"



The amount of turn of the dial dictates the number of revolutions of the cam gear and hence of the cam. And this guides the number of oscillations of the inner leaf and thus the number of pulses. And the accordance between the number of dials and the pulses is maintained.

The [release stroke](#) is completed when the knocker on the [main gear](#) knocks the plugger to make it to rotate anticlockwise, thus releasing the outer leaf, bringing the impulses to an end. Finally the release stroke is completed with the knocker separating "New number electrical leaves". Thus passing the information that the process of dialling of digit is complete and hence bringing the dialling mechanism to its original state, ready to accept a new digit in the form of a new dialling cycle.

Finally to explain the role of the "reducer." The reducer is designed from dynamic consideration. When the dial is released, during the release stroke, it is the dialler spring that rotates the system. If allowed to unwind on its own it would lead to the attainment of a high velocity (kinetic energy) by the system leading to a more severe collision at the end of the cycle, leading to greater stresses and quicker wear and tear. To avoid this is precisely the function of the reducer. It essentially acts as a coulomb damper (friction damper) and thus dissipates some of the energy stored in the spring during the release stroke.

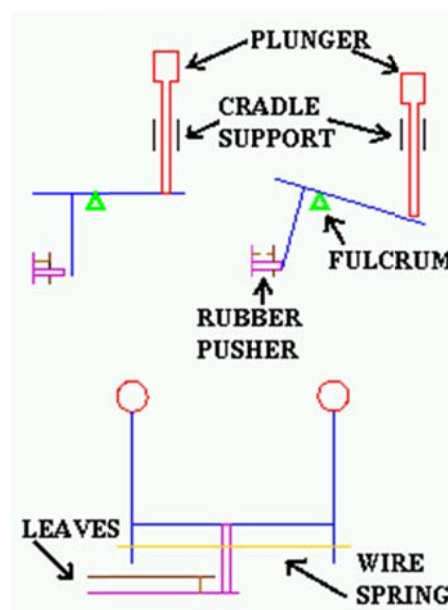
It works as follows:

Motion is transmitted to the reducer by the reducer gear which is rotated by the [transmission gear](#) which in turn is imparted motion from the [main gear](#). This gear train ensures that the reducer rotates at 24 times the angular velocity of the main gear. At such a higher angular velocity the centrifugal force on the half discs, tends to move them apart, bringing them outward and thus leading to the pressing of the friction heads upon the metal ring, thereby dissipating energy in the form of friction. [BACK TO TOP](#)

MECHANISM OF CRADLE SYSTEM

The cradle system acts as a switch for the receiver , when the plunger is up , the switch is on and when it is down , the switch is off. The cradle system consists of the following parts:

- CRADLE SUPPORT
- CRADLE
- PLUNGERS
- WIRE SPRING
- RUBBER CONTACTS
- LEAF SPRING CONTACTS WITH RUBBER PUSHERS



"The support acts as the main housing of the entire system. It allows the rocking motion of the cradle , holds the wire spring and guides the plungers. The cradle has a cross section which can be considered to be in the form of an irregular 'T' with one end attached to the wire spring , and the other receiving the force from the plunger. Thus when the plunger is pushed down , the plunger end of the cradle moves downward , thus rocking about the fulcrum(support cradle contact) and stressing the wire spring in bending. At the same time , the base of the 'T' pushes the rubber pushers which in turn separate the electrical leaf contacts. Thus turning the receiver off.

When the plungers are released , the wire springs , which were stressed release their energy , resulting in rocking back of the cradle, thereby releasing the electrical leaf contacts (as they are prestressed to remain so , when there are no external disturbances) and hence turn the receiver on.

[BACK TO TOP](#)

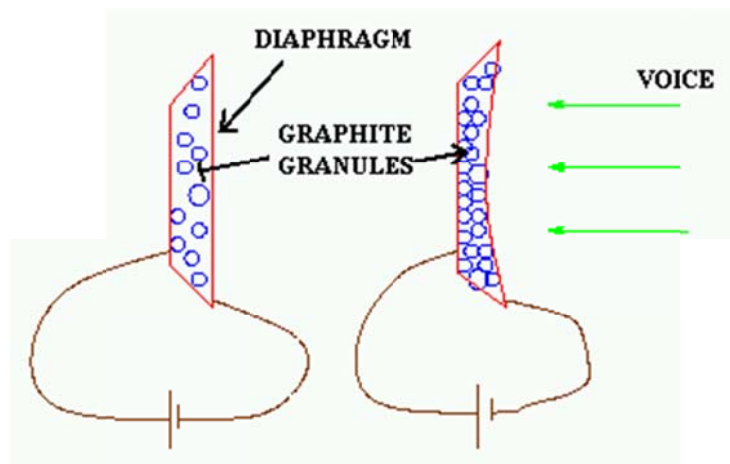
ELECTRICAL SYSTEM: DESCRIPTION

The telephone consists of the following ELECTRICAL COMPONENTS:

- (a) Transmitter
- (b) Receiver
- (c) Ringer
- (d) Amplifier

TRANSMITTER:-

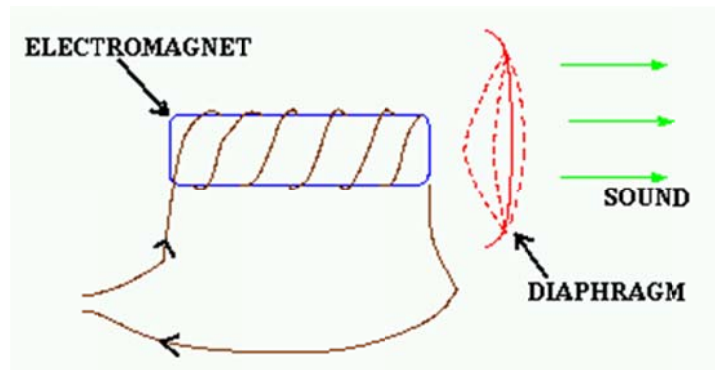
The transmitter is the device that converts the sound signal (voice) into a corresponding electrical signal. It comprises of graphite granules enclosed between two metallic plates, one of which remains stationary. The other plate, the diaphragm, is very thin, & vibrates with the sound wave. A voltage is applied across the plates. Thus, as the diaphragm vibrates with the sound waves, the graphite granules either get packed more tightly or less tightly, changing the resistance of the arrangement, thereby altering the current. Thus the sound signal gets electrically stored. This is then sent across the telephone wires.



RECEIVER:-

The receiver is the device that takes as input the electrical signal (produced by the transmitter at the speaker's end) and converts it into sound. The receiver basically consists of a diaphragm, which is a thin disc of a ferrous material, which when vibrated produces sound; and a coil, which acts as an electromagnet when current is passed through it. The diaphragm is supported along its periphery so that it is free to vibrate, while the coil is placed below it, such that when it gets magnetised, it pulls the diaphragm downwards (towards itself), & when demagnetised, lets the diaphragm move back on its own. Thus when the varying current from the speaker's transmitter is

fed into the coil of the receiver , it gets magnetised, and the strength of the magnet varies in accordance with the variation in the current. This makes the diaphragm vibrate , thereby producing sound & hence fulfilling its purpose.



RINGER:-

The ringer is a device which alerts the receiver of an incoming call. It basically functions as an electric bell. The basic principle is as follows:-

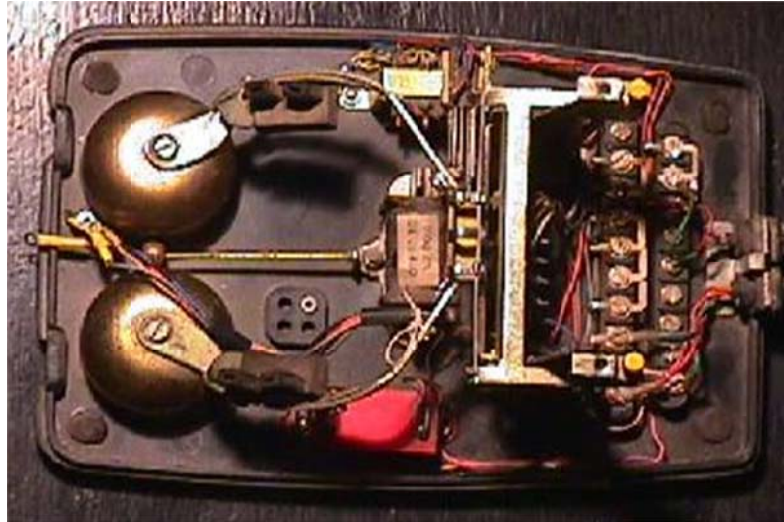
The sound is produced by the striker striking the gongs repeatedly. The striker forms part of the electrical circuit, which when allowing current to pass through activates a coil, making it act like a magnet, which thus pulls the striker towards it, making the striker strike the gong. No sooner does the striker move, than the circuit is broken. As the striker strikes the gong, it also completes the circuit for a second coil which pulls it back, thus making the striker strike the second gong and complete the original circuit. And thus the process continues, and the ringer rings continuously.

AMPLIFIER:-

The amplifier is a device which amplifies the input electrical signal. It converts the weak input signal into a much stronger output signal.

[BACK TO TOP](#)

WORKING OF THE ELECTRICAL SYSTEM



The telephone, it barely needs explanation, is a device, the primary function of which is to transmit voice over long distances. This is essentially performed by converting the sound signal into a corresponding electrical signal which is then transmitted. Finally at the receiving end, the electrical signal is converted back into sound signal, thus achieving the objective.

What follows is a step by step explanation of the working of a telephone.

When a caller picks up the receiver, the [cradle](#) puts on the receiver, i.e it allows a link between the caller's telephone and the exchange, which is realised by a current flowing from the exchange to the caller's telephone, which manifests itself as the dial tone. The caller then dials the number using the [dialler](#). As soon as the first digit is dialed, the dial tone is cut off. The exchange registers the number, & through a switching mechanism locates the required phone on the network. It then sends it a ringing signal, which then results in the ringing of the ringer at the receiver's end. As soon as the receiver picks up the handset, the cradle puts it on, and a connection is established.

Whenever one of them speaks into the transmitter, it converts the sound signal into an electrical signal. This signal is amplified and sent to the receiver's telephone through telephone wires (electric wires). This signal goes to the receiver where it is converted back into a sound signal. And thus effectively, sounds get transmitted over long distances.

Finally, when the conversation is over, and the cradle is pushed down, the connection is closed, and the original configuration is restored.

[BACK TO TOP](#)

DEVELOPMENTS

What we have looked at is the very basic telephone system. Today the concept of telephoning has undergone a sea change. The extensive use and application of electronics has led to the replacement of mechanical dialler by a push button dialler,

which also allows faster dialling by the advent of the 'tone dialling' format. Further , the area of telephone has been transformed to the world of telecommunication. Cordless phones and cellular phones , together with the internet which connects over telephone lines through the modem(which can transmit data as well)has today changed the way our world ticks.And riding on the crest of such a wave of information technology , we are ready to usher in the new millenium.

[BACK TO TOP](#)

A FINAL WORD

As is self evident we have looked at the telephone much more from the "Mechanical Engineering " point of view ; but at the same time have taken an over view of the Electrical System as well.We hope you find the page informative as well as interesting. Thank you for taking the time to go through it.

1. Anand Prakash (97050)
2. Anshul Pradhan (97062)
3. Bhavik Gupta (97096)

[BACK TO TOP](#)